UNIVERSITY OF CALIFORNIA SANTA CRUZ

2021 Long Range Development Plan

Final Environmental Impact Report

Draft EIR Appendices

State Clearinghouse Number 2020029086

September 2021

Appendix A

Notice of Preparation

UNIVERSITY OF CALIFORNIA, SANTA CRUZ

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

PHYSICAL PLANNING, DEVELOPMENT & OPERATIONS *SANTA CRUZ, CALIFORNIA 95064*

February 25, 2020

State of California
Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814

NOTICE OF PREPARATION
ENVIRONMENTAL IMPACT REPORT

Project Title:	UC Santa Cruz Long Range Development Plan
Project Location:	UC Santa Cruz Main Residential Campus & Westside Research Park (2300 Delaware Avenue), Santa Cruz (see Figures 1 and 2)
County	Santa Cruz County

Project Overview

The University of California, Santa Cruz (UC Santa Cruz), Long Range Development Plan (LRDP) is a comprehensive land use plan that guides the physical development necessary to achieve the campus' mission. The LRDP establishes a land use framework for, academic and administrative space needs, housing, open space, circulation and other land uses that ultimately facilitate the appropriate siting of capital projects. All UC campuses are required to prepare a Long Range Development Plan to guide physical campus development.

The proposed UC Santa Cruz LRDP would replace the 2005 LRDP for the campus and identifies land uses to support the academic mission of UC Santa Cruz through 2040. The LRDP campus population forecast is 28,000 Full-Time Equivalent (FTE) students[1] and 5,000 FTE faculty and staff. To accommodate the projected increase in campus population, the LRDP proposes to add 8,500 student housing beds,[2] up to 550 employee housing units, and approximately 2,800,000 assignable square feet (ASF) of academic and administrative building space. The LRDP land use plan supports potential growth on the UC Santa Cruz main residential campus and the Westside Research Park located at 2300 Delaware Avenue in the City of Santa Cruz.

Environmental Review and Comment

The University of California is the Lead Agency under the California Environmental Quality Act (CEQA) (PRC, § 21000 et seq.) and will prepare an Environmental Impact Report (EIR) for the LRDP as required by PRC § 21080.09. The LRDP EIR will function as a Program EIR (pursuant to CEQA Guidelines Section 15168) that can be used to tier the environmental review of subsequent campus development projects during implementation of the LRDP. Because UC Santa Cruz has determined that an EIR will be required for the project, and as allowed by CEQA when the decision to prepare an EIR has already been made, an Initial Study has not been prepared. This Notice of Preparation (NOP) has been prepared pursuant to Sections 15082 and 15083 of the CEQA Guidelines.

UC Santa Cruz requests input from responsible and trustee agencies and the public regarding the proposed scope of the LRDP EIR analysis. UC Santa Cruz requests that responses to this NOP identify: 1) the significant environmental

[1] An FTE student is (1) an undergraduate student who enrolls for 45 credit hours per academic year; or (2) a graduate student (master's level or doctoral student not yet advanced to candidacy) enrolled in 36 hours per year; or (3) a graduate doctoral student who has been advanced to candidacy. This does not include students studying at locations other than the main residential campus and the Westside Research Park.

[2] UC Santa Cruz has provided student beds up to 15,000 FTE students and will continue to provide student beds for 67 percent of FTE students between 15,000 and 19,500 enrollment, in accordance with the 2008 Comprehensive Settlement Agreement (CSA). The proposed LRDP will provide 100 percent of student beds for 8,500 additional FTE students and enrollment of above 19,500.

issues, reasonable alternatives, and reasonable mitigation measures that should be explored in the Draft EIR; and 2) where submitted by an agency, whether that agency will be a responsible or trustee agency for the project.

COMMENT PERIOD: Written comments on the NOP will be accepted anytime during the NOP review period, which begins **Tuesday, February 25, 2020** and ends **Monday, March 30, 2020** at **5:00 pm**. The NOP comment period is extended by five days in order to close during the first day of Spring Quarter at UC Santa Cruz. Please state "LRDP NOP Comments" in the subject line, and send your written or electronic responses, with appropriate contact information, to the following address:

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development, and Operations
University of California, Santa Cruz
1156 High Street, Santa Cruz, CA 95064
Email: eircomment@ucsc.edu

SCOPING SESSIONS: Written comments on the NOP may also be provided at two public scoping sessions on **Thursday, March 12, 2020**:

Location: Merrill Cultural Center
Address: UC Santa Cruz, 200 McLaughlin Dr., Santa Cruz, CA
Time: 12:00 to 2:00 pm

Location: Louden Nelson Community Center, Room 3
Address: 301 Center Street, Santa Cruz, CA
Time: 6:00 to 8:00 pm

At each scoping session, project information will be presented by UC Santa Cruz staff and NOP comments will be accepted. If you have questions regarding this NOP, the scoping sessions, and/or require accommodation to participate in the scoping meeting, please contact Erika Carpenter at escarpen@ucsc.edu or (831) 212-0187.

Attachments:

A Detailed Project Information
B Impact Analysis Areas and Probable Environmental Effects of the EIR
C Draft Land Use Map, February 2020

ATTACHMENT A
UC SANTA CRUZ
LONG RANGE DEVELOPMENT PLAN
DETAILED PROJECT INFORMATION

1. Project Title

UC Santa Cruz Long Range Development Plan

2. Project Contact

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development, and Operations
University of California, Santa Cruz
1156 High Street, Santa Cruz, CA 95064
Email: eircomment@ucsc.edu

3. Lead Agency

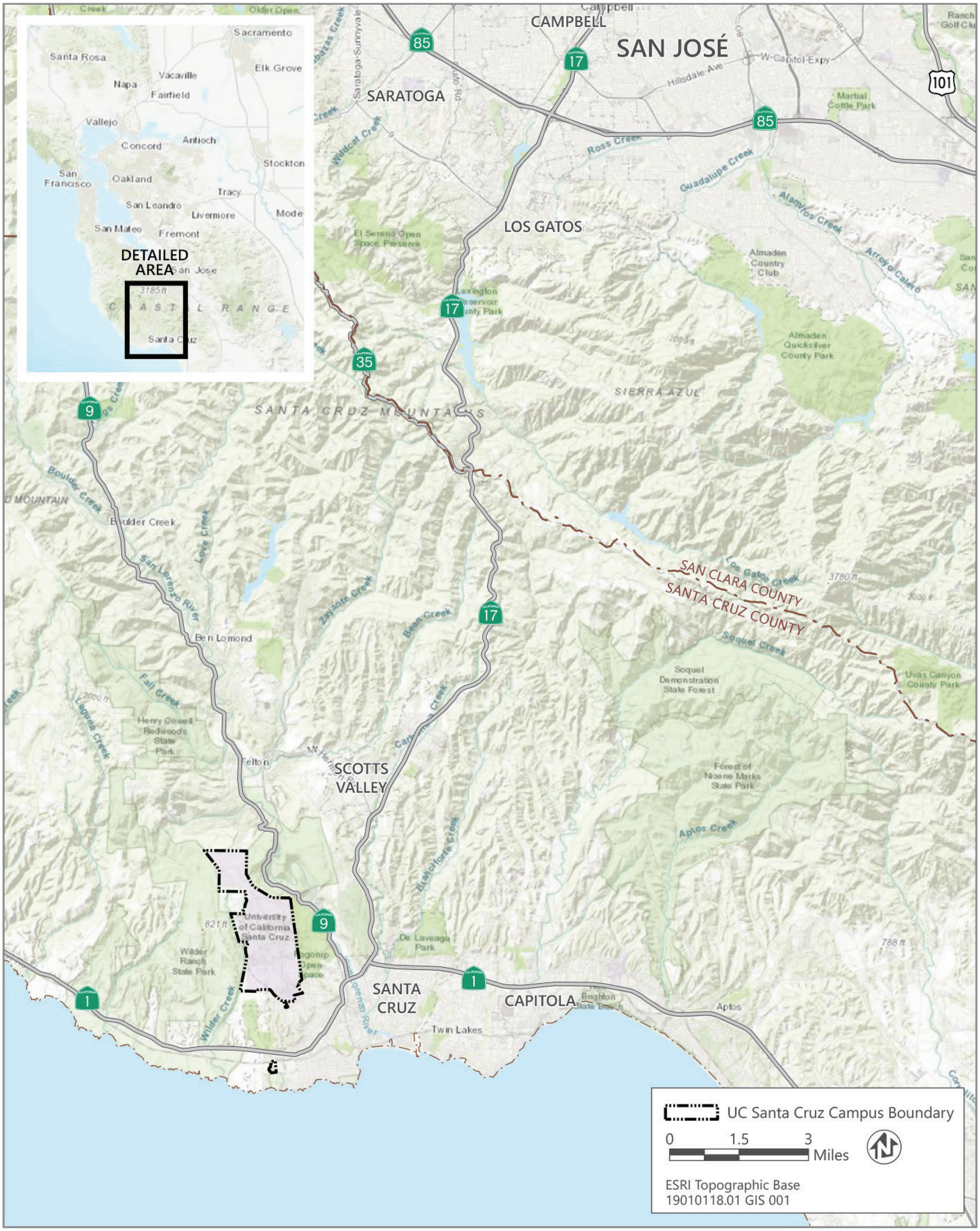
The Board of Regents of the University of California
1111 Franklin Street, 12th Floor
Oakland, California 94607

4. Project Location and Setting

The main residential campus is located in Santa Cruz County, along the northern coast of the Monterey Bay, and approximately 70 miles south of the city/county of San Francisco, 30 miles southeast of the city of San Jose, and 30 miles north of the city of Monterey (see Figure 1). Approximately 53 percent of the main residential campus (as shown in Figure 2), including the majority of the on-campus structures and facilities, is located within the city of Santa Cruz with the remaining acreage located within unincorporated Santa Cruz County. The main residential campus is bounded on the east by the Pogonip City Park and the Henry Cowell Redwoods State Park, on the north by privately held land, on the west by Wilder Ranch State Park and the Cave Gulch neighborhood and on the south by residential neighborhoods located in the city of Santa Cruz.

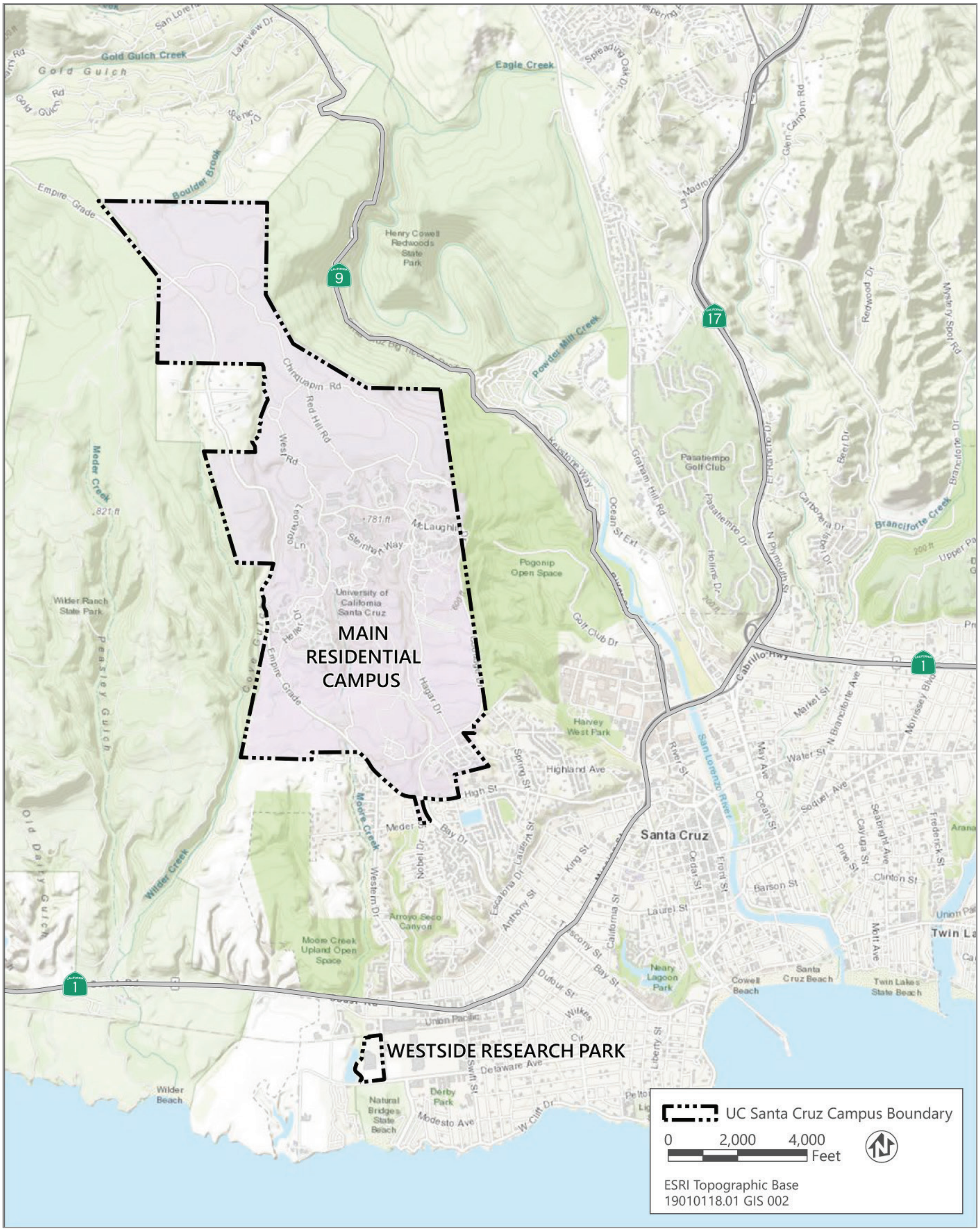
In addition to the main residential campus, UC Santa Cruz owns two other properties in the city of Santa Cruz. The Westside Research Park is located at 2300 Delaware Avenue on the west side of Santa Cruz and is included in the LRDP. The Westside Research Park is adjacent to the Natural Bridges State Park to the south, city properties zoned as mixed use to the west and north, and Antonelli Pond and the UC Santa Cruz Coastal Science Campus to the west. The surrounding area includes a mix of industrial, commercial, and housing uses, and natural areas.

UC Santa Cruz's Coastal Science Campus is a 100-acre property on the west side of the city and is governed by a Coastal Long Range Development Plan (CRLDP) that was adopted by the Board of Regents of the University of California (The Regents) and certified by the California Coastal Commission in 2008. As a result, the Coastal Science Campus is not included in the LRDP.



Source: data downloaded from Santa Cruz County in 2019

Figure 1 Regional Location



Source: data downloaded from Santa Cruz County in 2019

Figure 2 Project Location

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5. Description of Project

Planning Process

UC Santa Cruz began the planning process for the LRDP in the Fall of 2017 by conducting a series of meetings and interviews with campus and community stakeholders. The planning process was steered by the the LRDP Planning Committee, made up of students, staff, faculty, and community members and the Executive Committee. Expert workgroups engaged and provided feedback on planning efforts for specific topics. The campus also engaged regularly with a Community Advisory Group, consisting of city, county, and community representatives, to maintain an ongoing exchange of ideas and information and explore common goals and to discuss issues that confront both the campus and the surrounding community.

In the Spring of 2018, public workshops were held on the main residential campus and in the community, focusing on current concerns around the topics of housing, water, transportation, infrastructure and sustainability. The campus shared current planning efforts and sought feedback to help shape the approach to the LRDP. In Fall 2018, three initial land use scenarios were released for consideration and feedback through a public survey and an online visioning activity. In Fall 2019, UC Santa Cruz hosted several community and campus workshops and met with various campus stakeholders, in an effort to garner community input on potential land use plans. The draft land use map that is currently under consideration will be the proposed project considered in the EIR and is provided in Attachment C to this NOP.

Draft Project Goals

The overall objective of the LRDP is to support the teaching, research, and public service missions of UC Santa Cruz. The plan's growth assumptions are based on campus population projections and an understanding of campus needs and goals beyond the 19,500 FTE planned for within the 2005 LRDP. However, the LRDP does not commit UC Santa Cruz to any specific enrollment level, campus population, or development. The LRDP planning effort projects on-campus student population growth from approximately 18,518 FTE students (2018–2019 academic year) to approximately 28,000 FTE students by the 2040–2041 academic year, and faculty and staff population growth from approximately 2,800 FTE to approximately 5,000 FTE in the same timeframe. Because of housing challenges in the region, UC Santa Cruz plans to accommodate 100 percent of the increase in students and up to 25 percent of the increase of the anticipated 2,200 FTE faculty/staff members in on-campus housing.[3]

Proposed Project

The LRDP embraces a compact academic core with housing around the periphery. The plan incorporates employee housing that would be strategically located to allow access to community resources. An enhanced historic district at the entrance to the main residential campus would provide an improved community interface. Designated reserve areas would be set-aside for ecological, cultural, and educational uses and natural space would protect wildlife corridors and scenic views. To improve circulation, the LRDP includes an improved and more efficient roadway network and enhanced alternative transportation throughout the main residential campus. Finally, the Westside Research Park would incorporate mixed use academic, research, and housing on the west side of Santa Cruz.

The 2005 LRDP land use plan established a mix of land use categories to accommodate academic, open-space, residential, and infrastructural uses. Under the proposed LRDP, these types of land use categories would be maintained but have been further refined through the LRDP planning process to reflect campus needs and functions today. The proposed land use map for the LRDP is shown in Attachment C. The LRDP identifies the following land use categories to support anticipated campus growth:

- Academic Land Use Designations (approximately 200-300 acres)
    - Academic & Support—structures that facilitate teaching, research, student support and public service mission activities

[3] For more detail on the commitment to onsite housing, please see Footnote 2 on page 1.

- Outdoor Research—active landscapes for teaching, research and community education, including the following existing research programs: Center for Agroecology and Sustainable Food Systems farm, the Arboretum and Botanic Garden, and the Chadwick Garden.
- Historic District—land and structures intended to express the unique historic and cultural context for academic & support facilities, community-facing programs, and visitor resources.

- Open Space Land Use Designations (Approximately 1,350-1,550 acres)
  - Campus Natural Reserve—land preserved to protect natural features and processes for the purposes of teaching and research
  - Recreation & Athletics—indoor and outdoor athletic fields and facilities
  - Natural Space—land preserved as open space to maintain special campus landscapes due to scenic value, special vegetation and wildlife continuity
- Residential Land Use Designations (Approximately 250 – 400 acres)
  - Colleges and Student Housing—colleges and student housing, academic, and support spaces
  - Employee Housing— staff and faculty housing, and support space
  - Mixed Use—employee housing, academic and support space
- Other Campus Support—operations-oriented functions (Approximately 10-30 acres)

ATTACHMENT B
UC SANTA CRUZ
LONG RANGE DEVELOPMENT PLAN
IMPACT ANALYSIS AREAS AND PROBABLE ENIVIRONMENTAL EFFECTS OF THE EIR

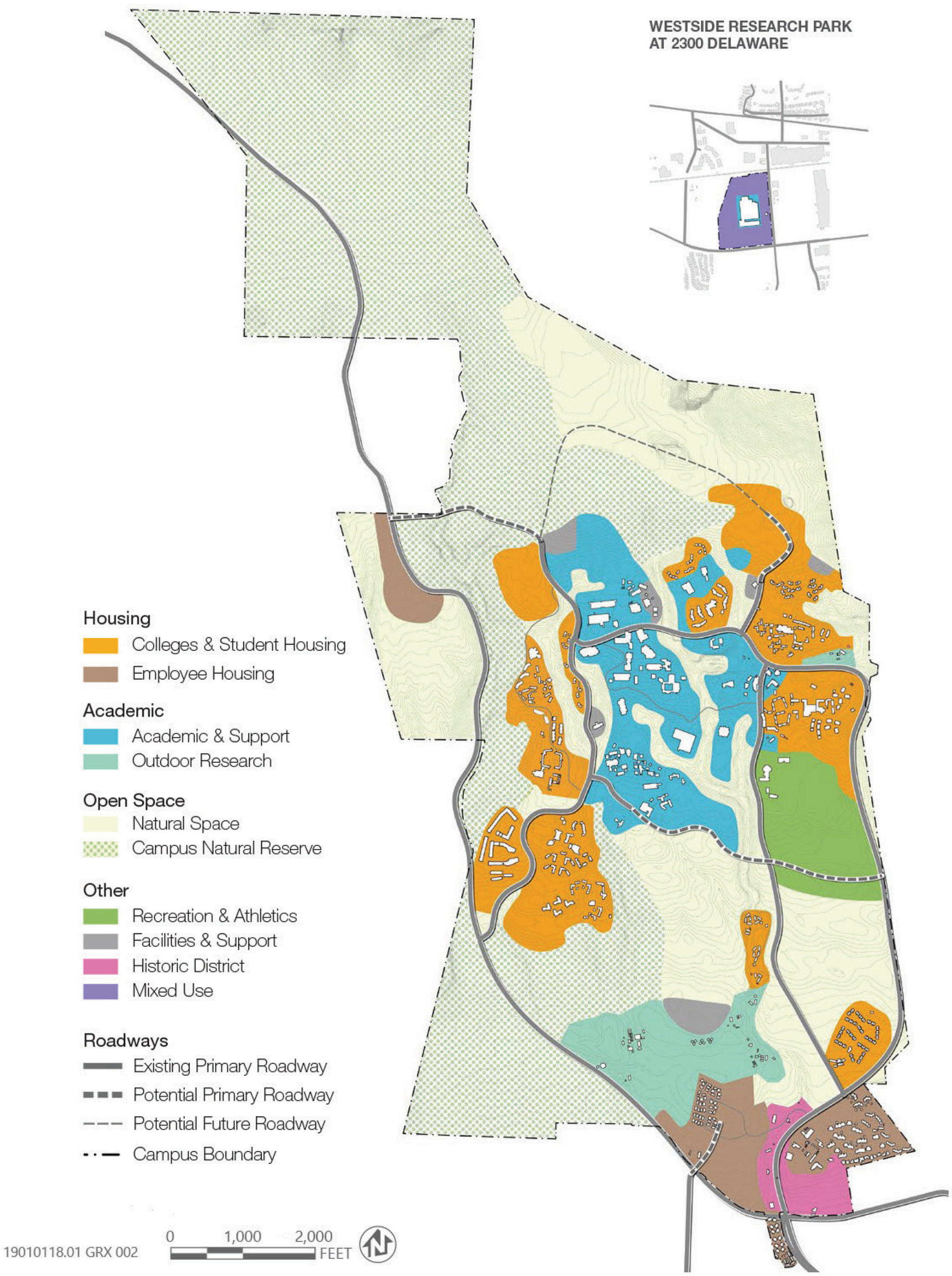
UC Santa Cruz has determined that PRC § 21080.09 requires that an EIR be prepared for this project. Therefore, as allowed under Section 15060 of the CEQA Guidelines (Title 14 Cal. Code Regs.), UC Santa Cruz has not prepared an Initial Study and will instead begin work directly on the EIR process described in Article 7 of the CEQA Guidelines, commencing with Section 15080. As required, the EIR will focus on the significant effects of the project and will document the reasons for concluding that other effects will be less-than-significant. Where significant or potentially significant environmental impacts are identified, the EIR will also discuss mitigation measures that may make it possible to avoid or reduce these impacts, when feasible.

The LRDP EIR will evaluate the probable environmental effects, including cumulative effects, of the project, in accordance with the following CEQA issue areas:

- Aesthetics – The EIR will evaluate the potential changes in the visual characteristics and quality of the main residential campus and the Westside Research Park and surrounding area.
- Agricultural and Forestry Resources – The EIR will evaluate the potential impacts to agricultural and forestry resources, including the conversion of agricultural uses to non-agricultural (educational/administrative) uses, associated with construction and operation under the LRDP.
- Air Quality – The EIR will evaluate the potential impacts resulting from implementation of the LRDP (during construction and operation) to air quality conditions, locally and regionally, and the potential for the LRDP to conflict with local and regional air quality planning efforts.
- Biological Resources –The EIR will evaluate the potential for implementation of the LRDP (including construction and operation of new/modified uses) to have a substantial adverse effect on sensitive biological species and/or habitat, as well as potential conflicts with local/regional conservation planning efforts.
- Cultural and Tribal Cultural Resources –The EIR will evaluate the potential for implementation of the LRDP (including construction and operational activities) to cause a substantial adverse change, either directly or indirectly, in the significance of archeological, historical, and tribal cultural resources.
- Energy – The EIR will evaluate potential impacts to energy resources and capacity associated with development under the LRDP.
- Geology, Soils, Paleontology, and Mineral Resources – The EIR will evaluate the potential for construction and operational activities associated with the LRDP to involve unstable geologic/soil conditions that could expose people and/or structures to substantial adverse effects. In addition, the EIR will also evaluate the potential for implementation of LRDP to affect paleontology and mineral resources.
- Greenhouse Gas Emissions – Implementation of the LRDP may result in the generation of additional greenhouse gas emissions during construction and operational activities. The EIR will evaluate the potential increase in emissions, as well as the LRDP's consistency with applicable planning efforts.
- Hazards & Hazardous Materials – The EIR will evaluate the potential for construction and operational activities associated with the LRDP to increase hazards on campus and in the area and the potential for increased risk of exposure to hazards and hazardous materials.

- Hydrology & Water Quality – The EIR will evaluate the potential for construction and operational activities associated with the LRDP to affect water quality (surface and groundwater supplies) and modify existing drainage patterns.
- Land Use & Planning – The EIR will evaluate the potential for implementation of the LRDP to affect established communities and conflict with applicable plans and policies adopted for the purpose of reducing or avoiding environmental impacts.
- Noise – The EIR will evaluate the potential for construction and operational activities associated with implementation of the LRDP to increase noise levels on-campus and in the area.
- Population & Housing – The EIR will evaluate the potential for implementation of the LRDP to induce (directly or indirectly) unplanned substantial population growth or displace substantial housing or residents.
- Public Services – The EIR will evaluate the potential for implementation of the LRDP to necessitate the construction of new or modified public facilities, including fire and police stations, which could result in environmental impacts as a result of their construction.
- Recreation – The EIR will evaluate the potential for implementation of the LRDP to increase the use of existing recreational facilities such that the condition of the facilities would be substantially and adversely affected and whether the construction and/or operation of any additional/modified recreational facilities resulting from implementation of the LRDP could result in similar effects.
- Transportation – The EIR will evaluate the potential for implementation of the LRDP to increase vehicle miles traveled (VMT) locally and in the region and whether such increases would conflict with applicable plans, policies, or regulations related to the effectiveness of the local/regional circulation system. The EIR will also include a discussion of emergency access adequacy, and potential transportation hazards resulting from or increased by implementation of the LRDP.
- Utilities & Service Systems – The EIR will evaluate the potential increases in demand for utilities and service systems as a result of implementation of the LRDP.
- Wildfire – The EIR will evaluate the potential increases in wildfire risk as a result of implementation of the LRDP.

ATTACHMENT C
UC SANTA CRUZ
LONG RANGE DEVELOPMENT PLAN
DRAFT LAND USE PLAN
FEBRUARY 2020



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Appendix B

Comments Received on the NOP

Appendix B1 - Notice of Preparation Commenter Log

UC SANTA CRUZ LONG RANGE DEVELOPMENT PLAN ENVIRONMENTAL IMPACT REPORT

Notice of Preparation Commenter Log

The following table provides a complete list of comments received on the Notice of Preparation (NOP) for the UC Santa Cruz Long Range Development Plan (LRDP). The following pages present the NOP comment letters in the order listed in the table.

Letter #	Date	Name
1	March 19, 2020	California Department of Fish and Wildlife
2	April 8, 2020	California Department of Forestry and Fire Protection
3	April 8, 2020	California Department of Transportation, District 5
4	March 18, 2020	City of Santa Cruz
5	April 8, 2020	City of Santa Cruz
6	April 8, 2020	Coalition for Limiting University Expansion
7	April 7, 2020	County of Santa Cruz
8	March 20, 2020	County of Santa Cruz Board of Supervisors
9	March 15, 2020	County of Santa Cruz Board of Supervisors
10	March 27, 2020	East Meadow Action Committee
11	April 8, 2020	Habitat and Watershed Caretakers
12	March 12, 2020	LAFCO
13	March 27, 2020	LAFCO
14	April 6, 2020	League of Women Voters - Barbara Lewis
15	April 6, 2020	League of Women Voters - Jan Karwin
16	February 25, 2020	Native American Heritage Commission
17	March 12, 2020	Santa Cruz City-County Task Force to Address UCSC Growth Plans
18	April 6, 2020	Santa Cruz City-County Task Force to Address UCSC Growth Plans
19	April 8, 2020	Santa Cruz Metropolitan Transit District (METRO)
20	April 8, 2020	US Fish and Wildlife
21	March 30, 2020	Alayne Meeks
22	April 3, 2020	Alex Jones
23	March 11, 2020	Alex Krohn

Letter #	Date	Name
24	April 6, 2020	Bonnie Cho
25	April 1, 2020	Brian Smith
26	April 1, 2020	Candace Brown
27	April 13, 2020	Carola Barton
28	March 12, 2020	Christopher Reithel
29	April 8, 2020	Chryssi Ladas
30	March 10, 2020	David Sawaya
31	March 31, 2020	Diane Cohan
32	March 31, 2020	Dohna Dunderdale
33	April 1, 2020	Elaine Sullivan
34	April 4, 2020	Elizabeth Saint
35	April 13, 2020	Evan Siroky
36	April 8, 2020	Frank Barron
37	April 8, 2020	Frank Zwart
38	April 6, 2020	GA Brewer
39	March 6, 2020	Gage Dayton
40	April 1, 2020	Gregg Herken
41	April 1, 2020	Grif Tmesc
42	April 1, 2020	Howard Scwartz
43	April 1, 2020	Ilan Zur
44	April 1, 2020	Iris Weaver
45	April 8, 2020	Isabella Brown
46	April 7, 2020	Isabelle Scott
47	April 6, 2020	Jamie Snyder
48	April 1, 2020	Jan Karwin
49	April 1, 2020	Jennifer Gonzalez
50	April 7, 2020	Jessica Evans
51	April 8, 2020	Jodi King
52	April 13, 2020	Joe De Meo
53	April 6, 2020	John Hall
54	April 13, 2020	John McGuire
55	April 4, 2020	Joseph Guiterrez
56	April 2, 2020	Judi Grunstra
57	March 27, 2020	Karen Holl
58	March 23, 2020	Kathy Haber
59	April 1, 2020	Kathy Blackwood
60	April 8, 2020	Katie Collins
61	April 1, 2020	Kenneth Coale
62	April 8, 2020	Kim Salisbury
63	March 12, 2020	Krisna Supatra-Campbell
64	April 1, 2020	Kurt and Melissa Workman

Letter #	Date	Name
65	March 12, 2020	Linda Werner
66	April 7, 2020	Linda Wilshusen
67	April 7, 2020	Mariam Moazed
68	April 1, 2020	Marianne Franks
69	March 31, 2020	Martha Seaver
70	April 8, 2020	Martha Brown
71	April 3, 2020	Matthew Wilbur
72	April 1, 2020	Melissa Hart
73	April 8, 2020	Melissa Hart
74	March 11, 2020	Michael Pisano
75	March 12, 2020	Michael Pisano
76	March 31, 2020	Michael Pisano
77	April 6, 2020	Mike Kalashian
78	April 13, 2020	Mike Munson
79	April 4, 2020	Milena Carothers
80	April 7, 2020	Nadene Thorne
81	April 4, 2020	Nancy Maynard
82	March 12, 2020	Neil Smith
83	April 4, 2020	Nola
84	March 12, 2020	Pam Newbury
85	April 1, 2020	Pat Obrien
86	April 5, 2020	Jim Weber
87	April 7, 2020	Patricia Knowles
88	April 1, 2020	Paula Sanford
89	March 31, 2020	Peter Cook
90	April 13, 2020	Pierluigi Olivero
91	April 1, 2020	Priscilla Williams
92	April 1, 2020	Rafa Sonnenfeld
93	April 1, 2020	Rick Longinotti
94	February 28, 2020	Rick Longinotti
95	March 11, 2020	Rick Longinotti
96	April 4, 2020	Roland Saher
97	March 12, 2020	Ronnie Lipschutz
98	March 12, 2020	Ronnie Lipschutz
99	March 31, 2020	Russell Weisz
100	March 31, 2020	Ruth Garland
101	March 10, 2020	Ruth Rabinowitz
102	March 30, 2020	Ryan Carle
103	April 1, 2020	Sarah Olson
104	April 1, 2020	Seth Levy
105	April 5, 2020	Sirleen Ghileri

Letter #	Date	Name
106	March 12, 2020	Smaura
107	April 5, 2020	Steve McCarthy
108	April 3, 2020	Susan Bruckner
109	April 1, 2020	Susan Coale
110	April 1, 2020	Ted Benhari
111	April 8, 2020	Tina Andreatta
112	April 1, 2020	Tracey Reynolds
113	April 8, 2020	Tsiem Schneider, Dian Gifford-Gonzalez, Jon Daehnke
114	April 1, 2020	Tutti Hacking
115	April 7, 2020	Valerie Bengal
116	April 1, 2020	Veronica Macramalla
117	April 9, 2020	Vikki Erickson
118	April 8, 2020	Vincent Molina
119	March 12, 2020	Woutje Swets
120	April 4, 2020	Zachary P

In addition, transcripts of the two scoping sessions held on March 12, 2020 are provided at the end of this appendix.

Appendix B2 – Notice of Preparation Comment Letters

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
2825 Cordelia Road, Suite 100
Fairfield, CA 94534
(707) 428-2002
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

March 19, 2020

Ms. Erika Carpenter, Senior Environmental Planner
Physical Planning, Development, and Operations
University of California, Santa Cruz
1156 High Street, Barn G
Santa Cruz, CA 95064
eircomment@ucsc.edu

Subject: UC Santa Cruz Long Range Development Plan, Notice of Preparation, SCH #2020029086, Santa Cruz County

Dear Ms. Carpenter:

The California Department of Fish and Wildlife (CDFW) has reviewed the Notice of Preparation (NOP) prepared by the Board of Regents of the University of California for the UC Santa Cruz Long Range Development Plan (Project) located in Santa Cruz County. CDFW is submitting comments on the NOP regarding potentially significant impacts to biological resources associated with the Project.

CDFW ROLE

CDFW is a Trustee Agency with responsibility under the California Environmental Quality Act (CEQA; Pub. Resources Code, § 21000 et seq.) pursuant to CEQA Guidelines section 15386 for commenting on projects that could impact fish, plant, and wildlife resources (e.g., biological resources). CDFW is also considered a Responsible Agency if a project would require discretionary approval, such as permits issued under the California Endangered Species Act (CESA), the Native Plant Protection Act (NPPA), the Lake and Streambed Alteration (LSA) Program, and other provisions of the Fish and Game Code that afford protection to the state's fish and wildlife trust resources.

PROJECT DESCRIPTION SUMMARY

The Project is a land use plan that proposes the construction of new buildings and infrastructure to accommodate for population growth at the main residential campus at the University of California, Santa Cruz (UCSC) and the Westside Research Park property at 2300 Delaware Avenue in the City of Santa Cruz.

The proposed building and infrastructure projects include the construction of 8,500 student housing beds, up to 550 employee housing units, and approximately 2,800,000 assignable square feet of academic and administrative building space.

The draft Environmental Impact Report (EIR), and subsequent EIR, will be a programmatic EIR and replace the UCSC 2005 Long Range Development Plan.

ENVIRONMENTAL SETTING

The special-status species that have the potential to occur in or near the Project site, include, but are not limited to:

- American badger (*Taxidea taxus*) – a state species of special concern;
- Bank swallow (*Riparia riparia*) – state listed as endangered under CESA;
- Burrowing owl (*Athene cunicularia*) – a state species of special concern;
- California giant salamander (*Dicamptodon ensatus*) – a state species of special concern;
- California red-legged frog (*Rana draytonii*) – federally listed as threatened under the Endangered Species Act (ESA) and a state species of special concern;
- Coho salmon (*Oncorhynchus kisutch*) – federally listed as endangered under ESA and state listed as endangered under CESA;
- Ohlone tiger beetle (*Cicindela ohlone*) – federally listed as endangered under ESA;
- Pacific Grove clover (*Trifolium polyodont*) – a state rare species;
- San Francisco popcornflower (*Plagiobothrys diffusus*) – state listed as endangered;
- Santa Cruz black salamander (*Aneides niger*) – a state species of special concern;
- Steelhead (*Oncorhynchus mykiss irideus)* – federally listed as threatened under ESA;
- Townsend's big-eared bat (*Corynorhinus townsendii*) – a state species of special concern;
- Western bumble bee (*Bombus occidentalis*) – a state candidate species under CESA;
- Western pond turtle (*Emys marmorata*) – a state species of special concern;
- White-rayed pentachaeta (*Pentachaeta bellidiflora*) – federally listed as endangered under ESA and state listed as endangered under CESA;
- White-tailed kite (*Elanus leucurus*) – a state fully protected species under Fish and Game Code; and
- Zayante band-winged grasshopper (*Trimerotropis infantilis*) – federally listed as endangered under ESA.

COMMENTS AND RECOMMENDATIONS

CDFW offers the following comments and recommendations to assist the Board of Regents of the University of California in adequately identifying and/or mitigating the Project's significant, or potentially significant, direct, and indirect impacts on biological resources.

Comment 1: Full Project Description of Project Features

The CEQA Guidelines (§§15124 & 15378) require that the draft EIR incorporate a full Project description, including reasonably foreseeable future phases of the Project, and require that it contain sufficient information to evaluate and review the Project's environmental impact.

To fully address the Project's impacts to biological resources, please include complete descriptions of the following features within the draft EIR:

- Building heights and widths;
- Introduction of sources of light and glare into habitat areas;

- Detailed description of any proposed work within sensitive habitats or streams;
- Trail locations, widths, and lengths; and
- Location, type, lengths, and heights of all fencing.

Comment 2: Cumulative Impacts

The Project has a potential to contribute to cumulative impacts, such as decreasing wildlife connectivity due to the installation of fencing and infrastructure; increase in deleterious material (e.g., trash, pollutants, etc.) into streams due to the increase of impervious surfaces; and increase in stream flow due to the culverting of ditches and the funneling of storm runoff throughout the project into streams. Any cumulative impact to biological resources should be mitigated to the extent possible or avoided.

CDFW recommends that the Project incorporate wildlife friendly fencing (if fencing is proposed), creation of wildlife bypasses to mitigate for decreases in wildlife connectivity, education of future faculty and students regarding leaving no trace, and ensuring that storm runoff is dispersed as sheet flow along the landscape and not funneled into streams.

Comment 3: New Buildings and Infrastructure within Developed Areas

The Project area includes, and is surrounded by, sensitive habitats (e.g., redwood forests, sandhills, grasslands) that contain special-status species. To avoid impacts to special-status species and encroachment into sensitive habitats, CDFW strongly recommends constructing new buildings and infrastructure within already paved areas within UCSC's main residential campus and the Westside Research Park or infilling between existing buildings.

Comment 4: Water Source

Water supply resources are limited in the Santa Cruz area. To ensure adequate long-term water supply at UCSC, CDFW recommends including mechanisms and/or infrastructure in the draft EIR to decrease the Project's water supply needs. This may include, but is not limited to, additional supplemental water supply infrastructure (e.g., rainwater catchments), conservation practices, and/or water reuse projects.

Comment 5: State Threatened or Endangered Wildlife Species

State threatened, endangered, or candidate wildlife species are known to occur within the Project area. Without appropriate mitigation measures, Project activities conducted within occupied territories or habitats have the potential to significantly impact these species.

Impacts to state-listed wildlife species include, but are not limited to, inability to reproduce, capture, burrow/den collapse, crushing as a result of burrow collapse, entombment, inadvertent entrapment, reduced reproductive success, reduction in health and vigor of young, nest abandonment, loss of nest trees/breeding habitat, or loss of foraging habitat that would reduce nesting success (loss or reduced health or vigor of eggs or young), and direct mortality. Unauthorized take of species listed as threatened or endangered pursuant to CESA is a violation of Fish and Game Code.

To evaluate potential impacts to state-listed wildlife species, CDFW recommends conducting the following evaluation of the Project area, incorporating the following mitigation measures into the draft EIR, and requiring these measures as conditions of approval for the Project.

Recommended Mitigation Measure 1: State Listed Wildlife Species Focused Surveys
CDFW recommends that the Project area be surveyed for state-listed wildlife species by a qualified biologist following species-specific protocol-level surveys, if applicable. Protocol-level surveys contain methods that, when adhered to, are intended to maximize detectability. In the absence of protocol-level surveys being performed or when performed outside of the parameters of the methodology, additional surveys may be necessary.

Recommended Mitigation Measure 2: State Listed Wildlife Species Avoidance
In the event a state listed wildlife species is found within or adjacent to the Project site, implementation of avoidance measures is warranted. CDFW recommends that a qualified wildlife biologist be on-site during all Project-related activities and that a no disturbance buffer be implemented. Fully addressing potential impacts to state listed wildlife species and requiring measurable and enforceable mitigation in the draft EIR is recommended.

Recommended Mitigation Measure 3: State Listed Species Take Authorization
If a state listed wildlife species is identified and detected during surveys or during Project implementation, consultation with CDFW is warranted to determine if the Project can avoid take. If take cannot be avoided, take authorization through acquisition of an Incidental Take Permit (ITP) issued by CDFW pursuant to Fish and Game Code section 2081(b) is necessary to comply with CESA.

Comment 6: State Threatened, Endangered, or Rare Plant Species

The Project area contains occurrence and habitat that may support special-status plants meeting the definition of rare, threatened, or endangered under Fish and Game Code sections 1901 and 1907 and CEQA Guidelines section 15380.

Without appropriate avoidance and minimization measures potential impacts to special-status plant species include inability to reproduce and direct mortality. Unauthorized take of plant species listed as threatened, endangered, or rare pursuant to CESA or NPPA is a violation of Fish and Game Code.

Many of the special-status plant species are narrowly distributed endemic species. These species are threatened with habitat loss and habitat fragmentation resulting from development, vehicle and foot traffic, road maintenance, and introduction of non-native plant species. Therefore, the Project has the potential to significantly impact populations of the species mentioned above.

To evaluate potential impacts to special-status plants, CDFW recommends conducting the following evaluation of the Project area, incorporating the following mitigation measures into the draft EIR, and requiring these measures as conditions of approval for the Project.

Recommended Mitigation Measure 4: Special-Status Plant Focused Surveys
CDFW recommends that the Project area be surveyed for special-status plant species by a qualified botanist following the "Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities" which can be found online at https://www.wildlife.ca.gov/Conservation/Survey-Protocols. This protocol, which is intended to maximize detectability, includes identification of reference populations to facilitate the likelihood of field investigations occurring during the appropriate floristic period. In the absence of protocol-level surveys being performed, additional surveys may be necessary.

Recommended Mitigation Measure 5: Special-Status Plant Avoidance
CDFW recommends special-status plant species be avoided whenever possible by delineation and observing a no disturbance buffer of at least 50 feet from the outer edge of the plant population(s) or specific habitat type(s) required by special-status plant species. Active management, such as removal of non-native weeds, may be required to protect plant populations, and should be done in consultation with CDFW.

Recommended Mitigation Measure 6: Special-Status Plant Take Authorization
If a state threatened, endangered, rare, or candidate plant is identified during botanical surveys, consultation with CDFW is warranted to determine if the Project can avoid take. If take cannot be avoided, acquisition of an ITP issued by CDFW Pursuant to Fish and Game Code sections 2081(b) and/or section 1900 et seq is necessary to comply with CESA and NPPA.

Comment 7: Nesting Birds

CDFW encourages that Project implementation occur during the bird non-nesting season; however, if ground disturbing or vegetation disturbing activities must occur during the breeding season (February through early September), the Project applicant is responsible for ensuring that implementation of the Project does not result in violation of the Migratory Bird Treaty Act of 1918 or Fish and Game Code section 3503.

To evaluate and avoid for potential impacts to nesting bird species, CDFW recommends incorporating the following mitigation measures into the Project's draft EIR, and that these measures be made conditions of approval for the Project.

Recommended Mitigation Measure 7: Nesting Bird Surveys
CDFW recommends that a qualified avian biologist conduct pre-activity surveys for active nests no more than seven (7) days prior to the start of ground or vegetation disturbance and every 14 days during Project activities to maximize the probability that nests that could potentially be impacted are detected. CDFW also recommends that surveys cover a sufficient area around the Project site to identify nests and determine their status. A sufficient area means any area potentially affected by the Project. Prior to initiation of ground or vegetation disturbance, CDFW recommends that a qualified biologist conduct a survey to establish a behavioral baseline of all identified nests. Once Project activities begins, CDFW recommends having the qualified biologist continuously monitor nests to detect behavioral changes resulting from the Project. If behavioral changes occur, CDFW

recommends halting the work causing that change and consulting with CDFW for additional avoidance and minimization measures.

Recommended Mitigation Measure 8: Nesting Bird Buffers
If continuous monitoring of identified nests by a qualified avian biologist is not feasible, CDFW recommends a minimum no-disturbance buffer of 250 feet around active nests of non-listed bird species and a 500-foot no disturbance buffer around active nests of non-listed raptors. These buffers are advised to remain in place until the breeding season has ended or until a qualified biologist has determined that the birds have fledged and are no longer reliant upon the nest or on-site parental care for survival. Variance from these no disturbance buffers is possible when there is compelling biological or ecological reason to do so, such as when the Project site would be concealed from a nest site by topography. CDFW recommends that a qualified avian biologist advise and support any variance from these buffers.

Comment 8: Bats

Bat species are known to occur within and surrounding the project site. To evaluate and avoid potential impacts to bat species, CDFW recommends incorporating the following mitigation measures into the Project's draft EIR, and requiring these measures as conditions of approval for the Project.

Recommended Mitigation Measure 9: Bat Habitat Assessment
To evaluate Project impacts to bats, a qualified bat biologist should conduct a habitat assessment for bats at work sites seven (7) days prior to the start of Project activities and every 14 days during Project activities. The habitat assessment shall include a visual inspection of features within 50 feet of the work area for potential roosting features (bats need not be present). Habitat features found during the survey shall be flagged or marked.

Recommended Mitigation Measure 10: Bat Habitat Monitoring
If any habitat features identified in the habitat assessment will be altered or disturbed by Project activities, the qualified bat biologist should monitor the feature daily to ensure bats are not disturb, impacted, or fatalities are caused by the Project.

Recommended Mitigation Measure 11: Bat Project Avoidance
If bat colonies are observed at the Project site, at any time, all Project activities should stop until the qualified bat biologist develops a bat avoidance plan to be implement at the Project site. Once the plan is implemented, Project activities may recommence.

REGULATORY REQUIREMENTS

California Endangered Species Act
Please be advised that a CESA Permit must be obtained if the Project has the potential to result in "take" of plants or animals listed under CESA, either during construction or over the life of the Project. Issuance of a CESA Permit is subject to CEQA documentation; the CEQA document must specify impacts, mitigation measures, and a mitigation monitoring and reporting program. If the Project will impact CESA listed species, early consultation is encouraged, as significant

modification to the Project and mitigation measures may be required in order to obtain a CESA Permit.

CEQA requires a Mandatory Finding of Significance if a project is likely to substantially impact threatened or endangered species [CEQA section 21001(c), 21083, and CEQA Guidelines section 15380, 15064, 15065]. Impacts must be avoided or mitigated to less-than-significant levels unless the CEQA Lead Agency makes and supports Findings of Overriding Consideration (FOC). The CEQA Lead Agency's FOC does not eliminate the Project proponent's obligation to comply with Fish and Game Code section 2080.

Lake and Streambed Alteration (LSA) Program
Notification is required, pursuant to CDFW's LSA Program (Fish and Game Code section 1600 et. seq.) for any Project-related activities that will substantially divert or obstruct the natural flow; change or use material from the bed, channel, or bank including associated riparian or wetland resources; or deposit or dispose of material where it may pass into a river, lake or stream. Work within ephemeral streams, washes, watercourses with a subsurface flow, and floodplains are subject to notification requirements. CDFW, as a Responsible Agency under CEQA, will consider the CEQA document for the Project. CDFW may not execute the final LSA Agreement until it has complied with CEQA (Public Resources Code section 21000 et seq.) as the responsible agency.

FILING FEES

CDFW anticipates that the Project will have an impact on fish and/or wildlife, and assessment of filing fees is necessary (Fish and Game Code section 711.4; Pub. Resources Code, section 21089). Fees are payable upon filing of the Notice of Determination by the Lead Agency and serve to help defray the cost of environmental review by CDFW.

Thank you for the opportunity to comment on the Project's NOP. If you have any questions regarding this letter or for further coordination with CDFW, please contact Ms. Monica Oey, Environmental Scientist, at (707) 428-2088 or monica.oey@wildlife.ca.gov; or Ms. Randi Adair, Senior Environmental Scientist (Supervisory), at (707) 576-2786 or randi.adair@wildlife.ca.gov.

Sincerely,

Gregg Erickson

Gregg Erickson
Regional Manager
Bay Delta Region

cc: State Clearinghouse #2020029086

DEPARTMENT OF FORESTRY AND FIRE PROTECTION
P.O. Box 944246
SACRAMENTO, CA 94244-2460
(916) 653-7772
Website: www.fire.ca.gov

Date: April 8, 2020
UC Santa Cruz Long Range Development Plan NOP

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development, and Operations
University of California, Santa Cruz
1156 High Street, Santa Cruz, CA 95064
eircomment@ucsc.edu

The UC Santa Cruz Long Range Development Plan Notice of Preparation (NOP) has been reviewed by the Resource Management office of the San Mateo-Santa Cruz Unit of the California Department of Forestry and Fire Protection (CAL FIRE). Please see our comments below.

Tree Removal

Much of the land proposed for this project can be classified as "Timberland" as defined under Public Resources Code (PRC) section 4526. A timberland conversion permit or timber harvest plan would be required prior to the cutting of trees. A consulting Register Professional Forester could assist you in this determination. Any harvesting or conversion for this project could be incorporated in a multiple project conversion permit and Timber Harvest Plan.

Fire Hazard

This project has been identified as being adjacent to wildlands. PRC 4291 requires the creation of a 100' fire break or fire protection area around and adjacent to buildings or structures. Compliance with this rule would be required by the fire inspector for this project. Specific mitigations and protection measures to comply with this rule will need to be made part of the building permit.

Sudden Oak Death

Sudden Oak Death (SOD), *Phytophthora ramorum*, is commonly found in the forests around the UCSC campus. During tree removal operations for this project, care should be taken to prevent the spread of this disease. Numerous sources of information have been developed to identify and manage this pest. One such site, maintained by the California Oak Mortality Task Force is available on the internet: http://nature.berkeley.edu/comtf/

If you need any assistance or information, please contact me at the telephone number or e-mail address listed below.

Sincerely,

Signed Original, on File

Richard Sampson
Forester II – Unit Forester
Unit Environmental Coordinator

RPF #2422
(831) 335-6742
Richard.sampson@fire.ca.gov

Cc:
Christopher Browder
Deputy Chief, Environmental Protection

DEPARTMENT OF TRANSPORTATION
CALTRANS DISTRICT 5
50 HIGUERA STREET
SAN LUIS OBISPO, CA 93401-5415
PHONE (805) 549-3101
FAX (805) 549-3329
TTY 711
www.dot.ca.gov/dist05/

Making Conservation a California Way of Life.

April 8, 2020

SCr/VAR
SCH#2020029086

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development, and Operations
University of California, Santa Cruz
1156 High Street
Santa Cruz, CA 95064

COMMENTS FOR THE NOTICE OF PREPARATION (NOP) OF THE UC SANTA CRUZ LONG RANGE DEVELOPMENT PLAN, SANTA CRUZ, CA

Dear Ms. Carpenter:

The California Department of Transportation (Caltrans) appreciates the opportunity to review the Notice of Preparation (NOP) for the UC Santa Cruz Long Range Development Plan (LDRP). The LDRP estimates 28,000 Full-Time Equivalent (FTE) students and 5,000 FTE faculty and staff along with 8,500 student housing beds, up to 550 employee housing units, and approximately 2,800,000 assignable square feet (ASF) of academic and administrative building space by 2035. Growth will occur at both the UC Santa Cruz main residential campus and the Westside Research Park.

1. Caltrans supports local development that is consistent with State planning priorities intended to promote equity, strengthen the economy, protect the environment, and promote public health and safety. We accomplish this by working with local jurisdictions to achieve a shared vision of how the transportation system should and can accommodate interregional and local travel and development. Projects that support smart growth principles which include improvements to pedestrian, bicycle, and transit infrastructure (or other key Transportation Demand Strategies) are supported by Caltrans and are consistent with our mission, vision, and goals.

2. Please be aware that if any work is completed in the State's right-of-way it will require an encroachment permit from Caltrans and must be done to our engineering and environmental standards, and at no cost to the State. The conditions of approval and the requirements for the encroachment permit are issued at the sole discretion of the Permits Office, and nothing in this letter shall be implied as limiting those future conditioned and requirements. For more information regarding the encroachment permit process, please visit our Encroachment Permit Website at: http://www.dot.ca.gov/trafficops/ep/index.html.

3. As a result of Senate Bill (SB) 743, effective July 2020 Caltrans will replace vehicle level of service (LOS) with vehicle miles traveled (VMT) as the primary metric for identifying transportation impacts from local development. The focus now will be on how projects are expected to influence the overall amount of automobile use instead of traffic congestion as a significant impact. For more information, please visit: http://opr.ca.gov/docs/20190122-743_Technical_Advisory.pdf. At times there may be certain locations of concern, such as at-grade connections to State Routes (SR) without channelization, that may require additional study or conflict analysis.

4. Employing VMT as the metric of transportation impact Statewide will help to promote Green House Gas (GHG) emission reductions consistent with SB 375 and can be achieved through influencing on-the-ground development. Implementation of this change will rely, in part, on local land use decisions to reduce GHG emissions associated with the transportation sector, both at the project level, and in long-term plans (including general plans, climate action plans, specific plans, and transportation plans) and supporting Sustainable Community Strategies developed under SB 375.

5. Based upon local concerns raised during the Draft Environmental Impact Report (DEIR) Scoping Session and known operational issues at the intersections on SR 1 at the Bay Street, High Street, and Western Drive intersections, additional study and safety analysis might be warranted.

6. Caltrans appreciates UC Santa Cruz's commitment to Strategy #4 in the LDRP's Proposed Land Use Strategies to focus on an enhanced shuttle, pedestrian, and bicycle network throughout campus. UC Santa Cruz has been successful in the past reducing vehicle trips as noted by weekday traffic to campus declining by 2,151 vehicle trips per day since 2005. We would further suggest looking into conversion of existing parking spaces into those supporting electric vehicles and electric vanpool fleets to help meet Statewide goals for reducing GHG's.

Thank you for the opportunity to review and comment on the proposed project. If you have any questions, or need further clarification on items discussed above, please contact me at (805) 549-3157 or email christopher.bjornstad@dot.ca.gov.

Sincerely,

Chris Bjornstad

Chris Bjornstad
Associate Transportation Planner
District 5 Development Review

cc: Rachel Moriconi, SCCRTC
Claire Gallogly, City of Santa Cruz

CITY OF
SANTA CRUZ

MAYOR AND CITY COUNCIL
809 Center Street, Room 10, Santa Cruz, CA 95060 • (831) 420-5010 • Fax: (831) 420-5011 • www.cityofsantacruz.com

March 18, 2020

Ms. Erika Carpenter
Senior Environmental Planner
Physical Planning, Development, and Operations
University of California, Santa Cruz
1156 High Street
Santa Cruz, CA 95064

Dear Ms. Carpenter:

At its meeting on March 10, 2020, the Santa Cruz City Council passed a motion to request that the comment period for the Notice of Preparation of the University of California at Santa Cruz (UCSC) Long Range Development Plan Environmental Impact Report (LRDP EIR) be extended.

As you know, UCSC staff have postponed the LRDP EIR public scoping meetings until the first week of April and have extended the scoping period for one week until April 8, 2020.

We understand and completely support the decision to delay this week's public meetings. The health emergency is clearly serious and is currently, and for the foreseeable future, disrupting the lives of everyone in the Santa Cruz community and elsewhere.

Because of this uncertainty regarding the future impact of the health crisis, we are greatly dismayed by the revised schedule of the scoping period. The fundamental purpose of the scoping period is for UCSC to hear comments from the general public and concerned public agencies regarding the draft LRDP EIR. It is clearly difficult for this to occur when both citizens and institutions are focused on a health crisis that seems to be worsening, at least in this country, on a daily basis.

The proposed UCSC scoping schedule seems to be based on the assumption that everything will be back to normal in a few weeks. This may or may not occur, but, even if it does, the community needs a reasonable period of time to refocus on issues like the LRDP EIR.

The California Environmental Quality Act requires meaningful public participation and is a central component in the EIR process, including the scoping period. To extend the thirty-day scoping period only one week in the middle of an international health crisis will not allow for the kind of robust public engagement called for by the law.

Therefore, we respectfully request that you extend the scoping period for at least three weeks after the end of the declared local health emergency and then open public sessions for public input per normal practice. This decision should be announced as soon as possible.

Sincerely,

Justin Cummings
Mayor

cc: City Clerk

ZONING / PERMIT PROCESSING
831/420-5100 • FAX 831/420-5434
COMPREHENSIVE PLANNING
831/420-5180 • FAX 831/420-5101

CITY OF SANTA CRUZ

INSPECTION SERVICES
831/420-5120 • FAX 831/420-5434
PLANNING ADMINISTRATION
831/420-5110 • FAX 831/420-5101

PLANNING AND COMMUNITY DEVELOPMENT DEPARTMENT
809 Center Street • Room 206 • Santa Cruz, CA 95060 • **www.cityofsantacruz.com**
Lee Butler, Director

April 8, 2020

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development, and Operations
University of California, Santa Cruz
1156 High Street, Santa Cruz, CA 95064

Subject: LRDP NOP Comments

Dear Ms. Carpenter,

The City of Santa Cruz (City) values the partnerships it has with the University of California, Santa Cruz (UCSC) and the many amenities, opportunities, and benefits that UCSC itself and the larger UCSC community bring to the City. As UCSC considers expansion, the City appreciates the opportunity to offer feedback on how said expansion may impact the City, its residents, and its visitors. The City has reviewed the information provided in the UCSC Long Range Development Plan (LDRP) Notice of Preparation (NOP) of an Environmental Impact Report (EIR) and provides comments as follows.

A complete, accurate, and detailed project description is critical to ensure that all impacts of the project are reviewed, analyzed, and, to the extent possible, mitigated. The project description in the Draft EIR will need to contain substantially more specificity and detail than that contained in the NOP in order to provide an accurate assessment of impacts and mitigations. Some of the comments contained herein stem from questions relating to the broad nature of the NOP's project description. Details related to the range of expected uses, along with the locations of specific development capacities (and/or expected student housing and faculty/staff increases) , will be needed to identify, understand, and analyze the impacts the overall development will have on the campus areas and on the larger community.

The timing of proposed mitigations is imperative to minimize negative impacts of future development. For instance, prior to increasing student enrollment and additional faculty/staff, the EIR should clearly note that the necessary transportation and housing mitigations, along with other infrastructure needs, will be in place prior to said increases, not afterwards, so that negative impacts to the environment, the City, and City residents are minimized.

Corrections for the EIR. The NOP's Project Information Location and Setting section of Attachment A, UCSC LDRP Detailed Project Information, contains several errors. In the first paragraph, the project location is described, in part, as being "southeast of the City of San Jose."

The location is southwest of the City of San Jose. In the second paragraph, the zoning of properties to west and north of the Westside Research Park (WRP) is described as being "mixed use." The properties to the north of the WRP are zoned Flood Plain, Park, Public Facility, Low Density Residential, and Industrial (IG/PER 2). Properties to the west of the WRP are zoned Park, Single-Family Residential, and General Industrial.

General Comments on Evaluation Methods and Approach. On page A-4 of Attachment A, additional information regarding the University's commitment to providing housing for faculty and staff is needed. The NOP states that up to 25% of the 2,220 full time equivalent faculty/staff members will be housed on campus. When faculty/staff are not housed on-campus, they create more impacts in the City, e.g., transportation impacts (vehicle miles traveled (VMT) and level of service (LOS) implications); housing availability, demand, and cost impacts; water use impacts (since water use of those living in the City will differ from those living on campus); etc. In order to adequately assess the impacts of the project, the percentage of faculty/staff living on campus will need to be clearly established. Carrying the NOP's statement that *up to* 25% of the new faculty/staff will be housed on campus into the EIR's project description would mean that the EIR would need to evaluate the impacts of all new faculty/staff being housed off campus. Instead, the EIR should commit to providing a specific amount of on-campus housing prior to expansions of faculty/staff members, as this will allow for a more accurate assessment of the project's impacts. Furthermore, since the provision of faculty/staff housing on-campus would result in fewer negative environmental effects experienced by the City and its residents, the EIR should consider a project or alternative that provides on-campus housing for a higher percentage of its workforce.

The NOP speaks to evaluations of full time equivalent (FTE) students and FTE faculty/staff. A definition of FTE is provided in Footnote 1 of the NOP; however, it is not clear how this definition considers additional students and faculty/staff who are not full time. The EIR should clearly identify how impacts from all new students and faculty/staff are assessed. In other words, if the FTE measure does not already consider non-full-time students and faculty/staff – e.g., continuing education students, part time students, faculty who are not full time but perhaps lecture for one class per semester, staff who are not full time but perhaps work one or two shifts per week on campus, etc. – then an alternative measure should seek to quantify the increase in such use and include an evaluation of the impacts associated with such users in the EIR. These individuals would likely be living off-campus and would likely result in more impacts in the City than a full-time student, faculty, or staff member who lives on campus.

The expansion of FTE students, FTE faculty/staff, facilities, special events (open lectures, sporting events, etc.), and classes may attract more individuals who enroll/participate in continuing education, who visit those living on campus, who attend the special events, or who otherwise are drawn to the campus as a result of its expansion. The methodology utilized in the EIR should analyze not only the impacts of additional students and faculty/staff but should also analyze any impacts (e.g., vehicle trips) associated with the above-described potential additional usage.

The NOP provides minimal information regarding the proposed development at the WRP. Attachment C indicates some "Academic and Support" uses directly adjacent to the existing facility with "Mixed Use" surrounding the facility. No detail is provided as to the quantity or extent of the uses that are proposed beyond the existing building, so additional comments may be necessary after more detailed information is provided. Not only could the range of uses potentially anticipated for this site have a variety of impacts within the City, but the manner in which those uses are operated and occupied will partially dictate some of the impacts. For example, if the mixed-use component includes housing, then housing for students traveling to the main campus would result in more impacts than if the site only included housing for students or faculty/staff who study or work exclusively at the WRP. The EIR should clearly specify the details of the potential uses, how/by whom they will be used, and the resulting environmental impacts, including but not limited to any impacts development on the WRP site may have on Antonelli Pond and its associated habitat and sensitive species.

Impact-Specific Comments. The following comments relate to the proposed impact analysis sections.

<u>Aesthetics</u>. Policy CD1.3 of the City's General Plan requires the City to "Ensure that development is designed to be in harmony with natural topography and vegetation." Action CD1.3.1 applies specifically to development by UCSC and states "Encourage UCSC development to blend with the natural landscape and maintain natural ridgelines as seen from the City." Please include an analysis of the aesthetic character of new development within the natural landscape, particularly as it relates to views from the City.

<u>Biological Resources</u>: Please include an analysis of any tree removal for consistency with the City of Santa Cruz (City) Heritage Tree Ordinance (Chapter 9.56, City of Santa Cruz Municipal Code (SCMC)).

<u>Energy</u>: The EIR's energy analyses should emphasize how the project avoids or reduces inefficient, wasteful, and unnecessary consumption of energy. Please include an analysis of compliance with the City's Electrification Ordinance (Chapter 6.100, SCMC) for all new construction.

<u>Geology and Soils</u>: Please analyze the potential of significant impacts due to earthquakes and seismic activity including shaking and ground failure, liquefaction, landslides, as well as soil erosion and loss of top soil due to the proposed project. Please also analyze the potential for the proposed project to directly or indirectly impact a unique paleontological resource or site or unique geological feature.

<u>Hydrology and Water Quality</u>: The maps provided with UCSC's NOP request letter indicate that the LRDP will likely include further development on UCSC's upper campus outside of City's existing water service boundaries. Extension of water and sewer service may be subject to Santa Cruz Municipal Code Chapter 16.22 regarding sustainability and university growth. A link to the relevant municipal code section is found here:
https://www.codepublishing.com/CA/SantaCruz/html/SantaCruz16/SantaCruz1622.html

It would be helpful for the UCSC LRDP Draft EIR to analyze the issue of extending water and sewer service as part of the Draft EIR, including an evaluation of any additional regulatory approvals necessary to complete the extension of services. Assessment of these issues is relevant to section XVIII of the CEQA Guidelines Appendix G initial study checklist dealing with utilities and service systems.

The City would be a responsible agency in relation to these issues. The Santa Cruz City Attorney's Office is willing to further discuss these issues with the UCSC Draft EIR team as needed.

Please include an analysis of the potential of the project to violate any waste water discharge standards.

<u>Population and Housing</u>: Many of the comments in the *General Comments on Evaluation Methods and Approach* section above have direct and indirect implications for population and housing growth and impacts. In particular, housing needs (and thus housing construction) will be one direct result of the increase in the number of FTE (and, as spelled out above, non-FTE) students and faculty/staff, and the City will likely bear the burden of much of the off-campus housing demand. The impacts of that demand should be analyzed in the EIR.

<u>Public Services</u>: As the City Fire Department serves the UCSC properties, please closely coordinate with the Fire Department during the preparation of the Draft EIR so they can assist in evaluating what new or expanded facility needs they may have to serve the growth considered by the project. Addressing these needs is an important step in providing safety to students, faculty, and staff. Specific concerns include the height of buildings that are beyond the reach of any ladder truck that would fit in the existing fire house on campus, requiring the renovation or rebuilding of the fire house to provide adequate fire protection on campus. With an increase in campus population and concurrent increase in traffic congestion, there will be an impact to emergency vehicle access and an increase in response times. To mitigate this impact, the Public Services section of the EIR should address the following access and response needs:

- All traffic signals installed on campus shall be outfitted with a Santa Cruz City Fire Department compatible Opticom Emergency Vehicle Traffic Pre-Emption (Opticom) system. This applies to future signals as well as the existing traffic signals already in use on campus.
- Bicycle/pedestrian paths should be wide enough and strong enough to support emergency vehicles. Currently there are a number of paths that do not support Emergency Vehicle Access (EVA), which significantly delays emergency response.
- Provide for EVA to all new and renovated buildings. Allow adequate approach and egress routes as determined by the Fire Marshal.
- Ensure elevators installed in new and renovated buildings are large enough to accommodate a medical gurney in the flat/level position along with the emergency response personnel.
- Turnouts, turn pockets, cut outs, lane widths, number of lanes, islands, and lane separators should all be evaluated in terms of emergency vehicle requirements.

Currently none of the buildings on campus adhere to California Fire Code (CFC) section 505.1:

SECTION 505
PREMISES IDENTIFICATION

505.1 Address identification. *New and existing buildings shall be provided with approved address identification. The address identification shall be legible and placed in a position that is visible from the street or road fronting the property. Address identification characters shall contrast with their background. Address numbers shall be Arabic numbers or alphabetical letters. Numbers shall not be spelled out. Each character shall be not less than 4 inches (102 mm) high with a minimum stroke width of 1/2 inch (12.7 mm). Where required by the fire code official, address identification shall be provided in additional approved locations to facilitate emergency response. Where access is by means of a private road and the building cannot be viewed from the public way, a monument, pole or other sign or means shall be used to identify the structure. Address identification shall be maintained.*

Please analyze how the lack of mandated and generally accepted addressing best practice creates delays in emergency response and how the project will adhere to the standards set forth within CFC 505.1 to mitigate this impact.

The existing on-campus station has reached end-of-life for functionality and will not accommodate additional staffing or equipment. The City does not own the station, nor has a new fire station site been identified on campus. Through coordination with the Fire Department, the EIR should evaluate the degree to which the LRDP contributes to a cumulative impact that would require a new fire station to support staffing changes or additional equipment in response to development. The EIR should address the criteria that will be used for the discussion of mitigating the impacts of development.

Please address the impact of radio coverage and discuss the need for in-building radio and cellular communications for emergency response.

Please discuss how the project will provide adequate water supply for structural fire firefighting.

The EIR should discuss the effects of the wildland-urban interface with regard to fire safety and emergency response. Specifically, the project should provide adequate emergency vehicle access to buildings and adequate defensible space within wildland urban interface around buildings. The project should maintain vegetation and landscaping around buildings as described in 2016 CFC Chapter 49. (See also “Wildfire”)

Recreation: The expansion of the student, faculty, and staff population will impact the use of existing recreational facilities, including local, regional, state, and federal parklands. Please include an analysis if these impacts, particularly as they relate to parkland per capita, as well as potential overuse of open space and natural areas including forests, beaches, and outdoor recreation areas.

Transportation: Please complete a Traffic Impact Analysis study per the City’s guidelines. This includes LOS analysis for critical intersections and a VMT analysis, working with the City to define which intersections should be evaluated. As the project will undoubtedly result in vehicular trips within the City, development considered under the LRDP should be treated the same as private development in the City and, for example, be required to pay a Traffic Impact Fee based on trips generated. In addition, please evaluate the capacity of transit to carry the projected number of students and faculty/staff at the goal mode split levels.

Wildfire: Action CD1.4.4 of the City's General Plan requires that the City work with local and state fire agencies to maintain and update urban wildfire interface zones that preserve the character of the natural environment while providing wildland fire safety. Please consider this requirement in the analysis of wildfire safety, biological resources, and aesthetics.

The City looks forward to its continued partnership with UCSC. Please feel free to contact me should you need additional context for the comments contained herein or should you need assistance in securing City information that can aid your preparation of a Draft EIR.

Sincerely,

Lee Butler
Director of Planning & Community Development

COALITION FOR LIMITING UNIVERSITY EXPANSION

Comments Regarding the Notice of Preparation of the Draft Environmental Impact Report for UCSC's 2020-2040 Long Range Development Plan

Dear Ms. Carpenter;

As you may be aware, the Coalition for Limiting University Growth (CLUE) was formed in response to UCSC's 2005-2020 Long Range Development Plan. We took an active part in that process, with suggestions and objections as the Environmental Impact Report for it proceeded. In 2006 we were one of the main proponents of the very successful Santa Cruz City initiative that became Measures I and J on the ballot, which were approved by about 80% of the city electorate. Measures I and J, which required the city to get approval from the voters before applying to the Local Agency Formation Commission for Santa Cruz County (LAFCO) to extend water and sewer service to UCSC's upper campus, outside the city boundary, were made null and void because the public noticing of the ballot initiative by the city was deemed inadequate in Superior Court. The language of those Measures, however, was made into law by the City Council in 2008.

CLUE opposed a lot of the growth proposed by the university in the 2005 LRDP, and eventually sued to throw out the Final EIR for that LRDP on the grounds that it violated provisions of the California Environmental Quality Act. The city and the County of Santa Cruz subsequently filed their own suits on similar grounds. Those court actions led to the nearly year-long negotiations among the city, county, CLUE and the university that resulted in the landmark Comprehensive Settlement Agreement (CSA) of 2008. Since that time we have participated in the quarterly and annual meetings regarding compliance with the CSA.

We are certain that the proposed increase in student enrollment to 28,500 called for in the new LRDP will have numerous significant negative impacts both on the UCSC campus and the surrounding communities of Santa Cruz and Bonny Doon, not to mention more distant parts of Santa Cruz County where students, staff and faculty live, now and in the future.

A moratorium on future enrollment increases until the needed on-campus infrastructure and off-campus mitigations are provided is what would be best both for the community and the university, where the large enrollment increases under the current LRDP, unsupported by adequate faculty growth, additional teaching facilities, and sufficient student housing and related infrastructure, has led to a noticeable deterioration in the quality of students' education and college experience. **We strongly request that such a moratorium be analyzed as a preferred alternative in the DEIR.**

At a minimum, the proposed new LRDP EIR must include a complete and adequate analysis, grounded in evidence, of the LRDP's potential environmental impacts; identification, with supportive documentary evidence as appropriate of feasible mitigation measures that would reduce the potential impacts to a less than significant level; and a detailed consideration of reasonable alternatives.

We hope that the university will take the comments we make below seriously and fully consider them in the DEIR, because their purpose is to achieve objectives good for both the community and the university's students, faculty, and staff.

We sincerely hope that litigation regarding the 2020-2040 Long Range Development Plan can be avoided, which would undermine the ongoing good relations that the city, county, CLUE and the community have enjoyed the past 12 years stemming from the 2008 Comprehensive Settlement Agreement, of which UCSC, the City, the County, CLUE, and a number of individuals were all signators. In that light we certainly would expect that our comments below will be taken seriously. Finally, it should be noted that while there are some differences and additions in this submission, much of the following text echoes or is taken literally from a similar submission by the city and county, because that document overwhelmingly states our views, too.

Project Description

• The DEIR should specify the total area of the campus currently developed with structures and the total land area to be developed under the proposed LRDP for each of the potential uses.

• The DEIR needs to identify the role of the Coastal Commission in the adoption of the LRDP for the 2300 Delaware Avenue facility, and the relevant policies from the City of Santa Cruz's Local Coastal Program (LCP). Any inconsistencies found need to be identified and mitigated.

• An inconsistency in the Notice of Preparation (NOP) with the map in Attachment C needs correction. Is the purpose of the "natural space" protecting "wildlife corridors and scenic views," or is natural space "land preserved…to maintain special campus landscapes due to scenic value, special vegetation and wildlife continuity." A roadway through the campus's natural areas conflicts with those objectives. The Project Description for the DEIR needs to address these issues, and should include a map clearly depicting the boundaries of the City of Santa Cruz in the North Campus area.

Aesthetics

• The DEIR should contain visuals of possible building masses at all the sites identified for development in the LRDP in order to analyze the potential aesthetic impacts. In its Draft LRDP the university already has identified specific areas for housing and academic uses and projected the amount of square footage for each, so this is not merely a speculative exercise.

• The DEIR should include mitigation measures to minimize the loss of trees, particularly those of special aesthetic and biotic value, and include a definition for "significant trees" based on size, type, visual and other characteristics, and specify how many of those trees (as well as non-significant trees) will potentially be lost in each area proposed for development.

• The proposed building construction will impact the vistas of parts of the campus from the City of Santa Cruz and adjoining areas of the County, like the North Coast and the Highway 1 corridor east of the city. These aesthetic impacts should be analyzed in the DEIR, as should predictable visual impacts to Empire Grade and other applicable County General Plan-designated scenic County roads, as listed in Policy 5.10.10 of the County General Plan, and mitigations proposed.

• The NOP indicates that the DEIR will evaluate the "potential changes in the visual characteristics and quality of the main residential campus and Westside research park and surrounding area." Also requiring evaluation are the potential impacts in visual characteristics and quality on the West Campus and the previously designated campus habitat reserve at the main entrance, as well as any other areas that will be affected.

Agricultural Resources

• The viability of the grazing program, and historically important agricultural practice on campus, will be affected by campus growth as envisaged in the Draft LRDP; consequently impacts should be analyzed and mitigations implemented.

• Land currently designated as Agricultural in the County's Local Coastal Program (LCP) area is shown in the Draft Land Use Plan (Attachment C of the NOP) as the site for future employee housing. Any development of this land must be consistent with the Coastal Commission approved County LCP, and the potential impacts of converting this land to non-agricultural uses must be addressed and mitigations proposed in the DEIR.

Air Quality

• The DEIR must include a worst-case analysis of all the emissions that might result from development and construction under the proposed 2020-2040 LRDP. The air quality analysis should include the impacts from off-campus traffic, not just from the increased campus growth but also the additional growth induced by the campus growth.

• The current high traffic volumes on High, Storey, King, Bay, and Mission streets, and Western Drive, will increase substantially under the proposed LRDP. The DEIR should consider the potential public health impact from the increased air emissions created by this increased traffic on nearby residents and on the Westlake and Bay View school populations, and the traffic impact analysis must be consistent with the analysis of public health impacts.

• Increased greenhouse gas releases, acknowledged in the NOP to be the result of construction vehicle and machinery emissions, conflicts with the Campus Sustainability Plan's commitment to achieve net-zero emissions for all new capital projects. The DEIR needs to reconcile this conflict.

Biological Resources

• Habitat connectivity issues must be analyzed in relation to potential biotic impacts of the Draft LRDP, in detail and with reference to specific areas.

• The campus contains many special status species, including those identified in the 1988 and 2005 LRDPs. All should be specifically reviewed in the DEIR and any inconsistencies fully explained.

• A number of species previously identified as sensitive have disappeared from the campus. Analysis of these should be included in the DEIR, the reasons for the disappearance addressed, and mitigation measures suggested so that similar disappearances don't re-occur.

• Up-to-date baseline surveys should be made over a full year period and included in the DEIR, for all sensitive species, specifying population numbers and distribution. and mitigation measures identified to ensure that sustainable thresholds won't be breached in the future.

• Endemic organisms in the Empire Cave System may be affected by proposed campus growth. For example, changes in hydrology could alter moisture and humidity levels critical to the sensitive species. The Pacific Giant Salamander population in that cave system, which may be a distinct race or subspecies, should be included in the DEIR analysis. Baseline population studies for endemic species should be completed to detect their abundance, distribution, and health, and environmental analysis should include identification of critical population and mitigation measures suggested to ensure that future campus planners prevent sustainable thresholds from being exceeded.

• Other sensitive species requiring analysis include mountain lion, raptors, grasshopper sparrow, San Francisco dusky-footed woodrat, California red-legged frog and Ohlone tiger beetle. Baseline surveys should include nesting pair numbers and locations for bird species and corridor use for mammals, red-legged frog, and the tiger beetle. Again, environmental analysis should identify critical population numbers for the sensitive species so that future campus planners can prevent sustainable thresholds from being exceeded.

• The DEIR should include a detailed but comprehensible definition (including scientific citations) for "sensitive habitat" and the sensitive habitat types.
The following sensitive habitats should be included in the DEIR: purple needlegrass stands, seeps and springs, coast live oak woodland, dwarf redwood forest, Shreve oak forest, freshwater wetland, wet meadow, and caves. These habitat types have been designated as requiring CEQA analysis.

• Cumulative impacts to these habitats in the region should be analyzed with regard to potential off-campus development and construction impacts over the timeline of the LRDP.

• Maritime chaparral requires additional levels of analysis, including cumulative impact analysis, loss of this habitat throughout the region due to fire suppression as well as development over the timeline of the LRDP.

• The DEIR analysis should identify and address any reduction in the potential to continue the campus's past practices of prescribed fire to manage this and other habitat types because of the increased proximity of students and facilities.

• Specific types of habitat for a number of species require analysis, including baseline studies and system-specific potential for cumulative impacts.

• All sensitive habitats may continue to increasingly be impacted by UCSC's overpopulation of deer. The decimation of forest understory may lead to increased erosion and sedimentation of surrounding wetlands and watercourses. UCSC has access to studies by its own Natural Reserve on impacts of deer overpopulation and has made several attempts to plan for this crisis. Increased development may lead to additional impacts to sensitive habitats and species in and around UCSC, including on adjoining land set aside for conservation of those species, by deer overpopulation. These potential impacts should be specifically identified and analyzed in the DEIR. A baseline inventory of forest understory and deer population is required to adequately assess impacts by additional campus growth. Fecal coliform bacteria levels resulting from deer overpopulation threatens surface and groundwater quality and should also be enumerated in a baseline study. Cumulative impacts analysis should include potential for additional build out under the County and City's existing General Plans and the potential for that to further increase the effects of deer overpopulation. While deer are not themselves a special status species, the potentially significant impact of their overpopulation on special status species justifies analysis in the DEIR.

• Campus development has failed to adequately plan for or mitigate the profusion of ad hoc pedestrian and bicycle trails that connect buildings and illegal homeless encampments in campus natural areas, and recreational use has increased with additional student population. Off-road bicyclists increasingly create and use trails, which are infrequently or inadequately maintained. These trails degrade sensitive habitat and imperil at-risk species. A baseline study and an analysis of their potential impacts of these trails is required in the DEIR, including a projection of additional trails likely to occur because of the campus growth proposed by the Draft LRDP.

• Increased campus growth will also increase the chance for the further introduction of non-native, invasive species including plants, animals, and pathogenic microorganisms (e.g., sudden oak death). A baseline of existing levels of impact from these species should be completed to inform an analysis of the potential impacts from additional introductions and/or disturbances that will allow for more invasions. The DEIR must include effective mitigation measures to prevent any further introduction of invasive species to the campus resulting from the proposed LRDP.

• Recent studies on adjoining ecosystems indicate potentially significant impacts from nitrogen in vehicle exhaust. These include increased growth of weeds that have crowded out sensitive species. The campus includes soils very low in nitrogen; additional nitrogen may constitute a significant threat to species associated with those soils. A baseline study of atmospheric nitrogen deposition in sensitive habitats needs to be completed to inform an analysis of the potential for additional impacts associated with campus growth.

• Campus growth into adjoining natural areas will require additional fire safety measures. The DEIR must analyze campus-wide impacts of fire safety measures and their cumulative impacts on sensitive species and habitats.

• The project description in the NOP neglects to mention several areas of jurisdictional wetlands. A campus-wide baseline study delineating wetlands should be completed and summarized in the DEIR. Development proposed by the Draft LRDP, including runoff from roads and parking lots, may create additional jurisdictional wetlands, so the DEIR must analyze this potentially significant impact and provide adequate mitigation measures. In past projects, catchment basins constructed to prevent runoff have become filled with potentially polluted sediments and often have not been maintained. These polluted sediments are then transported downstream in the water bodies they were meant to protect. A mitigation measure that includes basins should detail how these will be maintained.

• Five streams flow from campus to the Upper Westside. The DEIR should identify how these streams will be effected and what the downstream impacts may be, and mitigation measures proposed.

• Wilder Creek contains resident and migratory native fish directly downstream of the proposed campus development that will impact the Cave Gulch drainage. A baseline study of the hydrology that affects Wilder Creek from UCSC is necessary to determine the degree of impact on this important fish population and the proposed project's potentially significant impacts on these populations should be identified and mitigations measures proposed.

• The DEIR should analyze whether the UCSC upper campus contains corridor habitat for the Marbled Murrelet, which may pass over the band of native habitat when traveling between the ocean and old-growth redwood groves at Henry Cowell State Park. If such habitat is found to exist, the DEIR should contain mitigation measures to ensure its protection.

• In order to ensure the accuracy of data collected on wildlife species, surveys using radar or other sensitive detection devices should be employed to establish baseline use by these species.

• There are very few wildlife corridors connecting the east and west slopes along the spine of Ben Lomond Mountain from the City of Santa Cruz to the Lockheed installation. This expanse includes substantial protected natural areas. The North Campus may provide the most substantial corridor between Henry Cowell and Wilder Ranch state parks. A landscape-level baseline of wildlife corridors for mountain lion, deer, and meso-predators needs to be completed in order for the DEIR to adequately analyze the impacts of the proposed expansion of development northward.

•A baseline study is required to analyze the impacts of sedimentation and altered hydrology on the wildlife corridors for cave organisms and the Pacific Giant Salamander between the caves of the Empire Cave system.

• UCSC contains nursery sites for a number of endemic cave organisms, the Ohlone tiger beetle, and a number of sensitive raptor and other bird species. A baseline of these should be completed to inform the analysis of the proposed project's potentially significant impacts on these species.

• As part of the LRDP process the university will be required to prepare a Habitat Conservation Plan (HCP). The DEIR should discuss the status of this HCP and how it will relate to and be incorporated in the LRDP.

• As detailed herein, campus growth will impact adjoining protected areas through increased deer herbivory, the spread of non-native, invasive species, changed hydrology, deposition of nitrogen and proliferation of ad hoc and other recreational trails. All of these impacts could affect provisions in the HCP and therefore require analysis in the DEIR.

• In analyzing the potential impacts of the proposed LRDP on sensitive natural communities, their effect on the adopted Sensitive Habitat maps and General Plan policies of the County need to be identified and addressed.

• The DEIR should analyze how the LRDP may impact Antonelli Pond near 2300 Delaware. The DEIR should evaluate the potential impact from the use of chemical fertilizers and pesticides and require, as a mitigation, avoidance of such chemicals.

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• One of the planning principles in the NOP is the commitment to "preserve open space to maintain special campus landscapes due to scenic value, special vegetation and wildlife continuity". The DEIR needs to evaluate the potential impacts of the construction and implementation of developments proposed in the Draft LRDP on wildlife movement and fragmentation of habitats and propose mitigations that provide specific protection. The DEIR should also discuss the consistency of this planning principle with the amount and location of development proposed in the LRDP Land Use Map.

Geology

• Karst topography that supports the extensive Empire Cave system is inextricably linked with campus hydrology. To establish a baseline for the links between campus and the cave system the following studies need to be performed and made available as part of the DEIR: die testing, seasonal flow monitoring, water quality, sedimentation rates, residence time, rock dissolution rate, and humidity.

• The DEIR should recognize past failures to address the dangers of building on the campus, including the experience that led to the pumping of ~200 cubic yards of concrete into a void beneath Applied Sciences during the construction of that facility. A baseline should include collapse rates. The costs to-date of mitigating the potential for collapse should also be included. The DEIR should expressly indicate the amount of uncertainty and the potential risks involved with campus construction in and around karst areas.

• A thorough baseline of existing rates of soil erosion on the campus is necessary to adequately analyze the potential impacts of development proposed in the Draft LRDP.

Erosion

• The DEIR should contain a detailed evaluation of potential erosion impacts in each specific area proposed for development under the Draft LRDP.

• Construction creates the potential for significant soil erosion. This needs to be evaluated.

• Increase in impermeable surfaces (roofs, walkways, roadways) results in increased runoff and potentially increases erosion, which should be evaluated in detail in the DEIR, including any applicable effect on off-campus properties.

Hazards and Hazardous Materials

• Baseline fire risk rate should be assessed by mapping historic fires. The current baseline fire risk should also be assessed by using fire models in conjunction with consultation with CalFire. The baseline data should be used to inform the analysis of the potential impacts of proposed campus development on fire safety.

Hydrology and Water Quality

• The DEIR should contain a detailed evaluation of potential drainage impacts in each specific area proposed for development under the LRDP. On page B-2 of the NOP the university states that the EIR will evaluate "the potential for construction and operational activities associated with the LRDP to…modify existing drainage patterns." This is inadequate. Given the size and topography of the campus, each drainage area impacted by the LRDP should be analyzed separately and in detail.

• The NOP does not mention specific water quality standards with which the campus is required to adhere. The DEIR should list all water quality standards applicable to the campus or standards that the campus itself will propose. Additional analysis should include standards developed for municipalities in areas of karst topography, because use of these standards may mitigate potentially significant impacts of proposed campus development.

• The LRDP DEIR should recognize that sinkholes and swallow-holes drain directly into the groundwater. Standards for runoff should take into account the potential to pollute and become concentrated in groundwater. This is especially important as the university proposes to use well water as a mitigation for campus growth impacts, and campus runoff could impact local water systems.

• Baseline studies of erosion and siltation rates on- and off-site should be completed for the DEIR analysis.

• A hydrological model should be prepared for the entire campus and its sub-watersheds to analyze the baseline conditions under various scenarios. This baseline model would be useful in analyzing any impacts resulting from the Draft LRDP. Cumulative impacts are of particular concern in this area and must be addressed in the DEIR.

• Existing methods of draining stormwater from developed areas of campus may be illegal or overstressed; baseline discharge rates from campus, including into each individual karst feature, should be included in the DEIR. The DEIR should evaluate alternative methods of disposing of stormwater runoff.

• According to the Campus Sustainability Plan, as part of the proposed LRDP planning process the campus is exploring opportunities for purple pipe (recycled water) connections across campus. Specifically, Porter College has installed purple pipe and is ready to utilize recycled water when it becomes available, and Kresge College is designed to collect storm water into a treatment facility to feed back into its water closets. The possibility of using these storm water collection methods should be evaluated on each site proposed for development under the LRDP. In addition, the DEIR should contain mitigation measures to ensure compliance with the UC Office of The President's Sustainability Policy Practices Goal to reduce potable water usage by 36%, weighted by campus users, by 2025.

• Additional sources of potential pollution include parking lots, roads, construction sites and newly constructed facilities (which are sources of heavy metals, according to the EPA). The 2004 Mitigation and Monitoring Report details high levels of toxins from parking lot runoff long after the "first flush," which would have carried even higher levels of toxins. The DEIR analysis of impacts, as well as the mitigation measures imposed, should include citations of reports documenting the efficacy of such an analysis and proposed practices.

• The niversity has at least three dams near the Arboretum that may trap runoff if either the karst or the manufactured drainages fail to drain them. If these dams do trap runoff any dam failure may endanger structures and people downstream as well as cause significant environmental damage. The DEIR should evaluate this risk and include mitigations to adequately reduce the potential impacts should dam failure occur.

• Because campus development proposed under the LRDP could create potentially significant impacts in the areas surrounding the campus, the DEIR should analyze potential impacts on the Cave Gulch neighborhood groundwater and wells, impacts on Cave Gulch Creek, impacts on Moore Creek, impacts on Wilder Canyon and Wilder Creek, and impacts on streams and creeks on and below the east side of campus.

• Every water quality impact on campus, however slight, contributes to cumulative impacts on water quality in Monterey Bay, a national marine sanctuary. This is a primary natural resource for the community and vital to any economic sustainability. Recreation is centered around the ocean. Santa Cruz and Monterey counties have large tourism industries. People of all ages swim and play in the Bay. The DEIR should evaluate and mitigate this cumulative impact.

New Storm Water Drainage Facilities

• The proposed hydrologic model should be used to establish acreage figures for any additional storm water retention facilities. The DEIR should analyze offsite impacts of these retention facilities, including changed hydrology (adjoining areas will be wetter, affecting habitat quality) and add new sources of polluted sediment and runoff should these facilities be incorrectly maintained. Such facilities may also attract California red-legged frogs; if the water is polluted it would affect the frogs directly or indirectly. These basins may also be sources for the many amphibian diseases affecting red-legged frogs and the Pacific Giant Salamander. The DEIR should analyze all these potentially significant impacts and identify mitigations.

Wastewater

• Additional population resulting from growth in the proposed LRDP will contribute to additional wastewater burdens at the municipal treatment plant. The capital plus the operating costs of the additional burden must be evaluated in the DEIR as potentially significant impacts and mitigation measures included to reduce the impacts to a less than significant level.

• Any increase in carrying capacity of the wastewater piping resulting from growth proposed in the LRDP must be determined in the DEIR and the environmental impacts of any construction, as well as the impacts on water leaving the outfall, must be addressed.

• The UCSC Campus Sustainability Plan indicates that the university will meet the UC Office of the President's Sustainable Practices Policy goal to reduce potable water usage by 36 percent by weighted campus user by 2025 from a 2005-2008 baseline. The strategy commits the university to exploring the feasibility of all non-potable water sources for the campus as part of the LRDP planning process. The DEIR should discuss the university's efforts to implement this policy and analyze, as possible mitigation measures, feasible methods for achieving the policy's goal.

Drainage and Flood Control

• The DEIR should include federal and state regulations for wastewater management and evaluate UCSC's current level of compliance. The DEIR should include a mitigation measure to prohibit construction, additional enrollment, or staff or faculty hiring, until the impacts of current wastewater and runoff are assessed and adequately mitigated.

• The drainage analysis in the DEIR should be specific and not simply identify the need for additional drainage plans. Moreover, it should contain specific performance measures to ensure that any potentially significant impacts are reduced to a less than significant level.

Odors

• Odors emanating from the allowed use manufacturing at 2300 Delaware Avenue should be studied in the DEIR, and potential impacts must be mitigated.

Land Use Planning

• The evaluation in the DEIR of potential conflicts between development under the proposed LRDP and related City and County plans should contain a detailed analysis of the relationship between the proposed development and the specific policies in the local general plans, climate action plans, and other relevant plans.

• The DEIR should address the role of the California Coastal Commission and Coastal Act policies as they impact the proposed LRDP.

• The DEIR should analyze the consistency of the development proposed in the Draft LRDP with existing UCSC planning and land use policies and guidelines regarding sustainable development, including but not limited to the UCSC Campus Sustainability Plan, UC Sustainability Policy, and the prerequisites for the Laboratories for the 21st Century (Labs21) and LEED IV.

• On page A-4 of the NOP, UCSC acknowledges the differences between the land use categories identified in the 2005 LRDP and the current 2020 NOP. The University claims “Under the proposed LRDP, these types [those identified in the 2005 LRDP] of land use categories would be maintained, but have been further refined through the LRDP planning process to reflect campus needs and functions today.” Notable differences include the exclusion of any area that is “protected from development” or a “habitat reserve”. The DEIR must state the specific differences between the two LRDPs and specify the potential for development in the newly-defined “Campus Natural Reserve and Open Space,” neither of which include an explicit exemption from development under the 2020 -2040 Draft LRDP. In addition, the DEIR must identify and analyze the potentially significant impacts from development in these formally protected areas.

Noise

• Construction proposed in the DLRDP in West Campus will create an unprecedented intrusion of noise into the residential Cave Gulch neighborhood. The noise is likely to continue for several years. The DEIR should evaluate the potential significance of this impact and propose adequate mitigations to reduce this impact to a less than significant level.

• The location of recreational facilities, housing and academic buildings as proposed in the Draft LRDP will significantly increase the current number of hikers, walkers and bikers to the campus. This will increase the amount of activity and noise generated by these individuals. The DEIR should evaluate this impact.

Cultural Resources

• The 2020-2040 LRDP DEIR should analyze the potential impact of nearby on- and off-campus developments on on-campus archeological, historical, or cultural resources.

Population Growth

• The NOP indicates that the DEIR will analyze the increase in "regional" population resulting from the plan's implementation. This is inadequate. Given the already overwhelming impact that the university is having on the population in the City of Santa Cruz and, to a lesser extent, the County of Santa Cruz, **the DEIR must evaluate the impacts on the City and County both separately and combined.** In addition, this analysis should include not only direct campus growth, but the indirect community growth induced by the campus growth, **and be both comprehensive and detailed.**

Housing

• In the NOP the university commits to housing 100 percent of the net growth of students on-campus under the Draft LRDP. The 1988 LRDP contained a commitment to house 75% of the new students on-campus. At the end of that LRDP's term, the percentage of students housed on campus had not increased. A policy commitment, such as the one proposed, is insufficient to ensure that significant impacts from the housing of new students off-campus won't occur. **The provision of on-campus housing must be tied to enrollment levels so that enrollment cannot increase beyond certain levels until identified amounts of housing are provided.** The Comprehensive Settlement Agreement approved under the current LRDP includes this binding commitment and it has been implemented successfully. To ensure that the potentially significant impacts of housing net new students off-campus are avoided, **the DEIR needs to include a mitigation measure that ties any actual enrollment growth and its timing to the actual provided availability of on-campus housing.**

• The 1988 LRDP contained a commitment that UCSC would house 75% of students on campus. The Draft LRDP should commit to house 75% of students on campus, and study the impacts in the DEIR.

• The DEIR should contain a detailed analysis of the on and off-campus housing impacts of the proposed LRDP, for students, faculty, and staff. It should include consideration of potentially significant impacts from the campus community as well as the increased housing demand induced by campus growth. The increased housing demand will have environmental effects both on and off-campus. Since the demand for housing impacts the price of housing, in turn impacting the amount of housing constructed in a community, there is a direct nexus between the proposed LRDP and housing prices. **The DEIR should evaluate this nexus and identify mitigations to address its negative effects.**

• Housing demands in the City of Santa Cruz have grown steadily and made housing unaffordable for an increasingly large fraction of the non-University population. The result has been crowding in houses, changes in the character of neighborhoods, and deterioration of the quality of life for families. Mitigation of these impacts must be identified, including providing housing for all new students (as described above), as well as for faculty and staff, through specifically identified university-funded programs, subsidies, land contributions and other measures.

• On page A-4 of the NOP, the university states that it will include employee housing in places that will allow residents to "strategically access community resources". You should demonstrate, and the DEIR needs to define and provide, examples of strategic access to community resources, identify which community resources will be accessed, and identify the impact on those community resources separately from the increase in employees and students. This evaluation should include an analysis of potentially significant impacts from the increased access and use, including traffic, aesthetics and biology.

Recreation

• On page B-2 of the NOP, under "Recreation," the university acknowledges that the DEIR will evaluate the potential of the implementation of the Draft LRDP to increase the use of current athletic and recreational on-campus facilities, resulting in a "substantially and adversely affected" condition. Additionally, the NOP states that the EIR will evaluate "whether the construction and operation of any additional modified recreational facilities resulting from the implementation of the LRDP could result in similar effects." There is a conflict between the Attachment C map and the proposed Land Use Map. One show additional recreation facilities, one does not. It isn't clear whether there will be an expansion of the existing recreation area or whether additional facilities are planned in this area. Additionally, the DEIR should identify what new recreational facilities, if any, are planned, and where they and additional recreational services will be located. The DEIR needs to analyze the potentially significant impacts of the construction and implementation of the proposed facilities and services.

• If the proposed LRDP does not anticipate an expansion of on-campus recreational facilities, the DEIR should evaluate the potential impact of proposed growth on community recreational resources and propose adequate mitigations.

• The DEIR should consider opening recreational facilities at 2300 Delaware Avenue and, if there are no recreational uses intended under the proposed LRDP at 2300 Delaware, the DEIR needs to analyze the potentially significant impacts of the lack of recreational facilities on the surrounding community.

Traffic and Safety

• The DEIR should assess traffic and safety by the potentially significant impacts of construction proposed in the Draft LRDP on the campus, taking into account Vehicle Miles Travelled, congestion, and environmental (visual, noise, etc.) disruptions.

The NOP contains information regarding the location and necessity of new roads to "improve circulation." Therefore the DEIR should contain a detailed analysis of the potentially significant impacts of these roads not only on traffic and public safety but on other campus resources, such as wildlife, vegetation, erosion, etc.

• The DEIR should analyze in considerable and specific detail potential impacts of construction and implementation of the proposed LRDP on Highway 1 traffic and major county arterial intersections, as well as on intersections in the city

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• Vehicle Miles Travelled impacts are not directly proportional to the number of trips and should be calculated by type of vehicle, travel speed, and stops. This should be done by fully considering size, acceleration during level, downhill, and uphill grades, timing, weather (more students ride the buses during rainy weather), and specific roads. Direction of travel on grades, width of road at stopping points, and other factors significantly affect traffic impacts. The DEIR should incorporate these factors in its analysis of traffic impacts. Baseline traffic data should be collected at different times of the year and days of the week.

• The DEIR should ensure that all data on traffic impacts are consistent with the air quality findings. Additionally, the DEIR should consider UCSC initiatives to “Reduce commute travel mode impacts relative to a 2017 baseline by: reducing Scope 3 commuter greenhouse gas emissions 10 % by 2022; reducing commute vehicle miles travelled (VMT) 5% by 2022; and reducing per capita parking demand 10%by 2022.” (UCSC Campus Sustainability Plan) The DEIR should include mitigation measures to ensure successful implementation of this initiative.

• The NOP states that the DEIR will assess the need for “enhanced alternative transportation throughout the main residential campus.” However, the DEIR must address the need for alternative transportation beyond the main residential campus. For example, additional Metro buses will be necessary to accommodate peak loads, and it will be important to perform hour or even 30-minute interval analyses in the DEIR of the impacts of additional students, staff and faculty traveling to campus. All other alternative transportation options should be assessed in similar detail.

• Heavy traffic eastbound-southbound on High Street in the afternoon has long been a motivation for drivers to seek alternative routes, specifically, Bay Street and some of the other Westside streets such as Escalona and King. The lengthy delays in reaching the Mission and King intersection on both the High Street route and along Mission will further encourage travel on Laurel and Walnut streets through the downtown area and onto Broadway and Soquel Avenue for eastbound traffic. Detailed computer modeling will be necessary to adequately analyze and accurately characterize these impacts and should be included in the DEIR.

• Traffic northbound on Empire Grade to the proposed new Cave Gulch Bridge entrance will include construction vehicles and construction and maintenance materials deliveries. Heavy vehicles carrying capacity loads traveling up the steep grade to the proposed Cave Gulch Bridge entrance will sometimes have velocities as low as 5 or at most 10 mph. This will make the entrance less attractive to all users since the mile from the West Entrance to the proposed new Cave Gulch Bride Entrance will then take between 8 and 12 minutes to travel as compared with the 40 mph speed limit travel time of approximately 1.5 minutes. This slow traffic should be analyzed in terms of the actual projected usage of this new entrance.

• Empire Grade between the West Entrance and the Cave Gulch neighborhood is twisty, steep and dangerous. A large number of bicyclists use this area, to commute and for recreation. There is very limited surface area adjacent to the road over most of this 1+ mile distance. Numerous heavily-laden vehicles likely will significantly increase the hazardous travel conditions, resulting in an increase in accidents, injuries, and, almost surely, considering the bicycle travel, fatalities. It is unreasonable to expect the present road to support the proposed increased traffic without considerable increased safety hazards as well as vehicle damage to the canyon as vehicles leave the roadway and impact the hillside on the west side of the road, or tumble into the canyon on the east side. The potentially significant impacts of development under the proposed LRDP and, particularly the new entrance on Empire Grade, on public safety, should be analyzed in detail and mitigations imposed to reduce these impacts to a less than significant level. The terrain makes increasing roadway width very unlikely and expensive, and would have significant environmental impacts, which should be evaluated thoroughly if it is to be considered as a mitigation.

• The DEIR should evaluate the feasibility of a mitigation measure whereby the university would provide alternative transportation to reduce or eliminate increased impacts on traffic. This could include ride sharing and enhanced access for bikes.

The DEIR should identify the projected summer school population and evaluate the traffic impacts of this increase, especially since it occurs during the busy tourist and bike-riding season.

• Northbound traffic of heavy vehicles carrying full capacity loads from the West Entrance to the proposed corporate yard and Cave Gulch Bridge Entrance to campus will impose significant weight on the roadway. The downhill lane (east side of road) adjacent to the Cave Gulch Canyon washed out in the early 1980s during a period when the ground was heavily saturated. The stability of the road should be evaluated and necessary improvements should be identified, as should alternatives to the proposed increased uses. The costs of improvements and other mitigations should be identified and be part of the plan itself. Approval of the plan should include approval of the funds for implementation of the mitigations of negative impacts.

• There are more than a dozen locations on Empire Grade between the West Entrance and the proposed Cave Gulch Entrance where there is very little distance between the roadway and the edge of the canyon, and where there are clearly visible cracks in the pavement, indicating that the downhill side of the road has sunken or that the earth below has been compacted. These cracks are an ominous foreboding of landslides to come, as there were in the past. The addition of numerous heavily burdened construction materials transport vehicles as well as other construction vehicles on the road suggests that the campus planners have simply not examined this road and its capacity to carry more vehicles. There are also frequent tree falls on this road, both closing the road and taking out of service the power and communications lines that run alongside and over it. The DEIR should evaluate the potentially significant impacts of these dangers in light of the growth proposed in the LRDP.

• The geologic underpinnings, the history of slides, the narrowness of the road, the steepness of the grade, and steepness of the slopes above and below the road, and other factors should be thoroughly investigated to determine the suitability of Empire Grade between the West Entrance and the proposed new entrance at Cave Gulch for the increased volume and weight of traffic proposed in the plan.

• In addition to the above-mentioned impacts, the development under the proposed LRDP, especially during construction, will cause the physical deterioration of City and County roads leading to the campus, with a resulting increase in danger to the public. The DEIR should analyze the potentially significant impacts to public safety due to this deterioration of roads. In addition, the costs of improvements and other mitigations should be identified in detail in the DEIR and performance measures provided to ensure their implementation. Mitigations in the DEIR should require that approval of the proposed LRDP includes approval of the funds for implementation of the mitigation measures.

• Emergency egress for the private school and the neighborhood immediately above the proposed new entrance and road on Empire Grade in the Cave Gulch Neighborhood will be threatened by the planned new uses of the road and should be evaluated in the DEIR.

• As the danger of wildfire continues to increase as a result of climate change, the likelihood that there will be a need to evacuate Bonny Doon, the Cave Gulch Neighborhood, and the North Campus likewise increases. Cross traffic from a new or emergency entrance/exit onto Empire Grade will greatly increase the chances of an accident, especially when people are frightened and fleeing danger. Even if traffic flows freely in this situation, if the fires causes a need for evacuation of the Westside of Santa Cruz, it will impact the streets those residents are using to flee, with potentially disastrous results like those experienced in the horrible Paradise fire. The DEIR needs to very carefully study the impacts of this new entrance with the aid of first responders, and propose mitigations, if any are even possible.

• Current access to the campus via Mission, Bay and High streets will not accommodate the increased traffic. University furnished transit must be provided, bicycle access and usage must be increased, and public transit systems must be supported for increased usage. The DEIR should contain specific mitigations, including performance measures, to reduce the potential impacts to a less than significant level.

Public Services

The university's growth target in the proposed LRDP would overwhelm the city. The city's ability to provide public services such as water, public works, police, fire, etc. to support the additional campus population will be severely strained. For example, "Student Houses" often require special police attention, landlords often neglect student houses, and student houses are often overcrowded to afford rents. These all tax city services (which are not supported by property taxes, since the university is exempt) and impact family life in neighborhoods, leading often to families moving to quieter neighborhoods, further exacerbating the situation. The DEIR needs to analyze these potentially significant impacts and identify mitigations.

Cumulative Impacts

• In Attachment B-2 of the NOP, the university commits to evaluating the "potential for implementation of the LRDP to induce (directly or indirectly) unplanned substantial population growth or displace substantial housing or residents." Given the built-out condition of the city and the likelihood that, if housing is not tied to enrollment growth, an increased number of members of the campus population will live further from campus, the cumulative impact analysis of off-campus impacts should be countywide.

• The cumulative impact analysis in the DEIR should include worst case assumptions in order to calculate total cumulative impacts.

• The lack of details in the Draft LRDP should not result in failure to consider potentially significant impacts even in a Program EIR where information regarding developments proposed in the LRDP is available. For example, total vehicle trips and linear extrapolation of impacts for traffic, drainage, and air quality can be determined based on the NOP and the attached Land Use Map. The Cumulative Impact analysis in the DEIR should not understate the Draft LRDP's impacts or lead to inadequate mitigation measures.

• The DEIR analysis here and throughout should be as specific as possible based on all the information available

Sustainability

• According to its Campus Sustainability Plan, UCSC has identified a goal of zero-emissions for new capital projects. The DEIR should ensure that this goal is met through the provision of relevant mitigation measures. For example, as of 2018, the UC Office of the President enacted a mandate for the use of all-electric construction equipment in capital projects. The DEIR should include this as a mitigation measure for all construction projects.

Greenhouse Gases

• The NOP acknowledges that the DEIR will have to address that the “implementation of the LRDP may result in the generation of additional greenhouse gas emissions during construction and operational activities.” The DEIR should document the exact increase in greenhouse gas emissions, the source of the emissions, and state why it would not be feasible to adhere to the UCSC policy of zero-emissions on new capital projects.

• In 2013, the UC adopted the Sustainable Practices Policy which commits UC to emitting net zero greenhouse gases from its buildings and vehicle fleet by 2025. The DEIR should indicate how the university will adhere to this policy.

Economic Impacts

• An EIR must include an analysis of economic impacts where there is a nexus between such impacts and physical impacts. The erosion of the City's tax base resulting from the University's growth under the proposed LRDP due to, for example, the sponsoring of non-education activities on campus without paying the relevant taxes. Streets and parks are deteriorating as a result of this erosion of local tax revenues.

• Another example is the university's purchase of a major manufacturing facility at 2300 Delaware Avenue. When in operation, this facility was one of the largest property taxpayers in the City. It is now off the tax roll. The University has done nothing to compensate the City for revenue lost. The Draft LRDP proposes to expand the use of this facility.

• As a minimum, the DEIR should consider the economic impacts of the university's expanded use of 2300 Delaware on the decline of the City's streets and parks as a result of inadequate property tax revenues. The DEIR should include a mitigation measure to compensate the City for these losses.

• In addition, while the LRDP doesn't speak to additional off-campus acquisitions, it doesn't prevent them either. The DEIR should either include analysis of the potential impacts from the use of off-campus properties related to growth projected in the Draft LRDP, or should contain a mitigation measure to prohibit such uses.

Mitigations

• The EIR should not use budget limitations for mitigations to determine that a mitigation measure is infeasible. By deciding to grow, the university must recognize its need to budget sufficiently to adequately mitigate the significant impacts caused by that growth. As a major State institution with a large annual budget, the **university must adopt a planning principle that, at least in Santa Cruz given its special circumstances, UCSC shall not grow unless and until such time that it has the budget needed to fully support such growth.**

• In order for the DEIR to be adequate, it must contain clear, accountable, and measurable mitigations and performance standards. Ambiguous “goals” in previous plans have proven unsuccessful in the past and should not be repeated.

• Mitigation measures included in the DEIR should include timelines for implementation and be tied to enrollment levels. Concurrency requirements that tie growth to implementation of mitigation measures are not only feasible under CEQA but, given the experience in the implementation of some of the mitigation measures under past LRDP EIRs, are necessary to assure that the mitigation measures occur at the appropriate time.

• The costs of improvements and all mitigations should be identified and be included in the EIR. Subsequently, approval of the final LRDP should include commitments to approve the funds for implementation of the mitigation measures, as well as the developments proposed in the LRDP. **Thereafter, no approval of any proposed enrollment growth or construction or mitigations should occur without the availability of the funds needed for their implementation.**

• The DEIR must include information specifying the timing of mitigations, which should directly relate to the timing of impacts.

Alternatives

The DEIR should fully analyze the following reasonable alternatives:

• Several lower enrollment increases should be analyzed: 1,000 additional students, 3,000 additional students and 5,000 additional students, with the remainder of the proposed additional UCSC enrollment being apportioned to other campuses.

• Providing for the proposed additional student growth by building new campuses in larger communities that can more easily absorb the impacts.

• Delaying all additional enrollment and construction of new facilities to support additional growth until all mitigations of existing impacts from the 2005-2020 LRDP are implemented.

• Delaying enrollment increases until the resources are identified and committed to meet 100% of the academic and housing needs of students, faculty and staff

o

• The No Project Alternative should assume no enrollment growth beyond the 2005 LRDP enrollment level and no increase in the development of campus facilities to support the current campus population.

• There should be a No Project Alternative that assumes no additional enrollment growth but does include the development of the infrastructure proposed in the 2005 LRDP.

• Based on the likely impacts resulting from the implementation of the Draft LRDP, which should be documented in an adequate DEIR, **the Coalition for Limiting University Expansion (CLUE) strongly urges the university to reconsider the 8,500 FTE enrollment increase contained in the NOP,** and to significantly reduce or eliminate it. Nevertheless, we expect the university, in their preparation of the DEIR, to adequately meet the requirements of CEQA and to fully incorporate the comments contained in this letter.

Thank you again for your consideration,
John Aird
Ted Benhari
Coalition for Limiting University Expansion

COUNTY OF SANTA CRUZ

PLANNING DEPARTMENT
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KATHLEEN MOLLOY, PLANNING DIRECTOR
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April 7, 2020

Ms. Erika Carpenter
Senior Environmental Planner
Physical Planning, Development and Operations
University of California, Santa Cruz
1156 High Street
Santa Cruz, CA 95064

Dear Ms. Carpenter:

Thank you for the opportunity to comment on the scope of the Environmental Impact Report (EIR) to be prepared by the University of California Santa Cruz (University) for its Long Range Development Plan (LRDP). Below please find comments regarding Land Use, Population and Housing, Transportation, Biological Resources, and Water Resources.

In 2014, the Board of Supervisors accepted the Sustainable Santa Cruz County Plan (SSCC), which provides for more sustainable land use development patterns and transportation infrastructure. It includes a principle to work with other public agencies that impact growth and development in Santa Cruz County to improve collaboration and achieve sustainability. The University's growth will impact development within the County by creating a need for more housing and transportation resources in a system that is already constrained and lacking in resources. We request that the University consider the following comments recognizing the need for local collaboration to provide the necessary infrastructure and resources for a substantial increase in student and employee population due to the University's growth.

Land Use

The County of Santa Cruz is currently preparing its Sustainability Policy and Regulatory Update, a substantial revision to its 1994 General Plan and County Code to implement the SSCC and encourage more sustainable and compact urban development within its Urban Services Line. This General Plan update will also plan for growth in the unincorporated County through 2040. An EIR will be prepared to analyze the environmental impacts of these land use changes over the 20-year planning horizon, the draft of which is expected out late this year. The University's EIR should recognize these potential land use changes as part of the regulatory landscape in the EIR for the LRDP.

Population and Housing

Housing both university students and employees has been a challenge over the course of the University's current LRDP, and the University has responded by providing additional student beds in excess of the goals set forth in the Settlement Agreement that resulted from adoption of the current 2005 LRDP. However, both the supply and affordability of housing continue to be major regional problems, the extent and severity of which are far greater than they were in 2005. The housing and population analysis in the EIR must acknowledge a highly inadequate baseline environment of both housing supply and affordability, resulting in both critical homelessness and overcrowding of housing units.

The proposed 2040 LRDP goals include growth of an additional nearly 10,000 students to a total enrollment of 28,000 students, as well as a near doubling of employees from 2,800 to 5,000. We support the LRDP's stated goals of providing 100% of the needed housing for students. However, the stated goal for employee housing remains insufficient at 25% of the need. The County encourages the University to allocate additional on-site housing for employees in the 2040 LRDP and increase the percentage of University-provided on-campus housing.

Due to a variety of economic and development constraints, housing production in the region remains too low. In early discussions, Association of Monterey Bay Area Governments staff anticipates that the next Regional Housing Need Allocations (RHNA) distribution from the State to our region may be 1.5 to 3 times the current RHNA, for General Plan Housing Elements that must be updated by December 2023. Under new state housing regulations, jurisdictions will be prevented from relying on previously identified sites to fulfill RHNA requirements for available and zoned sites that would accommodate the range of housing needed by households at all income levels. The Population and Housing analysis in the University's EIR will need to acknowledge both the current and near-future housing requirements faced by the County. Further, the EIR must provide mitigation for the environmental impacts of shifting the burden of additional housing onto the City and County of Santa Cruz, including an exacerbation of homelessness.

Transportation

The County requests that the University complete a Traffic Impact Analysis study per the City of Santa Cruz's guidelines, inclusive of a level of service (LOS) analysis for critical intersections as well as a vehicle miles traveled (VMT) analysis. Please work with the County and the City of Santa Cruz to calculate VMT to ensure use of the most up to date local data, methods, and models. The Countywide Travel Demand Model was recently updated to account for current General Plans and specific plans adopted by each of the cities and the County of Santa Cruz, and therefore contains the most up to date land use and transportation network information.

In order for the University to grow to 28,000 students and 5,000 FTE employees and stay within the trip cap per the Comprehensive Settlement Agreement as well as keep VMT from becoming a significant impact, the University will have to aggressively pursue additional transportation demand management (TDM) measures to increase non-drive-alone travel modes. While TDM programs are important in reducing VMT, their effectiveness will be capped at a lower percent reduction if complementary infrastructure is not provided to promote and support use of non-drive-alone modes of travel. In the project description, there is no indication of bicycle, pedestrian, or transit infrastructure improvements that connect the campus to key destinations outside of campus. While the University is providing some housing, there will be a number of employees living off campus and there will be a need for off-campus travel for services and recreation for people living on campus. The campus does not operate in isolation from the surrounding community, and the VMT analysis should account for VMT that extends beyond jurisdictional boundaries. To the degree possible, the analysis should include off-campus housing hotspots (for instance, Live Oak and other communities). The EIR should include an analysis of circulation and mode share that addresses multimodal connectivity and access to off-campus destinations in order to support any claims of increased bicycle, pedestrian, or transit mode share and related decreases or savings in VMT.

Additionally, the University should evaluate consistency with the following County of Santa Cruz General Plan Circulation Element policies:

> 3.1.1 Land Use Patterns (Jobs/Housing Balance). Encourage concentrated commercial centers, mixed residential and commercial uses, and overall land use patterns which reduce urban sprawl and encourage the reduction of vehicle miles traveled per person.
>
> 3.2.2 Mode Split. Encourage large employers to provide incentives to carpoolers, bicyclists, pedestrians and transit riders such as priority parking, company car use, bicycle lockers, bus passes etc. in conjunction with the Trip Reduction ordinance.
>
> 3.2.3 Employee Carpool Program. Encourage large new developments to establish employee pool programs for car, van or bus pools.
>
> 3.4.4 On-Site Transit Facilities. Require developers of major traffic generating activities to provide fixed transit facilities, such as bus shelters and pullouts, consistent with the anticipated demand. Locate these facilities in areas convenient to pedestrians' use.
>
> 3.4.5 Bus Pullouts. Require developers of new large projects located on transit routes to dedicate the right-of-way and construct a bus pullout bay.
>
> 3.6.1 Transit-Friendly Design. Locate and design public facilities and new developments to facilitate transit access, both within the development and outside it.
>
> 3.8.5 Regional Continuity. Coordinate with other jurisdictions to adopt a system of bikeways that is functional throughout the County and region.

<u>Biological Resources</u>

We are interested in seeing clear protections covered by the probable environmental effects under Biological Resources. More detail on the public access and trail systems throughout the Natural Space and Campus Preserve landscapes should be provided, and protections should be implemented to ensure that sensitive habitats are protected from foot traffic, mountain bikes, and other anthropogenic disturbances. The EIR should identify sensitive wildlife habitat areas to be protected from disturbance, by having such measures as minimal trails and adequate fencing. It is also important that trails are properly maintained.

<u>Hydrology and Water Quality/Utilities and Service Systems</u>

The University has done an excellent job of protecting water resources on campus. The per capita water usage at the University is lower than the rest of the City of Santa Cruz, which is already a statewide leader in water conservation. We hope that you will consider the following suggestions in your further development of the LRDP and CEQA compliance:

In the scoping presentation associated with the NOP outreach, two goals stood out under Planning Considerations for Sustainability and Resilience:

- Meet or exceed state and UC system goals for energy, water, and carbon
- Minimize increase in water use on campus

These items are not highlighted specifically in the Notice of Preparation (NOP), however they fall under the probable environmental effects covered under Utilities and Service Systems.

- When considering the impact of the additional people coming to the campus, the LRDP needs to consider the multiplier effects of the families of the new students and employees that will be added to the community. While most of the additional 9,500 students are likely to be coming to the University alone, undoubtedly some will be bringing families with them, as will many of the additional 2,200 faculty members. The full impact on water resources to the community of the new residents, both on and off campus, must be evaluated.
- Work with the City of Santa Cruz Water Department to ensure that local goals for water conservation are being met. Some local standards are stricter than those statewide.
- Continue the practice of having native, drought-tolerant plants in any landscaping that is installed and keep irrigated landscaping to a minimum.
- There was minimal discussion of the use of alternative sources of water on campus in the presentation or the NOP. A few years ago, the University implemented a pilot project at the Wellness Center in which rainwater is captured from the roof, treated, and used for toilet flushing. This project could be expanded upon by requiring dual plumbing in all new housing to enable the use of either captured rainwater, or recycled water, to be used in place of potable water for toilets and washing machines. Discussions with the City of Santa Cruz on the possible use of tertiary treated recycled water, and with stormwater staff at the University could further identify the best source of non-potable water to use.

Sincerely,

Kathleen Molloy

Kathleen Molloy
Planning Director

County of Santa Cruz

BOARD OF SUPERVISORS

701 OCEAN STREET, SUITE 500, SANTA CRUZ, CA 95060-4069
(831) 454-2200 • FAX: (831) 454-3262 TDD/TTY - Call 711

March 20, 2020

Chancellor Cynthia Larive
UC Santa Cruz
1156 High Street
Santa Cruz, CA 95060
chancellor@ucsc.edu

Dear Chancellor Larive:

On behalf of the Santa Cruz County Board of Supervisors, I am contacting you regarding the scoping period for the Environmental Impact Report (EIR) being prepared for the UC Santa Cruz proposed Long Range Development Plan (LRDP). The Notice of Preparation for this scoping period was published on February 25, 2020, kicking off a legally required 30-day scoping period during which the public may submit comments regarding the content of the EIR. However, outreach to students during this scoping period is limited to two meetings scheduled for March 12. Unfortunately, these meetings are scheduled to take place the day before the last day of classes and it is unlikely students will focus on campus growth issues at that time.

The proposed LRDP provides for an enrollment increase from the current LRDP's maximum of 19,500 to 28,000 students. This increase will not only have profound impacts on the off-campus community but to the campus community as well. Students, then, have a strong interest in the next LRDP and the EIR that will examine its impacts. The proposed March 12 on-campus meetings effectively exclude students from this critical step in the EIR process.

The California Environmental Quality Act (CEQA) provides for a minimum 30-day Scoping Period after the release of the Notice of Preparation. Nothing prevents the University from extending this period. In the interest of fairness to UCSC students, our Board feels that it is important for your administration to include students in the EIR process by providing them an adequate opportunity to participate. We respectfully urge you, on behalf of students at UC Santa Cruz, to extend the scoping period two to three weeks into the Spring Quarter.

Thank you for your consideration.

Sincerely,

Greg Caput

GREG CAPUT, Chairman
Board of Supervisors

GC/jfr

CC: UCSC Chancellor
Santa Cruz City Council
UCSC Student Union Assembly
UCSC Academic Senate
CLUE (Coalition for Limiting University Expansion)
Santa Cruz Neighbors

County of Santa Cruz

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March 15, 2020

UCSC Academic Senate
Not Available

senate@ucsc.edu

Dear UCSC Academic Senate:

Please be advised that, at a meeting held on March 10, 2020, the County of Santa Cruz Board of Supervisors took action on the following agenda item(s):

DOC-2020-207 *Direct the Chairman to write to the UC Santa Cruz Chancellor urging her to extend the Scoping Period for the draft Long Range Development Plan (LRDP) Environmental Impact Report (EIR) and to hold an additional on-campus public meeting during the Spring Quarter in order for students to participate in the EIR process; and direct the County Planning Director to provide our Board with a copy of the County's comments on the LRDP EIR submitted during the Scoping Period, as recommended by Supervisor Coonerty*

RESULT:	**APPROVED BY CONSENT VOTE [UNANIMOUS]**
MOVER:	John Leopold, Ryan Coonerty
SECONDER:	Zach Friend, Second District Supervisor
AYES:	Leopold, Friend, Coonerty, Caput, McPherson

Click on the description (blue text) above to access agenda materials for this item.

This is being forwarded to you for your information and records. Any comments or responses to this item may directed to your District Supervisor at: 701 Ocean Street, Fifth Floor, Rm 525, Santa Cruz, CA 95060. Additional information is available for viewing electronically on the County's website at http://santacruzcountyca.iqm2.com, and available for viewing in the office of the Clerk of the Board, Room 520.

Respectfully,

Susan Galloway
Chief Deputy

cc: UCSC Academic Senate, Santa Cruz City Council, Santa Cruz Neighbors, Chancellor Cynthia Larive, Coalition for Limiting University Expansion, UCSC Student Union Assembly, Board of Supervisors

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development, and Operations
University of California Santa Cruz
1156 High Street, Santa Cruz CA 95064
eircomment@uscsc.edu

March 27, 2020

Re: LRDP NOP Comments

We are writing in response to the Notice of Preparation issued February 25, 2020.

For the past two years the campus and its legions of supporters in the larger community have been torn by concern that the campus administration, or at least a key portion of it, fails to understand, appreciate, and value the extraordinary asset UCSC has in the sweeping vistas of its iconic Great Meadow and East Meadow. The Notice of Preparation (NOP) is an unwelcome sign that that failure was not a one-time mistake, but is ongoing.

We offer the following observations, in the hope that a course correction is still possible:

(1) The NOP shows a portion of Student Housing West project as a *fait accompli* sprawled across the southern portion of the East Meadow. In fact, it is still an open question as to whether that project will be built at that location. The land use plan should at this point therefore show the southern portion of the East Meadow either as Natural Space (in the proposed system of land use designations) or as Campus Resource Land (as in the current system).

(2) The "Potential Primary Roadway" shown as extending right across the middle of both the Great Meadow and the East Meadow, from the Music Center/Recital Hall, across Hagar Drive, to Coolidge Drive, should be removed entirely.

(3) There should be no development in the East Meadow, by OPERS or otherwise, south of the existing East Remote Parking. The "temporary" corporation yard on the south side of that parking should be removed entirely and the land restored. It has been a "temporary" facility for more than a decade, has never been indicated on any LRDP, and is an eyesore.

(4) There should be no development in the Great Meadow south of the existing development at the north end of the Meadow. The Great Meadow from the southeast edges of University House, the Music Center/Recital Hall, and the Academic Resources Center to the north edge of the corporation yard should entirely be designated Natural Space except where designated Natural Reserve.

(5) Development of the Westside Research Park at Delaware Avenue should be maximized.

(6) The US Fish and Wildlife Service has long urged the administration to do a campus-wide Habitat Conservation Plan, so that habitat conservation issues

do not arise at the last minute, in the push to get a project built, as happened to the detriment of the Student Housing West project. And for just as long the administration has refused to do so. A campus-wide HCP would avoid wasted time and unnecessary controversy whenever a specific project is being planned, and would thereby facilitate the timely completion of future projects. The creation of a new LRDP is the perfect time to undertake that campus-wide HCP, and that HCP and the new LRDP should be concurrent efforts.

We encourage the University to recognize the value of what it has.

Yours truly,

The East Meadow Action Committee
eastmeadowaction@gmail.com

Stephan C. Volker
Alexis E. Krieg (Of Counsel)
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10.627.01

April 8, 2020

VIA EMAIL AND U.S. MAIL

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development and Operations
University of California, Santa Cruz
1156 High Street, Santa Cruz, CA 95064
Email: *eircomment@ucsc.edu*

Re: LRDP NOP Comments:
Scoping Comments on Behalf of Habitat and Watershed Caretakers, Don Stevens, Russell B. Weisz, Hal Levin, Harry D. Huskey, and Peter L. Scott on the UC Santa Cruz Long Range Development Plan

Dear Ms. Carpenter:

The University of California at Santa Cruz ("UCSC") campus is situated in an extraordinary environment whose deep, lush redwood forests give way to sweeping meadows overlooking Monterey Bay. This breath-taking setting hosts a vast array of sensitive plants and animals, and is blessed with iconic landscapes and world-class vistas. To date, the campus has been carefully interwoven into the natural fabric of its environment, sparing the most significant and sensitive natural features from irreparable ecologic and scenic harm.

However, that thoughtful balance is now threatened. The rapid and unsustainable growth contemplated in the University's early ruminations about its forthcoming 2020 Long Range Development Plan ("LRDP" or "Project") hint darkly of a jumbled, urban-styled mega-campus oblivious to its unique natural amenities and the heuristic values they hold. While UCSC is obliged to update its LRDP to address potential growth pressures, it must also recognize the opportunities thus presented to identify, analyze and protect the vulnerable and irreplaceable natural resources that inspired its founders to select this one-of-a-kind site for higher learning.

For these reasons, and because the California Environmental Quality Act ("CEQA") requires no less, the Environmental Impact Report ("EIR") for the campus's next LRDP must fully analyze that Project's impacts, and consider a broad range of creative alternatives–including in particular those that encourage and nourish off-site learning–that would avoid or lessen those impacts, as discussed below.

I. Project Description

An adequate project description is an essential starting point for analysis of a project's environmental impacts, and all environmental impact reports must provide one. 14 California Code of Regulations ["CEQA Guidelines"] § 15124. As directed by the CEQA Guidelines, the project description "shall contain the following information:

> (a) The precise location and boundaries of the proposed project . . . shown on a detailed map.
>
> (b) A statement of objectives sought by the proposed project[, which] will help the Lead Agency develop a reasonable range of alternatives to evaluate in the EIR . . . . The statement of objectives should include the underlying purpose of the project.
>
> (c) A general description of the project's technical, economic, and environmental characteristics . . . ."

Id.

"An accurate, stable and finite project description is the *sine qua non* of an informative and legally sufficient EIR." *County of Inyo v. City of Los Angeles* ("*County of Inyo*") (1977) 71 Cal.App.3d 185, 193.

The Notice of Preparation ("NOP") for the LRDP states that the "overall objective of the LRDP is to support the teaching, research, and public service missions of [UCSC]." NOP, Attachment A, A-4. However, this vital public service mission is often overlooked in order to promote campus growth. That mission is especially important here, because UCSC specifically prides itself on its "uncommon commitment to . . . public service." UCSC, *Campus Overview: About UC Santa Cruz*, available at: https://www.ucsc.edu/about/campus-overview.html (last accessed April 6, 2020). The EIR must ensure that all aspects of the LRDP's objectives are valued and considered when analyzing the project's impacts and considering alternatives. "'A clearly written statement of objectives will help the lead agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision makers in preparing findings. . .. The statement of objectives should include the underlying purpose of the project.'" *In re Bay-Delta Programmatic Environmental Impact Report* (2008) 43 Cal.4th 1143, 1163.

The NOP states that the proposed "growth assumptions are based on campus population projections and an understanding of campus needs . . . . However, the LRDP does not commit

UC Santa Cruz to any specific enrollment level, campus population, or development." NOP, Attachment A, A-4. This flexibility is extremely important to ensure that all the LRDP's objectives are met. Yet despite this supposed flexibility, the NOP stands CEQA on its head by allowing the "growth projection" tail to wag the environmental planning dog. The NOP prematurely commits the LRDP to accommodate the "project[ed] on campus student population growth from approximately 18,518 [full-time equivalent ("FTE")] students (2018–2019 academic year) to approximately 28,000 FTE students by the 2040–2041 academic year." NOP, Attachment A, A-4. This embedded premise that rapid on-campus growth is unavoidable because it is pre-ordained in the University's "growth projection" defeats the entire purpose of the long-range planning process. It is akin to announcing the winner of a race before the starting gun is fired. It subverts UCSC's public service commitment and renders the CEQA process a hollow exercise. It must not be allowed to constrain the EIR's statement of objectives.

The LRDP EIR should also disclose and re-examine UCSC's underlying drive toward the public-private partnership model, and how that contravenes UCSC's public service objectives. Because the LRDP is intended to serve as "a comprehensive land use plan that guides the physical development" of the campus, it is important to consider how the models proposed to facilitate development will affect, and potentially impair and impede, the LRDP's objective of promoting public service. NOP, 1.

II. Environmental Setting

The "EIR must include a description of the physical environmental conditions in the vicinity of the project . . . *as they exist* at the time the notice of preparation is published." CEQA Guidelines § 15125(a) (emphasis added). Because the Student Housing West Project is *not* currently constructed, and may never be built due to pending litigation, the 2020 LRDP EIR must not include it in the environmental setting. Rather, and as required by Guidelines section 15125(a), the environmental setting should describe the campus as it *now exists*, with sweeping ocean views and untrammeled open spaces, including most prominently, its iconic East Meadow.

III. Alternatives

CEQA requires an EIR to describe a reasonable range of alternatives that could feasibly attain most of the basic objectives of the project while avoiding or substantially lessening any of its significant effects. CEQA Guidelines § 15126.6(a) and (f). "An EIR's discussion of alternatives must contain analysis sufficient to allow informed decision making." *Laurel Heights Improvement Association v. Regents of the University of California* ("*Laurel Heights*") (1988) 47 Cal.3d 376, 404. An alternative may "not be eliminated from consideration solely because it would impede to some extent the attainment of the project's objectives." *Habitat and Watershed Caretakers v. City of Santa Cruz* ("*HAWC*") (2013) 213 Cal.App.4th 1277, 1304; CEQA Guidelines § 15126.6(b). "The EIR is required to make an in-depth discussion of those alternatives identified as at least potentially feasible." *HAWC,* 213 Cal.App.4th at 1303 (emphasis and quotation omitted).

The EIR should consider alternatives that focus on preserving UCSC's unique environment and advancing its public service mission. Alternatives that temper on-campus population growth in order to protect the campus's extraordinary environment must be given full consideration, as they can be fashioned to achieve the LRDP's stated objective to "support the teaching, research, and public service missions of [UCSC]." NOP, Attachment A, A-4. Limiting FTE on-campus student enrollment will allow UCSC to put more resources toward education and research for its students, while at the same time achieving its public service and environmental preservation objectives.

For example, the EIR should consider alternatives that shift some student growth to other UC campuses that have greater carrying capacities, such as greater water supplies and fewer environmental impacts and constraints. Instead of assuming that UCSC's on-campus student population must be expanded, and keep expanding, to accommodate more and more students on a campus that cannot support that growth, the LRDP should limit UCSC's on-campus growth to a more sustainable population, and explore off-campus alternatives.

Indeed, the University is contractually obliged to conduct a "comprehensive analysis of potentially feasible alternative locations to accommodate proposed UCSC enrollment growth" including "satellite campuses [and] remote-classrooms." Comprehensive Settlement Agreement between the University and the local residents on whose behalf these Scoping Comments are submitted, attached as Exhibit A to the Judgment filed September 22, 2008 in the matter *Don Stevens, et al. v. University of California Santa Cruz, et al.* Civ. Nos. CV 155583, et al. Santa Cruz County Superior Court, § 5.1. Feasible off-site alternatives include the University's 500-acre site in Marina that already has land use entitlements and infrastructure allowing its development as a satellite campus.

The EIR must also consider an alternative "that could avoid or lessen the significant environmental impact of [campus expansion] on the [City of Santa Cruz's] water supply." *HAWC*, 213 Cal.App.4th at 1305. As discussed below, UCSC relies on the City of Santa Cruz ("City") for its water supply and that water supply is "anticipated [to have] shortfalls under drought conditions." UC Santa Cruz LRDP 2005-2020 ("2005 LRDP"), 88. While UCSC did reduce its water use after 2005, it has been increasing again since 2014. Long-Range Development Plan, Water, Existing Conditions Today, 2. And the City of Santa Cruz expects the demand for water to exceed supplies by 2025. City of Santa Cruz, 2015 Urban Water Management Plan, 4-6, 6-24 (attached hereto as Exhibit 1). Because UCSC campus growth will necessarily increase water demand, the EIR must consider an alternative that reduces that impact on the City's water supply.

Furthermore, the EIR should include an alternative that promotes distance learning. As the campus adapts to the Covid-19 pandemic and its social distancing and related sequelae, it is expanding its capacity for remote learning. Procedures that once were foreign, are now more familiar and acceptable–indeed necessary–in this new reality. UCSC has an unprecedented opportunity to analyze the challenges that the world is facing, and utilize some of the new procedures and practices to its benefit. A distance learning alternative would alleviate many of the potential effects of campus growth, including water and transportation impacts, while promoting growth and public service, and potentially opening up enrollment to students who may not have been able to attend otherwise. And, as noted, "comprehensive" consideration of this alternative is already required under the Comprehensive Settlement Agreement the University signed in 2008 with the local residents on whose behalf these Scoping Comments are submitted.

IV. Impacts and Mitigation Measures

CEQA mandates that the FEIR adequately analyze a project's effects to foster informed decisionmaking and allow the public to understand those impacts. Public Resources Code ("PRC") § 21002.1; CEQA Guidelines §§ 15121, 15126, 15126.2. Where possible, the lead agency must employ feasible mitigation measures that could minimize the project's significant adverse impacts. PRC § 21002; CEQA Guidelines §§ 15121, 15126.4. The EIR must provide information in "an analytically complete and coherent" manner to foster CEQA's informational purpose. *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 440; *Berkeley Keep Jets Over the Bay Committee v. Board Port of Commissioners* (2001) 91 Cal.App.4th 1344, 1355-1356; CEQA Guidelines §§ 15121, 15144.

A. Aesthetics

According to the 2005 LRDP, the campus site was selected because it was "overlooking Santa Cruz and the Monterey Bay. . . . Often called the most spectacular university site in the world, the campus landscape has played a vital role in shaping UCSC's physical and academic development." 2005 LRDP, 16. "The natural landscape is the formative, iconic element of the UCSC campus and the dominant component of its powerful array of open spaces." 2005 LRDP, 33. The EIR must explore ways to ensure that these "vital,""spectacular" and "iconic" views are preserved and protected by the LRDP. Unless the EIR does its job, these extraordinary and irreplaceable scenic resources are at serious risk of irreparable degradation and loss due to contemplated, but insensitive and unnecessary, rapid and unsustainable campus growth.

For example, "[e]xpansive meadows at the campus's main entrance gradually transition to the rugged redwood forests of the Santa Cruz mountains, providing an incomparable natural setting." 2005 LRDP, 16. But UCSC has apparently already committed to develop "[a]n enhanced historic district at the entrance to the main residential campus." NOP, Attachment A, A-4. Will this "enhanced" historic district impact the current views of the "incomparable" East Meadow? The EIR should fully evaluate these impacts, and analyze alternatives and mitigation measures that would avoid or reduce them.

Impacts to the East Meadow cannot be dismissed from careful analysis because UCSC wants to build the Student Housing West Project. As discussed above, this project's structures do not exist currently. Ongoing litigation may overturn their unlawful approval, and prevent their construction. The impacts from the proposed Student Housing West Heller site likewise cannot be ignored on the mistaken grounds that this project is already part of the existing environment. It isn't. Its approval has been timely challenged in two lawsuits whose resolution may prevent its construction. The EIR must consider the impacts of the Student Housing West Project on the campus as it currently exists–*without* this project.

"UCSC occupies a magnificent site that provides a broad spectrum of visual images. Long range views are impressive and memorable, both from the forest edge on the upper campus looking downward to the ocean and the city and from the lower campus looking upward. From most viewpoints along the forest edge on the upper campus, sightlines are unbroken and sweeping." 2005 LRDP, 24. The EIR must, as CEQA requires, recognize the "iconic" and "incomparable" nature of these scenic resources, fully disclose and analyze the severe impacts that contemplated campus development will have on them, and evaluate a broad range of alternatives and mitigation measures that would avoid or lessen those impacts.

B. Biological Resources

The EIR should consider the impacts of the LRDP on special status species in the area, including the California Red-Legged Frog, the burrowing owl, golden eagles, and other imperiled aquatic, avian and terrestrial plant and animal species. It must address not only direct impacts to those species, but also indirect and cumulative impacts including long-term loss of their habitat and noise impacts from construction and additional students. Inclusion of that necessary information will provide a more thorough and complete analysis of the LRDP's impacts to biological resources.

In the past, the United States Fish and Wildlife Service ("USFWS") has noted that "[t]he piecemeal approach that UCSC has taken in terms of implementing individual development projects over time makes it difficult for the Service to adequately assess cumulative impacts." Comments on the City of Santa Cruz Sphere of Influence Amendment Draft EIR November 2009, December 1, 2009, p. 2 (attached hereto as Exhibit 2). USFWS also expressed similar concerns about the 2005 LRDP, "includ[ing] the following: '1) underestimating the effects of various development projects on federally listed species, 2) [inadequate] UCSC land use designations regarding conservation of federally listed species, and 3) the lack of a comprehensive management plan for listed species at UCSC.'" Exhibit 2, p. 2 (citing USFWS January 11, 2006 comment letter to UCSC on the 2005 LRDP DEIR).

These same concerns apply here. If the LRDP EIR fails to fully address the cumulative and indirect habitat impacts from all the development that the LRDP would allow over its life, those impacts could be hidden within piecemealed, individual project assessments. Thus buried from public and agency view, those impacts would never be recognized, leaving USFWS, the City and County, other agencies, and the public without a clear and complete understanding of the LRDP's cumulative and indirect biological impacts. Leaving agencies and the public in the dark would place those impacted resources at unnecessary risk. An agency must review the entire activity–in this case, the LRDP over its entire life–as a whole, rather than segment it into smaller parts. *Tuolumne County Citizens for Responsible Growth, Inc. v. City of Sonora* (2007) 155 Cal.App.4th 1214, 1230; *Laurel Heights Improvement Association v. UC Regents* (1988) 47 Cal.3d 376, 406; CEQA Guidelines § 15378(a), (c), (d). Because UCSC campus development has the potential, over the course of the LRDP's implementation, to significantly impact a long list of vital and vulnerable biological resources, the EIR must address all of those potential impacts, both short-term and long-term, now–when the go/no-go long-range planning decision is made–and before any further development may be allowed to proceed.

The EIR's biological resources analysis must include a discussion of the Student Housing West Project as well. As noted above, that project has not yet been constructed and therefore is not part of the existing environment. If it is eventually constructed, it will have significant impacts on biological resources. Even if this unlawful project is later approved under the 2020 LRDP, at that point it will be part of that larger, 2020 LRDP Project. Therefore, the EIR should consider the impacts of the Student Housing West Project together with the impacts of the other development proposed under the 2020 LRDP.

C. Greenhouse Gas Emissions

As a "comprehensive land use plan that guides physical development," the LRDP has the potential to significantly affect greenhouse gas ("GHG") emissions on campus. "Implementation of the LRDP may result in the generation of additional greenhouse gas emissions during construction and operational activities." NOP, Attachment B, B-1. The EIR should consider these increases in emissions on both a local and regional level. GHG emissions are not confined by the borders of the University, or the City. GHG emissions by UCSC have the potential to impact much more than just the campus and the City, and those cumulative impacts cannot be ignored.

Under CEQA, GHG emissions must be analyzed in a manner that recognizes the entirety of the impact including the emissions from the mining and gathering, cultivation and harvest, and manufacturing of the project's components, their fabrication, their transportation to the site, the on-site grading and construction of the project, and its long-term operation and ultimate decommissioning. This comprehensive review of a project's GHG emissions is known as a lifecycle analysis. The LRDP should require a lifecycle analysis of all development that is proposed pursuant to the LRDP. Such an analysis would provide a more accurate and complete understanding of the Project's GHG emissions and their impact on the surrounding environment.
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D. Hydrology and Water Quality

Campus development under the LRDP will impact hydrology and water quality. This is especially concerning given the extremely complex and readily erodible geologic formations known as "karst" underlying the campus. The karst system is a landform that is "produced primarily through the dissolving of rock" and features "sinkholes, caves, large springs, dry valleys and sinking streams." American Geosciences Institute, *Living with Karst: A Fragile Foundation*, 2001, p. 11 (attached hereto as Exhibit 3). Because of these features, karst landscapes "are characterized by efficient flow of groundwater through conduits that become larger as the bedrock dissolves. In karst areas, water commonly drains rapidly into the subsurface at zones of recharge and then through a network of fractures, partings, and caves, [and] emerges at the surface in zones of discharge at springs, seeps, and wells." *Id.*

Karst landscapes present numerous environmental uncertainties that make development pursuant to the LRDP and its impacts especially problematic. "Karst regions require special care to prevent contamination of vulnerable groundwater supplies and to avoid building in geologically hazardous areas." Exhibit 3, p. 7. "Most of the rain that falls in a karst area drains into the ground rather than flowing to a surface stream." Exhibit 3, p. 28. LRDP development, such as construction of the Student Housing West Project, can increase "pollution of groundwater by sewage, runoff containing petrochemicals derived from paved areas, domestic and industrial chemicals, and trash." Exhibit 3, p. 7. "Contamination is common in karst aquifers beneath urban areas with high population densities." Exhibit 3, p. 30. Because groundwater contamination is such a serious threat, the LRDP EIR should address this concern in detail and consider, among the required broad range of alternatives, limiting the amount of new construction and development allowed on campus.

Runoff is also a major concern with karst formations. "Impermeable ground covers such as roads, parking lots, and buildings increase the rate at which water collects and flows on the surface, flooding homes and businesses in [a] sinkhole." Exhibit 3, p. 28. These considerations must be addressed in the EIR.

E. Geology and Soils

As discussed above, the karst formation below the UCSC campus is fragile and presents numerous hazards and impacts that must be fully disclosed, evaluated and avoided or mitigated in the EIR. In addition to the hydrologic uncertainties posed by an underlying karst formation, the topography also creates geologic risks. "Problems occur when the landscape is altered by urban development. Erosion is a common side effect of construction, transporting soil to the lowest part of the sinkhole where it clogs the drain." Exhibit 3, p. 28. Development also "increases the risk of induced sinkhole collapse." Exhibit 3, p. 27. The EIR and LRDP should consider the potential catastrophic impacts of development overlying the underlying karst system. There are numerous alternatives that could lessen or avoid those impacts, including offsite learning options as noted above, that must be considered in light of these serious concerns.

F. Land Use and Planning

As the 2005 LRDP notes, "[a]s a central link between the city and state parks, the campus recognizes its role in conserving open space for habitat continuity." 2005 LRDP, 31. The EIR should consider the campus' "role in conserving open space for habitat continuity" when addressing any impacts from changes in land use designations. The EIR must ensure that land use designations preserve enough open space to achieve this goal, and where open space is not preserved, the impacts must be accurately stated and considered.

G. Population and Housing

According to the 2005 LRDP, housing is a "key issue[] essential to the planning processes of UCSC." 2005 LRDP, 23. "Rapidly increasing housing demand along much of the California coast (including Santa Cruz), coupled with limited supplies and a shortage of vacant land, make housing supply and affordability critical issues for the entire region. UCSC growth increases the pressure on the housing supply, and high housing costs make it more difficult to recruit students, faculty, and staff." 2005 LRDP, 25. Yet UCSC still plans to expand the campus by nearly 10,000 students. NOP, Attachment A, A-4. Furthermore, it plans to add an additional 2,200 FTE faculty and staff members, but it will only house 25% of that additional faculty and staff. NOP, Attachment A, A-4. The LRDP will therefore leave an additional 1,650 faculty and staff members to find housing in an already scarce and problematic market. UCSC claims that it plans to work with the City, yet its current plan will significantly drive up housing costs. The LRDP EIR must disclose this impact and consider alternatives and mitigation measures to lessen it, including the use of off-site alternatives such as satellite campuses and remote classrooms.

H. Public Safety

The EIR must also address the severe public safety hazards that will be created and exacerbated by the development proposed under the LRDP. Off-shore winds blowing from the north toward Monterey Bay occur frequently, especially during the peak fire season in the fall. In the event of a big fire propelled by off-shore winds blowing from the north, LRDP development in the West Campus area will create immediate and obvious fire evacuation hazards.

Many of the nearly 10,000 proposed additional students on the main campus, along with the faculty and staff housing proposed in the Coastal Zone, could only evacuate a wildfire via Empire Grade Road by exiting through the current West Campus entrance and the proposed bridge over Cave Gulch to Empire Grade. In certain likely fire scenarios, all of the population of

Bonny Doon would have only Empire Grade Road available as an evacuation route.

This outflux of people frantically evacuating to the south via Empire Grade Road would create instant gridlock, backing up south-bound traffic on Empire Grade Road toward the north–in the direction of the on-coming fire. Adding thousands of evacuees from the LRDP's proposed new development would create a death trap. Building up the West Campus would thus be a blueprint for disaster similar to the traffic gridlock that trapped and killed residents of Paradise fleeing from the Camp Fire in October 2018. It behooves the University to pay careful attention to this critical public safety issue in the EIR..

I. Traffic and Transportation

Along with the impacts of LRDP development on water and housing, other major infrastructure concerns the EIR must address include impacts on transportation and traffic. In the 2005 LRDP, UCSC stated that "[p]rojected increases in UCSC's population will increase pressure on citywide transportation systems, especially on the west side of Santa Cruz." 2005 LRDP, 27. That is even more of a concern now, since both population and GHG emissions have increased since publication of the 2005 LRDP. Increasing UCSC's student population to 28,000 FTE will only further exacerbate the pressure on citywide transportation systems. It is therefore imperative that the EIR address these concerns and adopt practices that could help minimize the impacts to transportation, including limiting campus development and promoting distance learning such as remote or virtual classrooms and satellite campuses. Additionally, UCSC could work with the City to improve its transportation systems by making them more efficient and encouraging ridership.

Furthermore, as noted above, a fire moving toward the campus from the north could create deadly traffic and safety hazards on Empire Grade Road. That gridlock would not only endanger the lives of evacuees, but could also impede access for fire fighters. Both hazards must be analyzed in the EIR. These potentially deadly traffic safety hazards resulting from implementation of the LRDP must be given appropriate and adequate consideration.

J. Utilities

1. The City's Water Supply Is Insufficient

"Water is supplied to the campus by the City of Santa Cruz Water Department [("SCWD")]." 2005 LRDP, 88. "While the City of Santa Cruz water supply system is essentially the same as in 1960, the service population has increased 190 percent and is expected to increase. In normal and wet years, the water supply system is capable of meeting the needs of the current population, but even without population increases, the system is highly vulnerable to shortages in drought years." 2005 LRDP, 25. According to the City's Urban Water Management Plan ("UWMP"), "the City has had to declare a water shortage in five of the . . . seven years" between 2009 and 2015. Exhibit 1, p. 8-1. And the UWMP predicts that the SCWD will face a shortfall by 2025. Exhibit 1, pp. 4-6 (projected water use in 2025 is 3,225 mgy), 6-24 (projected water supply in 2025 is 3,164 mgy).

"Adequate water supply is a primary issue for UCSC and the City of Santa Cruz given future anticipated shortfalls." 2005 LRDP, 23, 88 (quote). Increased development under the LRDP would necessarily increase water demand. But the SCWD does not have an adequate water supply to meet even current demands.

CEQA requires that the EIR disclose the limitations on water supply. *Vineyard*, 40 Cal.4th at 438-447. Likewise, CEQA demands that the impacts of a project on that limited water supply be fully analyzed so that the public and decision makers can make an informed decision about the project–in this case, the LRDP. *Vineyard*, 40 Cal.4th at 431-432. "An EIR evaluating a planned land use project must assume that all phases of the project will eventually be built and will need water, and must analyze, to the extent reasonably possible, the impacts of providing water to the entire proposed project." *Vineyard*, 40 Cal.4th at 431. "[W]here, despite a full discussion, it is impossible to confidently determine that anticipated future water sources will be available, CEQA requires some discussion of possible replacement sources or alternatives to use of the anticipated water, and of the environmental consequences of those contingencies." *Vineyard*, 40 Cal.4th at 432.

Therefore, the EIR must disclose and discuss SCWD's projected water shortage and the impacts that UCSC growth will have on that shortfall. Furthermore, the EIR must identify the proposed sources of water for UCSC development and the consequences of relying on those sources. And, the EIR must also evaluate a broad range of alternatives–such as off-site learning options–that would avoid or reduce those impacts on the already inadequate water supply.

2. Increased Water Demand Will Be Detrimental to Special-Status Fish Species

The City's water sources support populations of Central California Coast ("CCC") Distinct Population Segment steelhead (*Oncorhynchus mykiss*), a threatened species (62 Fed. Reg. 43937 (August 18, 1997)), and CCC Evolutionarily Significant Unit (ESU) coho salmon (*Oncorhynchus kisutch*), an endangered species. 70 Fed.Reg. 37160 (June 28, 2005); 64 Fed.Reg. 24049 (May 5, 1999). The endangered CCC coho relies on the San Lorenzo River watershed for recovery. 64 Fed.Reg. 24049. The prospects for recovery of the CCC steelhead and coho are dependent on suitable habitat being restored and maintained. Certain minimum levels of flow and temperature are required in streams for the proper development, growth and spawning of salmonids.

Currently, in critically dry years, the City does not have enough water to meet the City's existing needs, including the instream needs for fish. 2005 LRDP, 88. And the City projects a water supply shortfall by 2025. Exhibit 1, pp. 4-6, 6-24. During dry years maintenance of instream flow is critically important for the survival of the salmonids, as rearing juveniles are typically unable to rear in small tributaries and will need adequate water flow in the main stem of the San Lorenzo River. As climate change continues to alter ambient temperatures, the need for cool water flows will increase, requiring corresponding reductions in water supplies for human uses, further limiting the City's ability to meet water demands. The EIR must address this when calculating the City's ability to meet water demand in light of UCSC's proposed development. *Friends of the Eel River v. Sonoma County Water Agency* (2003) 108 Cal.App.4th 859, 874-875 (EIR must address cumulative impacts of upstream and downstream diversions of water for human uses on salmonid species in the river); *Vineyard*, 40 Cal.4th at 448-449 (EIR must examine impact of seasonal reductions in river flow on both salmonids and human water supply).

Furthermore, the EIR should also analyze the impacts that would occur if the City were forced to pump groundwater to make up for reduced surface water supplies in the future. *Vineyard*, 40 Cal.4th at 438-447.

V. Information Needed by Responsible Agencies

The development proposed in the LRDP appears to include area outside the City's approved water service area. Providing water to such areas requires the approval of the Santa Cruz County Local Agency Formation Commission, which is therefore a responsible agency for this Project under CEQA. Accordingly, the EIR must address impacts on water supply in a manner that addresses the informational needs of LAFCO. *HAWC*, 213 Cal.App.4th at 1305.

The urban growth proposed by the LRDP also includes development within the California Coastal Zone that is subject to review by the California Coastal Commission. Just as the EIR must provide information needed by LAFCO to analyze the Project's impacts on water supply, so too the EIR must provide the Coastal Commission, which is likewise a responsible agency for this Project under CEQA, with the information it needs to evaluate the Project's impacts within the Coastal Zone. *HAWC*, 213 Cal.App.4th at 1305.

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VI. Conclusion

Because the UCSC campus possesses extraordinary, yet vulnerable and irreplaceable, environmental resources that the LRDP's proposed development threatens, those unique concerns merit heightened analysis and creative solutions–including off-site alternatives such as remote learning and satellite campuses–in the EIR. CEQA requires a thorough evaluation of the Project's potential impacts and alternatives that informs the public and decision makers about how best to avoid and lessen these potentially severe but eminently mitigable impacts.

Please include these Scoping Comments in the public record for this Project.

Thank you for your attention.

Very truly yours,

Stephan C. Volker
Attorney for Habitat and Watershed Caretakers,
Don Stevens, Russell B. Weisz, Hal Levin, Harry D.
Huskey, and Peter L. Scott

Exhibits

Exhibit 1: City of Santa Cruz, 2015 Urban Water Management Plan

Exhibit 2: Comments of U.S. Fish and Wildlife Service dated December 1, 2009 on the City of Santa Cruz Sphere of Influence Amendment Draft EIR dated November 2009

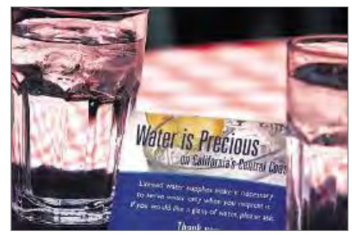
Exhibit 3: American Geosciences Institute, *Living with Karst: A Fragile Foundation*, 2001

EXHIBIT
1

City of Santa Cruz

2015 Urban Water Management Plan



Prepared by: City of Santa Cruz Water Department

August 2016

City of Santa Cruz Water Department

2015 Urban Water Management Plan

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August 2016

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Chapter 1

INTRODUCTION AND OVERVIEW

1.1 Urban Water Management Planning Act

This report has been prepared by the City of Santa Cruz Water Department in response to the Urban Water Management Planning Act. The Act, which became part of the California Water Code with the passage of Assembly Bill 797 in 1983, requires that every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually prepare and adopt an Urban Water Management Plan, and to update it every five years.

The Act requires water agencies to evaluate and describe their water resource supplies and projected needs over a twenty-year planning horizon and to address a number of related subjects including water conservation, water service reliability, water recycling, opportunities for water transfers, and contingency plans for drought events.

The Act recognizes that water is a limited and renewable resource subject to ever-increasing demands and that conservation and efficient use of urban water supplies is a statewide concern. The Act also states that a long-term reliable supply of water is essential to protect the productivity of California's businesses and economic climate and, as part of its long-range planning activities, every urban water supplier should make every effort to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its various categories of customers during normal, dry, and multiple dry years.

The purpose, required contents, and process for preparing and adopting Urban Water Management Plans are specified in Water Code sections 10608 and 10610 – 10656 (Appendix A). The overall goal is to provide water suppliers throughout the state a framework for carrying out their long-term planning responsibilities and for reporting their strategies to meet future water challenges to both state government and the communities they serve.

1.2 Recent Changes to the Water Code

The Act has been amended numerous times by the Legislature over the years in response to the State's water shortages, droughts, and other factors. A significant amendment was made in 2009, after the drought of 2007-2009 and as a result of the governor's call for a statewide 20 percent reduction in per capita water use by the year 2020. The Water Conservation Act of 2009, also known as SB X7-7, required urban water suppliers to establish water use targets for 2015 and 2020 that would result in statewide savings of 20 percent by 2020 (Appendix B). Under the law, each urban water supplier is required to determine its baseline daily per capita water use and to calculate future water use targets in accordance with technical methodologies developed by the California Department of Water Resources, and to include this information beginning in its 2010 Urban Water Management Plan. Progress towards decreasing daily per capita water use and achieving future water use targets is then to be documented in subsequent plans starting with this 2015 update.

Recent legislative amendments to the Water Code since 2010 include the following:

- Water suppliers are required to provide a narrative description of their water demand management measures over the past 5 years, as well as the measures a supplier plans to implement to achieve its water use targets.

- Water suppliers are required to submit their 2015 plan electronically to the Department of Water Resources by July 1, 2016,

- Water suppliers are required to use standardized forms, tables, or displays specified by the Department of Water Resources, to facilitate statewide planning.

- Plans must quantify and report on distribution system water losses for the most recent 12-month period using a standardized water balance methodology developed by the American Water Works Association.

- Agencies are authorized, but not required, to include certain energy–related information for collection, treatment, and distribution of water supplies, as well as the water savings estimated to result from adopted codes, standards, or ordinances.

A summary of the changes to the Water Code since 2010 is included in Appendix C.

1.3 Urban Water Management Plans in Relation to Other Planning Efforts

Urban Water Management Plans serve a variety of purposes and are intended to be consistent with and support other local, regional, and statewide plans and processes.

Information about water use and supplies reported by water agencies is collected and used by the state in updating the California Water Plan every five years. They provide a common basis for cooperative water resource management through preparation of Integrated Regional Water Management Programs, such as one now being implemented in Santa Cruz County, of which the City of Santa Cruz is an active project participant. Land use agencies rely on a water agency's Urban Water Management Plan as a long-range planning document to aid in updating city and county General Plans and for the preparation of environmental documents under the California Environmental Quality Act (CEQA). They also serve as a detailed source of information to coordinate local water supply availability and certain land use decisions made by cities and counties under Senate Bills 610 and 221 of 2001.

1.4 City of Santa Cruz' 2015 Urban Water Management Plan

This document constitutes the sixth update of the City's Urban Water Management Plan. The first version was adopted by City Council in 1986. The plan was most recently updated in 2010/11 and adopted in late 2011. Since then, circumstances and events have evolved in a way that was difficult to foresee only a few short years ago. Some of the interrelated factors that have changed in the last five years include the following:

- **New Vision for the City's Water Supply.** The City of Santa Cruz has long faced challenges with the reliability of its water supply and had been actively pursuing ocean desalination as a supplemental water source for more than a decade. In spring 2014, the Santa Cruz City Council changed course and appointed a committee of 14 residents representing diverse viewpoints to take an exhaustive look at the City's water issues and ways to address them. The Water Supply Advisory Committee (WSAC) worked for 18 months in an open, public, and transparent process to develop recommendations to ensure a more stable and reliable water supply. In addition to more conservation, the WSAC recommended the City embark on a program to enhance regional groundwater storage using in-lieu water exchanges and/or aquifer storage and recovery with neighboring water districts. Advanced treated recycled water or desalination were recommended as backup plans.

- **Historic Drought Conditions.** The City of Santa Cruz, along with the rest of the State of California, has recently faced one of the most severe droughts in its history. At the local level, the Santa Cruz City Council declared a water shortage in each of the last four years and instituted mandatory water rationing in both 2014 and 2015. At the state level, Governor Brown in January 2014 proclaimed a State of

Emergency to exist throughout California due to the ongoing drought, leading to emergency conservation regulations being imposed on all urban water suppliers to achieve a statewide 25 percent reduction in urban water use in 2015. While water conditions improved in 2016 for parts of California, including Santa Cruz, all urban water suppliers remain subject to updated emergency water restrictions through at least January 2017, as well as other statewide orders aimed at permanently using water more wisely, eliminating water waste, and strengthening drought resilience.

- **Endangered Species Act Issues and Ecosystem Restoration.** The City has not yet finalized a flow agreement with state and federal fishery agencies but has been voluntarily releasing higher flows at various points of diversion to protect endangered Coho salmon and threatened steelhead trout. Improving habitat conditions to restore declining fish populations, while consistent with community values, will further limit the availability of water for municipal purposes in the future. The ultimate resolution of fish flow requirements for the City's sources of supply will be a result of forthcoming negotiations with state and federal fishery agencies.

- **Sustainable Groundwater Management.** In 2014, California enacted landmark legislation to bring the state's groundwater basins into a more sustainable regime of pumping and recharge. Facing declining groundwater supplies, the City recently joined together with two overlying water districts and the County of Santa Cruz to form a Joint Powers Agreement for the creation of a local Groundwater Sustainability Agency (GSA) required by the act. The GSA will oversee the preparation of a cooperative groundwater management plan for the Santa Cruz Mid-County Groundwater Basin, the status of which was recently designated by the State to be in a condition of critical overdraft.

- **Aging Infrastructure.** Key components of the City water system, including the North Coast System, the Newell Creek Dam Inlet/Outlet pipe, and water treatment facilities have reached the end of their useful life and are overdue for renewal and replacement. The Water Department's long-range Capital Improvement Program envisions a total of almost $120 million in needed infrastructure reinvestment projects over the next 10 years, adding pressure on limited financial resources.

As with elsewhere in California, the challenges for managing water supply and demand in the central coast region are dynamic. This plan acknowledges that the future is both variable and uncertain and that change will continue to occur.

1.5 Report Format

For this 2015 submittal cycle, the City has elected to modify the basic structure and organization used in previous plans to better align the document and accompanying tables with the organization recommended in DWR's Guidebook for Urban Water Suppliers (CA DWR, 2016). Required content is grouped by topic as follows:

Chapter 1 – Introduction and Overview: This section covers the background, purpose, and scope of an Urban Water Management Plan.

Chapter 2 – Plan Preparation: This section covers the process used to develop the 2015 plan, including efforts in coordination and outreach.

Chapter 3 – System Description: This section describes the City's water service area including population, climate, and other factors affecting the City's water management planning, including governance and the Water Department's organizational structure.

Chapter 4 – System Water Use: This section covers the past, current, and projected water uses within the City's water service area. It also provides information on distribution system water losses.

Chapter 5 – Baselines and Targets: This section provides information about the City's baseline per capita water use and urban water use targets, describes the methods for calculating baseline and target consumption, and success in achieving its 2015 target.

Chapter 6 – System Supplies: This section describes and quantifies the current and projected sources of water available to the City, including surface water, groundwater, and potential new sources, transfers, or exchanges of water.

Chapter 7 – Water Supply Reliability: This section characterizes the reliability of the City water supply system, provides an updated assessment of the system reliability under differing hydrologic conditions and describes the overall strategy and work plan the City is pursuing to improve its water supply reliability.

Chapter 8 – Water Shortage Contingency Planning: This section summarizes the City's 5-stage plan for addressing water shortages and describes actions that would be undertaken in response to a catastrophic interruption of water supplies, including a regional power outage, earthquake, or other emergency situation.

Chapter 9 – Demand Management Measures: This section describes the measures currently being implemented by the City to promote conservation and discusses the planning process underway to guide water conservation activities in future years.

Chapter 10 – Plan Adoption, Submittal, and Implementation: This section describes the steps taken to adopt and submit the Urban Water Management Plan update, and to make the plan available for public use and reference.

1.6 UWMPs and Funding Eligibility

In order for an urban water supplier to be eligible for any state water grants or loans administered by DWR, the agency must have a current Urban Water Management Plan on file that has been determined by DWR to address the requirements of the Water Code.

Beginning in 2016, urban water suppliers must also comply with the requirements of the Water Conservation Act of 2009 in order to be eligible for state water grants and loans, meaning an agency must both meet its interim water use target and report compliance in its 2015 UWMP.

Chapter 2

PLAN PREPARATIOIN

2.1 Basis for Preparing a Plan

In accordance with the California Water Code, every urban water supplier with 3,000 or more service connections or supplying more than 3,000 acre-feet of water per year are required to prepare an Urban Water Management Plan every five years. With 24,534 active service connections, the City of Santa Cruz clearly meets the definition of “Urban Water Supplier” and therefore must prepare a plan.

The Santa Cruz water system also qualifies under the California Health and Safety Code, Section 116275, as a “Public Water System” that provides drinking water for human consumption and is regulated by the State Water Resources Control Board, Division of Drinking Water. The City operates a single, retail drinking water system. It receives no water from any wholesale supplier nor does it supply either raw or treated water to another agency at the present time.

Table 2-1. Public Water Systems

Public Water System Number	Public Water System Name	Number of Municipal Connections 2015	Volume of Water Supplied 2015
CA4410010	Santa Cruz Water Department	24,534	2,452
	TOTAL	24,534	2,452
NOTES: Volume of water supplied in million gallons			

2.2 Regional Planning and Compliance

> ***CWC 10620***
>
> ***(d)(1)*** *An urban water supplier may satisfy the requirements of this part by participation in area wide, regional, watershed, or basin wide urban water management planning where those plans will reduce preparation costs and contribute to the achievement of conservation and efficient water use.*

The City of Santa Cruz actively participates in several regional, interagency, groundwater and watershed basin management efforts. As indicated in Table 2-2, however, the City is choosing to prepare an individual Urban Water Management Plan.

Table 2-2. Plan Identification (Select One)		
☑	Individual UWMP	
☐	Regional UWMP (RUWMP)	
	Select One:	
	☐	RUWMP includes a Regional Alliance
	☐	RUWMP does not include a Regional Alliance
NOTES:		

> ***CWC 10608.20***
> ***(a)(1)*** *...Urban retail water suppliers may elect to determine and report progress toward achieving these targets on an individual or regional basis as provided in subdivision (a) of Section 10608.28...*

Similarly, for the purpose of determining, reporting, and assessing compliance with its urban water use baselines and targets described in Chapter 5, the City of Santa Cruz is choosing to report as an individual supplier.

2.3 Reporting Year and Units of Measure

All information in this plan, except where otherwise noted, is reported on a calendar year basis, and volumes are expressed in units of million gallons.

Table 2-3: Agency Identification	
Type of Agency (select one or both)	
☐	Agency is a wholesaler
☑	Agency is a retailer
Fiscal or Calendar Year (select one)	
☑	UWMP Tables Are in Calendar Years
☐	UWMP Tables Are in Fiscal Years
Units of Measure Used in UWMP (select from Drop down)	
Unit	MG
NOTES:	

2.4 Coordination and Outreach

The process of developing the City's 2015 Urban Water Management Plan really began with the Water Supply Advisory Committee process starting in 2014. This intensive process included an enormous amount of data collection, analysis, modeling, and evaluation of myriad topics and issues associated with water supply planning over an 18-month period. The Committee itself consisted of 14 individuals appointed by the City Council representing diverse viewpoints and interests; including residents, business organizations, environmental organizations, Water Commission members, and an outside City water customer representative. The process was supported by a facilitation team, a technical team, an independent review panel, and by Water Department staff.

All Committee meetings were open to the public with numerous opportunities for public input. The Committee had its own website to share materials, agendas, and to communicate with the public. The committee hosted several public workshops, enrichment sessions, a strategies and ideas convention, open houses, and other outreach activities. Many of the work products developed for the Committee, including a new econometric water demand model, were intended to also serve in updating the City's Urban Water Management Plan.

In late 2015, City staff participated in a webinar and attended a workshop sponsored by DWR to become familiar with changes to the law, the 2015 guidebook, new UWMP tables and tools, and changes in the reporting of wastewater and recycled water.

Written notice regarding the plan review and update was sent to both the City of Capitola and the County of Santa Cruz in December 2015, more than 60 days prior to the public hearing, as required by Section 10621(b) of the Act (Appendix D). Notices were provided both to the City Manager/County Administrative Officer and the Director of Planning/Community Development of these two jurisdictions.

In February 2016, the City hosted and led a meeting to coordinate preparation among all major public water agencies, wastewater utilities, and land use agencies in Santa Cruz County. This meeting was also attended by representatives of the following organizations:

- California Department of Water Resources
- Association of Monterey Bay Area Governments
- Santa Cruz County Local Agency Formation Commission.
- Regional Water Management Foundation (local IRWM entity)

- Resource Conservation District of Santa Cruz County
- Santa Cruz County Environmental Health

Water Department staff prepared the draft urban water management plan in winter and spring of 2016 with the help of the state's *Guidebook for Urban Water Suppliers* (DWR, 2016). Throughout development of this plan, City staff was communicating and coordinating with neighboring water agencies, city and county land use agencies within the service area, as well as the staff from the City's wastewater treatment facilities, City of Scotts Valley, and the Santa Cruz County Sanitation District in accordance with section 10620(d)(2) of the Act.

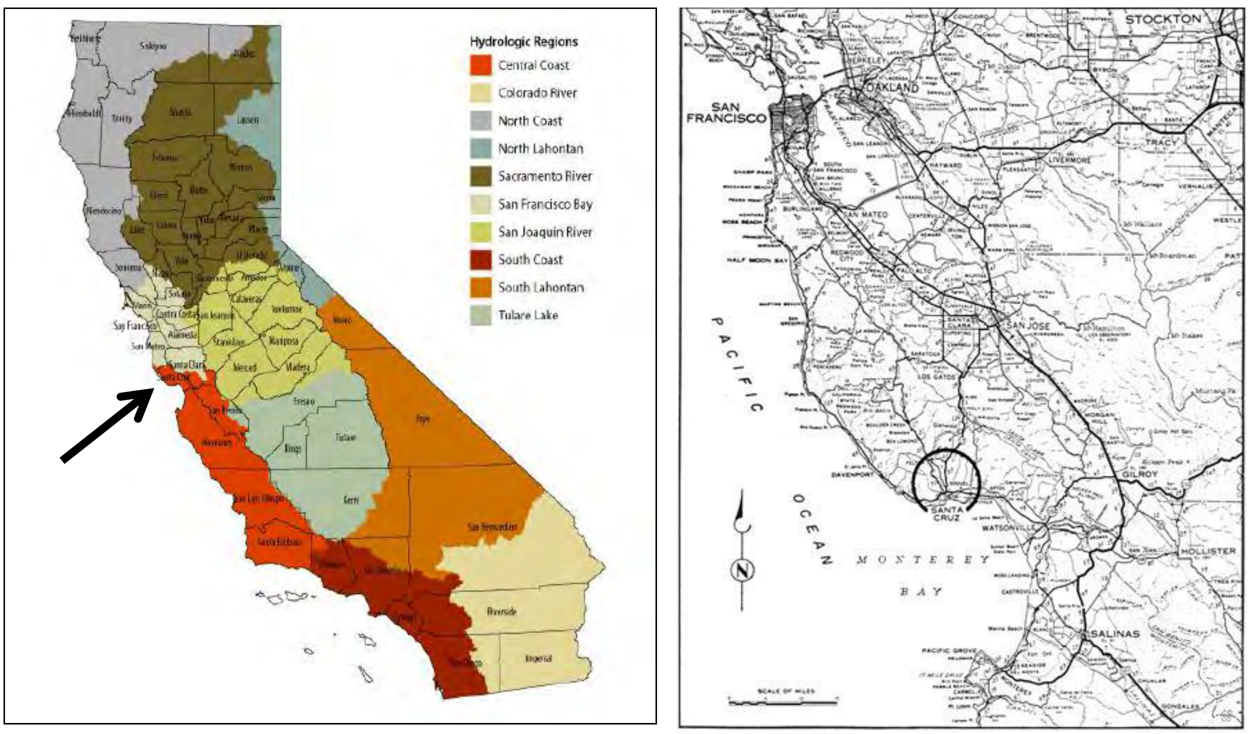
Chapter 3

SYSTEM DESCRIPTION

3.1 General Description of Service Area

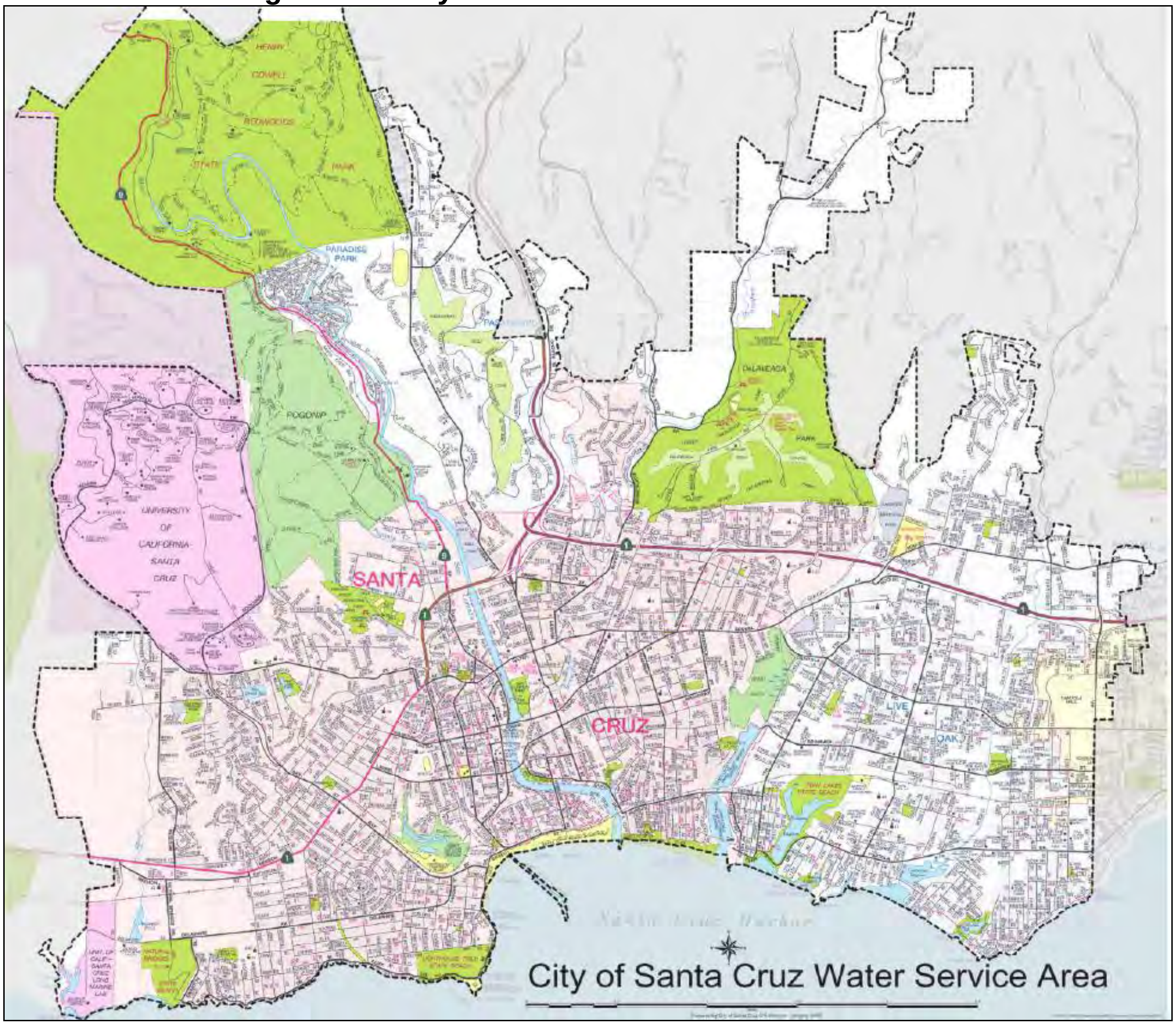
The City of Santa Cruz is located on the central coast of California along the northern shore of Monterey Bay. The City's position on the northern end of the state's Central Coast Hydrologic Region (Region 3) and vicinity relative to the San Francisco Bay Area are shown below in Figure 3-1.

Figure 3-1. California Hydrologic Region and Vicinity Maps



Water service is provided to an area approximately 20 square miles in size, including the entire City of Santa Cruz, adjoining unincorporated areas of Santa Cruz County, a small part of the City of Capitola, and coastal agricultural lands north of the city. A generalized map of the water service area, excluding the north coast, is provided in Figure 3-2. No significant changes to the City's service area boundary have occurred in many years.

Figure 3-2. City of Santa Cruz Water Service Area



People are drawn to the Santa Cruz area for its recreational attractions, its small town ambiance and sense of community, its pleasant weather, its natural beauty and scenic coastline, and its higher education facilities. The sandy beaches and nearby mountains attract millions of visitors to the region every year. The City is bounded by several state parks and open-space lands that provide facilities for bicycling, hiking and other outdoor activities. The seashore and ocean waters of the Monterey Bay National Marine Sanctuary serve as a prime destination in the summer months for sunbathers, surfers, and tourists. Other visitor attractions include the Santa Cruz Beach Boardwalk, Municipal Pier, and Pacific Avenue Mall.

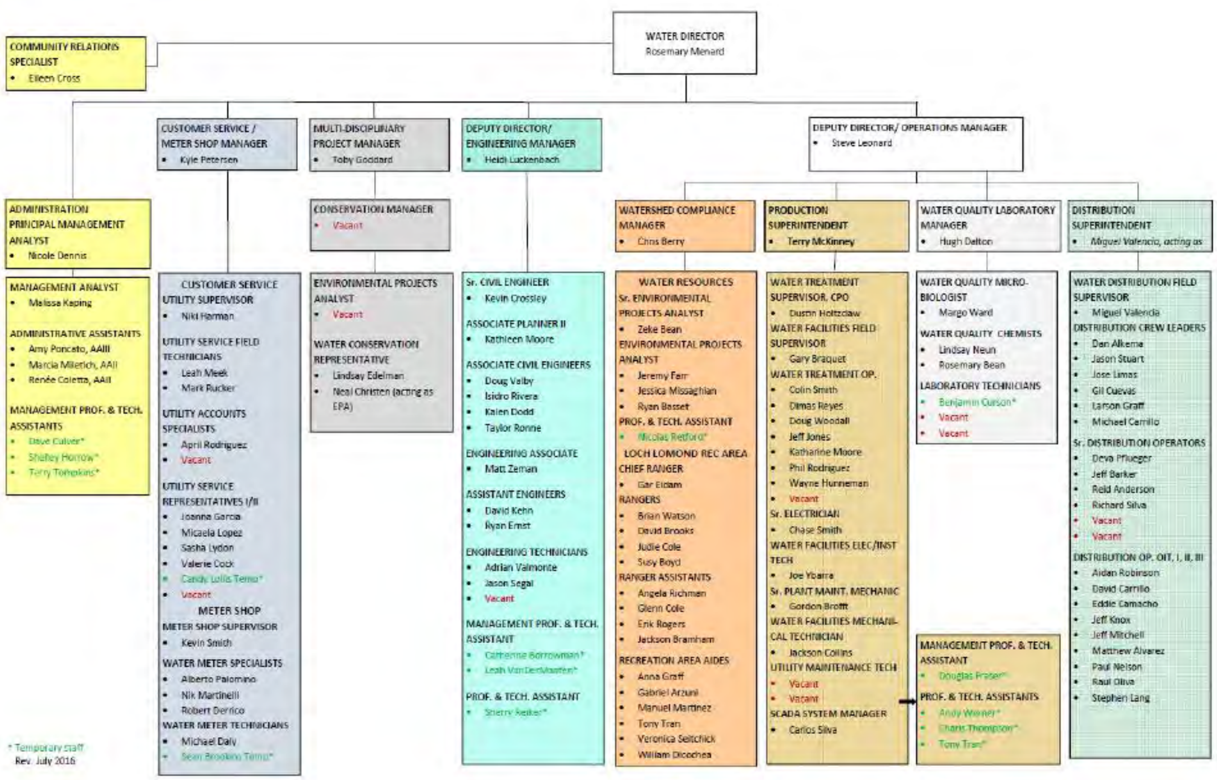
The University of California, Santa Cruz is situated atop the upper west side of the City overlooking the downtown area and Monterey Bay. The campus is nationally recognized for its quality of instruction, its academic stature, and its research impact. It currently accommodates an enrollment of slightly more than 17,000 students during the academic year.

3.2 Water Department

The Santa Cruz Water Department is a municipal utility that is owned and operated by the City of Santa Cruz. It is led by a Director who is appointed by the City Manager. The governing body for the Water Department is the City Council. A seven-member Water Commission advises Council on policy matters involving the operations and management of the water system. The Commission is composed of six members who reside within the City limits and one member who resides in the unincorporated portion of the water service area.

The Department is organized into eight sections. These include Administration, Customer Service, Water Conservation, Engineering, Water Resources/Recreation, Water Production, Water Quality, and Water Distribution. There is currently the equivalent of 102 full-time staff positions in the Water Department. An organization chart of the Water Department is shown in Figure 3-3.

Figure 3-3. Water Department Organization



The Water Department's adopted mission statement is as follows:

> ***"To provide a safe, clean, and continuous supply of water for municipal and fire protection purposes that meets or exceeds local, State, and Federal standards for public health and environmental quality, and to provide courteous, responsive, and efficient service in the most cost-effective manner to our customers".***

The Department operates financially as an enterprise in which all the costs of running the system are paid by water rates, service charges, and related revenues. The Water Fund receives no tax or general fund revenues. In addition to providing water service, the Department has responsibility for billing and customer service functions related to sewer, refuse, and recycling services inside the City limits.

Long-range goals and policies for guiding growth and development in the City, including civic and community facilities like the water system, are contained in the City's 2030 General Plan. The General Plan includes a series of policy statements regarding water service that support and promote the General Plan's overarching goal of achieving a safe, reliable, and adequate water supply. (Appendix E). Some of these policies will need updating with the change in direction for the City's future water supply resulting from the recent WSAC process.

3.3 Service Area Climate

Santa Cruz enjoys a pleasant Mediterranean climate that is characterized by warm, mostly dry summers and mild, wet winters. Due to its proximity to Monterey Bay, fog and low overcast are common during the night and morning hours, especially in the summer. Monthly and annual climate data for Santa Cruz are shown in Table 3-1 below.

Mean monthly temperatures range between 51 to 65 degrees, with the warmest weather usually occurring during August and September. Extreme temperatures are rare and short-lived, with weather conditions being moderated by the oceanic influence and presence of summer fog.

Rainfall in Santa Cruz averages 31.35 inches annually, but varies considerably from year to year. The bulk of seasonal rainfall occurs between November and March. In the watershed above the City's reservoir in the Santa Cruz Mountains, rainfall averages nearly 50 inches per year.

Table 3-1. Climate Data for Santa Cruz

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean High Temp (F)	62.2	64.4	66.4	69.5	71.9	74.7	75.3	76.2	76.4	73.2	66.8	61.9	69.9
Mean Low Temp (F)	41.3	43.3	44.4	46.0	48.9	51.8	54.0	54.3	53.0	49.5	44.9	41.2	47.7
Mean Temp (F)	51.9	53.8	55.4	57.8	60.4	63.2	64.7	65.2	64.7	61.4	55.8	51.5	58.8
Precipitation (in)	6.28	6.24	4.63	1.97	0.84	0.19	0.01	0.04	0.27	1.45	3.75	5.68	31.35
Evapotran-spiration (in)	1.5	1.8	2.6	3.5	4.3	4.4	4.8	4.4	3.8	2.8	1.7	1.2	36.6

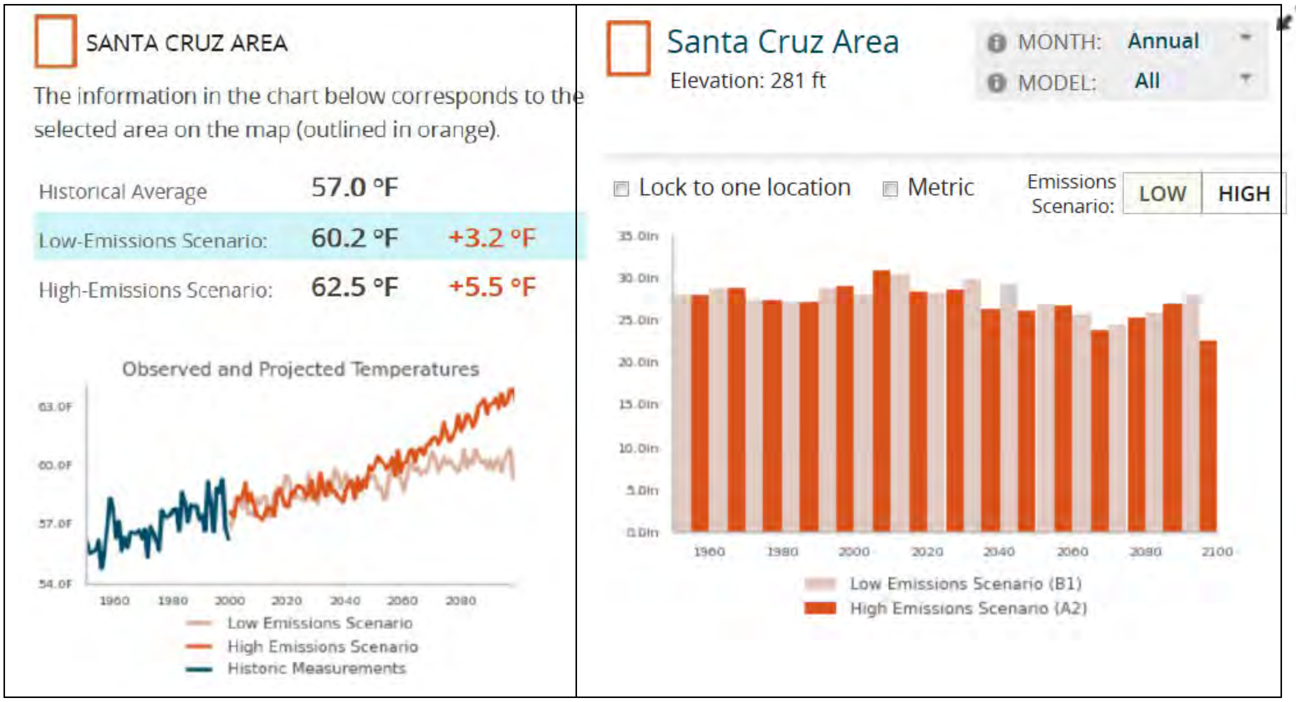
NOTES: National Climate Data Center 1981-2010 Monthly Normals; CA Department of Water Resources

Reference evapotranspiration - a standard measurement of environmental parameters used for determining irrigation needs - averages 36.6 inches per year in Santa Cruz. Average monthly evapotranspiration varies seasonally from a low of 1.2 inches in December to a high of 4.8 inches in July.

Like other coastal communities, the marine influence on local air temperature, humidity, and cloud cover helps keep demand for water relativity low in the City's service area. The presence of summer fog moderates outdoor water use during peak summer season compared to inland locations within Santa Cruz County and elsewhere in California.

Future average temperatures in Santa Cruz are expected to increase. Figure 3-4 below shows two projections of mean temperature to 2100 under different climate change scenarios (Cal-Adapt.org, 2016). A temperature increase of between 3.2 and 5.5 degrees F compared to the historic average is predicted by the end of the century. Conversely, models of future mean annual precipitation show a slight decline over time. The City's Climate Adaptation Study indicates changing temperatures and precipitation will impact ecosystems, fire risk, water quality and quantity, human and environmental health (City of Santa Cruz, 2009). As a coastal community, the City of Santa Cruz recognizes the significance of climate change to the City's economic well-being, public health, and environment, and has begun taking steps as a local agency to respond. Impacts of ongoing climate change on water demand, water supply, and water system reliability are discussed further in Chapters 4, 6, and 7.

Figure 3-4. Projected Mean Temperature and Annual Precipitation for Santa Cruz Area



3.4 Service Area Population and Demographics

The current population residing in the Santa Cruz water service area is estimated to be 95,251 people. Approximately two thirds of the total population, almost 64,000, lives inside the City limits. Within the City, about 9,100 people including students, faculty, staff, and their families reside on the UC Santa Cruz campus. It is estimated that another 31,462 people, or 34 percent of the service area population, live outside the City limits. Since the 2010 US Census, the water service area population has grown by approximately 4,000 persons, mostly inside the City limits.

Table 3-2 shows the current and projected population for the water service area out to 2035, in five year increments.

These figures are derived from a regional growth forecast prepared by the Association of Monterey Bay Area Governments (AMBAG, 2014). According to the forecast, the total number of people receiving water service is expected to grow by about 17,000 people and reach more than 112,000 in 2035. This equates to a population growth rate of less than one percent per year.

Table 3-2. Population - Current and Projected						
Population Served	2015	2020	2025	2030	2035	2040*(opt)*
City of Santa Cruz	63,789	66,860	70,058	73,375	76,692	n/a
County of Santa Cruz, City of Capitola	31,462	32,543	33,562	34,614	35,698	n/a
Total	95,251	99,403	103,620	107,989	112,390	n/a
NOTES: AMBAG 2014 Regional Growth Forecast (adopted June 11, 2014), and City of Santa Cruz GIS section.						

Population is a key factor in determining water use. However, reductions in per capita water use over the last decade have more than offset gradual population increases; that is, even though the service area population has been slowly but steadily rising, total water use has declined. More information on per capita water use is covered in Chapter 5 of this report.

3.5 Housing

According to utility billing records, there are some 37,003 housing units within the City's water service area. The number of housing units, broken down by account type and jurisdiction is shown in Table 3-3 below. Approximately 19,029, or a little over half of all households in the service area are classified as single family accounts[1]. The other 17,974 homes are multiple family dwelling units consisting of various housing types including duplexes, condominium and townhouse complexes, apartments, mobile homes and alternative housing types such as live/work units, mixed use development, single room occupancy, and accessory dwelling units. The figures below do not include dormitory rooms, apartments, and other housing units located on the UC Santa Cruz main campus, nor does it include residential units associated with mixed use/commercial accounts. A large proportion of the local housing stock (over 50 percent) is rented.

Each of the three jurisdictions served by the City has a recently adopted Housing Element that addresses its required regional fair share of the statewide housing needs established by AMBAG. These documents set forth goals and objectives for housing construction, rehabilitation, and conservation for the period 2015-2023.

[1] Water account categories are not the same as housing type. A single family account has one dwelling unit per meter, but may be any type of residence. A multifamily account has two or more dwelling units per meter.

Table 3-3. Housing Units, by Account Type and Jurisdiction			
Jurisdiction	Single Family	Multi-family	Total
City of Santa Cruz	12,273	10,034	22,307
County of Santa Cruz	6,622	7,821	14,443
City of Capitola	134	119	253
Service Area Total	19,029	17,974	37,003
NOTES: 2015 Annual Sales Report, EDEN Multi-residential units counts report Feb 3, 2016			

The regional housing goals for the three jurisdictions served by the City are shown below in Table 3-4. For this housing element cycle, the City is planning for an additional 747 units. The County is planning for a total of 1,837 units to be built Countywide through 2023, of which perhaps 372 units would be located within the City water service area. Capitola has a goal to construct 143 units by 2023 in its housing element, but only a small number of these are expected to fall into the City's water service area. Together, these housing plans represent a total residential development potential in the near term of about 1149 new homes within the City's water service area, of which an estimated 414, about one-third, are planned for lower income categories.

Table 3-4. Regional Housing Goals				
Period: 2015-2023	Total Housing Units		Units in Lower Income Categories	
	Entire Jurisdiction	City Water Service Area	Entire Jurisdiction	City Water Service Area
City of Santa Cruz	747	747	298	298
County of Santa Cruz	1,837	372	636	110
City of Capitola	143	30	57	6
Service Area Total	--	1,149	--	414
NOTES: County housing estimates within City water service area based on personal communication with Sarah Neuse, Santa Cruz County Planning Department. Capitola housing estimates within the City water service area based on personal communication with Richard Grunow, Community Development Director.				

It is important to note that while each jurisdiction must demonstrate it has land zoned that can accommodate its fair share of the regional housing needs, it does not necessarily mean such housing actually will be constructed. Some of the units listed above are already permitted and under construction. The City is planning to incentivize smaller, more vertical, mixed-use or multifamily-type housing units along its major transportation corridors. What type of housing is ultimately built, though, will depend largely on market forces. And despite the collective vision for increased housing in the community, actual progress remains slow. In the last five years, only 204 new single family units, and 6 multifamily projects have been built.

3.6 Community Growth and Development

All three jurisdictions served by the Santa Cruz water system have general plans, local coastal programs, zoning regulations, and development standards that determine the location, type, and density of growth allowed in the region. The General Plan serves as the principal policy and planning document guiding long-range land use and conservation decisions in cities and counties.

The cities of Santa Cruz and Capitola have both completed comprehensive updates to their General Plans in the last few years. The Santa Cruz City General Plan timeline extends to 2030, and Capitola's has a 20 to 30 year planning horizon. The County's current General Plan was adopted in 1994. It has recently prepared and adopted a Sustainable Santa Cruz County plan addressing sustainable land use, housing, economic development, and transportation objectives in the urban area of the County, part of which is served by the City's water system (Santa Cruz County, 2015). The time horizon of that plan is through 2035.

In addition to city and county General Plans, the University of California has Long Range Development Plans (LRDPs) for both its main campus (UCSC, 2005) and its marine science campus (UCSC, 2008, revised 2013) located on the western edge of the City. These plans provide a comprehensive framework to guide physical development, land use, and resource protection to meet the University's academic and institutional objectives through the year 2020.

The size of the City water service area has remained relatively fixed over time due to a long-standing prohibition against new water connections along the north coast, the acquisition of open space lands which created a greenbelt around the City, and the County's urban services boundary, all of which have served to inhibit urban sprawl. Accordingly, most growth and redevelopment that does happen going forward is expected to be concentrated within the confines of the existing service area boundary. Any proposed changes to the City's service area boundary that do come forward are subject to approval by both City Council and the Santa Cruz Local Agency Formation Commission (LAFCO).

Within the City of Santa Cruz, only a small amount of land remains undeveloped. The same is true in the parts of the County and City of Capitola served by the City. Because of the relative scarcity of raw land, the majority of future growth in the area is likely to be achieved through redevelopment, remodeling, increased density on underutilized land, and infill development in the urban core and along major transportation corridors, along with new construction on the little amount of vacant land remaining

Many of the major decisions made by local governing bodies about public improvements and private development are also subject to the review and oversight of, or may be appealed to, the California Coastal Commission. Accordingly, change in the City water service area tends to occur slowly, if at all, and only after exhaustive public process.

3.7 Employment and the Economy

The State Employment Development Department estimates employment within the City's water service area in 2014 (the most recent year for which complete data exists) to average about 42,800, which represents roughly 50 percent of all non-farm jobs in Santa Cruz County (CA EDD, 2016). The three largest employment sectors are health care and social assistance, retail trade, and educational services (Table 3-5).

The University is a key component of the region's economic fabric in terms of employment, spending, research, and business creation. It is the area's largest single employer. Other top employers include the County of Santa Cruz, City of Santa Cruz, Plantronics, and the Santa Cruz Beach Boardwalk. Tourism and lodging are additional major economic drivers in the community. Commercial development is centered in downtown Santa Cruz including River Street, around 41st Avenue in Capitola, and along the major transportation corridors including Mission, Ocean, and Water Streets and Soquel Avenue. The Harvey West area and west side of Santa Cruz support a diverse mix of light industry, retail, high tech, research, and consumer goods and service enterprises. Regional hospitals, medical, and health care facilities and services are concentrated along Soquel Drive in unincorporated Santa Cruz County.

The local economy has rebounded from the great recession, continuing on trend to pace behind the San Jose market by about six months as reflected by reduced unemployment, an improved housing market, increased development activity, a vibrant tourism base, and sustainable increases in sales and hotel revenues. Like other coastal communities, the housing supply is very tight and housing affordability has become a major political, economic, and social issue for families, residents, and employers alike.

Table 3-5. Employment in Santa Cruz Water Service Area, 2014

Major Industry NAICS Sector	NAICS Classification	Employment
Agriculture, Forestry, Fishing & Hunting	11	144
Utilities	22	*****
Construction	23	1,157
Manufacturing	31-33	2,015
Wholesale Trade	42	1,021
Retail Trade	44-45	6,160
Transportation & Warehousing	48-49	431
Information	51	408
Finance & Insurance	52	680
Real Estate & Rental & Leasing	53	568
Professional, Scientific, & Technical Skills	54	1,986
Management Of Companies And Enterprises	55	177
Admin & Support & Waste Mgmt & Remediation	56	1,714
Educational Services	61	5,282
Health Care & Social Assistance	62	7,722
Arts, Entertainment, & Recreation	71	1,460
Accommodation & Food Services	72	5,622
Other Services	81	1,737
Non-Classified	99	*****
Government	92	599
Sub-Total		38,989
Multiple Sites (Government Only)		3,829
Federal		210
Local		3,620
Service Area Total		**42,818**
NOTES: Source: Andy Wong, CA Employment Development Department, Labor Market Information Division, 2016		

Chapter 4

SYSTEM WATER USE

This chapter describes the City's customer classification system, summarizes trends in water consumption, and presents projections of water use out to the year 2035. It also covers information on distribution system losses, water for low income housing units, and future water savings expected water savings from plumbing codes and standards.

4.1 Customer Classification System

The City divides its water customers into eight major classes and one miscellaneous category, as follows:

Single Family Residential: Individually metered residential units (regardless of housing type).

Multiple Family Residential*:* Any residential account with more than one dwelling unit served by one water meter.

Business: Commercial establishments including restaurants, hotel/motel, retail, medical, schools, offices, churches and mixed-use buildings. This category also includes county and state government accounts.

Industry/UCSC: This category is comprised of one primary customer - the University of California, Santa Cruz - and a small number of manufacturing businesses.

Municipal: These are City-owned and operated facilities such as city offices, parks, police and fire stations, a wastewater treatment plant, street medians, and parking lots.

Irrigation: Dedicated water services for landscape irrigation associated with large multiple residential complexes and homeowners associations, or with commercial, industrial, and institutional sites, including schools, churches, parks, etc.

Golf Irrigation: Accounts serving the two golf courses in the service area.

Coast Irrigation: Agricultural accounts receiving untreated or "raw" water on the north coast.

Other: Miscellaneous uses such as temporary construction accounts, hydrant meters, and bulk water sales.

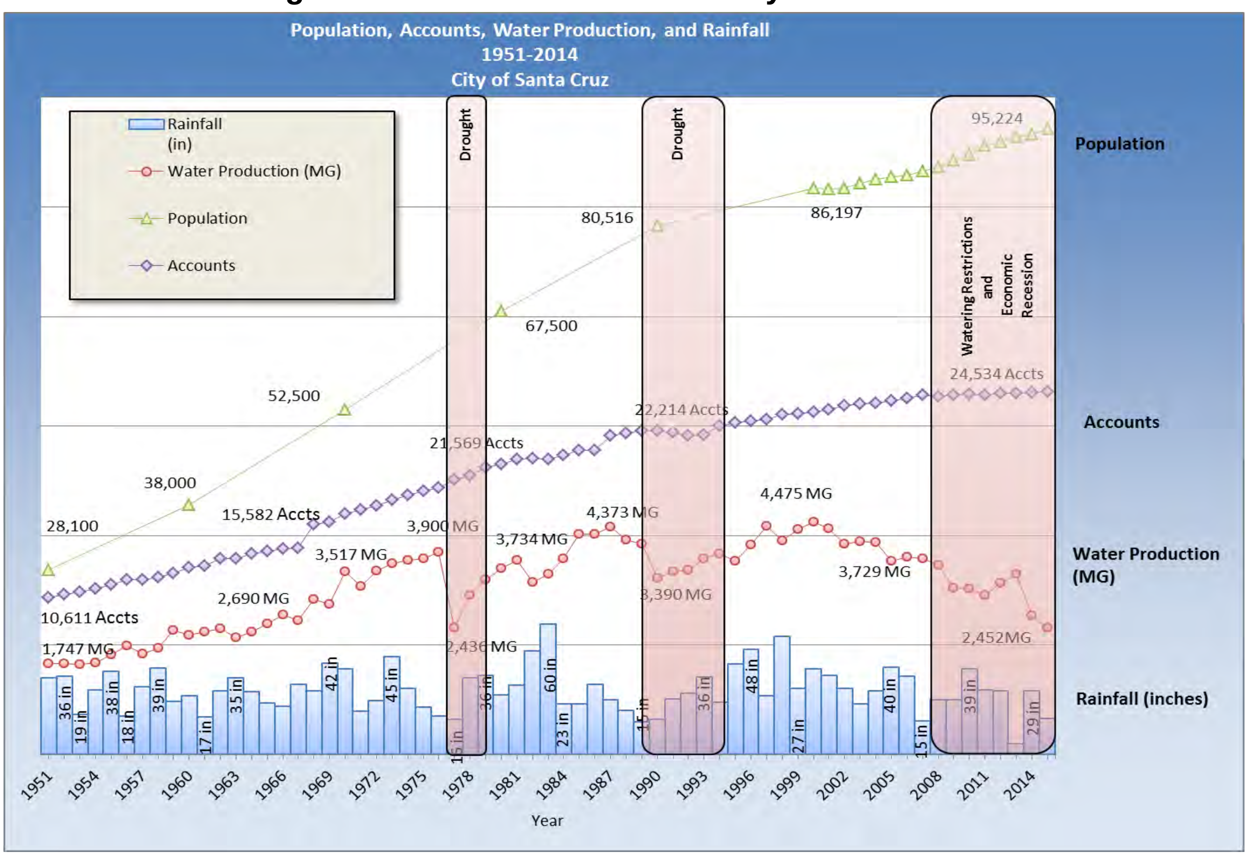
In addition to designating accounts into various customer classes, the City also groups its customers into either "inside-City" or "outside-City" categories for billing purposes.

Except for coast irrigation which receives raw water, all water supplied is potable water. The City does not currently provide recycled water within its service territory. Moreover, no water is presently sold to other agencies, or used for groundwater recharge, saline water intrusion barriers, conjunctive use, or any combination thereof. The potential future use of treated water for transfer, exchange, or groundwater recharge is discussed in Chapter 7.

4.2 Historical Water Use

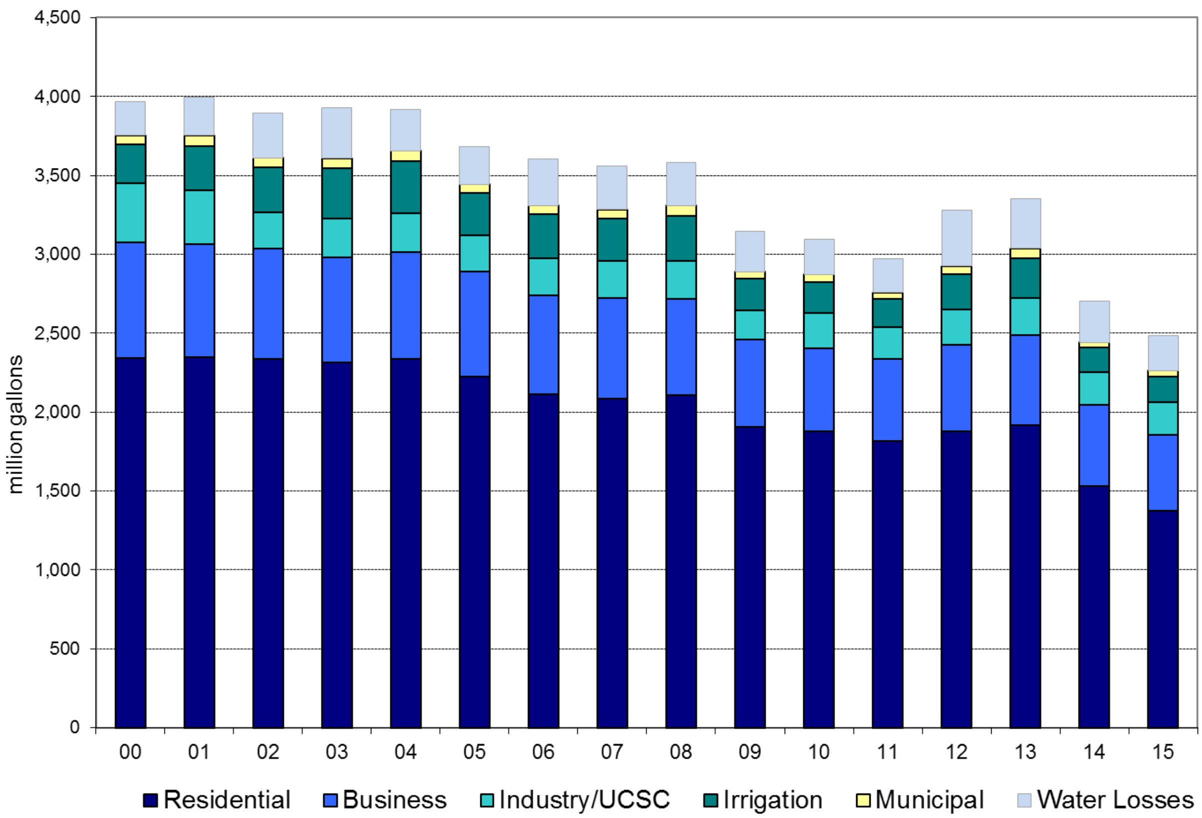
The overall trend in population, number of accounts and total annual water use going back to the 1950s is presented below in Figure 4-1.

Figure 4-1. Historic Trends for City of Santa Cruz



Until recently, the general trend in system demand was one in which water use rose roughly in parallel with account and population growth over time, except during two major drought periods in the late 1970s and the early 1990s. Around 2000, this pattern changed and system demand began a long period of decline, accelerated by pricing changes, drought, economic downturn, and other factors. In 2015, after 2 years of water rationing, annual water use fell to a level of about 2.45 billion gallons, similar to the level experienced during the 1970s drought. A breakdown of annual water consumption by City's major customer classes since 2000, along with system water losses, is illustrated in Figure 4-2.

Figure 4-2. Annual Water Consumption by Customer Category (million gallons)



4.3 Water Use by Sector

Actual demands for potable water in calendar year 2015 are reported by customer class in Table 4.1 below. As illustrated above, both the level and the composition of demand have been strongly affected by the recent drought. Compared to two years before, total system water demand was down nearly 900 million gallons or 27 percent due to local drought response and implementation of water rationing during 2015. In addition to the potable water demand listed below, the City also supplied 34 million gallons of raw water to coast irrigation accounts in 2015.

Table 4-1. Demands for Potable Water – Actual			
Use Type	2015 Actual		
	Additional Description *(as needed)*	Level of Treatment When Delivered	Volume (mg)
Single Family	Individually meter dwellings	Drinking Water	835
Multi-Family	2 or more dwelling units	Drinking Water	538
Commercial		Drinking Water	485
Industrial		Drinking Water	43
Industrial	UC Santa Cruz	Drinking Water	160
Institutional/Governmental	Municipal (city) accounts	Drinking Water	35
Landscape	Dedicated Irrigation Accounts	Drinking Water	46
Landscape	Golf Irrigation	Drinking Water	87
Losses		Drinking Water	223
		TOTAL	2,452

NOTES: System water losses are considered provisional until 2015 annual water audit is completed. Figures above do not include raw water sales of 34 mg in 2015 for coast irrigation, or 2 mg received from Soquel Creek Water District during a major valve replacement project. No drinking water was otherwise used for groundwater recharge, saline water intrusion barrier, wetlands or wildlife habitat, or for sales, transfers, or exchanges to other agencies.

4.4 Distribution System Water Losses

Total system water demand includes not only metered water sales but also authorized, unmetered uses from fire hydrants such as main flushing, fire fighting, street sweeping, and sewer flushing, as well as losses due to underground leaks. The difference between the amount of water produced at the City's water treatment plants entering the distribution system and the amount of water consumed, including both metered and unmetered uses, is referred to as system water losses. System losses have two components: physical losses from leaking service lines and water mains, and apparent losses in which actual consumption is underreported due to sales meter inaccuracies and other factors.

The City has conducted audits of the distribution system annually since the late 1990's to account for unmetered water uses and to track how much water is lost to leakage over time. The City uses AWWA water balance software to help quantify and track water losses associated with the water distribution system and identify areas for improved efficiency and cost recovery. Total water losses vary from year to year, averaging 265 million gallons per year or about 7.5 percent of treated water production.

The volume of water loss for calendar year 2014, which is the most recent 12-month period available, is presented in Table 4-2. The City is currently conducting a Water Loss Control project to examine the City's water system and operations practices to better validate where losses are occurring, evaluate options, and set forth a formal strategy to improve water accountability and reduce lost water. More information on distribution system water losses is covered in Chapter 9.

Table 4-2. 12 Month Water Loss Audit Reporting	
Reporting Period Start Date (mm/yyyy)	Volume of Water Loss (million gallons)
01/2014	261
NOTES: AWWA Water Audit Software, V5.0 for Calendar Year 2014	

4.5 Water Demand Projections

One of the first requests made by the WSAC was for the Water Department to update the demand forecast to reflect current information on water usage and to account for effects of conservation, water rates, and other factors expected to impact the future demand for water. Accordingly, the Water Department contracted with M.Cubed to develop two products: 1) an interim forecast to assist the WSAC process, and 2) a separate econometric demand forecast for the service area extending to year 2035.

The forecast of future water demand is a foundational component of any Urban Water Management Plan. In recent years the historical patterns of water demand have been upended by a variety of factors, including the cumulative effects of tighter efficiency standards for appliances and plumbing fixtures, greater investment in conservation, a significant uptick in water rates, an equally significant downturn in economic activity during the Great Recession, and on-going drought. These events have resulted in even more uncertainty than usual regarding future water demand and have placed even greater importance on sorting out the effect each has had on demand in recent years as well as how they are likely to affect demand going forward.

Econometric demand forecasting develops statistically-based models of average water use per service by customer class. A demand forecast was developed based on these models covering the period 2020-2035 and incorporating empirical relationships between water use and key explanatory variables, including season, weather, water rates, household income, employment, conservation, and drought restrictions. The approach builds on similar models of water demand developed for the California Urban Water Conservation Council (Western Policy Research, 2011), Bay Area Water Supply and Conservation Agency (Western Policy Research, 2014), California Water Service

Company (A&N Technical Services, 2014, M.Cubed 2015), and Contra Costa Water District (M.Cubed 2014).

The statistical models of demand were estimated using historical data on customer class water use, weather, water price, household income, conservation, and other economic variables driving water demand. The monthly models of water demand were combined with service and housing growth forecasts to predict future water demands. The demand models explain 90 to 99% of the observed variation in historical average use over the 14-year estimation period.

A description of the model and forecasts of average demand by customer class are detailed in Appendix F. The forecasts include adjustments for future effects of water rates, plumbing codes and the City's baseline conservation program and are predicated on average weather and normal (predicted) income and growth.

Additional modeling was conducted to factor in updated information on passive and active conservation savings through the 2035 planning period (Maddaus Water Management, 2016). The resulting water demand projection, by customer class, is presented in Table 4-3. As summarized below, system water demands are expected to decline and then stabilize at a level of about 3.2 billion gallons per year.

Table 4-3. Demands for Potable Water - Projected

Use Type	Additional Description	Projected Water Use (mgy)				
		2020	2025	2030	2035	2040-opt
Single Family	Individually metered dwellings	1,277	1,223	1,191	1,170	n/a
Multi-Family	2 or more dwelling units	772	714	690	678	n/a
Commercial		574	541	525	519	n/a
Industrial		56	59	60	61	n/a
Institutional/ Governmental	Municipal (city) accounts	46	42	40	40	n/a
Landscape	Dedicated Irrigation	112	119	134	144	n/a
Landscape	Golf Irrigation	58	52	47	47	n/a
Other	UC Santa Cruz	196	234	271	308	n/a
Water Losses		236	241	247	253	n/a
	TOTAL	3,327	3,225	3,205	3,220	n/a

NOTES: David Mitchell, M Cubed, October 2015, and by Maddaus Water Management, February 2016

Total water demands are presented in Table 4-4.

Table 4-4. Total Water Demands (mgy)						
	2015	2020	2025	2030	2035	2040 *(opt)*
Potable and Raw Water	2,452	3,327	3,225	3,205	3,220	n/a
Recycled Water Demand	0	0	0	0	0	0
TOTAL WATER DEMAND	2,452	3,327	3,225	3,205	3,220	n/a
NOTES: Excludes 34 mg of raw water for coast ag in 2015, projection of coast ag use not available; See Chapter 6 for information on recycled water as a potential source of supply.						

4.6 Estimating Future Water Savings

CWC 10631

(e)(4)(A) *If available and applicable to an urban water supplier, water use projections may display and account for the water savings estimated to result from adopted codes, standards, ordinances, or transportation and land use plans identified by the urban water supplier, as applicable to the service area.*

(B) *To the extent that an urban water supplier reports the information described in subparagraph (A), an urban water supplier shall do both of the following: (i) Provide citations of the various codes, standards, ordinances, or transportation and land use plans utilized in making the projections.(ii) Indicate the extent that the water use projections consider savings from codes, standards, ordinances, or transportation and land use plans. Water use projections that do not account for these water savings shall be noted of that fact.*

The City is in the final stages of completing a Water Conservation Master Plan, described later in Chapter 9. A major part of this planning effort was to model the impact of natural replacement of existing fixtures and appliances on future water use inside homes and businesses, as well as the impact of fixture codes on water use in new development. The model takes into account the existing proportion and characteristics of fixtures from a recent Baseline Water Use Survey, estimated annual replacement rate, fixture life, and assumed market share at various points in the planning horizon (Envirosmart Solutions Group, 2013).

Different federal and state laws regulate the sale or manufacturing of various water using fixtures and appliances. The following laws and regulations were taken into account to estimate the decrease in water use expected to occur over the next 20 years:

- California Energy Commission Appliance Efficiency Regulations, Sept 2015 (toilets, urinals, faucets, and showerheads)
- U.S. Department of Energy standards (residential clothes washers, dishwashers)
- Federal Energy Policy Act of 1992 (toilets, urinals, showerheads, faucets, pre-rinse spray valves)
- 2013 California Green Building Code (new development)
- AB 715 (toilets, urinals)

The estimated cumulative impact of plumbing codes on water use over the next 20 years is a reduction of some 329 million gallons or 8.6 percent of baseline water demand (Table 4-5).

Table 4-5. Future Cumulative Water Savings From Plumbing and Appliance Codes

	2020	2025	2030	2035	2040 *(opt)*
Water Savings (mgy)	94	179	269	329	n/a
NOTES: Maddaus Water Management, Inc., 2016					

4.7 Water Use for Lower Income Households

In its demand forecast, the City expects nearly 1,000 new housing units to be built in its service area by 2025. Table 3-4 on page 3-8 (Chapter 3) provides details about these housing units, including the 414 units that are planned for lower income categories. The water demand for these low income units, while not separately calculated, is well within the range of housing units factored into the City's demand forecast.

4.8 Climate Change

Information in Section 3.3 on the service area climate suggests a gradually hotter and somewhat drier climate can be expected to occur in Santa Cruz in future years. Indeed, in 2014 and 2015, at the height of the current drought, the mean annual temperature was between 2 and 3 degrees higher than the historic, long-term average temperature. It is not unreasonable, given normal seasonality of water use, to expect that a warmer and drier future could result in an overall increase in water demand.

Using parameters from the econometric demand models, weather effects on City water demand were investigated using historical data on sales and weather and expressed as the expected change in demand per a 1(one) degree F increase in average maximum daily air temperature over the entire year (M.Cubed, 2016). The analysis shows, based on current water use patterns, demand would increase from between 0.19 to 1.38

percent for one degree increase in average daily high temperature for every customer group except industrial. Results are summarized in Table 4-6. Golf consumption shows the largest increase in demand due to change in maximum daily temperature and multifamily consumption is the least responsive. Total system demand would be expected to increase by about 0.45 percent per one degree F increase in average daily high temperature (Appendix G). Therefore, in the higher scenario for projected temperature in year 2100 shown in Figure 3-4, if average temperature in Santa Cruz were to rise by 5.5 degrees, water demand could be expected according to this analysis to increase by 2.5 percent.

Table 4-6. Expected % Change in Demand per 1 Degree F Change in Monthly Average Maximum Daily Air Temperature	
SFR	0.62
MFR	0.19
BUS	0.29
MUN	1.09
IRR	0.80
GOLF	1.38
IND	0.00
Weighted Average	0.45
NOTES: M.Cubed, 2016. UCSC not listed since it was not modeled in econometric demand forecast.	

Chapter 5

SB X7-7 BASELINES AND TARGETS

This chapter provides a description and calculations for the City's baseline daily per capita water use and future water use targets, in accordance with technical methods developed by the California Department of Water Resources, as required by Water Code section 10608.

> ***CWC 10608.20***
>
> ***(e)*** *An urban retail water supplier shall include in its urban water management plan . . . the baseline daily per capita water use, urban water use target, interim water use target, along with the bases for determining those estimates, including references to supporting data.*

5.1 Background Information

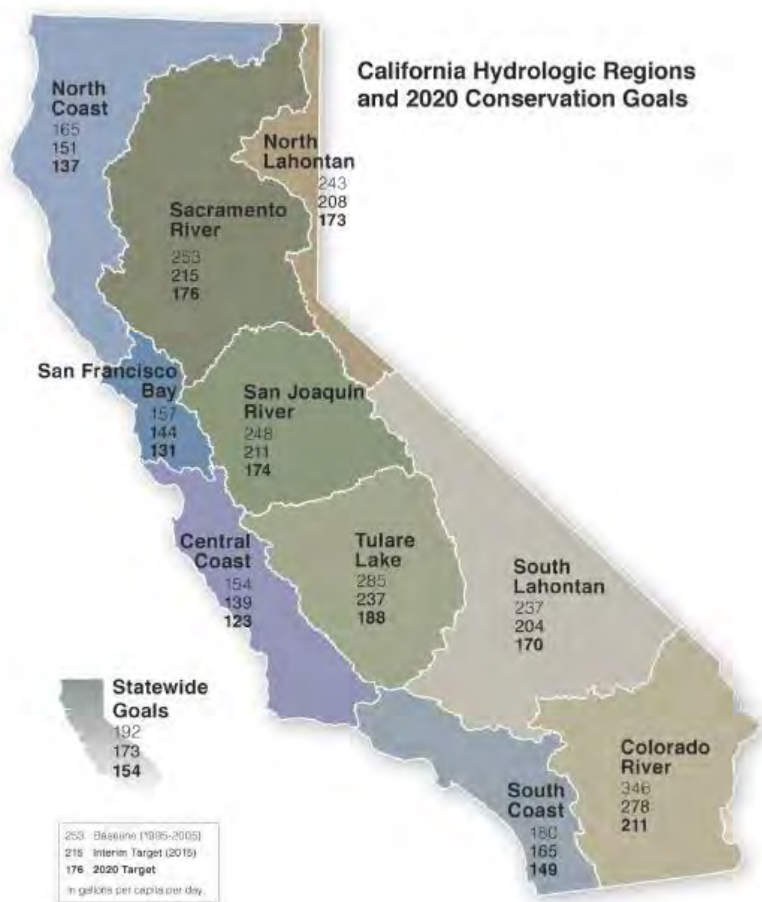
In February 2008, the Governor introduced a seven-part comprehensive plan for improving the Sacramento-San Joaquin Delta. As part of this effort, the Governor directed state agencies to develop a plan to reduce statewide per capita water use by 20 percent by the year 2020.

The 20x2020 Water Conservation Plan was designed to address several key questions, including the following:

- What is per capita use?
- How does it vary across the state?
- What is the conservation potential from current measures and new actions?
- Is it feasible to expect a 20 percent reduction in per capita water use?

The final 20x2020 Water Conservation Plan was issued February 2010 (DWR, 2010). It reported urban water use currently varies between **152 gpcd** in the Central Coast region (Region 3) to **346 gpcd** in the Colorado River region (Region 10) and averages **192 gpcd** statewide**.** The report concluded that California could achieve a 20 percent reduction in urban per capita water use to an average of **154 gpcd** using current and new conservation actions. It also established for water resources planning purposes baseline values and future water use targets for each of the state's ten hydrologic regions, summarized in Figure 5-1.

Figure 5-1. Regional Urban Water Use Targets



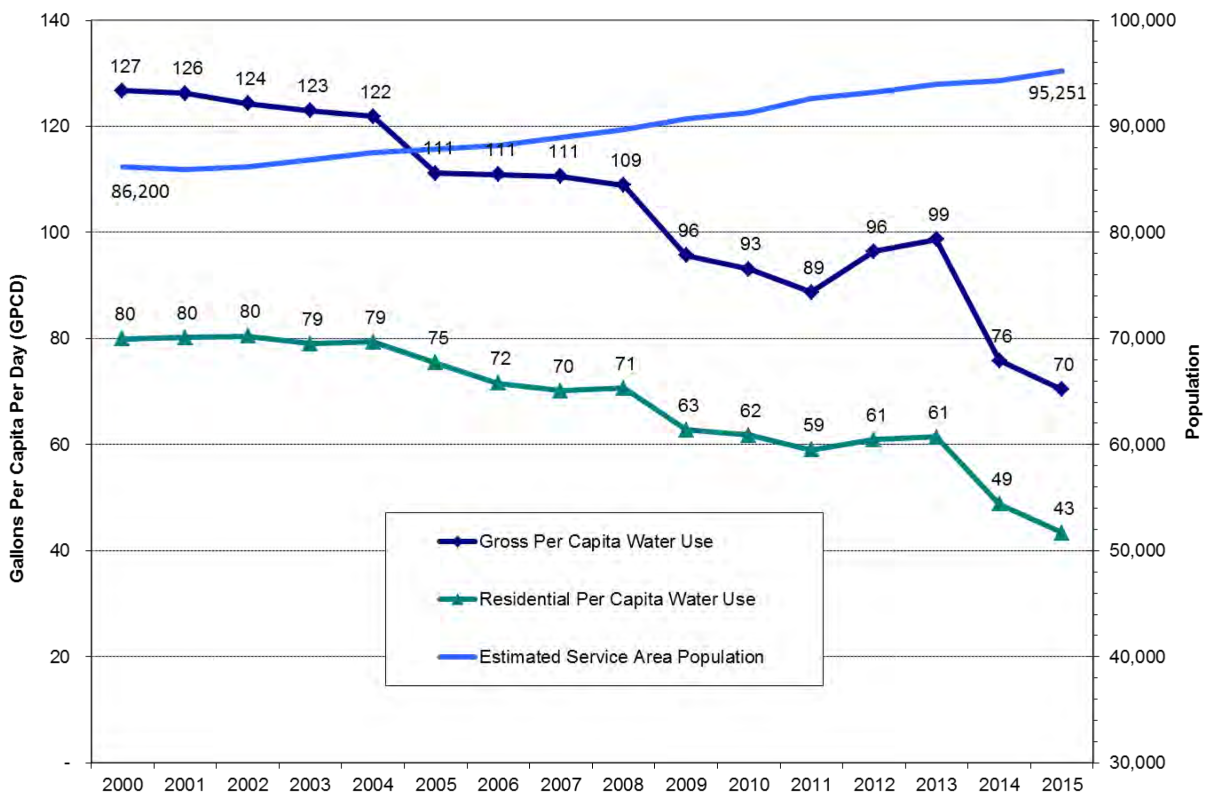
With the enactment of the Water Conservation Act of 2009, also known as SB X7-7, the state is required to set a goal to reduce urban per capita water use by 20 percent by the year 2020. Each retail urban water supplier must determine its baseline water use during their baseline period and also target water use for the years 2015 and 2020 in order to help the State achieve the 20 percent reduction. A copy of the law is included as Appendix B.

To provide for consistent implementation of the law, suppliers are required to conform to Technical Methodologies prepared by the CA Department of Water Resources, which details the process that urban water suppliers are to follow and the options available for complying with the legislation (DWR, February 2016). Water suppliers have some flexibility in setting and revising water use targets. For instance, a water supplier may set its water use target and comply individually, or as part of a regional alliance. The City of Santa Cruz is electing to report as an individual retail supplier.

In this 2015 Plan, water agencies must demonstrate compliance with their established water use target for the year 2015. This will also demonstrate whether or not the agency is currently on track to achieve its 2020 target. Retail water agencies are also required to separately complete and submit the standard tables in the SB X7-7 verification form.

Figure 5-2 below shows the City's per capita water use and estimated population since 2000. The top line labeled **Gross Per Capita Water Use** is the metric that water agencies are required to calculate and to reduce under SB X7-7. It represents all the treated water entering the distribution system over one year's time, divided by the total population, and expressed in gallons per person per day. As explained further below, gross per capita water use includes residential and nonresidential uses of water in the community, as well as unmetered uses such as firefighting and losses that occur due to leakage on the distribution system.

Figure 5-2. Per Capita Water Use and Service Area Population



The bottom line labeled Residential Per Capita Water Use is included for reference only. It represents the total annual metered water consumption at single and multiple residential accounts, divided by the residential population[1]. It is intended to show the estimated average amount of water used by a person both indoors and outdoors at their home on a daily basis. This metric better approximates how most people relate to their own personal water use at their property. It is also the same metric used by the State Water Board to set urban water reduction targets in 2014 and 2015, explained in Section 5.9 below.

Over the last 15 years, the City's gross per capita water use has declined from about **127 gpcd** in 2000 to **70 gpcd** in 2015. Similar to the pattern in total water use discussed in Chapter 4, the trend in per capita water has been mostly declining over this period, for various reasons. These include the cumulative effects of more conservation, higher water rates, economic downturn, drought, and industrial closures. The steep drop in 2014 and 2015 reflects the effect of water rationing that was instituted both years as a result of a declared emergency water shortage.

As is described below, the City's gross per capita water use is presently far below both its **2015 interim target of 111 gpcd** and its **2020 target of 110 gpcd,** as determined in accordance with DWR's technical methodologies. Accordingly, the City is presently in compliance with all requirements of SB X7-7.

The remainder of this Chapter strictly follows the DWR Guidebook for demonstrating and documenting compliance with the City' water use target for the year 2015.

5.2 Updating Calculations from 2010 Urban Water Management Plan

In accordance with Water Code section 10608.20, an urban retail water supplier may update its 2020 urban water use target in its 2015 Urban Water Management Plan. In the 2010 plan, the City elected to use **Target Method 3** (for an explanation of the four target methods, see section 5.7). No change to the target method is being made in this 2015 plan.

The 2010 plan also used both 2000 and 2010 U.S. Census data at the block level in its baseline population calculations. As a result, no recalculation of the baseline population calculations is needed for this 2015 plan. It should be noted, however, that the annual population estimates from the CA Department of Finance (CA DOF) for the Santa Cruz City in non-census years were slightly revised since the 2010 plan, and those revisions

[1] Residential population differs from total population. There are several thousand students, families, and staff living on the University main campus, which is classified as an industrial account. Only the people living in residences off-campus are counted for the purpose of calculating R-GPCD.

have been incorporated in this update. The change in population inside the City estimated by CA DOF ranged from a decline of 0.1 percent in 2001 to an increase of 0.6 percent in 2009 (-62 to +341 persons). These small revisions made no difference in the City's base daily per capita water use.

The baseline and targets water use development process consists of four basic steps, which are summarized below and detailed in a flow chart in Appendix H.

Step 1: Determine Baseline Daily Per Capita Water Use
Step 2: Determine Urban Water Use Target
Step 3: Confirm Urban Water Use Target
Step 4: Determine Interim Urban Water Use Target

Step 1 - determining baseline daily per capita water use – involves several steps on its own, as listed below:

1A. Establishing the baseline period,
1B. Estimating the service area population for each year in the baseline period,
1C. Measuring gross water use, typically expressed in million gallons per year, and
1D. Determining the daily per capita water use in each of the baseline years.

The calculations for Step 1, A-D are detailed further below in Sections 5.3 through 5.6. Steps 2 through 4 are then described in Section 5.7.

5.3 Baseline Period (Step 1A)

Under SB X7-7, water suppliers must define two baseline periods. The first is a continuous 10-year baseline period (or 15-year period if more than 10 percent of system water demand is met through recycled water) ending no earlier than December 2004 and no later than December 2010. The City does not provide recycled water service so the 15-year baseline period does not apply. The 10-year baseline period selected by the City of Santa Cruz is **2001-2010**.

The second is a continuous five-year baseline period ending no earlier than December 2007 and no later than December 2010. This second baseline period is used to confirm that the selected target meets the minimum water use reduction requirement (see section 5.7 on target confirmation). The 5-baseline period selected by the City of Santa Cruz is **2003-2007**. Both the 10-year and the 5-year baseline periods presented in this plan are the same as were reported in the 2010 plan.

5.4 Service Area Population (Step 1B)

Estimates of the City's water service area population are based on the sum of separate population estimates for inside and outside the Santa Cruz city limits.

Inside the City limits, population data is readily available on an annual and decennial basis for the City as a whole. The City uses data published by both the U.S. Census Bureau for census years and the California Department of Finance in non-census years.

Outside the City limits, however, including parts of unincorporated Santa Cruz County and the City of Capitola that are served by the City water system, population data are available only every ten years through the census. Moreover, because the City's service area boundary in those jurisdictions does not coincide neatly with census tract or block boundaries, estimates must be derived using a Geographic Information System at the census block level. In split census blocks, population is apportioned based the percentage of each individual block that is located within the water service area.

For non-census years, it is standard practice among water utilities to estimate population growth by using a people-per-residential connection method. Between 2000 and 2010, approximately 425 residential accounts were added to the system outside the City limits. But because census data indicated that the overall population outside the City actually declined during this period, this approach was not considered to be applicable or appropriate for that time period. Therefore, annual estimates of the outside city population were derived simply by interpolating between the 2000 and 2010 census years. Between 2010 and 2015, the outside City population was determined using a people-per-connection method.

5.5 Gross Water Use (Step 1C)

Gross water use[2] is a measure of water that enters the distribution system of a supplier over a specified period of time. Gross water use includes not just residential consumption but all the other uses of water in a community, including schools, parks, and commercial buildings such as restaurants, hotels, and office buildings. It also captures water used for public purposes, such as firefighting and water main flushing, and losses that arise from leaks on the water system.

[2] The terms "gross water use" as used in this chapter and "net water production" used in Chapter 3 mean effectively the same thing; i.e., they both refer to treated water production volumes supplied to the distribution system.

Gross water use was determined in a manner that is consistent with the definition in Water Code section 10608.12(g) and the method outlined in the AWWA Manual M36 as part of the City's annual distribution system water audit process (AWWA, 2016). These annual water use figures represent the total amount of treated water entering the distribution system from the City's Graham Hill and Live Oak water treatment plants, after corrections have been applied to adjust for both production meter accuracy and net change in distribution system storage at the beginning and end of the year.

Gross water use does not include raw water sales to coast agriculture, since it is fed to these customers before it reaches the water treatment plant.

5.6 Baseline Daily Per Capita Water Use (Step 1D)

The calculation of baseline daily per capita water use combines information described above and is provided in Tables 5-1 below. The City's baseline daily per capita use is **113 gpcd**.

Table 5-1: Gallons Per Capita Per Day (GPCD)				
Baseline Year		Service Area Population	Gross Water Use (million gallons)	Daily Per Capita Water Use (GPCD)
10 Year Baseline GPCD				
Year 1	2001	85,972	3,962	126
Year 2	2002	86,158	3,909	124
Year 3	2003	86,865	3,898	123
Year 4	2004	87,556	3,895	122
Year 5	2005	87,864	3,567	111
Year 6	2006	88,170	3,570	111
Year 7	2007	88,929	3,590	111
Year 8	2008	89,666	3,565	109
Year 9	2009	90,728	3,169	96
Year 10	2010	91,291	3,103	93
10 Year Average Baseline GPCD				**113**

5 Year Baseline GPCD				
Baseline Year		Service Area Population	Gross Water Use	Daily Per Capita Water Use
Year 1	2003	86,865	3,898	123
Year 2	2004	87,556	3,895	122
Year 3	2005	87,864	3,567	111
Year 4	2006	88,170	3,570	111
Year 5	2007	88,929	3,590	111
5 Year Average Baseline GPCD				**116**
NOTES:				

5.7 2015 and 2020 Targets

CWC 10608.20

(e) *An urban retail water supplier shall include in its urban water management plan due in 2010. . . urban water use target, interim urban water use target,...along with the bases for determining those estimates, including references to supporting data (10608.20(e)).*

CWC 10608.20

(g) *An urban retail water supplier may update its 2020 urban water use target in its 2015 urban water management plan...*

5.7.1 Select and Apply a Target Method (Step 2)

Under SB X7-7, urban water suppliers must next set a 2020 water use target using one of the following four methods:

<u>Method 1</u>: Eighty percent of the water supplier's baseline per capita water use.

<u>Method 2</u>: Per capita daily water use estimated using the sum of performance standards applied to indoor residential use; landscaped area water use; and commercial, industrial and institutional water uses.

<u>Method 3</u>: Ninety-five percent of the applicable state hydrologic region target as stated in the State's April 30, 2009, draft 20x2020 Water Conservation Plan.

Method 4: A method developed by CA DWR that identifies water savings obtained through identified practices and subtracts them from the agency's baseline GPCD.

As mentioned above, the City of Santa Cruz elected in 2010 to use **Method 3**. For the Central Coast Region, 95 percent of the region's 2020 target is **117 gpcd** (0.95 x 123 gpcd = 117 gpcd). 100 percent of the City's water service area is located within the Central Coast region.

5.7.2 5-Year Baseline – 2020 Target Confirmation (Step 3)

CWC 10608.22

Notwithstanding the method adopted by an urban retail water supplier pursuant to Section 10608.20, an urban retail water supplier's per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use as defined in paragraph (3) of subdivision (b) of Section 10608.12. This section does not apply to an urban retail water supplier with a base daily per capita water use at or below 100 gallons per capita per day.

Water Code section 10608.22 requires water suppliers to achieve at least a 5 percent minimum reduction in per capita water use, as compared to a different, 5-year baseline period, as mentioned earlier in section 5.3. The 5-year baseline period may end no earlier than December 2007 and no later than December 2010. The 5-year baseline period selected by the City of Santa Cruz is **2003-2007**.

As indicated in Table 5-1 above, the City's 5-year baseline water use calculates out to be **116 gpcd.** Accordingly, the City's maximum allowable gpcd target in 2020 (per section 10608.22) is **110 gpcd** (0.95 x 116 gpcd = 110 gpcd).

5.7.3 Calculate the 2015 Interim Urban Water Use Target (Step 4)

The last step in complying with SB X7-7 requires calculating an interim urban water use target, meaning the midpoint between the base daily per capita water use and the 2020 target water use for measuring progress in the year 2015. The City's interim urban water use target is:

Interim Urban Water Use Target = (113 gpcd + 110 gpcd)/2 = **111.5 gpcd**

5.7.4 Baselines and Targets Summary

All the discussion above regarding baseline periods, baseline GPCD, 2015 interim target and 2020 target is summarized in Table 5-2 below:

Table 5-2. Baselines and Targets Summary					
Baseline Period	Start Year	End Year	Average Baseline GPCD*	2015 Interim Target *	Confirmed 2020 Target*
10-15 year	2001	2010	113	111	110
5 Year	2003	2007	116		
*All values are in Gallons per Capita per Day (GPCD)					
NOTES:					

5.8 2015 Compliance Daily per Capita Water Use

All water suppliers are required to calculate their actual 2015 water use to determine whether or not they have met their per capita 2015 target and to assess their progress toward meeting their 2020 target. Beginning in 2016, eligibility for state grants and loans is conditioned on an agency meeting its 2015 target.

Table 5-2 below documents the City of Santa Cruz has not only met but far surpassed its 2015 target and is therefore in compliance with the requirements in SB X7-7.

Table 5-2. 2015 Compliance								
Actual 2015 GPCD	2015 Interim Target GPCD	**Optional Adjustments to 2015 GPCD** Enter "0" for adjustments not used *From Methodology 8*					2015 GPCD *(Adjusted if applicable)*	Did Supplier Achieve Targeted Reduction for 2015? Y/N
		Extraordinary Events	Economic Adjustment	Weather Normalization	TOTAL Adjustments	Adjusted 2015 GPCD		
70	111	0	0	0	0	70	70	Yes
**All values are in Gallons per Capita per Day (GPCD)*								
NOTES:								

5.9 Drought Emergency Water Conservation and R-GPCD

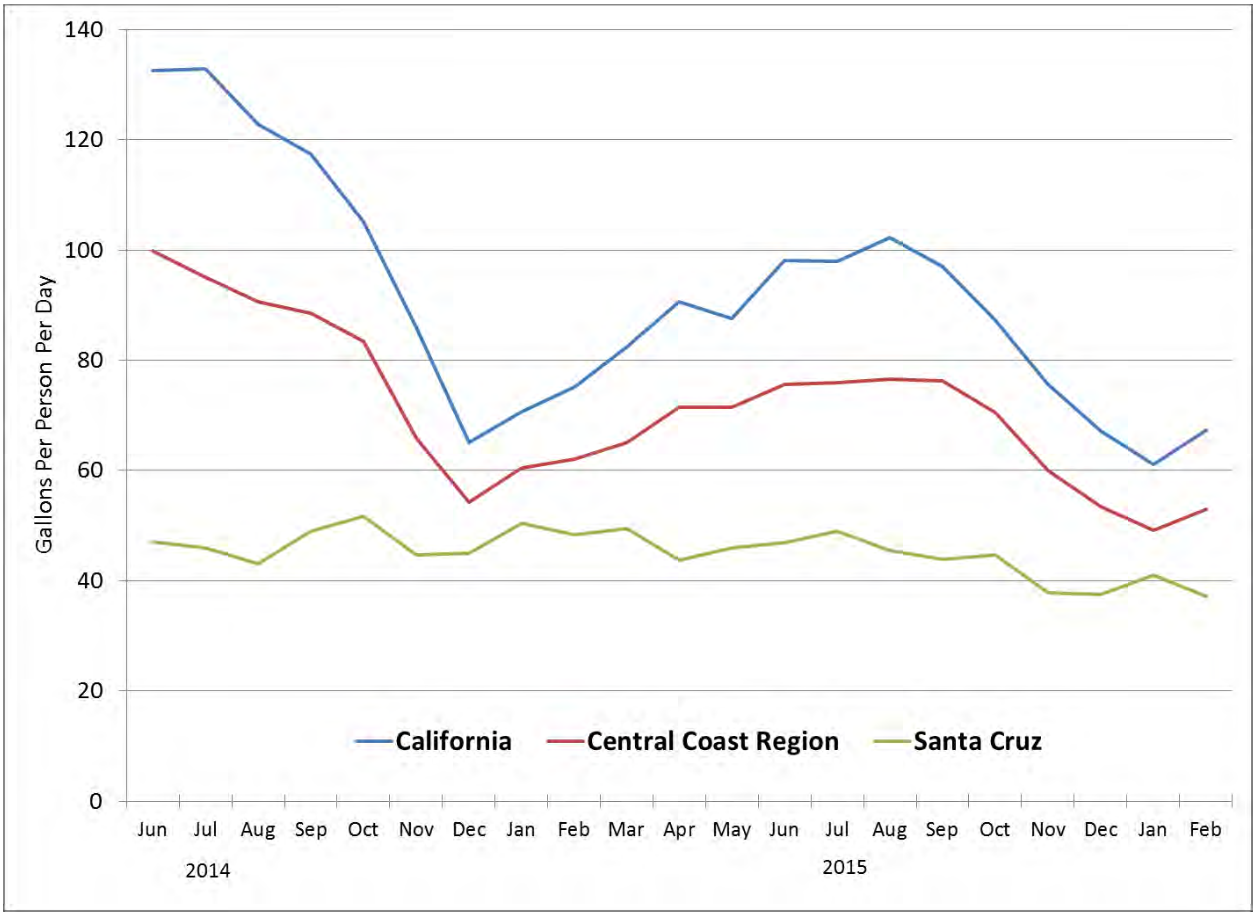
Beginning June 2014, urban water suppliers were required under separate drought emergency regulations to submit monthly reports to the State Water Resources Control Board on their urban water conservation efforts. These reports initially focused on the total monthly water production compared to the amount produced in the same month during 2013.

Shortly thereafter, beginning October 15, 2014, urban water suppliers were required to report R-GPCD (residential per capita water use) on a monthly basis to the State Water Board as an informational metric. An agency's monthly R-GPCD differs from the annual GPCD calculation discussed above. It takes into account the percentage of total monthly potable water production being used for residential purposes and the residential population served. Unlike gross daily per capita water use, R-GPCD does not include commercial, industrial or institutional water or non-revenue water (water losses).

On April 1 2015, the Governor issued an Executive Order that directed the State Board to impose restrictions on water suppliers to achieve a 25 percent reduction in potable urban usage. The regulations that were adopted shortly thereafter gave agency-specific reduction targets based on their R-GPCD. Agencies with a higher R-GPCD were required to cutback more than agencies with a lower R-GPCD. Targets ranged from 8 percent for agencies, including the City of Santa Cruz, whose average R-GPCD was less than 65 gallons per person per day, up to 36 percent for agencies whose R-GPCD was 215 gallons per person per day, or more.

Figure 5-3 below shows the R-GPCD for the City of Santa Cruz compared to the statewide and the Central Coast Hydrologic Region averages for the period June 2014 through February 2016, as reported by the State Water Resources Control Board on its Conservation Reporting website in April 2016. Over this period, as a result of strict water rationing in effect through October 2015, the City consistently had one of the lowest levels for R-GPCD in all of California. The City will continue to report and track R-GPCD through at least January 2017, as required under statewide emergency water conservation regulations.

Figure 5-3. Reported Residential Water Use Per Capita (R-GPCD)



5.10 New Water Use Targets

On May 9, 2016, the Governor issued Executive Order B-37-16. One of the provisions in this order was that the CA Department of Water Resources work with the State Water Resources Control Board to develop new targets as part of a permanent framework for urban water agencies. These new targets would build upon the state law requirements that the state achieve a 20 percent reduction in urban per capita water use by 2020. The targets would be customized to the unique conditions of each water agency, would generate more statewide conservation than existing requirements, and would be based on strengthened standards for:

- Indoor residential per capita water use;
- Outdoor irrigation, in a manner that incorporates landscape area, local climate, and new satellite imagery data;
- Commercial, industrial, and institutional water use; and
- Water lost through leaks

A draft framework for these new water use targets is planned for early 2017. It is unknown how this new target will change the current 2020 requirement for the City.

Chapter 6

SYSTEM SUPPLIES

This chapter describes the City's water supply system, presents supply source production volumes, and discusses possible future sources and opportunities to enhance the City's existing supply portfolio, including potential transfers, exchanges, and recycled water. Potential new sources are discussed further, in terms of planning for supply reliability, in Chapter 7.

The Santa Cruz water system relies predominantly on local surface water supplies, which include the North Coast sources, the San Lorenzo River, and Loch Lomond Reservoir. Together, these surface water sources represent approximately 95 percent of the City's total annual water production. The balance of the City's supply comes from groundwater, all of which is extracted from wells in the Purisima Formation in the mid-County area. These main production elements of the City's water supply system are illustrated below in Figure 6-1.

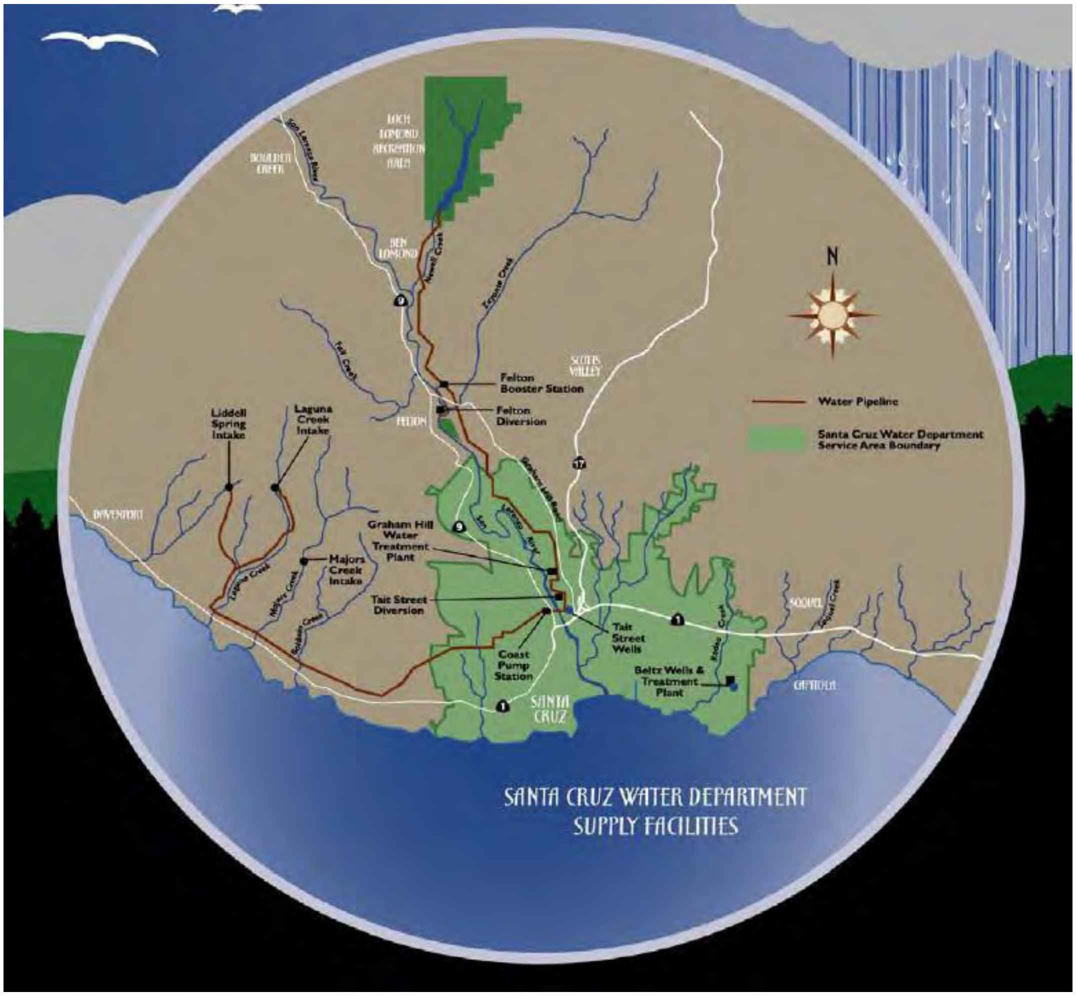
6.1 Purchased or Imported Water

The City of Santa Cruz does not now, nor does it plan to, import water, either from outside the Central Coast Hydrologic Region, or outside the Santa Cruz County boundaries. All of its water resources are obtained from local sources. The system relies entirely on rainfall, surface runoff, and groundwater infiltration occurring within watersheds located in Santa Cruz County. No water is purchased from state or federal sources or imported to the region from outside the Santa Cruz area.

6.2 Groundwater

Even though groundwater constitutes only up to about 5 percent of the entire City water supply on an annual basis, it has been a crucial component of the water system for meeting peak season demands, maintaining pressure in the eastern portion of the distribution system, and for weathering periods of drought since the facilities were acquired from the Beltz Water Company in 1964.

Figure 6-1. City of Santa Cruz Water Supply System



The Live Oak Well system consists of four production wells and two water treatment plants located in the eastern portion of the City water service area. The facilities were originally acquired by the City from the Beltz Water Company in 1964, and are still referred to as the "Beltz" wells. Wells 8 and 9 were installed in 1998 as replacement wells for Wells 1 and 2, which were damaged in the 1989 Loma Prieta earthquake. Well 7, which began operating in 1974, has been replaced by Well 10. The newest well, Beltz 12 and associated water treatment facilities, were completed in 2015.

The geographical area from which the City pumps groundwater is identified as the *West Santa Cruz Terrace Groundwater Basin* (Basin Number 3-26), whose western and eastern boundaries coincide roughly with the City's water service area (CA DWR, Bulletin 118). The entire production of the City's Live Oak well field is derived from the Purisima Formation, which is the primary groundwater aquifer underlying the entire

Mid-county region and makes up most of what is commonly referred to elsewhere as the "Soquel-Aptos" basin. As will be discussed in Section 6.2.2, a request to redefine the basin includes the reassignment of the eastern portion of the West Santa Cruz Terrace Groundwater Basin into the new Santa Cruz Mid-County Groundwater Basin.

Groundwater from the Purisima Formation is used by the City, the Soquel Creek and Central Water Districts, several small water systems, and numerous private rural water wells. A map of the public water supplier's monitoring and production well networks within the region is shown in Figure 6-2. The City's groundwater production and monitoring wells are concentrated on the western side, shown in the light pink area.

Figure 6-2. Public Water System Production and Monitoring Wells

6.2.1 Basin Description

The Purisima Formation is a collection of distinct geologic units composed of sandstone interbedded with layers of siltstone and claystone. These units, designated as AA through FF, vary in thickness and hydrogeological characteristics, with AA being the deepest and oldest unit. The formation is relatively shallow under the City's water service area, but dips southeast, becoming deeper and thicker towards Capitola and Aptos and outcrops at the cliffs along the Monterey Bay shoreline. The A zone is the primary supply for both the City's Live Oak (Beltz) wells and the Soquel Creek Water District's Service Area 1 wells and is continuous and connected between these areas of groundwater extraction (Hopkins Groundwater Consultants, 2009). Recharge is thought to occur from deep percolation of rainfall in the upper watersheds and along streambeds of Branciforte Creek, Arana Gulch, Rodeo Creek and Soquel Creek.

To better understand how the Purisima Formation responds to pumping stresses and to detect seawater intrusion, the City has installed and maintains a network of 34 monitoring wells at 14 sites. Groundwater levels and water quality, including chlorides, pH, total dissolved solids, general minerals, and other constituents are measured at regular intervals. Several new inland monitoring wells were added in 2012 and 2013. Data collected from these monitoring wells are shared with adjoining public water agencies interested in management and planning of groundwater supply.

6.2.2 Groundwater Management

The City of Santa Cruz Water Department has not itself prepared a groundwater management plan; however, a groundwater management plan has been prepared by the Soquel Creek and Central Water Districts for the Soquel-Aptos Area consistent with Assembly Bill 3030. This plan was originally prepared in 1996 then updated in 2007 and currently serves as a living document with the most recent update having occurred in 2013.

A new framework for sustainable management of groundwater supplies was provided in 2014 when Governor Brown signed the landmark Sustainable Groundwater Management Act or SGMA. Key milestones of SGMA are shown in the sidebar to the right.

In July 2015, the Soquel-Valley Groundwater Basin (Basin Number 3-01) was identified by the Department of Water Resources as one of 21 groundwater basins to be reclassified as **critically overdrafted**. This was done on the basis of seawater intrusion detected at the coastline, and the local declaration of a Groundwater Emergency by Soquel Creek Water District in 2014.

In September 2015, the Soquel-Aptos Groundwater Management Committee (SAGMC) was formed which

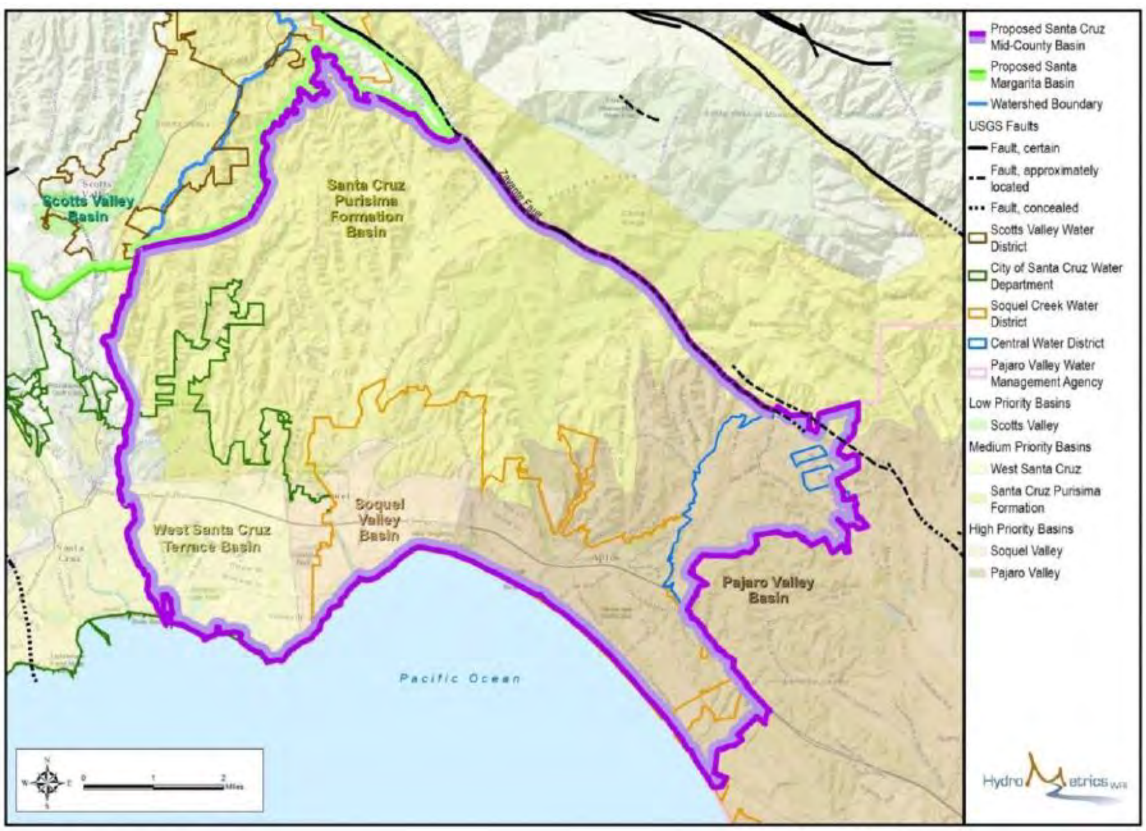
TIMELINE FOR SUSTAINABILITY

June 30, 2017	Local groundwater sustainability agencies formed.
Jan. 31, 2020	Groundwater sustainability plans adopted for critically overdrafted basins.
Jan. 31, 2022	Groundwater sustainability plans adopted for high and medium priority basins not currently in overdraft.
By 2040	All high and medium priority groundwater basins must acheive sustainability.

includes representatives from the County of Santa Cruz, Central Water District, Soquel Creek Water District, the City of Santa Cruz, and private well owners. This group is a joint exercise of powers entity with interest in management of the Soquel-Aptos groundwater basin. Its efforts include collecting, maintaining and sharing data; undertaking cooperative research and resource management initiatives; jointly pursing groundwater management grants and studies; and facilitating requirements of the Sustainable Groundwater Management Act. The SAGMC also provides public outreach and education on groundwater topics and issues.

The SAGMC established a Groundwater Sustainability Agency Formation Subcommittee and appointed six members. Following the framework provided by the state, the subcommittee was charged with creating an approved Groundwater Sustainability Agency prior to the June 2017 deadline. Additional activities recently initiated by the SAGMC include requesting a basin boundary revision, developing quarterly monitoring reports, conducting an evaluation of shallow wells, and making progress on a comprehensive groundwater model by integrating information available for the entire management area.

Figure 6-3. Proposed Santa Cruz Mid-County Basin Boundary Area



Part of the recently completed work to redefine the boundary includes changing the name from Soquel-Aptos to Santa Cruz Mid-County Groundwater Basin, as illustrated in Figure 6-3. In early 2016 the SAGMC drafted a joint powers agreement (JPA) to create a fully empowered and independent Santa Cruz Mid-County Groundwater Agency (MGA) as authorized by the Sustainable Groundwater Sustainability Act (Appendix I). With the establishment of the Agency, the focus will shift from agency creation to the development of the Groundwater Sustainability Plan (GSP) that is required to be completed and submitted to the state in 2020. The City is a partner agency in the JPA and will have an allocated share of the total annual budget for the MGA that is consistent with the contributions provided under the previous planning and management efforts for the Soquel-Aptos Basin.

6.2.3 Overdraft Conditions

At this time, no court or board has adjudicated the right to pump groundwater from the Purisima aquifer, nor has the California Department of Water Resources identified the West Santa Cruz Terrace basin as critically overdrafted. Even so, the aquifer from which the City pumps long has been recognized locally as being threatened by the problem of over-pumping, as evidenced by a decline in static water levels and a broad, persistent trough consistently below sea level surrounding the Soquel Creek Water District's production wells, signaling that cumulative groundwater production exceeds the long-term sustainable yield of the aquifer.

Moreover, there is an ongoing risk of seawater intrusion into productive units of the Purisima Formation that could jeopardize the future production of groundwater by the City. This condition is due to coastal groundwater levels being below protective elevations. Although all units of the Purisima Formation extend offshore, the westernmost area of the A unit outcrops in the vicinity of Pleasure Point in close proximity to the Live Oak (Beltz) well field. This outcrop provides a pathway for seawater to enter the Unit A aquifer. Even though pumping by the City constitutes a small portion of the total extraction from the Purisima Formation, because the City's wells are located closest to the shoreline, they would be among the first impacted by seawater intrusion. This potential for seawater intrusion could reduce the City's dry year supply and exacerbate supply shortfalls during extended dry periods.

6.2.4 Groundwater Pumping

In 2010, the City was advised by its hydrogeologist that the yield of the Live Oak (Beltz) well field was substantially less than half the 420 mgy annual production that the City had long assumed for water supply planning purposes, and that the dry season pumping rate that can be sustained without causing seawater intrusion in average years was closer to 170 mgy (Hopkins Groundwater Consultants, 2010). As a direct result of these findings, the City relocated pumping further inland to a new well site, shown as “Beltz 12” on the Figure 6-4 aerial image. This unexpected loss of drought year groundwater yield is emblematic of the continuing change and uncertainty facing the City in its effort to provide a safe, reliable, and adequate municipal water supply.

Figure 6-4. Location of Beltz Well Sites

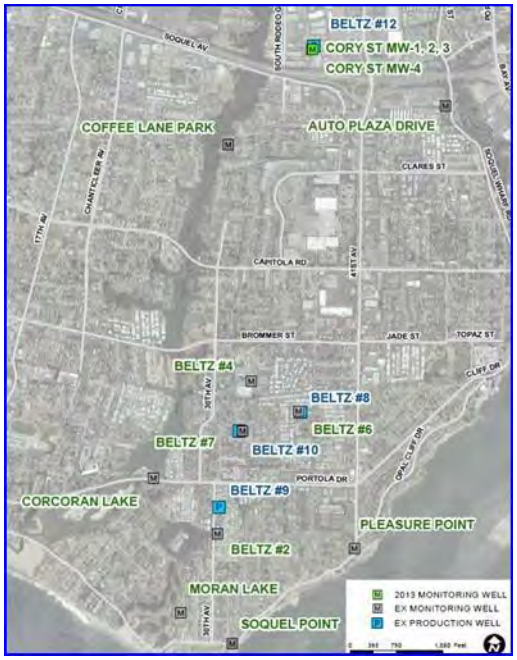


Table 6-1 below shows the actual volume pumped from the City’s well fields during the peak season over the last five years. Average volume over this time is 164 mgy. As a result of the hydrogeology work, the City has limited groundwater pumping to a volume far below 420 mgy level. The current agreed upon sustainable yield volume is 170 mgy and has been utilized by the City when planning for the operation of the well fields. Due to the severe drought conditions in 2014, the City did rely on groundwater for a somewhat higher volume in order to meet peak demand in the dry summer months.

Table 6-1. Groundwater Volume Pumped (mgy)

Groundwater Type	Location or Basin Name	2011	2012	2013	2014	2015
Alluvial Basin	West Santa Cruz Terrace Groundwater Basin (3-26)	163	163	160	188	145
	TOTAL	163	163	160	188	145

6.3 Surface Water

As presented in Chapter 3, the surface water system supplies are located both within and outside of the City of Santa Cruz with a mix of flowing sources and a storage reservoir. The map provided as Figure 6-1 in the introductory section illustrates the various surface water sources and the conveyance systems that comprise the supply facilities of the City. Each of the surface water sources are briefly described in the following sections.

6.3.1 North Coast Creeks and Springs

The North Coast sources consist of surface diversions from three coastal streams and a natural spring located approximately six to eight miles northwest of downtown Santa Cruz. These sources are: Liddell Spring, Laguna Creek, Reggiardo Creek, and Majors Creek. The use of these sources by the City dates back as far as 1890.

Figure 6-5. Laguna Creek Diversion Dam

6.3.2 San Lorenzo River

The San Lorenzo River is the City's largest source of water supply. The main surface water diversion is located at Tait Street near the City limits just north of Highway 1. Use of this source dates back to the 1870s and was consolidated under public ownership in

1917. The Tait Street Diversion is supplemented by shallow, auxiliary wells located directly across the river. These wells are potentially hydraulically connected to the river and tied to the City's appropriative rights for surface diversion. The drainage area above the Tait Street Diversion is 115 square miles.

Figure 6-6. San Lorenzo River Diversions at Tait Street and at Felton

The other diversion on the San Lorenzo River is Felton Diversion, which is an inflatable dam and intake structure built in 1974, located about six miles upstream from the Tait Street Diversion. Water is pumped from this diversion through the Felton Booster Station to Loch Lomond Reservoir. The facility is used to augment storage in the reservoir during dry years when natural inflow from Newell Creek is low.

While the City is the largest user of water from the San Lorenzo River basin, two other water districts, several private water companies and numerous individual property owners share the San Lorenzo River watershed as their primary source for drinking water supply (Figure 6-7).

6.3.3 Newell Creek and Loch Lomond Reservoir

Loch Lomond Reservoir is located near the town of Ben Lomond in the Santa Cruz Mountains. The reservoir was constructed in 1960 and has a maximum capacity of 2,810 million gallons (mg). In addition to providing surface water storage, the reservoir and surrounding watershed are used for public recreation purposes, including fishing, boating, hiking, and picnicking (swimming and wading are prohibited). The Newell Creek watershed above the reservoir is about nine square miles. In addition to the City, the San Lorenzo Valley Water District is entitled by contract to receive a portion of the water stored in Loch Lomond.

Water System Operations

The Water Department follows a variety of policies, procedures, and legal restrictions in operating the water supply system. In general, the system is managed to use available flowing sources to meet daily demands as much as possible. Groundwater and stored water from Loch Lomond are used mainly in the summer and fall months when flows in the coast and river sources decline and additional supply is needed to meet higher daily water demands. On a typical summer day, the North coast sources yield 1-2 mgd, the San Lorenzo River produces 7.5 mgd, groundwater makes up 0.8 mgd, and the reservoir contributes an average of 1-2 mgd.

The amount of water produced from each of the City surface water sources is controlled by different water rights. A summary of these water rights is presented below.

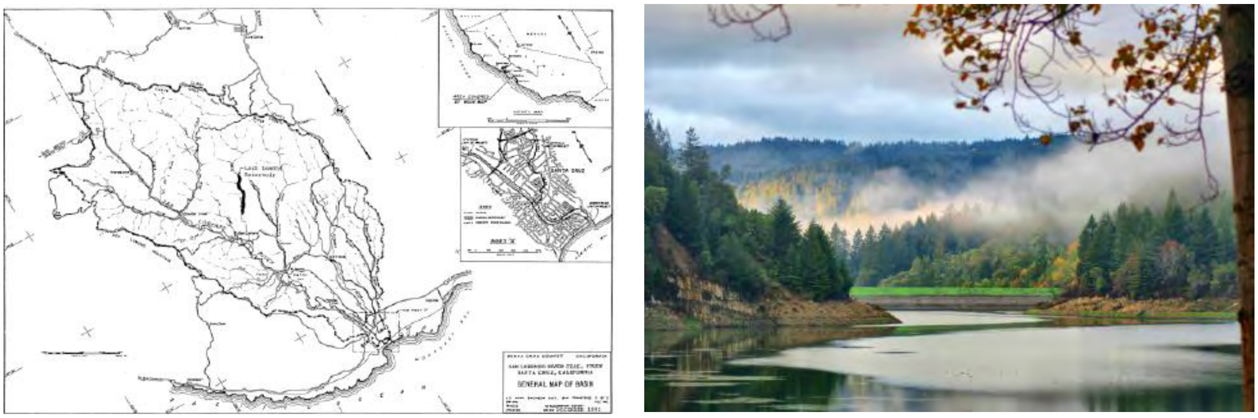
Summary of Water Rights Held by the City of Santa Cruz

Source	License/ Permit Number	Period	Maximum Diversion Rate (cfs)	Fish Flow Requirement (cfs)	Annual Diversion Limit (mg)
North Coast	Pre-1914	Year round	No limit	None	None
San Lorenzo River:					
Tait Street Diversion and Wells	1553, 7200	Year-round	12.2	None	None
Felton Diversion to Loch Lomond Reservoir	16601, 16123	Sept	7.8	10	977
		Oct	20	25	
		Nov-May	20	20	
		Jun-Aug	0	--	
Newell Creek:	9847				
Collection to storage (max amount/year)		Sept-Jun	No limit	--	1,825
Withdrawal		--	--	1	1,042

In accordance with the requirements of its water rights, the City releases a minimum flow of 1.0 cfs (equal to 0.65 mgd or approximately 20 million gallons per month) from storage in Loch Lomond Reservoir, to support fishery resources beneath the dam.

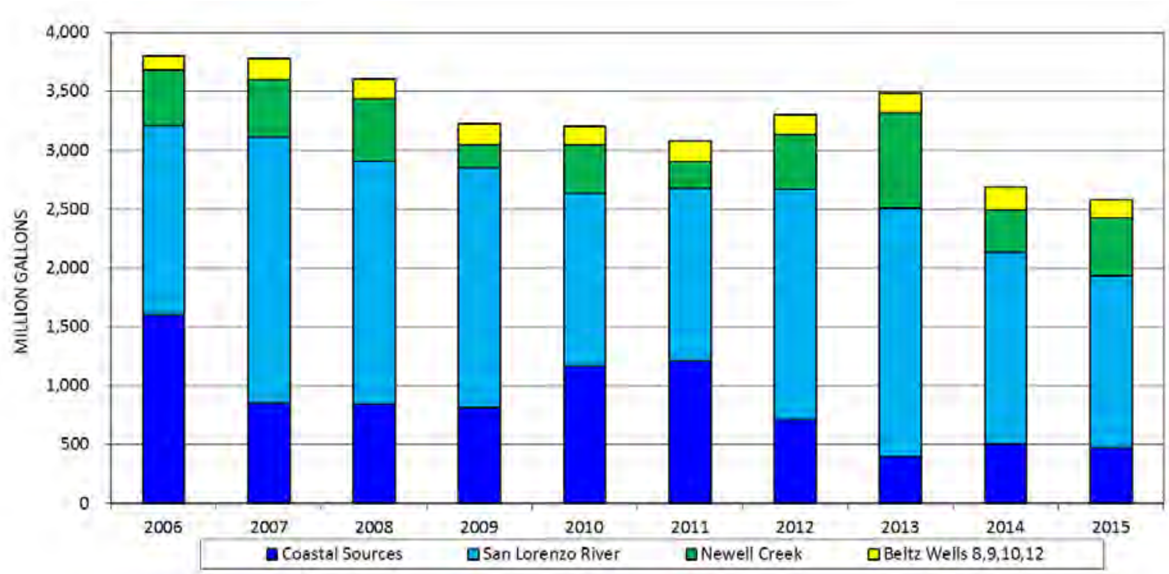
The City in 2007 voluntarily began releasing in-stream flows from the North Coast system on an interim basis in connection with an ongoing pursuit of an Incidental Take Permit under the Federal Endangered Species Act. Over the last 3 years, the City has dramatically reduced its diversion of water from Laguna Creek and increased instream flow releases on the San Lorenzo River to benefit fisheries habitat. Water system operations are likely to continue shifting toward using less flowing water and more water from reservoir storage to meet demand in the future (See Chapter 7).

Figure 6-7. San Lorenzo River Watershed and Loch Lomond Reservoir



Gross annual production volumes from the City's surface and groundwater sources over the past 10 years are shown in Figure 6-8, broken down by source of supply. During the past decade, the North Coast sources represented 26 percent of the total water supply, the San Lorenzo River represented 55 percent, Newell Creek (Loch Lomond Reservoir) represented 14 percent, and Live Oak (Beltz) wells contributed the remaining 5 percent.

Figure 6-8. Annual Production Volumes by Source of Supply (million gallons)



6.4 Storm Water

At this time, local urban storm runoff is not used by the City to meet its urban water demands. The City is regulated, however, by the California Regional Water Quality Control Board and has responsibility to reduce the amount of pollutants discharged in urban runoff, and to improve and protect water quality. The City is currently covered under the State's General Permit for Storm Water Discharges from Small Municipal Storm Sewer Systems (MS4s). The General Permit requires the City to develop and implement a comprehensive Storm Water Management Program (SWMP). A complete description of this program is provided in the Storm Water Annual Report.

The City of Santa Cruz, through its Public Works Department, maintains seven miles of underground storm water pipelines, eight miles of surface storm ditches, one pump station, approximately 1,500 catch basins, and 125 outfalls. The City also maintains the U.S. Army Corps of Engineers flood control channel and levee system on the San Lorenzo River, which is approximately three miles long with five pump stations. The City's operations and maintenance program for the flood control facilities on the San Lorenzo River includes removal of sand and silt from the channels of the river and Branciforte Creek; maintenance of pumps, gates and levees; and removal of weeds and growth in drainage ditches and catch basins. As a best management practice the City has routine street sweeping and regularly cleans the storm drain pipeline system, among other activities.

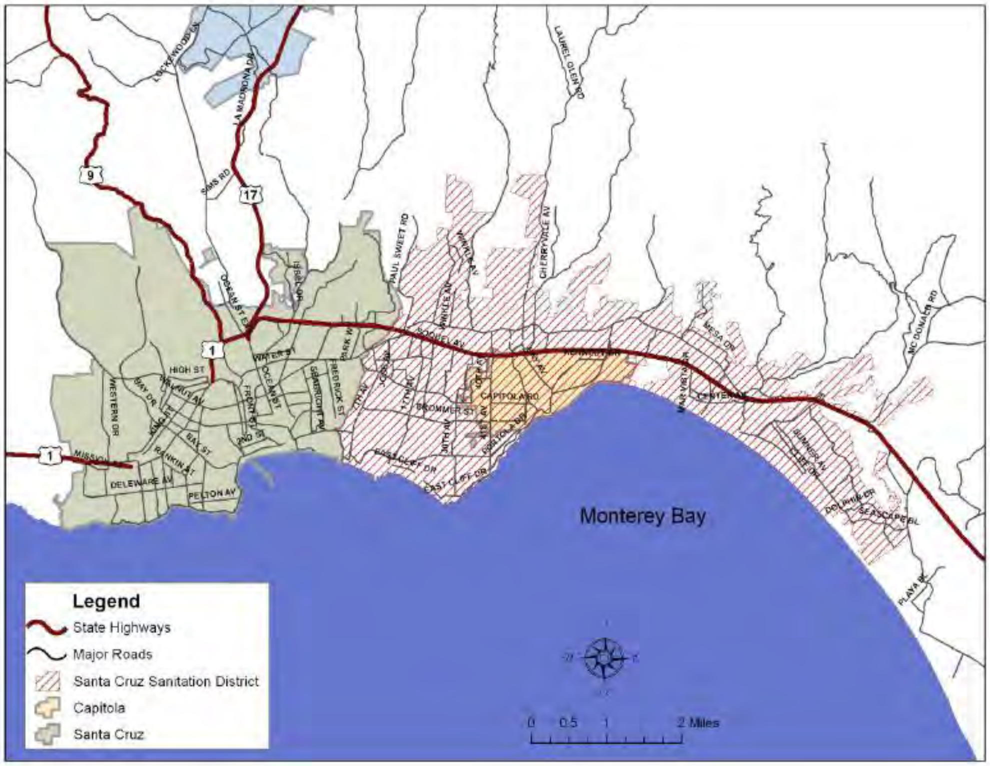
Storm water system management maintenance in the unincorporated area and Capitola is provided by the Santa Cruz County Flood Control and Water Conservation District, Zone 5, operated through the County Public Works Department. The County Board of Supervisors serves as the Board of Directors for the District. Facilities include underground storm drain systems and above ground ditches and watercourses.

6.5 Wastewater and Recycled Water

The City of Santa Cruz owns and operates a city-wide wastewater collection and regional wastewater treatment and disposal facility providing service to a total urban population of approximately 130,000 people in an area extending from Santa Cruz out to the communities of Seascape and Aptos in unincorporated Santa Cruz County (Figure 6-9).

The City's Wastewater Treatment Facility (WWTF) is not currently permitted for and does not now produce recycled water for offsite reuse. Treated wastewater is reused internally within the wastewater plant to meet its major process water needs, including chemical mixing, contact and non-contact cooling water, equipment washing, heating, and cleaning. The 1998 upgrade of the plant to provide reuse water for on-site activities reduced potable water demand at the WWTF by about 90 percent. It now operates using only 3 to 4 million gallons per year for sanitary, irrigation, and other miscellaneous onsite uses. The only use of recycled water outside the WWTF has been that used by the City's Public Works crews in trucks for flushing the sanitary sewer system as a way to conserve potable water during the recent drought.

Figure 6-9. Geographic Area Served by Santa Cruz Wastewater Facility



Over the years, the City has commissioned several engineering studies regarding the potential uses of recycled water for agricultural irrigation, landscape irrigation, groundwater recharge, direct potable reuse, and use of recycled water from neighboring water districts. These studies include the following:

- Alternative Water Supply Study (Carollo Engineers, 2000)
- Evaluation of Regional Water Supply Alternatives (Carollo Engineers, 2002)
- Integrated Water Plan Environmental Impact Report (City of Santa Cruz, 2005)
- Opportunities and Limitations for Recycled Water Use (Kennedy/Jenks, 2010)
- Current and Potential Future Opportunities for Indirect and Direct Potable Reuse of Recycled Water Use (Kennedy/Jenks, 2010)

The City of Santa Cruz is once again actively investigating the feasibility of recycled water though a regional Recycled Water Facilities Planning Study, funded in part by a grant from the State Water Board Division of Financial Assistance, Water Recycling

Funding Program. In addition, the City has been working to establish a small recycled water facility and is coordinating with the Pasatiempo Golf Club on a project to use treated wastewater from the Scotts Valley wastewater plant instead of potable water supplied by the City for the majority of its irrigation needs. A groundbreaking ceremony for the golf club's recycled water project was recently held. These two projects are described further in Section 6.5.4 in the discussion on beneficial uses of recycled water within the service area.

6.5.1 Recycled Water Coordination

As presented in Section 2.4, preparation of this 2015 UWMP was coordinated with all local water, wastewater, groundwater, and planning agencies throughout the water service area and Santa Cruz County. For this recycled water section, in particular, coordination involved working with the following entities:

- Santa Cruz Public Works Department (regional WWTF operator)
- Santa Cruz County Sanitation District (local wastewater collection agency)
- City of Scotts Valley Public Works (local WWTF operator)
- Scotts Valley Water District
- Soquel Creek Water District
- Pasatiempo Golf Course

6.5.2 Wastewater Collection, Treatment, and Disposal

6.5.2.1 Wastewater Collection

Municipal wastewater generated within the City limits is delivered to the treatment plant through a collection system consisting of 160 miles of gravity mains, 3.5 miles of force main, and 21 pumping stations. The City's collection system, treatment plant and ocean disposal system are managed and operated by the City's Public Works Department.

The Santa Cruz County Sanitation District, a special district operated through the Santa Cruz County Public Works Department, collects wastewater from the Live Oak, Capitola, Soquel, Aptos, and Seacliff areas through a system consisting of 188 miles of gravity main, 14 miles of force main, and 35 pump stations. It transports wastewater from a central pumping facility in Live Oak to the Santa Cruz WWTF for treatment and disposal. This wastewater is generated from outside the service area of the City of Santa Cruz and is treated within the service area. Table 6-2 summarizes wastewater collected from these two agencies in 2015.

Table 6-2. Wastewater Collected Within Service Area in 2015						
Wastewater Collection			Recipient of Collected Wastewater			
Name of Wastewater Collection Agency	Wastewater Volume Metered or Estimated?	Volume of Wastewater Collected in 2015 (mgy)	Name of Wastewater Treatment Agency Receiving Collected Wastewater	Treatment Plant Name	Is WWTP Located Within UWMP Area?	Is WWTP Operation Contracted to a Third Party?
City of Santa Cruz	Metered	1,480	City of Santa Cruz	Wastewater Treatment Facility	Yes	No
Santa Cruz County Sanitation District	Metered	1,149	City of Santa Cruz	Wastewater Treatment Facility	Yes	No
Total Wastewater Collected from Service Area in 2015:		2,629				

With the exception of some outlying areas and individual parcels that have onsite wastewater systems, the vast majority of the estimated 95,251 persons residing in the City of Santa Cruz water service area are served by these two wastewater collection systems. A third-party organization is not operating a facility under contract in the Santa Cruz service area.

In addition to the City and County Sanitation District, two small County Service Areas serving the communities of Rollingwoods and Woods Cove are connected to the City's wastewater system. Dry weather flows from Neary Lagoon are also diverted through the WWTF to help protect water quality at local beaches for public health and recreation.

6.5.2.2 Wastewater Treatment

The City's treatment plant was modernized in the late 1990's from the advanced primary level to provide full secondary treatment in order to meet State and Federal waste discharge requirements (Figure 6-10).

The treatment process consists of screening, grit removal, primary sedimentation, biological treatment (trickling filters), secondary clarification, and disinfection (UV).

Bio-solids removed from the wastewater stream are treated by gravity thickening, anaerobic digestion, and dewatering by centrifuges.

Figure 6-10. City of Santa Cruz Wastewater Treatment Facility

The City's WWTF is designed to treat an average dry weather flow of 17 million gallons per day (mgd) and can accommodate peak wet weather flows of up to 81 mgd. Typical dry weather flows in past years have ranged between 9-10 mgd. Due to strict conservation measures in recent years, the amount of wastewater generated in the City and the Sanitation District's service areas has dropped substantially, averaging 6.5 mgd during the dry season and totaling 2,629 million gallons in 2015.

In 2013 the WWTF was awarded Plant of the Year by the California Water Environment Association (for facilities in the range of 5-20 million gallons per day). The award is based on the review of infrastructure, management practices and compliance records.

6.5.2.3 Wastewater Disposal

Wastewater effluent from the WWTF is disinfected with UV prior to being discharged to the Pacific Ocean through a deep water outfall extending 12,250 feet on the ocean bottom and terminating one mile offshore at a depth of approximately 110 feet below sea level. A 2,100 foot diffuser at the end of the pipe provides a minimum initial dilution of 139 parts seawater to one part wastewater.

The City's wastewater facility is regulated under a waste discharge permit issued by the California Regional Water Quality Control Board, Central Coast Region (Order No. R3 - 2010 - 0043). Monterey Bay and surrounding ocean waters was designated in 1992 as a National Marine Sanctuary and is widely recognized for its unique and diverse biological characteristics and physical features. To protect receiving water quality and sanctuary resources, the wastewater influent and effluent characteristics are carefully monitored for compliance with state water quality requirements. The City also performs receiving water monitoring and participates in a regional monitoring program with other dischargers in the Monterey Bay area, known as Central Coast Long-Term Environmental Assessment Network (CCLEAN).

The City of Scotts Valley treats its wastewater separately and transmits secondary treated effluent to Santa Cruz for combined disposal through the City's ocean outfall. Since 2002, the City of Scotts Valley, in conjunction with Scotts Valley Water District, has operated a 1.0 mgd tertiary treatment plant and delivered recycled water within its service area mainly for landscape irrigation purposes.

Table 6-3 below provides the total amount of wastewater treated and disposed by the City's wastewater treatment facility in 2015.

Table 6-3: Wastewater Treatment and Discharge Within Service Area in 2015

☐	No wastewater is treated or disposed of within the UWMP service area. The supplier will not complete the table below.							
							2015 volumes (mgy)	
Wastewater Treatment Plant Name	Discharge Location Name or Identifier	Discharge Location Description	Wastewater Discharge ID Number *(optional)*	Method of Disposal	Does This Plant Treat Wastewater Generated Outside the Service Area?	Treatment Level	Wastewater Treated	Discharged Treated Wastewater
Wastewater Treatment Facility	Monterey Bay/Pacific Ocean Bay Outfall	Deep water outfall	3-440102001	Ocean outfall	Yes	Secondary, Undisinfected	2,629	2,629
						Total	2,629	2,629
NOTES: Treatment and discharge volumes are presented as equal to satisfy the objective of this table. The recycled water that is reused within the Facility is not considered eligible for designation as recycled water under current Title 22 requirements. Figures presented do not include Scotts Valley waste discharge volumes.								

6.5.3 Recycled Water System

As mentioned above, the City does not operate a recycled water system in its service area at this time. The only use of recycled water outside the WWTF has been that used by the City's Public Works crews in trucks for flushing the sanitary sewer system as a way to conserve potable water during the recent drought.

6.5.4 Recycled Water Beneficial Uses

6.5.4.1 Current and Planned Uses of Recycled Water

Title 22 California Code of Regulations, Division 4, Chapter 3, Sections 60301-60355 is the regulation overseeing the reuse or recycling of municipal wastewater to protect public health. Level of treatment and bacteriological water quality standards define what uses are legally allowed. The quality of wastewater produced at the City's treatment plant currently would be best classified under the Title 22 criteria as "Secondary, Undisinfected", even though the wastewater plant provides ultraviolet disinfection, and the City consistently meets its receiving water limitations contained in its NPDES permit for bacteriological objectives. The City's treated wastewater is therefore potentially suitable for only very limited agricultural applications and for flushing sanitary sewers according to the standards in Title 22.

The present level of wastewater treatment is not sufficient for the water to be used for unrestricted use on playgrounds, parks, schoolyards, construction, cooling and other non-contact industrial processes, or general landscape irrigation. Additional treatment above that currently provided would be needed to meet the state public health and safety requirements. In addition to the treatment upgrades, a separate distribution system, including pumps, storage facilities, and piping would be required to convey non-potable recycled water to potential customers.

As mentioned earlier, the City is undertaking a regional Recycled Water Facilities Planning Study (RWFPS) under a contract with Kennedy/Jenks Consultants. The goals of the RWFPS are:

- to assess beneficial reuse of wastewater from a resource recovery perspective
- to evaluate local and regional recycled water projects
- to identify near-term, mid-term and long-term projects
- to meet the schedule for the WSAC Implementation Plan, and
- to initiate a strategy for continued outreach related to recycled water.

Table 6-4 below lists the number and type of recycled water projects that are being considered in the planning study. This planning study is scheduled to be completed in 2017. The scope of work for this project is included as Appendix J.

Table 6-4. List of Potential Recycled Water Projects Under Investigation				
Project No:	**Recycled Water Use**	**Source Water**	**Treatment**	**Project Area(s)**
1a	Industrial Use/ Landscape Irrigation	Santa Cruz WWTF	Tertiary	City, District and County
1b		Local Raw Wastewater	MBR Tertiary	UC Santa Cruz
2a	Irrigation	Santa Cruz WWTF	Tertiary	North Coast Agricultural Irrigation
2b		Santa Cruz WWTF -or- SVWD WWTP	Secondary or Tertiary	Pasatiempo + Other Landscape
2c		Santa Cruz WWTF	Tertiary	Landscape
3	Seawater Barrier	Santa Cruz WWTF	Advanced Treatment	Lower Groundwater Basins
4a	Groundwater Replenishment	Santa Cruz WWTF	Advanced Treatment	Upper/Lower Purisma Formation and Soquel Valley Groundwater Basin
4b		Local Raw Wastewater	MBR + Advanced Treatment	
4c		Santa Cruz WWTF -and- Scotts Valley WWTP	Advanced Treatment	Santa Margarita GW Basin
5	Reservoir Augmentation	Santa Cruz WWTF	Advanced Treatment	Loch Lomond Reservoir
6	Streamflow Augmentation	Santa Cruz WWTF	Tertiary or Advanced Treatment	San Lorenzo River
7	Direct Potable Reuse	Santa Cruz WWTF	Advanced Treatment	City, District and County

In the meantime, the City is actively pursuing two recycled water projects: 1) a bulk recycled water fill station and pilot City park irrigation project adjacent to the WWTF, and 2) supporting delivery of recycled water from Scotts Valley to the Pasatiempo golf course.

The City Department of Public Works is planning to expand the internal reuse water system at the WWTF to produce Title 22 tertiary treated water and to build a small distribution system for offsite use. The maximum amount of recycled water production from this system would be about 0.25 mgd; about half of which would be used within the plant and the other half potentially available for offsite demand. Current bulk water use in the service area is approximately 4 mgy, which could be reduced partially or wholly by switching to recycled water. In addition, there is the potential demand at La Barranca Park of about 1 mgy for landscape irrigation.

The Pasatiempo Golf Course is also in the process of finalizing arrangements to receive secondary effluent from the City Scotts Valley. The Scotts Valley Water District has been working on an agreement with the management of the Pasatiempo Golf Club and the City of Scotts Valley to allow the golf course to have a right to receive up to 170,000 gallons per day (up to 35 MGY – equivalent of 206 days per year) of secondary treated water from the City of Scotts Valley. The Golf Club would then treat the water to meet the standard in Title 22 for unrestricted access golf courses. The City of Santa Cruz would continue to supply a portion of the water demand as needed for potable water uses and supplemental water for recycled water irrigation.

The current and projected uses of recycled water for these near-term projects within the City's service area are presented in Table 6-5 below.

Table 6-5. Current and Projected Recycled Water Direct Beneficial Uses Within Service Area (mgy)

☐	Recycled water is not used and is not planned for use within the service area of the supplier. The supplier will not complete the table below.								
Name of Agency Producing (Treating) the Recycled Water:				City of Santa Cruz/SVWD/SqCWD					
Name of Agency Operating the Recycled Water Distribution System:				City of Santa Cruz/City of Scotts Valley/SVWD/SqCWD					
Beneficial Use Type		General Description of 2015 Uses	Level of Treatment	2015	2020	2025	2030	2035	2040 (opt)
Agricultural irrigation									
Landscape irrigation (excludes golf courses)		N/A	Tertiary	N/A	up to 1	up to 2	up to 3	up to 4	
Golf course irrigation		N/A	Tertiary	N/A	35 (est)	35 (est)	35 (est)	35 (est)	
Wildlife Habitat Enhancement/Wetland									
Commercial, Industrial		N/A	Tertiary	N/A	up to 4	up to 4	up to 4	up to 4	
Groundwater recharge (IPR)					TBD	TBD	TBD	TBD	
Reservoir Augementation					TBD	TBD	TBD	TBD	
Direct potable reuse					TBD	TBD	TBD	TBD	
Other	Type of Use								
			Total:	0	0	0	0	0	0

IPR - Indirect Potable Reuse

NOTES: Due to the preliminary nature of the proposed recycled water projects, please refer to the narrative for details as these numbers represent potential volumes for planning purposes and are not known quantities suitable for operational purposes. Agencies involved include the City of Santa Cruz, City of Scotts Valley, Scotts Valley Water Distrct (SVWD), and Soquel Creek Water District (SqCWD). For golf course irrigation, the source of water is the City of Scotts Valley wastewater plant treated to secondary level and then treated to a teriary level at the golf course.

6.5.4.2 Planned Versus Actual Use of Recycled Water

Recycled water, as defined by the California Department of Water Resources, was not used by the City in 2010 nor projected for use in 2015.

Table 6-6. 2010 UWMP Recycled Water Use Projection Compared to 2015 Actual	
☑	Recycled water was not used in 2010 nor projected for use in 2015. The supplier will not complete the table below.

6.5.5 Description of Actions to Encourage and Optimize Future Recycled Water Use

Currently the City does not produce recycled water for use outside its wastewater treatment plant, therefore actions to encourage the use, including financial incentives, and development of a plan to optimize the use of recycled water in the City's service area do not apply at this time. The steps and actions to encourage and optimize recycled water will be defined in the future if and when recycling is selected and pursued to diversify the City's water supply portfolio.

Currently, the City is pursuing groundwater storage strategies including projects for in-lieu/passive recharge, and aquifer storage and recovery/active recharge (ASR). In the event these strategies prove insufficient to meet the accepted goals of cost-effectiveness, timeliness, or yield, either advanced treated recycled water or desalinated water would be developed as a supplemental replacement supply. These strategies and the underlying assumptions and goals are discussed further in Chapter 7.

To prevent significant delay in developing an effective supply of reliable water, recycled water is being considered simultaneously with groundwater storage feasibility (in-lieu and ASR). After the initial five-year study phase, strategy options will be selected for buildout beginning in year 2020 to augment the existing supply by 2025.

Table 6-7. Methods to Expand Future Recycled Water Use			
☐	Supplier does not plan to expand recycled water use in the future. Supplier will not complete the table below but will provide narrative explanation.		
	Provide page location of narrative in UWMP		
Name of Action	Description	Planned Implementation Year	Expected Increase in Recycled Water Use
Recycled Water Facilities Planning Study	Contract with Kennedy/Jenks to research potential uses of recycled water	TBD	TBD
		Total	TBD
NOTES:			

6.6 Desalinated Water Opportunities

For a decade or more, the City had been pursuing a 2.5 mgd desalination facility as a regional project with Soquel Creek Water District to diversify both agencies' water supply portfolio. It remains a possible project for the City. In the recently completed Final Report on Agreements and Recommendations (Appendix K), the Water Supply Advisory Committee presented a supply strategy that includes desalinated water, but only as a last resort, and after exhausting several other preferred options (City of Santa Cruz, 2015). Soquel Creek Water District is continuing to consider desalinated water through a Memorandum of Interest with a different regional "Deepwater Desal" project proposed at Moss Landing Harbor.

6.7 Exchanges or Transfers

Following years of discussion and coordination on groundwater management, the City and Soquel Creek Water District recently signed a "Cooperative Water Transfer Pilot Project for Groundwater Recharge and Water Resource Management" agreement to transfer a small amount of water to Soquel Creek Water District in the winter months when surface water from the North Coast is available (Appendix Y). This transfer would allow the District to assess the effects of reduced pumping of the basin. The agreement is a first step in the implementation of the Water Supply Augmentation Strategy and serves to further study and determine the potential benefits of local exchanges and transfers as a groundwater management tool and supply reliability strategy.

6.8 Future Water Projects

The Final Report on Agreements and Recommendations presented by the Water Supply Advisory Committee includes an implementation strategy and work plan for determining which project to pursue. At this time it is unknown which project(s) will be carried out over the 20-year planning horizon of this Urban Water Management Plan. The Final Report, summarized in Chapter 7, provides the framework for the decision-making for initiating future water projects and describes the need either for substantial additional storage or some other strategy to increase supply reliability. Therefore the City is unable to complete Table 6-8 as some or all of the future water supply projects or programs are not compatible with the table and are described in a narrative format within the Plan.

Table 6-8. Expected Future Water Supply Projects or Programs	
☑	Some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format.
6-21 & 7-12 to 7-21	Provide page location of narrative in the UWMP

6.9 Summary of Existing and Planned Sources of Water

6.9.1 Existing Sources of Water

The City's existing sources and actual production volumes for 2015 are presented in Table 6-9. The figures represent production volumes experienced under severe drought conditions and with emergency water shortage regulations and restrictions in effect locally between the months of May and October.

Table 6-9.Water Supplies — Actual				
Water Supply	Additional Detail on Water Supply	2015		
		Actual Volume	Water Quality	Total Right or Safe Yield *(optional)*
Surface water	North Coast	382	Raw Water	
Surface water	San Lorenzo River	1,458	Raw Water	
Surface water	Loch Lomond	495	Raw Water	
Groundwater	Live Oak Wells	145	Raw Water	
	Total	2,480		0
NOTES: Net production figures in million gallons				

6.9.2 Planned Sources of Water

Table 6-10 provides an estimate of the volume of water, by source, that is reasonably available from 2020 to 2035. These volumes are based on deliveries for average years, projected water demands, and available surface water flows consistent with ecosystem protection goals, according to the City's water supply operations model, Confluence.

The City is currently developing a supply augmentation plan that will include increased production between 2020 and 2035. However these volumes and the prospective sources are not fully understood at this time. A shift in the balance of the supply sources may occur as a component of the supply augmentation strategies shown as potential planned water sources. For instance, the City expects to produce less water from the North Coast sources in the future compared to historic production levels. In total, the expectation is that existing and planned sources of water available to the City over the next twenty years, on average, are estimated to meet the predicted total annual water demand of about 3.2 to 3.3 billion gallons annually.

As part of the augmentation strategy the City recognizes the importance of additional supply storage as a safeguard against future water shortages. Chapter 7 discusses the challenges to the City's supply system and provides additional narrative that proves useful in understanding the information presented in Table 6-10 below.

Table 6-10. Water Supplies — Projected						
Water Supply	Additional Detail on Water Supply	Projected Water Supply (mgy) *Report To the Extent Practicable*				
		2020	2025	2030	2035	2040 *(opt)*
		Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume
Surface water	North Coast Sources	637	642	671	671	n/a
Surface water	San Lorenzo River	1,882	1,842	1,829	1,834	n/a
Surface water	Loch Lomond Reservoir	595	551	540	547	n/a
Groundwater	Live Oak/Beltz Wells	138	129	127	128	n/a
Transfers		Near term transfer to SqCWD of up to 100 mgy to assess the effect of reduced pumping on the groundwater basin and explore the opportunity of developing a longer-term agreement for aquifer storage and recovery				
Exchanges						
Recycled Water		Recycled water feasibility study investigating options including regional partnership opportunities for a recycled water project to provide drought resistant supply and options for groundwater management strategies due to overdraft conditions of local basins				
Desalinated Water				Potential project to expand recycled water supply or investigate desalination		
Other						
	Total	3,252	3,164	3,167	3,180	0
NOTES: Projected supply volumes shown represent the output values from the City's Confluence (water supply) model. These projections consider the operations of the City's current supply system in response to a projected demand.						

6.10 Climate Change Impacts to Supply

As the City of Santa Cruz water supply consists of only local sources maintained and recharged by natural processes, the potential weather conditions related to climate change could greatly impact the sources of supply. A widely accepted profile is that climate change may make the future hydrology drier than the historical record maintained in the region (1937 to today). General forecasts describe deviation in the seasonal patterns of rainfall with longer and more severe droughts. Additionally, the annual average temperature in the region may increase leading to variability in the rate of evaporative processes that can greatly impact local sources and watersheds (Stratus Consulting, 2015).

With these potential impacts to the available local supply in mind, the City is exploring projects that not only diversify supply options, but also enhance the reliability of the system. In Chapter 7, the long-term reliability of the system supplies is presented along with an analysis of known constraints on existing sources. Climate change impacts are likely to be a contributor to a less reliable supply and also a driver for strengthening demand management planning as discussed in Chapter 9.

Chapter 7

WATER SUPPLY RELIABILITY ASSESSMENT

This chapter of the plan describes the long-term reliability of the City's water supplies including assessment of supply relative to demand and the management strategies being implemented to create a more dependable supply. While this chapter is focused on assessment, Chapter 9 discusses the City's water conservation planning process and demand management measures currently being implemented. Short-term reliability planning that requires immediate action, such as drought or a catastrophic supply interruption, is addressed in Chapter 8, Water Shortage Contingency Planning.

7.1 Constraints on Water Sources

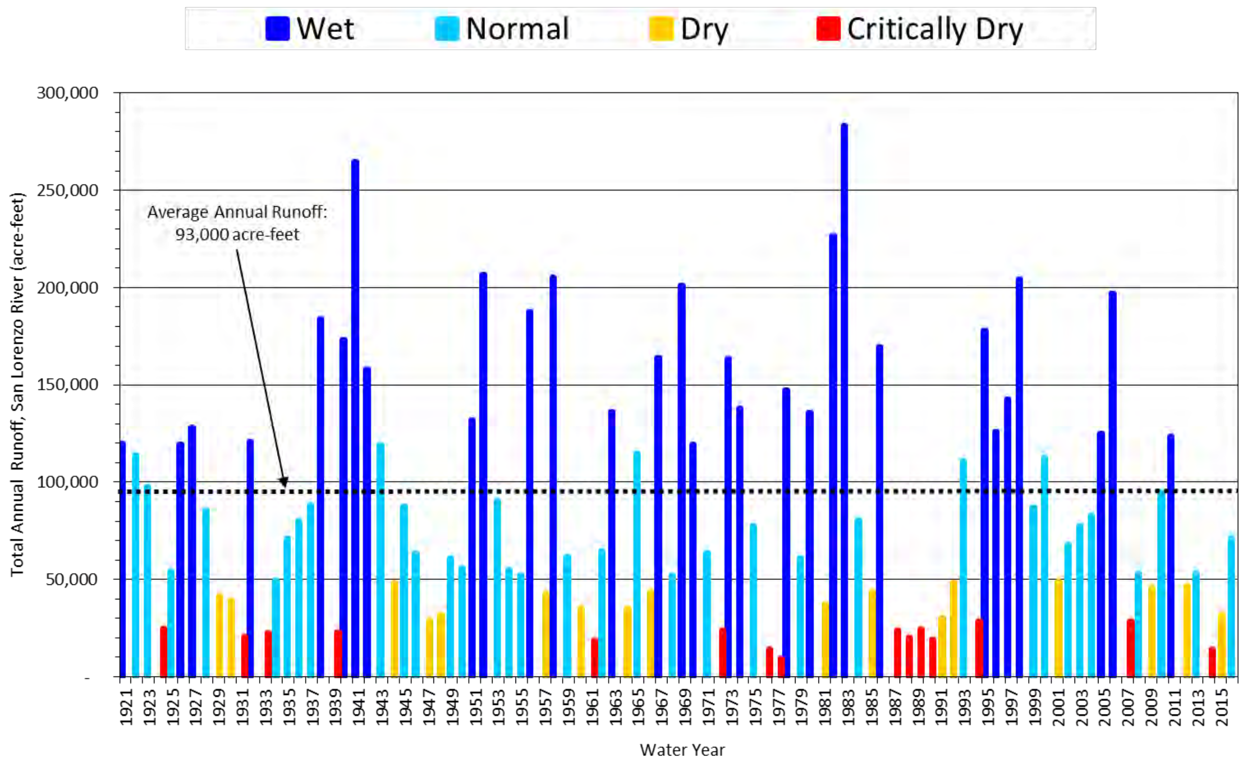
The City of Santa Cruz is facing several obstacles in meeting its present and future water supply needs. While each complication presents a unique set of water management challenges, the common theme is the limitation in where, when, and how much water is available to meet the area's water service needs, particularly during years when rainfall is below average. The following sections outline the known constraints on supply and include the management strategies implemented for each.

7.1.1 Local Supply Variability

As explained in Chapter 3, the City water system draws almost exclusively on local surface water sources, whose yield varies from year to year depending on the amount of rainfall received during the winter season and generated runoff that provides beneficial inflows. This local variation has been a significant constraint in recent years as the Central Coast, and the State of California more generally, were held in the grip of a multi-year drought. Declaration of a local water shortage emergency for the past two years underscores the effect of the drought on the City of Santa Cruz system.

Figure 7-1 below shows the total annual runoff for the San Lorenzo River over the 95-year period from 1921 to 2016 and the classification for each water year. The graph illustrates the dramatic variation in discharge from year to year. This natural variation in the level of runoff available in local streams and rivers, from which the City draws the majority of its supply, is the major factor that results in an inconsistent level of water supply from year to year. Ultimately, the only water available to the City is that which originates from rain that falls on the ocean side of the Santa Cruz Mountains. In normal and wet years, when rainfall and runoff are abundant, the water system is capable of meeting the community's current total and anticipated annual water requirements.

Figure7-1. Total Annual Stream Discharge from the San Lorenzo River (Acre feet)



The system is highly vulnerable to shortage, however, in extended dry periods or critically dry years, when the flow in local streams and river sources runs low. Moreover, like other communities on California's central coast, the Santa Cruz water system is physically and geographically isolated. Limited emergency interconnection capability may be possible due to existing interties with a neighboring water district. The primary function of the interties is to allow for the movement of water to the Soquel Creek Water District that currently relies solely on groundwater from a critically over drafted basin.

Water is currently stored in Loch Lomond Reservoir (impounded by the Newell Creek Dam) to serve peak season demands and is an integral part of the supply system. Some amount of storage is used each year, mainly in the summer and fall months when the flows in the coast and river sources decline and additional supply is needed to meet higher daily water demands than during winter and spring.

During dry years, the system relies more heavily on water stored in Loch Lomond to satisfy demand, which draws down the reservoir level lower than usual and depletes available storage. In multi-year or critical drought conditions, the combination of very low surface flows in the coast and river sources and depleted storage in Loch Lomond reservoir reduces available supply to a level which cannot support average dry season demands. Compounding the situation is the need to retain a certain amount of water in the reservoir if drought conditions continue into the following year. The existing system is not able to provide a reliable supply during multi-year droughts or prolonged periods of drier than normal hydrologic conditions within the source watersheds.

7.1.2 Ecosystem Restoration and Protected Species

Since 2002, the City of Santa Cruz has been working toward the development of a Habitat Conservation Plan (HCP) that covers operation and maintenance activities at the North Coast streams and San Lorenzo River diversions as well as other activities which may result in “take” of threatened and/or endangered species. An HCP is an operational avoidance and minimization and mitigation plan prepared under Section 10 of the Federal Endangered Species Act (FESA) and Section 2081 of the California Endangered Species Act (CESA) by nonfederal parties seeking to obtain a permit for incidental take of federally or state-listed threatened and endangered species.

The City initiated the HCP process because the streams from which the City diverts water currently support steelhead trout and the San Lorenzo River and Laguna Creek support coho salmon. Within the Central California Coast Region, steelhead (*Oncorhynchus mykiss*) is currently listed as “threatened” and Coho salmon *(Oncorhynchus kisutch*) is listed as “endangered” on the ESA federal list and Coho salmon are also listed as “threatened” under CESA.

Numerous studies undertaken in support of the HCP have evaluated what limiting factors may be affecting fish in these streams. Among other things, this includes evaluation of instream flow needs during all freshwater life phases (migration, spawning, incubation and rearing) over a range of hydrologic year types. Because these studies indicated that habitat conditions in these streams could be improved with increased instream flows, the City began voluntarily diverting less flow in 2007 on an interim basis in connection with the pursuit of the HCP.

Although the HCP negotiations are ongoing, the City is forecasting that ultimate compliance with the state and federal Endangered Species Acts will result in less water being available from the City’s flowing sources for supply in future years compared to the past. This, in turn, will place greater reliance on water stored in Loch Lomond Reservoir to meet the community’s annual water needs and exacerbate the aforementioned vulnerability to shortage.

7.1.3 Source Water Quality and Treatment Capacity

The City's Graham Hill Water Treatment Plant (GHWTP) currently complies with all drinking water standards set by the US Environmental Protection Agency (EPA) and the State Water Resources Control Board Division of Drinking Water (DDW). These regulations require monitoring of water sources, watershed protection, treatment techniques, and extensive monitoring of treated water quality throughout the distribution system.

The primary issues with respect to water quality are the treatment challenges posed by future changes in our source water mix driven in part by ecosystem protection requirements. The GHWTP is a conventional surface water treatment plant that was commissioned in 1960 as a 12 mgd plant and has undergone an expansion and a number of improvements over the last 50 years. Except for groundwater from the Live Oak wells, all water delivered through the City system is treated at this plant. In other words, it must operate properly 100 percent of the time to maintain water service throughout the entire system.

Following the last major expansion the plant can process up to 16 mgd and year-round average production is 10 mgd. The City has been evaluating improvements to accommodate a variety of changing conditions such as potential higher daily plant output in the winter, evolving water quality regulations, and future changes in the source water mix. As information has become available from the various studies such as the Initial Distribution System Evaluation—conducted as part of preparing to comply with the State 2 Disinfectant and Disinfection Byproducts Rule, and work toward the HCP, the focus has narrowed to strategies to reduce the formation of disinfection byproducts and the treatment of more turbid source water with greater natural organic matter.

The City plans to continue investment in the plant by taking on projects that upgrade the existing facility to enhance water quality and respond to detection of contaminants of emerging concern (CECs) including pharmaceuticals and personal care products (PPCPs). As water quality and treatment regulations change these investments are designed to prevent noncompliance with drinking water standards and/or mission-critical values of supplying adequate, safe, and reliable water for the City's customers.

7.1.4 The Water Rights Conformance Project for Water Rights and Entitlements

In 2008, the City developed and submitted filings to the SWRCB to address a historical oversight in the language of the City's water rights documents for Newell Creek and the San Lorenzo River at Felton (Felton Diversion) and to request a time extension for the full development of the 3,000 ac-ft permit to divert water from the San Lorenzo River at Felton.

The Newell Creek and San Lorenzo River permits to divert at Felton were originally granted as "diversion to storage," rather than as "direct diversion" rights. A diversion to storage is used when the water diverted is put into storage and is retained in storage for some time prior to being used. Current State Water Resources Control Board practice, however, requires rights of "direct diversion" as well as diversion to storage for the same operations as the City originally proposed and has historically undertaken.

The City's interest in initiating the Water Rights Conformance Project is to eliminate technical constraints for the operations of its water supply resources. While the water rights granted pursuant to the original filings were thought to be adequate at the time, it is now necessary to add the right of direct diversion to the rights to divert to storage. If this is not rectified, the Newell Creek inflow could be considered unavailable as a source for City use during times when, for example, the reservoir is receiving more inflow from Newell Creek than is being released downstream (Gary Fiske & Associates, 2003).

The City's permits to divert water at Felton for storage in Loch Lomond Reservoir (as amended by earlier requests for time extensions in the mid-1980s and again in the mid-1990s) required the City to put all of its approximately 980 mgy entitlement to full beneficial use by December 2006. While the City has been diligently using water from the Felton Diversion for beneficial use over the years, to date the City has used just over half the permitted amount on an annual basis. In the future, the City expects to need the full 980 mgy and, therefore, filed timely petitions (in 2008) with the SWRCB to extend the time allowed for putting the full 980 mgy to beneficial use. The need for such time extensions is typical for municipal water rights, the use of which increases over time.

Recently completed water supply planning work done by the Water Supply Advisory Committee identified water from the Felton Permits as being critical to meeting the City's projected future demand. In particular, the winter water harvest strategy is highly likely to result in greater use of water from Felton during the coming decade. In addition, water from the Felton diversion is an important asset during operational outages, changes in operations in response to environmental concerns, and as a significant component of the City's response to dry year conditions. The City mid-1990s extension required reaching an agreement with California Department of Fish and Wildlife (DFW) and execution of a Memorandum of Agreement that modified the manner in which the City operated the Felton Diversion facility to enhance fish passage.

Like the petitions to add direct diversion to the Newell Creek and Felton Diversion permits, the time extension petition are currently pending while the City works with the DFW and the National Marine Fisheries Service to complete a Habitat Conservation Plan and a federal Endangered Species Act Section 10 permit and a 2081 state permit that will address the impacts of the water system on threatened steelhead trout and endangered Coho salmon.

The Water Supply Advisory Committee's priority water supply augmentation strategy recommended developing and implementing conjunctive use of surface and groundwater resources in mid and northern Santa Cruz County. A significant barrier to proceeding to implement more conjunctive use of the City's San Lorenzo sources of supply is constraints on the Place of Use language included in the water rights documents for these sources. In particular, the Soquel Creek and Central Water Districts are not included in the Place of Use for any of the San Lorenzo water rights, which include rights related to Newell Creek, Felton Diversion and Tait Street Diversion. In addition, while Scotts Valley and the San Lorenzo Valley Water Districts are covered in the Place of Use descriptions for the Newell Creek and Felton Diversion water rights, they are not included in the Place of Use language of the Tait Street water right.

To address these Place of Use issues the City will be folding into the Water Rights Conformance Project a request to modify the Place of Use for the City's San Lorenzo River water rights and permits.

7.2 Reliability by Type of Year

For the purposes of assessing reliability, DWR uses the following definitions for determining year type:

Average/Normal Year: a year, or averaged range of years, that most closely represents the average water supply available to the agency.

Single-dry Year: a year that represents the lowest water supply available to the agency.

Multiple-dry Year: a period that represents the lowest average water supply available to the agency for a consecutive multiple year period of three years or more.

Table 7-1. Basis of Water Year Data			
Year Type	Base Year	Available Supplies if Year Type Repeats (mgy)	
		Agency may provide volume only, percent only, or both	
		Volume Available	% of Average Supply
Average Year		3,251	100%
Single-Dry Year	2014	2,692	83%
Multiple-Dry Years 1st Year	1976	2,430	75%
Multiple-Dry Years 2nd Year	1977	1,969	61%
Multiple-Dry Years 3rd Year	1977	1,597	49%
NOTES: Quantity volume of available water represents the maximum over time by year type. Projected volumes of available water produced by the Confluence model take into account demand assumptions.			

For this assessment the normal or average water supply available to the City was developed using the long-term average over the 78-year period of record (1936-2014). This record does include all water year types from critically dry to extremely wet and therefore represents a historical hydrologic average base year type.

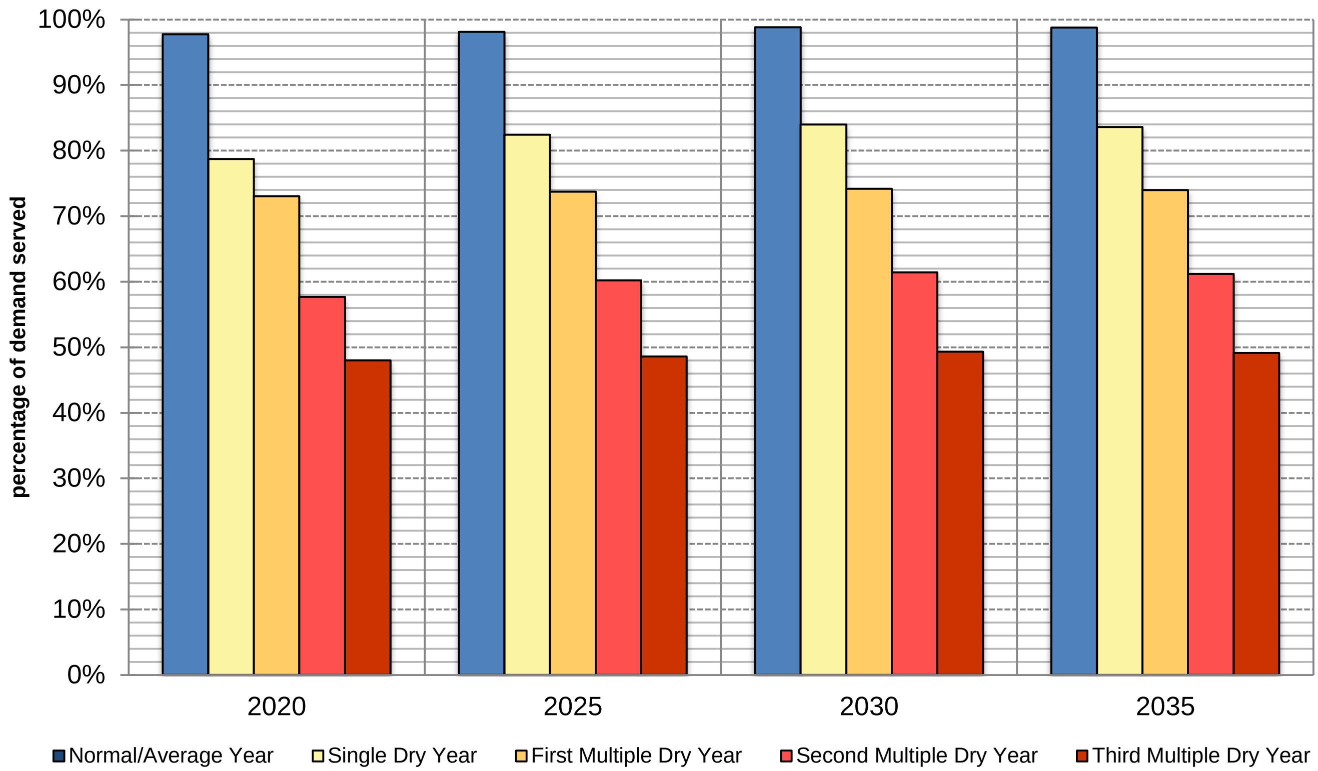
The City chose water year 2014 to represent the lowest water supply available to the agency for a single-dry year. Although 2014 was part of a larger drought sequence, the City was able to isolate the conditions for that single year. In terms of local source assessment, water year 2014 was representative of critically dry conditions for the City.

Consistent with previous plans and assessments, the City chose water years 1976-1977 as representing the most critical drought on record for a consecutive multiple-year period. A second 1977 year type was appended to the sequence to create the required third year for the assessment exercise. This sequence was used in the recent supply planning work completed in 2015 (see Section 7.4) and is consistent with the stated goal to create a reasonable worst-case scenario in a multi-year drought.

Each of the volumes included in the chart are the maximum available volumes by base year type as projected at the five-year intervals from 2020 to 2035. As such the percentage of average supply shown is the highest relative to average supply for all the base year types modelled.

To demonstrate the slight variability over time for each base year type modelled, Figure 7-2 shows the projected supply available relative to demand. Although the City chose the maximum value for comparison in Table 7-1, use of an average supply volume or a minimum supply volume would not substantially alter the presentation of the projections.

Figure 7-2. Projected Supply Availability as Demand Served



As will be expanded on in the following section, operationally the City has sufficient water supply available in normal years to meet demand even though a slight deficit seems to exist in the modelled projections. In single dry years, supplies are slightly inadequate to meet expected demands by 2020 and beyond. In multiple dry years, available supplies fall substantially short of system demands. The one variable that represents the biggest unknown at this time is the amount of water that will be required for ecosystem protection purposes. Should the City agree to release more water than is assumed in the operations model utilized for this analysis, these conclusions could change and shortages could be even greater than the estimated available supply presented.

7.3 Supply and Demand Assessment

The City of Santa Cruz utilizes the Confluence model to analyze the variability of water supplies to determine potential water supply shortages. The City has been utilizing the

Confluence model to support water supply planning activities since 2003 and this model was used to generate the results for the 2010 UWMP (City of Santa Cruz, 2011). The model takes into account the variation in demand both within and between years, the availability of water from various sources, and the capacity of infrastructure to pump and treat the water. The results presented in this section provide perspective on the City's water supply reliability based on accepted assumptions and projected conditions in the water system.

Water suppliers are required to characterize water supply reliability in a manner prescribed by law. In the analysis that follows, estimates of supply are given by both individual source and for the total available supply. The analysis assumes that future diversions, beginning sometime within the next five years will be limited due to the constraints of the specific factors described above. Although the constraints may ultimately be modified, the City is presenting the proposed forecasts as a composite of what total supply is likely to be, based on what is known at this time.

7.3.1 Normal/Average Water Year

After developing the normal year from the 78-year period of record, average conditions were projected for the future 5-year intervals. The summary results of this assessment are presented in Table 7-2 below. Notice the maximum availability of water for this base year type occurs in 2020; however reliability improves over time due to projected demand reduction in the future (M.Cubed, 2015).

Table 7-2. Normal Year Supply and Demand Comparison (mgy)

	2020	2025	2030	2035
North Coast Sources	637	642	671	671
San Lorenzo River	1882	1842	1829	1834
Loch Lomond Reservoir	595	551	540	547
Groundwater	138	129	127	128
Supply totals	3,252	3,164	3,167	3,180
Demand totals	3,327	3,225	3,205	3,220
Difference (mg)	(75)	(61)	(38)	(40)
Demand served %	97%	97%	98%	98%

In order to understand the source balance behind the numbers in Table 7-2, the City chose to provide the projected supply volumes by source to illustrate how the system provides water during these years. Of note, production from the North Coast sources is shown at a much lower diversion rate (637-671) than was projected in the 2010 UWMP (860 mgy). However, the modeling to support these new projections includes approval of an HCP with significant bypass flow requirements prior to the first five-year forecast year. This reduction is partly compensated for in normal water years by increased diversion from the San Lorenzo River and greater withdrawals from Loch Lomond Reservoir. Additionally, the expected future demand has reduced considerably since the 2010 Plan due to significant conservation and water efficiency programs.

Although the City has not previously seen shortages in normal water years, by adding the ecosystem protection conditions (HCP) likely to begin prior to 2020 a small shortage (1-3%) can be reasonably expected. Historically in normal water years, the City experienced a slight surplus of supply and this trend can be expected to continue until the HCP agreement is approved and higher instream flows are maintained. As the City chose to create a representative average year by using the historic record, the inclusion of the dry years and critically dry years within the average may explain the predicted small deficit. It is important to note that the City predicts the supply and demand volumes to be in balance for 90% of all normal water years for 2020-2035.

7.3.2 Single Dry Water Year

This assessment presents water supply available to the City as reflecting conditions comparable to water year 2014, which was a recent critically dry year. As shown in Table 7-3, water supply during a single dry year is not sufficient to meet the demand in the near term although the shortage experienced is projected to decrease over time. During a single dry year annual shortages of 16-21% are projected given the modelled supply and demand figures developed for planning and reliability purposes.

Due to the local conditions of the water supply sources and the tourist economy of the City, water shortages are typically concentrated into a “peak season” with much greater gaps between demand and supply of available water. The greatest demand for water occurs in the summer months when less water is available from surface water sources. Therefore the model predicts greater dependence on groundwater supply in dry years by increasing the volume by 25-35% more than during normal years. Evidence of this shift is shown in the groundwater supply volumes for Table 7-2 and 7-3.

Table 7-3 Retail: Single Dry Year Supply and Demand Comparison (mgy)				
	2020	2025	2030	2035
North Coast	429	432	452	452
San Lorenzo River	1300	1275	1268	1271
Newell Creek	716	780	802	798
Groundwater	174	171	170	171
Supply totals	2619	2658	2692	2692
Demand totals	3,327	3,225	3,205	3,220
Difference (mg)	(708)	(567)	(513)	(528)
Demand served %	79%	82%	84%	84%
NOTES:				

Of interest when discussing a single dry year, the model makes assumptions about management of the reserve supply to be maintained in storage at Loch Lomond. The City may choose to draw more water from storage to meet customer demand in a dry year during the peak season than the model predicts (shown in Table 7-3) as operations are not always consistent with modeling assumptions. This decision is commonly applied when the storage level of the reservoir is reasonably expected to return to capacity during the following winter.

7.3.3 Multiple Dry Water Year Period

The City chose to present the estimated water supply available during the multiple dry water year period of a three-year drought sequence using hydrology from 1976, 1977, and a second 1977 year. The results of the multiple dry year supply and demand comparison are provided as totals and overall differences in Table 7-4. A breakdown of supply by source is not provided for this sequence in an effort to simplify the table for easy navigation and comparison between years and over time.

In an extreme multi-year drought similar to the 1976-77 event, the estimated water supply available to the City in the first year of that event, according to model, ranges between 2,430 and 2,377 or an average of 25% less water on an annual basis than is available in a normal water year. During the second year the average shortage over time increases to 39% and in the third year modeled, the average reduction compared to a normal year is over 50%. Fortunately, growth in water demand is not anticipated to be a contributing factor to shortage as the City is projecting a small decrease in overall demand between 2020 and 2035.

Table 7-4. Multiple Dry Years Supply and Demand Comparison (mgy)

		2020	2025	2030	2035
First year	Supply totals	2,430	2,377	2,377	2,381
	Demand totals	3,327	3,225	3,205	3,220
	Difference	(897)	(848)	(828)	(839)
Second year	Supply totals	1,918	1,942	1,968	1,969
	Demand totals	3,327	3,225	3,205	3,220
	Difference	(1,409)	(1,283)	(1,237)	(1,251)
Third year	Supply totals	1,597	1,567	1,580	1,581
	Demand totals	3,327	3,225	3,205	3,220
	Difference	(1,730)	(1,658)	(1,625)	(1,639)

The deficit calculated for Table 7-4 is expressed as annual average deficits. However, as discussed in the single dry year analysis, supplies available to meet demand are reduced mainly during the peak season period between April and October, the actual shortage is likely to be experienced at a much greater percentage over a reduced number of months.

The annual shortages associated with the multiple dry year sequence range from 25%-52% and the peak season could experience a shortage greater than 60% at least once during a multiple year drought. The magnitude of a shortage volume of 60% is roughly equivalent to the total water usage for all residential customers in the service area during the year of 2014. As the likelihood of a recurring multiple dry year sequence is strong, the City is seeking a solution to this dilemma through an increase in storage of 3.0 billion gallons and/or a project to increase the reliability of peak season supply.

7.4 Water Supply Reliability Management Strategies

The City follows a variety of policies, procedures, and legal restrictions in operating the water supply system. As indicated in the foregoing sections, there are many complex challenges and uncertainties that the City faces in its effort to maintain a safe, adequate, and reliable water supply. These include hydrologic, environmental, water quality, and legal factors. The City is pursuing a balanced approach to meet these challenges that includes both demand reduction and a phased, flexible augmentation strategy to diversify the City's and the region's existing water supply sources.

Over the past several decades the City has been studying ways to improve the reliability of its water supply; the problem has been defined in a variety of reports, plans, and projects that speak to the relative importance of the issues faced at the time. Participation by the community has been a significant element in the planning process for previous Integrated Water, Water Shortage Contingency, and Water Conservation Master Plans in addition to the review process for potential supply projects.

The most recent shift toward a new water supply vision occurred in late 2013 following expressed interest from the community to enhance public engagement on the subject of water supply planning. In response to this interest, the City developed a framework for moving forward in order to:

- greatly expand opportunities for community engagement;
- improve our water conservation efforts; and,
- help set a course for the future approach to improving the reliability of the City's water supply.

In early 2014, City Council appointed members to the Water Supply Advisory Committee (WSAC). The aim of the WSAC process was to 1) explore the City's water profile, including supply, demand and future risks; 2) analyze potential solutions to deliver a safe, adequate, reliable, affordable and environmentally sustainable water supply; and 3) develop recommendations for City Council consideration.

The backbone of the WSAC work is the problem statement developed for use by the City when addressing the assessment of supply reliability.

Committee Agreement on Problem Statement

On September 11, 2015, the Committee Agreed to the following problem statement:

Santa Cruz's water supply reliability issue is the result of having only a marginally adequate amount of storage to serve demand during dry and critically dry years when the system's reservoir doesn't fill completely. Both expected requirements for fish flow releases and anticipated impacts of climate change will turn a marginally adequate situation into a seriously inadequate one in the coming years.

Santa Cruz's lack of storage makes it particularly vulnerable to multi-year droughts. The key management strategy currently available for dealing with this vulnerability is to very conservatively manage available storage. This strategy typically results in regular calls for annual curtailments of demand that may lead to modest, significant, or even critical requirements for reduction. In addition, *the Santa Cruz supply lacks diversity, thereby further increasing the system's vulnerability to drought conditions and other risks.*

The projected worst-year gap between peak-season available supply and demand during an extended drought is about 1.2 billion gallons. While aggressive implementation of conservation programs will help reduce this gap, conservation alone cannot close this gap. The Committee's goal is to establish a reasonable level of reliability for Santa Cruz water customers by substantially decreasing this worst-year gap while also reducing the frequency of shortages in less extreme years.

City of Santa Cruz, 2015

One of the primary objectives in creating the WSAC was to allow for broad representation of community interests by bringing together individuals with a diverse set of perspectives and viewpoints. The WSAC began and concluded the process with fourteen appointed members:

Water Supply Advisory Committee Members

David Green Baskin, Santa Cruz Water Commission	**Sarah Mansergh**, Surfrider Foundation
Peter Beckman, Think Local First	**Mark Mesiti-Miller**, Santa Cruz Chamber of Commerce
Doug Engfer, City Resident	**Greg Pepping**, Coastal Watershed Council
Suzanne Holt, Outside-City Water Customer	**Mike Rotkin**, Sustainable Water Coalition
Dana Jacobson, City Resident	**Sid Slatter**, Santa Cruz County Business Council
Charlie Keutmann, City Resident	**Erica Stanojevic**, Sierra Club
Rick Longinotti, Santa Cruz Desalination Alternatives	**David Stearns**, Santa Cruz Water Commission

The overarching goal of the WSAC process that concluded in October 2015 was "to provide significant improvement to the sufficiency and reliability of the Santa Cruz water supply by 2025." While this planning horizon is a decade shorter than the required UWMP 20-year outlook, it presents a strategy that can be built upon based on the analysis and progress during the first 10-12 years. The WSAC process recognized that "like all long range planning, water supply planning must deal with the realities of an uncertain future" and further that a final strategy requires the ability "to respond to the new information that will emerge and the potential changes in our understanding of circumstances that will occur over time." (City of Santa Cruz, 2015)

7.4.1 Water Supply Advisory Committee Final Report

In late 2015, consensus was achieved among WSAC members for how best to address an agreed-upon worst year gap of 1.2 billion gallons between water supply and water demand during times of extended drought.

A report was created to conclude the WSAC process and was presented to City Council, as a Final Report on Agreements and Recommendations in November 2015. The Final Report was accepted by the City Council and staff was directed to integrate the water supply portfolio strategy (including the entirety of the agreements and recommendations) into the Urban Water Management Plan update to be submitted to DWR in 2016. The guiding recommendations are provided below and further reference material for the underlying agreement details can be found in the full report provided as Appendix K (City of Santa Cruz, 2015).

Article IV. Recommendations

Section 4.01 The Water Supply Augmentation Plan

The Committee has worked on developing a Plan that would eliminate future water shortages by 2025, give or take two years, while allowing for robust stream flows to support and enhance fish habitat.

*The agreed-upon **Water Supply Augmentation Plan** (Plan) includes:*

1. *A **specific goal for Yield**, as well as the assumptions underlying this goal;*
2. *A **Timeframe** for improving the reliability of the Santa Cruz Water Supply;*
3. *The **Water Supply Augmentation Plan Elements**;*
4. *An **Adaptive Pathway** to provide a structure within which work on the Elements can be pursued and evaluated; and*
5. *A **Change Management Strategy** to guide adjustments and adaptations within the Plan, as described below.*

Section 4.02 Yield Goal

The Committee recommends the City implement additional demand management and supply augmentation programs and projects and address key infrastructure and operating constraints to reliably make available an additional 1.2 bgy during modeled worst-year conditions.

Section 4.03 Timeframe for Improvement

The Committee recommends that the City adopt a goal of completing the improvements to Santa Cruz's water supply necessary to meet the specified yield goal by the end of 2025;

Section 4.04 Water Supply Augmentation Plan Portfolio Elements

The Water Supply Advisory Committee recommends that the City Council adopt a portfolio of measures for improving the reliability of the water supply. The recommended package includes the following Elements:

- ***Element 0:*** *Additional water conservation with a goal of achieving an additional 200 to 250 million gallons of demand reduction by 2035 by expanding water conservation programs;*
- ***Element 1:*** *Passive recharge of regional aquifers by working to develop agreements for delivering surface water as an in lieu supply to the Soquel Creek Water District and/or the Scotts Valley Water Districts so they can rest their wells, help the aquifers recover, and effectively store water for use by Santa Cruz Water Department in drought years;*
- ***Element 2:*** *Active recharge of regional aquifers by using existing infrastructure (wells, pipelines, and treatment capacity) and potential new infrastructure (wells, pipelines and treatment capacity) in the regionally shared Purisima aquifer in the Soquel-Aptos basin and/or in the Santa Margarita/Lompico/Butano aquifers in the Scotts Valley area to store water that can be available for use by Santa Cruz in drought years;*
- ***Element 3:*** *A potable water supply using advanced treated recycled water as its source, as a supplemental or replacement supply in the event the groundwater storage strategies described above prove insufficient to meet the Plan's goals of cost effectiveness, timeliness or yield. In the event advanced treated recycled water does not meet the needs, desalination would then become Element 3.*

Section 4.05 WSAC Value Statement on Implementing Plan Elements

The recommended Water Supply Augmentation Plan reflects the Committee's preference for pursuing a groundwater storage and retrieval strategy provided the yield goal can be achieved in a cost-effective and timely manner. Before making a choice to move away from groundwater storage, the Committee recommends that the City diligently pursue all reasonable measures to make the groundwater strategies work.

Recognizing the cost differential between some of the strategies the Committee considered in developing its recommendations, the WSAC agreed to express its preference for the Strategy One, groundwater storage and retrieval, over Strategy Two, and has agreed that as long as the annualized cost per million *gallons of average year yield (ACAYY) for implementing Strategy One is not more than 130% of the ACAYY for Strategy Two, while still meeting other metrics, Strategy One should be pursued.*

Section 4.06 Adaptive Pathway Implementation Strategy

The Committee recommends that the Council adopt a staggered Adaptive Pathway to guide implementation of the Plan and that decision-making at the various decision-nodes identified in this Adaptive Pathway be guided by the provisions of the Change Management Strategy.

Section 4.07 Change Management Strategy

The Committee recommends that the Council adopt the Change Management Strategy described in Section 3.24 (City of Santa Cruz, 2015).

Section 4.08 Additional Recommendations Related to Infrastructure and Operating Constraints

(a) Infrastructure Constraints

The Committee also supports the Water Department's plans to address certain key infrastructure constraints that are keeping the City from fully utilizing available water, especially during the high flow season. These include, but are not limited to:

- *Rehabilitation of the pipeline between the Felton Diversion and Loch Lomond that would allow the City to increase diversions to Loch Lomond during the high flow season;*
- *Evaluation of additional pumping capacity at Felton to push more water to Loch Lomond through the replacement pipeline; and*
- *If proven cost-effective, and needed for the implementation of Strategy One, complete improvements that will allow the Department to treat water with turbidities that are higher than can be effectively treated by the current Graham Hill Water Treatment Plant facilities and processes. The specific method for how to address the water treatment constraint should include evaluating a range of potential options, including, but not limited to Ranney Collectors or satellite treatment plants, and choosing the most cost-effective approach.*

(b) Operating Constraints

Another focus of the Committee's review relates to some system operational constraints. Operating constraints typically include both daily parameters for drawing water from the City's sources and operating constraint parameters that are used in modeling system performance.

The Committee recommends that the Water Department identify and regularly evaluate operating constraints to determine whether those constraints continue to be justified as necessary to protect the system and finished water quality and to support efficient and cost-effective operations. Early focus should be given to issues related to Loch Lomond year-end carry over storage requirements, particularly if/when in lieu and/or ASR have provided a sufficient drought supply, and to the "first flush" constraint impacting the City's ability to pump water from Felton to Loch Lomond under critically dry year conditions.

Section 4.09 Implementation Plan and Timeline

As part of the process for developing the WSAC Agreement, City Staff and the technical team developed a Gantt chart shown in Figure 12. This Gantt chart, together with the Decision Node Table (Table 16) and the Staggered Adaptive Pathways Map (Figure 11) comprise the Implementation Plan and Timeline.

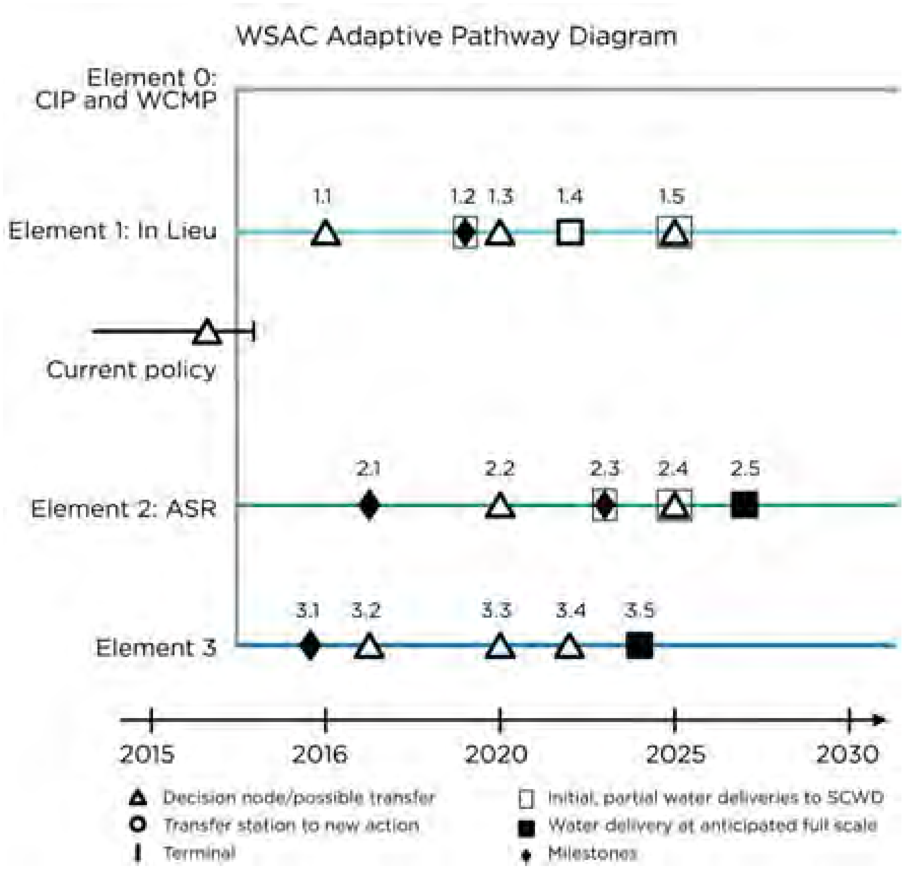
On the following page, Figure 7-3 is a reproduction of the Gantt chart originally included as Figure 12 in the Final Report and referenced in Article IV. Recommendations provided above. This Strategy Implementation Plan and Timeline was developed by City Staff and the technical team as a tool to move the City into the work plan phase.

Figure 7-3. Water Supply Strategy Implementation Plan and Timeline, Water Supply Advisory Committee. Final Report, 2015

Upon acceptance of the Report by City Council, development began on the supply augmentation strategy work plan that further defines the components of the implementation plan and timeline included in the WSAC Final Report. The initial phase of the strategy involves enhancement of the existing conservation programs as well as significant exploration of feasibility and potential alternatives for future supply projects focused on solving the 1.2 billion gallon supply gap.

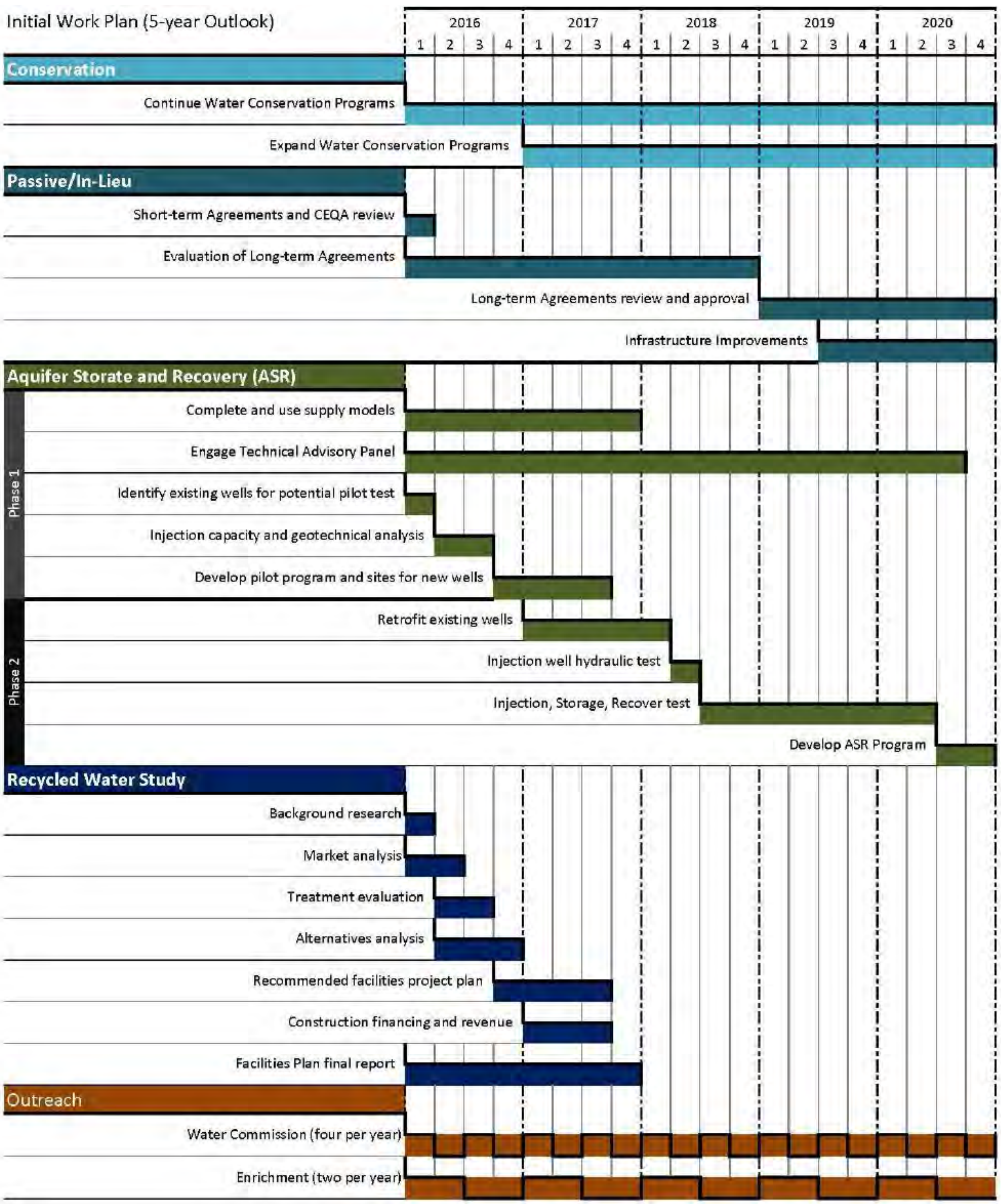
As shown in Figure 7-4 below and discussed as the “Staggered Adaptive Pathway” in the recommendations, the City will use the WSAC change management strategy to determine when and why adjustment of the progressing elements will occur. This movement will occur between the component elements of Strategies 1 and 2 while the tasks within the Capital Improvement Plan (CIP) and the Water Conservation Master Plan (WCMP) shown as Element 0 will continue along a consistent trajectory.

Figure 7-4. Change Management Strategy



The final components of the supply augmentation portfolio are not yet fully defined and will not be known prior to the adoption of this Plan. Therefore, the City provided projections on the long-term reliability of demand relative to supply based solely on the information available at this time. Development of the work plan to support the progress of the Elements began in Spring 2016 with a snapshot of the current associated tasks and timelines provided in Figure 7-5 below.

Figure 7-5. Water Supply Augmentation Strategy, Implementation Timeline



The City intends to implement the recommendations developed through the WSAC process as accepted by City Council in the Final Report. Adopting this update to the UWMP signifies adoption of the recommendations as the City's water supply strategy and the new course to overcome known supply reliability constraints and challenges.

7.5 Regional Supply Reliability

CWC 10620

> ***(f)*** *An urban water supplier shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions.*

The City of Santa Cruz continues to focus supply planning and reliability efforts on programs and projects that emphasize the maximization of available resources. To date, the City has avoided supply planning that included importing water from outside the Central Coast hydrologic region by concentrating on options within Santa Cruz County.

Currently, all of the City's water resources are obtained from local sources. In order to build drought supply reliability, the City continually works to develop partnerships within the region that promote responsible and sustainable water resource management. A known constraint on the regional supply are the over drafted, threatened, and recovering aquifers. The City's future supply vision includes projects serving to benefit regional aquifer recovery and increased reliability of groundwater sources. Recognizing the path toward regional reliability requires a comprehensive framework that supports dependability of all recognized supplies within the region, the types of tools being proposed and evaluated at present seek to benefit multiple stakeholders.

At this point in time, the City is participating in two recognized regional teams formed to increase coordination of activities among resource agencies. The first is the Santa Cruz Integrated Regional Water Management Group (IRWM) made up of nine local agencies. Several of the City's augmentation plan elements may benefit from the ability to work collaboratively with the partners and stakeholders that include government and non-government resource management agencies. Additionally, the City is one of four members of the Mid-County Groundwater Agency (MGA). As discussed in Chapter 6, the MGA was only formally established in May 2016 and the City has participated in several partnership groups with the mission to promote responsible management of the Soquel-Aptos Basin over the past several decades. Coordination and collaboration is expected to increase even further within Santa Cruz County in the coming decades with the potential for similar programs throughout the Central Coast Region.

Chapter 8

WATER SHORTAGE CONTINGENCY PLANNING

This chapter presents information about how the City of Santa Cruz manages the water system during a water shortage emergency that arises as a result of drought. It also describes actions that would be undertaken in response to a catastrophic interruption of water supplies, including a regional power outage, earthquake, or other emergency situation.

8.1 Background

In 2009, the City of Santa Cruz completed a comprehensive update of its Water Shortage Contingency Plan. This project was an outgrowth of a previous Urban Water Management Plan, which recognized the many changes in regional conditions and local water supply planning that had taken place over the previous decade and identified a need to better prepare for the possibility of future water shortages in advance of the next major drought. Since then, the City has had to declare a water shortage in five of the past seven years, including a Stage 3 Water Shortage Emergency in both 2014 and 2015.

The City's Water Shortage Contingency Plan describes the conditions which constitute a water shortage and provides guidelines, actions, and procedures for managing water supply and demands during a declared water shortage. The primary focus of the plan is on measures that reduce customer demand for water, but it also covers actions that can be implemented to stretch or increase the water supply.

The overarching goals of this plan are as follows:

1. to conserve the water supply of the City for the greatest public benefit,
2. to mitigate the effects of a water supply shortage on public health and safety, economic activity, and customer lifestyle, and
3. to budget water use so that a reliable and sustainable minimum supply will be available for the most essential purposes for the entire duration of the water shortage.

Development of the City's Water Shortage Contingency Plan was a collaborative effort among the City Water Department staff, the City's Water Commission, City Council, and the public over a three year period beginning in 2006. Research involved reviewing state regulations and legal requirements (Water Code section 350 et seq.) and the water shortage plans of 21 other urban water utilities from throughout California, and from selected cities in the western United States and across the country. The Water Commission provided its input and recommendations throughout the process.

The plan is based on lessons learned here and from other water agencies during past droughts. Nevertheless, it is important to note that every drought will evolve differently and that it is not practical to develop a set of hard and fast rules that apply to all situations. The plan should be thought of as a general framework that will need to be adjusted and refined based on actual conditions.

Early in the planning process, staff and the Water Commission developed a set of principles to guide the water shortage planning process. These principles are as follows:

- **Shared contribution.** All customers will be asked to save their share in order to meet necessary reduction goals during water shortages.

- **Reduce non-essential uses first.** The plan concentrates on the elimination of non-essential water uses and on outdoor reductions, and gives the highest priority to essential health and safety uses.

- **Preserve jobs and protect the local economy.** The plan minimizes actions that would have substantial impact on the community's economy and provides large users the flexibility to determine their own reduction strategies within a water budget.

- **Existing conservation measures recognized.** Customers that have already implemented water conservation measures are acknowledged to have less potential for reduction and should not be penalized for conserving.

- **Communication at every stage.** A public information campaign at every level of shortage is essential for customer preparation and will encourage confidence in the City's ability to respond to water shortages.

- **Public participation.** Public participation in the development and implementation of the plan will help to ensure fairness, encourage cooperation, and facilitate implementation and with demand reduction measures in times of shortage.

The final Water Shortage Contingency Plan was adopted by resolution of the City Council of the City of Santa Cruz in March 2009 as an amendment to the City's Urban Water Management Plan (Appendix L) and is adopted herein by reference. Subsequently, the City Council adopted an ordinance implementing the water shortage regulations and restrictions contained in the plan (Santa Cruz Municipal Code Chapter 16.01, Appendix M). The water shortage regulations and restrictions were updated in early 2015 to integrate some changes recognized as being needed during implementation of rationing in 2014.

Portions of the City's Water Shortage Contingency Plan have since been published and highlighted by the American Water Works Association in its new Manual of Water Supply Practices, *M60: Drought Preparedness and Response* as an example of a model staged demand reduction program (AWWA, 2011).

8.2 Stages of Action

The updated Water Shortage Contingency Plan uses a staged approach that classifies a shortage event into one of five levels spanning a range from less than 5 percent up to 50 percent (Table 8-1).

Table 8-1. Stages of Water Shortage Contingency Plan

Stage	Percent Supply Reduction[1] *Numerical value as a percent*	Water Supply Condition
1	0-5%	Water Shortage Alert
2	5-15%	Water Shortage Warning
3	15-25%	Water Shortage Emergency
4	25-35%	Severe Water Shortage Emergency
5	35-50%	Critical Water Shortage Emergency
[1] *One stage in the Water Shortage Contingency Plan must address a water shortage of 50%.*		
NOTES:		

The overall concept is that water shortages of different magnitudes require different measures to overcome the deficiency. Because there is so little the City can do in the short run to increase the supply of water, the focus of this plan is primarily on measures that reduce demand. Each stage includes a set of demand reduction measures that become progressively more stringent as the shortage condition escalates. When a demand reduction is necessary, typically one of these five stages would be put into effect by a resolution of the Santa Cruz City Council at the recommendation of the Water Director in the spring and remain in force for the entire dry season.

8.2.1 Assessing Water Supply and Demand

There is no one single criterion, trigger, or definition that is used to determine if a water shortage exists. The determination of a shortfall involves consideration of multiple indicators of water supply, as well as expected system demand.

Rainfall, runoff, reservoir storage, and water year classification are the key hydrologic indicators used by the City to evaluate water conditions. The plan describes these factors affecting the City's water supply and discusses the forecasting process and management considerations used in dry years to determine whether a water shortage is expected for the year ahead and how much water use must be cut back system-wide in response. In recent years, the City has also considered statewide drought intensity, long-range weather predictions, and local instream flow requirements in its analysis.

In Santa Cruz, a water shortage occurs when the combination of low surface flows in the coast and river sources and depleted surface water storage in Loch Lomond Reservoir reduces the available supply to a level that cannot support existing demand.

After an unusually dry winter or period of consecutive dry years, when a lack of supply appears possible, the Water Department undertakes an analysis to determine whether water supplies will be deficient relative to estimated water needs for the coming dry season. This analysis involves first comparing projected water supply and demand on a monthly basis, assuming no restriction on water use, to forecast the end of season water level and storage volume in Loch Lomond Reservoir. The Department then evaluates whether the amount of carryover storage in Loch Lomond at the end of the year will be sufficient to meet essential health and safety needs in case the dry weather pattern continues into the following year. If this analysis shows that Loch Lomond Reservoir would be depleted to a dangerously low level, then a decision is made regarding how much reservoir water is available to use in the current year and how much should be banked as a safeguard against the possibility of another dry year. The amount of cutback in demand needed to reduce the rate of reservoir depletion and end the year at a safer level of storage is then determined. If necessary, cutbacks would go into effect in late April/early May and span the entire dry season, typically through late

October. A hypothetical situation is provided in the full plan to illustrate this decision-making process.

The degree of shortage is normally defined as the supply deficiency in relation to normal water use over a given period of time, and expressed as a percentage. For example, a 25 percent shortage means the City has one-quarter less water supply available than what is normally used during the seven-month long dry season.

8.2.2 Timeline for Declaring Water Shortage

The timeline showing when the City evaluates water supply conditions and, if necessary, declares a water shortage is presented in Table 8-2 below.

Table 8-2. Calendar for Declaring Water Shortage

Target Date	Action
Months of Oct -Dec	Monitor rainfall, reservoir level, and runoff amounts
Late January	Prepare written status report on water supply conditions
Early February	Present initial estimate of water supply availability for year ahead
Early March	Present revised estimate of water supply availability for year ahead
Mid-March	SCWD announces existence of water shortage (if applicable)
Mid to late March	SCWD determines monthly water production budget and need for voluntary or mandatory response.
Early April	Present shortage response recommendation to Water Commission; notice of public hearing published
Mid-April	City Council formally declares a water shortage, adopts emergency ordinance
May	Water shortage regulations become effective
NOTES:	

8.2.3 Process for Declaring Water Shortage

Once the water shortage condition has been defined (as soon as reasonably certain), recommendations regarding water shortage rules and regulations consistent with this contingency plan are discussed with the City Water Commission. Monthly Water Commission meetings serve as a public forum for discussing water conditions and for hearing issues associated with implementation of the water shortage ordinance throughout the entire duration of the water shortage event.

Following consideration by the Water Commission, a declaration of water shortage is made by a resolution of the City Council. The legal requirements for such action are covered in Section 350 et seq. of the California Water Code. The code requires the following process be followed:

- That City Council hold a public hearing on the matter;
- That the public hearing be properly noticed (minimum of publishing once in newspaper at least seven days prior to the date of the hearing);
- Upon determining and declaring the existence of a water shortage, City Council may then adopt regulations and restrictions governing the use and delivery of water.

In accordance with Municipal Code section 16.04.480, rules adopted by the City Council establishing water use regulations become effective immediately after their publication in a newspaper of general circulation published in the City of Santa Cruz.

8.3 Demand Reduction Strategy

The City's strategy for dealing with water shortages of all levels involves the following four interrelated components:

1. An allocation system to establish reduction goals for different customer groups
2. Demand reduction measures
3. Publicity and communications
4. Operating actions

These four components are summarized below.

8.3.1 Allocation System

A fundamental issue any water supplier faces in managing a water shortage involves the allocation of water and how to distribute the available supply among customer categories when supplies fall short. In the process of updating this plan, various options and alternatives were reviewed and a priority-based allocation system was selected. This allocation system produces specific demand reduction goals for each major customer category at various levels of shortfall based on the unique usage characteristics of each customer category.

Customer reduction goals for all but the first stage were developed by evaluating the composition of demand for each major group and dividing it into three usage priorities. These priorities are, from highest to lowest, 1) health/safety, i.e., all domestic and sanitary uses, 2) business and industrial uses and, 3) irrigation and other outdoor uses. Normal demands were then scaled back in accordance with the schedule presented in Table 8-3.

Table 8-3. Reduction in Water Delivery by Usage Priority (percent of normal deliveries)

Stage	Magnitude of Water Shortage:	Health/Safety	Business	Irrigation
2	15%	95	95	64
3	25%	95	90	34
4	35%	90	85	12
5	50%	75	67	0

In essence, this allocation system strives to balance available supplies in times of drought as much as possible through cutbacks in outdoor water use. At each level of shortfall, public health and sanitation usage is afforded the highest priority by cutting back on interior usage the least. The importance of water in protecting the City's employment base is also acknowledged through disproportionate, modest cutbacks to the commercial sector as compared to the overall system shortfall. Irrigation and other outdoor uses are cut back the most. The larger the water shortage, the greater the cutbacks, but this same order of priorities is maintained throughout the range of potential shortages.

The heavy reliance on outdoor use reductions makes sense, both from a water system perspective because it reduces peak demands, which is important to preserving storage in Loch Lomond Reservoir, and from a public health and welfare perspective, because irrigation and other outdoor uses are the most discretionary of all uses when drinking water is in short supply. It also makes sense from an operational perspective because outdoor water use cutback can be achieved relatively quickly. From a legal perspective, this allocation system is consistent with the priorities and requirements of Water Code section 354. The resulting water supply allocation and customer reduction goals are presented in Table 8-4.

Because both total and categorical water demand has undergone a significant decline in the intervening time since this allocation was initially developed in 2009, it is recommended that this schedule and the monthly rationing allotments be revised once demand stabilizes again following the 2014-2015 implementation of residential/irrigation water rationing.

Table 8-4. Water Supply Allocation and Customer Reduction Goals

Normal Peak Season Demand = 2,473 mil gal	No Deficiency		Stage 2 15% Deficiency		Stage 3 25% Deficiency		Stage 4 35% Deficiency		Stage 5 50% Deficiency	
	Delivery		Delivery		Delivery		Delivery		Delivery	
Customer Category:	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)
Single Family Residential	100	1,031	84%	864	73%	753	62%	639	48%	495
Multiple Residential	100	524	87%	454	78%	411	69%	361	55%	287
Business	100	438	95%	416	92%	402	87%	381	70%	307
UC Santa Cruz	100	132	85%	113	76%	100	66%	87	52%	68
Other Industrial	100	23	95%	22	90%	21	85%	20	67%	15
Municipal	100	48	76%	36	57%	27	41%	20	28%	14
Irrigation	100	110	64%	70	34%	37	12%	13	0%	0
Golf Course Irrigation	100	106	73%	78	51%	54	34%	36	20%	21
Coast Agriculture	100	59	95%	56	90%	53	85%	50	67%	40
Other	100	2	95%	2	90%	2	50%	1	50%	1
Total	**100**	**2,473**	**85%**	**2,111**	**75%**	**1,861**	**65%**	**1,607**	**50%**	**1,247**
Demand Reduction %, Million gallons	**0**	**0**	**15%**	**-362**	**25%**	**-612**	**35%**	**-866**	**50%**	**-1,226**

8.3.2 Demand Reduction Measures

The City's Water Shortage Contingency Plan uses a combination of voluntary and mandatory demand reduction measures, which vary depending on level of cutback. As mentioned earlier, the regulations against water waste are in effect in Santa Cruz on a permanent basis. Once a water shortage is declared, however, enforcement of this ordinance is increased and enhanced by the use of fines.

The primary demand reduction measures used in **Stage 1** are to restrict all landscape irrigation to certain hours of the day and to prohibit certain uses defined as non-essential.

The main approach to reducing water use in **Stage 2** involves expanding mandatory water restrictions and limiting landscape irrigation to specified days, times, and durations. Large landscape users are required to adhere to water budgets.

A **Stage 3** water shortage constitutes an emergency situation. The three primary measures to meet this emergency reduction goal are 1) residential water rationing, 2) mandatory water shortage signage in all commercial buildings, and 3) reduced water budgets for large landscapes. Single family residential customers are rationed using a hybrid approach that provides a base allocation for a family of four and an additional amount per person for larger households. Multi-family residential accounts are rationed based on the number of dwelling units at an account.

A **Stage 4** water shortage requires expanding water rationing to cover all water customers, including business, and reducing residential allocations. At this severe level of shortage, only minimal water is available for outdoor purposes.

Stage 5 represents an extraordinary crisis threatening health, safety, and security of the community. It would involve reduced rationing levels for all customers and a ban on outdoor uses to cut back normal water use by half.

A summary of the demand reduction methods and mandatory prohibitions against specific water use practices is provided in Table 8-5.

8.3.3 Publicity and Communications

Effective communication is essential to the success of any water shortage contingency plan in achieving the desired water use reductions. All customers need to be adequately informed about water supply conditions, understand the need to conserve, and know what actions they are being requested or required to take to mitigate the shortage. The full Water Shortage Contingency Plan articulates the City's communications strategy, identifies the main customers and groups that need to be kept updated, advised, and informed, and outlines various communication and public outreach measures to employ in a water shortage. The plan also provides prepared public statements for each of the 5 stages that are intended to help communications stay on message and set the tone for subsequent communications through the duration of the incident.

8.3.4 Operating Actions

The City's Water Shortage Contingency Plan outlines the added responsibilities and internal actions taken Water Department when a water shortage arises. Many represent increased costs to the Department for additional personnel, services, and supplies. An important initial step is to designate a working group consisting of the Water Director and senior staff to lead and manage the Department's internal and external water shortage response. The Water Department then must mobilize the necessary personnel, resources, and equipment to undertake the various activities that are critical to implementing an effective response. These initial actions may include, among other things:

- Establishing water production budgets
- Coordinating with other city departments and affected public agencies
- Establishing a public communications program to publicize use restrictions and to engage and involve the community and key water-using sectors in curtailing their demand
- Ensuring adequate staff and training to effectively respond to customer inquiries and enforce water shortage regulations
- Adapting utility billing format and database capabilities
- Expanding water conservation assistance, outreach, and education
- Instituting a system for processing exception requests and appeals
- Addressing policy issues and updating status with decision makers
- Implementing monitoring mechanisms to track actual usage and measure performance

A summary of these key operating and communications actions is provided in Table 8-5.

Table 8-5. Summary of Demand Reduction Actions and Measures

Water Shortage Condition	Key Water Department Communication and Operating Actions	Customer Demand Reduction Measures
Stage 1: **Water Shortage Alert** **(0-5%)**	• Initiate public information and advertising campaign • Publicize suggestions and requirements to reduce water use • Adopt water shortage ordinance prohibiting nonessential uses • Step up enforcement of water waste • Coordinate conservation actions with other City Departments, green industry	• Voluntary water conservation requested of all customers • Adhere to water waste ordinance • Landscape irrigation restricted to early morning and evening • Non-essential water uses banned • Shutoff nozzles on all hoses used for any purpose • Encourage conversion to drip, low volume irrigation
Stage 2: **Water Shortage Warning** **(5-15%)**	• Intensify public information campaign • Send direct notices to all customers • Establish conservation hotline • Conduct workshops on large landscape requirements • Optimize existing water sources; intensify system leak detection and repair; suspend flushing • Increase water waste patrol • Convene and staff appeals board	• Continue all Stage 1 measures • Landscape irrigation restricted to designated watering days and times • Require large landscapes to adhere to water budgets • Prohibit exterior washing of structures • Require large users to audit premises and repair leaks • Encourage regular household meter reading and leak detection
Stage 3: **Emergency Water Shortage** **(15-25%)**	• Expand, intensify public information campaign • Provide regular media briefings; publish weekly consumption reports • Modify utility billing system and bill format to accommodate residential rationing, add penalty rates • Convert outside-City customers to monthly billing • Hire additional temporary staff in customer service, conservation, and water distribution • Give advance notice of possible moratorium on new connections if shortage continues	• Institute water rationing for residential customers • Reduce water budgets for large landscapes • Require all commercial customers to prominently display "save water" signage and develop conservation plans • Maintain restrictions on exterior washing • Continue to promote regular household meter reading and leak detection
Stage 4: **Severe Water Shortage Emergency** **(25-35%)**	• Contract with advertising agency to carry out major publicity campaign • Continue to provide regular media briefings • Open centralized drought information center • Promote gray water use to save landscaping • Scale up appeals staff and frequency of hearings • Expand water waste enforcement to 24/7 • Develop strategy to mitigate revenue losses and plan for continuing/escalating shortage	• Reduce residential water allocations • Institute water rationing for commercial customers • Minimal water budgets for large landscape customers • Prohibit turf irrigation, installation in new development • Prohibition on on-site vehicle washing • Rescind hydrant and bulk water permits
Stage 5: **Critical Water Shortage Emergency** **(35-50%)**	• Continue all previous actions • Implement crisis communications plan and campaign • Activate emergency notification lists • Coordinate with CA Department of Public Health regarding water quality, public health issues and with law enforcement and other emergency response agencies to address enforcement challenges • Continue water waster enforcement 24/7	• Further reduce residential water allocations • Reduce commercial water allocations • Prohibit outdoor irrigation • No water for recreational purposes, close pools • Continue all measures initiated in prior stages as appropriate

8.4 Prohibitions on End Uses

As identified above, the City's water shortage regulations and restrictions include a variety of temporary prohibitions on various end uses of water, which vary according to the stage of shortage. These prohibitions fall into four main categories:

- Landscape irrigation
- Washing of outdoor surfaces, structures, and vehicles
- Commercial end uses
- Swimming pools, spas and water features

These restriction and prohibitions are summarized in Table 8-6 below:

Table 8-6. Restrictions and Prohibitions on End Uses (continues on next page)

Stage	Restrictions and Prohibitions on End Uses	Additional Explanation or Reference	Penalty, Charge, or Other Enforcement?
1-3	Landscape - Limit landscape irrigation to specific times		Yes
1-3	Landscape - Restrict or prohibit runoff from landscape irrigation		Yes
2,3	Landscape - Limit landscape irrigation to specific days	1-2 days per week	Yes
2-4	Landscape - Other landscape restriction or prohibition	Limit on duration of watering with automatic irrigation systems	Yes
4	Landscape - Prohibit certain types of landscape irrigation		Yes
5	Landscape - Prohibit all landscape irrigation		Yes
3	Landscape - Other landscape restriction or prohibition	within 48 hours of measureable rainfall	
2-4	Landscape - Other landscape restriction or prohibition	Require large landscapes to adhere to water budgets	Yes
4,5	Landscape - Other landscape restriction or prohibition	Prohibit installation in new development	Yes
1-5	CII - Lodging establishment must offer opt out of linen service		Yes
1-5	CII - Restaurants may only serve water upon request		Yes

Stage	Restrictions and Prohibitions on End Uses	Additional Explanation or Reference	Penalty, Charge, or Other Enforcement?
2-5	CII - Other CII restriction or prohibition	Mandatory water conservation plans for large businesses	
3-5	CII - Other CII restriction or prohibition	Business water conservation plans required	Yes
3-5	CII - Other CII restriction or prohibition	Mandatory water waste signage for all business establishments	Yes
1-2	Other water feature or swimming pool restriction	Prohibit initial filling or draining and refilling of residential swimming pools	Yes
2-5	Water Features - Restrict water use for decorative water features, such as fountains		Yes
3	Other water feature or swimming pool restriction	Prohibit initial filling or draining and refilling of all swimming pools	Yes
4-5	Other water feature or swimming pool restriction	Prohibit filling or topping off swimming pools and outdoor spas	Yes
1-5	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner		Yes
1-5	Other - Require automatic shut of hoses		Yes
4-5	Other - Prohibit use of potable water for construction and dust control		Yes
4,5	Other	Prohibit vehicle washing, except at commercial car washes that use recycled water	Yes

8.5 Penalties, Charges, Other Enforcement of Prohibitions

The City's water shortage regulations and restrictions ordinance contains provisions for enforcing water use rules and regulations, and processes for issuing exceptions and hearing appeals. Administrative enforcement methods include the following:

<u>Administrative Penalties</u> These penalties are for failure to comply with water waste prohibitions and mandatory water use restrictions and are applied to the customer's

next utility bill. The object of imposing increasingly significant penalties is to assure compliance by creating a meaningful disincentive to commit future code violations. When a violation occurs, the Water Department first provides a written notice and gives the customer an opportunity to correct the situation. Additional violations are penalized as follows:

2nd Violation $100
3rd Violation $250
4th Violation $500

Large users (defined as using over a million gallons per year) are penalized at triple the amounts listed above.

<u>Excessive Water Use Penalties</u> These penalties are assessed when a customer uses more water in a given billing cycle that their rationing allocation provides. Excessive use penalties are in addition to ordinary water consumption charges, as follows:

1% to 10% over customer rationing allotment:	$25.00/CCF
More than 10% over customer rationing allotment:	$50.00/CCF

In addition to any administrative penalties and excess water use penalties, a flow restrictor and/or discontinuation of service may be ordered for willful violations of the City's water shortage regulations and restrictions ordinance.

The ordinance contains an exception process and that allows the Water Department, upon making specified findings, to provide for special or exceptional circumstances that otherwise would create undue hardship for an individual customer or class of customers. It also allows any water service customer who considers an enforcement action to have been erroneously undertaken to appeal their case before an independent hearing officer. The hearing officer considers the evidence presented by the customer and by the City and decides whether to uphold the enforcement action or to provide relief.

In 2014 and 2015, the City created and administered a "Water School" to provide one-time relief from excessive use penalties in exchange for customers attending a 2-hour evening class about the drought and ways to save water. More than 1,200 penalties totaling over $800,000 were waived through Water School during this time.

8.6 Consumption Reduction Methods

Refer to Section 8.3.2 and Table 8.5 above for a discussion and summary of the primary consumption reduction methods used by the City at various stages of water shortage. The City also implements measures listed in Table 8-7 below:

Table 8-7. Stages of Water Shortage Contingency Plan - Consumption Reduction Methods

Stage	Consumption Reduction Methods by Water Supplier	Additional Explanation or Reference *(optional)*
1-5	Expand Public Information Campaign	
3	Increase Frequency of Meter Reading	The City permanently changed to monthly meter reading in 2014 to facilitate water rationing
1-5	Provide Rebates on Plumbing Fixtures and Devices	Increased marketing of ongoing programs
1-5	Provide Rebates for Landscape Irrigation Efficiency	Increased marketing of ongoing programs
1-5	Provide Rebates for Turf Replacement	Increased marketing of ongoing programs
1-5	Decrease Line Flushing	
1-5	Increase Water Waste Patrols	
5-Mar	Implement or Modify Drought Rate Structure or Surcharge	
NOTES:		

8.7 Determining Water Shortage Reductions

Under normal water supply conditions, water production and gross consumption are recorded daily and monthly by treatment plant operators and reported to the Production Superintendent. Metered water consumption is reported on a monthly basis through automated sales reports generated by the utility billing system.

During a water shortage, a monthly production forecast and budget are developed for each source of supply. Actual production and the lake level are closely monitored on a daily and weekly basis to verify that the budgeted goals are being met. Consumption by large users is monitored and reported on a frequent basis. In severe stages of a water shortage, production and consumption data would be evaluated daily and the status reported to the Water Director's office. If the trend in consumption is such that the rate of drawdown at Loch Lomond is greater than anticipated, the City Manager and Council are notified so that corrective action (such as increased publicity and enforcement or consideration of declaring the next higher stage) can be taken.

Beginning in August 2014, the Water Department began reporting its monthly water production on a statewide database used to keep track of urban water use in response to emergency water conservation regulations. These reports include the amount of potable water produced in the preceding month, an estimate of the gallons of water used per person per day by its residential customers, and various enforcement statistics. This reporting is expected to become a permanent requirement in 2016.

The University of California, the City's largest customer, closely tracks its consumption on campus and meets regularly with the City to ensure it is meeting its reduction target.

Figures 8-1 and 8-2 below show two examples of charts used by the Water Department to track production and water savings goals in the 2014 and 2015 drought and to publicize the community's success in meeting water reduction goals.

Figure 8-1. 2015 Water Production Goals (mgd)

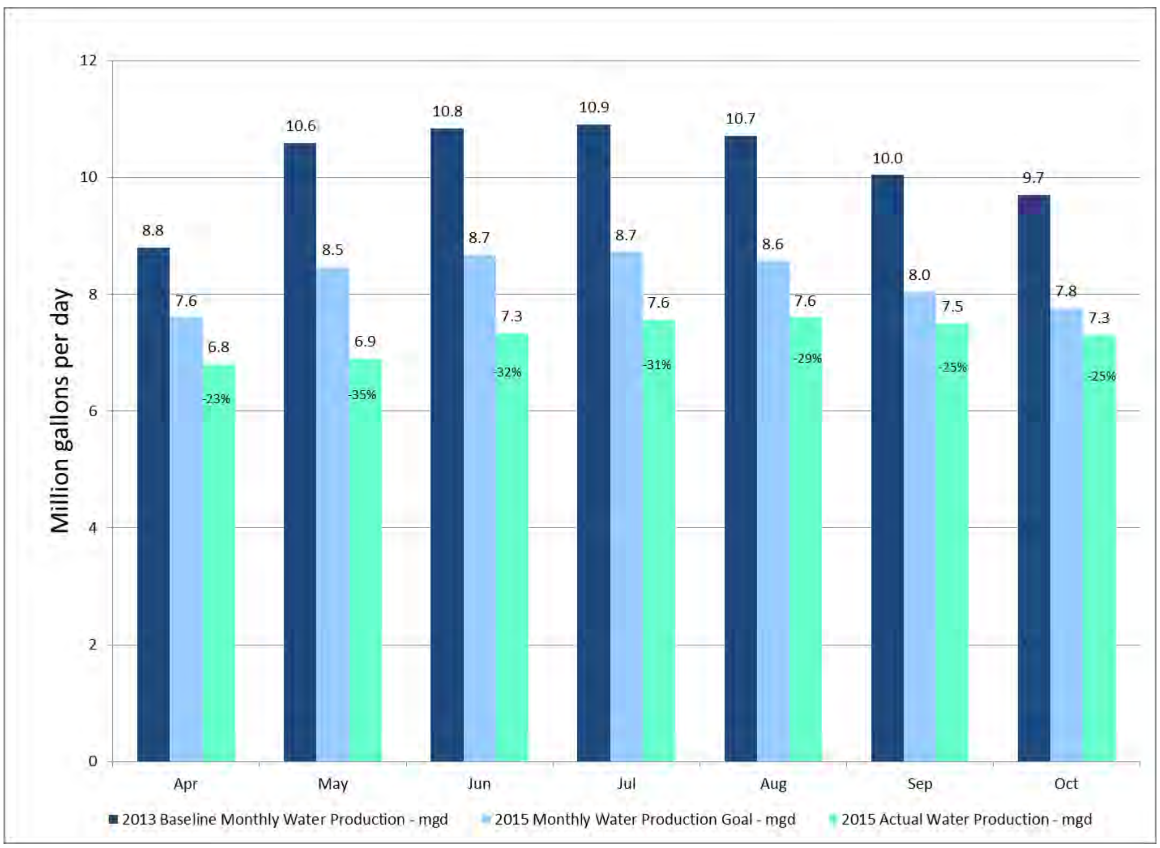
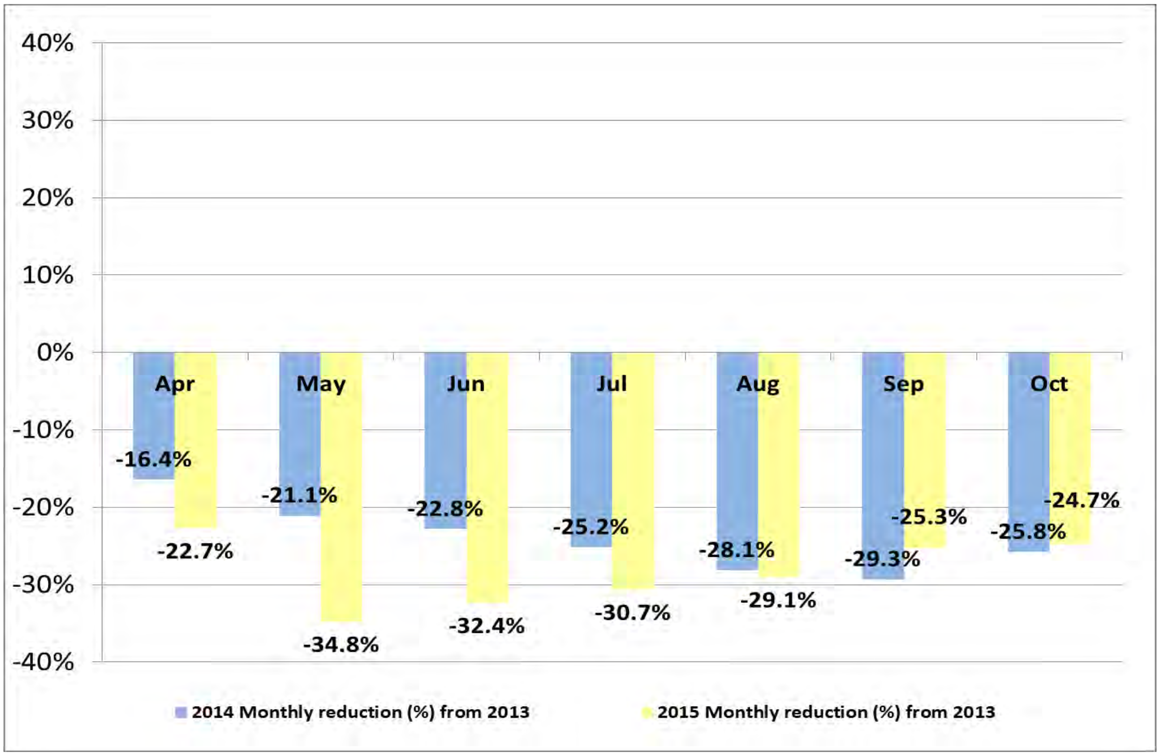


Figure 2. Monthly Water Savings Compared to 2013 (%)



8.8 Revenue and Expenditure Impacts

One of the negative consequences of using demand reduction to deal with water shortages is the corresponding reduction in revenue that occurs to the City's Water Fund as a result of reduced water sales. The full plan provides an analysis of the magnitude of revenue losses that the Water Fund might experience for each of the five stages, based on annual revenues at the time of just over $22 million.

The analysis assumes the "ready-to-serve" or fixed monthly service charge that is based on meter size would remain unaffected while the volumetric portion of the Department's revenue derived from water sales would vary by customer class in accordance with the allocation presented in Table 8-4 over the seven month period in which water shortage regulations are likely to be in effect.

The analysis shows revenue losses ranging from just under $0.6 million in a 5 percent water shortage situation to almost $5.8 million in a critical 50 percent water shortage. These estimates of losses were considered ballpark figures only and probably underestimate the problem. Actual revenue losses would be different for the following reasons:

- The spreadsheet did not model the effect of tiered pricing in the single family residential category, which would exacerbate revenue losses from this group;
- It is unlikely that system water use would immediately recover to normal levels in the months following a period of curtailment as modeled, thereby further depressing income;
- The table above does not include added operating costs of staff, equipment, and materials related to the water shortage response.

On the other hand, the time of year in which regulations would take effect is spread over two fiscal years, so the full effect of revenue losses of a single year drought would not impact the Department's annual budget to such a large degree. In addition, there would be relatively minor cost savings associated with reduced power and chemical usage at the Graham Hill water treatment plant, ranging from <$0.1 million in Stage 1 to about $0.4 million in Stage 5. Finally, some of the revenue loss would be offset by penalty and/or excess use fees. On the expenditure side, the major expense of implementing the water shortage plan identified was for added personnel costs for temporary field and office positions, which were estimated to range from approximately $100,000 in Stage 1 to $600,000 in Stage 5, and power cost for pumping water from Felton to Loch Lomond.

The Water Department's total annual revenue has increased somewhat since the Water Shortage Contingency Plan was prepared in 2009, but the actual revenue impact of the recent drought was fairly close to the $2.9 million projected annual loss estimated for Stage 3.

To address this problem, the City in 2014 instituted a new Drought Cost Recovery Fee, which is a surcharge that is automatically triggered by City Council action declaring a water shortage and continues through the end of the fiscal year following the shortage (Appendix N). The fee is a fixed monthly amount that varies by meter size and stage of shortage. It is designed to mitigate the risk of revenue shortfalls associated with usage curtailment events. The maximum targeted cost recovery amount ranges from $1.0 million in Stage 1 to $7.5 million in Stage 5. Table 9-4 below shows the Drought Cost Recovery fees in effect in 2015 and 2016.

Table 8-8. Drought Cost Recovery Fee Rate (2015)	
Meter Size	Inside & Outside City (monthly)
5/8 & 3/4"	$7.37
1"	$18.43
1.5"	$36.85
2"	$58.96
3"	$110.55
4"	$184.25
6"	$368.50
8"	$847.55
10"	$1,046.54

8.9 Resolution or Ordinance

The City's water shortage regulations and restrictions were adopted as an ordinance and codified as Santa Cruz Municipal Code Chapter 16.01 (Appendix M). The water shortage regulations and restrictions were last updated in early 2015.

8.10 Plan Evaluation

In 2009, after a year's experience implementing a Stage 2 Water Shortage Warning, Water Department staff prepared a report to document the response and compile records for future reference. This report, entitled: The 2009 Water Shortage: An Evaluation of Water Management Strategies, Actions, and Results evaluates which aspects of the plan succeeded and which didn't, and why, and makes recommendations and refinements to the plan for the next time a water shortage occurs. Much progress was made with putting enforcement systems, procedures, and tools in place that were not in place prior to 2009 and will help in future events. Even so, there were numerous lessons learned from this experience and several areas where improvements could be made to better manage water shortages in the future.

It is recommended that the Water Department conduct a similar review and prepare an "After Action" report based on the lessons learned during the recent 2014/15 Stage 3 Water Shortage Emergency.

8.11 Catastrophic Supply Interruption

CWC 10632

(a)(3) *Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.*

The City plans for and responds to emergency incidents, including floods, earthquakes, fires, and hazardous materials incidents in accordance with the Santa Cruz County Operational Area Memorandum of Understanding (MOU). The MOU ratifies local government agreements to follow the Standardized Emergency Management System or SEMS, as mandated under California law. The City maintains an Emergency Management Plan, which defines and describes the emergency management organization and guides the response of appropriate personnel to a major emergency. The City Manager, functioning as the City's Director of Emergency Services, would coordinate the emergency response to maintain water delivery and/or restore service as necessary. The Emergency Management Plan also addresses the integration and coordination with other government agencies and levels when required.

The Water Department maintains a mutual assistance agreement with other water agencies through the Water/Wastewater Agency Response Network (WARN) to share equipment, personnel, and supplies in times of an emergency. The City is within the California Office of Emergency Services Coastal Region II, which includes the counties in the San Francisco Bay region and northern California coast.

The Water Department has its own **General Emergency Plan and Emergency Response Plan for Terrorist Activity and Natural Disasters** in accordance with state and federal laws. This document sets forth the primary objectives of the Department in an emergency as follows:

- Maintain water service for domestic and firefighting purposes,
- Protect the water supply from possible contamination,
- Control the loss of water, and
- Keep the public informed

The plan outlines the roles and responsibilities of key Departmental personnel during an emergency at both the City Emergency Operations Center and Water Department

Operations Center. It also describes general actions to be taken to 1) assess situation status and extent of damage to the water system, 2) prevent contamination and loss of water, and 3) restore water service in response to the following types of emergencies:

- Earthquake
- Tsunami
- Flood
- Fire
- Suspected Contamination of Water Supply
- Civil Disorder
- Power Outage
- Treatment Plant Failure
- Damage to Distribution Storage Reservoirs or Booster Pumping Station
- Telecommunications Failure

The plan contains an emergency water rationing plan intended to preserve treated water supplies in the event a catastrophe results in impairment of the water system. The emergency rationing plan has two stages, which are defined as follows:

Serious shortage: This condition exists when the system is unable to meet normal demand, but can supply enough water for basic public health and safely needs. In this situation, not taking swift action to ration water could jeopardize available water in storage, or could leave the City vulnerable in the event of further outages.

Critical shortage: This condition exists when production facilities are rendered incapable of meeting 50% or less of normal daily production levels and the current rate of consumption poses an immediate threat of draining Bay Street reservoir or other storage tank.

The restrictions that would be instituted in a serious or critical shortage are summarized in Table 8-9.

The City has four portable auxiliary generators to run booster pumps in case of an extended power outage. In addition, the treatment plant and major pump stations have stationary diesel-powered electrical generators as a stand-by source of power in case of a local or regional power outage.

Table 8-9. Emergency Water Rationing Plan	
Serious Shortage	
Prohibited Uses:	*Permitted Uses:*
1. Watering lawns, gardens or landscaping 2. Washing cars, boats, building exteriors 3. Washing sidewalks, driveways, or any exterior surfaces 4. No outdoor use for any reason 5. Car washes closed 6. Watering plants at nurseries, garden centers 7. Filling of swimming pools, hot tubs, decorative pools, or fountains (must be turned off) 8. Public showers closed	1. Normal domestic uses: drinking, cooking (paper plates and plastic utensils requested) 2. Toilet flushing, only when necessary 3. Limit showers to three minutes 4. Bathing only if absolutely necessary (no more than half full) 5. Minimize clothes and dish washing
Critical Shortage	
Prohibited Uses:	*Permitted Uses:*
1. Outdoor water use for any reason (garden, landscape, car washing, cleaning, maintenance) 2. Clothes washing and commercial laundering, except for health reasons 3. Janitorial cleaning 4. Businesses and institutions that use water in their operations may be forced to close or restrict operations: - Restaurants, bars, and coffee shops - Laundromats - Public and Private Schools - Manufacturing - Gyms and health spas - Beauty salons and barber shops 5. No water for construction 6. No water for crop irrigation	1. Water limited to health and safety only: drinking and cooking (paper plates and plastic utensils required) 2. Toilet flushing for solid waste only 3. Shower/bathing should be limited to every other day 4. Use water only when absolutely necessary

A separate Emergency Response and Public Notification Plan was developed in 2007 in anticipation of the deconstruction of Bay Street Reservoir. As part of this plan, communication and standard public notification procedures were put in place in the event a water emergency arose. This plan included developing the capability to trigger an automated call-out notification system (Reverse 911) to rapidly disseminate a generalized water emergency warning throughout the Santa Cruz water service area.

Finally, the Water Department has separate earthquake response procedures that outline responsibilities for inspection and reporting the status of critical structures, including Newell Creek Dam and other major water production facilities following an earthquake.

8.12 Minimum Supply Next Three Years

CWC 10632

(a)(2) *An estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply.*

For this exercise, it is assumed that the next three water years spans the period 2016-2018. For water year 2016, more than half the year has already passed and conditions are fairly well known. The reservoir is currently at full capacity and the water year is classified as Normal. Accordingly, no water shortage is expected for the remainder of the 2016. It is assumed that the supply available under this circumstance is the same as in an Average year as listed in Table 7-1. But because system water demand continues to be low, the total annual supply available, 3.2 billion gallons, likely overstates actual production the City expects to see through the remainder of 2016.

For 2017 and 2018, water conditions are assumed to be as dry as they were in 1976 and 1977, corresponding with the first two years of the 3-year, multiple dry year sequence listed in Table 7-1. The supply available for those two years is substantially lower, and would likely require significant cutbacks to balance supply and demand, especially in 2018. For 2017, a production level of 2.4 billion gallons is close to what the City actually experienced in 2015 with a declared Stage 3 Water Shortage Emergency in place. For 2018, an annual production level of 1.9 billion gallons would represent a critical water shortage emergency and require a tough decision about whether to tap the 1.0 billion gallon reserve in Loch Lomond Reservoir to meet essential public health needs.

Table 8-10. Minimum Supply Next Three Years (mg)

	2016	2017	2018
Available Water Supply	3,252	2,430	1,969

NOTES: Reference Table 7-1.

Chapter 9

DEMAND MANAGEMENT MEASURES

The City of Santa Cruz has long recognized the importance of conserving water as a responsible demand management strategy to help protect the area's natural resources, to stretch existing water supplies, to help downsize and/or delay the need for costly additional water supply, treatment, and distribution upgrades, and to fulfill the City's overall goal of ensuring a safe, reliable, and adequate water supply. This section describes the water demand management measures (DMMs) currently being implemented by the City and discusses the City's water conservation planning process that will guide water conservation activities over the next decade and beyond.

In June 2001, the City of Santa Cruz became a signatory to the MOU Regarding Urban Water Conservation in California and joined the California Urban Water Conservation Council (CUWCC) in promoting water conservation locally and statewide. By becoming a signatory, the City committed to implementing all 14 urban water conservation Best Management Practices (BMPs) contained in the MOU deemed to be locally cost-effective and to periodically report progress made to the CUWCC.

9.1 Demand Management Measures for Wholesale Agencies

The City of Santa Cruz currently is not a wholesale water supplier nor does it receive water from a wholesale agency. This requirement does not apply to the City.

9.2 Demand Management Measures for Retail Agencies

9.2.1 Water Waste Prevention Ordinances

The definition of water waste prevention under the MOU consists of enacting, enforcing, or supporting legislation, regulations, ordinances, or terms of service that prohibit water waste in new development and by existing users, or that facilitate implementation of water shortage response measures.

The City's water conservation ordinance (Santa Cruz Municipal Code 16.02) has been in operation since 1981 and was updated last in 2003 (Appendix O). Under the ordinance it is unlawful for any person to use water for any of the following:

- unauthorized use of water from a fire hydrant,
- watering of landscaping in a manner or to an extent that allows excess water running off the property,
- allowing plumbing leaks to go unrepaired,
- outdoor washing of structures, vehicles, or surfaces without the use of an automatic shut-off nozzle, and
- operation of a fountain unless water is recycled

Provisions of the ordinance regulating new development include prohibitions on:

- The use of water in new ice-making machines and any other new mechanical equipment that utilizes a single pass cooling system to remove and discharge heat to the sanitary sewer,
- washing of vehicles at a commercial car wash unless the facility utilizes water recycling equipment
- the use of water for new non-recirculating industrial clothes wash systems, and
- the use of potable water for dust control or soil compaction purposes in construction activities where there is a reasonably available source of reclaimed water appropriate for such use

The ordinance is in effect at all times and is upheld mainly through communication with the responsible customer. However, during mandatory water restrictions, violations of the water waste ordinance are enforced first by a warning and then by progressive series of fines ranging from $100 up to $500 and levied on the utility bill. Under a declared water shortage, field staff actively patrols the water service area to enforce restrictions, including water waste violations, seven days per week.

The public is also encouraged to report water waste, either by calling the Water Conservation Office's designated "leak line" (831 420-LEAK) or reporting water waste through the City website. When water waste is observed, site visits, in-person customer contact, phone, and/or mail correspondence is used to resolve the issue. Field staff will increase drive-by checks of sites receiving water waste complaints to help ensure the issue was resolved. New software was acquired in 2009 to help document, track and manage water waste complaints, including the photo evidence of water waste incidents. Since then, the City documented and addressed over 6,000 cases with this software.

Water waste prevention is also implemented through the City's Landscape Water Conservation Ordinance (Santa Cruz Municipal Code Chapter 16.16) to ensure landscapes and irrigation systems in new and renovated development are designed to avoid runoff, overspray, low-head drainage and other similar conditions where water flows off site onto adjacent property.

9.2.2 Metering

All of the City's 24,534 water connections are fully metered with most using Automated Meter Reading (AMR) technology. Approximately 15 percent of all City water meters are now connected with Advanced Metering Infrastructure (AMI) technology, allowing access to hourly meter reads. Water meters are required for all new service connections. In addition, a separate, dedicated irrigation meter is required for all new and renovated multi-family and commercial landscape projects with over 5,000 square feet of landscaped area.

All meters are read and billed monthly according to the volume of water consumed. Monthly billing was first instituted inside the City in 2005 mainly to facilitate rising rates for all City utilities, but it also served in aiding in leak detection and allowing for more accurate monitoring of individual account usage and categorical water consumption. Outside City customers were later transitioned to monthly billing in April 2014 to facilitate water rationing.

As a member of the CUWCC, the City undertook two actions required under BMP 1.3 regarding metering. First, the Water Department in 2010 adopted a new Meter Testing, Repair, and Replacement Policy that accelerated large meter replacement and should help improve overall meter accuracy. In 2013, the Water Conservation Office completed a feasibility study to assess the merits of a program to switch mixed-use commercial accounts that have substantial irrigation demands by installing a dedicated landscape meter. Of the almost 1,900 commercial properties analyzed, only nine sites, mostly schools, were identified as potential commercial candidates meriting retrofitting or future sub-metering.

9.2.3 Conservation Pricing

The Customer Service section, also referred to as "Santa Cruz Municipal Utilities," provides customer service and handles utility billing for water, sewer, refuse, and recycling services to the residents and businesses of the City of Santa Cruz, and services for water only to the unincorporated surrounding areas and part of the City of Capitola.

The water portion of the City's utility bill consists of three components: 1) a fixed, monthly "Readiness-to-serve" charge, 2) a volumetric charge, and 3) for customers residing in elevated pressure zones, an elevation charge applies.

The current Readiness-to-serve charge varies by meter size and location (Table 9-1).

Table 9-1. Readiness to Serve Charges (2015)

Meter Size	Inside City (monthly)	Outside City (monthly)
5/8 and 3/4"	$21.08	$26.87
1"	$52.67	$67.16
1.5"	$105.34	$134.29
2"	$168.52	$214.86
3"	$315.99	$402.88
4"	$526.65	$671.47
6"	$1,053.27	$1,342.91
8"	$2,422.49	$3,089.55
10"	$2,991.23	$3,813.84

For the volumetric charges, the City has had a multi-block, inclining rate structure in place for single family residential customers since 1995. In 2004, following a comprehensive water rate study, a five-tier rate structure was adopted that applies to residential accounts with either one or two dwelling units. The current rates are listed in Table 9-2. For all other customers, including multi-family (3 or more dwelling units), business, industrial, municipal, and irrigation customers, water is billed at a uniform rate corresponding with Block 2.

Table 9-2. Single Family and Two-Unit Residential Water Rate Structure (2015)

Block	Category	Inside City (monthly)		Outside City (monthly)	
		Units	Rate	Units	Rate
1	Essential needs	1-4 ccf	$1.91	1-4 ccf	$2.42
2	Average indoor needs	5-9 ccf	$4.84	5-9 ccf	$6.18
3	Average outdoor needs	10-14 ccf	$6.23	10-14 ccf	$7.94
4	High use	15-18 ccf	$8.54.	15-18 ccf	$10.87
5	Inefficient or excessive use	>18 ccf	$10.64	>18 ccf	$13.58

Customers in elevated pressure zones also pay an elevation surcharge of $0.20/CCF for the cost of being served by an elevated storage reservoir.

In August 2014, the Santa Cruz City Council adopted an annual 10 percent water rate increase over the next five years to complete several critical infrastructure projects. These projects included: Phase 3 of the North Coast System pipeline ($10 mil), rehabilitating and replacing six filter basins at the Graham Hill Treatment Plant ($6 mil), converting the Bay Street Reservoir to two modern, 6-million gallon tanks ($25 mil), annually replacing 2-4 miles of aging main, and rehabilitated storage tanks, pumps, and completing the Beltz 12 well project. All utility rates and rate change proposals are established by resolution of the City Council. See Appendix P for the 2014 Notice of Proposed Rate Changes.

The City of Santa Cruz is currently in the process of developing a long-range, 10-year financial plan and undertaking a new, 5-year rate study to support the Department's ongoing operations and planned capital improvement programs (Appendix Q). Capital projects during the first five years will be focused on system rehabilitation and replacement projects. Major investments to implement the Water Supply Augmentation Strategy are anticipated to occur in the second five years of the financial planning horizon. The new rate study is expected to be completed in fall 2016. Table 9-3 shows the recommended rate design proposed to meet both conservation pricing and other pricing objectives.

Table 9-3. Recommended Basic Rate Structures for Customer Classes

Customer Category	Basic Rate Structure
Single Family Residential	Keep inclining rates but reduce both tier width and number of tiers
Multi-Family Residential	Change from uniform to tiered rates based on number of dwelling units
Commercial/Municipal/UCSC	Maintain uniform rate structure
Landscape Irrigation	Transition all irrigation accounts to a simple water budget-based rate
North Coast Agriculture	Maintain uniform rate structure

The rate structure being recommended will move from one that collects about 65 percent of revenue in volume charges (based on the amount of water used) to one that collects about 90 percent of revenues from volume charges. Other planned changes include:

- Establishing an Infrastructure Reinvestment Fee that will collect the funding needed to support pay-as-you-go capital and debt service costs. The fee would be collected as a separate charge based on water use.

- Establishing a $1.00/CCF surcharge on water use beginning in July 2017 to increase the Department's Rate Stabilization Fund. This fund would be used to mitigate the potential revenue instability associated with the recommended rate structure, and augment revenues in normal years should consumption fall below a level of 2.5 billion gallons per year.

- Retaining the existing Drought Cost Recovery Fees that are triggered by a City Council declared water shortage and would be collected as a fixed charge for the full fiscal year.

The financial plan and recommended rates are needed to ensure the long-term financial health of the utility, and enable the Water Department to support ongoing operations and maintenance of the water system and make the capital investments required to comply with regulations, rehabilitate and replace aging infrastructure. The notice of proposed new rates that would go into effect starting in October 2016 is included as Appendix R.

9.2.4 Public Education and Outreach

The City of Santa Cruz Water Department actively values and promotes public awareness and education about the City's water resources and the importance of water conservation. The City of Santa Cruz disseminates information to the general public in different forms including: 1) media, 2) workshops and community events, 3) billing and customer service, and 4) school education programs.

The City uses media coverage in order to broadly share information and updates on events, programs, and news to the public in the following ways:

- "SCMU Review", utility newsletter which includes news and information on water conservation topics;
- City of Santa Cruz Water Conservation website;
- Water Supply Advisory Committee website;
- Formal water supply outlook published three times a year sharing the water conditions/ supply availability;
- Weekly water conditions webpage;

- Paid advertising in local newspapers;
- Opinion page coverage;
- Marketing and advertising of EPA's "Fix a Leak Week"; and
- Television and radio news interviews and community television programs.

In addition, the City uses workshops and community events to engage and interact with the public by the following:

- Public meetings and speaking events to community organizations, industry and homeowners associations, and service groups;
- Tabling at local fairs, farmers markets, and events;
- Participation in regional water forums;
- Participation with other local water agencies in local events and sponsorships of water conservation-related activities;
- Free workshops on irrigation efficiency, new irrigation technologies, and water conservation strategies for the landscape; and
- Financial support to the Green Gardener Program, California Water Awareness Campaign, Water-Smart Gardening Faire, Green Business Program, and the Water Education Foundation.

The City of Santa Cruz also uses a personable approach to public education and outreach through billing and customer service, which includes the following:

- Marketing and distribution of free water conservation devices and literature;
- Marketing of rebates and distribution of rebate applications;
- Bill inserts;
- Field representatives showing customers how to read their meter and check for leaks at their properties;
- Partnership with the Monterey Bay Area Green Business Program;
- Messages and information on customer's bills showing daily consumption and a graph charting monthly consumption for the entire year; and
- Water supply tours.

The City offers school education activities for students ranging from upper elementary age children up to the University level. The program gives students an opportunity to learn about the City's water supply system and water conservation. School educational activities include:

- Field trips and ranger presentations at Loch Lomond Reservoir and San Lorenzo River;
- Loch Lomond Trout in the Classroom fish release field trip;
- Distribution of age and grade level appropriate curriculum and educational materials, including a water education booklet specially developed for Santa Cruz County students;
- Classroom presentations; and
- High School Watershed Academy program.

9.2.4.1 Water School

In summer 2014, the City of Santa Cruz Water Department started hosting Water School as a result of rationing and curtailment during a declared water shortage. Residential customers were required to stay within their assigned allotment or pay an excessive use penalty for each additional unit of water used over their allotment. Water School served as a one-time opportunity for customers who exceeded their monthly allotment to dismiss their penalty by attending a two-hour class session held at the local community center. The session was followed by a short quiz and a survey for feedback and additional questions. The class curriculum consisted of an overview of the City water system, statewide and local drought conditions, Santa Cruz Municipal Utility (SCMU) services, water use regulations and restrictions, and water conservation strategies to practice at home and outside. The purpose of water school was to educate customers about the water shortage and local impacts, show customers support, empower customers to conserve and think critically about their own usage, and prevent customers from exceeding their allotment in the future. The City's Water School curriculum was used as a model in the CUWCC's Water Shortage Toolkit for other water agencies starting their own water schools. In 2014, the city held 27 classes for 702 customers, which collectively waived $462,050 in penalties. In 2015, there were 14 classes for 461 customers, which dismissed $266,760.

The City of Santa Cruz also offered a separate Water School for large landscape account that exceeded their water budget created from landscape water budget software, Waterfluence. The landscape water school shared some elements with the residential water school curriculum and included tips on how to use Waterfluence effectively and communicate with different staff or stakeholders. In 2014, 28 irrigation customers attended and dismissed $40,375. In 2015, a pre-rationing water efficient workshop was offered to prepare irrigation accounts for rationing where 19 customers attended. The 2015 landscape water school consisted of 20 customers and dismissed $34,850 in excessive use penalties.

9.2.4.2 Water Supply Advisory Committee

In 2015, City Council created the Water Supply Advisory Committee to engage the community in an examination of water supply issues. The Committee consisted of 14 members of the community who represented various interests including the environment, business, education, and the Water Commission. The Water Supply Advisory Committee offered meetings, forums, and other opportunities for the public to learn, engage, and share their opinions about the future of Santa Cruz's water supply. In addition, the City invited the public to attend a series of Enrichment Session installments with different topics including climate change, groundwater, water reuse and more. The goal for these forums and workshops was to bring transparency and collaboration to the community regarding decision-making of water supply alternatives for the City of Santa Cruz.

9.2.5 Programs to Assess and Manage Distribution System Losses

As mentioned in section 4.4, the Water Conservation Office has conducted an annual water audit of the City's water distribution system since 1997 using the approach described in the AWWA M36 "Manual of Water Supply Practices". The purpose of the audit is to quantify how much water and revenue is lost through physical leaks and apparent losses and to identify steps to minimize system losses and improve the operational efficiency of the water system. Beginning in 2006, the City also began to use the water balance approach developed through the International Water Association (IWA), now advocated by AWWA, to better characterize water losses in the distribution system.

Water audit results indicate average system water loss from 1997 to 2014 is approximately 7.5 percent of total treated water production or 266 mgy. Of this amount, it is estimated that 5 to 6 percent (198 mgy) is lost due to physical leakage in the distribution system, also referred to as "real" losses, including leaking service lines, valves, fittings, and water mains. It is estimated that another 1 to 2 percent (68 mgy) is not physically lost but goes unreported on the billing system primarily due to sales meter inaccuracies, billing and accounting errors, and other factors. This second category of losses, labeled "apparent" losses, has a negative impact on both utility revenue and on consumption data accuracy.

In 2015, the City contracted with Water Systems Optimization, Inc. (WSO) to examine the City's water system and operations practices, validate where losses are occurring, evaluate options, and set forth a formal strategy to improve water accountability and reduce lost water. WSO's proposed scope of work is organized into three tasks, involving the following elements:

1. Water audit validation, to assess the accuracy of the system input meters and data transfer systems, and to perform a business process review of meter testing, reading, and billing activities;

2. Component analysis of real losses, to quantify the volume of different types of leaks and determine the economic level of leakage – the balance between the value of the water that is lost through leakage and the cost of finding and fixing leakage or reducing leakage through pressure management; and

3. Water loss control program design, to outline the most cost-effective strategies for reducing both real and apparent losses over time.

Results of the 2014 water audit that was validated as part of the project are summarized in Figure 9-1.

Figure 9-1. 2014 Water Balance

<table>
<tr><td rowspan="8">Water from Treatment Plant
2,416 MG</td><td rowspan="11">Water Supplied
2,603 MG</td><td rowspan="4">Authorized Consumption
2,355 MG</td><td rowspan="2">Billed Authorized Consumption
2,344 MG</td><td>Billed Metered Consumption
2,343 MG</td><td rowspan="2">Revenue Water
2,344 MG</td></tr>
<tr><td>Billed Unmetered Consumption
1 MG</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption
11 MG</td><td>Unbilled Metered Consumption
7 MG</td><td rowspan="9">Nonrevenue Water
259 MG</td></tr>
<tr><td>Unbilled Unmetered Consumption
4 MG</td></tr>
<tr><td rowspan="7">Water Losses
248 MG</td><td rowspan="3">Apparent Losses
47 MG</td><td>Unauthorized Consumption
6 MG</td></tr>
<tr><td>Customer Metering Inaccuracies
41 MG</td></tr>
<tr><td>Systematic Data Handling Errors
0 MG</td></tr>
<tr><td rowspan="4">Real Losses
201 MG</td><td>Leakage on Mains</td></tr>
<tr><td rowspan="3">Water from Wells
187 MG</td><td>Leakage on Service Connections</td></tr>
<tr><td>Leakage on Appurtenances</td></tr>
<tr><td>Leakage and Overflow at Storage Tanks</td></tr>
</table>

The recommendations produced from this year-long study will be used to guide development of a robust water loss control strategy and will serve as a foundation for completing and reporting future annual water audits to the state beginning in 2017 under the requirements of SB 555 of 2015.

Currently, the Water Department addresses physical leakage by expediting leak repairs on service connections and mains, and by performing service line and water main replacements on an ongoing basis. The Water Department budgets a total of about $1.25 million annually in its capital improvement program for water main replacement projects. Although a formal leak detection program is currently not in place, the Water Department uses sonic leak detection equipment to locate and repair leaks in the water system. In addition, the Department monitors for leaks on the customer's side of the meter by reviewing exception reports for high meter readings. Customers are notified so they can take appropriate action to repair leaks, even before they receive their water bills.

9.2.6 Water Conservation Program Coordination and Staffing Support

The Water Conservation section is responsible for promoting efficient water use and implementing management practices that reduce customer demand for water. This section consists of the Water Conservation Manager, one Water Conservation Analyst, and two Water Conservation Representatives. The Water Conservation Manager is responsible for planning, organizing, and directing the operations of the Water Conservation section and for reporting on BMP implementation. The Water Conservation Manager meets regularly with the Water Director and senior managers to coordinate conservation activities with the administration, engineering, production, distribution, and customer service sections. The Water Conservation Analyst and Water Conservation Representatives are responsible for operating existing programs and assisting with new program development.

9.2.6.1 Water Conservation Program Responsibilities and Activities

The responsibilities and major activities fall into the following four general categories:

<u>Public Awareness and Education</u>: to promote public awareness and education about the City's water resources and the importance of water conservation; and to provide timely and accurate information to utility customers and the general public about conservation practices and technologies, as well as the City's conservation programs and policies.

<u>Water Demand Monitoring</u>: to monitor water production, consumption and system water losses; to track weather and population data; to evaluate trends in per capita water use; to track demand associated with new service connections; to compare actual water demand with projected use by customer category; and to develop and support water demand forecasts for the water service area for use in supply planning.

Long-Term Water Conservation Programs: to develop and implement various conservation projects and programs that result in a sustained reduction in customer water demand; to track water savings from ongoing conservation programs; and to evaluate the need for program modifications to improve efficiency, customer service, and water savings in keeping with conservation goals.

Planning and Emergency Management: to periodically update and implement the City's Water Shortage Contingency Plan and the Urban Water Management Plan, and to assist in Departmental and City-wide emergency planning and management activities.

Between 2012 and 2015, drought management became the section's primary function, which dramatically accelerated public education and outreach activities as well as public interest and participation in long-term conservation programs.

9.2.6.2 Program Funding

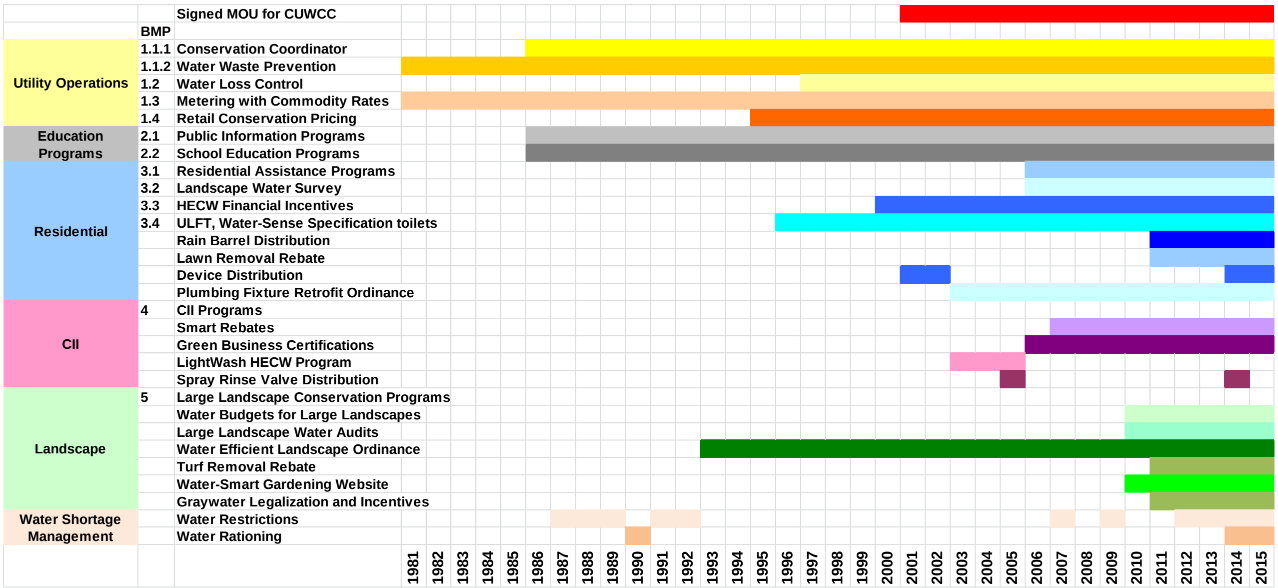
The City's water conservation program is funded by a combination of water rates, system development charges, and miscellaneous service fees. With regard to water conservation, revenues from system development charges are used primarily for various rebate programs, including residential and commercial toilets, urinals, clothes washers, Smart Rebates, and more recently, lawn removal rebates, which account for the majority of long-term water savings generated each year. The total amount resources budgeted for the Water Conservation Section in FY 2017 is $1.1 million.

9.2.7 Other Demand Management Practices

As a member of the California Urban Water Conservation Council, the City of Santa Cruz is implementing all the CUWCC's Best Management Practices. These demand management measures apply to all customer types including residential, business, and landscape accounts. Figure 9-2 below provides a summary and timeline of past and current water conservation activities, organized in accordance with the MOU.

The nature and extent of these measures are described below.

Figure 9-2. Timeline of Past and Current Water Conservation Activities



9.2.7.1 Demand Management Measures for Residential Customers

Residential water use constitutes almost two thirds of system consumption and therefore is a main focal point of the City's water conservation efforts. The residential water conservation programs consist of the following: 1) Home Water Survey Program, 2) High Efficiency Clothes Washer Rebate Program, 3) Toilet Rebate Program, 4) Laundry to Landscape Rebate Programs, 5) Rain Barrel Program and 6) Plumbing Fixture Retrofit Ordinance.

The Home Water Survey program is a free service offered to single and multi- family residences and consists of reviewing billing and consumption information, showing how to read a meter and detect leaks, inspecting home plumbing fixtures and offering free showerheads, faucet aerators, and rebate forms. The survey also assesses outdoor water use and needs by checking the irrigation system and timer, and evaluating the landscape area, design, and plants. Although home water surveys are not in high demand – only 124 were performed in the last five years - they play an important role in providing education and customer service.

The High Efficiency Clothes Washer Rebate program offers $100 for the purchase and installation of an Energy Star clothes washer to single and multi-family (non-communal laundry) residences. The City will soon be modifying the rebate program to offer an additional $100 for Energy Star Most Efficient models. The Energy Star Most Efficient models have the lowest water factor and energy factor of all clothes washers. In addition, only these models qualify for a rebate through PG&E. By increasing the rebate amount for these specific models, the City is hoping to encourage customers to use clothes washers that have the lowest water factors. Between 2011 and 2015, the City approved rebates for about 3,000 water efficient clothes washers saving an estimated 25 million gallons per year.

The City has operated a rebate program to promote the installation of ultra-low-flush or high efficiency toilets in residential accounts since 1995. The program originally featured a $75 rebate as a financial incentive for customers to remove their higher-volume toilets and replace them with 1.6 gallon ultra-low-flush toilets. This $75 rebate was discontinued in 2010. The City's current toilet rebate program offers $150 rebate for toilets meeting Water Sense criteria of 1.28 gallon per flush maximum. Eligibility requirements depend on the flush volume of the toilet that customer is replacing. Older, higher usage toilets of 3.5+ gallons per flush are eligible with the replacement of a high efficiency toilet of 1.28 gpf or lower. Customers who have toilets less than 3.5 gallons per flush must install ultra-high efficiency toilets of 1.0 gallons per flush or less to be eligible. In the last five years, 2,257 water efficient toilets were installed under the program saving approximately 14.7 million gallons of water annually.

The City also offers a Laundry to Landscape rebate of $150 to customers who install a laundry to landscape greywater system and attend a workshop offered by Central Coast Grey Water Alliance. The requirement to attend a workshop is intended to ensure systems are installed in accordance with guidelines listed in the CA plumbing code. The program has attracted only very sporadic participation though.

The Rain Barrel Program currently offers a 50-gallon rain barrel catchment system at a subsidized rate of $50 per barrel. Customers are able to order online during the rainy season from Rainwater Solutions to reserve rain barrels for the upcoming distribution event. Several distribution events are held during the rain barrel sale for customers to pick up their orders at the City's corporation yard. At the beginning of the program in 2010, rain barrels were delivered to customers' homes, but this has since changed due to increased customer interest. A total of more than 4,000 rain barrels have been sold since then saving about 0.8 mgy.

In 2003, the City adopted a plumbing fixture retrofit ordinance, codified as Santa Cruz Municipal Code Chapter 16.03. This regulation requires that all residential, commercial, and industrial properties be retrofitted with low consumption showerheads, toilets, and urinals when real estate is sold. As part of the initial program implementation, the City worked closely with the County of Santa Cruz and the City of Capitola to have similar ordinances passed in these other jurisdictions. Under the law, the seller of the property is responsible for retrofitting any older toilets, urinals, and showerheads on the property with low consumption fixtures, and for obtaining a water conservation certificate from the Water Department. There is an option in the ordinance that allows the responsibility for retrofitting to be transferred from the seller to the buyer, if both parties agree. In either case, the City tracks real estate sales and requires every property to be inspected to verify that the plumbing fixtures on the property being sold meet the low consumption standards, with the exception of already existing 1.6 gallon per flush toilets. A custom database program was developed by a consultant to manage property sales data on local properties and retrofitting records, as well as follow-up enforcement of the ordinance. In the last five years, 2,359 properties have been certified under the program, saving about 12.5 million gallons per year.

9.2.7.2 Demand Management Measures for Commercial Customers

The City provides water to about 1,900 commercial and industrial accounts within the service area, which together represents about 26 percent of total system water use. The City offers several programs to encourage commercial customers to become more water efficient by using water-saving technology. These include: 1) Smart Business Rebate Program and 2) The Monterey Bay Green Business Program.

The Smart Business Rebate Program was offered as a result of the conclusion of the statewide Smart Rebate program in 2013. The City’s Smart Business Rebate Program mirrors the old statewide program by offering businesses rebates for installing water efficient fixtures including:

- High Efficiency (1.28 gpf) or Ultra High Efficiency (1.0 gpf) toilets- $200
- High Efficiency Urinals (0.125 gpf)- $300
- High Efficiency Clothes Washer- $400

The eligibility requirements for these rebates are the same for the other programs. Clothes washers must be Energy Star certified and inspected if five or more are installed. Toilet rebate eligibility depends on what is currently being replaced, like the residential program. In the last five years, 46 businesses have taken advantage of the program, saving an estimated 10.2 million gallons per year.

The Monterey Bay Area Green Business program is a partnership of environmental agencies, utilities, and nonprofit organizations that assist, recognize and promote businesses that volunteer to operate sustainably. To be certified "green," participants must be in compliance with all regulations and program standards for conserving water and energy, preventing pollution, and minimizing waste. The City became a participant in the program in 2006, which is coordinated through the Public Works Department.

Businesses must meet a set of indoor and outdoor water conservation standards as part of achieving their Green Business Certification. All businesses are required to meet basic, mandatory measures and a minimum number of elective requirements from several categories. Customers are also required to meet additional measures specific to their type of business (e.g. low flow spray rinse valves for restaurants). In order to certify a business, a water conservation representative meets with the applicants and inspects the site, checks for leaks and interviews the applicants.

The City has also distributed water conservation materials to all local hotels, and drinking water upon request table tents to all local restaurants, and continues to make them available upon request.

9.2.7.3 Demand Management Measures for Landscapes

The City of Santa Cruz also offers rebates and programs for outdoor water use and landscapes which include: 1) Lawn Removal Rebate Program, 2) Large Landscape Water Budgets, and 3) Water Efficient Landscape Ordinance.

The Lawn Removal Rebate Program currently offers $.50 per square foot of lawn removed for single family, multi-family, and commercial customers. Single family residences are eligible to receive up to $500 (1,000 square feet) and multi-family or commercial are eligible for up to $2,500 (5,000 square feet). The general requirements are the following:

- Lawn that is maintained or previously maintained prior to drought,
- Lawn must be watered by an in-ground irrigation system,
- Removal or capping of the overhead spray system in the area to be converted,
- Replacement of lawn with very low or low water use plants and mulch (with or without low volume drip irrigation) or install no water use permeable hardscape options,
- Agreement to pre- and post- inspections to take measurements and ensure eligibility requirements have been met,
- Completion of landscape conversion within a year, and
- One rebate per customer per year.

The City plans on increasing the rebate to $1.00 per square foot removed with the same limitations of rebating up to 1,000 square feet for single family residences and 5,000 square feet for multi-family and commercial. The City hopes to encourage more lawn conversions by offering a higher rebate. Over the last five years, this program has resulted in a total of over 395,000 square feet (9.0 acres) of turf to be removed, saving an estimated 7.5 million gallons of water per year.

In July, 2010, the City launched a new program for customers with large landscapes and dedicated irrigation accounts. After converting all dedicated irrigation accounts to monthly meter reading, the City contracted with a consultant, Waterfluence LLC, to map landscape areas using aerial imagery, to develop irrigation budgets for the City's 110 largest irrigation customers, and to distribute the information through monthly Landscape Water Use Reports. Since then the program has expanded its participation to 230 sites representing 426 acres or 18.5 million square feet of irrigated area and over 250 million gallons per year of water. For each site, Waterfluence provides a site-specific irrigation budget based on landscape size and plantings, type of irrigation, and real-time local weather conditions that is obtained from the CIMIS station located at the DeLaveaga golf course. Customers receive monthly reports via mail or email comparing their actual consumption to the irrigation budget over a 1-3 year long period. A 2013 program assessment showed annual savings equal to about 15 million gallons per year. With these accounts being rationed the last two years, however, water use at large landscape sites was temporarily reduced by more than 130 million gallons in 2015. Further evaluation is needed in the future to better quantify long-term program impact.

In addition to receiving monthly reports, participants in the program are also eligible for a professional irrigation audit performed by Waterfluence. The audits include an assessment of irrigation efficiency, notation of irrigation issues (scheduling, tilted nozzles, leaks, breaks, pressure, overspray etc.), and a confirmation of the landscape area measurements. Customers receive a detailed report with site photos noting irrigation problems, a sprinkler condition analysis, cost-effective recommendations, scheduling suggestions, and a list of water management essentials.

The City is currently enrolling more participants into the program in order to continue adding customers that have recent history of high usage or water waste of over 100 CCF per year. Large landscape and irrigation account customers that used between 10-100 CCF per year are being mapped for potential enrollment in the future. Irrigation customers that used under 10 CCF were simply noted. The City is measuring all landscape irrigation accounts using over 10 CCF in anticipation of changing over to a simple water budget-based rate structure.

The City's Water Efficient Landscape Ordinance was first adopted to establish landscape water conservation regulations for major development projects situated in the City's service area in 1993 (Santa Cruz Municipal Code Chapter 16.16). Since then it has been rewritten and revised in 2001 and 2010. It is in the process of being updated again in response to 2015 emergency conservation regulations. The overall purpose of the ordinance is to ensure that the City's limited water supply is used efficiently and effectively in new landscapes within the City's water service area and to avoid certain landscape and irrigation design aspects that have the potential to result in water waste.

The City's ordinance applies throughout the entire water service area as a condition of receiving water service. It covers all new and renovated, commercial, industrial, and public projects, new single-family and multifamily development projects resulting in three or more dwelling units where: 1) the landscape is installed by the developer, and 2) the total landscape area of the project is 500 square feet or more, and new single family and two-unit residential development projects on properties equal to or larger than 10,000 square feet. Certain provisions also apply to pre-existing landscapes over one acre in size. The ordinance contains provisions for:

- Dedicated irrigation meters for new landscapes or expansion of existing landscapes over 5,000 square feet in area;
- Landscape water budget based on 55 % (residential) and 45% (non-residential) of reference evapotranspiration;
- Turf is limited to 25% on residential projects (turf not permitted for non-residential);
- Requiring very low to moderate water using plant materials, grouping plants with similar water needs;
- Irrigation design to avoid conditions that lead to runoff and overspray;
- Appropriate irrigation equipment, including requiring weather-based irrigation controllers and flow sensors to maximize water efficiency and detect leaks;
- Soil preparation and mulching;
- Storm water management; and
- Alternative water sources.

A complete landscape plan must be submitted and found to satisfy the standards before a building permit can be issued. Water Conservation staff reviews the landscape plans for compliance with the ordinance, coordinates plan review with Water Engineering and other City Departments and jurisdictions, and once installed, performs final inspections of the completed landscape.

9.3 Implementation over the Past Five Years

All of the water conservation programs described above in Section 9. 2 and illustrated in Figure 9-1 have been actively implemented over the past 5 years. Since 2011, however, most activity has been devoted to addressing four consecutive years of water shortage. In particular, emergency water shortages in both 2014 and 2015 saw a dramatic increase in the level of public information and outreach, water waste enforcement, conservation program and staffing support, short-term changes in pricing, and huge increases in participation in the City's turf removal, rain barrel, and conservation device distribution programs, as well as a repurposing of the landscape water budget program from an informational aid to a water rationing tool. A second round of a pre-rinse spray nozzle replacement program was completed in 2014, and the new water loss control study was begun. On top of all that, the City continued working on its long-term Water Conservation Master Plan, which is described further below.

9.4 Planned Implementation to Achieve Water Use Targets

In 2013, the City contracted with Maddaus Water Management, Inc. (MWM) to develop an updated Water Conservation Master Plan. The goal of the updated plan is to define the next generation of water conservation activities and serve as a roadmap to help the community achieve maximum, practical water use efficiency. Strengthening water conservation efforts has been identified as a top priority by the City Council, the City's Water Commission, and more recently by the City's Water Supply Advisory Committee in its effort aimed at delivering a safe, adequate, affordable, and environmentally sustainable water supply.

The process used to develop the plan included analyzing conservation measures and programs using the consultant's Least Cost Planning Water Demand Management Decision Support System Model (DSS Model). Work was divided into two phases separated by a year of in-depth review of the work by the City's Water Supply Advisory Committee. The Recommended Plan, which covers the same 2035 planning horizon as this Urban Water Management Plan, matches the recommended measures list published in the Final Report on Agreements and Recommendations (Appendix K). The WSAC's involvement helped shape the plan in two important ways: 1) it shifted conservation program emphasis to the peak season period (April – October) to better address the City's supply-demand gap, and 2) it produced recommendations leading to several additional conservation measures.

The plan includes a total of 35 measures for implementation between now and 2021 (Figure 9-3). Many are already underway. The City Council accepted the plan in concept as a Technical Memorandum in April 2016 (Appendix S), and the final report is almost complete. The goal is to include and adopt the Water Conservation Master Plan in its entirety as an element of this 2015 Urban Water Management Plan.

Figure 9-3. Recommended Program Implementation Schedule

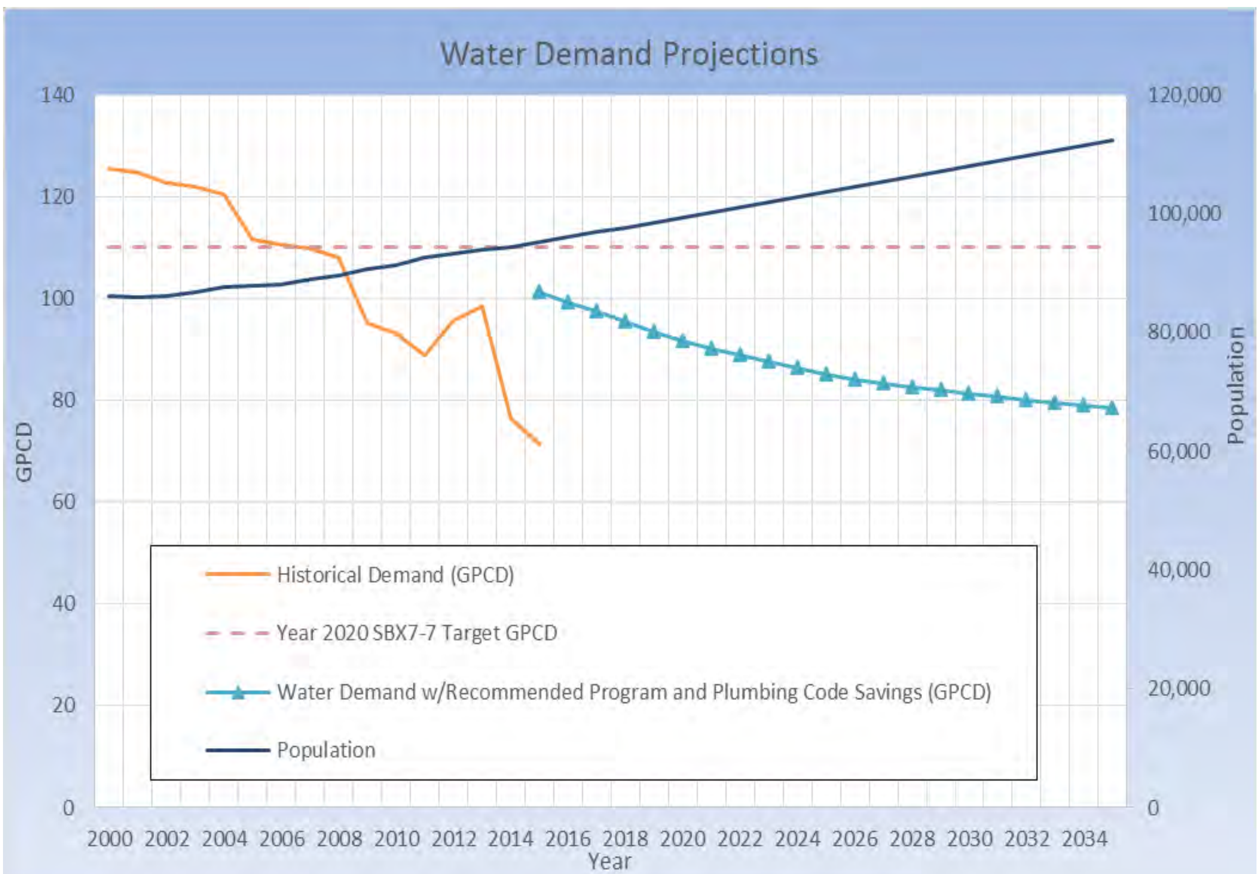
No.	Measure	Time Period
1	System Water Loss Reduction	2015 - 2035
2	Advanced Metering Infrastructure	2021 - 2035
3	Large Landscape Budget-Based Water Rates	2018 - 2020
4	General Public Information	2015 - 2035
5	Public Information (Home Water Use Report)	2018 - 2035
6	Residential Leak Assistance	2018 - 2035
7	Single Family Residential Surveys	2015 - 2035
8	Plumbing Fixture Giveaway/Opt	2015 - 2017
9	Residential Ultra High Efficiency Toilet Rebates	2015 - 2020
10	High Efficiency Clothes Washer Rebates	2015 - 2026
11	High Efficiency Clothes Washer - New Development	2021 - 2035
12	Hot Water On Demand - New Development	2021 - 2035
13	Toilet Retrofit at Time of Sale	2015 - 2019
14	CII MF Common Laundry Room High Efficiency Clothes Washer	2015 - 2024
15	CII Incentives	2021 - 2026
16	Pre-Rinse Spray Nozzle Installation	2015 - 2016
17	CII Surveys	2021 - 2026
18	High Efficiency Urinal Program	2015 - 2018
19	Public Restroom Faucet Retrofit - MUN	2021 - 2023
20	Public Restroom Faucet Retrofit - COM	2021 - 2030
21	School Retrofit	2021 - 2030
22	Water Efficient Landscape Ordinance	2015 - 2035
23	Single Family Residential Turf Removal	2015 - 2035
24	Multifamily Residential/CII Turf Removal	2015 - 2035
25	Expand Large Landscape Survey/Water Budgets	2018 - 2035
26	Sprinkler Nozzle Rebates	2018 - 2035
27	Gray Water Retrofit	2015 - 2035
28	Residential Rain Barrels	2015 - 2035
29	Climate Appropriate Landscaping and Rainwater Infiltration	2015 - 2035
30SF	SF Conservation Pricing - Water and Sewer	2018 - 2035
30MF	MF Conservation Pricing - Water and Sewer	2018 - 2035
30COM	COM Conservation Pricing - Water and Sewer	2018 - 2035
31	Single Family Multifamily Dishwasher Rebates	2018 - 2022
32	Hot Water Recirculation Systems	2018 - 2022
33	Rewarding Businesses For Adopting Best Practices	2020 - 2035
34	Additional Building Code Requirements for New Development	2018 - 2035
35	Innovation Incubator Program	2021 - 2035

Table 9-5 presents the projected water savings in 5-year increments, broken down into two components: the passive plumbing codes savings referenced in Chapter 4, and active water savings associated with the Recommended Program, expressed in millions of gallons per year.

Table 9-5. Long-Term Conservation Program Savings (mgy)				
Conservation Program	2020	2025	2030	2035
Plumbing Code	96	179	269	329
Recommended Program	137	232	269	291
Recommended Program with Plumbing Code Savings	233	411	538	620
NOTES: Maddaus Water Management, Inc., 2016				

Figure 9-4 shows the projected per capita water use in gallons per person per day (GPCD) in 5-year increments for the projected demand with the recommended program implementation and plumbing code savings. The model indicates that the City's GPCD in 2020 will decline to about 92 gallons per person per day, far below the City's 2020 target of 110 GPCD under SB X7-7, and continuing to decline to a level of about 78 GPCD by 2035.

Figure 9-4. Water Conservation Program Savings, GPCD



9.5 Members of the California Urban Water Conservation Council

CUWCC members have the option of submitting their 2013–2014 Best Management Practice (BMP) annual reports in lieu of, or in addition to, describing the DMMs in their UWMP. The City is including its 2013 and 2014 BMP reports for additional informational purposes in Appendix T. In 2013 and 2014, the City was considered to be “On Track” by the California Urban Water Conservation Council in all areas with the following exceptions:

BMP 1.2 Water Loss Control:

- Completed training in component analysis process? No (Since completed in 2016)
- Component Analysis? No (Since completed in 2016)

BMP 1.4 Retail Conservation Pricing:

- Conservation pricing for sewer service: For water agencies that provide retail sewer service, rates that charge customers a fixed amount per billing cycle for sewer service regardless of the units of service consumed do not satisfy the CUWCC’s definition of conservation pricing of sewer service. This applies to City’s single family and multifamily sewer charges, which are charged a flat monthly rate for sewer service[1].

The Water Department has raised this matter previously and will continue to discuss sewer rates and conservation pricing as a matter of policy within the City organization.

[1]Low water users who meet an average winter use criteria of 2.25 CCF/month or less qualify for a reduced sewer rate.

Chapter 10

PLAN ADOPTION, SUBMITTAL, AND IMPLEMENTATION

The City of Santa Cruz began the process of developing the 2015 Urban Water Management Plan after participating in a webinar and workshop sponsored by DWR in late 2015. While Chapter 2 describes the process of preparing the plan, this chapter summarizes the process of plan adoption, submittal, and implementation including the steps for amendment if it becomes necessary.

10.1 Inclusion of all 2015 Data

As mentioned in Section 2.3, the City is reporting on a calendar year basis. The plan was prepared in 2016 and accordingly includes water use and planning data for the entire calendar year of 2015, except where noted.

10.2 Notice of Public Hearing

Water suppliers must hold a public hearing before adopting an Urban Water Management Plan. The public hearing provides an opportunity for the public to provide input before it is adopted by City Council.

Prior to the public hearing, the draft plan was made available for public inspection, review, and comment on the City's web site, at the Water Department office, and at the City's Central Library beginning in late July 2016.

In addition, the City Water Commission reviewed the draft plan and provided comments at its August 1, 2016 meeting. Water Commission meetings serve to encourage active involvement and participation of diverse groups and individuals, in accordance with section 10642 of the Act. In the process of reviewing the plan, the Water Commission recommended several changes and additions for the final plan, including the following:

- Updating Table 6-10 regarding volume of water transferred to Soquel Creek, and include recent interagency agreement,
- Updating language about water rights (flexibility, place of use) needed to support regional solutions,
- Correcting statement of storage amount needed to overcome supply/demand gap,
- Better characterizing the distinctions between inside and outside customers, and
- Miscellaneous editorial clarifications and corrections

The Water Commission's full written comments, and all other written comments received from the public are included as Appendix W.

The draft plan was also circulated in July 2016, along with notice of the time and place of the public hearing, to the County of Santa Cruz and the City of Capitola as required by law. Notification letters included the location where the 2015 UWMP could be viewed, the hearing schedule, and contact information of the preparer for the City. Copies of these letters are provided in Appendix U.

Table 10-1 below lists all the cities and counties that receive water service from the City of Santa Cruz and that were sent a notice of the public hearing. As mentioned in Section 2.4, these jurisdictions were previously sent written notice regarding the plan review and update process well in advance of 60 days before the public hearing (Appendix D), in accordance with the Section 10621(b) of the Act.

Table 10-1 Retail: Notification to Cities and Counties		
City Name	60 Day Notice	Notice of Public Hearing
City of Capitola	☑	☑
City of Santa Cruz	☑	☑
County Name	60 Day Notice	Notice of Public Hearing
Santa Cruz County	☑	☑

In addition to these jurisdictions, the City provided the notice of the public hearing to the Association of Monterey Bay Area Governments, local elected officials, the Santa Cruz Local Agency Formation Commission, and to all major public water utilities in Santa Cruz County, including the following:

- Soquel Creek Water District
- San Lorenzo Valley Water District
- Scotts Valley Water District
- Central Valley Water District
- City of Watsonville

The public hearing was noticed to the public in the local newspaper as prescribed in Government Code 6066. The notice included the time and place of the hearing, as well as the various locations where the plan was made available for public review. A copy of the notice of the public hearing published in the newspaper is provided as Appendix V.

10.3 Public Hearing and Adoption

The City Council held the public hearing on the plan in accordance with CWC section 10642 on August 9, 2016. At the public hearing, City Council directed that the final plan be brought back for adoption at its August 23, 2016 meeting. Copies of all written comments received during the public review process and at the public hearing are included in Appendix W. The official minutes of the public hearing are included with the Notice of Public Hearing in Appendix V.

City Council adopted the plan, as modified by input from the Water Commission, on August 23 2016. The official resolution adopting the plan is provided as Appendix X.

In accordance with the City Council resolution adopting the plan, the Water Supply Advisory Committee's Final Report on Agreements and Recommendations, the Water Shortage Contingency Plan, and the City's final Water Conservation Master Plan are adopted by reference in their entirety as elements of the City's 2015 Urban Water Management Plan.

10.4 Plan Submittal

The final plan was then submitted electronically to DWR and the California State Library within 30 days of its adoption, and transmitted to all jurisdictions receiving water service from the City of Santa Cruz within 60 days of its submission to DWR, in accordance with CWC sections 10644(a) and 10635(b). Additionally, the final data tables were submitted using the WUE data tool available online through the DWR Urban Water Management webpage.

10.5 Public Availability

The final, adopted plan was also made available to the public in accordance with section 10645 of the Act by posting it on the City's web site.

10.6 Amending an Adopted UWMP

If the City of Santa Cruz chooses or needs to amend the adopted 2015 plan, proper notification including copies of the amendments will be provided in accordance with sections 10644(a) and 10621 in a manner set forth for the notification, public hearing, adoption and submittal.

References

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28 American Water Works Association (AWWA), 2011. M60: Drought Preparedness and Response, First Edition.

List of Appendices

California Water Code Division 6, Part 2.6.

Chapter 1. General Declaration and Policy

SECTION 10610-10610.4

10610. This part shall be known and may be cited as the "Urban Water Management Planning Act."

10610.2. (a) The Legislature finds and declares all of the following:

(1) The waters of the state are a limited and renewable resource subject to ever-increasing demands.

(2) The conservation and efficient use of urban water supplies are of statewide concern; however, the planning for that use and the implementation of those plans can best be accomplished at the local level.

(3) A long-term, reliable supply of water is essential to protect the productivity of California's businesses and economic climate.

(4) As part of its long-range planning activities, every urban water supplier should make every effort to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its various categories of customers during normal, dry, and multiple dry water years.

(5) Public health issues have been raised over a number of contaminants that have been identified in certain local and imported water supplies.

(6) Implementing effective water management strategies, including groundwater storage projects and recycled water projects, may require specific water quality and salinity targets for meeting groundwater basins water quality objectives and promoting beneficial use of recycled water.

(7) Water quality regulations are becoming an increasingly important factor in water agencies' selection of raw water sources, treatment alternatives, and modifications to existing treatment facilities.

(8) Changes in drinking water quality standards may also impact the usefulness of water supplies and may ultimately impact supply reliability.

(9) The quality of source supplies can have a significant impact on water management strategies and supply reliability.

(b) This part is intended to provide assistance to water agencies in carrying out their long-term resource planning responsibilities to ensure adequate water supplies to meet existing and future demands for water.

10610.4. The Legislature finds and declares that it is the policy of the state as follows:

(a) The management of urban water demands and efficient use of water shall be actively pursued to protect both the people of the state and their water resources.

(b) The management of urban water demands and efficient use of urban water supplies shall be a guiding criterion in public decisions.

(c) Urban water suppliers shall be required to develop water management plans to actively pursue the efficient use of available supplies.

Chapter 2. Definitions

SECTION 10611-10617

10611. Unless the context otherwise requires, the definitions of this chapter govern the construction of this part.

10611.5. “Demand management" means those water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable and efficient use and reuse of available supplies.

10612. "Customer" means a purchaser of water from a water supplier who uses the water for municipal purposes, including residential, commercial, governmental, and industrial uses.

10613. "Efficient use" means those management measures that result in the most effective use of water so as to prevent its waste or unreasonable use or unreasonable method of use.

10614. "Person" means any individual, firm, association, organization, partnership, business, trust, corporation, company, public agency, or any agency of such an entity.

10615. "Plan" means an urban water management plan prepared pursuant to this part. A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities. The components of the plan may vary according to an individual community or area's characteristics and its capabilities to efficiently use and conserve water. The plan shall address measures for residential, commercial, governmental, and industrial water demand management as set forth in Article 2 (commencing with Section 10630) of Chapter 3. In addition, a strategy and time schedule for implementation shall be included in the plan.

10616. "Public agency" means any board, commission, county, city and county, city, regional agency, district, or other public entity.

10616.5. "Recycled water" means the reclamation and reuse of wastewater for beneficial use.

10617. "Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. An urban water supplier includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers. This part applies only to water supplied from public water systems subject to Chapter 4 (commencing with Section 116275) of Part 12 of Division 104 of the Health and Safety Code.

Chapter 3. Urban Water Management Plans

Article 1. General Provisions

SECTION 10620-10621

10620. (a) Every urban water supplier shall prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640).

(b) Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier.

(c) An urban water supplier indirectly providing water shall not include planning elements in its water management plan as provided in Article 2 (commencing with Section 10630) that would be applicable to urban water suppliers or public agencies directly providing water, or to their customers, without the consent of those suppliers or public agencies.

(d) (1) An urban water supplier may satisfy the requirements of this part by participation in areawide, regional, watershed, or basinwide urban water management planning where those plans will reduce preparation costs and contribute to the achievement of conservation and efficient water use.

(2) Each urban water supplier shall coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that

share a common source, water management agencies, and relevant public agencies, to the extent practicable.

(e) The urban water supplier may prepare the plan with its own staff, by contract, or in cooperation with other governmental agencies.

(f) An urban water supplier shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions.

10621. (a) Each urban water supplier shall update its plan at least once every five years on or before December 31, in years ending in five and zero, except as provided in subdivision (d).

(b) Every urban water supplier required to prepare a plan pursuant to this part shall, at least 60 days before the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. The urban water supplier may consult with, and obtain comments from, any city or county that receives notice pursuant to this subdivision.

(c) The amendments to, or changes in, the plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640).

(d) Each urban water supplier shall update and submit its 2015 plan to the department by July 1, 2016.

Article 2. Contents of Plan

SECTION 10630-10634

10630. It is the intention of the Legislature, in enacting this part, to permit levels of water management planning commensurate with the numbers of customers served and the volume of water supplied.

10631. A plan shall be adopted in accordance with this chapter that shall do all of the following:

(a) Describe the service area of the supplier, including current and projected population, climate, and other demographic factors affecting the supplier's water management planning. The projected population estimates shall be based upon data from the state, regional, or local service agency population projections within the service area of the urban water supplier and shall be in five-year increments to 20 years or as far as data is available.

(b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a). If groundwater is identified as an existing or planned source of water available to the supplier, all of the following information shall be included in the plan:

(1) A copy of any groundwater management plan adopted by the urban water supplier, including plans adopted pursuant to Part 2.75 (commencing with Section 10750), or any other specific authorization for groundwater management.

(2) A description of any groundwater basin or basins from which the urban water supplier pumps groundwater. For basins that a court or the board has adjudicated the rights to pump groundwater, a copy of the order or decree adopted by the court or the board and a description of the amount of groundwater the urban water supplier has the legal right to pump under the order or decree. For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition.

(3) A detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(4) A detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the urban water supplier. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(c) (1) Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following:

(A) An average water year.

(B) A single-dry water year.

(C) Multiple-dry water years.

(2) For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors, describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.

(d) Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.

(e) (1) Quantify, to the extent records are available, past and current water use, over the same five-year increments described in subdivision (a), and projected water use, identifying the uses among water use sectors, including, but not necessarily limited to, all of the following uses:

(A) Single-family residential.

(B) Multifamily.

(C) Commercial.

(D) Industrial.

(E) Institutional and governmental.

(F) Landscape.

(G) Sales to other agencies.

(H) Saline water intrusion barriers, groundwater recharge, or conjunctive use, or any combination thereof.

(I) Agricultural.

(J) Distribution system water loss.

(2) The water use projections shall be in the same five-year increments described in subdivision (a).

(3) (A) For the 2015 urban water management plan update, the distribution system water loss shall be quantified for the most recent 12-month period available. For all subsequent updates, the distribution system water loss shall be quantified for each of the five years preceding the plan update.

(B) The distribution system water loss quantification shall be reported in accordance with a worksheet approved or developed by the department through a public process. The water loss quantification worksheet shall be based on the water system balance methodology developed by the American Water Works Association.

(4) (A) If available and applicable to an urban water supplier, water use projections may display and account for the water savings estimated to result from adopted codes, standards, ordinances, or transportation and land use plans identified by the urban water supplier, as applicable to the service area.

(B) To the extent that an urban water supplier reports the information described in subparagraph (A), an urban water supplier shall do both of the following:

(i) Provide citations of the various codes, standards, ordinances, or transportation and land use plans utilized in making the projections.

(ii) Indicate the extent that the water use projections consider savings from codes, standards, ordinances, or transportation and land use plans. Water use projections that do not account for these water savings shall be noted of that fact.

(f) Provide a description of the supplier's water demand management measures. This description shall include all of the following:

(1) (A) For an urban retail water supplier, as defined in Section 10608.12, a narrative description that addresses the nature and extent of each water demand management measure implemented over the past five years. The narrative shall describe the water demand management measures that the supplier plans to implement to achieve its water use targets pursuant to Section 10608.20.

(B) The narrative pursuant to this paragraph shall include descriptions of the following water demand management measures:

(i) Water waste prevention ordinances.

(ii) Metering.

(iii) Conservation pricing.

(iv) Public education and outreach.

(v) Programs to assess and manage distribution system real loss.

(vi) Water conservation program coordination and staffing support.

(vii) Other demand management measures that have a significant impact on water use as measured in gallons per capita per day, including innovative measures, if implemented.

(2) For an urban wholesale water supplier, as defined in Section 10608.12, a narrative description of the items in clauses (ii), (iv), (vi), and (vii) of subparagraph (B) of paragraph (1), and a narrative description of its distribution system asset management and wholesale supplier assistance programs.

(g) Include a description of all water supply projects and water supply programs that may be undertaken by the urban water supplier to meet the total projected water use, as established pursuant to subdivision (a) of Section 10635. The urban water supplier shall include a detailed description of expected future projects and programs that the urban water supplier may implement to increase the amount of the water supply available to the urban water supplier in average, single-dry, and multiple-dry water years. The description shall identify specific projects and include a description of the increase in water supply that is expected to be available from each project. The description shall include an estimate with regard to the implementation timeline for each project or program.

(h) Describe the opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply.

(i) For purposes of this part, urban water suppliers that are members of the California Urban Water Conservation Council shall be deemed in compliance with the requirements of subdivision (f) by complying with all the provisions of the "Memorandum of Understanding Regarding Urban Water Conservation in California," dated December 10, 2008, as it may be amended, and by submitting the annual reports required by Section 6.2 of that memorandum.

(j) An urban water supplier that relies upon a wholesale agency for a source of water shall provide the wholesale agency with water use projections from that agency for that source of water in five-year increments to 20 years or as far as data is available. The wholesale agency shall provide information to the urban water supplier for inclusion in the urban water supplier's plan that identifies and quantifies, to the extent practicable, the existing and planned sources of water as required by subdivision (b), available from the wholesale agency to the urban water supplier over the same five-year increments, and during various water-year types in accordance with subdivision (c). An urban water supplier may rely upon water supply information provided by the wholesale agency in fulfilling the plan informational requirements of subdivisions (b) and (c).

10631.1. (a) The water use projections required by Section 10631 shall include projected water use for single-family and multifamily residential housing needed for lower income households, as defined in Section 50079.5 of the Health and Safety Code, as identified in the housing element of any city, county, or city and county in the service area of the supplier.

(b) It is the intent of the Legislature that the identification of projected water use for single-family and multifamily residential housing for lower income households will assist a supplier in complying with the requirement under Section 65589.7 of the Government Code to grant a priority for the provision of service to housing units affordable to lower income households.

10631.2. (a) In addition to the requirements of Section 10631, an urban water management plan may, but is not required to, include any of the following information:

(1) An estimate of the amount of energy used to extract or divert water supplies.

(2) An estimate of the amount of energy used to convey water supplies to the water treatment plants or distribution systems.

(3) An estimate of the amount of energy used to treat water supplies.

(4) An estimate of the amount of energy used to distribute water supplies through its distribution systems.

(5) An estimate of the amount of energy used for treated water supplies in comparison to the amount used for nontreated water supplies.

(6) An estimate of the amount of energy used to place water into or withdraw from storage.

(7) Any other energy-related information the urban water supplier deems appropriate.

(b) The department shall include in its guidance for the preparation of urban water management plans a methodology for the voluntary calculation or estimation of the energy intensity of urban water systems. The department may consider studies and calculations conducted by the Public Utilities Commission in developing the methodology.

10631.5. (a) (1) Beginning January 1, 2009, the terms of, and eligibility for, a water management grant or loan made to an urban water supplier and awarded or administered by the department, state board, or California Bay-Delta Authority or its successor agency shall be conditioned on the implementation of the water demand management measures described in Section 10631, as determined by the department pursuant to subdivision (b).

(2) For the purposes of this section, water management grants and loans include funding for programs and projects for surface water or groundwater storage, recycling, desalination, water conservation, water supply reliability, and water supply augmentation. This section does not apply to water management projects funded by the federal American Recovery and Reinvestment Act of 2009 (Public Law 111-5).

(3) Notwithstanding paragraph (1), the department shall determine that an urban water supplier is eligible for a water management grant or loan even though the supplier is not implementing all of the water demand management measures described in Section 10631, if the urban water supplier has

submitted to the department for approval a schedule, financing plan, and budget, to be included in the grant or loan agreement, for implementation of the water demand management measures. The supplier may request grant or loan funds to implement the water demand management measures to the extent the request is consistent with the eligibility requirements applicable to the water management funds.

(4) (A) Notwithstanding paragraph (1), the department shall determine that an urban water supplier is eligible for a water management grant or loan even though the supplier is not implementing all of the water demand management measures described in Section 10631, if an urban water supplier submits to the department for approval documentation demonstrating that a water demand management measure is not locally cost effective. If the department determines that the documentation submitted by the urban water supplier fails to demonstrate that a water demand management measure is not locally cost effective, the department shall notify the urban water supplier and the agency administering the grant or loan program within 120 days that the documentation does not satisfy the requirements for an exemption, and include in that notification a detailed statement to support the determination.

(B) For purposes of this paragraph, "not locally cost effective" means that the present value of the local benefits of implementing a water demand management measure is less than the present value of the local costs of implementing that measure.

(b) (1) The department, in consultation with the state board and the California Bay-Delta Authority or its successor agency, and after soliciting public comment regarding eligibility requirements, shall develop eligibility requirements to implement the requirement of paragraph (1) of subdivision (a). In establishing these eligibility requirements, the department shall do both of the following:

(A) Consider the conservation measures described in the Memorandum of Understanding Regarding Urban Water Conservation in California, and alternative conservation approaches that provide equal or greater water savings.

(B) Recognize the different legal, technical, fiscal, and practical roles and responsibilities of wholesale water suppliers and retail water suppliers.

(2) (A) For the purposes of this section, the department shall determine whether an urban water supplier is implementing all of the water demand management measures described in Section 10631 based on either, or a combination, of the following:

(i) Compliance on an individual basis.

(ii) Compliance on a regional basis. Regional compliance shall require participation in a regional conservation program consisting of two or more urban water suppliers that achieves the level of conservation or water efficiency savings equivalent to the amount of conservation or savings achieved if each of the participating urban water suppliers implemented the water demand management measures. The urban water supplier administering the regional program shall provide participating urban water suppliers and the department with data to demonstrate that the regional program is consistent with this clause. The department shall review the data to determine whether the urban water suppliers in the regional program are meeting the eligibility requirements.

(B) The department may require additional information for any determination pursuant to this section.

(3) The department shall not deny eligibility to an urban water supplier in compliance with the requirements of this section that is participating in a multiagency water project, or an integrated regional water management plan, developed pursuant to Section 75026 of the Public Resources Code, solely on the basis that one or more of the agencies participating in the project or plan is not implementing all of the water demand management measures described in Section 10631.

(c) In establishing guidelines pursuant to the specific funding authorization for any water management grant or loan program subject to this section, the agency administering the grant or loan program shall include in the guidelines the eligibility requirements developed by the department pursuant to subdivision (b).

(d) Upon receipt of a water management grant or loan application by an agency administering a grant and loan program subject to this section, the agency shall request an eligibility determination from the department with respect to the requirements of this section. The department shall respond to the request within 60 days of the request.

(e) The urban water supplier may submit to the department copies of its annual reports and other relevant documents to assist the department in determining whether the urban water supplier is implementing or scheduling the implementation of water demand management activities. In addition, for urban water suppliers that are signatories to the Memorandum of Understanding Regarding Urban Water Conservation in California and submit biennial reports to the California Urban Water Conservation Council in accordance with the memorandum, the department may use these reports to assist in tracking the implementation of water demand management measures.

(f) This section shall remain in effect only until July 1, 2016, and as of that date is repealed, unless a later enacted statute, that is enacted before July 1, 2016, deletes or extends that date.

10631.7. The department, in consultation with the California Urban Water Conservation Council, shall convene an independent technical panel to provide information and recommendations to the department and the Legislature on new demand management measures, technologies, and approaches. The panel shall consist of no more than seven members, who shall be selected by the department to reflect a balanced representation of experts. The panel shall have at least one, but no more than two, representatives from each of the following: retail water suppliers, environmental organizations, the business community, wholesale water suppliers, and academia. The panel shall be convened by January 1, 2009, and shall report to the Legislature no later than January 1, 2010, and every five years thereafter. The department shall review the panel report and include in the final report to the Legislature the department's recommendations and comments regarding the panel process and the panel's recommendations.

10632. (a) The plan shall provide an urban water shortage contingency analysis that includes each of the following elements that are within the authority of the urban water supplier:

(1) Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions that are applicable to each stage.

(2) An estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply.

(3) Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.

(4) Additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.

(5) Consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are

appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply.

(6) Penalties or charges for excessive use, where applicable.

(7) An analysis of the impacts of each of the actions and conditions described in paragraphs (1) to (6), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.

(8) A draft water shortage contingency resolution or ordinance.

(9) A mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.

(b) Commencing with the urban water management plan update due July 1, 2016, for purposes of developing the water shortage contingency analysis pursuant to subdivision (a), the urban water supplier shall analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas, as defined in subdivision (a) of Section 115921 of the Health and Safety Code.

10633. The plan shall provide, to the extent available, information on recycled water and its potential for use as a water source in the service area of the urban water supplier. The preparation of the plan shall be coordinated with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area, and shall include all of the following:

(a) A description of the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.

(b) A description of the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.

(c) A description of the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use.

(d) A description and quantification of the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, indirect potable reuse, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses.

(e) The projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected pursuant to this subdivision.

(f) A description of actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre-feet of recycled water used per year.

(g) A plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use.

10634. The plan shall include information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five-year increments as described in subdivision (a) of Section 10631, and the manner in which water quality affects water management strategies and supply reliability.

Article 2.5. Water Service Reliability

SECTION 10635

10635. (a) Every urban water supplier shall include, as part of its urban water management plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare the total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. The water service reliability assessment shall be based upon the information compiled pursuant to Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier.

(b) The urban water supplier shall provide that portion of its urban water management plan prepared pursuant to this article to any city or county within which it provides water supplies no later than 60 days after the submission of its urban water management plan.

(c) Nothing in this article is intended to create a right or entitlement to water service or any specific level of water service.

(d) Nothing in this article is intended to change existing law concerning an urban water supplier's obligation to provide water service to its existing customers or to any potential future customers.

Article 3. Adoption and Implementation of Plans

SECTION 10640-10645

10640. Every urban water supplier required to prepare a plan pursuant to this part shall prepare its plan pursuant to Article 2 (commencing with Section 10630). The supplier shall likewise periodically review the plan as required by Section 10621, and any amendments or changes required as a result of that review shall be adopted pursuant to this article.

10641. An urban water supplier required to prepare a plan may consult with, and obtain comments from, any public agency or state agency or any person who has special expertise with respect to water demand management methods and techniques.

10642. Each urban water supplier shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned water supplier pursuant to Section 6066 of the Government Code. The urban water supplier shall provide notice of the time and place of hearing to any city or county within which the supplier provides water supplies. A privately owned water supplier shall provide an equivalent notice within its service area.

After the hearing, the plan shall be adopted as prepared or as modified after the hearing.

10643. An urban water supplier shall implement its plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan.

10644. (a) (1) An urban water supplier shall submit to the department, the California State Library, and any city or county within which the supplier provides water supplies a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be submitted to the department, the California State Library, and any city or county within which the supplier provides water supplies within 30 days after adoption.

(2) The plan, or amendments to the plan, submitted to the department pursuant to paragraph (1) shall be submitted electronically and shall include any standardized forms, tables, or displays specified by the department.

(b) (1) Notwithstanding Section 10231.5 of the Government Code, the department shall prepare and submit to the Legislature, on or before December 31, in the years ending in six and one, a report summarizing the status of the plans adopted pursuant to this part.

The report prepared by the department shall identify the exemplary elements of the individual plans. The department shall provide a copy of the report to each urban water supplier that has submitted its plan to the department. The department shall also prepare reports and provide data for any legislative hearings designed to consider the effectiveness of plans submitted pursuant to this part.

(2) A report to be submitted pursuant to paragraph (1) shall be submitted in compliance with Section 9795 of the Government Code.

(c) (1) For the purpose of identifying the exemplary elements of the individual plans, the department shall identify in the report water demand management measures adopted and implemented by specific urban water suppliers, and identified pursuant to Section 10631, that achieve water savings significantly above the levels established by the department to meet the requirements of Section 10631.5.

(2) The department shall distribute to the panel convened pursuant to Section 10631.7 the results achieved by the implementation of those water demand management measures described in paragraph (1).

(3) The department shall make available to the public the standard the department will use to identify exemplary water demand management measures.

10645. Not later than 30 days after filing a copy of its plan with the department, the urban water supplier and the department shall make the plan available for public review during normal business hours.

Chapter 4. Miscellaneous Provisions

SECTION 10650-10656

10650. Any actions or proceedings to attack, review, set aside, void, or annul the acts or decisions of an urban water supplier on the grounds of noncompliance with this part shall be commenced as follows:

(a) An action or proceeding alleging failure to adopt a plan shall be commenced within 18 months after that adoption is required by this part.

(b) Any action or proceeding alleging that a plan, or action taken pursuant to the plan, does not comply with this part shall be commenced within 90 days after filing of the plan or amendment thereto pursuant to Section 10644 or the taking of that action.

10651. In any action or proceeding to attack, review, set aside, void, or annul a plan, or an action taken pursuant to the plan by an urban water supplier on the grounds of noncompliance with this part, the inquiry shall extend only to whether there was a prejudicial abuse of discretion. Abuse of discretion is established if the supplier has not proceeded in a manner required by law or if the action by the water supplier is not supported by substantial evidence.

10652. The California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) does not apply to the preparation and adoption of plans pursuant to this part or to the implementation of actions taken pursuant to Section 10632. Nothing in this part shall be interpreted as exempting from the California Environmental Quality Act any project that would significantly affect water supplies for fish and wildlife, or any project for implementation of the plan, other than projects implementing Section 10632, or any project for expanded or additional water supplies.

10653. The adoption of a plan shall satisfy any requirements of state law, regulation, or order, including those of the State Water Resources Control Board and the Public Utilities Commission, for the preparation of water management plans or conservation plans; provided, that if the State Water Resources Control Board or the Public Utilities Commission requires additional information concerning water conservation to implement its existing authority, nothing in this part shall be deemed to limit the board or the commission in obtaining that information. The requirements of this part shall be satisfied by any urban water demand management plan prepared to meet federal laws or regulations after the effective date of this part, and which substantially meets the requirements of this part, or by any existing urban water management plan which includes the contents of a plan required under this part.

10654. An urban water supplier may recover in its rates the costs incurred in preparing its plan and implementing the reasonable water conservation measures included in the plan. Any best water management practice that is included in the plan that is identified in the "Memorandum of Understanding Regarding Urban Water Conservation in California" is deemed to be reasonable for the purposes of this section.

10655. If any provision of this part or the application thereof to any person or circumstances is held invalid, that invalidity shall not affect other provisions or applications of this part which can be given effect without the invalid provision or application thereof, and to this end the provisions of this part are severable.

10656. An urban water supplier that does not prepare, adopt, and submit its urban water management plan to the department in accordance with this part, is ineligible to receive funding pursuant to Division 24 (commencing with Section 78500) or Division 26 (commencing with Section 79000), or receive drought assistance from the state until the urban water management plan is submitted pursuant to this article.

Appendix B
California Water Code
Sustainable Water Use and Demand Reduction

California Water Code Division 6, Part 2.55.

Chapter 1. General Declarations and Policy

SECTION 10608-10608.8

10608. The Legislature finds and declares all of the following:

(a) Water is a public resource that the California Constitution protects against waste and unreasonable use.

(b) Growing population, climate change, and the need to protect and grow California's economy while protecting and restoring our fish and wildlife habitats make it essential that the state manage its water resources as efficiently as possible.

(c) Diverse regional water supply portfolios will increase water supply reliability and reduce dependence on the Delta.

(d) Reduced water use through conservation provides significant energy and environmental benefits, and can help protect water quality, improve streamflows, and reduce greenhouse gas emissions.

(e) The success of state and local water conservation programs to increase efficiency of water use is best determined on the basis of measurable outcomes related to water use or efficiency.

(f) Improvements in technology and management practices offer the potential for increasing water efficiency in California over time, providing an essential water management tool to meet the need for water for urban, agricultural, and environmental uses.

(g) The Governor has called for a 20 percent per capita reduction in urban water use statewide by 2020.

(h) The factors used to formulate water use efficiency targets can vary significantly from location to location based on factors including weather, patterns of urban and suburban development, and past efforts to enhance water use efficiency.

(i) Per capita water use is a valid measure of a water provider's efforts to reduce urban water use within its service area. However, per capita water use is less useful for measuring relative water use efficiency between different water providers. Differences in weather, historical patterns of urban and suburban development, and density of housing in a particular location need to be considered when assessing per capita water use as a measure of efficiency.

10608.4. It is the intent of the Legislature, by the enactment of this part, to do all of the following:

(a) Require all water suppliers to increase the efficiency of use of this essential resource.

(b) Establish a framework to meet the state targets for urban water conservation identified in this part and called for by the Governor.

(c) Measure increased efficiency of urban water use on a per capita basis.

(d) Establish a method or methods for urban retail water suppliers to determine targets for achieving increased water use efficiency by the year 2020, in accordance with the Governor's goal of a 20-percent reduction.

(e) Establish consistent water use efficiency planning and implementation standards for urban water suppliers and agricultural water suppliers.

(f) Promote urban water conservation standards that are consistent with the California Urban Water Conservation Council's adopted best management practices and the requirements for demand management in Section 10631.

(g) Establish standards that recognize and provide credit to water suppliers that made substantial capital investments in urban water conservation since the drought of the early 1990s.

(h) Recognize and account for the investment of urban retail water suppliers in providing recycled water for beneficial uses.

(i) Require implementation of specified efficient water management practices for agricultural water suppliers.

(j) Support the economic productivity of California's agricultural, commercial, and industrial sectors.

(k) Advance regional water resources management.

10608.8. (a) (1) Water use efficiency measures adopted and implemented pursuant to this part or Part 2.8 (commencing with Section 10800) are water conservation measures subject to the protections provided under Section 1011.

(2) Because an urban agency is not required to meet its urban water use target until 2020 pursuant to subdivision (b) of Section 10608.24, an urban retail water supplier's failure to meet those targets shall not establish a violation of law for purposes of any state administrative or judicial proceeding prior to January 1, 2021. Nothing in this paragraph limits the use of data reported to the department or the board in litigation or an administrative proceeding. This paragraph shall become inoperative on January 1, 2021.

(3) To the extent feasible, the department and the board shall provide for the use of water conservation reports required under this part to meet the requirements of Section 1011 for water conservation reporting.

(b) This part does not limit or otherwise affect the application of Chapter 3.5 (commencing with Section 11340), Chapter 4 (commencing with Section 11370), Chapter 4.5 (commencing with Section 11400), and Chapter 5 (commencing with Section 11500) of Part 1 of Division 3 of Title 2 of the Government Code.

(c) This part does not require a reduction in the total water used in the agricultural or urban sectors, because other factors, including, but not limited to, changes in agricultural economics or population growth may have greater effects on water use. This part does not limit the economic productivity of California's agricultural, commercial, or industrial sectors.

(d) The requirements of this part do not apply to an agricultural water supplier that is a party to the Quantification Settlement Agreement, as defined in subdivision (a) of Section 1 of Chapter 617 of the Statutes of 2002, during the period within which the Quantification Settlement Agreement remains in effect. After the expiration of the Quantification Settlement Agreement, to the extent conservation water projects implemented as part of the Quantification Settlement Agreement remain in effect, the conserved water created as part of those projects shall be credited against the obligations of the agricultural water supplier pursuant to this part.

Chapter 2 Definitions

SECTION 10608.12

10608.12. Unless the context otherwise requires, the following definitions govern the construction of this part:

(a) "Agricultural water supplier" means a water supplier, either publicly or privately owned, providing water to 10,000 or more irrigated acres, excluding recycled water. "Agricultural water supplier" includes a supplier or contractor for water, regardless of the basis of right, that distributes or sells water for ultimate resale to customers. "Agricultural water supplier" does not include the department.

(b) "Base daily per capita water use" means any of the following:

(1) The urban retail water supplier's estimate of its average gross water use, reported in gallons per capita per day and calculated over a continuous 10-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.

(2) For an urban retail water supplier that meets at least 10 percent of its 2008 measured retail water demand through recycled water that is delivered within the service area of an urban retailwater supplier or its urban wholesale water supplier, the urban retail water supplier may extend the calculation described in paragraph (1) up to an additional five years to a maximum of a continuous 15-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.

(3) For the purposes of Section 10608.22, the urban retail water supplier's estimate of its average gross water use, reported in gallons per capita per day and calculated over a continuous five-year period ending no earlier than December 31, 2007, and no later than December 31, 2010.

(c) "Baseline commercial, industrial, and institutional water use" means an urban retail water supplier's base daily per capita water use for commercial, industrial, and institutional users.

(d) "Commercial water user" means a water user that provides or distributes a product or service.

(e) "Compliance daily per capita water use" means the gross water use during the final year of the reporting period, reported in gallons per capita per day.

(f) "Disadvantaged community" means a community with an annual median household income that is less than 80 percent of the statewide annual median household income.

(g) "Gross water use" means the total volume of water, whether treated or untreated, entering the distribution system of an urban retail water supplier, excluding all of the following:

(1) Recycled water that is delivered within the service area of an urban retail water supplier or its urban wholesale water supplier.

(2) The net volume of water that the urban retail water supplier places into long-term storage.

(3) The volume of water the urban retail water supplier conveys for use by another urban water supplier.

(4) The volume of water delivered for agricultural use, except as otherwise provided in subdivision (f) of Section 10608.24.

(h) "Industrial water user" means a water user that is primarily a manufacturer or processor of materials as defined by the North American Industry Classification

System code sectors 31 to 33, inclusive, or an entity that is a water user primarily engaged in research and development.

(i) "Institutional water user" means a water user dedicated to public service. This type of user includes, among other users, higher education institutions, schools, courts, churches, hospitals, government facilities, and nonprofit research institutions.

(j) "Interim urban water use target" means the midpoint between the urban retail water supplier's base daily per capita water use and the urban retail water supplier's urban water use target for 2020.

(k) "Locally cost effective" means that the present value of the local benefits of implementing an agricultural efficiency water management practice is greater than or equal to the present value of the local cost of implementing that measure.

(l) "Process water" means water used for producing a product or product content or water used for research and development, including, but not limited to, continuous manufacturing processes, water used for testing and maintaining equipment used in producing a product or product content, and water used in combined heat and power facilities used in producing a product or product content. Process water does not mean incidental water uses not related to the production of a product or product content, including, but not limited to, water used for restrooms, landscaping, air conditioning, heating, kitchens, and laundry.

(m) "Recycled water" means recycled water, as defined in subdivision (n) of Section 13050, that is used to offset potable demand, including recycled water supplied for direct use and indirect potable reuse, that meets the following requirements, where applicable:

(1) For groundwater recharge, including recharge through spreading basins, water supplies that are all of the following:

(A) Metered.

(B) Developed through planned investment by the urban water supplier or a wastewater treatment agency.

(C) Treated to a minimum tertiary level.

(D) Delivered within the service area of an urban retail water supplier or its urban wholesale water supplier that helps an urban retail water supplier meet its urban water use target.

(2) For reservoir augmentation, water supplies that meet the criteria of paragraph (1) and are conveyed through a distribution system constructed specifically for recycled water.

(n) "Regional water resources management" means sources of supply resulting from watershed-based planning for sustainable local water reliability or any of the following alternative sources of water:

(1) The capture and reuse of stormwater or rainwater.

(2) The use of recycled water.

(3) The desalination of brackish groundwater.

(4) The conjunctive use of surface water and groundwater in a manner that is consistent with the safe yield of the groundwater basin.

(o) "Reporting period" means the years for which an urban retail water supplier reports compliance with the urban water use targets.

(p) "Urban retail water supplier" means a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes.

(q) "Urban water use target" means the urban retail water supplier's targeted future daily per capita water use.

(r) "Urban wholesale water supplier," means a water supplier, either publicly or privately owned, that provides more than 3,000 acre-feet of water annually at wholesale for potable municipal purposes.

Chapter 3 Urban Retail Water Suppliers

SECTION 10608.16-10608.44

10608.16. (a) The state shall achieve a 20-percent reduction in urban per capita water use in California on or before December 31, 2020.

(b) The state shall make incremental progress towards the state target specified in subdivision (a) by reducing urban per capita water use by at least 10 percent on or before December 31, 2015.

10608.20. (a) (1) Each urban retail water supplier shall develop urban water use targets and an interim urban water use target by July 1, 2011. Urban retail water suppliers may elect to determine and report progress toward achieving these targets on an individual or regional basis, as provided in subdivision (a) of Section 10608.28, and may determine the targets on a fiscal year or calendar year basis.

(2) It is the intent of the Legislature that the urban water use targets described in paragraph (1) cumulatively result in a 20-percent reduction from the baseline daily per capita water use by December 31, 2020.

(b) An urban retail water supplier shall adopt one of the following methods for determining its urban water use target pursuant to subdivision (a):

(1) Eighty percent of the urban retail water supplier's baseline per capita daily water use.

(2) The per capita daily water use that is estimated using the sum of the following performance standards:

(A) For indoor residential water use, 55 gallons per capita daily water use as a provisional standard. Upon completion of the department's 2016 report to the Legislature pursuant to Section 10608.42, this standard may be adjusted by the Legislature by statute.

(B) For landscape irrigated through dedicated or residential meters or connections, water efficiency equivalent to the standards of the Model Water Efficient Landscape Ordinance set forth in Chapter 2.7 (commencing with Section 490) of Division 2 of Title 23 of the California Code of Regulations, as in effect the later of the year of the landscape's installation or 1992. An urban retail water supplier using the approach specified in this subparagraph shall use satellite imagery, site visits, or other best available technology to develop an accurate estimate of landscaped areas.

(C) For commercial, industrial, and institutional uses, a 10-percent reduction in water use from the baseline commercial, industrial, and institutional water use by 2020.

(3) Ninety-five percent of the applicable state hydrologic region target, as set forth in the state's draft 20x2020 Water Conservation Plan (dated April 30, 2009). If the service area of an urban water supplier includes more than one hydrologic region, the supplier shall apportion its service area to each region based on population or area.

(4) A method that shall be identified and developed by the department, through a public process, and reported to the Legislature no later than December 31, 2010. The method developed by the department shall identify per capita targets that cumulatively result in a statewide 20-percent reduction in urban daily per capita water use by December 31, 2020. In developing urban daily per capita water use targets, the department shall do all of the following:

(A) Consider climatic differences within the state.

(B) Consider population density differences within the state.

(C) Provide flexibility to communities and regions in meeting the targets.

(D) Consider different levels of per capita water use according to plant water needs in different regions.

(E) Consider different levels of commercial, industrial, and institutional water use in different regions of the state.

(F) Avoid placing an undue hardship on communities that have implemented conservation measures or taken actions to keep per capita water use low.

(c) If the department adopts a regulation pursuant to paragraph (4) of subdivision (b) that results in a requirement that an urban retail water supplier achieve a reduction in daily per capita water use that is greater than 20 percent by December 31, 2020, an urban retail water supplier that adopted the method described in paragraph (4) of subdivision (b) may limit its urban water use target to a reduction of not more than 20 percent by December 31, 2020, by adopting the method described in paragraph (1) of subdivision (b).

(d) The department shall update the method described in paragraph (4) of subdivision (b) and report to the Legislature by December 31, 2014. An urban retail water supplier that adopted the method described in paragraph (4) of subdivision (b) may adopt a new urban daily per capita water use target pursuant to this updated method.

(e) An urban retail water supplier shall include in its urban water management plan due in 2010 pursuant to Part 2.6 (commencing with Section 10610) the baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data.

(f) When calculating per capita values for the purposes of this chapter, an urban retail water supplier shall determine population using federal, state, and local population reports and projections.

(g) An urban retail water supplier may update its 2020 urban water use target in its 2015 urban water management plan required pursuant to Part 2.6 (commencing with Section 10610).

(h) (1) The department, through a public process and in consultation with the California Urban Water Conservation Council, shall develop technical methodologies and criteria for the consistent implementation of this part, including, but not limited to, both of the following:

(A) Methodologies for calculating base daily per capita water use, baseline commercial, industrial, and institutional water use, compliance daily per capita water use, gross water use, service area population, indoor residential water use, and landscaped area water use.

(B) Criteria for adjustments pursuant to subdivisions (d) and (e) of Section 10608.24.

(2) The department shall post the methodologies and criteria developed pursuant to this subdivision on its Internet Web site, and make written copies available, by October 1, 2010. An urban retail water supplier shall use the methods developed by the department in compliance with this part.

(i) (1) The department shall adopt regulations for implementation of the provisions relating to process water in accordance with subdivision (l) of Section 10608.12, subdivision (e) of Section 10608.24, and subdivision (d) of Section 10608.26.

(2) The initial adoption of a regulation authorized by this subdivision is deemed to address an emergency, for purposes of Sections 11346.1 and 11349.6 of the Government Code, and the department is hereby exempted for that purpose from the requirements of subdivision (b) of Section 11346.1 of the Government Code. After the initial adoption of an emergency regulation pursuant to this subdivision, the department shall not request approval from the Office of Administrative Law to readopt the regulation as an emergency regulation pursuant to Section 11346.1 of the Government Code.

(j) (1) An urban retail water supplier is granted an extension to July 1, 2011, for adoption of an urban water management plan pursuant to Part 2.6 (commencing with Section 10610) due in 2010 to allow the use of technical methodologies developed by the department pursuant to paragraph (4) of subdivision (b) and subdivision (h). An urban retail water supplier that adopts an urban water management plan due in 2010 that does not use the methodologies developed by the department pursuant to subdivision (h) shall amend the plan by July 1, 2011, to comply with this part.

(2) An urban wholesale water supplier whose urban water management plan prepared pursuant to Part 2.6 (commencing with Section 10610) was due and not submitted in 2010 is granted an extension to July 1, 2011, to permit coordination between an urban wholesale water supplier and urban retail water suppliers.

10608.22. Notwithstanding the method adopted by an urban retail water supplier pursuant to Section 10608.20, an urban retail water supplier's per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use as defined in paragraph(3) of subdivision (b) of Section 10608.12. This section does not apply to an urban retail water supplier with a base daily per capita water use at or below 100 gallons per capita per day.

10608.24. (a) Each urban retail water supplier shall meet its interim urban water use target by December 31, 2015.

(b) Each urban retail water supplier shall meet its urban water use target by December 31, 2020.

(c) An urban retail water supplier's compliance daily per capita water use shall be the measure of progress toward achievement of its urban water use target.

(d) (1) When determining compliance daily per capita water use, an urban retail water supplier may consider the following factors:

(A) Differences in evapotranspiration and rainfall in the baseline period compared to the compliance reporting period.

(B) Substantial changes to commercial or industrial water use resulting from increased business output and economic development that have occurred during the reporting period.

(C) Substantial changes to institutional water use resulting from fire suppression services or other extraordinary events, or from new or expanded operations, that have occurred during the reporting period.

(2) If the urban retail water supplier elects to adjust its estimate of compliance daily per capita water use due to one or more of the factors described in paragraph (1), it shall provide the basis for, and data supporting, the adjustment in the report required by Section 10608.40.

(e) When developing the urban water use target pursuant to Section 10608.20, an urban retail water supplier that has a substantial percentage of industrial water use in its service area may exclude process water from the calculation of gross water use to avoid a disproportionate burden on another customer sector.

(f) (1) An urban retail water supplier that includes agricultural water use in an urban water management plan pursuant to Part 2.6 (commencing with Section 10610) may include the agricultural water use in determining gross water use. An urban retail water supplier that includes agricultural water use in determining gross water use and develops its urban water use target pursuant to paragraph (2) of subdivision (b) of Section 10608.20 shall use a water efficient standard for agricultural irrigation of 100 percent of reference evapotranspiration multiplied by the crop coefficient for irrigated acres.

(2) An urban retail water supplier, that is also an agricultural water supplier, is not subject to the requirements of Chapter 4 (commencing with Section 10608.48), if the agricultural water use is incorporated into its urban water use target pursuant to paragraph (1).

10608.26. (a) In complying with this part, an urban retail water supplier shall conduct at least one public hearing to accomplish all of the following:

(1) Allow community input regarding the urban retail water supplier's implementation plan for complying with this part.

(2) Consider the economic impacts of the urban retail water supplier's implementation plan for complying with this part.

(3) Adopt a method, pursuant to subdivision (b) of Section 10608.20, for determining its urban water use target.

(b) In complying with this part, an urban retail water supplier may meet its urban water use target through efficiency improvements in any combination among its customer sectors. An urban retail water supplier shall avoid placing a disproportionate burden on any customer sector.

(c) For an urban retail water supplier that supplies water to a United States Department of Defense military installation, the urban retail water supplier's implementation plan for complying with this part shall consider the conservation of that military installation under federal Executive Order 13514.

(d) (1) Any ordinance or resolution adopted by an urban retail water supplier after the effective date of this section shall not require existing customers as of the effective date of this section, to undertake changes in product formulation, operations, or equipment that would reduce process water use, but may provide technical assistance and financial incentives to those customers to implement efficiency measures for process water. This section shall not limit an ordinance or resolution adopted pursuant to a declaration of drought emergency by an urban retail water supplier.

(2) This part shall not be construed or enforced so as to interfere with the requirements of Chapter 4 (commencing with Section 113980) to Chapter 13 (commencing with Section 114380), inclusive, of Part 7 of Division 104 of the Health and Safety Code, or any requirement or standard for the protection of public health, public safety, or worker safety established by federal, state, or local government or recommended by recognized standard setting organizations or trade associations.

10608.28. (a) An urban retail water supplier may meet its urban water use target within its retail service area, or through mutual agreement, by any of the following:

(1) Through an urban wholesale water supplier.

(2) Through a regional agency authorized to plan and implement water conservation, including, but not limited to, an agency established under the Bay Area Water Supply and Conservation Agency Act (Division 31 (commencing with Section 81300)).

(3) Through a regional water management group as defined in Section 10537.

(4) By an integrated regional water management funding area.

(5) By hydrologic region.

(6) Through other appropriate geographic scales for which computation methods have been developed by the department.

(b) A regional water management group, with the written consent of its member agencies, may undertake any or all planning, reporting, and implementation functions under this chapter for the member agencies that consent to those activities. Any data or reports shall provide information both for the regional water management group and separately for each consenting urban retail water supplier and urban wholesale water supplier.

10608.32. All costs incurred pursuant to this part by a water utility regulated by the Public Utilities Commission may be recoverable in rates subject to review and approval by the Public Utilities Commission, and may be recorded in a memorandum account and reviewed for reasonableness by the Public Utilities Commission.

10608.36. Urban wholesale water suppliers shall include in the urban water management plans required pursuant to Part 2.6 (commencing with Section 10610) an assessment of their present and proposed future measures, programs, and policies to help achieve the water use reductions required by this part.

10608.40. Urban water retail suppliers shall report to the department on their progress in meeting their urban water use targets as part of their urban water management plans submitted pursuant to Section 10631. The data shall be reported using a standardized form developed pursuant to Section 10608.52.

10608.42. (a) The department shall review the 2015 urban water management plans and report to the Legislature by July 1, 2017, on progress towards achieving a 20-percent reduction in urban water use by December 31, 2020. The report shall include recommendations on changes to water efficiency standards or urban water use targets to achieve the 20-percent reduction and to reflect updated efficiency information and technology changes.

(b) A report to be submitted pursuant to subdivision (a) shall be submitted in compliance with Section 9795 of the Government Code.

10608.43. The department, in conjunction with the California Urban Water Conservation Council, by April 1, 2010, shall convene a representative task force consisting of academic experts, urban retail water suppliers, environmental organizations, commercial water users, industrial water users, and institutional water users to develop alternative best management practices for commercial, industrial, and institutional users and an assessment of the potential statewide water use efficiency improvement in the commercial, industrial, and institutional sectors that would result from implementation of these best management practices. The taskforce, in conjunction with the department, shall submit a report to the Legislature by April 1, 2012, that shall include a review of multiple sectors within commercial, industrial, and institutional users and that shall recommend water use efficiency standards for commercial, industrial, and institutional users among various sectors of water use. The report shall include, but not be limited to, the following:

(a) Appropriate metrics for evaluating commercial, industrial, and institutional water use.
(b) Evaluation of water demands for manufacturing processes, goods, and cooling.
(c) Evaluation of public infrastructure necessary for delivery of recycled water to the commercial, industrial, and institutional sectors.
(d) Evaluation of institutional and economic barriers to increased recycled water use within the commercial, industrial, and institutional sectors.
(e) Identification of technical feasibility and cost of the best management practices to achieve more efficient water use statewide in the commercial, industrial, and institutional sectors that is consistent with the public interest and reflects past investments in water use efficiency.

10608.44. Each state agency shall reduce water use at facilities it operates to support urban retail water suppliers in meeting the target identified in Section 10608.16.

Chapter 4 Agricultural Water Suppliers

SECTION 10608.48

10608.48. (a) On or before July 31, 2012, an agricultural water supplier shall implement efficient water management practices pursuant to subdivisions (b) and (c).

(b) Agricultural water suppliers shall implement all of the following critical efficient management practices:

(1) Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of Section 531.10 and to implement paragraph (2).

(2) Adopt a pricing structure for water customers based at least in part on quantity delivered.

(c) Agricultural water suppliers shall implement additional efficient management practices, including, but not limited to, practices to accomplish all of the following, if the measures are locally cost effective and technically feasible:

(1) Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.

(2) Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.

(3) Facilitate the financing of capital improvements for on-farm irrigation systems.

(4) Implement an incentive pricing structure that promotes one or more of the following goals:

(A) More efficient water use at the farm level.

(B) Conjunctive use of groundwater.

(C) Appropriate increase of groundwater recharge.

(D) Reduction in problem drainage.

(E) Improved management of environmental resources.

(F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.

(5) Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance, and reduce seepage.

(6) Increase flexibility in water ordering by, and delivery to, water customers within operational limits.

(7) Construct and operate supplier spill and tailwater recovery systems.

(8) Increase planned conjunctive use of surface water and groundwater within the supplier service area.

(9) Automate canal control structures.

(10) Facilitate or promote customer pump testing and evaluation.

(11) Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress reports.

(12) Provide for the availability of water management services to water users. These services may include, but are not limited to, all of the following:

(A) On-farm irrigation and drainage system evaluations.

(B) Normal year and real-time irrigation scheduling and crop evapotranspiration information.

(C) Surface water, groundwater, and drainage water quantity and quality data.

(D) Agricultural water management educational programs and materials for farmers, staff, and the public.

(13) Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.

(14) Evaluate and improve the efficiencies of the supplier's pumps.

(d) Agricultural water suppliers shall include in the agricultural water management plans required pursuant to Part 2.8 (commencing with Section 10800) a report on which efficient water management practices have been implemented and are planned to be implemented, an estimate of the water use efficiency improvements that have occurred since the last report, and an estimate of the water use efficiency improvements estimated to occur five and 10 years in the future. If an agricultural water supplier determines that an efficient water management practice is not locally cost effective or technically feasible, the supplier shall submit information documenting that determination.

(e) The data shall be reported using a standardized form developed pursuant to Section 10608.52.

(f) An agricultural water supplier may meet the requirements of subdivisions (d) and (e) by submitting to the department a water conservation plan submitted to the United States Bureau of Reclamation that meets the requirements described in Section 10828.

(g) On or before December 31, 2013, December 31, 2016, and December 31, 2021, the department, in consultation with the board, shall submit to the Legislature a report on the agricultural efficient water management practices that have been implemented and are planned to be implemented and an assessment of the manner in which the implementation of those efficient water management practices has affected and will affect agricultural operations, including estimated water use efficiency improvements, if any.

(h) The department may update the efficient water management practices required pursuant to subdivision (c), in consultation with the Agricultural Water Management Council, the United States Bureau of Reclamation, and the board. All efficient water management practices for agricultural water use pursuant to this chapter shall be adopted or revised by the department only after the department conducts public hearings to allow participation of the diverse geographical areas and interests of the state.

(i) (1) The department shall adopt regulations that provide for a range of options that agricultural water suppliers may use or implement to comply with the measurement requirement in paragraph (1) of subdivision (b).

(2) The initial adoption of a regulation authorized by this subdivision is deemed to address an emergency, for purposes of Sections 11346.1 and 11349.6 of the Government Code, and the department is hereby exempted for that purpose from the requirements of subdivision (b) of Section 11346.1 of the Government Code. After the initial adoption of an emergency regulation pursuant to this subdivision, the department shall not request approval from the Office of Administrative Law to readopt the regulation as an emergency regulation pursuant to Section 11346.1 of the Government Code.

Chapter 5 Sustainable Water Management

Section 10608.50

10608.50. (a) The department, in consultation with the board, shall promote implementation of regional water resources management practices through increased incentives and removal of barriers consistent with state and federal law. Potential changes may include, but are not limited to, all of the following:

(1) Revisions to the requirements for urban and agricultural water management plans.

(2) Revisions to the requirements for integrated regional water management plans.

(3) Revisions to the eligibility for state water management grants and loans.

(4) Revisions to state or local permitting requirements that increase water supply opportunities, but do not weaken water quality protection under state and federal law.

(5) Increased funding for research, feasibility studies, and project construction.

(6) Expanding technical and educational support for local land use and water management agencies.

(b) No later than January 1, 2011, and updated as part of the California Water Plan, the department, in consultation with the board, and with public input, shall propose new statewide targets, or review and update existing statewide targets, for regional water resources management practices, including, but not limited to, recycled water, brackish groundwater desalination, and infiltration and direct use of urban stormwater runoff.

Chapter 6 Standardized Data Collection

SECTION 10608.52

10608.52. (a) The department, in consultation with the board, the California Bay-Delta Authority or its successor agency, the State Department of Public Health, and the Public Utilities Commission, shall develop a single standardized water use reporting form to meet the water use information needs of each agency, including the needs of urban water suppliers that elect to determine and report progress toward achieving targets on a regional basis as provided in subdivision (a) of Section 10608.28.

(b) At a minimum, the form shall be developed to accommodate information sufficient to assess an urban water supplier's compliance with conservation targets pursuant to Section 10608.24 and an agricultural water supplier's compliance with implementation of efficient water management practices pursuant to subdivision (a) of Section 10608.48. The form shall accommodate reporting by urban water suppliers on an individual or regional basis as provided in subdivision (a) of Section 10608.28.

Chapter 7 Funding Provisions

Section 10608.56-10608.60

10608.56. (a) On and after July 1, 2016, an urban retail water supplier is not eligible for a water grant or loan awarded or administered by the state unless the supplier complies with this part.

(b) On and after July 1, 2013, an agricultural water supplier is not eligible for a water grant or loan awarded or administered by the state unless the supplier complies with this part.

(c) Notwithstanding subdivision (a), the department shall determine that an urban retail water supplier is eligible for a water grant or loan even though the supplier has not met the per capita reductions required pursuant to Section 10608.24, if the urban retail water supplier has submitted to the department for approval a schedule, financing plan, and budget, to be included in the grant or loan agreement, for achieving the per capita reductions. The supplier may request grant or loan funds to achieve the per capita reductions to the extent the request is consistent with the eligibility requirements applicable to the water funds.

(d) Notwithstanding subdivision (b), the department shall determine that an agricultural water supplier is eligible for a water grant or loan even though the supplier is not implementing all of the efficient water management practices described in Section 10608.48, if the agricultural water supplier has submitted to the department for approval a schedule, financing plan, and budget, to be included in the grant or loan agreement, for implementation of the efficient water management practices. The supplier may request grant or loan funds to implement the efficient water management practices to the extent the request is consistent with the eligibility requirements applicable to the water funds.

(e) Notwithstanding subdivision (a), the department shall determine that an urban retail water supplier is eligible for a water grant or loan even though the supplier has not met the per capita reductions required pursuant to Section 10608.24, if the urban retail water supplier has submitted to the department for approval documentation demonstrating that its entire service area qualifies as a disadvantaged community.

(f) The department shall not deny eligibility to an urban retail water supplier or agricultural water supplier in compliance with the requirements of this part and Part 2.8 (commencing with Section 10800), that is participating in a multiagency water project, or an integrated regional water management plan, developed pursuant to Section 75026 of the Public Resources Code, solely on the basis that one or more of the agencies participating in the project or plan is not implementing all of the requirements of this part or Part 2.8 (commencing with Section 10800).

10608.60. (a) It is the intent of the Legislature that funds made available by Section 75026 of the Public Resources Code should be expended, consistent with Division 43 (commencing with Section 75001) of the Public Resources Code and upon appropriation by the Legislature, for grants to implement this part. In the allocation of funding, it is the intent of the Legislature that the department give consideration to disadvantaged communities to assist in implementing the requirements of this part.

(b) It is the intent of the Legislature that funds made available by Section 75041 of the Public Resources Code, should be expended, consistent with Division 43 (commencing with Section 75001) of the Public Resources Code and upon appropriation by the Legislature, for direct expenditures to implement this part.

Chapter 8 Quantifying Agricultural Water Use Efficiency

SECTION 10608.64

10608.64. The department, in consultation with the Agricultural Water Management Council, academic experts, and other stakeholders, shall develop a methodology for quantifying the efficiency of agricultural water use. Alternatives to be assessed shall include, but not be limited to, determination of efficiency levels based on crop type or irrigation system distribution uniformity. On or before December 31, 2011, the department shall report to the Legislature on a proposed methodology and a plan for implementation. The plan shall include the estimated implementation costs and the types of data needed to support the methodology. Nothing in this section authorizes the department to implement a methodology established pursuant to this section.

Appendix C
Changes to the Water Code since 2010 UWMPs

Topic	CWC Section	Legislative Bill	Summary	Guidebook Section
Demand Management Measures	10631 (f)(1) and (2)	AB 2067 Weber 2014	Requires water suppliers to provide narratives describing their water demand management measures, as provided. Requires retail water suppliers to address the nature and extent of each water demand management measure implemented over the past 5 years and describe the water demand management measures that the supplier plans to implement to achieve its water use targets.	Chapter 9
Submittal Date	10621 (d)	AB 2067 Weber 2014	Requires each urban water supplier to submit its 2015 plan to the Department of Water Resources by July 1, 2016.	Chapter 10
Submittal Format	10644 (a) (2)	SB 1420 Wolk 2014	Requires the plan, or amendments to the plan, to be submitted electronically to the department.	Chapter 10
Standardized Forms	10644 (a) (2)	SB 1420 Wolk 2014	Requires the plan, or amendments to the plan, to include any standardized forms, tables, or displays specified by the department.	CH 1, Section 1.4
Water Loss	10631 (e) (1) (J) and (e) (3) (A) and (B)	SB 1420 Wolk 2014	Requires a plan to quantify and report on distribution system water loss.	Appendix L

Voluntary Reporting of Passive Savings	10631 (e) (4)	SB 1420 Wolk 2014	Provides for water use projections to display and account for the water savings estimated to result from adopted codes, standards, ordinances, or transportation and land use plans, when that information is available and applicable to an urban water supplier.	Appendix K
Voluntary Reporting of Energy Intensity	10631.2 (a) and (b)	SB 1036	Provides for an urban water supplier to include certain energy-related information, including, but not limited to, an estimate of the amount of energy used to extract or divert water supplies.	Appendix O
Defining Water Features	10632		Requires urban water suppliers to analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas.	CH 8, Section 8.2.4

CITY OF SANTA CRUZ

WATER DEPARTMENT

212 Locust Street, Santa Cruz, CA 95060 • (831) 420-5200 • Fax (831) 420-5201 • www.cityofsantacruz.com

December 15, 2015

Susan Mauriello, County Administrative Officer
County of Santa Cruz
701 Ocean Street, Room 520
Santa Cruz, CA 95060

SUBJECT: Urban Water Management Plan Update

Dear Ms. Mauriello,

The City of Santa Cruz is preparing an update to its Urban Water Management Plan, as required by state law. This letter is to notify the County of Santa Cruz that the Santa Cruz Water Department will be reviewing the plan and considering changes and amendments over the next few months and welcomes your input and comments during the update process. The updated plan is scheduled to be presented to the Santa Cruz City Council at a public hearing in June 2016 to meet the state's submittal deadline of July 1, 2016. We will send you notice of the time and place of the public hearing, along with information on where the 2015 UWMP can be viewed, in advance of that meeting.

Please contact Toby Goddard, Administrative Services Manager, at 420-5232, if you have any questions or wish to discuss the information covered in the plan.

Sincerely,

Rosemary Menard

Rosemary Menard
Water Director

cc: Kathy Previsich, Planning Director

CITY OF
SANTA CRUZ

WATER DEPARTMENT

212 Locust Street, Santa Cruz, CA 95060 • (831) 420-5200 • Fax (831) 420-5201 • www.cityofsantacruz.com

December 15, 2015

Jamie Goldstein, City Manager
City of Capitola
420 Capitola Ave.
Capitola, CA 95010

SUBJECT: Urban Water Management Plan Update

Dear Mr. Goldstein,

The City of Santa Cruz is preparing an update to its Urban Water Management Plan, as required by state law. This letter is to notify the City of Capitola that the Santa Cruz Water Department will be reviewing the plan and considering changes and amendments over the next few months and welcomes your input and comments during the update process. The updated plan is scheduled to be presented to the Santa Cruz City Council at a public hearing in June 2016 to meet the state's submittal deadline of July 1, 2016. We will send you notice of the time and place of the public hearing, along with information on where the 2015 UWMP can be viewed, in advance of that meeting.

Please contact Toby Goddard, Administrative Services Manager, at 420-5232, if you have any questions or wish to discuss the information covered in the plan.

Sincerely,

Rosemary Menard

Rosemary Menard
Water Director

cc: Richard Grunow, Community Development Director

Appendix E:

City of Santa Cruz General Plan 2030 Policies Regarding Water Service

Goal CC 3 A safe, reliable, and adequate water supply

CC3.1 Implement the City's Integrated Water Plan.

CC3.1.1 Implement the City's Long-Term Water Conservation Plan to reduce average daily water demand and maximize the use of existing water resources.

CC3.1.2 Periodically update the City's Water Shortage Contingency Plan to prepare for responding to future water shortages.

CC3.1.3 Develop a desalination plant of 2.5 mgd for drought protection, with the potential for incremental expansion to 4.5 mgd, if it is environmentally acceptable and financially feasible.

CC3.2 Meet or exceed all regulatory drinking water standards.

CC3.2.1 Regularly and comprehensively evaluate the water system relative to federal and State water quality regulations and standards, and develop recommendations and an action plan to address findings.

CC3.2.2 Develop, maintain, and update sampling and analysis programs, and laboratory procedures for the treated water distribution system and storage facilities.

CC3.2.3 Maintain required federal and State laboratory certification.

CC3.2.4 Prepare and submit compliance reports to all regulatory agencies.

CC3.2.5 Regularly sample and analyze finished water in accordance with approved methods and parameters identified by the State, U.S. Environmental Protection Agency, and the City.

CC3.2.6 Monitor the quality of water from all sources.

CC3.2.7 Provide annual drinking water quality reports to all consumers of city water.

CC3.3 Safeguard existing surface and groundwater sources.

CC3.3.1 Manage City watershed lands relative to protecting the sources of drinking water.

CC3.3.2 Maintain compliance with all applicable drinking water source protection-related regulations.

CC3.3.3 Secure and maintain all City water rights to existing and future water supplies to provide certainty and operational flexibility for the water system.

CC3.3.4 Review and comment on new State Water Resources Control Board water rights applications and timber harvest plans on City drinking water source watersheds.

CC3.3.5 Pursue appropriate regulatory enforcement of environmental violations committed by other watershed stakeholders.

CC3.3.6 Conduct hydrologic and biotic monitoring throughout drinking water source watersheds to protect water supplies and habitat. Cf. CD4.3.3 and NRC2.1, 2.2, 2.4, and 6.3.

CC3.3.7 Ensure that fisheries conservation strategies address and protect water storage, drinking water source quality, and water system flexibility, as well as protect the environmental resource.

CC3.3.8 Provide adequate pumping, treatment, and distribution facilities for peak season production of groundwater of 170 mgy in normal years and 215 mgy during droughts.

CC3.3.9 Monitor groundwater levels and quality.

CC3.3.10 Participate with the Soquel-Aptos Groundwater Management Alliance in cooperative efforts to assure the quality and production of groundwater resources.

CC3.4 Maintain and improve the integrity of the water system.

CC3.4.1 Maintain and improve water facilities to meet pressure and fire flow requirements and ensure customer delivery. Cf. HZ1.4.3.

CC3.4.2 Modernize City water treatment plants.

CC3.4.3 Optimize storage, transmission, and distribution capacities and efficiencies.

CC3.4.4 Evaluate and improve the water system so as to minimize water outages due to emergencies and disasters.

CC3.5 Promote maximum water use efficiency.

CC3.5.1 Implement 14 urban water conservation “best management practices” and meet reporting requirements in the Memorandum of Understating Regarding Urban Water Conservation in California.

CC3.5.2 Promote public education and awareness about the City’s water resources and the importance of water conservation.

CC3.5.3 Offer water audit programs and technical assistance for homes, businesses, and large landscapes to help customers reduce their average daily water use and control their utility bills.

CC3.5.4 Provide financial incentives to City water customers for installing high efficiency plumbing fixtures, appliances, and equipment.

CC3.5.5 Provide public information regarding onsite water catchment systems.

CC3.5.6 Administer and enforce water waste regulations, plumbing fixture retrofit requirements, and water efficient landscape standards for new development.

CC3.5.7 Explore and consider promoting or requiring new opportunities and technologies for more efficient use of water and energy.

CC3.5.8 Evaluate water use by residential, commercial, industrial and other customer categories and trends per capita.

CC3.5.9 Regularly audit the water distribution system and implement programs to minimize system losses and underground leaks.

CC3.5.10 Participate in regional water conservation partnerships, events, and opportunities.

CC3.5.11 Play a leadership role in supporting research, policy development, standards, and legislation aimed at furthering water use efficiency across the state.

CC3.5.12 Implement additional water conservation programs that provide a reliable gain in supply and can be justified in terms of their cost.

CC3.6 Coordinate major land use planning decisions in all three jurisdictions served by the City water system based on water supply availability.

CC3.6.1 Implement the City's Urban Water Management Plan and update it periodically as required by State law.

CC3.6.2 Provide annual updates to the city council on the status of remaining water supply.

CC3.6.3 Confirm or adjust the estimate of remaining supply to avoid oversubscribing the water system.

CC3.6.4 Consider developing criteria for determining significance of environmental impacts of development projects on the City water system to streamline the environmental review process.

CC3.7 Allow extension of the Water Service Area only if an application is approved by city council and/or LAFCO

CC3.8 Prohibit additional connections to the North Coast water system, in accordance with City Council Resolutions NS-17372 and NS-21056.

CC3.9 Sustain long-term fiscal stability.

CC3.9.1 Maintain a rate schedule based on cost of service and designed to provide an economic incentive for conservation.

CC3.9.2 Collect sufficient revenues to assure adequate maintenance of the water system infrastructure.

CC3.9.3 Maintain a Water Rate Stabilization Fund to protect against unanticipated emergencies, and Operating Reserves as needed for cash flow.

CC3.9.4 Confine long-term borrowing to major capital improvements.

CC3.9.5 Develop and implement a long-term Capital Improvements Plan for prioritizing and financing major projects.

CC3.10 Investigate new supply options to meet planned growth.

CC3.10.1 Explore opportunities to use recycled water for future water supply.

CC3.11 Conserve water resources. Cf. NRC1.3.1 and 3.1.

CC3.11.1 Promote water conservation.

CC3.11.2 Regularly update guidelines and standards for new landscaping that emphasizes xeriscaping, climate-appropriate landscape design, and other water-conserving practices.

CC3.11.3 Conduct a landscape irrigation audit program and target large water consumers to reduce consumption. Examples of large consumers are large turf customers, large commercial and industrial customers, and property management firms.

CITY OF SANTA CRUZ WATER DEMAND FORECAST

Abstract

This report presents an econometric analysis of water demand and forecasts of class-level customer demands and total system production through 2035. The report was commissioned by the City of Santa Cruz Water Department and the City's Water Supply Advisory Committee to update the Department's existing demand forecast to reflect current information on water usage and to account for effects of conservation, water rates, and other factors expected to impact the future demand for water.

Prepared by
David Mitchell
M.Cubed

October 2015

CONTENTS

EXECUTIVE SUMMARY

The City of Santa Cruz is currently undertaking a comprehensive evaluation of its future water supply and infrastructure requirements. The forecast of future water demand is a foundational component to this assessment. In recent years the historical patterns of water demand have been upended by a variety of factors, including the cumulative effects of tighter efficiency standards for appliances and plumbing fixtures, greater investment in conservation, a significant uptick in water rates, an equally significant downturn in economic activity during the Great Recession, and on-going drought. These events have resulted in even more uncertainty than usual regarding future water demand and have placed even greater importance on sorting out the effect each has had on demand in recent years as well as how they are likely to affect demand going forward.

The City of Santa Cruz has appointed a public Water Supply Advisory Committee (WSAC) to examine the City's water supply situation. Its specific charge, as stated in its Charter, is to

> *explore, through an iterative, fact-based process, the City's water profile, including supply, demand and future risks; analyze potential solutions to deliver a safe, adequate, reliable, affordable, and environmentally sustainable water supply and develop recommendations for City Council consideration.*

The Water Department last prepared a formal forecast of water demand as part of its 2010 Urban Water Management Plan (UWMP). That forecast covered the period 2010 to 2030. The forecast reflected average consumption levels circa 2008 and growth projections based on the City's General Plan, UC Santa Cruz's (UCSC) Long Range Development Plan (LRDP) and Association of Monterey Bay Area Governments (AMBAG) population and housing projections. The 2010 UWMP forecast did not account for potential effects of future conservation, higher water rates, or other factors affecting average water use over time. Since the adoption of its 2010 UWMP, actual demand has trended well below forecasted demand. Drought, economic recession, higher water rates, and conservation have been cited as possible reasons for the divergence.

One of the first requests made by the WSAC was for the Water Department to update the demand forecast to reflect current information on water usage and to account for effects of conservation, water rates, and other factors expected to impact the future demand for water.

Statistical Models of Average Demand

This report develops statistically-based models of average water demand. The demand forecasts based on these models cover the period 2020-2035 and incorporate empirical relationships between water use and key explanatory variables, including season, weather, water rates, household income, employment, conservation, and drought restrictions. The approach builds on similar models of water demand developed for the California Urban Water Conservation Council (Western Policy Research, 2011), Bay Area Water Supply and Conservation Agency (Western Policy Research, 2014), California Water Services Company (A&N Technical Services, 2014, M.Cubed 2015), and Contra Costa Water District (M.Cubed 2014).

The statistical models of demand were estimated using historical data on class water use, weather, water price, household income, conservation, and other economic variables driving water demand. The monthly models of average water demand are combined with service and housing growth forecasts to predict future water demands. The average demand models explain 90 to 99% of the observed variation in historical average use over the 14 year estimation period.

The forecasts of average demand by customer class are summarized in Table ES-1. The forecasts include adjustments for future effects of plumbing codes and the City's baseline conservation program[1] and are predicated on average weather and normal economic conditions.

Table ES - 1. Forecasted Average Demand by Customer Class (CCF/Year)

YEAR		2013	2020		2025		2030		2035	
	Per	Actual 1/	Forecast	CI	Forecast	CI	Forecast	CI	Forecast	CI
Single Family	Housing Unit	87	86	± 3	83	± 3	80	± 4	78	± 4
Multi Family	Housing Unit	53	56	± 2	52	± 2	50	± 2	49	± 3
Business	Service	405	400	± 12	389	± 12	382	± 13	377	± 13
Municipal	Service	388	296	± 26	290	± 27	283	± 29	277	± 30
Irrigation	Service	365	286	± 28	271	± 28	257	± 28	244	± 28
Golf	Acre	990	671	± 130	641	± 134	606	± 137	593	± 144

1/ Actual use, unadjusted for weather or economy. Stage 1 drought water use restrictions in effect May - Dec.

CI = 95% confidence interval.

Industrial and UCSC Demand Forecast

Because of their unique characteristics, industrial and UCSC demands were forecasted separately from the other customer categories. In the case of industrial demand, there is a strong relationship between Santa Cruz County manufacturing employment and aggregate industrial water use. This relationship is used to generate the industrial demand forecast shown in Table ES-2.

Table ES - 2. Industrial Demand Forecast (MGY)

	2013 1/	2020	2025	2030	2035
Mfg Employment Forecast 2/		5,900	6,200	6,400	6,500
Industrial Water Demand (MG)					
Low	56	56	58	59	60
Primary	56	57	59	61	62
High	56	57	60	63	64

Notes
1/ Actual per Water Department billing records.
2/ Caltrans Economic Forecast for Santa Cruz County.

The forecast of future UCSC demand is based on a linear projection of the university's buildout demand in its 2005 LRDP, assuming two alternative buildout dates. In both cases, buildout demand is 349 MGY. In the lower bound forecast, buildout occurs in 2050. In the upper bound forecast it occurs in 2035. The primary forecast is the midpoint between the lower and upper bound forecasts. The forecast of UCSC

[1] The baseline conservation program level is Program A in the City's forthcoming water conservation master plan.

demand is given in Table ES-3. The primary forecast almost exactly replicates a forecast based on projected enrollment and average rates of water use per student.[2]

Table ES - 3. UCSC Water Demand Forecast (MGY)

	2013 1/	2020	2025	2030	2035
Low	182	186	213	240	268
Primary	182	196	234	271	308
High	182	207	254	302	349
Notes					
1/ Actual per Water Department billing records.					

Population, Housing, and Non-Residential Connection Forecasts

Forecasts of population, housing units, and non-residential connections are anchored to AMBAG's 2014 Regional Growth Forecast (AMBAG 2014). Projected growth in single- and multi-family housing units are shown in Table ES-4 and projected growth in non-residential services (excluding industrial and UCSC) are summarized in Table ES-5.[3]

Table ES - 4. Forecast of Occupied Housing Units

	2014 1/	2020	2025	2030	2035
Inside-City					
Single Family	12,246	12,534	12,780	13,030	13,246
Multi Family	9,583	10,958	11,398	12,106	12,679
Subtotal	21,829	23,492	24,177	25,136	25,925
Outside-City					
Single Family	6,743	6,922	7,074	7,230	7,390
Multi Family	7,901	7,910	8,033	8,310	8,495
Subtotal	14,644	14,832	15,107	15,540	15,884
Service Area					
Single Family	18,989	19,456	19,854	20,260	20,636
Multi Family	17,484	18,868	19,431	20,416	21,174
Total	36,473	38,324	39,284	40,676	41,809
Notes					
1/ Actual per Water Department billing records.					

[2] The enrollment-based approach yields a 2035 demand of 304 MG, which differs from the primary forecast by less than 2%.
[3] The decrease in forecasted golf acreage is due to the intention of Pasatiempo golf course to shift to non-City sources of irrigation water.

Table ES - 5. Forecast of Non-Residential Services and City-Irrigated Golf Acreage

	2013 [1/]	2020	2025	2030	2035
Business [2/]	1,889	1,948	1,971	2,008	2,055
Municipal [3/]	218	218	218	218	218
Irrigation [4/]	452	651	723	845	951
Golf					
Delaveaga	79	79	79	79	79
Pasatiempo	68	40	30	20	20
Total Golf	146	119	109	99	99

Notes
1/ Actual per Water Department billing records.
2/ Based on ratio of business to residential demand.
3/ No expected growth in number of municipal services.
4/ Based on historical rate of gain in irrigation services per gain in multi-family and business services.

Demand Forecasts

The primary, low, and high forecasts of system demand are provided in Tables ES-6, ES-7, and ES-8. Under the primary forecast, total system demand is expected to remain stable at about 3,400 MGY over the forecast period, despite a 13 percent increase in population over the same period. Per capita water use is projected to go from 93 gallons per day in 2020 to 84 gallons per day in 2035, a decrease of approximately 10 percent.

Forecasted demands are significantly lower than the 2010 UWMP forecast, as shown in Figure ES-1. The primary reasons for this are that the 2010 UWMP forecast (1) did not include adjustments for the future effects of passive and active conservation and higher water rates on future water use and (2) assumed higher UCSC demand.

While the econometric demand models were under development, an interim demand forecast was developed for the WSAC by adjusting the 2010 UWMP forecast for future conservation and other economic effects and by adjusting downward the UC demands (M.Cubed, 2015b). Figure ES-2 provides a comparison of the econometric model and WSAC interim demand forecasts. On average, the econometric demand forecast is approximately five and a half percent greater than the WSAC interim forecast. The econometric forecast represented by the dark blue line essentially tracks the upper-bound of the WSAC interim forecast while the WSAC interim forecast represented by the dark yellow line essentially tracks the lower-bound of the econometric forecast. Between these two lines, the forecasts overlap. Future production in the range of 3,200 to 3,400 MGY is consistent with both forecasts.

Figure ES-3 shows a comparison of historical production and the primary, lower, and upper bound forecasts. It is interesting to see how historical production has been influenced by weather and economic events. The forecast does not exhibit a similar degree of variability because it is based on average weather and normal economic conditions. In other words, it is a forecast of *expected future demand*. Realized future demand will certainly not be smooth like the forecast. It will vary about the expected value depending on year-to-year variation in future weather and economic conditions. The forecast, however, provides the baseline around which this variability is likely to occur.

Figure ES - 1. Comparison of Demand Forecast with 2010 UWMP Forecast

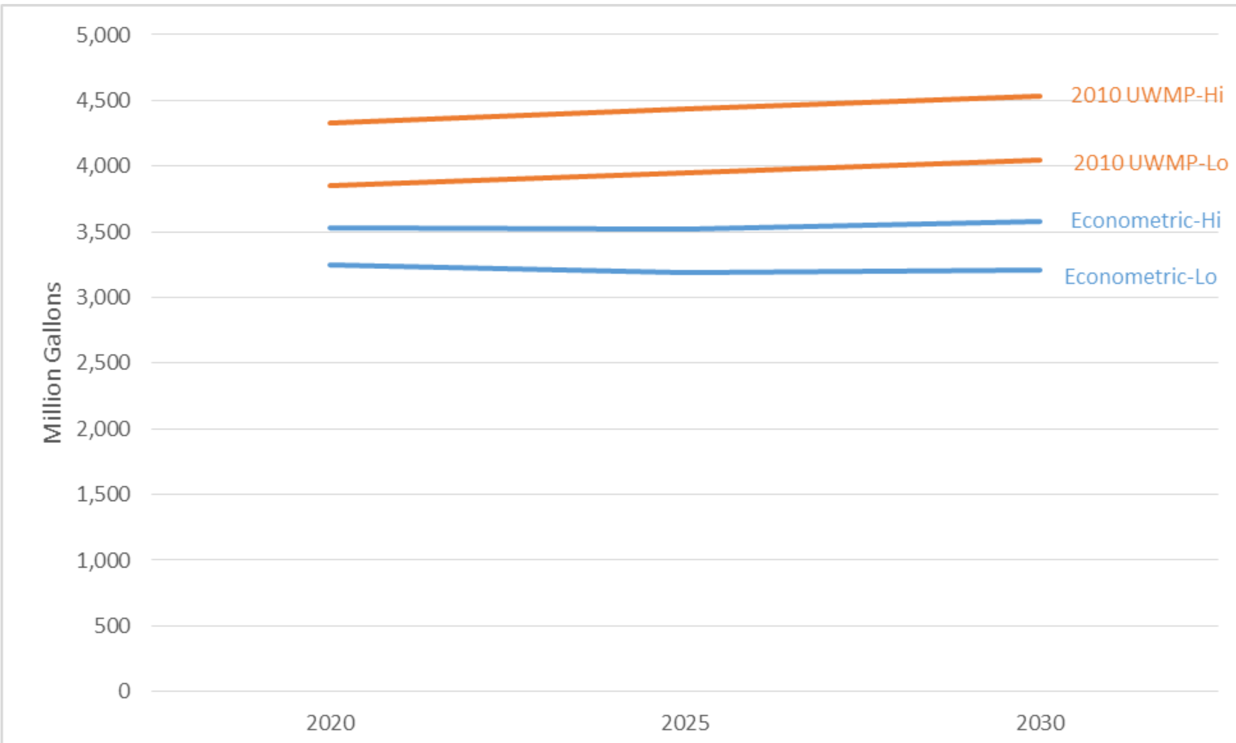

Figure ES - 2. Comparison of Demand Forecast with Interim WSAC Demand Forecast

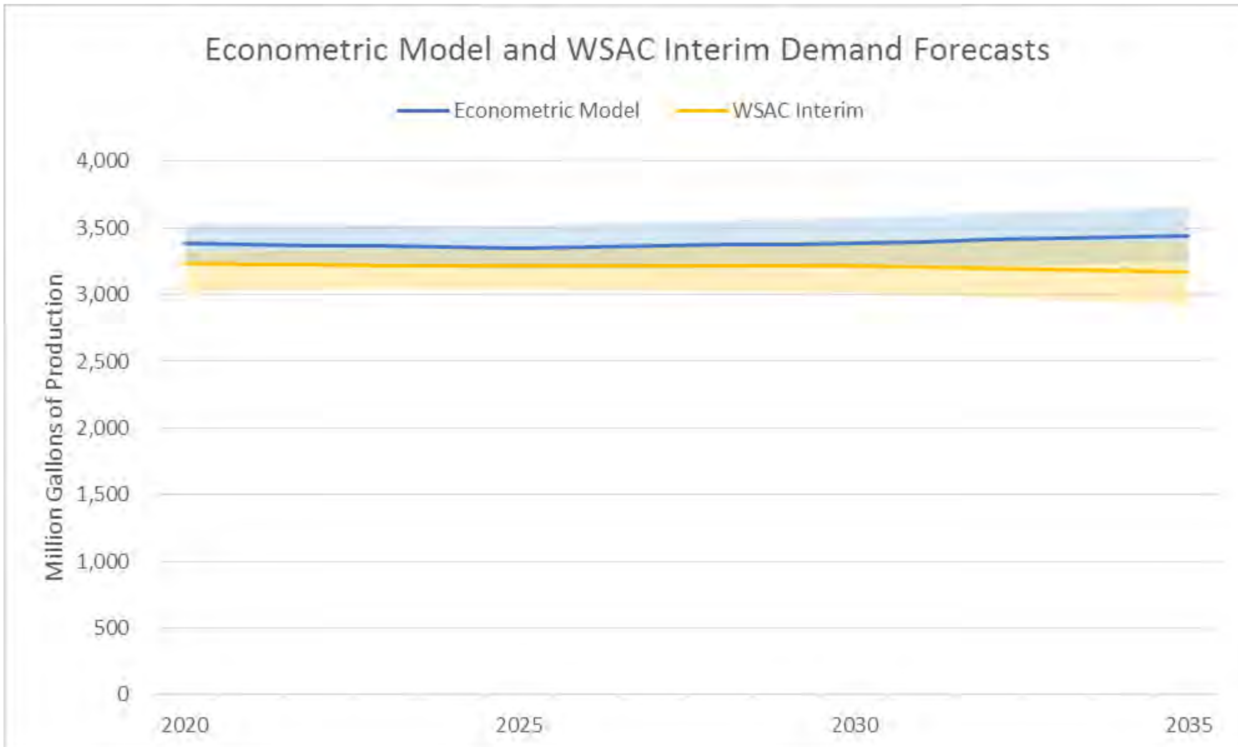

Figure ES - 3. Historical and Forecast Production in Millions of Gallons

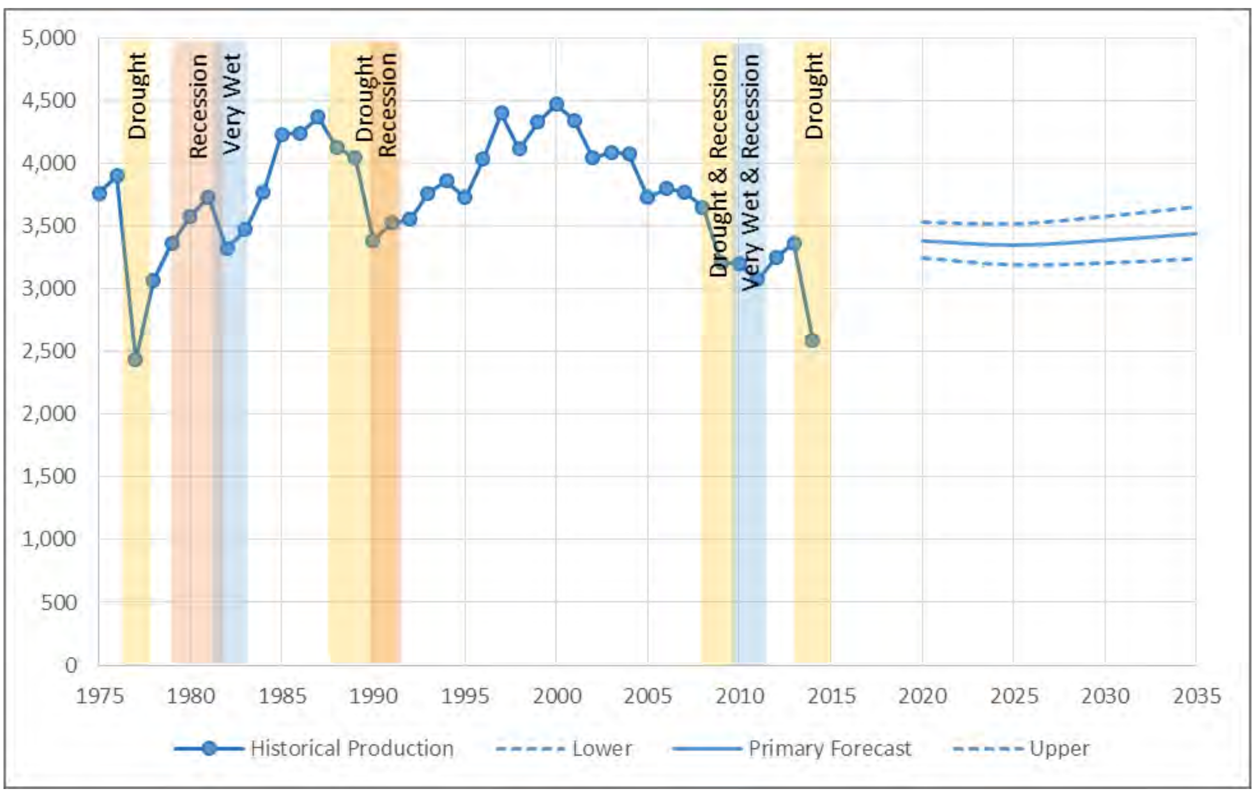

Table ES - 6. Primary Forecast of Class Demands and System Production

YEAR		**2020**	**2025**	**2030**	**2035**
		Forecast	Forecast	Forecast	Forecast
Service Units	**Units**				
SFR	Housing Units	19,456	19,854	20,260	20,636
MFR	Housing Units	18,867	19,430	20,416	21,174
BUS	Services	1,948	1,971	2,008	2,055
IND	NA	NA	NA	NA	NA
MUN	Services	218	218	218	218
IRR	Services	651	723	845	951
GOLF	Acres	119	109	99	99
UC	NA	NA	NA	NA	NA
Avg Demand	**Units**				
SFR	CCF	86	83	80	78
MFR	CCF	56	52	50	49
BUS	CCF	400	389	382	377
IND	NA	NA	NA	NA	NA
MUN	CCF	296	290	283	277
IRR	CCF	286	271	257	244
GOLF	CCF	671	641	606	593
UC	NA	NA	NA	NA	NA
Annual Demand	**Units**				
SFR	MG	1,256	1,228	1,208	1,196
MFR	MG	792	759	766	775
BUS	MG	583	573	575	580
IND	MG	57	59	61	62
MUN	MG	48	47	46	45
IRR	MG	139	147	163	174
GOLF	MG	60	52	45	44
UC	MG	196	234	271	308
Total Demand	**MG**	**3,131**	**3,099**	**3,134**	**3,184**
MISC/LOSS	MG	254	251	254	258
Total Production	**MG**	**3,385**	**3,351**	**3,388**	**3,442**
Rounded	**MG**	**3,400**	**3,400**	**3,400**	**3,400**

Table ES - 7. Lower Bound Forecast of Class Demands and System Production

YEAR		2020	2025	2030	2035
		Forecast	Forecast	Forecast	Forecast
Service Units	**Units**				
SFR	Housing Units	19,456	19,854	20,260	20,636
MFR	Housing Units	18,867	19,430	20,416	21,174
BUS	Services	1,948	1,971	2,008	2,055
IND	NA	NA	NA	NA	NA
MUN	Services	218	218	218	218
IRR	Services	651	723	845	951
GOLF	Acres	119	109	99	99
UC	NA	NA	NA	NA	NA
Avg Demand	**Units**				
SFR	CCF	83	79	76	74
MFR	CCF	54	50	48	46
BUS	CCF	389	377	370	364
IND	NA	NA	NA	NA	NA
MUN	CCF	271	264	256	248
IRR	CCF	260	245	231	218
GOLF	CCF	553	521	485	466
UC	NA	NA	NA	NA	NA
Annual Demand	**Units**				
SFR	MG	1,208	1,178	1,155	1,142
MFR	MG	764	728	731	736
BUS	MG	567	556	556	560
IND	MG	56	58	59	60
MUN	MG	44	43	42	40
IRR	MG	126	133	146	155
GOLF	MG	49	42	36	35
UC	MG	186	213	240	268
Total Demand	**MG**	**3,001**	**2,951**	**2,965**	**2,995**
MISC/LOSS	MG	243	239	240	243
Total Production	**MG**	**3,244**	**3,190**	**3,206**	**3,238**
Rounded	**MG**	**3,200**	**3,200**	**3,200**	**3,200**

Table ES - 8. Upper Bound Forecast of Class Demands and System Production

YEAR		2020	2025	2030	2035
		Forecast	Forecast	Forecast	Forecast
Service Units	**Units**				
SFR	Housing Units	19,456	19,854	20,260	20,636
MFR	Housing Units	18,867	19,430	20,416	21,174
BUS	Services	1,948	1,971	2,008	2,055
IND	NA	NA	NA	NA	NA
MUN	Services	218	218	218	218
IRR	Services	651	723	845	951
GOLF	Acres	119	109	99	99
UC	NA	NA	NA	NA	NA
Avg Demand	**Units**				
SFR	CCF	90	86	83	81
MFR	CCF	58	54	53	52
BUS	CCF	412	401	395	391
IND	NA	NA	NA	NA	NA
MUN	CCF	323	318	313	308
IRR	CCF	315	300	287	274
GOLF	CCF	814	790	758	754
UC	NA	NA	NA	NA	NA
Annual Demand	**Units**				
SFR	MG	1,305	1,280	1,262	1,253
MFR	MG	820	792	803	816
BUS	MG	601	591	594	601
IND	MG	57	60	63	64
MUN	MG	53	52	51	50
IRR	MG	153	162	181	195
GOLF	MG	72	64	56	56
UC	MG	207	254	302	349
Total Demand	**MG**	**3,268**	**3,255**	**3,311**	**3,383**
MISC/LOSS	MG	265	264	268	274
Total Production	**MG**	**3,533**	**3,519**	**3,580**	**3,658**
Rounded	**MG**	**3,500**	**3,500**	**3,600**	**3,700**

1 INTRODUCTION

1.1 NEED FOR UPDATED DEMAND FORECAST

The City of Santa Cruz is currently undertaking a comprehensive evaluation of its future water supply and infrastructure requirements. The forecast of future water demand is a foundational component to this assessment. In recent years the historical patterns of water demand have been upended by a variety of factors, including the cumulative effects of tighter efficiency standards for appliances and plumbing fixtures, greater investment in conservation, a significant uptick in water rates, an equally significant downturn in economic activity during the Great Recession, and on-going drought. These events have resulted in even more uncertainty than usual regarding future water demand and have placed even greater importance on sorting out the effect each has had on demand in recent years as well as how they are likely to affect demand going forward.

The City of Santa Cruz has appointed a public Water Supply Advisory Committee (WSAC) to examine the City's water supply situation. Its specific charge, as stated in its Charter, is to

> *explore, through an iterative, fact-based process, the City's water profile, including supply, demand and future risks; analyze potential solutions to deliver a safe, adequate, reliable, affordable, and environmentally sustainable water supply and develop recommendations for City Council consideration.*

The Water Department last prepared a formal forecast of water demand as part of its 2010 Urban Water Management Plan (UWMP). That forecast covered the period 2010 to 2030. The forecast reflected average consumption levels circa 2008 and growth projections based on the City's General Plan, UC Santa Cruz's (UCSC) Long Range Development Plan (LRDP) and Association of Monterey Bay Area Governments (AMBAG) population and housing projections. The 2010 UWMP forecast did not account for potential effects of future conservation, higher water rates, or other factors affecting average water use over time. Since the adoption of its 2010 UWMP, actual demand has trended well below forecasted demand. Drought, economic recession, higher water rates, and conservation have been cited as possible reasons for the divergence.

One of the first requests made by the WSAC was for the Water Department to update the demand forecast to reflect current information on water usage and to account for effects of conservation, water rates, and other factors expected to impact the future demand for water. Because of timing considerations, it was decided to do this in two steps. First, the Water Department would prepare an interim demand forecast based on the 2010 UWMP forecast. The interim forecast would extend the forecast period to 2035 and include adjustments for conservation and rate effects as well as incorporate new information on economic development and expansion of UCSC. The data and methods used to develop the interim forecast are documented in two Technical Memoranda (M.Cubed 2015a, M.Cubed 2015b). Second, the Water Department would compile data and complete statistical models needed to prepare a new demand forecast. The remainder of this report describes the data and methods used to prepare the new demand forecast that replaces the interim forecast.

1.2 Project Objective

The objective of this project is to develop statistically-based models of water demand that will be used to support WSAC deliberations as well as the 2015 UWMP being developed by the Water Department. Demand forecasts based on these models will cover the period 2020-2035 and will incorporate empirical relationships between water use and key explanatory variables, including season, weather, water rates, household income, employment, and drought restrictions.

1.3 Report Organization

The remainder of this report is organized as follows. In Section 2, the statistical models of average demand are presented, including general approach, data development, model definition, model estimation, and forecasts of average demand by customer class. In Section 3, forecasts of population, housing units, and services are presented. The population and housing unit forecasts are derived from the most recently adopted AMBAG regional forecasts (AMBAG, 2014). Forecasts of non-residential services (e.g. business, irrigation, golf, and municipal) are derived from the residential projections using empirical relationships between the different sectors. In Section 4, forecasts of water demand are developed by combining the forecasts of average demand with the forecasts of housing units and non-residential services. Industrial and UCSC demands, which are treated separately from the other customer categories, are also addressed in this section. In Section 5, a comparison of the new forecast with previous forecasts is presented.

2 Statistical Models of Average Demand

2.1 Approach

The general approach is to statistically estimate class-level conditional expectation functions of water demand using historical data on class water use, weather, water price, household income, conservation, and other economic variables driving water demand. The result for each customer class is a monthly model of average water use per housing unit (for single- and multi-family residential classes), service (for business, municipal, and irrigation classes), or acre (for golf courses), which can then be combined with forecasts of housing units, services, and acres, to forecast future water demands. The conditional expectation functions are used with forecasts of future conservation, water rates, household income, unemployment, and other economic factors to predict the trajectory of average water use over the forecast period. This represents a key departure from the 2010 UWMP forecast methodology, which relied on static average use estimates to forecast future demands.

2.2 Model Definition

The model of expected demand builds on similar models of water demand developed for the California Urban Water Conservation Council (Western Policy Research, 2011), Bay Area Water Supply and Conservation Agency (Western Policy Research, 2014), California Water Services Company (A&N Technical Services, 2014, M.Cubed 2015), and Contra Costa Water District (M.Cubed 2014).

The model of expected demand has several useful features. First, climate and weather effects on demand are decomposed into two distinct components. The climate component measures the seasonal load shape of monthly demand under normal weather conditions. The weather component measures the effect on demand when weather departs from normal conditions. The seasonal and weather components can be interacted to get season-specific weather effects. This is useful if the response to weather is expected to vary by season. For example, the effect of above normal rainfall on demand in winter, when outdoor water uses are lower, may be different than its effect in spring or fall, when outdoor water uses are higher. Second, prior to model estimation, monthly water use is adjusted for historical conservation from plumbing codes. This helps to address the confounding effect of conservation on the estimation of other demand parameters like price, employment, and income. Third, the model includes economic parameters (e.g. price, household income, unemployment) known to influence urban water demand (Renzetti, 2002; Billings and Jones, 1996). Fourth, the model includes drought policy parameters to measure the effect of drought restrictions on demand. Thus, expected demand can be expressed conditional on season, weather, conservation, economic conditions, and drought stage.

The model of expected demand is stated as:

$$ln(\tilde{y}_{it}) = \mu_i + \beta_S Season_t + \beta_W Weather_t + \beta_E Economic_{it} + \beta_D Drought_t + \varepsilon_{it} \quad (1)$$

Where:

$\tilde{y}_{it}$	average use in month t for service region i adjusted to remove the effects of water savings due to plumbing codes and appliance standards
μ_i	model intercept for service region i
$\beta_S Season_t$	seasonal component of average use in month t
$\beta_W Weather_t$	weather component of average use in month t
$\beta_E Economic_{it}$	economic component of average use in month t
$\beta_D Drought_t$	drought component of average use in month t
ε_{it}	stochastic component (error term)

The seasonal component is specified using eleven monthly indicator variables. The monthly indicator variables take the value of one if t = j, and zero otherwise.

$$\beta_S Season_t = \sum_{j=2}^{12} \beta_j \, month_{jt} \quad (2)$$

The eleven monthly parameters plus the model intercept describe the seasonal load shape of average demand. A seasonal index of monthly demand, where January has an index value of one, is easily constructed as shown in Table 1. The eleven seasonal parameters are seen to scale monthly demand relative to January demand.

Table 1. Seasonal Index of Monthly Average Demand

Month	Seasonal Index	Month	Seasonal Index
Jan	1	Jul	e^{β_7}
Feb	e^{β_2}	Aug	e^{β_8}
Mar	e^{β_3}	Sep	e^{β_9}
Apr	e^{β_4}	Oct	$e^{\beta_{10}}$
May	e^{β_5}	Nov	$e^{\beta_{11}}$
Jun	e^{β_6}	Dec	$e^{\beta_{12}}$

The weather component is comprised of weather measures (monthly rainfall, monthly average of maximum daily air temperatures, monthly ETo) that are transformed logarithmically with their monthly average subtracted away. In the case of rainfall, both contemporaneous and lagged measures are included in the model.

$$\beta_W Weather_t = \beta_{w1} dlR_t + \beta_{w2} dlR_{t-1} + \beta_{w3} dlR_{t-2} + \beta_{w4} dlT_t \ (or\ dlET_t) \tag{3}$$

Where[4]

$$dlR_t = ln(Rain_t + 1) - \overline{ln(Rain_t + 1)} \tag{4}$$

$$dlT_t = ln(Temp_t) - \overline{ln(Temp_t)} \tag{5}$$

$$dlET_t = ln(ET_t) - \overline{ln(ET_t)} \tag{6}$$

For the residential and business customer classes, average daily maximum air temperature is used rather an ET. For the golf, irrigation, and municipal categories, which have greater landscape water uses, ET is used.

The percentage effect on demand due to changes in weather can be calculated from the model parameters and weather observations. Let α be a scalar that expresses the weather measure as a percentage of the observed weather measure. If, for example, α is 1.1, then αR_t would be 110% of observed rainfall. For any αR_t, the expected change in average demand, all else equal, is

$$\%\ change\ in\ average\ demand\ given\ (\alpha - 1)\%\ change\ in\ rain = \left(\frac{\alpha R_t + 1}{R_t + 1}\right)^{\beta_{w1}} - 1 \tag{7}$$

For temperature or ET, which do not have one added to their values prior to transforming them logarithmically, the calculation is even simpler.

$$\%\ change\ in\ average\ demand\ given\ (\alpha - 1)\%\ change\ in\ temp\ or\ ET = \alpha^{\beta_{w4}} - 1 \tag{8}$$

[4] One is added to monthly rain totals to ensure the rainfall measure is defined in months in which total rainfall is zero.

During model estimation, the weather component is interacted with seasonal indicators to estimate separate seasonal weather effects for fall-winter (Nov-Mar), spring (Apr-Jun), and summer-fall (Jul-Oct).[5]

Weather normalization of historical demands can be done in two ways. The first way is to use the predicted model values assuming average weather. In this case the model's weather component simply falls away and we are left with:

$$Weather\ Normalized\ \tilde{y}_{it} = exp(\mu_i + \beta_S Season_t + \beta_E Economic_{it}) \tag{9}$$

The second approach is to rescale observed water use using the estimated weather effects. The ratio of observed to weather normalized demand is

$$WeatherEffect_t = exp\big(\beta_{w1} dlR_t + \beta_{w2} dlR_{t-1} + \beta_{w3} dlR_{t-2} + \beta_{w4} dlT_t\ (or\ dlET_t)\big) \tag{10}$$

Weather normalized observed demand is then given by

$$Weather\ Normalized\ \tilde{y}_{it} = \frac{\tilde{y}_{it}}{WeatherEffect_t} \tag{11}$$

The economic component consists of economic variables that influence average water demand, including water price, household income, vacancy rate, and unemployment rate.

$$\beta_E Economic_{it} = \beta_{E1} lPrice_{it} + \beta_{E2} lInc_{it} + \beta_{E3} dlVac_t + \beta_{E4} dlUnempl_t \tag{12}$$

Where

$$lPrice_{it} = ln(marginal\ price)\ in\ service\ region\ i, period\ t \tag{13}$$

$$lInc_{it} = ln(median\ household\ income)\ in\ service\ region\ i, period\ t \tag{14}$$

$$dlVac_t = ln(housing\ vacancy\ rate) - \overline{ln(housing\ vacancy\ rate)} \tag{15}$$

$$dlUnempl_t = \ln(unemployment\ rate) - \overline{\ln(unemployment\ rate)} \tag{16}$$

The economic variables are logarithmically transformed prior to model estimation. The vacancy rate and unemployment rate variables are expressed as departures from their long-run average values. Each customer class model uses a restricted form of equation 12, as shown in the following table. These restrictions are guided both by economic theory and model diagnostics. For the single family model, the primary economic drivers are marginal water price and household income. For the multi-family model, vacancy rate replaces household income. For the business and municipal class models, marginal price and unemployment measures are used. For golf and irrigation, only marginal price is included in the models.

[5] The seasonal construct follows the CUWCC's GPCD weather normalization methodology (Western Policy Research, 2011).

Table 2. Economic Variable Restrictions in Customer Class Models

Customer Class Model	**Economic Variable Restrictions**
Single Family	$\beta_{E3} = \beta_{E4} = 0$
Multi Family	$\beta_{E2} = \beta_{E4} = 0$
Business, Municipal	$\beta_{E2} = \beta_{E3} = 0$
Golf, Irrigation	$\beta_{E2} = \beta_{E3} = \beta_{E4} = 0$

2.3 DATA DEVELOPMENT

2.3.1 Water Consumption

The models were estimated with monthly consumption data for the period January 2000 to November 2014. Class-level aggregated meter read data were obtained from the Water Department. The Water Department data were separated between Inside City and Outside City accounts, and contained aggregated data from both bi-monthly and monthly meter read cycles. Before the data could be used for model estimation, it had to be transformed into estimated aggregate monthly consumption. This was done as follows:

- Aggregated meter read data were allocated to consumption month using the share of total consumption days in each month represented in the aggregated meter read data.
- In the case of aggregated data from bi-monthly meter reads done in month t, the aggregated consumption was allocated approximately 25% to month t-2, 50% to month t-1, and 25% to month t. Thus for data from meters read in March, approximately 25% of the consumption was allocated to January, 50% to February, and 25% to March.
- In the case of aggregated data from monthly meter reads done in month t, the aggregated consumption was allocated approximately 50% to month t-1 and 50% to month t. Thus for data from monthly meters read in March, approximately 50% was allocated to February and 50% to March.
- The allocation percentages cited above are approximate values. To do the actual allocations, seasonal weights were applied to each month to account for the seasonal shape of consumption. The seasonal weights and allocation percentages for each customer class are provided in Attachment 1.
- For Inside City customers, meters were read on a bi-monthly schedule until 2005, when the City started billing customers on a monthly cycle. In the case of Outside City customers, bi-monthly billing was continued until 2014.

Once aggregate monthly consumption was estimated, it was divided by the annual number of housing units (for single and multi-family classes), services (for business, municipal, and irrigation classes), or acres (for golf courses) to get average monthly consumption. Figure 1 illustrates the transformation of the raw aggregated meter read data into its corresponding estimated monthly aggregate and average consumption for the Inside City Single Family customer class. The erratic pattern in the raw meter read data prior to 2005 is primarily due to variability in the number of meters being read in a month and thus total consumption recorded in the aggregate data.[6]

2.3.2 Weather

The weather variables were constructed from monthly data on precipitation, ETo, and average maximum air temperature from October 1990 to April 2015 taken from CIMIS Station 104 (De Laveaga), which is situated within Santa Cruz city limits. Even though model estimation uses monthly data from 2000 to 2014, the average weather values used in equations (4) – (6) are based on the full 1990 to 2015 data series – i.e., they are 25 year normals. The weather data used to estimate the models are provided in Attachment 2.

2.3.3 Economic Variables

The economic data came from multiple sources. The water rate data set was constructed with Water Department records of water rates for each customer class. Annual unemployment rates in Santa Cruz for the period 1990 to 2014 come from the California Employment Development Department. Median and per capita income estimates for Inside City and Outside City customers come from Decennial Census and American Community Survey data. The income data cover estimation years 2000 and 2005-2013. Values for other years were imputed. Average annual residential vacancy rates for City of Santa Cruz for the years 1991-2014 are taken from the California Department of Finance (DOF E-8). These data sets are provided in Attachment 3.

2.3.4 Conservation Adjustment

Prior to estimating the model given by equation (1), average monthly use was adjusted to remove the effect of plumbing codes. That is, if y_{it} is observed average use and c_{it} is estimated average water savings from plumbing codes in month t, then adjusted average monthly use, $\tilde{y}_{it}$, is given by:

$$\tilde{y}_{it} = y_{it} + c_{it} \tag{17}$$

The estimated model yields a predicted value for adjusted monthly use, which we symbolize as $\widehat{\tilde{y}_{it}}$. The predicted value for observed average use, $\hat{y}_{it}$, is then given by:

$$\hat{y}_{it} = \widehat{\tilde{y}_{it}} - c_{it} \tag{18}$$

This adjustment is made to limit the confounding effect of passive conservation on the estimation of the other economic parameters (e.g. price, income, unemployment). Average monthly passive water savings over the estimation period were estimated using the Alliance for Water Efficiency's Water Conservation Tracking Tool. The conservation adjustment, c_{it}, and adjusted average monthly use from which the models were estimated, $\tilde{y}_{it}$, are given in Attachment 4.

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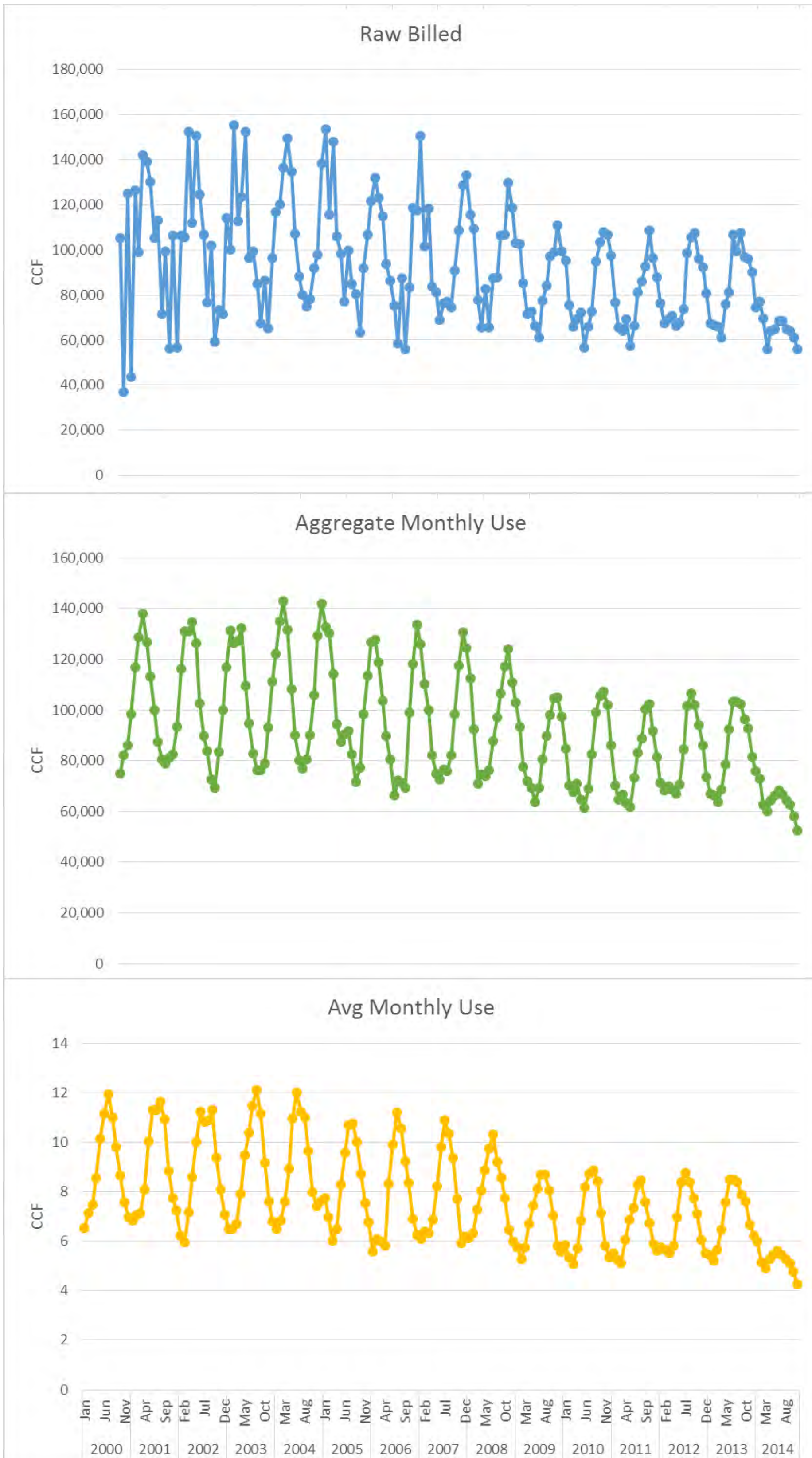
[6] In Jan 2000, for example, 7,823 Inside City Single Family meters were read. In Feb 2000, only 3,004 meters were read. In March 2000, 9,529 meters were read, and so on.

Figure 1. Inside City Single Family Consumption Data



2.4 Model Estimation Results

The average demand models were estimated with R version 3.2 statistical software. Robust regression methods were applied to down-weight outlier consumption data. For customer classes that had both Inside City and Outside City customers (e.g. residential, business, irrigation, and golf) fixed effects models were estimated so that the data could be pooled. Estimation results as summarized by adjusted R-squared are shown in Table 3. Across all classes, the models explain 90% to 99% of the observed variation in the data. All statistically significant model coefficients have the expected signs and magnitudes. Estimation results for each customer class are provided in Attachment 5.

Table 3. Average Demand Model Estimation, Adjusted R-Square

Customer Class	Number of Observations	Adjusted R-Square
Single Family	358	0.917
Multi Family	351	0.900
Business	353	0.942
Municipal	177	0.951
Irrigation	358	0.916
Golf	352	0.988

2.4.1 Seasonal Load Shape

The seasonal load shape describes how monthly average demand changes over the year due to seasonal effects. Average demand is lower in the winter months and peaks in the summer months. However, the degree of difference between these periods varies by customer class depending on the extent of irrigation uses. Table 1 shows how the seasonal parameter estimates can be used to estimate a seasonal index for each customer class. The estimated seasonal indices are given in Table 4.[7] The indices express average monthly demand as a percentage of total annual demand. For example, from Table 4 it is seen that single family average demand in May is about 1.6 times greater than average demand in January. More generally, single family average demand in the summer months is a bit less than double winter average demand. Summer peaking for multi-family is much less pronounced, with summer average demand only about 20% greater than winter average demand. Business average demand mostly falls between single- and multi-family average demands. The municipal and irrigation classes show greater peaking than the residential or business categories, with summer average demand five to eight times greater than winter average demand.[8] Average demands by the two golf courses served by the City are almost entirely in the summer. There is very little golf course demand in the winter months.

[7] These have been expressed as average monthly share of total annual demand. Thus the 12 monthly values sum to 100.

[8] Summer peak demands have been greatly reduced during the current drought so that the differential between winter and summer average use has been almost erased. This is likely to be a transitory response to the drought. However, peak demand may not fully return to its historical pattern if the drought induces more drought-tolerant landscaping or the elimination of landscaped area within the service area.

Table 4. Seasonal Indices of Average Demand

	Inside City Seasonal Index 1/					
Month	**SFR**	**MFR**	**BUS**	**MUN**	**IRR**	**GOLF**
Jan	6.0	7.6	7.0	3.1	2.0	0.0
Feb	5.9	7.7	7.2	3.1	2.1	0.0
Mar	6.1	7.6	7.3	3.5	2.9	0.0
Apr	7.1	7.9	7.8	6.8	6.9	2.2
May	9.5	8.8	8.9	10.6	10.8	8.5
Jun	10.6	9.2	9.7	13.0	13.7	16.6
Jul	11.3	9.3	10.3	14.8	15.0	19.7
Aug	11.1	9.2	10.2	15.2	14.4	21.4
Sep	10.4	8.9	9.1	12.2	13.4	17.1
Oct	8.6	8.5	8.3	9.1	9.9	11.2
Nov	7.0	7.9	7.3	5.3	5.8	2.7
Dec	6.3	7.6	6.9	3.4	3.2	0.7
	Outside City Seasonal Index 1/					
Month	**SFR**	**MFR**	**BUS**	**MUN**	**IRR**	**GOLF**
Jan	6.0	7.4	7.0	NA	2.0	0.2
Feb	5.9	7.3	7.0	NA	2.1	0.3
Mar	6.1	7.4	7.2	NA	2.9	0.4
Apr	7.1	8.1	8.0	NA	6.9	3.9
May	9.5	8.7	8.7	NA	10.8	9.5
Jun	10.6	9.1	9.5	NA	13.7	15.3
Jul	11.3	9.4	9.8	NA	15.0	17.9
Aug	11.1	9.3	9.6	NA	14.4	19.3
Sep	10.4	9.1	9.3	NA	13.4	15.6
Oct	8.6	8.4	8.5	NA	9.9	11.3
Nov	7.0	8.0	7.8	NA	5.8	5.0
Dec	6.3	7.7	7.3	NA	3.2	1.2
1/ Average monthly share of total annual demand.						

2.4.2 Weather Effects

The average demand models include controls for the effects of weather – rainfall and temperature for residential and business classes and rainfall and ETo for municipal, irrigation, and golf classes. During model estimation, the weather component is interacted with seasonal indicators to estimate separate seasonal weather effects for fall-winter (Nov-Mar), spring (Apr-Jun), and summer-fall (Jul-Oct).[9] Estimated weather effects were found to be largest in the spring, when outdoor irrigation can be either accelerated or delayed depending on weather. Spring weather effects are statistically significant in

[9] The seasonal construct follows the CUWCC's GPCD weather normalization methodology (Western Policy Research, 2011).

every class model whereas they are not always statistically significant in the fall-winter or the summer-fall seasons. Table 5 shows the estimated weather parameters for each customer class. As would be expected, average demand is negatively correlated with rainfall and positively correlated with temperature and ETo. With the exception of the multi-family category, average monthly demand is also negatively correlated with lagged rainfall.

Table 5 shows that municipal, irrigation, and golf average demands are more weather sensitive than residential and business average demands. This is expected since outdoor water use makes up a larger share of average demand in these three customer classes. Multi-family demand is the least sensitive to weather.

Table 5. Statistically Significant Weather Parameters in Average Demand Models

Rainfall	**SFR**	**MFR**	**BUS**	**MUN**	**IRR**	**GOLF**
Fall-Winter (Nov-Mar)	-0.016	NS	NS	NS	-0.044[1/]	-0.129
Spring (Apr-Jun)	-0.069	-0.020	-0.034	-0.147	-0.116	-0.441
Summer-Fall (Jul-Oct)	-0.040	-0.018	-0.028	NS	-0.085	-0.038[1/]
Lagged 1 month	-0.034	NS	-0.017[2/]	-0.097	-0.166	-0.546
Lagged 2 months	-0.026	NS	NS	-0.063	-0.090	-0.074[1/]
Temperature						
Fall-Winter (Nov-Mar)	0.203	0.100[1/]	0.243	NA	NA	NA
Spring (Apr-Jun)	0.422	0.338	0.400	NA	NA	NA
Summer-Fall (Jul-Oct)	0.636	NS	NS	NA	NA	NA
ETo						
Fall-Winter (Nov-Mar)	NA	NA	NA	0.516	0.509	1.135
Spring (Apr-Jun)	NA	NA	NA	0.804	0.660	0.173[1/]
Summer-Fall (Jul-Oct)	NA	NA	NA	0.357	0.163	0.792
1/ Correct sign but not statistically significant. 2/ Apr-Jun only. NA = Not applicable. NS= Not statistically different from 0.						

Using equations (7) and (8), the effect of a given change in a weather measure on average demand can be calculated using the parameter estimates in Table 5. An example is provided in Table 6, which shows the percentage effect on average demand in January, April, and July, given weather that is one standard deviation above the average for the month. Note that in Table 6 the percentage effect for each weather measure is being calculated independently of the other weather measures to show their relative impact. When doing weather normalization or forecasting, the weather effects need to be combined. For example, if in April, rainfall was one standard deviation above its average and temperature was one standard deviation below its average (i.e., April is wet and cool), the combined effect on single-family demand would be -5.3%.[10]

The estimated weather parameters in Table 5 can also be used to weather normalize historical average demand using equations (10) and (11). An example is provided in Table 7. It shows the estimated

[10] This presumes average lagged rainfall. In this example and in Table 6 the effect of lagged rainfall is being ignored for sake of simplicity.

monthly weather effects and weather normalization factors for the single family and irrigation classes for water year (WY) 2011. Rainfall in WY 2011 was above average in most months and the spring, in particular, was unusually wet. WY 2011 was also cooler than normal in every month. As shown in the table, above average rainfall and below average temperature (and ETo) had a negative effect on average demand. The effect is more pronounced in the irrigation class than in the single family class, but in both cases the effect is substantial, especially in the May-August period.

Table 6. Percentage Effect on Average Demand if Weather Measure is 1 S.D. above its Average

Rainfall	**SFR**	**MFR**	**BUS**	**MUN**	**IRR**	**GOLF**
Jan	-0.9%	NS	NS	NS	NS	-7.0%
Apr	-3.2%	-0.9%	-1.6%	-6.6%	-5.3%	-18.6%
Jul	-0.5%	-0.2%	-0.4%	NS	-1.1%	-1.6%
Temperature						
Jan	1.1%	NS	1.3%	NA	NA	NA
Apr	2.1%	1.7%	2.0%	NA	NA	NA
Jul	3.7%	NS	NS	NA	NA	NA
ETo						
Jan	NA	NA	NA	10.8%	10.6%	25.3%
Apr	NA	NA	NA	10.1%	8.3%	2.1%
Jul	NA	NA	NA	3.1%	1.4%	6.9%
Note: Rainfall effect is only for change in contemporaneous rainfall. Effects of lagged rainfall are not shown in the table.						

Table 7. Single Family and Irrigation Class Monthly Weather Effects for WY 2011

	Monthly Weather Measures				SFR Weather Parameters				Weather	Normalization
WY 2011	dIR_t	dIR_{t-1}	dIR_{t-2}	dIT_t	dIR_t	dIR_{t-1}	dIR_{t-2}	dIT_t	Effect [1/]	Factor [2/]
Oct-10	0.707	-0.142	0.088	-0.042	-0.040	-0.034	-0.026	0.636	0.95	1.05
Nov-10	0.460	0.707	-0.142	-0.021	-0.016	-0.034	-0.026	0.203	0.97	1.03
Dec-10	0.826	0.460	0.707	-0.024	-0.016	-0.034	-0.026	0.203	0.95	1.05
Jan-11	-0.483	0.826	0.460	0.039	-0.016	-0.034	-0.026	0.203	0.98	1.02
Feb-11	0.312	-0.483	0.826	-0.038	-0.016	-0.034	-0.026	0.203	0.98	1.02
Mar-11	1.180	0.312	-0.483	-0.042	-0.016	-0.034	-0.026	0.203	0.97	1.03
Apr-11	-0.400	1.180	0.312	-0.010	-0.069	-0.034	-0.026	0.422	0.98	1.03
May-11	0.481	-0.400	1.180	-0.031	-0.069	-0.034	-0.026	0.422	0.94	1.07
Jun-11	1.028	0.481	-0.400	-0.068	-0.069	-0.034	-0.026	0.422	0.90	1.11
Jul-11	0.080	1.028	0.481	-0.018	-0.040	-0.034	-0.026	0.636	0.94	1.06
Aug-11	-0.027	0.080	1.028	-0.065	-0.040	-0.034	-0.026	0.636	0.93	1.07
Sep-11	-0.056	-0.027	0.080	-0.027	-0.040	-0.034	-0.026	0.636	0.98	1.02
	Monthly Weather Measures				IRR Weather Parameters				Weather	Normalization
WY 2011	dIR_t	dIR_{t-1}	dIR_{t-2}	$dIET_t$	dIR_t	dIR_{t-1}	dIR_{t-2}	$dIET_t$	Effect	Factor
Oct-10	0.707	-0.142	0.088	-0.165	-0.085	-0.166	-0.090	0.163	0.93	1.07
Nov-10	0.460	0.707	-0.142	0.048	-0.044	-0.166	-0.090	0.509	0.90	1.11
Dec-10	0.826	0.460	0.707	-0.337	-0.044	-0.166	-0.090	0.509	0.71	1.42
Jan-11	-0.483	0.826	0.460	0.194	-0.044	-0.166	-0.090	0.509	0.94	1.06
Feb-11	0.312	-0.483	0.826	0.156	-0.044	-0.166	-0.090	0.509	1.07	0.93
Mar-11	1.180	0.312	-0.483	-0.120	-0.044	-0.166	-0.090	0.509	0.89	1.13
Apr-11	-0.400	1.180	0.312	0.016	-0.116	-0.166	-0.090	0.660	0.85	1.18
May-11	0.481	-0.400	1.180	0.022	-0.116	-0.166	-0.090	0.660	0.92	1.08
Jun-11	1.028	0.481	-0.400	-0.108	-0.116	-0.166	-0.090	0.660	0.79	1.26
Jul-11	0.080	1.028	0.481	0.057	-0.085	-0.166	-0.090	0.163	0.81	1.24
Aug-11	-0.027	0.080	1.028	-0.149	-0.085	-0.166	-0.090	0.163	0.88	1.14
Sep-11	-0.056	-0.027	0.080	-0.060	-0.085	-0.166	-0.090	0.163	0.99	1.01
1/ Calculated with equation (10). 2/ The inverse of the weather effect, per equation (11).										

2.4.3 Economic Effects

The estimated economic parameters are summarized in Table 8. The price and income parameters are elasticities, which measure the percentage change in average demand given a one percent change in price or income. For example, a one percent increase in price would be expected to cause 0.075 and 0.139 percent decreases in winter and summer single family demands, respectively. Similarly, a one percent increase in price would be expected to result in 0.237 and 0.545 percent decreases in municipal and irrigation average demands, respectively.

The estimated price responses for single family are significantly lower than what the interim WSAC forecast assumed: -0.15 versus -0.075 for winter and -0.30 versus -0.139 for summer.[11] However, the estimated price responses for multi-family and business (inside city) are essentially identical to what was assumed in the interim forecast: -0.12 for multi-family and -0.10 for business. Outside city business use showed significantly more price response. As discussed in the next section, it also showed greater response to drought restriction.

[11] In terms of an average annual price response, the interim WSAC forecast assumed an elasticity of -0.24 whereas the econometric analysis indicates the true value is in the neighborhood of -0.11.

The estimated income elasticity for the single family customer class is also very close to the 0.25 assumption used in the interim WSAC forecast. Thus, the econometric analysis mostly confirms the price and income elasticity assumptions used to prepare the interim WSAC demand forecast. Table 8 also confirms the expectation that the magnitude of price response is positively correlated with outdoor irrigation water use. The Pasatiempo golf course is an exception to this general finding. Its price response was not statistically different from zero. Perhaps this is because it is a top tier course and has a substantially higher willingness to pay for water than other irrigators.

Table 8. Economic Parameter Estimates

Parameter	**SFR**	**MFR**	**BUS**	**MUN**	**IRR**	**GOLF**
Price	winter: -0.075 Summer: -0.139	-0.124	Inside City: -0.099 Outside City: -0.262	-0.237	-0.545	-0.358[1/]
Income	0.228					
Vacancy		-0.164				
Unemployment			-0.160	-0.142		
1/Delaveaga price response. Pasatiempo price response not statistically significant.						

The vacancy and unemployment rate parameters measure the effect that deviations from normal have on average demand. That is, how average demand is expected to change if the vacancy or unemployment rate is above or below its long-term average. Both parameters are negative, as expected. A higher rate of vacancy is expected to decrease average multi-family demand. Likewise, a higher rate of unemployment is expected to decrease average business demand. The effect of a departure from normal on average demand can be calculated in the same manner that temperature (or ETo) effects are calculated, per equation (8). For example, a 50% increase in the unemployment rate from its long-term average would be expected to reduce average business demand by approximately 6.4% and municipal demand by approximately 5.6%.[12] Similarly, a vacancy rate that is 20% above its long-term average would be expected to decrease average multi-family demand by about 2.9%.

2.4.4 Drought Effects

The model's drought component uses an indicator variable for each drought stage that takes the value of one if the drought stage was in effect and zero otherwise. The months in which each drought stage was in effect during the model estimation period are shown in Attachment 6. The estimated drought stage parameters are shown in Table 9.

[12] For business, the effect is calculated as $1.5^{-0.16} - 1 = 0.0643$; while for municipal the effect is calculated as $1.5^{-0.142} - 1 = 0.0559$.

Table 9. Estimated Drought Stage Parameters

Parameter	SFR	MFR	BUS	MUN	IRR	GOLF
Stage 1	-0.051	-0.009 1/	NS	NS	-0.077 1/	NS
Stage 2	-0.071	-0.028	NS	-0.108	-0.250	NS
Stage 3	-0.431	-0.192	Inside City: -0.123 Outside City: -0.191	-0.621	-0.930	-0.319
NS = not statistically different from zero. 1/ correct sign but not statistically different from zero.						

The average percentage effect of a drought stage on average demand is estimated by exponentiating the parameter estimates in Table 9 and subtracting one from the result. Thus, the expected reduction in single family average demand during a Stage 1 drought restriction is $e^{-0.051} - 1 = -0.0497$, or about 5%. Table 10 shows the estimated average change in monthly demand by drought stage and customer class.

Table 10. Percent Reduction in Average Demand by Drought Stage and Customer Class

Stage	SFR	MFR	BUS	MUN	IRR	GOLF
Stage 1	-5%	-1% 1/	NS	NS	-7% 1/	NS
Stage 2	-7%	-3%	NS	-10%	-22%	NS
Stage 3	-35%	-17%	Inside City: -12% Outside City: -17%	-46%	-61%	-27%
NS = not statistically different from zero. 1/ correct sign but not statistically different from zero.						

2.5 Forecasts of Average Demand by Customer Class

Class-level forecasts of average demand derived from the econometric models are shown in Table 11. These forecasts are based on the water rate and income growth assumptions developed for the interim WSAC demand forecast and have been adjusted for plumbing code and Program A water savings. The water rate and income growth forecasts are provided in Attachment 7. The plumbing code and Program A water savings forecasts are provided in Attachment 8. The forecasts in Table 11 assume normal weather and economic conditions.[13] The 95% confidence interval for each forecast is shown in the column to the right of the forecast.[14]

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[13] This means the weather, unemployment rate, and housing vacancy rate variables are set to their long-term average values in the forecast.

[14] Given a vector of forecast inputs, $\mathbf{x}_0$, the predicted mean response, y_0, is $y_0 = \mathbf{x}_0{}'\mathbf{b}$, where $\mathbf{b}$ is the vector of estimated model coefficients. The 100(1-α)% confidence interval for the expected value of the mean response is $\pm t_c(\frac{\alpha}{2}, n-p-1)\sqrt{\hat{\sigma}^2 \mathbf{x}_0{}'(\mathbf{X}'\mathbf{W}\mathbf{X})^{-1}\mathbf{x}_0}$, where $\mathbf{X}$ is the n x p design matrix used to estimate the model, $\mathbf{W}$ is the n x n diagonal matrix of estimation weights, $\hat{\sigma}$ is the estimated standard error of the model, n is the number of

The predicted decreases in residential and business average use over the forecast period is due to the combination of plumbing code and Program A water savings and the effects of increasing water rates. Higher water costs are the primary factor in the predicted decreases for municipal and irrigation average uses. The predicted decrease in average golf use reflects both a response to higher water costs and the expected decrease in acreage irrigated with City water at the Pasatiempo golf course.[15]

The 95% confidence intervals are generally in the ± 3 to 10% range. The confidence intervals for golf are an exception. They are wider because of the significant within-month variation in water use over the model estimation period. The increasing width of all the intervals over the forecast horizon is a reflection of the greater uncertainty associated with outer years of the forecast.[16]

Table 11. Forecasted Average Demand by Customer Class (CCF/Year)

YEAR		**2013**	**2020**		**2025**		**2030**		**2035**	
	Per	Actual 1/	Forecast	CI	Forecast	CI	Forecast	CI	Forecast	CI
Single Family	Housing Unit	87	86	± 3	83	± 3	80	± 4	78	± 4
Multi Family	Housing Unit	53	56	± 2	52	± 2	50	± 2	49	± 3
Business	Service	405	400	± 12	389	± 12	382	± 13	377	± 13
Municipal	Service	388	296	± 26	290	± 27	283	± 29	277	± 30
Irrigation	Service	365	286	± 28	271	± 28	257	± 28	244	± 28
Golf	Acre	990	671	± 130	641	± 134	606	± 137	593	± 144

1/ Actual use, unadjusted for weather or economy. Stage 1 drought water use restrictions in effect May - Dec.

CI = 95% confidence interval.

observations, p is the number of parameter estimates, and t_c is the t-distribution critical value given n-p-1 degrees of freedom.

[15] Average golf use in Table 11 is an acreage-weighted average of the two golf courses the City serves. Historically, Pasatiempo average water use per acre has been greater than Delaveaga. Therefore, as Pasatiempo's share of total golf acreage irrigated with City water decreases over the forecast, average use per acre also decreases.

[16] The confidence intervals only reflect uncertainty in the estimate of adjusted average use, $\widehat{y_{it}}$, which is derived from the econometric models. The DSS model, which generated the forecast of plumbing code and Program A water savings, is not a statistical model and forecast errors cannot be derived from its output. The confidence intervals in Table 11 therefore are implicitly assuming 100% accuracy in the plumbing code and Program A water savings forecasts.

3 Forecasts of Population, Housing, and Services

3.1 Approach

The population and housing unit forecasts are based on the AMBAG 2014 Regional Growth Forecast (AMBAG 2014). The forecasts of business and irrigation services are in turn driven by the residential forecasts. Currently, Water Department staff do not expect appreciable growth in the number of municipal services. Municipal services are therefore assumed to remain at their current number throughout the forecast period.

3.2 Forecast Development

3.2.1 Population

The forecast of service area population is divided into its inside-city and outside-city components. The inside-city component comes directly from the AMBAG 2014 Regional Growth Forecast (AMBAG 2014) and is inclusive of the UCSC population. The outside-city component was derived by Water Department staff using data from the 2014 Regional Growth Forecast. The component population forecasts and total service area population forecast are shown in Table 12.

Table 12. Service Area Population Forecast

	2010 1/	2020	2025	2030	2035
Inside-City 2/	59,946	66,860	70,058	73,375	76,692
Outside-City 3/	31,342	32,543	33,562	34,614	35,698
Service Area	91,288	99,403	103,620	107,989	112,390

Notes:
1/ Actual per 2010 Census
2/ AMBAG 2014 Regional Growth Forecast (adopted June 11, 2014). Includes UCSC population.
3/ Developed by Water Department Staff from 2014 Regional Growth Forecast data.

3.2.2 Housing Units

The forecast of occupied housing units is calculated by dividing the population in households by average household size. This is the same methodology AMBAG uses, but we use our own forecast of population in households.[17]

For the inside-city portion of the service area, the population in households is the total inside-city population from Table 12 less the UCSC campus population and the off campus population in group quarters. AMBAG's student enrollment forecast is multiplied by the ratio of students living on campus to total enrollment to get the UCSC campus population estimate (see Attachment 9). The ratio of group quarters population to total (non-campus) population is then multiplied by total (non-campus)

[17] We use our own forecast for two reasons. First, the AMBAG forecast only covers the inside-city (i.e. City of Santa Cruz) portion of the service area. Second, AMBAG's City of Santa Cruz housing unit forecast incorrectly equates student enrollment with campus population, causing it to underestimate off-campus housing units.

population to get the group quarters population estimate.[18] The household population is the residual population. These calculations are shown in Table 13 for the inside-city portion of the service area.

The same approach is used to forecast household population for the outside-city portion of the service area, except that no adjustment for campus population is required. Table 14 gives the outside-city household population forecast.

Table 13. Inside-City Household Population Forecast

	2010 1/	2020	2025	2030	2035
Total Population	59,946	66,860	70,058	73,375	76,692
Adjustments					
Campus population 2/	7,331	8,845	9,602	10,359	11,116
Group quarters 3/	1,904	2,099	2,188	2,280	2,373
Non-household population	9,235	10,944	11,790	12,639	13,489
Population In households 4/	50,711	55,916	58,268	60,736	63,203

Notes
1/ Actual per 2010 Census.
2/ See Attachment 9 for calculation.
3/ Ratio of group quarters population to total (non-campus) population from 2010 Census multiplied by total (non-campus) population.

Table 14. Outside-City Household Population Forecast

	2010 1/	2020	2025	2030	2035
Total Population	31,342	32,543	33,562	34,614	35,698
Group quarters adjustment 2/	665	690	712	734	757
Population In households	30,677	31,853	32,850	33,880	34,941

Notes
1/ Actual per 2010 Census
2/ Ratio of group quarters population to total population from 2010 Census multiplied by total population.

Total occupied housing units are then estimated by dividing household population by average household size. Average household size starts with the 2010 Census estimate, which is then scaled to increase at the same rate as average household size in the AMBAG 2014 Regional Growth Forecast. The forecast of

[18] The ratio of within-city population in group quarters to total population (excluding campus population) is calculated from 2010 Census data. This ratio is approximately 0.0362, or 3.62% of the population.

total occupied housing units for the inside- and outside-city portions of the service are shown in Table 15.[19]

Table 15. Forecast of Occupied Housing Units

	2010 1/	2020	2025	2030	2035
Household Population					
Inside-City	50,711	55,916	58,268	60,736	63,203
Outside-City	30,677	31,853	32,850	33,880	34,941
Average Household Size 2/					
Inside-City	2.34	2.38	2.41	2.42	2.44
Outside-City	2.39	2.43	2.46	2.46	2.48
Occupied Housing Units					
Inside-City	21,657	23,492	24,177	25,136	25,925
Outside-City	12,856	13,132	13,376	13,759	14,064

Notes
1/ Actual per 2010 Census
2/ Average household size starts with the 2010 Census estimate, which is then scaled to increase at the same rate as average household size in the AMBAG 2014 Regional Growth Forecast.

The last step in the forecast of service area housing units is to allocate total housing units between single-family and multi-family units. This is shown in Table 16. It starts with the Water Department's 2014 estimates of housing units calculated from its billing data. Single-family housing units are then increased at their historical growth rate. In the case of inside-city single-family housing, growth is capped at 1,000 units based on the General Plan's estimate of potential for new single family housing.[20] No cap is applied to the outside-city forecast. Multi-family units are then the difference between the forecast of total units and single-family units. For the inside-city portion of the service area, three-fourths of the gain in housing units is in the multi-family category. For the outside-city portion of the service area, a little less than half of the gain is in the multi-family category. For the whole service area, more than two-thirds of the gain in housing units is in the multi-family category.

Total housing units shown for the inside-city portion of the service area in Table 16 calibrates exactly to the total shown in Table 15. This is not the case for the outside-city total in Table 16. There is a discrepancy between Water Department data on total outside-city housing units in 2014 and the forecast of occupied housing units in Table 15. The Water Department's estimate is higher by several hundred housing units. The water demand forecast uses the housing unit forecasts shown in Table 16.[21]

[19] Occupied housing units rather than total housing units are used to forecast water demand because it is assumed that water use in vacant units is negligible.
[20] The General Plan, which extends to 2030, identified a potential for 840 new single family units. This was increased to 1000 units since this forecast runs to 2035.
[21] The outside-city housing unit forecast in Table 16 assumes the same rate of growth in the housing stock as the forecast in Table 15, but starts with the Water Department's higher estimate of housing units in 2014.

Table 16. Service Area Single-Family and Multi-Family Housing Unit Forecast

	2014 1/	2020	2025	2030	2035	Gain From 2014	% of Gain
Inside-City							
Single Family	12,246	12,534	12,780	13,030	13,246	1,000	24%
Multi Family	9,583	10,958	11,398	12,106	12,679	3,096	76%
Subtotal	21,829	23,492	24,177	25,136	25,925	4,096	
Outside-City							
Single Family	6,743	6,922	7,074	7,230	7,390	647	52%
Multi Family	7,901	7,910	8,033	8,310	8,495	594	48%
Subtotal	14,644	14,832	15,107	15,540	15,884	1,240	
Service Area							
Single Family	18,989	19,456	19,854	20,260	20,636	1,647	31%
Multi Family	17,484	18,868	19,431	20,416	21,174	3,690	69%
Total	36,473	38,324	39,284	40,676	41,809	5,336	

Notes
1/ Actual per Water Department billing records.

3.2.3 Non Residential Services and City-Irrigated Golf Acreage

The forecast of business services is based on the ratio of business to residential water use. Historically this ratio has averaged about 0.295 with very little variation (see Figure 2). The number of new business services is forecast such that the ratio of business to residential water use is maintained at 0.295 over the forecast period. This results in a gain of 166 new business services between 2013 and 2035.[22]

As seen in Figure 3, there is a strong relationship between growth in irrigation services and growth in multi-family and business services. On average, 0.6 irrigation services are added for each new multi-family or business service. This growth factor is used with the forecast of multi-family and business services to project new irrigation services over the forecast horizon.

The City is currently the sole water sources for the Delaveaga and Pasatiempo golf courses. This is not forecast to change for Delaveaga. However, interviews with Pasatiempo staff indicate it has plans to reduce its reliance of City water starting this year. It expects to irrigate not more than 40 acres with City

[22] As a check on the forecast, it is noted that over the 18 year period 1996-2013, there was a gain of 120 business services. Extending this rate of growth to 22 years to match the length of our forecast would results in 147 new services, which is very close to the forecast of 166 new services for the 22 year period 2013 to 2035.

water by 2020 and not more than 20 acres by 2030. It currently irrigates about 67.5 acres with City water.

The forecasts of non-residential services and City-irrigated golf acreage are given in Table 17.

Table 17. Forecast of Non-Residential Services and City-Irrigated Golf Acreage

	2013 [1/]	**2020**	**2025**	**2030**	**2035**	**Gain From 2013**
Business [2/]	1,889	1,948	1,971	2,008	2,055	166
Municipal [3/]	218	218	218	218	218	0
Irrigation [4/]	452	651	723	845	951	499
Golf						
Delaveaga	79	79	79	79	79	0
Pasatiempo	68	40	30	20	20	-48
Total Golf	146	119	109	99	99	-48

Notes

1/ Actual per Water Department billing records.

2/ Based on ratio of business to residential demand.

3/ No expected growth in number of municipal services.

4/ Based on historical rate of gain in irrigation services per gain in multi-family and business services.

Figure 2. Ratio of Business to Residential Water Demand: 1999-2013

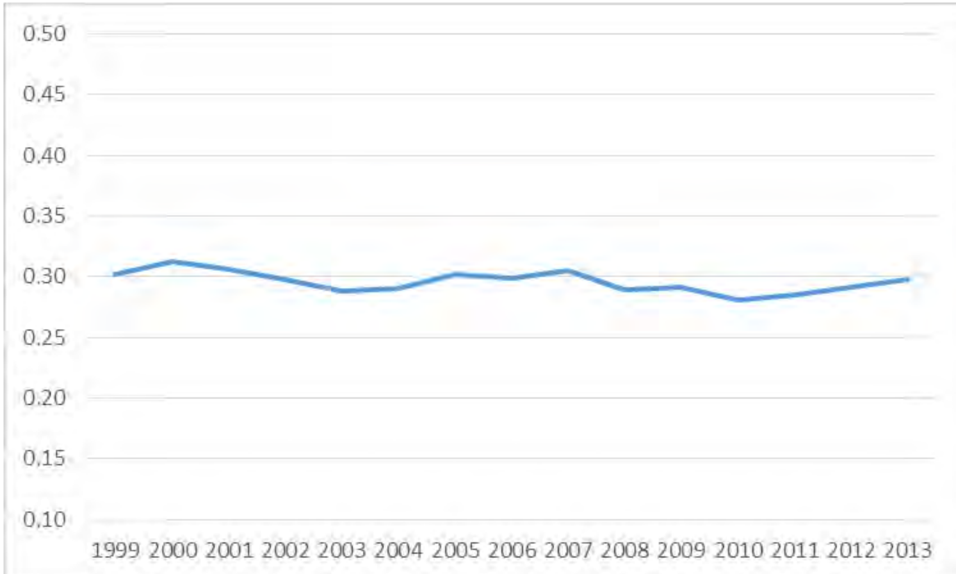
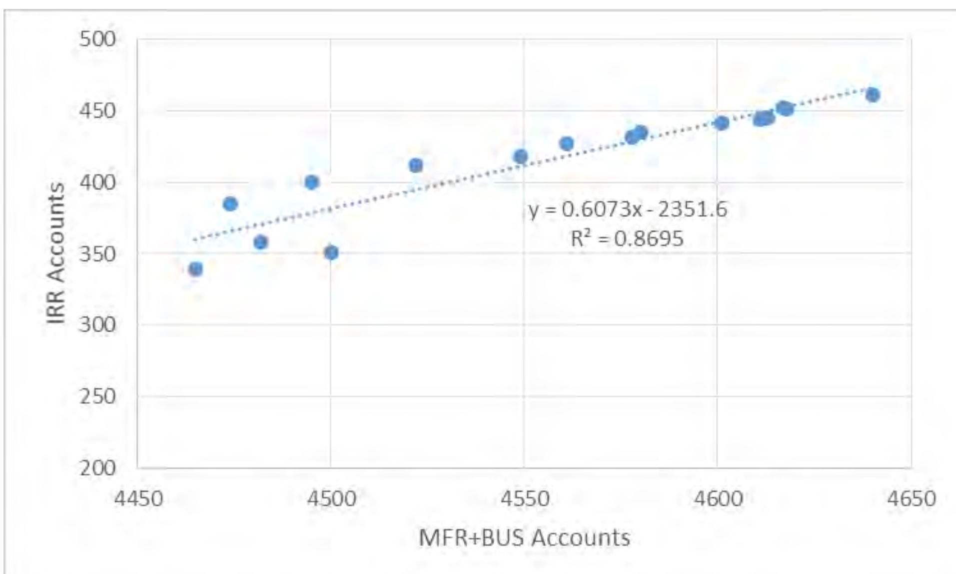


Figure 3. Irrigation vs Multi-Family + Business Accounts: 1999-2013



4 FORECASTS OF WATER DEMAND

4.1 APPROACH

4.1.1 Class Demands other than Industrial and UCSC

The approach to the forecast of customer class demands other than industrial and UCSC is straightforward. The class average use forecasts from Table 11 are multiplied by their respective housing unit, service, or acreage forecasts from Tables 16 and 17 to yield the class-level demand forecasts. Lower and upper bounds are put on the forecasts using the confidence intervals in Table 11. In all cases, the forecasts are assuming normal economic conditions, average weather, and no drought or other restrictions on customer water use.

4.1.2 Industrial and UCSC Demands

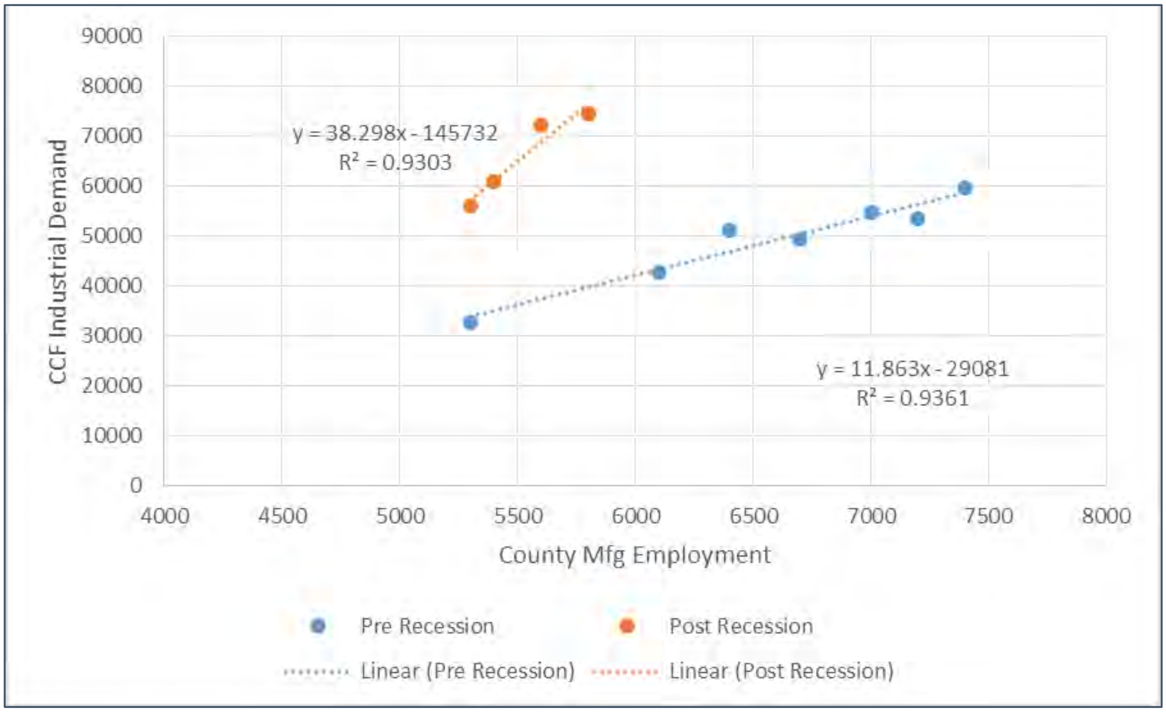
There is a strong relationship between Santa Cruz County manufacturing employment and industrial water demand. This relationship is illustrated in Figure 4. Prior to the recession, annual industrial demand increased by 11.9 CCF per manufacturing job, on average. Immediately after the recession this increased to about 38.3 CCF per job. We use the pre-recession rate with a forecast of manufacturing employment in Santa Cruz County to project future industrial water demand. The pre-recession rate of water use per job is used because it does not include the transitory effects of the economic recovery. The 95% confidence interval for the water use per job parameter is used to produce the lower and upper bound forecasts.[23] The Caltrans forecast of manufacturing employment for Santa Cruz County is used to forecast industrial water use. The California Employment Development Department also has a forecast of manufacturing employment, but this forecast extends only to 2022. However, the two forecasts are consistent. The forecast of industrial demand is given in Table 18.

Table 18. Industrial Demand Forecast

	2013 1/	**2020**	**2025**	**2030**	**2035**
Mfg Employment Forecast					
Cal Trans		5,900	6,200	6,400	6,500
Industrial Water Demand (MG)					
Low	56	56	58	59	60
Primary	56	57	59	61	62
High	56	57	60	63	64
Notes					
1/ Actual per Water Department billing records.					

[23] The 95% confidence interval is [8.4, 15.3]. The data and model output are provided in Attachment 10.

Figure 4. Industrial Demand vs County Manufacturing Employment



The forecast of UCSC demand is the same as in the interim WSAC demand forecast. The interim forecast was based on a linear projection of the UCSC demand requirement under its LRDP, assuming two alternative buildout dates. In both cases, buildout demand is 349 MGY. In the lower bound forecast, buildout occurs in 2050. In the upper bound forecast it occurs in 2035. The primary forecast is the midpoint between the lower and upper bound forecasts. The forecast of UCSC demand is given in Table 19. The primary forecast almost exactly replicates a forecast based on projected enrollment and average rates of water use per student.[24]

Table 19. UCSC Water Demand Forecast

	2013 1/	2020	2025	2030	2035
Low	182	186	213	240	268
Primary	182	196	234	271	308
High	182	207	254	302	349
Notes					
1/ Actual per Water Department billing records.					

[24] The enrollment-based approach yields a 2035 demand of 304 MG, which differs from the primary forecast by less than 2%.

4.1.3 System Production

System production is calculated as the sum of the demand forecasts plus miscellaneous uses and system losses, which are estimated at 7.5% of total production. The 7.5% rate of system loss and miscellaneous use is based on historical rates of system loss.

4.2 Class Demands and System Production Forecasts

Complete summaries of the primary, lower, and, upper bound forecasts of class demands and system production are provided in Tables 20, 21, and 22, respectively.

Table 20. Primary Forecast of Class Demands and System Production

YEAR		**2020**	**2025**	**2030**	**2035**
		Forecast	Forecast	Forecast	Forecast
Service Units	**Units**				
SFR	Housing Units	19,456	19,854	20,260	20,636
MFR	Housing Units	18,867	19,430	20,416	21,174
BUS	Services	1,948	1,971	2,008	2,055
IND	NA	NA	NA	NA	NA
MUN	Services	218	218	218	218
IRR	Services	651	723	845	951
GOLF	Acres	119	109	99	99
UC	NA	NA	NA	NA	NA
Avg Demand	**Units**				
SFR	CCF	86	83	80	78
MFR	CCF	56	52	50	49
BUS	CCF	400	389	382	377
IND	NA	NA	NA	NA	NA
MUN	CCF	296	290	283	277
IRR	CCF	286	271	257	244
GOLF	CCF	671	641	606	593
UC	NA	NA	NA	NA	NA
Annual Demand	**Units**				
SFR	MG	1,256	1,228	1,208	1,196
MFR	MG	792	759	766	775
BUS	MG	583	573	575	580
IND	MG	57	59	61	62
MUN	MG	48	47	46	45
IRR	MG	139	147	163	174
GOLF	MG	60	52	45	44
UC	MG	196	234	271	308
Total Demand	**MG**	**3,131**	**3,099**	**3,134**	**3,184**
MISC/LOSS	MG	254	251	254	258
Total Production	**MG**	**3,385**	**3,351**	**3,388**	**3,442**
Rounded	**MG**	**3,400**	**3,400**	**3,400**	**3,400**

Table 21. Lower Bound Forecast of Class Demands and System Production

YEAR		2020	2025	2030	2035
		Forecast	Forecast	Forecast	Forecast
Service Units	**Units**				
SFR	Housing Units	19,456	19,854	20,260	20,636
MFR	Housing Units	18,867	19,430	20,416	21,174
BUS	Services	1,948	1,971	2,008	2,055
IND	NA	NA	NA	NA	NA
MUN	Services	218	218	218	218
IRR	Services	651	723	845	951
GOLF	Acres	119	109	99	99
UC	NA	NA	NA	NA	NA
Avg Demand	**Units**				
SFR	CCF	83	79	76	74
MFR	CCF	54	50	48	46
BUS	CCF	389	377	370	364
IND	NA	NA	NA	NA	NA
MUN	CCF	271	264	256	248
IRR	CCF	260	245	231	218
GOLF	CCF	553	521	485	466
UC	NA	NA	NA	NA	NA
Annual Demand	**Units**				
SFR	MG	1,208	1,178	1,155	1,142
MFR	MG	764	728	731	736
BUS	MG	567	556	556	560
IND	MG	56	58	59	60
MUN	MG	44	43	42	40
IRR	MG	126	133	146	155
GOLF	MG	49	42	36	35
UC	MG	186	213	240	268
Total Demand	**MG**	**3,001**	**2,951**	**2,965**	**2,995**
MISC/LOSS	MG	243	239	240	243
Total Production	**MG**	**3,244**	**3,190**	**3,206**	**3,238**
Rounded	**MG**	**3,200**	**3,200**	**3,200**	**3,200**

Table 22. Upper Bound Forecast of Class Demands and System Production

YEAR		2020	2025	2030	2035
		Forecast	Forecast	Forecast	Forecast
Service Units	**Units**				
SFR	Housing Units	19,456	19,854	20,260	20,636
MFR	Housing Units	18,867	19,430	20,416	21,174
BUS	Services	1,948	1,971	2,008	2,055
IND	NA	NA	NA	NA	NA
MUN	Services	218	218	218	218
IRR	Services	651	723	845	951
GOLF	Acres	119	109	99	99
UC	NA	NA	NA	NA	NA
Avg Demand	**Units**				
SFR	CCF	90	86	83	81
MFR	CCF	58	54	53	52
BUS	CCF	412	401	395	391
IND	NA	NA	NA	NA	NA
MUN	CCF	323	318	313	308
IRR	CCF	315	300	287	274
GOLF	CCF	814	790	758	754
UC	NA	NA	NA	NA	NA
Annual Demand	**Units**				
SFR	MG	1,305	1,280	1,262	1,253
MFR	MG	820	792	803	816
BUS	MG	601	591	594	601
IND	MG	57	60	63	64
MUN	MG	53	52	51	50
IRR	MG	153	162	181	195
GOLF	MG	72	64	56	56
UC	MG	207	254	302	349
Total Demand	**MG**	**3,268**	**3,255**	**3,311**	**3,383**
MISC/LOSS	MG	265	264	268	274
Total Production	**MG**	**3,533**	**3,519**	**3,580**	**3,658**
Rounded	**MG**	**3,500**	**3,500**	**3,600**	**3,700**

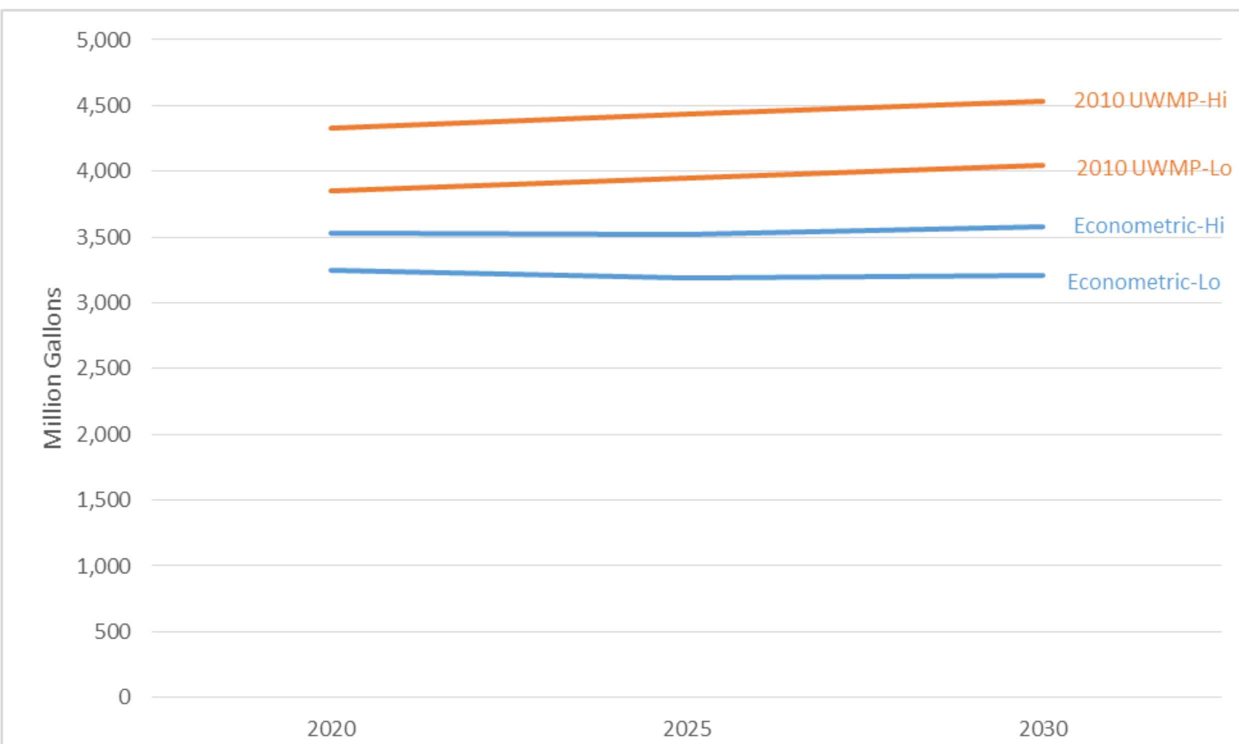
5 COMPARISON WITH PREVIOUS FORECASTS AND HISTORICAL PRODUCTION

5.1 2010 UWMP FORECAST

The 2010 UWMP included two water demand forecast scenarios that run to 2030. The lower scenario is based on class-level average water use for 2007-08. The higher scenario is based on class-level average water use for 1999-2004. Neither scenario makes adjustments for future effects of conservation or other economic factors on average water use. Each scenario uses the same service growth assumptions, which are tied to the City's General Plan 2030 buildout analysis and AMBAG's regional population forecasts. Importantly, both scenarios assume UCSC demands reach their buildout level of 349 MG by 2030, five years sooner than we assume in the upper bound forecast and 20 years sooner than we assume in the lower bound forecast.

Predicted future demand in both scenarios is significantly higher than the forecast presented in this report, as illustrated in Figure 5. The primary reasons for this are stated above: (1) not including adjustments for the effects of passive and active conservation and higher water rates on future water use and (2) the higher UCSC forecast. As shown in this report, future conservation and price effects are expected to be significant. Indeed, the econometric analysis shows that the effects of conservation and higher water rates have been working to reduce average demand for some time. These trends are predicted to continue. This plus the lower UCSC forecast explain the report's lower forecast compared to the 2010 UWMP forecast.

Figure 5. Comparison of Demand Forecast with 2010 UWMP Forecast

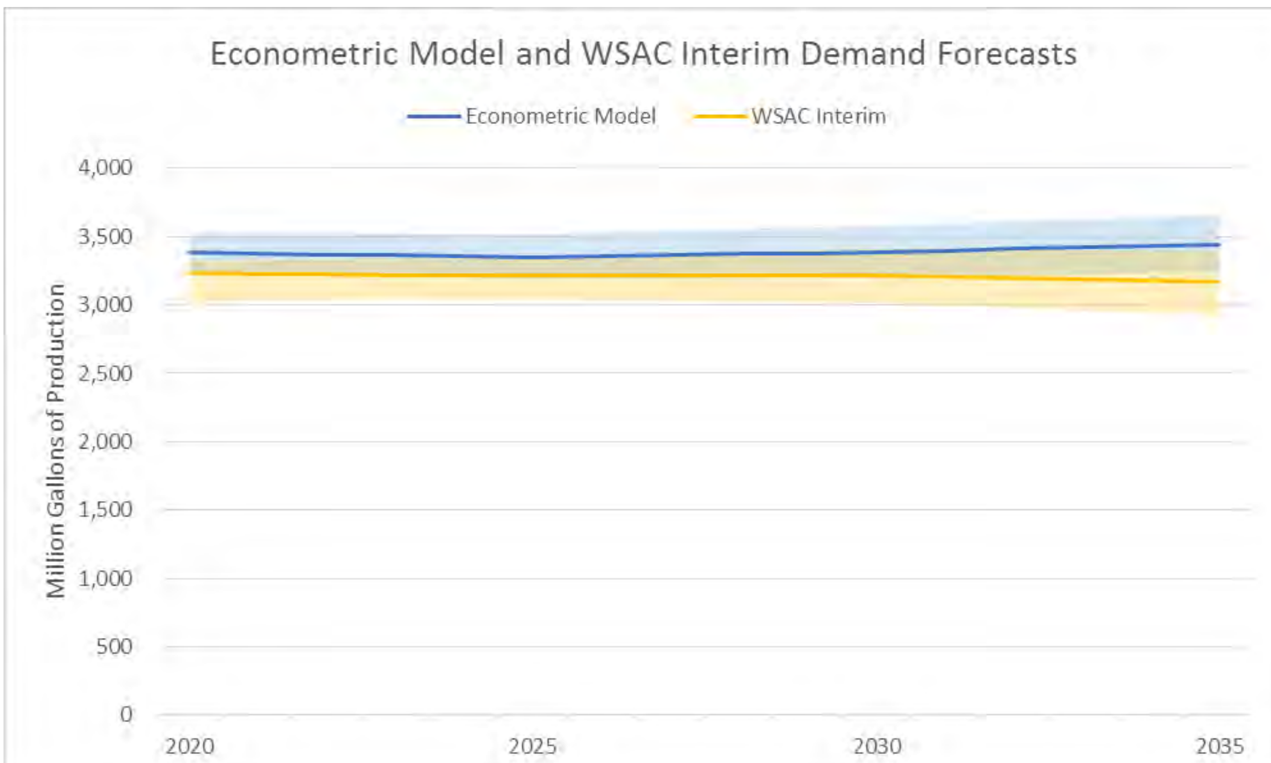


5.2 Interim WSAC Demand Forecast

The WSAC interim demand forecast (M.Cubed, 2015b) was developed from the 2010 UWMP demand forecast by adjusting that forecast for future conservation and other economic effects and by replacing the UCSC demand forecast with the one in Table 19.

The WSAC Interim and econometric demand forecasts are compared in Figure 6. On average, the econometric demand forecast is approximately five and a half percent greater than the WSAC interim forecast. Figure 6 also shows the uncertainty band around each forecast – light blue for the econometric model forecast and light yellow for the WSAC interim forecast. The uncertainty band on the econometric forecast is based on the 95% confidence intervals for the class-level average use per service forecasts developed with the econometric models. The uncertainty band on the WSAC interim forecast is the range between the low and high interim forecasts. From Figure 6 it is seen that the econometric forecast represented by the dark blue line essentially tracks the upper-bound of the WSAC interim forecast while the WSAC interim forecast represented by the dark yellow line essentially tracks the lower-bound of the corrected econometric forecast. Between these two lines, the forecasts overlap. Future production in the range of 3,200 to 3,400 MGY is consistent with both forecasts.[25]

Figure 6. Comparison of Demand Forecast with Interim WSAC Demand Forecast

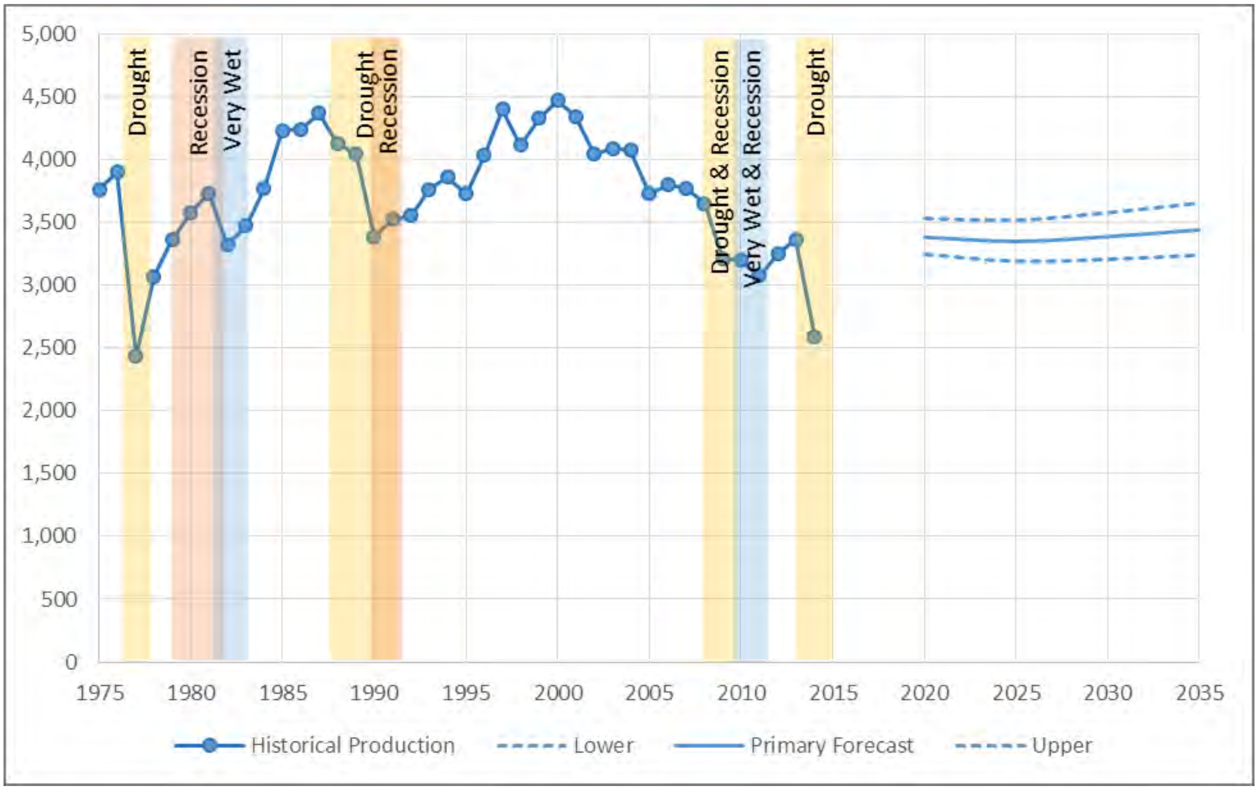


[25] A more conservative uncertainty band obtained by taking the union of the two forecasts suggests future production in the range of 3,000 to 3,500 MGY over most of the forecast period, with a slightly wider band in the last five years of the forecast.

5.3 Historical Production

Figure 7 shows a comparison of historical production and the primary, lower, and upper bound forecasts. It is interesting to see how historical production has been influenced by weather and economic events. The forecast does not exhibit a similar degree of variability because it is based on average weather and normal economic conditions. In other words, it is a forecast of *expected future demand*. Realized future demand will certainly not be smooth like the forecast. It will vary about the expected value depending on year-to-year variation in future weather and economic conditions. The forecast, however, provides the baseline around which this variability is likely to occur.

Figure 7. Historical and Forecast Production in Millions of Gallons



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ATTACHMENT 1 MONTHLY ALLOCATION PERCENTAGES FOR AGGREGATED METER READ DATA

The customer class seasonal use indices in the following table were used to weight the monthly allocation percentages that were used to distribute the aggregated meter read data into consumption months. The season indices were taken from Weber Analytical (2010).

Seaonal Use Indices

Month	SFR	MFR	BUS	IRR/GOLF	MUNI
Jan	0.74	0.90	0.84	0.24	0.34
Feb	0.80	0.97	0.91	0.24	0.31
Mar	0.78	0.92	0.89	0.34	0.39
Apr	0.82	0.92	0.89	0.53	0.65
May	1.05	1.04	1.04	1.21	1.13
Jun	1.25	1.02	1.16	1.57	1.60
Jul	1.28	1.11	1.16	1.80	1.70
Aug	1.29	1.14	1.24	1.83	1.91
Sep	1.22	1.08	1.11	1.65	1.79
Oct	1.07	1.04	1.03	1.35	1.06
Nov	0.89	0.94	0.89	0.71	0.75
Dec	0.81	0.91	0.85	0.53	0.38
Total	12.00	12.00	12.00	12.00	12.00

The next two tables provide the monthly allocation percentages for aggregated meter read data from bi-monthly billing cycles.

	SFR			MFR			BUS		
	% Allocated to Month			% Allocated to Month			% Allocated to Month		
Read Month (t)	t-2	t-1	t	t-2	t-1	t	t-2	t-1	t
Jan	26%	52%	23%	24%	51%	25%	24%	51%	25%
Feb	25%	49%	26%	23%	51%	26%	23%	50%	26%
Mar	27%	48%	25%	27%	48%	24%	27%	48%	25%
Apr	23%	51%	26%	24%	51%	25%	24%	51%	25%
May	22%	47%	30%	24%	48%	27%	24%	48%	28%
Jun	18%	52%	30%	21%	53%	25%	20%	52%	28%
Jul	22%	52%	27%	25%	49%	27%	23%	51%	26%
Aug	23%	52%	25%	22%	52%	26%	23%	51%	26%
Sep	24%	52%	24%	23%	53%	24%	23%	54%	23%
Oct	27%	51%	22%	26%	50%	24%	28%	50%	23%
Nov	27%	52%	21%	25%	52%	23%	26%	52%	22%
Dec	29%	49%	22%	27%	49%	24%	28%	49%	23%

	IRR/GOLF			MUNI		
	% Allocated to Month			% Allocated to Month		
Read Month (t)	t-2	t-1	t	t-2	t-1	t
Jan	33%	55%	12%	38%	43%	19%
Feb	40%	40%	20%	26%	51%	23%
Mar	26%	42%	32%	28%	43%	29%
Apr	15%	49%	36%	17%	46%	37%
May	13%	41%	46%	14%	46%	40%
Jun	11%	55%	34%	13%	52%	35%
Jul	20%	51%	29%	19%	53%	28%
Aug	21%	53%	26%	22%	51%	28%
Sep	24%	53%	23%	22%	54%	24%
Oct	28%	51%	21%	29%	55%	16%
Nov	31%	55%	14%	36%	48%	16%
Dec	41%	43%	16%	36%	51%	13%

The next two tables provide the monthly allocation percentages for aggregated meter read data from monthly billing cycles.

	SFR		MFR		BUS	
Read Month (t)	t-1	t	t-1	t	t-1	t
Jan	52%	48%	50%	50%	50%	50%
Feb	48%	52%	48%	52%	48%	52%
Mar	51%	49%	51%	49%	51%	49%
Apr	49%	51%	50%	50%	50%	50%
May	44%	56%	47%	53%	46%	54%
Jun	46%	54%	51%	49%	47%	53%
Jul	49%	51%	48%	52%	50%	50%
Aug	50%	50%	49%	51%	48%	52%
Sep	51%	49%	51%	49%	53%	47%
Oct	53%	47%	51%	49%	52%	48%
Nov	55%	45%	52%	48%	54%	46%
Dec	52%	48%	51%	49%	51%	49%

	IRR/GOLF		MUNI	
Read Month (t)	t-1	t	t-1	t
Jan	69%	31%	53%	47%
Feb	50%	50%	52%	48%
Mar	41%	59%	45%	55%
Apr	39%	61%	38%	62%
May	30%	70%	36%	64%
Jun	44%	56%	42%	58%
Jul	47%	53%	48%	52%
Aug	50%	50%	47%	53%
Sep	53%	47%	52%	48%
Oct	55%	45%	63%	37%
Nov	66%	34%	59%	41%
Dec	57%	43%	66%	34%

ATTACHMENT 2 WEATHER DATA

The weather data are from CIMIS Station 104 (DeLaveaga)

Average maximum daily air temperature (F)

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1990										75.0	67.0	58.0
1991	59.5	65.6	57.0	66.9	66.3	66.9	68.6	74.8	71.0	72.8	68.3	61.3
1992	61.8	63.8	62.9	71.7	69.6	69.3	77.2	75.9	74.6	73.8	67.7	58.1
1993	59.1	59.2	66.2	68.8	69.2	76.0	70.1	74.2	73.9	72.8	66.4	60.9
1994	62.8	58.6	65.8	66.3	67.1	75.3	66.8	74.4	72.8	71.0	58.8	57.7
1995	58.4	63.9	62.2	64.7	64.4	71.4	76.6	75.4	75.2	72.9	70.1	61.0
1996	61.1	64.2	69.5	75.8	78.0	84.5	88.2	93.4	78.3	71.0	63.9	59.9
1997	58.8	63.1	66.2	69.2	76.8	72.5	71.1	77.5	81.4	73.7	65.8	61.4
1998	59.6	58.3	62.1	64.0	64.5	68.8	73.3	76.3	72.7	71.5	62.4	58.5
1999	60.8	58.4	57.9	63.6	65.1	67.8	72.2	74.1	70.1	73.5	63.2	62.5
2000	57.7	60.3	63.2	67.8	71.5	70.5	72.1	72.6	74.9	66.5	61.2	63.7
2001	58.7	57.7	63.9	63.3	73.0	77.0	69.7	73.9	70.6	69.1	63.7	57.3
2002	56.8	63.2	61.3	63.3	68.2	73.4	71.6	72.1	75.4	68.8	68.5	59.0
2003	64.8	61.3	65.0	61.0	70.4	71.6	74.7	76.9	76.8	76.6	61.4	58.1
2004	57.5	58.3	70.4	68.2	72.4	72.4	72.0	74.3	78.2	68.3	61.6	60.5
2005	59.4	61.6	64.2	65.9	69.9	70.4	71.9	71.0	70.3	69.0	65.7	55.2
2006	56.8	63.7	56.1	60.7	68.4	72.9	76.8	70.0	71.4	70.5	64.7	60.2
2007	57.9	59.7	66.9	66.7	68.8	73.3	75.2	75.0	73.9	70.3	66.0	56.6
2008	55.9	60.3	65.5	67.7	68.5	74.8	73.0	73.6	75.0	75.2	66.6	57.9
2009	65.2	58.9	62.9	66.6	68.1	70.2	73.4	74.7	77.2	69.1	66.5	57.5
2010	60.0	60.0	63.2	62.5	67.5	73.2	68.3	70.4	76.6	68.7	63.6	57.9
2011	62.9	58.9	61.1	65.7	67.5	67.5	71.4	69.9	72.4	72.0	62.1	60.3
2012	62.5	62.2	59.4	65.4	69.8	72.5	70.2	73.7	71.2	72.8	66.7	56.6
2013	60.6	61.4	65.4	68.7	73.2	73.1	69.6	75.3	77.6	70.3	67.1	64.2
2014	68.5	61.4	66.5	68.4	75.6	71.5	72.9	72.8	74.3	77.2	66.4	60.1
2015	66.9	66.2	71.7	68.0								
Avg	**60.6**	**61.2**	**63.9**	**66.4**	**69.7**	**72.4**	**72.8**	**74.7**	**74.4**	**71.7**	**65.0**	**59.4**

Monthly total precipitation (in)

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1990										4.8	0.6	1.6
1991	0.8	4.9	11.6	0.8	0.1	0.3	0.0	0.1	0.1	2.4	1.5	4.2
1992	3.2	11.3	4.1	0.3	0.0	0.7	0.0	0.5	0.4	1.5	0.3	7.9
1993	14.8	8.7	3.8	1.5	1.5	1.1	0.6	0.5	0.3	0.7	2.0	3.9
1994	2.6	8.0	0.0	2.1	2.3	0.6	0.5	0.6	0.4	1.0	5.1	3.3
1995	18.6	0.5	9.6	5.0	1.2	2.5	0.0	0.0	0.7	1.5	0.0	0.7
1996	10.3	8.6	4.1	2.2	3.5	0.0	0.0	0.0	0.2	2.5	6.8	15.2
1997	10.1	0.3	1.4	0.8	0.1	0.1	0.0	0.5	0.2	0.5	8.9	3.6
1998	15.0	18.7	4.3	3.1	3.3	0.1	0.0	0.0	0.1	0.9	6.0	1.4
1999	7.9	10.3	3.6	2.8	0.0	0.3	0.0	0.0	0.1	0.3	3.7	0.5
2000	11.4	9.9	2.3	1.7	1.4	0.2	0.0	0.2	0.5	4.6	1.2	1.1
2001	5.7	7.0	3.4	1.9	0.0	0.1	0.0	0.0	0.2	0.8	6.2	11.3
2002	3.7	2.3	4.0	0.4	0.8	0.0	0.0	0.0	0.0	0.0	4.4	5.7
2003	2.0	1.9	1.6	0.5	1.1	0.0	0.0	0.0	0.0	0.1	1.8	9.4
2004	3.2	5.9	1.4	0.8	0.1	0.0	0.0	0.0	0.0	5.3	2.9	10.5
2005	5.7	5.9	7.5	2.9	1.0	0.0	0.0	0.0	0.0	0.2	2.0	13.4
2006	6.2	2.7	11.1	6.9	0.8	0.0	0.0	0.0	0.0	0.0	2.0	4.9
2007	0.8	6.2	0.3	1.7	0.6	0.0	0.0	0.0	0.0	1.1	0.6	1.5
2008	12.6	6.5	0.5	0.6	0.1	0.0	0.0	0.0	0.0	1.0	2.1	3.0
2009	1.8	11.3	2.0	0.6	1.7	0.0	0.0	0.0	0.0	4.7	0.3	4.4
2010	9.4	6.5	4.0	4.6	0.8	0.0	0.0	0.2	0.0	3.4	4.2	10.2
2011	2.2	6.3	11.9	0.7	1.8	2.5	0.1	0.1	0.1	2.7	2.6	0.1
2012	3.7	1.0	7.3	3.0	0.1	0.3	0.0	0.0	0.0	0.1	6.0	9.0
2013	0.9	0.3	1.7	0.9	0.0	0.1	0.0	0.1	0.1	0.1	0.3	0.1
2014	0.0	3.2	1.4	0.5	0.0	0.1	0.2	0.0	1.0	0.0	3.2	11.8
2015	0.0	0.0	0.0	0.0								
Avg	**6.1**	**5.9**	**4.1**	**1.8**	**0.9**	**0.4**	**0.1**	**0.1**	**0.2**	**1.6**	**3.0**	**5.5**

Monthly total ETo (in)

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1990										3.4	2.2	1.7
1991	1.7	2.1	2.3	4.5	4.6	4.7	4.5	4.3	3.3	2.8	2.1	1.5
1992	1.8	1.9	2.8	4.9	5.1	5.0	5.7	5.1	4.1	2.8	1.9	1.1
1993	1.2	1.6	3.5	4.9	4.9	6.1	4.8	4.8	3.7	2.8	2.1	1.4
1994	1.9	1.9	3.9	4.1	4.7	6.3	4.2	5.2	3.9	2.8	1.3	0.9
1995	0.9	1.9	2.8	3.7	3.0	5.3	5.9	5.3	4.1	3.2	2.0	1.2
1996	1.5	1.7	3.9	4.7	5.4	5.6	5.6	5.3	3.9	3.1	1.5	1.1
1997	1.3	2.7	3.9	5.0	6.1	5.5	4.7	5.1	4.9	3.3	1.6	1.6
1998	1.2	1.4	3.2	4.2	4.2	4.5	5.2	5.3	3.4	3.1	1.6	1.5
1999	1.6	1.9	3.3	4.4	5.1	5.3	5.5	4.8	3.3	3.4	1.6	1.8
2000	1.1	1.6	4.0	4.7	5.4	5.4	5.3	4.7	3.9	2.4	1.8	1.6
2001	1.7	2.1	3.6	4.4	6.0	6.4	4.9	4.9	3.6	2.8	1.5	1.0
2002	1.6	2.4	3.7	3.6	5.4	5.9	5.2	4.5	4.3	2.8	2.1	1.7
2003	1.8	2.2	3.9	3.9	5.3	5.0	5.6	5.3	4.2	3.5	1.6	1.0
2004	1.5	1.9	4.3	4.9	5.9	5.6	4.6	4.6	4.3	2.7	1.8	1.4
2005	1.5	1.9	3.3	4.2	4.7	4.9	4.7	3.9	3.2	2.6	1.9	1.0
2006	1.4	2.2	2.6	2.7	4.9	5.0	5.3	4.1	3.4	2.9	1.6	1.3
2007	2.0	1.7	4.1	4.5	5.4	5.9	5.5	5.3	4.0	3.1	2.0	1.4
2008	1.3	2.3	4.1	5.4	5.6	6.0	5.9	5.6	4.6	3.8	1.9	1.5
2009	2.0	2.0	4.0	4.7	4.7	5.4	5.5	5.1	4.4	3.0	2.0	1.2
2010	1.3	1.7	3.7	3.9	5.2	6.1	4.7	4.6	4.2	2.5	1.9	0.9
2011	1.9	2.3	3.1	4.5	5.3	4.9	5.4	4.2	3.7	2.8	1.8	1.8
2012	2.0	2.6	3.0	4.5	5.6	6.0	5.1	4.8	3.9	2.8	1.7	1.1
2013	2.0	2.5	3.8	4.9	5.9	5.3	5.0	5.0	4.4	3.2	2.1	2.1
2014	2.4	1.9	3.7	4.7	6.2	5.5	5.1	4.6	3.7	2.9	1.7	1.1
2015	2.2	2.4	4.5	4.7								
Avg	**1.6**	**2.0**	**3.6**	**4.4**	**5.2**	**5.5**	**5.2**	**4.8**	**3.9**	**3.0**	**1.8**	**1.4**

ATTACHMENT 3 ECONOMIC DATA

Inside city water rate per unit (100 cubic feet = 748 gallons = 1 billing unit)

			SFR and duplex* customers, In City							
Year	Billing cycle	Effective date	Units 1-4	Units 5-8	Unit 9	Units 10-14	Units 15-18	Units 19-40	Units 40+	MFR and CII
1999	Bi-monthly		0.76	0.76	1.81	1.81	1.81	1.81	3.31	1.81
2000	Bi-monthly		0.76	0.76	1.81	1.81	1.81	1.81	3.31	1.81
2001	Bi-monthly		0.76	0.76	1.81	1.81	1.81	1.81	3.31	1.81
2002	Bi-monthly		0.76	0.76	1.81	1.81	1.81	1.81	3.31	1.81
2003	Bi-monthly		0.76	0.76	1.81	1.81	1.81	1.81	3.31	1.81
2004	Bi-monthly	6/9/2004	0.90	2.30	2.30	2.95	4.05	5.05	5.05	2.30
2005	Monthly	1/1/2005	1.08	2.76	2.76	3.54	4.86	6.06	6.06	2.76
2005	Monthly	9/1/2005	1.05	2.68	2.68	3.44	4.72	5.88	5.88	2.68
2006	Monthly	1/1/2006	1.21	3.08	3.08	3.95	5.43	6.77	6.77	3.08
2007	Monthly	1/1/2007	1.36	3.47	3.47	4.45	6.10	7.61	7.61	3.47
2008	Monthly	1/1/2008	1.49	3.81	3.81	4.89	6.71	8.37	8.37	3.81
2009	Monthly		1.49	3.81	3.81	4.89	6.71	8.37	8.37	3.81
2010	Monthly		1.49	3.81	3.81	4.89	6.71	8.37	8.37	3.81
2011	Monthly	1/1/2011	1.57	4.00	4.00	5.14	7.05	8.79	8.79	4.00
2012	Monthly		1.57	4.00	4.00	5.14	7.05	8.79	8.79	4.00
2013	Monthly		1.57	4.00	4.00	5.14	7.05	8.79	8.79	4.00
2014	Monthly	1/1/2014	1.73	4.40	4.40	5.66	7.76	9.67	9.67	4.40

Outside city water rate per unit (100 cubic feet = 748 gallons = 1 billing unit)

			SFR and duplex* customers							
Year	Billing cycle	Effective date	Units 1-4	Units 5-8	Unit 9	Units 10-14	Units 15-18	Units 19-40	Units 40+	MFR and CII
1999	Bi-monthly		0.97	0.97	2.29	2.29	2.29	2.29	3.79	2.29
2000	Bi-monthly		0.97	0.97	2.29	2.29	2.29	2.29	3.79	2.29
2001	Bi-monthly		0.97	0.97	2.29	2.29	2.29	2.29	3.79	2.29
2002	Bi-monthly		0.97	0.97	2.29	2.29	2.29	2.29	3.79	2.29
2003	Bi-monthly		0.97	0.97	2.29	2.29	2.29	2.29	3.79	2.29
2004	Bi-monthly	6/9/2004	1.15	2.93	2.93	3.76	5.16	6.44	6.44	2.93
2005	Bi-monthly	1/1/2005	1.38	3.52	3.52	4.51	6.19	7.73	7.73	3.52
2005	Bi-monthly	9/1/2005	1.34	3.42	3.42	4.38	6.01	7.50	7.50	3.42
2006	Bi-monthly	1/1/2006	1.54	3.93	3.93	5.04	6.91	8.63	8.63	3.93
2007	Bi-monthly	1/1/2007	1.73	4.42	4.42	5.67	7.78	9.71	9.71	4.42
2008	Bi-monthly	1/1/2008	1.91	4.86	4.86	6.23	8.56	10.68	10.68	4.86
2009	Bi-monthly		1.91	4.86	4.86	6.23	8.56	10.68	10.68	4.86
2010	Bi-monthly		1.91	4.86	4.86	6.23	8.56	10.68	10.68	4.86
2011	Bi-monthly	1/1/2011	2.00	5.10	5.10	6.55	8.98	11.21	11.21	5.10
2012	Bi-monthly		2.00	5.10	5.10	6.55	8.98	11.21	11.21	5.10
2013	Bi-monthly		2.00	5.10	5.10	6.55	8.98	11.21	11.21	5.10
2014	Monthly	1/1/2014	2.20	5.61	5.61	7.21	9.88	12.34	12.34	5.61

Per capita and median household income (2013 dollars)

		Per Capita			Median Household		
Year	Source	County	Inside City	Outside City	County	Inside City	Outside City
1999	Census	37,605	36,696	40,980	76,688	71,845	76,369
2000	imputed	42,919	35,797	48,603	87,525	70,681	89,610
2001	imputed	33,542	42,936	50,199	68,402	84,777	92,552
2002	imputed	31,937	33,580	42,814	65,129	66,302	78,936
2003	imputed	32,876	31,349	39,566	67,044	61,898	72,948
2004	imputed	34,384	32,439	40,287	70,120	64,050	74,278
2005	imputed	39,701	35,403	41,088	71,081	69,901	75,755
2006	imputed	37,448	36,600	42,144	73,033	72,265	77,700
2007	imputed	38,394	35,945	44,607	72,534	67,295	82,242
2008	imputed	38,512	37,986	44,979	74,414	69,710	82,928
2009	ACS	32,865	36,359	40,101	67,341	65,474	73,816
2010	ACS	31,390	31,790	40,161	65,969	63,899	73,206
2011	ACS	32,026	29,917	39,611	65,813	62,507	72,032
2012	ACS	34,279	29,949	38,713	69,483	64,215	73,334
2013	ACS	31,609	29,604	37,847	68,630	62,756	68,983
2014	imputed	31,812	29,793	38,090	69,069	63,157	69,425

California Department of Finance Report E-8
Housing Vacancy Rates

Year	Date	Santa Cruz	Capitola	County
1991	1/1/1991	6.3	11.4	3.6
1992	1/1/1992	6.1	11.4	3.4
1993	1/1/1993	6.0	11.5	3.3
1994	1/1/1994	5.8	11.5	3.1
1995	1/1/1995	5.7	11.5	3.0
1996	1/1/1996	5.5	11.5	2.8
1997	1/1/1997	5.4	11.6	2.8
1998	1/1/1998	5.2	11.6	2.6
1999	1/1/1999	5.1	11.6	2.5
2000	1/1/2000	5.0	11.6	2.4
2001	1/1/2001	5.1	12.0	2.5
2002	1/1/2002	5.3	12.5	2.7
2003	1/1/2003	5.4	13.0	2.9
2004	1/1/2004	5.6	13.5	3.1
2005	1/1/2005	6.9	13.9	3.3
2006	1/1/2006	6.6	14.4	3.6
2007	1/1/2007	6.7	14.9	3.8
2008	1/1/2008	6.9	15.3	3.9
2009	1/1/2009	6.9	15.8	4.1
2010	1/1/2010	7.1	16.3	4.3
2011	1/1/2011	7.1	16.4	9.6
2012	1/1/2012	7.0	16.4	9.5
2013	1/1/2013	7.0	16.4	9.4
2014	1/1/2014	6.8	16.3	9.2

California Employment Development Department Unemployment Rates

Year	County	Santa Cruz
1990	7.2	
1991	8.8	
1992	9.7	
1993	10.4	
1994	9.7	
1995	9.3	
1996	8.5	
1997	7.9	
1998	7.3	
1999	6.4	
2000	5.1	4.2
2001	5.7	4.7
2002	7.3	6.1
2003	7.7	6.4
2004	7	5.8
2005	6.3	5.2
2006	5.6	4.6
2007	5.9	4.9
2008	7.4	6.1
2009	11.1	9.4
2010	13.3	11.9
2011	13.1	11.7
2012	11.8	10.6
2013	10.3	9.2
2014	8.7	7.8

ATTACHMENT 4 CONSERVATION ADJUSTMENT DATA

SFR Inside City Plumbing Code Water Savings Since 2000 (MG)

	Month												
Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	8.1
2002	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.4	15.7
2003	1.4	1.5	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4	22.8
2004	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.6	29.6
2005	2.6	2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.2	3.2	3.3	3.4	36.0
2006	3.4	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.6	3.6	3.6	41.9
2007	3.6	3.7	3.8	3.8	3.9	3.9	4.0	4.0	4.1	4.2	4.2	4.3	47.5
2008	4.3	4.3	4.3	4.4	4.4	4.4	4.4	4.4	4.5	4.5	4.5	4.5	52.8
2009	4.6	4.6	4.7	4.7	4.8	4.8	4.8	4.9	4.9	5.0	5.0	5.1	57.9
2010	5.1	5.1	5.2	5.2	5.2	5.2	5.2	5.3	5.3	5.3	5.3	5.3	62.7
2011	5.4	5.4	5.5	5.5	5.5	5.6	5.6	5.7	5.7	5.8	5.8	5.8	67.3
2012	5.9	5.9	5.9	5.9	5.9	6.0	6.0	6.0	6.0	6.1	6.1	6.1	71.8
2013	6.1	6.2	6.2	6.2	6.3	6.3	6.4	6.4	6.4	6.5	6.5	6.5	76.0
2014	6.6	6.6	6.7	6.7	6.8	6.8	6.9	6.9	7.0	7.0	7.0		74.9

SFR Outside City Plumbing Code Water Savings Since 2000 (MG)

	Month												
Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.7	4.5
2002	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	8.8
2003	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	12.8
2004	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	16.7
2005	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.9	1.9	20.3
2006	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	23.6
2007	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.3	2.4	2.4	26.7
2008	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	29.7
2009	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.8	2.8	2.8	2.8	2.9	32.6
2010	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.0	3.0	3.0	35.3
2011	3.0	3.1	3.1	3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.3	3.3	37.9
2012	3.3	3.3	3.3	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	40.4
2013	3.5	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.7	3.7	42.7
2014	3.7	3.7	3.8	3.8	3.8	3.8	3.9	3.9	3.9	3.9	4.0		42.1

SFR Inside City Housing Units

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	11,516	11,519	11,523	11,526	11,530	11,533	11,537	11,540	11,544	11,547	11,551	11,554
2001	11,559	11,564	11,569	11,574	11,579	11,584	11,588	11,593	11,598	11,603	11,608	11,613
2002	11,624	11,634	11,645	11,656	11,666	11,677	11,688	11,698	11,709	11,720	11,730	11,741
2003	11,748	11,755	11,762	11,769	11,776	11,783	11,789	11,796	11,803	11,810	11,817	11,824
2004	11,827	11,829	11,832	11,835	11,837	11,840	11,843	11,845	11,848	11,851	11,853	11,856
2005	11,859	11,862	11,865	11,867	11,870	11,873	11,876	11,879	11,882	11,884	11,887	11,890
2006	11,896	11,903	11,909	11,915	11,922	11,928	11,934	11,941	11,947	11,953	11,960	11,966
2007	11,972	11,978	11,984	11,990	11,996	12,003	12,009	12,015	12,021	12,027	12,033	12,039
2008	12,039	12,039	12,039	12,039	12,039	12,039	12,038	12,038	12,038	12,038	12,038	12,038
2009	12,042	12,045	12,049	12,052	12,056	12,060	12,063	12,067	12,070	12,074	12,077	12,081
2010	12,084	12,088	12,091	12,095	12,098	12,102	12,105	12,108	12,112	12,115	12,119	12,122
2011	12,123	12,125	12,126	12,127	12,129	12,130	12,131	12,133	12,134	12,135	12,137	12,138
2012	12,141	12,144	12,147	12,149	12,152	12,155	12,158	12,161	12,164	12,166	12,169	12,172
2013	12,175	12,178	12,181	12,184	12,187	12,190	12,192	12,195	12,198	12,201	12,204	12,207
2014	12,210	12,214	12,217	12,220	12,223	12,227	12,230	12,233	12,236	12,240	12,243	

SFR Outside City Housing Units

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	6,257	6,263	6,268	6,273	6,279	6,284	6,289	6,295	6,300	6,305	6,311	6,316
2001	6,321	6,325	6,330	6,334	6,339	6,344	6,348	6,353	6,357	6,362	6,366	6,371
2002	6,377	6,383	6,389	6,394	6,400	6,406	6,412	6,418	6,424	6,429	6,435	6,441
2003	6,443	6,445	6,447	6,449	6,451	6,454	6,456	6,458	6,460	6,462	6,464	6,466
2004	6,469	6,471	6,474	6,476	6,479	6,481	6,484	6,486	6,489	6,491	6,494	6,496
2005	6,501	6,506	6,510	6,515	6,520	6,525	6,529	6,534	6,539	6,544	6,548	6,553
2006	6,557	6,561	6,565	6,569	6,573	6,577	6,580	6,584	6,588	6,592	6,596	6,600
2007	6,609	6,618	6,627	6,636	6,645	6,654	6,662	6,671	6,680	6,689	6,698	6,707
2008	6,708	6,709	6,711	6,712	6,713	6,714	6,715	6,716	6,718	6,719	6,720	6,721
2009	6,722	6,723	6,725	6,726	6,727	6,728	6,729	6,730	6,732	6,733	6,734	6,735
2010	6,735	6,736	6,736	6,737	6,737	6,738	6,738	6,738	6,739	6,739	6,740	6,740
2011	6,741	6,741	6,742	6,742	6,743	6,743	6,744	6,744	6,745	6,745	6,746	6,746
2012	6,747	6,748	6,748	6,749	6,750	6,751	6,751	6,752	6,753	6,754	6,754	6,755
2013	6,754	6,754	6,753	6,752	6,751	6,751	6,750	6,749	6,748	6,748	6,747	6,746
2014	6,746	6,746	6,745	6,745	6,745	6,745	6,744	6,744	6,744	6,744	6,743	

SFR Inside City Plumbing Code Water Savings Since 2000 (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.9
2002	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	1.8
2003	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	2.6
2004	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3.3
2005	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	4.1
2006	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.7
2007	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	5.3
2008	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.9
2009	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	6.4
2010	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6.9
2011	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	7.4
2012	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7.9
2013	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.3
2014	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8		8.2

SFR Outside City Plumbing Code Water Savings Since 2000 (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0
2002	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.8
2003	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	2.7
2004	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3.4
2005	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	4.2
2006	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.8
2007	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	5.4
2008	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.9
2009	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	6.5
2010	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	7.0
2011	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	7.5
2012	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.0
2013	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.5
2014	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8		8.4

SFR Inside City Avg Use (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	6.5	7.1	7.5	8.6	10.1	11.2	12.0	11.0	9.8	8.7	7.6	7.0	106.9
2001	6.8	7.0	7.1	8.1	10.1	11.3	11.3	11.6	10.9	8.8	7.7	7.2	108.1
2002	6.2	5.9	7.2	8.6	10.0	11.2	10.8	10.9	11.3	9.4	8.1	7.1	106.7
2003	6.5	6.5	6.7	7.9	9.5	10.4	11.5	12.1	11.2	9.2	7.6	6.8	105.7
2004	6.5	6.8	7.6	8.9	10.9	12.0	11.2	11.0	9.6	8.0	7.4	7.6	107.7
2005	7.7	7.0	6.0	6.5	8.3	9.6	10.7	10.7	10.0	8.7	7.6	6.8	99.6
2006	5.6	6.1	6.0	5.8	8.3	9.9	11.2	10.6	9.2	8.4	6.9	6.3	94.2
2007	6.1	6.4	6.3	6.9	8.2	9.8	10.9	10.4	9.4	7.7	5.9	6.2	94.1
2008	6.1	6.3	7.3	8.0	8.8	9.7	10.3	9.2	8.5	7.8	6.5	6.0	94.6
2009	5.8	5.3	5.8	6.7	7.4	8.1	8.7	8.7	8.1	7.0	5.8	5.6	83.0
2010	5.9	5.4	5.1	5.7	6.8	8.2	8.7	8.9	8.4	7.1	5.8	5.3	81.3
2011	5.5	5.2	5.1	6.1	6.9	7.3	8.3	8.4	7.6	6.7	5.9	5.6	78.6
2012	5.8	5.6	5.5	5.8	7.0	8.4	8.8	8.4	7.7	7.1	6.0	5.5	81.6
2013	5.4	5.2	5.6	6.4	7.6	8.5	8.5	8.4	7.9	7.6	6.7	6.2	84.1
2014	6.0	5.1	4.9	5.3	5.4	5.6	5.5	5.3	5.1	4.8	4.3		57.3

SFR Outside City Avg Use (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	7.1	7.2	7.7	9.2	10.4	11.4	12.9	11.9	11.7	9.5	8.4	7.7	115.1
2001	7.4	7.0	6.8	8.8	10.6	11.7	12.8	11.8	11.6	9.9	8.8	7.5	114.6
2002	6.9	6.9	7.1	8.7	10.3	11.6	13.3	12.5	12.6	10.2	8.8	7.6	116.4
2003	7.0	7.1	7.2	8.1	9.0	11.0	13.9	13.0	12.8	10.4	9.0	7.6	116.1
2004	6.9	7.0	7.6	9.6	11.2	12.0	13.3	12.6	12.6	9.9	8.4	7.7	118.8
2005	7.4	6.7	6.1	7.4	8.7	10.2	12.5	11.5	11.3	9.4	8.5	7.2	107.0
2006	6.4	6.2	5.9	7.0	8.3	10.0	12.2	11.3	11.2	9.4	8.3	7.3	103.5
2007	6.8	6.8	6.7	7.9	8.9	10.0	11.5	10.4	10.3	8.6	7.9	7.0	102.9
2008	6.3	6.0	5.9	7.7	11.0	12.7	9.0	8.4	13.0	11.5	7.4	6.5	105.5
2009	6.0	5.6	6.5	7.6	8.6	9.4	9.6	9.8	8.6	7.5	6.4	5.9	91.5
2010	5.6	5.5	5.8	6.4	7.7	9.1	9.5	9.8	8.8	7.4	6.1	5.7	87.6
2011	5.5	5.4	6.0	6.8	7.8	8.6	8.9	9.2	8.0	7.0	6.3	6.2	85.6
2012	5.9	5.7	6.1	6.7	8.1	9.4	9.4	9.3	8.3	7.3	6.2	5.8	88.3
2013	5.6	5.7	6.4	7.4	8.5	9.3	9.3	9.4	8.7	8.1	7.2	6.7	92.2
2014	6.5	6.8	7.1	5.7	6.0	6.3	6.2	5.9	5.5	5.1	4.5		65.6

SFR Inside City Adjusted Avg Use (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	6.5	7.1	7.5	8.6	10.1	11.2	12.0	11.0	9.8	8.7	7.6	7.0	106.9
2001	6.8	7.0	7.2	8.1	10.1	11.4	11.4	11.7	11.0	9.0	7.9	7.4	109.0
2002	6.4	6.1	7.3	8.7	10.2	11.4	11.0	11.0	11.5	9.5	8.2	7.2	108.5
2003	6.7	6.7	6.9	8.1	9.7	10.6	11.7	12.3	11.4	9.4	7.9	7.1	108.3
2004	6.8	7.1	7.9	9.2	11.2	12.3	11.5	11.3	9.9	8.3	7.7	7.9	111.0
2005	8.0	7.3	6.3	6.8	8.6	9.9	11.0	11.1	10.4	9.1	7.9	7.2	103.6
2006	6.0	6.5	6.4	6.2	8.7	10.3	11.6	11.0	9.6	8.8	7.3	6.7	98.9
2007	6.5	6.8	6.7	7.3	8.6	10.2	11.3	10.8	9.8	8.2	6.4	6.7	99.4
2008	6.6	6.8	7.8	8.5	9.3	10.2	10.8	9.7	9.0	8.2	7.0	6.5	100.5
2009	6.3	5.8	6.3	7.2	8.0	8.7	9.2	9.2	8.6	7.6	6.4	6.2	89.4
2010	6.4	5.9	5.6	6.3	7.4	8.7	9.3	9.4	9.0	7.7	6.4	5.9	88.2
2011	6.1	5.8	5.7	6.7	7.5	7.9	8.9	9.1	8.2	7.4	6.5	6.3	86.0
2012	6.4	6.3	6.2	6.5	7.6	9.0	9.4	9.0	8.4	7.8	6.7	6.2	89.5
2013	6.1	5.9	6.3	7.1	8.3	9.2	9.2	9.1	8.6	8.3	7.4	6.9	92.4
2014	6.7	5.9	5.6	6.0	6.2	6.3	6.2	6.0	5.9	5.5	5.0		65.4

SFR Outside City Adjusted Avg Use (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	7.1	7.2	7.7	9.2	10.4	11.4	12.9	11.9	11.7	9.5	8.4	7.7	115.1
2001	7.4	7.0	6.8	8.8	10.7	11.7	12.9	11.9	11.8	10.0	8.9	7.6	115.6
2002	7.0	7.0	7.2	8.9	10.4	11.7	13.5	12.7	12.8	10.4	8.9	7.8	118.3
2003	7.2	7.3	7.4	8.3	9.2	11.2	14.1	13.2	13.1	10.7	9.2	7.9	118.7
2004	7.1	7.3	7.9	9.9	11.5	12.3	13.6	12.8	12.9	10.2	8.7	8.0	122.2
2005	7.7	7.0	6.4	7.7	9.1	10.5	12.8	11.9	11.7	9.8	8.9	7.6	111.1
2006	6.8	6.6	6.3	7.4	8.7	10.4	12.6	11.7	11.6	9.8	8.7	7.7	108.3
2007	7.2	7.2	7.2	8.4	9.4	10.4	12.0	10.9	10.7	9.1	8.4	7.5	108.2
2008	6.8	6.5	6.4	8.2	11.5	13.2	9.5	8.9	13.5	12.0	7.9	7.0	111.4
2009	6.5	6.1	7.0	8.1	9.2	10.0	10.1	10.3	9.1	8.0	7.0	6.5	98.0
2010	6.2	6.0	6.4	7.0	8.3	9.7	10.1	10.4	9.4	8.0	6.7	6.3	94.6
2011	6.1	6.0	6.6	7.4	8.4	9.2	9.5	9.8	8.7	7.6	6.9	6.8	93.1
2012	6.6	6.4	6.7	7.4	8.8	10.1	10.1	9.9	9.0	7.9	6.9	6.5	96.3
2013	6.3	6.3	7.1	8.1	9.2	10.0	10.0	10.1	9.4	8.8	7.9	7.5	100.7
2014	7.3	7.5	7.8	6.4	6.7	7.0	7.0	6.7	6.3	5.9	5.3		74.0

MFR Inside City Plumbing Code Water Savings Since 2000 (MG)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.9	1.0	6.4
2002	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	12.4
2003	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	18.2
2004	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	23.7
2005	2.1	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.7	2.7	28.9
2006	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9	33.8
2007	2.9	3.0	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.4	3.4	3.5	38.4
2008	3.5	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.7	3.7	42.9
2009	3.7	3.8	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.1	4.1	4.1	47.2
2010	4.2	4.2	4.2	4.2	4.2	4.3	4.3	4.3	4.3	4.3	4.4	4.4	51.2
2011	4.4	4.5	4.5	4.5	4.6	4.6	4.7	4.7	4.8	4.8	4.8	4.9	55.7
2012	4.9	4.9	4.9	5.0	5.0	5.0	5.0	5.0	5.1	5.1	5.1	5.1	60.1
2013	5.2	5.2	5.2	5.3	5.3	5.3	5.4	5.4	5.4	5.5	5.5	5.6	64.3
2014	5.6	5.6	5.7	5.7	5.8	5.8	5.9	5.9	5.9	6.0	6.0		64.0

MFR Outside City Plumbing Code Water Savings Since 2000 (MG)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.7	0.8	0.9	5.6
2002	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	11.0
2003	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.7	16.1
2004	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	21.0
2005	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4	2.4	25.6
2006	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.6	2.6	30.0
2007	2.6	2.7	2.7	2.7	2.8	2.8	2.9	2.9	2.9	3.0	3.0	3.1	34.1
2008	3.1	3.1	3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.3	38.0
2009	3.3	3.3	3.4	3.4	3.4	3.5	3.5	3.5	3.6	3.6	3.6	3.7	41.8
2010	3.7	3.7	3.7	3.7	3.8	3.8	3.8	3.8	3.8	3.8	3.9	3.9	45.4
2011	3.9	4.0	4.0	4.0	4.1	4.1	4.1	4.2	4.2	4.2	4.3	4.3	49.4
2012	4.3	4.4	4.4	4.4	4.4	4.4	4.4	4.5	4.5	4.5	4.5	4.5	53.3
2013	4.6	4.6	4.6	4.7	4.7	4.7	4.8	4.8	4.8	4.9	4.9	4.9	57.0
2014	5.0	5.0	5.0	5.1	5.1	5.2	5.2	5.2	5.3	5.3	5.4		56.8

MFR Inside City Housing Units

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	8,667	8,668	8,669	8,670	8,671	8,672	8,673	8,674	8,675	8,675	8,676	8,677
2001	8,682	8,686	8,691	8,695	8,699	8,704	8,708	8,713	8,717	8,722	8,726	8,731
2002	8,732	8,733	8,735	8,736	8,737	8,739	8,740	8,741	8,743	8,744	8,745	8,747
2003	8,755	8,763	8,771	8,779	8,787	8,795	8,802	8,810	8,818	8,826	8,834	8,842
2004	8,858	8,873	8,888	8,903	8,918	8,933	8,948	8,963	8,978	8,993	9,009	9,024
2005	9,036	9,048	9,060	9,072	9,084	9,096	9,108	9,120	9,132	9,144	9,156	9,168
2006	9,170	9,172	9,174	9,176	9,179	9,181	9,183	9,185	9,188	9,190	9,192	9,194
2007	9,205	9,216	9,226	9,237	9,248	9,258	9,269	9,280	9,290	9,301	9,312	9,322
2008	9,325	9,328	9,331	9,335	9,338	9,341	9,344	9,347	9,350	9,353	9,356	9,359
2009	9,365	9,371	9,377	9,383	9,388	9,394	9,400	9,406	9,411	9,417	9,423	9,429
2010	9,434	9,439	9,443	9,448	9,453	9,458	9,463	9,468	9,473	9,478	9,483	9,487
2011	9,488	9,488	9,489	9,489	9,490	9,490	9,491	9,491	9,491	9,492	9,492	9,493
2012	9,493	9,493	9,493	9,493	9,493	9,493	9,493	9,493	9,493	9,493	9,493	9,493
2013	9,495	9,496	9,498	9,500	9,502	9,503	9,505	9,507	9,509	9,510	9,512	9,514
2014	9,518	9,523	9,527	9,532	9,536	9,541	9,545	9,550	9,554	9,558	9,563	

MFR Outside City Housing Units

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	7,940	7,938	7,935	7,932	7,929	7,926	7,924	7,921	7,918	7,915	7,912	7,910
2001	7,910	7,911	7,912	7,912	7,913	7,914	7,915	7,915	7,916	7,917	7,917	7,918
2002	7,915	7,912	7,910	7,907	7,904	7,901	7,898	7,896	7,893	7,890	7,887	7,885
2003	7,885	7,886	7,887	7,887	7,888	7,889	7,889	7,890	7,891	7,892	7,892	7,893
2004	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893
2005	7,896	7,900	7,903	7,907	7,910	7,914	7,917	7,921	7,924	7,928	7,931	7,935
2006	7,936	7,938	7,939	7,940	7,942	7,943	7,945	7,946	7,947	7,949	7,950	7,952
2007	7,950	7,949	7,947	7,946	7,945	7,943	7,942	7,940	7,939	7,938	7,936	7,935
2008	7,933	7,932	7,931	7,929	7,928	7,926	7,925	7,924	7,922	7,921	7,919	7,918
2009	7,917	7,915	7,914	7,912	7,911	7,910	7,908	7,907	7,905	7,904	7,903	7,901
2010	7,903	7,904	7,905	7,907	7,908	7,910	7,911	7,912	7,914	7,915	7,917	7,918
2011	7,915	7,912	7,910	7,907	7,904	7,901	7,898	7,896	7,893	7,890	7,887	7,885
2012	7,885	7,886	7,887	7,887	7,888	7,889	7,889	7,890	7,891	7,892	7,892	7,893
2013	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893	7,893
2014	7,894	7,894	7,895	7,896	7,896	7,897	7,898	7,898	7,899	7,900	7,901	

MFR Inside City Plumbing Code Water Savings Since 2000 (CCF/Housing Unit)

	Month												
Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	1.0
2002	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.9
2003	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	2.8
2004	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3.5
2005	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	4.2
2006	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.9
2007	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.5
2008	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	6.1
2009	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6.7
2010	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	7.2
2011	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7.9
2012	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.5
2013	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	9.0
2014	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		9.0

MFR Outside City Plumbing Code Water Savings Since 2000 (CCF/Housing Unit)

	Month												
Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0
2002	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.9
2003	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	2.7
2004	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3.6
2005	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.3
2006	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	5.0
2007	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.7
2008	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	6.4
2009	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	7.1
2010	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	7.7
2011	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.4
2012	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	9.0
2013	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	9.7
2014	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9		9.6

MFR Inside City Avg Use (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	5.1	5.3	5.3	5.6	6.2	6.5	6.5	6.5	6.1	5.8	5.5	5.2	69.5
2001	5.2	5.3	5.0	5.3	6.1	6.5	6.2	6.2	6.1	5.8	5.4	5.1	68.2
2002	4.5	4.5	5.3	5.7	5.8	6.2	5.7	5.8	5.9	5.5	5.1	4.8	64.8
2003	4.6	4.6	4.7	5.0	5.6	5.8	5.9	6.3	6.0	5.3	4.8	4.7	63.2
2004	4.8	5.4	5.3	5.0	6.0	6.3	5.9	5.6	5.0	4.9	4.8	5.3	64.2
2005	5.9	5.6	4.4	4.3	5.3	5.3	5.6	5.6	5.3	5.0	4.8	4.6	61.6
2006	4.1	4.7	4.2	3.8	5.5	5.3	5.8	5.4	5.1	5.0	4.2	4.4	57.7
2007	4.2	4.7	4.2	4.1	4.7	5.3	6.0	5.6	5.2	4.8	3.8	4.1	56.7
2008	4.6	4.7	5.0	4.8	4.7	5.2	5.6	5.1	4.9	4.7	4.2	3.9	57.5
2009	4.0	3.9	4.0	4.3	4.6	4.7	4.8	4.8	4.6	4.5	4.1	3.9	52.2
2010	4.3	4.0	3.7	4.0	4.5	4.7	4.8	4.9	4.7	4.6	4.1	3.8	52.4
2011	4.0	3.9	3.7	4.2	4.5	4.5	4.7	4.8	4.5	4.2	4.0	3.8	51.0
2012	3.9	4.1	3.9	4.0	4.4	4.8	4.9	4.7	4.4	4.4	4.2	3.9	51.5
2013	3.9	3.7	3.9	4.1	4.5	4.7	4.6	4.6	4.5	4.6	4.3	4.0	51.6
2014	3.9	3.6	3.6	3.7	3.7	3.7	3.6	3.6	3.5	3.4	3.2		39.7

MFR Outside City Avg Use (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	5.1	5.2	5.4	5.8	6.1	6.1	6.6	6.5	6.7	6.0	5.8	5.5	70.8
2001	5.3	4.9	4.9	5.8	6.4	6.4	6.6	6.4	6.6	6.0	5.8	5.5	70.5
2002	5.2	4.8	4.9	5.5	5.9	6.1	6.5	6.3	6.6	5.8	5.5	5.1	68.4
2003	4.9	4.9	5.0	5.2	5.5	6.0	6.6	6.3	6.4	5.7	5.3	4.9	66.8
2004	4.7	4.8	4.9	5.5	6.0	5.9	6.2	6.1	6.2	5.5	5.2	5.0	66.0
2005	5.1	4.6	4.3	4.8	5.4	5.6	5.9	5.7	5.9	5.4	5.1	4.7	62.4
2006	4.5	4.3	4.3	4.7	5.0	5.3	5.7	5.5	5.7	5.2	4.9	4.5	59.6
2007	4.3	4.2	4.2	4.6	4.9	5.0	5.3	5.0	5.1	4.7	4.7	4.5	56.6
2008	4.3	4.0	3.9	4.5	6.0	6.0	4.2	4.2	6.6	6.1	4.2	4.2	58.2
2009	4.0	3.9	4.2	4.6	4.9	5.1	5.1	5.2	4.6	4.4	4.1	4.0	54.1
2010	3.9	4.0	4.1	4.2	4.8	5.3	5.3	5.3	4.7	4.5	4.1	4.0	54.2
2011	3.9	3.9	4.2	4.6	4.8	5.0	5.1	5.1	4.5	4.3	4.1	4.2	53.6
2012	4.0	3.9	4.1	4.3	4.8	5.4	5.2	5.1	4.6	4.4	4.2	4.1	54.2
2013	3.9	3.9	4.2	4.5	4.9	5.3	5.2	5.2	4.8	4.7	4.4	4.2	55.3
2014	3.9	4.4	5.0	3.9	3.8	3.9	4.0	3.9	3.8	3.6	3.4		43.5

MFR Inside City Adjusted Avg Use (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	5.1	5.3	5.3	5.6	6.2	6.5	6.5	6.5	6.1	5.8	5.5	5.2	69.5
2001	5.2	5.3	5.0	5.3	6.2	6.6	6.3	6.3	6.2	5.9	5.5	5.3	69.1
2002	4.6	4.6	5.4	5.9	6.0	6.3	5.9	6.0	6.1	5.7	5.3	5.0	66.7
2003	4.8	4.8	4.9	5.2	5.8	6.0	6.1	6.5	6.2	5.5	5.1	5.0	66.0
2004	5.1	5.6	5.5	5.3	6.3	6.6	6.2	5.9	5.3	5.2	5.1	5.6	67.8
2005	6.2	5.9	4.7	4.7	5.6	5.6	6.0	6.0	5.6	5.4	5.2	4.9	65.9
2006	4.5	5.1	4.6	4.2	5.9	5.8	6.2	5.8	5.5	5.5	4.7	4.8	62.6
2007	4.6	5.1	4.7	4.5	5.2	5.8	6.5	6.0	5.7	5.3	4.2	4.6	62.3
2008	5.1	5.2	5.5	5.4	5.3	5.7	6.2	5.6	5.4	5.3	4.7	4.5	63.6
2009	4.6	4.4	4.6	4.9	5.1	5.2	5.3	5.4	5.2	5.1	4.7	4.5	58.9
2010	4.9	4.6	4.3	4.6	5.1	5.3	5.4	5.5	5.3	5.2	4.8	4.4	59.6
2011	4.7	4.5	4.4	4.8	5.2	5.2	5.4	5.5	5.2	4.9	4.7	4.5	58.8
2012	4.6	4.8	4.6	4.7	5.1	5.5	5.6	5.4	5.2	5.1	4.9	4.6	60.0
2013	4.6	4.5	4.6	4.9	5.3	5.5	5.4	5.4	5.3	5.4	5.1	4.8	60.7
2014	4.7	4.4	4.4	4.5	4.5	4.5	4.5	4.4	4.3	4.3	4.1		48.7

MFR Outside City Adjusted Avg Use (CCF/Housing Unit)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	5.1	5.2	5.4	5.8	6.1	6.1	6.6	6.5	6.7	6.0	5.8	5.5	70.8
2001	5.3	5.0	4.9	5.8	6.4	6.5	6.7	6.5	6.7	6.1	5.9	5.7	71.5
2002	5.4	5.0	5.1	5.7	6.1	6.3	6.7	6.5	6.7	6.0	5.7	5.3	70.3
2003	5.1	5.1	5.1	5.4	5.7	6.3	6.8	6.6	6.7	6.0	5.6	5.2	69.5
2004	5.0	5.1	5.2	5.8	6.2	6.2	6.5	6.4	6.5	5.8	5.5	5.3	69.6
2005	5.4	4.9	4.6	5.2	5.7	6.0	6.3	6.1	6.2	5.8	5.5	5.1	66.8
2006	4.9	4.7	4.7	5.1	5.4	5.7	6.1	5.9	6.1	5.6	5.3	5.0	64.6
2007	4.8	4.7	4.7	5.0	5.3	5.5	5.8	5.5	5.6	5.3	5.2	5.0	62.3
2008	4.8	4.5	4.4	5.0	6.6	6.5	4.7	4.7	7.2	6.7	4.7	4.8	64.6
2009	4.6	4.4	4.8	5.2	5.4	5.7	5.7	5.8	5.2	5.0	4.7	4.6	61.2
2010	4.5	4.6	4.7	4.9	5.4	5.9	6.0	6.0	5.4	5.2	4.7	4.6	61.9
2011	4.5	4.5	4.9	5.2	5.5	5.7	5.8	5.8	5.2	5.0	4.8	4.9	62.0
2012	4.7	4.7	4.9	5.0	5.6	6.1	6.0	5.9	5.3	5.2	4.9	4.9	63.2
2013	4.7	4.7	5.0	5.3	5.7	6.1	6.0	6.0	5.6	5.6	5.2	5.0	65.0
2014	4.7	5.3	5.8	4.7	4.6	4.8	4.9	4.8	4.7	4.5	4.3		53.1

BUS Inside City Plumbing Code Water Savings Since 2000 (MG)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	2.3
2002	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.6
2003	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	6.8
2004	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	8.9
2005	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	10.9
2006	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	12.8
2007	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	14.6
2008	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	16.4
2009	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.6	1.6	18.1
2010	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	19.8
2011	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.9	21.5
2012	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	23.2
2013	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.2	24.9
2014	2.2	2.2	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1		23.6

BUS Outside City Plumbing Code Water Savings Since 2000 (MG)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	1.1
2002	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.3
2003	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3.3
2004	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.4
2005	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	5.4
2006	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	6.3
2007	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	7.2
2008	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.1
2009	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	8.9
2010	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	9.7
2011	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	10.6
2012	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	11.4
2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	12.3
2014	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1		11.6

BUS Inside City Services

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	1,273	1,276	1,278	1,280	1,283	1,285	1,287	1,290	1,292	1,294	1,297	1,299
2001	1,297	1,294	1,292	1,289	1,287	1,285	1,282	1,280	1,277	1,275	1,272	1,270
2002	1,269	1,269	1,268	1,267	1,267	1,266	1,265	1,265	1,264	1,263	1,263	1,262
2003	1,262	1,263	1,263	1,264	1,264	1,265	1,265	1,265	1,266	1,266	1,267	1,267
2004	1,266	1,266	1,265	1,265	1,264	1,264	1,263	1,262	1,262	1,261	1,261	1,260
2005	1,260	1,260	1,260	1,259	1,259	1,259	1,259	1,259	1,259	1,258	1,258	1,258
2006	1,258	1,258	1,258	1,258	1,258	1,258	1,257	1,257	1,257	1,257	1,257	1,257
2007	1,257	1,257	1,257	1,257	1,257	1,258	1,258	1,258	1,258	1,258	1,258	1,258
2008	1,258	1,258	1,258	1,257	1,257	1,257	1,257	1,257	1,257	1,256	1,256	1,256
2009	1,256	1,257	1,257	1,258	1,258	1,259	1,259	1,259	1,260	1,260	1,261	1,261
2010	1,261	1,260	1,260	1,260	1,259	1,259	1,259	1,258	1,258	1,258	1,257	1,257
2011	1,257	1,258	1,258	1,259	1,259	1,260	1,260	1,260	1,261	1,261	1,262	1,262
2012	1,262	1,262	1,262	1,261	1,261	1,261	1,261	1,261	1,261	1,260	1,260	1,260
2013	1,260	1,259	1,259	1,259	1,258	1,258	1,258	1,257	1,257	1,257	1,256	1,256
2014	1,256	1,257	1,257	1,258	1,258	1,259	1,259	1,259	1,260	1,260	1,261	

BUS Outside City Services

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	620	621	621	622	623	624	624	625	626	627	627	628
2001	628	628	628	628	628	628	628	628	628	628	628	628
2002	628	628	628	628	628	629	629	629	629	629	629	629
2003	629	629	628	628	628	628	627	627	627	627	626	626
2004	626	626	626	626	626	626	626	626	626	626	626	626
2005	626	626	625	625	625	625	624	624	624	624	623	623
2006	624	624	625	625	626	626	627	627	628	628	629	629
2007	629	628	628	627	627	626	626	625	625	624	624	623
2008	623	623	623	623	623	623	622	622	622	622	622	622
2009	622	623	623	624	624	625	625	625	626	626	627	627
2010	627	627	627	627	627	628	628	628	628	628	628	628
2011	628	628	628	628	628	628	628	628	628	628	628	628
2012	629	629	630	630	631	631	632	632	633	633	634	634
2013	634	634	634	634	634	634	633	633	633	633	633	633
2014	634	634	635	635	636	637	637	638	638	639	639	

BUS Inside City Plumbing Code Water Savings Since 2000 (CCF/Service)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	2.4
2002	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.8
2003	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	7.2
2004	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	9.4
2005	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.1	11.6
2006	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	13.6
2007	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	15.6
2008	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5	17.4
2009	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	19.2
2010	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	21.0
2011	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0	22.8
2012	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	24.6
2013	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.3	2.3	2.3	26.5
2014	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3		25.1

BUS Outside City Plumbing Code Water Savings Since 2000 (CCF/Service)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	2.4
2002	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4.8
2003	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	7.1
2004	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	9.3
2005	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1	11.5
2006	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	13.5
2007	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	15.4
2008	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	17.3
2009	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	19.1
2010	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	20.7
2011	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.0	22.6
2012	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1	24.2
2013	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	25.9
2014	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2		24.4

BUS Inside City Avg Use (CCF/Service)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	31.0	33.1	34.3	37.3	42.4	45.1	45.7	46.1	41.2	38.6	34.9	32.3	462.1
2001	33.2	33.8	32.5	35.3	44.4	48.1	43.7	43.0	41.1	38.3	32.6	30.3	456.4
2002	26.9	27.8	35.0	39.2	40.5	42.6	40.3	42.0	40.6	37.1	32.5	30.1	434.5
2003	29.6	30.9	31.8	34.6	39.2	40.8	43.8	49.5	43.9	34.1	28.6	28.5	435.2
2004	29.9	35.8	36.0	34.8	42.1	45.0	44.0	40.8	32.8	31.9	30.3	33.1	436.6
2005	38.1	34.8	28.7	29.8	37.7	37.3	44.8	46.5	39.4	35.7	32.6	31.2	436.6
2006	27.4	31.9	27.6	26.0	40.1	40.0	48.3	45.0	37.1	35.0	28.1	29.3	415.8
2007	27.9	33.3	30.4	31.1	36.7	43.4	53.1	48.3	41.0	35.0	24.9	27.1	432.2
2008	30.4	29.8	32.4	32.3	34.3	38.8	43.4	39.9	34.6	32.4	27.4	25.5	401.1
2009	25.6	24.6	27.1	29.6	31.7	34.1	38.1	39.3	34.1	29.7	25.3	23.8	363.0
2010	26.4	24.5	24.4	27.1	30.5	34.5	37.2	37.0	33.3	29.4	25.0	22.2	351.5
2011	24.1	23.4	23.2	27.3	30.1	32.3	36.7	36.4	32.0	28.8	26.2	25.2	345.7
2012	25.1	25.5	26.0	27.0	29.9	35.0	38.4	37.5	34.0	30.7	27.8	25.4	362.4
2013	25.1	24.6	26.9	29.3	33.2	37.3	39.0	38.3	35.0	33.3	30.6	27.9	380.6
2014	27.1	25.1	27.2	29.8	30.8	32.7	34.2	32.5	29.3	27.3	24.2		320.4

BUS Outside City Avg Use (CCF/Service)

	Month												
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Annual**
2000	43.5	43.8	45.2	50.3	54.0	56.6	60.2	58.1	59.1	52.0	48.5	45.5	616.6
2001	42.8	40.2	40.1	47.2	52.8	55.0	57.9	56.4	57.9	51.9	48.7	44.6	595.7
2002	41.9	42.7	43.8	47.7	51.2	55.2	59.5	58.3	60.0	51.2	45.1	40.8	597.3
2003	38.0	38.4	39.3	41.4	44.0	51.0	56.9	53.6	53.1	46.1	42.4	39.0	543.2
2004	36.3	37.9	40.8	47.3	51.8	54.3	58.7	57.7	57.7	49.1	44.6	42.8	579.1
2005	41.9	38.1	35.4	41.0	46.8	49.6	52.8	51.4	53.3	47.7	44.7	39.6	542.5
2006	35.3	34.2	34.3	38.4	42.3	47.4	51.8	49.6	51.3	45.5	41.4	37.7	509.2
2007	35.8	36.1	36.8	39.4	42.0	45.8	49.4	46.9	47.6	42.9	41.3	38.1	502.1
2008	34.9	33.3	33.3	39.6	55.9	55.0	36.0	37.9	61.1	56.3	35.7	33.8	512.6
2009	31.8	30.7	34.8	39.3	42.0	43.9	44.2	45.5	38.8	36.1	31.6	29.3	448.0
2010	29.4	30.1	30.8	31.2	36.7	41.9	41.8	42.7	37.3	34.8	29.8	27.4	414.0
2011	27.2	27.7	30.5	33.6	36.4	38.8	41.0	44.0	37.7	34.9	32.0	31.8	415.6
2012	30.7	29.9	31.7	33.8	39.3	43.9	42.5	43.2	38.7	37.1	33.2	31.5	435.4
2013	30.9	31.6	34.9	38.2	41.4	43.2	41.7	42.6	39.6	40.5	36.5	32.7	453.8
2014	30.0	35.0	40.0	31.9	34.2	36.7	36.0	34.8	33.6	31.9	28.3		372.4

BUS Inside City Adjusted Avg Use (CCF/Service)

	Month												
Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
2000	31.0	33.1	34.3	37.3	42.4	45.1	45.7	46.1	41.2	38.6	34.9	32.3	462.1
2001	33.2	33.9	32.6	35.5	44.6	48.3	43.9	43.3	41.3	38.6	32.9	30.7	458.9
2002	27.3	28.2	35.4	39.5	40.9	43.0	40.7	42.5	41.0	37.5	32.9	30.5	439.4
2003	30.0	31.4	32.3	35.1	39.8	41.4	44.4	50.1	44.5	34.8	29.3	29.2	442.4
2004	30.7	36.6	36.7	35.5	42.9	45.8	44.8	41.6	33.6	32.7	31.1	33.9	446.0
2005	39.0	35.6	29.6	30.7	38.6	38.2	45.8	47.5	40.5	36.7	33.7	32.3	448.2
2006	28.5	33.0	28.8	27.1	41.2	41.1	49.4	46.2	38.3	36.2	29.3	30.5	429.4
2007	29.1	34.5	31.7	32.4	37.9	44.7	54.4	49.6	42.3	36.3	26.3	28.5	447.8
2008	31.8	31.2	33.8	33.7	35.7	40.3	44.9	41.3	36.1	33.8	28.8	27.0	418.5
2009	27.1	26.1	28.7	31.2	33.3	35.7	39.7	40.9	35.7	31.4	27.0	25.5	382.2
2010	28.1	26.2	26.1	28.8	32.3	36.2	38.9	38.8	35.1	31.1	26.8	24.0	372.5
2011	25.9	25.2	25.0	29.2	31.9	34.2	38.6	38.3	34.0	30.8	28.2	27.2	368.6
2012	27.1	27.6	28.0	29.1	31.9	37.1	40.5	39.6	36.0	32.7	29.9	27.5	387.0
2013	27.3	26.7	29.0	31.5	35.4	39.5	41.2	40.6	37.2	35.6	32.9	30.2	407.0
2014	29.4	27.4	29.5	32.0	33.1	35.0	36.5	34.8	31.6	29.6	26.5		345.5

BUS Outside City Adjusted Avg Use (CCF/Service)

	Month												
Year	1	2	3	4	5	6	7	8	9	10	11	12	Annual
2000	43.5	43.8	45.2	50.3	54.0	56.6	60.2	58.1	59.1	52.0	48.5	45.5	616.6
2001	42.9	40.3	40.2	47.3	53.0	55.2	58.2	56.7	58.2	52.2	49.1	44.9	598.1
2002	42.2	43.0	44.2	48.1	51.6	55.6	59.9	58.7	60.4	51.6	45.5	41.3	602.1
2003	38.5	38.9	39.8	41.9	44.6	51.6	57.5	54.2	53.7	46.8	43.2	39.7	550.3
2004	37.1	38.6	41.6	48.0	52.6	55.1	59.5	58.5	58.5	49.9	45.5	43.6	588.5
2005	42.8	39.0	36.3	41.9	47.7	50.5	53.8	52.4	54.4	48.8	45.8	40.7	554.0
2006	36.4	35.3	35.4	39.5	43.4	48.5	52.9	50.8	52.4	46.7	42.5	38.8	522.6
2007	37.0	37.3	38.0	40.6	43.2	47.0	50.7	48.2	48.9	44.3	42.7	39.5	517.5
2008	36.3	34.7	34.7	41.0	57.3	56.4	37.4	39.3	62.6	57.8	37.2	35.3	530.0
2009	33.3	32.2	36.3	40.8	43.6	45.5	45.8	47.1	40.4	37.8	33.3	30.9	467.1
2010	31.1	31.8	32.5	32.9	38.4	43.7	43.6	44.4	39.1	36.6	31.5	29.2	434.8
2011	29.0	29.5	32.4	35.4	38.3	40.7	42.9	45.9	39.7	36.8	34.0	33.8	438.2
2012	32.7	31.9	33.7	35.8	41.4	45.9	44.5	45.2	40.7	39.1	35.3	33.5	459.6
2013	33.0	33.7	37.0	40.3	43.6	45.4	43.9	44.8	41.8	42.7	38.7	35.0	479.7
2014	32.3	37.2	42.2	34.1	36.4	38.9	38.2	37.0	35.8	34.1	30.5		396.8

ATTACHMENT 5 MODEL ESTIMATION RESULTS

Single Family Customer Class Model

Heteroscedastic and auto-correlation consistent standard errors reported in parentheses.

	Dependent variable: ln.adj.use
geooutside	0.061 (0.018)***
fmonthFeb	-0.013 (0.010)
fmonthMar	0.014 (0.015)
fmonthApr	0.159 (0.015)***
fmonthMay	0.451 (0.021)***
fmonthJun	0.564 (0.021)***
fmonthJul	0.632 (0.022)***
fmonthAug	0.615 (0.023)***
fmonthSep	0.550 (0.018)***
fmonthOct	0.360 (0.017)***
fmonthNov	0.143 (0.014)***
fmonthDec	0.053 (0.009)***
temp.nov.mar	0.203 (0.091)**
temp.apr.jun	0.422 (0.204)**
temp.jul.oct	0.636 (0.191)***
rain.nov.mar	-0.016 (0.009)*
rain.apr.jun	-0.069 (0.014)***
rain.jul.oct	-0.040 (0.020)**
ln.rain.dev.lag1	-0.034 (0.006)***
ln.rain.dev.lag2	-0.026 (0.007)***
ln.price.winter	-0.075 (0.010)***
ln.price.summer	-0.139 (0.017)***
ln.hh.inc	0.228 (0.076)***
drght.stage1	-0.051 (0.019)***
drght.stage2	-0.071 (0.017)***
drght.stage3	-0.431 (0.019)***
geooutside:ln.price.summer	0.020 (0.009)**
Constant	-0.605 (0.845)
Observations	358
R2	0.923
Adjusted R2	0.917
Residual Std. Error	0.064 (df = 330)
F Statistic	147.089*** (df = 27; 330)
Note:	*p<0.1; **p<0.05; ***p<0.01

Multi Family Customer Class Model

Heteroscedastic and auto-correlation consistent standard errors reported in parentheses.

	Dependent variable: ln.adj.use
geooutside	0.055 (0.012)***
fmonthFeb	0.009 (0.014)
fmonthMar	-0.006 (0.014)
fmonthApr	0.031 (0.014)**
fmonthMay	0.141 (0.013)***
fmonthJun	0.185 (0.012)***
fmonthJul	0.194 (0.015)***
fmonthAug	0.189 (0.013)***
fmonthSep	0.150 (0.012)***
fmonthOct	0.111 (0.011)***
fmonthNov	0.033 (0.015)**
fmonthDec	-0.001 (0.013)
temp.nov.mar	0.100 (0.066)
temp.apr.jun	0.338 (0.099)***
temp.jul.oct	-0.037 (0.089)
rain.nov.mar	0.001 (0.005)
rain.apr.jun	-0.020 (0.009)**
rain.jul.oct	-0.018 (0.008)**
ln.price	-0.124 (0.029)***
ln.vac.cap.dev	-0.164 (0.058)***
drght.stage1	-0.009 (0.010)
drght.stage2	-0.028 (0.008)***
drght.stage3	-0.192 (0.010)***
geooutside:fmonthFeb	-0.030 (0.017)*
geooutside:fmonthMar	0.002 (0.021)
geooutside:fmonthApr	0.051 (0.017)***
geooutside:fmonthMay	0.018 (0.016)
geooutside:fmonthJun	0.022 (0.018)
geooutside:fmonthJul	0.044 (0.017)***
geooutside:fmonthAug	0.031 (0.016)**
geooutside:fmonthSep	0.057 (0.018)***
geooutside:fmonthOct	0.017 (0.014)
geooutside:fmonthNov	0.041 (0.016)**
geooutside:fmonthDec	0.033 (0.014)**
Constant	1.726 (0.035)***
Observations	351
R2	0.909
Adjusted R2	0.900
Residual Std. Error	0.035 (df = 316)
F Statistic	93.266*** (df = 34; 316)
Note:	*p<0.1; **p<0.05; ***p<0.01

Business Customer Class Model

Heteroscedastic and auto-correlation consistent standard errors reported in parentheses.

	Dependent variable: ln.adj.use
geooutside	0.486 (0.048)***
fmonthFeb	0.033 (0.017)*
fmonthMar	0.048 (0.017)***
fmonthApr	0.116 (0.015)***
fmonthMay	0.250 (0.016)***
fmonthJun	0.330 (0.015)***
fmonthJul	0.396 (0.017)***
fmonthAug	0.380 (0.018)***
fmonthSep	0.273 (0.015)***
fmonthOct	0.172 (0.014)***
fmonthNov	0.044 (0.020)**
fmonthDec	-0.005 (0.020)
temp.nov.mar	0.243 (0.103)**
temp.apr.jun	0.400 (0.193)**
temp.jul.oct	-0.135 (0.121)
rain.nov.mar	0.001 (0.007)
rain.apr.jun	-0.034 (0.013)***
rain.jul.oct	-0.028 (0.010)***
rain.lag1.apr.jun	-0.017 (0.008)**
ln.price	-0.099 (0.017)***
ln.unemp.rate.dev.city	-0.160 (0.011)***
drght.stage3	-0.123 (0.008)***
geooutside:fmonthFeb	-0.037 (0.021)*
geooutside:fmonthMar	-0.021 (0.026)
geooutside:fmonthApr	0.010 (0.020)
geooutside:fmonthMay	-0.037 (0.022)*
geooutside:fmonthJun	-0.031 (0.023)
geooutside:fmonthJul	-0.064 (0.022)***
geooutside:fmonthAug	-0.067 (0.024)***
geooutside:fmonthSep	0.007 (0.024)
geooutside:fmonthOct	0.018 (0.020)
geooutside:fmonthNov	0.062 (0.025)**
geooutside:fmonthDec	0.040 (0.022)*
geooutside:ln.price	-0.163 (0.028)***
geooutside:drght.stage3	-0.068 (0.011)***
Constant	3.488 (0.023)***
Observations	353
R2	0.948
Adjusted R2	0.942
Residual Std. Error	0.047 (df = 317)
F Statistic	163.460*** (df = 35; 317)

Municipal Customer Class Model

Heteroscedastic and auto-correlation consistent standard errors reported in parentheses.

	Dependent variable: ln.use
fmonthFeb	-0.025 (0.040)
fmonthMar	0.101 (0.057)*
fmonthApr	0.767 (0.052)***
fmonthMay	1.214 (0.049)***
fmonthJun	1.424 (0.046)***
fmonthJul	1.553 (0.040)***
fmonthAug	1.579 (0.041)***
fmonthSep	1.360 (0.045)***
fmonthOct	1.061 (0.042)***
fmonthNov	0.521 (0.039)***
fmonthDec	0.087 (0.034)**
eto.nov.mar	0.516 (0.138)***
eto.apr.jun	0.804 (0.242)***
eto.jul.oct	0.357 (0.107)***
rain.nov.mar	0.037 (0.036)
rain.apr.jun	-0.147 (0.050)***
rain.jul.oct	0.006 (0.038)
ln.rain.dev.lag1	-0.097 (0.019)***
ln.rain.dev.lag2	-0.063 (0.019)***
ln.price	-0.237 (0.063)***
ln.unemp.rate.dev.city	-0.142 (0.046)***
drght.stage2	-0.108 (0.034)***
drght.stage3	-0.621 (0.035)***
Constant	2.645 (0.076)***
Observations	177
R2	0.957
Adjusted R2	0.951
Residual Std. Error	0.137 (df = 153)
F Statistic	149.772*** (df = 23; 153)
Note:	*p<0.1; **p<0.05; ***p<0.01

Irrigation Customer Class Model

Heteroscedastic and auto-correlation consistent standard errors reported in parentheses.

	Dependent variable:
	ln.use
geooutside	0.150 (0.034)***
fmonthFeb	0.058 (0.039)
fmonthMar	0.380 (0.076)***
fmonthApr	1.256 (0.069)***
fmonthMay	1.697 (0.052)***
fmonthJun	1.938 (0.045)***
fmonthJul	2.028 (0.046)***
fmonthAug	1.992 (0.046)***
fmonthSep	1.920 (0.048)***
fmonthOct	1.614 (0.049)***
fmonthNov	1.073 (0.043)***
fmonthDec	0.479 (0.053)***
eto.nov.mar	0.509 (0.207)**
eto.apr.jun	0.660 (0.243)***
eto.jul.oct	0.163 (0.184)
rain.nov.mar	-0.044 (0.049)
rain.apr.jun	-0.116 (0.065)*
rain.jul.oct	-0.085 (0.040)**
ln.rain.dev.lag1	-0.166 (0.025)***
ln.rain.dev.lag2	-0.090 (0.021)***
ln.price	-0.545 (0.069)***
drght.stage1	-0.077 (0.048)
drght.stage2	-0.250 (0.044)***
drght.stage3	-0.930 (0.081)***
Constant	2.681 (0.080)***
Observations	358
R2	0.922
Adjusted R2	0.916
Residual Std. Error	0.216 (df = 333)
F Statistic	164.036*** (df = 24; 333)
Note:	*p<0.1; **p<0.05; ***p<0.01

Golf Customer Class Model

Heteroscedastic and auto-correlation consistent standard errors reported in parentheses.

	Dependent variable: ln.use
geooutside	7.105 (0.201)***
fmonthFeb	-0.242 (0.129)*
fmonthMar	-0.006 (0.100)
fmonthApr	9.812 (0.225)***
fmonthMay	11.174 (0.177)***
fmonthJun	11.845 (0.159)***
fmonthJul	12.018 (0.165)***
fmonthAug	12.098 (0.166)***
fmonthSep	11.876 (0.161)***
fmonthOct	11.448 (0.161)***
fmonthNov	10.043 (0.147)***
fmonthDec	8.628 (0.245)***
ln.eto.nov.mar	1.135 (0.329)***
ln.eto.apr.jun	0.173 (0.452)
ln.eto.jul.oct	0.792 (0.228)***
ln.rain.nov.mar	-0.129 (0.083)
ln.rain.apr.jun	-0.441 (0.140)***
ln.rain.jul.oct	-0.038 (0.055)
ln.rain.dev.lag1	-0.546 (0.060)***
ln.rain.dev.lag2	-0.074 (0.047)
ln.price.summer	-0.358 (0.098)***
drght.stage3	-0.319 (0.064)***
geooutside:fmonthFeb	0.749 (0.255)***
geooutside:fmonthMar	0.896 (0.275)***
geooutside:fmonthApr	-6.721 (0.297)***
geooutside:fmonthMay	-7.186 (0.277)***
geooutside:fmonthJun	-7.384 (0.258)***
geooutside:fmonthJul	-7.400 (0.263)***
geooutside:fmonthAug	-7.408 (0.258)***
geooutside:fmonthSep	-7.397 (0.262)***
geooutside:fmonthOct	-7.287 (0.256)***
geooutside:fmonthNov	-6.698 (0.232)***
geooutside:fmonthDec	-6.703 (0.332)***
geooutside:ln.price.summer	0.364 (0.124)***
Constant	-6.701 (0.103)***
Observations	332
R2	0.989
Adjusted R2	0.988
Residual Std. Error	0.367 (df = 297)
F Statistic	805.493*** (df = 34; 297)
Note:	*p<0.1; **p<0.05; ***p<0.01

ATTACHMENT 6 MONTHS DROUGHT STAGES IN EFFECT

Drought Stage 1: 0 = Not In Effect, 1 = In Effect

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	1	1	1	1	1	1	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	1	1	1	1	1	1	0	0
2013	0	0	0	0	1	1	1	1	1	1	1	1
2014	1	1	1	1	0	0	0	0	0	0	0	

Drought Stage 2: 0 = Not In Effect, 1 = In Effect

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	1	1	1	1	1	1	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	

Drought Stage 3: 0 = Not In Effect, 1 = In Effect

	Month											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	1	1	1	1	1	1	1	

ATTACHMENT 7 WATER RATE AND INCOME FORECASTS

Forecasted Increase in Water Rates

Year	Caltrans Inflation Rate Forecast	% Change in Water Rate	% Change Net of Inflation	Real Water Rate Index	% Change from 2014
2014	2.8%			100.0	
2015	3.3%	10.0%	6.7%	106.7	6.7%
2016	3.2%	10.0%	6.8%	114.0	14.0%
2017	2.4%	10.0%	7.6%	122.6	22.6%
2018	2.3%	10.0%	7.7%	132.1	32.1%
2019	2.4%	10.0%	7.6%	142.1	42.1%
2020	2.3%	4.4%	2.1%	145.1	45.1%
2021	2.5%	4.4%	1.9%	148.0	48.0%
2022	2.6%	4.4%	1.8%	150.7	50.7%
2023	2.5%	4.4%	1.9%	153.6	53.6%
2024	2.5%	4.4%	1.9%	156.6	56.6%
2025	2.5%	4.4%	1.9%	159.7	59.7%
2026	2.5%	4.4%	1.9%	162.8	62.8%
2027	2.5%	4.4%	1.9%	166.0	66.0%
2028	2.5%	4.4%	1.9%	169.2	69.2%
2029	2.5%	4.4%	1.9%	172.5	72.5%
2030	2.5%	4.4%	1.9%	175.9	75.9%
2031	2.5%	4.4%	1.9%	179.3	79.3%
2032	2.5%	4.4%	1.9%	182.8	82.8%
2033	2.5%	4.4%	1.9%	186.3	86.3%
2034	2.5%	4.4%	1.9%	190.0	90.0%
2035	2.5%	4.4%	1.9%	193.7	93.7%

The forecasted nominal annual percentage change in water rate for 2014-2019 is from the Water Department. The forecasted nominal annual percentage change in water rate from 2020-2035 is set to the long-term annual rate of increase in the BLS Consumer Price Index for Water, Sewer, and Solid Waste Services (http://data.bls.gov/timeseries/CUSR0000SEHG). The source of the Caltrans inflation rate forecast for Santa Cruz County is:
http://www.dot.ca.gov/hq/tpp/offices/eab/socio_economic_files/2014/SantaCruz.pdf#zoom=75

Forecasted Increase in Income

Year	Caltrans Real Per Capita Income Forecast	% Change from 2014
2014	$56,085	
2015	$57,661	2.8%
2016	$59,004	5.2%
2017	$60,267	7.5%
2018	$61,653	9.9%
2019	$62,994	12.3%
2020	$64,379	14.8%
2021	$65,679	17.1%
2022	$66,829	19.2%
2023	$67,986	21.2%
2024	$69,191	23.4%
2025	$70,394	25.5%
2026	$71,482	27.5%
2027	$72,552	29.4%
2028	$73,614	31.3%
2029	$74,679	33.2%
2030	$75,749	35.1%
2031	$76,826	37.0%
2032	$77,844	38.8%
2033	$78,920	40.7%
2034	$80,043	42.7%
2035	$81,138	44.7%

The source of the Caltrans forecasted increase in real per capita income for Santa Cruz County is:

http://www.dot.ca.gov/hq/tpp/offices/eab/socio_economic_files/2014/SantaCruz.pdf#zoom=75

While per capita income is projected to grow over the forecast period, it is less clear that median household income will exhibit similar growth. According to Census data, median household income in Santa Cruz County after adjusting for inflation has been stagnant to declining since 1989. Consequently, the demand forecasts hold median household income constant at the 2013 level in the single family forecast.

Santa Cruz County, CA

Median Household Income

Year	Nominal	CPI	Inflator	2013 $
1989	$37,112	128.000	1.8877	$70,056

1999	$53,998	168.500	1.4340	$77,431
2005	$58,640	202.600	1.1926	$69,935
2009	$64,349	224.110	1.0781	$69,378
2010	$65,253	226.919	1.0648	$69,481
2013	$66,519	241.623	1.0000	$66,519

Source: US Census and ACS

ATTACHMENT 8 PLUMBING CODE AND PROGRAM A SAVINGS FORECASTS

Forecasts of plumbing code water savings, Program A water savings, and allocation of Program A savings to customer classes were produced by Maddaus Water Management's DSS model.

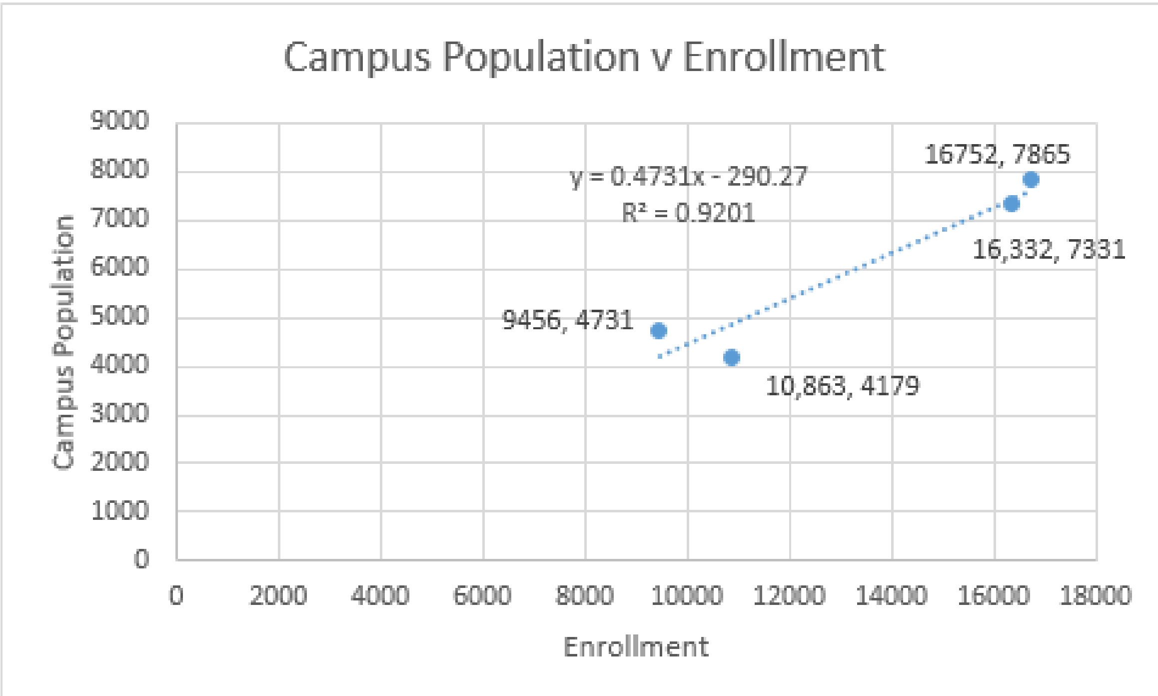
	SFR Code Savings, 2013 Base Year			
Year	MG/Yr	CCF/Yr	Services	CCF/Service
2020	32.7	43,717	19559	2.2
2025	68.0	90,909	19907	4.6
2030	103.3	138,102	20256	6.8
2035	124.7	166,711	20256	8.2
	SFR Prog A Savings, 2013 Base Year			
Year	MG/Yr	CCF/Yr	Services	CCF/Service
2020	55.8	74,663	19559	3.8
2025	61.6	82,393	19907	4.1
2030	59.8	79,932	20256	3.9
2035	57.2	76,533	20256	3.8
	MFR Code Savings, 2013 Base Year			
Year	MG/Yr	CCF/Yr	Services	CCF/Service
2020	29.6	39,544	18867	2.1
2025	58.6	78,394	19430	4.0
2030	87.7	117,286	20416	5.7
2035	103.2	137,991	21174	6.5
	MFR Prog A Savings, 2013 Base Year			
Year	MG/Yr	CCF/Yr	Services	CCF/Service
2020	33.0	44,082	18867	2.3
2025	50.9	68,078	19430	3.5
2030	48.0	64,205	20416	3.1
2035	45.7	61,048	21174	2.9
	BUS Code Savings, 2013 Base Year			
Year	MG/Yr	CCF/Yr	Services	CCF/Service
2020	3.1	4,110	2373	1.7
2025	4.9	6,498	2494	2.6
2030	6.3	8,477	2621	3.2
2035	6.9	9,249	2755	3.4
	BUS Prog A Savings, 2013 Base Year			
Year	MG/Yr	CCF/Yr	Services	CCF/Service
2020	18.4	24,557	2373	10.3
2025	28.1	37,553	2494	15.1
2030	28.5	38,047	2621	14.5
2035	28.3	37,848	2755	13.7

Program A Savings Allocation to Customer Classes

		Class Shares (%)				
Year	Total (MG)	SFR	MFR	BUS	MUN	IND
2020	110	51%	30%	17%	2%	0%
2025	143	43%	36%	20%	1%	0%
2030	139	43%	35%	21%	1%	0%
2035	134	43%	34%	21%	1%	0%

ATTACHMENT 9 UCSC CAMPUS POPULATION FORECAST

Data on enrollment and campus population were collected for 1990, 2000, 2010, and 2013. Enrollment data are from UCSC. Population data are for Census Tract 1004. The enrollment data are from University of California Office of the President. The relationship between enrollment and campus population is shown in the following figure.



The average gain in population per one student gain in enrollment over this period was 0.47. Over the 23 year period considered, campus population has averaged about 45% of total enrollment. According to the UCSC Long Range Development Plan (LRDP, p. 71), future campus development will maintain or possibly increase this ratio. The campus population forecast used for this report assumes the rate of campus population gain is the same as show in the figure above, resulting in the following campus population forecast.

UCSC	**2010**	**2020**	**2025**	**2030**	**2035**
AMBAG UCSC Enrollment Projection	16,300	19,500	21,100	22,700	24,300
Gain		3,200	4,800	6,400	8,000
Projected Campus Population	7,331	8,845	9,602	10,359	11,116
Gain		1,514	2,271	3,028	3,785

ATTACHMENT 10 INDUSTRIAL DEMAND FORECAST MODEL

Year	Industrial Water Use (CCF)	County Mfg Empl	Recovery Dummy
2003	54623	7000	0
2004	59656	7400	0
2005	53384	7200	0
2006	49297	6700	0
2007	51018	6400	0
2008	42607	6100	0
2009	32753	5300	0
2010	56145	5300	1
2011	60782	5400	1
2012	72070	5600	1
2013	74451	5800	1

Model: use = constant + recovery.dummy + employment + employment x recovery.dummy

```
===============================================
                        Dependent variable:
                    ---------------------------
                                use
-----------------------------------------------
recovery.dum        -116,651.400 (38,297.110)**
emp                      11.863 (1.451)***
recovery.dum:emp         26.434 (6.861)***
Constant             -29,081.030 (9,608.094)**
-----------------------------------------------
Observations                    11
R2                            0.967
Adjusted R2                   0.953
Residual Std. Error    2,575.436 (df = 7)
F Statistic          69.305*** (df = 3; 7)
===============================================
Note:               *p<0.1; **p<0.05; ***p<0.01
```

M.CUBED
POLICY ANALYSIS FOR THE PUBLIC AND PRIVATE SECTORS

5358 MILES AVENUE
OAKLAND, CA 94618
PH: 510-547-4369
FX: 510-547-3002
MITCHELL@MCUBED-ECON.COM

DATE: March 30, 2016
TO: Toby Goddard, City of Santa Cruz
FR: David Mitchell
RE: Effect of Temperature on City of Santa Cruz Water Demands

Summary

This memorandum presents estimates of the expected percentage change in demand per a 1 degree F change in monthly average maximum daily air temperature. These estimates are shown in Table 1. Per the table, a 1 degree F increase in monthly average maximum daily air temperature would be expected to increase SFR demand by 0.62 percent, but golf course demand by 1.38 percent. Total system demand would be expected to increase by 0.45 percent.

The estimates in Table 1 assume a 1 degree F increase from the long-term average in monthly average maximum daily air temperature across all twelve months. Thus it is the average change across the entire year given a uniform increase in temperature. The expected change in demand for specific months would differ from the estimates in Table 1, being generally higher in the spring and fall and lower in the winter.

Table 1. Expected % Change in Demand per 1 Degree F Change in Monthly Average Maximum Daily Air Temperature

Customer Category	% change in demand per 1 degree F
SFR	0.62
MFR	0.19
BUS	0.29
MUN	1.09
IRR	0.80
GOLF	1.38
IND	0.00
Weighted Average	0.45

Estimation

The following analytical steps were taken to develop the estimates in Table 1.

Step 1: Estimate relationship between temperature, rainfall, and ETo

Weather effects for City of Santa Cruz water demand were estimated econometrically. For the residential and business customer categories, the weather effects were measured based on deviations in rainfall and temperature from their 25-year normal. However, for the municipal, irrigation, and golf course customer categories, ETo was used instead of temperature. It therefore is necessary to translate a 1 degree F change in temperature to the corresponding change in ETo. This was done by regressing rainfall and temperature against ETo for each month to get the average change in monthly ETo per 1 degree change in temperature. The results are shown in Table 2.

Table 2. Change in ETo per 1 Degree F Change in Temperature

Month	**Mean Monthly Value**		**Change in ETo per Degree Change in Temp**
	Max Daily Temp F	ETo Inches	
Jan	60.6	1.63	0.0478
Feb	61.2	2.03	0.0000
Mar	63.9	3.56	0.0485
Apr	66.4	4.42	0.0760
May	69.7	5.18	0.1064
Jun	72.4	5.48	0.1233
Jul	72.8	5.16	0.0648
Aug	74.7	4.85	0.0623
Sep	74.4	3.93	0.1322
Oct	71.7	2.98	0.0828
Nov	65.0	1.80	0.0491
Dec	59.4	1.35	0.0560

Step 2: Estimate % Change in Demand per 1 Degree F Change in Temp by Month and Customer Category

The next step was to use the results of the econometric demand models to estimate the percentage change in demand given a 1 degree F change in monthly average maximum daily air temperature by month and by customer category.

If all variables in the econometric demand models other than temperature or ETo are assumed constant, a customer category's expected monthly demand can be represented as:

$$y = kx^{\beta}$$

where y is expected monthly demand, x is temperature or ETo, k is a constant, and β is the econometrically estimated parameter for temperature or ETo.

Let $\bar{x}$ be the 25-year normal for monthly average maximum daily air temperature or ETo. Then for the residential and business demand categories, the expected percentage change in monthly demand given a 1 degree F increase in the 25-year normal temperature is given by

$$\frac{y_1 - y_0}{y_0} = \frac{k(\bar{x}+1)^{\beta} - k\bar{x}^{\beta}}{k\bar{x}^{\beta}} = \left(\frac{\bar{x}+1}{\bar{x}}\right)^{\beta} - 1$$

For the customer categories that utilize ETo the 1 degree F increase in temperature must be translated into the corresponding expected change in ETo using the results in Table 2. Denoting the change in ETo by ε, the expected percentage change in monthly demand for these customer categories is given by

$$\frac{y_1 - y_0}{y_0} = \frac{k(\bar{x}+\varepsilon)^\beta - k\bar{x}^\beta}{k\bar{x}^\beta} = \left(\frac{\bar{x}+\varepsilon}{\bar{x}}\right)^\beta - 1$$

The 25-year normals for temperature and ETo used to implement these equations are given in Table 2. The β parameters from the econometric demand models are given in Table 3.

Table 3. β Parameters for Temperature and ETo from Econometric Demand Models

	Temperature			**ETo**		
Month	SFR	MFR	BUS	MUN	IRR	GOLF
Jan	0.203	0.100	0.243	0.516	0.509	1.135
Feb	0.203	0.100	0.243	0.516	0.509	1.135
Mar	0.203	0.100	0.243	0.516	0.509	1.135
Apr	0.422	0.338	0.400	0.804	0.660	0.173
May	0.422	0.338	0.400	0.804	0.660	0.173
Jun	0.422	0.338	0.400	0.804	0.660	0.173
Jul	0.636	0.000	0.000	0.357	0.163	0.792
Aug	0.636	0.000	0.000	0.357	0.163	0.792
Sep	0.636	0.000	0.000	0.357	0.163	0.792
Oct	0.636	0.000	0.000	0.357	0.163	0.792
Nov	0.203	0.100	0.243	0.516	0.509	1.135
Dec	0.203	0.100	0.243	0.516	0.509	1.135

The resulting estimates of the percentage change in demand given a 1 degree F increase in temperature by month and customer category are shown in Table 4.

Table 4. Expected % Change in Demand per 1 Degree F Change in Temperature

Month	**SFR**	**MFR**	**BUS**	**MUN**	**IRR**	**GOLF**
Jan	0.333	0.164	0.399	1.504	1.483	3.338
Feb	0.330	0.162	0.395	0.000	0.000	0.000
Mar	0.316	0.155	0.378	0.700	0.691	1.546
Apr	0.632	0.506	0.599	1.381	1.132	0.295
May	0.603	0.482	0.571	1.647	1.350	0.352
Jun	0.581	0.465	0.550	1.804	1.479	0.385
Jul	0.872	0.000	0.000	0.447	0.204	0.993
Aug	0.850	0.000	0.000	0.457	0.208	1.017
Sep	0.853	0.000	0.000	1.188	0.541	2.655
Oct	0.885	0.000	0.000	0.985	0.448	2.197
Nov	0.310	0.153	0.372	1.400	1.381	3.105
Dec	0.340	0.167	0.407	2.115	2.086	4.710

Step 3: Estimate Annual % Change in Demand per 1 Degree F Change in Temperature for Each Customer Category

The next step is to use each customer categories seasonal demand index to estimate the percentage change in annual demand per 1 degree F change in temperature. The seasonal demand indices for the customer categories were estimated using the econometric demand models and are shown in Table 5.

Table 5. Seasonal Demand Indices

Month	SFR	MFR	BUS	MUN	IRR	GOLF
Jan	6.02	7.62	6.96	3.14	1.97	0.18
Feb	5.94	7.69	7.19	3.06	2.09	0.29
Mar	6.11	7.57	7.30	3.47	2.88	0.43
Apr	7.06	7.86	7.81	6.75	6.92	3.89
May	9.45	8.77	8.94	10.55	10.75	9.54
Jun	10.58	9.17	9.68	13.03	13.69	15.32
Jul	11.33	9.25	10.34	14.81	14.97	17.92
Aug	11.14	9.21	10.18	15.22	14.44	19.26
Sep	10.44	8.85	9.14	12.21	13.44	15.59
Oct	8.63	8.51	8.26	9.06	9.90	11.35
Nov	6.95	7.88	7.27	5.28	5.76	5.02
Dec	6.35	7.61	6.92	3.42	3.18	1.21
Total	100.00	100.00	100.00	100.00	100.00	100.00

Denoting the monthly change in demand from Table 4 for customer category j as d_{ij} and the monthly seasonal index value from Table 5 as s_{ij}, then the percentage change in annual demand for customer category j, D_j, per 1 degree F change in temperature is given by

$$D_j = \frac{1}{100}\sum_{i=1}^{12} d_{ij} \times s_{ij}$$

The results of this calculate for each customer category is given in Table 6.

Table 6. Expected % Change in Demand per 1 Degree F Change in Monthly Average Maximum Daily Air Temperature

Customer Category	% change in demand per 1 degree F
SFR	0.62
MFR	0.19
BUS	0.29
MUN	1.09
IRR	0.80
GOLF	1.38

Step 4: Estimate Annual % Change in Demand per 1 Degree F Change in Temperature for Total Demand

The final step is to construct the consumption-weighted average change in annual demand across all customer categories. This was done using the customer category demand shares given in Table 7.

Table 7. Customer Category Demand Shares

Year	SFR	MFR	BUS	MUN	IRR	GOLF	IND
2001	1486	859	717	63	130	110	342
2002	1503	836	696	60	129	114	233
2003	1502	812	666	64	132	108	247
2004	1521	798	671	55	124	80	229
2005	1424	798	671	55	124	80	229
2006	1359	752	630	53	118	83	236
2007	1357	728	636	59	131	111	238
2008	1374	735	610	66	137	120	240
2009	1217	687	554	46	91	91	185
2010	1185	691	527	49	96	78	227
Total	13928	7696	6378	570	1212	975	2406
% Total	42%	23%	19%	2%	4%	3%	7%

Denoting the annual change in demand from Table 6 for customer category j as D_j and the customer category j's share of demand from Table 7 as δ_j, then the weighted average percentage change in annual demand, D, per 1 degree F change in temperature is given by

$$D = \frac{1}{100}\sum_{j=1}^{7} D_j \times \delta_j$$

In this calculation, it is assumed the temperature effect for the industrial customer category is zero. The resulting value for the percentage change in total demand per 1 degree F increase in temperature is 0.45, as shown in the last row of Table 1.

Calculation Workbook

The calculations described above are provided in the workbook "uwmp_climate_effects_workbook.xlsx."

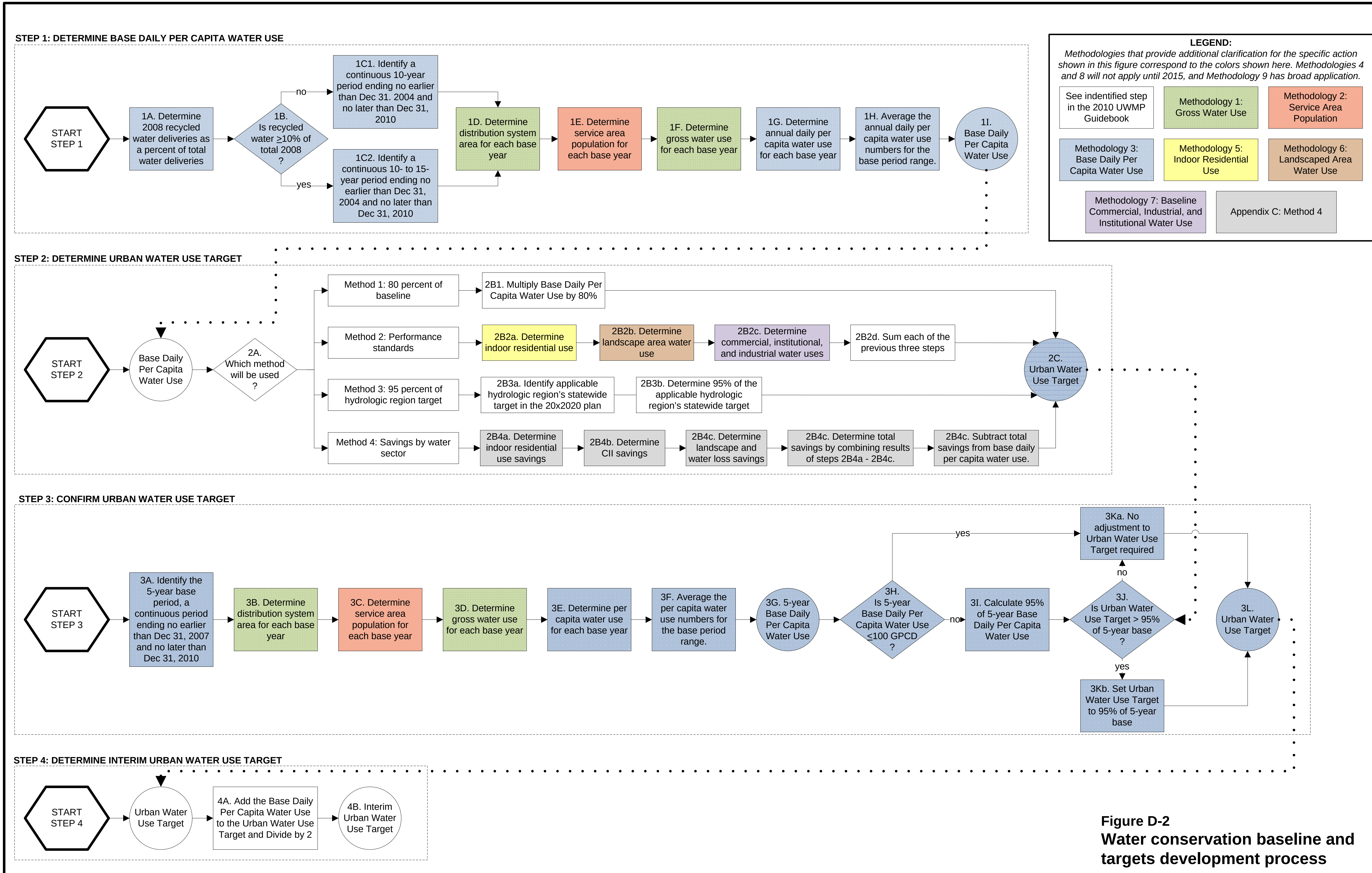


Figure D-2
Water conservation baseline and targets development process

JOINT EXERCISE OF POWERS AGREEMENT

by and among

CENTRAL WATER DISTRICT

CITY OF SANTA CRUZ

COUNTY OF SANTA CRUZ

and

SOQUEL CREEK WATER DISTRICT

creating the

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

March 17, 2016

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JOINT EXERCISE OF POWERS AGREEMENT
OF THE SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

This **Joint Exercise of Powers Agreement ("Agreement")** is made and entered into as of March 17, 2016 ("Effective Date"), by and among the Central Water District, the City of Santa Cruz, the County of Santa Cruz, and the Soquel Creek Water District, sometimes referred to herein individually as a "**Member**" and collectively as the "**Members**" for purposes of forming the Santa Cruz Mid-County Groundwater Agency ("**Agency**") and setting forth the terms pursuant to which the Agency shall operate. Capitalized defined terms used herein shall have the meanings given to them in Article 1 of this Agreement.

RECITALS

A. Each of the Members is a local agency, as defined by the Sustainable Groundwater Management Act of 2014 ("**SGMA**"), duly organized and existing under and by virtue of the laws of the State of California, and each Member can exercise powers related to groundwater management.

B. SGMA requires designation of a groundwater sustainability agency ("**GSA**") by June 30, 2017, for groundwater basins designated by the California Department of Water Resources ("**DWR**") as medium- and high-priority basins.

C. SGMA requires adoption of a groundwater sustainability plan ("**GSP**") by January 31, 2020, for all medium- and high-priority basins identified as being subject to critical conditions of overdraft.

D. Each of the Members either extracts groundwater from or regulates land use activities overlying a common groundwater basin located within the mid-county coastal region of the County of Santa Cruz. This Basin includes all or part of four basins identified in DWR's Bulletin Number 118, including the following basins (designated by the name of the basin and number assigned to it in DWR-Bulletin No. 118): Soquel Valley (3-1), West Santa Cruz Terrace (3-26), Santa Cruz Purisima Formation (3-21), and Pajaro Valley Basin (3-2). All or some of these basins have been designated as medium or high priority basins. Through the Agency, the Members provided modifications to the Bulletin-118 boundaries as allowed by Title 23 of the California Code of Regulations to create a new consolidated basin called the "Santa Cruz Mid-County Groundwater Basin" with 3-1 as the number for the consolidated basin under DWR Bulletin No. 118 (hereafter "**Basin**").

E. The Members intend for the Agency to develop a GSP and manage the Basin pursuant to SGMA.

F. Under SGMA, a combination of local agencies may form a GSA through a joint powers agreement.

G. The Members have determined that the sustainable management of the Basin pursuant to SGMA may best be achieved through the cooperation of the Members operating through a joint powers agency.

H. The Joint Exercise of Powers Act of 2000 ("Act") authorizes the Members to create a joint powers authority, to jointly exercise any power common to the Members, and to exercise additional powers granted under the Act.

I. The Act, including the Marks-Roos Local Bond Pooling Act of 1985 (Government Code sections 6584, *et seq.*), authorizes an entity created pursuant to the Act to issue bonds, and under certain circumstances, to purchase bonds issued by, or to make loans to, the Members for financing public capital improvements, working capital, liability and other insurance needs or projects whenever doing so results in significant public benefits, as determined by the Members. The Act further authorizes and empowers a joint powers authority to sell bonds so issued or purchased to public or private purchasers at public or negotiated sales.

J. The Members have a history of collaborating on groundwater management issues in the Santa Cruz Mid-County Groundwater Basin, originally with a joint powers agreement formed in 1995 by the Soquel Creek Water District and the Central Water District, which was subsequently amended in August of 2015 to include the City of Santa Cruz and the County of Santa Cruz, to form the Soquel-Aptos Groundwater Management Committee.

K. The Members agree that by approving the creation of the Santa Cruz Mid-County Groundwater Agency they are withdrawing from and disbanding the joint powers agency formed as a result of earlier joint powers agreements originally creating the Basin Implementation Group as subsequently amended to create the Soquel-Aptos Groundwater Management Committee.

L. Based on the foregoing legal authority, the Members desire to create a joint powers authority for the purpose of taking all actions deemed necessary by the joint powers authority to ensure sustainable management of the Basin as required by SGMA.

M. The governing board of each Member has determined it to be in the Member's best interest and in the public interest that this Agreement be executed.

TERMS OF AGREEMENT

In consideration of the mutual promises and covenants herein contained, the Members agree as follows:

ARTICLE 1
DEFINITIONS

The following terms have the following meanings for purposes of this Agreement:

1.1 "Act" means the Joint Exercise of Powers Act, set forth in Chapter 5 of Division 7 of Title 1 of the Government Code, sections 6500, *et seq.*, including all laws supplemental thereto.

1.2 "Agreement" has the meaning assigned thereto in the Preamble.

1.3 "Auditor" means the auditor of the financial affairs of the Agency appointed by the Board of Directors pursuant to Section 14.3 of this Agreement.

1.4 "Agency" has the meaning assigned thereto in the Preamble.

1.5 "Basin" has the meaning assigned thereto in Recital D.

1.6 "Board of Directors" or "Board" means the governing body of the Agency as established by Article 6 of this Agreement.

1.7 "Bylaws" means the bylaws, if any, adopted by the Board of Directors pursuant to Article 11 of this Agreement to govern the day-to-day operations of the Agency.

1.8 "Director" and "Alternate Director" mean a director or alternate director appointed pursuant to Sections 6.3 and 6.4 of this Agreement. "Member Director" is a Director or Alternate Director appointed by and representing a Member agency pursuant to Section 6.1.1 of this agreement.

1.9 "DWR" has the meaning assigned thereto in Recital B.

1.10 "GSA" has the meaning assigned thereto in Recital B.

1.11 "GSP" has the meaning assigned thereto in Recital C.

1.12 "Member" means each party to this Agreement that satisfies the requirements of Section 5.1 of this Agreement, including any new members as may be authorized by the Board, pursuant to Section 5.2 of this Agreement.

1.13 "Officer(s)" means the Chair, Vice Chair, Secretary, or Treasurer of the Agency to be appointed by the Board of Directors pursuant to Section 7.1 of this Agreement.

1.14 "SGMA" has the meaning assigned thereto in Recital A.

1.15 "State" means the State of California.

ARTICLE 2
CREATION OF THE AGENCY

2.1 Creation of a Joint Powers Authority. There is hereby created pursuant to the Act a joint powers authority, which will be a public entity separate from the Members to this Agreement, and shall be known as the Santa Cruz Mid-County Joint Powers Agency ("**Agency**"). Within 30 days after the Effective Date of this Agreement and after any amendment, the Agency shall cause a notice of this Agreement or amendment to be prepared and filed with the office of the California Secretary of State containing the information required by Government Code section 6503.5. Within 10 days after the Effective Date of this Agreement, the Agency shall cause a statement of the information concerning the Agency, required by Government Code section 53051, to be filed with the office of the California Secretary of State and with the County Clerk for the County of Santa Cruz, setting forth the facts required to be stated pursuant to Government Code section 53051(a).

2.2 Purpose of the Agency. Each Member to this Agreement has in common the power to study, plan, develop, finance, acquire, construct, maintain, repair, manage, operate, control, and govern the water supply and water management within the Basin, either alone or in cooperation with other public or private non-member entities, and each is a local agency eligible to serve as a GSA within the Basin, either alone or jointly through a joint powers agreement as provided for by SGMA. The purpose of this Agency is to serve as the GSA for the Basin and to develop, adopt, and implement the GSP for the Basin pursuant to SGMA and other applicable provisions of law.

ARTICLE 3
TERM

This Agreement shall become effective upon execution by each of the Members and shall remain in effect until terminated pursuant to the provisions of Article 17 (Withdrawal of Members) of this Agreement.

ARTICLE 4
POWERS

The Agency shall possess the power in its own name to exercise any and all common powers of its Members reasonably related to the purposes of the Agency, including but not limited to the following powers, together with such other powers as are expressly set forth in the Act and in SGMA. For purposes of Government Code section 6509, the powers of the Agency shall be exercised subject to the restrictions upon the manner of exercising such powers as are imposed on the County of Santa Cruz, and in the event of the withdrawal of the County of Santa Cruz as a Member under this Agreement, then the manner of exercising the Agency's powers shall be those restrictions imposed on the City of Santa Cruz.

4.1 To exercise all powers afforded to a GSA pursuant to and as permitted by SGMA.

4.2 To develop, adopt and implement the GSP pursuant to SGMA.

4.3 To adopt rules, regulations, policies, bylaws and procedures governing the operation of the Agency and adoption and implementation of the GSP.

4.4 To obtain rights, permits and other authorizations for or pertaining to implementation of the GSP.

4.5 To perform other ancillary tasks relating to the operation of the Agency pursuant to SGMA, including without limitation, environmental review, engineering, and design.

4.6 To make and enter into all contracts necessary to the full exercise of the Agency's power.

4.7 To employ, designate or otherwise contract for the services of agents, officers, employees, attorneys, engineers, planners, financial consultants, technical specialists, advisors, and independent contractors.

4.8 To exercise jointly the common powers of the Members, as directed by the Board, in developing and implementing a GSP for the Basin.

4.9 To investigate legislation and proposed legislation affecting the Basin and to make appearances regarding such matters.

4.10 To cooperate and to act in conjunction and contract with the United States, the State of California or any agency thereof, counties, municipalities, public and private corporations of any kind (including without limitation, investor-owned utilities), and individuals, or any of them, for any and all purposes necessary or convenient for the full exercise of the powers of the Agency.

4.11 To incur debts, liabilities or obligations, to issue bonds, notes, certificates of participation, guarantees, equipment leases, reimbursement obligations and other indebtedness, and, to the extent provided for in a duly adopted Agency to impose assessments, groundwater extraction fees or other charges, and other means of financing the Agency as provided in Chapter 8 of SGMA commencing at Section 10730 of the Water Code.

4.12 To collect and monitor data on the extraction of groundwater from, and the quality of groundwater in, the Basin.

4.13 To establish and administer a conjunctive use program for the purposes of maintaining sustainable yields in the Basin consistent with the requirements of SGMA.

4.14 To exchange and distribute water.

4.15 To regulate groundwater extractions as permitted by SGMA.

4.16 To impose groundwater extraction fees as permitted by SGMA.

4.17 To spread, sink and inject water into the Basin.

4.18 To store, transport, recapture, recycle, purify, treat or otherwise manage and control water for beneficial use.

4.19 To apply for, accept and receive licenses, permits, water rights, approvals, agreements, grants, loans, contributions, donations or other aid from any agency of the United States, the State of California, or other public agencies or private persons or entities necessary for the Agency's purposes.

4.20 To develop and facilitate market-based solutions for the use and management of water rights.

4.21 To acquire property and other assets by grant, lease, purchase, bequest, devise, gift or eminent domain, and to hold, enjoy, lease or sell, or otherwise dispose of, property, including real property, water rights, and personal property, necessary for the full exercise of the Agency's powers.

4.22 To sue and be sued in its own name.

4.23 To provide for the prosecution of, defense of, or other participation in actions or proceedings at law or in public hearings in which the Members, pursuant to this Agreement, may have an interest and may employ counsel and other expert assistance for these purposes.

4.24 To exercise the common powers of its Members to develop, collect, provide, and disseminate information that furthers the purposes of the Agency, including but not limited to the operation of the Agency and adoption and implementation of the GSP to the Members, legislative, administrative, and judicial bodies, as well the public generally.

4.25 To accumulate operating and reserve funds for the purposes herein stated.

4.26 To invest money that is not required for the immediate necessities of the Agency, as the Agency determines is advisable, in the same manner and upon the same conditions as Members, pursuant to Government Code section 53601, as it now exists or may hereafter be amended.

4.27 To undertake any investigations, studies, and matters of general administration.

4.28 To perform all other acts necessary or proper to carry out fully the purposes of this Agreement.

ARTICLE 5
MEMBERSHIP

5.1 Members. The Members of the Agency shall be the Central Water District, the City of Santa Cruz, the County of Santa Cruz, and the Soquel Creek Water District, as long as they have not, pursuant to the provisions hereof, withdrawn from this Agreement.

5.2 New Members. Any public agency (as defined by the Act) that is not a Member on the Effective Date of this Agreement may become a Member upon: (a) the approval of the Board of Directors by a supermajority of at least seventy-five (75%) of the votes held among all Directors as specified in Article 9 (Member Voting); (b) payment of a pro rata share of all previously incurred costs that the Board of Directors determines have resulted in benefit to the public agency, and are appropriate for assessment on the public agency; and (c) execution of a written agreement subjecting the public agency to the terms and conditions of this Agreement.

ARTICLE 6
BOARD OF DIRECTORS AND OFFICERS

6.1 Formation of the Board of Directors. The Agency shall be governed by a Board of Directors ("**Board**"). The Board shall consist of eleven (11) Directors consisting of the following representatives who shall be appointed in the manner set forth in Section 6.3:

6.1.1 Two representatives appointed by the governing board of each of the following public agency Members: the Central Water District, the City of Santa Cruz, the County of Santa Cruz, and the Soquel Creek Water District.

6.1.2 Three representatives of private well owners within the boundaries of the Agency.

6.2 Duties of the Board of Directors. The business and affairs of the Agency, and all of its powers, including without limitation all powers set forth in Article 4 (Powers), are reserved to and shall be exercised by and through the Board of Directors, except as may be expressly delegated to the staff or others pursuant to this Agreement, Bylaws, or by specific action of the Board of Directors.

6.3 Appointment of Directors. The Directors shall be appointed as follows:

6.3.1 The two representatives from the Central Water District shall be appointed by resolution of the Central Water District Board of Directors.

6.3.2 The two representatives from the City of Santa Cruz shall be appointed by resolution of the City of Santa Cruz City Council.

6.3.3 The two representatives from the County of Santa Cruz shall be appointed by resolution of the County of Santa Cruz Board of Supervisors.

6.3.4 The two representatives from the Soquel Creek Water District shall be appointed by resolution of the Soquel Creek Water District Board of Directors.

6.3.5 The three representatives of private well owners shall be appointed by majority vote of the eight public agency Member Directors. The procedures for nominating the private well owners shall be set forth in the Bylaws.

6.4 Alternate Directors. Each Member may have one Alternate to act as a substitute Director for either of the Member's Directors. One Alternate shall also be appointed to act as a substitute Director for any of the three Directors representing private well owners. All Alternates shall be appointed in the same manner as set forth in Section 6.3. Alternate Directors shall have no vote, and shall not participate in any discussions or deliberations of the Board unless appearing as a substitute for a Director due to absence or conflict of interest. If the Director is not present, or if the Director has a conflict of interest which precludes participation by the Director in any decision-making process of the Board, the Alternate Director appointed to act in his/her place shall assume all rights of the Director, and shall have the authority to act in his/her absence, including casting votes on matters before the Board. Each Alternate Director shall be appointed prior to the third meeting of the Board. Alternates are strongly encouraged to attend all Board meetings and stay informed on current issues before the Board.

6.5 Requirements. Each Member's Directors and Alternate Director shall be appointed by resolution of that Member's governing body to serve for a term of four years except, for the purpose of establishing staggered terms, one of the initially-appointed Directors of each Member shall, as designated by the Member, serve an initial term of two years. A Member's Director or Alternate Director may be removed during his or her term or reappointed for multiple terms at the pleasure of the Member that appointed him or her. A Director representing private well owners may be removed or reappointed in the same manner as he or she was appointed as set forth in Section 6.3. No individual Director may be removed in any other manner, including by the affirmative vote of the other Directors.

6.6 Vacancies. A vacancy on the Board of Directors shall occur when a Director resigns or at the end of the Director's term as set forth in Section 6.5. For Member Directors, a vacancy shall also occur when he or she is removed by his or her appointing Member. For Directors representing private well owners, a vacancy shall also occur when the Director is removed as set forth in Section 6.5. Upon the vacancy of a Director, the Alternate Director shall serve as Director until a new Director is appointed as set forth in Section 6.3 unless the Alternate is already serving as a substitute Director in the event of a prior vacancy, in which case, the seat shall remain vacant until a replacement Director is appointed as set forth in Section 6.3. Members shall provide notice of any changes in Director or Alternate Director positions to the Board of Directors or its designee in writing and signed by an authorized representative of the Member.

ARTICLE 7
OFFICERS

7.1 Officers. Officers of the Agency shall be a Chair, Vice Chair, Secretary, and Treasurer. The Treasurer shall be appointed consistent with the provisions of Section 14.3. The Vice Chair, or in the Vice Chair's absence, the Secretary, shall exercise all powers of the Chair in the Chair's absence or inability to act.

7.2 Appointment of Officers. Officers shall be elected annually by, and serve at the pleasure of, the Board of Directors. Officers shall be elected at the first Board meeting, and thereafter at the first Board meeting following January 1st of each year, or as duly continued by the Board. An Officer may serve for multiple consecutive terms, with no term limit. Any Officer may resign at any time upon written notice to the Board, and may be removed and replaced by a simple majority vote of the Board.

7.3 Principal Office. The principal office of the Agency shall be established by the Board of Directors, and may thereafter be changed by a simple majority vote of the Board.

ARTICLE 8
DIRECTOR MEETINGS

8.1 Initial Meeting. The initial meeting of the Board of Directors shall be held in the County of Santa Cruz, California, within thirty (30) days of the Effective Date of this Agreement.

8.2 Time and Place. The Board of Directors shall meet at least quarterly, at a date, time and place set by the Board within the jurisdictional boundaries of one or more of the Members, and at such other times as may be determined by the Board.

8.3 Special Meetings. Special meetings of the Board of Directors may be called by the Chair or by a simple majority of Directors, in accordance with the provisions of Government Code section 54956.

8.4 Conduct. All meetings of the Board of Directors, including special meetings, shall be noticed, held, and conducted in accordance with the Ralph M. Brown Act (Government Code sections 54950, *et seq.*). The Board may use teleconferencing in connection with any meeting in conformance with and to the extent authorized by applicable law.

8.5 Local Conflict of Interest Code. The Board of Directors shall adopt a local conflict of interest code pursuant to the provisions of the Political Reform Act of 1974 (Government Code sections 81000, *et seq.*)

ARTICLE 9
MEMBER VOTING

9.1 Quorum. A quorum of any meeting of the Board of Directors shall consist of an absolute majority of Directors plus one Director. In the absence of a quorum, any meeting of the Directors may be adjourned by a vote of the simple majority of Directors present, but no other business may be transacted. For purposes of this Article, a Director shall be deemed present if the Director appears at the meeting in person or participates telephonically, provided that the telephone appearance is consistent with the requirements of the Ralph M. Brown Act.

9.2 Director Votes. Voting by the Board of Directors shall be made on the basis of one vote for each Director. A Director, or an Alternate Director when acting in the absence of his or her Director, may vote on all matters of Agency business unless disqualified because of a conflict of interest pursuant to California law or the local conflict of interest code adopted by the Board of Directors.

9.3 Affirmative Decisions of the Board of Directors. Except as otherwise specified in this Agreement, all affirmative decisions of the Board of Directors shall require the affirmative vote of a simple majority of all appointed Directors participating in voting on a matter of Agency business, provided that if a Director is disqualified from voting on a matter before the Board because of a conflict of interest, that Director shall be excluded from the calculation of the total number of Directors that constitute a majority. Notwithstanding the foregoing, a unanimous vote of all Member Directors participating in voting shall be required to approve any of the following: (i) any capital expenditure that is estimated to cost $100,000 or more; (ii) the annual budget; (iii) the GSP for the Basin or any amendment thereto; (iv) the levying of assessments or fees; (v) issuance of indebtedness; or (vi) any stipulation to resolve litigation concerning groundwater rights within or groundwater management for the Basin.

ARTICLE 10
AGENCY ADMINISTRATION, MANAGEMENT AND OPERATION

The Board of Directors may select and implement an approach to Agency administration and management that is appropriate to the circumstances and adapted to the GSA's needs as they may evolve over time. Details of the Board's decision on Agency administration, management and operation shall be incorporated into the GSA's bylaws and reviewed and revised as needed using the established process for revising the GSA's bylaws.

ARTICLE 11
BYLAWS

The Board of Directors shall cause to be drafted, approve, and amend Bylaws of the Agency to govern the day-to-day operations of the Agency. The Bylaws shall be adopted at or before the first anniversary of the Board's first meeting.

ARTICLE 12
ADVISORY COMMITTEES

The Board of Directors may from time to time appoint one or more advisory committees or establish standing or ad hoc committees to assist in carrying out the purposes and objectives of the Agency. The Board shall determine the purpose and need for such committees and the necessary qualifications for individuals appointed to them.

ARTICLE 13
OPERATION OF COMMITTEES

Each committee shall include a Director as the chair thereof. Other members of each committee may be constituted by such individuals approved by the Board of Directors for participation on the committee. However, no committee or participant on such committee shall have any authority to act on behalf of the Agency except as duly authorized by the Board.

ARTICLE 14
ACCOUNTING PRACTICES

14.1 General. The Board of Directors shall establish and maintain such funds and accounts as may be required by generally accepted public agency accounting practices. The Agency shall maintain strict accountability of all funds and a report of all receipts and disbursements of the Agency.

14.2 Fiscal Year. Unless the Board of Directors decides otherwise, the fiscal year for the Agency shall run concurrent with the calendar year.

14.3 Appointment of Treasurer and Auditor; Duties. The Treasurer and Auditor shall be appointed in the manner, and shall perform such duties and responsibilities, specified in Sections 6505.5 and 6505.6 of the Act.

ARTICLE 15
BUDGET AND EXPENSES

15.1 Budget. Within 120 after the first meeting of the Board of Directors, and thereafter prior to the commencement of each fiscal year, the Board shall adopt a budget for the Agency for the ensuing fiscal year no later than June 30^{th} . In the event that a budget is not so approved, the prior year's budget shall be deemed approved for the ensuing fiscal year, and any groundwater extraction fee or assessment(s) of contributions of Members, or both, approved by the Board during the prior fiscal year shall again be assessed in the same amount and terms for the ensuing fiscal year.

15.2 Agency Funding and Contributions. For the purpose of funding the expenses and ongoing operations of the Agency, the Board of Directors shall maintain a funding account in connection with the annual budget process. The Board of Directors may fund the Agency and the GSP as provided in Chapter 8 of SGMA, commencing with Section 10730 of the Water Code, and may also issue assessments for contributions by the Members in the amount and frequency determined necessary by the Board. Such Member contributions shall be paid by each Member to the Agency within 30 days of assessment by the Board.

15.3 Return of Contributions. In accordance with Government Code section 6512.1, repayment or return to the Members of all or any part of any contributions made by Members and any revenues by the Agency may be directed by the Board of Directors at such time and upon such terms as the Board of Directors may decide; provided that (1) any distributions shall be made in proportion to the contributions paid by each Member to the Agency, and (2) any capital contribution paid by a Member voluntarily, and without obligation to make such capital contribution pursuant to Section 15.2, shall be returned to the contributing Member, together with accrued interests at the annual rate published as the yield of the Local Agency Investment Fund administered by the California State Treasurer, before any other return of contributions to the Members is made. The Agency shall hold title to all funds and property acquired by the Agency during the term of this Agreement.

15.4 Issuance of Indebtedness. The Agency may issue bonds, notes or other forms of indebtedness, as permitted under Section 4.11, provided such issuance be approved at a meeting of the Board of Directors by unanimous vote of the Member Directors as specified in Article 9 (Member Voting).

ARTICLE 16
LIABILITIES

16.1 Liability. In accordance with Government Code section 6507, the debt, liabilities and obligations of the Agency shall be the debts, liabilities and obligations of the Agency alone, and not the Members.

16.2 Indemnity. Funds of the Agency may be used to defend, indemnify, and hold harmless the Agency, each Member, each Director, and any officers, agents and employees of the Agency for their actions taken within the course and scope of their duties while acting on behalf of the Agency. Other than for gross negligence or intentional acts, to the fullest extent permitted by law, the Agency agrees to save, indemnify, defend and hold harmless each Member from any liability, claims, suits, actions, arbitration proceedings, administrative proceedings, regulatory proceedings, losses, expenses or costs of any kind, whether actual, alleged or threatened, including attorney's fees and costs, court costs, interest, defense costs, and expert witness fees, where the same arise out of, or are in any way attributable, in whole or in part, to negligent acts or omissions of the Agency or its employees, officers or agents or the employees, officers or agents of any Member, while acting within the course and scope of a Member relationship with the Agency.

ARTICLE 17
WITHDRAWAL OF MEMBERS

17.1 Unilateral Withdrawal. Subject to the Dispute Resolution provisions set forth in Section 18.9, a Member may unilaterally withdraw from this Agreement without causing or requiring termination of this Agreement, effective upon 30 days written notice to the Board of Directors or its designee.

17.2 Rescission or Termination of Agency. This Agreement may be rescinded and the Agency terminated by unanimous written consent of all Members, except during the outstanding term of any Agency indebtedness.

17.3 Effect of Withdrawal or Termination. Upon termination of this Agreement or unilateral withdrawal, a Member shall remain obligated to pay its share of all debts, liabilities and obligations of the Agency required of the Member pursuant to terms of this Agreement, and that were incurred or accrued prior to the effective date of such termination or withdrawal, including without limitation those debts, liabilities and obligations pursuant to Sections 4.11 and 15.4. Any Member who withdraws from the Agency shall have no right to participate in the business and affairs of the Agency or to exercise any rights of a Member under this Agreement or the Act, but shall continue to share in distributions from the Agency on the same basis as if such Member had not withdrawn, provided that a Member that has withdrawn from the Agency shall not receive distributions in excess of the contributions made to the Agency while a Member. The right to share in distributions granted under this Section 17.3 shall be in lieu of any right the withdrawn Member may have to receive a distribution or payment of the fair value of the Member's interest in the Agency.

17.4 Return of Contribution. Upon termination of this Agreement, any surplus money on-hand shall be returned to the Members in proportion to their contributions made. The Board of Directors shall first offer any property, works, rights and interests of the Agency for sale to the Members on terms and conditions determined by the Board of Directors. If no such sale to Members is consummated, the Board of Directors shall offer the property, works, rights, and interest of the Agency for sale to any non-member for good and adequate consideration. The net proceeds from any sale shall be distributed among the Members in proportion to their contributions made.

ARTICLE 18
MISCELLANEOUS PROVISIONS

18.1 No Predetermination or Irretrievable Commitment of Resources. Nothing herein shall constitute a determination by the Agency or any of its Members that any action shall be undertaken, or that any unconditional or irretrievable commitment of resources shall be made, until such time as the required compliance with all local, state, or federal laws, including without limitation the California Environmental Quality Act, National Environmental Policy Act, or permit requirements, as applicable, has been completed.

18.2 Notices. Notices to a Director or Member hereunder shall be sufficient if delivered to the respective Director or clerk of the Member agency and addressed to the Director or clerk of the Member agency. Delivery may be accomplished by U.S. Postal Service, private mail service or electronic mail.

18.3 Amendments to Agreement. This Agreement may be amended or modified at any time only by subsequent written agreement approved and executed by all of the Members.

18.4 Agreement Complete. The foregoing constitutes the full and complete Agreement of the Members. This Agreement supersedes all prior agreements and understandings, whether in writing or oral, related to the subject matter of this Agreement that are not set forth in writing herein.

18.5 Severability. Should any part, term or provision of this Agreement be decided by a court of competent jurisdiction to be illegal or in conflict with any applicable federal law or any law of the State of California, or otherwise be rendered unenforceable or ineffectual, the validity of the remaining parts, terms, or provisions hereof shall not be affected thereby, provided however, that if the remaining parts, terms, or provisions do not comply with the Act, this Agreement shall terminate.

18.6 Withdrawal by Operation of Law. Should the participation of any Member to this Agreement be decided by the courts to be illegal or in excess of that Member's authority or in conflict with any law, the validity of the Agreement as to the remaining Members shall not be affected thereby.

18.7 Assignment. The rights and duties of the Members may not be assigned or delegated without the written consent of all other Members. Any attempt to assign or delegate such rights or duties in contravention of this Agreement shall be null and void.

18.8 Binding on Successors. This Agreement shall inure to the benefit of, and be binding upon, the successors and assigns of the Members.

18.9 Dispute Resolution. In the event that any dispute arises among the Members relating to (i) this Agreement, (ii) the rights and obligations arising from this Agreement, or (iii) or a Member proposing to withdraw from membership in the Agency, the aggrieved Member or Member proposing to withdraw from membership shall provide written notice to the other Members of the controversy or proposal to withdraw from membership. Within thirty (30) days thereafter, the Members shall attempt in good faith to resolve the controversy through informal means. If the Members cannot agree upon a resolution of the controversy within thirty (30) days from the providing of written notice specified above, the dispute shall be submitted to mediation prior to commencement of any legal action or prior to withdraw of a Member proposing to withdraw from membership. The mediation shall be no less than a full day (unless agreed otherwise among the Members) and the cost of mediation shall be paid in equal proportion among the Members. The mediator shall be either voluntarily agreed to or appointed by the Superior Court upon a suit and motion for appointment of a neutral mediator. Upon completion of mediation, if the controversy has not been resolved, any Member may exercise all rights to bring a legal action relating to the controversy or (except where such controversy relates to withdrawal of a Member's obligations upon withdrawal) withdraw from membership as otherwise authorized pursuant to this Agreement.

18.10 Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original.

18.11 Singular Includes Plural. Whenever used in this Agreement, the singular form of any term includes the plural form and the plural form includes the singular form.

18.12 Member Authorization. The legislative bodies of the Members have each authorized execution of this Agreement, as evidenced by their respective signatures below.

IN WITNESS WHEREOF, the Members hereto have executed this Agreement by authorized officials thereof.

CENTRAL WATER DISTRICT

By: [signature]

Title: Board President -CWD

APPROVED AS TO FORM:

By: [signature]

Title: District Counsel

CITY OF SANTA CRUZ

By: [signature]

Title: City Manager

2-23-16

APPROVED AS TO FORM:

By: [signature]

Title: Anthony P. Condotti City Attorney

COUNTY OF SANTA CRUZ

By: [signature]

Title: County Administrative Officer

APPROVED AS TO FORM:

By: [signature]

Title: County Counsel

SOQUEL CREEK WATER DISTRICT

By: Bruce Daniels

Title: President, Board

APPROVED AS TO FORM:

By: [signature]

Title: District Counsel

Appendix A
Scope of Work for the City of Santa Cruz
Regional Recycled Water Facilities Planning Study

Detailed Scope of Work for City of Santa Cruz-Kennedy/Jenks Consultants Agreement

The following Tasks summarize the proposed scope of work to develop a Santa Cruz Regional Recycled Water Facilities Planning Study (RWFPS), which is prepared to meet the goals posed by the City of Santa Cruz (City) and satisfies the project report requirements under the State Water Resource Control Board (SWRCB) Water Recycling Funding Program Guidelines. The primary purpose of the RWFPS for the Water Department is to meet the timeline outlined in the WSAC Agreements and Recommendations Report with the development of information on recycled water alternatives by December 2016, and to develop information about the recommended recycled water alternative early in 2017 for inclusion in a separate evaluation of In Lieu/ASR, recycled water, and seawater desalination, which will be completed by the end of 2017. The primary purpose of the RWFPS for the Department of Public Works is to develop a plan to reduce wastewater discharge into the Monterey Bay by determining the footprint and cost effectiveness of its treatment, distribution, and sale to potential new customers of the regional wastewater resource managed by the City of Santa Cruz and the County of Santa Cruz Sanitation District. The Santa Cruz Regional RWFPS will also meet the requirements of the SWRCB planning grant, which will position the City to apply for future grants and financial incentives available for recycled water projects, should a recommended recycled water project rise to the top in the analysis of the three water supply options noted above. The purpose for public outreach in the Santa Cruz Regional RWFPS is to share information with the public about the topics in the RWFPS as directed by the Santa Cruz City Council, to involve stakeholders in the progress of the study, and to satisfy the requirements of the SWRCB recycled water planning grant with regard to public outreach.

Additionally, the Santa Cruz Regional RWFPS will bring together information from former and newer studies of recycled water regarding opportunities in the region, incorporating the feasibility studies that are nearing completion. Seasonal demands also require thought to make full use of the recycled water resource, which is climate independent. For example, the City may elect to implement direct potable reuse, groundwater replenishment, irrigation water of North Coast agriculture and golf courses, and/or surface water augmentation with recycled water in dry years from the Spring to the Fall. However, there could be some evaluation of utilizing more surface water from Loch Lomond reservoir during the winter season to meet regional potable water demands and rest groundwater pumping to make room for purified recycled water when dilution water is available, and bank the groundwater for use in the dry season. Kennedy/Jenks will evaluate the efficiency of using recycled water year-round for multiple end-uses, taking into consideration the combination of several end uses for tertiary and purified recycled water in the region. This work will efficiently build on previous planning and design documents by the City and other Regional entities, including the Soquel Creek Water District (District), County of Santa Cruz (County), Scotts Valley Water District (SVWD) and other local agencies, as appropriate. This work will also build on the technical work described in the Water Supply Advisory Committee Agreements and Recommendations Final Report (City of SC, October 2015).

Summary of Work

The scope of work for the Regional RWFPS is organized to follow the State Water Resource Control Board's (SWRCB) Water Recycling Program Funding - Recommended Planning Outline for Water Recycling Projects (Appendix B). The scope is organized into ten tasks, as shown in Table 1, which align with chapters recommended in the SWRCB outline. A more detailed discussion of each task is provided in the Scope of Work section. Table 2 provides additional detail about each task, including subtasks, key deliverables, the associated format for each deliverable, the Regional RWFPS Chapter the work will feed into, the City's role, key Subconsultant roles and dependencies.

Table 1: Task Structure

Task	Regional RWFPS Chapter
Task 1 - Project Management & QA/QC	
Task 2 - Background Information	Chapter 1 – Study Area Characteristics Chapter 2 – Water Supply Characteristics and Facilities
Task 3 - RW Market Analysis	Chapter 3 – Wastewater Characteristics and Facilities Chapter 5 – Recycled Water Market
Task 4 - Treatment Evaluation / Reg Requirements	Chapter 4 – Treatment Requirements for Discharge and Reuse
Task 5 - Alternatives Analysis	Chapter 6 – Project Alternative Analysis
Task 6 – Stakeholder Involvement	Chapter 5 – Recycled Water Market
Task 7 - Recommended Project	Chapter 7 – Recommended Facilities Project Plan
Task 8 – Financial Analysis	Chapter 8 – Construction Financing Plan and Revenue Program
Task 9 – Regional RWFPS Report	
Task 10 - Meetings and Workshops	

Table 2: Sub-Task Structure, Deliverables, Roles and Dependencies

Task	Key Deliverable	Presentation Format	RWFPS Chapter(s)	Lead	City Role	Dependent on
Task 1 – PM & QA/QC						
1.1 Monthly Status Reports and Invoices	18 invoices	Email to City	n/a	K/J - Dawn	Approve Invoices	Effort to date
1.2 Status Calls/Web Meetings	36 - 1 hr calls	Conf Call/Web	n/a	K/J - Dawn	Participation	Include participants involved in current task as-needed
1.3 Subonctracting Agreements	n/a	n/a	n/a	K/J - Dawn	n/a	Scope of Work
1.4 Schedule	Monthly schedule update	digital	n/a	K/J - Dawn	Review / Comment, Schedule mtgs with Regional Stakeholders and TWG	TWG milestones and Stakeholder Mtgs
1.5 Project Setup and Establish QA/QC Program	Project Work Plan	Update as-needed	n/a	K/J - Dawn	Review / Comment	n/a
Task 2 – Background Info						
2.1 Data Collection and Review	Data Request	Tracking Table	n/a	Team	Respond/Fulfill	Availability and speed of acquisition
2.2 Study Area Characteristics	Summary Table/Figure	Draft	Chapter 1	K/J	Review and provide updated information	Data Collection and Review
2.3 Water Supply and Facilities	Summary Table/Figure	Draft	Chapter 2	K/J	Review and provide updated information	
Task 3 – Recycled Water Market Analysis						
3.1 WWTF Facility and Supply Analysis	Summary Table/Figure	Draft	Chapter 3	Trussell - K/J	Coordination with WWTF and Santa Cruz County Sanitation District (SCCSD)	SqCWD Groundwater Replenishment Recycled Water Feasibility Study
3.2 NPR Demand Analysis	Summary Tables/ Chapter Text	Draft	Chapter 5	K/J	Coordination with City Staff who will identify and communicate with customers	Available meter data from City, input from customers, input from CA State Parks and farmers regarding recycled water use on the North Coast
3.3 Recycled Water Market Survey Map	Market Survey Map	Draft	Chapter 5	K/J	Provide GIS files	RW IPR maps would include SVWD and SqCWD; Loch Lomond; RW NPR maps would include North Coast Ag, and irrigation/industrial
3.4 IPR Potential - GW Replenishment	Tech Memo #1	Draft	Chapter 5	K/J	Coordination with Groundwater Stakeholders (SVWD, SqCWD, and the Soquel-Aptos Groundwater Management Committee)	Available hydrogeologic assessments, In-Lieu ASR Feasibility Study Consultant Input from SqCWD on Mid-County GWR Project and from SVWD on RW Hansen Quarry project
3.5 IPR Potential - Reservoir Augmentation	Tech Memo #2	Draft	Chapter 5	Welch - K/J	Coordination with Stakeholders	
3.6 Streamflow Augmentation	Tech Memo #3	Draft	Chapter 5	K/J - Smith	Coordination with Stakeholders / Regulators	Input from Regulators
3.7 DPR Potential	Tech Memo #4	Draft	Chapter 5	K/J	Coordination with Stakeholders	Input from Brown and Caldwell on DPR Project
Task 4 – Treatment Eval/Reg Requirements						
4.1 Define Water Quality Objectives for Uses	Summary Tables	Draft	Chapter 4	K/J	Coordination with customers	Input from potential users
4.2 Summarize Regulatory Requirements	Summary Tables	Draft	Chapter 4	K/J		
4.3 Treatment Evaluation	Tech Memo #5	Draft	Chapter 4	Trussell - K/J	Coordination with WWTF	Input from WWTF
Task 5 – Alternatives Analysis						
5.1 Refine Long-List of Alternatives	Summary Table/Figure	Draft	Chapter 6	K/J	Coordination with Regional Stakeholders	Input from City & Regional Partners and TWG
5.2 Preliminary Screening	Summary Table	Draft	Chapter 6	K/J - GHD	Coordination with Regional Stakeholders/ Regulators	
5.3 Evaluate Short List of Alternatives	Screening Tables	Draft	Chapter 6	K/J	Coordination with Regional Stakeholders	
5.4 Alternative Capital, O&M and Life Cycle Costs	Cost Tables	Draft	Chapter 6	K/J		
Task 6 – Stakeholder Involvement						
6.1 Outreach Strategy and Advice	Materials as requested	Draft	Chapter 5	DI - K/J	Development of strategy for maintaining stakeholder communication	May include input from stakeholders and potential users
6.2 Outreach Materials and Support	Materials as requested	Draft	Chapter 5	DI - K/J	Coordination/Logistics/Materials for meetings	Questions/Requests received, collection of data for report regarding customer commitments
Task 7 – Recommended Project						
7.1 Preliminary Facilities Design Criteria	Summary Table/Figure	Draft	Chapter 7	K/J	Facilities Input	Outcome of Task 5 and City Preferences
7.2 Implementation Plan	Summary Table/Figure	Draft	Chapter 7	K/J	Operational Input	
Task 8 – Financial Analysis						
8.1 Anticipated Financing Plan	Tech Memo #6	Draft	Chapter 8	RFC	City Staff or Contract with Raftelis Financial Consultants, Inc	Cost Tables from Task 5
8.2 Revenue Projection Program	Tech Memo #6	Draft	Chapter 8	RFC	City Staff or Contract with Raftelis Financial Consultants, Inc	Cost Tables from Task 5
Task 9 – Regional RWFPS Report						
9.1 Admin Draft for City	Admin Draft	digital	n/a	K/J	Distrbute, coordinate and compile comments from City, Regional Partners and Stakeholders	
9.2 SWRCB Draft	Draft	digital/hard copy	n/a	K/J		
9.3 Final Report	Final	digital/hard copy	n/a	K/J	Distribute final document	
Task 10 - Meetings and Workshops						
10.1 Kick-off Meeting (1)	Meeting Materials	digital/hard copy	n/a	K/J	Meeting Minutes	
10.2 F2F Meeting (w/ City PW and Water, TWG & Regional Partners) (2)	Meeting Materials / ppt	Draft/Final	Chapter 4/5	K/J	Create/manage TWG, logistics for workshops (coordinate, distribute materials, meeting minutes), facilitate workshop, team meeting before and after workshop	Task 3 & 4
10.3 Workshops - Alternatives Analysis/Recommmended Project (2)	Meeting Materials / ppt	Draft/Final	Chapter 6	K/J		Task 5
10.4 Present Final RWFPS (1)	Meeting Materials / ppt	Draft/Final	Chapter 6	K/J		Task 5
10.5 SWRCB Mid-Course Mtg - Draft Report (1)	Meeting Materials / ppt	Draft/Final	Chapter 7	K/J		Task 7

General Assumptions

The general assumptions used to prepare this Scope of Work are summarized as follows.

- Regional Partners for this study include the Soquel Creek Water District, Scotts Valley Water District and the County of Santa Cruz Sanitation District.
- Project geographic area includes the City of Santa Cruz service area and portions of each Regional Partners service area and/or jurisdiction.
- This work will build on the technical team work described in the WSAC Agreement and Recommendations Final Report, other City and SqCWD consultants, and prior and ongoing planning work.
- Draft technical memoranda (TM), summary tables and figures produced under each task will be presented during meetings/workshops and are intended to be incorporated in the Regional RWFPS as-appropriate. Comments received will be integrated into a revised version to be incorporated into the Admin Draft Regional RWFPS for further review by the City and Regional Partners.
- Each subtask deliverable will include a draft presented during a conference call or meeting, and a final incorporating any comments. Summary tables, figures and associated text will be integrated into the Regional RWFPS as appropriate.
- The Regional RWFPS Report will include (1) administrative initial draft for review by the City and Regional Partners, (2) second draft for review by the City, Regional Partners and the SWRCB and (3) final Report for publication.
- For each deliverable, the City will provide a set of combined written comments from City and/or Regional Partners. The project schedule has been developed assuming all review comments will be received within two weeks of the draft documents' date. Comments will be discussed as required and incorporated into the final document as appropriate.
- The Kennedy/Jenks team will provide verbal progress updates to City staff during scheduled conference calls and a monthly status report will accompany each invoice for work.
- The work under this task order is assumed to be performed over an 18-month period starting upon receipt of the Notice to Proceed (NTP). If the work extends beyond this time period due to delays caused by others, the project management budget shall be increased as-required based on discussions with the City. This budget will be used to cover additional effort associated with additional meetings, invoices and coordination, etc resulting from the schedule extension.
- The Scope of Work shall be managed to be within the overall budget established for the project. Some tasks and subtasks may require more or less effort to complete, based on conditions that may be unforeseen at the time of scoping. Kennedy/Jenks reserves the right to move budget between tasks/subtasks for the base scope.
- Sampling and other field work is not included in this scope of work.
- Design or implementation of a pilot study is not included in this scope of work. Treatment technologies and facilities sizing will be evaluated using existing effluent water quality data from the Santa Cruz Wastewater Treatment Facility (WWTF), and other information provided by the City. Recommendations for bench-scale and/or pilot-scale treatment technology studies may be provided depending on the recommended project.

Public Outreach Assumptions

- Outreach activities will be coordinated with existing City Communications staff, who will provide services as described in the scope of work.
- The Kennedy/Jenks Team will prepare and present outreach materials within the scope described herein.

- As needed graphic support (layout, text & design) for collateral outreach materials and public meeting support materials such as posters, PowerPoint presentations and handouts is included up to the budgets established herein.

Services Provided by the City

The scope of work, schedule and budget assumes that the following services will be provided by City:

- The City will designate one or more individuals (as-needed) to:
    - Serve as a point of contact to assist the Kennedy/Jenks Team in obtaining needed data and scheduling meetings, workshops, site visits as defined in the scope of work.
    - Coordinate with other City Departments, other City consultants, potential customers, groundwater (GW) stakeholder groups, regulators and other stakeholders as-requested to support the scope of work.
    - Coordinate, schedule and provide logistics for meetings with potential users, workshops and meetings with Regional Partners.
    - Create and manage the Technical Working Group (TWG) and provide coordination and logistics for TWG workshops.
    - Distribute materials, take meeting minutes and provide support as-needed during meetings/workshops.
    - Distribute deliverables and coordinate the review process with the Regional Partners and other reviewers, and to provide consolidated comments and information to the Kennedy/Jenks team within the durations shown on the project schedule.
- The City will provide prior reports, technical memoranda, presentations and other information from prior planning efforts upon request, and in digital format if available.
- Aerial photos, GIS shapefiles, AutoCAD files and other facility information from previous planning and design efforts, or other City sources will be made available at no additional cost to the Kennedy/Jenks Team.
- The City Water Engineering and Public Works Staff will provide draft report text/tables/figures from previous planning efforts and will provide data to assist K/J GIS staff with the production of graphics for workshops as-requested.
- The City will provide relevant customer water use data including all meter data and previous demand estimates, at the start of the project to facilitate confirmation of the market assessment demands. These data will be provided in a digital format. If data input for hard copy information is required, additional scope and budget will be required.

Work by Subconsultants

- Merritt Smith Consulting– Regulatory Strategy Support
- Data Instincts – Stakeholder Outreach
- Trussell Technologies – WWTF Facility/Supply Analysis, Treatment Technologies and QA/QC Support
- Stratus Consulting/Abt Associates – Triple Bottom Line Analysis
- GHD Inc. – CEQA/Environmental Compliance Support
- Michael Welch, PhD. – Reservoir Augmentation

City of Santa Cruz
Water Supply Advisory Committee

Final Report on
Agreements and Recommendations

October, 2015

The Water Supply Advisory Committee

SantaCruzWaterSupply.com

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GLOSSARY

Active recharge: Regarding aquifer storage, active recharge implies artificially moving water from the surface into ground water systems.
Adaptation framework: General approach to enable the City and Water Department to adjust plans (i.e., to adapt) in the face of key future uncertainties, by taking account of future information as it becomes available.
Adaptive flexibility: The ability of a plan to adjust to changing circumstances and emerging information over time.
Adaptive pathway: The path forward through time, representing where and why plans may need adjustment (adaptation) as new information becomes available.
Adjustment framework: Similar to the adaptation framework, but pertaining to modest-sized adjustments to a path rather than a possible movement from one future path to another.
AFY, acre feet per year: A unit of measurement that demonstrates both water supply and demand on a municipal-wide scale. One acre foot is the volume of one acre of surface area to a depth of one foot. One acre foot is 43,560 cubic feet or 325,851 gallons.
Alternatives: Proposed solutions or alleviations to the system's supply shortfall that intend to use new or underutilized sources of water, expanding storage, and/or creating or adapting production methods.
CII: Commercial, institutional and industrial entities; non-residential customers of the Water Department.
CII MF: CII (see above) and multi-family residential customers.
Confluence®: An analytical water resources planning tool that simulates current and future water supply and demand scenarios, evaluates the results, and presents them in an understandable fashion. (Confluence was developed by Gary Fiske and Associates.)
Confluence model: The presentation of the Confluence results which provides a vast array of information in a flexible manner.
Conjunctive use: Using groundwater and surface waters together to improve water availability and reliability.
Decision nodes: Points along an adaptive pathway at which information is anticipated that may support a decision to either proceed as initially planned, or adjust the plan (e.g., switch to a different pathway forward).
Decision space: The factors, information, and time in which a decision is to be made.
Demand management: The guidance of reduced water consumption through conservation and other curtailment methods (e.g., departmental rebate for low-flow toilet installation).
Direct potable reuse: An approach to recycled water where advanced purified wastewater is introduced directly into a potable water supply distribution system.
Drought-resistant: Alternative water supply that is not highly dependent on rainfall for its source.
Econometric: A form of statistical analysis applied in the social sciences (e.g., to explain or forecast water demand).
Fish flows: Designation of specific stream flows at a particular location for a defined time, and typically follows seasonal variations with the intent of protecting and preserving resources for the surrounding environment and fish. [Ref. http://www.dfg.ca.gov/water/instream_flow.html]
Flow regime: The amount of water that is (or is required to be) found instream, across seasons and hydrologic years.

Forward osmosis (FO): Forward osmosis (FO) is an osmotic process that uses a semi-permeable membrane to effect separation of water from dissolved solutes. The driving force for this separation is an osmotic pressure gradient between a solution of high concentration, often referred to as a "draw" and a solution of lower concentration, referred to as the "feed".

Gantt chart: A bar chart that demonstrates components of a project's schedule.

GPCD: Gallons per capita per day, or the average daily water usage per person.

HCP: A Habitat Conservation Plan (HCP) is a required part of an application for permits to continue to take water from the San Lorenzo River and North Coast Streams. The HCP evaluates the impacts the City's water withdrawals have on endangered fish and spells out how they will be avoided or minimized. The HCP establishes an agreed upon amount of water that is needed for fish protection, and therefore how much remains for City consumption.

Indirect potable reuse: An approach to recycled water where advanced purified water is combined with water from a natural water source (often in an aquifer or reservoir) where it can later receive more treatment before being introduced to a potable water supply distribution system.

Interest-based bargaining: A method intended to increase the effectiveness of negotiations to develop consensus. The goal is for every member of the negotiation to win something, and to do so by addressing all interests, maintain a cooperative approach, and focus on the importance of relationships among members. There is usually more than one satisfactory solution in Interest-based bargaining.

Intertie: A connecting pipeline between water systems that allows the transfer of potable water.

Karst: A terrain with distinctive landforms and hydrology created from the dissolution of soluble rocks, principally limestone and dolomite. Karst terrain is characterized by springs, caves, sinkholes, and a unique hydrogeology that results in aquifers that are highly productive but extremely vulnerable to contamination. In the United States, about 40% of the groundwater used for drinking comes from karst aquifers. [Ref. http://water.usgs.gov/ogw/karst/pages/whatiskarst]

MGY, Million gallons per year: A unit of measurement that demonstrates both water supply and demand on a municipal-wide scale.

Modeling and forecasting: Water supply planning and analytical tools used in designing the water system and estimating its performance and demands under various future scenarios.

Multi criteria decision system (MCDS): A framework for organizing, analyzing, and communicating considerations of proposed approaches to water supply and demand. MCDS produces a model that contains criterion and alternatives. Each criterion and alternative has a description, ratings scales, and weights.

NTUs (Nephelometric Turbidity Units): A measure of the level of turbidity, or suspended particles, in a liquid. Drinking water standards require turbidity to be in the range of ~ 0-1NTU.

Passive recharge: Regarding aquifer storage, passive recharge implies moving water naturally from the surface into ground water systems (such as by substituting surface water to supply water users, and thereby resting extraction wells).

Peak season: The months between May and October where demand for water is higher than the remaining months due to dry weather conditions and a significant increase in tourist activity.

Portfolio: Collections of potential solutions and alleviations to the system's supply and demand shortfall distributed to the Committee to review, consider, and assess.

Production: The volume of potable water generated in a specific time period, which may vary during different times of the year and different hydrologic conditions. The difference between production and yield is production measures each supply source, while yield measures the water supply system as a whole.

Price elasticity: Regarding demand, price elasticity is an economic term that represents the responsiveness of demand when the price of goods and/or services are subjected to changes.

Ranney collectors: A patented type of radial collector well used to extract water from a direct connection to a surface water source (e.g., a river) by extending radially under the surface floor (e.g., river bed). These radial or horizontal wells flow to a conventional well before being pumped to the surface.

Reverse osmosis: A system of filtering dissolved solids from water by driving the water through a semi-permeable membrane. Compared to forward osmosis, reverse osmosis is a high pressure driven system.

Rule curve: As applied to dam operations, for example, indicating the guidelines for how releases from the dam are managed (i.e., when to use the water, and when to store it).

Runoff: The flow of surface water from excess rain or other sources. This occurs when the source of water is distributed faster than the surface is able to absorb it, resulting in the flow of water.

Scalability: The capability to alter a project's plans to meet differing demand scenarios (ex.: adapting the plans regarding the size of a recycled water plant to produce less water for a smaller customer base than what was originally imagined).

Scenario planning: Exercises intended to demonstrate potential future water supply and demand situations (ex.: long periods of drought, lowered demand due to conservation, etc.).

Supply augmentation: Adding to the water supply.

Supply-demand gap: The difference between a water system's ability to sustainably store and provide water to its customers and the demand on the system. The amount by which demand may exceed supply, such as in the peak demand season.

Turbidity: The cloudiness or haziness of a fluid caused by the presence of particulates in the water.

UHET: Ultra high efficiency toilet.

Urban Water Management Plan: A report that fulfills the requirements described in the Urban Water Management Planning Act. The report describes the utility's water resource supplies and projects needs over a twenty-year planning horizon with relation to conservation, water service reliability, water recycling, opportunities for water transfers, and contingency plans for drought events. The latest report was published in 2010.

Yield: The resulting reduction in system-wide water shortages during the peak season when a new source is added to the system. Two measures of yield are typically shown: (1) under the worst hydrologic conditions; and (2) as an average across all hydrologic conditions. The difference between production and yield is production measures each supply source, while yield measures the water supply system as a whole.

Water year: Each water year begins October 1 and extends through September 30.

Water-neutral: As applied to development paths (i.e., levels of population or economic growth), signifying an approach that does not change overall demand for water.

Article I. Executive Summary

Appointed by City Council in 2014, the Water Supply Advisory Committee's (WSAC) charge was to *explore, through an iterative, fact-based process, the City's water profile, including supply, demand and future risks; analyze potential solutions to deliver a safe, adequate, reliable, affordable and environmentally sustainable water supply; and, to develop recommendations for City Council consideration.* This document lays out the WSAC Process, Information Developed and Considered, Analysis, Agreements and Recommendations.

The WSAC brought together a diverse set of perspectives and viewpoints from a broad sector of the community. The Committee placed a high value on transparency, trust and consensus. With that in mind, developing the "how" – the Agreements – was as critical as the "what" – the Recommendations.

The Agreements lay out strategies for how the recommendations will be implemented, with particular emphasis on how to approach managing change. The Committee agreed to a S*taggered Implementation Approach*, allowing work to begin on full scale implementation of the Strategy One elements, with clearly defined decision points, thresholds and metrics; and to begin preliminary work on Strategy Two elements. The implementation protocol is discussed in Section 3.22 of this document.

In addressing the issues of trust and transparency, the Agreements provide an in-depth *Change Management Strategy.* This strategy underscores the guidelines and principles that reflect the Committee's values and priorities, and establishes mechanisms for dealing with changes that will occur over time. The Change Management Strategy includes procedures for planning, doing, checking and acting; an Adaptive Pathway framework for implementing the three main supply recommendations; defined roles and responsibilities for Water Department staff and the Water Commission; and clear guidance for decision making. The Change Management Strategy is discussed in Section 3.24.

The overarching goal of the Committee's Plan is to provide significant improvement to the sufficiency and reliability of the Santa Cruz water supply by 2025. The recommendations made in this report reflect consensus among WSAC members for how best to address an agreed-upon worst year gap of 1.2 billion gallons between water supply and water demand during times of extended drought. The strategies recommended include: strengthened water conservation programs; storage of available San Lorenzo River flows during the rainy season in regional aquifers, through processes known as "In Lieu" water transfers, for passive recharge, and Aquifer Storage and Recovery (ASR) for active recharge; and a supply augmentation plan to use advanced-treated recycled water,[1] with desalination as a back-up, should the use of advanced-treated recycled water not be feasible. This report provides detailed information on each of the recommended strategies. Importantly, the Committee's Plan accomplishes the City's water supply goal while providing robust stream flows to support and enhance fish habitat restoration and protection.

In brief:

Strategy 0 – Conservation – In addition to the existing conservation programs such as home and business evaluations, water saving rebates, water budgets for large landscapes and free water-saving

[1] See Framework for Direct Potable Reuse: Water Reuse Foundation, American Water Works Association, Water Environment Foundation, National Water Research Institute, September 2015.

devices, the WSAC recommends looking at new programs, such as increased rebates and better management of peak season demand. The goal of these additional programs would be to further reduce demand by 200 to 250 million gallons per year (mgy) by 2035, with a particular focus on producing savings during the peak season.

Strategy One – Groundwater Storage: In Lieu Water Exchanges – In normal years, the Santa Cruz Water Department (SCWD) receives more rainfall than is needed to meet customer demand and can be stored in Loch Lomond Reservoir. Using In Lieu Water Exchanges, available winter flows would be delivered to Soquel Creek Water District (SqCWD) and/or Scotts Valley Water District (SVWD) customers, thus allowing reduced pumping from these regional aquifers and enabling the aquifer to passively rest and recharge. Using **Aquifer Storage and Recover (ASR),** available winter flows would be injected into aquifers through new and existing wells owned by the SCWD, SVWD and/or SqCWD, thereby actively recharging aquifers. A portion of the water delivered using In Lieu or ASR would be effectively banked in the aquifers to be extracted and returned to SCWD when needed in future dry years.

Strategy Two – Advanced Treated Recycled Water or Desalinated Water would be developed as a supplemental or replacement supply in the event the groundwater storage strategies described above prove insufficient to meet the plan's goals of cost-effectiveness, timeliness or yield. If it is determined that recycled water cannot meet our needs, then desalinated seawater would be used.

With these recommendations, the Water Supply Advisory Committee has met its charge to reach consensus on how best to deliver a safe, adequate, reliable, affordable and environmentally sustainable water supply to our community by 2025. The body of this report provides the detailed information that which supports the findings reported in this Executive Summary.

Article II. Preamble

Section 2.01 Committee Charge

The Committee's purpose is to explore, through an iterative, fact-based process, the City's water profile, including supply, demand and future risks; analyze potential solutions to deliver a safe, adequate, reliable, affordable and environmentally sustainable water supply and develop recommendations for City Council consideration.

Section 2.02 Committee Membership

The following individuals were appointed to the Water Supply Advisory Committee to represent the interests listed:

Community Interest	**Representative**
Business Organization (Think Local First)	Peter Beckmann
City Resident	Doug Engfer
Santa Cruz Water Commission	David Green Baskin
Non-City Resident (Outside-City Water Customer)	Sue Holt
City Resident	Dana Jacobson
City Resident	Charlie Keutmann
Santa Cruz Desalination Alternatives	Rick Longinotti
Environmental Organization (Surfrider Foundation)	Sarah Mansergh
Business Organization (Santa Cruz Chamber of Commerce)	Mark Mesiti-Miller
Environmental Organization (Coastal Watershed Council)	Greg Pepping
Santa Cruz Sustainable Water Coalition	Mike Rotkin
Business Organization (Santa Cruz County Business Council)	Sid Slatter
Environmental Organization (Sierra Club)	Erica Stanojevic
Santa Cruz Water Commission	David Stearns
Santa Cruz Water Department (ex officio/non-voting member)	Rosemary Menard

Section 2.03 Committee Agreement about Decision-Making

The Committee's decision-making processes will differ from the Council or City Commissions in that it is intended to reach consensus through a collaborative process. Therefore, the Committee will use this hierarchy of decision tools:

i. The preferred decision tool is for the Committee to arrive at a "sense of the meeting."

ii. Consensus is highly desirable.
iii. Informal voting may only be used to explore the decision space.
iv. Formal voting may be used as a fallback when consensus fails as long as there is consensus that a vote should take place. The voting shall be by a supermajority of 10.

Section 2.04 General Context and Framing Issues

The most important element of a problem solving process is defining the problem. Yet one of the characteristics of long range planning for complex systems is that even the problem itself is difficult to define. This is true of Santa Cruz's water planning.

Like all long range planning, water supply planning must deal with the realities of an uncertain future. In a historical context, water supply planning uncertainties have included the normal sources of variability:

- Weather and its impacts on supply;
- Demand increases in the future due to growth and development;
- Demand decreases resulting from changing plumbing codes, technologies, demographics, or consumer behaviors (conservation); and
- Potential supply decreases due to regulatory requirements to release water to support threatened or endangered fish species.

Today, uncertainties related to impacts of climate change must be added to this list.

During the first phase of the WSAC's work, the Committee was presented information about a variety of decision tools that the technical and facilitation teams believed could be useful in the Committee's work. The Committee considered and applied a variety of tools:

1. Scenario planning, including portfolio development,
2. Risk analysis and risk management, and
3. Criteria based evaluation of alternatives and portfolios using a Multi-Criteria Decision Support tool (MCDS).

The Committee explored or applied all of these tools as it did its work. The Adaptation Strategy described in more detail in Section 3.24 later in this document exists largely as a result of the Committee's efforts to create a plan that would be able to respond to the new information that will emerge and the potential changes in our understanding of circumstances that will occur over time.

Section 2.05 Overview of Committee Process

The Committee's process was divided into three phases:

- A Reconnaissance Phase where the Committee learned about the water system and its issues and identified a broad range of alternatives approaches for addressing the system reliability issues;

- An Analysis Phase where more detailed information about supply, demand, the supply shortfall, and the alternative approaches to solving the problem were explored in some detail; and
- An Agreements Phase where the Committee developed the agreements and recommendations that they conveyed to the City Council. The process has been iterative without stark boundaries between the phases but with a steadily increasing level of understanding of the issues, drivers, opportunities and constraints that the Committee was dealing with.

The Committee's process has been supported by a technical team that brought a diverse range of skills, experience and expertise to the tasks the Committee defined. The Committee also selected a group of four water professionals to serve as an Independent Review Panel and provide perspective about technical issues that the Committee dealt with. Finally, the Committee was professionally facilitated by a team of individuals experienced in collaborative problem solving and multi-party negotiations.

All Committee meetings were open to the public and opportunities for public comment and input were regularly provided including, specifically, in advance of the Committee's taking action on any important decisions. The Committee had its own website and received and responded to all website communications received from the public. All public communications received via the website were shared with all Committee members, and with City staff and the technical team.

Section 2.06 WSAC Process and Support Team

In addition to their monthly meetings, a number of other opportunities were made available to inform the WSAC on the myriad topics and issues associated with water supply planning. Six "Modeling and Forecasting" workshops were offered to WSAC members and the community on the various tools used by the Water Department related to water supply planning. These workshops covered topics on surface and groundwater supplies, forecasting water demand, demand management, and water shortage contingency planning. There were also a series of "Enrichment" meetings which included discussions on building code impacts on water demand, fishery agency perspective on protecting and enhancing fish habitat, climate change, water transfers/exchanges as a water supply augmentation, conservation, and recycled water.

The WSAC was supported by a Facilitation Team, Independent Review Panel, and Technical Support Team as described below.

Facilitation Team: The facilitation team was hired to guide the WSAC through its process including assessing community concerns; designing the WSAC process; reviewing committee composition; assisting with establishing committee meeting agendas, format and structure, legal and ethical guidelines and other process considerations; proposing work plans, objectives and deliverables; interfacing with City staff, consultants and community members; and maintaining strong lines of communications and relationships between the City, Committee and the greater community toward the end of timely delivering a set of water supply recommendations for City Council consideration. The prime consultant was Nicholas Dewar (Public Policy Collaboration) with subconsultants Carie Fox (Fox Mediation) and Philip Murphy (InfoHarvest).

Independent Review Panel: The WSAC hired four individuals to assist them to effectively interact with the technical consulting support team by providing critical review of products created by the technical team and offering advice or suggestions to the WSAC regarding lines of inquiry or technical questions that should be evaluated by the technical team.

- Michael A. Cloud, Registered Geologist, County of Santa Cruz (retired)
- Patrick T. Ferraro, Water Resource management, Executive Director The Silicon Valley Pollution Prevention Center (1995 – 2004); Director on the Board of the Santa Clara Valley Water District (1973 – 1995)
- Brian L. Ramaley, P.E., Drinking water supply, treatment, distribution; Director City of Newport News Department of Public Works (1989 – 2013) (retired)
- Roy L. Wolfe, PH.D., Environmental science, water resources, utility management, water research, Metropolitan Water District of Southern California (retired).

Technical Team: A number of consultants were available to develop and provide information on the various topics considered by the WSAC. Stratus Consulting functioned as a general contractor and, together with Water Department staff, orchestrated the work of a number of subject matter experts. Stratus Consulting and the other consultants listed below were approved by the WSAC at their May, June, August and September 2014 meetings.

- Stratus Consulting Inc. acted as general contractor to the WSAC. Stratus provided environmental research, analytics and consulting services and responded to technical and analytical issues.
- Brown and Caldwell provided engineering support services, developing conceptual level designs and cost estimates on a myriad of options.
- Balance Hydrologics provided information related to stream flows and impacts to those flows resulting from climate change and potential release requirements for fish and other habitat.
- Gary Fiske and Associates developed the Confluence model to assist utilities manage water supply resources. Gary has consulted to the City for many years and assisted the WSAC evaluate various water supply alternatives.
- Hagar Environmental Science provided information to the WSAC on fisheries and aquatic issues as they relate to water resource management and aquatic species conservation.
- Lennihan Law provided information related to water rights.
- Maddaus Water Management Inc. has several decades of experience with water resource planning, water demand management and conservation. Maddaus has worked with the Water Department on several water conservation master planning efforts and worked with the WSAC on several occasions to discuss conservation practices and approaches to lower Santa Cruz demands.
- M. Cubed developed an econometric demand model during the WSAC to more comprehensively evaluate the water demands of the city and its influencing factors.

Article III. Agreements

Section 3.01 Introduction

This Article summarizes the work the Committee members did in several major topic areas that were key to developing their understanding of the issues and their recommendations to the Council. Each of the following sections describes a topic, summarizes the Committee's work on that topic, presents any agreement that the Committee reached about that topic, and articulates the key assumptions.

The analysis, assumptions and agreements presented in this section create the foundation for the Committee's recommendations to the City Council presented in Article IV.

Section 3.03 begins with a brief statement about the nature of Santa Cruz's water supply problem that was based on conventional wisdom and past studies and analysis. The analysis described in Section 3.04 through Section 3.07 deconstructs and then reconstructs that conventional wisdom to quantify the supply-demand gap and to include the potential impacts of fish flow releases and climate change on the size and characteristics of Santa Cruz's water supply reliability issues.

Section 3.02 Background

The Water Supply Advisory Committee's Analysis Phase work program was designed around the use of scenario planning to explore and evaluate a range of alternatives. This section summarizes the basic work to date and provides an overview of the products developed to support the Committee's work. Several additional documents are attached to this document as appendices; they provide more detailed information where such information was thought to be relevant and potentially of interest.

The key ingredients of the Committee's scenario planning include:

- Problem definition
    1. Forecasts of current and future water demand;
    2. Analyses of supply available to meet current and future water demand; and
    3. Identification of probable and plausible challenges that will need to be addressed in the future; in this case these include a probable requirement for releasing water for fish flows and plausible impacts of climate change.
- Solution development
    - A range of demand management (water conservation) and supply augmentation alternatives that can be combined in various portfolios to meet the supply demand gap; and
    - Evaluation criteria to use in considering the portfolios created.

The following sections provide a high level summary of the Committee's progress in their work related to scenario planning and, where relevant, links are provided to more detailed information, typically found in materials developed for committee meetings. In addition, comprehensive information about the Committee's work is available through its website: www.santacruzwatersupply.com.

Section 3.03 Preliminary Problem Definition

Over the many years that Santa Cruz has been studying ways to improve the reliability of its water supply, the problem has been defined in a variety of ways that were relevant at the time. Today, it is fair to say that the fundamental cause of the Santa Cruz water system's reliability problem is the inability to store sufficient volumes of available winter flows for use in the driest years and/or the lack of a supply that does not depend on those flows. At least one of these is needed to ensure an adequate and dependable supply during water years classified as critically dry and, to some degree, dry.

Section 3.04 Historical Context – The Challenge of Variability

The City uses a water year classification system as an index of water supply conditions for operations, to forecast river flows, and to communicate its water supply status to the public. The system is based on total annual runoff in the San Lorenzo River, the City's most important source, measured at the Big Trees gage in Henry Cowell Redwoods State Park.

Annual discharge of the San Lorenzo River was selected as the best individual benchmark of the City's water supply condition for two reasons. First, the river is the city's single largest source of drinking water, providing about half the normal annual supply. Second, about three quarters of all the water used by city water customers is obtained from a flowing source of supply. In general, the higher the volume discharged from the San Lorenzo River means that:

- the local watersheds in the Santa Cruz mountains are more saturated;
- the stream sources will flow at higher levels later into the dry season; and
- there is more water available from all surface water sources, including the reservoir, to meet system demands over the course of the year.

The converse is also generally true: the lower the volume discharged by the San Lorenzo River means less water is available from all surface water sources to meet system demands.

Under this classification system, the water year (October 1- September 30) is designated as one of four types: wet, normal, dry, or critically dry, depending on the total annual river discharge, as follows:

Table 1 – Water Year Classification System

Classification	Runoff (ac-ft)
Wet	> 119,000
Normal	49,000 - 119,000
Dry	29,000 – 49,000
Critically Dry	<29,000

Figure 1 and Figure 2 show two versions of local, historical information for water years (October 1 to September 30) classified into water-year types. These are familiar figures to many, but the purpose of including them up front is to emphasize two issues:

- Figure 1 shows the data sorted chronologically over the period from 1921 - 2015[2]. This view underlines the significant variability of the data emphasizing the fact that the City has no certainty about what the following year will bring, nor any certainty about how long any pattern may last. Average runoff during this period is about 93,000 acre-feet or 30 billion gallons[3]. The least amount of runoff, 9,500 ac-ft, occurred in the drought of 1977. The maximum recorded discharge was over 280,000 ac-ft in 1983, one of the wettest years on record in California. This natural variation in the level of runoff available in local streams and rivers, from which the City draws the majority of its supply, is the major factor that results in an inconsistent level of water supply from year to year.
- Figure 2 sorts the data into year types, showing the number of years that have historically fallen into each year type. As will be discussed later in this section, a plausible impact of climate change on Santa Cruz's water supply would be an increase, perhaps even a significant increase, in the fraction of dry and critically dry years that Santa Cruz will experience, thereby exacerbating the reliability issues the system currently faces.

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[2] The actual period of record for the gage on the San Lorenzo River began in 1936, but synthesized flow records generated for earlier modeling studies were used to extend the period of record back to 1921.

[3] One ac-ft equals 325,851 gallons; 3.07 ac-ft equals one million gallons.

Figure 1 – Water Year Classification System Based on San Lorenzo River Runoff (by year)

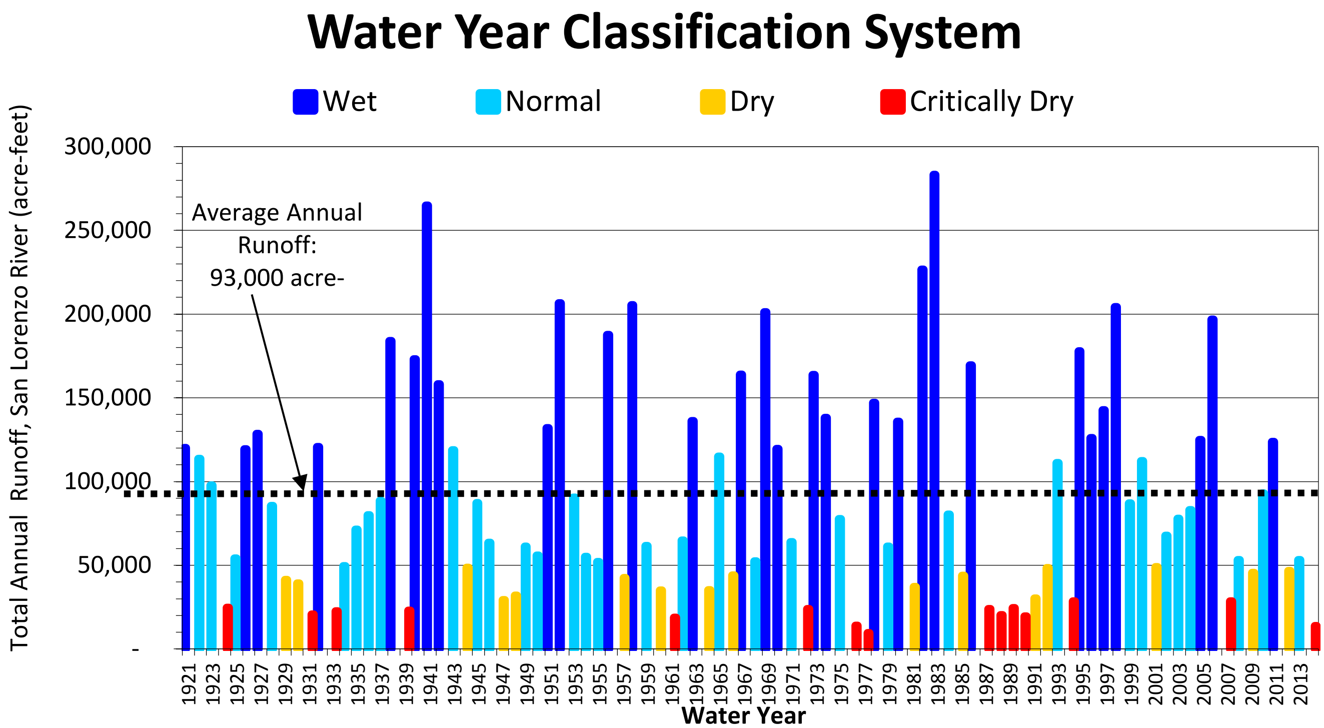
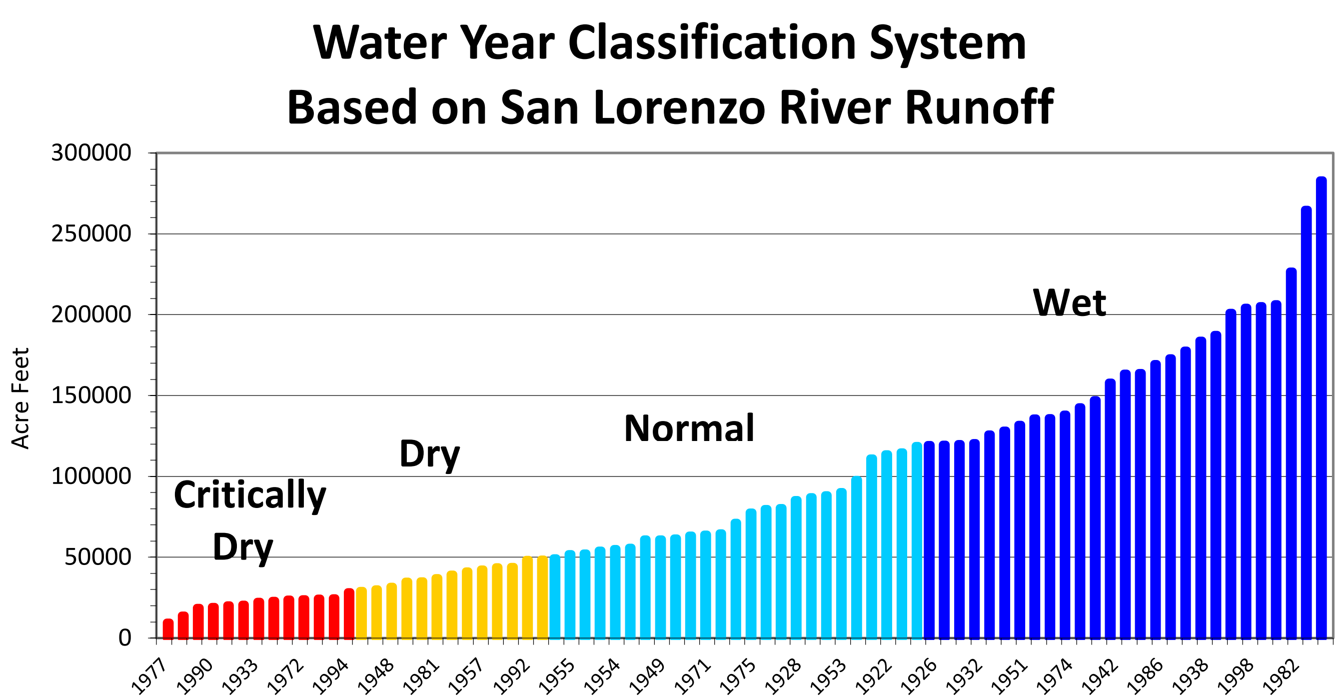


Figure 2 – Water Year Classification System Based on San Lorenzo River Runoff (by water year type)



Section 3.05 Forecast of Current and Future Water Demand

(a) Water Demand and Growth – the City General Plan

At its August 1, 2014 meeting, the Water Supply Advisory Committee agreed that using water scarcity to change the assumptions about the City's future growth and development, as laid out in the 2010 Council adopted General Plan, was not part of the Committee's charge from the Council. In making this agreement, the Committee recognized that there are several growth issues that are within the Committee's purview including, for example, the potential impacts of growth on water demand for the period after that covered by the General Plan.

The Committee also acknowledged the requirements in the California Urban Water Management Planning Act (Water Code Section 10631) requiring that "… The projected population estimates shall be based upon data from the state, regional, or local service agency population projections within the service area of the urban water supplier and shall be in five-year increments to 20 years or as far as data is available."

(b) Water Demand and Growth – UCSC Future Demands

Significant work has been done to update the water demand forecast used in the 2010 Urban Water Management Plan. This demand forecast incorporates the changes in population and development that were part of the City's General Plan update as well as whatever up to date information was available at the time for the Water Department's outside-city service area.

The University's estimated build-out demand is 349 mgy. The WSAC did not generate an independent estimate of UCSC demand. The 349 mgy figure for the University's build-out demand is based in part on its 2005 - 2020 Long Range Development Plan with added demand for the University's Marine Science and Delaware Street facilities. The only change made by City staff to the University water demand was to extend the previous forecast of 349 mgy in 2030 further out into the future to reflect a lower, more realistic, rate of growth, with two potential endpoints: 2035 and 2050. In the lower bound forecast, build-out occurs in 2050. In the upper bound forecast it occurs in 2035. The primary forecast is the midpoint between the lower and upper bound forecasts. The forecast of UCSC demand is given in Table 2. The primary forecast almost exactly replicates a forecast based on projected enrollment and average rates of water use per student.[4]

Table 2 – Primary, High and Low Projections for University Growth

	2013*	2020	2025	2030	2035
Low	182	186	213	240	268
Primary	182	196	234	271	308
High	182	207	254	302	349

Notes

*Actual per Water Department billing records.

[4] The enrollment-based approach yields a 2035 demand of 304 MG, which differs from the primary forecast by less than 2%.

(c) Interim Demand Forecast – February to April 2015

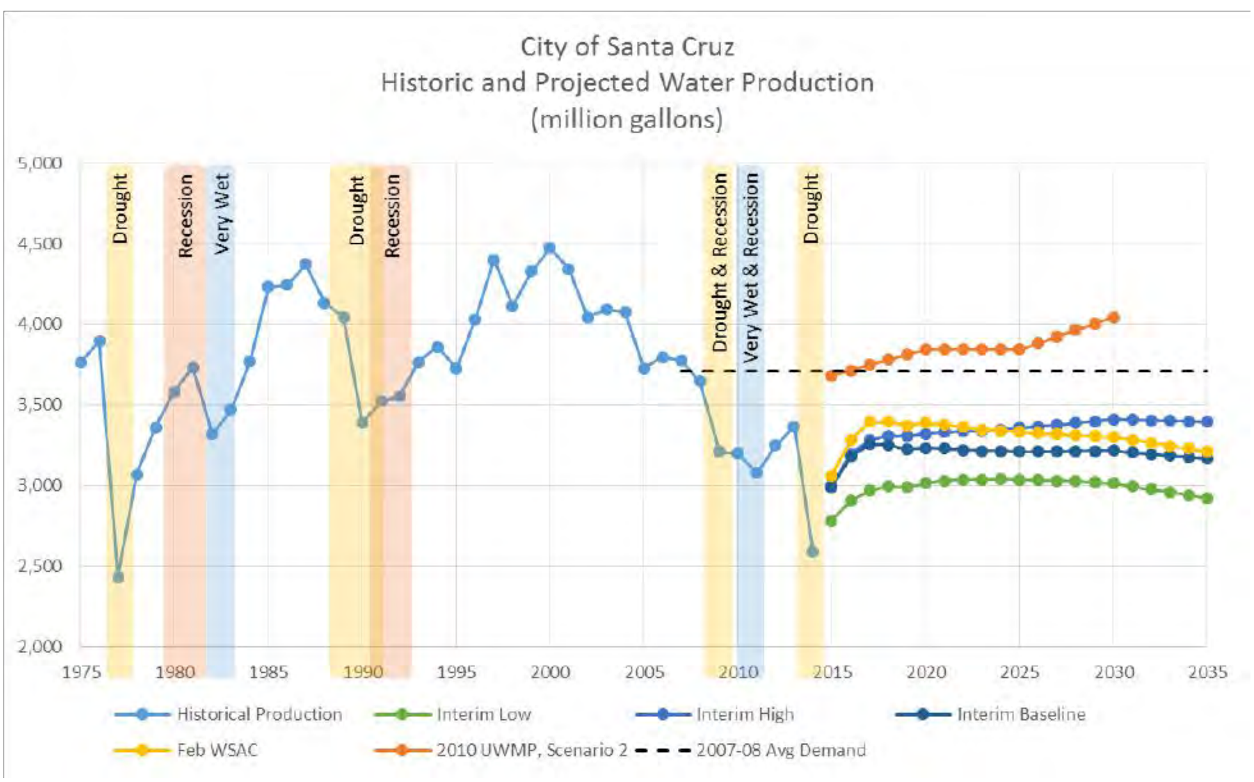
An interim demand forecast was developed by working from the demand forecast used in the 2010 Urban Water Management Plan. The 2010 Urban Water Management Plan demand forecast incorporates the changes in population and development that were part of the City's General Plan update as well as whatever up-to-date information was available at the time for the Water Department's outside-city service area at the time. Working from the 2010 forecast, the interim forecast incorporated a number of key changes including:

- Incorporating effects of existing, ongoing water conservation programs,
- Integrating the expected impacts of changes in the state's building and plumbing codes that will affect future water use in both existing and new construction,
- Adding into the forecast the effects of income changes and price increases on water use,
- Revising the projected growth of commercial services, and
- Using the university's projection of its ultimate build-out demand but extending its time for completion as described above.

The result was a forecast for current and future demand that looks substantially different from the 2010 Urban Water Management Plan forecast. Most notably, the revised forecast no longer shows an increase in water demand during the coming 20 years.

Figure 3 below portrays the interim demand forecast and incorporates the changes described above as well as the revisions to the University's growth projections described above.

Figure 3 – April 2015 Interim Demand Forecast with High and Low Forecasts



An explanation of how the high and low demand forecasts were developed can be found in the April 17, 2015 Technical Memo included in Appendix 1.[5]

At the April 30 – May 1, 2015 meeting the Committee agreed that this interim forecast would be used as the basis for the Committee's work until the results of the econometric forecast became available.

(d) Econometric Demand Forecast – July to September 2015

The forecast of future water demand is a foundational component to any water utility of its future needs for water supply. In recent years the historical patterns of water demand have been upended by a variety of factors, including the cumulative effects of tighter efficiency standards for appliances and plumbing fixtures, greater investment in conservation, a significant uptick in water rates, an equally significant downturn in economic activity during the Great Recession, and on-going drought. These events have resulted in even more uncertainty than usual regarding future water demand and have placed even greater importance on sorting out the effect each has had on demand in recent years as well as how they are likely to affect demand going forward.

One of the first requests made by the WSAC was for the Water Department to update the demand forecast to reflect current information on water usage and to account for effects of conservation, water rates, and other factors expected to impact the future demand for water.

i) Statistical Models of Average Demand

Econometric demand forecasting develops statistically-based models of average water use per service by customer class. A demand forecast was developed based on these models covering the period 2020-2035 and incorporating empirical relationships between water use and key explanatory variables, including season, weather, water rates, household income, employment, conservation, and drought restrictions. The approach builds on similar models of water demand developed for the California Urban Water Conservation Council (Western Policy Research, 2011), Bay Area Water Supply and Conservation Agency (Western Policy Research, 2014), California Water Service Company (A&N Technical Services, 2014, M.Cubed 2015), and Contra Costa Water District (M.Cubed 2014).

The statistical models of demand were estimated using historical data on customer class water use, weather, water price, household income, conservation, and other economic variables driving water demand. The monthly models of water demand were combined with service and housing growth forecasts to predict future water demands. The demand models explain 90 to 99% of the observed variation in historical average use over the 14-year estimation period.

The forecasts of average demand by customer class are summarized in Table 3. The forecasts include adjustments for future effects of water rates, plumbing codes and the City's baseline conservation program[6] and are predicated on average weather and normal (predicted) income and growth.

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[5] Appendix 1 includes Technical Memos on Demand Forecasts authored by M.Cubed (D. Mitchell) and City Staff.

[6] The baseline conservation program level is Program A in the City's forthcoming water conservation master plan.

Table 3 – Forecasted Average Demand by Customer Class (CCF/Year)[7]

YEAR		2013	2020		2025		2030		2035	
	Per	Actual 1/	Forecast	CI	Forecast	CI	Forecast	CI	Forecast	CI
Single Family	Housing Unit	87	86	± 3	83	± 3	80	± 4	78	± 4
Multi Family	Housing Unit	53	56	± 2	52	± 2	50	± 2	49	± 3
Business	Service	405	400	± 12	389	± 12	382	± 13	377	± 13
Municipal	Service	388	296	± 26	290	± 27	283	± 29	277	± 30
Irrigation	Service	365	286	± 28	271	± 28	257	± 28	244	± 28
Golf	Acre	990	671	± 130	641	± 134	606	± 137	593	± 144

1/ Actual use, unadjusted for weather or economy. Stage 1 drought water use restrictions in effect May - Dec.

CI = 95% confidence interval.

ii) Industrial Demand

Because of its unique characteristics, industrial demand was forecasted separately from the other customer categories. In the case of industrial demand, there is a strong relationship between Santa Cruz County manufacturing employment and aggregate industrial water use. This relationship is used to generate the industrial demand forecast shown in Table 4 below.

Table 4 – Industrial Demand Forecast

	2013 1/	2020	2025	2030	2035
Mfg Employment Forecast 2/		5,900	6,200	6,400	6,500
Industrial Water Demand (MG)					
Low	56	56	58	59	60
Primary	56	57	59	61	62
High	56	57	60	63	64

Notes
1/ Actual per Water Department billing records.
2/ Caltrans Economic Forecast for Santa Cruz County.

iii) Population, Housing, and Non-Residential Connection Forecasts

Forecasts of population, housing units, and non-residential connections are anchored to AMBAG's 2014 Regional Growth Forecast (AMBAG 2014). Projected growth in single- and multi-family housing units are shown in Table 5 and projected growth in non-residential services (excluding industrial and UCSC) are summarized in Table 6.[8]

[7] Table 2 through Table 7 are from M.Cubed's August 2015 Draft Final Report on its work developing the econometric demand model, which can be found in Appendix 1.
[8] The decrease in forecasted golf acreage is due to the intention of Pasatiempo golf course to shift to non-City sources of irrigation water.

Table 5 – Forecast of Occupied Housing Units

	2014 [1/]	2020	2025	2030	2035
Inside-City					
Single Family	12,246	12,534	12,780	13,030	13,246
Multi-Family	9,583	10,958	11,398	12,106	12,679
Subtotal	21,829	23,492	24,177	25,136	25,925
Outside-City					
Single Family	6,743	6,922	7,074	7,230	7,390
Multi-Family	7,901	7,910	8,033	8,310	8,495
Subtotal	14,644	14,832	15,107	15,540	15,884
Service Area					
Single Family	18,989	19,456	19,854	20,260	20,636
Multi-Family	17,484	18,868	19,431	20,416	21,174
Total	36,473	38,324	39,284	40,676	41,809

Notes
1/ Actual per Water Department billing records.

Table 6 – Forecast of Non-Residential Services and City-Irrigated Golf Acreage

	2013 [1/]	2020	2025	2030	2035
Business [2/]	1,889	1,948	1,971	2,008	2,055
Municipal [3/]	218	218	218	218	218
Irrigation [4/]	452	651	723	845	951
Golf					
DeLaveaga	79	79	79	79	79
Pasatiempo	68	40	30	20	20
Total Golf	146	119	109	99	99

Notes
1/ Actual per Water Department billing records.
2/ Based on ratio of business to residential demand.
3/ No expected growth in number of municipal services.
4/ Based on historical rate of gain in irrigation services per gain in multi-family and business services.

iv) Demand Forecasts

The primary forecast of system demand is provided in Table 7. Under the primary forecast, total system demand is expected to remain stable at about 3,400 MGY over the forecast period, despite a 13 percent increase in population over the same period. Per capita water use is projected to go from 93 gallons per day in 2020 to 84 gallons per day in 2035, a decrease of approximately 10 percent.

Table 7 -- Primary Forecast of Class Demands and System Production

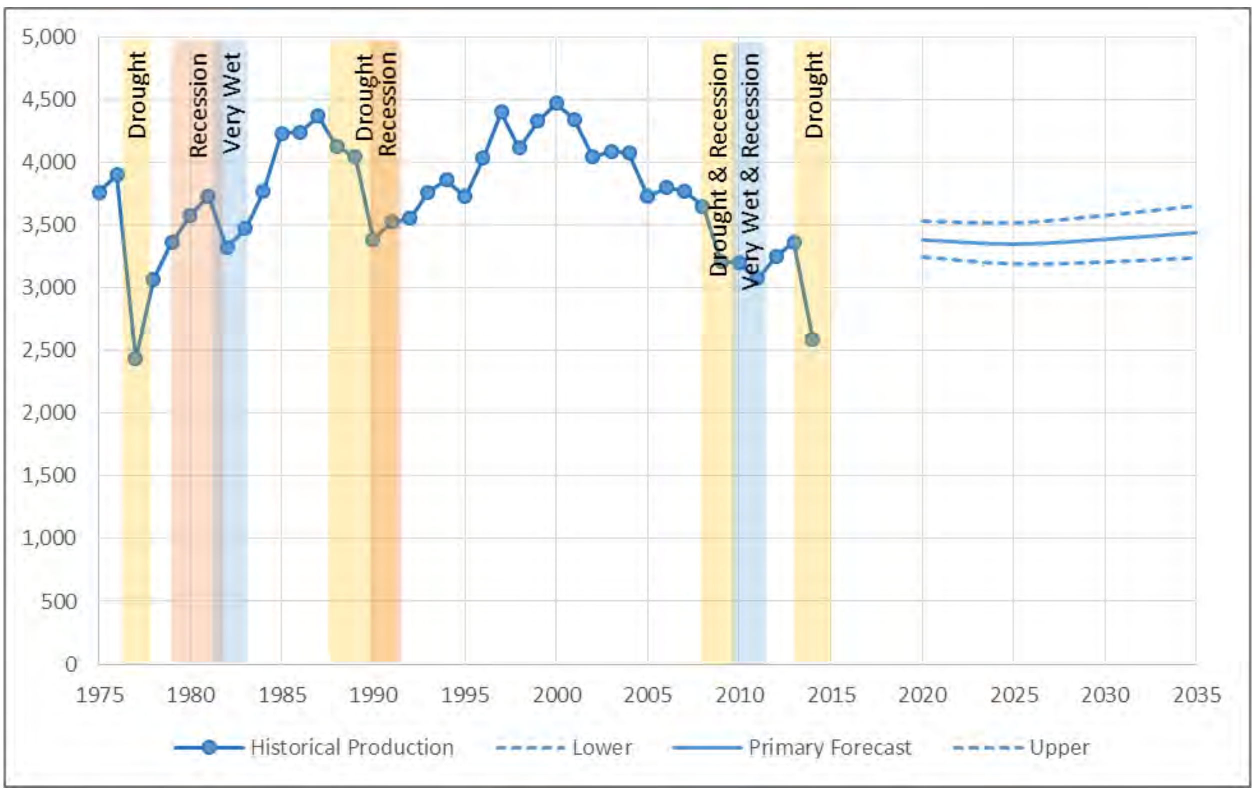
YEAR		**2020**	**2025**	**2030**	**2035**
		Forecast	Forecast	Forecast	Forecast
Service Units	**Units**				
SFR	Housing Units	19,456	19,854	20,260	20,636
MFR	Housing Units	18,867	19,430	20,416	21,174
BUS	Services	1,948	1,971	2,008	2,055
IND	NA	NA	NA	NA	NA
MUN	Services	218	218	218	218
IRR	Services	651	723	845	951
GOLF	Acres	119	109	99	99
UC	NA	NA	NA	NA	NA
Avg Demand	**Units**				
SFR	CCF	86	83	80	78
MFR	CCF	56	52	50	49
BUS	CCF	400	389	382	377
IND	NA	NA	NA	NA	NA
MUN	CCF	296	290	283	277
IRR	CCF	286	271	257	244
GOLF	CCF	671	641	606	593
UC	NA	NA	NA	NA	NA
Annual Demand	**Units**				
SFR	MG	1,256	1,228	1,208	1,196
MFR	MG	792	759	766	775
BUS	MG	583	573	575	580
IND	MG	57	59	61	62
MUN	MG	48	47	46	45
IRR	MG	139	147	163	174
GOLF	MG	60	52	45	44
UC	MG	196	234	271	308
Total Demand	**MG**	**3,131**	**3,099**	**3,134**	**3,184**
MISC/LOSS	MG	254	251	254	258
Total Production	**MG**	**3,385**	**3,351**	**3,388**	**3,442**
Rounded	**MG**	**3,400**	**3,400**	**3,400**	**3,400**

Forecasted demands are significantly lower than the 2010 UWMP forecast. The primary reasons for this are that the 2010 UWMP forecast

1. did not include adjustments for the future effects of passive and active conservation and higher water rates on future water use, and
2. assumed higher UCSC demand.

Figure 4 shows a comparison of historical production and the primary, lower, and upper bound forecasts from the econometric models. It is interesting to see how historical production has been influenced by weather and economic events. The forecast does not exhibit a similar degree of variability because it is based on average weather and normal economic conditions. In other words, it is a forecast of *expected future demand*. Realized future demand will certainly not be smooth like the forecast. It will vary about the expected value depending on year-to-year variation in future weather and economic conditions. The forecast, however, provides the baseline around which this variability is likely to occur.

Figure 4 – Historical and Forecast Production in Millions of Gallons[9]



9 An explanation of how the high and low demand forecasts from the economic demand model were developed can be found in the August 2015 City of Santa Cruz Water Demand Forecast report included in Appendix 1.

(e) Committee Agreement(s)

At the Committee's April 30 – May 1, 2015 meeting they agreed that the interim forecast would be used as the basis for the Committee's work until the results of the econometric forecast became available.

At its July 23, 2015 meeting, the Water Supply Advisory Committee agreed to use the econometric demand forecast as presented by David Mitchell of M Cubed Consulting at this meeting.

On September 10, 2015, the Committee accepted a revised forecast that corrected an error in the way that future plumbing and building code changes were incorporated into the forecast. Figure 4 above, reflects the revised, corrected forecast.

(f) List of Key Assumptions for Econometric Demand Forecast

- Future growth rates for service area population, housing units, and service connections are based on AMBAG's 2014 Regional Growth Projections and the City's General Plan.
- UC demand at build-out is assumed to be 349 MGY. Upper- and lower-bound demand forecasts assume UC build-out occurs in 2035 and 2050, respectively. The primary forecast uses the midpoint of the upper- and lower-bound forecasts.
- Future demand is progressively adjusted for expected water savings from national appliance standards (clothes and dish washers), California plumbing codes (showerheads, faucets, toilets, and urinals), and continuation of the City's basic conservation programs. These adjustments total approximately 370 MGY by 2035.
- The Pasatiempo Golf Course is assumed to shift off of City water so that by 2030 no more than 20 acres of the course (29%) are irrigated with City water.
- Water rates are assumed to increase by an average of 10% per year for the next five years and by an average of 4.4% per year thereafter.
- Median household income is assumed to grow at its long-term historical rate of growth (based on 30 years of census data).
- Regional unemployment and housing vacancy rates are assumed to equal their long-term average rates.
- Monthly rainfall and average maximum daily air temperature are assumed to equal their 30-year normal values.
- No restrictions on water use due to drought or other reason are assumed to be in place. The forecast assumes unrestricted customer water demands.

Section 3.06 Analysis of Supply Available to Meet Current and Projected Future Water Demand[10]

The projected change in demand has had an immediate and important impact on the analysis of the adequacy of current supply to meet demand. Essentially the projected stabilization and longer term reduction in demand would allow the water system to fully meet customer demand, under natural

[10] Appendix 2 includes Technical Memos used in the analyses described in Sections 3.06 and 3.07.

(unconstrained) flow conditions, even in historically worst case conditions such as the 1976-1977 drought.

City staff and members of the technical team discussed this result and recognized that modeled results based on historic hydrological information underestimate the real-world likelihood of curtailments being implemented. This is because water managers making decisions in the late winter and spring of one water year may act more conservatively than the model to conserve storage in light of the uncertainty the coming months and the next water year will bring. In fact, this reality was behind City staff's recommendation for implementing Stage 3 water restrictions in the spring of 2015.

The key assumption of using natural (unconstrained) flow conditions is also an important one. Natural flows mean no externally driven constraints on the City's ability to withdraw water from its existing sources, except for those associated with the City's water rights. The likelihood of this condition being the case in the future is low. The more likely case is that the City's ability to withdraw water from its supply sources will be affected by both the need to release water for fish flows (to meet the federal and state requirements for the protection of threatened and endangered coho salmon and steelhead trout) and the impact climate change will have on available resources resulting in changed hydrology and increased likelihood of extended droughts. The implications of both of these factors on the City's future supply are discussed in more detail in the next sections.

(a) Future Challenges – Fish Flow Releases

The City has not yet finalized a flow agreement with state and federal fishery agencies. Two flow regimes have been identified and were used by the WSAC to assess water supply reliability. The lower bound flow regime is called "City Proposal" and the upper bound flow regime is called "DFG-5." Both result in less water available for diversion than the natural flows discussed above and both have different impacts on the long-term availability of water to meet City needs.

i) Potential implications of Fish Flow Releases on the Frequency and Severity of Water Shortages

Table 8 and Table 9 respectively show the forecasted peak-season shortage profiles in 2020 and 2035.

Table 8 – 2020 Shortage Profiles

2020 Shortage Profiles						Worst-Year Peak-Season Shortage
FLOWS	Likelihood of Peak-Season Shortages					
	0%	<15%	15%-25%	25%-50%	>50%	
	0	<300 mg	300-500 mg	500-1000 mg	>1000 mg	
Natural	100%	0%	0%	0%	0%	0%
City Prop	86%	12%	0%	1%	0%	34%
DFG-5	81%	10%	7%	1%	1%	68%

Table 9 – 2035 Shortage Profiles

2035 Shortage Profiles						Worst-Year Peak-Season Shortage
FLOWS	Likelihood of Peak-Season Shortages					
	0%	<15%	15%-25%	25%-50%	>50%	
	0	<305 mg	305-515 mg	515-1025 mg	>1025 mg	
Natural	100%	0%	0%	0%	0%	0%
City Prop	86%	12%	0%	1%	0%	34%
DFG-5	81%	10%	4%	4%	1%	69%

ii) Committee Conclusions on Fish Flow Releases

The Committee discussed this information and agreed that the following conclusions can be drawn from these profiles:

- With unconstrained natural flows, there are no shortages of any magnitude under any hydrologic condition. Since we saw above that there are no expected shortages under worst-year conditions, this is not surprising.
- As expected, the DFG-5 profile is worse (i.e., results in a higher likelihood of larger shortages) than the profile for City Proposed flows. For example, in both forecast years, there is about a 10% likelihood (7 out of 73 years) of a peak-season shortage larger than 15% under DFG-5. This compares to around 1% (1 out of 73 years) under the City Proposal.
- Even under the most stringent flow regime (DFG-5), there are no expected shortages in 80% of historic hydrologic conditions. Without taking into account the possible impacts of climate change, the City's supply reliability challenges have been and will continue to be in the driest years.
- The 2020 and 2035 profiles are similar since the forecast demands for those two years are similar.
- The key conclusion is that under baseline conditions, and assuming that future hydrology looks like the historic record, the City would have sufficient supply to serve its demands in the absence of any HCP flow restrictions. Under either of the habitat conservation plan flow proposals, the City faces peak-season shortages in the driest hydrologic conditions. In those driest years, those shortages can be significant, around 700 million gallons under City-Proposed flows and 1.2 billion gallons under DFG-5 flows.

iii) Key Assumptions about Fish Flow Releases

Fish flow assumptions used in the WSAC process are based on two key data sets:

- The City's July 2012 flow proposal to state and federal agencies for flow releases for the San Lorenzo River and Laguna and Majors creeks and Liddell Springs (City Proposal); and
- The September 2012 response received from the (then) California Department of Fish and Game suggesting modifications to the City Proposal (DFG-5).

Both fish flow regimes are designed to address flow requirements needed to maintain habitat for endangered coho salmon and threatened steelhead trout during their various fresh water life-stages. Both flow regimes are indexed to the amount of water available using a modified version of the year class types shown in Figure 1 and Figure 2, which divide years into five rather than four categories and specifically link flow releases for a coming month to the year class type for the amount of water in the system in the previous month.

The ultimate resolution of fish flow requirements for the City's sources of supply will be the result of the City's negotiations with state and federal fishery agencies. Negotiated flows will be the foundation of a habitat conservation plan for the City's water system. At the completion of the environmental review of the habitat conservation plan, the City will receive a long term permit, called an Incidental Take Permit (and a state version), that will give the City an ability to plan for and operate its water system with long term certainty.

iv) Committee Agreements on Fish Flow Releases

On April 30, 2015, the WSAC agreed that, for planning purposes, using the DFG-5 flows as an upper bound or the potential impacts of fish flow releases on Santa Cruz's water system made the most sense. If the ultimate negotiated flow releases are lower, then the supply demand gap will be smaller and those results can be incorporated into future planning for supply augmentation.

(b) Potential Impacts of Climate Change

The second potentially significant factor to impact the City's current water system is climate change. With California in the throes of a deep multi-year drought, the City's water system may already be experiencing the impacts of climate change. For example, with the exception of the summer of 2011, the City has imposed some form of water restrictions on its customers every year since 2009. And this year's second consecutive year of rationing is unprecedented.

The Water Supply Advisory Committee explored the impacts on future water supply reliability of two potential manifestations of climate change:

- Longer and more severe extended droughts; and
- Changes in ongoing hydrologic patterns.

i) Extended Droughts

As the Committee began to delve into the issue of climate change, the Technical Team conducted a brief literature search to frame the discussion. A summary of information related to drought is provided here.

Recent evaluations of paleoclimate records and future climate model projections indicate that longer droughts have occurred in the past and are likely to occur again within the next century. In this section we review paleoclimate and climate change projection studies relevant to drought planning in California and the Santa Cruz region. Several publications, including some very recent ones, compare modern climate observations to historical records and to future climate projections.

Fritts (1991) shows that droughts in the Santa Cruz region were frequently much longer than three to eight years. Paleoclimate reconstruction for the California valleys show that precipitation from the 17th century until the 20th century was consistently below average 20th-century values, with long periods of relative drought and short periods of high rainfall. These data show that cycles of below-average precipitation have commonly lasted from 30 to 75 years (Fritts, 1991)[11].

Other paleoclimate analyses, summarized in Fritts (1991), have concluded:

- "The variability of precipitation was reconstructed to have been higher in the past three centuries than in the present" (p. 7).
- "Lower variability occurred in twentieth-century precipitation. Reconstructions of this kind should be used to extend the baseline information on past climatic variations so that projections for the future include a more realistic estimate of natural climatic variability than is available from the short instrumental record" (p. 8).

A recent publication by Cook et al. (2015)[12] compares paleoclimate drought records with future predicted conditions based on climate change models. Using tree ring data and current climate models, the authors found that drought conditions in the coming century are likely to be as bad as or worse than the most severe historical droughts in the region, with severe dry periods lasting several decades (20–30 years). In some cases, winter precipitation may increase, but gains in water during that period will most likely be lost due to hotter, drier summers and greater evaporation.

Other recent studies linking climate change, precipitation changes, and drought conditions have found that warming temperatures greatly increase drought risks in California (Diffenbaugh et al., 2015)[13].

The historic hydrologic record on which all of the prior analyses of Santa Cruz water supplies are based only goes back to 1937. This record therefore cannot adequately capture the kind of historic variability found in these paleoclimate studies and by extension the conditions the City might face under future conditions of climate change. The WSAC technical team created an extended-drought planning scenario that represents a discrete plausible future event that can help guide water resource planning in Santa Cruz. Building on examples from utilities around the state, the Santa Cruz extended drought planning sequence combines and places back to back the City's two worst drought sequences: 1976-77 and 1987-92. This eight-year drought sequence is worse than anything in the historic hydrologic record, but is intended to represent what might be experienced under climate change. It was combined with each of the fish flow proposals discussed above and evaluated for the frequency and severity of the shortages that would be produced. Table 10 summarizes these results.

[11] Fritts, H.C. 1991. Reconstructing Large-Scale Climatic Patterns from Tree-Ring Data: A Diagnostic Analysis. University of Arizona Press, Tucson, AZ.
[12] Cook, B.I., T.R. Ault, and J.E. Smerdon. 2015. Unprecedented 21st century drought risk in the American southwest and central plains. Science Advances 1(1):e1400082. doi: 10.1126/sciadv.1400082
[13] Diffenbaugh, N.S., D.L. Swain, and D. Touma. 2015. Anthropogenic warming has increased drought risk in California. PNAS. doi: 10.1073/pnas.1422385112.

Table 10 – Extended drought peak-season shortage statistics (mg)

	City Proposal	DFG-5
Total 8-year (mg)	875	5,300
Average	5%	33%
Maximum	34%	69%
Minimum	0%	0%
Years > 20%	1	7

The key take-away message from Table 10 is that combining a multi-year drought with a significant commitment to fish flow releases would result in serious water shortages for Santa Cruz's water service customers. In the eight years modeled, customers would face curtailments of greater than 20% in seven out of the eight peak seasons. On average the shortage would be 33% and in the worst year the shortage would be nearly 70%.

To put these data in perspective, prior to the droughts occurring in water years 2014 and 2015 (October 1, 2013 through September 30, 2015) Santa Cruz's residential customers used on average about 60 gallons of water per person per day (gpcd). On average, during the extended drought modeled in this analysis, residential use would have to be reduced to 40 gpcd, and in the worst year, residential use would need to be reduced to 18 gpcd.

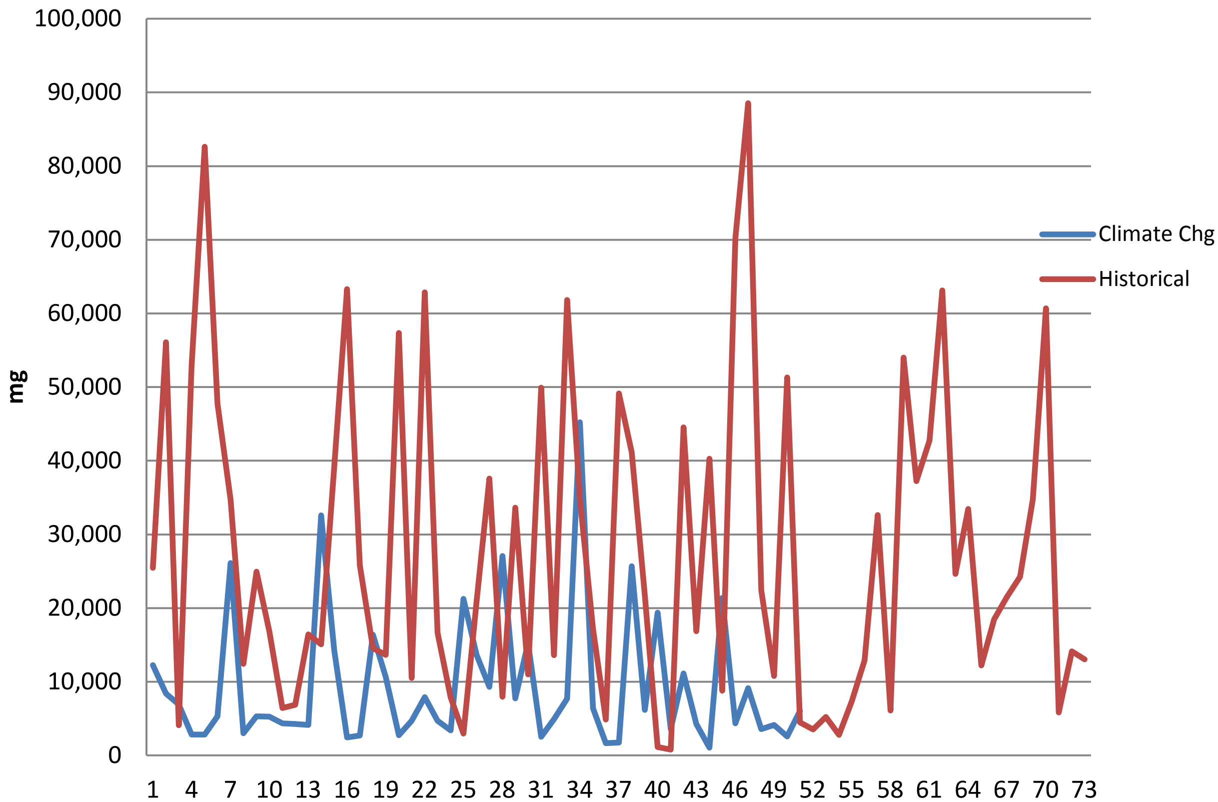
ii) Changes in Ongoing Hydrology

Across hundreds of modeling runs evaluating Santa Cruz water supplies, beginning with the 2003 Integrated Water Plan, the essential characteristics of the historic hydrologic flow record have remained constant. The worst drought event was 1976–1977. The 1987–1992 period represented another major drought. It was clear which years in the record were very wet and which were exceptionally dry.

This historical foundation on which to plan and operate water systems no longer applies when analyzing how the system will respond to potential changed hydrology driven by climate change. The essence of analyzing this type of climate change is the assumption that future weather and stream flows will not be the same as the past.

To analyze the plausible impact of climate change, a new 51 year flow record has been produced by working with hydrologic conditions that would occur in a selected global climate model and downscaling those conditions to Santa Cruz's sources and local conditions. In the resulting flow projection, there is no longer a 1976–1977 worst-case drought benchmark or a 1987–1992 sequence. As is illustrated in Figure 5 for City proposed HCP flows at Big Trees, a standard and long-term flow gauging station on the San Lorenzo River, the distribution of flows is completely different from that of the historic record.

Figure 5 – Comparison of annual flows at Big Trees: City proposal



While the worst years in the climate change scenario are no worse than the driest historic years, the overall pattern is a considerably drier one, which might be expected to result in a higher fraction of years in which there is insufficient water to meet the needs of both Santa Cruz water customers and fisheries.

iii) Committee Agreements on Climate Change

On April 30, 2015, the WSAC agreed that the Climate (hydrologic) Change and Extended Drought scenarios provide plausible parameters to use in its water system planning and that this analysis provides a useful point of depart for its scenario planning work. For planning purposes, the Committee agreed that the eight year drought sequence was useful as a design drought, and recognized that this drought sequence would be reviewed and revised as new information became available.

iv) Key Assumptions about Climate Change

Use of climate change projections to assess potential impacts to water supply carries the following major assumptions.

1. The utilized climate projections provide plausible climate trajectories, not predictions, for the future time period simulated.
2. The utilized climate projections provide reasonably bounded potential impacts/trends to water supply for the future time period simulated.

3. The physical character and nature of the watersheds utilized by the City for water supply will not change appreciably for the future time period simulated, specifically including:
    a. The physical characteristics which lead to development of surface runoff including types, spatial patterns and intensities of land use, and landscape scale vegetative communities and
    b. The physical expression of instream habitat conditions based on channel morphology types, occurrences, etc.
4. Historical hydrologic characteristics of supply source watersheds are a reasonable basis to simulate general hydrologic conditions under future climate trajectories, specifically including:
    a. The distribution of average daily flows for any month of the year over the historical period will not change appreciably during the future time period simulated and
    b. The relative timing and magnitude of average daily flows between supply source watersheds will not change appreciably during the future time period simulated.
5. Historical utilization or exercising of water rights within the supply source watersheds will not change appreciably during the future time period simulated, and includes water rights held by the City, other water purveyors, and others.
6. Summertime and late fall stream flows will be the primary limiting condition for water supply and instream habitat, as it has been during the historical time period, for the future time period simulated.

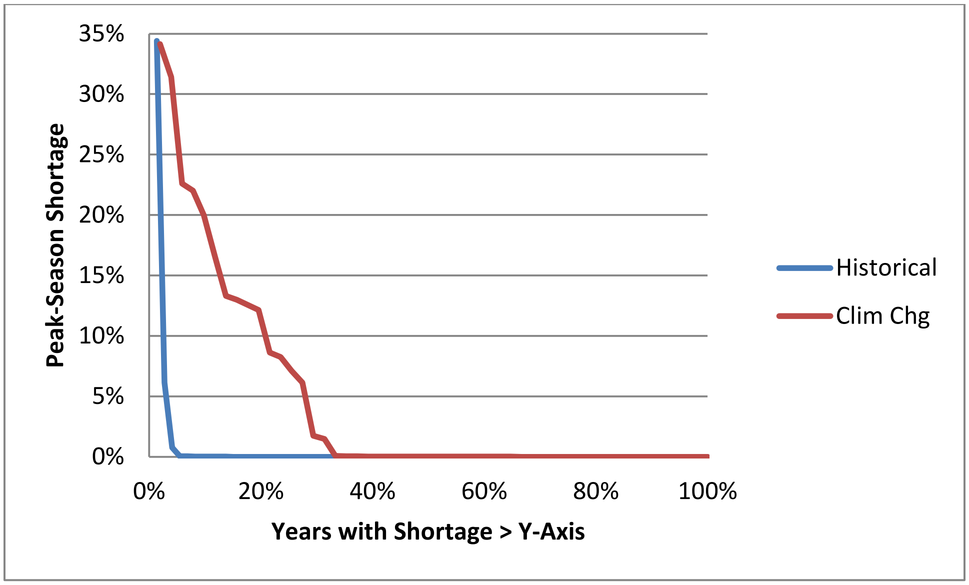
Section 3.07 How Climate Change Affects the System Modeling Results:

Combining potential fish flow releases and climate change impacts shows that climate change results in increasing both the frequency and the size of shortages. The discussion below summarizes and explores these results.

(a) City Proposed Flows

Figure 6 compares the peak-season shortage duration curves for City Proposed flows with and without climate change.

Figure 6 – Peak season shortage duration curves with and without climate change: City Proposed Flows

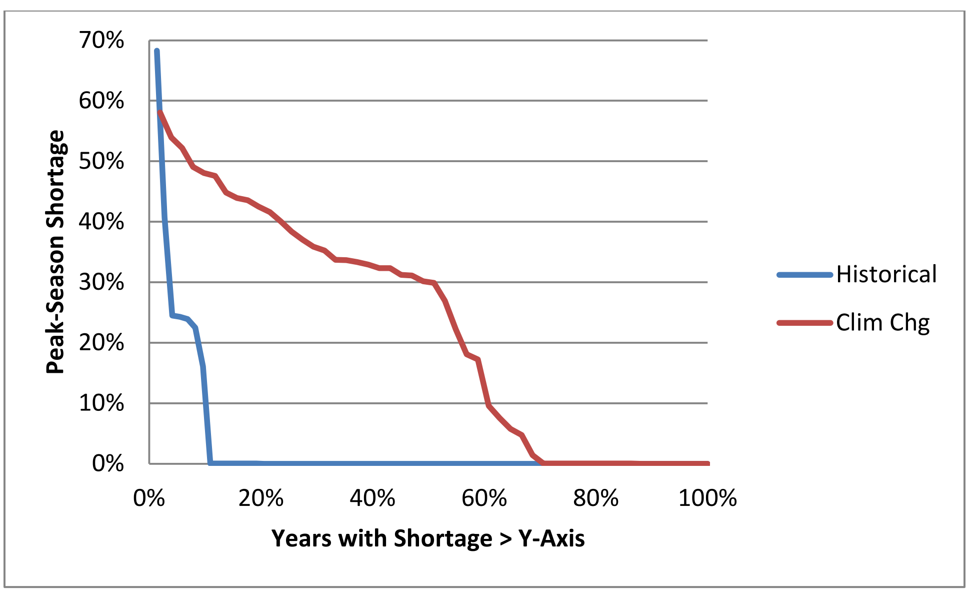


The differences between the two curves are immediately noticeable: Climate change shifts the curve upward and to the right, meaning there is an increased likelihood of larger shortages. Whereas with historic flows, there is a small chance (< 10%) of any shortage at all, this rises to more than 20% with climate change. The probability of a shortage greater than 20% increases from about 1% with historic flows to about 8% with climate change.

(b) DFG-5 Flows

Figure 7 shows the same system reliability comparisons for DFG-5 flows.

Figure 7 – Peak season shortage duration curves with and without climate change: DFG – 5 flows



While the types of impacts are similar, their magnitudes with DFG-5 are increased. For example, with DFG-5 flows and climate change there will be a peak-season shortage under nearly 70% of hydrologic conditions. In fact, a shortage exceeding 25% can be expected in just over half the years.

The foregoing results are consistent with the flow patterns of Figure 5, and highlight the importance of considering climate change as Santa Cruz plans for its water supply future. Even under the City's proposed HCP flows, which represent the potential lowest impact to Santa Cruz's water supply, water customers would have to contend with frequent shortages under this climate change scenario. If the outcome of the HCP negotiations are closer to the California Department of Fish and Wildlife's (CDFW's) DFG-5 proposal, the frequency and magnitude of shortages becomes much more onerous.

Thus with climate change, the City's water future will look qualitatively different. With historical flows, while there is a real possibility of large peak-season shortages, these are generally confined to the driest years with the large majority of conditions having no shortages. Clearly, that will not be the case with the impact of climate change. Instead, significant shortages can be expected in many years. With DFG-5 flows, large shortages can be expected in the majority of years. The pattern of water availability to customers will be markedly altered and water rationing will be both more frequent and more severe.

Section 3.08 Problem Statement

Based on the preceding analysis, the WSAC recommendations are designed to address the following revised problem statement:

> *Santa Cruz's water supply reliability issue is the result of having only a marginally adequate amount of storage to serve demand during dry and critically dry years when the system's reservoir doesn't fill completely. Both expected requirements for fish flow releases and anticipated impacts of climate change will turn a marginally adequate situation into a seriously inadequate one in the coming years.*
>
> *Santa Cruz's lack of storage makes it particularly vulnerable to multi-year droughts. The key management strategy currently available for dealing with this vulnerability is to very conservatively manage available storage. This strategy typically results in regular calls for annual curtailments of demand that may lead to modest, significant, or even critical requirements for reduction. In addition, the Santa Cruz supply lacks diversity, thereby further increasing the system's vulnerability to drought conditions and other risks.*
>
> *The projected worst-year gap between peak-season available supply and demand during an extended drought is about 1.2 billion gallons. While aggressive implementation of conservation programs will help reduce this gap, conservation alone cannot close this gap. The Committee's goal is to establish a reasonable level of reliability for Santa Cruz water customers by substantially decreasing this worst-year gap while also reducing the frequency of shortages in less extreme years.*

On September 11, 2015 meeting, the Committee adopted this formal problem statement. The basic understandings reflected in this problem statement underpin all the work the Committee did during the Analysis Phase of its process to identify, evaluate and select strategies for improving the reliability of Santa Cruz's water supply.

The Committee also noted that the Water Department is already taking steps to address the supply-demand gap, including incorporating into its Capital Improvement Plan funding for replacement of the pipeline between Felton and Loch Lomond.

Section 3.09 Data Driven Decision Making

The Council asked the Committee to "… explore, through an iterative, fact-based process, the City's water profile, including supply, demand and future risks; analyze potential solutions to deliver a safe, adequate, reliable, affordable and environmentally sustainable water supply and develop recommendations for City Council consideration."

After defining the problem, the Committee worked hard to use a fact-based process in its work. Section 3.10 summarizes the work the Committee did to:

- Identify and evaluate alternatives, to
- Identify and apply committee's evaluation criteria, and
- Use scenario planning and portfolio building to explore risks and uncertainties.

Section 3.10 Evaluation Criteria

Criteria that enable one to distinguish among potential solutions are essential for effective problem solving. Understanding how various alternatives or portfolios of alternatives rate against those criteria is at the heart of the Committee's problem solving process. The development of the multi-criteria decision support (MCDS) model provided a focal point for the definition of criteria, subcriteria, and rating scales. Committee members also individually prioritized the criteria by applying weights to them. A key purpose of using this approach is to support data-driven decision-making.

The Council's charge to the Committee emphasizes the importance of data-driven decision making. The goal of developing and using a MCDS tool is not to produce an outcome by "pouring in the ingredients, turning the crank and having the answer come out."

No analytical tool can (or should) completely replace the judgment and careful weighing and balancing of values, uncertainties, and risks in this kind of decision-making. Rather the goal of using such a tool is to help develop information in a form that decision-makers can effectively and efficiently use as they make their decisions.

An additional benefit is that the careful thought that goes in to the creation of the MCDS tool creates many opportunities to talk about values and interests that are important to address as the collaborative problem solving process proceeds. Creating the MCDS model required the WSAC to identify important criteria and subcriteria, define what is meant by those criteria, establish individual weights for the criteria, and create rating scales for each criterion. When the model was applied to the alternatives or portfolios the Committee developed, it allowed Committee members to see how their evaluations of the options were similar and different, and how their values were reflected in the way they prioritized the criteria.

Table 11 lists the evaluation criteria used by the Committee in the MCDS evaluation it conducted in the spring of 2015. The questions articulated in the table reflect what was relevant at the time the Committee used these criteria in their work.

In addition to using these criteria in that formal evaluation, these criteria were used more informally through much of the Committee's work during the Spring and Summer of 2015 as they worked together to identify and evaluate portfolios of measures to improve the reliability of Santa Cruz's water supply.

Table 11– WSAC Evaluation Criteria

Criterion	Questions
Technical Feasibility	How likely is each Plan to be technically successful? For Plan B, consider the technical feasibility at the time the plan would actually start
Time Required to Demonstrate Technical Feasibility	How much time is required to demonstrate whether a Plan is technically feasible? When rating Plan B, start from the time Plan B actually begins.
Time Required to Full Scale Production	What is the time required to full scale production? For all Plans, start the clock when the Plan is permitted, has all needed rights and property ownership issues resolved and is ready to proceed.
Adaptive Flexibility (includes Scalability)	What benefits in terms of adaptive flexibility is each Plan likely to contribute in the face of external conditions such as climate change, demand levels or streamflow requirements?
Supply Reliability	How likely would each Plan be to improve the reliability of the Santa Cruz water system in the face of different operating conditions such as turbidity, low flows, etc.?
Supply Diversity (Portfolio Level Only)	How does the Portfolio affect the diversity of Santa Cruz water supply portfolio?
Energy Profile	How much energy does each Plan require? Units are megawatts of energy per million gallons produced, mw/mg expressed as weighted average by Plan.
Environmental Profile	What is the environmental profile of each Plan? Note: this criterion covers a range of issues and a diversity of Plans. This is a great place to provide details about your rating using the comment button.
Regulatory Feasibility	How easy or difficult would the regulatory approval process be for these Plans?
Legal Feasibility	How easily and within what time period are these Plans likely to obtain the necessary rights in the form needed? When considering a Plan B that would start after a trigger, start the clock at the point at which the trigger actually occurs.
Administrative Feasibility	To what degree do each of the Plans require cooperation, collaboration, financial participation, and/or intergovernmental agreements to succeed? How likely is it that these can be obtained?
Potential for Grants or Special Low Interest Loans for Engineering and/or Construction	What is the potential for these Plans to qualify for grants and/or special low interest loans?
Political Feasibility	What level of political support is each Plan approach likely to have? When rating Plan B, take into account the impacts of additional time and the (hypothetical) failure of Plan A would have on Santa Cruz's political landscape.
Cost Metrics	How much do each of these Plans cost? Metric is annualized unit cost in dollars per million gallons, $/mg.

Appendix 3 provides the detailed criteria the Committee used in its MCDS modeling and portfolio-building exercises conducted in the spring and summer of 2015.

(a) Identifying and Evaluating Solutions[14]

The WSAC used an iterative process to identify and evaluate alternative approaches to improving the reliability of the Santa Cruz water supply. Their efforts began with their work in the summer and fall of 2014 to identify a full range of demand management and water supply options for consideration. Since then, the WSAC, City staff and the technical team supporting the WSAC have invested considerable resources in developing and fleshing out demand management and supplemental water supply and infrastructure addition and operating change options to develop more specific planning level information for use in evaluating alternatives.

This section, describes the Committee's iterative process for identifying and evaluating alternatives to improve the reliability of the Santa Cruz water supply.

i) Alternatives Identification: Our Water, Our Future – The Santa Cruz Water Supply Convention

During the community discussions of the desalination Draft Environmental Impact Report (DEIR), a common criticism was that the City hadn't adequately evaluated other alternatives during the decades of water supply planning that preceded the selection of desalination in the Integrated Water Planning process in early 2000s. A key element of the Council's decision to convene the WSAC was to have a community based process to consider alternatives to solve the water supply problem. The goal was to look in more detail at alternatives to desalination while not excluding desalination from further consideration.

As the Committee got underway in the spring of 2014, it was clear that a handful of very engaged citizens had ideas they wanted to share with the Committee regarding how to improve the reliability of the Santa Cruz water system. The challenge was to make sure that all those who might have ideas to share would have the opportunity to do so.

In June, the WSAC decided to include in its Reconnaissance phase an event that would engage the broader public by inviting those with strategies, alternatives, or ideas for improving water supply reliability to submit their proposals. The goal was to ensure that citizen and community-based ideas, as well as those provided by the technical team and other outside experts, were considered as possible strategies to improve water supply reliability in the Santa Cruz water system.

By late July, the Committee was starting to receive submissions covering a wide range of topics including but not limited to:

- Enhancing conservation efforts
- Climate appropriate landscaping improvements
- Expanding rainwater catchments and grey water systems
- Incentivizing conservation through pricing structures

[14] See Appendix 4 – Identifying and Evaluating Alternatives for Committee work products and related Technical Memos.

- Revisiting old strategies such as exchanging highly treated wastewater for irrigation water used for north coast agriculture
- Developing recycled water facilities and systems
- More groundwater development
- Aquifer storage and recovery
- On-stream and off-stream storage projects
- Desalination using a variety of existing and new approaches and technologies for both the desalination process and the energy issues related to desalination.

In August those submitting ideas in the first round were invited to further develop their proposals for submission to the WSAC and for public review at an event called "*Our Water, Our Future – the Santa Cruz Water Supply Convention*."

The *Convention* was held from 11:00 a.m. to 9:00 p.m. on Thursday, October 16, 2014 at the Civic Auditorium. More than 40 ideas were presented in poster session presentations set up around the hall. Brief oral presentations by the submitters were provided at noon and at 6:00 p.m. and attendees were invited and encouraged to visit the poster presentations of strategies, ideas, and alternatives and to interact with the submitters.

Approximately 350 people attended the convention. Attendees included most of the members of the WSAC, members of the City Council, and many staff members of the Water Department. WSAC members practiced rating and ranking the proposals using four criteria: effectiveness, environmental impact, community impact, and practicability.

Following the conclusion of the *Convention*, the WSAC continued to accept ideas and alternatives for addressing the issues that have been identified. The most recent proposal, a project for storing water in Hanson Quarry, was received in early January 2015. The Committee's purpose in keeping the door open for submission of new proposals was to ensure that the arbitrary exercise of a deadline did not keep a great idea from being considered.

ii) Selected Alternatives

Between the Committee's October and November meetings, WSAC members provided their technical consultant, Stratus Consulting, with their input on the alternatives identified in the *Convention* that they were most interested in considering further. Stratus' job was to select a dozen or so alternatives that were representative of a broad range of approaches that the Committee would use in testing the decision model. Alternatives not selected as part of this effort were not eliminated from further consideration, just not selected for further evaluation in the Reconnaissance phase of the Committee's work.

Twelve alternatives were selected by Stratus and approved by the Committee at their November meeting. The alternatives selected were:

- WaterSmart Software Implementation
- Landscaping Revisions, Rainwater Capture and Grey Water Reuse
- Water Neutral Development

- North Coast Off Stream Storage
- The Lochquifer Alternative
- Expanded Treatment Capacity on San Lorenzo River
- Ranney Collectors on San Lorenzo River
- Reuse for Agriculture
- Aquifer Restoration
- Potable Water Reuse
- Reverse Osmosis Desalination
- Forward Osmosis Desalination

The varied and often incomplete nature of the information provided by those proposing many of the alternatives submitted in the Water Supply Convention proved to be a challenge for the Committee, City staff, and the technical team. Almost immediately following the November Committee meeting, information and assumptions about the selected alternatives were needed to support the Committee's use of the Reconnaissance MCDS model. To facilitate this timing, City staff made a variety of assumptions to fill in data gaps and used this information to provide default ratings for the alternatives and scenarios in the MCDS model. Still there is was a critical need to develop reasonably accurate technical details to support further analysis.

iii) Consolidated Alternatives

From the more than 80 initial suggestions and the more than 40 proposals presented by community interests, project proponents, and City staff during and after the October 16, 2014 Water Supply Convention, the technical team created 20 Consolidated Alternatives.

"Consolidated Alternatives" were created from groups of Water Convention Alternatives with similar concepts and attributes. Consolidated Alternatives were created for a range of options and approaches such as additional demand management activities, approaches to improving storage for available system flows in the winter, to developing supply augmentation sources such as using advanced treated recycled water.

Table 12 is a list of Consolidated Alternatives and the Water Convention Alternatives they were inspired by.

Table 12 – Consolidated Alternatives

#	Name/ Water Source	Description	#	Author and comments
CA-01	Peak Season Reduction/ Conservation (mandated)	Develop programs to decrease peak season demands through peak reduction or peak-demand shifting	WCA-69	SCWD: Peak season reductions – 10%, 25% and 50%
CA-02	Water-Neutral Development/ Conservation (mandated)	Implement a demand offset program required for new development to offset new demands	WCA-03	SCDA:Water-Neutral Development
CA-03	Water conservation measures/ Conservation (voluntary)	Implement Program C Recommended (Crec) -- Maddaus Water Management, September 30, 2014, Table 4)	WCA-20	McGilvray (9): Implement Conservation
			WCA-22	SCDA: Conservation Education
			WCA-65	zNano: Conservation rebate program
			WCA-68	SCWD: Program C from Long-Term Water Conservation Master Plan
CA-04	WaterSmart Home Water Reports/ Conservation (voluntary)	Use this software to promote conservation and efficient water use	WCA-04	WaterSmart: Home Water Reports
			WCA-16	Gratz: Maximize Conservation Behavior
CA-05	Home Water Recycling/ Decentralized (graywater)	Package automatic treatment system suitable for single family home or condo or multi-family development; recycles gray water for toilet flushing and landscape irrigation; requires dual plumbing.	WCA-39	Garges: Residential Gray-Water
			WCA-66	zNano: Onsite Water re-use
			WCA-70	Home Water Recycling
CA-06	Landscaping, Capture, Reuse/ Decentralized (rainwater, graywater)	Use gray water for irrigation; minimize irrigation for lawns; capture and use rainwater for domestic, non-potable	WCA-01	Markowitz: Landscaping, Capture, Re-use
			WCA-21	SCDA: Climate Appropriate Landscape

#	Name/ Water Source	Description	#	Author and comments
CA-07	Deepwater Desalination/ Seawater	In cooperation with Soquel Creek Water District, sign up for water delivered from the Deepwater Desalination Project at Moss Landing. Work with SqCWD to create the transfer facilities for potable water conveyance. Upgrade SCWD distribution system to accept water transferred through SqCWD.	WCA-19	McGilvray: (11) Seawater Desal
			WCA-36	Aqueous: Desalination (non-membrane)
			WCA-37	Brown: Zero-emission Wave energy
			WCA-67	Tanaka: Energy Efficient Desal
			WCA-72	Seawater desalination--Deepwater Desalination
CA-08	Water from Atmosphere/ Moist air	Extract water from the air to offset other demands	WCA-38	DewPoint : Atmospheric Water Generation
			WCA-77	SKYH2O
CA-09	Winter flows capture/ Winter flows	Capture winter flows for treatment and storage or infiltration	WCA-29	Malone: Stormwater capture
			WCA-60	SCDA: Watershed Restoration
			WCA-63	Smallman: Water Skate Parks
			WCA-71	SVWD: Quarry storage/GW recharge at Hanson Quarry
			WCA-74	McGilvray: Additional Pipeline--Felton Diversion to Loch Lomond
			WCA-76	Bixler: Olympia Quarry
			WCA-31	McGilvray: (3) Water Capture and Transfers
CA-10	Water Reuse for aquifer recharge/ Reclaimed water	Produce CAT water at City WWTP and pump to SVWD for aquifer recharge (IPR--Indirect Potable Reuse).	WCA-44	McGilvray: (8) Tertiary Treatment, Re-use
			WCA-62	Smallman: (17) Recycled Water
			WCA-64	Weisz: Water Recycling

#	Name/ Water Source	Description	#	Author and comments
CA-11	Water reuse for direct potable/ Reclaimed water	Produce CAT water at City WWTP and pump to GHWTP for treatment and distribution system addition, a Direct Potable Reuse (DPR) alternative.	WCA-11 WCA-46 WCA-64	SCWD: Water Reuse McKinney: Water Reuse Weisz: Water Recycling
CA-12	Water Reuse for indirect potable/ Reclaimed water	Produce CAT water at City WWTP and pump to Loch Lomond.	WCA-44 WCA-52 WCA-62 WCA-64	McGilvray: (8) Tertiary Treatment, Re-use Paul: (17) Detention Tub String Smallman: Recycled Water Weisz: Water Recycling
CA-13	Water Reuse for non-potable/ Reclaimed water or groundwater	The City would pump the Title 22 unrestricted effluent north through a new pipeline aligned along the railroad right of way, with turnouts to irrigate up to about 1,300 acres on private land and leased land. The City would use wells on ag land to produce water for treatment at GHWTP.	WCA-09 WCA-40 WCA-41 WCA-45 WCA-43 WCA-64	Ripley: Reuse for Agriculture Gratz: Recycled Water for Irrigation McGilvray: (1) Recycled Water for Irrigation McKinney: Additional Wells and WTPs McGilvray: (6,7) Pipelines Along RR Line Weisz: Water recycling
CA-14	Desal using Forward Osmosis/ Reclaimed water or seawater	Use seawater desalting through a Trevi forward osmosis (FO) system. This alternative's other components would match those for seawater desalting. The alternative has several outstanding issues, e.g., Trevi technology and other FO technologies are still in their infancy and being tested at a pilot scale. As described, Trevi would require a lower grade heat source for separately drawing the solution from the potable water but the alternative description did not designate a source for lower grade heat.	WCA-13	Trevi: Forward Osmosis Desalination (separate FAQs and technical memorandum summarize FO in its various incarnations and its implementation status around the world)

#	Name/ Water Source	Description	#	Author and comments
CA-15	Desalination using Reverse Osmosis/ Seawater	This alternative for initial comparison would use seawater desalting through a new reverse osmosis desalination facility to produce about 2.5 mgd for addition to the City potable water supply. This alternative's components and development would match those for the previously proposed scwd2 desalination facility. The City would own and operate the facility and would use the water produced year round. Excess water would allow the City either to idle the Live Oak wells for conjunctive-use aquifer recovery or to undertake Live Oak well operation in an ASR mode to restore the aquifer more rapidly. In wet years, the City could sell excess desalted to SqCWD and/or SVWD.	WCA-12 WCA-19 WCA-36 WCA-37 WCA-67	Sustainable Water Coalition: Desalination McGilvray: (11) Seawater Desal Aqueous: Desalination (non-membrane) Brown: Zero-emission Wave energy Tanaka: Energy Efficient Desal
CA-16	Aquifer restoration and storage/ Winter flows	The City would sell treated water to SqCWD during normal and wet years. SqCWD would use the transferred water for either groundwater recharge or demand reduction and conjunctive use. SqCWD would sell pumped groundwater water to City during droughts. The City also should have improved production from its Live Oak wells.	WCA-08 WCA-28 WCA-49 WCA-59 WCA-10	Paul: (13) The Lochquifer Alternatives Malone: Regional Water Exchanges (also possibly addressed through CA-11) Paul: (14) Upgrade Water Intertie SCDA: Enhance Existing Infrastructure SCDA: Regional Aquifer Restoration
CA-17	Expand Treatment Capacity/ Winter Flows	Add a new 14-mgd water treatment plant (WTP) (pretreatment for turbidity control and membrane filtration) near the Tait Street Diversion to produce treated water that would be piped directly into the distribution system. It would increase capacity to divert to Loch Lomond and produce additional water for aquifer recharge.	WCA-06 WCA-27	McKinney: Expanded Treatment Capacity Malone: Enhanced Storage and Recharge

#	Name/ Water Source	Description	#	Author and comments
CA-18	Off-stream water storage/ Winter Flows	Convert Liddell Quarry into 650 MG reservoir, filled with water from City North Coast diversions; use stored water to offset water demand during drought	WCA-05	Bevirt: North Coast Quarries (modified to include diversion of water from City existing sources)
			WCA-26	Fieberling: expand storage (addresses off stream storage)
			WCA-30	McGilvray (2): Quarries for Water Storage
			WCA-32	SCWD: Zayante Dam and Reservoir
			WCA-33	Smallman: Reservoirs
			WCA-34	Smallman: Storm Aquarries
CA-19	Ranney Collectors/ Winter flows	Use Ranney collectors with a 12.9-mgd capacity (maximum capacity allowed under the current City of Santa Cruz [City] diversion permit), installed near the City's Felton diversion to draw water allocated under the City's existing water rights. Water drawn through the collectors would have greatly reduced turbidity and allow continuous refilling of Loch Lomond while also operating the GHWTP. It would produce additional water for aquifer recharge.	WCA-07	McKinney: Ranney Collectors on SLR (requires a storage component to be a viable alternative)
			WCA-42	McGilvray: (4,5) Upgrade Water Treatment
			WCA-48	Paul: (12) Diversion Alternatives
			WCA-49	Paul: (14) Upgrade Water Intertie
			WCA-57	Paul: (23) Loch-Down Alternatives
CA-20	Interagency Cooperation - County Water Authority/ Institutional and Administrative	Establish Santa Cruz County Water Authority to manage water resources development and use for public agencies and private diverters and groundwater users	WCA-14	Gratz: Regional Water Authority
			WCA-15	Smallman: Regional Water Authority
			WCA-18	McGilvray: (10) Regional Collaboration

(b) Analytical Work on Alternatives

During the spring and early summer of 2015, the technical team developed and shared information with the Committee about each of the Consolidated Alternatives. The Committee worked with this material, which included information about capital, operating, and energy costs, yield, as well as planning level information for each CA for each evaluation criteria. Based on questions raised and comments received from both Committee members and the public, the WSAC directed the technical team to do additional vetting of the CAs to understand the potential benefits and contributions to the water supply issues facing the City of Santa Cruz.

Committee members also developed and used the multi-criteria decision support (MCDS) model to individually rate CAs as well as portfolios of measures, including expressing their values by weighting the criteria. At their December 2014 and July 2015 meeting, the Committee discussed the results of their evaluations and used this information to both better understand their various interests and points of view as well as to focus the alternatives for further explanation.

Appendix 4 to this document includes some of the key technical memos and Committee reports that provide examples of the Committee's analysis of alternatives. In addition, an archive of all of the Committee's meeting materials is available on DVD and at www.santacruzwatersupply.com

(c) Alternatives Considered but Not Pursued at this Time

As the Committee explored the diverse range of CAs in some detail, some CAs emerged as being more feasible and better fitted to the WSAC's vision of how to approach improving water system reliability than others. As the technical team's research and analysis work continued, information became available about some of the alternatives that raised questions about their feasibility. For others, issues of potential scale or suitability created issues that took them out of the running. As the Committee moved into their portfolio building efforts during the summer of 2015, they directed staff and the technical team to put together a list of all the CAs and the status, including those that were no longer being considered. For each CA, information was provided about its current status, and the WCAs covered by that CA. Appendix 5 includes information about the CAs, WCA's and other submittals not selected for further consideration at this time. At its September 10, 2015 meeting the WSAC, the Committee approved the information in Appendix 5 as its conclusions about the alternatives it evaluated and its reasons for not further pursuing these alternatives at this time.

Section 3.11 Scenario Planning

Scenario planning is a tool often used to facilitate planning in the face of uncertainty. A goal of scenario planning is to explore a range of futures that are different from what would occur if current trends continue, but not so unlikely as to be a waste of time. One way to maximize the benefits of scenario planning is to create scenarios based on what are called "deep drivers of change." For Santa Cruz, the obvious deep drivers of change are climate change and fish flows.

Scenario planning isn't intended to result in the selection of a preferred scenario to pursue but to explore and get a better understanding of the degree to which key uncertainties such as climate change could affect the problem we need to solve or the outcomes we might be able to achieve. The "best" solutions are those that address conditions in multiple scenarios.

Throughout the Reconnaissance Phase of its work, the Committee used simple scenario planning to explore a range of potential water futures. For example, different scenarios were created to explore how the community's water supply needs would be affected by the need to release water for fish, the implications of climate change, and potential changes to the local economy that would make Santa Cruz a place where people could both live and work.

During the first half of 2015, the technical team worked to develop consistent information about Consolidated Alternatives so that the Committee could use them as building blocks in the two rounds of scenario planning. Among the most important information emerging from this technical analysis was the result of system simulation modeling using the Confluence model.[15] These simulations concluded that two broad approaches have the potential to completely address the City's water supply challenges:

1. Harvesting and storing winter flows. This approach can work, even with current water rights, DFG-5 instream flows, and climate change. The analysis considered how the Santa Cruz water system would benefit if there were additional storage in the form of a "virtual reservoir." To achieve this benefit, the "virtual reservoir" used in the Confluence analysis would have to become real, i.e. suitable infrastructure improvements and institutional arrangements would have to be made to have a place to reliably store sufficient water and to be able to recover and use a sufficient portion of that water. The analysis indicated that the estimated quantity, about three billion gallons, would need to be banked and be recoverable at required daily volumes. This would require increasing the capacities of various current infrastructure components.
2. Developing a more drought-resistant supply (i.e. one that is insulated from year-to-year variability in weather and streamflow). Examples of such a supply include desalination and use of advanced treated recycled water. These alternatives would also require development and improvement of infrastructure.

The first round of scenario planning occurred during the March 2015 meeting. In this effort, Committee members broke into small groups, with each group working on one of three scenarios:

- Changed hydrology that results from City proposed flows;
- Changed hydrology that results from DFG-5 flows; and
- DFG-5 flows and a potential extended drought that is a plausible event under future climate change conditions.

Following several hours of work in their small groups, Committee members presented the demand management and water supply improvement measures they had created to address the conditions described in their scenario. These groups of measures were called portfolios.

Two key themes emerged from this work:

1. Committee members created water supply portfolios which included additional investments in demand management; and
2. Each of the groups gravitated to some form of winter flow capture and storage as a key strategy for meeting future water supply needs for Santa Cruz. One group acknowledged the potential need for a supplemental supply to help get the aquifer storage program going before it could

[15] See Appendix 2 for a description of the Confluence model and its use in the WSAC process.

be completely filled by available winter flows, and chose to fill that potential gap with recycled water.

Round two of scenario planning occurred at the Committee's April/May 2015 meeting and included two scenarios:

- DFG-5 flows with extended drought and
- DFG-5 flows with climate change.

Two working groups of Committee members were assigned to each scenario. Again, winter flow harvest was the centerpiece of each group's solution to the scenario they were given, and again, advanced treated recycled water played a role if and as needed as a back-up resource.

Section 3.12 Portfolio Development and Evaluation [16]

Starting in May 2015, the Committee began exploring and building portfolios of measures to close the supply-demand gap. Portfolios were typically made up of combinations of demand management and supply augmentation strategies that often included projects or approaches for improving the performance of the existing water system, particularly as it relates to its ability to capture and store winter flows.

One goal of portfolio building was to provide opportunities for Committee members to explore the risks and uncertainties associated with various combinations of measures. Another was for Committee members to work with each other to create portfolios that met their common interests using interest based bargaining techniques. And a third was to give Committee members a hands-on way to engage with the information about the technical aspects of various approaches.

Especially with respect to the last goal, Committee members have received, processed, and asked for clarification of and additional information about just about every aspect of water system operation, technical and financial assumptions, and have built a substantial base of knowledge upon which to create their recommendations. The diversity of Committee member backgrounds and interests has been a significant asset to the group as it has done this important work and they have learned from each other as well as from the Technical Team and City staff participating in their work. In addition, this hands-on approach has created an unparalleled opportunity for Committee members to learn about, and learn to respect their individual perspectives and interests, which is an invaluable asset to any collaborative problem solving process.

Section 3.13 Issues of Risks and Uncertainties

At the Committee's June 2015 meeting, Committee members worked with a set of four different staff-created water supply portfolios that have at their center some form of winter water harvest. In addition to a winter water harvest approach provided as a "Plan A," each portfolio contained a proposed "Plan B" and a "trigger" that would define the conditions for moving from Plan A to Plan B. The task was to consider the risks and uncertainties related to the various approaches, and the

[16] See Appendix 6 Portfolio Development and Evaluation for Committee materials related to work summarized in Sections 3.12 through 3.14

addition of a Plan B and a trigger was designed to get the Committee members thinking about and working with ideas related to "what ifs."

The four portfolios developed were:

1. **Plan A**: In lieu recharge of regional aquifers by providing system flows during the rainy season to Soquel Creek Water District and Scotts Valley Water District to meet their customer demand, thereby allowing them to rest their wells. Infrastructure or operating rule changes were added to extend the season during which in lieu recharge could be provided, thereby increasing the rate of recharge. The goal would be for groundwater to come back to Santa Cruz Water Department customers from water stored in regional aquifers when Santa Cruz needs it during drought years or other unusual events. **Plan B**: Advanced treated recycled water piped back to and mixed with Loch Lomond supplies (a technique called indirect potable reuse or IPR).
2. **Plan A**: Active recharge of regional aquifers using injection wells (a technique called Aquifer Storage and Recovery, or ASR) by providing excess flows to SVWD or SqCWD for injection into the aquifers to accelerate the rate of groundwater recharge. The goal would be for groundwater to come back to SCWD from regional aquifers when needed. **Plan B**: Advanced treated recycled water piped to and mixed with North Coast and San Lorenzo River supplies, retreated at Graham Hill Water Treatment Plant and delivered to customers (a technique called direct potable reuse, or DPR).
3. **Plan A**: ASR along with using advanced treated recycled water to create a seawater barrier along the coast to manage and impede salt water intrusion. The ultimate goal would be for groundwater to come back to Santa Cruz from regional aquifers when Santa Cruz needs it. Creating a salt water intrusion barrier would accelerate the timeline when this source would fully meet Santa Cruz's needs. Should the ASR program ultimately completely solve Santa Cruz's problem, the stranded assets in this plan would be an advanced water treatment plant for producing advanced treated recycled water and related infrastructure. **Plan B**: Converting the advanced treated recycled water plant producing water for the salt water intrusion barrier to a source of water for DPR use.
4. **Plan A**: ASR coupled with desalinated water from the proposed DeepWater Desalination plant at Moss Landing. The ultimate goal would be for groundwater to come back to Santa Cruz from regional aquifers when Santa Cruz needs it. Creating a supplemental source of potable water could result in a combined ASR and in lieu recharge strategy that would accelerate the restoration of regional aquifers, making the timeline when this source would fully meet Santa Cruz's needs shorter. Should the ASR program ultimately completely solve Santa Cruz's problem, the stranded assets in this plan would be a share of a regional desalination facility that might be sold to another party and a pipeline that might be repurposed for a different use. **Plan B**: DeepWater Desalination.

None of these portfolios was designed to be the best one. Rather, they were designed to be purposefully different from each other so that the Committee could explore the risks and uncertainties associated with different approaches. It was not part of the goal of the Committee's June meeting to select one of the portfolios as the preferred approach.

The focus on risks and uncertainties associated with the performance of these portfolios is an important one. At the level of analysis and information currently available, it is inevitable that there will be questions about actual performance of various approaches.

Section 3.14 Committee Member Portfolio Building

Between the July and August meetings (2015) Committee members worked independently or in teams to prepare portfolios that addressed the supply demand gap.

One portfolio was created by David Baskin, Peter Beckmann, Sue Holt, Charlie Keutmann and David Stearns. This proposal includes In Lieu and ASR along with direct potable reuse (a more drought resistant element to be implemented concurrently). This portfolio was designed to effectively cover the "gap" and, in the long term, would go further by providing the capacity to supply water even if events occurred such as a wildfire around Loch Lomond.

A second portfolio was created by Greg Pepping, Rick Longinotti, Mark Mesiti-Miller and Sid Slatter. This portfolio proposed a combination of In Lieu and aquifer storage and recovery (ASR) with direct potable reuse. This group reached consensus on the component parts and found that they disagreed as to whether, to ensure success, it would be necessary to implement the parts of the proposal sequentially or concurrently. This proposal provides for concurrent implementation, and Rick Longinotti developed a separate portfolio (described below) that proposed a sequential implementation.

A third portfolio was developed by Rick Longinotti in consultation with Erica Stanojevic and members of Santa Cruz Desalination Alternatives. As noted above, this proposal scales down the in lieu to operate initially within the capacity of the existing system, thus avoiding significant upgrade costs for modifications to the Graham Hill Water Treatment Plant. Ongoing monitoring of the response of the aquifer would provide the information needed to determine whether to maintain the level of effort or scale up as necessary.

A fourth portfolio was developed by Sarah Mansergh. This proposal shows an approach that portrays a lower level of urgency for moving forward than some of the other portfolios. The portfolio is also designed to seek and achieve multiple benefits through regional partnerships focused on restoring regional aquifers.

The fifth portfolio was developed by Erica Stanojevic. This proposal combines the storage capacity of Loch Lomond with the aquifer. By starting the project immediately and sorting out our water rights, security will be increased and we could achieve 3BG in storage by 2020.

All of these portfolios incorporated demand management.

In the discussion that followed the following agreements were articulated:

- The Committee developed consensus that the environmental benefits of fish habitat restoration is an important value and that the supply-demand gap should reflect a commitment to releasing flows to support restoration of threatened and endangered fish species. (The specifics of the DFG-5 flow proposal are not agreed to, as the Committee wants the City to work with the agencies to define the final flow proposal.)

- The Committee has developed consensus that there are substantial benefits from pursuing regional solutions for Santa Cruz's water supply issues and that reasonable regional solutions should be pursued if possible.
- The Committee developed consensus that energy requirements for any new water supply augmentation project should be met with power from renewable sources.
- The Committee reached agreement that groundwater storage strategies implemented by in lieu (passive recharge) and ASR (active recharge) are preferred.
- The Committee has developed consensus that their direction be focused on policy versus prescriptive level detail.
- The Committee has developed consensus that the plan they develop and recommend to the City Council will include an adaptation or Change Management Strategy.

Section 3.15 Alternatives that Emerged as Key Strategies to Consider

As the Committee worked through its first several meetings of the Analysis Phase, information developed by the WSAC Technical Team identified challenges with some of the alternatives. For example, it would be impractical to build surface water storage reservoirs in old quarries underlain by Karst formation geology. Other alternatives emerged as being more feasible and began to appear consistently as measures included in scenario planning results. By late spring 2015 the Committee had defined a set of alternatives and approaches that became their focus. Each area is described briefly below in Section 3.16 through Section 3.20.

Section 3.16 Demand Management

During much of the Committee's work a program known as "C recommended" (Crec) was a focus of the conversation around what additional demand management activities the City should pursue. Crec is a combination of water conservation measures identified during the development of the City's updated Water Conservation Master Plan in a process that began in 2013 but was still underway in the spring and summer of 2014.

As the Committee gained a better understanding of the nature of the reliability problem Santa Cruz faces, it began to look at whether and how well the measures combined into Program Crec focused on peak season demand. In the spring of 2015, the Committee formed a Peak Season Demand Management Working Group to look at strategies for improving the focus of the future Demand Management program on peak season reductions.

The Working Group developed and presented some strategies focusing on peak season demand management. When its results were received, the Working Group had proposed that the City set a goal of reducing peak season demand by an additional 150 mgy using a variety of strategies. This proposal raised a concern about the potential for double counting demand management savings due to the significant impact of price elasticity in reducing future demand. Double counting of demand reductions in a concern because of the possibility that an unknown number of customers will respond to higher rates by switching to water-conserving landscapes, for example, and will also participate in a water Department rebate program while doing so. If this occurs, their water savings would be counted twice – once as a program participant and again as a response to higher rates. Double counting could lead to overestimating the potential for demand reductions from programmatic conservation.

Table 13 below, lays out the impact of price response on future water demand.

Table 13 – Peak Season Savings Due to Price Response[17]

Peak (May-Oct) Demand Without Price Response, MG

	SFR	MFR	BUS	MUN	IRR	GOLF	**TOTAL**
2020	750	386	372	39	123	58	**1,728**
2025	763	375	373	39	138	52	**1,739**
2030	778	383	381	39	162	46	**1,790**
2035	798	393	393	39	184	46	**1,854**

Peak (May-Oct) Demand With Price Response, MG

	SFR	MFR	BUS	MUN	IRR	GOLF	**TOTAL**
2020	705	364	348	35	93	52	**1,598**
2025	703	347	342	35	104	45	**1,575**
2030	702	347	341	34	111	37	**1,572**
2035	703	347	342	33	119	35	**1,580**

Peak (May-Oct) Savings from Price Response, MG

	SFR	MFR	BUS	MUN	IRR	GOLF	**TOTAL**	**% Savings**
2020	46	22	23	4	30	5	**131**	**8%**
2025	60	28	31	5	34	7	**164**	**9%**
2030	76	36	40	6	51	9	**218**	**12%**
2035	95	46	51	7	65	11	**274**	**15%**

The price elasticity used to produce these numbers was based on the measured impact of price on the demand of various customer groups in Santa Cruz between 2000 and 2013. These elasticities were integrated into the econometric demand forecast presented to the Committee in July of 2015.

During the development of the econometric forecast, considerable effort was expended to ensure water conservation savings were not counted twice. The forecast includes an estimated 274 mgy of peak season demand reduction due to price, an estimated 170 mgy due to continuing existing programs and 248 mgy in demand reductions due to the impacts of building and plumbing codes. An additional 170 mgy in demand reduction from Program Crec was included as a supply alternative in all the Confluence modeling analyses, including those analyses used to establish the 1.4 billion gallon worst year shortage.

As the Conservation Master Plan is finalized, the new conservation measures proposed by the Working Group will be more fully analyzed and the Committee agreed that until that analysis is completed, it

[17] From Presentation by David Mitchell (M. Cubed) to the Water Supply Advisory Committee, July 23, 2015.

was best to be cautious about including the full additional 150 mgy of demand reduction in the projections.

(a) Development of Recommendations on Demand Management[18]

At its July 24, 2015 meeting, the Committee members decided they wanted their recommendations on Demand Management to combine providing the Council with their recommendations on a package of demand management programs as well as with a results-oriented, policy level direction, including guidance about key criteria.

City staff worked with two members of the Demand Management Working Group to develop recommendations reflecting both the Committee's strong interest in pursuing conservation with the uncertainties regarding costs and water savings associated with the package of measures outlined by the working group. The recommendations developed included:

1. **Expressly acknowledge the conservation savings that have been embedded into the new econometric demand forecast.** The econometric forecast carefully factored in different estimates of conservation savings that together amount to over 700 million gallons of water per year saved by 2035. These include the savings representing the passive effects of plumbing codes (278 mgy), active water savings associated with measures currently being implemented, (also referred to "Program A", 170 mgy), and the peak season savings that is related to economic effects over the 20-year planning horizon (274 mgy). These three elements play a large role in keeping water demand relatively constant over the next 20 years, and represent a combined 17 percent savings that should be communicated and highlighted as a key part of the overall solution to balancing the City's future water supply and demand.
2. **Set a goal, expressed as a range, between 200 and 250 million gallons per year of additional water savings by 2035, with emphasis on implementing measures that focus on peak season demand reduction.** Although the exact number is yet to be finalized and needs to be revisited, modeling performed by Maddaus indicates another 168 mgy of water savings is potentially attainable by 2035 through new or expanded conservation measures (referred to as "Program C"). More savings may be possible by incorporating the working group's recommendations into the City's Water Conservation Master Plan. Various estimates have been put forward about the savings of its recommendations, ranging from 81 to 183 mgy. The proposed goal recognizes and agrees with the Working Group that more water savings is possible, especially in the peak season, but expresses it as a range to reflect the uncertainty involved at this time.
3. **Complete additional analysis** to finalize the package of programs to be implemented and to more specifically establish the savings goal. Earlier modeling performed by Maddaus Water Management indicates another 168 mgy of water savings is potentially attainable by 2035 through new or expanded conservation measures from Program Crec. Additional programmatic savings will be identified both due to changing the $2500 per million gallon threshold used in the Maddaus Water Management modeling work conducted in 2013 to a $10,000 per million gallon average program cost recommended by the WSAC and by identifying, developing and implementing more programs focused on peak season savings.

[18] See Appendix 7 for materials related to Demand Management Recommendations.

4. **Identify the water conservation measures listed in Program C and in the working group's report as the demand management package the Committee recommends.** Providing a list such as the one presented in Table 14 below would fulfill the Committee's desire to articulate a recommended suite of demand management measures.

Table 14 – Recommended Water Conservation Measures

No.	Water Conservation	Included in Working Groups	Comments
1	System Water Loss Reduction		Project Initiated July 2015
2	Advanced Metering Infrastructure		
3	Large Landscape Budget-Based Water Rates	Yes	Identified in Peak Season Report as "Shifting Landscape Budgets Toward Climate Appropriate Irrigation Levels"; lower water budgets over time
4	General Public Information		
5	Public Information (Home Water Use Report)	Yes	Assume 3-5% savings
6	Residential Leak Assistance		
7	Single Family Residential Surveys	Yes	Identified in Peak Season Report as "Personalized Outreach to Highest Users and Generic Landscape Budgets"; combine with water budgets
8	Plumbing Fixture Giveaway/Opt		
9	Residential UHET Rebates		
10	High Efficiency Clothes Washer Rebates B	Yes	Alternative delivery/financing mechanisms
11	High Efficiency Clothes Washer - New Development		
12	Hot Water On Demand - New Development		
13	Toilet Retrofit at Time of Sale		
14	CII MF Common Laundry Room High Efficiency Clothes Washer		
15	CII Incentives	Partially	
16	Pre-Rinse Spray Nozzle Installation		Project Completed 2014
17	CII Surveys		
18	HEU Program		
19	Public Restroom Faucet Retrofit - MUN		
20	Public Restroom Faucet Retrofit - COM		

No.	Water Conservation	Included in Working Groups	Comments
21	School Retrofit		
22	Water Efficient Landscape Ordinance		State mandated update due by end of 2015
23	Single Family Residential Turf Removal A	Yes, as part of "Climate Appropriate Landscaping and Rainwater infiltration	Recommend B (increased rebate amount)
24	Multifamily Residential/CII Turf Removal A		Recommend B (increased rebate amount)
25	Expand Large Landscape Survey/Water Budgets	Yes	
26	Sprinkler Nozzle Rebates		
27	Gray Water Retrofit		
28	Residential Rain Barrels		
29	Climate Appropriate Landscaping and Rainwater Infiltration		Includes requirement to convert spray to drip for shrub irrigation, prohibit spray irrigation in narrow areas. Rainwater infiltration component to be led by other City Department or agency
30	Conservation Pricing - Water and Sewer		Water rate project underway through separate contract with Raftelis Financial Consultants; conservation pricing for sewer service
31	Dishwashers		Not recommended by staff
32	Hot Water Recirculation Systems		Not included in Program C but worth reconsideration
33	Rewarding Businesses For Adopting Best Practices		Hotel laundry recycling one example; reduced curtailment level as reward
34	Additional Building Code Requirements for New Development		Some requirements already in place; urinals, dishwashers, graywater, pre-rinse spray nozzles
35	Innovation Incubator Program		Capitalize on local programs to support research and continue role as conservation innovators

5. **Acknowledge that a final estimate of conservation savings is subject to change pending completion of the Master Plan.** A contract amendment for a second phase of work on this project was approved by the City Council at its September 8, 2015 meeting. Work is scheduled to resume this fall and will include coordinating the consultant's DSS model with the latest demand forecast, adjusting model parameters based on input received from Committee members and the Water Commission, incorporating new measures with greater emphasis on peak season savings

forwarded by the working group, and rerunning modeling scenarios. This will ensure consistency in how water savings and costs are estimated and help avoid speculation and/or double counting. In addition, staff has identified the need to revisit the sequencing and scheduling of measures listed in the latest version of Program C, and this will affect estimated savings. The final plan will, of course, be subject to public review and stakeholder input prior to its final adoption by City Council.

(b) Committee Agreement about Demand Management

At the Committee's meeting of September 10, 2015, the Committee agreed to the recommendations described in Section 3.16(a) above.

(c) Key Assumptions about Demand Management

The following are key assumptions about the Demand Management Program being recommended by the WSAC:

- The Econometric Demand Forecast includes significant demand reductions associated with the implementation of existing plumbing and building codes, the continuation of existing demand management programs (as a baseline) and as a function of the effect on demand of expected increases in water rates.
- A focus of new demand management programs will be on peak season demand reduction, which is also a significant focus of the expected demand reduction associated with anticipated price increases.
- New and enhanced demand management programs will be developed to build on the Water Department's current program that has contributed to reducing per capita demand in Santa Cruz to one of the lowest levels in the state.
- The programs to be implemented in the coming decade are a mix of lower cost and some higher cost measures. Those higher cost measures are meant as small-scale experiments that may be broadened if they prove popular and their costs decline over time. Together these measures incur an average total program cost of no more than $10,000 per million gallons of water saved. This figure is lower than the expected cost of supply augmentation projects recommended to be pursued as a result of WSAC's work.

Section 3.17 Supply Development

As described earlier, the Committee considered a wide range of supply augmentation alternatives during its deliberations. Committee members focused on options that are local including demand management, capturing and storing surface water flows during the rainy season, or developing some form of either recycled water or desalinated water to augment existing supplies.

As the Committee worked through the process of defining the problem and evaluating potential solutions during the winter and spring of 2015, they consistently identified winter water capture and storage through passive and active recharge as an opportunity that made sense to pursue.

As previously described, the Committee's scenario planning and portfolio building efforts focused on selecting supply alternatives and then exploring the risks and uncertainties associated with the portfolios they selected. During the Committee's work, the supply augmentation strategies that emerged included:

- Passive recharge of regional aquifers (in lieu);
- Active recharge of regional aquifers (aquifer storage and recovery – ASR);
- Some form of advanced treated recycled water (indirect potable reuse or direct potable reuse); and
- Some form of desalinated water (local desalination or a regional project called DeepWater Desalination).

To help the Committee consider the effectiveness of the supply augmentation options they were most interested in pursuing, all of the options were evaluated using the Confluence model. The estimated Confluence model yields are shown in Table 15. The yields indicated are defined as the reduction in peak-season shortages that are realized when each element is fully operational, i.e., when all technical and institutional (legal, regulatory, public acceptance) uncertainties have been successfully resolved.

Table 15 – Estimated Peak-Season Yields and Remaining Shortage

	Worst Year			**Average**		
Element	**Peak-Season Yield**	**Remaining Peak-Season Shortage**		**Peak-Season Yield**	**Remaining Peak-Season Shortage**	
	mg	**mg**	**%**	**mg**	**mg**	**%**
Base Case	--	*1230*	*63%*	--	*470*	*24%*
In Lieu	750	480	25%	350	120	6%
ASR	760	470	24%	380	90	5%
Combined In Lieu, ASR	760	470	24%	380	90	5%
Advanced treated RW/Desalination *	810	420	22%	440	30	2%
All Elements Combined	1230	0	0%	470	0	0%

* Either DPR, Deepwater Desalination, or Local Desalination.

The yield[19] estimates are necessarily based on a variety of infrastructure and operational assumptions, including but not limited to:

- For both in lieu storage and ASR, it is assumed that the maximum daily capacity to pump water from the aquifer and convey it to Santa Cruz is 4 million gallons per day (mgd). For ASR, it is assumed that the maximum ability to inject water is 5 mgd.
- For ASR, it is assumed that 80% of the injected water is recoverable. This is a function of assumed physical characteristics of the aquifers. For in lieu, it is assumed that 60% of the water conveyed to neighboring water districts is available to Santa Cruz, a function of both assumed aquifer characteristics and the outcome of discussions with the city's negotiating partners.
- For advanced treated recycled water/desalination, it is assumed that the maximum available supply on any day is 3 mgd, which is based on the estimated availability of local wastewater (i.e., excluding Soquel Creek wastewater).
- In all cases, the modeling of these supply elements makes particular assumptions about how they will be operated in conjunction with current supplies.

Given these assumptions, none of the elements on its own completely eliminates all projected water shortages though each substantially improves water supply reliability. However, since it is likely that some or all of these and other assumptions will change as better information is generated regarding physical, operational, and institutional parameters, these yields will also undoubtedly change.

During the Committee's scenario planning work, the idea of packaging various demand management and supply augmentation measures into a portfolio or integrated strategy emerged as an effective way to deal with the various uncertainties that are inevitably present in any long range planning work.

Ultimately the Committee selected two basic strategies to pursue, in addition to demand management (Element 0):

1. **Strategy One**: Development of groundwater storage using a combination of both passive and active recharge approaches and available surface water flows during the rainy season; and
2. **Strategy Two**: Development of advanced treated recycled water or desalinated water if and as needed to address any remaining supply-demand gap.

Strategy One includes the following Elements:

- **Element 1** – in lieu, passive recharge of the groundwater aquifers with either or both the Scotts Valley Water District and the Soquel Creek Water District; and

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[19] "Yield is used to characterize the capacity of a water resource to serve as a long-term water supply. It is a fundamental water-supply planning concept, and an understanding of its attributes is critical for those who participate in water-supply issues. In the context of surface-water resources, yield is often synonymous with safe yield or firm yield. Safe yield or firm yield in the context of water reservoirs is defined as the maximum quantity of water which can be guaranteed during a critical dry period (Linsley and Franzini, 1979). The simplicity of this definition, however, belies two "complicating" factors. First, yield changes as watershed conditions, such as land use and ground-water-surface-water interactions, evolve. Second, yield is uncertain because of our inability to know the severity and duration of future drought periods."
From: http://www.kgs.ku.edu/Publications/Bulletins/239/Leib/
See also, page 3 of https://www.owasa.org/Data/Sites/1/media/whatwedo/appendix%20iii-a.pdf
Additional definitions of production and yield are provided in the Glossary and Appendix 8.

- **Element 2** – aquifer storage and recovery, active recharge of the groundwater aquifers, with or without regional partners in regional aquifers.

Strategy Two includes the following Elements:

- **Element 3** – advanced treated recycled water to be used in either an indirect potable reuse or a direct potable reuse application, as the initial focus of Strategy Two approaches. In the event advanced treated recycled water is eliminated from consideration, desalination would then become Element 3.

As the WSAC discussed the potential development of the potential for advanced treated recycled water to be developed if Element 3 were to be needed, it received numerous comments from members of the public who expressed the critical importance of ensuring that all supply options be safe to human health. Specifically, comments received included cautions related to recycled water, a desire for the SCWD to carefully analyze the latest research on potential human health risks from contaminants of emerging concern and the synergistic or compounding effects of mixtures of multiple constituents that may occur in advanced treated recycled water, a recommendation that the SCWD use the precautionary principle when evaluating advanced treated recycled water options, and also that the City learn from other communities using similar supplies.

Section 3.18 Rationale for the Committee's Preference for the Groundwater Storage and Retrieval Strategy

Throughout the Committee's work in the spring and summer of 2015, it consistently demonstrated a preference for developing available winter flows as a supplemental supply. As the list below shows, the Committee's reasons for this preference were numerous and diverse.

1. More fully utilizes winter water flows in the San Lorenzo River.
2. Can contribute water to storage in many years. Even in dry years winter water may be available to store in local aquifers.
3. May start returning water before the entire groundwater system is built out.
4. May help reduce the threat of seawater intrusion.
5. Groundwater strategies are regional solutions. Regional solutions may help the regional economy, and thus the local economy.
6. Even without agreements to return water to SCWD in the future, in lieu recharge strategies can start immediately with existing infrastructure (an agreement is already in place for winter 2015), and can grow over time.
7. Because each ASR injection well acts as an independent storage and recovery site, together the individual wells create a flexible, resilient and scalable system, not just for the groundwater strategy but for Santa Cruz's overall water supply portfolio.
8. Water stored underground is much less affected by evaporation.
9. As aquifers are restored, base flows from groundwater to local creeks and streams may be improved and may offset some fish flow requirements.

10. May eliminate future water use curtailments during extended droughts.
11. It is believed to be politically feasible.

Section 3.19 Infrastructure Constraints

As is the case with all water systems, the City of Santa Cruz water system's operation is limited by a number of infrastructure constraints. Chief among these is the inability of the Graham Hill Water Treatment Plant to efficiently treat waters with turbidities over about 15 Nephelometric turbidity units[20] (NTU). Additional infrastructure constraints involve the limited hydraulic capacity and pressure constraints of the existing pipeline between the Felton Booster Station and Loch Lomond Reservoir. Once the pipeline between Felton and Loch Lomond is replaced, the capacity of the existing Felton pumps could potentially be increased.

In the recently completed Conjunctive Use and Water Transfer Phase II study report,[21] the Graham Hill Water Treatment Plant turbidity constraint was identified as a potentially significant barrier to the idea of capturing and using winter flows for passive and active recharge of regional groundwater basins. That report laid out a phased implementation of in lieu (passive) recharge that would not require addressing the treatment plant constraints right away. The report also described various infrastructure improvements to both Graham Hill Water Treatment Plant and the Tait Street Diversion that could be required as winter water deliveries to Soquel Creek and Scotts Valley are increased.

During the Committee's scenario planning process, the technical team modified the Confluence model's operating parameters in order to assess how the water system would perform without infrastructure constraints. The Committee, City staff and the technical team gave the issue of infrastructure constraints considerable attention, and a range of possible approaches to addressing these problems was discussed.

In the "State of the Water System Report" provided to the Committee at its April/May 2015 meeting, City staff provided a high level overview of the deferred maintenance and major rehabilitation and replacement issues the system has and laid out a conceptual framework for a 15 year Capital Improvement Program (CIP) to tackle these issues. The CIP includes projects to address certain infrastructure constraints, such as the need for a replacement pipeline from Felton to Loch Lomond, but not others, like upgrades to the Graham Hill Water Treatment plant to allow it to treat higher turbidity water. The rationale for including the pipeline is that it is needed to improve system operation whether or not a winter harvest option is pursued. The need for other infrastructure improvements to address the higher turbidities of winter water, whether through the implementation of the treatment plant upgrades identified in the Conjunctive Use and Water Transfer report, or possibly the installation of Ranney collectors or other approaches, is dependent upon selection of a water supply augmentation strategy. Including such improvements in a long term CIP prior to the Committee having completed its work would not be appropriate.

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[20] Nephelometric turbidity units (NTU) is a measure of water clarity that is used in drinking water treatment and safe drinking water regulations.

[21] Final Report, Conjunctive Use and Water Transfers – Phase II, May 2015 http://scceh.com/Portals/6/Env_Health/water_resources/Task%206%20Report%20051215%20clean.pdf

While current infrastructure does allow some initial regional cooperation efforts to get underway relatively soon, to fully utilize available winter water for in lieu and/or ASR will require substantial additional infrastructure. The minimum additional infrastructure requirements include creating an intertie with Scotts Valley, expansion of transmission capacity to Soquel Creek, and creating the infrastructure necessary to transfer water stored in aquifers back to Santa Cruz when needed during drought years.

Section 3.20 Operational Constraints

The Santa Cruz water system uses a variety of operating rules and practices to guide its daily operation. A utility's operating rules provide straightforward and reasonable parameters for both operating the system and for modeling system performance.

Most of the City's operating rules and practices have developed over time and are based on experience operating the system. A major influence underlying the operating rules is that avoiding problems is more effective than dealing with their consequences after the fact. Some of the key operating constraints have been incorporated into the Confluence Model to help insure that system modeling results reasonably represent reality.

The WSAC examined operating rules and constraints that limit the water system's ability to provide water. During the dry season, the key constraint is the existing operating rule curve for Loch Lomond drawdown. During the rainy season, the key constraints were related to taking first flush water and dealing with turbidity levels over 15 NTU, whether for treatment at the Graham Hill Water Treatment Plant or to send to Loch Lomond to store in years when winter precipitation is not expected to fill the reservoir.

The technical team explored modifying the operating parameters using the Confluence model to simulate different operating rules. A number of recommendations for change and further evaluation were developed. Of those, two particular operating constraints stand out: the rule curve used to operate Loch Lomond, and the first flush constraint for sending water from Felton to Loch Lomond.

The existing Loch Lomond rule curve is designed to keep about a billion gallons of water in the reservoir as drought supply for a potential third year of drought conditions. When modeling the system, the Confluence Model currently runs the system to ensure that on October 31st of the second year of a drought, the reservoir still has one billion gallons remaining in storage. This constraint could potentially be relaxed in the event the City develops additional storage. The first flush constraint is designed to allow a sufficient quantity of water to bypass the City's Felton Diversion on the San Lorenzo River to avoid introducing large quantities of nutrients and pathogens into Loch Lomond. In critically dry years the quantity of water needed to meet the first flush criterion, 48 hours at 100 cubic feet per second or greater, may never be achieved. If this criterion can be relaxed without threatening Loch Lomond's water quality or ecosystem health, the additional water diverted to Loch Lomond during dry years could have significant benefits in reducing the size of worst year shortages.

Bearing in mind the complexity of Loch Lomond's ecosystem and the need to avoid creating a problem that would likely be time-consuming and expensive to solve, the potential supply-enhancing benefits of changing any of these constraints make it worthwhile to seriously explore this matter over the coming years. If it is feasible to modify this operating constraint, the fix may entail operational changes, infrastructure modifications, or both.

Section 3.21 Agreement on Elements of the Water Supply Augmentation Plan

As WSAC proceeded, it focused on both what the Plan should include and how it should be implemented. As had been the case during the Committee's scenario planning and portfolio building work during the spring and summer of 2015, the Committee found it relatively easy to coalesce around groundwater storage strategies, but more challenging to build agreement around whether or how it might make sense to include additional supply augmentation measures.

Beginning with the Committee's July 2015 meeting, the WSAC began developing an adaptive management plan that would be used to guide the implementation of the Plan. Through the August and early September 2015 meetings, the Committee continued to solidify its agreement about the elements of the Plan, while recognizing that final agreement would be based on both what the Plan Elements were as well as how the Plan would be implemented. At its September 11, 2015, the Committee agreed to the following Plan Elements, contingent on the Committee also reaching agreement on the implementation plan and adaptive management strategy.

Element 0: Demand Management, with a goal to generate an additional 200 to 250 million gallons of demand reduction by 2035 from expanded water conservation;

Element 1: In Lieu start quickly as a small program relying on existing infrastructure to provide potable water to the SqCWD. The program is intended to grow over time, if/as additional infrastructure is developed, additional agreements are reached with SqCWD and SVWD, and any needed changes to water rights are granted by the State of California. Details of sharing capital and operating costs would and how much water returns to Santa Cruz and when it would be available would be addressed in these agreements.

Element 2: Aquifer Storage and Recovery (ASR), involves development of a program to inject treated water from available winter flows into regional aquifers and recover a large portion of the stored water as a supplemental supply for Santa Cruz. This program would proceed through evaluation and piloting steps as detailed in technical reports (e.g., the May 2015 Pueblo Water Resources report) and, if successful, can be implemented on a scale sufficient to meet the yield goals of this Plan.

Element 3: Advanced Treated Recycled Water, is intended to supplement or replace Elements 1 and 2 to the extent they do not generate sufficient yield to fill the supply/demand gap in a cost-effective and timely manner, as stipulated in the Plan. In the event advanced treated recycled water is eliminated from consideration, desalination would then become Element 3.

In addition to developing Elements 0, 1, 2 and 3 above, the Committee suggests that the City should continuously review and take steps to address infrastructure and operating constraints that are keeping the existing system from performing as well as it could, within reason. Some specific suggestions are included in the recommendation section of this report.

Section 3.22 Implementation Strategy Options

Following the August 2015 Committee meeting, staff and the technical team worked to lay out a phased implementation plan for Strategies One and Two. The purpose of this task was to provide Committee members with a way to visualize how a staggered plan might actually be implemented, and to support a more thorough discussion of implementation strategy options.

As they mixed and matched supply augmentation strategies, the Committee also considered how measures in the portfolio would be implemented. The technical team provided the Committee with a useful model for thinking about both potential implementation options and adaptive management drawn from work done in the Netherlands (see https://www.deltares.nl/en/adaptive-pathways/).

As part of developing both the Committee's implementation and adaptive management strategies, the WSAC evaluated several implementation approaches, including sequential, staggered and parallel. Each approach is briefly described below.

- A sequential implementation plan would involve working on Strategy One approaches until they either succeeded or failed. Only if these approaches fail to meet the yield target would Priority Two approaches be pursued.
- A staggered implementation plan involves advancing work on Strategy One approaches to demonstrate their effectiveness, while simultaneously doing some work on Strategy Two approaches with a goal of shortening the time required to produce water from a Strategy Two approach should Strategy One approaches not prove successful.
- A parallel approach would involve moving forward on both Strategy One and Strategy Two strategies with a goal of pursuing both types of projects and significantly enhancing the City water system's reliability and robustness.

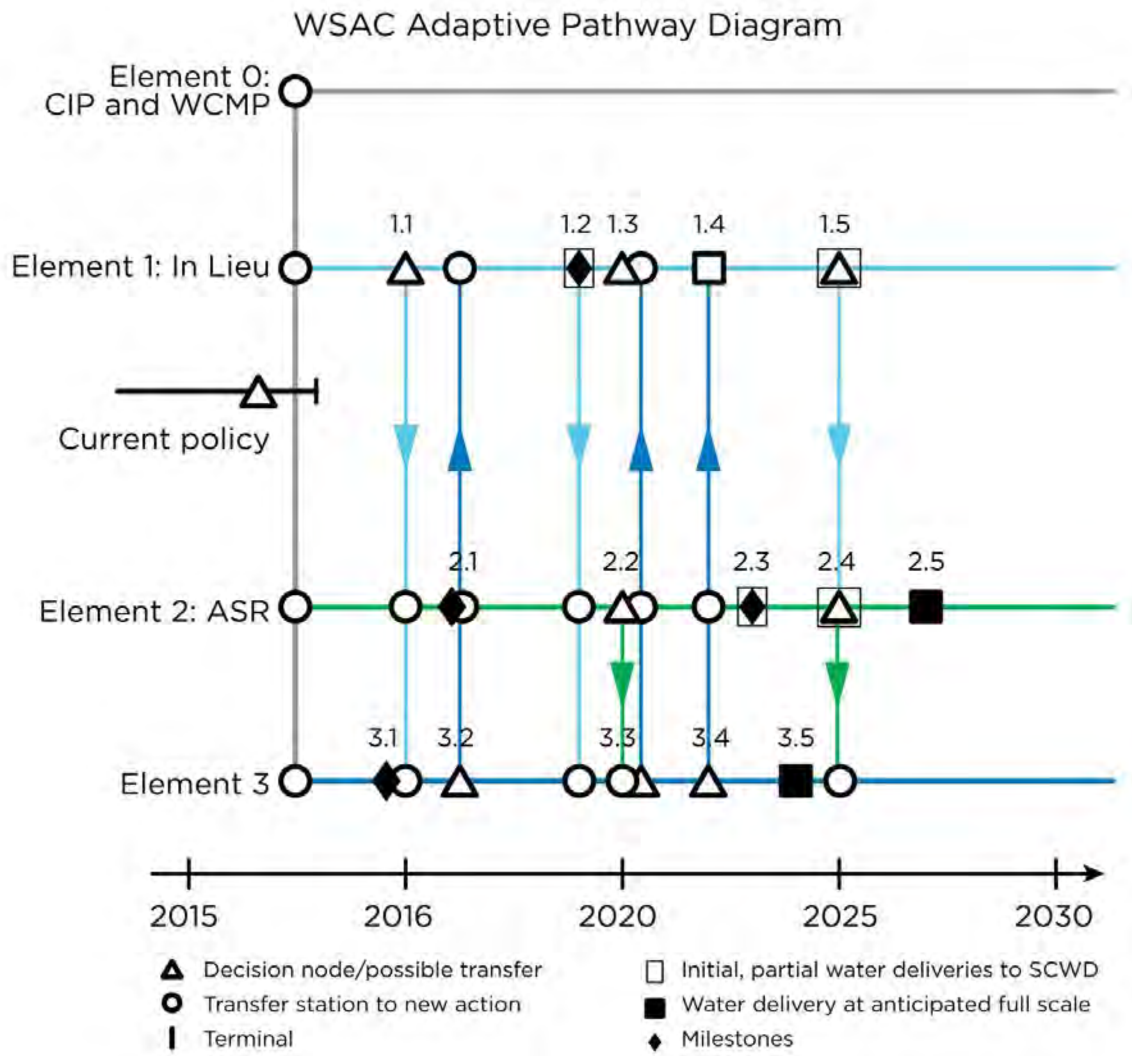
The idea behind an adaptive pathway is that you work down a path through the phases of a project or program and when you reach a decision node, you have an opportunity to decide whether to continue or change to a different approach. There are two types of decision nodes used in the adaptive pathways:

1. Open circles represent start points and possible change direction points and
2. Open triangles represent project transition points between one phase of work and the next.

Opportunities for initiating work or reviewing progress and making changes, either in the form of adjustments or as a result of assessments occur at these decision nodes. As an additional feature, the Committee decided to develop thresholds that would act as triggers for considering either adjustments or assessments. The Change Management Strategy, including further information on adjustments, assessments, and thresholds, is presented in more detail in Section 3.24.

Figure 8 shows the adaptive pathway chosen for implementation.

Figure 8 –Adaptive Pathway Map for Implementing the Water Supply Augmentation Plan



Section 3.23 Developing a Change Management Strategy

At the same time as the Committee members were developing the implementation strategy, they were also thinking about how to deal with decision-making and dealing with the new and changing information that will develop as the plan or project is implemented.

(a) Exploring Example Change Management Approaches

The Committee had explored several types of strategies used by others in setting up a policy and/or procedural framework to guide implementation of various kinds of plans over time. Included in this review were several specific examples of different approaches to developing policy or implementation frameworks. The most relevant examples are:

- Borrego Water Coalition Recommendations on the Groundwater Sustainability Plan being developed by the Borrego Water District.
  - Example of: Policy recommendations with phased in reduction in water production to improve groundwater sustainability and specific incremental performance targets http://www.borregospringschamber.com/bwc/documents/2014/BWC%20Policy%20Recs%20FINAL%2011-06-14.pdf
- Clackamas River Hydro Relicensing Settlement Agreement/Agreement in Principle – Fish Passage Provisions with performance based phased-in of fish passage measures:
  - Example of: Performance Benchmarks used in determining additional actions, in this case, additional measures to improve/enhance the success of fish passage at a hydroelectric dam facility.

    For details of the A, B, C and D measures called for as part of the performance based implementation of fish passage improvements, see Clackamas Agreement in Principle (AIP) document, Section II – Downstream Fish Passage Measures. This section begins on page 3 and goes to page 11 of the Agreement in Principle Fish Passage and Protection Plan that is embedded in the larger document. Using the pdf document page counter, typically found in the upper left hand area of the screen, this section starts on page 39 and goes to page 47.

    Additional Information: General information about Portland General Electric's Fish Protection Programs: https://www.portlandgeneral.com/community_environment/initiatives/protecting_fish/clackamas_river/default.aspx
- Owens Lake Dust Control – Section 5 – Framework for Resource Protection Protocols (RPP) including criteria, monitoring, indicators, triggers, and actions, significant impact thresholds, and mitigation measures.
  - Example of: Outcome oriented performance criteria; performance measurement; tiered (incremental) action oriented steps to take if performance metrics are not being met; and significant impact thresholds with required mitigation.

    https://owenslakebed.pubspsvr.com/masterproject/Master%20Project%20Document%20Library/Advisory%20Committee/April%202015/Owens%20Lake%20MP%20Advisory%20Committee%20Recommendations%20to%20LADWP.pdf (Section 5 starts on page 28 of the pdf that opens at this link.)

Two common themes of these examples are the idea that implementing plans is an inherently adaptive process and that, within reason, it is feasible to lay out an approach to making future decisions that maintains the integrity of the agreements on which the plans were based.

By the early summer of 2015, the WSAC understood that the planning level information available was only going to be adequate to allow them to make contingent recommendations. The City would need to be able to adjust or adapt them during implementation. The Committee acknowledged that questions would arise about how to proceed when new information became available and concluded that developing a Change Management Strategy, and especially guidelines and principles that reflected their values and priorities, was as important as agreeing upon the portfolio of measures to recommend to the Santa Cruz City Council.

Section 3.24 WSAC's Change Management Strategy

A major goal of the WSAC's Change Management Strategy is to establish clearly defined mechanisms for dealing with changes that will need to be made to the Plan over time. The success of whatever is done to implement the proposed recommendations is dependent upon a high degree of both transparency and accountability. The Change Management Strategy the WSAC has developed is specifically designed to facilitate that success.

(a) The Plan-Do-Check-Act Cycle[22]

The basic premise of the WSAC's Change Management Strategy is that developing and implementing any Plan, and the projects within a plan, is a cyclic activity of continuous improvement that involves planning, doing, checking and acting (PDCA). Figure 9 shows this cycle and describes each part.

Figure 9 – Plan, Do, Check, Act Cycle

Plan–Do–Check–Act Procedure

1. Plan. Recognize an opportunity and plan a change.
2. Do. Test the change. Carry out a small-scale study.
3. Check. Review the test, analyze the results and identify what you've learned.
4. Act. Take action based on what you learned in the study step: If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate what you learned from the test into wider changes. Use what you learned to plan new improvements, beginning the cycle again.

This cycle is designed to incorporate new information and well adapted to the circumstances involved in implementing the Water Supply Augmentation Plan (Plan).

The elements of the WSAC's Change Management Strategy include the following:

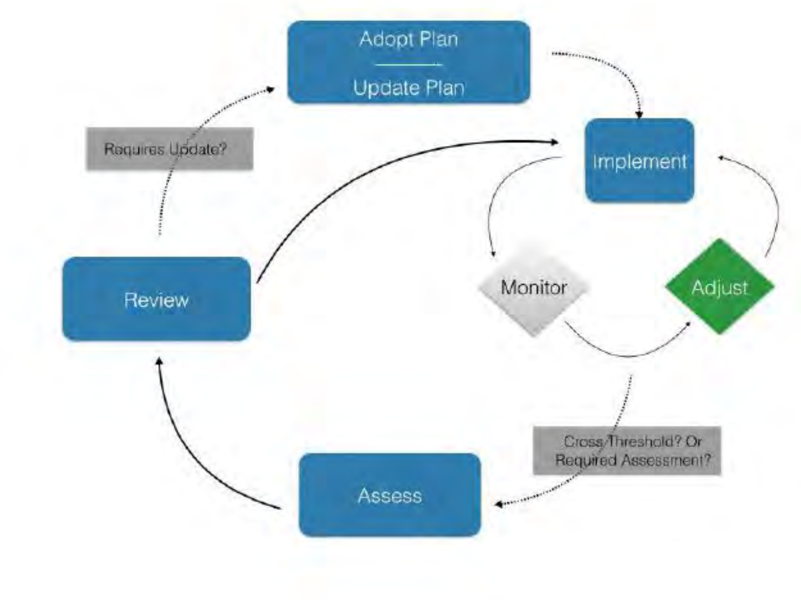
1. A Plan-Do-Check-Act model specifically adapted to the work being planned;
2. An Adaptive Pathway framework for implementing the three main supply augmentation elements;
3. Guiding Principles reflecting the WSAC's values and priorities;

22 From: http://asq.org/learn-about-quality/project-planning-tools/overview/pdca-cycle.html

4. Procedures for implementing the strategy, including roles and responsibilities for Water Department staff and the Water Commission as they work with the Council on the issues and initiatives covered by the plan; and
5. Guidance for Decision-Making.

Figure 10 shows the Change Management Process WSAC developed:

Figure 10 – WSAC Change Management Process



This framework actually incorporates a smaller PDCA cycle within the larger PDCA cycle. The larger PDCA framework functions in concert with the adaptive pathways and mostly relates to adaptive decisions that would need to be made to switch from one path to another. The smaller PDCA cycle is shown on the upper right of the figure above as the "Implement, Monitor, Adjust" cycle and would be used to make needed adjustments while implementing the various Plan Elements that are part of the Plan. For example, as in lieu and ASR are being developed, their progress in meeting their project goals would be monitored. An adjustment would be needed if, for example, eight wells were needed to produce the desired yield instead of the six originally estimated. The sections below present the parameters and mechanisms the WSAC developed to guide the implementation of the Water Supply Augmentation Plan.

(b) Definitions and Context

The WSAC's Change Management Strategy was built around several specific definitions and application of concepts. This section provides the definitions and context used in the Change Management Strategy and the circumstances under which the various adaptation approaches would be used.

1. An **Adjustment** is a change in implementation that helps the Plan stay on track. In a continuous feedback loop, the Water Department will make adjustments to help achieve (or exceed) performance targets for the various Plan Elements.

2. A**n Adaptation** is a shift from an Element or a set of Elements to another Element or set of Elements within the Plan's Adaptive Pathway. An adaptation may be recommended when certain thresholds are reached.
3. **Guiding Principles** are qualitative policy and value-based provisions that are taken into account in decision-making along with quantitative information that will be available.
4. A T**hreshold** is the set of information that leads to an Assessment of the Plan and possible adaptation. The Committee identified thresholds for the key issues that need to be considered during decision-making about a possible Adaptation. The goal was to avoid trying to address each possible eventuality, and to focus on overall program goals rather than implementation specifics. Once a threshold issue has prompted an assessment, other considerations captured in the Guiding Principles, such as regional collaborations or the collateral benefits of an approach, may be taken into consideration. The thresholds are:
   - Cost
   - Yield
   - Timeliness
5. **Performance Metrics** are developed and used to assess how well individual Elements are tracking against their performance targets. As work on implementing the Plan Elements goes forward, tracking performance will generate information that will be used in several ways:
   a. Deliver greater understanding about the system from management activities, technical work, pilot testing and modeling results and other work.
   b. Ongoing cycles of monitoring and adjusting may help the Department keep the Elements moving forward to achieve their goals and determine when and how Adjustments might affect overall goals or when Adaptation may be appropriate.

   The Committee had a chance to learn about the potential Performance Metrics that would be used in assessing Element 2, ASR, through all of its developmental phases. Further work will be needed to develop Performance Metrics for other Plan Elements.
6. **Catastrophic Events** (or other exogenous events), such as earthquakes or wildfire could disrupt the plan. Catastrophic Events are low probability/high consequence events.

(c) Guiding Principles

The Committee recommends that the following Guiding Principles be taken into account in all applications of the Change Management Strategy:

- **Public Health** – public health protection is every water utility's most fundamental duty. The SCWD, as an organization, and as individual employees, work every day to produce and deliver an adequate and high quality supply of water that complies with numerous public health-based regulatory standards and is used for human consumption, sanitation, for other domestic and commercial use and for fire protection.

  WSAC recommends that, prior to reaching a decision on a potential preferred supply augmentation project; the City will consult with experts (recommended by the Water Department and approved by City Council) in public health, endocrinology and water chemistry to evaluate and report on local water quality data and the public health implications of the preferred choice. This consultation would take place with ample opportunity for public review and input.

- **Public Acceptance** –The Committee was aware that the most important reason for convening the WSAC was to address the public's concerns about the proposed desalination plant. The Committee notes public acceptance issues were raised during the WSAC process about costs, including overall costs and costs to rate-payers, energy consumption, schedule for implementation and public health concerns.

  The WSAC has, throughout its process, created and applied criteria reflecting the community's values. Along with the yield, costs, timeliness and technical feasibility of various supply augmentation alternatives (including conservation), the Committee also considered energy use, and environmental impacts of the alternatives. Accordingly, these considerations and criteria should be taken into account in any future decision-making.
- **Regional Collaboration** – Where consistent with the goal of achieving a sufficient water supply, the City should promote regional collaboration to improve water supplies, reversing or slowing seawater intrusion, and support habitat restoration.
- **Plan Goal** – The Committee agrees that, to improve the sufficiency and reliability of Santa Cruz's supply using groundwater storage, an additional 2.4 billion gallons of water needs to be accessible from regional aquifers in a timely manner which will require storage of a larger volume. This additional storage, along with other key infrastructure modifications outlined in the Plan, would provide water needed to meet a worst year peak season shortage of 1.2 billion gallons under forecasted climate change and DFG5 flows.
- **Incremental Implementation** – An important premise of the Water Supply Augmentation Plan is incremental implementation. The Committee worked to develop a phased approach to develop the additional water supply needed and to integrate this approach into the Adaptive Pathway and Change Management Strategy. A significant benefit of this approach is that it will help the City avoid investing resources before they are needed and justified based on performance and other metrics.

(d) Change Management Strategy

As the Water Department implements this Plan, the Committee recommends that staff apply the following Committee agreements in making adjustments and recommending adaptations:

For Adjustments:

1. Diligently implement the groundwater storage strategy: when implementing Plan Elements related to groundwater storage, the City will take all reasonable and necessary steps to explore and demonstrate the technical feasibility of these approaches.
2. In addition, the City will adopt and implement communication practices that support the goals of transparency and accountability about Adjustments or Adaptations.

For Adaptations:

1. Prefer groundwater storage strategies: before making a choice to move away from groundwater storage, diligently pursue all reasonable measures to make the groundwater strategies work.
2. Should the choice need to be made between options available within Element 3, the Committee's preference is for advanced treated recycled water, rather than desalination, which is estimated to cost more and use more energy than advanced treated recycled water. The Committee viewed recycled water as more sustainable than desalinating seawater and therefore more aligned with the community's values. However, if the City determines that recycled water cannot provide sufficient yield then desalination should be pursued.
3. System robustness, resilience, redundancy, and adaptive flexibility are important values.

Thresholds are an important element of the overall Change Management Strategy. The Committee developed its agreements based on assumptions and information available to it at the time it did its work and recognized that new information would be developed as the Plan is implemented. Establishing thresholds (which could, themselves, be updated as new information is developed and analyzed) gave the Committee a way to provide parameters within which to continue developing an Element as well as clear sign posts for when the Plan or an Element might be failing to perform as anticipated. Exceeding a threshold value would not necessarily result in stopping work on an Element, but would trigger an Assessment. There are three key types of thresholds:

1. Cost
2. Yield
3. Timeliness

For several of these thresholds there is no fixed number or value. This is because for items such as cost and timeliness, the threshold value is necessarily relative to the other options available at the time the threshold is reached. The achievable schedule for implementing the Elements will become clearer as additional work is done. At a decision node, the most up-to-date information should be considered.

The Committee understood that new information would be developed as the Plan was implemented and therefore what was important was to set the threshold metric rather than the threshold value. And, in addition, the Committee understood that numbers produced by planning level analyses cannot be considered exact and thus applying an acceptable range around a threshold metric would be an appropriate way to express the Committee's values and provide flexibility in implementing the Plan.

While thresholds may operate as independent triggers for an assessment, once an assessment is undertaken it would look at each Plan Element's status as it relates to each of the thresholds as well as to the Guiding Principles. Taking this more comprehensive approach to the Assessment is intended to avoid unintended consequences that could result from applying a more narrow focus.

(i) Cost Metric

Cost-effectiveness is an important consideration in making pathway changes. Any decision on cost-effectiveness will require comparing the costs of available alternatives at the time a decision is made.

After considering the range of possible cost metrics to evaluate cost-effectiveness, the Committee recommends the threshold Cost Metric be the Annualized Cost per million gallons of Average Year Yield (ACAYY). This is the cost identified in Line k of the Project Elements Summary Table included in Appendix 8, Cost Data and Cost Analysis, which table is incorporated by reference.

This metric adds the amortized annual cost of capital investments and the annual operating and maintenance cost and divides it by the estimated project average year yield.

Amortized annual cost is preferred because it takes into account the amortized capital investment as well as operation and maintenance costs. *Average year yield* is preferred because *yield* focuses on benefits to the overall system and *the average year yield* allows comparison among options. While other costs may be considered in future decision-making, this Cost Metric was favored because it focuses on the cost of the yield produced in an average year.

(ii) Committee Preference Statement Related to Cost

Recognizing the cost differential between some of the strategies the Committee considered in developing its recommendations, the WSAC agreed to express its preference for Strategy One over Strategy Two, and has agreed that as long as the ACAYY for implementing Strategy One is not more than 130% of the ACAYY for Strategy Two, Strategy One should be pursued provided Strategy One meets other threshold metrics.

(iii) Yield Metric

The Yield Metric is the most straight-forward, the most quantifiable, and the least flexible of the thresholds. As described earlier in this document, the supply-demand gap has been established at 1.2 billion gallons per year (bgy) for the worst year, based on Confluence modeling of the frequency and severity of shortages. The analysis takes into account DFG-5 fish flows and a plausible estimate of climate change impacts.

Updating the supply-demand gap requires both new demand forecasts and the kinds of analyses described earlier in Section 3.05 and Section 3.06. This analysis will be refreshed every five years as part of the Urban Water Management Plan update.

(iv) Timeliness Metric

For the Timeliness Metric, the Committee has agreed that a 10-year window is a reasonable target for achieving water supply sufficiency, defined as having a fully functional water system able to meet the supply-demand gap forecasted during extended droughts. Assessments, Reviews and Update to Plan

1. Procedural Steps
   a. An **Assessment** is performed by the Water Department and includes updated information and a recommendation about whether a change to the Plan is needed.

b. The Water Department submits a report to the Water Commission for its **Review, including development of recommendations to the Council**. Following Water Commission action, the recommendation is forwarded to the Council for its consideration.

c. If the Council so chooses, the Plan will be **updated**.

2. Information Sharing

a. The Water Department will report to the Water Commission and the City Council

i. At all decision nodes identified in the Plan;

ii. Informally, as part of the Water Director's Oral Report at each Water Commission meeting, providing specific information about work in progress, successes and failures, and challenges and opportunities;

iii. Quarterly in the spring, summer and fall, as an agenda item with accompanying staff report on the Water Commission agenda for discussion, public comment, and action as needed; and

iv. Formally and annually to the Water Commission and the City Council in the winter of each year during the budget cycle, including Plan performance and significant adjustments

b. As part of the Water Commission's and City Council's review of an updated Urban Water Management Plan, including

i. Performance

ii. Significant adjustments

iii. Updated Plan Goals and Assumptions (including demand, climate change, systems improvements etc.)

3. If the Water Department recommends an adaptation, such a report must contain a synthesis of each Strategy and/or Element's actual performance or most current projected performance against the most current Thresholds and an evaluation of whether the performance of individual Elements warrants making a change to the Plan as a whole, or to one or more Elements within the Plan.

(e) Staggered Adaptive Pathway and Decision Nodes

At its September 10, 2015 meeting, the Committee agreed to use a staggered implementation approach. Figure 11 shows the agreed-upon adaptive pathway map, and Table 16 lists the numbered decision nodes and provides descriptions about the expected information, decision, or result anticipated at that node.

Figure 11 – Agreed-Upon Adaptive Pathway Map

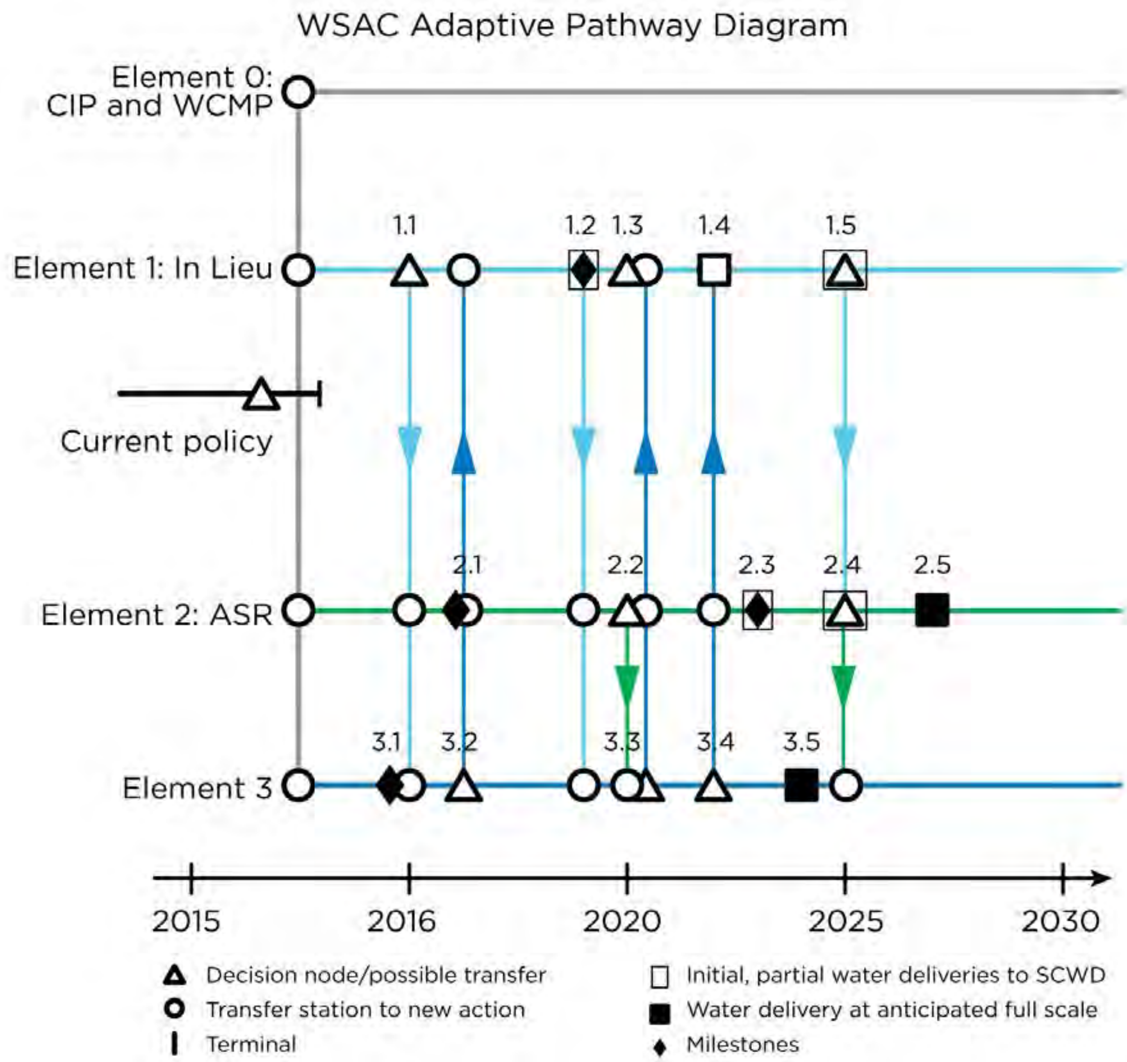


Table 16 – Table of Decision Nodes and Related Milestones

NODE	ABBREVIATED DESCRIPTION	ENDING YEAR
In Lieu (Element 1)		
1.1D	Near Term: Initiation of near term water transfer/sale to SqCWD using North Coast water; agreements in place, and CEQA completed.	c. 2016
1.2M	Larger Project: Understanding the feasibility of a potentially larger water transfer/exchange project with SqCWD and/or SVWD using North Coast and San Lorenzo River waters. Includes quantifying return water (using groundwater models) from SqCWD and/or SVWD to Santa Cruz as well as understanding of water rights and inter-agency collaboration.	c. 2018
1.3W/D	Larger Project: Completion of agreements specifying terms of transfers to/from SqCWD and/or SVWD, water right modifications, planning/prelim design; complete assessments of cost, yield and schedule; and define CEQA. Decision point for proceeding on final design of associated infrastructure improvements.	c. 2019 c. 2020
1.4W	Larger Project: Potential for return of water from SqCWD, and/or SVWD, to SCWD with the construction of infrastructure/treatment improvements.	c. 2022
1.5D/W	Assess in lieu performance: amount to SqCWD, SVWD, and SCWD; reduced groundwater pumping, groundwater elevations, etc.	c. 2025
Aquifer Storage and Recovery, ASR (Element 2) Includes evaluation of Purisima and Santa Margarita		
2.1M	High level feasibility work: use of groundwater model; completion of site specific injection capacity and geochemical analyses; development of pilot program.	c. 2017
2.2D	Completion of all administrative items to conduct pilot testing (e.g., CEQA/permits/agreements and well modifications), completion of pilot testing, and assessment of probable ASR system performance, cost and schedule to complete build out of ASR system.	c. 2020
2.3M/W	Develop/construct ASR wells, ready to operate.	c. 2022
2.4D/W	Assess ASR performance against projections and ability to meet project goals.	c. 2024
2.5W	Aquifer storage target attained (ability to sustain return flows to SCWD at desired levels).	c. 2027
Advanced Treated Recycled Water or Desalination (Element 3)		
3.1M	Identify recycled water alternatives; increase understanding of recycled water (regulatory framework, feasibility, funding opportunities, public outreach and education)	c. 2016

3.2D	Complete high level feasibility studies, as-needed demonstration testing, and conceptual level designs of alternatives;, define CEQA processes; and continue public outreach and education. Select preferred Element 3.	c. 2017
3.3D	Preliminary design, CEQA (including preparation of draft EIR), and apply for approvals and permits (except building permit).	c. 2020
3.4M	Complete property acquisition, final design, complete CEQA and all permits.	c. 2022
3.5W	Construction completed: plant start-up, water production begins	c. 2024

Abbreviations

ASR = Aquifer Storage and Recovery
CEQA = California Environmental Quality Act
DDW = Division of Drinking Water
DPR = Direct Potable Reuse
GHWTP = Graham Hill Water Treatment Plant
IPR = Indirect Potable Reuse
SCWD = Santa Cruz Water Department
SqCWD = Soquel Creek Water District
SVWD = Scotts Valley Water District

Notes

- This table is intended as a companion piece to the implementation Gantt chart and subway map. Gantt chart contains additional activity detail(s) for each node.
- Node types
  - D = decision node (triangle on subway chart)
  - M = milestone (diamond on the subway chart), furthering the understanding of feasibility.
  - W = water production potentially available (squares on the subway chart; open square indicates some water; solid square represents full goal being met).
- Node types have been assigned based on a set of assumptions as to how the implementation will proceed. However, if a threshold is being tripped, the node becomes a decision node regardless of its current designation.
- Ending Year refers to when all work associated with reaching node and/or achieving goal(s) will be accomplished. Dates shown are approximate based on current information and project understanding. Dates may adjust depending on: volumes of water available due to winter precipitation levels (which may limit amount of in lieu and ASR); ability to establish agreements, permits, etc.; and ability to implement workload.

As noted in earlier discussions, thresholds represent “special decision nodes” that can be reached by any Element, at any time.

(f) Guidance for Decision-Making at Decision Nodes

This section provides guidance for decision-making.

When a decision node on the adaptive pathway map is reached, or when the Plan or any Element appears it will fail to meet any threshold value at any time, the Committee’s Change Management Strategy recommends a “pause and assess” step. At this juncture, there are three basic kinds of decisions:

1. A decision to stay on the same path;
2. A decision to add another path or paths; or
3. A decision to switch to a different path or paths.

A decision to stay on the same path may include consideration of a range of actions. A decision to continue to the next phase in the Plan's development could involve, for example:

- Moving from preliminary engineering to design, or
- Expanding an element by deciding to make additional infrastructure investments, or
- Deciding not to put additional money into an element or approach that is struggling but to maintain the production already developed.

In general the possible decisions associated with the staying on the same pathway include:

- Start planning and/or pilot testing,
- Start preliminary engineering and/or regulatory and permitting processes,
- Start final design,
- Start construction,
- Build out or scale up,
- Stop further investment,
- Operate and maintain, and
- Stop pursuing altogether.

A decision to switch to a different path or paths may result from concluding that a particular task cannot be accomplished, for example not reaching agreement with other regional water providers for in lieu recharge, or from a failure to meet any threshold.

Recommended factors to be taken into account in decision-making about Plan implementation include the Guiding Principles as well as how well Plan Elements are performing relative to their Performance Metrics or Thresholds.

(i) Examples of Decision Guidance

This section provides several specific examples of decision guidance or special considerations for adjustments, adaptation or decision-making at specific decision nodes. Refer to Table 16 for details about decision nodes.

- **Element 1, Decision Node 1.3**
  - Build Out Element 1 – If agreements with one or more regional partners are reached, water rights issues have been resolved, assumptions about the availability of river flows are confirmed, and groundwater modeling indicates sufficient water will be returned to Santa Cruz in a cost-effective and timely manner, then proceed to build out water transfers up to the original design limits of Element 1, adding additional infrastructure as needed to optimize project effectiveness.

- Stop Element 1 – If no agencies choose to participate with the City in pursuing in lieu recharge, including return of sufficient stored water in a cost-effective and timely manner, the City will evaluate whether Element 1 should be pursued further or abandoned.

- **Element 2, Decision Node 2.2**
  - Build Out Element 2 – Use results of pilot testing and estimates of cost-effectiveness and schedule for final system build-out to decide whether to continue implementing ASR up to the original design limits of Element 2.
  - Stop Element 2 – Consider stopping Element 2 if the solution is not working within acceptable performance parameters, for example, something systemic to the aquifer appears to make too many test sites unsuccessful in effecting aquifer recharge, or costs greatly exceed budget, or the schedule for final build-out exceeds the target completion date, and other Elements can meet or exceed their performance parameters, such that the Plan can meet its goals without Element 2.
- **Element 3, Decision Node 3.2** – Select preferred approach for Element 3 (e.g., DPR, IPR, desalination), initiate high level feasibility studies, as needed demonstration testing, and conceptual designs, define CEQA process; continue public outreach and education, and select preferred alternative.
  - Start Preliminary Design Engineering and Regulatory Process for selected Element 3 – (start work outlined in 3.3). Initiate preliminary design, prepare a draft EIR, and continue public discussions about the selected Element 3. This effort involves activity up to, but not including, site acquisition, final design and EIR (Draft EIR only at this stage). A key goal of the work would be to have Element 3 ready to go into the final design stage at node 2.2.
  - Stopping Element 3 -- Decide to stop or pause Element 3 if other Elements can meet or exceed their performance parameters, such that the Plan can meet its goals without Element 3.

As each decision is made, thresholds, performance metrics developed for each Strategy and/or Element, including budget, schedule, and yield, objective results-oriented measures, would be reviewed and changes made either within the **Adjustment** framework by the Water Department, or within the **Adaptation** framework in collaboration with the Water Commission and under the direction of the City Council. In both cases, communication about progress, issues, and actions would be open, frequent and data-based.

Section 3.25 Article III Summary – listing of all Committee Agreements

As indicated in Section 2.02, the Committee chose to use a consensus based decision-making process during its work. All Agreements presented in this section and elsewhere in this document were reached using this consensus process.

(a) Committee Agreements on Demand Forecasts

At the Committee's April 30 – May 1, 2015 meeting they agreed that the interim forecast would be used as the basis for the Committee's work until the results of the econometric forecast became available.

At its July 23, 2015 meeting, the Water Supply Advisory Committee agreed to use the econometric demand forecast as presented by David Mitchell of M Cubed Consulting at this meeting.

On September 10, 2015, the Committee accepted a revised forecast that corrected an error in the way that future plumbing and building code changes were incorporated into the forecast. Figure 4 above, reflects the revised, corrected forecast.

(b) Committee Agreement on Fish Flow Releases

On April 30, 2015, the WSAC agreed that, for planning purposes, using the DFG-5 flows as an upper bound or the potential impacts of fish flow releases on Santa Cruz's water system made the most sense. If the ultimate negotiated flow releases are lower, then the supply demand gap will be smaller and those results can be incorporated into future planning for supply augmentation.

(c) Committee Agreement on Climate Change

On April 30, 2015, the WSAC agreed that the Climate (hydrologic) Change and Extended Drought scenarios provide plausible parameters to use in its water system planning and that this analysis provides a useful point of depart for its scenario planning work. For planning purposes, the Committee agreed that the eight-year drought sequence was useful as a design drought, and recognized that this drought sequence would be reviewed and revised as new information became available.

(d) Committee Agreement on Problem Statement

On September 11, 2015, the Committee Agreed to the following formal problem statement:

> *Santa Cruz's water supply reliability issue is the result of having only a marginally adequate amount of storage to serve demand during dry and critically dry years when the system's reservoir doesn't fill completely. Both expected requirements for fish flow releases and anticipated impacts of climate change will turn a marginally adequate situation into a seriously inadequate one in the coming years.*
>
> *Santa Cruz's lack of storage makes it particularly vulnerable to multi-year droughts. The key management strategy currently available for dealing with this vulnerability is to very conservatively manage available storage. This strategy typically results in regular calls for annual curtailments of demand that may lead to modest, significant, or even critical requirements for reduction. In addition, the Santa Cruz supply lacks diversity, thereby further increasing the system's vulnerability to drought conditions and other risks.*
>
> *The projected worst-year gap between peak-season available supply and demand during an extended drought is about 1.2 billion gallons. While aggressive implementation of conservation programs will help reduce this gap, conservation alone cannot close this gap. The Committee's goal is to establish a reasonable level of reliability for Santa Cruz water customers by substantially decreasing this worst-year gap while also reducing the frequency of shortages in less extreme years.*

(e) Committee Agreement on the List of Alternatives Considered but Not Being Pursued at this Time

At its September 10, 2015 meeting the WSAC, the Committee approved the information in Appendix 5 as its conclusions about the alternatives it evaluated and its reasons for not further pursuing these alternatives at this time.

(f) Committee Agreement about Demand Management (Conservation)

At the Committee's meeting of September 10, 2015, the Committee agreed to the recommendations related to demand management described in Section 3.16(a) of this report.

(g) Committee Agreement on Supply Augmentation Strategies

At its September 10-11, 2015 meeting, the Committee agreed to the following Supply Augmentation Strategies:

1. **Strategy One**: Development of groundwater storage using a combination of both passive and active recharge approaches and available surface water flows during the rainy season; and
2. **Strategy Two**: Development of advanced treated recycled water or desalinated water if and as needed to address any remaining supply-demand gap.

(h) Committee Agreement on Elements of the Water Supply Augmentation Plan

At its September 10-11, 2015 meeting, the Committee agreed to the following Elements of the Water Supply Augmentation Plan:

Element 0: Demand Management, with a goal to generate an additional 200 to 250 million gallons of demand reduction by 2035 from expanded water conservation;

Element 1: In Lieu, start quickly as a small program relying on existing infrastructure to provide potable water to the SqCWD. The program is intended to grow over time, if/as additional infrastructure is developed, additional agreements are reached with SqCWD and SVWD, and any needed changes to water rights are granted by the State of California. Details of sharing capital and operating costs would and how much water returns to Santa Cruz and when it would be available would be addressed in these agreements.

Element 2: Aquifer Storage and Recovery (ASR), involves development of a program to inject treated water from available winter flows into regional aquifers and recover a large portion of the stored water as a supplemental supply for Santa Cruz. This program would proceed through evaluation and piloting steps as detailed in technical reports (e.g., the May 2015 Pueblo Water Resources report) and, if successful, can be implemented on a scale sufficient to meet the yield goals of this Plan.

Element 3: Advanced Treated Recycled Water, is intended to supplement or replace Elements 1 and 2 to the extent they do not generate sufficient yield to fill the supply/demand gap in a cost-effective and timely manner, as stipulated in the Plan. In the event advanced treated recycled water could not meet the needs, desalination would then become Element 3.

In addition to developing Elements 0, 1, 2 and 3 above, the Committee suggests that the City should continuously review and take steps to address infrastructure and operating constraints that are keeping the existing system from performing as well as it could, within reason. Some specific suggestions are included in the recommendation section of this report.

(i) Committee Agreement on a Staggered Implementation Adaptive Pathway

At its September 30, 2015 meeting, the Committee agreed that implementation of the Water Supply Augmentation Plan should use a staggered approach that would include active pursuit of Strategy One at the same time as initial project planning and development work is occurring on Strategy Two. This approach is designed to ensure that should Strategy Two be needed as a water supply, enough work would have been done so that it will be feasible to achieve the yield goal within the original 10 to 12 year timeframe.

(j) Committee Agreement on a Change Management Strategy

At its October 2, 2015 meeting, the Committee agreed to the Change Management Plan presented in Section 3.24.

(k) Committee Agreement on Conveyance of Recommendations to the Santa Cruz City Council.

At its October 2, 2015 meeting, the Committee agreed to convey the Recommendations in Article IV of this report to the Santa Cruz City Council.

(l) Committee Agreement on the WSAC Agreement

Eleven of the 14 WSAC members were present at the October 2, 2015 meeting. By consensus (including proxies for two of the absent members) the Committee unanimously affirmed and approved the Agreements and Recommendations described in this report. The Committee's consensus reflects the strong commitment of the parties to move forward with addressing and ultimately resolving the community's long-standing water supply issues.

Article IV. Recommendations

Section 4.01 The Water Supply Augmentation Plan

The Committee has worked on developing a Plan that would eliminate future water shortages by 2025, give or take two years, while allowing for robust stream flows to support and enhance fish habitat.

The agreed-upon **Water Supply Augmentation Plan** (Plan) includes:

1. A **specific goal for Yield**, as well as the assumptions underlying this goal;
2. A **Timeframe** for improving the reliability of the Santa Cruz Water Supply;
3. The **Water Supply Augmentation Plan Elements**;
4. An **Adaptive Pathway** to provide a structure within which work on the Elements can be pursued and evaluated; and
5. A **Change Management Strategy** to guide adjustments and adaptations within the Plan, as described below.

Section 4.02 Yield Goal

The Committee recommends the City implement additional demand management and supply augmentation programs and projects and address key infrastructure and operating constraints to reliably make available an additional 1.2 bgy during modeled worst-year conditions.

Section 4.03 Timeframe for Improvement

The Committee recommends that the City adopt a goal of completing the improvements to Santa Cruz's water supply necessary to meet the specified yield goal by the end of 2025;

Section 4.04 Water Supply Augmentation Plan Portfolio Elements

The Water Supply Advisory Committee recommends that the City Council adopt a portfolio of measures for improving the reliability of the water supply. The recommended package includes the following Elements:

- **Element 0:** <u>Additional water conservation</u> with a goal of achieving an additional 200 to 250 million gallons of demand reduction by 2035 by expanding water conservation programs;
- **Element 1:** <u>Passive recharge of regional aquifers</u> by working to develop agreements for delivering surface water as an in lieu supply to the Soquel Creek Water District and/or the Scotts Valley Water Districts so they can rest their wells, help the aquifers recover, and effectively store water for use by SCWD in drought years;
- **Element 2:** <u>Active recharge of regional aquifers</u> by using existing infrastructure (wells, pipelines, and treatment capacity) and potential new infrastructure (wells, pipelines and treatment capacity) in the regionally shared Purisima aquifer in the Soquel-Aptos basin and/or in the Santa Margarita/Lompico/Butano aquifers in the Scotts Valley area to store water that can be available for use by Santa Cruz in drought years;

- **Element 3:** A potable water supply using advanced treated recycled water as its source, as a supplemental or replacement supply in the event the groundwater storage strategies described above prove insufficient to meet the Plan's goals of cost effectiveness, timeliness or yield. In the event advanced treated recycled water does not meet the needs, desalination would then become Element 3.

Section 4.05 WSAC Value Statement on Implementing Plan Elements

The recommended Water Supply Augmentation Plan reflects the Committee's preference for pursuing a groundwater storage and retrieval strategy provided the yield goal can be achieved in a cost-effective and timely manner. Before making a choice to move away from groundwater storage, the Committee recommends that the City diligently pursue all reasonable measures to make the groundwater strategies work.

Recognizing the cost differential between some of the strategies the Committee considered in developing its recommendations, the WSAC agreed to express its preference for the Strategy One, groundwater storage and retrieval, over Strategy Two, and has agreed that as long as the ACAYY for implementing Strategy One is not more than 130% of the ACAYY for Strategy Two, while still meeting other metrics, Strategy One should be pursued.

Section 4.06 Adaptive Pathway Implementation Strategy

The Committee recommends that the Council adopt a staggered Adaptive Pathway to guide implementation of the Plan and that decision-making at the various decision-nodes identified in this Adaptive Pathway be guided by the provisions of the Change Management Strategy.

Section 4.07 Change Management Strategy

The Committee recommends that the Council adopt the Change Management Strategy described in Section 3.24.

Section 4.08 Additional Recommendations Related to Infrastructure and Operating Constraints

(a) Infrastructure Constraints

The Committee also supports the Water Department's plans to address certain key infrastructure constraints that are keeping the City from fully utilizing available water, especially during the high flow season. These include, but are not limited to:

- Rehabilitation of the pipeline between the Felton Diversion and Loch Lomond that would allow the City to increase diversions to Loch Lomond during the high flow season;
- Evaluation of additional pumping capacity at Felton to push more water to Loch Lomond through the replacement pipeline; and
- If proven cost-effective, and needed for the implementation of Strategy One, complete improvements that will allow the Department to treat water with turbidities that are higher than can be effectively treated by the current Graham Hill Water Treatment Plant facilities and

processes. The specific method for how to address the water treatment constraint should include evaluating a range of potential options, including, but not limited to Ranney Collectors or satellite treatment plants, and choosing the most cost-effective approach.

(b) Operating Constraints

Another focus of the Committee's review relates to some system operational constraints. Operating constraints typically include both daily parameters for drawing water from the City's sources and operating constraint parameters that are used in modeling system performance.

The Committee recommends that the Water Department identify and regularly evaluate operating constraints to determine whether those constraints continue to be justified as necessary to protect the system and finished water quality and to support efficient and cost-effective operations. Early focus should be given to issues related to Loch Lomond year-end carry over storage requirements, particularly if/when in lieu and/or ASR have provided a sufficient drought supply, and to the "first flush" constraint impacting the City's ability to pump water from Felton to Loch Lomond under critically dry year conditions.

Section 4.09 Implementation Plan and Timeline

As part of the process for developing the WSAC Agreement, City Staff and the technical team developed a Gantt chart shown in Figure 12. This Gantt chart, together with the Decision Node Table (Table 16) and the Staggered Adaptive Pathways Map (Figure 11) comprise the Implementation Plan and Timeline.

Figure 12 – Gantt Chart: Implementation Plan and Timeline

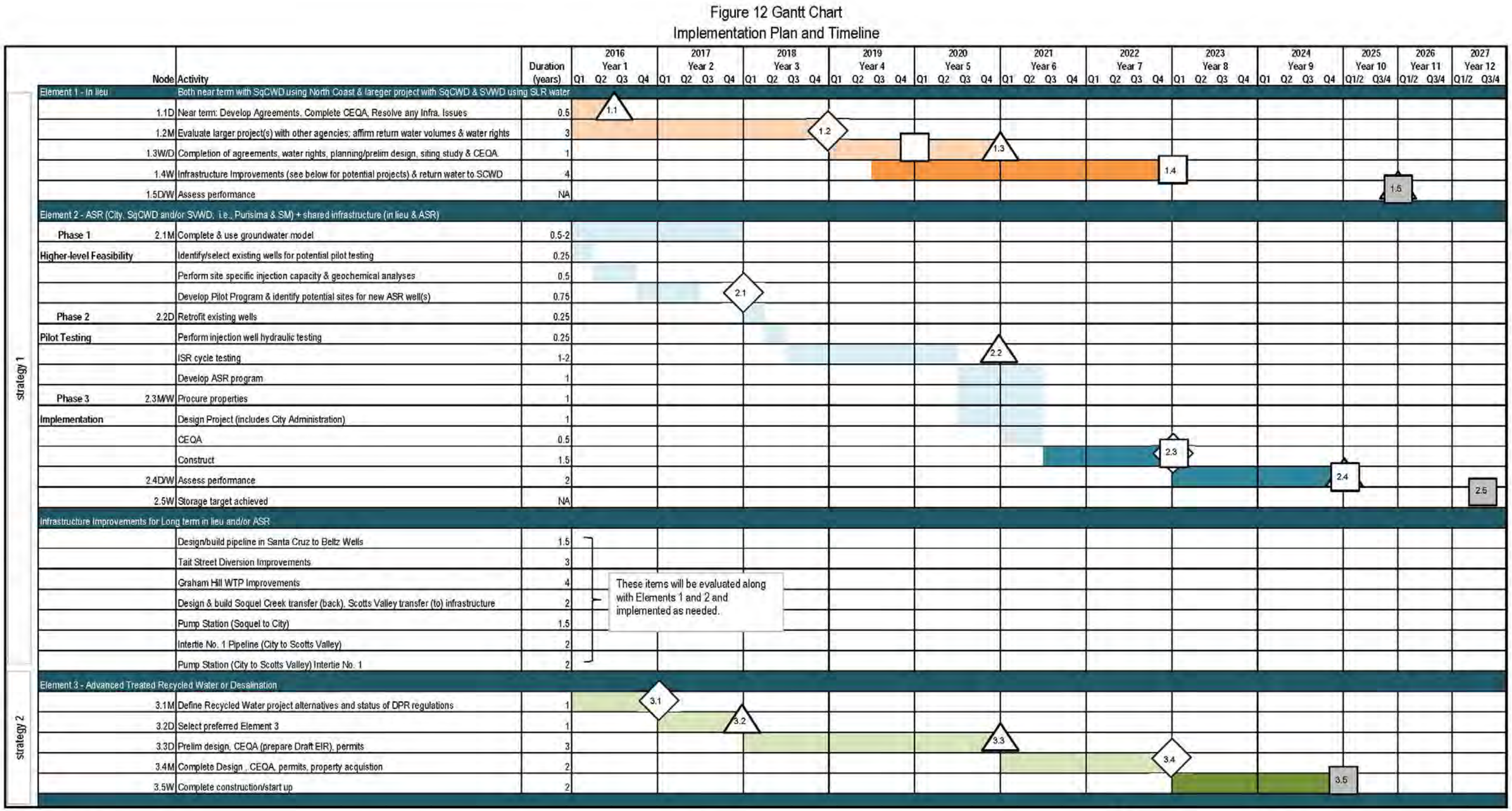


Table Notes & Select Assumptions

This table approximates activities, costs, durations and sequencing of each element, all of which are subject to change.
Elements are shown to start in Q1 - 2016. This may or may not occur depending upon agreements, contracts, etc.
Rehab/replacement of the Newell Creek Pipeline is part of the existing CIP and not shown here.
Some infrastructure improvements may not be required if other pursuits are successful. E.g., evaluation of Ranney collectors may substitute GHWTP Improvements.
CEQA is used generically; implies compliance with California Environmental Quality Act.
Pilot ASR work assumes major infrastructure not required. E.g., intertie to Scotts Valley or new well(s).
Element 2 includes 8 wells for in lieu plus 8 additional wells for ASR.

Legend

ASR = Aquifer Storage and Recovery
CEQA = California Environmental Quality Act
DDW = Division of Drinking Water
DPR = Direct Potable Reuse
EIR = Environmental Impact Report
GHWTP = Graham Hill Water Treatment Plant
IPR = Indirect Potable Reuse
ISR = Injection, Storage, Recovery
SCWD = Santa Cruz Water Department
SqCWD = Soquel Creek Water District
SVWD = Scotts Valley Water District

△ Decision Node
◇ Milestone Node
□ Some amount of water returned to SCWD
■ Full required amount of water returned to SCWD

Appendix 8
Cost Data and Cost Analyses

Overview

This Appendix describes key activities undertaken by City staff and the project technical team to support the Water Supply Advisory Committee (WSAC or Committee) as it evaluated alternatives and later defined the recommended water resources plan and associated costs (capital, operations and maintenance [O&M], and present value).

Progression: Ideas to Building Block Development to a Robust Adaptive Program

Figure A8-1 presents an overall flow schematic for the progressive development that moved from public and staff ideas offered at the Strategies and Ideas Convention (October 2014), through consolidated alternatives (CAs) to building blocks (BBs), portfolios, and final elements and strategies.

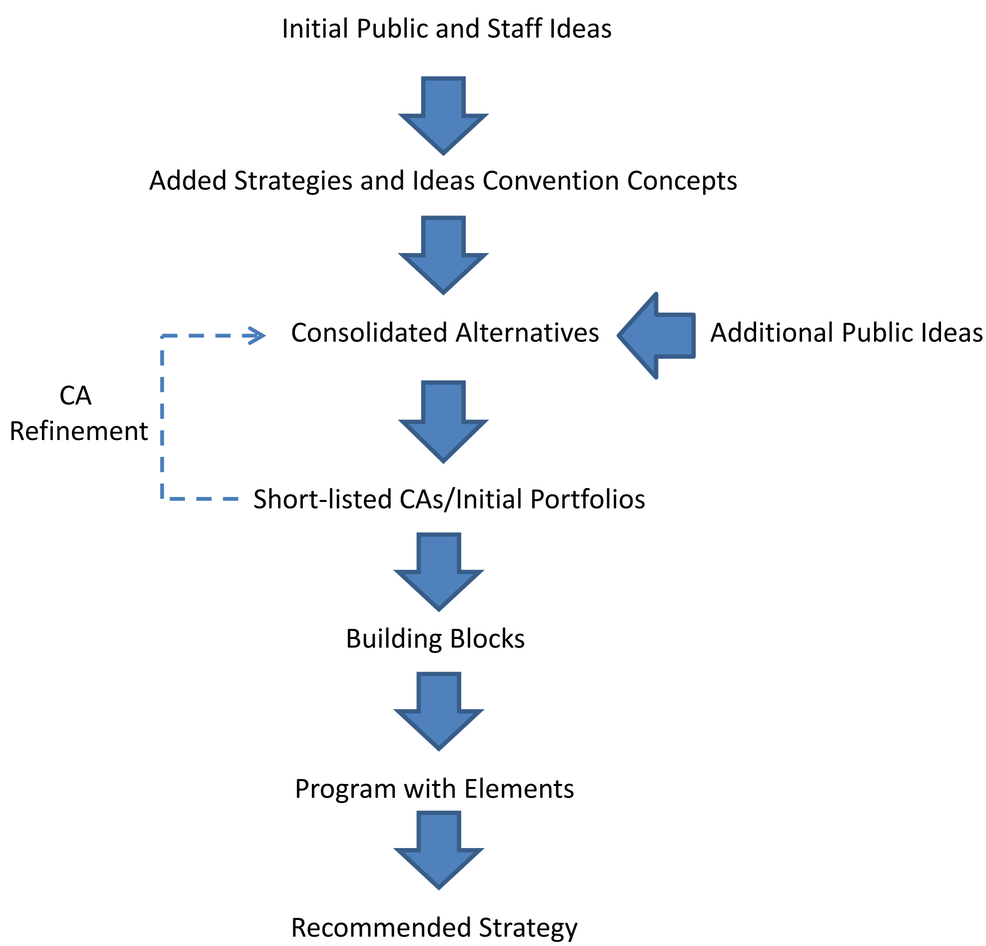


Figure A8-1 Overall flow schematic for the progressive development of the Proposed Water Supply Program

The April/May 2015 WSAC meeting marked the start of the modeling of the manner in which supply/ infrastructure alternatives address the reliability issues identified to that point. Analyses were performed on the following Consolidated Alternatives (CAs):

- Harvesting Winter Flows (CA-9, CA-16, CA-18)
- Ranney Collectors and Additional Storage (CA-19)
- North Coast Reclaimed Water Exchange (CA-13)
- Indirect Potable Reuse (CA-10)
- Additional Water Conservation (Program CRec) (CA-03)

By the June 2015 WSAC meeting, the Consolidated Alternatives considered above had evolved into several portfolios. All of the portfolios included the CRec conservation programs (CA-3). In addition, each portfolio included a Plan A and a Plan B. The initial supply/infrastructure additions represented by Plan A depended in whole or in part on storing excess winter flows in groundwater aquifers. The Plan B additions consisted of drought-proof supplies that did not vary with streamflow.

The portfolios were refined in several iterations, and the final set that was discussed at the June meeting was intended to enable the Committee to wrestle with different adaptive approaches to dealing with the uncertainties associated with all of the alternatives, particularly the abilities of the regional aquifers to store and allow recovery of significant volumes of water. Resolution of these uncertainties requires a robust program of groundwater modeling, analysis, and testing, and the portfolios recognized the significant risk of simply relying on the Plan A alternatives.

Based on WSAC discussions around these potential portfolios assembled from parts of the CAs, City staff and the Project Team developed BBs that WSAC combined into its preferred/recommended Elements. In this process, CAs were refined and consolidated into BB portfolios that could accomplish key water production, transfer and return goals. Elements from the BB portfolios were then extracted and further refined as separate potential projects. These elements were as follows:

1. In lieu recharge to Soquel Creek Water District (SqCWD) and Scotts Valley Water District (SVWD),
2. ASR as a supplement or in place of in lieu recharge to SqCWD and SVWD, and
3. Advanced Treated Recycled Water or Desalination.

The Elements form an adaptive program that the City, likely with cooperation with adjacent agencies, will implement and modify based on relative success of the Elements. Attachment 1 presents a summary of the recommended elements, including estimated capital costs, energy use, yield, etc., of the Elements in this Plan. Attachment 2 is a Gantt Chart timeline for implementation. Attachment 3 is the companion piece describing the decision points and milestones. And Attachment 4 includes the three subway diagrams that can be used with the other attachments to understand in the implementation plan.

Key Physical Components

The City plans to use existing facilities wherever possible and build new facilities as needed to augment its existing supply. Key existing components include:

- The City's diversions (North Coast streams and San Lorenzo River via Tait Street and Felton),
- Beltz Wells,
- Loch Lomond Reservoir,
- Graham Hill Water Treatment Plant (GHWTP),
- Associated storage and conveyance infrastructure (raw water and treated water pipelines, pumping stations and distribution system reservoirs),
- The City's wastewater treatment plant (WWTP) and ocean effluent outfall.

Potential new facilities include:

- Upgrades to the GHWTP,
- Modifications to diversions (e.g., Ranney collectors and/or upgraded Felton and Tait Street facilities, and replacement of the pipeline from Felton Pump Station to the Newell Creek Dam/Loch Lomond),
- New wastewater effluent advanced purification facilities (likely at the WWTP),
- Replacement or addition of new infrastructure (both within the City and connecting to/within the Soquel Creek Water District and Scotts Valley Water District), and
- New wells within the City, Soquel Creek Water District (SqCWD), and/or Scotts Valley Water District (SVWD).

The diagrams in Figures A8-2, A8-3, and A8-4 show examples of how the pieces could fit together into functioning systems.

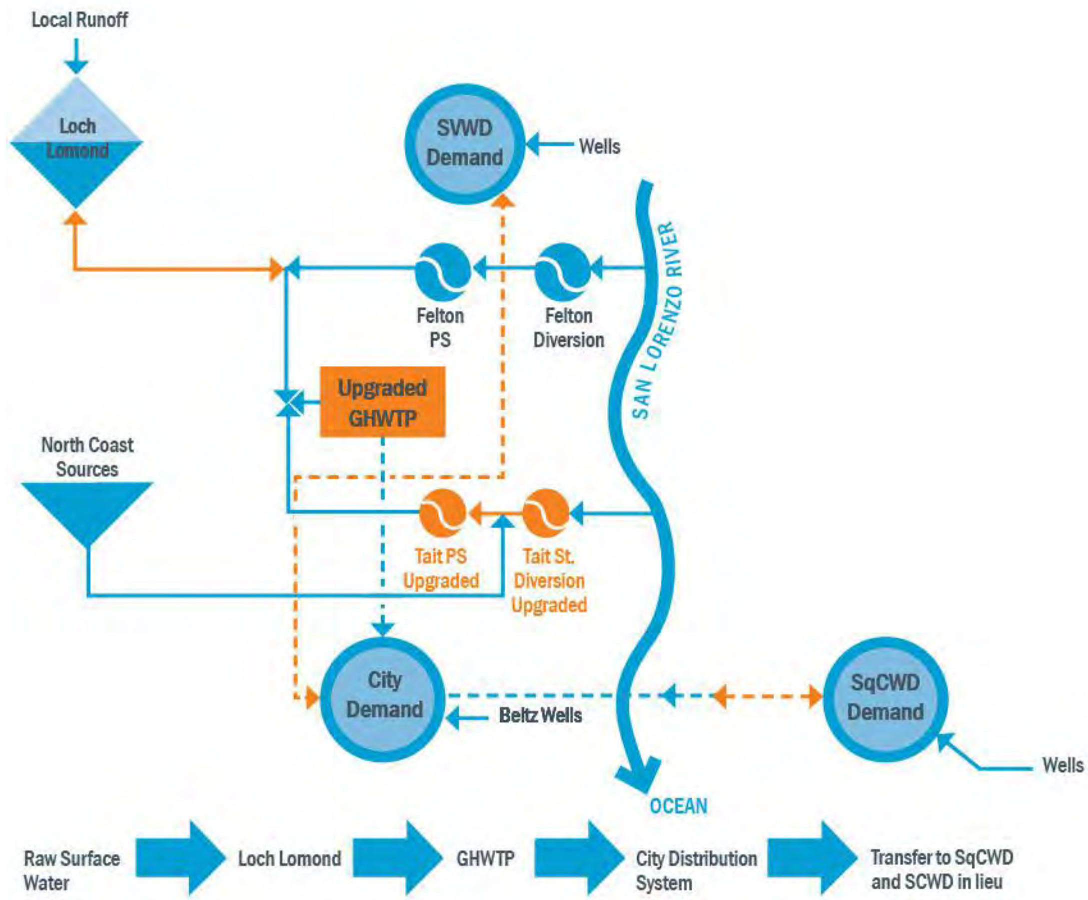


Figure A8-2. Illustration of the Conceptual Approach for Element 1, In lieu Recharge

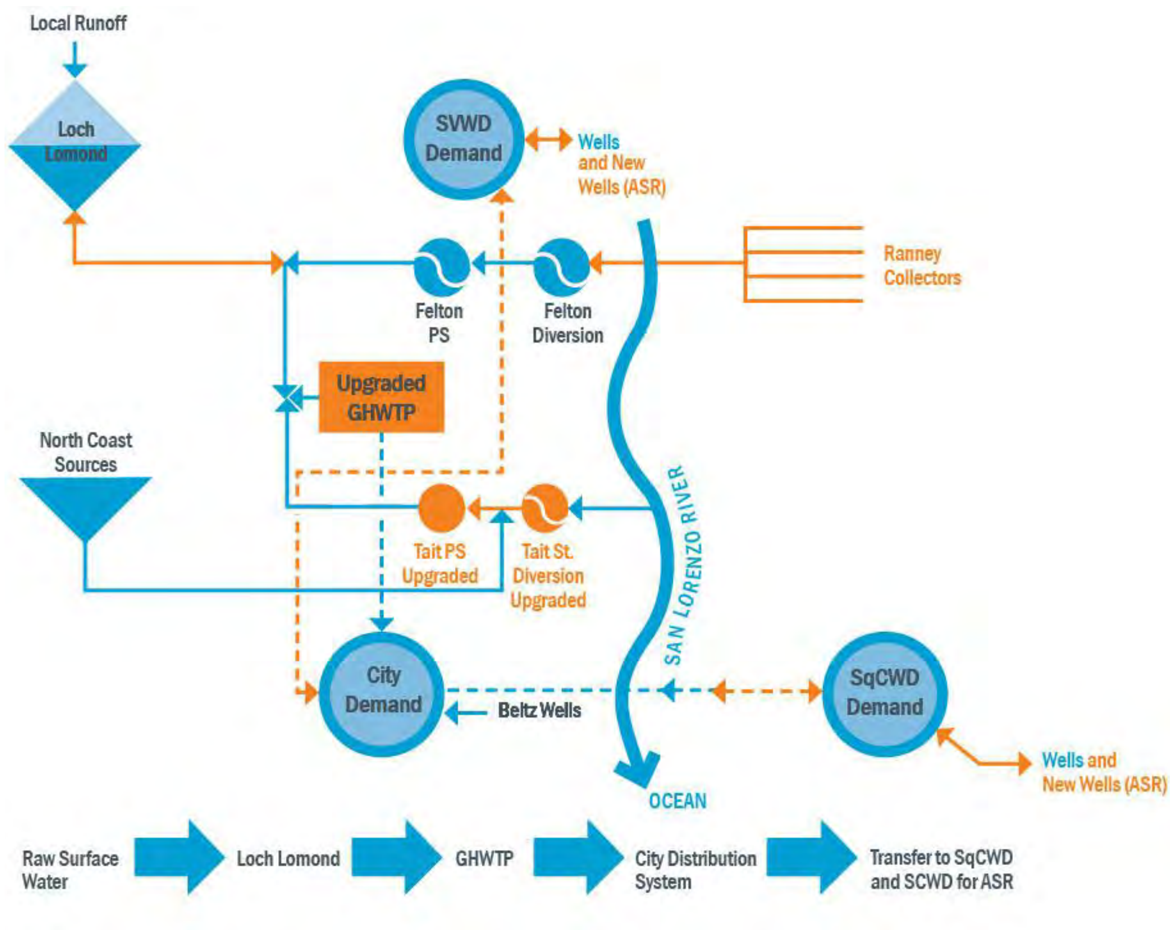


Figure A8-3. Illustration of the Conceptual Approach for Element 2, ASR.

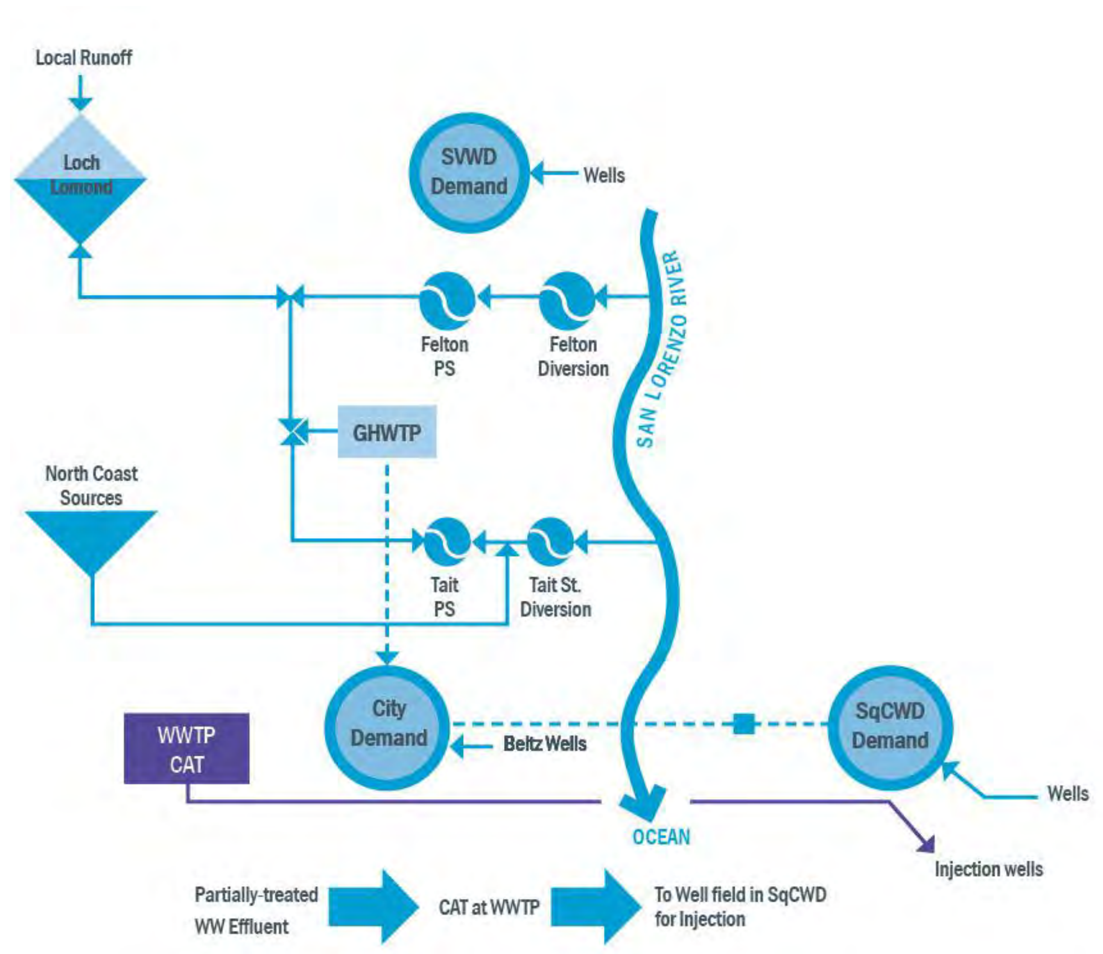


Figure A8-4. Illustration of the Conceptual Approach for Element 3a, Potable Reuse via Groundwater Recharge—i.e., Indirect Potable Reuse

Cost Estimating

The technical team developed costs (capital, operations and maintenance [O&M] and present value) at several stages of potential program component development**.** All costs, from the Portfolio stage through the original Building Block concepts (which were expanded on by committee members) to the final Recommended Project Elements were based on the conceptual-level construction and operating costs on project components like those shown in the schematics above. Information available in previous technical studies conducted by the City, Santa Cruz County, SVWD, and SqCWD and previous projects/studies by Brown and Caldwell (BC) were used to inform this work. For example, the 2015 Pueblo ASR report informed the development of the ASR well number and cost estimates; the new conveyance between Soquel Creek Water District and the City is based on the alignment for a potential intertie and pump station developed for the City by Kennedy Jenks; and the treatment train concept for this work was based on the most exhaustive complete advanced treatment (CAT) process being piloted in California as of Summer 2015: nitrification of the wastewater effluent—ozone with biologically active carbon (O_3/BAC)—microfiltration (MF)—reverse osmosis (RO)—advanced oxidation ultraviolet light with peroxide (UV-AOP) conditioning of the product water, as illustrated in Figure A8-5. This process train is very robust since regulations for potable reuse via reservoir augmentation and direct reuse are still in flux and the City may wish to pursue one of these options. The more robust process train also responds to concerns expressed by citizens at WSAC meetings. The proposed train would ensure a greater removal of constituents such as emerging contaminants of concern (e.g., pharmaceuticals).

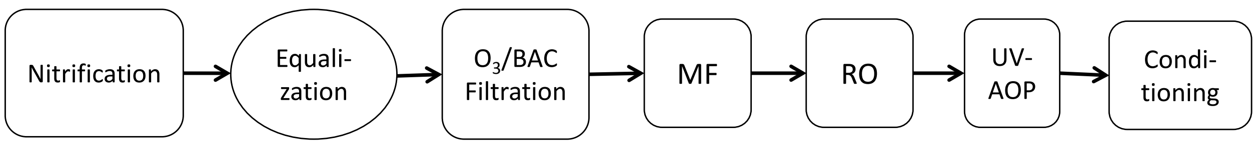


Figure A8-5. Illustration of the CAT Conceptual Approach for Element 3a, Potable Reuse

Table A8-1 below describes the final project elements. The cost estimates for Elements 1, 2 and 3 all contain a range of uncertainty. For example, while it is possible that the final cost for implementing Strategy 1 may be substantially less, it is also possible the costs may be more. Focusing only on Strategy 1, the factors that may lead to lower costs include the following:

1. It is beyond the scope of the WSAC to recommend the actual design of these Elements. For example, in lieu recharge (Element 1) might be implemented in many different ways, depending on the interests of neighboring districts, the constraints of water treatment, the constraints of existing distribution pipelines, etc. Similarly, direct injection (Element 2) may be conducted by the City alone, or in conjunction with neighboring districts, focused on one aquifer strata, or focused on several strata, etc. I.e., there are many unknowns that must be answered to define the final project.
2. The Project Elements Summary does not include the revenue from sale of water to neighboring districts, or other means of potential cost-sharing. It is premature to estimate that cost sharing contribution or possible revenues back to Santa Cruz.
3. The cost of upgrade of GHWTP, $62 million, is the largest single line item on the Gantt Chart. The purpose of this expenditure is to allow treatment of more winter water from the San Lorenzo River for the purpose of maximizing Elements 1 and 2. To be able to produce and deliver more water in the winter, we may need to deal with water with turbidity levels that are beyond that which can be effectively treated by the GHWTP. Lower cost options for addressing this purpose may be available and include: a) using existing GHWTP treatment capacity, b) constructing a Ranney Collector to reduce turbidity, and/or c) installation of a small-scale satellite treatment plant. The information needed to assess the feasibility of these alternatives is currently

unavailable. A principal piece of needed data is an understanding of the current GHWTP’s ability to treat water at the quality and quantity needed for Elements 1 and 2, followed by an understanding of the most cost-effective way of meeting treatment goals associated with these elements where the GHWTP might fall short.

4. The cost of upgrading the Tait St. Diversion, $14 million, is included in the cost estimate and is a placeholder for achieving increased diversion capacity on the San Lorenzo River for the purposes of maximizing Elements 1 and 2. However, with the City adoption of the aquifer recharge strategy and the completion of a Habitat Conservation Plan, the expectation is that state and federal fisheries agencies will remove their long-standing protest of the City's water rights application to use Felton Diversion for direct pumping to Graham Hill Treatment Plant. State approval of this water rights revision may allow the City to use the Felton Diversion for additional winter water diversion, rather than expand the Tait St. Diversion.
5. Current calculations are based on a 30-year life-cycle and do not account for residual value in capital expenditures beyond 30 years. Longer-lived infrastructure, such as pipelines between Santa Cruz and neighboring districts, likely has value that is not included in the cost accounting.
6. Costs could be significantly greater in order to generate yield sufficient to meet the gap, e.g., final pipeline routes could be longer or geological conditions could require more injection wells.
7. Strategy 1 will be implemented in incremental fashion. Initial expenditures are intended to define the project(s) and its feasibility at meeting the Plan’s goals in the most cost effective way possible. Subsequent expenditures would be made based on feasibility and cost effectiveness with little risk of creating stranded assets.

Table A8-1. Project Element Capital Cost Components and Assumptions

Element Number/Type	Capital Cost Components	Basis for Assumptions
1 – In lieu	Existing Infrastructure Improvements • Tait Street Diversion Improvements • Graham Hill WTP Improvements Pumps and Pipelines • 3,600 gpm Pump Station (City to Scotts Valley)at Intertie No. 1 • 16-inch Intertie 1 Pipeline (City to Scotts Valley), 3,600 linear feet (LF) • 3,600 gpm Pump Station (Soquel to City) at SqCWD Intertie • 16-inch Intertie Pipeline (City to Soquel Creek), 25,000 LF Wells • 4 350-gpm extraction wells in SVWD • 4 350-gpm extraction wells in SqCWD • Iron & manganese treatment, 8 wells • Land acquisition for wells, 4 sites in SqCWD and 4 sites in SVWD	• In lieu is based on winter demands for SqCWD and SVWD. • Water could be transferred to wells within the City, to SqCWD, and to SVWD. • Infrastructure is sized to accommodate 2.5-mgd (million gallons per day) peak flow between the City and SVWD and between the City and SqCWD. This sizing is to allow inclusion additional flows for ASR in the future. • The ultimate number and distribution of wells between agencies will be determined during project development. • The Tait Street and GHWTP improvements are based on current information that indicates that these facility upgrades are needed to treat a larger volume of higher turbidity water. This will be better defined moving forward. • It is assumed that the wells will all have a peak extraction flow rate of 350 gpm. • It is assumed that on-site iron and manganese treatment will be needed at each well. • Well footprints are estimated at 0.1 acre each. •
2 – ASR	Pumps and Pipelines • In-City pipeline to Beltz Wells, 4,000 LF Wells • 2 350-gpm Wells in SVWD)	• ASR is based on the assumption that there is adequate capacity in the basin to store and produce water as supplied from available winter flows. It is also assumed that early project activities will include field work to evaluate the validity of these initial assumptions (i.e., how well ASR is likely to work in terms of both storage capacity and future yield). • The project elements for the ASR program build on the project elements already developed in

	• 2 350-gpm Wells in SqCWD • 4 350-gpm Wells in Santa Cruz • Iron & manganese treatment, 4 wells • Land acquisition, 0.1 ac. each in SVWD and SqCWD	Element 1. • Water could be transferred to wells within the City, to SqCWD, and to SVWD. • Infrastructure is sized to accommodate 2.5-mgd peak flow between the City and SVWD and between the City and SqCWD. • The ultimate number and distribution of wells between agencies will be determined during project development. • It is assumed that the wells will all have a peak injection flow rate of 250 gpm and a peak extraction flow rate of 350 gpm. • It is assumed that on-site iron and manganese treatment will be needed at each well. • Well footprints are estimated at 0.1 acre each.
3 – Indirect potable reuse via groundwater recharge	CAT Process • Nitrification (3.9 mgd) • Ozone/BAC Filters (3.9 mgd) • Microfiltration (3.9 mgd) • Reverse Osmosis (3.5 mgd) • Advanced Oxidation (Peroxide + UV) (3.0 mgd) • Conditioning Facilities (3.0 mgd) • Effluent Diffuser Modification <u>Pumps and Pipelines</u> • 2,700 gpm Pumping System—WWTP to CAT • Pipeline Installation—WWTP to CAT, 200 LF • Equalization Basin, 0.5 million gallons • 2,100 gpm Pumping System—WWTP to Soquel Creek • 16-inch Pipeline to Wells, 20,100 LF • 16-inch Pipeline under San Lorenzo River, 350 LF • 16-inch Pipeline Under Woods Lagoon, 445 LF	• Potable reuse capacity is designed for 3-mgd product water 365 days a year based on treating only City of Santa Cruz flows. (I.e., conservatively assuming raw sewage and/or effluent from SqCWD and SVWD was unavailable.) • Infrastructure for potable reuse treatment is identical for all potable reuse alternatives. Treatment is on-site at the WWTP. Costs to treat blended water at GHWTP not included (~$2.7M/yr for 3 mgd daily flow) • Groundwater recharge is assumed to occur near the coast.

	• 16-inch Pipeline Installation—transmission line to well 1, 2,640 LF • 14-inch Pipeline Installation— well 1 to well 2, 2,640 LF • 12-inch Pipeline Installation— well 2 to well 3 to well 4, 5,280 LF • 10-inch Pipeline Installation (WWTP to wells 5-6, 10"), 5,280 LF • 8-inch Pipeline Installation—well 6 to well 7, 2,640 LF • 6-inch Pipeline Installation—well 7 to well 8, 2,640 LF <u>Wells</u> • 8 350-gpm Injection Wells at SqCWD	
4 – City desalination	• City Desalination Plant Capital Cost (from earlier Santa Cruz work) • Effluent Outfall Modifications	• The City desalination option capacity is 3 mgd product water 365 days a year. • Cost includes property rights acquisition. • Water from the facility would be added in at Bay Street has been added (instead of into the distribution system at a lower point).

Capital Costs.

The capital cost estimates represent an order-of-magnitude (AACEI Class 5) approach. For an order of magnitude estimate the planners, hydrogeologists and engineers have defined major project components (see examples above), estimated approximate required capacities, established preliminary design criteria, and selected rough locations for facilities and routings for connection infrastructure such as pipelines. BC used capital cost information from other similar projects (for example, City of San Diego Pure Water and Orange County Sanitation District/Orange County Water District Groundwater Replenishment Supply—GWRS) and many Northern California pumping stations and pipelines from previous BC planning and design assignments. Pueblo Water Resources supplied information about well construction costs. In terms of costs, Class 5 planning-level estimates, which include a 50 percent contingency factor, are also accompanied by an accuracy range of -30% to +50%. For example, a project presented with a $100M cost including contingency allowance ($66.7 million plus $33.3 million = $ 100 million) likely would have a final cost between $70 million and $150 million. Table A8-2 and Figure A8-6 below summarize the AACE Estimate Classification System.

Table A8-2 AACE Estimate Classification System, adapted from AACE RP No. 18R-97, *Cost Estimate Classification System – As Applied in Engineering, Procurement and Construction for the Process Industries* (1998)

Estimate Class	**Primary Characteristic**	**Secondary Characteristic**			
	Level of Project Definition (% complete)	**End Use**	**Methodology**	**Expected Accuracy Range** (Typical variation in low and high ranges)	**Preparation Effort** (Typical degree of effort relative to least cost index of 1)
Class 5	0-2%	Concept Screening	Capacity factored, parametric models, judgement or analogy	L: -20% to -50% H: +30% to 100%	1
Class 4	1-15%	Study or Feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%	2 – 4
Class 3	10-40%	Budget Authorization or Control	Semi-detailed unit costs with assembly-level line items	L: -10% to -20% H: +10% to +30%	3 – 10
Class 2	30-70%	Control or Bid/Tender	Detailed unit cost with forced detailed take-off	L: -5% to – 15% H: +5% to 20%	4 – 20
Class 1	50-100%	Check Estimate or Bid/Tender	Detailed unit cost with detailed take-off	L: -3% to – 10% H: +3% to 15%	5 - 100

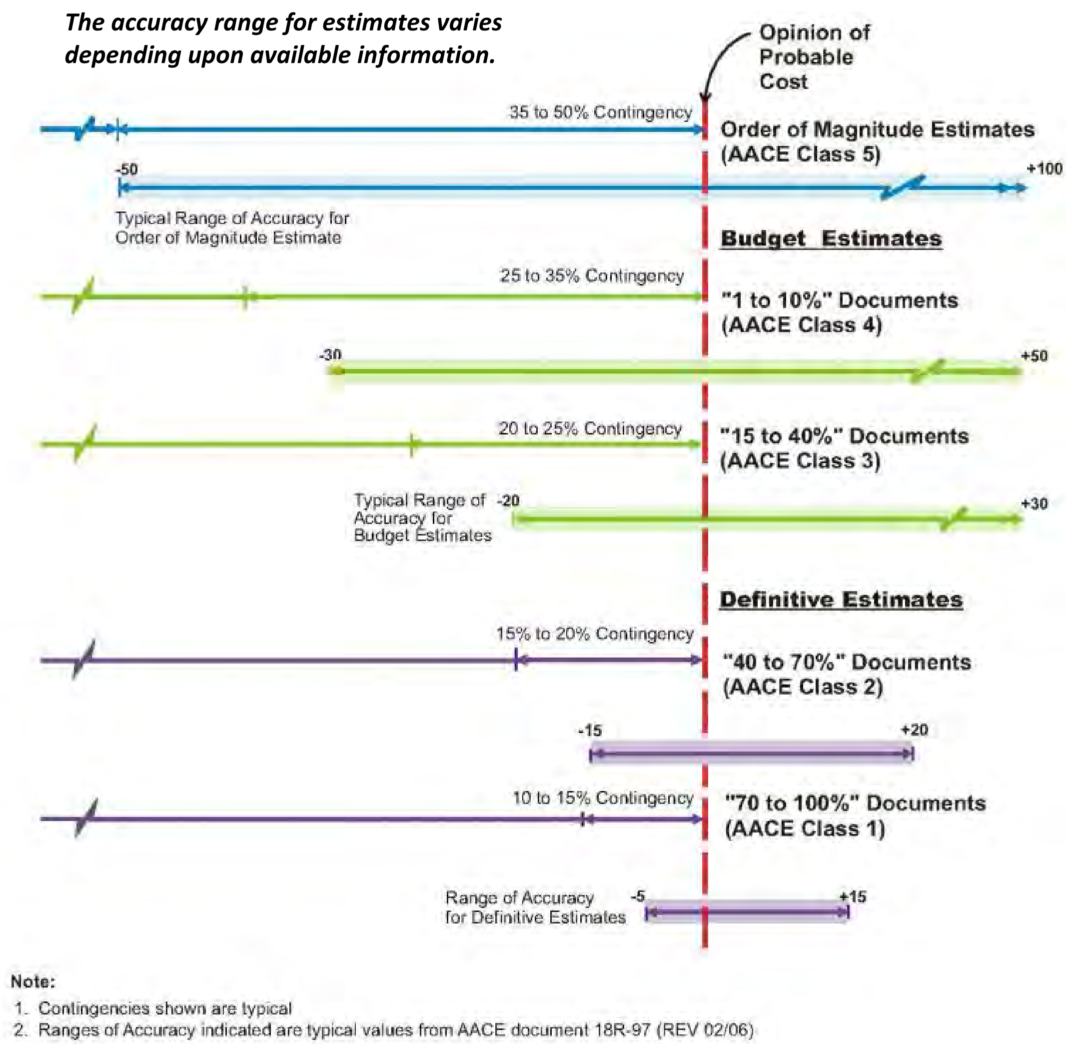


Figure A8-6 Opinions of Probable Cost Typical Contingencies and Ranges of Accuracy

The standard cost multipliers used on the construction subtotal (1.5X the base capital materials cost) in the capital estimates included:

- Engineering and Administration 20%
- Legal 5%
- Geotechnical Investigation 1%
- Permitting - CEQA/NEPA 5%

Project sizing, e.g., flow rate for a pumping station or pipeline, came from a combination of Confluence® model runs (for available raw water from the City's current sources) and assessment of available resources such as raw wastewater flows and estimated recovery of recycled water after allowing for production losses. For this project, the reader should note that each estimated construction cost includes a contingency allowance for both "known unknowns" and "unknown unknowns." Known unknowns include items such as site geotechnical conditions (at most sites no investigations have occurred yet but some sites such as the WWTP are built over originally swampy ground) and existing potential utility interferences. Unknown unknowns could be things such as endangered species habitat that requires rerouting/relocation of facilities or potential well site exploration that would show unsuitable underlying geology. The contingency allowance was set at 50 percent to reflect the very early conceptual level for the work.

Capital costs also recognize that the City will expend considerable funds in its planning, design, and facilities permitting.

<u>O&M Costs</u>

O&M costs include a wide variety of ongoing project costs. CAT-specific treatment O&M costs were based on South District WWTP (Miami-Dade Sanitation District Miami, FL) costs prepared by BC. Basic O&M cost elements included:

- Electricity to run equipment and to pump (based on elevation lift and frictional losses) at $0.013/kW-hr,
- Infrastructure and mechanical spare parts, equipment repairs and replacement:
  - <u>Pumping Systems</u>: Pump replacement every 15 years + pumping system replacement every 30 years.
  - <u>Pipelines</u>: Annual O&M 1.5% of capital cost + 60-year replacement.
  - <u>Storage Tank</u>: Annual O&M at 0.5% of capital cost + painting every 20 years + 60-year replacement.
  - <u>Treatment Processes Nitrification, Ozone/BAC, Conditioning Facilities</u> – Annual O&M 1.5% of capital cost + 60-year replacement for full unit.
  - <u>Treatment Processes MF, RO, and UV-AOP:</u> Microfiltration and RO based on expected average membrane life and company warranty, UV and Ballast based on average life and company warranty. This also includes 60-year replacement for full unit.
- Treatment chemicals (e.g., greensand and chlorine for the wellhead treatment systems, anti-scalant for the RO system, caustic for pH adjustment post-RO), and
- Cost of treating water through the GHWTP (if the City would choose direct potable reuse later in project implementation).

The O&M costs have similar uncertainty to capital costs.

Unit Costs

BC based unit costs on those prepared by BC for North City Water Reclamation Plant (NCWRP), Harbor Drive Advanced Water Purification Facility (HD AWPF), and North City Water Reclamation Plant, NCWRP Upgrades/Improvements. BC used the sizing criteria from San Diego's Pure Water program for unit processes with a general assumption that the City could modify the existing highly under-loaded SC TF/SC WWTP to achieve nitrification. BC knows the effluent flow rates available and general water quality. The cost curves and the six-tenth rule served as the basis for adjusting estimated capital costs for facility scale changes. For final analysis, a 3-mgd output facility was considered that would treat only City wastewater.

Why was "yield" selected as the basis of the cost comparison?

An important metric for evaluating different water supply (and conservation) enhancement options can be developed by examining the cost per some unit of water-related benefit provided. Two water-related benefit measures that might be applied in this context are:

1. ***Yield*** is defined within the WSAC context as the amount by which a water option, or a portfolio of options, decreases the gap between peak season demand and the supply of water available in that peak season. Yield is typically measured in terms of the estimated millions of gallons (mg) by which the gap is reduced over the peak season. Yield may also be portrayed in terms of the size of the remaining peak season gap in a given projected water year (measured in MG, and/or in terms of the percent of peak season demand remaining unmet). Yield estimates reflect how the water supply components operate together as part of the overall SCWD *system*, and yield estimates are generated through application of the *Confluence* model.
2. ***Production*** is the volume of water potentially generated when operating at full design capacity by a water supply option, and is typically described in terms of volume produced in a typical day (e.g., 3 mgd). Production also may be described as how much water would likely be produced over a year (e.g., a 3 mgd facility producing water at that rate for 365 days would produce almost 1,100 MG per year). Production can be a somewhat hypothetical measure of the actual amount of water generated, as many options do not operate at full scale every day of the year (e.g., they may be constrained by the amount of river flows, and/or limited by other components of the overall water system). Production estimates do not account for how components of the overall system interact, but they are useful for scaling the size of the necessary infrastructure and estimating annual operation and maintenance costs.

Either of these water measures can be applied in a "unit cost" metric – i.e., one can use a cost per yield metric and/or a cost per production metric or both.

Of these two possible metrics, the “cost per yield” version was selected by the WSAC as the most informative and relevant during the evaluation phase. This is because “yield” reflects the true value to the community of the water generated by an alternative–it reflects how much an option (or portfolio of options) helps address water shortages in the times of year when shortages otherwise would arise and result in curtailments being imposed on the Water Department’s customers.

In contrast, water “production” reflects how much water might theoretically be generated in total, but not necessarily how much water would be truly generated, nor how much of the water shortage problem it might help address.

- **How will “Annualized Cost per Average Year Yield” be used with other metrics in comparing projects?**

A metric selected by WSAC for evaluating options is the Annualized Cost per Average Year Yield (ACAYY). This metric applies the estimated total annualized cost of an option (the annualized capital expense, such as would be incurred through bond repayments, plus the annual operation and maintenance costs), divided by the estimated average year yield (AYY).

The total annualized costs portion of the metric provides a useful approximation of how much the community will pay each year for the alternative. The AYY portion of the metric reflects the estimated value realized by the community (in terms of yield–the amount by which water shortage problems are resolved) averaged across projected future water year outcomes. This metric thus provides an indication of costs borne relative to the benefit received by rate payers.

This metric will be used to help guide deliberations about how the preferred water plan elements may be adjusted over time, as more information becomes available through the initial stages of investigation and implementation. For example, if technical or institutional complications (or simplifications) arise that render the expected cost of a preferred alternative considerably higher (or lower) than initially estimated, and/or result in lower (or higher) anticipated water yields, then the expected ACAYY cost per yield metric for that element will increase (or decrease). If the increase (or decrease) in ACAYY is sufficiently large, then the unit cost information will be considered—along with other factors—with respect to whether there should be some change in the portfolio moving forward (e.g., to enlarge or reduce the scale of one element as compared to another).

It is important to note that there is <u>not</u> a hard cut-off value for ACAYY for when an alternative may be modified or dropped from further consideration. WSAC opted for a benchmark of a 130% difference in the ACAYY unit cost metric, for comparing one portfolio element against another, as a basis for whether or not an adaptive change in strategy should be *considered*.

However, WSAC also clearly indicated that an ACAYY beyond the 130% level should not necessarily result in a change in strategy. WSAC also noted that some options provide ancillary benefits that are not necessarily reflected in the ACAYY metric (e.g., aquifer restoration may enhance instream flows), and such additional benefits may justify a higher unit cost compared to the ACAYY of other options.

List of Attachments

Attachment 1 Project Element Summary

Attachment 2 Gantt Chart, Implementation Plan and Timeline

Attachment 3 Table of Decision Nodes and Related Milestones

Attachment 4 Subway Diagrams

Project Elements Summary

	Element	1	2	3a	3b	3c	3d
	Building Block Approach	**In-Lieu**	**ASR and In-Lieu Combined***	**DPR Small (3 mgd)**	**IPR-Loch (3 mgd)**	**IPR-GW (3 mgd)**	**Local Desal (3mgd)**
a	Capital Cost ($ M)	131	159	89	132	119	147
b	Annual O&M cost ($ M/yr)	2.6	3.7	3.5	5.2	4.2	3.9
c	Total Annualized Cost ($ M/yr)	11.6	14.6	9.6	14.3	12.4	14.0
d	Present Value Costs ($M)	185	237	162	241	207	229
h	Worst Year Yield (MG)	750	760	810	660	740	810
i	Average Year Yield (MG)	350	380	440	430	380	440
j	Worst year yield unit cost (Total Ann Cost/Wst Yr Yield)	15,500	19,300	11,900	21,600	16,700	17,300
k	ACAYY** (Total Ann Cost/Ave Yr Yield)	33,200	38,500	21,900	33,200	32,600	31,800
l	Worst Year Peak Season Shortage (MG)	480	470	420	570	490	420
m	Worst Year Peak Season Shortage (%)	25%	24%	22%	29%	25%	22%
n	Average Year Peak Season Shortage (MG)	120	90	30	40	90	30
o	Average Year Peak Season Shortage (%)	6%	5%	2%	2%	5%	2%

* Both the costs and yields in this column reflect the combined costs of implementing both in-lieu and ASR.

**ACAYY = Annualized Cost per million gallons of Average Year Yield

NOTES:

1 All estimates are preliminary, rounded, and subject to revision and refinement as more detailed analysis is developed.

2 Total annualized costs based on amortizing capital outlays using a capital recovery factor of 0.0688 (reflecting a 30-year bond term at a 5.5% rate of interest to estimate the annual payment), and adding annual O&M costs.

3 Present Value Costs calculated based on capital outlays occuring in first year, followed by 30 years of annual O&M expense, discounted to present worth using a 2.5% real discount rate. No inflation escalation included.

4 ASR costs and yields reflect the *combined* cost and yields associated with adding ASR to the In-lieu program. Energy use for the combined ASR and In-Lieu elements reflect a volume-weighted average across the two elements.

5 Potential for revenues from water sales, cost sharing, and grant funding are not reflected.

6 All Element 3 options scaled at 3 mgd, reflecting potential reuse production based soley on City of Santa Cruz effluent flows.

7 See additional notes on following page.

C = Averaged Costs (All BBs)

	-30%	Mean	+30%
Worst Yr	11,935	17,050	22,165
Avg Yr	22,307	31,867	41,427
median		32,900	1.03

C' = Averaged Costs (Element 3 BBs)

	-30%	Mean	+30%
Worst Yr	11,813	16,875	21,938
Avg Yr	20,912	29,875	38,837
median		32,200	1.08

C'' = Averaged Costs (Element 1 & 2 BBs)

	-30%	Mean	+30%
Worst Yr	12,180	17,400	22,620
Avg Yr	25,095	35,850	46,605
median		35,850	1

ADDITIONAL NOTES

Elements 1&2: In lieu/ASR: Capital Costs

1. Infrastructure is sized to accommodate In-lieu plus ASR (to allow peak flow for recharge of 5 mgd -- 2.5 mgd out to Soquel Creek and 2.5 mgd to Scotts Valley).
2. All infrastructure costs needed for the in lieu program are included in the in lieu option. The ASR capital costs added to the in-lieu costs for the combined option include only additional elements that would be needed for doing recharge and recovery: pipeline to Beltz wells, upgrade of in lieu extraction wells to allow for injection, and additional wells and treatment of the extracted water.
3. In a departure from previous Building Blocks, in the ASR option, a pipeline to the Beltz Wells and 4 wells in Santa Cruz are included. This addition is to allow flexibility in where the water is moved.
4. The capital costs associated with in lieu and ASR include $62M for upgrading the GHWTP and $14M to upgrade the San Lorenzo River Tait Street Diversion. Feasibility studies will evaluate whether there are alternative(s) to these two large projects to meet the same goals at a lower cost. One alternative, as it relates to ASR & in lieu combined, may be installing Ranney Collectors at Felton Diversion. Together with a modified water right to allow for direct diversion from Felton Diversion to GHWTP. This change could lower the cost of this strategy by as much as ~$60M. This would result in an Average year yield unit cost of $27,700.

O&M Costs

1. Operations for recharge and for recovery are set at 180 days each for both in lieu and ASR. That means moving water out for 180 days and moving water back for 180 days. Real-world costs will vary over time.
2. Flow rates are similar to previous building block scenarios. Cost includes both sending water out to SqCWD and SVWD and later sending water back to SCWD.
3. Average flow rate for costing in lieu returns = 4 mgd, split evenly between Soquel Creek and Scotts Valley.
4. Average flow rate for costing ASR = 5 mgd out (same volume would be available for transfer whether it was in lieu or ASR, and this also maintains consistency), split evenly between SqCWD and SVWD. Flow back would be 80% of that volume, or 4 mgd split evenly between SqCWD and SVWD. Real-world recovery will vary from well-to-well.
5. Well extraction pumping in SVWD or SqCWD is ***not*** included - it is roughly balanced out by the energy savings of not running wells in SqCWD and in SVWD when in lieu water is being sent.
6. Cost and energy use estimates for combined In-lieu and ASR would be higher if less water were directed to in-lieu and instead directed to ASR (e.g., more water injected if more goes to ASR).

Element 3

General assumptions

1. Potable reuse capacity is designed for 3-mgd *product water 365 days a year* based on treating only City of Santa Cruz flows. (I.e., conservatively assuming effluent from SqCWD and SVWD are unavailable.)
2. Infrastructure for potable reuse treatment is identical for all potable reuse alternatives. Treatment is on-site at the WWTP. Costs to treat blended water at GHWTP not included (~$2.7M/yr).

Element 3a: DPR

1. DPR water blends with raw water near Bay Street Reservoir. Energy calculation uses very conservative estimate that existing pressure pipe will not be changed.(A pipeline improvement would decrease energy needs.)
2. It is reasonable to assume that the City would investigate pipeline improvements and a lower-pressure operating scenario might be found. This change could significantly reduce the energy cost per MG.

Element 3b: IPR to Loch Lomond

1. A very significant portion of energy use is embedded in the pumping costs to move water ~800 vertical feet up to Loch Lomond.

Element 3c: IPR for Groundwater Recharge

1. Groundwater recharge is assumed to occur near the coast.
2. Eight wells included for 3 mgd capacity scenario used here.

Element 3d: Local Desal

1. The City desalination option capacity is 3 mgd product water 365 days a year.
2. Cost now includes property rights acquisition.
3. An O&M cost element for lifting the water to Bay Street has been added (instead of into the distribution system at a lower point).

	Item	Units	Quantity	Cost, dollars	
				Cost per unit	Cost
Treatment Processes					
1	Nitrification (6.1 mgd)	LS	1	1,500,000	1,500,000
2	Ozone/BAC Filters (6.1 mgd)	LS	1	9,000,000	9,000,000
3	Microfiltration (6.1 mgd)	LS	1	14,000,000	14,000,000
4	Reverse Osmosis (5.5 mgd)	LS	1	20,000,000	20,000,000
5	Advanced Oxidation (Peroxide + UV) (4.7 mgd)	LS	1	3,250,000	3,250,000
6	Conditioning Facilities (4.7 mgd)	LS	1	1,432,500	1,432,500
7	Effluent Diffuser Modification	LS	1	1,000,000	1,000,000
	Site Work Subtotal				**50,182,500**
Pumps and Pipes					
8	Pumping System (WWTP to CAT)	GPM	4,300	400	1,720,000
9	Pipeline Installation (WWTP to CAT)	LF	200	600	120,000
10	Pumping System (CAT to Bay St. Reservoir)	GPM	3,200	400	1,280,000
11	Pipeline Installation (CAT to Bay St. Reservoir)	LF	6,000	440	2,640,000
12	Equalization Basin	LS	1		500,000
	Pipeline, Pumps, Dam, Appurtenances Subtotal				**6,260,000**
	Construction Subtotal				**56,442,500**
	Contingency	percent	50	---	28,221,250
	Subtotal				**84,663,750**
	Engineering and Administration	percent	20	---	16,932,750
	Legal	percent	5	---	4,233,188
	Geotechnical Investigation	percent	1	---	846,638
	Permitting - CEQA/NEPA	percent	5	---	4,233,188
	Other	percent	0	---	0
	Subtotal				**26,245,763**
	Line Maintenance Facility Relocation				**5,200,000**
	Total Project Cost				**116,200,000**

Operation and Maintenance Cost for Building Block 3	
Parameter	**Value**
Nitrification Tower Rework & Pipeline capital cost ($)	$2,947,500
Nitrification Tower electricity cost ($/year)	$28,470
Nitrification Tower O&M Cost	1.5%
Annual O&M cost ($/year)	$44,212.50
Nitrification Tower Replacement	60
Nitrification Tower Replacement Cost ($/year)	$49,125
Total Nitrification Tower electricity, O&M and replacement cost ($/year)	**$121,808**
Ozone/BAC Filters	
Ozone/BAC Filter capital cost ($)	$17,685,000
Ozone/BAC electricity cost ($/year)	$48,916
Ozone/BAC O&M Cost	1.5%
Ozone/BAC Filter annual cost ($/year)	$265,275
Ozone/BAC Filter replacement	60
Ozone/BAC Filter replacement cost ($/year)	$294,750
Total Ozone/BAC Filter O&M and replacement cost ($/year)	**$608,941**
Microfiltration	
Microfiltration system installation cost ($)	$27,510,000
Electricity consumption cost ($/year)	$250,536
Microfiltration maintenance cost ($/year)	$51,429
Chemical/Cleaning Cost	$207,386
Microfiltration system replacement	60
Microfiltration system replacement cost ($/year)	$458,500
Total Microfiltration system O&M and replacement cost ($/year)	**$967,851**
Reverse Osmosis	
RO system installation cost ($)	$39,300,000
Electricity Consumption Cost ($/year)	$740,220
RO System maintenance cost ($/year)	$136,080
Chemical/cleaning cost	$193,389
RO system replacement	60
RO system replacement cost ($/year)	655,000
Total RO system O&M and replacement cost ($/year)	**$1,724,689**
Peroxide/UV Disinfection	
UV system installation cost ($)	$6,386,250
Electricity Consumption Cost ($/year)	$182,208
Maintenance/Replacement UV & Ballast cost ($/year)	$73,234
Hydrogen Peroxide	$67,634
UV system replacement	30
UV system replacement cost ($/year)	$212,875
Total UV system replacement cost ($/year)	**$535,951**

Conditioning Facilities	
Conditioning facilities installation cost ($)	$2,814,863
Electricity Consumption Cost ($/year)	$28,470
Maintenance cost ($/year)	1.5%
Maintenance cost ($/year)	$42,223
Conditioning facility replacement	30
Conditioning facility replacement cost ($/year)	$93,829
Total Conditioning facility O&M and replacement cost ($/year)	**$164,522**
Pumping System (WWTP to CAT)	
Pumping System	$3,379,800
Electricity Consumption Cost ($/year)	$64,912
Pump replacement interval	15
Pump replacement cost ($)	$250,000
Pump replacement cost ($/year)	$16,667
Pumping System Replacement	30
Pumping System Replacement cost ($/year)	$112,660
Total Pump and Pumping System O&M and Replacement cost ($/year)	**$194,238**
Pipeline (WWTP to CAT)	
Pipeline capital cost ($)	235,800
Pipeline O&M Cost	1.5%
Pipeline annual cost ($/year)	$3,537
Pipeline replacement	60
Pipeline replacement cost ($/year)	$3,930
Total Pipeline O&M and replacement cost ($/year)	**7,467**
Pumping System (CAT to Bay St. Reservoir)	
Pumping System	$2,515,200
Electricity Consumption Cost ($/year)	$580,788
Pump replacement interval	15
Pump replacement cost ($)	$250,000
Pump replacement cost ($/year)	$16,667
Pumping System Replacement	30
Pumping System Replacement cost ($/year)	$83,840
Total Pump and Pumping System O&M and Replacement cost ($/year)	**$681,295**
Pipeline (CAT to Bay St. Reservoir)	
Pipeline capital cost ($)	5,187,600
Pipeline O&M Cost	1.5%
Pipeline annual cost ($/year)	$77,814
Pipeline replacement	60
Pipeline replacement cost ($/year)	$86,460
Total Pipeline O&M and replacement cost ($/year)	**164,274**
Equalization Basin	
Steel Equalization Tank	$982,500

Operation and Maintenance	$4,913
Painting Cost ($)	$150,000
Painting interval	20
Painting Cost ($/year)	$7,500
Tank replacement	60
Tank replacement cost ($/year)	$16,375
Total tank painting, O&M, and replacement cost ($/year)	**$28,788**
Sampling/Water Quality Analysis	
Sampling/Water Quality Analysis	**$25,999.12**
Total Annual O&M Cost	**$5,200,000**

Figure 12 Gantt Chart
Implementation Plan and Timeline

Strategy		Node	Activity	Duration (years)
strategy 1	Element 1 - In lieu		Both near term with SqCWD using North Coast & lareger project with SqCWD & SVWD using SLR water	
		1.1D	Near term: Develop Agreements, Complete CEQA, Resolve any Infra. Issues	0.5
		1.2M	Evaluate larger project(s) with other agencies; affirm return water volumes & water rights	3
		1.3W/D	Completion of agreements, water rights, planning/prelim design, siting study & CEQA.	1
		1.4W	Infrastructure Improvements (see below for potential projects) & return water to SCWD	4
		1.5D/W	Assess performance	NA
	Element 2 - ASR (City, SqCWD and/or SVWD; i.e., Purisima & SM) + shared infrastructure (in lieu & ASR)			
	Phase 1	2.1M	Complete & use groundwater model	0.5-2
	Higher-level Feasibility		Identify/select existing wells for potential pilot testing	0.25
			Perform site specific injection capacity & geochemical analyses	0.5
			Develop Pilot Program & identify potential sites for new ASR well(s)	0.75
	Phase 2	2.2D	Retrofit existing wells	0.25
	Pilot Testing		Perform injection well hydraulic testing	0.25
			ISR cycle testing	1-2
			Develop ASR program	1
	Phase 3	2.3M/W	Procure properties	1
	Implementation		Design Project (includes City Administration)	1
			CEQA	0.5
			Construct	1.5
		2.4D/W	Assess performance	2
		2.5W	Storage target achieved	NA
	Infrastructure Improvements for Long term in lieu and/or ASR			
			Design/build pipeline in Santa Cruz to Beltz Wells	1.5
			Tait Street Diversion Improvements	3
			Graham Hill WTP Improvements	4
			Design & build Soquel Creek transfer (back), Scotts Valley transfer (to) infrastructure	2
			Pump Station (Soquel to City)	1.5
			Intertie No. 1 Pipeline (City to Scotts Valley)	2
			Pump Station (City to Scotts Valley) Intertie No. 1	2
strategy 2	Element 3 - Advanced Treated Recycled Water or Desalination			
		3.1M	Define Recycled Water project alternatives and status of DPR regulations	1
		3.2D	Select preferred Element 3	1
		3.3D	Prelim design, CEQA (prepare Draft EIR), permits	3
		3.4M	Complete Design , CEQA, permits, property acquistion	2
		3.5W	Complete construction/start up	2

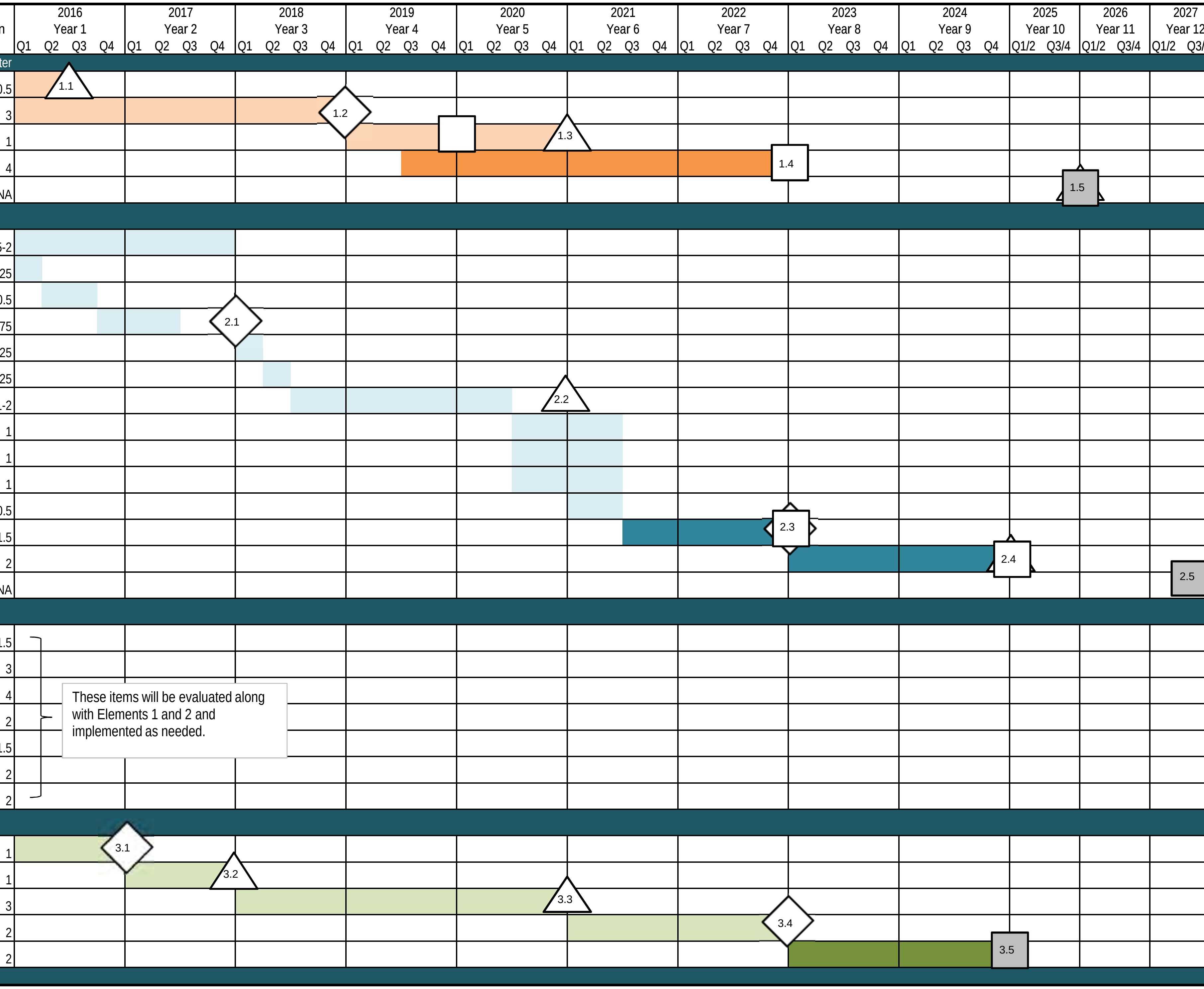


Table Notes & Select Assumptions

This table approximates activities, costs, durations and sequencing of each element, all of which are subject to change.
Elements are shown to start in Q1 - 2016. This may or may not occur depending upon agreements, contracts, etc.
Rehab/replacement of the Newell Creek Pipeline is part of the existing CIP and not shown here.
Some infrastructure improvements may not be required if other pursuits are successful. E.g., evaluation of Ranney collectors may substitute GHWTP Improvements.
CEQA is used generically; implies compliance with Califorina Environmental Quality Act.
Pilot ASR work assumes major infrastructure not required. E.g., intertie to Scotts Valley or new well(s).
Element 2 includes 8 wells for in lieu plus 8 additional wells for ASR.

Legend

ASR = Aquifer Storage and Recovery
CEQA = California Environmental Quality Act
DDW = Division of Drinking Water
DPR = Direct Potable Reuse
EIR = Environmental Impact Report
GHWTP = Graham Hill Water Treatment Plant
IPR = Indirect Potable Reuse
ISR = Injection, Storage, Recovery
SCWD = Santa Cruz Water Department
SqCWD = Soquel Creek Water District
SVWD = Scotts Valley Water District

△ Decision Node
◇ Milestone Node
□ Some amount of water returned to SCWD
■ Full required amount of water returned to SCWD

Overview of Decision Nodes and Related Milestones along Adaptive Pathway Diagram

NODE	ABBREVIATED DESCRIPTION	ENDING YEAR
In-Lieu (Element 1)		
1.1D △	Near Term: Initiation of near term water transfer/sale to SqCWD using North Coast water; agreements in place, and CEQA completed.	c. 2016
1.2M ◇	Larger Project: Understanding the feasibility of a potentially larger water transfer/exchange project with SqCWD and/or SVWD using North Coast and San Lorenzo River waters. Includes quantifying return water (using groundwater models) from SqCWD and/or SVWD to Santa Cruz as well as understanding of water rights and inter-agency collaboration.	c. 2018
1.3W/D □ △	Larger Project: Completion of agreements specifying terms of transfers to/from SqCWD and/or SVWD, water right modifications, planning/prelim design; complete assessments of cost, yield and schedule; and define CEQA. Decision point for proceeding on final design of associated infrastructure improvements.	c. 2019 c. 2020
1.4W □	Larger Project: Potential for return of water from SqCWD, and/or SVWD, to SCWD with the construction of infrastructure/treatment improvements.	c. 2022
1.5D/W △ ■	Assess in-lieu performance: amount to SqCWD, SVWD, and SCWD; reduced groundwater pumping, groundwater elevations, etc.	c. 2025
Aquifer Storage and Recovery, ASR (Element 2) Includes evaluation of Purisima and Santa Margarita		
2.1M ◇	High level feasibility work: use of groundwater model; completion of site specific injection capacity and geochemical analyses; development of pilot program.	c. 2017
2.2D △	Completion of all administrative items to conduct pilot testing (e.g., CEQA/permits/agreements and well modifications), completion of pilot testing, and assessment of probable ASR system performance, cost and schedule to complete build out of ASR system.	c. 2020
2.3M/W ◇ □	Develop/construct ASR wells, ready to operate.	c. 2022
2.4D/W △ □	Assess ASR performance against projections and ability to meet project goals.	c. 2024
2.5W ■	Aquifer storage target attained (ability to sustain return flows to SCWD at desired levels).	c. 2027
Advanced Treated Recycled Water or Desalination (Element 3)		
3.1M ◇	Identify recycled water alternatives; increase understanding of recycled water (regulatory framework, feasibility, funding opportunities, public outreach and education)	c. 2016
3.2D △	Complete high level feasibility studies, as-needed demonstration testing, and conceptual level designs of alternatives;, define CEQA processes; and continue public outreach and education. Select preferred Element 3.	c. 2017
3.3D △	Preliminary design, CEQA (including preparation of draft EIR), and apply for approvals and permits (except building permit).	c. 2020
3.4M ◇	Complete property acquisition, final design, complete CEQA and all permits.	c. 2022

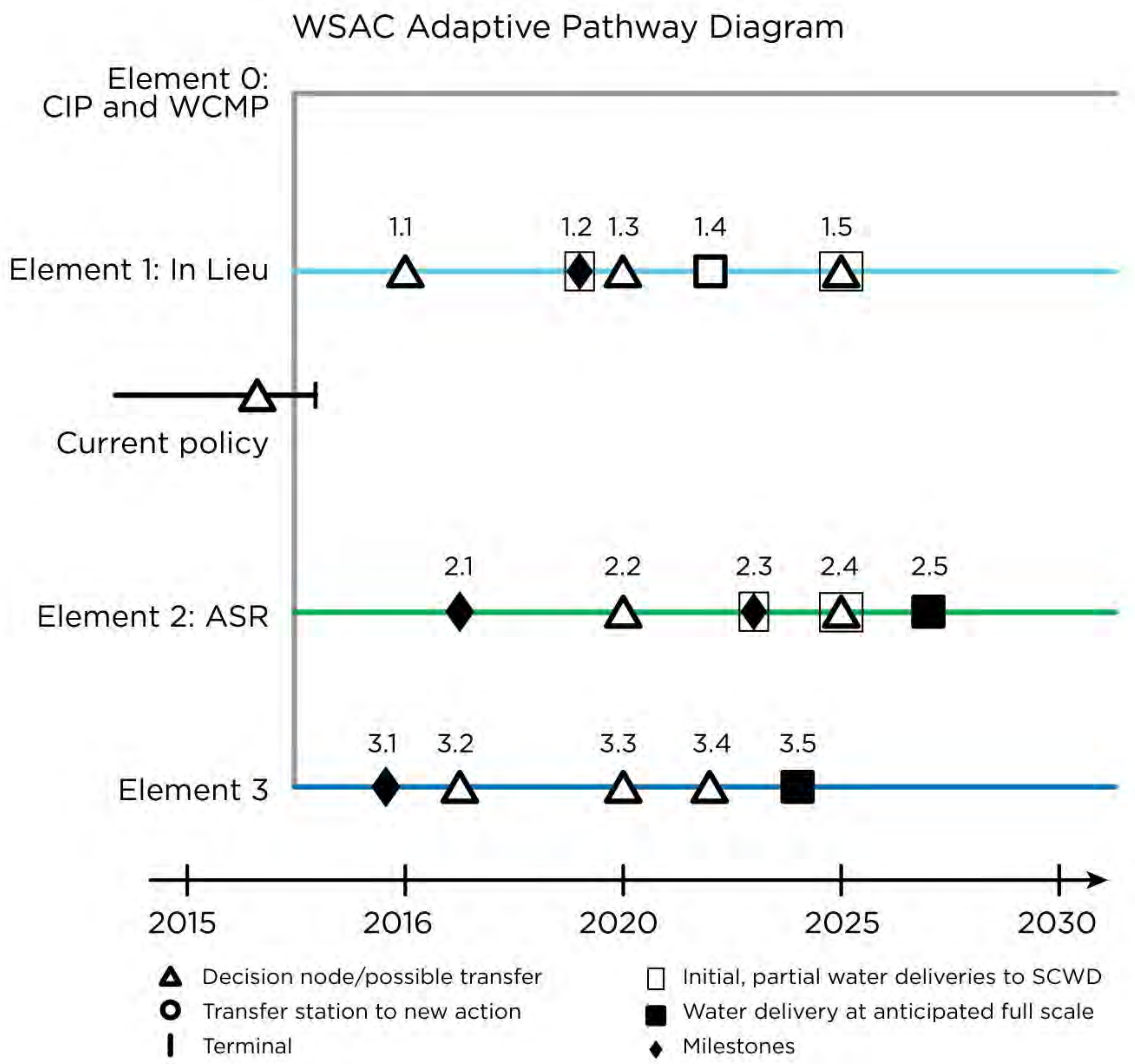
3.5W	Construction completed: plant start-up, water production begins	c. 2024

Abbreviations

ASR = Aquifer Storage and Recovery
CEQA = California Environmental Quality Act
DDW = Division of Drinking Water
DPR = Direct Potable Reuse
GHWTP = Graham Hill Water Treatment Plant
IPR = Indirect Potable Reuse
SCWD = Santa Cruz Water Department
SqCWD = Soquel Creek Water District
SVWD = Scotts Valley Water District

Notes

- This table is intended as a companion piece to the implementation Gantt chart and subway map. Gantt chart contains additional activity detail(s) for each node.
- Node types
  - D = decision node (triangle on subway chart)
  - M = milestone (diamond on the subway chart), furthering the understanding of feasibility.
  - W = water production potentially available (squares on the subway chart; open square indicates some water; solid square represents full goal being met).
- Node types have been assigned based on a set of assumptions as to how the implementation will proceed. However, if a threshold is being tripped, the node becomes a decision node regardless of its current designation.
- Ending Year refers to when all work associated with reaching node and/or achieving goal(s) will be accomplished. Dates shown are approximate based on current information and project understanding. Dates may adjust depending on: volumes of water available due to winter precipitation levels (which may limit amount of in-lieu and ASR); ability to establish agreements, permits, etc.; and ability to implement workload.



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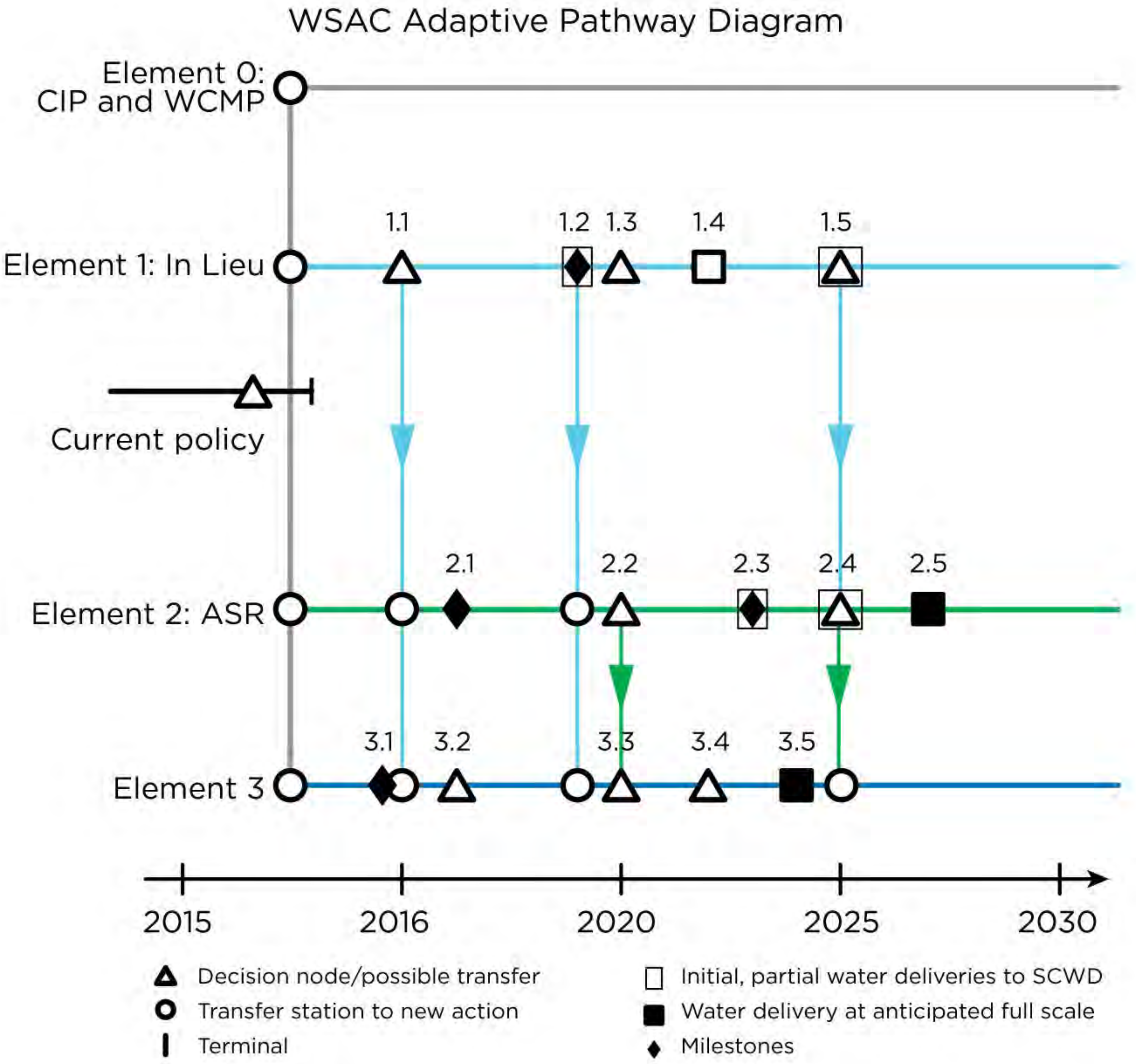
Decision node/possible transfer
Transfer station to new action
Terminal
Initial, partial water deliveries to SCWD
Water delivery at anticipated full scale
Milestones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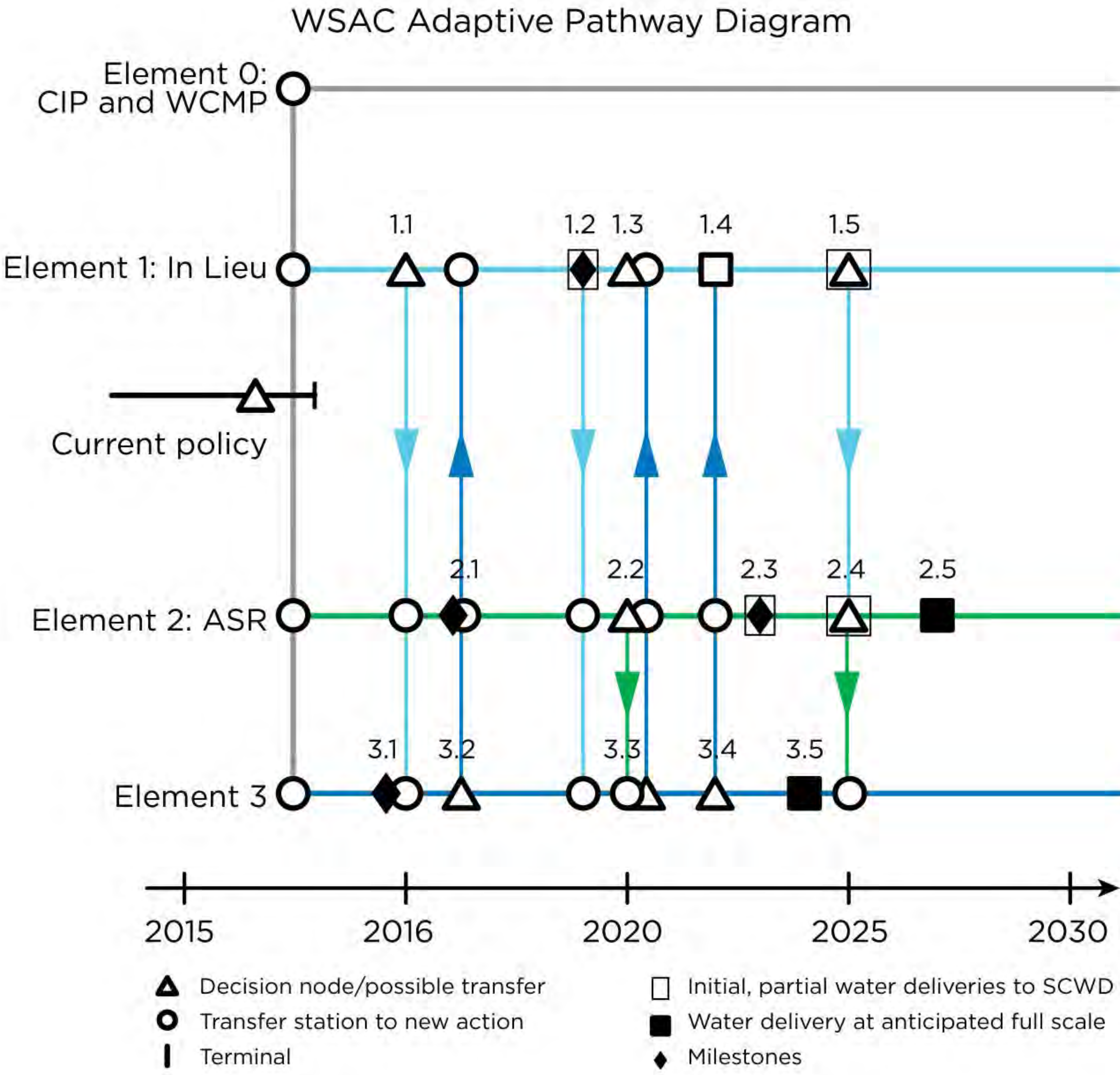
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Water Shortage Contingency Plan

Prepared by:

City of Santa Cruz Water Department

March 2009

City of Santa Cruz Water Department

Water Shortage Contingency Plan

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March 2009

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Cover graphic courtesy of the California Department of Water Resources

Executive Summary

This report constitutes the first comprehensive review and update of the City's Water Shortage Contingency Plan since the early 1990's. The project is an outgrowth of the City's 2005 Urban Water Management Plan, which recognized the many changes in regional conditions and local water supply planning that had taken place over the previous decade, and identified the need to better prepare for the possibility of future water shortages in advance of the next major drought.

Introduction

This section provides background information about the City water system and the City's Integrated Water Plan, explains the purposes and goals of this plan, summarizes state regulations that pertain to water shortage contingency planning, and describes the process and principles that were used to guide the preparation of this document.

The last time the Santa Cruz area was confronted with a serious water shortage was during a statewide drought that lasted from 1987 through 1992. The exceptional drought of 1976-77, however, remains the most severe event on record. In 2003, the City adopted a long range planning document known as the "Integrated Water Plan", the goal of which was to reduce near term drought shortages and provide a more reliable public water supply through the year 2030. One component of this plan deliberately involves cutting back or "curtailing" system water demand by 15 percent in dry years when water is in short supply.

This plan was developed to fulfill two fundamental purposes:

1. To establish the procedures and actions necessary to achieve the up to 15 percent cutback in system-wide demand established in the City's Integrated Water Plan, and

2. To describe how the City would respond if faced with much larger shortages in water supply ranging as high as 50 percent (not only because, as a public water supplier, the City is required to do so by state law, but also because the City remains vulnerable in the near term to a critical water shortage of this magnitude until it secures a new source of supply for drought protection).

Whatever magnitude of shortfall the City may experience, the overarching goals of this plan are as follows:

1. To conserve the water supply of the City for the greatest public benefit,

2. To mitigate the effects of a water supply shortage on public health and safety, economic activity, and customer lifestyle, and

3. To budget water use so that supply will be available for the most essential purposes for the entire duration of the water shortage.

Development of this plan was a collaborative effort among the City Water Department staff, the City's Water Commission, City Council, and the public. The process included reviewing the City's existing ordinance and water shortage plans from many other water agencies, addressing various planning and policy issues, and taking into account state regulations. The Water Commission provided its input and recommendations throughout the entire process. The final step will be to prepare an ordinance that incorporates the structure and policy recommendations embodied in this plan. This ordinance would then be adopted and go into effect only if necessary in an actual water shortage following appropriate public notification and public hearing before City Council.

Assessing Water Supply and Demand

This section describes the key hydrologic factors affecting the City's water supply and discusses the process staff uses to determine whether a water shortage is expected in the year ahead.

The City of Santa Cruz relies on surface flows in coastal streams and the San Lorenzo River for most of its annual water supply needs. The yield of these sources in any given year is directly related to the amount of rainfall received and runoff generated during the winter season.

After an unusually dry winter or period of consecutive dry years, when a lack of supply appears possible, the Water Department undertakes an analysis to determine whether water supplies will be deficient relative to estimated water needs for the coming dry season. This analysis involves first comparing projected water supply and demand on a monthly basis, assuming no restriction on water use, to forecast the end of season water level and storage volume in Loch Lomond Reservoir. The Department then evaluates whether the amount of carryover storage in Loch Lomond at the end of the year will be sufficient to meet essential health and safety needs in case the dry weather pattern continues into the following year. If this analysis shows that Loch Lomond Reservoir would be depleted to a dangerously low level, then a decision is made regarding how much reservoir water is available to use in the current year and how much should be banked as a safeguard against the possibility of another dry year. The amount of cutback in demand needed to reduce the rate of reservoir depletion and end the year at a safer level of storage is then determined. If necessary, cutbacks would go into effect in late April or early May and span the entire dry season through the end of October.

The degree of shortage is normally defined as the supply deficiency in relation to normal water use over a given period of time, and expressed as a percentage. For example, a 25 percent shortage means the City has one-quarter less water supply available than what is normally used during the seven month long dry season.

Demand Reduction Program

This section describes the five-stage approach and overall strategy for dealing with water shortages, explains how available water would be allocated among various customer categories according to priority of use, and presents the recommended menu of actions for cutting back water demand during a declared water shortage. This section also covers policies and recommendations regarding enforcement methods, exceptions, and appeals.

Table ES-1. Five Stage Structure to Water Shortage Contingency Plan

Stage	Magnitude of Water Shortage	Stage Title
1	0-5%	Water Shortage Alert
2	5-15%	Water Shortage Warning
3	15-25%	Water Shortage Emergency
4	25-35%	Severe Water Shortage Emergency
5	35-50%	Critical Water Shortage Emergency

The updated Water Shortage Contingency Plan uses a staged approach that classifies a shortage event into one of five levels spanning a range from less than 5 percent up to 50 percent. The overall concept is that water shortages of different magnitudes require different measures to overcome the deficiency. Because there is so little the City can do in the short run to increase the supply of water, the focus of this plan is primarily on measures that reduce demand. Each stage includes a set of demand reduction measures that become progressively more stringent as the shortage condition escalates. Normally, only one of these five stages would be put into effect early in the year at the recommendation of the Water Director and remain in force for the entire dry season.

There is an important distinction between Stages 1 and 2, designated above in shades of yellow, and the upper three stages. The lower two stages represent a level of curtailment that is envisioned as being necessary to balance water supply and demand from time to time under the City's Integrated Water Plan. Shortages of 15 percent or less, while inconvenient, do not directly threaten public safety or pose undue economic impact. The upper three stages (3-5) are characterized as emergency water shortages since they result in more widespread hardships being felt throughout the community, may threaten public health and welfare, and cause more economic harm. The intent of the City's Integrated Water Plan, however, is to limit future water shortages to no more than more than 15 percent.

Customer reduction goals for all but the first stage were derived by evaluating the composition of demand for each major group and dividing it into three usage priorities. These priorities are, from highest to lowest, 1) health/safety, i.e., all domestic and sanitary uses, 2) business and industrial uses and, 3) irrigation and other outdoor uses). Normal demands were then scaled back in accordance with the schedule below. The recommended allocation is presented in Table ES-3.

Table ES-2. Reduction in Water Delivery by Usage Priority
(percent of normal deliveries)

Stage	Magnitude of Water Shortage:	Health/Safety	Business	Irrigation
2	15%	95	95	64
3	25%	95	90	34
4	35%	90	85	12
5	50%	75	67	0

Table ES-3. Water Supply Allocation and Customer Reduction Goals

	No Deficiency		**Stage 2 15% Deficiency**		**Stage 3 25% Deficiency**		**Stage 4 35% Deficiency**		**Stage 5 50% Deficiency**	
	Delivery		Delivery		Delivery		Delivery		Delivery	
Normal Peak Season Demand = 2,473 mil gal	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)
Single Family Residential	100	1,031	84%	864	73%	753	62%	639	48%	495
Multiple Residential	100	524	87%	454	78%	411	69%	361	55%	287
Business	100	438	95%	416	92%	402	87%	381	70%	307
UC Santa Cruz	100	132	85%	113	76%	100	66%	87	52%	68
Other Industrial	100	23	95%	22	90%	21	85%	20	67%	15
Municipal	100	48	76%	36	57%	27	41%	20	28%	14
Irrigation	100	110	64%	70	34%	37	12%	13	0%	0
Golf Course Irrigation	100	106	73%	78	51%	54	34%	36	20%	21
Coast Agriculture	100	59	95%	56	90%	53	85%	50	67%	40
Other	100	2	95%	2	90%	2	50%	1	50%	1
Total	**100**	**2,473**	**85%**	**2,111**	**75%**	**1,861**	**65%**	**1,607**	**50%**	**1,247**
Demand Reduction %, Million gallons	**0**	**0**	**15%**	**-362**	**25%**	**-612**	**35%**	**-866**	**50%**	**-1,226**

In essence, this allocation system strives to balance available supplies in times of drought as much as possible through cutbacks in outdoor water use. At each level of shortfall, public health and sanitation usage is afforded the highest priority by cutting back on interior usage the least. The importance of water in protecting the City's employment base is also acknowledged through proportionately modest cutbacks to the commercial sector as compared to the overall system shortfall. Irrigation and other outdoor uses in all cases is cut back the most. The larger the water shortage, the greater the cutbacks, but this system of priorities is maintained throughout the range of potential shortages. The heavy reliance on outdoor use reductions makes sense, both from a water system perspective because it reduces peak demands, which is important to preserving storage in Loch Lomond Reservoir, and from a public health and welfare perspective, because irrigation and other outdoor uses are the most discretionary of all uses when drinking water is in short supply.

The remainder of this section discusses the demand reduction measures, communications, publicity, and operational activities that apply to each stage.

The primary demand reduction measures used in **Stage 1** are to restrict all landscape irrigation to certain hours of the day and to prohibit various uses deemed to be non-essential.

The recommended approach to reducing water use **Stage 2** involves expanding mandatory water restrictions and limiting landscape irrigation to specified days and times. Large landscape users would be required to adhere to water budgets.

A **Stage 3** water shortage constitutes an emergency situation. The three primary measures being recommended to meet this emergency reduction goal are 1) residential water rationing, 2) mandatory water shortage signage in all commercial buildings, and 3) reduced water budgets for large landscapes.

A **Stage 4** water shortage requires expanding water rationing to cover all water customers, including business, and reducing residential allocations. At this severe level of shortage, only minimal water is available for outdoor purposes.

Stage 5 represents an extraordinary crisis threatening health, safety, and security of the community. It would involve reduced rationing levels for all customers and a ban on outdoor uses to cut back normal water use by half.

Table ES-4. Summary of Demand Reduction Actions and Measures

Water Shortage Condition	Key Water Department Communication and Operating Actions	Customer Demand Reduction Measures
Stage 1: Water Shortage Alert (0-5%)	• Initiate public information and advertising campaign • Publicize suggestions and requirements to reduce water use • Adopt water shortage ordinance prohibiting nonessential uses • Step up enforcement of water waste • Coordinate conservation actions with other City Departments, green industry	• Voluntary water conservation requested of all customers • Adhere to water waste ordinance • Landscape irrigation restricted to early morning and evening • Non-essential water uses banned • Shutoff nozzles on all hoses used for any purpose • Encourage conversion to drip, low volume irrigation
Stage 2: Water Shortage Warning (5-15%)	• Intensify public information campaign • Send direct notices to all customers • Establish conservation hotline • Conduct workshops on large landscape requirements • Optimize existing water sources; intensify system leak detection and repair; suspend flushing • Increase water waste patrol • Convene and staff appeals board	• Continue all Stage 1 measures • Landscape irrigation restricted to designated watering days and times • Require large landscapes to adhere to water budgets • Prohibit exterior washing of structures • Require large users to audit premises and repair leaks • Encourage regular household meter reading and leak detection
Stage 3: Emergency Water Shortage (15-25%)	• Expand, intensify public information campaign • Provide regular media briefings; publish weekly consumption reports • Modify utility billing system and bill format to accommodate residential rationing, add penalty rates • Convert outside-City customers to monthly billing • Hire additional temporary staff in customer service, conservation, and water distribution • Give advance notice of possible moratorium on new connections if shortage continues	• Institute water rationing for residential customers • Reduce water budgets for large landscapes • Require all commercial customers to prominently display “save water” signage and develop conservation plans • Maintain restrictions on exterior washing • Continue to promote regular household meter reading and leak detection
Stage 4: Severe Water Shortage Emergency (25-35%)	• Contract with advertising agency to carry out major publicity campaign • Continue to provide regular media briefings • Open centralized drought information center • Promote gray water use to save landscaping • Scale up appeals staff and frequency of hearings • Expand water waste enforcement to 24/7 • Develop strategy to mitigate revenue losses and plan for continuing/escalating shortage	• Reduce residential water allocations • Institute water rationing for commercial customers • Minimal water budgets for large landscape customers • Prohibit turf irrigation, installation in new development • Prohibition on on-site vehicle washing • Rescind hydrant and bulk water permits
Stage 5: Critical Water Shortage Emergency (35-50%)	• Continue all previous actions • Implement crisis communications plan and campaign • Activate emergency notification lists • Coordinate with CA Department of Public Health regarding water quality, public health issues and with law enforcement and other emergency response agencies to address enforcement challenges • Continue water waster enforcement 24/7	• Further reduce residential water allocations • Reduce commercial water allocations • Prohibit outdoor irrigation • No water for recreational purposes, close pools • Continue all measures initiated in prior stages as appropriate

The City's existing water shortage emergency ordinance contains several provisions for enforcing water use rules and regulations, and a process for issuing exceptions and hearing appeals. These provisions were reviewed by staff and the Water Commission, which put forth several recommendations to be incorporated into the updated water shortage ordinance. Recommendations include revised penalty fees and excess use fees, adding specified findings for authorizing exceptions, and adding an alternative enforcement approach to reduce the likely caseload of appeals.

Implementation

This section describes the essential elements of implementing the updated Water Shortage Contingency Plan, discusses the approximate lead time needed to prepare for and activate a demand reduction program, outlines the process for declaring a water shortage, and identifies areas where additional ongoing efforts are necessary to address critical gaps.

Although the Water Department closely monitors rainfall, runoff and reservoir storage all winter, it is not usually until the end of March that the water supply outlook for the year ahead becomes certain. This leaves very little lead time to prepare for implementing the water shortage contingency plan.

Formal action declaring a water shortage is taken by City Council. The legal requirements for such action are covered in Section 350 et.seq. of the California Water Code. The code requires the following process be followed:

- That City Council hold a public hearing on the matter;
- That the public hearing be properly noticed (minimum of publishing once in newspaper at least seven days prior to the date of the hearing);
- Upon determining and declaring the existence of a water shortage, City Council may then adopt regulations and restrictions governing the use and delivery of water.

By municipal code, rules adopted by the City Council establishing water use regulations become effective immediately after their publication in the newspaper.

Effective communication is essential to the success of any water shortage contingency plan in achieving the desired water use reductions. All customers need to be adequately informed about water supply conditions, understand the need to conserve, and know what actions they are being requested or required to take to mitigate the shortage. Even before formal declaration of a water shortage, a public information/media program should be activated to provide customers with as much advance notice as possible. Following Council action, all residents and businesses, not just customers of record, would need to be provided notice of water shortage rules and regulations via a variety of media and communications methods, including print and television media, internet, utility newsletter, and other methods. Public notification and communication will be provided in Spanish language for non-English speakers.

The additional staff needed to carry out this contingency plan and personnel costs are estimated according to stage. These may consist of existing staff reassigned from regular duties in the Water or other City departments, new part-time temporary employees, interns, or some combination of the above. Additional office space and equipment needs are also addressed.

The financial impact of short-term demand reduction was estimated to range from just under $0.6 million in a Stage 1 water shortage alert situation to almost $5.8 million in a Stage 5 critical water shortage emergency. Compared to 2007 revenues of just over $22 million, the Department's net revenue would be reduced to approximately $21.5 million in Stage 1 to less than $16.4 million in Stage 5. Options to lessen or overcome the revenue shortfall include the following:

- Tapping into the Department's Rate Stabilization Fund (currently $2.2 million)
- Deferring planned capital improvements
- Considering possible rate adjustments or surcharges

Implementing this Water Shortage Contingency Plan will require utility billing system software that provides the necessary capabilities and flexibility to quickly shift from normal billing practices to water rationing mode. The newly installed EDEN utility billing module appears to be able to handle the type of computations needed to implement the recommended method for rationing residential customers. It does not, however, have the capability or flexibility to handle large landscape water budgets, or commercial water rationing which is based on some percentage of past use. This capability will have to be custom developed over time.

Another key challenge involves implementing large landscape water budgets. This is the next major work priority scheduled for the City's Water Conservation Office. These programs have a long development time (1-2 years) due to the need to measure landscape areas, differentiate among plant materials, and integrate water budget data into the billing system. This latter task requires changing the bill design and layout to show water budget information and tying performance relative to the water budget to water pricing. If the City were confronted with a water shortage before large landscape water budgets and budget-based pricing could be implemented, alternative methods to curtail water in the large landscape sector would have to be considered.

The final tasks in updating the City's Water Shortage Contingency Plan include the following steps:

- Involving the community and soliciting public review and input on this document;
- Finalizing and presenting the plan to City Council for adoption;
- Preparing an updated water shortage ordinance;
- Preparing and mailing a Proposition 218 notice about proposed changes to penalty and excess use fees.

As far as critical gaps that require ongoing work, the most important recommendations are to:

1. Continue to work on the new utility billing system so that the database is able to meet the City's requirements for use in water rationing if it becomes necessary, and

2. Focus on developing the large landscape program so that water budgets described above can be used to professionally manage large irrigation accounts the next time a water shortage arises.

3. As much as possible, prepare water shortage notices, announcements, materials, and mailing lists in advance, including bilingual materials for non-English speakers.

Section 1 INTRODUCTION

This report constitutes the first comprehensive review and update of the City's Water Shortage Contingency Plan since the early 1990's. The project is an outgrowth of the City's 2005 Urban Water Management Plan, which recognized the many changes in regional conditions and local water supply planning that had taken place over the previous decade, and identified the need to better prepare for the possibility of future water shortages in advance of the next major drought.

1.1 Background

The City of Santa Cruz water system serves a geographic area that includes the entire City of Santa Cruz, adjoining unincorporated areas of Santa Cruz County, a small part of the City of Capitola, and coastal agricultural lands north of the City. The water service area includes about 90,000 people, some 35,000 households, and an employment base of 45,000 jobs.

The City water system draws almost exclusively on local surface water sources, whose yield varies from year to year depending on the amount of rainfall received and runoff generated during the winter season. In normal and wet years, when rainfall and runoff are abundant, the water system is capable of meeting the community's current total annual water requirements. The system is highly vulnerable to shortage, however, in extended dry periods or critically dry years, when the flow in local streams and river sources runs low. Moreover, like other communities on California's central coast, the Santa Cruz water system is physically and geographically isolated. There are no interconnections with other water suppliers in place to transfer water among adjacent water districts or import emergency supplies from outside the region.

The last time the Santa Cruz area was confronted with a serious water shortage was during a statewide drought that lasted from 1987 through 1992. While this event was notable for its extended duration, the most severe event on record was the critical drought of 1976-77. Both situations were considered to be emergencies whose magnitude or duration had been unanticipated prior to their occurrence and for which little preparation had been made. Operations modeling shows **if an event similar to one in 1976-77 were to recur now, the system would barely be able to meet half the community's normal water requirements in the second year of that drought.**

In 2003, the City adopted a long range document known as the “Integrated Water Plan”, the goal of which was to reduce near term drought shortages and provide a more reliable public water supply through the year 2030. The preferred water supply strategy that evolved from that process consists of 3 components:

1. Reduce water demand in all years through water conservation measures,

2. Increase the water supply through seawater desalination, and

3. Cut back water demand temporarily in drought years

This approach, of cutting back on demand in dry years when water is in short supply, is becoming more commonplace in virtually every region of the country that is faced at times with emergency shortages of deliverable water. Rather than strive to meet 100 percent of customer water demand during periods of extreme drought, more and more urban water utilities are beginning to anticipate and plan for a certain degree of water shortage from time to time, and respond with programs that temporarily reduce water use. Whether for financial, political, or environmental reasons, or simply the recognition that public water systems can never be totally drought-proof, water agencies are deliberately incorporating short-term demand management or “use curtailment” as part of their overall water management strategy.

The City’s Integrated Water Plan envisions satisfying 85 percent of normal water needs during a worst-case scenario like the 1976-77 event, thereby reducing the potential shortfall from the current almost 50 percent to no more than 15 percent. This reliability goal was considered to be the best overall balance between ensuring public health and safety, cost, and impact on the environment, given the many public policy tradeoffs involved. Now, instead of treating any shortage as a water supply emergency situation and responding reactively, the City has effectively accepted the risk of incurring relatively modest shortages every so often, which drives the need for having a fully developed contingency plan and well-defined, measured responses in place.

1.2 Purpose and Goals

This Water Shortage Contingency Plan describes the conditions which constitute a water shortage and provides guidelines, actions, and procedures for managing water supply and demands during a declared water shortage. The primary focus of the plan is on measures that reduce customer demand for water, but it also covers actions that can be implemented to stretch or increase the water supply.

This plan was developed to fulfill two fundamental purposes:

1. To establish the procedures and actions necessary to achieve the up to 15 percent cutback in system-wide demand established in the City's Integrated Water Plan, and

2. To describe how the City would respond if faced with much larger shortages in water supply ranging as high as 50 percent.

There are several reasons why it is necessary to consider and plan for shortfalls larger than 15 percent. First, the City remains vulnerable in the near term to a critical water shortage of that scale until it secures an additional source of supply for drought protection. The City is currently implementing a broad set of water conservation programs and is testing the feasibility of seawater desalination before proceeding with the design, permitting, and construction of a full scale plant. Commissioning of a new water source, though, remains years away and is by no means a certainty. Much planning remains to be done and project approvals have yet to be secured. In the meantime, the City is potentially at risk of experiencing a major water shortage, as demonstrated by the exceptionally dry conditions experienced during the 2007 water year and by the Governor's declaration of a statewide drought in 2008. Second, state law requires all public water suppliers to develop contingency plans for situations of up to a 50 percent shortage in water supply. Finally, the City's long range water supply planning is predicated on past hydrologic records which focused on the two year, 1976-77 event as a worst case scenario. No one can predict how the future will unfold, especially in light of the emerging science of global climate change, which some predict could bring more frequent, longer, or more intense water shortages across the state, and which compounds the uncertainty and risk going forward at the local government level.

Whatever magnitude of shortfall the City may experience, the overarching goals of this plan are as follows:

1. to conserve the water supply of the City for the greatest public benefit,

2. to mitigate the effects of a water supply shortage on public health and safety, economic activity, and customer lifestyle, and

3. to budget water use so that supply will be available for the most essential purposes for the entire duration of the water shortage.

1.3 State Regulations and Planning Requirements

For California water agencies, there are two main provisions of the California Water Code that pertain to water shortage contingency planning.

Sections 350-359 provide the authority for the governing body of a water agency to declare a water shortage emergency. Once having done so, the local agency is provided with broad powers to implement and enforce regulations and restrictions for managing a water shortage. Water needed for domestic, sanitation and fire protection purposes is given priority and discrimination between consumers using water for the same purpose or purposes is not allowed.

Section 10632 requires water agencies to provide a water shortage contingency analysis as part of their Urban Water Management Plans. The code requires agencies plan for shortages up to a 50 percent reduction in water supply, and to describe the actions and consumption reduction methods that apply to each stage of the plan.

The full text of these two code sections is included in Appendix A.

1.4 Planning Process and Water Shortage Management Principles

Development of this plan was a collaborative effort among the City Water Department staff, the City's Water Commission, City Council, and the public.

The project was initiated in 2006 with a work plan that organized the job into 12 individual tasks covering specific topics or issues (Table 1-1). For each task, staff prepared a written report for review and input by the Water Commission at its regularly scheduled meetings. These reports reviewed one or more aspects of the City's existing water shortage emergency ordinance, described alternative methods or approaches used by other water agencies, analyzed the different

Table 1-1. Water Shortage Contingency Plan Update Work Plan

Task	Description
Task 1	Identify Laws, Goals, and Principles
Task 2	Determining Water Supply Availability
Task 3	Declaration of Water Shortage Emergency
Task 4	Review Stages and Associated Terms
Task 5	Allocation of Water
Task 6	Review Allotment Methods
Task 7	Consumption Reduction Methods
Task 8	Water Department Actions
Task 9	Enforcement and Appeals Procedures
Task 10	Draft New Water Shortage Contingency Plan
Task 11	Present Recommended Plan to Water Commission and City Council
Task 12	Draft, Review New Ordinance

options, and presented a recommendation on the topic for inclusion in this plan. The Water Commission provided its input and recommendations throughout the process. Helpful guidance was obtained from the California Department of Water Resources' recently updated Urban Drought Guidebook. In addition, research involved reviewing the water shortage plans of 21 other urban water utilities from throughout California, and from selected cities in the western United States and across the country (Appendix B).

The subject that generated the most public interest, input, and debate was how to allocate the available water when supplies run short. The issue was discussed before City Council and negotiated with several large customers before reaching a final recommendation.

This document synthesizes the results of that process into a single report. It was presented to the Water Commission for review in January 2009, revised, distributed throughout the community, presented again at a public hearing before City Council, and adopted on March 10, 2009. The final plan was then redrafted in the form of an ordinance that was adopted in May 2009 and revised in June 2010. The final, approved water shortage contingency ordinance would then become effective only as necessary in an actual water shortage following appropriate public notification and public hearing before City Council.

The plan is based on lessons learned here and from other water agencies during past droughts. Nevertheless, it is important to note that every drought will evolve differently and that it is not practical to develop a set of hard and fast rules that apply to all situations. The plan should be thought of as a general framework that will need to be adjusted and refined based on actual conditions.

Early in the planning process, staff and the Water Commission developed a set of principles to guide this planning process. These principles are as follows:

- **Shared contribution.** All customers will be asked to save their share in order to meet necessary reduction goals during water shortages.

- **Reduce non-essential uses first.** The plan concentrates on the elimination of non-essential water uses and on outdoor reductions, and gives the highest priority to essential health and safety uses.

- **Preserve jobs and protect the local economy.** The plan minimizes actions that would have substantial impact on the community's economy and provides large users the flexibility to determine their own reduction strategies within a water budget.

- **Existing conservation measures recognized.** Customers that have already implemented water conservation measures are acknowledged to have less potential for reduction and should not be penalized for conserving.

- **Communication at every stage.** A public information campaign at every level of shortage is essential for customer preparation and will encourage confidence in the City's ability to respond to water shortages.

- **Public participation.** Public participation in the development and implementation of the plan will help to ensure fairness, encourage cooperation, and facilitate implementation and with demand reduction measures in times of shortage.

1.5 Relationship Between This Document and Other Plans

This Water Shortage Contingency Plan, as described above, represents one of the three components in the City's Integrated Water Plan. It also constitutes one of several elements in the City's Urban Water Management Plan, as required by State law.

Water supply interruptions and shortages may result from a variety of causes, including facility failure, such as a major pipeline break, earthquake, flood, or other natural disaster. This plan specifically addresses longer-term water shortages that occur as a result of drought conditions that may extend several months or span several years in duration. For shorter term emergency incidents or disasters, the Water Department maintains a separate General Emergency Plan, which is subordinate to and complements the Citywide Emergency Operations Plan, to guide emergency operations response and recovery for shorter term water supply interruptions and outages.

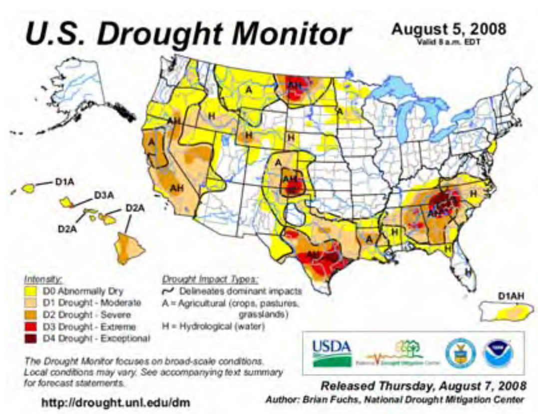
Section 2 ASSESSING WATER SUPPLY AND DEMAND

Rainfall, runoff, and reservoir storage are the key hydrologic indicators used by the City to evaluate water conditions. This section describes these factors affecting the City's water supply and discusses the forecasting process and management considerations used in dry years to determine whether a water shortage is expected for the year ahead and how much water use must be cut back systemwide in response. As a preface, this section includes a brief discussion on the distinction between the terms drought and water shortage.

2.1 Drought vs. Water Shortage

Drought is a normal, naturally occurring but unpredictable climatic phenomenon of varying frequency, duration and severity. Droughts differ from other natural hazards in that they are not distinct weather events, like floods, hurricanes, or tornados. They may have a slow onset, persist and evolve over a period of years, affect a large spatial region, but cause little structural damage. The most difficult aspect of a drought is that no one can tell how long it will last.

Figure 2-1. National Drought Map



Five degrees of drought intensity are recognized nationally, including abnormally dry, moderate, severe, extreme, and exceptional.

The California Department of Water Resources describes drought as:

> *"A deficiency of precipitation over an extended period of time resulting in a water shortage for some activity, group, or environmental sector."*

A water shortage, on the other hand, occurs when a particular utility's water supply is insufficient to meet its customers' ordinary drinking water needs.

Besides weather conditions, there are a number of factors that affect water supply availability, including:

- Source yield and reliability
- Infrastructure capacity and operating constraints
- Access to alternative sources
- System demand characteristics

In Santa Cruz, a water shortage occurs when the combination of low surface flows in the coast and river sources and depleted surface water storage in Loch Lomond Reservoir reduces the available supply to a level that cannot support existing demand.

Ordinarily, one abnormally dry year does not create a water shortage in Santa Cruz. Usually there is sufficient storage in Loch Lomond Reservoir, even after one dry winter, to carry the system though the following summer. Based on past experience, however, a shortage is likely to occur when the central coast region experiences **two or more** dry winter seasons in a row.

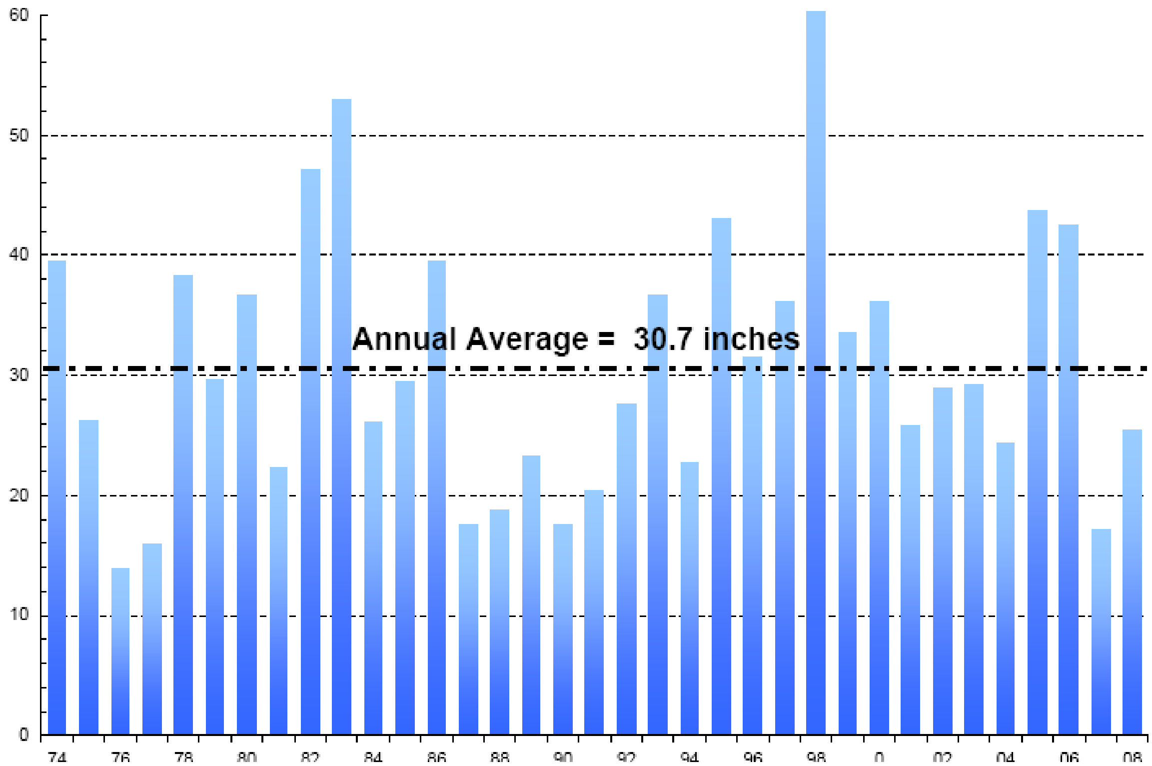
2.2 Precipitation

The water supply of the City of Santa Cruz all originates from precipitation that falls in the form of rain on the Pacific Ocean side of the Santa Cruz Mountains during the fall, winter, and early spring. The majority of rainfall normally occurs in a five-month period between November and March. The amount of precipitation that falls is one basic indicator of whether the city is experiencing a wet or dry year. Rainfall amounts on the central coast vary widely from year to year.

Daily rainfall data is collected for water supply purposes at various sites in the Newell Creek watershed, at Ben Lomond, and in the City of Santa Cruz. The Ben Lomond and Santa Cruz sites are both official National Oceanographic and Atmospheric Administration (NOAA) weather observation stations with extended rainfall records.

Annual variation in rainfall at Santa Cruz is illustrated below in Figure 2-2. Long-term average rainfall in the Santa Cruz area is about 30 inches. In the 1987-92 drought, annual rainfall ranged from 17 to 23 inches, and in the 1976-77 drought, annual rainfall amounts in the City measured 14 to 16 inches.

Figure 2-2. Annual Rainfall at Santa Cruz, 1974-2008 (inches)



In Ben Lomond, rainfall averages about 49 inches per year. In the 1987-92 drought, annual rainfall ranged from 25 to 32 inches, and in the 1976-77 drought, annual rainfall amounts measured 19 to 21 inches.

The pattern in both timing and distribution of rainfall can be as important in determining water supply availability as the total amount of rainfall received. Years in which the majority of rainfall occurs early in the rainy season or is concentrated in a short time frame tend to produce lower river and stream flows during the peak summer season. Conditions where storms are spread out through the winter season or occur late into spring help sustain higher base flows in the coastal streams and the San Lorenzo River later into the year.

2.3 Runoff

Under normal operating conditions, the north coast and San Lorenzo River flows provide about 80 percent of the City's total annual water supply. Accordingly, runoff is a key parameter used to assess the City's water supply condition.

Stream flow in the San Lorenzo River is monitored at two locations using the U.S. Geological Survey (USGS) gauges located at Henry Cowell Redwoods State Park near Felton and downstream next to the Tait Street intake. The gauge in Felton is particularly important for assessing water supply conditions because the river is the City's single largest source and because of the long historic record that exists for the site. Real time flow records are available on the USGS website, http://waterdata.usgs.gov/ca/nwis/uv?11160500. The USGS also prepares printed reports that provide a record of average daily and monthly flows, in cubic feet per second (cfs), and stream discharge, expressed in acre-feet (ac-ft). Monthly flows are charted by the Water Department and compared with the long-term averages and the previous year's flow to assess trends.

On the north coast sources, there were no stream gauges until a few years ago. Flow records are now being gathered for these sources, which will become valuable in future years for assessing water conditions on the north coast.

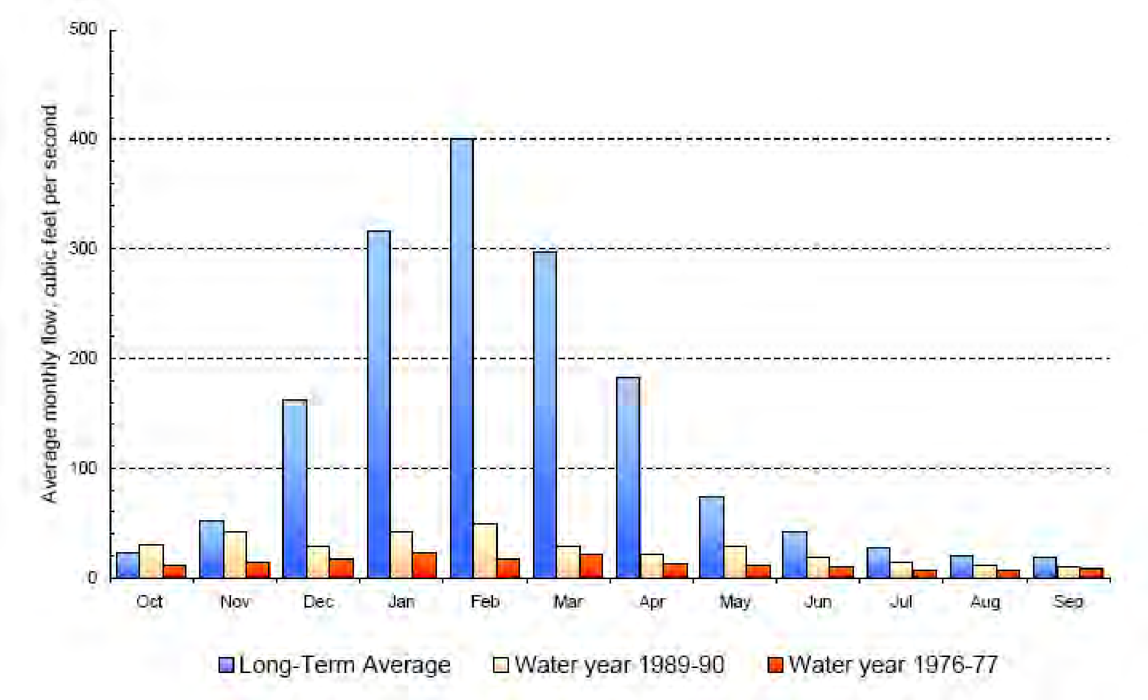
In the San Lorenzo River, runoff fluctuates annually and seasonally, depending on the amount and timing of rainfall. The majority of runoff typically occurs over a three month period from January through March, once the watershed becomes saturated. After the rainy season ends, stream flow in the San Lorenzo River gradually declines over the course of the summer dry season.

In normal years, average monthly runoff ranges from 300 to 400 cfs in winter, and then drops from 70 cfs to 18 cfs over the course of the dry season. As long as the flow in the channel continuously exceeds 12 - 14 cfs, which it typically does in normal years, the water system is capable of making full production within its water rights from the San Lorenzo River all season long.

In dry years, runoff is substantially lower. Figure 2-3 below illustrates the difference between average monthly flow and the flow in the San Lorenzo River during two drought years. Under these conditions, when stream flow in summer declines below 12-14 cfs, production from the river must be scaled back to avoid damaging pumps. In the 1977 drought, the flow in the river dropped to a historic low of about 6 cfs, significantly reducing water production.

The same is true, even more so, for the north coast sources. The stream flow in Laguna and Majors creeks dwindles to extremely low levels in dry years. Liddell Spring is a steadier, more reliable source in dry years than either Laguna or

Figure 2-3. Monthly Stream Flow in the San Lorenzo River at Felton



Majors Creek, but does exhibit some decline in flow during dry periods. As such, the spring is a crucial component of the City's water supply in drought years.

2.4 Water Year Type

The City uses a water year classification system as a primary index of its water supply conditions. Under this classification system, the water year, which runs from October 1 to September 30, is designated as one of four types, depending on the total annual stream discharge of the San Lorenzo River, measured at Felton, and expressed in acre-feet[1].

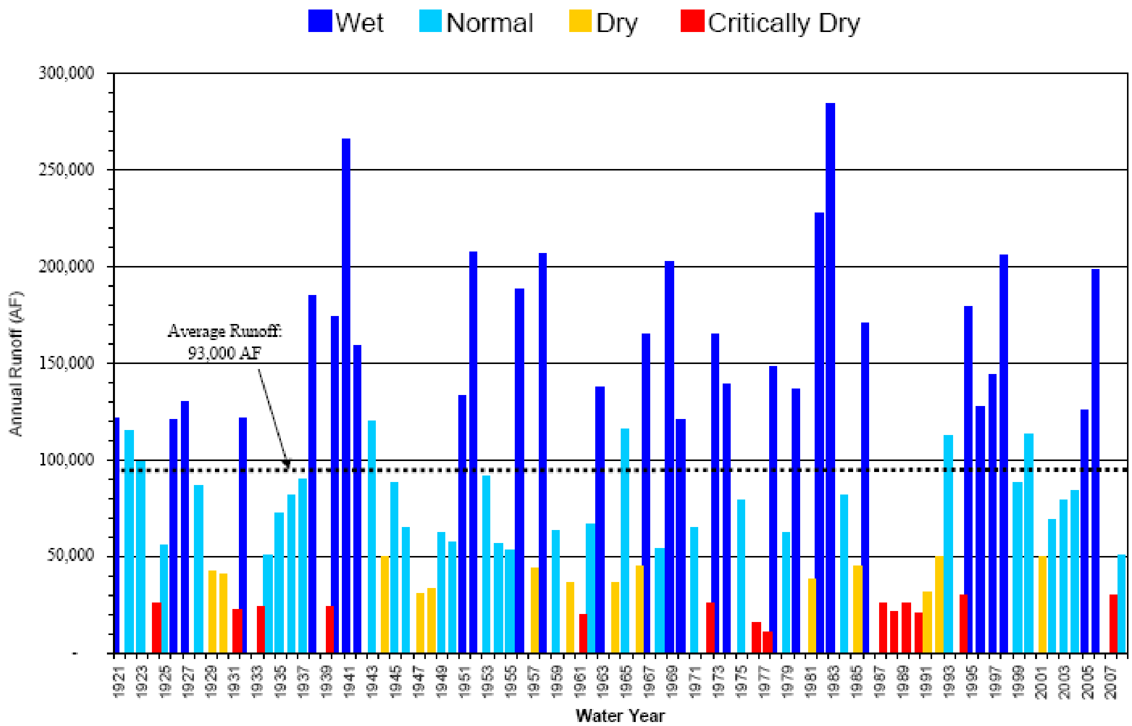
Table 2-1. Water Year Classification System

Classification	Total annual discharge (ac-ft)
Wet	> 119,000
Normal	49,000 - 119,000
Dry	29,000 – 49,000
Critically Dry	< 29,000

[1] An acre-foot of water is equal to 325,851 gallons. One million gallons equals 3.07 acre-feet.

Figure 2-4 below shows the total annual discharge for the San Lorenzo River over the 87 year period from 1921 to 2008, and the classification for each water year. The graph illustrates the dramatic variation in discharge from year to year. Long-term average annual discharge for the San Lorenzo River at Felton is 93,000 acre-feet or almost 30 billion gallons per year. In the long 1987-92 drought, total annual discharge measured between 20,000 and 30,000 acre-feet, and in the 1976-77 drought - the most critical on record - the total annual discharge in the San Lorenzo River dropped to between 10,000 and 14,000 acre-feet.

Figure 2-4. Total Annual Stream Discharge from San Lorenzo River



While the current water year type is of primary consideration in assessing water conditions, the previous water year type also has some influence on summer water supply availability. An antecedent year that is classified as wet will help sustain river base flows longer into the year, whereas a previous dry year can cause river flows to decline sooner and lower than would otherwise be expected.

2.5 Reservoir Storage

Loch Lomond Reservoir is the City's only source of stored water and has a total storage capacity of 2.8 billion gallons. In normal and wet years, reservoir storage

Figure 2-5. Loch Lomond Reservoir

refills naturally to full capacity with runoff from the Newell Creek watershed, usually by February or March. Storage can also be supplemented in dry years with water pumped up to the reservoir from the San Lorenzo River via the Felton booster station when natural runoff is low.

In a normal year, the reservoir will start the dry season full with 2.8 billion gallons in storage. In the 1987-92 drought, reservoir storage at the beginning of April ranged from 1.5 to 1.7 billion gallons (53 to 61 percent of capacity). In the 1976-77 drought, reservoir storage at the beginning of April 1976 measured 1.6 billion gallons or 57 percent of capacity. In April 1977, beginning season storage was only 1.0 billion gallons or 36 percent of capacity.

2.6 Determining If a Water Shortage is Imminent

In normal or wet years when the water supply outlook is favorable, there is generally a surplus of water available from the various sources to meet existing demand. A general rule of thumb is that if Loch Lomond Reservoir is at full capacity by spring, it is not necessary for the City to institute any short-term demand reduction measures the following summer.

After an unusually dry winter or period of consecutive dry years, though, when a lack of supply appears possible, the Water Department undertakes an analysis to forecast whether water supplies will be deficient relative to estimated water needs for the coming dry season. This calculation must be made before the end of rainy season in time to decide on appropriate actions and to provide adequate notice to the public. There is always the chance that late winter rains will change the water supply outlook. Thus, the situation remains dynamic through the end of April.

The peak season from roughly May 1 through October 31 is considered the critical period for the purpose of defining the degree of water supply shortfall, and for selecting the appropriate demand reduction goal. This is the period when water availability in the City's flowing sources is generally lowest and water demand normally would be at its highest, creating a summer water supply "crunch".

Past experience indicates that, even in water short years, there is generally adequate water in the City's flowing sources to meet system demands during the off-peak months between November and April, and that there is little if any need to reduce water demand this time of year when consumption is low.

There is no one single criterion, trigger, or definition that is used to determine if a water shortage exists. The determination of a shortfall involves consideration of all the parameters mentioned previously, as well as expected system demand. To determine the degree of shortfall, the Department follows a three-step process, described below:

1. Develop a monthly forecast of supply available from flowing sources and wells.

2. Compare the supply available from flowing sources and wells to the expected water demand and estimate production needed from Loch Lomond. Calculate the monthly and seasonal drawdown on Loch Lomond Reservoir.

3. Evaluate whether the amount of water in Loch Lomond Reservoir is adequate to meet expected demand for the coming dry season and for the following year in case the dry weather pattern continues through the next winter.

2.6.1 Forecasting Water Production from Flowing Sources and Wells

Of primary importance to the system operation is the ability to know at the end of a winter season how the San Lorenzo River, the City's most important source, will flow through the coming summer and into the dry fall season. In wet and normal years, the river flows at the Tait Street diversion are sustained consistently above the 12.2 cfs level that the City is authorized to divert under the City's water rights. The three river pumps normally make a steady 7.5 million gallons per day from this source, or between 225 and 232 million gallons per month, all season long.

In dry and critically dry years, natural flows can drop below the 12 cfs level at the intake during summer, requiring pumping from the San Lorenzo River to be scaled back. Once the water year type has been established, statistical tables are used to forecast the mean monthly flow in the San Lorenzo River through the remainder of the dry season (Appendix C). This technique helps to identify at what point in the year river production will be reduced and by how much.

Forecasting supplies available from coastal sources involves less certainty due to the lack of historic stream flow information. The technique used to forecast supplies on the north coast is to find historic water years with a similar pattern in rainfall amount and timing. The production records from those years are examined to assess the likely yield of those sources for the coming season, while taking into account any operational rules, capacity constraints, or in-stream flow releases that may have changed from those previous years. Water production from the City's Live Oak well field is projected as a function of the production capacity for any wells in operation and duration that the wells will be operated.

The Department necessarily uses a conservative estimate of yield to ensure the supply forecast for flowing sources and groundwater production is reliable.

2.6.2 Calculating Drawdown on Loch Lomond Reservoir

Once the forecast of supply available from surface diversions and wells is made, supplies are compared with expected water demand to determine how much lake water would be needed to meet unrestricted system demand. The amount of water lost from the reservoir to evaporation and released for downstream fisheries preservation is then factored in. From this analysis, a projection can be made about:

- the expected rate of drawdown of the reservoir over the dry season;
- the lake level at the end of October; and
- the expected carryover storage for the following year.

Table 2-2 below presents an example with the City's current sources of supply to illustrate the forecast technique. This situation represents a hypothetical year in which the lake does not refill over winter and begins the season on April 1 with 2.1 billion gallons in storage, or 73 percent of capacity. Flow in the San Lorenzo River is projected to drop below 12 cfs during the month of July, reducing river production. Without any constraint on water demand, a total of 680 million gallons of water would be needed from the lake to meet normal system demand over the dry season, which, along with other losses and outfows, would result in an end of season reservoir volume of about 1.2 billion gallons, or just under 42 percent of capacity.

Table 2-2. Example of Water Storage Forecast with Unrestricted Water Demand

SCWD Production Forecast (million gallons)	April	May	June	July	Aug	Sep	Oct	Total
North Coast (gross production) [2]	82	74	64	50	50	49	35	404
North Coast (net production)	61	55	48	38	38	37	26	303
San Lorenzo River	207	232	225	212	200	175	160	1,411
Live Oak Wells	24	24	24	24	24	24	24	168
Total Production without Lake	293	311	297	274	262	236	210	1,882
Projected System Demand	295	344	388	410	415	365	345	2,562
Lake Production Needed to Meet Demand	**2**	**33**	**91**	**136**	**153**	**129**	**135**	**680**
Evaporation (feet)	0.2	0.3	0.3	0.4	0.4	0.3	0.2	2.1
Evaporation (mil gal)	11	14	14	18	16	11	6	90
Fish Release (mil gal)	21	21	21	21	21	21	21	147
Beginning Lake Volume	**2,100**	**2,066**	**1,998**	**1,872**	**1,696**	**1,506**	**1,345**	
End of Month Lake Volume	**2,066**	**1,998**	**1,872**	**1,696**	**1,506**	**1,345**	**1,183**	
End of Month Lake Elevation (ft above msl)	**562.8**	**561.2**	**558.5**	**554.3**	**549.3**	**544.6**	**539.6**	
Monthly change in elevation	-0.8	-1.6	-2.7	-4.2	-5.0	-4.7	-5.0	
Cumulative change in elevation	-0.8	-2.4	-5.1	-9.3	-14.3	-19.0	-24.0	
Percent of capacity of Loch Lomond (%)	73.0	70.6	66.1	59.9	53.2	47.5	**41.8**	

2.6.3 Evaluating Adequacy of Supply

The determination of whether a shortage exists essentially boils down to a risk assessment regarding the predicted end of season lake level and carryover storage needed in Loch Lomond Reservoir. The Water Department's main considerations in undertaking this assessment include the following:

- Would allowing unrestricted water use in the current year leave insufficient reserves if drought conditions continue into next year?

[2] Gross production refers to the amount of water entering the system at the source, while net production is the amount reaching the City's water treatment plant. The difference is due to coast irrigation sales, leakage, and maintenance.

- Knowing that another dry year could mean the City's flowing sources would drop even lower, how much water should be withheld in the reservoir for the following year to be prudent?

The key decision thus revolves around how much Loch Lomond water to allocate in spring for the current year, whose tradeoffs are summarized in Table 2.3 below.

Table 2.3 Tradeoffs of Alternative Allocations from Loch Lomond Reservoir

Allocation	Frequency	Revenue Impact	Consequence
Large	Shortages occur less frequently	Less impact on water sales and revenue	Would require a smaller cutback in the current year, but would draw down the reservoir faster and potentially would require much more draconian cutbacks if the drought persisted into the following year
Small	Shortages occur more frequently	Lower sales and reduced revenue	Would mean customers would be required to cut back more in the current year, but would preserve storage enabling the City to withstand more prolonged drought before running out of stored water

There is no set formula to determine the optimal allocation. Rule curves were developed for operations modeling purposes as part of the City's Integrated Water Plan to mimic how lake resources theoretically would be allocated under various water conditions. Under these rule curves, no shortage is indicated if lake storage is above 2.4 billion gallons (85 percent of capacity) on April 1 and as long as the lake is forecast to remain above 1.8 billion gallons (64 percent of capacity) though the end of September. Below these levels, a shortage is assumed to occur. The lower the lake level, the greater the shortage. One important rule regarding utilization of lake storage established during the development of the Integrated Water Plan was to always regard the bottom 1.0 billion gallons (35 percent of capacity) in the reservoir as unusable, so there is always some limited amount of supply preserved in storage for the following year.

In the real world, though, with imperfect information about both supply and demand, and no ability to tell when the drought will end, prudent management dictates that the long-term welfare of the City and its residents outweighs the short-term benefit to the community and higher revenues that would be realized by setting a higher allocation. This means generally favoring a smaller allocation and calling for larger cutbacks than may actually be necessary in retrospect to avoid the possibility of experiencing more critical water shortages if drought conditions continue to worsen. **Ideally, the carryover storage amount will be enough, along with other sources, to meet essential health and safety needs if the subsequent winter is as dry as the driest year on record.** According to the literature, the main lesson from other utilities that have been through droughts is that they would have acted earlier to save more water, in retrospect, in order lessen the impact of implementing more severe cutbacks later on.

Going back to the example in Table 2-2, it is logical to assume that a season-end level of less than 1.2 billion gallons (42 percent of capacity) would be regarded as unsafe and leaving the system vulnerable in case of another dry year. In this example, it is not unreasonable to assume that a decision would be made to curtail water use with the goal of retaining somewhere between 1.5 and 1.6 billion gallons of water in storage (55 percent of capacity) at the end of the season as a hedge against a subsequent dry year. To achieve that target storage, lake withdrawals would need to be reduced from 680 to less than 300 million gallons and customers would be required to cut back by 15 percent or 387 million gallons compared to the normal demand of 2,562 million gallons. Table 2-4 shows the effect a 15 percent cutback would have in terms of increasing carryover storage and lake level at the end of the dry season.

Table 2-4. Example of Water Storage Forecast with 15 Percent Demand Reduction

SCWD Production Forecast (million gallons)	April	May	June	July	Aug	Sep	Oct	Total
North Coast (gross production)	82	74	64	50	50	49	35	404
North Coast (net production)	61	55	48	38	38	37	26	303
San Lorenzo River	207	232	225	212	200	175	160	1,411
Live Oak Wells	24	24	24	24	24	24	24	168
Total Production without Lake	293	311	297	274	262	236	210	1,882
Reduced System Demand	295	315	320	330	320	300	295	2,175
Allowable Lake Production	**2**	**4**	**23**	**56**	**58**	**64**	**85**	**293**
Evaporation (feet)	0.2	0.3	0.3	0.4	0.4	0.3	0.2	2.1
Evaporation (mil gal)	11	14	14	18	16	11	6	90
Fish Release (mil gal)	21	21	21	21	21	21	21	147
Beginning Lake Volume	**2,100**	**2,066**	**2,027**	**1,969**	**1,873**	**1,778**	**1,682**	
End of Month Lake Volume Goal	**2,066**	**2,027**	**1,969**	**1,873**	**1,778**	**1,682**	**1,570**	
End of Month Lake Elevation (ft above msl)	**562.8**	**561.9**	**560.6**	**558.5**	**556.3**	**553.9**	**551.1**	
Monthly change in elevation	-0.8	-0.9	-1.3	-2.1	-2.2	-2.4	-2.8	
Cumulative change in elevation	-0.8	-1.7	-3.0	-5.1	-7.3	-9.7	-12.5	
Percent of capacity of Loch Lomond (%)	73.0	71.6	69.6	66.2	62.8	59.4	**55.5**	

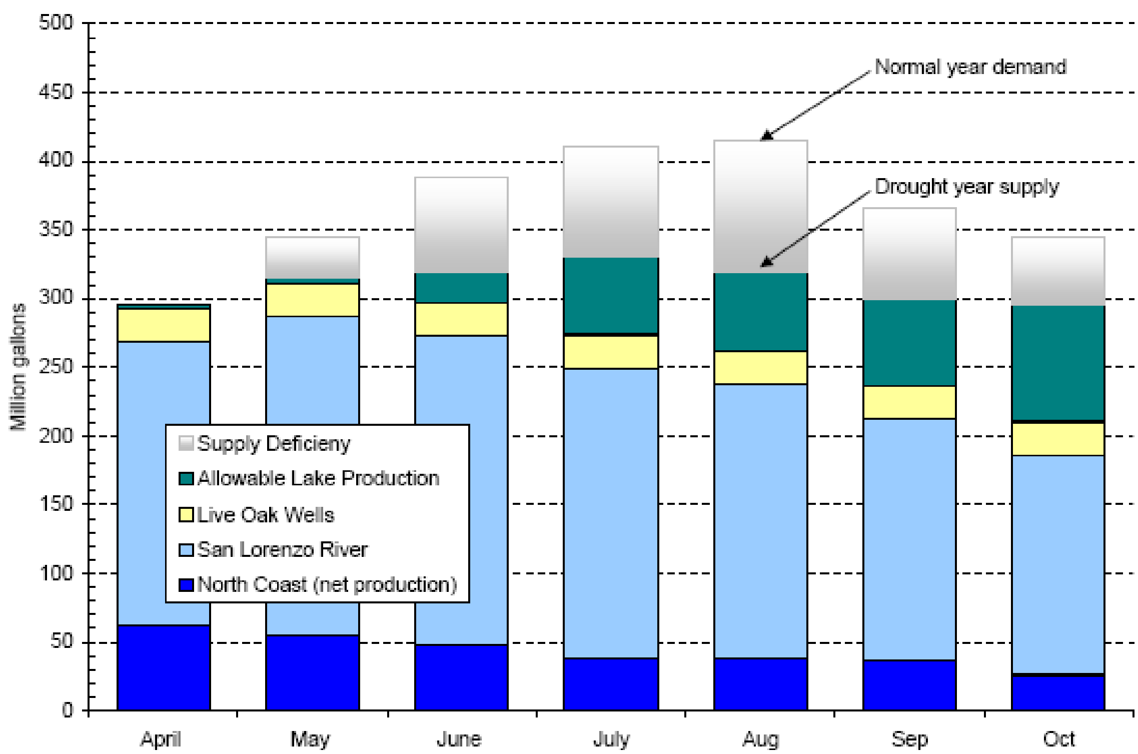
In this case, the reservoir at the end of the dry season stays over half full and 13 feet higher than it would have without any reduction in demand.

The overall water shortage is calculated simply by dividing the supply deficiency for the seven month period from April to October (387 million gallons), by the total unrestricted demand during the same period, expressed as a percentage:

Supply deficiency (mg):	387
Unrestricted demand (mg):	÷ 2,562
Water shortage:	= 0.15 or **15%**

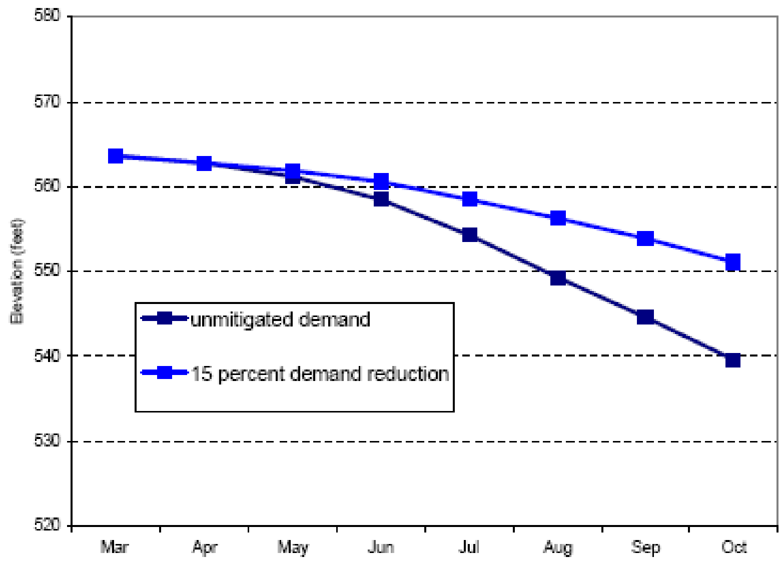
Figure 2-6 below illustrates the 15 percent supply deficiency relative to available supplies on a month to month basis.

Figure 2-6. Example of a 15 Percent Water Shortage



The difference in the drawdown rate between the two scenarios is illustrated in Figure 2-7. This chart shows the effect reducing water demand has on slowing the depletion rate of the City's stored water supply.

Figure 2- 7. Reservoir Drawdown



The ultimate decision about whether supplies are adequate in Santa Cruz for a given dry year are thus dependent not just how much water is available in that year from the City's sources of supply, but also on the level of demand exerted by customers over the coming season and management's comfort level with predicted carry over storage. In the last few years, systemwide water demands have experienced a noticeable downturn which means the City can better withstand dry conditions like the current 2008 water year and have a lower seasonal impact on lake levels than in the past. The one caveat, though, is that because at present use is so conservative, there is a declining ability for "belt tightening" when the next shortage arises.

2.7 New Water Sources and Potential Changes to Existing Supplies

There are several major projects currently under way that are intended to improve the City water system reliability in drought years.

The City and Soquel Creek Water District are jointly pursuing seawater desalination as a supplemental water source, which is expected to become available sometime around 2015. As currently envisioned, this facility would add 2.5 mgd capacity to the City water system, which could provide upwards of 500 million gallons over the dry season as a backup supply in times of drought. The operation of such a facility between the two agencies is yet to be determined, but the process of evaluating the City's dry year supply and demonstration of need by the City for use of the plant would be similar to the example shown above.

The other major capital improvement project affecting the City's water supply is the renovation of the Live Oak well system, which includes upgrades to wells, treatment plant, and the distribution system to restore production capacity back to its full 2 mgd level that it was in operation during the 1987-92 drought. This assumes the entire groundwater basin is not compromised by continued regional over-pumping of the Purisima aquifer.

Another possible long-term project currently being pursued that may have some minor beneficial effect on City water supplies by reducing summertime peak demand is an exchange of water with the Scotts Valley Water District. The District is exploring ways to provide recycled water from the City of Scotts Valley to the Pasatiempo golf course, which now uses water obtained from the City of from Santa Cruz. The District would receive in exchange surplus water from the City during winter to reduce its groundwater pumping and restore groundwater levels in the Scotts Valley area. While net water production by the City would remain unchanged, the project would shift demands from the peak to off-peak season and shift production away from the lake toward the City's flowing supplies.

In addition to these projects, there are also several uncertainties facing the City's existing sources, particularly along the north coast, that have the very real potential to reduce water supply in dry years.

The City is pursuing an Endangered Species Act Section 10 permit and habitat conservation plan. Long-term requirements for in-stream flow releases affecting the City's surface water diversions have yet to be determined and are pending the outcome of further data collection, analysis, and negotiations with federal and state regulatory authorities. However, preliminary voluntary releases are now being made an all three North Coast sources (Laguna and Majors Creeks, and Liddell Spring) and expectation is that the City will lose more water as a result of regulatory actions at the state or federal level for the protection of listed species. The City is also involved in two water rights matters pending before the State Water Resources Control Board that could affect future operations of the Felton diversion and Loch Lomond Reservoir.

The net effect of all these projects and issues is unclear at this time, but the likelihood is that the City stands to lose some portion of its existing supply before it gains any new source. Those changes will have to be factored into the assessment of supply and demand the next time the City is confronted with a potential water shortage.

Section 3 DEMAND REDUCTION PROGRAM

This section describes how the City will respond to future water shortages and discusses the various actions it would take to reduce water demand under different shortage scenarios.

3.1 Staged Demand Reduction Approach

The recommended Water Shortage Contingency Plan uses a staged approach that classifies a shortage event into one of five levels spanning a range from less than 5 percent up to 50 percent. Each stage has been ascribed a specific title to describe and convey the severity of the water shortage to the public.

Table 3-1. Five Stage Structure to Water Shortage Contingency Plan

Stage	Magnitude of Water Shortage	Stage Title
1	0-5%	Water Shortage Alert
2	5-15%	Water Shortage Warning
3	15-25%	Water Shortage Emergency
4	25-35%	Severe Water Shortage Emergency
5	35-50%	Critical Water Shortage Emergency

To put these different levels into context, the City water system normally produces a total of about 2.5 to 2.6 billion gallons of water from April through October. This is the time period when water production is typically the most constrained by shortages and when consumption would need to be reduced. Normal daily usage during this period varies seasonally from 10 to 14 mgd and averages about 12 mgd. Table 3-2 below shows the amount of reduction in demand that would need to be achieved system-wide, on both a seasonal and a daily basis, which corresponds with the upper end of each stage.

The overall concept of this approach is that water shortages of different magnitudes require different measures to overcome the deficiency. As explained in further detail below, each stage includes a set of demand reduction actions and measures which become progressively more stringent as the shortage condition escalates.

Table 3-2. System-wide Demand Reduction Volumes

Stage	Magnitude of Water Shortage	Seasonal Demand Reduction (million gallons)	Average Daily Demand Reduction (mgd)
1	5%	125	0.6
2	15%	375	1.8
3	25%	625	3.0
4	35%	875	4.2
5	50%	1,250	6.0

Normally, only one of these five stages would be put into effect early in the year at the recommendation of the Water Director and remain in force for the entire dry season. Which one would depend on the water supply outlook at the beginning of the dry season. However, conditions and circumstances will vary with each shortage event. Although it would not be desirable to do so for sake of consistency, the City might be forced to transition to the next higher stage mid-season if the reduction efforts at the initial stage do not achieve the needed result.

There is an important distinction between the lower two stages (1 and 2), designated above in shades of yellow, and the upper three stages (3, 4, and 5) designated in shades of red, with the break point occurring at the 15 percent shortage level. The lower two stages (1 and 2) represent the **anticipated curtailment** that is envisioned as being necessary to balance water supply and demand from time to time under the City's Integrated Water Plan. Shortages of 15 percent or less, while inconvenient, do not directly threaten public safety or pose undue economic impact.

The upper three stages (3, 4 and 5), conversely, are all characterized as **emergency water shortages** since they result in more widespread hardships being felt throughout the community, may threaten public health and welfare, and cause considerably more economic harm. For these reasons, the City is making considerable effort and investing substantial capital to avoid shortages of this magnitude in the future. Nevertheless, as a public water supplier, the City must still prepare and plan for the possibility of experiencing such large deficits under state law.

3.2 Overview of Demand Reduction Strategy

The City's strategy for dealing with water shortages of all levels involves the following four interrelated components:

- An allocation system to establish reduction goals for different customer groups
- Demand reduction measures
- Publicity and communications
- Operating actions

These four components are summarized below.

3.2.1 Allocation System

A fundamental issue any water supplier faces in managing a water shortage involves the allocation of water and how to distribute the available supply among customer categories when supplies fall short. In the process of updating this plan, staff and the City Water Commission examined various options and alternatives and selected a priority-based system. This allocation system produces specific demand reduction goals for each major customer category at various levels of shortfall based on the unique usage characteristics of each customer category. It is one of the key mechanisms to ensure that the overarching goals of: 1) conserving the water supply of the City for the greatest public benefit and 2) mitigating the effects of a water shortage on public health, safety, and economic activity, are achieved. It also provides the means for determining whether demand reduction goals are being met or, if not, making needed adjustments. The allocation system is described in more detail below.

3.2.2 Demand Reduction Measures

There are a variety of demand reduction techniques that can be used to curtail customer water use during a supply shortfall. These techniques fall into the following general categories:

<u>Voluntary Water Use Reductions</u> This approach would include issuing guidelines and suggestions to conserve water, encouraging installation or active distribution of conservation devices, stepping up financial incentives for fixtures and

appliances that reduce per capita water use, discouraging installation of new landscape, or encouraging replanting with low water materials. Offering technical assistance in the form of water audits for various types of customers would fall into this category.

Prohibitions on Certain Uses This technique includes banning nonessential uses not required for protection of public health and safety that are not normally prohibited by definition under the city's water waste ordinance. Examples include prohibition on the use of potable water for washing sidewalks and paved surfaces, dust control, or the draining and refilling of private swimming pools. Included in this category would be serving of water in restaurants or other places where food is served unless expressly requested by the customer.

Limits on Certain Uses This approach involves placing mandatory restrictions such as watering only between certain hours or on specific days, watering of landscape only by certain methods (sprinkler ban), or restricting the manner in which vehicles or buildings may be washed.

Mandatory Requirements This technique includes adopting regulations mandating that certain measures be taken by selected customers ranging from the posting of signage in various establishments to save water to requiring the preparation and filing of site-specific conservation plan or requiring an audit of company water use demonstrating conservation efforts.

Rationing This approach involves establishing a fixed volume or allocation for individual customers or for groups of customers that is intended to reduce water use to a certain level commensurate with the seriousness of the situation. Possible methods that can be used to assign customer allotments include setting a uniform or flat amount, applying a percentage reduction from past use (or other benchmark), establishing a ration on a unit basis (per capita, per dwelling unit, per connection) or using a hybrid approach that is based on a combination of factors.

In updating this plan, staff and the City's Water Commission identified and reviewed available options for application to various customer groups and inclusion at different stages, and took into consideration the following factors:

- Water savings
- Seasonality
- Time frame and procedural requirements to implement the measure
- Administrative burden
- Applicable sector (residential, commercial, irrigation)
- Measures used by other water agencies

3.2.3 Publicity and Communications

Effective communication is essential to the success of any water shortage contingency plan in achieving the desired water use reductions. All customers need to be adequately informed about water supply conditions, understand the need to conserve, and know what actions they are being requested or required to take to mitigate the shortage. The Water Department naturally assumes a central role in publicizing the extent of the water shortage problem and in advising and assisting customers to conserve. The more severe the shortage, the more vigorous the public information campaign will need to be. No matter what the situation though, any public communications strategy undertaken in connection with water shortage ideally should contain the following fundamental attributes:

<u>Timely</u> – information should be disseminated well in advance of voluntary and mandatory actions that are to take effect, repeated often, and updated at regular intervals.

<u>Credible</u> – public information efforts should strive to be clear, professional, consistent, straightforward, reasoned, and honest to build trust and community support.

<u>Multimodal</u> – information should be made available to the public using a variety of methods, including the internet, newsletters and newspapers, radio, television, special events, visual displays, public meetings, speaking engagements, and other techniques to maximize reach.

<u>Open</u> – the Department will actively listen to, engage, and involve its customers, solicit feedback, address identified concerns, and respond to public input in a manner that is respectful, appreciative, welcome to creative solutions, and acknowledges each individual’s sacrifice, inconvenience, and contribution to the situation.

Coordinated – the Department should collaborate with other City departments, affected public agencies and organizations, its own employees, interest groups, and the news media to ensure that everyone is on the same page and working together.

Action Oriented – information should always contain positive action steps people can take to help foster a spirit of cooperation and create an overall atmosphere that encourages the public to save water for the common good.

There are a number of **key groups** to whom water shortage communications will need to be aimed. These include, but are not limited to the following:

City Council and other local elected officials The Council authorizes the use of emergency powers and funds, adopts water shortage regulations, and makes appointments to a special appeals board. As the City's governing body, it will have to deal with frequent inquiries from the media and constituents. It will need to know about possible impacts on citizens and the City's own municipal water use. The City Council will be provided in-depth information for its decision-making. The Water Commission, which advises City Council, is a primary forum where policy issues are discussed and the public is able to make its voice heard. The County Board of Supervisors, Capitola City Council, and governing bodies of adjoining water districts also will need to be kept informed.

City Departments and other governmental bodies All City departments, including Parks, Fire, Public Works, as well as other public institutions will be asked to provide leadership and present a good example to the community by reducing their own water demand. The Water Department will need to work closely to promote and ensure such interdepartmental and government cooperation.

News media The media has a key role to play in helping communicate timely and accurate information to the public, especially when water restrictions or regulations are initially announced. The Water Director or Water Conservation Manager (as alternate) serve as official spokespersons to television and print media, answering questions and explaining reasons for certain actions. Because the news media is such a powerful force, care always must be given to deliver accurate and consistent messages and to maintain good relationships with the media. Feature reporters and editors can also be instrumental in writing about personal interest stories and alternative approaches to help people deal with water shortage in a positive way.

Large water users and groups most affected by water shortage The local landscaping and hospitality industries, along with other high water using businesses, University, and special needs customers (hospitals, nursing care facilities, etc) will need additional information about water shortage restrictions or regulations that affect their business or clients more than average.

City water customers/general public All 90,000 City water users, regardless of whether they are the customer of record, will need to be properly notified so that everyone understands the reasons for voluntary or mandatory cutbacks, what is expected in terms of usage restrictions, and the consequences of failing to abide by any adopted regulations. The Department will need to step up distribution of conservation tips and water saving ideas and respond to an increasing number of individual customer contacts. Special efforts also will need to be made to translate copies of all public notices, regulations, and outreach materials into Spanish and other appropriate languages for non-English speakers.

There are various methods the Department could employ to carry out added communications and public outreach responsibilities that become necessary in a water shortage situation. The menu of possible techniques is listed in Table 3-3.

Table 3.3 Communications and Public Outreach Methods

• Press releases • Press conferences • Opinion page coverage • Paid advertising (print, radio, television) • Community television • Radio interviews • Public service announcements • Internet • Bill inserts • Utility bill messages • Revisions to utility bill layout • Direct mail • Printed material (posters, banners, signage) • E-mail • Utility newsletter	• Public meetings, forums • Publish figures and charts of actual water supply and demand on graph, comparing system use against daily, weekly, or monthly water budgets • Presentations at neighborhood, homeowner's associations, service, and community meetings • Telephone hotline • Fliers at schools, churches, libraries, grocery markets, and other social gathering places • Outdoor signs for visitors • Conservation events, contests, booths • Lead or participate in regional drought awareness media campaigns

In reviewing other agency's contingency plans, one feature that was considered valuable to have prepared in advance was a concise public message for each stage of the Water Shortage Contingency Plan. These statements, set forth below, are intended to help communications stay on message and set the tone for subsequent communications through the duration of the incident.

A working list of contacts for major public agencies, media contacts, business organizations, landscape interests, and large customers is provided in Appendix D for reference.

3.2.4 Operating Actions

The Water Department must be flexible in the use of its own workforce and adaptable in realigning its priorities when a water shortage arises. The added responsibilities change what must be done in both field and office operations on a daily basis compared to usual duties under normal water supply conditions. These actions begin early in the water year with monitoring and forecasting water supply conditions and quickly ramp up in spring as the likelihood of a shortage increases. Many will represent increased costs to the Department for additional personnel, services, and supplies.

An important initial step is to designate a working group consisting of the Water Director and senior staff to lead and manage the Department's internal and external water shortage response. The size and composition of the group and frequency of meetings (monthly, weekly, daily) would vary depending on the severity of the shortage.

The Water Department must then mobilize the necessary personnel, resources, and equipment to undertake the various activities that are critical to implementing an effective response. These initial actions may include, among other things:

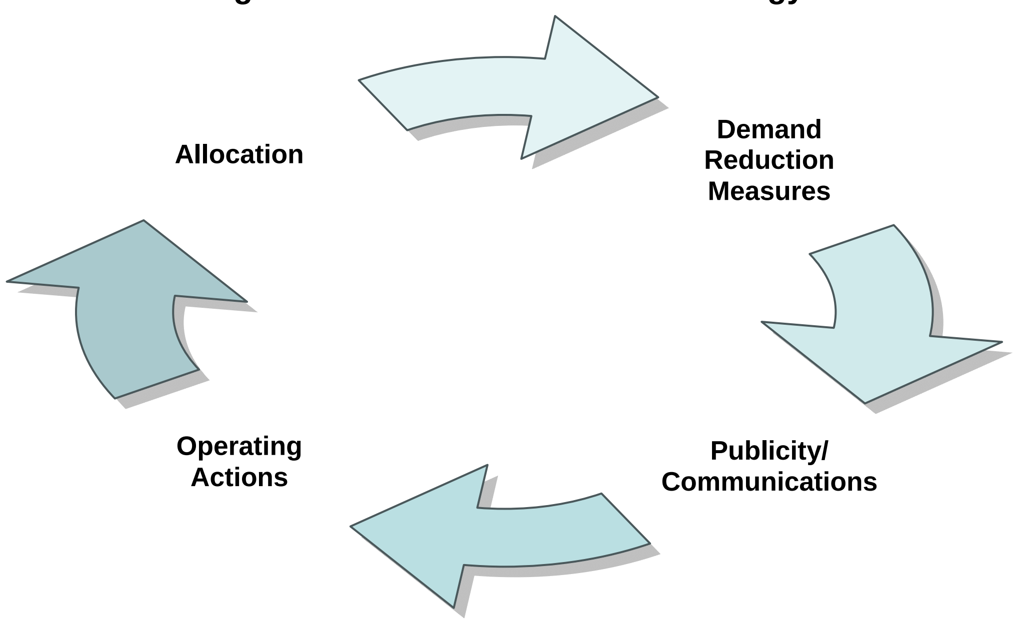
- Establishing water production budgets
- Coordinating with other city departments and affected public agencies
- Establishing a public communications program to publicize use restrictions and to engage and involve the community and key water-using sectors in curtailing their demand
- Ensuring adequate staff and training to effectively respond to customer inquiries and enforce water shortage regulations
- Adapting utility billing format and database capabilities
- Expanding water conservation assistance, outreach, and education

- Instituting a system for processing exception requests and appeals
- Addressing policy issues and updating status with decision makers
- Implementing monitoring mechanisms to track actual usage and measure performance

These and other operating actions are described further below and in Section 4 covering plan implementation.

Together, these four demand reduction strategy components can be thought of as a system whose parts function together to accomplish change; change in customer understanding and awareness, change in their behavior and actions, and fundamentally change in how much water residents, businesses, and visitors use in times of water shortage. As illustrated in Figure 3-1, these interrelated components provide the standards and feedback mechanism to ensure that water consumption is reduced to the level that the system can safely support.

Figure 3-1. Demand Reduction Strategy



3.3 Priority-Based Water Shortage Allocation

The recommended allocation system is based on the premise that, when water is in short supply, certain end uses should have a higher priority than others. Using a priority-based approach, the normal water demands of each major customer category are first classified into three basic priorities, as follows:

1. **Health and safety.** This is the highest priority use, which includes residential and non-residential interior domestic and sanitary uses.

2. **Business.** This category is the second highest priority and includes all non-sanitary usage related to commercial and industrial activity.

3. **Irrigation.** This is the lowest priority and includes all irrigation and outdoor usage in the single family, multiple residential, UC and irrigation categories.

Table 3-4 shows the normal water use for each of the City's major customer groups during the April to October peak season and the composition of that demand according to usage priority. These figures are based on an analysis of actual consumption records for the three-year period from 2002 through 2004, which was selected as being representative of typical water consumption patterns in a stable period marked by normal weather and water conditions.

Table 3-4. Composition of Peak Season Water Use, by Usage Priority
(Million gallons)

Customer Class:	**Usage Priority: 1 Health/ Safety**	**2 Business**	**3 Irrigation**	**Total**	**Percent of Total**
Single Family Residential	660		371	1,031	42%
Multiple Residential	382		142	524	21%
Business	165	273		438	18%
University of California	91		41	132	5%
Other Industrial		23		23	1%
Municipal	18		30	48	2%
Irrigation			110	110	4%
Golf Course Irrigation		32	74	106	4%
Coast Agriculture		59		59	2%
Other		2		2	0%
SUBTOTAL	1,316	389	768	2,473	100%
Percent of Total	**53%**	**16%**	**31%**	**100%**	
System uses/losses				168	
TOTAL SYSTEM PRODUCTION (million gallons)				2,641	

Metered water use by all customers during this 7-month period averages 2,473 million gallons, or roughly 2.5 billion gallons. In terms of the breakdown by usage priority, water used for health and safety purposes amounts to 1.3 billion gallons or just over half (53%) of the total demand during the peak season. Water used for business-related purposes amounts to less than 400 million gallons (16%) and the volume of water used for irrigation and associated outdoor purposes totals 768 million gallons (31%). Expressed on a daily basis, this breakdown equates to an average of 6.3 mgd for to satisfy heath and safety needs, 1.9 mgd for business activities, and 3.7 mgd for irrigation/outdoor purposes.

To arrive at demand reduction goals for each customer group, the normal year demands shown in Table 3-4 are scaled back by usage priority in accordance with the schedule shown in Table 3-5.

Table 3-5. Reduction in Water Delivery by Usage Priority
(percent of normal deliveries)

Stage	Overall System Shortfall:	Health/Safety	Business	Irrigation
2	15%	95	95	64
3	25%	95	90	34
4	35%	90	85	12
5	50%	75	67	0

In essence, this allocation system strives to balance available supplies in times of drought as much as possible through cutbacks in outdoor water use. At each level of shortfall, public health and sanitation usage is afforded the highest priority by cutting back on interior usage the least[1]. The importance of water in protecting the City's employment base is also acknowledged through proportionately modest cutbacks to the commercial sector as compared to the overall system shortfall. Irrigation and other outdoor uses in all cases is cutback the most. The larger the water shortage, the greater the cutbacks, but this system of priorities is maintained throughout the range of potential shortages. The heavy reliance on outdoor use reductions makes sense, both from a water system perspective because it reduces peak demands, which is important to preserving storage in Loch Lomond Reservoir, and from a public health and

[1] No separate allocation was developed for Stage 1 shortfall due to the minimal level of demand reduction needed, voluntary nature of conservation measures requested, and regulations that affect all customer groups equally.

welfare perspective, because irrigation and other outdoor use are the most discretionary of all uses when drinking water is in short supply.

Under this system, a systemwide water shortage of 15 percent - the maximum unserved demand envisioned in the Integrated Water Plan - can be addressed through modest cutbacks (5%) in both indoor and business water uses, combined with an approximately one-third reduction in outdoor water use. Emergency water shortages would involve far deeper cutbacks. A 25 percent systemwide shortage requires slightly greater reduction in business water use combined with a harsher two-thirds reduction in outdoor watering. A 35 percent systemwide shortage requires reducing health/safety and business uses somewhat more, combined with drastic reductions, amounting to almost 90 percent, in outdoor water use. To achieve a 50 percent reduction would take nothing less than a significant reduction in both health/safety and business usage, combined with the elimination of all outdoor water use.

The resulting water supply allocation is shown in Table 3-6. The figures are expressed as a percent of normal delivery and by volume in million gallons for each sector. For example, an allocation of 80 percent means a 20 percent cutback from normal use. Single family residential customers are cut back in all stages slightly more than the overall system shortfall and more than the multifamily customers due to their relatively higher proportion of outdoor to indoor use. Business and industrial customers are also cut back, but by less than the system deficit. The University's cutback would be equal or close to system shortfall, while municipal facilities would be cut back substantially greater due to the high percentage of water use that goes to outdoor purposes. Dedicated landscape/irrigation customers suffer the deepest cutbacks of any single group.

The contribution of each customer category to the overall demand reduction goal is shown in Table 3-7. Approximately two-thirds of the total cutback would be realized through reductions at single and multifamily residential accounts, which is roughly proportional to their overall percentage of normal system demand.

This allocation system is the one recommended by the City's Water Commission after considering several options, and is based on current patterns and composition of water consumption. As demand level changes over time, it should be reviewed and possibly revised. In addition, alternative allocations may always be considered at the time a given stage is implemented.

Table 3-6. Water Supply Allocation and Customer Reduction Goals

	No Deficiency		**Stage 2 15% Deficiency**		**Stage 3 25% Deficiency**		**Stage 4 35% Deficiency**		**Stage 5 50% Deficiency**	
	Delivery		Delivery		Delivery		Delivery		Delivery	
Normal Peak Season Demand = 2,473 mg	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)
Single Family Residential	100	1,031	84%	864	73%	753	62%	639	48%	495
Multiple Residential	100	524	87%	454	78%	411	69%	361	55%	287
Business	100	438	95%	416	92%	402	87%	381	70%	307
UC Santa Cruz	100	132	85%	113	76%	100	66%	87	52%	68
Other Industrial	100	23	95%	22	90%	21	85%	20	67%	15
Municipal	100	48	76%	36	57%	27	41%	20	28%	14
Irrigation	100	110	64%	70	34%	37	12%	13	0%	0
Golf Course Irrigation	100	106	73%	78	51%	54	34%	36	20%	21
Coast Irrigation	100	59	95%	56	90%	53	85%	50	67%	40
Other	100	2	95%	2	90%	2	50%	1	50%	1
Total	**100**	**2,473**	**85%**	**2,111**	**75%**	**1,861**	**65%**	**1,607**	**50%**	**1,247**
Demand Reduction %, Million gallons	**0**	**0**	**15%**	**-362**	**25%**	**-612**	**35%**	**-866**	**50%**	**-1,226**

Table 3-7. Contribution of Each Customer Category to Toward Overall Cutback Goal

	Stage 2 15% Deficiency		Stage 3 25% Deficiency		Stage 4 35% Deficiency		Stage 5 50% Deficiency	
Demand Reduction:	Million gallons	Percent of total	Million gallons	Percent of total	Million gallons	Percent of total	Million gallons	Percent of total
Single Family Residential	167	46%	278	45%	392	45%	536	44%
Multiple Residential	70	19%	113	18%	163	19%	238	19%
Business	22	6%	36	6%	57	7%	131	11%
UC Santa Cruz	19	5%	32	5%	45	5%	64	5%
Other Industrial	1	0%	2	0%	3	0%	8	1%
Municipal	12	3%	21	3%	28	3%	35	3%
Irrigation	40	11%	73	12%	97	11%	110	9%
Golf Course Irrigation	28	8%	52	9%	70	8%	85	7%
Coast Irrigation	3	1%	6	1%	9	1%	19	2%
Other	0	0%	0	0%	1	0%	1	0%
Total Demand Reduction	**362**	**100%**	**612**	**100%**	**866**	**100%**	**1,226**	**100%**

A prime concern of any water shortage contingency plan is maintaining sufficient water for public health and sanitation. Table 3-8 below presents the health and safety allocation for residential customers in terms of gallons per person per day under the four deficit conditions. Current indoor water use averages 58 gallons per person per day for single residential accounts and about 50 gallons per person per day for multifamily accounts. In all but the most extreme case, there is enough water to meet essential health and safety needs, which is considered to be between 45 and 50 gallons per person per day for single family homes, assuming they have been fitted with water conserving fixtures and leakage is minimized. At a 50 percent deficiency, even highly water-efficient households would have to take additional actions to get their usage down to the upper 30 or low 40 gallons per person per day.

Table 3-8. Health & Safety Indoor Residential Use

Deficiency condition	Health / Safety Allocation	Single Residential (gal/person/day)	Multiple Residential (gal/person/day)
No deficiency	100%	58	50
15%, 25%	95%	55	47
35%	90%	52	45
50%	75%	43	37

3.4 Water Shortage Response Actions

The allocation system described above serves to establish demand reduction goals for each of the City's major customer groups. The challenge in crafting this contingency plan is to select the most appropriate set of measures that logically correlate with these targets for each sector and stage of shortfall, acknowledging the inherent uncertainties involved and difficulty in predicting their effectiveness in advance.

The recommended menu of actions to cut water use is presented below. It is meant primarily to help inform the public and decision-makers about the types of measures the Water Department would take under various water shortage scenarios and to aid in structuring an updated water shortage ordinance, but should not be construed as limiting other possible options. Specific circumstances will vary with each shortage and decisions about the most appropriate response should be based on the water supply and demand conditions at the time, and the collective judgment of staff, Water Commission, and City Council, with ample public input. These actions are thus intended as a list of probable measures for advance preparation purposes rather than a set script to be strictly followed, recognizing that as supply and demand change over time, or as a shortage evolves, the ultimate choice of options and actions to best address the shortage also may change.

It is also important to recognize that flexibility in selecting the most appropriate stage may be needed. In the case of a borderline situation, for instance, where there is reasonable likelihood that system demand could be curtailed sufficiently with the lesser restrictions, it may be advantageous to initially choose the lower stage, conditioned with a well publicized caveat that, if water use exceeds targets, the more restrictive regulations would kick in.

Each section that follows includes:

- an overview of the response,
- a discussion of any key issues involved in that stage,
- the prepared public message, and
- a list of the recommended demand reduction measures, communications actions, and operating actions applicable to that stage

3.4.1 Stage 1 – Water Shortage Alert

Stage 1 applies to relatively minor water shortages that can be accommodated with a combination of voluntary conservation measures and minimal usage restrictions, combined with enhanced enforcement of the City's ongoing ordinance prohibiting water waste. Except for a few instances, all demand reduction measures apply uniformly to nearly all customers, therefore no specific allocation is proposed during this stage.

A Stage 1 response may also be appropriate in other situations. It may be prudent as a precautionary measure during an unusually dry year in advance of a declared water shortage to help preserve reservoir storage, or during the winter season following an actual shortage event if needed to maintain a continuing level of awareness among customers until normal water conditions are restored.

The Stage 1 public message is as follows:

"Due to abnormally dry conditions this winter, we're asking all customers to voluntarily cut back water use this summer by 5 percent to stretch the available water supply. City water users should stop using water for non-essential purposes and conserve where possible in case the dry period experienced this past winter continues into next year. If everyone cooperates, we may avoid imposing more stringent watering restrictions. As always, wasting water is prohibited by law"

Table 3-9. Stage 1 Water Shortage Alert Response Measures

System-wide Reduction Goal: 0-5% 0.6 mgd or less
Demand Reduction Measures: • Request voluntary water conservation by all customers • Step up enforcement of water waste • Restrict the time of landscape irrigation to early morning and evening • Prohibit non-essential water use: - serving drinking water by restaurant or food service establishments except upon request - use of potable water for washing driveways, patios, parking lots or other paved surfaces - require hotel, motel, and other commercial lodging establishments to offer option of not laundering towels and linen daily - draining and refilling of swimming pools • Require hoses used for any purpose to have shut off nozzles • Encourage use of drip and other low volume irrigation systems **Publicity/Communications** • Conduct press conference to announce water conditions, request cooperation • Initiate public information campaign through media, utility newsletter, website • Develop regular advertising campaign to remind consumers of the need to conserve water • Prepare and disseminate suggestions/requirements to reduce water use • Inform large landscape/property managers/green industry of irrigation restrictions • Implement customer meter reading program **Operating Actions** • Coordinate water conservation actions with other City Departments and public agencies • Adopt water shortage ordinance prohibiting non-essential water use • Eliminate system water uses deemed non-essential • Delegate water waste patrol duties to all field personnel • Institute regular monitoring and reporting of water production and consumption • Undertake contingency planning for continuing/escalating shortage

3.4.2 Stage 2 – Water Shortage Warning

Stage 2 applies to moderate water shortages. This condition requires more vigorous public information and outreach and an expansion of mandatory water restrictions and prohibitions, particularly on outdoor water uses. The primary methods to meet target consumption levels are to limit irrigation to specified days of the week and to institute water budgets for large landscapes and parks.

The recommended approach to reducing outdoor water use in this stage would be to restrict watering of all lawns and established landscapes to twice weekly during specified hours and to disallow any watering with automatic sprinkler systems on certain days to maximize reduction. Exact schedules would be developed with public input.

Large landscape users, including parks, residential and commercial landscapes, and golf courses with separate irrigation accounts would be required to complete on-site water audits, adhere to monthly water budgets based on their irrigated area and plant materials, and modify their irrigation schedules to achieve the equivalent of a one-third reduction in site water use. The lead time to develop landscape water budgets is long due to the need to collect site specific information, implement billing system changes, and to educate people and transform standard irrigation practices. However, development of water budgets for large users is the next major priority for the City’s long-term conservation program, and once they become implemented as an ongoing program, they may be quickly adapted as a shortage management tool. Professional water budgets for dedicated irrigation accounts are typically tied to real-time weather data and tiered pricing systems or surcharges to be effective.

Other measures that would be imposed under Stage 2 would include mandatory leak inspection and repair for large customers and to expand restrictions on exterior washing to dwellings, buildings, and structures.

The Stage 2 public message is as follows:

“It is necessary to impose mandatory restrictions on water use to ensure that throughout the duration of this water shortage an adequate supply of water is maintained for public health and safety purposes. Our overall goal is to reduce water use by 15 percent, which can be achieved if everyone cuts back their

outdoor watering by one-third the normal amount. We are relying on cooperation and support of all water users to abide by all restrictions and to reach this goal. Otherwise, the shortage could deteriorate into a more serious emergency that requires rationing household water use to avoid depleting the available water supply."

Table 3-10. Stage 2 Water Shortage Warning Response Measures

System-wide Reduction Goal: 5-15% 0.6 to 1.8 mgd
Demand Reduction Measures: • Continue all measures initiated at Stage 1 • Restrict landscape irrigation to designated watering days and times • Require large landscapes to adhere to water budgets • Prohibit exterior washing of dwellings, buildings, or structures (with exceptions for window washing or in preparation for painting) • Reduce time allowed to resolve water waste • Require large users audit premises and repair leaks • Continue to promote meter reading and regular leak detection by all customers **Publicity/Communications** • Intensify public information campaign with regular media updates, direct notices to all customers, paid advertising, billing inserts. • Generate publicity about individuals and businesses demonstrating leadership to save water • Consult with major customers to develop conservation plans • Publish weekly consumption graph in daily newspaper • Inform large landscape/property managers/green industry of additional irrigation restrictions • Conduct workshops on large landscape requirements for property owners, contractors, maintenance personnel **Operating Actions** • Coordinate with all City Departments and public agencies to reduce water use • Optimize existing sources (increase groundwater production, reduce transmission losses) • Suspend main flushing except as required for emergency and essential operations • Intensify distribution system leak detection and repair • Hire, train, dispatch water waste patrol • Establish water conservation "hot line" to respond to questions and reports of waste • Expand home water survey program and offer large landscape water audits • If necessary, use City Water Commission to process requests for exceptions • Continue regular monitoring and reporting of water production and consumption • Undertake contingency planning for continuing/escalating shortage • Develop strategy to mitigate revenue losses

3.4.3 Stage 3 – Water Shortage Emergency

This level of water shortage constitutes an emergency situation requiring significant actions by the public to achieve up to a 25 percent reduction in normal water use to avoid depleting limited water storage. It requires the equivalent of 5 to 10 percent reduction in all indoor use and a drastic two-thirds reduction in outdoor use systemwide. The three primary measures being recommended to meet this emergency reduction goal are:

1. Residential water rationing
2. Required water shortage signage in all nonresidential establishments
3. Reduced landscape water budgets for large landscapes

The basic concept of water rationing is that each utility customer is given a certain allocation of water, expressed in billing units, to use in a billing period[2]. If they use the amount they are allocated or less, charges for water are calculated at the normal rate. If they exceed their allocation, the portion in excess of their allocation is charged a penalty rate. The penalty rate may be broken into multiple tiers so the more the excess usage, the higher the penalty price per CCF used. The purpose is <u>not</u> to generate revenue but rather to use water pricing as a way to motivate the customer to modify their usage to stay within their allocation and avoid being penalized, which most customers do. Those that don't reduce are charged for their overuse at the penalty rates.

The method to allocate water when rationing is instituted varies according to customer type. It may be based on the number of people in a home, the number of dwelling units in a multifamily complex, or set as a percentage of past use during some prior year. Staff and the Water Commission reviewed the water shortage contingency plans of many other water agencies to identify the methods used elsewhere to ration water and considered the advantages and disadvantages of various methods.

For single family residential customers, the **per capita approach** is probably the fairest practical method, easiest to communicate, would be best understood and accepted by the general public, and is effective in achieving cutbacks where they are needed most, in outdoor water use. In addition, past experience

[2] One billing unit equals one hundred cubic feet (CCF) or 748 gallons.

demonstrates that this method was very successful in reducing outdoor water demand for the single residential category when rationing was last instituted in 1990 and in 1977.

One of the key challenges to implementing water rationing using a pure per capita approach is the need to perform a census of household size at over 18,000 single family accounts and to maintain information on household size as number of residents changes over time. In lieu of performing a census, Staff and the Water Commission recommend using a modified per capita rationing system developed by the Goleta Water District. Under this system, all households are given a default allocation sufficient for a family of 4 persons. Households that have more than four persons would be required to contact the Water Department and verify household size in order to be granted an increased allocation, which would depend on the actual number of persons living at the residence.

Recent census data for the City of Santa Cruz indicate that only 17 percent of all occupied households within the City have four or more persons per household. Assuming this figure is similar for the unincorporated part of the City's water service area, establishing a default allocation for a family of four would more than satisfy the 83 percent majority of households that have three or fewer persons per household. This method is similar to that last used by the City to ration water in 1990, which provided a baseline allocation for households of three or less, except that a census was undertaken then to survey the actual number of persons living at each household.

The Goleta rationing model is considered to be preferable because it eliminates the significant work associated with carrying out an occupancy census and alleviates concerns about potential for inaccurate responses. The principle drawback is the problem of equity, since there will be less "cushion" in the allocation for households with four residents than there is for homes with fewer number of residents, and an increased possibility of exceeding their allocation. Whatever method is selected, allocation disagreements are to be expected and procedures need to be put in place to handle valid appeals and exceptions.

Table 3-11 below shows a typical rationing calculation for a single family residence in Stage 3.

Table 3-11. Water Rationing Schedule:
Single Family Residential Account

	Ccf/month	Gallons per day:
Up to four persons:	11	265
Each additional person:	2	50
Example monthly allocation for a 6-person household:		
Base allocation:	11 ccf	
2 additional persons x 2 ccf per person	+ 4 ccf	
Monthly Allocation	= 15 ccf	= 374 or 62 gpcd [3]

What makes multifamily customers more challenging for developing a water rationing system are the large differences in housing types, the presence or absence of irrigation meters at a complex, and the fact that many larger accounts are handled by an independent property management firm on behalf of the homeowner's association. These companies typically do not track how many people reside in each unit or in the complex as a whole.

It is recommended that multiple-residential accounts be rationed based on the **number of dwelling units** associated with the water service account. The number of dwelling units is the best starting point since that data is available on the utility billing system and, in the absence of information about the number of people living on the property, it is the next best driver for indoor water demand. It is further recommended that multiple-residential accounts be allowed alternative rationing options that reflect the heterogeneous nature of building types on multifamily properties and the fact that some of these properties have separate irrigation accounts while others don't. These wide differences in user characteristics cause inequities in allocation based solely on the number of dwelling units. Offering alternatives allows the customer choose for themselves the option that works best in their particular case. These options include:

- an allocation based on the number of persons residing at the property
- an allocation based partly on the number of persons residing at the property and partly on landscape water needs at the property that reflect the same cutback to irrigation that other customers would experience (for properties without irrigation accounts)

[3] gpcd = gallons per capita per day

- the same allocation per dwelling unit as single family accounts would receive for certain properties that resemble single family lots in terms of lot coverage

Recommended rationing allotments for single and multiple residential accounts are presented in Appendix E.

If water rationing becomes necessary, it is also recommended that all outside city customers be converted from bimonthly to monthly billing. This change will enhance the customer's ability to monitor their water usage, enable them to detect and repair leaks quicker, and help them stay within their allocation.

The main obstacle in implementing water rationing at this time is the uncertainly about the capability of the new EDEN utility billing system. The system has been in use only since September 2008 and its ability to calculate rationing allocations and excess use charges is unknown. In the event rationing becomes necessary before the billing system can be adequately programmed and tested, other options could be considered to achieve substantial outdoor use reductions in the residential sector in lieu of water rationing. Although not ideal, these include:

- Restricting watering to once weekly, or
- Banning sprinkler irrigation

This problem is discussed further in Section 4.

It should be reiterated that **water rationing is a situation that the City is seeking to avoid** through long-term conservation efforts and the development of an additional water supply. It is, however, necessary to have a contingency plan in place should the need arise.

Commercial customers would be exempted from individual water rationing in Stage 3. Instead they would be expected to meet their collective 8 percent reduction goal by adhering to continuing water restrictions, and by being required to prominently post **"SAVE WATER – REPORT LEAKS AND WATER WASTE"** signs at the entrance and in every bathroom of commercial, industrial and institutional buildings, including:

- Hotels, motels, lodging
- Restaurants, cafeterias, cafes, and all food service establishments

- Offices and government buildings
- Hospitals and health care centers
- Schools

Large landscape customers would be held to water budgets as described in Stage 2, reduced in accordance with the allocation for irrigation customers in Stage 3.

One charged policy issue that often arises in connection with a water shortage emergency is the question of whether or not to continue allowing new connections on the system. In the past, it has been the City's policy to continue allowing new connections mainly because the demand they add in any one year is so negligible. The water that would be made available to existing customers by banning new water connections, therefore, would not make any real difference in terms of increasing the existing customers' allocation. This issue is typically driven by customers who are called on to make sacrifices and feel that water agencies should concentrate on fulfilling present obligations rather than accepting new customers. A number of agencies, however, do have provision for a temporary ban or place a low priority on new connections in later stages of their drought plans.

The Water Commission considered this issue carefully and recommended giving the public a one-year advance notice, beginning in Stage 3, stating that a temporary water service connection ban would be strongly considered if the shortage emergency continues or escalates into the following year. This notice would allow those people with plans and projects already underway time to complete work or make arrangements, and those considering future construction projects to make timely decisions about proceeding with the knowledge that they risk not being able to secure a water service connection until the shortage is over.

The Stage 3 public message is as follows:

"The City faces a serious water shortage emergency due to prolonged drought. To conserve the available water supply for the greatest public benefit while minimizing impacts on our local economy, it has become necessary to institute a water rationing program for all residential customers. Our goal is to reduce system water demand by ___%. While rationing amounts are adequate for

normal domestic needs, significant cuts to outdoor water use may be necessary to remain within set allocations. All customers are urgently asked to make every effort to conserve water and abide by watering restrictions or face further reductions in water allotments."

Table 3-12. Stage 3 Water Shortage Emergency Response Measures

System-wide Reduction Goal: 15-25% 1.8 to 3.0 mgd

Demand Reduction Measures:

- Institute water rationing for residential customers
- Continue landscape irrigation restrictions to designated watering days and times
- Require large landscapes to adhere to reduced water budgets
- Require all commercial customers to prominently display "save water" signage with specified language at specified locations
- Maintain restrictions on exterior washing of surfaces and structures
- Continue to promote meter reading and regular leak detection by all customers

Publicity/Communications

- Expand, intensify public information campaign focused on 2/3 reduction in outdoor use
- Provide regular media briefings, manage media coverage
- Provide regular information reports to Water Commission, City Council and other agencies
- Consult with major customers to develop conservation plans
- Publish weekly consumption graph in daily newspaper
- Enlist support of business groups: chamber, CVC, lodging association, etc.
- Inform large landscape/property managers/green industry of reduced allocations
- Conduct workshops on large landscape requirements for property owners, contractors, maintenance personnel
- Prepare public notice regarding possible future service connection moratorium

Operating Actions

- Modify utility billing system and bill format to compare actual use with customer allocation
- Adopt penalty rates
- Increase customer service training to address high bills, irate customers
- Convene and staff appeals board to process requests for exceptions and appeals of penalties
- Expand size and coverage of water waste patrol
- Expand, strengthen water conservation education, activities, and program
- Continue all operating actions listed under Stage 2
- Increase frequency of monitoring and reporting of water production and consumption
- Convert outside City customers from bimonthly to monthly billing
- Undertake contingency planning for continuing/escalating shortage
- Develop strategy to mitigate revenue losses

3.4.4 Stage 4 – Severe Water Shortage Emergency

The water supply conditions that would trigger Stage 4 parallel the difficult situation the City experienced in the drought of late 1970s. Under this scenario, virtually all available water must be reserved either for health and safety purposes or to sustain local business.

Achieving a 35 percent systemwide reduction would require expanding water rationing to cover all water customers, including business. Residential customers would continue to be rationed as described in Stage 3, but with reduced monthly allotments.

Unfortunately, there is no practical way to assign a commercial water budget based on variables like the number of employees, square footage, etc. given the variety of usage characteristics in this sector. Every business (or group of businesses sharing a single water account, as is often the case in shopping centers) is unique. They include laundries, restaurants, health care facilities, retail outlets, hotels, car washes, and office buildings. We see no choice other than to ration business customers individually based on a **percent of prior use in a normal year** that is consistent with the overall allocation for Stage 4. Where essential water use at a business establishment involves a public health service, including hospitals, doctor's offices, medical laboratories, and skilled nursing facilities, or where a business can demonstrate it has already achieved maximum practical water conservation, provision for additional water could be made on a case by case basis through an exceptions process.

Other actions/restrictions that likely would be necessary in a severe water shortage emergency, in addition to those previously described, include the following:

- Prohibition on lawn/turf irrigation and on installation of new landscaping in new development
- Prohibition on potable water in fountains and ornamental water features
- Prohibition on on-site vehicle washing, including dealer lots, company fleets
- Rescinding hydrant and bulk water permits
- Suspending water main replacement program

Gray water use can be allowed and should be promoted for saving valuable landscape trees and shrubs. It includes drain water from showers, bathtubs, bathroom sinks, and clothes washers. It does not include water that has come in contact with toilet waste, water from kitchen sinks and dishwashers, or laundry water used for washing diapers. There are no restrictions on the use of gray water if it is carried in a bucket. Plumbed gray water systems can also be built to convey drain water and provide subsurface irrigation to trees and shrubs.

The Stage 4 public message is as follows:

"Due to continuing deterioration in storage and overall scarcity of available supply, all customers, residential and business alike, are now unavoidably subject to water rationing. The current water shortage is among the most severe ever faced in modern times. We must all continue to conserve water to the maximum extent possible and strive to maintain water use within our established rationing limits as long as the drought endures in order to avert a water crisis."

Table 3-13. Stage 4 Severe Water Shortage Emergency Response Measures

System-wide Reduction Goal: 25-35% 3.0 to 4.2 mgd
Demand Reduction Measures: • Reduce residential water allocations • Institute water rationing for commercial customers • Minimize water use by large landscape customers – only for most valuable plant and tree survival • Prohibition on lawn/turf irrigation and on installation of new landscaping in new development • Prohibition on on-site vehicle washing, including dealer lots, company fleets • Rescind hydrant and bulk water permits, prohibit use except by special permission **Publicity/Communications** • Contract with outside advertising agency to carry out major publicity campaign • Continue to provide regular media briefings, manage media coverage • Provide regular information reports to Water Commission, City Council and other agencies • Publish daily consumption graph in all local newspapers • Prepare public notice regarding possible service connection moratorium • Publish information on ways to minimize most valuable landscape damage and loss, including promote appropriate use of gray water **Operating Actions** • Scale up administrative appeals staff and increase frequency of hearings • Expand water waste enforcement to 24/7

- Delegate field staff to assist in enforcement (shut offs, flow restrictors)
- Open separate, centralized drought information center
- Hire temporary staff to conduct conservation training
- Continue all applicable operating actions listed under Stage 3
- Increase frequency of monitoring and reporting of water production and consumption
- Undertake contingency planning for continuing/escalating shortage
- Revise Department operating budget to address revenue shortfall
- Defer portions of capital improvement program
- Consider surcharges, rate changes

3.4.5 Stage 5 – Critical Water Shortage Emergency

Stage 5 represents an imminent and extraordinary crisis threatening health, safety, and security of the entire community. Under this dire situation, extreme measures are necessary to cut back water use by up to half the normal amount. Not enough water would exist even to meet the community's full health and safety needs, the top priority. All water should be reserved for human consumption, sanitation, and fire protection purposes and any remaining amount allocated to minimize economic harm. A shortage of this severity could be expected to generate stress, confusion, and chaos much the same as any major emergency and at some point could transform into a full blown natural disaster that can no longer be governed by local ordinance and may need to be managed by the same basic principles and command structure under the state Standardized Emergency Management System that other natural disasters are. The City has experienced water shortages in the past but never one of such large proportion.

This fifth stage would involve nothing less than rationing all customer groups and instituting a prohibition on residential outdoor use for any reason (e.g., garden, car-washing, cleaning, maintenance, etc.) It may also require shutting down or severely restricting use at certain public facilities, like local parks and school play fields. Some businesses may be forced or required to either partially or completely close.

The planned response for a shortage of this magnitude would involve reducing rationing allocations for residential customers to minimal levels and reducing commercial rationing amounts in accordance with their overall allocation. All outdoor irrigation would be prohibited (other than by hand-held container and what has been captured or collected from another non-prohibited use). No water would be available for public showers or private, community, or public pools and hot tubs. These facilities likely would be forced to close.

A shortage of this magnitude could affect other local water suppliers as people substitute normal activities, such as laundry, showers, etc. from their home to other locations not so affected. The City's response would therefore involve greater coordination at a regional and perhaps even statewide level.

The Stage 5 public message is as follows:

"The City of Santa Cruz is confronted with a critical water shortage emergency of unprecedented proportions. At this time, there exists barely enough drinking water for the most essential human health, sanitation, and safety needs. As a result, all outdoor watering is now prohibited. We understand the hardship this extraordinary condition poses to every resident and business in the City and appreciate the sacrifices people are making to ensure that water system does not run dry. Everyone is urgently requested to do whatever necessary to maintain water use within or below their allotted amount."

Table 3-14. Stage 5 Critical Water Shortage Emergency Response Measures

System-wide Reduction Goal: 35-50% 4.2 to 6.0 mgd
Demand Reduction Measures: • Further reduce residential water allocations • Reduce commercial water allocation • Prohibit all outdoor irrigation • No water for outdoor washing or recreational purposes; close pools, public showers • Continue all measures initiated in prior stages as appropriate **Publicity/Communications** • Contract with crisis/emergency communications consultant to develop crisis communications plan and major publicity campaign • Assign Public Information Officer to communicate with media • Set up emergency notification lists for medical/dental facilities, public facilities, large users, food and beverage facilities, and critical businesses • Promote appropriate use of gray water for reuse

Operating Actions

- Consider shifting to EOC model of command management for overall policy guidance and coordination
- Coordinate with CA Dept of Public Health, District Engineer and other emergency response agencies regarding water quality, public health issues
- Coordinate with law enforcement agencies to address enforcement challenges
- Continue water waste enforcement 24/7
- Delegate field staff to assist in enforcement (shut offs, flow restrictors)
- Continue all applicable operating actions listed under Stage 4
- Coordinate with local sanitation agencies regarding sewer line maintenance
- Continue close monitoring and reporting of water production and consumption
- Investigate potential for reduced in-stream release
- Procure resources to utilize dead storage, if needed
- Undertake emergency planning for continuing/escalating shortage

3.5 Enforcement, Exceptions, and Appeals

An important part of a water shortage plan is to have the appropriate authority and a combination of methods to enforce mandatory measures such as water restrictions or rationing in order to protect public health and safety. General authority and powers of the City to enforce ordinances is contained in Chapter 4 of the Santa Cruz Municipal Code. In addition, the City's water shortage ordinance contains specific language regarding enforcement of water use rules and regulations and includes provisions for issuing exceptions and hearing appeals. These provisions were reviewed by staff and the Water Commission, which put forth several recommendations to be incorporated into the updated water shortage ordinance.

3.5.1 Enforcement Methods

Enforcement is carried out in a number of ways during a water shortage. In cases such as a report of water waste, the first step is to communicate with the customer by telephone, letter, door tag, or by making personal contact in the field to educate them about regulations. Many times this contact is all that is required to get the problem resolved. If not, enforcement progresses to a written notice of violation. Beyond this, there are several methods in the City's existing water conservation and water shortage ordinances that can be used to enforce water restrictions and rationing regulations. These methods are described below.

Penalty fees This method would apply in situations involving violation of water restrictions, if, after multiple warnings had been given, a violation continued to occur at an account. The fee would be added to a customer's utility bill along with a written notice sent to the customer in advance. The penalty fee would increase with subsequent violations, as follows:

1st Violation $100
2nd Violation $250
3rd Violation $500
4th Violation $1,000

The Water Commission recommended that additional, higher penalty fees also be established and applied to large users that willfully violate water restrictions.

Excess use fees Excess use fees are the primary method for enforcing water rationing and are imposed on customers whose water use exceeds their allocation when rationing is in effect. The purpose of the excess use fee is to make the consequences of exceeding one's rationing allocation so severe that the customer is induced to keep their water use within their allocation and avoid being fined. Like water rates, there are two components to setting excess use fees: 1) the way they are structured, and 2) the dollar amount.

Staff and the Water Commission looked at several models from other agencies and recommend maintaining the same excess use fee structure as in the existing water shortage ordinance, for billing reasons and for clarity in communicating penalties to the public. It is, however, recommended that the penalty amount be increased to bring it more in line with current rates, as shown below:

Table 3-15. Proposed Excess Use Fees

Excess Use Range	Percent of water used in Excess of Allotment	Excess Use Charge per 100 Cubic Feet for all Water Used in Excess of Allotment (in addition to ordinary water consumption charges)
A	0% to 10% over allotment	$25.00
B	More than 10% over allotment	$50.00

For example, in Table 3-11 above, a 4-person household is provided an allocation of 11 CCF per month in Stage 3. At 2008 rates, the normal water charges for an inside city customer using 11 CCF would total $51.37, including the $16.58 readiness-to-serve charge for a 5/8” meter. Under water rationing, if that same customer used 18 CCF, their normal water charges would amount to $92.88, and excess use fees would cost $325 (1 ccf @$25 and 6 ccf @ $50), for a total of $417.88.

The purpose of a two-tier excess use structure is to avoid very large penalties for households that make a good faith effort to stay within their allocation but wind up going over a little. If a customer’s water use exceeds one’s allocation by a large amount, though, the penalty should be very steep.

Flow restriction Some customers will continue to exceed their allotment regardless of the amount of their water bill. In such instances, the Water Department is authorized to install a flow restricting device to provide minimal water flow, just enough for health and safety purposes. In these cases the customer is charged a fee to cover the staff time needed to install the flow restrictor and another fee for its removal. The Water Department would not use this method where fire suppression sprinklers are on the same supply line as domestic water.

Disconnection/reconnection fees Water suppliers have the legal authority to enforce water shortage regulations by terminating service for egregious violations. In such cases, the customer would be charged for both disconnection and reconnection.

Citation Finally, the City’s water shortage ordinance authorizes staff to issue citations that would have to be paid or challenged in court. This method could be used in cases like a multifamily property where terminating service or restricting flow to all households may not be an option.

3.5.2 Exceptions

No water shortage plan can account for all situations. The exception procedure allows the Water Department to provide for special or exceptional circumstances that otherwise would create undue hardship for an individual customer or class of customers.

An exception allows a customer to be relieved of a particular regulation or receive an increased allocation for the duration of the shortage. Therefore, it should be granted only when justified on specific grounds that warrant allocating more water than other similarly situated customers and when consistent with the intent of the water shortage regulations, while providing equal treatment of all customers.

The City's existing ordinance includes an exception process. Some of its features are as follows:

- Under water restrictions, an exception application is not accepted unless the customer alleges unfair treatment.
- Under water rationing, an exception application is not accepted unless an excess use fee has been assessed.
- Leaks do not qualify for an exception.
- It allows a resident who is not an account holder to force the customer of record to appeal.
- The process is administered by the Water Director.

This policy is to make the customer first demonstrate the demand reduction efforts taken to meet the restriction or allocation, and places responsibility for managing and monitoring water use on the customer, where it belongs. It also serves to minimize the number of exception applications from those merely seeking more water without having gone to the effort to try to live within their given allocation.

Recommendations Regarding Exceptions

It is recommended that the updated water shortage contingency ordinance be amended to include a process that requires the Director make a formal finding to authorize an exception. This change is proposed to better articulate the standard that must be met in order to receive relief. The suggested language for such findings is as follows:

- Failure to do so would cause a condition affecting the health, sanitation, fire protection, or safety of the applicant or the public;

- Strict application of the allotment provisions imposes a severe or undue hardship on a particular business, or render it infeasible for a business or class of business to remain in operation;

- Alternative restrictions which achieve the same level of demand reduction as the restrictions from which an exception is being sought are available and are binding and enforceable;

- The customer has demonstrated to the Director's satisfaction that circumstances have changed warranting a change in the customer's allocation.

- Hospitals and health care facilities using industry best management practices are eligible for an exception.

- Demonstration by a business of actions already taken to increase environmental sustainability that have reduced water consumption to the maximum extent feasible, as determined by the Water Director.

Additional recommendations regarding the exception process are as follows:

- That the denial of an exception may be appealed to an Appeals Board;

- The Department adopt administrative procedures similar to those used by the City of Tampa Bay for including appropriate information on an exception application, including the requirement that the applicant must demonstrate maximum practical reduction in water consumption;

- That a policy be added allowing the Director to impose conditions requiring long-term water efficiency changes from customers as part of the exception process.

3.5.3 Appeals

The City's existing ordinance allows any water service customer who considers an enforcement action to have been erroneously undertaken to appeal their case before a City Council appointed ad hoc Drought Appeals Board. The Appeals

Board considers the evidence presented by the customer and decides whether to uphold the enforcement action or to provide relief.

The difference between an exception and an appeal is that an appeal gives an individual the opportunity to challenge an official decision about an enforcement action. It is not the primary means to secure a larger allocation or get an exception to a water use regulation. However, as mentioned above, customers should be able to appeal a denial by the Water Director of such an exception request to the Appeals Board.

From past experience, the most common reason for filing an appeal was to contest large excess use fees that were levied while under water rationing, often due to a leak in the customers' plumbing fixture or system. This resulted in a large and difficult backlog of cases for the Appeals Board. The Water Department would continue to follow its existing water leak rebate policy that provides administrative relief, including forgiveness of excess use fees, for certain types of leaks that are considered to be beyond the customer's control, such as a leak that develops in an underground pipeline serving a property. Common maintenance items, such as a leaking toilet or failing automatic irrigation valve, that are considered to be customer's responsibility to control, are not eligible for such forgiveness.

One feature of the existing ordinance was to allow a resident who is not a customer of record to force the account customer to appeal the excess water use fee. The ordinance also allowed a customer to request to use a portion of the excess use fee, on a one-time only basis, toward the installation of water conservation equipment in lieu of paying it to the Water Department.

Recommendations Regarding Appeals

It is recommended that the provisions included in the existing ordinance regarding appeals be continued. The Water Commission felt that a formal Appeals Board would not need to be convened until Stage 3, and felt it could serve in that capacity instead during the early stages (1 and 2), if necessary. Furthermore, as an alternative enforcement approach, we recommend adding a new process that would provide one-time forgiveness of excess use charges while under water rationing. To be considered for such forgiveness, the customer would be required to sign up and complete a short weekend or evening course covering basic meter reading, leak detection, and other topics relevant to the water restrictions in place at the time. This approach (like traffic school) would help reduce the number cases heard by the Appeals Board, provide financial relief to customer receiving the high bill, and most importantly, would give them the opportunity, education, and tools they need to achieve ongoing compliance with water use rules and regulations for the remainder of the shortage.

3.6 Water Shortage Recovery and Plan Termination

A water shortage ends when local rainfall, runoff, and reservoir storage levels improve to the point where the water system is once again capable of supporting unrestricted water demand. Any water use rules and regulations in effect at the time are officially rescinded by City Council and public notice is given that the water shortage is over. The Water Director would then oversee any remaining termination and plan review activities. These activities could include:

- Publicize gratitude for the community's cooperation
- Restore water utility operations, organization, and services to pre-event levels
- Document the event and response and compile applicable records for future reference
- Continue to maintain liaison as needed with external agencies
- Collect cost accounting information, assess revenue losses and financial impact, and review deferred projects or programs
- Debrief staff to review effectiveness of actions, to identify the lessons learned, and to enhance response and recovery efforts in the future
- Complete a detailed evaluation of affected facilities and services to prepare an "after action" report
- Update the water shortage contingency plan as needed.

Section 4 IMPLEMENTATION

This section describes the essential elements of implementing the updated Water Shortage Contingency Plan and discusses the approximate lead time needed to prepare for and activate a demand reduction program. The elements discussed below differ in the amount of staff time, effort, priority, and funding that is required for implementation; some steps can be taken relatively quickly and inexpensively while others will require substantial ongoing work and expense before they are able to be set up and applied as shortage management tools. The primary purpose of this section is to map out the major tasks and timelines required to implement the demand reduction program described in Section 3 and to identify where additional ongoing efforts are necessary to address critical gaps.

4.1 Timeline for Declaring Water Shortage

The table below indicates the approximate times of the year when the City evaluates water supply conditions and, if necessary, declares a water shortage. Planning for a water shortage may begin earlier in winter, and should commence early if conditions that winter are unusually dry or are preceded by a dry year, but it is not usually until the end of March that the water supply outlook for the year ahead becomes certain. This leaves very little lead time to prepare for implementing the water shortage contingency plan.

Table 4-1. Calendar for Declaring Water Shortage

Target Date	Action
Months of Oct -Dec	Monitor rainfall, reservoir level, and runoff amounts
Late January	Prepare written status report on water supply conditions
Early February	Present initial estimate of water supply availability for year ahead
Early March	Present revised estimate of water supply availability for year ahead
Mid-March	SCWD announces existence of water shortage (if applicable)
Mid to late March	SCWD determines monthly water production budget and need for voluntary or mandatory response.
Early April	Present shortage response recommendation to Water Commission; notice of public hearing published
Mid-April	City Council formally declares water supply shortage, adopts emergency ordinance
Mid to late April	Water shortage regulations become effective

Long-range weather forecasting has not yet advanced to the point where it is possible to know in advance with certainty whether the City will experience a water shortage. Therefore, it is not practical to plan more than one season at a time, other than to prepare possible scenarios using multiple dry years for modeling purposes.

4.2 Process for Declaring Water Shortage

Once the water shortage condition has been defined (as soon as reasonably certain), recommendations regarding water shortage rules and regulations consistent with this contingency plan are discussed with the City Water Commission. Monthly Water Commission meetings serve as a public forum for discussing water conditions and for hearing issues associated with implementation of the water shortage ordinance throughout the entire duration of the water shortage event.

Following consideration by the Water Commission, formal action declaring a water shortage is taken by City Council. The legal requirements for such action are covered in Section 350 et.seq. of the California Water Code. The code requires the following process be followed:

- That City Council hold a public hearing on the matter;
- That the public hearing be properly noticed (minimum of publishing once in newspaper at least seven days prior to the date of the hearing);
- Upon determining and declaring the existence of a water shortage, City Council may then adopt regulations and restrictions governing the use and delivery of water.

In accordance with Municipal Code section 16.04.480, rules adopted by the City Council establishing water use regulations become effective immediately after their publication in a newspaper of general circulation published in the City of Santa Cruz.

4.3 Public Notification and Coordination

Even before formal declaration of a water shortage, a public information/media program should be activated to provide customers with as much advance notice as possible. Following Council action, all residents and businesses, not just customers of record, would need to be provided notice of water shortage rules and regulations via a variety of media and communications methods, including print and television media, internet, and other methods. The timeline for getting information out to the public on television, radio, and through newspaper articles is very short. Additional notification would occur though the City's utility newsletter, which requires a longer lead time of six to eight weeks to produce and mail. It is also recommended that a separate website be designed in advance if rationing becomes necessary to provide basic information about the program, conservation information, forms related to the program, contact information, etc., which then can be modified and expanded as necessary. Large water users and those businesses that are most likely to be seriously affected should be contacted directly in writing. Public notification will be provided in Spanish language for non-English speakers.

Coordination with other City departments and other public agencies can begin prior to formal declaration of a water shortage and can be accomplished through regular meetings, e-mail group updates, and presentations.

Getting the public involved and keeping them informed will require a significant expansion of existing water conservation public information and outreach efforts. Contracting with an advertising agency to assist with a communications campaign and mass media advertising is one way to expand outreach efforts quickly. A substantial amount of printed information on how to conserve water during a water shortage has already been developed and tailored to various types of water customers and is available for immediate use.

4.4 Personnel, Office Space, and Equipment

The estimated additional staff needed to carry out this contingency plan is shown below in Table 4-2. Program staff may consist of existing staff reassigned from regular duties in the Water or other City departments, new limited-term employees, interns, or some combination of the above.

The role of the administrative and office assistants would be to help with the processing of customer appeal and exception requests, administration of the appeals board meetings, and related correspondence. The field utility representatives would be responsible for patrolling the service area for violations of watering rules and restrictions and public contact, while the office utility representatives would deal with the greatly increased customer contact (in person and by telephone) and would help with utility billing issues. The meter technician's role would be to support the additional customer service workload related to verifying meter reads, data-logging, and other field activities. The water conservation representative's role would be to assist customers with on-site water audits, provide conservation education, and publicity. Distribution personnel (or possible contractor) would provide leak detection and repair services as well as functions related to meters and flow restriction. The programmer analyst position would provide utility billing system software services when water rationing is in effect.

Table 4-2. Potential Additional Staff Positions

Section/Position	Water Shortage Stage:			
	2	3	4	5
Water Administration:				
105 Administrative Assistant I		1	1	2
Customer Services:				
199 Utility Service Representative (field)	1	2	4	6
199 Utility Service Representative (office)	1	2	3	4
212 Water Meter Technician		1	1	1
333 Utility Supervisor				1
Water Conservation:				
208 Water Conservation Representative	1	2	2	3
Water Distribution:				
209 Water Distribution Worker	1	2	2	2
Other Temporary:				
229 Programmer Analyst II		1	1	1
914 Office Assistant			1	2
Total Positions	4	11	15	22
Estimated personnel costs* ($000)	$113	$324	$425	$622

**assuming seven months, including overhead*

The timeline associated with recruiting and hiring new or additional staff varies from several weeks to several months depending on the type of employment opportunity, whether there is an existing recruitment list to draw from, or whether a new job announcement would need to be advertised.

Any newly hired staff would need to be quickly integrated into the organization with basic training in the following areas:

- Water Department functions, organization, facilities, and service area boundary,
- Customer service standards, City policies, and safety responsibilities,
- Computer equipment and the utility billing system,
- Water rates and charges and meter reading,
- Water shortage regulations and enforcement processes.

In addition, all existing Water Department personnel would need to understand water shortage rules and regulations in effect at the time to be able to respond to customer questions wherever they may come into contact with the public on the job.

Additional staff, particularly during stages when rationing is in effect, means expanded office space and additional equipment also would be needed to carry out office and field functions. Even though the Water Department recently moved to a new, larger office, the Customer Service section of the office is currently unable to accommodate any additional office personnel. The Water Department office would need to be reconfigured or new temporary workspace acquired, or vacant storefront property rented. In addition, the Water Department would need to purchase or lease the following equipment:

<u>Office personnel:</u>

- Furniture
- Telephones
- Computers

<u>Field personnel:</u>

- Automobiles
- Cell phones
- Digital cameras

4.5 Effect of Water Shortages on Revenue

One of the negative consequences of using demand reduction to deal with water shortages is the corresponding reduction in revenue that occurs to the City's Water Fund as a result of reduced water sales. To better understand the magnitude of revenue losses that the Water Fund might experience, a spreadsheet model was developed based on 2007 calendar year revenues, the most recent year for which complete revenue data is available. The model assumes the "ready-to-serve" or fixed monthly service charge that is based on meter size would remain unaffected while the volumetric portion of the Department's revenue derived from water sales would vary by customer class in accordance with the allocation presented in Table 3-6 over the seven month period in which water shortage regulations are likely to be in effect. Results are summarized in Table 4-3.

Table 4-3. Revenue Losses Associated with Various Water Shortages

	2007 Revenue ($000)			Revenue Losses due to Reduced Water Sales ($000):				
Customer Category:	From service charges	From water sales	Total	Stage 1 (5%)	Stage 2 (15%)	Stage 3 (25%)	Stage 4 (35%)	Stage 5 (50%)
Single Family Residential	3,770	6,027	9,797	-229	-687	-1,236	-1,740	-2,381
Multi-Family Residential	1,069	3,742	4,810	-126	-329	-556	-784	-1,137
Business	917	3,207	4,124	-111	-111	-177	-288	-665
UC Santa Cruz	99	1,022	1,121	-33	-99	-158	-224	-317
Other Industry	44	130	174	-4	-4	-8	-13	-28
Municipal	149	301	450	-13	-62	-112	-153	-187
Irrigation	234	682	916	-29	-207	-379	-505	-574
Golf	32	581	614	-27	-148	-268	-361	-437
Coast	34	36	70	-1	-1	-3	-4	-9
Other	19	43	62	-1	-1	-3	-13	-13
Total 2007 Revenue	**$6,366**	**$15,770**	**$22,137**					
Total Revenue Losses				-$575	-$1,649	-$2,900	-$4,085	-$5,749
Estimated Net Revenue				**$21,562**	**$20,488**	**$19,236**	**$18,051**	**$16,388**

Table 4-3 shows revenue losses ranging from just under $0.6 million in a 5 percent water shortage situation to almost $5.8 million in a critical 50 percent water shortage. Compared to 2007 revenues of just over $22 million, the Department's net revenue would be reduced to approximately $21.5 million in Stage 1 to less than $16.4 million in Stage 5. These estimates of losses are ballpark figures only and probably underestimate the problem. Actual losses would be different for the following reasons:

- The spreadsheet did not model the effect of tiered pricing in the single family residential category, which would exacerbate revenue losses from this group;

- It is unlikely that system water use would immediately recover to normal levels in the months following a period of curtailment as modeled, thereby further depressing income;

- The table above does not include added operating costs of staff, equipment, and materials related to the water shortage response.

On the other hand, the time of year in which regulations would take effect includes parts of two fiscal years, so the full effect of revenue losses would not impact the Department's annual budget to such a large degree. In addition, there would be relatively minor cost savings associated with reduced power and chemical usage at the Graham Hill water treatment plant, ranging from <$0.1 million in Stage 1 to about $0.4 million in Stage 5. Finally, some of the revenue loss would be offset by penalty and/or excess use fees.

Whatever the situation, one element of implementing this Water Shortage Contingency plan involves examining the Water Department's proposed budget for the coming year and recommending action(s) to lessen or overcome the revenue shortfall. Options include the following:

- Tapping into the Department's Rate Stabilization Fund (currently $2.2 million)
- Deferring planned capital improvements
- Considering possible rate adjustments or surcharges

As a matter of policy, since the City's Integrated Water Plan anticipates occasional water shortages of up to 15 percent, it is recommended that the Rate Stabilization Fund be maintained at least at a level that would fully mitigate expected revenue losses associated with that level of shortfall. The Rate Stabilization Fund would now fully cover the losses of a 15 percent shortfall lasting one year, but may need to be increased in the future, either to keep pace with expected revenue losses, or to mitigate revenue losses from water shortages lasting more than a single year.

Another implementation issue associated with pricing is the Proposition 218 procedure for increasing water rates, fees, and charges. It is assumed that the proposed changes to both penalty fees and excess use fees discussed in Section 3 would require written notice to all customers, a public hearing, and consideration of written protests and comments before implementing the new fees. Given the minimum 45 day protest period, the entire Prop 218 process can take several months to complete.

4.6 Household Survey

To implement water rationing for single residential customers in Stages 3 through 5, it is recommended that the City of Santa Cruz use the system developed by Goleta Water District in lieu of performing a household census or survey. The advantages are that it is simpler, easy to understand, more likely to be feasible with the new utility billing system, avoids having to perform a household survey or census, allows adjustments for larger households, and achieves the fundamental goal of reducing peak season water use, particularly outdoor use . Goleta also required that, for households larger than four, certain efficiency steps be taken before authorizing a larger allocation.

For the majority of households that have fewer than four residents, little opposition to this approach is expected. However, the one downside to this approach is that it does afford somewhat unequal amounts of water on a per person basis to households of different sizes, and so some may object to the City adopting this system. If, based on public input, a true per capita rationing system becomes the preferred approach to ration water instead of the Goleta model, the following describes the work involved to update the number of people residing at each account on the billing system. In the past this survey has been done by mail and is based fundamentally on the honor system. There are currently over 18,700 accounts classified as single residential customers on the water system. This task would involve data processing personnel to prepare data files for mailing, a mailing service vendor to provide printing and mailing services and to provide return envelopes, and two additional temporary staff to handle data input. The task would also involve maintaining census data on a daily basis as household sizes change and new utility accounts are established. The estimated cost for postage and services related to performing such a survey is about $20,000, not counting data entry. The lead time necessary to conduct the survey and enter data is approximately 3 months.

The other major work item involved in a census-based approach to rationing involves configuring the utility billing system to calculate allotments based on household size, discussed below.

4.7 Utility Billing/Data Processing Capabilities

Implementing this Water Shortage Contingency Plan will require utility billing system software that provides the necessary capabilities and flexibility to quickly shift from normal billing practices to water rationing mode. To manage a water shortage as outlined in this plan, the billing system must eventually be able, at a minimum, to do the following:

- Integrate penalty fees into the utility bill,
- Change billing frequency, as needed, to monthly from bimonthly for outside City customers,
- Calculate rationing allocations, whether determined by per capita, per dwelling unit, or percentage of past use method,
- Maintain long-term water usage history,
- Calculate excess use fees,
- Address special needs customers (overwrite default allocation to handle rationing exceptions),
- Handle special cases, such as multiple meters serving a single property,
- Calculate seasonally varying landscape water budgets.

In addition, the utility bill format and the data files that are generated to create the utility bills must be modified to incorporate water restrictions, water budgets, and rationing requirements.

The newly installed EDEN utility billing module appears to be able to handle the type of computations needed to implement both the Goleta rationing model for single family residential customers and the per dwelling unit method for multi-family accounts. It currently <u>does not</u> have the capability or flexibility to handle a census-based approach to rationing, large landscape water budgets, or commercial water rationing which is based on some percentage of past use. Acquiring this capability is a top priority but it will have to be custom developed over time. The Customer Service Manager indicates that such programming would likely take in excess of one year to complete. The Department's FY 09 budget includes $25,000 for utility billing software development expenses.

4.8 Customer Exceptions and Appeals

One of the actions that is triggered when City Council adopts the water shortage ordinance is the establishment of an Appeals Board. Part of implementing this plan involves providing administrative support to the Appeals Board, including processing requests, preparing recommendations, posting agendas, attending meetings, preparing meeting minutes, and handling correspondence. After the Board's membership has been established and approved by City Council, the Appeals Board function can be implemented quickly, but depending on the stage of water shortage and number of appeals filed, may require substantial staff time over the course of the water shortage to address the resulting caseload.

4.9 Large Landscape Water Budgets

The next major work priority scheduled for the City's Water Conservation Office involves implementing a large landscape program. The program will consist of developing water budgets for over 400 large landscape sites served by dedicated irrigation meters, offering water audits, and supporting activities (financial incentives, education, and possible separation of large landscapes currently on mixed use meters). These programs have a long development time (1-2 years) due to the need to measure landscape areas, differentiate among plant materials, and integrate water budget data into the billing system. This latter task requires changing the bill design and layout to show water budget information and tying performance relative to the water budget to water pricing. The project will be designed so that water budgets can be quickly adapted for use as a water shortage management tool in Stages 2-5. If the City were confronted with a water shortage before large landscape water budgets and budget based pricing could be implemented, however, alternative methods to curtail water in the large landscape sector would have to considered.

4.10 Monitoring Water Supply and Demand

Under normal water supply conditions, water production and gross consumption are recorded daily and monthly by treatment plant operators and reported to the Production Superintendent. Metered water consumption is reported on a monthly basis through automated sales reports generated by the utility billing system.

During a water shortage, a monthly production forecast and budget are developed for each source of supply. Actual production and the lake level are closely monitored on a daily and weekly basis to verify that the budgeted goals are being met. Consumption by large users is monitored on a frequent basis. In severe stages of a water shortage, production and consumption data would be evaluated daily and the status reported to the Water Director's office. If the trend in consumption is such that the rate of drawdown at Loch Lomond is greater than anticipated, the City Manager and Council are notified so that corrective action (such as increased publicity and enforcement or consideration of declaring the next higher stage) can be taken.

An example of a monthly water supply and demand monitoring report is presented in Appendix F.

4.11 Ongoing Implementation Steps

The final tasks in updating the City's Water Shortage Contingency Plan include the following steps:

- Involving the community and soliciting public review and input on this document;
- Finalizing and presenting the plan to City Council for adoption;
- Preparing an updated water shortage ordinance;
- Preparing and mailing a Proposition 218 notice about proposed changes to penalty and excess use fees.

As far as critical gaps that require ongoing work, the most important recommendations are to:

1. Continue to work on the new utility billing system so that the database is able to meet the City's requirements for use in water rationing if it becomes necessary, and

2. Focus on developing the large landscape program so that water budgets described above can be used to professionally manage large irrigation accounts the next time a water shortage arises.

3. As much as possible, prepare water shortage notices, announcements, materials, and mailing lists in advance, including bilingual materials for non-English speakers.

Appendices

Appendices

Appendix A

California Water Code Sections 350-359 and 10632

Water Code Section 350-359

350. The governing body of a distributor of a public water supply, whether publicly or privately owned and including a mutual water company, may declare a water shortage emergency condition to prevail within the area served by such distributor whenever it finds and determines that the ordinary demands and requirements of water consumers cannot be satisfied without depleting the water supply of the distributor to the extent that there would be insufficient water for human consumption, sanitation, and fire protection.

351. Excepting in event of a breakage or failure of a dam, pump, pipe line or conduit causing an immediate emergency, the declaration shall be made only after a public hearing at which consumers of such water supply shall have an opportunity to be heard to protest against the declaration and to present their respective needs to said governing board.

352. Notice of the time and place of hearing shall be published pursuant to Section 6061 of the Government Code at least seven days prior to the date of hearing in a newspaper printed, published, and circulated within the area in which the water supply is distributed, or if there is no such newspaper, in any newspaper printed, published, and circulated in the county in which the area is located.

353. When the governing body has so determined and declared the existence of an emergency condition of water shortage within its service area, it shall thereupon adopt such regulations and restrictions on the delivery of water and the consumption within said area of water supplied for public use as will in the sound discretion of such governing body conserve the water supply for the greatest public benefit with particular regard to domestic use, sanitation, and fire protection.

354. After allocating and setting aside the amount of water which in the opinion of the governing body will be necessary to supply water needed for domestic use, sanitation, and fire protection, the regulations may establish priorities in the use of water for other purposes and provide for the allocation, distribution, and delivery of water for such other purposes, without discrimination between consumers using water for the same purpose or purposes.

355. The regulations and restrictions shall thereafter be and remain in full force and effect during the period of the emergency and until the supply of water available for distribution within such area has been replenished or augmented.

356. The regulations and restrictions may include the right to deny applications for new or additional service connections, and provision for their enforcement by discontinuing service to consumers willfully violating the regulations and restrictions.

357. If the regulations and restrictions on delivery and consumption of water adopted pursuant to this chapter conflict with any law establishing the rights of individual consumers to receive either specific or proportionate amounts of the water supply available for distribution within such service area, the regulations and restrictions adopted pursuant to this chapter shall prevail over the provisions of such laws relating to water rights for the duration of the period of emergency; provided, however, that any distributor of water which is subject to regulation by the State Public Utilities Commission shall before making such regulations and restrictions effective secure the approval thereof by the Public Utilities Commission.

358. Nothing in this chapter shall be construed to prohibit or prevent review by any court of competent jurisdiction of any finding or determination by a governing board of the existence of an emergency or of regulations or restrictions adopted by such board, pursuant to this chapter, on the ground that any such action is fraudulent, arbitrary, or capricious.

359. (a) Notwithstanding any other provision of law that requires an election for the purpose of authorizing a contract with the United States, or for incurring the obligation to repay loans from the United States, and except as otherwise limited or prohibited by the California Constitution, a public water agency, as an alternative procedure to submitting the proposal to an election, upon affirmative vote of four-fifths of the members of the governing body thereof, may apply for, accept, provide for the repayment together with interest thereon, and use funds made available by the federal government pursuant to Public Law 95-18, pursuant to any other federal act subsequently enacted during 1977 that specifically provides emergency drought relief financing, or pursuant to existing federal relief programs receiving budget augmentations in 1977 for drought assistance, and may enter into contracts that are required to obtain those federal funds pursuant to the provisions of those federal acts if the following conditions exist:

(1) The project is undertaken by a state, regional, or local governmental agency.
(2) As a result of the severe drought now existing in many parts of the state, the agency has insufficient water supply needed to meet necessary agricultural, domestic, industrial, recreational, and fish and wildlife needs within the service area or area of jurisdiction of the agency.

(3) The project will develop or conserve water before October 31, 1978, and will assist in mitigating the impacts of the drought.
(4) The agency affirms that it will comply, if applicable, with Sections 1602, 1603, and 1605 of the Fish and Game Code
(5) The project will be completed on or before the completion date, if any, required under the federal act providing the funding, but not later than March 1, 1978.

(b) Any obligation to repay loans shall be expressly limited to revenues of the system improved by the proceeds of the contract.

(c) No application for federal funds pursuant to this section shall be made on or after March 1, 1978.

(d) Notwithstanding the provisions of this section, a public agency shall not be exempt from any provision of law that requires the submission of a proposal to an election if a petition requesting such an election signed by 10 percent of the registered voters within the public agency is presented to the governing board within 30 days following the submission of an application for federal funds.

(e) Notwithstanding the provisions of this section, a public water agency that applied for federal funds for a project before January 1, 1978, may make application to the Director of the Drought Emergency Task Force for extension of the required completion date specified in paragraph (5) of subdivision (b). Following receipt of an application for extension, the Director of the Drought Emergency Task Force may extend the required completion date specified in paragraph (5) of subdivision (b) to a date not later than September 30, 1978, if the director finds that the project has been delayed by factors not controllable by the public water agency. If the Drought Emergency Task Force is dissolved, the Director of Water Resources shall exercise the authority vested in the Director of the Drought Emergency Task Force pursuant to this section.

(f) For the purposes of this section, "public water agency" means a city, district, agency, authority, or any other political subdivision of the state, except the state, that distributes water to the inhabitants thereof, is otherwise authorized by law to enter into contracts or agreements with the federal government for a water supply or for financing facilities for a water supply, and is otherwise required by law to submit those agreements or contracts or any other project involving long-term debt to an election within that public water agency.

Water Code Section 10632

10632. The plan shall provide an urban water shortage contingency analysis which includes each of the following elements which are within the authority of the urban water supplier:

(a) Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions which are applicable to each stage.

(b) An estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply.

(c) Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.

(d) Additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.

(e) Consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply.

(f) Penalties or charges for excessive use, where applicable.

(g) An analysis of the impacts of each of the actions and conditions described in subdivisions (a) to (f), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.

(h) A draft water shortage contingency resolution or ordinance.

(i) A mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.

Appendix B

Cities and Agencies whose Water Shortage Contingency Plans or Ordinances were Reviewed

Alameda County Water District

Contra Costa Water District

Denver Water, Colorado

East Bay Municipal Utilities District (EBMUD)

El Paso Water Utilities, Texas

Marin Municipal Water District

Monterey Peninsula Water Management District

New York City, New York

Salt Lake City Department of Public Works, Utah

San Diego County Water Authority

San Francisco Public Utilities Commission (SFPUC)

San Luis Obispo, City of

Santa Barbara, City of

Santa Monica, City of

Santa Rosa, City of

Seattle Public Utilities, Washington

Sonoma County Water Agency

Southern Nevada Water Authority, Nevada

St. Helena, City of

Tampa, Florida, City of

Yuba City, City of

Appendix C

Exceedance Probabilities for San Lorenzo River at Felton

Month	Exceedence Probability	Wet	Normal	Dry	Critically Dry		Month	Exceedence Probability	Wet	Normal	Dry	Critically Dry
Jan.	100	120	34.2	13.8	20.5		Feb.	100	126	75.7	20.9	16.6
	90	244	56.4	28.6	22.4			90	218	102	34.9	21.6
	75	386	92.2	35.2	30.6			75	337	123	63.2	25.3
	50	656	181	57.3	35.9			50	637	301	141	47.3
	25	831	271	108	43.3			25	1177	466	220	77.5
	10	1153	600	139	57.5			10	1318	573	256	124.0
Mar.	100	113	70.1	54.9	21.4		April	100	67.9	58.0	36.7	12.3
	90	237	87.7	58.5	22.3			90	106	63.3	42.7	20.6
	75	308	99.9	71.1	28.3			75	140	77.6	43.3	25.5
	50	462	219	126	37.1			50	246	112	60.3	28.9
	25	705	303	197	75.9			25	459	149	70.0	32.8
	10	842	494	229	93.1			10	849	170	75.4	35.5
May	100	43.9	34.5	21.9	11.6		June	100	33.6	23.1	15.4	9.4
	90	65.9	40.2	27.2	15.7			90	42.5	26.1	17.3	11.6
	75	82.1	45.1	27.9	19.9			75	49.0	29.7	19.4	13.3
	50	105	58.5	31.7	21.3			50	60.5	36.1	22.7	14.7
	25	154	72.0	44.3	22.7			25	77.2	44.8	28.5	17.2
	10	185	87.2	77.5	29.4			10	93.0	51.6	34.8	17.8
July	100	24.1	16.5	10.6	6.7		Aug.	100	18.5	12.7	8.4	6.5
	90	25.9	18.2	12.9	8.7			90	21.3	15.4	10.1	8.3
	75	33.2	20.1	13.4	9.8			75	23.0	16.2	11.0	9.2
	50	40.1	24.1	15.5	10.5			50	27.4	18.7	12.0	10.1
	25	46.6	28.8	20.6	12.1			25	34.2	22.3	15.6	10.8
	10	56.7	33.2	23.9	13.2			10	40.2	25.3	18.7	11.5
Sept.	100	16.9	13.6	8.3	8.3		Oct.	100	8.3	9.8	10.1	9.3
	90	19.1	14.1	8.9	8.8			90	12.0	14.4	15.3	11.3
	75	21.1	14.6	10.8	9.3			75	15.7	16.1	17.5	12.7
	50	23.3	16.1	12.5	10.2			50	21.1	21.0	25.4	15.8
	25	26.1	20.0	14.9	10.9			25	28.0	24.6	27.3	23.2
	10	32.9	22.7	16.8	11.5			10	32.1	29.0	28.4	30.0
Nov.	100	12.8	11.8	11.4	14.5		Dec.	100	15.3	24.4	14.7	16.4
	90	22.6	15.2	15.0	18.2			90	52.4	26.7	21.8	22.4
	75	27.0	24.1	20.3	20.9			75	77.3	31.0	28.3	25.4
	50	32.9	36.4	28.1	23.7			50	168	65.1	36.3	33.7
	25	65.7	53.0	67.6	25.3			25	272	238	43.1	53.3
	10	173	73.5	110	34.5			10	501	376	85.5	82.4

Table 1: Exceedence probabilities for San Lorenzo River at Big Trees from 1936-2002 (USGS Gage ID #11160500). Wet, average, dry and drought years are classified by the total flow for the water year (Method A)

Appendix D

Public Agency and Major Customer Contact List

FACILITY	CONTACT NAME(S)	TELEPHONE	Email
Water Districts:			
CA Dept of Public Health	Jan Sweigert	831-655-6939	After hours/emergency 831-236-4311
Soquel Creek Water District	Laura Brown	831-475-8500	
Scotts Valley Water District	Charlie McNeish	831-438-2363	contact@svwd.org
San Lorenzo Valley Water District	Jim Mueller	831-338-2153	jmueller@slvwd.com
County of Santa Cruz/City of Capitola:			
County CAO	Dinah Phillips	831-454-2100	dinah.phillips@co.santa-cruz.ca.us
County Public Health Officer	Poki Namkung	831-454-4000	poki.namkung@co.santa-cruz.ca.us
County Director of Environmental Health	Bob Kennedy	831-454-2022	bob.kennedy@co.santa-cruz.ca.us
County OES	Paul Horvat	831-458-7109	oes014@co.santa-cruz.ca.us
Santa Cruz County Public Works	John Presleigh	831-454-2160	dpwweb@co.santa-cruz.ca.us
Emergency/General Services	Nancy Carr-Gordon	831-454-2714	nancy.gordon@co.santa-cruz.ca.us
NETCOMM	Scotty Douglas	831-471-1000	scotty@sccecc.org
County Safety Officer	Josh Riley	831-454-4820	josh.reilly@co.santa-cruz.ca.us
County Parks	Gretchen Iliff Maintenance Supt.	831-454-7908 Office 831-247-2615 Cell	prc043@scparks.com
County Redevelopment Agency	Anita Kane	831 454-2776	red017@co.santa-cruz.ca.us
City of Capitola	Richard Hill	831-475-7300	rhill@ci.capitola.ca.us
Capitola Public Works	Steve Jesberg	831-475-7300 x217	sjesberg@ci.capitola.ca.us

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Public Agency and Major Customer Contact List

FACILITY	CONTACT NAME(S)	TELEPHONE	Email
Medical Facilities:			
Dominican Hospital Main phone: 462-7700	Tom Bruce	831-462-7550	tbruce@chw.edu
Sutter Main phone: 477-2200	Facilities Office	831-477-2299	
Santa Cruz Medical Clinic Main phone: 423-4111	Brian Crispell Facilities Director	831-227-7110	
University of California, Santa Cruz:			
Campus Dispatch		831-459-4856	
Physical Plant (Non-Emergency)	Jim Dunne	831-459-4444	jfdunne@ucsc.edu
Physical Planning and Construction	Dean Fitch	831-459-4936	drfitch@ucsc.edu
University Relations	Donna Blitzer	831-459-3938	dblitzer@ucsc.edu
School Districts:			
City Schools Main phone: 429-3837	John Bramlett	831-429-3968 Office 831-251-6803 Cell	bram@sccs.santacruz.k12.ca.us
Live Oak School Dist. Main phone: 475-6333	Keith Houchen Director of Maint.	831-475-6095 Office 831-212-4862 Cell	khoutchen@santacruz.k12.ca.us
Other:			
PG&E	Phil Furnas	831-479-5892 831-915-8168	24 Hour emergency service: 1(800) PGE-5000
Pasatiempo Golf Course Corporate Office: 459-9169	Paul Chojnacky	831-459-9713 Office 415-336-5099 Cell	paul@pasatiempo.com
DeLaveaga Golf Course	Miles Hicks Alt. Contact: Steve Pacheco 831-236-0700	831-420-6121 Office 831-212-8699 Cell	mhicks@cityofsantacruz.com

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Public Agency and Major Customer Contact List

FACILITY	CONTACT NAME(S)	TELEPHONE	Email
Santa Cruz Memorial, Oakwood Cemeteries	Randy Krassow	831-426-1601	rkrassow@scmemorial.com
Chaminade Main phone: 831-475-5600	Al Hittle Facilities Director	831-465-3451 Office 831-212-1616 Cell	
SC Beach Boardwalk Main phone: 423-5590	Security Head of Maint.	831-345-5590 Supv. 831-818-3336 Cell	Also: Ted Whiting: 460-1610 Carl Henn, Facility Manager 460-3364
City Parks	Steve Hammack	831-420-5366 Office 831-212-5687 Cell	shammack@cityofsantacruz.com
Port District	Rick Smith	831-475-6161	scpd@santacruzharbor.org
IT Main phone: 420-5555 Operators for SCADA systems: 420-5457, 24 hrs	Carlos Silva Network Administrator	831-420-5093 Office 831-227-0635 Cell	csilva@cityofsantacruz.com
Capitola Mall	Steve Bettencourt	831-901-8618	SMS1257@smsclean.com

Appendix E

Residential Water Rationing Allotments

(Monthly allotment, in ccf or billing units)

<table>
<tr><td></td><td colspan="2">Stage 3
15–25% Deficiency</td><td>Stage 4
25-35% Deficiency</td><td>Stage 5
35-50% Deficiency</td></tr>
<tr><td>Single Residential Accounts
Up to 4 persons:
Each Additional person:</td><td colspan="2">11
2</td><td>9
2</td><td>7
2</td></tr>
<tr><td rowspan="3">Multiple Residential Accounts
Allotment is per dwelling unit based on number of dwelling units on account:
2-4:
5-20:
Over 20:</td><td colspan="2">Separate irrigation meter serving property?</td><td colspan="2" rowspan="2">All multiple residential accounts, regardless of whether there is a separate irrigation meter serving the property or not:</td></tr>
<tr><td>No</td><td>Yes</td></tr>
<tr><td>7
6
5</td><td>6
5
4</td><td>6
5
4</td><td>5
4
3</td></tr>
<tr><td>Multiple Residential Accounts Alternative A
Allotment is in gallons per person per day (gpcd) based on the number of permanent residents at the account:</td><td colspan="2">47 gpcd</td><td>45 gpcd</td><td>37 gpcd</td></tr>
<tr><td>Multiple Residential Accounts Alternative B
(not applicable to 2-unit accounts)

Where lot coverage, by dwelling units is <35% of entire property</td><td colspan="4">Same allotment as single residential accounts</td></tr>
</table>

Appendix F

Example of Monthly Water Supply and Demand Monitoring Report

SCWD Production Forecast	April			May				Sep			Oct			Total		
(million gallons)	Projected	Actual	Variance	Projected	Actual	Variance		Projected	Actual	Variance	Projected	Actual	Variance			
North Coast (gross production)																
North Coast (net production)																
San Lorenzo River																
Live Oak Wells																
Total Production without Lake																
Projected System Demand																
Lake Production Needed to Meet Demand																
Evaporation (feet)																
Evaporation (mil gal)																
Fish Release (mil gal)																
Beginning Lake Volume (mil gal)																
End of Month Lake Volume (mil gal)																
End of Month Lake Elevation (ft above msl)																
Monthly change in elevation (ft)																
Cumulative change in elevation (ft)																
Percent of capacity (%)																

Previous Year Water Consumption
Current Year Water Consumption
Difference

Notes:

North Coast gross production based on …

North Coast net production assumed to be …

San Lorenzo River forecast assumes ___ year type, ___ percent exceedance probability

Projected system demand based on …

Assumptions for Loch Lomond Reservoir include: starting elev: ____ no additional pumping from Felton Diversion, & no natural inflow.

Appendix G

RESOLUTION NO. NS-28,024

RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SANTA CRUZ
ADOPTING THE 2009 WATER SHORTAGE CONTINGENCY PLAN

WHEREAS, the City Council of the City of Santa Cruz in 2003 adopted a long range planning document known as the Integrated Water Plan, which was intended to provide a flexible, phased approach for reducing near-term drought year shortages and to provide a reliable supply that meets long-term needs while ensuring protection of public health and safety; and

WHEREAS, in addition to implementing water conservation programs to reduce average daily water use and pursuing a cooperative desalination project to increase the supply of water, the Integrated Water Plan includes a curtailment component calling for temporary cutbacks of water use by up to 15 percent to help balance available water supply against demand in drought years; and

WHEREAS, the need to better prepare for the possibility of future water shortages in advance of the next major drought was identified as a top priority in the city's 2005 Urban Water Management Plan; and

WHEREAS, California Water Code section 10632 requires water agencies to plan for water shortages of up to 50 percent as part of their Urban Water Management Plan; and,

WHEREAS, development of the Water Shortage Contingency Plan was a collaborative, open, and public process among the City Water Department staff, the City's Water Commission, City Council and the public; and

WHEREAS, the Water Commission has reviewed the Water Shortage Contingency Plan and unanimously recommended that City Council adopt it to provide a framework for guiding the City's response to future droughts; and

WHEREAS, the State of California is now in its third consecutive year of drought and despite the recent rain, water conditions in Santa Cruz remain below normal; and

WHEREAS, because stream flows that constitute the City's primary drinking water source of supply are projected to run lower than usual this year, voluntary and mandatory actions to temporarily reduce water demand will likely be needed this summer to help preserve valuable reservoir storage in case dry conditions continue beyond 2009.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Santa Cruz that it hereby adopts the 2009 Water Shortage Contingency Plan, authorizes the Water Director to file a copy with the California Department of Water Resources as an amendment to the City's 2005 Urban Water Management Plan, and directs staff to develop a water shortage ordinance that is consistent with the recommendations outlined in the plan.

RESOLUTION NO. NS-28,024

PASSED AND ADOPTED this 10th day of March, 2009, by the following vote:

AYES: Councilmembers Coonerty, Robinson, Lane, Madrigal, Beiers, Vice Mayor Rotkin; Mayor Mathews.

NOES: None.

ABSENT: None.

DISQUALIFIED: None.

APPROVED: Cynthia Mathews
Mayor

ATTEST: L Brew
City Clerk

Appendix H

ORDINANCE NO. 2010-12

AN ORDINANCE OF THE CITY OF SANTA CRUZ REPEALING ORDINANCE 2009-14 AND ADDING A NEW CHAPTER 16.01 OF THE MUNICIPAL CODE PROHIBITING AND REGULATING CERTAIN USES OF WATER FROM THE CITY WATER SUPPLY SYSTEM NOT ESSENTIAL TO THE PUBLIC HEALTH AND SAFETY FOR WATER CONSERVATION PURPOSES, PRESCRIBING PENALTIES FOR VIOLATIONS, AND ESTABLISHING A WATER SHORTAGE APPEAL BOARD

BE IT ORDAINED by the City Council of the City of Santa Cruz as follows:

SECTION 1: Ordinance 2009-14 is hereby repealed.

SECTION 2: Chapter 16.01 of the Santa Cruz Municipal Code is hereby enacted to read as follows:

"Chapter 16.01

Water Shortage Regulations and Restrictions

Sections:

16.01.010 FINDINGS.

WHEREAS, the City of Santa Cruz water system draws almost exclusively on local surface water sources, whose yield varies from year to year depending on the amount of rainfall received and runoff generated during the winter season; and

WHEREAS, the City water system is susceptible to water shortages in dry and critically dry years or in periods of prolonged regional drought when water conditions characterized by low surface flows in the north coast streams and San Lorenzo River sources, depleted storage in Newell Creek Reservoir, or both, reduce the available supply to a level that cannot support seasonal water demand; and

WHEREAS, on March 10, 2009, the City Council of the City of Santa Cruz adopted an updated Water Shortage Contingency Plan that describes how the City will respond to future water shortages and lists the various actions the City would take to reduce water demand under different water shortage scenarios ranging from 5 percent or less up to and including a 50 percent seasonal water supply deficiency; and

WHEREAS California Water Code sections 350 et seq. authorize water suppliers, after holding a properly noticed public hearing and after making certain findings, to declare a water shortage (emergency) and to adopt such regulations and restrictions to conserve the water supply for the greatest public benefit with particular regard for domestic use, sanitation, and fire protection; and

WHEREAS, the voluntary and mandatory water conservation measures and progressive restrictions on water use and method of use set forth herein provide an effective and immediately available means of conserving water which is essential during periods of water shortage to ensure a reliable and sustainable minimum supply of water for the public health, safety, and welfare and to preserve valuable limited reservoir storage, avoid depleting water storage to an unacceptably low level, and thereby lessen the possibility of experiencing more critical shortages if dry conditions continue or worsen; and

WHEREAS, the usage allotments hereinafter established will equitably spread the burden of restricted and prohibited usage in a manner prescribed by the City's Water Shortage Contingency Plan over all City Water Department customers and other consumers of City water; and

WHEREAS, the purposes of this chapter are to conserve the water supply of the City of Santa Cruz for the greatest public benefit, to mitigate the effects of a water supply shortage on public health and safety and economic activity, and to budget water use so that a reliable and sustainable minimum supply of water will be available for the most essential purposes for the entire duration of the water shortage.

16.01.020 DECLARATION OF WATER SHORTAGE.

The provisions of this chapter shall take effect whenever the Director, upon engineering analysis of City water supplies, finds and determines that a water shortage exists or is imminent within the City of Santa Cruz water service area and a declaration of a water shortage is made by a resolution of the City Council, and they shall remain in effect for the duration of the water shortage set forth in the resolution.

16.01.030 APPLICATION OF REGULATIONS.

The provisions of this chapter shall apply to all persons using or consuming water both inside and outside the City and within the City water service area, and regardless of whether any person using water shall have a contract for water service with the City.

16.01.040 PRECEDENCE OF REGULATIONS.

Where other provisions of the Municipal Code, whether enacted prior or subsequent to this chapter, are inconsistent with this the provisions of this chapter, the provisions of this chapter shall supersede and control for the duration of the water shortage set forth in the resolution of the City Council.

16.01.050 DEFINITIONS.

(a) "Director" refers to the Director of the City of Santa Cruz Water Department.

(b) "Water" refers to water produced and served by the City of Santa Cruz Water Department.

(c) "City" refers to the City of Santa Cruz.

(d) "Water Department" refers to the City of Santa Cruz Water Department.

(e) "Seasonal water demand" refers to the demand, measured in gallons, placed by customers on the City water supply between April 1 and October 31 each calendar year.

(f) "Issue"/"Declare". Whenever this chapter references the Director's issuance or declaration of an alert, warning, emergency, or regulation, said alert, warning, emergency or regulation shall be put into effect by the placement of a legal advertisement in a newspaper of general circulation, by a posting on the City's internet website and by a posting in the following public places: Santa Cruz City Hall, 809 Center Street, Santa Cruz; Santa Cruz Water Department Office, 212 Locust Street, Santa Cruz; Capitola City Hall, 420 Capitola Avenue, Capitola, and the Santa Cruz County Governmental Center, 701 Ocean Street, Santa Cruz. Any such alert, warning, emergency or regulation shall take effect upon the date of its publication in the Santa Cruz Sentinel.

(g) "Customer" shall refer to any account customer of the City of Santa Cruz Water Department as well as to any consumer of City water who may not be City of Santa Cruz Water Department account customer.

(h) "Dry Year" refers to the type of water year under the City's water year classification system, which begins October 1 and ends September 30, in which the total annual discharge of the San Lorenzo River at Felton measures between 29,000 and 49,000 acre-feet.

(i) "Critically Dry Year" refers to the type of water year under the City's water year classification system, which begins October 1 and ends September 30, in which the total annual discharge of the San Lorenzo River at Felton measures less than 29,000 acre-feet.

16.01.060 WATER WASTE PROHIBITIONS.

It shall be unlawful during any water shortage stage for any person, firm, partnership, association, corporation, political entity (including the City) or any other Water Department customer to use water for any of the following:

(a) Fire Hydrants. Use of water from any fire hydrant unless specifically authorized by permit from the City, except by regularly constituted fire protection agencies for fire suppression purposes, or for other authorized uses, including distribution system flushing, fire flow testing, and filling of approved vehicles for sewer system flushing, storm drain maintenance, and street sweeping purposes.

(b) Watering/Irrigation. The watering of grass, lawn, groundcover, shrubbery, open ground, crops and trees, including agricultural irrigation, in a manner or to an extent that causes or allows excessive water flow or runoff onto an adjoining sidewalk, driveway, street, gutter or ditch.

(c) Plumbing Leaks. The escape of water through leaks, breaks, or other malfunctions within the water user's plumbing or distribution system for any period of time after such break or leak should have reasonably been discovered and corrected. It shall be presumed that a period of twenty-four hours after the water user discovers such break, leak or malfunction, or receives notice from the City of such condition, whichever occurs first, is a reasonable time within which to correct such condition or to make arrangements for correction.

(d) Washing of Exterior Surfaces. The washing of sidewalks, walkways, driveways, parking lots, patios, or other exterior surfaces unless the hose is equipped with an automatic shutoff nozzle.

(e) Cleaning of Structures and Vehicles. The cleaning of building exteriors, mobile homes, cars, boats, and recreational vehicles unless the hose is equipped with an automatic shutoff nozzle.

(f) Fountains and Decorative Water Features. The operation of a water fountain or other decorative water feature that does not use re-circulated water.

(g) Commercial Car Washes. The washing of vehicles at a commercial car wash unless the facility utilizes water recycling equipment, or operates on a timer for a limited time period and shuts off automatically at the expiration of the time period.

(h) Construction. The use of potable water for dust control or soil compaction purposes in construction activities where there is a reasonably available source of reclaimed water appropriate for such use.

(i) The indiscriminate running of water or washing with water not otherwise prohibited in this section, which is wasteful, and without reasonable purpose.

16.01.070 STAGE 1: WATER SHORTAGE ALERT.

(a) The Director is empowered to issue a Water Shortage Alert and to enforce the water shortage restrictions in this Section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the City's adopted Water Shortage Contingency Plan, will be five percent (5%) and a minimal consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 1 water shortage, the City will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of 125 million gallons or an average daily water demand reduction of 600,000 gallons.

(b) During Stage 1, it shall be unlawful for any person, firm, partnership, association, corporation, political entity (including the City) or any other Water Department customer:

1. to water or irrigate lawn, landscape, or other vegetated area between the hours of 10:00 a.m. and 5:00 p.m., except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low-volume, non-spray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system;

2. to use a hose that is not equipped with a shut off nozzle;

3. to use potable water to wash down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other paved surfaces, except when it is necessary to alleviate safety or sanitation hazards or to prepare paved surfaces for sealing;

4. to initially fill or to drain and refill residential swimming pools;

5. to serve water in a restaurant or other commercial food service establishment except upon the request of a patron; and/or

6. to operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens.

16.01.080 STAGE 2: WATER SHORTAGE WARNING.

(a) The Director is empowered to issue a Water Shortage Warning and to enforce the water shortage restrictions in this Section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the City's adopted Water Shortage Contingency Plan, will be between five percent (5%) and fifteen percent (15%) and a moderate consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 2 water shortage, the City will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of up to 375 million gallons and an average daily water demand reduction of up to 1.8 million gallons.

(b) During Stage 2, it shall be unlawful for any person, firm, partnership, association, corporation, political body (including the City) or other Water Department customer:

1. to water or irrigate lawn, landscape, or other vegetated area between the hours of 10:00 a.m. and 5:00 p.m., except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low-volume, non-spray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system;

2. to use a hose that is not equipped with a shut off nozzle;

3. to use potable water to wash down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other paved surfaces, except when it is necessary to alleviate safety or sanitation hazards or to prepare paved surfaces for sealing;

4. to initially fill or to drain and refill residential swimming pools;

5. to serve water in a restaurant or other commercial food service establishment except upon the request of a patron;

6. to operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens;

7. to water or irrigate lawn, landscape, or other vegetated area on days of the week other than the two days of the week authorized and publicized by the Director, except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low-volume, non-spray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system. Hourly restrictions set forth in subsection (1) above continue to apply on authorized watering days. This provision shall not apply to commercial growers/nurseries or to residential vegetable gardens/edible plantings watered with a hose equipped with a shut off nozzle;

8. to water or irrigate lawn, landscape, or other vegetated area using an automatic irrigation system for more than fifteen minutes per watering station per assigned day. This provision shall not apply to automatic irrigation systems exclusively using low output sprinkler equipment, including rotors, stream rotors, or micro-spray systems;

9. to wash the exterior of dwellings, buildings or structures (with the exception of window washing and preparation of property for painting or for sale);

10. to irrigate or water landscapes in a manner that conflicts with a customer's landscape irrigation water budget when such a budget is required by the Director per the criteria delineated in the City's adopted Water Shortage Contingency Plan; and/or

11. to disobey Water Department direction to large commercial, industrial or irrigation customers using 1,337 or more billing units (one million gallons) per year to conduct water use audits, to prepare water conservation plans and to submit progress reports, or to immediately repair water system leaks, including leaks attributable to faulty pipes or fixtures.

16.01.090 STAGE 3: WATER SHORTAGE EMERGENCY.

(a) The Director is empowered to declare a Water Shortage Emergency and to enforce the water shortage restrictions in this Section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the City's adopted Water Shortage Contingency Plan, will be between fifteen percent (15%) and twenty five percent (25%) and a significant consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 3 water shortage, the City will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of up to 625 million gallons and an average daily water demand reduction of up to 3.0 million gallons.

(b) During Stage 3, it shall be unlawful for any person, firm, partnership, association, corporation, political body (including the City) or other Water Department customer:

1. to water or irrigate lawn, landscape, or other vegetated area between the hours of 10:00 a.m. and 5:00 p.m., except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low-volume, non-spray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system;

2. to use a hose that is not equipped with a shut off nozzle;

3. to use potable water to wash down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other paved surfaces, except when it is necessary to alleviate safety or sanitation hazards or to prepare paved surfaces for sealing;

4. to initially fill or to drain and refill any swimming pools, outdoor spas, wading pools, and ornamental water features;

5. to serve water in a restaurant or other commercial food service establishment except upon the request of a patron;

6. to operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens;

7. to water or irrigate lawn, landscape, or other vegetated area on days of the week other than the specified day(s) of the week authorized and publicized by the Director, except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low-volume, non-spray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system. Hourly restrictions set forth in subsection (1) above continue to apply on authorized watering days. This provision shall not apply to commercial growers/nurseries or to residential vegetable gardens/edible plantings watered with a hose equipped with a shut off nozzle;

8. to water or irrigate lawn, landscape, or other vegetated area using an automatic irrigation system for more than ten minutes per watering station per assigned day. This

provision shall not apply to automatic irrigation systems exclusively using low output sprinkler equipment, including rotors, stream rotors, or micro-spray systems;

9. to wash the exterior of dwellings, buildings or structures (with the exception of window washing and preparation of property for painting or for sale);

10. to irrigate or water landscapes in a manner that conflicts with a customer's landscape irrigation water budget when such a budget is required by the Director per the criteria delineated in the City's adopted Water Shortage Contingency Plan; and/or

11. to disobey Water Department direction to large commercial, industrial or irrigation customers using 1,337 or more billing units (one million gallons) per year to conduct water use audits, to prepare water conservation plans and to submit progress reports, or to immediately repair water system leaks, including leaks attributable to faulty pipes or fixtures;

12. to violate residential customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the Director in accordance with guidelines set forth in the City's' adopted Water Shortage Contingency Plan; and/or

13. to disobey Water Department directives issued to commercial customers requiring the prominent placement of "Save Water" signage at specified locations at the customer's premises.

16.01.100 STAGE 4: SEVERE WATER SHORTAGE EMERGENCY.

(a) The Director is empowered to declare a Severe Water Shortage Emergency and to enforce the water shortage restrictions in this Section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the City's adopted Water Shortage Contingency Plan, will be between twenty five percent (25%) and thirty five percent (35%) and an extraordinary consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 4 water shortage, the City will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of up to 875 million gallons and an average daily water demand reduction of up to 4.2 million gallons.

(b) During Stage 4, it shall be unlawful for any person, firm, partnership, association, corporation, political body (including the City) or other Water Department customer:

1. to water or irrigate landscape or other vegetated area between the hours of 10:00 a.m. and 5:00 p.m., except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low-volume, non-spray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system;

2. to use a hose that is not equipped with a shut off nozzle;

3. to use potable water to wash down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other paved surfaces, except when it is necessary to alleviate safety or sanitation hazards or to prepare paved surfaces for sealing;

4. to fill or to top off any swimming pools, outdoor spas, wading pools, and ornamental water features;

5. to serve water in a restaurant or other commercial food service establishment except upon the request of a patron;

6. to operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens;

7. to water or irrigate landscape or other vegetated area on days of the week other than the specified day(s) of the week authorized and publicized by the Director, except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low-volume, non-spray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system. Hourly restrictions set forth in subsection (1) above continue to apply on authorized watering days. This provision shall not apply to commercial growers/nurseries or to residential vegetable gardens/edible plantings watered with a hose equipped with a shut off nozzle;

8. to water landscapes using automatic irrigation systems for more than ten minutes per watering station per assigned day. This provision does not apply to automatic irrigation systems using water efficient devices, including but not limited to weather-based controllers, drip/micro-irrigation systems and stream rotor sprinklers.

9. to wash the exterior of dwellings, buildings or structures (with the exception of window washing and preparation of property for painting or for sale);

10. to irrigate or water landscapes in a manner that conflicts with a customer's landscape irrigation water budget when such a budget is required by the Director per the criteria delineated in the City's adopted Water Shortage Contingency Plan; and/or

11. to disobey Water Department direction to large commercial, industrial or irrigation customers using 1,337 or more billing units (one million gallons) per year to conduct water use audits, to prepare water conservation plans and to submit progress reports, or to immediately repair water system leaks, including leaks attributable to faulty pipes or fixtures;

12. to violate residential customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the Director in accordance with guidelines set forth in the City's' adopted Water Shortage Contingency Plan;

13. to disobey Water Department directives issued to commercial customers requiring the prominent placement of "Save Water" signage at specified locations at the customer's premises;

14. to violate commercial customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the Director in accordance with guidelines set forth in the City's adopted Water Shortage Contingency Plan;

15. to disobey a Water Department order to customers identified as "dedicated irrigation accounts" directing those customers to further limit their landscape irrigation and watering activity so as to preserve only the customers' most valuable trees and plants;

16. to water lawns or turf, unless such watering is authorized by the Director in accordance with a landscape irrigation water budget and is consistent with the guidelines set forth in the City's adopted Water Shortage Contingency Plan;

17. to install new landscaping which requires any irrigation or watering;

18. to wash or clean vehicles, including but not limited to automobile, truck, van, bus, motorcycle, boat, or trailer including the washing of fleet vehicles and the washing of vehicles on dealer lots. This restriction will not apply to commercial car wash businesses which use recycled water; and/or

19. to exercise any rights conferred by hydrant and bulk water permits that were issued prior to the Severe Water Shortage Emergency declaration absent special permission

granted by the Director. Said special permission may be granted only for projects necessary to protect the public health, safety and welfare where no alternative to potable water exists and for emergency response purposes.

16.01.110 STAGE 5: CRITICAL WATER SHORTAGE EMERGENCY.

(a) The Director is empowered to declare a Critical Water Shortage Emergency and to enforce the water shortage restrictions in this Section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the City's adopted Water Shortage Contingency Plan, shall be between thirty five percent (35%) and fifty percent (50%) and an extreme consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 5 water shortage, the City will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of up to 1,250 million gallons and an average daily water demand reduction of up to 6.0 million gallons.

(b) During Stage 5, it is unlawful for any person, firm, partnership, association, corporation, political body (including the City) or other Water Department customer:

1. to water or irrigate any outdoor landscaping, unless such watering is authorized by the Director and is consistent with the guidelines set forth in the City's adopted Water Shortage Contingency Plan;
2. to use a hose that is not equipped with a shut off nozzle;
3. to use water for any outdoor washing purpose including commercial car washing, window washing, and paint preparation;
4. to fill or to top off any swimming pools, outdoor spas, wading pools, and ornamental water features;
5. to serve water in a restaurant or other commercial food service establishment except upon the request of a patron;
6. to operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens;
7. to use water for recreational purposes;
8. to operate public swimming pools;
9. to operate public showers;
10. to disobey Water Department direction to large commercial, industrial or irrigation customers using 1,337 or more billing units (one million gallons) per year to conduct water use audits, to prepare water conservation plans and to submit progress reports, or to immediately repair water system leaks, including leaks attributable to faulty pipes or fixtures;
11. to violate residential customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the Director in accordance with guidelines set forth in the City's adopted Water Shortage Contingency Plan;
12. to violate commercial customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the Director in accordance with guidelines set forth in the City's December 2008 Water Shortage Contingency Plan;
13. to disobey Water Department directives issued to commercial customers requiring the prominent placement of "Save Water" signage at specified locations at the customer's premises;

14. to install new landscaping which requires any irrigation or watering; and/or

15. to exercise any rights conferred by hydrant and bulk water permits that were issued prior to the Critical Water Shortage Emergency declaration absent special permission granted by the Director. Said special permission may be granted only for projects necessary to protect the public health, safety and welfare where no alternative to potable water exists and for emergency response purposes.

16.01.120 EXCEPTIONS.

(a) The Director, upon application made in writing by a customer on a form promulgated by the Water Department and accompanied by supporting documentation, shall be authorized to issue an exception from the strict application of any restriction, regulation or prohibition enforced pursuant to this chapter, upon the customer's production of substantial evidence demonstrating the existence of one or more of the following circumstances that are particular to that customer and which are not generally shared by other Water Department customers:

1. Failure to approve the requested exception would cause a condition having an adverse effect on the health, sanitation, fire protection, or safety of the customer or members of the public served by the customer;

2. Strict application of the subject restriction, regulation or prohibition would impose a severe or undue hardship on a particular business customer or render it infeasible for a particular business customer or class of business customers to remain in operation;

3. Alternative restrictions to which the customer is willing to adhere are available that would achieve the same level of demand reduction as the restriction for which an exception is being sought and such alternative restrictions are enforceable by the Water Department;

4. Circumstances concerning the customer's property or business have changed since the implementation of the subject restriction warranting a change in the customer's water usage allocation; or

5. A hospital or health care facility customer using industry best management practices is eligible for an exception upon demonstrating that the subject restriction, regulation or prohibition is interfering with or preventing it from providing health care service to its customers in accordance with industry hygiene, sanitation and health care standards.

6. A business customer has already implemented environmental sustainability measures that have reduced water consumption to the maximum extent feasible. As used in this subsection the term "environmental sustainability measures" refers to installation of high efficiency plumbing fixtures, devices, equipment, and appliances, recycled water systems, and landscaping consisting exclusively of low water using plant materials using drip or similar high efficiency, non-spray irrigation systems, or to buildings that are designed, built, and continuously operated according to Leadership in Energy and Environmental Design (LEED) certification standards.

(b) In order to qualify for an exception, a customer must first complete a self water audit pursuant to standards and procedures promulgated by the Water Department. This audit shall be made part of the customer's exception application and water conservation measures indicated by the audit may be incorporated as conditions of approval to an exception in addition to any other conditions of approval imposed by the Director in connection with the Director's approval of the customer's exception application.

16.01.130 WATER SHORTAGE APPEAL BOARD.

(a) A Water Shortage Appeal Board is hereby established and shall be eligible to convene upon the Director's issuance of any water shortage declaration and the implementation of water shortage restrictions pursuant to Sections 16.010.070 though 16.01.110. Thereafter the Water Shortage Appeal Board will remain available to convene for as long as the water shortage remains in effect.

(b) Under water shortage Stages 1 and 2, the Water Shortage Appeal Board will be comprised of members of the City Water Commission. Under water shortage Stages 3, 4, and 5, the Water Shortage Appeal Board will be appointed by City Council and will be comprised of one member of the Water Commission, one business customer, one landscape industry customer, one residential customer, and two at-large members who reside within the City's water service area.

(c) Any customer who considers an action taken by the Director or an enforcement official under the provisions of this chapter, including actions on exception applications and the assessment of administrative penalties, to have been erroneously taken or issued, may appeal that action or penalty to the Water Shortage Appeal Board in the following manner:

1. The appeal shall be made in writing, shall state the nature of the appeal specifying the action or penalty that is being appealed and the basis upon which the action or penalty is alleged to be in error. Penalty appeals shall include a copy of the Notice of Violation;

2. An appeal, to be effective, must be received by the Director not later than ten (10) business days following the date of the Notice of Violation or the date that the Director took the action which is the subject to the appeal;

(A) A water service resident who is not an account customer may notify the Water Department of his or her intention to file a petition to force the resident's account customer to appeal an excess water use penalty within ten (10) business days following the penalty;

(B) If the Water Department has been given a notice of intention to file a petition per subsection 2(A) by a water service area resident who is not an account customer, the appeal from the account customer must be received within fifteen (15) business days after the account customer has been petitioned by the resident.

3. The Director shall schedule the appeal for consideration by the Water Shortage Appeal Board at a Water Shortage Appeal Board meeting. The Water Shortage Appeal Board shall hear the appeal within 90 days of the date of the appeal and issue its decision within 30 days of the date of the hearing.

4. The decision of the Water Shortage Appeal Board shall be final. In ruling on appeals, the Water Shortage Appeal Board shall strictly apply the provisions of this chapter, and shall not impose or grant terms and conditions not authorized by this chapter.

(d) The Chair of the Water Shortage Appeal Board shall have the discretion to divide the Board into two-three member hearing panels. Each hearing panel shall have the same authority to hear and rule upon appeals as the entire Water Shortage Appeal Board. A hearing panel shall have no more than one at-large appointee as a member. The decision of any hearing panel shall be final.

16.01.140 ADMINISTRATIVE ENFORCEMENT.

(a) Any person firm, partnership, association, corporation, political entity or other Water Department customer violating any provision of this chapter may be assessed an administrative penalty.

(b) Each and every day a violation of this chapter exists constitutes a separate and distinct offense for which an administrative penalty may be assessed.

(c) Penalties. The purpose of the administrative penalties assessed pursuant to this Section is to assure future chapter compliance by the cited customer through the imposition of increasingly significant penalties so as to create a meaningful disincentive to commit future chapter violations. In acknowledgment of the fact that the City's water is a scarce and irreplaceable commodity and that this chapter is intended to equitably distribute that commodity among Water Department customers and to assure that, to the extent feasible, City water is conserved and used only for purposes deemed necessary for public health and safety, the penalty schedule herein prescribed is not to be construed as creating a "water pricing" structure pursuant to which customers may elect to pay for additional water at significantly higher rates. To this end, a customer's repeated violation of the chapter shall result in either the installation of a flow restriction device or disconnection of the customer's property from the City's water service system at the customer's cost.

(d) Administrative penalties for failure to comply with water waste prohibitions requirements in Section 16.01.060 or mandatory water use restrictions and regulations commencing with Stage 1 in Section 6 are as follows:

1. First Offense: Written notice of violation and opportunity to correct violation.

2. Second Offense: A second violation within the preceding twelve (12) calendar months is punishable by a fine not to exceed one hundred dollars ($100).

3. Third Offense: A third violation within the preceding twelve (12) calendar months is punishable by a fine not to exceed two hundred fifty dollars ($250).

4. Fourth Offense: A fourth violation within the preceding twelve (12) calendar months is punishable by a fine not to exceed five hundred dollars ($500). In addition to any fines, the Director may order a water flow restrictor device be installed.

5. Large customers. Administrative penalties for customers that use an average of 1,337 billing units (one million gallons) or more per calendar year shall be triple the amounts listed above.

6. Discontinuing Service. In addition to any fines and the installation of a water flow restrictor, the Director may disconnect a customer's water service for willful violations of mandatory restrictions and regulations in this chapter. Upon disconnection of water service, a written notice shall be served upon the customer which shall state the time, place, and general description of the prohibited or restricted activity and the method by which reconnection can be made.

(e) Excessive Water Use Penalties. An excessive use penalty shall be assessed where the customer, during any given billing cycle, uses more than the customer's water allotment per the Director's water rationing regulations issued pursuant to this chapter commencing with Stage 3 in Section 16.01.090. Excess use penalties shall be in addition to ordinary water consumption charges, as follows:

1. 1% to 10% over customer rationing allotment: $25.00/CCF
2. More than 10% over customer rationing allotment: $50.00/CCF

3. In addition to any excess use penalties, the Director may order a water flow restrictor device be installed and/or may disconnect a customer's water service for willful violations of the water rationing regulations in this chapter. Upon disconnection of water service, a written notice shall be served upon the customer which shall state the time, place, and general description the prohibited or restricted activity and the method by which reconnection can be made.

(f) Cost of Flow Restrictor and Disconnecting Service: A person or entity that violates this chapter is responsible for payment of charges for installing and/or removing any flow restricting device and for disconnecting and/or reconnecting service in accordance with the City's Miscellaneous Water Service Fee Resolution then in effect. The charge for installing and/or removing any flow restricting device must be paid before the device is removed. Nonpayment will be subject to the same remedies as nonpayment of basic water rates.

(g) Notice and Hearing. The Director will issue a Notice of Violation by mail or personal delivery at least ten (10) business days before taking any enforcement action described in subsection 13D. Such notice must describe the violation and the date by which corrective action must be taken. A customer may appeal the Notice of Violation by filing a written notice of appeal with the City no later than the close of business day before the date scheduled for enforcement action accompanied by a $25 appeal fee. Any Notice of Violation not timely appealed will be final. Upon receipt of a timely appeal, a hearing on the appeal will be scheduled, and the City will mail written notice of the hearing date to the customer at least ten (10) days before the date of the hearing. Pending receipt of a written appeal or pending a hearing pursuant to an appeal, the Director may take appropriate steps to prevent the unauthorized use of water as appropriate to the nature and extent of the violation and the current declared water shortage condition.

16.01.150 ADDITIONAL ENFORCEMENT AUTHORITY.

In addition to the remedies referenced above, the Director is empowered to pursue any additional remedies necessary, including criminal, civil and administrative remedies listed in Title 4 of the Santa Cruz Municipal Code, to correct a violation of this chapter.

16.01.160 SEVERABILITY.

If any portion of this chapter is held to be unconstitutional, it is the intent of the City Council that such portion of the chapter be severable from the remainder and that the remainder be given full force and effect."

SECTION 3: This ordinance shall take effect 30 days after final adoption.

ORDINANCE NO. 2010-12

PASSED FOR PUBLICATION this 25th day of May, 2010, by the following vote:

AYES: Councilmembers Lane, Beiers, Madrigal, Robinson; Mayor Rotkin.

NOES: None.

ABSENT: Councilmember Mathews, Vice Mayor Coonerty.

DISQUALIFIED: None.

APPROVED: ______________________
Mayor

ATTEST: ______________________
City Clerk

PASSED FOR FINAL ADOPTION on this 8th day of June, 2010, by the following vote:

AYES: Councilmembers Lane, Beiers, Robinson; Vice Mayor Coonerty; Mayor Rotkin.

NOES: None.

ABSENT: Councilmembers Mathews, Madrigal.

DISQUALIFIED: None.

APPROVED: ______________________
Mayor

ATTEST: ______________________
City Clerk

This is to certify that the above and foregoing document is the original of Ordinance No. 2010-12 and that it has been published or posted in accordance with the Charter of the City of Santa Cruz.

____
City Clerk

Chapter 16.01
WATER SHORTAGE REGULATIONS AND RESTRICTIONS

Sections:

16.01.010 FINDINGS.

Whereas, the city of Santa Cruz water system draws almost exclusively on local surface water sources, whose yield varies from year to year depending on the amount of rainfall received and runoff generated during the winter season; and

Whereas, the city water system is susceptible to water shortages in dry and critically dry years or in periods of prolonged regional drought when water conditions characterized by low surface flows in the north coast streams and San Lorenzo River sources, depleted storage in Newell Creek Reservoir, or both, reduce the available supply to a level that cannot support seasonal water demand; and

Whereas, on March 10, 2009, the city council of the city of Santa Cruz adopted an updated water shortage contingency plan that describes how the city will respond to future water shortages and lists the various actions the city would take to reduce water demand under different water shortage scenarios ranging from five percent or less up to and including a fifty percent seasonal water supply deficiency; and

Whereas California Water Code Sections 350 et seq. authorize water suppliers, after holding a properly noticed public hearing and after making certain findings, to declare a water shortage (emergency) and to adopt such regulations and restrictions to conserve the water supply for the greatest public benefit with particular regard for domestic use, sanitation, and fire protection; and

Whereas, the voluntary and mandatory water conservation measures and progressive restrictions on water use and method of use set forth herein provide an effective and immediately available means of conserving water which is essential during periods of water shortage to ensure a reliable and sustainable minimum supply of water for the public health, safety, and welfare and to preserve valuable limited reservoir storage, avoid depleting water storage to an unacceptably low level, and thereby lessen the possibility of experiencing more critical shortages if dry conditions continue or worsen; and

Whereas, the usage allotments hereinafter established will equitably spread the burden of restricted and prohibited usage in a manner prescribed by the city's water shortage contingency plan over all city water department customers and other consumers of city water; and

Whereas, the purposes of this chapter are to conserve the water supply of the city of Santa Cruz for the greatest public benefit, to mitigate the effects of a water supply shortage on public health and safety and economic activity, and to budget water use so that a reliable and sustainable minimum supply of water will be available for the most essential purposes for the entire duration of the water shortage.

(Ord. 2010-12 § 2 (part), 2010).

16.01.020 DECLARATION OF WATER SHORTAGE.

The provisions of this chapter shall take effect whenever the director, upon engineering analysis of city water supplies, finds and determines that a water shortage exists or is imminent within the city of Santa Cruz water service area and a declaration of a water shortage is made by a resolution of the city council, and they shall remain in effect for the duration of the water shortage set forth in the resolution.

(Ord. 2010-12 § 2 (part), 2010).

16.01.030 APPLICATION OF REGULATIONS.

The provisions of this chapter shall apply to all persons using or consuming water both inside and outside the city and within the city water service area, and regardless of whether any person using water shall have a contract for water service with the city.

(Ord. 2010-12 § 2 (part), 2010).

16.01.040 PRECEDENCE OF REGULATIONS.

Where other provisions of the municipal code, whether enacted prior or subsequent to this chapter, are inconsistent with the provisions of this chapter, the provisions of this chapter shall supersede and control for the duration of the water shortage set forth in the resolution of the city council.

(Ord. 2010-12 § 2 (part), 2010).

16.01.050 DEFINITIONS.

(a) "Director" refers to the director of the city of Santa Cruz water department.

(b) "Water" refers to water produced and served by the city of Santa Cruz water department.

(c) "City" refers to the city of Santa Cruz.

(d) “Water department” refers to the city of Santa Cruz water department.

(e) “Seasonal water demand” refers to the demand, measured in gallons, placed by customers on the city water supply between April 1st and October 31st each calendar year.

(f) Issue/Declare. Whenever this chapter references the director’s issuance or declaration of an alert, warning, emergency, or regulation, said alert, warning, emergency or regulation shall be put into effect by the placement of a legal advertisement in a newspaper of general circulation, by a posting on the city’s Internet website and by a posting in the following public places: Santa Cruz City Hall, 809 Center Street, Santa Cruz; Santa Cruz Water Department Office, 212 Locust Street, Santa Cruz; Capitola City Hall, 420 Capitola Avenue, Capitola; and the Santa Cruz County Governmental Center, 701 Ocean Street, Santa Cruz. Any such alert, warning, emergency or regulation shall take effect upon the date of its publication in the Santa Cruz Sentinel.

(g) “Customer” shall refer to any account customer of the city of Santa Cruz water department as well as to any consumer of city water who may not be a city of Santa Cruz water department account customer.

(h) “Dry year” refers to the type of water year under the city’s water year classification system, which begins October 1st and ends September 30th, in which the total annual discharge of the San Lorenzo River at Felton measures between twenty-nine thousand and forty-nine thousand acre-feet.

(i) “Critically dry year” refers to the type of water year under the city’s water year classification system, which begins October 1st and ends September 30th, in which the total annual discharge of the San Lorenzo River at Felton measures less than twenty-nine thousand acre-feet.

(j) “Independent hearing officer” refers to a person appointed by the city to preside at administrative hearings pursuant to Title 4 of this code.

(Ord. 2015-07 § 1, 2015: Ord. 2010-12 § 2 (part), 2010).

16.01.055 WATER DEPARTMENT CUSTOMER CLASSIFICATIONS/ALLOCATIONS.

For determining a water department customer’s water allocation during a declared water shortage under this chapter and for all other purposes under this title, the following customer classification definitions shall apply based on the customer’s ownership or occupation of the following types of property served by the water department:

(a) 1. Single-Family Residential. Individually metered residential dwelling units (regardless of housing type). This classification shall apply whether or not the residential dwelling unit is being put to a use other than, or in addition to, residential use, and whether or not the residential use is permanent or transient in nature including use as a vacation rental unit. A residential dwelling unit is considered an occupant’s permanent residence when, on average, the occupant resides in the unit for at least twenty-one days within each monthly water service period.

2. Multiple-Family Residential. Any residential account with more than one residential dwelling unit served by one water meter. This classification shall apply whether or not the residential dwelling units are being put to a use other than, or in addition to, residential use and whether or

not the residential use is permanent or transient in nature including use as a vacation rental unit. A residential dwelling unit is considered an occupant's permanent residence when, on average, the occupant resides in the unit for at least twenty-one days within each monthly water service period.

3. Business. Commercial establishments including restaurants, hotel/motel, retail, medical, schools, offices, churches and mixed-use buildings. This category also includes county and state government accounts.

4. Industry/UCSC. This category is comprised of one primary customer, the University of California, Santa Cruz, and a small number of manufacturing businesses.

5. Municipal. This category is comprised of city-owned and operated facilities such as city offices, parks, police and fire stations, water and wastewater treatment plants, street medians, and parking lots.

6. Irrigation. Dedicated water services for landscape irrigation associated with large multiple residential complexes and homeowners associations, or with commercial, industrial, and institutional sites, including schools, churches, and parks.

7. Golf Irrigation. Accounts serving the two golf courses in the water service area.

8. Coast Irrigation. Agricultural accounts receiving untreated water on the north coast.

9. Miscellaneous. Other uses such as temporary construction accounts, hydrant meters, and bulk water sales.

(b) Residency. For the purpose of determining residential water rationing allotments under water shortage Stages 3, 4 or 5 of this chapter, the number of persons in each household shall be determined by calculating the number of that household's permanent residents. A permanent resident is an occupant who resides in the subject residential dwelling unit, on average, for at least twenty-one days within each monthly water service period.

(Ord. 2015-07 § 2, 2015).

16.01.060 WATER WASTE PROHIBITIONS.

It shall be unlawful during any water shortage stage for any person, firm, partnership, association, corporation, political entity (including the city) or any other water department customer to use water for any of the following:

(a) Fire Hydrants. Use of water from any fire hydrant unless specifically authorized by permit from the city, except by regularly constituted fire protection agencies for fire suppression purposes, or for other authorized uses, including distribution system flushing, fire flow testing, and filling of approved vehicles for sewer system flushing, storm drain maintenance, and street sweeping purposes.

(b) Watering/Irrigation. The watering of grass, lawn, groundcover, shrubbery, open ground, crops and trees, including agricultural irrigation, in a manner or to an extent that causes or allows excessive water flow or runoff onto an adjoining sidewalk, driveway, street, gutter or ditch.

(c) Plumbing Leaks. The escape of water through leaks, breaks, or other malfunctions within the water user's plumbing or distribution system for any period of time after such break or leak should have reasonably been discovered and corrected. It shall be presumed that a period of twenty-four hours after the water user discovers such break, leak or malfunction, or receives notice from the city of such condition, whichever occurs first, is a reasonable time within which to correct such condition or to make arrangements for correction.

(d) Washing of Exterior Surfaces. The washing of sidewalks, walkways, driveways, parking lots, patios, or other exterior surfaces unless the hose is equipped with an automatic shutoff nozzle.

(e) Cleaning of Structures and Vehicles. The cleaning of building exteriors, mobile homes, cars, boats, and recreational vehicles unless the hose is equipped with an automatic shutoff nozzle.

(f) Fountains and Decorative Water Features. The operation of a water fountain or other decorative water feature that does not use re-circulated water.

(g) Commercial Car Washes. The washing of vehicles at a commercial car wash unless the facility utilizes water recycling equipment, or operates on a timer for a limited time period and shuts off automatically at the expiration of the time period.

(h) Construction. The use of potable water for dust control or soil compaction purposes in construction activities where there is a reasonably available source of reclaimed water appropriate for such use.

(i) The indiscriminate running of water or washing with water, not otherwise prohibited in this section which is wasteful and without reasonable purpose.

(Ord. 2010-12 § 2 (part), 2010).

16.01.070 STAGE 1: WATER SHORTAGE ALERT.

(a) The director is empowered to issue a water shortage alert and to enforce the water shortage restrictions in this section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the city's adopted water shortage contingency plan, will be five percent and a minimal consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 1 water shortage, the city will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of one hundred twenty-five million gallons or an average daily water demand reduction of six hundred thousand gallons.

(b) During Stage 1, it shall be unlawful for any person, firm, partnership, association, corporation, political entity (including the city) or any other water department customer:

1. To water or irrigate lawn, landscape, or other vegetated area between the hours of 10:00 a.m. and 5:00 p.m., except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low volume, nonspray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system;

2. To use a hose that is not equipped with a shutoff nozzle;

3. To use potable water to wash down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other paved surfaces, except when it is necessary to alleviate safety or sanitation hazards or to prepare paved surfaces for sealing;

4. To initially fill or to drain and refill residential swimming pools;

5. To serve water in a restaurant or other commercial food service establishment except upon the request of a patron; and/or

6. To operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens.

(Ord. 2010-12 § 2 (part), 2010).

16.01.080 STAGE 2: WATER SHORTAGE WARNING.

(a) The director is empowered to issue a water shortage warning and to enforce the water shortage restrictions in this section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the city's adopted water shortage contingency plan, will be between five percent and fifteen percent and a moderate consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 2 water shortage, the city will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of up to three hundred seventy-five million gallons and an average daily water demand reduction of up to one million eight hundred thousand gallons.

(b) During Stage 2, it shall be unlawful for any person, firm, partnership, association, corporation, political body (including the city) or other water department customer:

1. To water or irrigate lawn, landscape, or other vegetated area between the hours of 10:00 a.m. and 5:00 p.m., except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low volume, nonspray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system;

2. To use a hose that is not equipped with a shutoff nozzle;

3. To use potable water to wash down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other paved surfaces, except when it is necessary to alleviate safety or sanitation hazards or to prepare paved surfaces for sealing;

4. To initially fill or to drain and refill residential swimming pools;

5. To serve water in a restaurant or other commercial food service establishment except upon the request of a patron;

6. To operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens;

7. To water or irrigate lawn, landscape, or other vegetated area on days of the week other than the two days of the week authorized and publicized by the director, except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low volume, nonspray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system. Hourly restrictions set forth in subsection (b)(1) continue to apply on authorized watering days. This provision shall not apply to commercial growers/nurseries or to residential vegetable gardens/edible plantings watered with a hose equipped with a shutoff nozzle;

8. To water or irrigate lawn, landscape, or other vegetated area using an automatic irrigation system for more than fifteen minutes per watering station per assigned day. This provision shall not apply to automatic irrigation systems exclusively using low output sprinkler equipment, including rotors, stream rotors, or micro-spray systems;

9. To wash the exterior of dwellings, buildings or structures (with the exception of window washing and preparation of property for painting or for sale);

10. To irrigate or water landscapes in a manner that conflicts with a customer's landscape irrigation water budget when such a budget is required by the director per the criteria delineated in the city's adopted water shortage contingency plan; and/or

11. To disobey water department direction to large commercial, industrial or irrigation customers using one thousand three hundred thirty-seven or more billing units (one million gallons) per year to conduct water use audits, to prepare water conservation plans and to submit progress reports, or to immediately repair water system leaks, including leaks attributable to faulty pipes or fixtures.

(Ord. 2010-12 § 2 (part), 2010).

16.01.090 STAGE 3: WATER SHORTAGE EMERGENCY.

(a) The director is empowered to declare a water shortage emergency and to enforce the water shortage restrictions in this section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the city's adopted water shortage contingency plan, will be between fifteen percent and twenty-five percent and a significant consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 3 water shortage, the city will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of up to six hundred twenty-five million gallons and an average daily water demand reduction of up to three million gallons.

(b) During Stage 3, it shall be unlawful for any person, firm, partnership, association, corporation, political body (including the city) or other water department customer:

1. To water or irrigate lawn, landscape, or other vegetated area between the hours of 10:00 a.m. and 5:00 p.m., except when performed with a bucket or watering can, or by use of a drip

irrigation system or similar low volume, nonspray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system;

2. To use a hose that is not equipped with a shutoff nozzle;

3. To use potable water to wash down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other paved surfaces, except when it is necessary to alleviate safety or sanitation hazards or to prepare paved surfaces for sealing;

4. To initially fill or to drain and refill swimming pools;

5. To serve water in a restaurant or other commercial food service establishment except upon the request of a patron;

6. To operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens;

7. To water or irrigate lawn, landscape, or other vegetated area on days of the week other than the specified day(s) of the week authorized and publicized by the director, except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low volume, nonspray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system. Hourly restrictions set forth in subsection (b)(1) continue to apply on authorized watering days. This provision shall not apply to commercial growers/nurseries or to residential vegetable gardens/edible plantings watered with a hose equipped with a shutoff nozzle;

8. To water or irrigate lawn, landscape, or other vegetated area using an automatic irrigation system for more than ten minutes per watering station per assigned day. This provision shall not apply to automatic irrigation systems exclusively using low output sprinkler equipment, including rotors, stream rotors, or micro-spray systems;

9. To apply potable water to outdoor landscapes during and within forty-eight hours after measurable rainfall;

10. To wash the exterior of dwellings, buildings or structures (with the exception of window washing and preparation of property for painting or for sale);

11. To irrigate or water landscapes in a manner that conflicts with a customer's landscape irrigation water budget when such a budget is required by the director per the criteria delineated in the city's adopted water shortage contingency plan;

12. To disobey water department direction to large commercial, industrial or irrigation customers using one thousand three hundred thirty-seven or more billing units (one million gallons) per year to conduct water use audits, to prepare water conservation plans and to submit progress reports, or to immediately repair water system leaks, including leaks attributable to faulty pipes or fixtures;

13. To violate residential customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the director in accordance with guidelines set forth in the city's adopted water shortage contingency plan; and/or

14. To disobey water department directives issued to commercial customers requiring the prominent placement of "Save Water" signage at specified locations at the customer's premises.

(Ord. 2015-07 § 3, 2015: Ord. 2010-12 § 2 (part), 2010).

16.01.100 STAGE 4: SEVERE WATER SHORTAGE EMERGENCY.

(a) The director is empowered to declare a severe water shortage emergency and to enforce the water shortage restrictions in this section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the city's adopted water shortage contingency plan, will be between twenty-five percent and thirty-five percent and an extraordinary consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 4 water shortage, the city will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of up to eight hundred seventy-five million gallons and an average daily water demand reduction of up to four million two hundred thousand gallons.

(b) During Stage 4, it shall be unlawful for any person, firm, partnership, association, corporation, political body (including the city) or other water department customer:

1. To water or irrigate landscape or other vegetated area between the hours of 10:00 a.m. and 5:00 p.m., except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low volume, nonspray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system;

2. To use a hose that is not equipped with a shutoff nozzle;

3. To use potable water to wash down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking lots, tennis courts, patios, or other paved surfaces, except when it is necessary to alleviate safety or sanitation hazards or to prepare paved surfaces for sealing;

4. To fill or to top off any swimming pools, outdoor spas, wading pools, and ornamental water features;

5. To serve water in a restaurant or other commercial food service establishment except upon the request of a patron;

6. To operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens;

7. To water or irrigate landscape or other vegetated area on days of the week other than the specified day(s) of the week authorized and publicized by the director, except when performed with a bucket or watering can, or by use of a drip irrigation system or similar low volume,

nonspray irrigation equipment, or for very short periods of time for the express purpose of allowing landscape contractors to adjust or repair an irrigation system. Hourly restrictions set forth in subsection (b)(1) continue to apply on authorized watering days. This provision shall not apply to commercial growers/nurseries or to residential vegetable gardens/edible plantings watered with a hose equipped with a shutoff nozzle;

8. To water landscapes using automatic irrigation systems for more than ten minutes per watering station per assigned day. This provision does not apply to automatic irrigation systems using water-efficient devices, including but not limited to weather-based controllers, drip/micro-irrigation systems and stream rotor sprinklers;

9. To wash the exterior of dwellings, buildings or structures (with the exception of window washing and preparation of property for painting or for sale);

10. To irrigate or water landscapes in a manner that conflicts with a customer's landscape irrigation water budget when such a budget is required by the director per the criteria delineated in the city's adopted water shortage contingency plan;

11. To disobey water department direction to large commercial, industrial or irrigation customers using one thousand three hundred thirty-seven or more billing units (one million gallons) per year to conduct water use audits, to prepare water conservation plans and to submit progress reports, or to immediately repair water system leaks, including leaks attributable to faulty pipes or fixtures;

12. To violate residential customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the director in accordance with guidelines set forth in the city's adopted water shortage contingency plan;

13. To disobey water department directives issued to commercial customers requiring the prominent placement of "Save Water" signage at specified locations at the customer's premises;

14. To violate commercial customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the director in accordance with guidelines set forth in the city's adopted water shortage contingency plan;

15. To disobey a water department order to customers identified as "dedicated irrigation accounts" directing those customers to further limit their landscape irrigation and watering activity so as to preserve only the customers' most valuable trees and plants;

16. To water lawns or turf, unless such watering is authorized by the director in accordance with a landscape irrigation water budget and is consistent with the guidelines set forth in the city's adopted water shortage contingency plan;

17. To install new landscaping which requires any irrigation or watering;

18. To wash or clean vehicles, including but not limited to automobiles, trucks, vans, buses, motorcycles, boats, or trailers, including the washing of fleet vehicles and the washing of vehicles on dealer lots. This restriction will not apply to commercial car wash businesses which use recycled water; and/or

19. To exercise any rights conferred by hydrant and bulk water permits that were issued prior to the severe water shortage emergency declaration absent special permission granted by the director. Said special permission may be granted only for projects necessary to protect the public health, safety and welfare where no alternative to potable water exists and for emergency response purposes.

(Ord. 2010-12 § 2 (part), 2010).

16.01.110 STAGE 5: CRITICAL WATER SHORTAGE EMERGENCY.

(a) The director is empowered to declare a critical water shortage emergency and to enforce the water shortage restrictions in this section upon finding that the magnitude of an anticipated water shortage, per the criteria delineated in the city's adopted water shortage contingency plan, shall be between thirty-five percent and fifty percent and an extreme consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water supply conditions. In a Stage 5 water shortage, the city will enforce the following water shortage restrictions with the objective of realizing a seasonal water demand reduction of up to one billion two hundred fifty million gallons and an average daily water demand reduction of up to six million gallons.

(b) During Stage 5, it is unlawful for any person, firm, partnership, association, corporation, political body (including the city) or other water department customer:

1. To water or irrigate any outdoor landscaping, unless such watering is authorized by the director and is consistent with the guidelines set forth in the city's adopted water shortage contingency plan;

2. To use a hose that is not equipped with a shutoff nozzle;

3. To use water for any outdoor washing purpose including commercial car washing, window washing, and paint preparation;

4. To fill or to top off any swimming pools, outdoor spas, wading pools, and ornamental water features;

5. To serve water in a restaurant or other commercial food service establishment except upon the request of a patron;

6. To operate a hotel, motel or other commercial lodging establishment without offering patrons the option to forego the daily laundering of towels, sheets and linens;

7. To use water for recreational purposes;

8. To operate public swimming pools;

9. To operate public showers;

10. To disobey water department direction to large commercial, industrial or irrigation customers using one thousand three hundred thirty-seven or more billing units (one million gallons) per year to conduct water use audits, to prepare water conservation plans and to submit progress reports, or to immediately repair water system leaks, including leaks attributable to faulty pipes or fixtures;

11. To violate residential customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the director in accordance with guidelines set forth in the city's adopted water shortage contingency plan;

12. To violate commercial customer water rationing regulations, including regulations intended to preclude excessive water usage and specifying maximum water usage limitations, issued by the director in accordance with guidelines set forth in the city's December 2008 water shortage contingency plan;

13. To disobey water department directives issued to commercial customers requiring the prominent placement of "Save Water" signage at specified locations at the customer's premises;

14. To install new landscaping which requires any irrigation or watering; and/or

15. To exercise any rights conferred by hydrant and bulk water permits that were issued prior to the critical water shortage emergency declaration absent special permission granted by the director. Said special permission may be granted only for projects necessary to protect the public health, safety and welfare where no alternative to potable water exists and for emergency response purposes.

(Ord. 2010-12 § 2 (part), 2010).

16.01.120 EXCEPTIONS.

(a) The director, upon application made in writing by a customer on a form promulgated by the water department and accompanied by supporting documentation, shall be authorized to issue an exception from the strict application of any restriction, regulation or prohibition enforced pursuant to this chapter, upon the customer's production of substantial evidence demonstrating the existence of one or more of the following circumstances that are particular to that customer and which are not generally shared by other water department customers:

1. Exceptions Applicable to All Water Department Customers:

A. Failure to approve the requested exception would cause a condition having an adverse effect on the health, sanitation, fire protection, or safety of the customer or members of the public served by the customer;

B. Alternative restrictions to which the customer is willing to adhere are available that would achieve the same level of demand reduction as the restriction for which an exception is being sought and such alternative restrictions are enforceable by the water department;

C. Circumstances concerning the customer’s property or business have changed since the implementation of the subject restriction warranting a change in the customer’s water usage allocation.

2. Exceptions Applicable Only to Water Department Nonresidential Customers. For purposes of this subsection a residential dwelling unit which is used as a vacation rental shall not be classified as a business.

A. Strict application of the subject restriction, regulation or prohibition would impose a severe or undue hardship on a particular business customer or render it infeasible for a particular business customer or class of business customers to remain in operation;

B. A hospital or health care facility customer using industry best management practices is eligible for an exception upon demonstrating that the subject restriction, regulation or prohibition is interfering with or preventing it from providing health care service to its customers in accordance with industry hygiene, sanitation and health care standards; or

C. A business customer has already implemented environmental sustainability measures that have reduced water consumption to the maximum extent feasible. As used in this subsection the term “environmental sustainability measures” refers to installation of high efficiency plumbing fixtures, devices, equipment, and appliances, recycled water systems, and landscaping consisting exclusively of low-water-using plant materials using drip or similar high efficiency, nonspray irrigation systems, or to buildings that are designed, built, and continuously operated according to Leadership in Energy and Environmental Design (LEED) certification standards.

(b) In order to qualify for an exception, a customer must first complete a self water audit pursuant to standards and procedures promulgated by the water department. This audit shall be made part of the customer’s exception application and water conservation measures indicated by the audit may be incorporated as conditions of approval to an exception in addition to any other conditions of approval imposed by the director in connection with the director’s approval of the customer’s exception application.

(Ord. 2015-07 § 4, 2015: Ord. 2010-12 § 2 (part), 2010).

16.01.130 WATER SHORTAGE APPEALS.

(a) A water shortage appeal procedure is hereby established which shall apply upon the director’s issuance of any water shortage declaration and the implementation of water shortage restrictions pursuant to Sections 16.01.070 through 16.01.110. Thereafter during the declared water shortage, independent hearing officers shall be appointed to hear and rule upon water shortage appeals filed in accordance with this section.

(b) Any customer who considers an action taken by the director or an enforcement official under the provisions of this chapter, including actions on exception applications and the assessment of administrative penalties, to have been erroneously taken or issued may appeal that action or penalty in the following manner:

1. The appeal shall be made in writing, shall state the nature of the appeal specifying the action or penalty that is being appealed and the basis upon which the action or penalty is alleged to be in error. Penalty appeals shall include a copy of the notice of violation;

2. An appeal, to be effective, must be received by the director not later than ten business days following the date of the notice of violation or the date that the director took the action which is the subject of the appeal;

(A) A water service resident who is not an account customer may notify the water department of his or her intention to file a petition to force the resident's account customer to appeal an excess water use penalty within ten business days following the penalty;

(B) If the water department has been given a notice of intention to file a petition per subsection (b)(2)(A) by a water service area resident who is not an account customer, the appeal from the account customer must be received within fifteen business days after the account customer has been petitioned by the resident;

3. The director shall schedule the appeal for consideration by an independent hearing officer. The independent hearing officer shall hear the appeal within ninety days of the date of the appeal and issue its decision within thirty days of the date of the hearing;

4. The decision of the independent hearing officer shall be final. In ruling on appeals, the independent hearing officer shall strictly apply the provisions of this chapter, and shall not impose or grant terms and conditions not authorized by this chapter.

(Ord. 2015-07 § 5, 2015: Ord. 2010-12 § 2 (part), 2010).

16.01.140 ADMINISTRATIVE ENFORCEMENT.

(a) Any person, firm, partnership, association, corporation, political entity or other water department customer violating any provision of this chapter may be assessed an administrative penalty.

(b) Each and every day a violation of this chapter exists constitutes a separate and distinct offense for which an administrative penalty may be assessed.

(c) Penalties. The purpose of the administrative penalties assessed pursuant to this section is to assure future chapter compliance by the cited customer through the imposition of increasingly significant penalties so as to create a meaningful disincentive to commit future chapter violations. In acknowledgment of the fact that the city's water is a scarce and irreplaceable commodity and that this chapter is intended to equitably distribute that commodity among water department customers and to assure that, to the extent feasible, city water is conserved and used only for purposes deemed necessary for public health and safety, the penalty schedule herein prescribed is not to be construed as creating a "water pricing" structure pursuant to which customers may elect to pay for additional water at significantly higher rates. To this end, a customer's repeated violation of this chapter shall result in either the installation of a flow restriction device or disconnection of the customer's property from the city's water service system at the customer's cost.

(d) Administrative penalties for failure to comply with water waste prohibition requirements in Section 16.01.060 or mandatory water use restrictions and regulations commencing with Stage 1 in Section 16.01.070 are as follows:

1. First Offense. Written notice of violation and opportunity to correct violation.

2. Second Offense. A second violation within the preceding twelve calendar months is punishable by a fine not to exceed one hundred dollars.

3. Third Offense. A third violation within the preceding twelve calendar months is punishable by a fine not to exceed two hundred fifty dollars.

4. Fourth Offense. A fourth violation within the preceding twelve calendar months is punishable by a fine not to exceed five hundred dollars. In addition to any fines, the director may order a water flow restrictor device be installed.

5. Large Customers. Administrative penalties for customers that use an average of one thousand three hundred thirty-seven billing units (one million gallons) or more per calendar year shall be triple the amounts listed above.

6. Discontinuing Service. In addition to any fines and the installation of a water flow restrictor, the director may disconnect a customer's water service for willful violations of mandatory restrictions and regulations in this chapter. Upon disconnection of water service, a written notice shall be served upon the customer which shall state the time, place, and general description of the prohibited or restricted activity and the method by which reconnection can be made.

(e) Excessive Water Use Penalties. An excessive use penalty shall be assessed where the customer, during any given billing cycle, uses more than the customer's water allotment per the director's water rationing regulations issued pursuant to this chapter commencing with Stage 3 in Section 16.01.090. Excess use penalties shall be in addition to ordinary water consumption charges, as follows:

1. One percent to ten percent over customer rationing allotment: not to exceed twenty-five dollars/CCF.

2. More than ten percent over customer rationing allotment: not to exceed fifty dollars/CCF.

3. In addition to any excess use penalties, the director may order a water flow restrictor device be installed and/or may disconnect a customer's water service for willful violations of the water rationing regulations in this chapter. Upon disconnection of water service, a written notice shall be served upon the customer which shall state the time, place, and general description of the prohibited or restricted activity and the method by which reconnection can be made.

4. The director is authorized to develop administrative policies and procedures for the waiver of excessive water use penalties.

(f) Cost of Flow Restrictor and Disconnecting Service. A person or entity that violates this chapter is responsible for payment of charges for installing and/or removing any flow-restricting device and for disconnecting and/or reconnecting service in accordance with the city's miscellaneous water service fee resolution then in effect. The charge for installing and/or removing any flow restricting device must be paid before the device is removed. Nonpayment will be subject to the same remedies as nonpayment of basic water rates.

(g) Notice and Hearing. The director will issue a notice of violation by mail or personal delivery at least ten business days before taking any enforcement action described in subsection (d). Such notice must describe the violation and the date by which corrective action must be taken. A customer may appeal the notice of violation by filing a written notice of appeal with the city no later than the close of the business day before the date scheduled for enforcement action, accompanied by a twenty-five-dollar appeal fee. Any notice of violation not timely appealed will be final. Upon receipt of a timely appeal, a hearing on the appeal will be scheduled, and the city will mail written notice of the hearing date to the customer at least ten days before the date of the hearing. Pending receipt of a written appeal or pending a hearing pursuant to an appeal, the director may take appropriate steps to prevent the unauthorized use of water as appropriate to the nature and extent of the violation and the current declared water shortage condition.

(Ord. 2015-07 § 6, 2015: Ord. 2010-12 § 2 (part), 2010).

16.01.150 ADDITIONAL ENFORCEMENT AUTHORITY.

In addition to the remedies referenced above, the director is empowered to pursue any additional remedies necessary, including criminal, civil and administrative remedies listed in Title 4 of the Santa Cruz Municipal Code, to correct a violation of this chapter.

(Ord. 2010-12 § 2 (part), 2010).

16.01.160 SEVERABILITY.

If any portion of this chapter is held to be unconstitutional, it is the intent of the city council that such portion of the chapter be severable from the remainder and that the remainder be given full force and effect.

(Ord. 2010-12 § 2 (part), 2010).

RESOLUTION NO. NS-29,012

RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SANTA CRUZ AMENDING RESOLUTION NO. NS-28,836 CONCERNING DROUGHT COST RECOVERY FEE

WHEREAS, Title 16 of the Santa Cruz Municipal Code Provides rules governing the administration and operation of the City's Water System, including identification of the various sources of authority to establish and amend rates, fees, and system development charges by Resolution; and

WHEREAS, on September 23, 2014, the City Council adopted Resolution No. NS-28,836 establishing new water rates and ready-to-serve charges; and

WHEREAS, this resolution pertains to Section 1, number 4, Drought Cost Recovery Fee rates only; and

WHEREAS, the City Council recognized the need to replenish water sales revenues lost due a water shortage declaration and instituted a Drought Cost Recovery Fee on September 23, 2014; and

WHEREAS, the maximum amount of revenue which can be collected through the Drought Cost Recovery Fee is tied to estimated annual revenue shortfalls effected by a water shortage stage declared by the City Council; and

WHEREAS, the language contained in the resolution regarding the Drought Cost Recovery Fee needs further clarification to be consistent with prior noticing and intent; and

WHEREAS, the City Council further finds that the rates established by Resolution No. NS-26,836 and as hereinafter set forth do not exceed the amount of the estimated costs required to provide the services for which the rates are levied; and

WHEREAS, the City Council further finds that the rates previously established to cover the estimated annual shortfall caused by a drought declaration are reasonable and required for the proper operation of the water system, and are exempt from the California Environmental Quality Act, pursuant to Section 21080(b)(8) of the Public Resources Code, because they are for the purposes of (1) meeting operating expenses, (2) purchasing or leasing supplies, equipment and materials, (3) meeting financial reserve requirements, and (4) obtaining funds for capital projects necessary to maintain service within existing service areas.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Santa Cruz as follows:

Section 1: WATER RATES AND CHARGES

The water rates for customers inside and outside of the City Limits are hereby amended to read as follows:

4. The Drought Cost Recovery Fee maximum amounts set forth below are a fixed fee and are hereby established and shall be applicable for the full fiscal year (twelve months) following the water shortage declaration made by City Council. The maximum targeted cost recovery amount is indicated below and is linked to the water shortage stage declared by the City Council.

Service Size	Stage 1 – 5% Shortage	Stage 2 – 15% Shortage	Stage 3 – 25% Shortage	Stage 4 – 35% Shortage	Stage 5 – 50% Shortage
Maximum Targeted Cost Recovery	$ 1,000,000	$ 2,500,000	$ 4,000,000	$ 5,500,000	$ 7,500,000
5/8-in	$ 2.45	$ 6.12	$ 9.79	$ 13.46	$ 18.35
3/4-in	$ 2.45	$ 6.12	$ 9.79	$ 13.46	$ 18.35
1-in	$ 6.13	$ 15.30	$ 24.48	$ 33.65	$ 45.88
1 1/2-in	$ 12.25	$ 30.60	$ 48.95	$ 67.30	$ 91.75
2-in	$ 19.60	$ 48.96	$ 78.32	$ 107.68	$ 146.80
3-in	$ 36.75	$ 91.80	$ 146.85	$ 201.90	$ 275.25
4-in	$ 61.25	$ 153.00	$ 244.75	$ 336.50	$ 458.75
6-in	$ 122.50	$ 306.00	$ 489.50	$ 673.00	$ 917.50
8-in	$ 281.75	$ 703.80	$ 1,125.85	$ 1,547.90	$ 2,110.25
10-in	$ 347.90	$ 869.04	$ 1,390.18	$ 1,911.32	$ 2,605.70

BE IT FURTHER RESOLVED that, except as amended by this resolution, all water-related fees and charges established by Resolution No. NS-28,836 and not amended herein shall not be affected by this Resolution.

Section 2. <u>EFFECTIVE DATE</u>.

This Resolution shall be in force and effect so as to appear in all billings from and after October 27, 2015.

PASSED AND ADOPTED this 27th day of October, 2015, by the following vote:

AYES: Councilmembers Chase, Terrazas, Comstock, Posner, Noroyan; Vice Mayor Mathews; Mayor Lane.

NOES: None.

ABSENT: None.

DISQUALIFIED: None.

APPROVED: ______________________
Mayor

ATTEST: ______________________
City Clerk Administrator

Chapter 16.02
WATER CONSERVATION

Sections:

16.02.010 PURPOSE.

The purpose of this chapter is to ensure that the water supply of the city of Santa Cruz is put to maximum beneficial use and that waste or unreasonable use or unreasonable method of use of water be prevented.

(Ord. 2003-13 § 2 (part), 2003).

16.02.020 APPLICATION OF REGULATIONS.

The provisions of this chapter shall apply to all persons using water, both in and outside the city and within city water service areas, and regardless of whether any person using water shall have a contract for water service with the city. Notwithstanding other code provisions inconsistent with this chapter, the provisions of this chapter shall supersede and prevail until termination of this chapter.

(Ord. 2003-13 § 2 (part), 2003).

16.02.030 DEFINITIONS.

For the purpose of this chapter, the following words shall have the meanings set forth below:

(a) "Director" is the director of the water department of the city of Santa Cruz, or his or her designated representative.

(b) "Drip irrigation" shall mean low-flow point specific irrigation systems that apply water directly to plant root zones through emitters, low volume micro-spray devices that are components of a drip irrigation system, and soaker hoses.

(c) "Person" shall mean any individual, firm, partnership, association, corporation, or political entity.

(d) "Water" shall mean any water obtained from the water department of the city of Santa Cruz.

(Ord. 2003-13 § 2 (part), 2003).

16.02.040 REGULATIONS.

It is unlawful for any person to use water for any of the following:

(a) Fire Hydrants. Use of water from any fire hydrant unless specifically authorized by permit from the city, except by regularly constituted fire protection agencies for fire suppression purposes, or for other authorized uses, including distribution system flushing, fire flow testing, and filling of approved vehicles for sewer system flushing, storm drain maintenance, and street sweeping purposes.

(b) Watering/Irrigation. The watering of grass, lawn, groundcover, shrubbery, open ground, crops and trees, including agricultural irrigation, in a manner or to an extent which allows excess water to run to waste.

(c) Plumbing Leaks. The escape of water through leaks, breaks, or malfunction within the water user's plumbing or distribution system for any period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of twenty-four hours after the water user discovers such break, leak or malfunction, or receives notice from the city of such condition, whichever occurs first, is a reasonable time within which to correct such condition or to make arrangements for correction.

(d) Washing of Exterior Surfaces. The washing of sidewalks, walkways, driveways, parking lots, patios, or other exterior surfaces unless the hose is equipped with an automatic shutoff nozzle.

(e) Cleaning of Structures and Vehicles. The cleaning of building exteriors, mobile homes, cars, boats, and recreational vehicles unless the hose is equipped with an automatic shutoff nozzle.

(f) Fountains. The operation of an ornamental fountain, unless such water is recycled in the fountain.

(g) Cooling. The use of water in new ice-making machines and any other new mechanical equipment that utilizes a single pass cooling system to remove and discharge heat to the sanitary sewer. Water used for all cooling purposes shall be recycled.

(h) Commercial Car Washes. The washing of vehicles at a commercial car wash unless the facility utilizes water recycling equipment, or operates on a timer for a limited time period and shuts off automatically at the expiration of the time period.

(i) Construction. The use of potable water for dust control or soil compaction purposes in construction activities where there is a reasonably available source of reclaimed water appropriate for such use.

(j) Clothes Washing. Water for new non-recirculating industrial clothes wash systems.

(k) The indiscriminate running of water or washing with water not otherwise prohibited in this section, which is wasteful, and without reasonable purpose.

(l) Any other nonessential uses of water, as determined and publicly announced by the director, in response to below average water supply conditions that could result in carryover storage in Loch Lomond Reservoir being drawn down to levels that would trigger the declaration of a water supply emergency in the event of a subsequent dry year, including, but not limited to:

1. Use of potable water to irrigate turf, lawns, gardens, or ornamental landscaping between 10:00 a.m. and 5:00 p.m. unless by drip irrigation, or by hand watering with a quick acting positive shut off nozzle. (Exceptions may be made by the director for professional gardeners where there is no ability to not water between 10:00 a.m. and 5:00 p.m.).

2. Serving drinking water to any customer, unless expressly requested, by a restaurant, hotel, cafe, cafeteria, or other public place where food is sold, served, or offered for sale.

The water director shall provide notification to city council and the public before any such restrictions are put into effect.

(Ord. 2003-13 § 2 (part), 2003).

16.02.050 DISCONNECTION.

Any person in violation of the provisions of this chapter who failed to take corrective action within fifteen days of receiving the first notification of the violation shall be subject to disconnection of water service. Upon disconnection of water service a written notice shall be served upon the violator, or conspicuously posted at the entrance of the violator's premises, and shall state the time, place and general description of the violation and the method by which reconnection can be accomplished.

(Ord. 2003-13 § 2 (part), 2003).

16.02.060 RECONNECTION.

Where water service is disconnected, as authorized above, it shall be immediately reconnected upon correction of the condition or activity and the payment of the reconnection charge in an amount specified by resolution of the city council.

(Ord. 2003-13 § 2 (part), 2003).

16.02.070 APPEAL.

Any person who feels that the activity or condition, which resulted in the disconnection of water service pursuant to this chapter, did not constitute a violation of this chapter may appeal the disconnection to the city council in the manner specified in Chapter 1.16 of the Santa Cruz Municipal Code. If the city council finds that the activity or conduct did not constitute a violation of this chapter, the reconnection charge will be refunded.

(Ord. 2003-13 § 2 (part), 2003).

16.02.080 VIOLATION.

Any person violating this chapter shall be deemed guilty of an infraction. Any person violating this chapter shall be subject to criminal, civil, and/or administrative enforcement action as provided in Title 4 of the Santa Cruz Municipal Code. Each and every day a violation of this chapter exists constitutes a separate and distinct offense for which enforcement action may be taken.

(Ord. 2003-13 § 2 (part), 2003).

16.02.090 ENFORCEMENT.

All peace officers and persons authorized by law to issue citations within the water service area shall, in conjunction with duties imposed by the law, diligently enforce the provisions of this chapter. Pursuant to the provisions of Section 836.5 of the State Penal Code, the following officers and employees of the city of Santa Cruz are hereby designated and authorized to issue citations for enforcement of this chapter:

Director of the water department;

Deputy director/Operations manager;

Water quality manager;

Customer service manager;

Utility supervisor;

Production superintendent;

Water conservation coordinator;

Utility service representative;

Water department employees designated by the director.

(Ord. 2003-13 § 2 (part), 2003).

Information About Proposed Water Rate Increases

To Fund Water System Upgrades
August 2014

Learning From the Past; Preparing for the Future

The mission of the City of Santa Cruz Water Department is to provide a safe, clean and continuous supply of water that meets or exceeds local, State and Federal standards for public health and environmental quality, and to provide courteous, responsive and efficient service in the most cost-effective manner to our customers. The Department provides water to 93,000 customers, 24 hours a day, 365 days per year and there hasn't been a lapse in our service delivery in over 100 years.

There have been a lot of changes to the process of producing and delivering water. A century ago, Santa Cruz's water pipes were hollowed out redwood logs. Raw water from local rivers and creeks was piped directly to homes, without any treatment. Water was taken from rivers and creeks without concern that there wouldn't be enough left for fish.

A lot has been learned from the past to help us now prepare for the future. Our past tells us that our water sources aren't always plentiful, so we need to conserve what we have. With dramatically increased regulations to treat and store water, we've learned how critical it is for us to maintain and improve the facilities we have. We've learned that our consumption of water has had negative impacts on critical habitat for endangered species. And we've learned that our local rainfall, which provides 100% of our water supply, isn't as predictable as it was in years past.

Our community's health, safety, economy and quality of life rely on our water supply. Local water infrastructure needs to be updated so we don't waste precious drops of water and to ensure continued service efficiency. The water treatment plant needs to be retrofitted so we are prepared to comply with changing processes and regulations to effectively treat water. And pipes and delivery systems that have far outlived their lifespans need to be replaced.

www.cityofsantacruz.com/waterrates

Proposed Rate Increases

Collecting, treating and delivering water is a capital-intensive service. We're proposing a rate increase over the next five years.

What will the proposed rate increases look like?

Customers currently pay a monthly "Ready to Serve" charge, which is a service charge to cover part of the fixed costs of delivering water. This service charge is currently approximately $17 to $22 per month for residential customers and we are proposing to increase it by 10% each year for the next five years. Customers also pay for the volume of water consumed, which is currently in the range of $1.50 to $9.00 per unit (a unit is 748 gallons of water) for residential customers. The rate for the volume of water is proposed to increase 10% each year for the next five years. (See enclosed proposed rate and fee schedules.)

The City is also proposing a Drought Cost Recovery fee for the next two years. Under curtailment and rationing, customers use less water and the Water Department earns less revenue. However, it still costs the Department just as much to operate the water delivery system – those costs don't decrease because most of the expense for delivering water is in system infrastructure.

For each stage of water shortage during drought conditions, Water Department revenue declines over $1 million dollars, combined with increased costs for implementing curtailment and rationing, while most Water Department costs for continued operations, maintenance and capital replacement of the water system remain fairly constant. The current Stage 3 water shortage, for example, has resulted in approximately $3 million dollars in lost revenue, combined with additional costs related to implementing Stage 3 rationing. In order to cover the cost of Department operations, maintenance and capital depreciation during periods of reduced consumption, the proposed rate increase includes Drought Cost Recovery fee that is progressively higher for each stage of water shortage, as shown on the proposed fee schedule below.

The proposed Drought Cost Recovery Fee will be assessed on a monthly basis and would be implemented for the full fiscal year.

What will you get for your money?

In addition to funding ongoing Water Department operations, administration and future planning, during the next five years, the Water Department proposes to make significant investments in upgrading and rehabilitating your water delivery system. While still functional, most of the system is many decades old and things are wearing out. In addition, there are many new regulations for treating water that didn't exist when our system was built. You can think of our system like a classic car; still a solidly built machine, but continually requiring replacements and upgrades to keep it running smoothly.

The projects that the water department will be undertaking to upgrade, improve and maintain the water system are as follows. These projects are proposed to be funded through a rate increase.

<table>
<tr><th>PROJECT</th><th>FY 2015</th><th>FY 2016</th><th>FY 2017</th><th>PROJECT TOTALS 2008-2017</th></tr>
<tr><td>North Coast System Rehabilitation</td><td colspan="2">$8.9 million</td><td>$1 million</td><td>$14.1 million</td></tr>
<tr><td>Graham Hill Water Treatment Plant Upgrades</td><td colspan="3">$14.4 million</td><td>$15.8 million</td></tr>
<tr><td>Bay Street Reservoir Tank Construction</td><td>$6.1 million</td><td></td><td></td><td>$26.3 million</td></tr>
<tr><td>Water Main Replacement Projects</td><td>$2.6 million</td><td>$2.6 million</td><td>$2.6 million</td><td>$12.1 million</td></tr>
<tr><td>Other: Storage Tank Rehab, Well and Pump Station Rehab, Facility Improvements</td><td colspan="3">$7.7 million</td><td>$47.9 million</td></tr>
</table>

Water System Upgrade Projects

North Coast System Rehabilitation

The Santa Cruz Water Department has operated and maintained the 18-mile-long North Coast system since the 1880s. Diversion structures ranging in age from approximately 80 years to over 120 years direct flows from North Coast sources (including Liddell Springs and Reggiardo, Laguna and Majors creeks,) into a pipe system, which conveys water by gravity to the Coast Pump Station adjacent to the City's San Lorenzo River intake. The Coast Pump Station lifts water to the Graham Hill Water Treatment Plant where it is treated and delivered to customers. The North Coast sources rely on rainfall and groundwater to furnish up to 30% of the City's overall water production and this water is the City's highest quality water. A significant portion of the 18-miles of pipeline is approaching, or has exceeded, its lifespan. This aging infrastructure is prone to higher levels of maintenance and an increased potential for failure. This $45 million project is segmented into 6 phases to be completed over approximately 15 years. Phases 1 and 2 were completed between 2006 and 2012; the City is currently working on Phase 3.

Graham Hill Water Treatment Plant Upgrades

The Graham Hill Water Treatment Plant (GHWTP) was commissioned in 1960 and has undergone expansion and improvements over the last five decades. A series of recent studies have identified a number of projects that are necessary to meet complex water quality regulations and plant reliability goals. The priority project includes rehabilitation of the existing filters and filter bays. Valued at $4.5 million, this project consists of structural improvements to the filter and drain system infrastructure and associated piping, valve, and electrical and instrumentation improvements. Construction of the project is scheduled to begin in fall 2014. The project is tentatively scheduled to be completed by October 2015. Future proposed projects include rehabilitation of various other tanks and basins as well as their mechanical, electrical and communications components.

Bay Street Reservoir

The Bay Street Reservoir was originally constructed in 1924 to hold untreated water from North Coast water sources. The reservoir originally held approximately 35 million gallons of water. The reservoir was converted to store treated water and a roof was added in 1976 to protect finished drinking water from airborne contaminants. Due to growing risks of the aging infrastructure and the management practice of reducing the overall volume of stored treated water to reduce stagnation and byproduct build-up the Water Department demolished the original Bay Street Reservoir in fall 2007. A $26 million project to construct two replacement 6-million gallon tanks at the facility is currently underway, with the first tank placed into service in October 2013. The second tank is under construction and expected to be complete in spring of 2015.

Water Main Replacement

The Santa Cruz water delivery system is made up of over 300 miles of water mains. This includes over 30 miles of large diameter mains from the City's water sources, such as Loch Lomond Reservoir, and more than 250 miles of water mains within City and County streets, which deliver treated drinking water to customers. Guided by water industry standards, the Water Department reserves funds to replace 2-4 miles of aging water mains each year. Many factors guide replacement priority including the need to maintain water system reliability and water quality, deliver adequate fire flows, improve circulation, and reduce maintenance costs by coordinating street paving with other planned projects.

Storage Tank Rehabilitation, Facilities Improvements, Well and Pump Station Rehabilitation

These projects will include the rehabilitation of a storage tank for treated water located on Empire Grade, an evaluation of the intake system on the San Lorenzo River, replacement of several pumps and motors throughout the system and completion of the Beltz 12 well project.

CITY OF SANTA CRUZ

Rates Inside the City of Santa Cruz

Inside City Ready-to-Serve Rates (fixed)

Meter Size	Current Rates	FY 2015 Effective October 2014	FY 2016 Effective July 2015	FY 2017 Effective July 2016	FY 2018 Effective July 2017	FY 2019 Effective July 2018
5/8-in	$17.41	$19.16	$21.08	$23.19	$25.51	$28.07
3/4-in	$17.41	$19.16	$21.08	$23.19	$25.51	$28.07
1-in	$43.52	$47.88	$52.67	$57.94	$63.74	$70.12
1 1/2-in	$87.05	$95.76	$105.34	$115.88	$127.47	$140.22
2-in	$139.27	$153.20	$168.52	$185.38	$203.92	$224.32
3-in	$261.14	$287.26	$315.99	$347.59	$382.35	$420.59
4-in	$435.24	$478.77	$526.65	$579.32	$637.26	$700.99
6-in	$870.46	$957.51	$1,053.27	$1,158.60	$1,274.46	$1,401.91
8-in	$2,002.05	$2,202.26	$2,422.49	$2,664.74	$2,931.22	$3,224.35
10-in	$2,472.09	$2,719.30	$2,991.23	$3,290.36	$3,619.40	$3,981.34

Inside City Commodity Rates (volumetric)

	Current Rates	FY 2015 Effective October 2014	FY 2016 Effective July 2015	FY 2017 Effective July 2016	FY 2018 Effective July 2017	FY 2019 Effective July 2018
SFR	$ / ccf	$ / ccf	$ / ccf	$ / ccf	$ / ccf	$ / ccf
Tier 1	$1.57	$1.73	$1.91	$2.11	$2.33	$2.57
Tier 2	$4.00	$4.40	$4.84	$5.33	$5.87	$6.46
Tier 3	$5.14	$5.66	$6.23	$6.86	$7.55	$8.31
Tier 4	$7.05	$7.76	$8.54	$9.40	$10.34	$11.38
Tier 5	$8.79	$9.67	$10.64	$11.71	$12.89	$14.18
Uniform (Non-SFR)	$4.00	$4.40	$4.84	$5.33	$5.87	$6.46
North Coast	$1.27	$1.40	$1.54	$1.70	$1.87	$2.06

Rates Outside the City of Santa Cruz

Outside City Ready-to-Serve Rates (fixed)

Meter Size	Current Rates	FY 2015 Effective October 2014	FY 2016 Effective July 2015	FY 2017 Effective July 2016	FY 2018 Effective July 2017	FY 2019 Effective July 2018
5/8-in	$22.20	$24.42	$26.87	$29.56	$32.52	$35.78
3/4-in	$22.20	$24.42	$26.87	$29.56	$32.52	$35.78
1-in	$55.50	$61.05	$67.16	$73.88	$81.27	$89.40
1 1/2-in	$110.98	$122.08	$134.29	$147.72	$162.50	$178.75
2-in	$177.56	$195.32	$214.86	$236.35	$259.99	$285.99
3-in	$332.95	$366.25	$402.88	$443.17	$487.49	$536.24
4-in	$554.92	$610.42	$671.47	$738.62	$812.49	$893.74
6-in	$1,109.83	$1,220.82	$1,342.91	$1,477.21	$1,624.94	$1,787.44
8-in	$2,553.34	$2,808.68	$3,089.55	$3,398.51	$3,738.37	$4,112.21
10-in	$3,151.92	$3,467.12	$3,813.84	$4,195.23	$4,614.76	$5,076.24

Outside City Commodity Rates (volumetric)

	Current Rates	FY 2015 Effective October 2014	FY 2016 Effective July 2015	FY 2017 Effective July 2016	FY 2018 Effective July 2017	FY 2019 Effective July 2018
SFR	$ / ccf	$ / ccf	$ / ccf	$ / ccf	$ / ccf	$ / ccf
Tier 1	$2.00	$2.20	$2.42	$2.67	$2.94	$3.24
Tier 2	$5.10	$5.61	$6.18	$6.80	$7.48	$8.23
Tier 3	$6.55	$7.21	$7.94	$8.74	$9.62	$10.59
Tier 4	$8.98	$9.88	$10.87	$11.96	$13.16	$14.48
Tier 5	$11.21	$12.34	$13.58	$14.94	$16.44	$18.09
Uniform (Non-SFR)	$5.10	$5.61	$6.18	$6.80	$7.48	$8.23

Drought Cost Recovery Fees & Water Rate Comparison

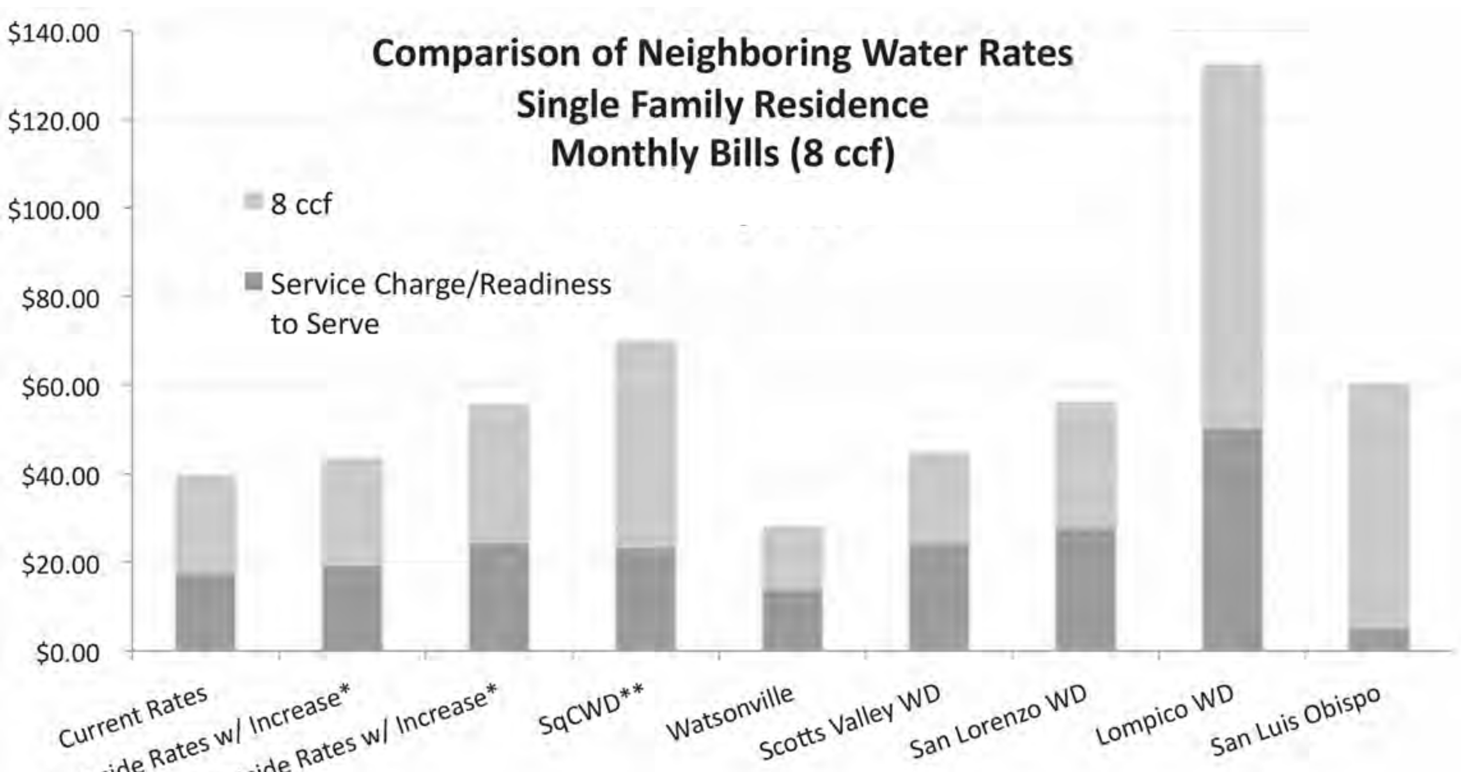
Proposed Drought Cost Recovery Fees

DROUGHT STAGE	CUTBACK REQUIRED	MAXIMUM TARGETED COST RECOVERY	3/4-INCHOR 5/8-INCH DROUGHT RECOVERY FEE
Stage 1	5%	$1,000,000	$2.45
Stage 2	15%	$2,500,000	$6.12
Stage 3	25%	$4,000,000	$9.79
Stage 4	35%	$5,500,000	$13.46
Stage 5	50%	$7,500,000	$18.35

The proposed Drought Cost Recovery Fee will be assessed on a monthly basis and would be implemented for the full fiscal year

Inside and Outside City Drought Cost Recovery Fee Ready-to-Serve Rates (fixed)

DROUGHT FEES	FY 2015 – EFFECTIVE OCTOBER 2014	FY 2016 – EFFECTIVE JULY 2015
ON RTS		
5/8-IN	$7.37	$2.45
3/4-IN	$7.37	$2.45
1-IN	$18.43	$6.13
1 1/2-IN	$36.85	$12.25
2-IN	$58.96	$19.60
3-IN	$110.55	$36.75
4-IN	$184.25	$61.25
6-IN	$368.50	$122.50
8-IN	$847.55	$281.75
10-IN	$1,046.54	$347.90
COMMODITY	$0 / CCF	$0 / CCF



*Does not include Drought Cost Recovery Fee. **Does not include Water Shortage Emergency Fees.

Notice of Public Hearing

The City Council for the City of Santa Cruz will hold a Public Hearing Tuesday, September 23, 2014, during the regular meeting of the City Council at 7:00 pm.

The City Council will consider adoption of a proposed water rate increase affecting all water customers. Interested persons are encouraged to attend and comment on the issues being discussed. The meeting will be held in City Council Chambers at 809 Center Street.

Written protests: **Any property owner or a tenant who is a customer of the Water Department may protest the proposed water rates.** Only one written protest per parcel, filed by an owner or a tenant who is a customer, will be counted. Only written and signed protests that include the writer's address and/or assessor parcel number will be counted to determine whether a majority protest to the proposed water rate increase exists. Written protests may be mailed or hand delivered to the Mayor and Council of Santa Cruz at 809 Center Street, Room 10, Santa Cruz, CA 95060.

If you oppose the proposed rate increases, your protest must be submitted in writing to be counted, even if you plan to attend the Public Hearing. To be counted, the protest must: 1) be in writing; 2) state opposition to the proposed rate increase; 3) identify the parcel by assessor's parcel number or street address; 4) include the original signature of the owner of record or a tenant who is a customer of the Water Department submitting the protest; 5) be received before the conclusion of the Public Hearing on September 23, 2014. The meeting will be held in City Council Chambers at 809 Center Street.

For more information, visit www.cityofsantacruz.com/waterrates.

CITY OF SANTA CRUZ

Santa Cruz Water District
212 Locust Street
Santa Cruz, CA 95060

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Notice of Public Hearing
Proposed Water Rates
Affecting Your Area

CITY OF SANTA CRUZ WATER DEPARTMENT

LONG RANGE FINANCIAL PLAN

JUNE 2016

LONG RANGE FINANCIAL PLAN

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Executive Summary

The Long Range Financial Plan (LRFP or Financial Plan) was developed to ensure the financial sustainability of the City of Santa Cruz's Water Enterprise Fund during the ten year period 2016 – 2026. This Financial Plan is specifically designed to support the continued operations and maintenance of the water system and its ability to serve the community with a high quality and reliable water supply, and to lay out the funding strategy that will be needed to finance major capital investments in water system infrastructure and the construction of a water supply augmentation project.

To prepare this Financial Plan, the Water Department and its consultants Raftelis Financial Consultants and Public Financial Management developed a series of financial planning inputs and outputs including:

- Prepared annual Operations and Maintenance Budgets for the Water Department;
- Developed a 10 Year Capital Improvement Plan;
- Integrated the Department's financial planning with existing Financial Policies and Goals, including developing a new financial policy on debt service coverage ratios and providing a strategy for fully funding all reserves;
- Projected revenue requirements for the 10 year period July 1, 2016 through June 30 2026;
- Completed a comprehensive Cost of Service Analysis;
- Identified a financing strategy that combines debt financing and pay-as-you-go investments to support the implementation of the 10 Year Capital Improvement Program;
- Updated Water Rate Structures, including considering the impacts to customers or a range of rate structure options; and
- Developed recommended Water Rates to implement the recommended water rate structure and meet the identified revenue requirements.

Capital investments of $127.9 million are planned for the next five years from Fiscal Year (FY) 2017 through FY 2021, with 33% of those costs ($42 Million) required to comply with state regulatory requirements. The CIP for FY 2022 through FY 2026 requires an additional investment of $169 million for a ten year CIP total of $296.9 million.

Using the revenue requirements data developed as part of the financial planning work, a five-year schedule of water rates is proposed for implementation. The proposed water rate structure includes the following assumptions and provisions:

- For the purposes of rate development, assume that the amount of water to be sold during the five-years covered by the proposed rates is 2.5 billion gallons per year.
- Adopt a rate structure that collects enough fixed fee revenue to recover the revenue necessary to cover the cost of meter reading, meter maintenance, billing preparation and distribution, and customer service. For FY 2017 this amounts to about 10% of total operating costs. Adopt volume-based user rates to collect the remaining revenues.
- Create a new fee called the Infrastructure Reinvestment Fee (IRF). The purpose of this fee is to help communicate to customers what their rate dollars are paying for which, in this case, involves major reinvestments in existing water system infrastructure. This fee would generate the revenues needed to pay for "pay-as-you-go" capital investments and debt service for capital projects. The cost to customers of this fee would be based on customer water use which, again, supports achievement of high priority pricing objectives.
- Acknowledge and mitigate for the risks to revenue stability associated with moving to a more volume based rate using two strategies:
    1. Maintaining the conservative assumption at 2.5 billion gallons per year;
    2. Beginning with the planned July 1, 2018 rate increase, apply a $1.00 surcharge per unit of water consumption (a hundred cubic feet or CCF) to increase the amount of the Rate Stabilization Reserve from the current minimum level of $2.3 million to a total of $10 million. In any normal water year where 2.5 billion gallons of water is not sold, the revenue shortfall associated with this situation would be covered by resources from this fund.

This Financial Plan lays out a road map for the Department and informs policy makers and the community about what it will take for the Department to develop and operate the water system needed to deliver service to 95,000 customers in northern Santa Cruz county.

In addition to three appendices that provide some additional details, a Glossary of terms can be found at the end of the Plan.

1. INTRODUCTION

This Long Range Financial Plan includes a ten year financing strategy with a specific financial plan for the first five year period. Overall, the Financial Plan is intended to support the City of Santa Cruz Water Department in achieving the following goals:

- **Address the repair and rehabilitation of critical infrastructure and the needed augmentation of the City's available water supply;**
- **Establish and maintain financial policies, reserve levels, and stable revenues needed to ensure financial sustainability and provide flexibility to adapt to unforeseen circumstances or challenges;**
- **Maintain the credit rating needed to support the Department's ability to debt finance the major capital investments and reinvestments needed to ensure supply and system reliability;**
- **Maintain reasonable rates in the near and medium term;**
- **Achieve an equitable allocation of capital costs/charges between current and future system users; and**
- **Manage rates in a predictable and reasonably stable manner.**

Working together with its consultants, Public Financial Management (PFM) and Raftelis Financial Consultants (Raftelis), a financial planning model was created to allow the Department to project operating and capital budgets and forecast annual revenue requirements. These projections include:

- **Revenues needed to cover debt service payments for the financing expected to be used to fund capital investments;**
- **Assumptions about how much of the capital program will be cash (pay-as-you-go funding) financed versus debt financed; and**
- **Funds required to meet financial reserve targets.**

Raftelis developed proposed water rates using these revenue projections, the Cost of Service Analysis, and Rate Structure Redesign work they completed during the fall and winter of 2015. Based on input received from the Water Commission and City Council in March 2015, priority objectives for pricing water were established to include:

- Revenue sufficiency,
- Promotes efficiency;
- Perceived to be fair by the public;

- Affordable for essential uses,
- Revenue stability,
- Understandable by customers,
- Promotes conservation, and
- Rate stability.

2. BACKGROUND

The Santa Cruz Water Department is an entirely self-funded operation. User rates, fees, and charges are the source of all revenues used to support the ongoing operation, maintenance, planning, management, and capital investments needed to deliver water to some 95,000 water users every day.

The unrestricted fund balance of the Water Operating fund (Fund 711) has historically been strong, but has been declining during the past four fiscal years. A major cause of this decline is cash funding of large Capital Improvement Program (CIP) projects such as the $26 million reconstruction of the Bay Street Reservoir.

The customer base is stable, primarily residential and reasonably diverse with the top 10 customers accounting for only 11% of total operating revenues. The service area economy is also stable and anchored by the University of California at Santa Cruz.

The three primary cost drivers of the LRFP include the following;

- **Capital projects to comply with State regulatory requirements;**
- **Capital projects to address infrastructure reinvestment and rehabilitation of major elements of the water system; and**
- **One or more capital projects to augment water supply that will result from implementing the recommendations of the Water Supply Advisory Committee.**

1.1 PLANNED CAPITAL INVESTMENTS

Capital investments of $127.9 million are planned for the next five years from Fiscal Year (FY) 2017 through FY 2021, with 33% of those costs ($42 Million) required to comply with state regulatory requirements. The CIP for FY 2022 through FY 2026 requires an additional investment of $169 million[1] for a ten year CIP total of $296.9 million.

Capital projects planned for over the ten year period include:

- **PROJECTS FOCUSED ON EITHER REHABILITATING OR REPLACING EXISTING FACILITIES:**
    - Felton Diversion Dam and Pump Station
    - Laguna Dam
    - Majors Creek Diversion
    - San Lorenzo River Diversion and Tait Wells
    - Newell Creek Pipeline (between Newell Creek Dam and the Graham Hill Water Treatment Plant via Felton)
    - Newell Creek Dam Inlet/Outlet Pipeline – a project required to meet state regulatory requirements
    - Additional Phases of the North Coast Pipeline Replacement Project
    - Graham Hill Water Treatment Plant Concrete Tanks
    - Graham Hill Water Treatment Plant Solids Handling
    - Distribution System Water Main Replacements
    - Recoating of University Reservoir Tanks No. 4 and 5
    - Pressure Regulating Stations
    - Beltz 11 Well Replacement
    - Water Treatment Upgrades
- **PROJECTS FOCUSED ON UPGRADING OR IMPROVING EXISTING FACILITIES:**
    - Advanced Metering Infrastructure
    - Loch Lomond Recreation ADA Improvements
    - Photovoltaic/Solar Projects
    - Building for Water Resources Staff
    - Security Camera and Building Access Upgrades
- **PROJECTS FOCUSED ON IMPLEMENTING THE RECOMMENDATIONS OF THE WATER SUPPLY ADVISORY COMMITTEE TO IMPROVE WATER SUPPLY RELIABILITY:**
    - Winter water harvest strategies including in lieu recharge and studies to evaluate and pilot test aquifer storage and recovery

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[1] These figures are in inflation adjusted 2015 dollars

- Study of options for the development and use of recycled water
- Source water quality evaluation related to future potential water treatment requirements, especially as changing source water characteristics might affect water treatment requirements
- Construction of one or some combination of water supply augmentation projects as needed to either increase available stored water by 2.4 billion gallons or provide an additional 3 to 4 million gallons per day source of supply to meet community needs during drought conditions.

The Department proposes to fund these projects with a combination of annual pay-as-you-go revenues and long-term debt.

The total capital investment for the 10 year planning horizon equals $296.9 million.

1.2 CURRENT FINANCIAL PROFILE

In the spring of 2014, the Water Department worked with the City's Finance Department staff to refinance its one existing debt issue from 2006. This step was undertaken to deal with a declining fund balance and the looming impacts of drought-required reductions in water use. The goal of the refinancing was to lower the interest rate and establish a less constraining debt service coverage requirement.

Standard and Poor's Rating Service and Fitch Ratings were asked to provide credit ratings for the Water Department as part of the 2014 refinancing of its debt. A credit rating is useful when an agency needs to access capital markets and issue debt at lower interest rates than would be available without a credit rating. Higher credit ratings can reduce borrowing costs and generate more competition from investors.

The Department's historical credit rating has been AA (high quality). Following the credit rating agency review, Standard and Poor's Rating Service downgraded the utility's credit rating to AA- with a Negative Rating Outlook. Fitch Ratings went farther, providing a rating of A+ (upper medium grade), two steps down from the Department's former AA rating. Both Rating Agencies cited the lack of a recent rate increase, the Department's declining fund balance, in insufficient debt service coverage, and the pending drought as reasons for their views of the Department's creditworthiness.

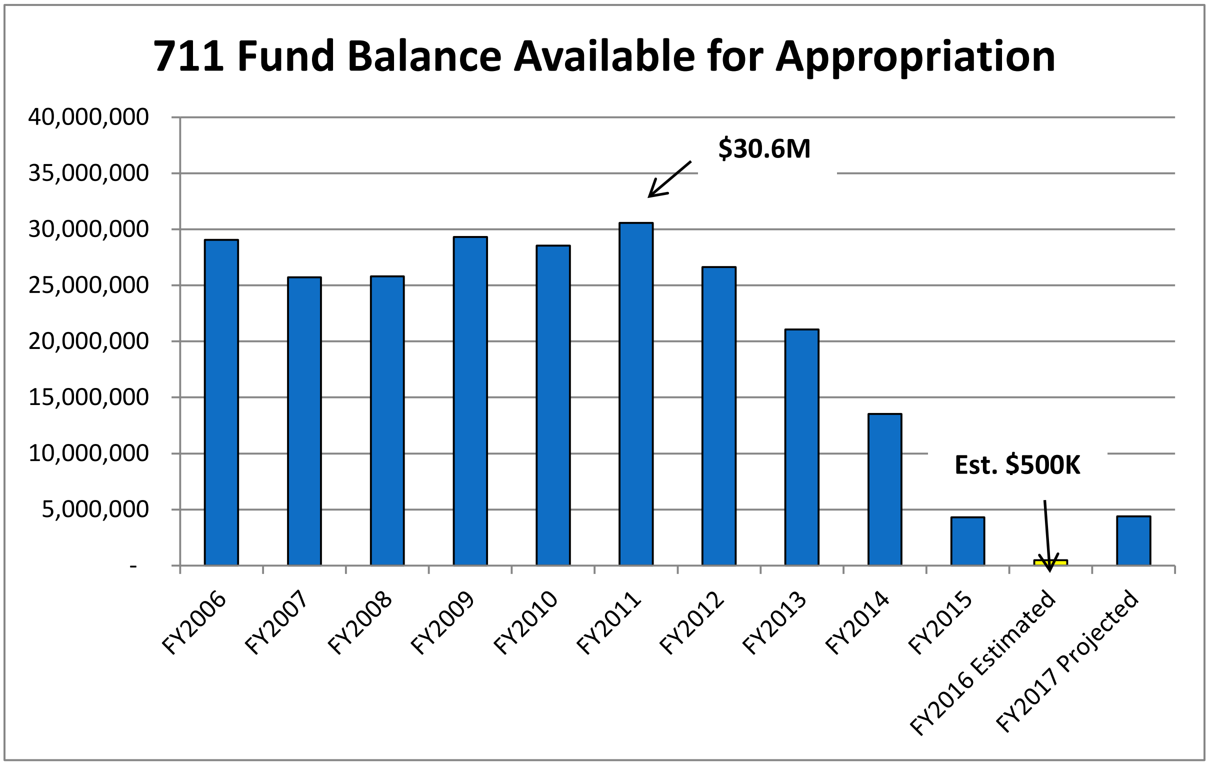
In the summer of 2015, Standard & Poor's revisited the Water Department's rating. This review took into account the City's action on a five-year program of rate increases in September 2014, the utility's and the community's positive response to required water rationing, and the progress being made on the community-based water supply planning process. Standard and Poor's chose to retain the previous AA- rating but revised its rating outlook from Negative to Stable. Fitch Ratings is scheduled to revisit its rating for the Water Department in June of this year.

Annual rate increases of 10% have been approved through 2018. Water rate structure redesign and rate-setting work are currently underway and revised rates will be proposed for action by the Water Commission and the City Council during the winter and spring of 2016. The redesigned rates will replace and extend the original five-year rate increase program adopted in 2014.

For planning purposes, it has been assumed that the first year of any revised rate structure and increase will be applied on October 1, 2016. However, to address the immediate issue of declining cash and fund balance it is recommended that the originally planned 10% increase be implemented on July 1, 2016 and be replaced when the new structure is implemented in October. Remaining rate increases for years two through five of the new five-year rate program would be applied on July 1, in each year 2017, 2018, 2019, and 2020.

Figure 1 shows the Department's fund balance in Water Enterprise Operating Fund (Fund 711) demonstrating a high of $30.6 Million in 2011 that has steadily declined in the last five years and is estimated to approach $500,000 by end of FY 2016. The cause of the steady decline in this fund balance is cash financing the Department's Capital Improvement Program, reduced revenues resulting from restricting water use in the summers of 2014 and 2015, and rates not being set high enough to recover ongoing operating costs, even when water use is not restricted.

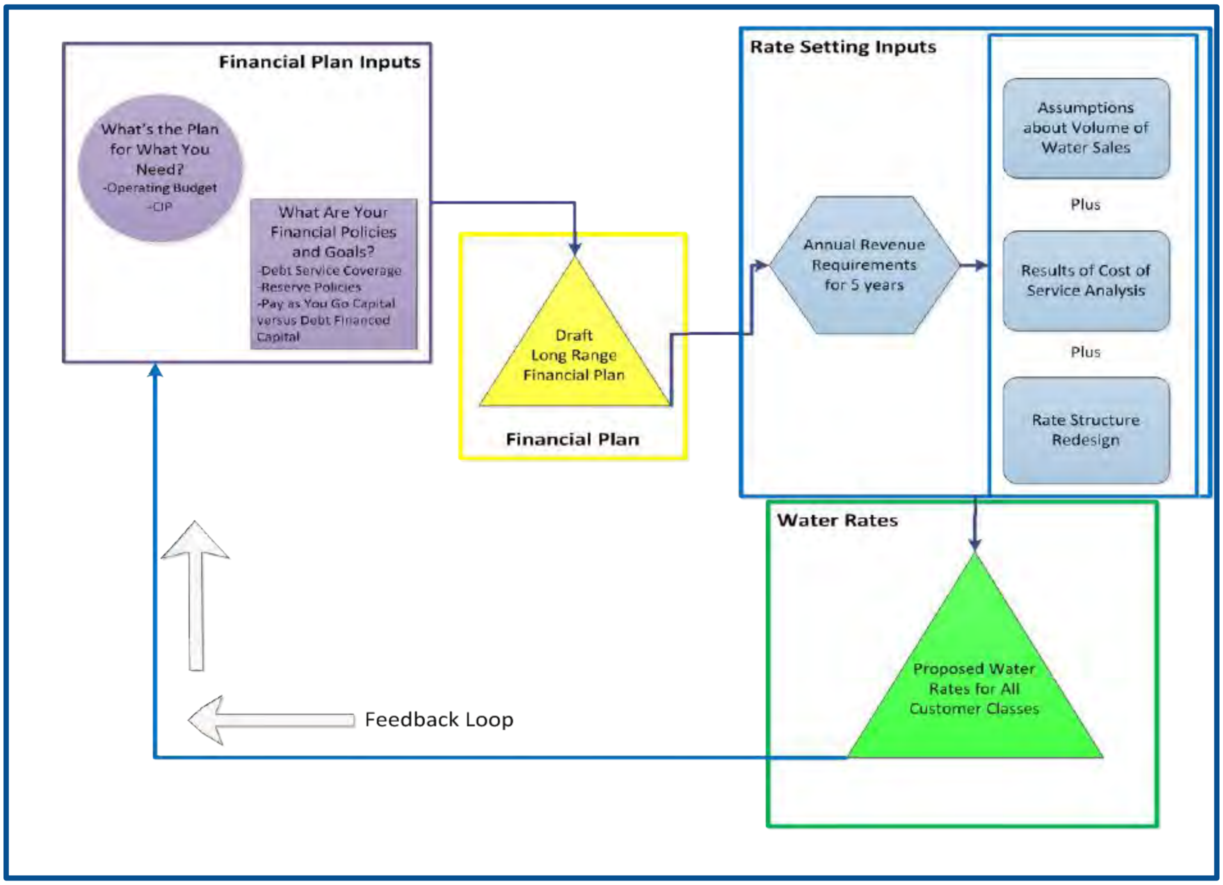
Figure 1
Operating Fund Balance



3. CONCEPTUAL MODEL FOR UTILITY FINANCIAL PLANNING

Financial planning and rate making for today's water utility involves a multi-stepped process depicted in Figure 2 below. The figure shows the inputs and outputs of the utility financial planning and rate making processes. It also shows the feedback loop between proposed rates, the end product of the process, and the organization's budget and CIP, which are key inputs to the beginning of the process.

Figure 2
Conceptual Model of Utility Financial Planning and Rate Making



Financial policies and financial indicators are a second key input in the financial planning process. These policies and indicators help measure financial performance. An organization's financial performance is a key factor in establishing its credit rating, which affects the interest rate that will be charged on borrowed funds.

4. INPUTS TO THE FINANCIAL PLAN

The draft Financial Plan and ten-year Pro Forma shown in Appendix A have been prepared using an Excel-based capital planning model developed by PFM. Briefly, the model uses as inputs the following financial data:

1. **The beginning fund balance for the Department's Operating Fund (Fund 711),**
2. **Multi-year operating expenses, as modified by specific inflation factors,**
3. **Multi-year capital costs, including specific inflation factors, and**
4. **Multi-year debt service costs.**

The model then produces the following outputs:

1. **Multi-year revenue projections,**
2. **Financial performance metrics related to the debt service coverage ratio and financial reserve goals, and**
3. **The sizing and timing of new debt issues.**

4.1 KEY FINANCIAL POLICIES AND GOALS

Having and meeting goals for key financial performance indicators is central to good financial management. This Financial Plan is purposefully focused on defining and creating a clear and achievable method to meet a set of financial policies and performance indicators that will be necessary for the Department's financial success.

4.1.1 UTILITY CREDIT RATINGS

One typical measure of a Utility's financial performance is its credit rating. Table 1 below describes the factors considered by Credit Rating Agencies in assigning credit ratings.

Table 1
Rating Agency Factors Used in Assigning an Agency Credit Rating

Rating Factor	Rating Sub-Factors & Description
System Characteristics	• asset condition • service area wealth (median family income) • gross county product • unemployment rate • annual utility bill as a % of median family income • system size (O&M)
Financial Strength	• annual debt service coverage • days cash on hand • debt to operating revenues • debt to capitalization ratio
Management	• rate management • regulatory compliance • capital planning • financial planning (debt & investment policies) • operational risk (water supply adequacy)
Legal Provisions	• rate covenant • debt service reserve requirement

Credit rating agencies consider a variety of factors in assigning a credit rating, and utilities that have the best credit ratings typically will include policies that specifically address the financial strength metrics listed in Table 1.

4.1.2 FINANCIAL GOALS AND PERFORMANCE INDICATORS

Over the years, the City Council has established some financial performance metrics for the Water Utility, including a Rate Stabilization Reserve in 1993, and Operating and Emergency Reserves in 2014. As of June 30, 2015, the Rate Stabilization Reserve Fund balance was $2.4 million and the Emergency Reserve Fund balance was $600,000. A 90 Day Operating Reserve Fund was also created in September 2014, but was not funded at June 30, 2015.

The Council's intent in creating the Rate Stabilization Reserve[2] in 1993 was to "shield the Water Fund from the financial effects of extraordinary circumstances." As originally approved by the Council at the time, the rate stabilization reserve would have been used to help the Department deal with one or a combination of the following conditions:

- **Increased CIP or capital outlay expenditures due to an extraordinary non-recurring need or circumstance;**
- **A fluctuation in water consumption revenues creating an unanticipated shortfall, or**
- **Catastrophic losses as the result of a natural disaster.**

In the 23 years since the City Council created this $2.3 million reserve, infrastructure and operating costs have increased substantially and in 2014 the Department recommended and the Council approved creating additional reserves. These additional reserves, one for 90 days of operating cash, and one to address natural disaster types of emergency conditions, effectively replaced the first and third purposes intended to be served by the original Rate Stabilization Reserve. These more substantial reserves also begin the process of moving the utility to a stronger financial position, which better prepares it to deal with future costs.

This Financial Plan incorporates and, in the Financial Plan implementation section later in this document, proposes a method to fund the following goals for key financial performance metrics:

- **Maintain the Rate Stabilization Reserve (Fund 713) of $2.3 million;**
- **Maintain a Water Emergency Reserve Fund (Fund 717) at minimum level of $3 million; and**
- **Create additional operating reserves equal to 180 days of operating expenses. This would be accomplished by Maintaining the new Water Operating Cash Reserve Fund (Fund 716) at the equivalent of 90 days of operating cash and maintaining a minimum fund balance in Operating Fund (Fund 711) at a minimum of an additional 90 days of operating cash.**[3]

Another key financial performance metric is a target for debt service coverage ratio (DSCR). The DSCR is a measure of net operating revenues to annual debt payments. The Water Department has issued relatively little debt over the past 20 years so hasn't formally established or used a debt service coverage ratio (DSCR) target in its financial planning. The

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[2] See http://www.cityofsantacruz.com/home/showdocument?id=3255

[3] In Fiscal 2017, 90 days of operating cash is equivalent to $6.5 Million

bond covenant for utility debt issued in 2006 included a 1.25 DSCR. When that debt was refinanced in 2014, the DSCR was reduced to 1.15.

A financial plan that only supports meeting the legal minimum figure can put the utility at risk of technical default on its bonds if revenues are reduced by, say, drought conditions when water use restrictions are put into place. Establishing a target that is above the minimum legal requirement is a good idea because it builds into the system needed flexibility that makes the utility more financially resilient in the face of uncertainty. The LRFP specifically includes the following debt service coverage ratio target:

- **Maintain a minimum debt service coverage ratio target of 1.5, requiring that a ratio of 1.5 be maintained between annual net revenues and annual debt service.**

Typically the calculation of the debt service coverage ratio does not include funds held in reserve as including reserves in calculating the ratio could result in masking a structural problem in the way rates are set.

4.2 PROJECTED OPERATING BUDGETS

Table 2 shows anticipated operating and capital expenses for FYs 2017 through 2021. Appendix A includes the complete ten year Pro Forma from which the information in Table 2 was excerpted.

Table 2

Anticipated Expenses FY 2017 – 2021

Operating Expenses	2017	2018	2019	2020	2021
Personnel	$12,741,984	$13,868,008	$15,086,021	$15,882,276	$16,733,349
Services, Supplies & Other	12,616,410	13,247,231	13,909,592	14,605,072	15,335,325
Capital Outlay	965,000	1,013,250	1,063,913	1,117,108	1,172,964
Total Operating	**$26,323,394**	**$28,128,488**	**$30,059,525**	**$31,604,455**	**$33,241,638**

Operating costs have been developed based on very modest changes to staffing and departmental operations over time. The changes in Operating costs are based on the annual inflation factors shown in Table 3. These inflation factors are based on actual historical experience and long term industry trends.

Table 3[4]
Operating Budget Inflation Factors

Expense Category	Annual Inflation Factors (percent)		
	2017	2018	2019-2026
Salaries & Wages	3.0	3.0	3.0
Employee Benefits	9.0	9.0	9.0
Operating Supplies and Chemicals	9.2	5.0	5.0
Energy	9.1	5.0	5.0
All Other Categories	3.0	3.0	3.0

1.3 CAPITAL IMPROVEMENT PLAN

Section 1.1 describes the Department's anticipated capital spending of $127.9 million during the first five years covered by the Financial Plan. Capital projects during the first five years will be focused on system rehabilitation and replacement projects. Major expenses to implement the Water Supply Augmentation Strategy[5] are anticipated to occur in the second five years of the financial planning horizon. Figure 3 summarizes the planned capital spending in the three categories described in Section 1.1 Planned Capital Expenditures. Those categories are:

- **Rehabilitation and Replacement, including projects to meet regulatory requirements**
- **Upgrades and Improvements**
- **Water Supply Augmentation**

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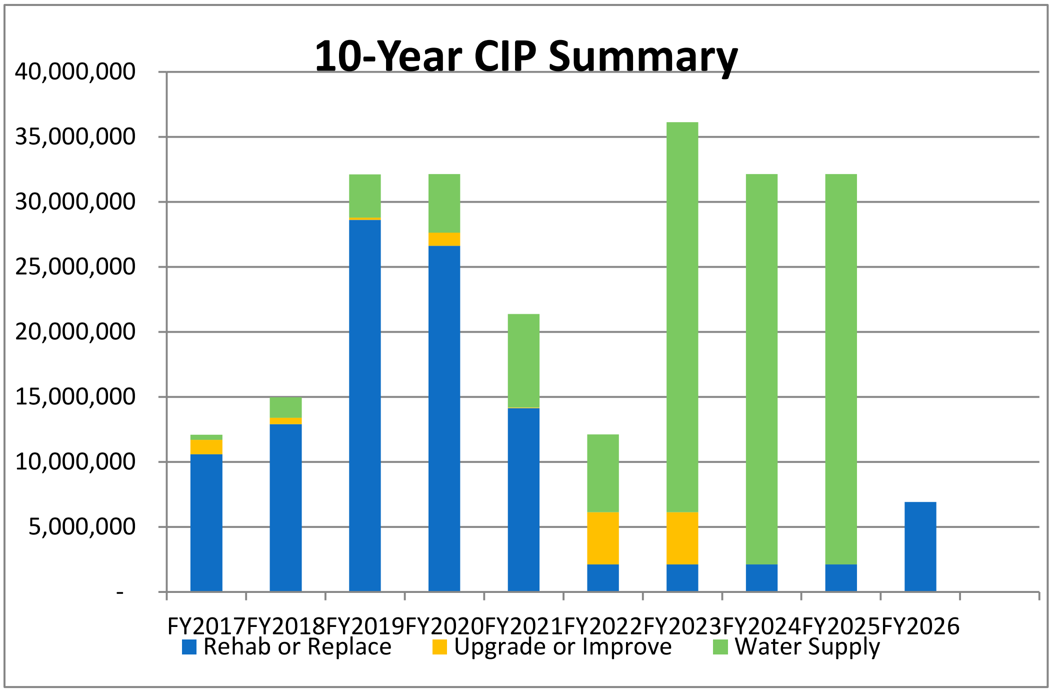
[4] Inflation factors were developed using a combination of actual historical experience (Energy and Chemicals), City projections (salaries and benefits) and industry trends for everything else. The Handy Whitman Index, which focuses on the inflation of construction cost for projects using significant quantities of concrete and steel, and is particularly applicable for water utilities, has been used to escalate the cost of projects in the Capital Improvement Program.

[5] The Water Supply Augmentation Strategy is the result of the community-based water supply planning process completed by the City Council appointed Water Supply Advisory Committee in October 2015.

Figure 3
10 Year CIP



Appendix B provides the details of the Ten Year Capital Improvement Plan, including both brief project descriptions and a ten year plan of spending.

5. LONG RANGE FINANCIAL PLAN RECOMMENDATIONS

This LRFP has been developed based on a specific five year forecast within a ten year planning horizon. The purpose of using the 10 year time frame is to ensure that steps taken during the first five years don't unduly constrain what financial capacity the Department has to address the financial investments needed during the second five years when it expects to construct one or more projects to augment water supply. The specific recommendations are limited to the first five years because that is as far ahead as the Department can establish rates under the limits set by California's Proposition 218.

$113 M

The elements of the Long Range Financial Plan integrate the key financial plan inputs included in Section 4 above, as well as a Capital Financing Strategy, a forecast of Revenue Requirements, and Water Rates needed to meet the Revenue Requirements.

5.1 CAPITAL FINANCING STRATEGY

The Financial Plan recommends that the identified CIP be funded with a combination of rate revenue and debt financing. Over the next five years, pay-as-you-go rate revenue would cover an average of 33% of capital costs, with debt financing covering 67%. Using debt financing to fund a major portion of the CIP provides for inter-generational equity and, by spreading these costs over time, helps to moderate and stabilize near term adjustments to water rates.

In a preliminary way, implementation of this recommendation has already begun. The Department’s request for a loan of $25 million from the California Infrastructure and Economic Development Bank (I-Bank) was approved on March 22, 2016. Funding from the I-Bank is expected to be disbursed following completion of the anticipated Proposition 218 notification process planned for August 2016.

The I-Bank loan provides for the retro-active debt financing of significant capital expenditures that have resulted in depletion of the utility’s fund balance in its main operating fund (Fund 711). This approach was authorized by the Council when it adopted a reimbursement resolution on April 8, 2014. Of the $25 Million I-Bank loan, the Department expects to replenish its fund balances by reimbursing itself for $22 Million in already expended capital costs. As discussed later in this Financial Plan, once the department has been reimbursed for prior capital costs, available funding will provide the resources needed to fully fund reserves. The remainder of the I-Bank funds would support additional capital projects planned to be completed in FY 2017 and 2018.

One of the reasons for developing the LRFP was to be able to assess the Department’s capacity to use debt financing for major elements of its CIP. A measure of the Department’s financial capacity is what portion of its revenues would be used for debt service. For example, the amount of financial flexibility of an organization is substantially reduced as the percent of its revenue dedicated to paying debt service rises.

During the first five years, the Department anticipates issuing debt totaling $85.9 million. The annual average debt service is not expected to exceed 8% of annual rate revenue during the first five years, but it would continue to rise to a maximum of about 24% of annual revenues at the end of the 10 year period. These figures are obviously significantly greater than the Department’s figure of less than 5% of its revenues being currently dedicated to debt service, but the Department’s financial advisors are satisfied that the Department has the debt capacity needed to support the implementation of the LRFP capital financing strategy, as long as the

Department is able to increase rates and charges as outlined in the LRFP, and is able to meet key financial targets, including maintaining financial reserves and meeting the 1.5 debt service coverage ratio.

5.2 REVENUE REQUIREMENTS FOR FY 2017 – FY 2021

As shown in Figure 2, a significant output of financial planning is the revenue requirements that inform the rate making process. Based on the recommendations and assumptions described in Section 4, the Department was able to calculate revenue requirements. Table 4 summarizes the revenue requirements, operating and capital costs, and debt service coverage in the first five years of the financial plan.

Table 4
FY 2017 – FY 2021 Projected Revenue Requirements

	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Infrastructure Reinvestment Fee Amount	$5,990,512	$8,700,797	$9,166,040	$10,169,506	$11,239,068
Rate Stabilization Reserve Amount	-	$3,342,224	$3,342,224	$3,342,224	$3,342,224
O&M Revenue Requirement	$26,323,394	$28,128,488	$30,059,525	$31,604,455	$33,241,638
TOTAL	**$32,313,906**	**$40,171,529**	**$42,567,809**	**$45,116,205**	**$47,822,950**

Revenue requirements have been set at a level needed to ensure that both a minimum 1.50 debt service coverage ratio and a minimum of 180 days of operating cash are maintained.

A more complete version of this table which provides the Department's detailed Financial Pro Forma can be found in Appendix A.

5.3 WATER RATES

Using the revenue requirements data developed as part of the financial planning work and shown in Table 4 above, a five-year schedule of water rates is proposed for implementation. The proposed water rate structure includes the following assumptions and provisions:

- **For the purposes of rate development, assume that the amount of water to be sold during the five-years covered by the proposed rates is 2.5 billion gallons per year[6].**
- **Adopt a rate structure that collects enough fixed fee revenue to recover the revenue necessary to cover the cost of meter reading, meter maintenance, billing preparation and distribution, and customer service. For FY 2017 this amounts to about 10% of total operating costs. Adopt volume-based user rates to collect the remaining revenues.**
- **Create a new fee called the Infrastructure Reinvestment Fee (IRF). This fee would generate the revenues needed to pay for "pay-as-you-go" capital investments and debt service for capital projects. The cost to customers of this fee would be based on customer water use which, again, supports achievement of high priority pricing objectives.**

The IRF is designed specifically to help focus and support customer communication about what water rates are paying for, particularly during the first five years of the CIP, which is emphasizing system rehabilitation and replacement projects for major elements of the system's backbone infrastructure.

- **Acknowledge and mitigate for the risks to revenue stability associated with moving to a more volume based rate using two strategies**:

  1. **Maintaining the conservative assumption at 2.5 billion gallons per year;**
  2. **Beginning with the planned July 1, 2018 rate increase, apply a $1.00 surcharge per unit of water consumption (a hundred cubic feet or CCF) to increase the amount of the Rate Stabilization Reserve from the current minimum level of $2.3 million to a total of $10 million. In any normal water year where 2.5 billion gallons of water is not sold, the revenue shortfall associated with this situation would be covered by resources from this fund.[7]**

In addition to the water rate structure changes and described above, the revenue requirements shown in Table 4 require a significant increase in FY 2017 to begin to fund the capital program, maintain operations, and establish the financial foundation described in Section 4. On a simple

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[6] Note: Water sales in calendar year 2013 equaled 3 billion gallons, in calendar year 2014 equaled 2.5 billion gallons and in calendar year 2015 equaled 2.25 billion gallons.

[7] The Rate Stabilization Reserve Fund would be used to augment revenues during "normal" water years if the amount of water sold falls below 2.5 billion gallons. In water years where water restrictions are required due to inadequate supply, a Drought Cost Recovery charge would be used to ensure revenues are adequate to meet system costs and debt service obligations.

year over year basis, revenues need to increase 21% between FY 2016 and FY 2017, followed by a 24% increase in FY 2108, a by 6% a year in FY 2019, FY 2020 and FY 2021. The big driver of rate increases in FY 17 is capital spending, which is reflected in the Infrastructure Reinvestment Fee. In 2018, the big drivers are additional capital spending and initiating the effort to increase the Rate Stabilization Reserve Fund from the current $2.4 million to $10 million.

These percent increases in revenues are not translated directly to customer bills because of different use patterns and the recommended rate structures. For example, one impact of the recommended rate structure that emphasizes volume based rates is that it will tend to stabilize the cost of water for those whose use of water is very low. Conversely, customers whose use of water contributes to peaking will experience greater increases. And inside city customer will experience a greater increase than outside city customers due to the reduction in the outside city surcharge from 27.5% to 14.5%.

Additional details about the recommended rate structure and water rates can be found in Appendix C.

5.4 REVIEW AND REVISION OF THE LRFP

The LRFP is designed to be used as an ongoing guide for the Water Department as the plan is implemented. The financial planning and rate models that from the analytical basis of the LRFP are effective tools for support the Department's financial decision-making, and will be used and updated as new information is available. In 2021, the Department would expect to complete a new Cost of Service Analysis to use in setting rates of FY 2022 through FY 2026. Using these results as well as updated information on revenue requirements, the Department will comprehensively review and revise the LFRP to guide the next five years.

6. IMPLEMENTING THE LONG RANGE FINANCIAL PLAN

The LRFP is intended to be a living document that will provide a financial foundation for the Department to use in annual budget planning and management activities. A major review and revision of the LRFP will occur at the five year mid-point and, along with other relevant work such as an updated cost of service analysis, revisions to the Financial Plan and water rates will be developed as needed. The LFRP will also be used to measure progress toward meeting LRFP goals during each five year segment covered by the plan.

Working with its consultant team, Department staff has created a Financial Plan that is realistic and implementable. Details of the approaches needed to implement the Plan are presented in the following sections.

6.1 FUND BALANCE RESERVE GOALS

Reserve policies are particularly important to manage risks to an agency's financial condition. In addition, they help an organization establish and maintain a good bond rating, thereby reducing the cost of borrowing.

Beginning in 1993, the Department has built and maintained a Rate Stabilization Reserve Fund (Fund 713). In 2014, the City Council approved two additional reserve funds; a 90-Day Operating Cash Reserve Fund (716) and an Emergency Reserve Fund (717).

Apart from the Rate Stabilization Fund, the remaining reserves have not been fully funded as the utility's financial condition did not enable it to address this important goal. A major driver of the Department's inability to fund these new reserves was the drought, which had a significant negative impact on the Department's revenues. Table 5 provides information on the status at 6-30-2015 and goals of each of the Department's reserve funds.

Table 5
Fund Balance Reserve Goals

Fund		Fund Balance (6-30-2015)	Funding Goal
711	Water Operations & Maintenance	$4,321,718	90 Days Operating Cash $6.5M in 2017
713	Water Rate Stabilization Reserve[8]	$2,447,938	$10,000,000
716	Water 90-Day Operating Cash Reserve	$0	90 Days Operating Cash$6.5 M in 2017
717	Water Emergency Reserve	$600,000	$3,000,000

[8] Once implemented in FY 2018, the expectation is that it would take two years to achieve the $10 million goal for the Rate Stabilization Reserve. For further discussion of how funds in the Rate Stabilization Reserve would be accrued and used, please see section 6.5.2.2.

Establishing the 90-Day Operating Cash Reserve Fund was an important step, however for bond rating purposes a 180-day reserve is preferable. To that end, the financial plan also envisions keeping a 90-day reserve in the operating fund (711) in addition to the 90-Day Operating Cash Reserve Fund (716). Providing a reserve equal to 180-days of operating expenses (between balances in Fund 711 and 716) is considered to be the minimum reserve to maintain a strong bond rating (AA category) and access to capital markets. Increasing these reserves above 180-days operating cash may be pursued if and when resources become available.

The Rate Stabilization Reserve Fund has been maintained at the historic $2.3 million level and seeks to provide a cushion to cover one-time situations where expenses exceed rate revenue. At 6-30-2015, this fund had increased to $2.4 million including interest income. As noted above, the $1/CCF surcharge will be used to help increase this fund to $10 million, as part of the mitigation for moving to a more volume based rate structure. This approach is discussed in greater detail in Section 6.5.2 below.

Initial funding of $600,000 for the Emergency Reserve Fund was made possible by using drought related one-time excessive use penalty revenue accrued during calendar year 2014. An additional $500,000 was accrued from penalty revenue in calendar year 2015 and is expected to be used to increase this reserve for a total of $1.1 Million. The goal for the Emergency Reserve Fund is to maintain a $3 million funding level that would provide funds in the event of an extreme event or natural disaster.

6.2 APPROACH TO FULLY FUNDING RESERVES

In April of 2014, the Water Department recommended that the City Council approve a reimbursement resolution that would allow the Department to debt finance capital improvement work already in construction. The purpose of this request was to allow the Department to reimburse the Department's main operating fund for cash expenditures for capital projects such as the $26 Million Bay Street Reservoir replacement project once a bond issue was completed.

From the $25 Million I-Bank loan mentioned previously, the Department expects to receive reimbursement of $22 million in past capital expenditures from the Department's fund balance. Resources from this cash balance would be used to fund the Department's reserves as follows:

- **$6.5 Million to fully fund the 90-Day Operating Cash Reserve Fund (716)**
- **$2.0 Million to bring the existing $1.1 Million in cash (from excess water use penalties received in FY 2014 and 2015) to $3.1 Million (Fund 717); and**

- **Additional resources needed to maintain a fund balance in the Department's Operating Fund (711) at 90 days of operating cash**

6.3 DEBT FINANCING ASSUMPTIONS

In evaluating future financing needs, the LRFP includes assumptions on the initial and ongoing costs associated with issuing debt. Table 6 shows the projected current interest rate and terms for various debt issuance mechanisms that would most likely be used in debt funding the planned CIP.

Table 6
Debt Mechanism Estimated Rates & Terms

Debt Mechanism	Assumed Interest Rate (percent)	Term (years)
Tax-Exempt Financing (Bonds)	**5.0**	**30**
California Infrastructure & Economic Development Bank (I-Bank)	**3.24**	**30**
Drinking Water State Revolving Loan Fund	**1.6**	**30**

For planning purposes, additional debt issuance is assumed to be tax-exempt bonds issued in seven series. In addition to borrowing, the Department will work to acquire grant funding for capital investments if and as available. Grant funds may most likely be an option to defray some of the costs of the projects included in the Water Supply Augmentation Strategy. The Department will also pursue below market Drinking Water State Revolving Loan Fund loans for rehabilitation and replacement projects that would score well in meeting that program's competitive criteria.

The size and timing of debt issues to finance these capital projects are summarized in Table 7. The draft LRFP envisions three debt issue series from FY 2017 through FY 2021 for a total of $85.9 million. Another four debt issues series are shown from FY 2022 to FY 2025 for a total of $140 million. The total for all seven series is $226 million.

Table 7

Size and Timing of Debt Issues Needed to Fund Capital Program

Debt Issuance Assumptions								
Series	Series 2018	Series 2020	Series 2021	Series 2022	Series 2024	Series 2025	Series 2026	7 Series Total
Assumptions								
Debt Proceeds	$ 37,515,936	$ 29,775,262	$ 18,648,772	$ 51,733,379	$ 39,162,683	$ 42,572,248	$ 6,798,552	$ 226,206,832
Term of Debt	30 Years	30 Years	30 Years	30 Years	30 Years	30 Years	30 Years	
Call Date	3/1/2028	3/1/2030	3/1/2031	3/1/2032	3/1/2034	3/1/2035	3/1/2036	
Assumed Rate	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	
Project Fund Earnings	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	

6.4 CONSIDERATIONS IN THE TIMING AND SIZING OF DEBT

In order to effectively use a debt financing approach to minimize interest costs associated with borrowing, it is necessary to actively manage the timing and sizing of debt issues to avoid paying interest on cash sitting idle in a bank account. Given this concern, when issuing debt, it makes sense to take into account the following:

- **Set a minimum debt financing amount of $15 million;**[9]
- **Consider the spending rate on current and near term capital projects;**[10]
- **Consider market conditions or interest rate changes that might be more or less favorable in the future;**
- **Explore the potential to use one or more bridge funding mechanisms such as a bank letter of credit or internal borrowing (from City reserve funds, for example) that would allow for debt issuance at a later date.**

The PFM model includes a debt sizing function that can be used to forecast capital expenditures and anticipate when additional borrowing is needed. The model uses both built in parameters, such as the minimum $15 million in borrowing, and the opportunities to consciously consider

[9] The reason for establishing a minimum issuance amount for a debt issue is based on reasoning that is similar to the advice of travel gurus regarding going to the ATM when you're on vacation in a foreign country. There are certain transaction costs associated with taking money out of the ATM that don't vary (or don't vary very much) with the size of the withdrawal. Therefore, it is more cost effective to go to the ATM fewer times and take out more money rather than doing the opposite. Issuing debt also has certain borrowing costs that accrue, and borrowing in bigger chunks helps manage and minimize the impact of some of these costs.

[10] The Department's CIP shows spending patterns that reflect the staff's best estimate of how the project will play out. The environmental review, right-of-way, and regulatory climate in California is complex and project spending can be greatly influenced by this reality. In sizing and timing debt issues, it will be important to use the most up-to-date information about progress on projects.

the sizing and timing of debt. City staff will be actively using this model in ongoing financial analyses and management activities, and the timing and sizing of each debt issue may be revised based on market conditions at the time.

6.5 WATER RATES NEEDED TO MEET REVENUE REQUIREMENTS

During FY 2016, Water Department staff worked with Raftelis Financial Consultants and the Santa Cruz Water Commission to evaluate several options for rate structures, each of which would need to address the City's priority pricing objectives as identified by the Council and the Water Commission during the winter of 2015. These pricing objectives are shown in Table 8 below, in priority order:

Table 8
Priority Pricing Objectives

Composite Pricing Objectives for the City Council and Water Commission, March 2015	
1. Revenue sufficiency	5. Revenue stability
2. Promotes efficiency	6. Understandable by customers
3. Perceived to be fair by the public	7. Promotes conservation
4. Affordable for essential uses	8. Rate stability

In designing new rates for FY 2017 – FY 2021, the Department took into account these priorities and the very strong preference stated by customers in various forums to reduce the amount of revenue generated by fixed charges.

Santa Cruz's water customers are unusual in many respects, including their typically lower levels of water consumption. Even before the drought, 15% of single family customers used an average of 2 CCF or less per month. And 46% (15% + 31%) used an average of 5 or fewer CCF per month. Sixty-four percent used no more than 7 CCF per month.

In 2004, the Department changed its rate structure to increase the number of tiers for single family customers from three to five and also implemented a series of fairly significant price increases between 2004 and 2011. As a result of these actions, many single family residential customers were incentivized to reduce consumption of the more expensive blocks of water, contributing to the distribution patterns that were being observed prior to the drought. Included in this pattern was a shift of the total percent of annual consumption used between

May 1 and October 31 from 65% to 59%. Two years of water rationing for residential customers further reinforced these new use patterns.

Coupled with a strong conservation ethic in Santa Cruz is the concern for affordability of water for those customers using very low amounts of water. Fixed charges are viewed as diluting the conservation incentive that rates can provide as well as raising the cost of water for those routinely using small amounts of water.

6.5.1 CHANGES TO THE RATE STRUCTURE

The Department is recommending moving from its current rate structure in which about 35% of revenue is collected through fixed charges and 65% is collected through volume or commodity charges to one that collects substantially more of the total revenue through volume charges. Roughly 10% of operating costs would be collected in fixed costs based on meter size, with the remainder being collected in the form of charges related to the amount of water used.

Tiered rates for single family residential customer would be retained with the number of tiers being reduced from five to four[11]. Revised tiers would be as follows:

- **0 – 5 CCF = Tier 1 (average winter use)**
- **6 – 7 CCF = Tier 2 (average spring and fall use)**
- **8 – 9 CCF = Tier 3 (average summer use)**
- **≥ 10 CCF = Tier 4**

Multi-family residential rates would also be tiered using the same tiers as for single family but multiplying the tier allocations by the number of dwelling units in a master metered complex.[12]

Landscape irrigation accounts would be billed based on a simplified water budget system that would establish an allocation for each account. Usage up to that water budget allocation would be billed at tier 1 of the irrigation rates, up to 150% of the allocation would be billed at tier 2 of the irrigation rates, and all usage above 150% of the allocation would be billed at tier 3 of the landscape irrigation rates.

[11] The change in the number of tiers was the result of the analysis done by Raftelis Financial Consultants as part of the Cost of Service Study and was based on evolving water use patterns for residential customers.

[12] Master metered systems may include irrigation or have irrigation on a separate meter. For water utility billing purposes, individually metered multi-family units are treated as single family residential properties.

The remaining customer classes would be billed using uniform rates established for each class based on the Cost of Service Analysis. For example, this means that the University of California at Santa Cruz, whose water use includes some seasonal peaking, would pay a higher uniform rate than those customer classes that do not.

6.5.2 MITIGATING THE POTENTIAL REVENUE STABILITY RISKS OF MOVING TO A MORE VOLUME BASED RATE STRUCTURE

Moving to a more volume-based rate structure creates inherent revenue stability risks for a utility. In making a decision to move in this direction, Water Department staff carefully considered how this risk might influence revenues by evaluating the character and water use consumption patterns in the City's service area.

Even before the recent drought, Santa Cruz water customers were among the lowest water users in the state on both system-wide and residential gallons per capita per day metrics. During the drought, that pattern continued. Anecdotally, staff is observing some continuing shifts in water use that may reflect some long-term changes in use patterns that will ultimately be attributed to the drought becoming permanent. One very likely candidate for this kind of change is residential landscape irrigation.

Revenue streams that depend on the volume of water sold are particularly susceptible to weather driven changes in consumption, and changes in consumption due to price effects. The Department's recent experiences make it keenly aware of this dynamic. The challenges of managing ongoing operations and management of the water utility while simultaneously planning for and implementing major capital improvements aren't insurmountable with a more volume based rate structure, but certainly introduce an element of uncertainty that should be carefully considered before proceeding. This is what Department staff has done.

Rather than avoid recommending a rate structure that seems well-suited to the community's and policy maker's values and priorities, Department staff recommends planning for and implementing as part of the rate structure the mechanisms needed to mitigate these potential risks.

These risks come in two basic forms: drought risks, and non-drought risks. The risk mitigation approaches being recommended to address each is discussed in more detail below.

6.5.2.1 DROUGHT RISKS

In 2014, the Water Department instituted a drought cost recovery fee mechanism that is put in place as a fixed charge. Table 9 shows the Drought Cost Recovery Fee revenue recovery target for each stage of the City's Water Shortage Contingency Plan and provides the amount charged for a typical single family residential customer using a 5/8th or 3/4th inch meter.

Table 9
Drought Cost Recovery Fee Financial Targets and
Example Fixed Charge for 5/8th and 3/4th inch Meters

Drought Stage	Cutback Required	Targeted Cost Recovery	Fixed Charge per 5/8th or 3/4th inch meter
Stage 1	5%	$1.0 Million	$2.45
State 2	15%	$2.5 Million	$6.12
Stage 3	25%	$4.0 Million	$9.79
Stage 4	35%	$5.5 Million	$13.46
Stage 5	50%	$7.5 Million	$18.35

Additional Details on the Drought Cost Recovery Fees for other meter sizes can be found in Appendix C.

A Drought Cost Recovery Fee was levied in Santa Cruz from October 1, 2014 through June 30, 2016. Levying the fee is explicitly linked to an action by the Santa Cruz City Council to declare a drought and establish curtailment stage in advance of each year's dry season (May through October).

The Department's 2014 Proposition 218 notice included the Drought Cost Recovery Fee Schedule. The planned summer 2016 Proposition 218 notice will also include publication of this fee.

6.5.2.2 NON-DROUGHT RELATED RISKS

In the earlier discussion of rates in Section 5.3 above, the basic risk mitigation approach for non-drought years was described. It involved two basic strategies:

1 **Setting the assumption about how much water will be sold at a conservative 2.5 billion gallons per year;**

2 **Beginning in July 2018, apply a $1.00 per unit of water consumption surcharge to increase the amount of the Rate Stabilization Reserve from the current level of $2.3 million to a total of $10 million. In any "normal" year where 2.5 billion gallons of water is not sold, use revenues from the rate stabilization reserve to cover the resulting revenue shortfall.**

The planned $1.00 surcharge is not being designed to be an "on-off" mechanism but is currently proposed to be permanent. Use of these funds once the Rate Stabilization Reserve reaches $10 million is recommended to be used as follows:

- **Once the Rate Stabilization Reserve reaches its target level of $10 Million, funds from this surcharge would be allocated as needed to ensure that Operating Cash and Emergency Reserves are fully funded and then directed to fund "pay-as-you-go" capital expenditures, reducing the need to issue debt.**

6.5.3 ALLOCATIONS OF REVENUES THAT ARE HIGHER THAN EXPECTED

A reasonable question is what to do if revenue stability does not turn out to be an issue because consumption is either stable at 2.5 billion gallons per year or is greater than 2.5 billion gallons. The Department proposes the following conditional approach to addressing this situation if it occurs:

If….

- **the minimum debt service coverage ratio target of 1.5 is being consistently met, and**
- **reserves are fully funded, and**
- **"pay-as-you-go" capital is being funded at an average over the previous 3 years of at least 25%;**

Then either…

- **additional planned rate increases will be adjusted to the level needed to produce required revenues without any excess,[13] or**

[13] The public notices required under Proposition 218 are required to identify (and justify based on the cost of service) the maximum amount that will be charged for a service. A utility has the option of charging less than the maximum amount published in the required notices. The obverse, however, is not true, which is the major reason for building into a more heavily volumetric rate structure a mechanism to mitigate for lower than anticipated revenues due to lower than forecasted water sales.

- **The Water Department will ask the City Council for additional direction regarding adjusting the amount of funding in the Emergency Reserve and the Rate Stabilization Reserve to be an established percent of the Operating budget (rather than a fixed dollar amount), accelerating capital reinvestment in system infrastructure, or increasing the proportion of capital that is being paid for with "pay-as-you-go" funding.**

Glossary

- **Bond covenant** – A legally binding term of an agreement between a bond issuer and a bond holder. Bond covenants are designed to protect the interests of both parties. Bond covenants are commitments that the City makes to the bondholders to ensure timely payment of principal and interest.
- **Capital Improvement Plan** – A multi-year plan that lists the rehabilitation, replacement, major maintenance, and new water system facilities and systems that are needed to maintain reliable and high quality water service or meet regulatory requirements;
- **CCF** (One Hundred cubic feet of water) – 748 gallons of water. A CCF is the unit used by the Santa Cruz Water Department as the basis for charges to customers based on water use.
- **Debt service coverage ratio** – The ratio of net operating revenue to annual debt payments.
- **Emergency reserve fund** – A reserve fund specifically designed to provide resources to address the consequences of natural disasters on water system facilities or resources or a catastrophic failure of a water system facility;
- **Pro forma** (financial statement) - A pro forma financial statement is a forecast of the utility's revenues and expenditures based on certain assumptions and projections;
- **Ninety-day operating cash reserve fund** – A reserve created to help ensure the utility's ability to meet operating expenses, provide financial stability, and resilience and support establishing and maintaining a good credit rating.
- **Operating budget** – The portion of the Department's overall budget that pays for ongoing operations of the utility, including the costs related to personnel, materials and services such as water treatment chemicals, and energy resources, and non-capital improvement project professional and technical services;
- **Pay-as-you-go capital funding** – paying for capital improvement projects using current year or accumulated rate revenues rather than the use of short or long term debt;
- **Proposition 218** – a 1996 California Constitutional Amendment that established the "cost-of-service" requirements for utility rates as well as certain noticing and public review process requirements related to water rate increases;[14]
- **Rate structure design** – Characteristics of water rates that provides for the amount of revenue produced by fixed and variable charges, the use of different tiers for different amounts of water use, etc.;

[14] Proposition 218 also includes other provisions that aren't relevant to water rates and finances.

- **Rate stabilization reserve** – a financial reserve specifically intended to provide a hedge against revenue variability resulting from weather conditions, such as a cool wet spring that results in less water than projected being used for outdoor irrigation.
- **Reimbursement resolution** – A Council action that authorizes the Department to reimburse itself for funds expended on capital projects using proceeds from future debt issues.
- **Water Supply Augmentation Strategy** – This is the plan developed by the Council appointed Water Supply Advisory Committee and accepted by the City Council for implementation in November 2015.

APPENDIX A – FINANCIAL PRO FORMA

This Appendix includes a 10 year Pro Forma from the Department's financial Model.

City of Santa Cruz Water Department FY 2017 – FY 2026 Financial Pro-Forma

City of Santa Cruz Water Department Pro-Forma Projections										
Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Revenues										
Rate Revenue										
Fixed Fee Revenue	$ 4,655,461	$ 2,960,622	$ 3,153,062	$ 3,358,011	$ 3,576,282	$ 3,808,740	$ 4,056,308	$ 4,319,968	$ 4,600,766	$ 4,899,816
Volumetric Revenue	$ 27,555,340	$ 33,747,904	$ 35,941,518	$ 38,277,717	$ 40,765,768	$ 43,415,543	$ 46,237,553	$ 49,242,994	$ 52,443,789	$ 55,852,635
Elevation Surcharges	$ 103,105	$ 120,759	$ 130,985	$ 138,233	$ 138,656	$ 139,242	$ 139,830	$ 140,421	$ 141,015	$ 141,611
Rate Stabilization Surcharge	$ -	$ 3,342,244	$ 3,342,244	$ 3,342,244	$ 3,342,244	$ 3,342,244	$ 3,342,244	$ 3,342,244	$ 3,342,244	$ 3,342,244
Total Rate Revenue	$ 32,313,906	$ 40,171,529	$ 42,567,809	$ 45,116,205	$ 47,822,950	$ 50,705,769	$ 53,775,936	$ 57,045,628	$ 60,527,814	$ 64,236,306
Non-Rate Revenue										
Other Income	$ 203,600	$ 203,600	$ 203,600	$ 203,600	$ -	$ -	$ -	$ -	$ -	$ -
Investment Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Non-Rate Revenue	$ 203,600	$ 203,600	$ 203,600	$ 203,600	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenues	$ 32,517,506	$ 40,375,129	$ 42,771,409	$ 45,319,805	$ 47,822,950	$ 50,705,769	$ 53,775,936	$ 57,045,628	$ 60,527,814	$ 64,236,306
Operating Expenses										
Personnel	$ 12,741,984	$ 13,868,008	$ 15,086,021	$ 15,882,276	$ 16,733,349	$ 17,643,670	$ 18,618,048	$ 19,661,714	$ 20,780,352	$ 21,980,139
Services, Supplies & Other	$ 12,616,410	$ 13,247,231	$ 13,909,592	$ 14,605,072	$ 15,335,325	$ 16,102,091	$ 16,907,196	$ 17,752,556	$ 18,640,184	$ 19,572,193
Capital Outlay	$ 965,000	$ 1,013,250	$ 1,063,913	$ 1,117,108	$ 1,172,964	$ 1,231,612	$ 1,293,192	$ 1,357,852	$ 1,425,745	$ 1,497,032
Other Operating Expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Operating Expenses	$ 26,323,394	$ 28,128,488	$ 30,059,525	$ 31,604,455	$ 33,241,638	$ 34,977,373	$ 36,818,437	$ 38,772,122	$ 40,846,280	$ 43,049,364
Net Operating Revenues	$ 6,194,112	$ 12,246,641	$ 12,711,884	$ 13,715,350	$ 14,581,312	$ 15,728,396	$ 16,957,500	$ 18,273,506	$ 19,681,534	$ 21,186,943
Capital Expenditures	$ 12,457,850	$ 15,886,978	$ 35,774,344	$ 37,574,757	$ 26,251,158	$ 15,635,558	$ 48,913,507	$ 45,672,352	$ 47,955,970	$ 10,854,470
Grant Funded	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SRF Funded	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Currently Funded	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pay-Go Funded	$ 12,457,850	$ 9,092,599	$ 5,052,786	$ 7,799,495	$ 7,602,387	$ 7,467,490	$ 5,348,196	$ 6,509,669	$ 5,383,722	$ 4,055,918
Debt Funded	$ -	$ 6,794,378	$ 30,721,558	$ 29,775,262	$ 18,648,772	$ 8,168,068	$ 43,565,311	$ 39,162,683	$ 42,572,248	$ 6,798,552
Debt Service	$ 1,110,238	$ 2,089,418	$ 3,364,562	$ 4,286,397	$ 6,171,547	$ 7,404,928	$ 10,701,862	$ 10,800,876	$ 13,275,920	$ 16,046,053
Net Income	$ (7,373,976)	$ 1,064,624	$ 4,294,536	$ 1,629,457	$ 807,378	$ 855,979	$ 907,441	$ 962,961	$ 1,021,892	$ 1,084,972
Total Cash Balances										
Beginning Total Cash Balance	$ 4,071,118	$ 18,697,143	$ 22,761,766	$ 27,056,302	$ 28,685,759	$ 29,493,137	$ 30,349,115	$ 31,256,557	$ 32,219,518	$ 33,241,410
I-Bank Reimbursements	$ 22,000,000	$ 3,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Calculated Change to Cash Balances	$ (7,373,976)	$ 1,064,624	$ 4,294,536	$ 1,629,457	$ 807,378	$ 855,979	$ 907,441	$ 962,961	$ 1,021,892	$ 1,084,972
Ending Total Cash Balance	$ 18,697,143	$ 22,761,766	$ 27,056,302	$ 28,685,759	$ 29,493,137	$ 30,349,115	$ 31,256,557	$ 32,219,518	$ 33,241,410	$ 34,326,381
Beginning Cash Balances by Fund		``								
Fund 717 (Emergency Reserve)	$ 1,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000
Fund 713 (Rate Stabilization)	$ 2,447,939	$ 2,447,939	$ 5,790,183	$ 9,132,427	$ 10,000,000	$ 10,000,000	$ 10,000,000	$ 10,000,000	$ 10,000,000	$ 10,000,000
Fund 716 (90 Day Operating Reserve)	$ -	$ 6,490,700	$ 6,935,792	$ 7,411,938	$ 7,792,879	$ 8,196,568	$ 8,624,558	$ 9,078,519	$ 9,560,249	$ 10,071,685
Fund 711 (Water Operations)	$ 523,179	$ 6,658,504	$ 6,935,792	$ 7,411,938	$ 7,792,879	$ 8,196,568	$ 8,624,558	$ 9,078,038	$ 9,559,269	$ 10,069,724
Changes to Cash Balances by Fund										
Fund 717 (Emergency Reserve)	$ 2,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fund 713 (Rate Stabilization)	$ -	$ 3,342,244	$ 3,342,244	$ 867,573	$ -	$ -	$ -	$ -	$ -	$ -
Fund 716 (90 Day Operating Reserve)	$ 6,490,700	$ 445,092	$ 476,146	$ 380,942	$ 403,689	$ 427,989	$ 453,961	$ 481,731	$ 511,436	$ 543,226
Fund 711 (Water Operations)	$ 6,135,324	$ 277,288	$ 476,146	$ 380,942	$ 403,689	$ 427,989	$ 453,480	$ 481,231	$ 510,456	$ 541,746
Ending Cash Balances by Fund										
Fund 717 (Emergency Reserve)	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000	$ 3,100,000
Fund 713 (Rate Stabilization)	$ 2,447,939	$ 5,790,183	$ 9,132,427	$ 10,000,000	$ 10,000,000	$ 10,000,000	$ 10,000,000	$ 10,000,000	$ 10,000,000	$ 10,000,000
Fund 716 (90 Day Operating Reserve)	$ 6,490,700	$ 6,935,792	$ 7,411,938	$ 7,792,879	$ 8,196,568	$ 8,624,558	$ 9,078,519	$ 9,560,249	$ 10,071,685	$ 10,614,912
Fund 711 (Water Operations)	$ 6,658,504	$ 6,935,792	$ 7,411,938	$ 7,792,879	$ 8,196,568	$ 8,624,558	$ 9,078,038	$ 9,559,269	$ 10,069,724	$ 10,611,470
Coverage and Targets										
Debt Service Coverage (W/Out Reserves)	5.58x	4.26x	2.78x	3.00x	2.36x	2.12x	1.58x	1.69x	1.48x	1.32x
Debt Service Coverage Target	1.50x	1.50x	1.50x	1.50x	1.50x	1.50x	1.50x	1.50x	1.50x	1.50x
Debt Service Coverage (W/Reserves)	22.42x	16.76x	11.82x	9.89x	7.14x	6.22x	4.51x	4.67x	3.99x	3.46x
Days' Cash (Includes only Funds 711 & 716)	182	180	180	180	180	180	180	180	180	180
Days' Cash Target	180	180	180	180	180	180	180	180	180	180

APPENDIX B – 10 YEAR CIP

This Appendix includes a spreadsheet listing projects, funding and schedules and project descriptions

Water Department FY 2017 – FY 2018 Capital Improvement Program

10-Year CIP by Primary Driver

	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026
Rehabilitate or Replace										
Felton Diversion Replacement & Pump Station		1,500,000	1,500,000	1,500,000						
Laguna Dam										500,000
Majors Creek Diversion										300,000
San Lorenzo River Diversion & Tait Wells										
Newell Creek Pipeline Rehabilitation	1,000,000	1,000,000	8,000,000	8,000,000						
Newell Creek Dam I/O Pipeline & Aerators	2,000,000	2,000,000	14,000,000	12,000,000	12,000,000					
North Coast System Rehab	4,150,000									4,000,000
WTP Concrete Tank Evaluation & Replacement	600,000	3,000,000	3,000,000	3,000,000						
WTP Solids Handling	500,000									
Water Main Replacements - City Engineering	1,395,000	1,440,000	1,440,000	1,440,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000
Water Main Replacements - Outside Agency	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000
Water Main Replacements - Customer Initiated	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Water Main Replacements - Distribution	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000	325,000
Pressure Regulating Stations	10,000	60,000	60,000	60,000						
Recoat University Reservoir No. 4	75,000	1,300,000								
Recoat University Reservoir No. 5	75,000	1,675,000								
Beltz 11	70,000	300,000								
Water Treatment Upgrades	100,000									
Subtotal	**10,600,000**	**12,900,000**	**28,625,000**	**26,625,000**	**14,125,000**	**2,125,000**	**2,125,000**	**2,125,000**	**2,125,000**	**6,925,000**
With inflation	**10,918,000**	**13,685,610**	**31,886,676**	**31,141,725**	**17,347,257**	**2,740,252**	**2,877,265**	**3,021,128**	**3,172,185**	**10,854,470**
Upgrade or Improve										
Advance Metering Infrastructure (AMI)					50,000	4,000,000	4,000,000			
Loch Lomond Rec Improvements			165,000	1,000,000						
Photovoltaic/SolarProjects		500,000								
Water Resources Building	1,000,000									
Security Camera & Building Access Upgrades	95,000									
Subtotal	**1,095,000**	**500,000**	**165,000**	**1,000,000**	**50,000**	**4,000,000**	**4,000,000**	**-**	**-**	**-**
With inflation	**1,127,850**	**530,450**	**183,801**	**1,169,642**	**61,406**	**5,158,122**	**5,416,028**	**-**	**-**	**-**
Water Supply Reliability										
Aquifer Storage & Recovery		1,075,000	325,000	300,000						
Recycled Water										
Water Supply- WSAS Implementation				1,200,000	7,200,000	6,000,000	30,000,000	30,000,000	30,000,000	
Source Water Evaluation & Implementation	400,000	500,000	3,000,000	3,000,000						
Subtotal	**400,000**	**1,575,000**	**3,325,000**	**4,500,000**	**7,200,000**	**6,000,000**	**30,000,000**	**30,000,000**	**30,000,000**	**-**
With inflation	**412,000**	**1,670,918**	**3,703,867**	**5,263,390**	**8,842,495**	**7,737,183**	**40,620,213**	**42,651,224**	**44,783,785**	**-**
Total Projects w/o Inflation	12,095,000	14,975,000	32,115,000	32,125,000	21,375,000	12,125,000	36,125,000	32,125,000	32,125,000	6,925,000
Handy-Whitman Construction Inflation Factor	3%	3%	5%	5%	5%	5%	5%	5%	5%	5%
Total Projects with Cumulative Inflation	12,457,850	15,886,978	35,774,344	37,574,757	26,251,158	15,635,558	48,913,507	45,672,352	47,955,970	10,854,470

REHABILITATE OR REPLACE
Felton Diversion Replacement & Pump Station (c701602) This project consists of evaluating the existing dam and pump station with recommendations to rehabilitate or replace existing facilities. Alternate diversions to be considered will include horizontal collector wells and other subsurface intake(s). This project will replace aging facilities and evaluate potentially more efficient ways to divert water from the San Lorenzo River at Felton. Additional funding for construction in FY2019.
Laguna Dam (c70xxxx) Evaluate condition of dam and make recommended modifications. The project will follow completion of anadromous Habitat Conservation Plan.
Majors Creek Diversion (c701302) Majors Creek Diversion is nearly 100 years old. This project will evaluate the condition of the structure, make recommendations to replace or repair, and complete the construction. Evaluation of facility to occur in FY2017 with scheduling of rehabilitation TBD.
San Lorenzo River Diversion & Tait Wells (c709872) Conduct a condition assessment of the existing diversion and wells including consideration of sanding issues, potential dam replacement, the potential use of infiltration gallery, and relocation of existing wells. Project will ensure reliable and efficient diversion of water from the San Lorenzo River at Tait St. Condition assessment followed by recommended intake modifications and/or new wells. Current project consists of replacing 2 wells, rehabilitating 1 existing well, and abandoning 1 well. (Project title modified from San Lorenzo Tait Intake.)
Newell Creek Pipeline Rehabilitation (c701701) Conduct a condition assessment and program level environmental review followed by full or partial replacement of the pipeline between the base of Loch Lomond Reservoir and the Graham Hill Water Treatment Plant. This pipeline was constructed in the 1960s. This project is intended to ensure continued reliability of this water supply transmission main. (Project title modified from Newell Creek Supply Main Rehabilitation.)
Newell Creek Dam I/O Pipeline & Aerators (c701606) The Newell Creek Dam was installed in the 1960's. A pipeline runs through the base of the dam to deliver water to the reservoir from Felton Diversion and from the reservoir to the Graham Hill Water Treatment Plant. The pipeline rehabilitation includes inspection of the pipeline and its appurtenances which will result in rehabilitation or replacement of all or parts of the facility.
North Coast System Rehab (c709835) Springs and streams along the coast north of the City limits supply approximately 25% of the City's raw water. Some of the facilities related to these water supplies are reaching the end of their useful life. This program consists of multiple projects over the next 15 to 20 years to evaluate, rehabilitate, and replace portions of the existing infrastructure to ensure continued reliability. Engineering, environmental review, and permitting for the coast segment (Phase 3) began in FY 2013 and continues through FY 2017. Construction scheduled to begin in FY 2016.
WTP Concrete Tank Evaluation & Replacement (c701501) As part of an overall plan to ensure compliance with changing water quality regulations, improvements are needed at the Graham Hill Water Treatment Plant. This project will evaluate

the condition of four concrete tanks located at the site (as well as an off-site concrete tank), make improvement recommendation, and construction. Project title modified from WTP Filter Water Tank. Includes $145,000 endowment for MHJB HCP mitigation.
WTP Solids Handling (c701605) Solids produced at the Graham Hill Water Treatment Plant are currently disposed of in the City's sewer collection system. Treatment and disposal of these solids needs to be evaluated with the existing Water Treatment Plant Concrete Tank Assessment and Rehabilitation project (c701501) with improvements made accordingly.
Water Main Replacements - City Engineering (c700002, c709833, and c700017) Recurring program to replace deteriorated or undersized mains as identified and prioritized by the Department. Priorities are based on the need to maintain water system reliability, deliver adequate fire flows, improve circulation and water quality, and reduce maintenance costs. These projects focus on pipes less than 10" in diameter and are typically installed by contractors according to bid plans and specifications.
Water Main Replacements - Outside Agency (c700003) Water main, service line, valve, or water meter relocation necessitated by County or other Agency road improvement, storm drain improvement projects, and/or other projects that conflict with existing water infrastructure.
Water Main Replacements - Customer Initiated (c700004) Recurring program similar to the other Main Replacement Projects; however, these projects are initiated on an as-needed basis to accommodate customer-requested service connections to undersized or inadequate mains. Funds, to the extent of the appropriation, are disbursed to customers on a first-come, first-served basis. This project is funded by System Development Charges (100% SDC – Fund 715).
Water Main Replacements – Distribution (c701507) Recurring program to replace deteriorated or undersized water mains, as identified and prioritized by the Department and implemented by the Distribution Section. Projects are typically based on leak history, but also address water quality and fire flow issues.
Pressure Regulating Stations (c701703) Evaluation and replacement of pressure regulating stations (PRS). A PRS maintains (sustains or reduces) downstream pressure in order to deliver sufficient water pressure. The water distribution system contains 15 PRS and they vary in age from 66 years old to 8 years old. This project will evaluate the condition of each PRS and prioritize rehabilitation or replacement.
Recoat University Reservoir No. 4 (c701505) Perform engineering analysis and condition assessment of the aging University 4 tank to ensure continued reliable service. Establish scope of work for recoating/rehabilitation project. Acquire construction easements from UCSC and perform environmental analysis to install temporary tank for use during construction. Create plans and specifications for recoating/rehabilitation project.

Recoat University Reservoir No. 5 (c701506) Perform engineering analysis and condition assessment of the aging University 5 tank to ensure continued reliable service. Establish scope of work for recoating/rehabilitation project. Create plans and specifications for recoating/rehabilitation project. Install temporary tank and variable speed pumps for use during construction. Construct recoating/rehabilitation project.
Beltz 11 (c700026) This project would convert an existing monitoring well to a production well, renamed Beltz 11. Beltz 11 would pump from the Santa Margarita aquifer. The project would reduce pumping from the Purisima Formation which is impacted by pumping by the City and other users. Project includes feasibility study, pump test, CEQA and construction efforts.
Water Treatment Upgrades (c700025) Upgrades to the Graham Hill Water Treatment Plant are necessary to meet new and planned regulatory requirements, and increase overall system reliability. This is a recurring project to prioritize needs and make smaller improvements. The current project includes upgrades to the bulk chemical storage area.
UPGRADE OR IMPROVE
Advance Metering Infrastructure (AMI) (c701603) Evaluate the use of AMI as replacement to the current AMR metering (Automatic Meter Reading). AMR provides 1-way communication between a meter and the City and AMI provides two-way communication between a meter and the City as well as between a meter and the customer. Benefits include early leak detection, customer conservation affect, and workflow management. Implementation to occur in future years.
Loch Lomond Rec Improvements (c701301) Complete facilities assessment and improvement program at Loch Lomond. A Use study was completed in FY 2013 which resulted in a number of planned projects to enhance the recreation area usability for its visitors. Several ADA and other recreational improvements are being pursued over the next 5 years.
Photovoltaic/Solar Projects (c701607) Ongoing project to evaluate, design and construct PV systems on various water department facilities. The current project is at the Bay Street Tank Site. Once installed, each project will add to the departments and City's green energy portfolio and work towards meeting and exceeding our climate action goals.
Water Resources Building (c701702) The Watershed Resources Division is currently housed in temporary trailers. This project consists of a needs assessment, design, and construction. The needs assessment portion of the project has been completed; FY 2016 will focus on site selection and design; FY 2017 will be construction.
Security Camera & Building Access Upgrades (c701704) Evaluation and implementation of security camera and building access upgrades at various Water facilities. Current security equipment is proprietary and could be improved. A transition to a new system will require camera replacement and additional video storage equipment.

WATER SUPPLY RELIABILITY
Aquifer Storage & Recovery (c701609 and c701610) Evaluate the feasibility of Aquifer Storage and Recovery as per the recommendations of the Water Supply Advisory Committee. Funds in FY 2016 and 2017 will be used for Phase 1 of the proposed study. Phase 2 will include pilot work and be funded in FY 2018. Project would potentially provide additional potable water to City and other agency customers, addressing part or all of water supply deficiencies.
Recycled Water (c701611 and c701612) Evaluate the feasibility of using advanced treated wastewater for beneficial uses as per the recommendations of the Water Supply Advisory Committee. The project will be collaboration amongst the Water and Public Works Departments. The project would potentially provide additional water to City and other agency customers, addressing all or part of water supply deficiencies.
Water Supply- WSAS Implementation (c70xxxx) Funding tentatively scheduled for FY2020.
Source Water Evaluation & Implementation (c701608) Evaluate source water quality, operational and infrastructure alternatives to maximize use of surface water. This project was prompted in part by the recommendations of the Water Supply Advisory Committee, accepted by Council in Nov 2015, to evaluate use of additional winter flows in the San Lorenzo River for various purposes to solve the regional water supply issues.

APPENDIX C – PROPOSED WATER RATES AND FEES FOR FY 2017-FY 2021

The tables below were excerpted from a more complete presentation on water rates and charges prepared for and presented to the Santa Cruz Water Commission on June 6, 2016. That presentation can be accessed online at the Water Commission's website. (see http://www.cityofsantacruz.com/departments/water/city-water-commission/meetings-and-agenda)

Table C-1
Inside City Customer Fixed Monthly Charges

Inside		FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Meter Size	# of Meters	Proposed Ready-to-Serve ($/Meter)	9%	7%	5%	5%
5/8-in	14,348	$ 8.78	$ 9.53	$ 10.18	$ 10.71	$ 11.26
3/4-in	150	$ 9.01	$ 9.78	$ 10.45	$ 10.99	$ 11.56
1-in	748	$ 9.70	$ 10.53	$ 11.25	$ 11.83	$ 12.44
1 1/2-in	294	$ 10.61	$ 11.52	$ 12.31	$ 12.94	$ 13.61
2-in	250	$ 13.14	$ 14.26	$ 15.24	$ 16.02	$ 16.85
3-in	35	$ 31.74	$ 34.45	$ 36.82	$ 38.71	$ 40.71
4-in	15	$ 38.63	$ 41.93	$ 44.81	$ 47.11	$ 49.55
6-in	6	$ 54.70	$ 59.37	$ 63.45	$ 66.71	$ 70.16
8-in	3	$ 73.07	$ 79.31	$ 84.76	$ 89.11	$ 93.73
10-in	3	$ 93.74	$ 101.75	$ 108.73	$ 114.32	$ 120.24

Table C-2
Inside City Customer Volume Rates

Inside	FY 2017 Commodity Rate ($/ccf)	FY 2018 Commodity Rate ($/ccf)	FY 2019 Commodity Rate ($/ccf)	FY 2020 Commodity Rate ($/ccf)	FY 2021 Commodity Rate ($/ccf)
SFR & MFR					
Tier 1	$ 7.30	$ 8.97	$ 9.49	$ 10.03	$ 10.60
Tier 2	$ 8.75	$ 10.56	$ 11.18	$ 11.86	$ 12.59
Tier 3	$ 10.28	$ 12.25	$ 12.97	$ 13.78	$ 14.64
Tier 4	$ 12.65	$ 14.85	$ 15.73	$ 16.75	$ 17.84
COM					
Uniform	$ 8.84	$ 10.67	$ 11.29	$ 11.97	$ 12.70
UCSC					
Uniform	$ 9.11	$ 10.96	$ 11.60	$ 12.31	$ 13.06
North Coast AG					
Uniform	$ 6.63	$ 8.29	$ 8.74	$ 9.34	$ 9.99
Landscape					
Tier 1	$ 9.68	$ 11.59	$ 12.27	$ 13.04	$ 13.86
Tier 2	$ 13.38	$ 15.65	$ 16.58	$ 17.67	$ 18.83
Tier 3	$ 14.54	$ 16.91	$ 17.93	$ 19.10	$ 20.33
Elevation Surcharge					
Elevation Surcharge	$ 0.42	$ 0.46	$ 0.49	$ 0.51	$ 0.54

Table C-3
Outside City Customer Fixed Monthly Charges

Outside		FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Meter Size	# of Meters	Proposed Ready-to-Serve ($/Meter)	9%	7%	5%	5%
5/8-in	7,507	$ 10.05	$ 10.91	$ 11.66	$ 12.26	$ 12.89
3/4-in	65	$ 10.32	$ 11.20	$ 11.97	$ 12.59	$ 13.24
1-in	574	$ 11.11	$ 12.06	$ 12.89	$ 13.55	$ 14.25
1 1/2-in	164	$ 12.16	$ 13.20	$ 14.10	$ 14.83	$ 15.60
2-in	157	$ 15.05	$ 16.34	$ 17.46	$ 18.35	$ 19.30
3-in	14	$ 36.36	$ 39.47	$ 42.17	$ 44.34	$ 46.64
4-in	9	$ 44.25	$ 48.03	$ 51.33	$ 53.96	$ 56.76
6-in	5	$ 62.66	$ 68.01	$ 72.68	$ 76.42	$ 80.37
8-in	1	$ 83.71	$ 90.86	$ 97.10	$ 102.09	$ 107.38
10-in	-	$ 107.38	$ 116.55	$ 124.55	$ 130.95	$ 137.74

Table C-4
Outside City Customer Volume Rates

Outside	FY 2017 Commodity Rate ($/ccf)	FY 2018 Commodity Rate ($/ccf)	FY 2019 Commodity Rate ($/ccf)	FY 2020 Commodity Rate ($/ccf)	FY 2021 Commodity Rate ($/ccf)
SFR & MFR					
Tier 1	$ 8.38	$ 10.15	$ 10.75	$ 11.37	$ 12.03
Tier 2	$ 10.05	$ 12.00	$ 12.70	$ 13.49	$ 14.32
Tier 3	$ 11.85	$ 13.96	$ 14.79	$ 15.73	$ 16.72
Tier 4	$ 14.60	$ 16.98	$ 18.01	$ 19.18	$ 20.43
COM					
Uniform	$ 10.13	$ 12.07	$ 12.79	$ 13.57	$ 14.40
Landscape					
Tier 1	$ 11.09	$ 13.13	$ 13.91	$ 14.79	$ 15.73
Tier 2	$ 15.32	$ 17.78	$ 18.85	$ 20.10	$ 21.42
Tier 3	$ 16.66	$ 19.23	$ 20.40	$ 21.73	$ 23.14
Elevation Surcharge					
Elevation Surcharge	$ 0.48	$ 0.52	$ 0.56	$ 0.59	$ 0.62

Table C-5
Drought Cost Recovery Fees

Meter Size	Stage 1 – 5% cutback	Stage 2 – 15% cutback	Stage 3 – 25% cutback	Stage 4 – 35% cutback	Stage 5 – 50% cutback
5/8-in	$2.45	$6.12	$9.79	$13.46	$18.35
3/4-in	$2.45	$6.12	$9.79	$13.46	$18.35
1-in	$6.13	$15.30	$24.48	$33.65	$45.88
1 1/2-in	$12.25	$30.60	$48.95	$67.30	$91.75
2-in	$19.60	$48.96	$78.32	$107.68	$146.80
3-in	$36.75	$91.80	$146.85	$201.90	$275.25
4-in	$61.25	$153.00	$244.75	$336.50	$458.75
6-in	$122.50	$306.00	$489.50	$673.00	$917.50
8-in	$281.75	$703.80	$1,125.85	$1,547.90	$2,110.25
10-in	$347.90	$869.04	$1,390.18	$1,911.32	$2,605.70

Back Cover

CITY OF SANTA CRUZ

Water Department Prop. 218 Notice Proposed Rates

July 2016

Building a Water System for Our Future

The mission of the City of Santa Cruz Water Department is to provide a safe, clean and continuous supply of water that meets or exceeds local, state and federal standards for public health and environmental quality, and to provide courteous, responsive and efficient service in the most cost-effective manner to our customers. We provide service to about 95,000 customers, 24 hours a day, 365 days a year.

The City of Santa Cruz Water Department is proposing a rate increase and changes to rate structures.

The nation's water utilities face a significant challenge due to a need to repair and replace aging water systems, a decrease in water sales due to increased conservation, a changing climate that creates supply instability, and changes in regulatory requirements. The Santa Cruz water system faces all of these challenges and our current rates will not support the work needed to be done to respond to them. We are proposing increases to water rates and a change to the current rate structures, and new fees that will go directly to support projects that both maintain existing back-bone infrastructure and build critical new infrastructure.

When we raised rates in fall 2014, we committed to use the increased rates to fund ongoing Water Department projects and operations, as well as to complete several critical infrastructure projects. As promised, by the end of 2016 we will have completed:

- The $25 million Bay Street Tanks;
- A $6 million rehabilitation of six filter basins at the Graham Hill Water Treatment Facility;
- The $4.9 million Beltz 12 Well and Water Treatment Facility;
- The $10.3 million Phase 3 of the North Coast System; and
- Replacement of the $267,000 Ocean Street trunk main valve.

In addition, we have completed both the rate studies and financial planning work directed by the City Council in 2014, which results in this proposal to increase current rates, change current rate structures, and add new fees to directly support new infrastructure reinvestment.

Proposed Rate Changes

Historically, capital projects have been financed on a “pay-as-you-go” basis and in consequence, have depleted the Department’s available funds. Now, with several new capital projects facing the water system with significantly higher price tags than past projects, it would be impossible for the Department to continue to fund projects through “pay-as-you-go” without ongoing and unacceptably large increases to current rates. Accordingly, the Department will begin issuing debt to finance about two-thirds of planned capital spending. In addition to the financial constraints of “pay-as-you-go,” there is also an equity consideration; it is more equitable to spread costs of major system improvements out over time because projects funded and built today continue to benefit water users and rate payers for decades to come.

The proposed rate changes reflect the strong conservation values of the community by shifting away from collecting a large portion of water service costs from fixed charges (such as the Ready-to-Serve charge), to collecting over 90% of revenues through volumetric-pricing based on customer use. Though customers will see a decrease in their Ready-to-Serve charge, the proposed cost per unit of water will increase on all types of accounts and depending upon the amount of water used, customers may see a big jump in their water bill. Changes to rate structures are also proposed so that multi-family accounts will now pay the same per-unit costs as single families, and proposed changes to irrigation accounts include an assigned water budget that reflects efficient irrigation practices for each property.

The costs to treat and distribute drinking water are fixed; the shift to collect needed revenue through fluctuating water sales comes with some risk. To mitigate that risk while still implementing a more volume-based rate structure that encourages conservation, a $1 per unit of water Rate Stabilization fee will be charged beginning in 2017.

The newest change proposed to your water bill is an Infrastructure Reinvestment Fee that will support reinvestment in critical infrastructure projects. Since the rate increase in 2014, infrastructure projects have been added to the Water Department’s work plan at significantly greater costs than past projects: a state-required rehabilitation of the inlet-outlet pipeline in the Newell Creek dam for $42 million; rehabilitation of the pipeline between Loch Lomond and Felton for $18 million; replacement and improvements to the pump station at the Felton diversion dam for $4.5 million; replacement of several concrete tanks at the Graham Hill Water Treatment Plant for $9 million; and initial feasibility work on a water supply project, as directed by the Council-approved work of the Water Supply Advisory Committee, which was completed in fall 2015.

We are also proposing a continuation of the Drought Cost Recovery fee, which will only go into effect in the event that the Council imposes restrictions on water use due to drought.

For those customers who…

Are charged an Elevation Surcharge for the increased energy used to pump water to homes in higher elevations – the proposed new surcharge will be $0.42.

Have private fire protection/ sprinkler service – there is a proposed new $1 per fire-service meter charge, per month, to cover the costs for maintaining separate fire protection meters. There is no charge for water used to respond to a fire, but leaking fire services will be charged at the commercial per-unit rate for water, which is intended to incentivize prompt repairs to leaks.

Inside City Rates

Inside City Fixed Rates - Ready to Serve

Meter Size	Ready to Serve ($/Meter)				
	As of 10/1/16	As of 7/1/17	As of 7/1/18	As of 7/1/19	As of 7/1/20
5/8-in	$ 8.78	$ 9.53	$ 10.18	$ 10.71	$ 11.26
3/4-in	$ 9.01	$ 9.78	$ 10.45	$ 10.99	$ 11.56
1-in	$ 9.70	$ 10.53	$ 11.25	$ 11.83	$ 12.44
1 1/2-in	$ 10.61	$ 11.52	$ 12.31	$ 12.94	$ 13.61
2-in	$ 13.14	$ 14.26	$ 15.24	$ 16.02	$ 16.85
3-in	$ 31.74	$ 34.45	$ 36.82	$ 38.71	$ 40.71
4-in	$ 38.63	$ 41.93	$ 44.81	$ 47.11	$ 49.55
6-in	$ 54.70	$ 59.37	$ 63.45	$ 66.71	$ 70.16
8-in	$ 73.07	$ 79.31	$ 84.76	$ 89.11	$ 93.73
10-in	$ 93.74	$ 101.75	$ 108.73	$ 114.32	$ 120.24
Fire Service - All Sizes *	$1 /month	$1.09 /month	$1.15 /month	$1.21 /month	$1.26 /month

Inside City Volume (Commodity) Rates - Consumption

	As of 10/1/16	As of 7/1/17	As of 7/1/18	As of 7/1/19	As of 7/1/20
Single Family Residential and Multi-Family Residential (calculation is based upon the number of dwelling units multiplied by the tier width)					
Tier 1 (0-5 ccf**)	$ 5.75	$ 6.24	$ 6.66	$ 7.01	$ 7.37
Tier 2 (6-7 ccf)	$ 6.42	$ 6.97	$ 7.45	$ 7.83	$ 8.24
Tier 3 (8-9 ccf)	$ 7.41	$ 8.05	$ 8.60	$ 9.04	$ 9.51
Tier 4 (10 ccf & above)	$ 8.79	$ 9.54	$ 10.20	$ 10.72	$ 11.28
Commerical: Business, Industrial, Restaurant, Hotel, Golf, Municipal, Bulk, Fire Service Leaks					
Uniform	$ 6.57	$ 7.13	$ 7.62	$ 8.01	$ 8.43
UCSC					
Uniform	$ 6.70	$ 7.27	$ 7.77	$ 8.17	$ 8.60
Landscape / Irrigation (tiers based on percent of water budget)					
Tier 1 (≤100% of budget)	$ 6.86	$ 7.44	$ 7.95	$ 8.36	$ 8.80
Tier 2 (101% - 150%)	$ 9.15	$ 9.93	$ 10.62	$ 11.16	$ 11.74
Tier 3 (150% & above)	$ 10.27	$ 11.14	$ 11.91	$ 12.52	$ 13.17
Elevation Surcharge					
As Applicable	$ 0.42	$ 0.46	$ 0.49	$ 0.51	$ 0.54

Inside City Volume (Commodity) Rates - Infrastructure Reinvestment Fee

	As of 10/1/16	As of 7/1/17	As of 7/1/18	As of 7/1/19	As of 7/1/20
Single Family Residential and Multi-Family Residential (calculation is based upon the number of dwelling units multiplied by the tier width)					
Tier 1 (0-5 ccf**)	$ 1.55	$ 1.73	$ 1.82	$ 2.02	$ 2.23
Tier 2 (6-7 ccf)	$ 2.32	$ 2.59	$ 2.73	$ 3.03	$ 3.34
Tier 3 (8-9 ccf)	$ 2.86	$ 3.20	$ 3.37	$ 3.74	$ 4.13
Tier 4 (10 ccf & above)	$ 3.85	$ 4.30	$ 4.53	$ 5.02	$ 5.55
Commerical: Business, Industrial, Restaurant, Hotel, Golf, Municipal, Bulk					
Uniform	$ 2.27	$ 2.53	$ 2.66	$ 2.96	$ 3.27
UCSC					
Uniform	$ 2.40	$ 2.68	$ 2.82	$ 3.13	$ 3.46
Landscape / Irrigation (tiers based on percent of water budget)					
Tier 1 (≤100% of budget)	$ 2.82	$ 3.14	$ 3.31	$ 3.67	$ 4.06
Tier 2 (101% - 150%)	$ 4.22	$ 4.71	$ 4.96	$ 5.50	$ 6.08
Tier 3 (150% & above)	$ 4.27	$ 4.77	$ 5.02	$ 5.57	$ 6.16

Inside City Volume (Commodity) Rates - Rate Stabilization Fee

	As of 10/1/16	As of 7/1/17	As of 7/1/18	As of 7/1/19	As of 7/1/20
All accounts (Per ccf)	$ -	$ 1.00	$ 1.00	$ 1.00	$ 1.00

*This amount may be billed annually and will be added to any other applicable water use fixed and volume charges. **ccf equals 100 cubic foot of water.

Outside City Rates

Outside City Fixed Rates - Ready to Serve

Meter Size	Ready to Serve ($/Meter) As of 10/1/16	As of 7/1/17	As of 7/1/18	As of 7/1/19	As of 7/1/20
5/8-in	$ 10.05	$ 10.91	$ 11.66	$ 12.26	$ 12.89
3/4-in	$ 10.32	$ 11.20	$ 11.97	$ 12.59	$ 13.24
1-in	$ 11.11	$ 12.06	$ 12.89	$ 13.55	$ 14.25
1 1/2-in	$ 12.16	$ 13.20	$ 14.10	$ 14.83	$ 15.60
2-in	$ 15.05	$ 16.34	$ 17.46	$ 18.35	$ 19.30
3-in	$ 36.36	$ 39.47	$ 42.17	$ 44.34	$ 46.64
4-in	$ 44.25	$ 48.03	$ 51.33	$ 53.96	$ 56.76
6-in	$ 62.66	$ 68.01	$ 72.68	$ 76.42	$ 80.37
8-in	$ 83.71	$ 90.86	$ 97.10	$ 102.09	$ 107.38
10-in	$ 107.38	$ 116.55	$ 124.55	$ 130.95	$ 137.74
Fire Service - All Sizes *	$1.15 /month	$1.23 /month	$1.30 /month	$1.35 /month	$1.40 /month

Outside City Volume (Commodity) Rates - Consumption

	As of 10/1/16	As of 7/1/17	As of 7/1/18	As of 7/1/19	As of 7/1/20
Single Family Residential and					
Multi-Family Residential (calculation is based upon the number of dwelling units multiplied by the tier width)					
Tier 1 (0-5 ccf**)	$ 6.59	$ 7.16	$ 7.65	$ 8.04	$ 8.46
Tier 2 (6-7 ccf)	$ 7.37	$ 8.00	$ 8.55	$ 8.99	$ 9.46
Tier 3 (8-9 ccf)	$ 8.54	$ 9.27	$ 9.90	$ 10.41	$ 10.95
Tier 4 (10 ccf & above)	$ 10.15	$ 11.02	$ 11.78	$ 12.38	$ 13.02
Commerical: Business, Industrial, Restaurant, Hotel, Golf, Municipal, Bulk, Fire Service Leaks					
Uniform	$ 7.53	$ 8.17	$ 8.73	$ 9.18	$ 9.66
North Coast AG					
Uniform	$ 3.58	$ 3.88	$ 4.15	$ 4.36	$ 4.59
Landscape / Irrigation (tiers based on percent of water budget)					
Tier 1 (≤100% of budget)	$ 7.85	$ 8.53	$ 9.11	$ 9.58	$ 10.08
Tier 2 (101% - 150%)	$ 10.48	$ 11.38	$ 12.16	$ 12.79	$ 13.45
Tier 3 (150% & above)	$ 11.76	$ 12.77	$ 13.64	$ 14.34	$ 15.09
Elevation Surcharge					
As Applicable	$ 0.48	$ 0.52	$ 0.56	$ 0.59	$ 0.62

Outside City Volume (Commodity) Rates - Infrastructure Reinvestment Fee

	As of 10/1/16	As of 7/1/17	As of 7/1/18	As of 7/1/19	As of 7/1/20
Single Family Residential and					
Multi-Family Residential (calculation is based upon the number of dwelling units multiplied by the tier width)					
Tier 1 (0-5 ccf**)	$ 1.78	$ 1.99	$ 2.10	$ 2.33	$ 2.57
Tier 2 (6-7 ccf)	$ 2.68	$ 2.99	$ 3.15	$ 3.49	$ 3.86
Tier 3 (8-9 ccf)	$ 3.30	$ 3.69	$ 3.88	$ 4.31	$ 4.76
Tier 4 (10 ccf & above)	$ 4.44	$ 4.96	$ 5.22	$ 5.80	$ 6.41
Commerical: Business, Industrial, Restaurant, Hotel, Golf, Municipal, Bulk					
Uniform	$ 2.59	$ 2.90	$ 3.05	$ 3.38	$ 3.74
North Coast AG					
Uniform	$ 3.05	$ 3.40	$ 3.58	$ 3.98	$ 4.39
Landscape / Irrigation (tiers based on percent of water budget)					
Tier 1 (≤100% of budget)	$ 3.23	$ 3.60	$ 3.79	$ 4.21	$ 4.65
Tier 2 (101% - 150%)	$ 4.83	$ 5.39	$ 5.68	$ 6.30	$ 6.97
Tier 3 (150% & above)	$ 4.89	$ 5.46	$ 5.75	$ 6.38	$ 7.05

Outside City Volume (Commodity) Rates - Rate Stabilization Fee

	As of 10/1/16	As of 7/1/17	As of 7/1/18	As of 7/1/19	As of 7/1/20
All accounts (Per ccf)	$ -	$ 1.00	$ 1.00	$ 1.00	$ 1.00

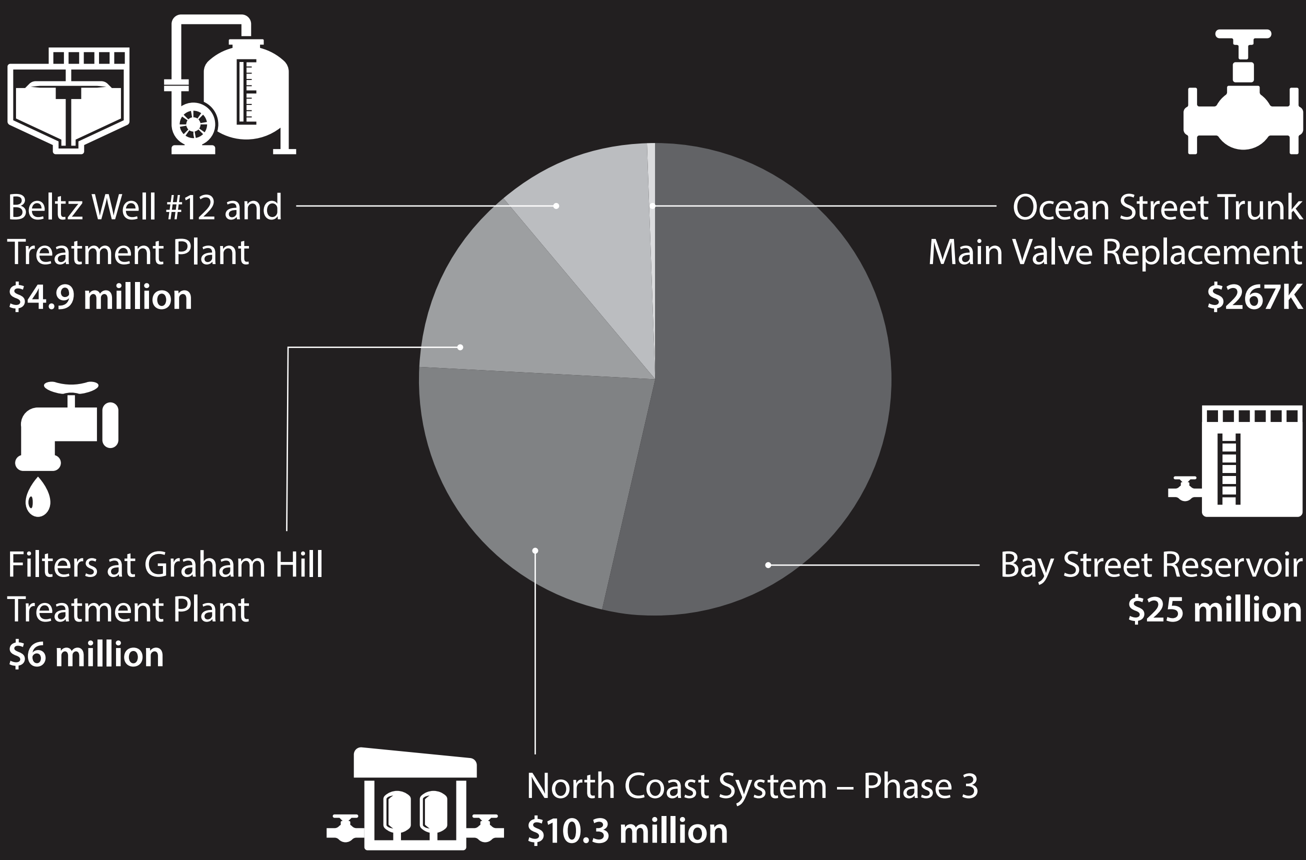
*This amount may be billed annually and will be added to any other applicable water use fixed and volume charges. **ccf equals 100 cubic foot of water.

Drought Cost Recovery Fee (DCRF)

	Stage 1 – 5% Shortage	Stage 2 – 15% Shortage	Stage 3 – 25% Shortage	Stage 4 – 35% Shortage	Stage 5 – 50% Shortage
Maximum Targeted Cost Recovery	$ 1,000,000	$ 2,500,000	$ 4,000,000	$ 5,500,000	$ 7,500,000
5/8-in	$ 2.45	$ 6.12	$ 9.79	$ 13.46	$ 18.35
3/4-in	$ 2.45	$ 6.12	$ 9.79	$ 13.46	$ 18.35
1-in	$ 6.13	$ 15.30	$ 24.48	$ 33.65	$ 45.88
1 1/2-in	$ 12.25	$ 30.60	$ 48.95	$ 67.30	$ 91.75
2-in	$ 19.60	$ 48.96	$ 78.32	$ 107.68	$ 146.80
3-in	$ 36.75	$ 91.80	$ 146.85	$ 201.90	$ 275.25
4-in	$ 61.25	$ 153.00	$ 244.75	$ 336.50	$ 458.75
6-in	$ 122.50	$ 306.00	$ 489.50	$ 673.00	$ 917.50
8-in	$ 281.75	$ 703.80	$ 1,125.85	$ 1,547.90	$ 2,110.25
10–in	$ 347.90	$ 869.04	$ 1,390.18	$ 1,911.32	$ 2,605.70

The Drought Cost Recovery Fee maximum amounts set forth above are a fixed fee and are hereby established and shall be applicable for the full fiscal year (twelve months) following the water shortage declaration made by City Council. The maximum targeted cost recovery amount is indicated below and is linked to the water shortage stage declared by the City Council.

How Your Money Has Been Spent



What is the need to increase water rates?

Much of the City's water infrastructure has reached or is reaching the end of its functional lifespan. Therefore the Water Department is planning a major infrastructure reinvestment program, with $128 million needed for projects over the next five years.

What are the proposed changes to rates?

The Water Department is proposing changes to both how rates are structured and to the per-unit costs. Water rates are currently structured so that about 1/3 of revenue comes from fixed rates, such as the Ready-to-Serve charge. The new rate structure will collect less from fixed charges and more from the volume of water used. Because fixed-fee revenues are going down, per unit water rates will be going up to produce needed revenues. This design is more in line with the values expressed by the community, which is to encourage less water use.

How much more will customers pay with the proposed rate increases?

It depends on how much water a customer uses. Very low water users will actually pay less than they currently pay; very high users will pay substantially more.

Customers were told to conserve water, but are now being told that the drop in water sales is causing the need to raise rates. That doesn't seem fair?

It's true that the loss in revenue from selling less water is part of the need to increase rates. However it's a small part. The driving force behind raising rates is the need to reinvest in the City's drinking water treatment and delivery infrastructure.

What will customers get for their money?

Major rehabilitation of the inlet-outlet pipeline in the dam at Loch Lomond; rehabilitation or replacement of the Felton Diversion Dam and Pump Station and the Felton-to-Loch Lomond pipeline; and additional rehabilitation of the Graham Hill Water Treatment Plant are all projects that will be completed.

What's the difference between the current Ready-to-Serve charge and the proposed new Infrastructure Reinvestment Fee?

The Ready-to-Serve charge pays for ongoing operations, such as meter reading and maintenance, producing and delivering bills, and customer service. The proposed Infrastructure Reinvestment Fee is specifically for pay-as-you-go capital investment and debt service for capital expenditures.

What's the difference in the Rate Stabilization Fee proposed and the Drought Cost Recovery Fee?

The Drought Cost Recovery Fee will only be levied during an official declaration of water restrictions. The Rate Stabilization Fee was created to mitigate the risk inherent in basing so much revenue on the volume of water sold.

Will there be a "lifeline" rate for those on fixed and low incomes?

Proposition 218 requires that all customers be charged only for the costs of service provided – no more; no less. Unfortunately it therefore does not make allowances for "lifeline" rates.

Notice of Public Hearing

The City Council for the City of Santa Cruz will hold a Public Hearing Tuesday, August 23, 2016, during the regular meeting of the City Council at 7:00 pm.

The City Council will consider adoption of a proposed water rate increase affecting all water customers. Interested persons are encouraged to attend and comment on the issues being discussed. The meeting will be held in City Council Chambers at 809 Center Street.

Written protests: Any property owner or a tenant who is a customer of the Water Department may protest the proposed water rates. Only one written protest per parcel, filed by an owner or a tenant who is a customer, will be counted. Only written and signed protests that include the writer's address and/or assessor parcel number will be counted to determine whether a majority protest to the proposed water rate increase exists. Written protests may be mailed or hand delivered to the Mayor and Council of Santa Cruz at 809 Center Street, Room 10, Santa Cruz, CA 95060.

If you oppose the proposed rate increases, Proposition 218 requires that your protest be submitted in writing to be counted, even if you plan to attend the Public Hearing. To be counted, the protest must: 1) be in writing; 2) state opposition to the proposed rate increase; 3) identify the parcel by assessor's parcel number or street address; 4) include the printed name and original signature of the owner of record or a tenant who is a customer of the Water Department; 5) be received before the conclusion of the Public Hearing on August 23, 2016.

For more information, visit www.cityofsantacruz.com/h2orates.

CITY OF SANTA CRUZ

Santa Cruz Water District
212 Locust Street
Santa Cruz, CA 95060

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Notice of Public Hearing
Proposed Water Rates
Affecting Your Area

Technical Memorandum

Prepared for: The City of Santa Cruz

Project Title: Water Conservation Master Plan, Phase 2

Subject: Overview of Current Findings from Water Conservation Master Planning Effort

Date: March 30, 2016

To: Toby Goddard, City of Santa Cruz Water Department

From: Lisa Maddaus, Maddaus Water Management Inc.

Bill Maddaus, Maddaus Water Management Inc.

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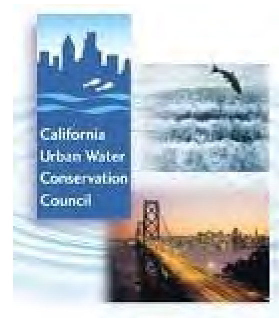
1. INTRODUCTION

This technical memorandum provides an overview of current findings from the water conservation master planning effort.

1.1 Background

Water is a precious natural resource that is vital to the health and welfare and to the economy of the Central Coast region. The City of Santa Cruz relies entirely on local sources for the community's drinking water supply. Because water supplies are limited, it is important that everyone uses water efficiently. The City of Santa Cruz has had a long-standing commitment to water conservation and offers a variety of programs, informational materials, and incentives to help City water customers become more water-efficient.



In 2000, the City adopted a Water Conservation Plan, the goal of which was to reduce water demand system-wide by 282 million gallons per year in 2010. Through plumbing fixture and appliance rebate programs, technical assistance, regulations, and other strategies, residential and commercial customers have saved over 330 million gallons of water per year so far. The City is also a member of the California Urban Water Conservation Council (CUWCC) and is active in promoting water conservation statewide.

In 2013, the Water Conservation Office contracted with Maddaus Water Management (MWM) to develop an updated Water Conservation Master Plan. The goal of the updated plan is to define the next generation of water conservation activities and serve as a roadmap to help our community achieve maximum, practical water use efficiency. Strengthening water conservation efforts has been identified as top priority by the City Council, the City's Water Commission, and more recently by the City's Water Supply Alternatives Committee in its effort aimed at delivering a safe, adequate, affordable, and environmentally sustainable water supply.

1.2 Need and Plan Objectives

The City of Santa Cruz's Water Conservation Master Plan (WCMP or Plan) strives to maximize the community's efficient use of water in the most equitable and cost-effective manner to the extent practical for implementation by City staff.

Key priorities of the WCMP include the following:

- Capitalize on opportunities to meet the future water needs of the Santa Cruz Water Department customers through cost-effective and sustained water conservation and water use efficiency efforts
- Demonstrate environmental stewardship and foster innovative, responsible and efficient practices
- Commit to and implement a water conservation program that supports the health of rivers, streams, and groundwater integral to the region's quality of life and economy
- Monitor and measure performance to ensure conservation potential is being met as forecasted

Achieving these goals will allow the Water Department to:

- Maintain and exceed the water savings already achieved by the City of Santa Cruz as well as identify the best path to achieve those savings and to monitor commitments to the CUWCC Memorandum of Understanding (MOU) Regarding Urban Water Conservation;
- Maintain a long-term plan for compliance with SB X7-7 to meet the gallons per capita per day (GPCD) target by 2020; and
- Meet the City's integrated water resource management goals to reduce peak season demands.

1.3 WSAC Recommended Approach to Demand Management

The City's Water Supply Advisory Committee (WSAC) was supported by City staff and Maddaus Water Management in its review of remaining conservation potential to future goals for the City's Conservation Program. In the WSAC's Final Report published in October 2015, the following key assumptions about the demand management program (Recommended Program) were presented:

- "The Econometric Demand Forecast [building on previous assumptions prepared by MWM in the DSS Model] includes significant demand reductions associated with the implementation of existing plumbing and building codes, the continuation of existing demand management programs (as a baseline) and as a function of the effect on demand of expected increases in water rates.
- "A focus of new demand management programs will be on peak season demand reduction, which is also a significant focus of the expected demand reduction associated with anticipated price increases.
- "New and enhanced demand management programs will be developed to build on the Water Department's current program that has contributed to reducing per capita demand in Santa Cruz to one of the lowest levels in the state.
- "The programs to be implemented in the coming decade[s] are a mix of lower cost and some higher cost measures. Those higher cost measures are meant as small-scale experiments that may be broadened if they prove popular and their costs decline over time. Together these measures incur an average total program cost of no more than $10,000 per million gallons of water saved. This figure is lower than the expected cost of supply augmentation projects recommended to be pursued as a result of WSAC's work."

2. PLAN DEVELOPMENT (SUMMARY OF PROCESS)

Work on the Water Conservation Master Plan began with a kick-off meeting in January 2013. Since that time, the Water Commission has developed the goals of the planning effort; identified and selected a suite of potential quantifiable conservation measures for technical analysis; and evaluated system-wide conservation potential through selection of a recommended program scenario.

In preparation for this project, the City completed a Residential and Commercial Baseline Water Use Survey in May 2013 to assess the current status of plumbing fixtures, appliances, and landscape characteristics present in the City's water service area.

There have been two (2) main phases in the City's planning process separated by an intervening year that included an in-depth review of the work by WSAC. The process followed in the Plan is summarized as follows:

Phase 1: January 2013-October 2014

- Analyze water use and review City's Baseline Survey for remaining conservation potential
- Identify, screen, and prioritize measures, with significant public input via Water Commission Meetings and workshops
- Model measures
- Formulate programs, leading to a recommended Program "C" to maximize total annual water savings based on conservation potential
- Present outcomes to Water Commission on October 6, 2014

WSAC Review: October 2014-September 2015

- Review prior Phase 1 analytical results from the Least Cost Decision Support System Model (DSS Model – Model described in Appendix A) and seek to answer additional questions with City and MWM technical assistance
- Shift conservation program emphasis to peak season (April-October) water savings rather than maximizing overall higher annual volume and/or more cost-effective water efficiency savings to better address the City's supply-demand gap.
- Prepare and adopt a new econometric-based demand forecast

- Produce recommendations for additional conservation measures to be included in the Final Water Conservation Master Plan

Phase 2: October 2015-present

- Recalibrate model to updated econometric demand forecast and reset planning horizon to 2015-2035
- Incorporate input (changes to existing measures and adding new measures) from WSAC process, with focus on peak season demand reduction
- Incorporate new plumbing code changes based on the State's Emergency Drought Regulations, effective December 1, 2015
- Formulate the "Recommended Program" into the DSS Model and evaluate results

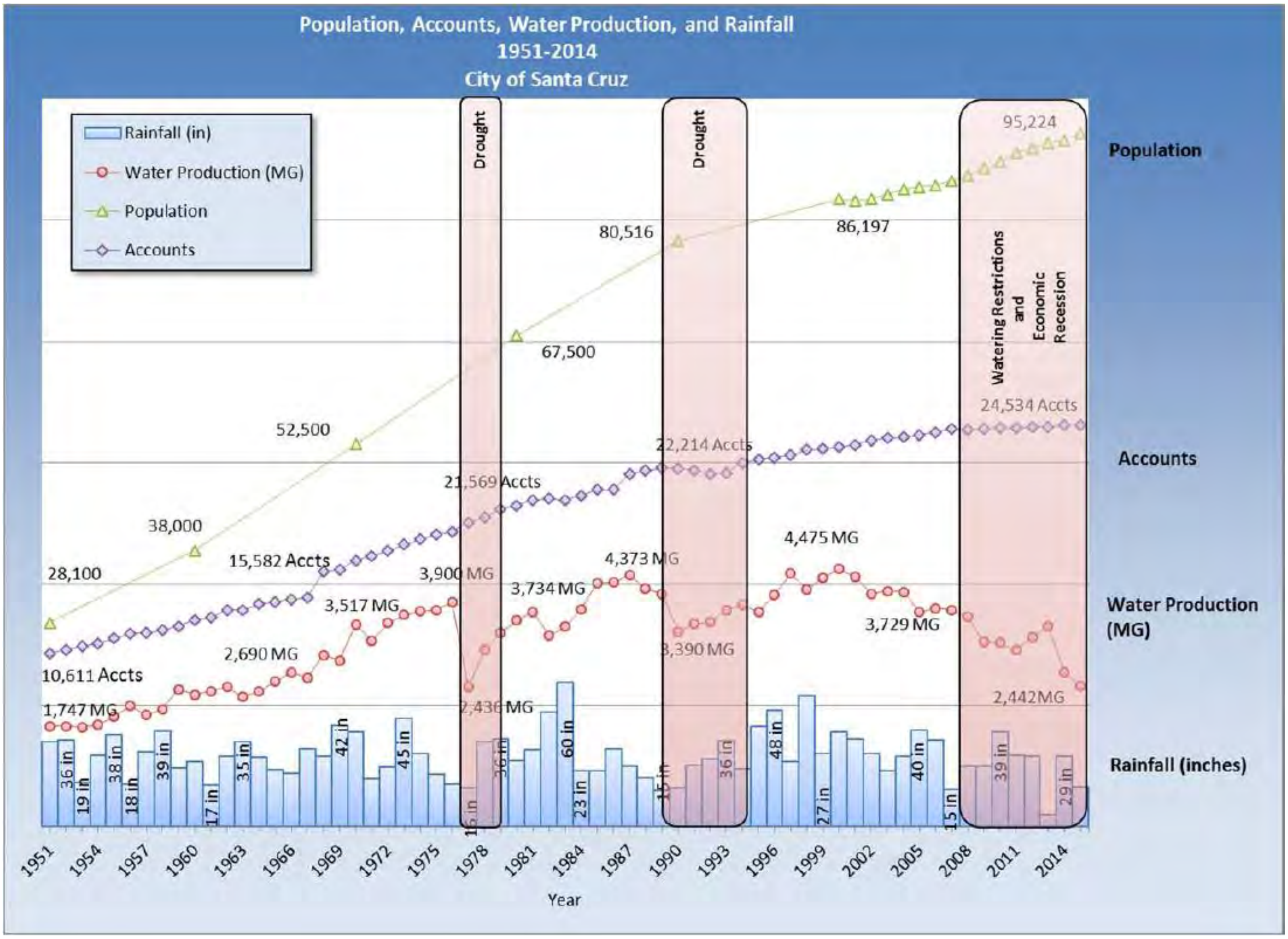
3. BASELINE DEMANDS

The WCMP process comprises four distinct steps: 1) input/analysis of system-wide demand projections to establish demand planning baseline with and without plumbing and building codes; 2) evaluation of system-wide conservation potential; 3) identification and study of potential conservation measures; and 4) deliberation and adoption of preferred long-term conservation program. Each of these steps is described in more detail in the following sections. This section presents a summary of the City's historical demand trends as well as the basis for the demand forecast.

3.1 Historical Trends

As seen in Figure 3-1, the historic trend in system water use paralleled account growth and population, except during two major drought periods. Around 2000, the pattern changed and system demand began a long period of decline, accelerated in 2009 by drought, economic downturn, and other influencing factors. The City has not seen a full demand recovery since the recent economic recession due to the ongoing drought. In 2013 system-wide demand was 3,364 million gallons per year, with Stage 1 water shortage regulations and restrictions in effect. In 2015 with the full rationing scheme in place, the City reduced production to 2,442 million gallons on the level not seen since the drought in the 1970s. Water demands are projected to remain depressed after the year 2015 due to persistent drought conditions and long-term behavioral changes related to water use. While it is prudent to assume that future demands will eventually recover when rainfall patterns/drought conditions and the economy normalize, it might not be to the same level as before due to widespread, long-term conservation measures taken in response to drought and ongoing adjustments in water rates.

Figure 3-1. Historical Trends for City of Santa Cruz



3.2 Basis for Demand Forecast

Maddaus Water Management (MWM) employed its Least Cost Planning Decision Support System Model (DSS Model) for the technical analysis. In addition to considering historical demand trends based on billing consumption data, the DSS Model takes into account the following parameters: total population, single family population, multifamily population, UC Santa Cruz population, commercial employment, business-industrial growth, and municipal growth.

In the M.Cubed August 2015 "City of Santa Cruz Water Demand Forecast," David Mitchell conducted an econometric analysis of water demand and forecasts of class-level customer demands and total system production through 2035. The report was commissioned by the City of Santa Cruz Water Department and the City's Water Supply Advisory Committee. Its purpose was to update the Department's existing demand forecast adopted as part of the 2010 UWMP to reflect current information on water usage and to account for effects of current conservation (using DSS Model Program A), water rates, and other factors expected to impact the future demand for water. With the start of Phase 2, MWM's DSS Model was carefully updated to incorporate this econometric analysis by inputting the regression equations and data sets used by M.Cubed and calibrated to ensure consistency between the two demand forecast models.

The updated DSS model starts with a "baseline" demand forecast, which is not the same forecast as presented by M.Cubed. It differs in that it backs out the earlier estimates for plumbing code savings and the estimated future water saving associated with the City's current water conservation program that were provided by MWM to M.Cubed in 2015 and embedded in that final demand forecast. All other variables, including average water use per account, forecasts of account growth, and economic factors used to forecast water use in the M.Cubed report, were taken directly from that model and used to populate the DSS model.

Table 3-1 below compares the primary water demand forecast presented by M.Cubed without the code savings and program savings that were previously generated from the DSS Model analysis completed in October 2014 compared to the updated DSS "baseline" demand completed in February 2016.

Table 3-1. Comparison of M.Cubed Demand Forecast and DSS "Baseline" Forecast (MG)

Demand (MG)	2020	2025	2030	2035
M.Cubed Final Demand Forecast, October 2015	3,385	3,351	3,388	3,442
2014 Estimate of Plumbing Code Savings (Prior DSS Model version)	65	132	197	235
2014 Estimate of Conservation Program Savings – Program "A" (Prior DSS Model version)	110	143	139	134
M.Cubed Final Demand Forecast without Plumbing Code or Conservation Program Savings	3,560	3,626	3,724	3,811
DSS Model "Baseline" Demand	3,560	3,636	3,743	3,838
Difference, MG	0	10	19	27
Difference, %	0.0%	0.3%	0.5%	0.7%

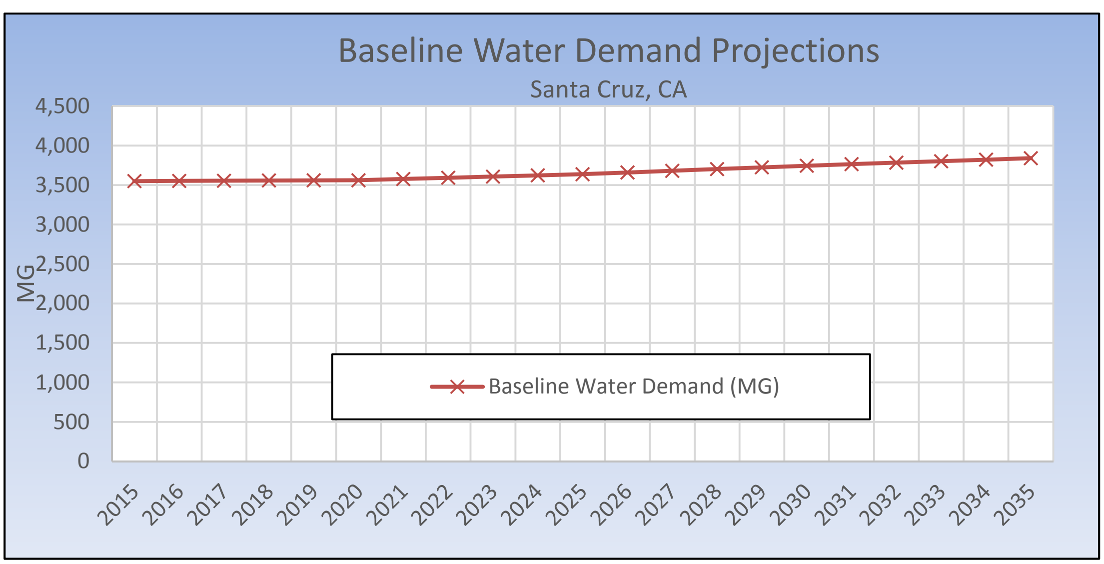
Note: Plumbing code and program savings: M.Cubed, 2015, Attachment 8, were originally based on results from the DSS Model prior work in 2014 by Maddaus Water Management, which are updated with the most recent DSS Model results from February 2016.

As can be seen in the above table, the two models are in close agreement and in all years differ by less than 1%.

The baseline demand forecast is shown in the following Figure 3-2. As referenced in the M Cubed report, the baseline forecast is predicated on average weather and normal economic conditions and is not expected to match realized demand, especially in the short term. City staff will continue to monitor production and consumption through and following the drought.

The next step involves calculating the effect of passive savings against the "baseline" demand. The results differ from earlier estimates of plumbing code savings presented in 2014-15 for two reasons: 1) lower baseline demand and 2) additional passive savings due to recent changes in California codes resulting from 2015 emergency conservation regulations adopted in California, effective December 1, 2015 (after the publication of the M.Cubed report).

Figure 3-2. Baseline Demand Forecast Without Plumbing Code Savings



Source: City of Santa Cruz. DSS Model, Section: Demand Analysis, Feb 16, 2016.

4. BASELINE DEMANDS WITH PASSIVE SAVINGS 2015-2035

Future community-wide conservation savings will be achieved by implementing both passive and active measures. Passive measures are federal and state codes and standards that increase conservation savings as older appliances and fixtures are replaced over time naturally with more water efficient models. Active measures are those in which the City will invest to promote water conservation, such as incentives and educational programs.

4.1 Basis for Plumbing Code Savings

Since it is beneficial to model the impact of the natural changes in the mix of types of appliances, the DSS Model forecasts service area water fixture use. In the codes and standards part of the DSS Model, specific fixture end-use type (point of use fixture or appliance), average water use, and lifetime are compiled. Additionally, state and national plumbing codes and appliance standards for toilets, urinals, showers, and clothes washers are modeled by customer category. These fixtures and plumbing codes can be added to, edited, and/or deleted by the user. This yields two demand forecasts – one with and one without plumbing code savings.

A key input in the model is fixture water use and life, as well as the initial proportions of individual fixtures in each customer class. The following Figure 4-1 presents an example of the initial proportions used in existing single family accounts. Table 4-1 on the following page provides the list of fixtures, average water use, and assumptions for fixture life used in this analysis.

Figure 4-1. Initial Fixture Proportions for Single Family Toilets (screen shot from the DSS Model)

Initial Fixture Proportions - Single Family Toilets	
1.28 gpf HET Residential	7.2%
1.6 gpf ULFT Residential	82.7%
High Use Toilet Residential	10.1%
<1.0 gpf Toilet Residential	0.0%
Total	100.0%

Data collected from the recently completed City of Santa Cruz Water Use Baseline Survey was used for this purpose. Other input parameters include estimates for annual replacement rate and assumed market share for both replacement and new equipment at various points in the planning horizon.

The scope of analysis involved assessing the rate of change of toilets, shower heads, lavatory and non-lavatory/kitchen faucets, and clothes washers in both existing single family and multifamily accounts, and toilets, urinals, and lavatory and non-lavatory/kitchen faucets in commercial accounts. Fixture characteristics are also tracked in new accounts, which are subject to the requirements of the 2015 California Green Building Code and 2015 California Code of Regulations Title 20 Appliance Efficiency Regulations adopted by the California Energy Commission (CEC) on September 1, 2015. This was an update in Phase 2, from the prior work in Phase 1, of preparing the DSS Model.

The controlling law for **toilets** is Assembly Bill (AB) 715. This bill requires high efficiency toilets (1.28 gpf) to be exclusively sold in California beginning January 1, 2014. The controlling law for wall-mounted urinals is the 2015 CEC efficiency regulations requiring that ultra-high efficiency pint **urinals** (0.125 gpf) be exclusively sold in California beginning January 1, 2016. This is an efficiency progression for urinals from AB 715's requirement of high-efficiency (0.5 gpf) urinals starting in 2014 that was modeled during WCMP Phase 1.

Standards for **residential clothes washers** fall under the regulations of the U.S. Department of Energy. Even though both front loading and top loading models will still be available for the foreseeable future, national water efficiency standards for both types are becoming more stringent over time, in steps. In March 2015, the federal standard reduced the maximum water factor for non-Energy Star certified top- and front-loading washing machines to 8.4 and 4.7, respectively. In 2018, the maximum water factor for standard top-loading machines will be further reduced to 6.5. Beginning in 2015, the maximum water factor for Energy Star certified washers was 4.3 for top-loading machines and 3.7 for front-loading.

Showerhead flow rates are newly regulated under the 2015 California Code of Regulations Title 20 Appliance Efficiency Regulations adopted by the CEC, which requires the exclusive sale in California of 2.0 gpm showerheads at 80 psi as of July 1, 2016 and 1.8 gpm showerheads at 80 psi as of July 1, 2018. The WaterSense specification applies to showerheads that have a maximum flow rate of 2.0 gallons per minute (gpm) or less. This represents a 20% reduction in showerhead flow rate over the current federal standard of 2.5 gpm, as specified by the Energy Policy Act of 1992.

Faucet flow rates have likewise been recently regulated by the 2015 CEC Title 20 regulations. This standard requires that the residential faucets and aerators manufactured on or after July 1, 2016 be exclusively sold in California at 1.2 gpm at 60 psi; and public lavatory and kitchen faucet/aerators sold or offered for sale on or after January 1, 2016 be 0.5 gpm at 60 psi, and 1.8 gpm at 60 psi (with optional temporary flow of 2.2 gpm), respectively. Previously, all faucets had been regulated by the 2010 California Green Building Code at 2.2 gpm at 60 psi.

Plumbing code related water savings are considered reliable, long-term savings, and can be counted on over time to help reduce the City's overall system water demand. This projection further assumes no active involvement by the City, and that the costs of purchasing and installing replacement equipment (and new equipment in new construction) are borne solely by the customers, occurring at no direct utility expense. The inverse of the Fixture Life is the natural replacement rate, expressed as a percent (i.e., 10 years is a rate of 10% per year).

Table 4-1. List of Fixtures

Fixture Name	End Use	Average Water Use	Units	Fixture Life (yrs.)
Efficient Front Loader	Clothes Washers	13.0	gal per use	10
Medium Efficient Front Loader	Clothes Washers	19.0	gal per use	10
Top Loader	Clothes Washers	34.0	gal per use	10
0.5 gpm Non-Residential Lavatory Faucet	Lavatory Faucets	0.1	gal per use	15
1.2 gpm Residential Lavatory Faucet	Lavatory Faucets	0.3	gal per use	10
2.2 gpm Residential Lavatory Faucet	Lavatory Faucets	0.6	gal per use	10
2.2 gpm Non-Residential Lavatory Faucet	Lavatory Faucets	0.6	gal per use	15
2.5 gpm Residential Lavatory Faucet	Lavatory Faucets	0.6	gal per use	10
2.5 gpm Non-Residential Lavatory Faucet	Lavatory Faucets	0.6	gal per use	15
>2.5 gpm Residential Lavatory Faucet	Lavatory Faucets	0.9	gal per use	10
>2.5 gpm Non-Residential Lavatory Faucet	Lavatory Faucets	0.9	gal per use	15
1.8 gpm Residential Non-Lavatory/Kitchen Faucet	Non-Lavatory/Kitchen Faucets	1.8	gal per use	10
1.8 gpm Non-Residential Non-Lavatory/Kitchen Faucet	Non-Lavatory/Kitchen Faucets	1.8	gal per use	15
2.2 gpm Residential Non-Lavatory/Kitchen Faucet	Non-Lavatory/Kitchen Faucets	2.2	gal per use	10
2.2 gpm Non-Residential Non-Lavatory/Kitchen Faucet	Non-Lavatory/Kitchen Faucets	2.2	gal per use	15
2.5 gpm Residential Non-Lavatory/Kitchen Faucet	Non-Lavatory/Kitchen Faucets	2.5	gal per use	10
2.5 gpm Non-Residential Non-Lavatory/Kitchen Faucet	Non-Lavatory/Kitchen Faucets	2.5	gal per use	15
>2.5 gpm Residential Non-Lavatory/Kitchen Faucet	Non-Lavatory/Kitchen Faucets	3.5	gal per use	10
>2.5 gpm Non-Residential Non-Lavatory/Kitchen Faucet	Non-Lavatory/Kitchen Faucets	3.5	gal per use	15
High Efficiency 1.5 gpm	Showers	10.4	gal per use	25
High Efficiency 1.8 gpm	Showers	12.5	gal per use	25
High Efficiency 2 gpm	Showers	13.9	gal per use	25
Low Flow 2.5 gpm	Showers	18.3	gal per use	25
High Flow > 3 gpm	Showers	23.5	gal per use	25

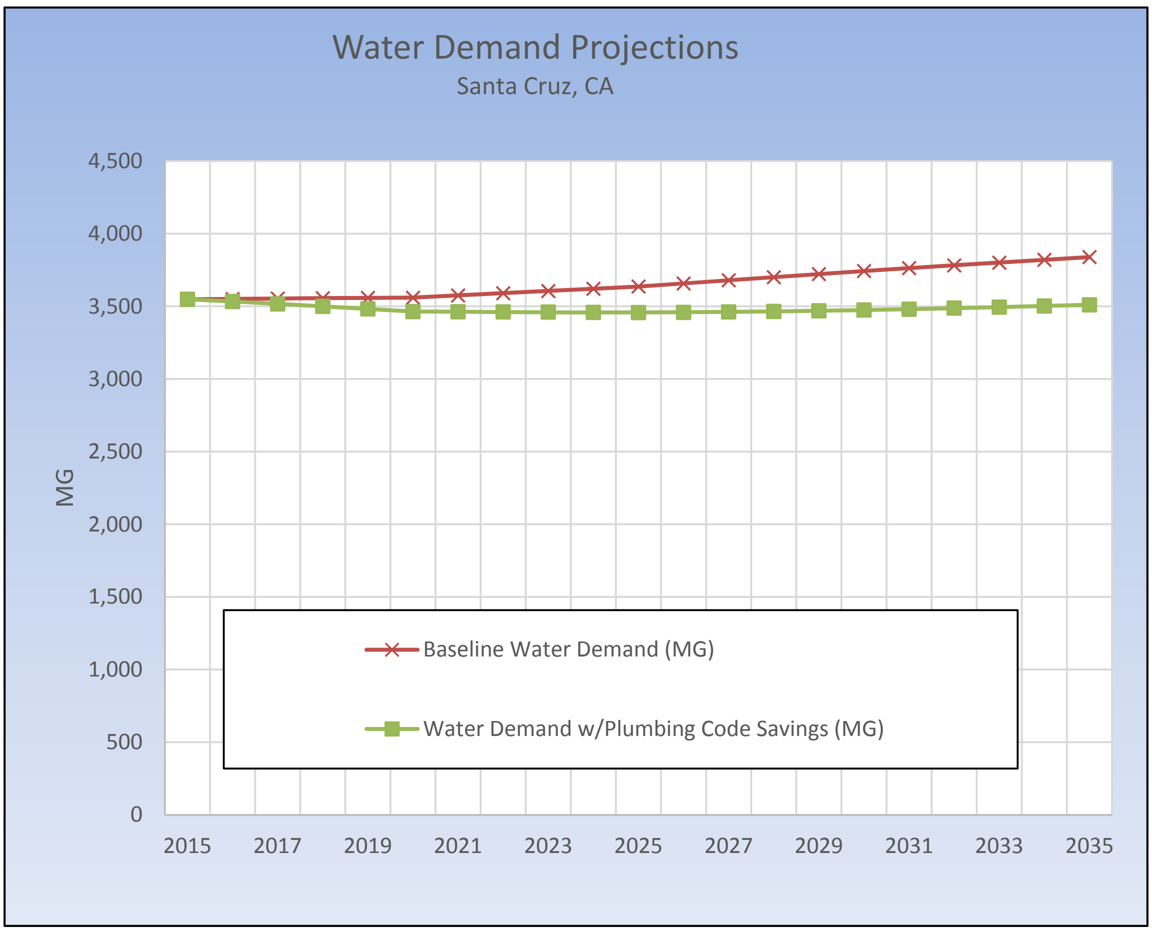
Table 4-1. List of Fixtures (continued)

Fixture Name	End Use	Average Water Use	Units	Fixture Life (yrs.)
<1.0 gpf Toilet Non-Residential	Toilets	1.0	gpf	50
1.28 gpf HET Residential	Toilets	1.3	gpf	50
1.28 gpf HET Non-Residential	Toilets	1.3	gpf	50
1.6 gpf ULFT Residential	Toilets	1.8	gpf	33
1.6 gpf ULFT Non-Residential	Toilets	1.8	gpf	50
High Use Toilet Residential	Toilets	3.5	gpf	25
High Use Toilet Non-Residential	Toilets	3.5	gpf	33
Waterless Urinal	Urinals	0.0	gpf	50
Pint Urinal	Urinals	0.1	gpf	50
Quart Urinals	Urinals	0.3	gpf	50

4.2 Baseline Demands with Passive Savings 2015-2035

The DSS Model estimates total cumulative plumbing code savings of 329 million gallons/year in 2035. As seen in Figure 4-2 below, water savings from fixture and appliance codes alone is expected to reduce total water demand (without plumbing code) from approximately 3.8 million gallons per year to about 3.5 million gallons by 2035, a reduction of about 8.6% due to plumbing code savings. Table 6-3 in section 6.1 shows the water savings in 5-year increments due to plumbing codes. Table 6-4 in section 6.2 presents projected water demands with plumbing code savings in 5-year increments.

Figure 4-2. Demand Forecast With and Without Plumbing Code Savings



Source: City of Santa Cruz. DSS Model, Section: Demand Analysis, Feb 16, 2016.

5. RECOMMENDED MEASURES

Maddaus Water Management (MWM) employed its Least Cost Planning Decision Support System Model (DSS Model) for the technical analysis. The following sections describe key elements used in the analysis that were reviewed during past Water Commission Meetings with public input along with both a webinar and two in-person workshops, including interested local community stakeholders, Water Commission members, and Water Supply Advisory Committee members. This section also presents a summary of the proposed measures, including their descriptions and estimated water savings. Background information on MWM's DSS Model can be found in Appendix A.

The initial process to identify and thoroughly evaluate potential conservation measures was iterative. First, an extensive list of more than 90 potential measures was generated based on input from City staff, consultants, Water Commissioners, and the public. This task included a review of the current active water conservation measures and the identification of new measures that may be appropriate for the City's service area. Next, the list of potential measures was screened to set aside measures that may not be appropriate for myriad reasons to seek those that would be included in the future program. The following criteria were used to narrow the list of potential measures:

- Water Saving Potential – emphasize measures that reduce average daily water use the most within the Santa Cruz community
- Sustainable Water Savings – emphasize measures that have long-term reliability
- Quantifiable Water Savings – emphasize measures where water savings can be accurately predicted
- Widespread Community and Social Acceptance – emphasize measures with high participation rates, low out-of-pocket expenses, and are equitable across customer type and social demographics
- Feasibility of Implementation/Secondary Impacts – emphasize measures that can achieve objectives
- Ancillary Benefits – emphasize measures that achieve additional goals, such as reducing energy/greenhouse gases (GHGs), reducing peak-season use, providing valuable customer service, and other non-quantifiable benefits (behavioral change, public awareness, etc.)

Further details about this process as well as a list of all the 90 potential measures are available from City staff. From the screening, the Water Commission added to and approved the recommended list of measures for the technical analysis phase of the project.

During the WSAC Report development, several additional measures were considered and added to the program. The result of the WSAC work on demand management was to shift the focus more toward reducing peak season use to increase supply reliability. It did so by considering measures to reduce outdoor use in residences and large landscapes, but also by enhancing base or indoor measures that lessen overall demand or that target specific uses, including visitor-serving uses, and thereby help reduce the City's peak season water use. The recommended program now matches the recommended measures list published in the October 2015 Water Supply Advisory Committee Final Report on Agreements and Recommendations, Table 14. The following table presents a basic description of each measure and the types of customers each measure targets. More detailed information and assumptions are described in the DSS Model.

Table 5-1. Basic Measure Descriptions

No.	Measure Name	Type of Customer	Description
1	System Water Loss Reduction	System	This measure's purpose is to identify and reduce water losses in the City's water system. The City is currently doing a water loss control study to review its annual water audit, look at water losses, and design a cost-effective water loss control program. The City currently loses an average of 7.5% of all treated water due to leaks, meter inaccuracies, and other problems. The goal of this measure is to reduce the City's system water losses on a long-term basis by an average of 1%. A new state law passed in 2015 that will require water suppliers to conduct water system audits, verify, and report water losses every year to the state beginning in 2017.
2	Advanced Metering Infrastructure (AMI)	Single Family (SF), Multifamily (MF), Commercial (COM)	This measure involves a major investment to upgrade meter reading technology and data management abilities. The City currently uses an Automatic Meter Reading system (AMR) in which water meters are read monthly by radio equipment that then transmits the information back to the City. This system may increase the frequency of meter reading from once a month to once an hour. The main water conservation (savings) benefits are for customer in-home or outdoor leak detection and increased customer awareness of water use. Other benefits include more action in enforcing the drought restrictions and more efficient customer service. Utility billing would continue to be on a monthly basis.
3	Large Landscape Budget-Based Water Rates	Irrigation (IRR)	This measure includes the development of individual monthly water budgets for irrigation customers. Water budgets are connected to a water rate schedule where water rates increase when a customer goes above their landscape water budget, or decreases if they are below budget. Budgets are typically based on factors like the size of the irrigated area, plant material and changes in weather conditions.
4	General Public Information	SF	This measure addresses opportunities to use public information programs as an effective tool to inform customers about the need for water conservation and conservation-related benefits. The current campaign is called "*Surf City Saves"* program. This measure includes paid and public service advertising, newsletters, bill inserts, information on the utility bill, a website, flyers and brochures, media campaigns, community meetings, direct mailings, community engagement at local activities, and other techniques. Public information is often carried out and coordinated with other agencies, groups, and schools.
5	Public Information (Home Water Use Report)	SF	This measure involves contracting with a firm to produce a detailed water billing report for high use customers that is in addition to their normal utility bill. This billing report compares water use in the neighborhood and offers suggestions to customers on ways to reduce water use.
6	Residential Leak Assistance	SF, MF	Customer leaks can go uncorrected at homes where owners are not able to pay the costs of repair. This measure would involve the City either paying part of the repair or paying the entire cost of the repair with funds that are paid back from customer water bills over time. This measure may also include an option to replace inefficient plumbing fixtures at low-income residences.
7	Single Family Residential Surveys	SF	This measure provides an outdoor water survey for existing single family residential customers. High water users will be targeted. This measure may include giving away water-efficient showerheads, faucet aerators, and toilet devices. This measure would provide a basic outdoor survey (look for leaks, irrigation problems and scheduling, plant information, etc.) and promote landscape and irrigation programs and improvements to reduce peak season water use.
8	Plumbing Fixture Giveaway/ Opt	SF, MF	The City would buy large amounts of efficient showerheads, kitchen and lavatory faucet aerators, shower timers and hose timers. Hose nozzles and leak detection tablets would be available for distribution at the Utility office and at community events.
9	Residential Ultra High Efficiency Toilet Rebates	SF, MF	This measure provides a rebate or voucher for the installation of an ultra-high efficiency toilet (UHET) that uses 1.0 gallons of water or less per flush (gpf).
10	High Efficiency Clothes Washer Rebates	SF, MF	The City would provide a rebate for high-efficiency clothes washing machines (HECW) to single family homes and in-unit condo/apartment complexes that do NOT have common laundry rooms. This program would be similar to the City's current program, except that higher rebate amounts would be increased for qualifying machines that are listed as Energy Star "Most Efficient" Clothes Washers.
11	High Efficiency Clothes Washer - New Development	SF, MF, COM	This measure would involve amending the City's building regulations to require building developers to install an efficient clothes washer (meeting certain water efficiency standards, such as gallons per load). Inspections would be coordinated with City and County building departments to make sure that an efficient washer is installed before the new home or building is occupied.
12	Hot Water On Demand - New Development	SF, MF, COM	The City would work to pass an ordinance requiring developers and major building remodels (for example, 50% of value of improvements) to equip new homes or buildings with efficient hot-water-on-demand systems. These systems use a pump placed under the sink to recycle water sitting in the hot water pipes to the water heater or to move the water heater into the center of the house and/or reduce hot water waiting times by having an on-demand pump on a recirculation line looping back to the hot water heater.
13	Toilet Retrofit at Time of Sale	SF, MF, COM	This measure involves tracking real estate sales within the City's water service area and working with buyers, sellers, and the real estate industry to retrofit older, inefficient toilets, showerheads, and urinals are upgraded with the most efficient fixtures when real estate is sold. A property inspection by either City staff or a licensed plumbing/general building would be required to verify compliance with the regulation.

No.	Measure Name	Type of Customer	Description
14	COM MF Common Laundry Room High Efficiency Clothes Washer	MF, COM	This measure provides a rebate for the installation of a high efficiency commercial washer (HEW) in COM laundromats and MF common area laundry rooms.
15	COM Incentives	MF, COM	After getting a free water use survey (Measure 17), the City will analyze the survey recommendations and determine if the MF or COM site qualifies for a financial incentive (reward). Financial incentives will be provided after analyzing the cost-benefit ratio of each proposed project. Incentives are designed to fit each individual site as each site has varying water savings potentials. Incentives will be given based on the decisions of the City specifically and while the money lasts.
16	Pre-Rinse Spray Nozzle Installation	COM	The City will provide free 1.3 gpm (or lower) pre-rinse spray nozzles, and possibly free installation of nozzles, in restaurants and other commercial kitchens.
17	COM Surveys	MF, COM	This measure will offer top MF and COM water customers a professional water survey that would evaluate ways for the site to save water and money. The surveys would be for large accounts (accounts that use more than 5,000 gallons of water per day, or the top 3%), such as hotels, restaurants, stores, and schools.
18	High Efficiency Urinal Program	COM, Municipal (MUN), Industrial (IND)	The City will provide a rebate or voucher for the replacement of older, high use urinals with high efficiency urinals (HEU) and flush valves using 0.125 gpf (1 pint) or less.
19	Public Restroom Faucet Retrofit - MUN	MUN	This measure includes the direct installation of high efficiency (0.5 gpm) sensor faucet fixtures in institutional (public) buildings, such as schools, hospitals, etc. High-use municipal building will be focused on first.
20	Public Restroom Faucet Retrofit - COM	COM	This measure includes the direct installation of high efficiency (0.5 gpm) sensor faucet fixtures in commercial buildings, such as businesses. High-use commercial buildings will be focused on first.
21	School Retrofit	MUN	This school retrofit program involves a school receiving funding to replace non-efficient fixtures, retrofit mixed use meters to dedicated irrigation meters, and upgrade irrigation systems.
22	Water Efficient Landscape Ordinance	SF, MF, COM, MUN, IND	This measure accounts for the lower irrigation water use that new accounts have due to their more efficient landscape designs, which are a result of the City's Landscape Code (implementation of Statewide Model Landscape Ordinance). The City is in the process of updating this code to keep up with new state regulations and technology for irrigation controllers and irrigation equipment.
23	Single Family Residential Turf Removal	SF	This measures provides a per-square-foot incentive to SF customers to remove and replace turf (grass) with low-water-use plants or permeable hardscape (pavers, concrete, etc. that allows water to soak through and into the ground). This is modeled after the City's current program. The rebate is currently $0.50 per square foot and capped at $500 per year for a single family residence. To increase participation, this measure would increase the rebate to $1 per square foot and a $1,000 maximum per year, or more in both cases.
24	Multifamily Residential/CII Turf Removal	MF, COM, MUN, IRR	This measure provides a per-square-foot incentive to MF, COM, MUN, and IRR customers to remove and replace turf with low-water-use plants or permeable pavers (or other permeable hardscape). The rebate is currently $0.50 per square foot of turf removed and capped at $2,500 per year for multifamily or commercial residences. This measure would increase the rebate to $1 per square foot and a $5,000 maximum per year, or more to increase participation.
25	Expand Large Landscape Survey/Water Budgets	IRR	This measure expands on the City's existing landscape water budget program to include more dedicated irrigation accounts Outdoor water audits will be offered for existing customers with problems of overwatering or water waste. Normally those with high water use are focused on and provided a customized report telling them how to save water. All multifamily residential, CII, and public irrigators of large landscapes would be eligible for free landscape water audits upon request. This measure is connected to Measure 3 above, Large Landscape Budget-Based Water Rates.
26	Sprinkler Nozzle Rebates	SF, MF, COM	The City will provide rebates to replace standard spray sprinkler nozzles with more efficient rotating nozzles. Nozzles cost about $6 each.
27	Gray Water Retrofit	SF	The City will hold a workshop to support a Gray Water Challenge or similar program. A rebate will be offered that will help to cover a portion of the cost to single family homeowners per year who install gray water systems. A gray water kit/package, available from local hardware stores, would be supported by this City rebate.
28	Residential Rain Barrels	SF	The City will provide an incentive for the installation of rain barrels. This could involve rebates, purchasing rain barrels in high quantities, and giveaways of barrels, as well as workshops on proper installation and use of captured rain water for landscape irrigation.
29	Climate Appropriate Landscaping	SF, MF, COM, MUN	This measure will provide incentives for the installation of climate-appropriate and rainwater infiltration landscape (soaks up water on-property as opposed to running off-property). This measure will provide rebates to Home Owners Associations (HOAs), businesses, and institutions that increase their outdoor water use efficiency

No.	Measure Name	Type of Customer	Description
	and Rainwater Infiltration		by replacing qualifying high water use landscape and/or upgrading to qualifying high efficiency irrigation equipment or climate appropriate landscape. To qualify, sites must participate in a pre-inspection before beginning their project or purchasing materials. Single family homes, multifamily homes, and business properties with qualifying irrigated landscape (i.e., irrigated turf or a functional swimming pool) can receive rebates for replacing high-water-use landscape (e.g., irrigated turf grass) with a minimum of 50% plant coverage consisting of low-water-use plants from the Approved Plant List. Recommendations from the Water Supply Alternatives Committee (WSAC) Report include: • Increase turf conversion rebate • Require conversion of spray to drip for shrub irrigation • Discourage runoff through rainwater infiltration features (i.e., permeable pavers) • Support local actions for climate-appropriate landscaping • Focus on landscape narrower than 10 feet – no spray irrigation and/or next to hardscapes
30 SF	SF Conservation Pricing - Water and Sewer	SF	This measure is awaiting the results of an ongoing rate study conducted by Rafetlis Financial Consultants, Inc. in 2016.
30 MF	MF Conservation Pricing - Water and Sewer	MF	This measure is awaiting the results of an ongoing rate study conducted by Rafetlis Financial Consultants, Inc. in 2016.
30 COM	COM Conservation Pricing - Water and Sewer	COM	This measure is awaiting the results of an ongoing rate study conducted by Rafetlis Financial Consultants, Inc. in 2016.
31	Single Family Multifamily Dishwasher Rebates	SF, MF	This measure provides incentives for the purchase of water efficient dishwashers (Residential WF of 6.25 or less).
32	Hot Water Recirculation Systems	SF, MF, COM	This measure provides incentives for the installation of a hot water recirculation system. Having hot water discharge promptly is important for energy and water use efficiency. A hot water recirculating system enables the cold water in the hot water pipes to be continually returned to the water heater and reheated before the hot water faucet is turned on. Rebates would be available to the following water customer groups: - single family dwellings, including townhomes and mobile homes - apartment complexes - commercial institutions - commercially zoned businesses or institutions Maximum rebates allowable: (a) $300 per single family account and (b) $3,000 per commercial, industrial, or institutional account (e.g., as laundromats and apartments).
33	Rewarding Businesses For Adopting Best Practices	COM	This measure offers commercial customers who employ best practices an increased water supply reliability and a lower price. For a business, the difficulty of rationing water during severe drought years can have a negative effect on its profits. This measure proposes that the City's Water Shortage Contingency Plan be changed so that businesses who adopt best practices, such as efficient plumbing fixtures, hotel laundry recycling, and climate-appropriate landscaping, would get a lower level of water usage reduction during a severe drought. For example, in a Stage 4 drought, with a system-wide goal of 35% reduction, the current plan is to have the water allotment of businesses be 87% of their normal year water use. Under this measure, businesses adopting best practices would be expected to cut back to only 95% of normal use, rather than 87%. These businesses could also be rewarded with a lower rate for their water use.
34	Additional Building Code Requirements for New Development	SF, MF, COM, MUN, IND	New CalGreen Building Codes already included in DSS Model (see Section 4 above) already takes many of the items recommended by WSAC into account. This measure currently cannot be measured with regard to future additional CalGreen updates and water savings. This measure involves the coming together of a working group of planners, builders, conservation groups, and Water Department personnel to evaluate possible additions to current codes and fee structures that would encourage water conservation. Some examples include: (1) requiring high efficiency washers in new development and (2) requiring hot water on demand/structured plumbing in new development. It is also intended that the work group track and incorporate new technologies in future City codes.
35	Innovation Incubator Program	SF, MF, COM, MUN	This measure would establish an Innovation Incubator Program allowing Santa Cruz to continue its leadership in water management by creating a program that supports new developments in: • New technologies, customer financing programs, and customer outreach programs; and • Pilot projects to promote popular adoption of rainwater for toilets & washers, new technology toilets in institutional buildings, onsite recycling of graywater, rainwater irrigated lawns, and promotion of native plant landscapes. Small grants would be offered to local businesses and/or working with state and national organizations like California Urban Water Conservation Council, California Water Foundation, California Urban

No.	Measure Name	Type of Customer	Description
			Water Agencies, University of California (Santa Cruz or Davis), Alliance for Water Efficiency, Water Research Foundation, US Bureau of Reclamation, or other coalitions of utilities or research-focused organizations.

Notes:	HECW – high efficient clothes washing machine	MF – multifamily
AMI – Advance Metering Infrastructure	HEU – high efficiency urinal	MUN – municipal
AMR – Automatic Meter Reading System	HEW – high efficiency commercial washer	SF – single family
COM – commercial	HOA – Home Owners Association	UHET – ultra-high efficiency toilet
gpf – gallons per flush	IND – industrial	WF – water factor, gallons per cubic foot
gpm – gallons per minute	IRR – irrigation	WSAC – Water Supply Alternatives Committee

A total of 35 individual measures are evaluated in the current Santa Cruz DSS Model. This number counts the three pricing measures as one measure (which is yet to be fully defined until the City's Water Rate Study is complete). For each measure selected to be modeled, a measure description, as well as details on each measure's utility and customer costs, time period, and targets can be found in the DSS Model's measure inputs. More detailed information on model inputs for each measure is available from City staff. Some of the key assumptions used in evaluating the water savings, benefits, and costs include the following:

- Applicable customer class
- Applicable end use
- Estimated annual account participation rates
- Evaluation start and end year
- Measure length, years
- Measure life, years
- Utility unit cost, $
- Customer unit cost, $
- Estimated annual administration and marketing overhead, %

These measures listed in Table 5-1 make-up the City's Recommended Program which consists of both passive and active elements. Plumbing code measures account for 53% of the future conservation potential achieved and are independent of any program – the savings are based on customers following applicable current local, state and federal laws, building codes and ordinances. Recommended Program active measures fall within one of four categories: 1) general measures, 2) residential measures (indoor), 3) commercial measures (indoor), and 4) irrigation measures (outdoor).

6. RECOMMENDED PROGRAM RESULTS

This section presents the Recommended Program water savings as well as projected demand and per capita water use with these savings. The Recommended Program's overall cost of water saved and proposed schedule is also shown.

6.1 Total Water Savings

Table 6-1 below presents each Recommended Program measure's water savings in million gallons (MG) per year for year 2035 as a result of each measure's design and implementation schedule. Year 2035 savings include ongoing savings still valid since the measure's start. Savings per measure presented in the Table assume the measures are implemented on a stand-alone basis (i.e., without interaction or overlap from other measures that might address the same end use or uses).

It is important to understand that the savings from measures presented in the table, which address the same end use(s) are not simply additive. The DSS Model uses impact factors to avoid double counting in estimating the water savings from programs of measures. For example, if two measures are planned to address the same end use and both save 10% of the prior water use, then the net effect is not the simple sum (20%). Rather it is the cumulative impact of the first measure reducing the use to 90% of what it was without the first measure in place and then reducing the use another 10% to result in the use being 81% of what it was originally. In this example the net savings is 19%, not 20%. Using impact factors, the model computes the reduction as follows, 0.9 x 0.9 = 0.81 or 19% water savings.

Since interaction between measures has not been accounted for in Table 6-1 below, it is not appropriate to include a total in the bottom row. However, the table is useful to give a close approximation of the savings of each individual measure.

Table 6-1. Recommended Program Individual Measure Cost of Water Saved and 2035 Water Savings (MGY)

No.	Measure Name	Cost of Water Saved ($/MG)	2035 Water Savings (MG)
1	System Water Loss Reduction	$3,923	34.87
2	Advanced Metering Infrastructure	$1,269	45.94
3	Large Landscape Budget-Based Water Rates	$194	12.83
4	General Public Information	$8,334	5.73
5	Public Information (Home Water Use Report)	$2,518	11.39
6	Residential Leak Assistance	$2,117	22.03
7	Single Family Residential Surveys	$7,735	2.78
8	Plumbing Fixture Giveaway/Opt	$1,479	2.03
9	Residential Ultra High Efficiency Toilet Rebates	$5,316	2.91
10	High Efficiency Clothes Washer Rebates	$2,794	36.20
11	High Efficiency Clothes Washer - New Development	$1,368	12.53
12	Hot Water On Demand - New Development	$7,849	4.46
13	Toilet Retrofit at Time of Sale	$1,516	8.70
14	CII MF Common Laundry Room High Efficiency Clothes Washer	$4,258	3.07
15	CII Incentives	$533	18.39
16	Pre-Rinse Spray Nozzle Installation	$153	9.16
17	CII Surveys	$4,056	19.24
18	High Efficiency Urinal Program	$5,220	3.22
19	Public Restroom Faucet Retrofit - MUN	$23,467	0.29
20	Public Restroom Faucet Retrofit - COM	$9,780	8.47
21	School Retrofit	$1,883	2.88
22	Water Efficient Landscape Ordinance	$602	6.66
23	Single Family Residential Turf Removal	$22,157	4.18
24	Multifamily Residential/CII Turf Removal	$32,186	2.39
25	Expand Large Landscape Survey/Water Budgets	$20,948	1.97
26	Sprinkler Nozzle Rebates	$13,643	3.35
27	Gray Water Retrofit	$15,742	0.24
28	Residential Rain Barrels	$4,672	3.42
29	Climate Appropriate Landscaping and Rainwater Infiltration	$33,221	8.26
30SF	SF Conservation Pricing - Water and Sewer[1]	N/A	N/A
30MF	MF Conservation Pricing - Water and Sewer[1]	N/A	N/A
30COM	COM Conservation Pricing - Water and Sewer[1]	N/A	N/A
31	Single Family Multifamily Dishwasher Rebates	$29,602	0.20
32	Hot Water Recirculation Systems	$15,650	1.38
33	Rewarding Businesses For Adopting Best Practices	$6,030	3.64
34	Additional Building Code Requirements for New Development[2]	N/A	N/A
35	Innovation Incubator Program	N/A	N/A

[1]Pricing measure costs and savings are not yet available. These measures are awaiting the results of an ongoing rate study scheduled to be completed in 2016.

[2] New CalGreen Building codes, effective as of January 2016, are already modeled. This measure is awaiting support from a Working Group yet to be formed.

Notes:

1. This table does not contain a total in the bottom row intentionally. It is not applicable since interaction between measures has not been accounted for in this table but is at the program level.
2. Source: City of Santa Cruz. DSS Model, Section: Conservation Analysis, Feb 16, 2016.

Table 6-2 presents the benefit cost analysis summary for the Recommended Program, which includes all the measures listed in the previous Table 6-1.

Cost categories are defined as follows:

- Utility Costs – those costs that the City as a water utility will incur to operate the measure including administrative costs

- Utility Benefits – the avoided cost of producing water

The column headings in Table 6-2 are defined as follows:

- Average Cost of Water Saved ($/MG) = average cost to implement the program divided by the water savings over the life of the conservation measure.
- Water Savings in 2035 (MGY) = water saved in million gallons. The year 2035 is presented as this represents the end of the planning horizon for both the 2015 UWMP and this analysis effort.

Table 6-2. Recommended Program Costs and Savings

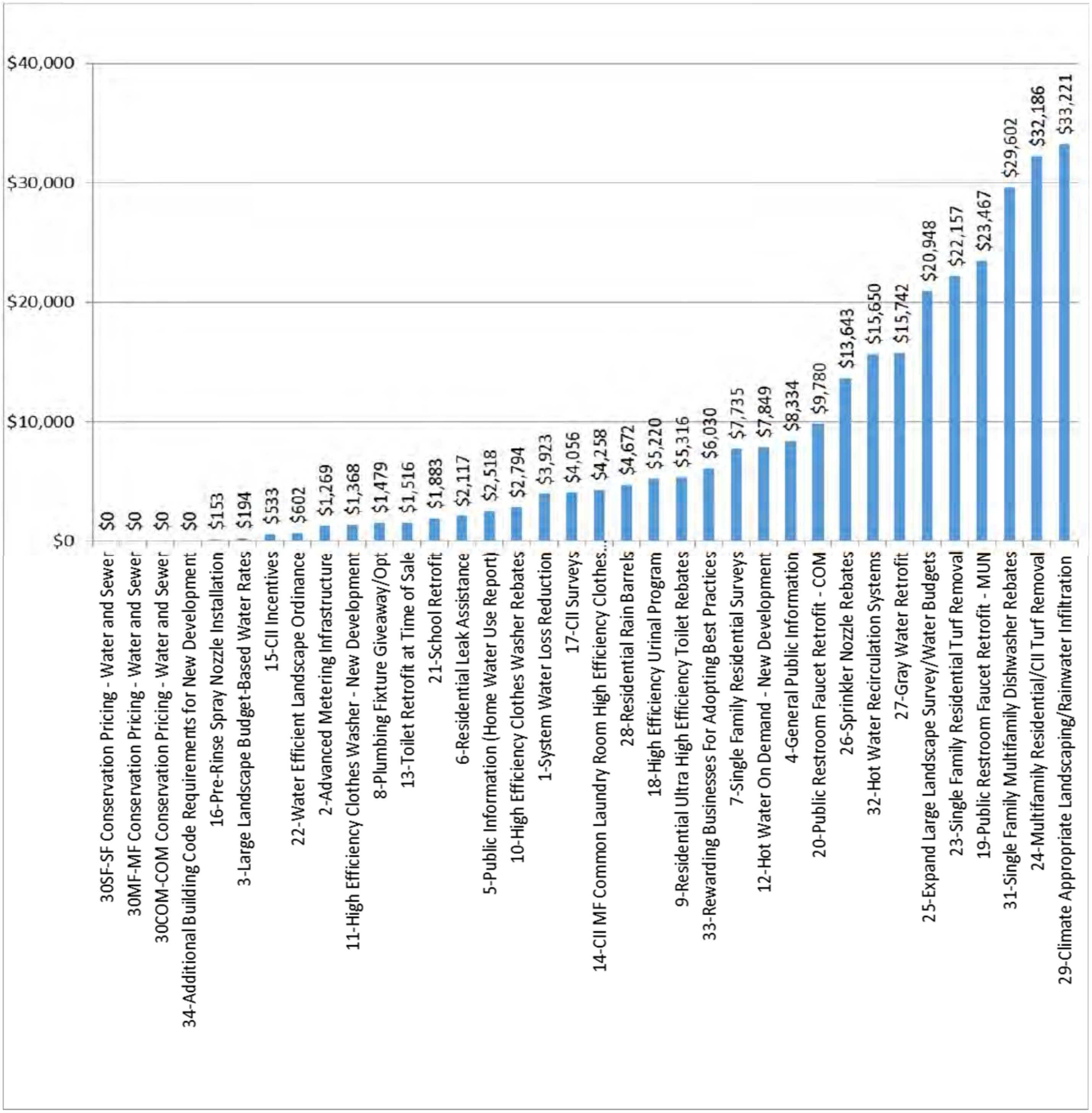
Conservation Program	Average Cost of Water Saved $/MG	Water Savings over "Baseline" Demand in 2035 (MGY)
Recommended Program with Plumbing Code Savings	$4,572/MG	619

Notes:

1. Across the modeling time period of 2015-2035, administrative costs average approximately 22% of total utility costs annually.
2. Source: City of Santa Cruz. DSS Model, Section: Results, Feb 16, 2016.

Figure 6-1 shows the costs of water saved for individual measures ranked from lowest to highest. The measures to be implemented in the next several years are a mix of some lower cost and some higher cost measures. Several of the measures addressing peak season water use have the highest unit costs, but, together as a package, the Recommended Program is $4,572/MG, well below the $10,000/MG the maximum level established by the WSAC which is lower than the expected unit cost of supply augmentation projects recommended to be pursued as a result of the WSAC's work.

Figure 6-1. Conservation Measures Unit Cost of Water Saved ($/MG)



Source: City of Santa Cruz. DSS Model, Section: Results, Feb 16, 2016.

Table 6-3 below shows the savings in 5-year increments for the plumbing codes, Recommended Program, and the Recommended Program with plumbing code savings.

Table 6-3. Long Term Conservation Program Savings over "Baseline" Demand (MG/Year)

Conservation Program	2020	2025	2030	2035
Plumbing Code	96	179	269	329
Recommended Program	137	232	269	291
Recommended Program with Plumbing Code Savings	233	411	538	619

Source: City of Santa Cruz. DSS Model, Section: Results, Feb 16, 2016.

The Recommended Program consists of both passive (plumbing codes which include state and Federal legislation for efficient fixture requirements for customers served by the City) and active elements. Plumbing code measures account for 53% of the future conservation potential achieved and are independent of any active conservation program.

6.2 Water Demand with Projected Savings

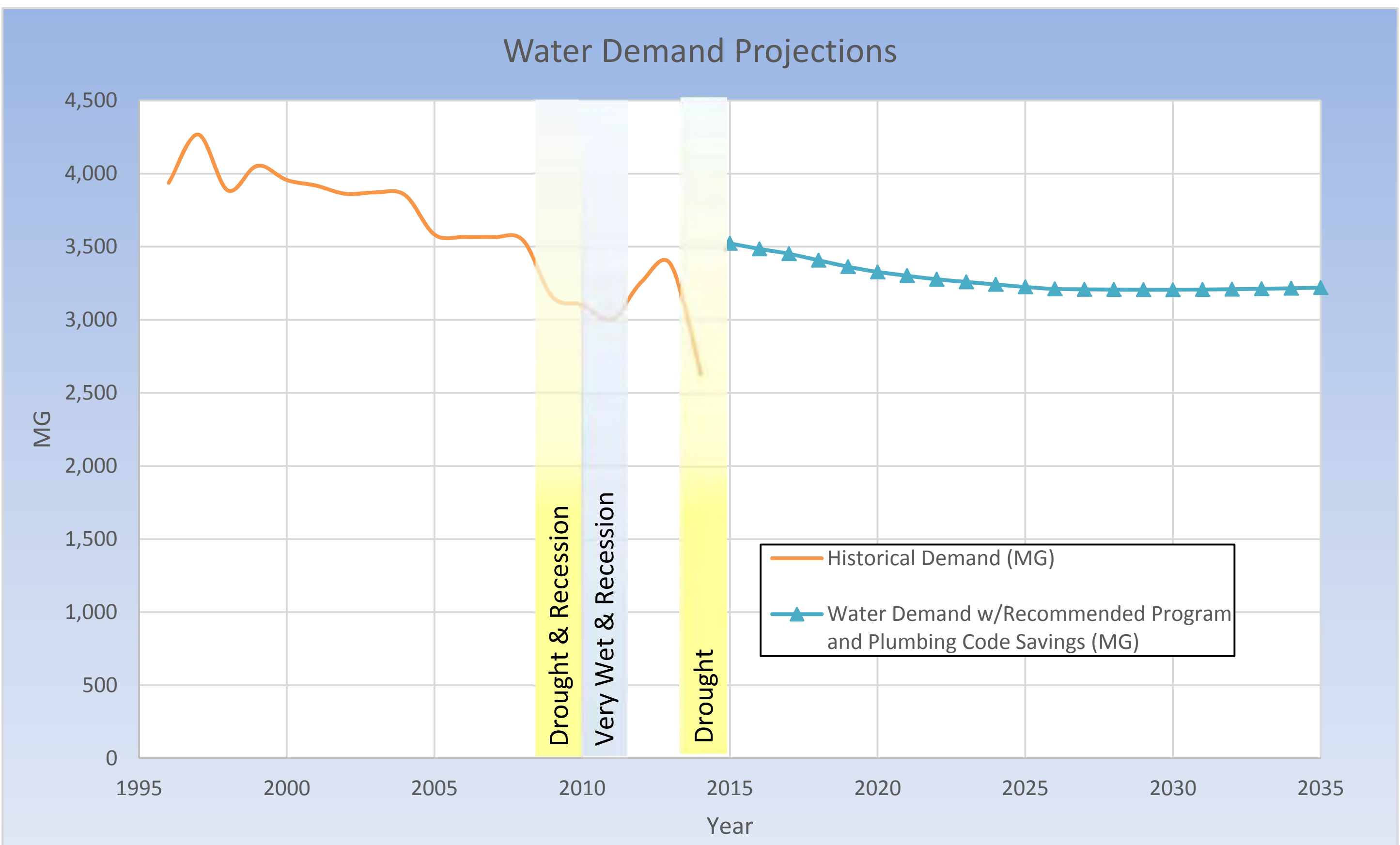
The Recommended Plan is envisioned to include strong customer participation to support additional planned growth while keeping total water use relatively constant for the next 20 years. New development will be built to water efficient standards following the 2015 CalGreen Plumbing Code, 2015 CEC Code, and other local ordinances (e.g., City's landscape ordinance). Water use in new homes should be less and more efficient than existing homes on comparable lot sizes. Table 6-4 and Figure 6-2 below present the Recommended Program projected water demands. Note that the Recommended Program with Plumbing Code is lower than the Demand Forecast by M.Cubed shown in Table 3-1. The Recommended Program forecast is 222 MGY lower (6%) than the M.Cubed forecast in 2035. This is due to increased savings by the new plumbing codes and new conservation programs that would be added over time.

Table 6-4. Water Use Projections (MG/Year)

	2020	2025	2030	2035
Demand with Plumbing Code (MGY)	3,464	3,456	3,474	3,510
Demand with Plumbing Code and Recommended Program (MGY)	3,327	3,225	3,205	3,220

Source: City of Santa Cruz. DSS Model, Section: Results, Feb 16, 2016.

Figure 6-2. Recommended Program Projected Water Demands



Source: City of Santa Cruz. DSS Model, Section: Results, Feb 16, 2016.

6.3 Per Capita Water Use

With two possible conservation target tracks to follow, the City has selected to aim to achieve SB X7-7 Method 3: 95% of State Hydrological Region Target by 2020. The City's baseline and target GPCD are as follows:

- Baseline GPCD = 113 GPCD
- 2015 Interim Target = 111 GPCD
- 2020 target = 110 GPCD
- CUWCC 2018 target = 101 GPCD

Table 6-5 below shows the projected per capita water use in gallons per day per person (GPCD) in 5-year increments for the projected demand with no plumbing code savings, projected demand with plumbing code savings, and projected demand with Recommended Program implementation and plumbing code savings.

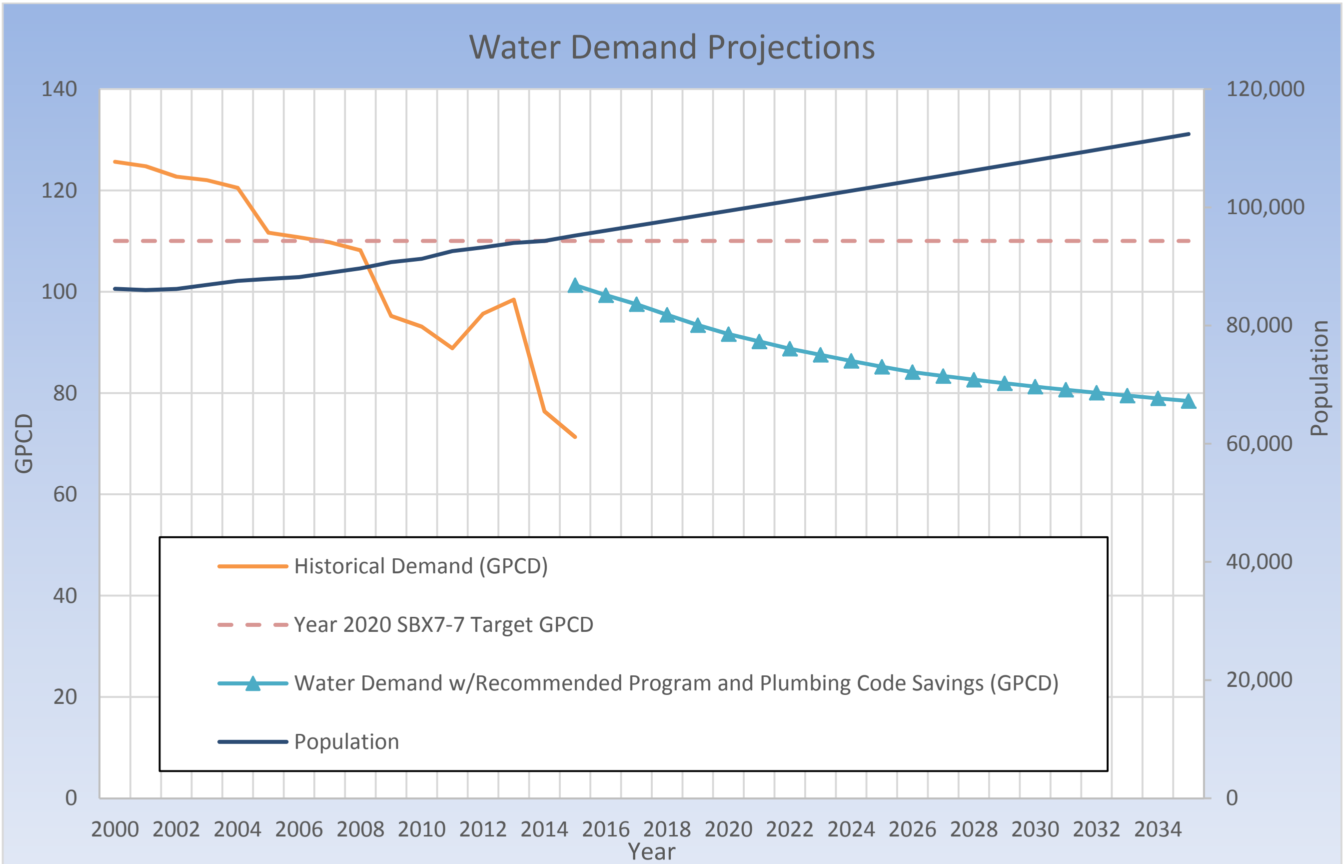
Table 6-5. Projected Population and Per Capita Water Use (GPCD)[1]

	2020	2025	2030	2035
Population [2]	99,403	103,620	107,989	112,390
"Baseline" Demand without Plumbing Code (GPCD)	98	96	95	94
Demand with Plumbing Code (GPCD)	95	91	88	86
Demand with Plumbing Code and Recommended Program (GPCD)	92	85	81	78

[1] City of Santa Cruz. DSS Model, Section: Results, Feb 16, 2016.
[2] WSAC Final Report, October 2015.

The following Figure 6-3 presents the SB X7-7 year 2020 GPCD target and historical and projected GPCD estimates with plumbing codes and Recommended Program savings. As seen below, the City has already met its state-mandated 2020 target and surpassed its voluntary CUWCC 2018 goal. The goal of the City's plan is to press beyond these state targets and instead maximize conservation savings to help meet local resource needs for current and future water demands.

Figure 6-3. Water Conservation Program Savings Projections – SB X7-7 Target, GPCD



Source: City of Santa Cruz. DSS Model, Section: Results, Feb 16, 2016.

6.4 Overall Cost of Water Saved

The cost of water saved per unit volume ($/MG) for the Recommended Program is $4,572/MG. This is below the Water Supply Alternatives Committee's recommended threshold for overall cost of water saved, which is $10,000/MG.

The cost of water saved for the Recommended Program can be compared to the City's avoided cost of water as one indicator of the cost effectiveness of the conservation program. It should be noted that the cost of water saved value somewhat undervalues the cost of savings because program costs are discounted to present value and the water benefit is not.

6.5 Key Findings

As a result of this comprehensive analysis here are some summary observations and conclusions:

1. The additional, incremental water savings from the Recommended Program, compared to the City's recent demand forecast, amount to about 220 million gallons in 2035.
2. The estimated annual demand will decline over time to about 3.2 billion gallons per year (bgy) in 2035, versus about 3.4 bgy estimated in the demand study. That estimate is comparable to the actual level of water production experienced in the late 1960s, when the service area population was around 50,000.
3. The impact on water savings from 2015 changes in the fixture plumbing codes prompted by the emergency conservation regulations (which would not have been factored in but for the delay associated with the Water Supply Advisory Committee's process) is over 100 million gallons more than previously estimated.
4. The overall cost of water saved by the Recommended Program is about half of what the WSAC set as a recommended threshold.
5. Gross per capita water use is expected to gradually decline to a level of less than 80 GPCD in 2035.

6.6 Proposed Schedule

The following Figure 6-4 presents the proposed Recommended Program implementation schedule.

Figure 6-4. Recommended Program Proposed Implementation Schedule

No.	Measure	Time Period	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	System Water Loss Reduction	2015 - 2035																					
2	Advanced Metering Infrastructure	2021 - 2035																					
3	Large Landscape Budget-Based Water Rates	2018 - 2020																					
4	General Public Information	2015 - 2035																					
5	Public Information (Home Water Use Report)	2018 - 2035																					
6	Residential Leak Assistance	2018 - 2035																					
7	Single Family Residential Surveys	2015 - 2035																					
8	Plumbing Fixture Giveaway/Opt	2015 - 2017																					
9	Residential Ultra High Efficiency Toilet Rebates	2015 - 2020																					
10	High Efficiency Clothes Washer Rebates	2015 - 2026																					
11	High Efficiency Clothes Washer - New Development	2021 - 2035																					
12	Hot Water On Demand - New Development	2021 - 2035																					
13	Toilet Retrofit at Time of Sale	2015 - 2019																					
14	CII MF Common Laundry Room High Efficiency Clothes Washer	2015 - 2024																					
15	CII Incentives	2021 - 2026																					
16	Pre-Rinse Spray Nozzle Installation	2015 - 2016																					
17	CII Surveys	2021 - 2026																					
18	High Efficiency Urinal Program	2015 - 2018																					
19	Public Restroom Faucet Retrofit - MUN	2021 - 2023																					
20	Public Restroom Faucet Retrofit - COM	2021 - 2030																					
21	School Retrofit	2021 - 2030																					
22	Water Efficient Landscape Ordinance	2015 - 2035																					
23	Single Family Residential Turf Removal	2015 - 2035																					
24	Multifamily Residential/CII Turf Removal	2015 - 2035																					
25	Expand Large Landscape Survey/Water Budgets	2018 - 2035																					
26	Sprinkler Nozzle Rebates	2018 - 2035																					
27	Gray Water Retrofit	2015 - 2035																					
28	Residential Rain Barrels	2015 - 2035																					
29	Climate Appropriate Landscaping and Rainwater Infiltration	2018 - 2035																					
30SF	SF Conservation Pricing - Water and Sewer	2018 - 2035																					
30MF	MF Conservation Pricing - Water and Sewer	2018 - 2035																					
30COM	COM Conservation Pricing - Water and Sewer	2018 - 2035																					
31	Single Family Multifamily Dishwasher Rebates	2018 - 2022																					
32	Hot Water Recirculation Systems	2018 - 2022																					
33	Rewarding Businesses For Adopting Best Practices	2020 - 2035																					
34	Additional Building Code Requirements for New Development	2018 - 2035																					
35	Innovation Incubator Program	2021 - 2035																					

Source: City of Santa Cruz. DSS Model. Section: Conservation Analysis, Feb 16, 2016.

6.7 Monitoring

The Plan is intended to be dynamic and changes and adjustments are expected. Monitoring progress on implementing recommended programs should be a priority. Costs, participation rates, and water use should be tracked to ensure that the plan is on target to meet goals. As new promising technologies emerge, they should be tested and possibly replace programs that are underachieving. Summary reports should be issued citing progress and recommending changes in program content. Comprehensive review of the plan every five years will ensure the plan reflects current technology and codes, and will provide an opportunity to check success and progress in meeting conservation goals.

7. NEXT STEPS

Obtain Commission approval and support to gain City Council direction to proceed with completion of writing the Water Conservation Master Plan document.

8. REFERENCES

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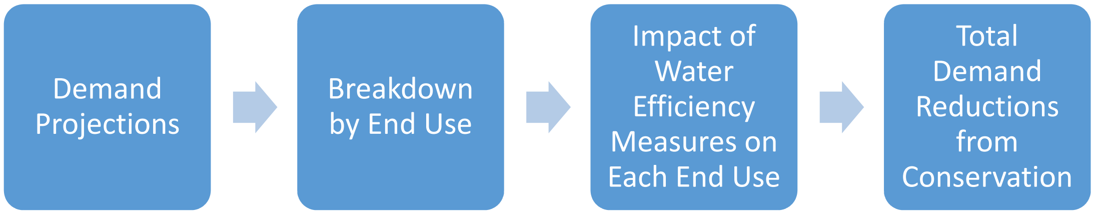
Western Policy Research. BMP Cost and Savings Study Update, A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices, prepared for the California Urban Water Conservation Council, July 2014 update. Online: http://cuwcc.org/Portals/0/Document%20Library/Resources/Publications/Cost%20and%20Savings%20Studies/BMP%20Cost%20and%20Savings%20Report%20Update%202014%20-%20%20Phase%201.pdf

APPENDIX A: DESCRIPTION OF THE DSS MODEL



The DSS Model prepares long-range, detailed demand projections. The purpose of the extra detail is to enable a more accurate assessment of the impact of water efficiency programs on demand. A rigorous modeling approach is especially important if the project will be subject to regulatory or environmental review.

The DSS Model is an end-use model that breaks down total water production (water demand in the service area) to specific water end uses. The model uses a bottom-up approach that allows for multiple criteria to be considered when estimating future demands, such as the effects of natural fixture replacement, plumbing codes, and conservation efforts. The DSS Model may also use a top-down approach with a utility prepared water demand forecast.

To forecast urban water demands using the DSS Model, customer demand data is obtained from the water agency being modeled. The demand data is reconciled with available demographic data to characterize the water usage for each customer category in terms of number of users per account and per capita water use. The data is further analyzed to approximate the split of indoor and outdoor water usage in each customer category. The indoor/outdoor water usage is further divided into typical end uses for each customer category. Published data on average per-capita indoor water use and average per-capita end use is combined with the number of water users to calibrate the volume of water allocated to specific end uses in each customer category. In other words, the DSS Model checks that social norms from end studies on water use behavior (e.g., flushes per person per day) are not exceeded.

The DSS Model evaluates conservation measures using benefit cost analysis with the present value of the cost of water saved ($/Acre-Foot). Benefits are based on savings in water and wastewater facility operations and maintenance (O&M). The figures above and to the left illustrate the processes for forecasting conservation water savings, including the impacts of fixture replacement due to plumbing codes and standards already in place.

The DSS Model has been used for practical applications of conservation planning in over 230 service areas representing 20 million people, including extensive efforts nationally in California, Colorado, Hawaii, Utah, Georgia, Florida, North Carolina, Oregon, and Ohio, and internationally in Australia, New Zealand, and Canada.

CUWCC BMP Retail Coverage Report 2013

Foundational Best Managemant Practices for Urban Water Efficiency

BMP 1.1 Operation Practices

ON TRACK

6270 City of Santa Cruz Water Department

1. Conservation Coordinator provided with necessary resources to implement BMPs?

Name: Toby Goddard

Title: Water Conservation Manager

Email: tgoddard@cityofsantacruz.com

2. Water Waste Prevention Documents

WW Document Name	WWP File Name	WW Prevention URL	WW Prevention Ordinance Terms Description
Option A Describe the ordinances or terms of service adopted by your agency to meet the water waste prevention requirements of this BMP.		http://www.codepublishing.com/CA/SantaCruz/html/SantaCruz16/SantaCruz16.html	See Santa Cruz Municipal Code Chapter 16 for the following: a) 16.01 Water Shortage Regulations and Restrictions b) 16.02 Water Conservation/Water Waste Prohibition Ordinance c) 16.16 Water Efficient Landscape Ordinance
Option B Describe any water waste prevention ordinances or requirements adopted by your local jurisdiction or regulatory agencies within your service area.			
Option C Describe any documentation of support for legislation or regulations that prohibit water waste.			
Option D Describe your agency efforts to cooperate with other entities in the adoption or enforcement of local requirements consistent with this BMP.			
Option E Describe your agency support positions with respect to adoption of legislation or regulations that are consistent with this BMP.			
Option F Describe your agency efforts to support local ordinances that establish permits requirements for water efficient design in new development.			

At Least As effective As No

CUWCC BMP Retail Coverage Report 2013

Foundational Best Managemant Practices for Urban Water Efficiency

BMP 1.1 Operation Practices

ON TRACK

Exemption No

Comments:

The City of Santa Cruz declared a Stage 1 Water Shortage Alert effective May 1, 2013 and insitituted water restrictions throughout the year. Two temporary staff were hired to patrol the service area leading to 731 water waste enforcement actions.

CUWCC BMP Coverage Report 2013

Foundational Best Management Practices For Urban Water Efficiency

BMP 1.2 Water Loss Control **NOT ON TRACK**

6270 City of Santa Cruz Water Department

Completed Standard Water Audit Using AWWA Software?	Yes
AWWA File provided to CUWCC?	Yes
City of Santa Cruz 2013 Annual Water Audit.xls	
AWWA Water Audit Validity Score?	65
Complete Training in AWWA Audit Method	Yes
Complete Training in Component Analysis Process?	No
Component Analysis?	No
Repaired all leaks and breaks to the extent cost effective?	Yes
Locate and Repar unreported leaks to the extent cost effective?	No
Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair.	Yes

Provided 7 Types of Water Loss Control Info

Leaks Repairs	Value Real Losses	Value Apparent Losses	Miles Surveyed	Press Reduction	Cost Of Interventions	Water Saved (AF)
267	100884	320768		False		

At Least As effective As No

Exemption No

Comments:

To CUWCC Staff: Please note that the operational efficiency indicators from the AWWA water audit software did not automatically populate the BMP database after uploading and saving. We tried converting format from .xlsx to .xls. We are using V5.0

CUWCC BMP Coverage Report 2013

Foundational Best Management Practices For Urban Water Efficiency

BMP 1.3 Metering With Commodity

ON TRACK

6270 City of Santa Cruz Water Department

Numbered Unmetered Accounts	No
Metered Accounts billed by volume of use	Yes
Number of CII Accounts with Mixed Use Meters	737
Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters?	Yes
Feasibility Study provided to CUWCC?	Yes

Date: 12/16/2013

Uploaded file name:

Completed a written plan, policy or program to test, repair and replace meters	Yes

At Least As effective As No

Exemption No

Comments:

1) The City bills all inside City and some large outside City customers on a monthly basis; outside City customers are billed bi-monthly. 2) Recent analysis of CII accounts shows 940 accounts with no outdoor water use, and 737 with mixed use.

NOT ON TRACK

CUWCC BMP Coverage Report 2013

Foundational Best Management Practices For Urban Water Efficiency

BMP 1.4 Retail Conservation Pricing

6270 City of Santa Cruz Water Department

Implementation (Water Rate Structure)

ON TRACK

Customer Class	Water Rate Type	Conserving Rate?	(V) Total Revenue Comodity Charges	(M) Total Revenue Fixed Carges
Single-Family	Increasing Block	Yes	5918548.95	4472338.86
Multi-Family	Uniform	Yes	4107973.04	1268495.67
Commercial	Uniform	Yes	3379123.99	1074308.13
Industrial	Uniform	Yes	1320577.7	164488.08
Institutional	Uniform	Yes	313841.02	165728.5
Dedicated Irrigation	Uniform	Yes	1423156.26	325452.27
Agricultural	Uniform	Yes	39245.11	35365.59
Other	Uniform	Yes	36483.72	12810.98
			16538949.79	**7518988.08**

Calculate: V / (V + M) **69 %**

Implementation Option: Use Canadian Water Wastewater Association Rate Design Model

☐ Use 3 years average instead of most recent year

Canadian Water and Wastewater Association

Upload file:

Agency Provide Sewer Service: Yes

NOT ON TRACK

Customer Class	Rate Type	Conserving Rate?
Single-Family	Non-Volumetric Flat Rate	No
Multi-Family	Non-Volumetric Flat Rate	No
Commercial	Uniform	Yes
Industrial	Uniform	Yes
Institutional	Uniform	Yes
Dedicated Irrigation	Service Not Provided	No

At Least As effective As No

Exemption No

Comments:

Note to CUWCC staff: We are using Option 3 for BMP 1.4. Coverage calculator does not seem to work; the City earned 37 points in our matrix score.

CUWCC BMP Coverage Report 2013

Foundational Best Management Practices For Urban Water Efficiency

BMP 2.1 Public Outreach

ON TRACK

6270 City of Santa Cruz Water Department **Retail**

Does your agency perform Public Outreach programs? Yes

The list of wholesale agencies performing public outreach which can be counted to help the agency comply with the BMP

The name of agency, contact name and email address if not CUWCC Group 1 members

Did at least one contact take place during each quater of the reporting year? Yes

Public Outreach Program List	Number
Newsletter articles on conservation	8
Flyers and/or brochures (total copies), bill stuffers, messages printed on bill, information packets	4
Website	12
Landscape water conservation media campaigns	2
General water conservation information	6
Total	**32**

Did at least one contact take place during each quater of the reporting year? Yes

Number Media Contacts	Number
Articles or stories resulting from outreach	12
News releases	12
Newspaper contacts	24
Total	**48**

Did at least one website update take place during each quater of the reporting year? Yes

Public Information Program Annual Budget

Annual Budget Category	Annual Budget Amount
Public Information and Outreach	28000
Total Amount:	**28000**

Public Outreah Additional Programs
Stage 1 Water Shortage Alert and associated water restrictions

Description of all other Public Outreach programs

Green Gardener program

Comments:

BMP 2.1 Public Outreach **ON TRACK**

In addition to Water Conservation, there was considerable public outreach about future water supply. In late 2013, the City created a citizen's Water Supply Advisory Committee. The Water Department also hired its first Community Relations Specialist

At Least As effective As	No

Exemption	No	0

CUWCC BMP Coverage Report 2013

Foundational Best Management Practices For Urban Water Efficiency

BMP 2.2 School Education Programs

ON TRACK

6270 City of Santa Cruz Water Department **Retail**

Does your agency implement School Education programs? Yes

The list of wholesale agencies performing public outreach which can be counted to help the agency comply with the BMP

Materials meet state education framework requirements? Yes

15 local 4th and 5th grade classes participated in the Wetlands and Watersheds program. The program includes a teacher workshop and day-long field trip to the City's reservoir and the San Lorenzo River to learn about water supply and water quality.

Materials distributed to K-6? Yes

Each student receives a copy of "Our Water Works in Santa Cruz County" booklet and a journal they complete at the river. Techers receive a county watershed map and background material to support watershed education in the classroom.

Materials distributed to 7-12 students? Yes (Info Only)

As part of the Watershed Academy, described below, materials include scientific literature, news articles, hydrographs, data sheets, etc.

Annual budget for school education program: 27000.00

Description of all other water supplier education programs

Watershed Academy: City staff teaches a small group of 10th grade students in the San Lorenzo Valley about watershed processes, fisheries, land use and drinking water source protection, both in the classroom and through a series of field trips

Comments:

Budget figure above is for the Coastal Watershed Council contract managed by Water Resources section.

At Least As effective As No

Exemption No 0

CUWCC BMP Retail Coverage Report 2014

Foundational Best Managemant Practices for Urban Water Efficiency

BMP 1.1 Operation Practices

ON TRACK

6270 City of Santa Cruz Water Department

1. Conservation Coordinator provided with necessary resources to implement BMPs?

Name: Toby Goddard

Title: Administrative Services Manager

Email: tgoddard@cityofsantacruz.com

2. Water Waste Prevention Documents

WW Document Name	WWP File Name	WW Prevention URL	WW Prevention Ordinance Terms Description
Option A Describe the ordinances or terms of service adopted by your agency to meet the water waste prevention requirements of this BMP.		http://www.codepublishing.com/CA/SantaCruz/html/SantaCruz16/SantaCruz16.html	See Santa Cruz Municipal Code Chapter 16 for the following: a) 16.01 Water Shortage Regulations and Restrictions b) 16.02 Water Conservation/Water Waste Prohibition Ordinance c) 16.16 Water Efficient Landscape Ordinance
Option B Describe any water waste prevention ordinances or requirements adopted by your local jurisdiction or regulatory agencies within your service area.			
Option C Describe any documentation of support for legislation or regulations that prohibit water waste.			
Option D Describe your agency efforts to cooperate with other entities in the adoption or enforcement of local requirements consistent with this BMP.			
Option E Describe your agency support positions with respect to adoption of legislation or regulations that are consistent with this BMP.			
Option F Describe your agency efforts to support local ordinances that establish permits requirements for water efficient design in new development.			

At Least As effective As No

CUWCC BMP Retail Coverage Report 2014

Foundational Best Managemant Practices for Urban Water Efficiency

BMP 1.1 Operation Practices

ON TRACK

Exemption No

Comments:

The City of Santa Cruz declared a Stage 3 Water Shortage Emergency effective May 1, 2014 and instituted water rationing for all residential and irrigation accounts, drought regulations for CII accounts, and outdoor water restrictions for all users.

CUWCC BMP Coverage Report 2014

Foundational Best Management Practices For Urban Water Efficiency

BMP 1.2 Water Loss Control

NOT ON TRACK

6270 City of Santa Cruz Water Department

Completed Standard Water Audit Using AWWA Software?	Yes
AWWA File provided to CUWCC?	Yes
City of Santa Cruz 2014 Annual Water Audit.xls	
AWWA Water Audit Validity Score?	66
Complete Training in AWWA Audit Method	Yes
Complete Training in Component Analysis Process?	No
Component Analysis?	No
Repaired all leaks and breaks to the extent cost effective?	Yes
Locate and Repar unreported leaks to the extent cost effective?	No
Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair.	Yes

Provided 7 Types of Water Loss Control Info

Leaks Repairs	Value Real Losses	Value Apparent Losses	Miles Surveyed	Press Reduction	Cost Of Interventions	Water Saved (AF)
227	119438.04	244565		False		

At Least As effective As No

Exemption No

Comments:

The City of Santa Cruz has contracted with Water Systems Optimization, Inc to conduct a water loss control project. The contract is for FY16, but the test period to be validated is 2014. See comment in 2013 re: AWWA OEI data not uploading properly

CUWCC BMP Coverage Report 2014

Foundational Best Management Practices For Urban Water Efficiency

BMP 1.3 Metering With Commodity

ON TRACK

6270 City of Santa Cruz Water Department

Numbered Unmetered Accounts	No
Metered Accounts billed by volume of use	Yes
Number of CII Accounts with Mixed Use Meters	737
Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters?	Yes
Feasibility Study provided to CUWCC?	Yes

Date: 12/16/2013

Uploaded file name:

Completed a written plan, policy or program to test, repair and replace meters	Yes

At Least As effective As No

Exemption No

Comments:

The City instituted water rationing in 2014 in response to a water shortage emergency and migrated all its customers to monthly billing effective April 2014. Previously most outside City accounts were billed bimonthly.

CUWCC BMP Coverage Report 2014

Foundational Best Management Practices For Urban Water Efficiency

BMP 1.4 Retail Conservation Pricing

6270 City of Santa Cruz Water Department

Implementation (Water Rate Structure) **ON TRACK**

Customer Class	Water Rate Type	Conserving Rate?	(V) Total Revenue Comodity Charges	(M) Total Revenue Fixed Carges
Single-Family	Increasing Block	Yes	4097421.24	4674757.04
Multi-Family	Uniform	Yes	3615070.34	1333880.79
Commercial	Uniform	Yes	3178492.82	1131061.45
Industrial	Uniform	Yes	1178030.78	168046.78
Institutional	Uniform	Yes	183173.76	168907.53
Dedicated Irrigation	Uniform	Yes	853359.46	338205.43
Agricultural	Uniform	Yes	35224.07	37459.42
Other	Uniform	Yes	33070.92	12069.64
			13173843.39	**7864388.08**

Calculate: V / (V + M) **63 %**

Implementation Option: Use Canadian Water Wastewater Association Rate Design Model

☐ Use 3 years average instead of most recent year

Canadian Water and Wastewater Association

Upload file:

Agency Provide Sewer Service: Yes **NOT ON TRACK**

Customer Class	Rate Type	Conserving Rate?
Single-Family	Non-Volumetric Flat Rate	No
Multi-Family	Non-Volumetric Flat Rate	No
Commercial	Uniform	Yes
Industrial	Uniform	Yes
Institutional	Uniform	Yes
Dedicated Irrigation	Service Not Provided	No

At Least As effective As No

Exemption No

Comments:

Note to CUWCC staff: The City of Santa Cruz is using Option 3 for BMP 1.4. Coverage calculator does not seem to work; City earned 39 points in its matrix score.

CUWCC BMP Coverage Report 2014

Foundational Best Management Practices For Urban Water Efficiency

BMP 2.1 Public Outreach

ON TRACK

6270 **City of Santa Cruz Water Department** **Retail**

Does your agency perform Public Outreach programs? Yes

The list of wholesale agencies performing public outreach which can be counted to help the agency comply with the BMP

The name of agency, contact name and email address if not CUWCC Group 1 members

Did at least one contact take place during each quater of the reporting year? Yes

Public Outreach Program List	Number
Newsletter articles on conservation	8
Flyers and/or brochures (total copies), bill stuffers, messages printed on bill, information packets	24
Website	100
Landscape water conservation media campaigns	2
General water conservation information	100
Total	**234**

Did at least one contact take place during each quater of the reporting year? Yes

Number Media Contacts	Number
Articles or stories resulting from outreach	50
News releases	24
Newspaper contacts	100
Total	**174**

Did at least one website update take place during each quater of the reporting year? Yes

Public Information Program Annual Budget

Annual Budget Category	Annual Budget Amount
Public Information and Outreach	28000
Total Amount:	**28000**

Public Outreah Additional Programs
Stage 3 Water Shortage Emergency and associated water restrictions
Water Supply Advisory Committee

Description of all other Public Outreach programs

Green Gardener program

Comments:

BMP 2.1 Public Outreach

ON TRACK

In addition to Water Conservation, there was considerable public outreach about future water supply. The City created a citizen's Water Supply Advisory Committee which met twice a month during 2014.

At Least As effective As	No

Exemption	No	0

CUWCC BMP Coverage Report 2014

Foundational Best Management Practices For Urban Water Efficiency

BMP 2.2 School Education Programs

ON TRACK

6270 City of Santa Cruz Water Department **Retail**

Does your agency implement School Education programs? Yes

The list of wholesale agencies performing public outreach which can be counted to help the agency comply with the BMP

Materials meet state education framework requirements? Yes

12 local 4th and 5th grade classes participated in the Wetlands and Watersheds program. The program includes a teacher workshop and day-long field trip to the City's reservoir and the San Lorenzo River to learn about water supply and water quality.

Materials distributed to K-6? Yes

Each student receives a copy of "Our Water Works in Santa Cruz County" booklet and a journal they complete at the river. Techers receive a county watershed map and background material to support watershed education in the classroom.

Materials distributed to 7-12 students? Yes (Info Only)

As part of Watershed Academy, described below, materials include scientific literature, news articles, hydrographs, data sheets, etc.

Annual budget for school education program: 27000.00

Description of all other water supplier education programs

Watershed Academy: City staff teaches a small group of 10th grade students in the San Lorenzo Valley about watershed processes, fisheries, land use and drinking water source protection, both in the classroom and through a series of field trips

Comments:

Budget figure above is for the Coastal Watershed Council contract managed by Water Resources section.

At Least As effective As No

Exemption No 0

CUWCC BMP Coverage Report 2014

6270 City of Santa Cruz Water Department

Baseline GPCD: 123.83

GPCD in 2014 75.8

GPCD Target for 2018: 101.50

Biennial GPCD Compliance Table **ON TRACK**

		Target		Highest Acceptable Bound	
Year	Report	% Base	GPCD	% Base	GPCD
2010	1	96.4%	**119.40**	100%	**123.80**
2012	2	92.8%	**114.90**	96.4%	**119.40**
2014	3	89.2%	**110.50**	92.8%	**114.90**
2016	4	85.6%	**106.00**	89.2%	**110.50**
2018	5	82.0%	**101.50**	82.0%	**101.50**

CITY OF SANTA CRUZ
WATER DEPARTMENT

212 Locust Street, Santa Cruz, CA 95060 • (831) 420-5200 • Fax (831) 420-5201 • www.cityofsantacruz.com

July 19, 2016

Susan Mauriello, County Administrative Officer
County of Santa Cruz
Santa Cruz County Governmental Center
701 Ocean Street, Room 520
Santa Cruz, CA 95060

SUBJECT: 2015 Urban Water Management Plan Update

Dear Ms. Mauriello,

This letter is to notify you that the City of Santa Cruz has recently completed an update of its 2015 Urban Water Management Plan. The draft plan is available online at the City's website for your review: http://www.cityofsantacruz.com/2015UWMP. We welcome comments and input from you and from applicable County departments on the draft plan.

The Santa Cruz Water Commission will review and discuss the plan at its meeting on Monday, August 1, 2016 at 7:00 p.m. in the City Council Chambers.

A public hearing on the proposed plan has been scheduled for Tuesday, August 9, 2016 at 2:30 p.m. in the City Council Chambers at Santa Cruz City Hall, 809 Center Street, Santa Cruz, California. The plan will be brought back to City Council at its following meeting August 23, 2016 for adoption, barring any substantial modifications.

Written comments on the plan may be received up to the date of the public hearing and should be sent to:

Santa Cruz Water Department
Attn: Mr. Toby Goddard
212 Locust Street, Suite B
Santa Cruz, CA 95060

Please contact Toby Goddard, Water Conservation Manager at 420-5232, or via email tgoddard@cityofsantacruz.com if you have any questions or wish to discuss the information contained in report.

Sincerely,

Rosemary Menard

Rosemary Menard
Water Director

cc: Ms. Kathleen Previsich, Director of Planning
Mr. John Ricker, Water Resources Division Director
Mr. John Presliegh, Director of Public Works

CITY OF
SANTA CRUZ

WATER DEPARTMENT

212 Locust Street, Santa Cruz, CA 95060 • (831) 420-5200 • Fax (831) 420-5201 • www.cityofsantacruz.com

July 19, 2016

Jamie Goldstein, City Manager
City of Capitola
420 Capitola Ave.
Capitola, CA 95010

SUBJECT: 2015 Urban Water Management Plan Update

Dear Mr. Goldstein,

This letter is to notify you that the City of Santa Cruz has recently completed an update of its 2015 Urban Water Management Plan. The draft plan is available online at the City's website for your review: http://www.cityofsantacruz.com/2015UWMP. We welcome your comments and input on the draft plan.

The Santa Cruz Water Commission will review and discuss the plan at its meeting on Monday, August 1, 2016 at 7:00 p.m. in the City Council Chambers.

A public hearing on the proposed plan has been scheduled for Tuesday, August 9, 2016 at 2:30 p.m. in the City Council Chambers at Santa Cruz City Hall, 809 Center Street, Santa Cruz, California. The plan will be brought back to City Council at its following meeting August 23, 2016 for adoption, barring any substantial modifications.

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> Attn: Mr. Toby Goddard
> 212 Locust Street, Suite B
> Santa Cruz, CA 95060

Please contact Toby Goddard, Water Conservation Manager at 420-5232, or via email tgoddard@cityofsantacruz.com if you have any questions or wish to discuss the information contained in report.

Sincerely,

Rosemary Menard

Rosemary Menard
Water Director

cc: Mr. Richard Grunow, Community Development Director

Santa Cruz Sentinel
1800 Green Hills Rd., Ste. 210
Scotts Valley, CA 95066
831-429-2415
scslegals@santacruzsentinel.com

3487424

SANTA CRUZ WATER DEPARTMENT
RENEE COLETTA
212 LOCUST ST
STE A
SANTA CRUZ, CA 95060

Proof of Publication
(2015.5 C.C.P.)

STATE OF CALIFORNIA
SS.
COUNTY OF SANTA CRUZ

Public Notice

I, the undersigned, declare:

That I am over the age of eighteen and not interested in the herein-referenced matter; that I am now, and at all times embraced in the publication herein mentioned was, a principal employee of the printer of the Santa Cruz Sentinel, a daily newspaper printed, published and circulated in the said county and adjudged a, newspaper of general circulation by the Superior Court of California in and for the County of Santa Cruz, under Proceeding No. 25794; that the advertisement (of which the annexed is a true printed copy) was published in the above-named newspaper on the following dates, to wit:

07/31/2016, 08/07/2016

I declare under penalty of perjury that, the foregoing is tru and correct to the best of my knowledge.

This 8th day of August, 2016 at Santa Cruz, California.

Signature

Legal No. **0005767616**

CITY OF SANTA CRUZ

Notice of Public Hearing

The City Council of the City of Santa Cruz will hold a public hearing on the draft

2015 Urban Water Management Plan

on Tuesday, August 9, 2016 at 2:30 p.m.
or soon thereafter
at City Council Chambers
809 Center Street, Santa Cruz

State-law requires water suppliers to prepare an Urban Water Management Plan and to update it every five years. The plan describes the City's water supply resources and projected needs through the year 2035 and covers related subjects including conservation, supply reliability, system sources, and water shortage management. The public hearing will also address the integration of the Final Report on Agreements and Recommendations, as developed by the Water Supply Advisory Committee, into the Plan.

The draft plan is available for review at:
- Water Department Office
- Online at www.cityofsantacruz.com/2015UWMP
- Central Library

Interested members of the public and local businesses are encouraged to provide comments to the City of Santa Cruz and participate in the plan review process.

For additional information please contact:
City of Santa Cruz Water Department
212 Locust St, Suite B
Santa Cruz, CA
(831) 420-5200
or email: tgoddard@cityofsantacruz.com

STATE OF CALIFORNIA)
) ss.
County of Santa Cruz)

EXCERPT OF MINUTES

I, Bren Lehr, City Clerk Administrator of the City of Santa Cruz, California, do hereby certify that the following is a true excerpt of the draft minutes showing the action taken at the August 9, 2016 Regular City Council Meeting:

PUBLIC HEARING ITEM:

11. 2015 Urban Water Management Plan Update (WT)

Associate Planner II K. Moore and Water Administrative Services Manager T. Goddard gave a presentation and responded to Councilmember questions.

Director of Water R. Menard briefly discussed this item.

Mayor Mathews opened the public comment period. The following person spoke:

Nate Kennedy

Mayor Mathews closed the public comment period.

MOTION: Councilmember Lane moved, seconded by Councilmember Terrazas, to direct staff to bring back to Council the final plans for adoption.

ACTION: The motion carried unanimously with the following vote.

AYES:	Councilmembers Noroyan, Lane, Terrazas, Posner, Comstock; Vice Mayor Chase; Mayor Mathews.
NOES:	None.
ABSENT:	None.
DISQUALIFIED:	None.

Bren Lehr
City Clerk Administrator
City of Santa Cruz

Written Comments Received from the Public

Water Commission Members

Doug Engfer

Thanks again for making time for me to discuss the UWMP in advance of Monday's meeting. This is the first time I've been involved in the review cycle, so I'm sure I have much to learn!

I'll say at the outset that I found the document clear and useful. I think that your strategy of "building on" the State's foundational organizational structure, specifically by including many and detailed documents as appendices, makes the package complete. As a recovering member of the WSAC, I will also note that I'm gratified to see that the committee's recommendations are adopted in the whole here. Yay!

As you'd expect, I have a number of questions and comments, as well as suggested copy edits. The attached Word file has all of my questions, comments, and suggestions. It's organized and formatted as follows:

- "State Act Questions"
    - Questions I have relating to our compliance with the State Act.
    - I would expect that we would discuss these during Friday's call. I may bring them up on Monday, depending upon our Friday conversation.
- "UWMP Draft"
    - "Questions, comments, suggestions"
        - I've identified these items by page number (both according to document pagination, and to relative page within the PDF).
        - Where you see ~~strikethrough~~ text, I've found the answer already, elsewhere in the document, or in the Act. You may ignore the strikethrough text.
        - I would expect that we would spend the bulk of our time on Friday on these items.
        - Items in this list would be candidates for me to bring up during the SCWC review of the document on Monday (though I may change my mind about the salience of individual items between now and Monday)
    - "Typos and stylistic suggestions"
        - I've identified these items by page number (both according to document pagination, and to relative page within the PDF).
        - Where you see ~~strikethrough~~ text, I've found the answer already, elsewhere in the document, or in the Act. You may ignore the strikethrough text.
        - I would expect these items to be non-controversial. I offer them here by way of helping you make the document the best it can be. I would not expect that you and I would spend any time on them on Friday's call. However, if something here seems controversial to you and you'd like to talk about it on Friday, that's fine with me.

        - I've highlighted the text in the DRAFT that corresponds to these items. If you'd like, I can upload the document to Dropbox so that you can use that highlighting to find the typos.

Anyway, thanks again for making some time for me. Looking forward to our call tomorrow!

UWMP

State Act Questions

- [page 4] 10621(a) – UWMP is due by 31 July following years ending in 5 and 0. We appear to be late with our plan. There are consequences outlined in the Act (can't receive certain State funding).
    - Has this been an issue for the Department?
    - Have we or will we suffer any consequences for our (apparently) late filing of the UWMP?
    - The Plan itself does not acknowledge that it's late. Should it?
- The Act directs us specifically to describe our efforts relating to both recycling and desalination. The Draft is pretty thorough on recycling. It is pretty terse on desalination. That may be appropriate, given (1) our history with desal, and (2) the fact that it is the lowest-priority option for a supplemental supply.
    - That said, do you think that the State would want us to "beef up" the desalination discussion?

UWMP DRAFT

- Questions, comments, suggestions
    - [page 2-2 (15)] – units as MG (not AF) – thank you!
    - [page 3-4 (21)] – what is process for updating the GP2030 to reflect the Department's new strategy relating to supply augmentation? There seem to be several items that need to be updated…
    - [page 3-8 (25)] – ~~why are we looking at lower income?~~ [State requirement.]
        - Wouldn't it also be interesting from a water-use perspective to look at SFR v MFR?
    - [page 3-9 (26)] – while past 5 years are interesting, they are likely not representative (Great Recession). What construction is currently in review, permitted and/or under construction?
    - [page 4-2 (30)] – add some per-capita historical data (SFR and MFR) to show trend for the service area
    - [page 4-7 (35)] – Table 4-4 should make clear that the values are MGY
    - [page 4-8 (36)] – please explain "cumulative" (seems to me it's more like "aggregate"). Cumulative would mean to me that we would have saved a *total* of 329MG by 2035, against our *total* demand between now and then.
        - Aren't these **MGY** figures (that is, demand will be reduced by 329MG in 2035, compared to what it would have been without code changes)?
        - 329MG represents 8.6% of what?
    - [page 4-8 (36)] – "these units" refers to the low-income component (414) or the full 1000 units? You should be clearer.

    - Also, what is your estimated consumption for lower-income units? How arrived at? Won't state require some data here? ("Estimate the projected use" section 4-5, page 4-15 of guidelines)
- [page 4-8/9 (36/37)] – this discussion would profit from including the estimated increase in monthly average daily high temperature for our area, so that the reader can determine the magnitude of the impact of climate change (say, by 2100).
- [page 5-4 (41)] should insert "the City's" before "gross per capita", in order to clarify that we are talking about use in our service area, not some other region
- ~~[page 5-4 (41)] the 2015 and 2020 targets are almost the same (111 and 110, respectively). Are these the correct values?~~
- [page 5-8 (45)] Makes sense to choose Method 3. That said, SC would have achieved its target goals irrespective of Method chosen (we were under the Method 3 target already). Should we explain why we chose Method 3? Should we take credit for even beating Method 1?
- [page 6-3 (53)] What is import of "bordered area" in the text? I don't see any part of the image in the Figure that is "bordered".
- [page 6-4 (54)] "annual" suggests that the document is updated annually (each year). If that is not the case, then strike "annual".
- [page 6-7 (57)] Table 6-1 should include an average (164 mgy) showing that our average use over the subject period was within the 170 mgy self-imposed deemed-sustainable limit.
- [page 6-11 (61)] Could add an amplifying sentence making clear that the service area for the wastewater treatment plant is a superset of the service area of the water department (that is, all water department folks are in the wastewater service area, but some folks in the wastewater service area are not served by the water system) – assuming that that is an accurate statement, of course!
    - You actually say this on page 6-14 – perhaps move that statement up here?
- [page 6-15 (65)] What are peak actual wet weather flows that we've seen (capacity is 81 mgd)?
- [page 6-15 (65)] Is the pipeline actually 12250 ft underwater, or does that include run from plant to shoreline?
- [page 6-18,19 (68,69)] Does it make sense to "do the math" to show an "average mgd" value for these two mgy values, and the seasonal ranges, so that we can see just how much could be offset by the tertiary treated volumes?
- [page 6-23 (73)] Table 6-10 has some issues:
    - Purisima is mis-spelled
    - Need to make clear that volumes are in mg
    - The potential transfer volume to Soquel is capped at 100mgy (per the current interim agreement), which is far below what may be possible in the future. Since we don't know the maximum perhaps we should say instead that while current agreement stipulates a cap of 100 mgy, the maximum available for transfer has yet to be determined.
- [page 7-1 (74)] Reference to our Stage 3 determination should include a link to how the City defines its stages of curtailment (since these are our policy standards, not the State's)
    - This could be a pointer to that section of the document that describes our curtailment policies.

- [page 7-2 (75)] Why not just say Soquel, instead of "an adjacent utility"? We've identified them elsewhere as potential collaborators for conjunctive use, and as pumpers from Purisima.
- [page 7-5 (78)] Water rights discussion says that we would not ask for any place-of-use changes. My understanding is that we want place-of-use changes at Newell, Tait, and Felton, to maximize our operational flexibility and to support regional solutions.
- [page 7-12 (85)] Reference to increased storage by 1.2BG. I think that the correct figure is 2.4BG of accessible supply, with up to 1.2BG deliverable in a given year (peak season). See WSAC recommendations and LRFP.
- ~~[page 8-11 (106)] Table doesn't include reference to "Water School" (probably among other things). Should we take credit for this, though, given its novelty and the amount of press coverage we received for it?~~ (addressed on page 8-14)
- [page 9-8 (126)] I believe that folks could attend Water School only once. Assuming that's correct, probably useful to include that fact in your discussion.
- [page 9-9 (127)] In the discussion of water system losses (both real and apparent), the percentage is less interesting than the amount, given that even if the amount stays the same, the percentage will vary up and down based on overall system demand. I suggest that you include both the average volume (~250MG) and the average percentage.
  - Over the past several years, demand has been depressed, and the % loss ratio has gone up at the same level of losses, making it look like we are doing worse. Going forward we expect demand to rebound (barring another drought cycle and concomitant curtailments), so the percentage will go down even if losses don't change, making it look like we're doing better.
- [9-22 (140)] What are City's plans for conservation pricing of sewer services?
- [Appendices in general]
  - Need to have the appendices properly annotated in the document, so that folks know which one is which (perhaps by inserting a "title page" before each one?).
  - Also, would be useful if the document TOC allowed navigation to the individual appendices by clicking on the corresponding TOC item.
  - Does it make sense to include the Soquel/City agreement on transfers as an Appendix?
- [Appendix K– WSAC report]
  - This appendix is incomplete; it must include the WSAC report's appendices, which are important components of the report (in particular, Appendix 8 and its footnotes).

- Typos and stylistic suggestions
  - [page 1-4 (11)] should read "recently designated by the state <u>to be</u>…"
  - [page 2-1 (14)] "an UWMP" should be "<u>a</u> UWMP"
  - [page 2-3 (16)] "representing a diverse" should be "<u>representing diverse</u>"
  - [page 3-5 (22)] "Similarly" should be "<u>Conversely</u>"
  - [page 3-8 (25)] "through 2014" should be "through <u>2023</u>", presumably
  - [page 4-8 (36)] "about almost 1000 now housing" should be "<u>nearly</u> 1000 <u>new</u> housing"
  - [page 4-8 (36)] "per a 1 degree F in" should be "per a 1 degree F <u>increase</u> in"
  - [page 4-9 (37)] "in demand to change" should be "in demand <u>due</u> to change"
  - [page 4-9 (37)] "by about 0.45 percent" should read "by about 0.45 percent <u>per one degree F increase in average daily high temperature</u>"
  - [page 5-1 (38)] "summarized Figure 5-1" should read "summarized <u>in</u> Figure 5-1"
  - [page 5-2 (39)] "water use water use"

- [page 5-5 (42)] “10-baseline” should read “10-year baseline”
- [page 5-8 (45)] “States’” should be “State’s”
- [page 5-12 (49)] “target would” should be “targets would”
- [page 6-1 (51)] “in below in” should be “below in”
- [page 6-2 (52)] “underlying entire” should be “underlying the entire”
- [page 6-4 (54)] “Districts’” should be “District’s”
- [page 6-4 (54)] “by in 1996” should be “in 1996”
- [page 6-5 (55)] “for entire management” should be “for the entire management”
- [page 6-6 (56)] “Basin shown” should be “Basin, as shown”
- [page 6-6 (56)] “proportion” should be “portion”
- [page 6-8 (58)] “provides an illustration of” could be “illustrates”, which would also eliminate the repetitive “provides”
- [page 6-10 (60)] “the city’s” should be “the City’s” (should confirm appropriate capitalization of the word throughout the document)
- [page 6-11 (61)] “Department maintains” should be “Department, maintains”
- [page 6-12 (62)] “the feasibility recycled water again though” should be “the feasibility of recycled water ~~again~~ through”, eliminating redundant “again”
- [page 6-13 (63)] “working the” should be “working with the”
- [page 6-14 (64)] Table 6-2 should make clear that the volumetric units are MGY. Same with table 6-3 on 6-16. Same with 6-5 on 6-19. And with table 7-1 on page 7-7. I’m going to stop mentionining this now; you should just make sure that each table includes volumetric units.
- [page 6-16 (66)] “City of Scotts Valley Water” should be “City of Scotts Valley” (no “Water”)
- [page 6-16 (66)] “plant of and” should be “plant and”
- [page 6-16 (66)] “currently…at this time” – pick one or the other; don’t need both phrases in the same sentence.
- [page 6-17 (67)] There is an open quote with no closing quote in the first sentence of section 6.5.4.1.
- [page 6-17 (67)] “in included” should be “is included”
- [page 6-21 (71)] “to allow the further study and determine” should be “to further study and determine”
- [page 6-21 (71)] “as to the project(s) to be carried out” should be “which project(s) will be carried out”
- [page 6-21 (71)] The sentence beginning “The Final Report summarized…” should be re-written. It is not at all clear or grammatical.
- [page 6-22 (72)] “source that” should be “source, that”
- [page 6-23 (73)] “recharged by the natural” should be “recharged by natural”
- [page 7-1 (74)] “held in the grips” should be “held in the grip”
- [page 7-3 (76)] “a HCP” should be “an HCP”. Make sure to make the change throughout.
- [page 7-6 (79)] section numbering should be 7.1.4.2 (not 7.4.1.2 as currently)
- [page 7-7 (80)] “recent supply” should be amplified to include “WSAC”, to make clear that you are referring to the previously-mentioned (and later discussed) WSAC process.
- [page 7-11 (84)] “single dry year, is the” should be “single dry year, the”
- [page 7-11 (84)] “difference” should be “differences”
- [page 7-12 (85)] reference to “Tables 7-4” should be to “Table 7-4”
- [page 7-13 (86)] “regions’” should be “region’s”

- [page 7-13 (86)] “to relevance” should be “to the relevance” (or could be “relative importance” instead of “relevance”)
- [page 8-2 (97)] The link to the Water Code does not display or retrieve a document on MacOS under Chrome.
- [page 8-7 (102)] “uses)” should be “uses” – eliminate stray trailing close-parenthesis.
- [page 8-7 (102)] Table 8-3 has some issues:
  - It should include the measures taken in response to Stage 1 (even if they are essentially moot), if only for the sake of completeness
  - The table title is “Reduction” but the values in the table communicate the amount of normal supply that is allocated (that is, the amount left *after* reduction). Change title to “Proportion of Normal Allocation” or something like that?
- [page 8-12 (107)] “restrictions and includes” should be “restrictions include”
- [page 8-18 (113)] “of two fiscal years” should be “two fiscal years”
- [page 8-18 (113)] “Stage 5 (however” should be “Stage 5” – looks like you tried to delete a parenthetical comment but didn’t get all of it.
- [page 8-18 (113)] “loch Lomond” should be “Loch Lomond”.
- [page 8-19 (114)] The link to the 2009 Water Shortage report does not work on MacOS under Chrome. Comes up with an “err-not-found” error.
- [page 8-20 (115)] “City is a within the” should be “City is within the”.
- [page 8-20 (115)] “City has it own” should be “City has its own”.
- [page 8-20 (115)] “form possible” should be “from possible”.
- [page 8-20 (115)] “roles responsibilities” should be “roles and responsibilities”.
- [page 8-23 (118)] “Finally, Water Department” should be “Finally, the Water Department”
- [page 9-3 (121)] Utilities” should be Utilities,”
- [page 9-6 (124)] “supply outlook supply” – should be “supply outlook”
- [page 9-7 (125)] “personable” – should be “personal”
- [page 9-8 (126)] “stay at their” – should be “stay within their”
- [page 9-9 (127)] In your brief WSAC discussion here, you may want to reference the previous section where you discussed the committee, its processes, and its findings in more detail.
- [page 9-11 (129)] “The current Water Conservation Manager” – should be “The Water Conservation Manager”; you could add “currently” to that if you expect job-responsibility changes.
- [page 9-12 (130)] The last sentence on the page (ending with “are described below”) needs a period at the end.
- [page 9-13 (130)] “Residential water use comprises” – should be “Residential water use constitutes”.
- [page 9-14 (132)] “Laundry to Landscape rebate program $150” – should be “Laundry to Landscape rebate of $150”.
- [page 9-15 (133)] “replaced like” – should be “replaced, like”.
- [page 9-15 (133)] “In the last five year” – should be “In the last five years”.
- [page 9-16 (134)] “i.e. low flow spray” – should be “e.g., low flow spray”.
- [page 9-16 (134)] “to makes them” – should be “to make them”.
- [page 9-17 (135)] “in the future better” – should be “in the future to better”.
- [page 9-19 (137)] “saw dramatic increase” – should be “saw a dramatic increase”.
- [page 9-19 (137)] “identified as top priority” – should be “identified as a top priority”.

- o [page 10-3 (143)] “the incorporation of” – should be “that”.

David Baskin

I only have a few comments, which are set forth below:

1. Why are we calling this the 2015 UWMP? Shouldn’t it be the 2016 Plan? Plans/ordinances, etc. are usually referred to by the year of their adoption.
2. Page 7-14. Listing of WSAC Members appears to be in alphabetical order, except that it incorrectly reflects that my last name is Green Baskin. Please correct, as Green is my middle name. Baskin is my last name.
3. Page 9-3 Conservation Pricing. Our discussion of the new rate structure should reflect that it has been approved, as it will have been by the time of the final report being adopted.
4. 9.2.4.2 could also state the WSAC made a series of demand management recommendations that are being incorporated into our Master Conservation Plan as appropriate.

My compliments on a very well drafted document, at least to the extent that I am qualified to so state. I am not familiar with the statutory scheme or the guidebook. I am confident that you have made the plan compliant.

Andy Schiffrin

- Page 7-9, Table 7-2 – Since it is expected that the ultimate agreement with the regulators will reduce the City’s ability to divert water from the North Coast streams, why does the table project increased diversions after 2020?

- Page 8-18 – There’s a typo in the first full paragraph – “(however.”

- Page 10-1 – Water Commission Changes – Assuming that the Commission does recommend changes, shouldn’t they be summarized after this paragraph.

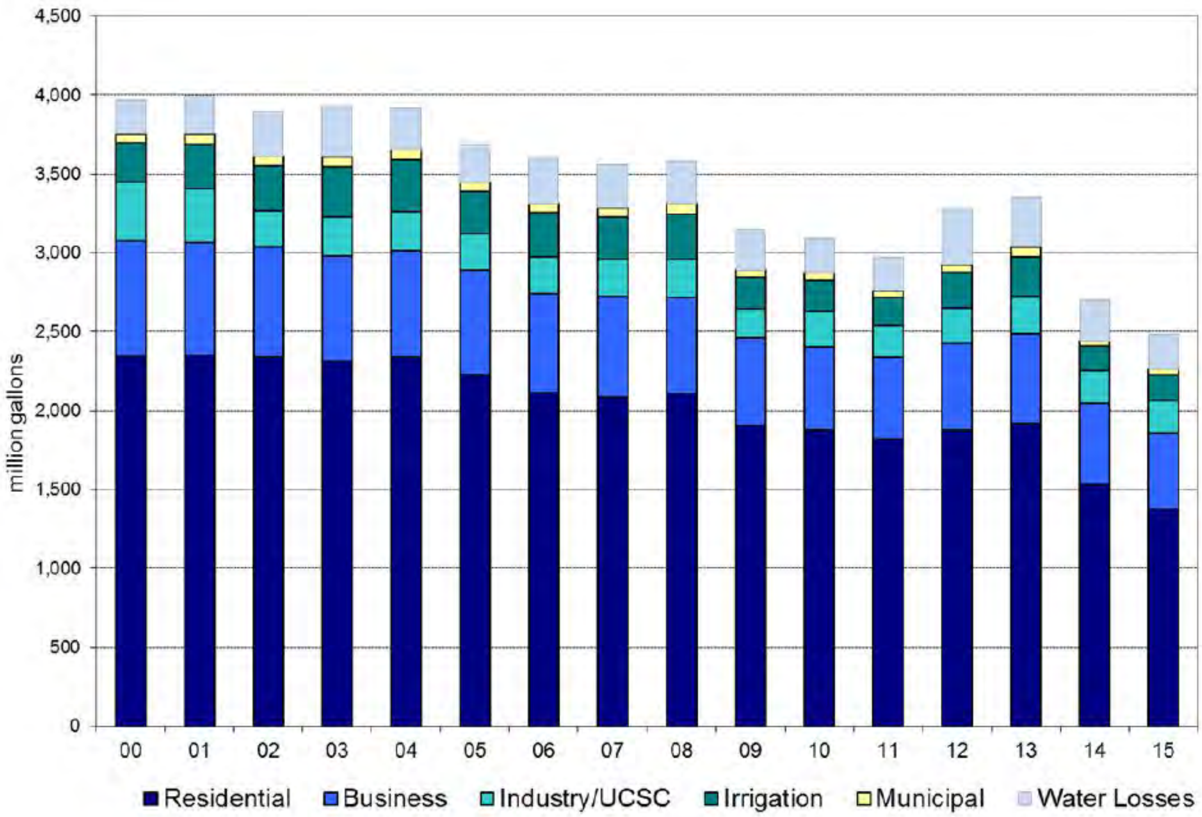
COMMENTS ON UWMP CHAPTERS 1 TO 6

Following are my comments, in **bold**, on the draft Plan:

1. New Vision for the City’s Water Supply. The City of Santa Cruz has long faced challenges with the reliability of its water supply and had been actively pursuing ocean desalination as a supplemental water source for more than a decade. In spring 2014, the Santa Cruz City Council changed course and appointed a committee of 14 residents representing diverse viewpoints to take an exhaustive look at the City’s water issues and ways to address them. The Water Supply Advisory Committee (WSAC) worked for 18 months in an open, public, and transparent process to develop recommendations to ensure a more stable and reliable water supply. In addition to more conservation, the WSAC recommended the City embark on a program to enhance regional groundwater storage using in-lieu water exchanges and/or aquifer storage and recovery with neighboring water districts. Advanced treated recycled water was recommended as a backup plan.

Shouldn't it mentioned that Desal is still an option if other approaches fail, especially since this is discussed later?

2.



The decline in Residential consumption is pretty amazing, if I understand it correctly. It was about 2.4 BGY in 2000 and in 2015 it was about 1.4 BGY, a decline of over 40%, and at a time when the service population was increasing, though of course there was the drought.)

3.

Table 4-3. Demands for Potable Water - Projected						
Use Type	Additional Description	Projected Water Use (mgy)				
		2020	2025	2030	2035	2040-opt
Single Family	Individually meter dwellings	1,277	1,223	1,191	1,170	n/a
Multi-Family	2 or more dwelling units	772	714	690	678	n/a
Commercial		574	541	525	519	n/a
Industrial		56	59	60	61	n/a
Institutional/ Governmental	Municipal (city) accounts	46	42	40	40	n/a
Landscape	Dedicated Irrigation	112	119	134	144	n/a
Landscape	Golf Irrigation	58	52	47	47	n/a
Other	UC Santa Cruz	196	234	271	308	n/a
Water Losses		236	241	247	253	n/a
	TOTAL	3,327	3,225	3,205	3,220	n/a
NOTES: David Mitchell, M Cubed, October 2015, and by Maddaus Water Management, February 2016						

From Table 4-1, total residential demand in 2015 was 1.373 BGY. In Table 4-3, it is projected to be 2.049 BGY, an increase of about 50%. Yet beyond 2020, demand is projected to decline. This significant increase to 2020 needs to be explained.

4.

Table 6-10. Water Supplies — Projected						
Water Supply	Additional Detail on Water Supply	Projected Water Supply *Report To the Extent Practicable*				
		2020	**2025**	**2030**	**2035**	**2040** *(opt)*
		Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume
Surface water	North Coast Sources	637	642	671	671	n/a
Surface water	San Lorenzo River	1,882	1,842	1,829	1,834	n/a
Surface water	Loch Lomond Reservoir	595	551	540	547	n/a
Groundwater	Live Oak/Beltz Wells	138	129	127	128	n/a
Transfers		Potential transfer to Soquel Creek Water District may be up to 100 mgy to assist with recovery of the western purisma basin and may result in future exchange to the City during peak season				
Exchanges						
Recycled Water		Recycled water feasibility study investigating options including regional partnership opportunities for a recycled water project to provide drought resistant supply and options for groundwater management strategies due to overdraft conditions of local basins				
Desalinated Water				Potential project to expand recycled water supply or investigate desalination		
Other						
	Total	3,252	3,164	3,167	3,180	0
NOTES:						

This may be discussed in later chapters but should there be an explanation here for why the percentage of water from the North Coast Streams is projected to decline, from the 24% cited earlier to the slightly less than 20% indicated in Table 6-10?

From the General Public

To: Toby Goddard
Water Conservation Manager
City of Santa Cruz
RE: Draft 2015 Urban Water Management Plan

Dear Toby,

I am interested in submitting comments to the draft 2015 Urban Water Management Plan. Please advise if this email is sufficient and timely or if I need to submit elsewhere.

In section 3.6 Community Growth and Development, no mention or discussion is made about the City of Santa Cruz's application that is currently on file with LAFCO to expand its urban services boundary line to include the upper UCSC campus. If the City of Santa Cruz were to proceed with this application, it could have significant impacts to the 2015 UWMP.

On page 3-10, the draft states: "Any proposed changes to the City's service area boundary that do come forward are subject to approval by both City Council and the Santa Cruz Local Agency Formation Commission (LAFCO)." This sentence is misleading because of the existing proposed change to the service area boundary that is not mentioned. Members of the public should be made aware of this and given the opportunity to consider and comment about it. Therefore, the draft should be changed to state that the City has applied to LAFCO to change its service area boundary and should include details about the application and what effects it could have upon the 2015 UWMP.

Since the City's LAFCO application was made a number of years ago, I think it would be helpful if the following questions could be answered in the 2015 UWMP:

1. Does the City have any intention of proceeding with its application to LAFCO?

2. If not, might the City decide to proceed with its application at a later date?

3. If the City does decide to consider proceeding with its LAFCO application, either during the time frame of the 2015 UWMP or at a later date, would that be a public process and would the City Council allow comments from the public before making any such decision?

4. Does the City have any intention of withdrawing its application to LAFCO? If not, please provide a detailed explanation of why not.

Of course, if the City decided to withdraw its application to LAFCO in the very near future, it would not be necessary to include all of the needed changes to the draft 2015 UWMP necessitated by the existing LAFCO application.

Thank you so much for your attention to these comments.

Sincerely,
Don Stevens
Habitat And Watershed Caretakers

RESOLUTION NO. NS-29,133

RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SANTA CRUZ ADOPTING THE 2015 URBAN WATER MANAGEMENT PLAN AND AUTHORIZING THE DIRECTOR OF THE WATER DEPARTMENT TO FILE A COPY WITH THE CALIFORNIA DEPARTMENT OF WATER RESOURCES

WHEREAS, the California Legislature enacted Assembly bill 797 (Water Code Section 10610 et seq., known as the Urban Water Management Planning Act) during the 1983-84 Regular session, and as amended subsequently, which mandates that every supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually, prepare an Urban Water Management Plan; and

WHEREAS, the City of Santa Cruz is an urban water supplier providing service to over 24,000 customers and is required to review and update the Plan every five years; and,

WHEREAS, the Urban Water Management Planning Act requires water agencies to evaluate and describe their water resource supplies and projected needs over a twenty-year planning horizon, and to address a number of related subjects including water conservation, water service reliability, water recycling, opportunities for water transfers, and contingency plans for drought events; and,

WHEREAS, beginning with the 2010 plans, Senate Bill X7-7 of 2009 (California Water Code Section 10608) requires each urban retail water supplier to include information on its baseline daily per capita water use and future water use targets to support the goal of reducing the state's per capita urban water consumption by 20 percent; and,

WHEREAS, the City of Santa Cruz exceeded its interim water use target for 2015 and fully complies with all requirements of Senate Bill X7-7; and,

WHEREAS, a completed Urban Water Management Plan is required in order for a water supplier to be eligible for California Department of Water Resources administered State grants, loans, and drought assistance; and,

WHEREAS, a Plan must be made available for public review and a public hearing held prior to adopting the Plan, and then filed with the California Department of Water Resources within thirty days of adoption; and,

WHEREAS, the City has therefore prepared and circulated for public review a draft 2015 Urban Water Management Plan, and a properly noticed public hearing regarding the subject Plan was held by the City Council on August 9, 2016,

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Santa Cruz that it hereby adopts the 2015 Urban Water Management Plan and authorizes the Director of Water to file a copy with the California Department of Water Resources.

RESOLUTION NO. NS-29,133

BE IT FURTHER RESOLVED that the Water Supply Advisory Committee's Final Report on Agreements and Recommendations as accepted by the City Council of Santa Cruz on November 24, 2015, the City's Water Shortage Contingency Plan, and the Water Conservation Master Plan approved by City Council on April 12, 2016 are hereby adopted by reference in their entirety as part of the City's 2015 Urban Water Management Plan.

PASSED AND ADOPTED this 23rd day of August, 2016, by the following vote:

AYES: Councilmembers Noroyan, Lane, Terrazas, Posner, Comstock; Vice Mayor Chase; Mayor Mathews.

NOES: None.

ABSENT: None.

DISQUALIFIED: None.

APPROVED: Cynthia Mathews
Mayor

ATTEST: ______________________
City Clerk Administrator

COOPERATIVE WATER TRANSFER PILOT PROJECT FOR GROUNDWATER RECHARGE AND WATER RESOURCE MANAGEMENT BETWEEN CITY OF SANTA CRUZ AND SOQUEL CREEK WATER DISTRICT

The parties to this Agreement are the CITY OF SANTA CRUZ, hereafter referred to as "CITY", and the SOQUEL CREEK WATER DISTRICT", hereafter referred to as "DISTRICT".

RECITALS

A. The CITY of Santa Cruz is a charter city which owns and operates a municipal water system in the City of Santa Cruz and in portions of the County of Santa Cruz adjoining the District water system.

B. The DISTRICT is a special district which operates a water system, adjacent to the eastern service boundary of the CITY, and provides water service to a significant portion of mid-Santa Cruz County.

C. A shared groundwater basin that the DISTRICT relies upon for a significant portion of its water supply, and from which the CITY obtains a small portion of its water supply, has been in a state of overdraft since the 1980s and is at risk of additional seawater intrusion.

D. The DISTRICT and the CITY cooperatively manage groundwater in the over-drafted basin and would benefit from this agreement.

E. The CITY and the DISTRICT have established three metered interties located at the DISTRICT's O'Neill Ranch well site, at Jade Street and at Bain Street.

F. During the winter and spring, the CITY may have available surface water from its pre-1914 North Coast water rights that could be treated and delivered to the DISTRICT for purchase.

G. Purchasing and using this treated surface water to meet some part of the DISTRICT's demand would enable the DISTRICT to reduce its groundwater pumping, reduce the potential for accelerating seawater intrusion, and contribute to the beginnings of a longer term process to ameliorate the overdraft condition of the groundwater basin that impacts both entities and other pumpers of groundwater from the Soquel-Aptos basin.

H. The period during which this agreement operates can be viewed as an opportunity to begin to assess the effects of reduced pumping of the basin by the DISTRICT on the shared groundwater basin. During this pilot project, the CITY and the DISTRICT intend to use this opportunity to collect information related to:

   1) the physical operating system issues;
   2) system water quality;
   3) response of groundwater levels from in-lieu recharge; and
   4) the potential opportunity of developing a longer term agreement in which the groundwater basin would be used for a combined in lieu and aquifer storage and recovery program that would help resolve the basin overdraft that would protect CITY and DISTRICT wells from addition seawater intrusion and provide needed drought storage for the CITY.

I. The CITY and DISTRICT recognize that a fair and appropriate agreement can benefit both parties, the community, and provide better management of locally available water resources.

NOW, THEREFORE, IT IS HEREBY AGREED:

1. AGREEMENT TERM:

Except as provided in Paragraph 11 hereafter, the term of this Agreement shall be for the period commencing at the completion of the CEQA process or November 1, 2015, whichever date is later and ending approximately five years later on December 31, 2020. This Agreement shall not extend beyond said date unless the governing bodies of both the CITY and the DISTRICT so agree in writing.

2. TERMS AND CONDITIONS FOR PROVIDING WATER:

Contingent upon the CITY securing all necessary permits and completion of the environmental review process in accordance with Paragraphs 4 and 5 below, water supplied by the CITY will be made available to the DISTRICT for purchase within the scope of the CITY's valid pre-1914 appropriative water rights and changes thereto in compliance with the law. The quantity and availability of water supplied by the CITY under the terms of this agreement shall be based on the following conditions and at the sole discretion of the Director of the Water Department of the CITY. In determining whether supply can be provided, the CITY may take into account any or all of the following factors:

a. The CITY has not declared, and is not operating under, any mandatory water curtailment stage of its 2009 Water Shortage Contingency Plan, as it may be amended, updated, or replaced by the CITY from time to time.[1]
b. Loch Lomond Reservoir is full and is spilling, or if not spilling is projected to be full by April 1 of the water year during which water will be provided to the DISTRICT. The calculation of the potential for the Loch Lomond Reservoir to fill shall be based on the City's short term streamflow modeling tools used to conduct the City's annual water supply forecast, as those tools or other measures to forecast water supply may be amended, updated, or replaced from time to time by CITY.
c. The CITY is providing flow for aquatic resources that meet regulatory requirements, or other requirements agreed to in writing with the fisheries agencies.
d. The City Beltz Wells are off, and not needed to meet daily demand.
e. The planned operation is in compliance with the project as described in the CEQA documents, including the general provision that the water transfer may occur when water is available as described in these terms and conditions between the months of November to April
f. On a monthly basis, the volume of water delivered to the DISTRICT shall be less than or equal to the amount diverted from the CITY's Liddell Springs and/or Majors Creek supplies as reported to the state of California.

[1] Mandatory curtailments begin with Stage 2 of the 2009 plan.

g. The daily volume of water supplied shall not exceed the hydraulic capacity of the interties between the CITY's system and the DISTRICT's system located at the District's O'Neill Ranch well site and at Jade Street and Bain Street. The hydraulic capacity of these interties is estimated to be 1.5 million gallons per day (mgd) during normal operations and up to 2 mgd on an emergency basis, and is a function of the pressure difference between the CITY and DISTRICT water systems at that point.
h. The CITY has not determined, in its discretion, that the supply of water to DISTRICT must be suspended or discontinued due to unusual or unanticipated circumstances, which suspension or discontinuation shall not be implemented without providing at least 3 days' advance written notice, except in the case of an emergency, in which event the City shall endeavor to provide DISTRICT notice as soon as reasonably possible after the emergency determination has been made.

3. PRICE

The CITY agrees to sell to the DISTRICT treated water delivered to the CITY-DISTRICT interties located on the DISTRICT's O'Neill Ranch well site and at Jade Street and Bain Street under the terms and conditions described hereof at a price that is equal to $1,000 per million gallons, or a pro rata amount thereof based on actual volume provided.

The CITY shall bill the DISTRICT on a monthly basis for water delivered to the DISTRICT based on the meter installed at the above specified intertie connections between the CITY and the DISTRICT. The pricing specified above is for this pilot project only. Future water deliveries made outside of this agreement will be subject to a pricing structure developed under any future water transfer or exchange agreement.

4. REGULATORY COMPLIANCE – CEQA

The CITY shall be the designated lead agency for the purposes of California Environmental Quality Act (CEQA) compliance. Cost of CEQA compliance, including preparation of an initial study and any negative declaration, mitigated negative declaration or environmental impact report, and implementation of mitigation measures identified therein and agreed to by the CITY will be equally split between the parties, with the DISTRICT's share shall be billed on a quarterly basis for the duration of this agreement.

CEQA compliance shall address the agreement herein to implement pilot testing of the transfer of water under certain conditions from the CITY to the DISTRICT commencing approximately November 1, 2015 and ending approximately five years later on December 31, 2020. Given that the agreement may potentially be extended beyond said date if both the CITY and the DISTRICT so agree in writing, CEQA shall also address the long-term transfer of water that may occur under such an extended agreement.

5. REGULATORY COMPLIANCE -- PERMITTING

The CITY shall be responsible for obtaining any other permits or approvals required to support providing water to the DISTRICT under this agreement, and shall be responsible for compliance with all laws, as necessary to make water available for purchase or to transfer pursuant to this Agreement.

6. REGULATORY COMPLIANCE – TREATED WATER DELIVERIES

Delivered water shall be in compliance with all drinking water regulatory requirements at the intertie point of delivery. Once the water has been delivered the DISTRICT shall be responsible in all respects for that water, and its delivery and use, including without limitation compliance with any distribution system requirements, and any relevant water quality regulations.

7. OPERATIONS PLAN

Prior to initiating the proposed water transfer, the CITY and the DISTRICT agree to jointly prepare and then implement an Operations Plan as the basis for joint operation. The CITY and the DISTRICT may amend the Operations Plan by written joint consent without needing to otherwise amend this agreement.

8. NOTICATION OF STARTING AND STOPPING WATER DELIVERIES

The water to be delivered hereunder shall be delivered to the DISTRICT on an interruptible basis, depending upon the availability of water and the terms and conditions described in paragraph 2 of this agreement. A determination that the delivery of water to the DISTRICT must be interrupted shall be at the sole discretion of the CITY Water Director, which determination shall be conclusive upon the DISTRICT. The CITY shall give the DISTRICT notice of interruption or cessation of the transfer of water in accordance with Paragraph 2(g), above.

9. DATA COLLECTION, MONITORING, AND ANALYSIS

The CITY and the DISTRICT shall jointly share the cost to develop, and implement, a data collection, monitoring, and analysis program to further characterize the benefits of the proposed water transfer and identify any potential issues. This program shall include, but not be limited to, monitoring and analyzing groundwater levels from existing wells in the vicinity of wells that the DISTRICT takes offline due to the available of water from an alternate water source, and distribution system water quality to assess any impacts from surface water being distributed through pipes that have only been used solely for groundwater distribution in the past. The plan shall be developed and implemented by the CITY and DISTRICT prior to commencing any sale of water.

10. NOTIFICATIONS AND RECORD KEEPING

For the purposes of this agreement, the parties shall abide by the record keeping and notification provisions in the Operations Plan.

11. NATURE OF AGREEMENT

It is understood and acknowledged by the DISTRICT and the CITY that this Agreement is only for the term specified herein, that no obligations are imposed on the parties beyond the term hereof, that the water rights of the CITY are not impacted, and that the water during the term hereof is solely dependent on the availability of surplus water as stated in this agreement.

This agreement makes no assumption about the availability or quantity of water to be delivered back to the CITY for use as a drought supply.

12. EFFECTIVE DATE:

This Agreement shall become effective only upon its approval by the governing bodies of each party hereto.

13. TERMINATION ON THIRTY-DAY NOTICE

This Agreement may be terminated by either party hereto upon the furnishing to the other party by United States Mail, first class, a thirty (30) day notice of intent to terminate or with an email notification that is acknowledged by the receiving party provided, however that DISTRICT'S obligations to pay for water delivered and indemnify, defend and hold CITY harmless pursuant to paragraph 14, below, shall survive termination.

14. RELEASE AND INDEMNITY

DISTRICT agrees to indemnify, defend and hold harmless CITY, and any agency or instrumentality thereof, and its elected and appointed officials, officers, employees and agents from and against all liabilities, claims, actions, causes of action, proceedings, suits, damages, judgments, liens, levies, costs and expenses of whatever nature, including reasonable attorneys' fees and disbursements (collectively "Claims") arising out of any actions taken by the City in the implementation of this agreement, or any environmental review conducted under the California Environmental Quality Act (CEQA) in connection with this agreement.

Dated: 8-2-16

CITY OF SANTA CRUZ

By: ____________________
City Manager of City of Santa Cruz

Dated: July 25, 2016

SOQUEL CREEK WATER DISTRICT

By: Bruce Daniels
President of the Board of Directors

APPROVED AS TO FORM:

____
CITY Attorney

____
DISTRICT Counsel

July 22, 2016

EXHIBIT
2

December 1, 2009

Attention:
Ken Thomas, City of Santa Cruz Planning
809 Center Street, Rm. 206
Santa Cruz, CA 95060
KThomas@ci.santa-cruz.ca.us

Chancellor George Blumenthal
UC Santa Cruz, Chancellors Office
1156 High Street
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Re: Comments on the City of Santa Cruz Sphere of Influence Amendment Draft EIR
November 2009

Protect Biological Diversity At UCSC

We, the undersigned, are deeply concerned about protecting rare and endangered species and their habitats on and around the University of California Santa Cruz campus. We are joined by the US Fish and Wildlife Service (USFWS) in believing that the piecemeal approach UCSC has taken over time with regard to planning individual development projects has not adequately accounted for or protected against the cumulative environmental impacts of those projects. We further believe that without an adequate comprehensive conservation plan certified by the USFWS and the California Department of Fish and Game (CDFG), future development will put at increasing risk the rare and sensitive species on UCSC land. Accordingly, we strongly urge UCSC to adopt a campus-wide Habitat Conservation Plan (HCP) as recommended by the USFWS in conjunction with a Natural Community Conservation Plan (NCCP) developed in coordination with the CDFG before any major new development of the North Campus takes place.

At-risk species in need of protection include Golden Eagle, Western Burrowing Owl, Townsend's big-eared bat, Western red bat, long-eared myotis bat, Loggerhead Shrike, Grasshopper Sparrow, California red-legged frog, San Francisco dusky-footed wood rat, Dolloff's cave spider, Santa Cruz telemid spider, Empire Cave pseudoscorpion, MacKenzie's cave amphipod, Ohlone tiger beetle, and a number of plant species including Santa Cruz manzanita and San Francisco popcorn flower.

The new UCSC growth plan includes extending City of Santa Cruz services to the currently undeveloped North Campus, adding over 3 million square feet of new development and logging 120 acres of forest. These actions could result in irreparable harm to sensitive species and their habitat unless a comprehensive protection plan is adopted. Furthermore, the requirements for fire protection will necessitate a large-scale plan for chaparral and Douglas Fir habitats that must be taken into account as those habitats house many sensitive species in addition to presenting considerable risks of wildfire to potential North Campus structures.

We quote from the December 2, 2008 USFWS letter to the City of Santa Cruz regarding the City's role in conducting an EIR on behalf of North Campus development: "The piecemeal approach that UCSC has taken in terms of implementing individual development projects over time makes it difficult for the Service to adequately assess cumulative impacts... We believe that UCSC, involved agencies, and the Service would benefit from the development of a campus-wide HCP by providing needed protection for listed species. Therefore, we recommend that the City support the development of a campus-wide HCP."

The USFWS also detailed concerns in a January 11, 2006 letter to UCSC about the 2005 Long Range Development Plan DEIR. The cited deficiencies included the following: "1) underestimating the effects of various development projects on federally listed species, 2) [inadequate] UCSC land use designations regarding conservation of federally listed species, and 3) the lack of a comprehensive management plan for listed species at UCSC."

A model management plan for protecting rare species and biological diversity at the UCSC campus is readily at hand in the form of what CDFG calls a Natural Community Conservation Plan (NCCP). The CDFG website describes the plan as "an unprecedented effort by the State of California, and numerous private and public partners that takes a broad-based ecosystem approach to planning for the protection and perpetuation of biological diversity. An NCCP identifies and provides for the regional or areawide protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity."

Habitat loss is the primary threat to most imperiled species. Without a broad-based ecosystem approach to protection, cumulative habitat loss through piecemeal development can be significant and harmful. An example of the sort of thinking that permits harmful development can be found in the UCSC 2005 LRDP EIR, which concluded that the elimination of 98 acres of habitat for Golden Eagles and Western Burrowing Owls is less-than-significant because other suitable habitat exists. UCSC reached similar conclusions about habit loss for other sensitive species, including that the logging of 120 acres of campus forest was not significant. Justifying a finding of a less-than-significant impact because there is suitable habitat elsewhere is spurious and evasive because it avoids the question of the impacts of the proposed development on a species where it occurs and is contrary to provisions of the California Environmental Quality Act

(CEQA) Guidelines (15065), (15380) and (15382). This is precisely why a campus-wide conservation plan is needed.

CEQA Guideline (15065) calls for "Mandatory Findings of Significance when: (1)… The project has the potential to substantially reduce the habitat of a fish or wildlife species; … (3) The project has possible environmental effects that are individually limited but cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects." CEQA Guideline (15380) refers to "rare" species that may become endangered if its environment worsens and (15382) says that "significant effect on the environment" means an adverse change in the physical conditions including flora and fauna.

Not only is UCSC in danger of undermining the intent of federal and state statutes, the lack of either a campus-wide HCP or an NCCP appears to ignore fundamental values UCSC supposedly shares with the City of Santa Cruz, for its proposed actions are inconsistent with the campus's espoused goals of working towards understanding and improving the natural environment and promoting sustainability in the world. UCSC should take full advantage of its unique biological circumstances and faculty expertise to further the study and protection of rare and special-status species and their habitats, rather than harming them through large-scale development without a comprehensive protection plan with enforceable provisions.

Unfortunately, we note that the City of Santa Cruz's November 2009 draft EIR for a Sphere Of Influence Amendment, which was jointly funded by UCSC and serving a dual purpose as the UCSC EIR for North Campus development, did not support the development of a campus-wide HCP as recommended by the USFWS December 2008 scoping letter or respond to the USFWS concerns in any meaningful way.

Therefore, we strongly urge the City of Santa Cruz in its role as a project proponent for UCSC development in the North Campus to take a protective approach, heed the recommendation of the USFWS, and support the development of a combined campus-wide HCP/NCCP at UCSC in its final EIR. Furthermore, we would point out that the Local Agency Formation Commission (LAFCO) has the responsibility to review environmental impacts and jurisdiction over whether to approve development of the North Campus. We hope that LAFCO will see a duty under state law, including CEQA, and require UCSC to develop an HCP/NCCP before approving the proposed development project. Absent a comprehensive HCP/NCCP, the environmental impacts of the proposed development cannot be fully understood, nor can rare and special-status species be protected.

Thank you for your attention.

Sincerely,

Jennifer Anderson, UCSC Retired Lecturer and Assistant to the Chair, Environmental Studies

Jeffrey Arnett, UCSC Lecturer in Writing, editor of An Unnatural History of UCSC

Martha Brown, Co-Editor of the Natural History of UCSC, Senior Editor, Center for Agroecology & Sustainable Food Systems.

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Jodi Frediani, Director, Central Coast Forest Watch

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Wallace J. Nichols, PhD, Research Associate California Academy of Sciences, Founder/Co-Director OceanRevolution.org

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John Wilkes, UCSC Senior Lecturer Emeritus in Science Writing and founding director of the Science Communication Program

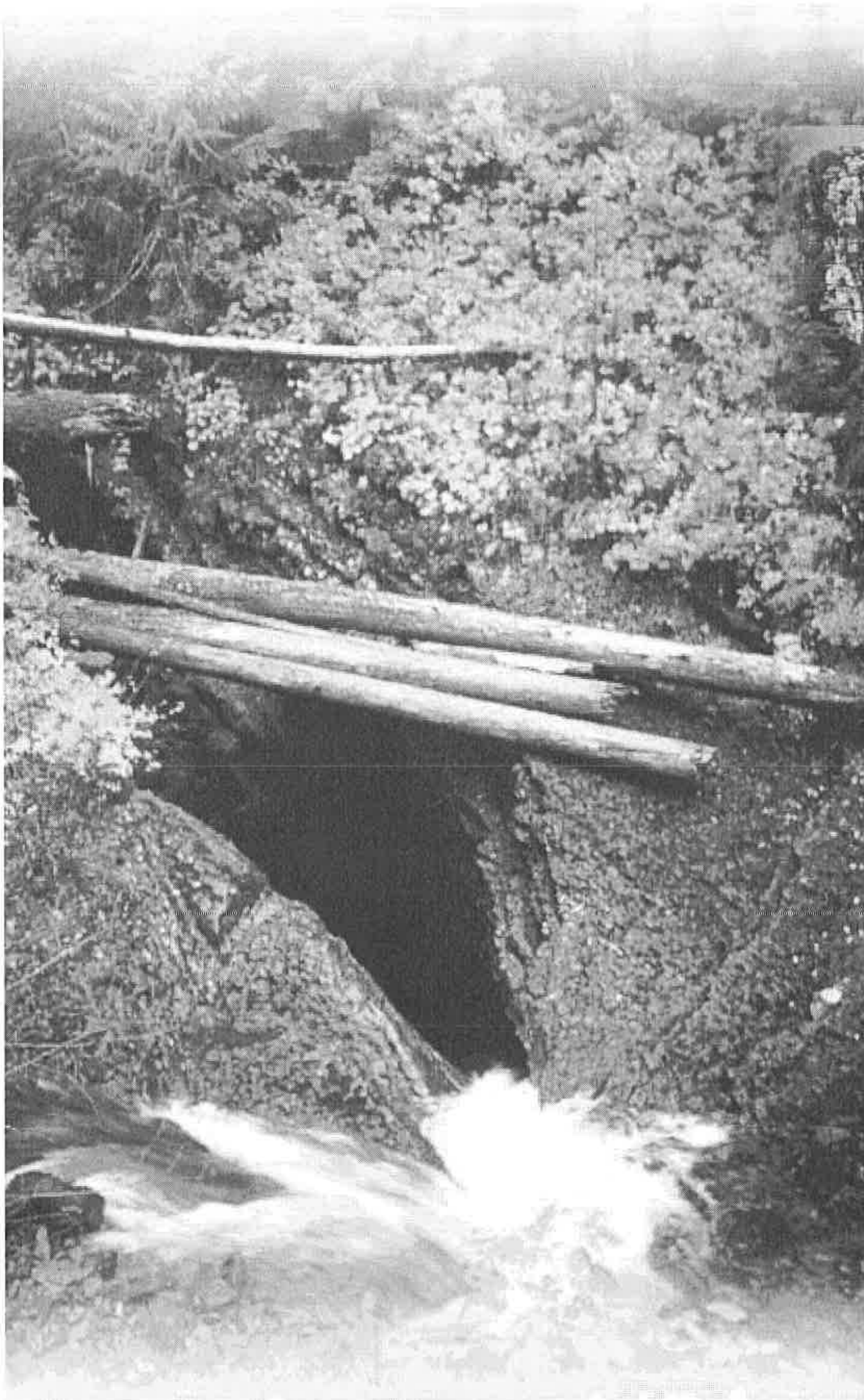
EXHIBIT

3

LIVING WITH KARST

A Fragile Foundation

AGI ENVIRONMENTAL AWARENESS SERIES



Publishing Partners

AGI gratefully acknowledges the following organizations' support for the *Living with Karst* booklet and poster. To order, contact AGI at www.agiweb.org or (703) 379-2480.

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Illinois Basin Consortium
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AGI Environmental Awareness Series, 4

LIVING WITH KARST

A Fragile Foundation

George Veni

Harvey DuChene

Nicholas C. Crawford

Christopher G. Groves

George N. Huppert

Ernst H. Kastning

Rick Olson

Betty J. Wheeler

With a Foreword by
Philip E. LaMoreaux

American Geological Institute

in cooperation with

National Speleological Society
and
American Cave Conservation Association, Illinois Basin Consortium
National Park Service, U.S. Bureau of Land Management, USDA Forest Service
U.S. Fish and Wildlife Service, U.S. Geological Survey

ABOUT THE AUTHORS

George Veni is a hydrogeologist and the owner of George Veni and Associates in San Antonio, TX. He has studied karst internationally for 25 years, serves as an adjunct professor at The University of Texas and Western Kentucky University, and chairs the Texas Speleological Survey and the National Speleological Society's Section of Cave Geology and Geography

Harvey R. DuChene, a petroleum geologist residing in Englewood, CO, has been studying caves throughout the world for over 35 years; he is particularly interested in sulfuric acid karst systems such as the Guadalupe Mountains of New Mexico and west Texas.

Nicholas Crawford, a professor in the Department of Geography and Geology and Director of the Center for Cave and Karst Studies at Western Kentucky University, has written over 200 articles and technical reports dealing with groundwater contamination of carbonate aquifers.

Christopher G. Groves is an associate professor and director of the Hoffman Environmental Research Institute at Western Kentucky University. His current work involves development of geochemical models to understand carbon cycling within karst landscape and aquifer systems. The Institute, hoffman.wku.edu, is working on a variety of cooperative karst-related research and educational programs.

Ernst H. Kastning is a professor of geology at Radford University in Radford, VA. As a hydrogeologist and geomorphologist, he has been actively studying karst processes and cavern development for over 30 years in geographically diverse settings with an emphasis on structural control of groundwater flow and landform development.

George Huppert is professor and chair of the Department of Geography and Earth Sciences at the University of Wisconsin at La Crosse. He has been active in researching karst management and conservation problems for over 30 years. He is also a life founding member and Vice President for Conservation of the American Cave Conservation Association.

Rickard A. Olson has served as the ecologist at Mammoth Cave National Park for the past seven years, and has conducted cave-related research on a variety of topics for the past 25 years. Most of his research efforts have been motivated by cave and karst conservation needs.

Betty Wheeler, a hydrogeologist in the Drinking Water Protection Section of the Minnesota Department of Health in St. Paul, has been studying karst groundwater processes for 17 years. She served as the book review editor for the *Journal of Cave and Karst Studies* for more than 10 years, and she is currently conducting susceptibility assessments of noncommunity public-water-supply wells throughout Minnesota.

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CONTENTS

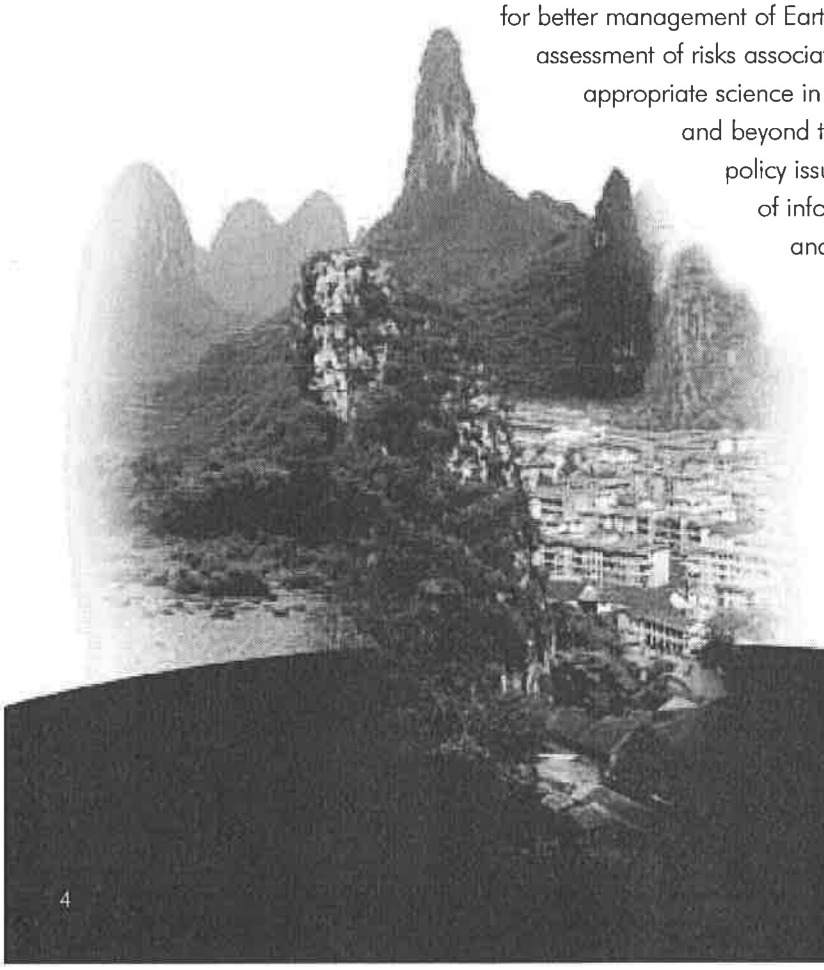
FOREWORD

Karst regions, areas underlain by limestone, dolomite, marble, gypsum, and salt, constitute about 25% of the land surface of the world. They are areas of abundant resources including water supplies, limestone quarries, minerals, oil, and natural gas. Many karst terrains make beautiful housing sites for urban development. Several major cities are underlain in part by karst, for example, St. Louis, MO; Nashville, TN; Birmingham, AL; Austin, TX; and others. However, since people have settled on karst areas, many problems have developed; for example, insufficient and easily contaminated water supplies, poor surface water drainage, and catastrophic collapse and subsidence features. By experience we have learned that each karst area is complex, and that special types of investigation are needed to help us better understand and live in them. In addition, urban development in these areas requires special sets of rules and regulations to minimize potential problems from present and future development.

The American Geological Institute produces the Environmental Awareness Series in cooperation with its Member Societies and others to provide a non-technical framework for a better understanding of environmental geoscience. This booklet was prepared under the sponsorship of the AGI Environmental Geoscience Advisory Committee (EGAC) with the support of the AGI Foundation. Publishing partners that have supported development of this booklet include: The American Cave Conservation Association, the Geological surveys in the states of Kentucky, Indiana, and Illinois (Illinois Basin Consortium), National Park Service, National Speleological Society, U.S. Bureau of Land Management, USDA Forest Service, U.S. Fish and Wildlife Service, and the U. S. Geological Survey.

Since its creation in 1993, the EGAC has assisted AGI by identifying projects and activities that will help the Institute achieve the following goals: increase public awareness and understanding of environmental issues and the controls of Earth systems on the environment; communicate societal needs for better management of Earth resources, protection from natural hazards, and assessment of risks associated with human impacts on the environment; promote appropriate science in public policy through improved communication within and beyond the geoscience community related to environmental policy issues and proposed legislation; increase dissemination of information related to environmental programs, research, and professional activities in the geoscience community.

This booklet describes ways to live safely, comfortably, and productively in karst areas, and illustrates that through use of improved science and technology, environmental concerns associated with karst can be better assessed and significantly resolved.



Philip E. LaMoreaux
Chair, AGI Environmental Geoscience Advisory Committee, 1993-

PREFACE

Karst areas are among the world's most diverse, fascinating, resource-rich, yet problematic terrains. They contain the largest springs and most productive groundwater supplies on Earth. They provide unique subsurface habitat to rare animals, and their caves preserve fragile prehistoric material for millennia. They are also the landscapes most vulnerable to environmental impacts. Their groundwater is the most easily polluted. Water in their wells and springs can dramatically and rapidly fluctuate in response to surface events. Sinkholes located miles away from rivers can flood homes and businesses. Following storms, droughts, and changes in land use, new sinkholes can form suddenly, collapsing to swallow buildings, roads, and pastures.

The unique attributes of karst areas present challenges. In many cases, understanding the complex hydrologies of karst aquifers still requires specialists for accurate assessments. Unlike other terrains where most processes occur and can be observed at the surface, many critical processes in karst occur underground, requiring monitoring of groundwater flow and exploration and study of caves. Rather than being mere geologic curiosities, caves are now recognized as subsurface extensions of karst landscapes, serving vital roles in the evolution of the landscapes, and in defining the environmental resources and problems that exist in those areas.

This booklet unravels some of the complexities and provides easy to understand, sound practical guidance for living in karst areas. Major topics include

- Describing what karst is and how it "works."
- Identifying the resources and uses of karst areas from prehistoric to modern times.
- Outlining the problems that can occur in karst areas and their causes.
- Providing guidelines and solutions for preventing or helping overcome problems.
- Presenting sources of additional information for further research and assistance.

Karst areas offer important resources, with much of their wealth hidden underground. Careful use can produce many economic and scientific benefits. Sound management of karst areas requires the conscientious participation of citizens including homeowners, planners, government officials, developers, farmers, ranchers, and other land-use decision makers. It's up to you to manage your karst areas wisely. We hope this booklet helps.

We greatly appreciate the assistance we received from individuals and organizations in preparing this booklet. Several reviews helped craft the manuscript and ensure that the information was correct and up-to-date. Numerous photographs, in addition to those provided by the authors, were kindly donated for use. Our special thanks go to the organizations named on the inside cover who supported the publication and to the American Geological Institute for producing it.

George Veni and Harvey DuChene, editors
May, 2001

1 IT HELPS TO KNOW...

Sinkhole plain, typical of many well-developed karst landscapes.

For a landscape that makes up over a fifth of the United States, "karst" is a word that is foreign to most Americans. Major karst areas occur in 20 states and numerous smaller karst regions occur throughout the nation (Fig. 1). Karst describes landscapes characterized by caves, sinkholes, underground streams, and other features formed by the slow dissolving, rather than mechanical eroding, of bedrock. As populations have grown and expanded into karst areas, people have discovered the problems of living on those terrains, such as sinkhole collapse, sinkhole flooding, and easily polluted groundwater that rapidly moves contaminants to wells and springs. With the help of science and technology, residents and communities are developing solutions to the problems of living with karst.

What the Environmental Concerns Are

Karst regions require special care to prevent contamination of vulnerable groundwater supplies and to avoid building in geologically hazardous areas. Living in karst environments may result in

- Urban pollution of groundwater by sewage, runoff containing petrochemicals derived from paved areas, domestic and industrial chemicals, and trash;
- Rural groundwater pollution from sewage, fertilizers, pesticides, herbicides, dead livestock, and trash;
- Destabilization of the delicate equilibrium between surface and underground components of karst resulting in alteration of drainage patterns and increasing incidents of catastrophic sinkhole collapse, particularly in areas of unplanned urban growth;
- Construction problems, particularly the clearing and stabilization of land for buildings and roads;
- Challenges to water-supply development;
- Challenges to mine dewatering and excavation.

The financial impacts of these problems are substantial. As an example, the repair costs of five large dam sites in karst settings were in excess of $140 million. According to the U.S. National Research Council report, *Mitigating Losses from Land Subsidence in the United States* (1991), six states have individually sustained at least $10 million in damages resulting from sinkholes. As a result, awareness programs for catastrophic subsidence areas have been developed, as well as insurance programs applicable to sinkhole problems.

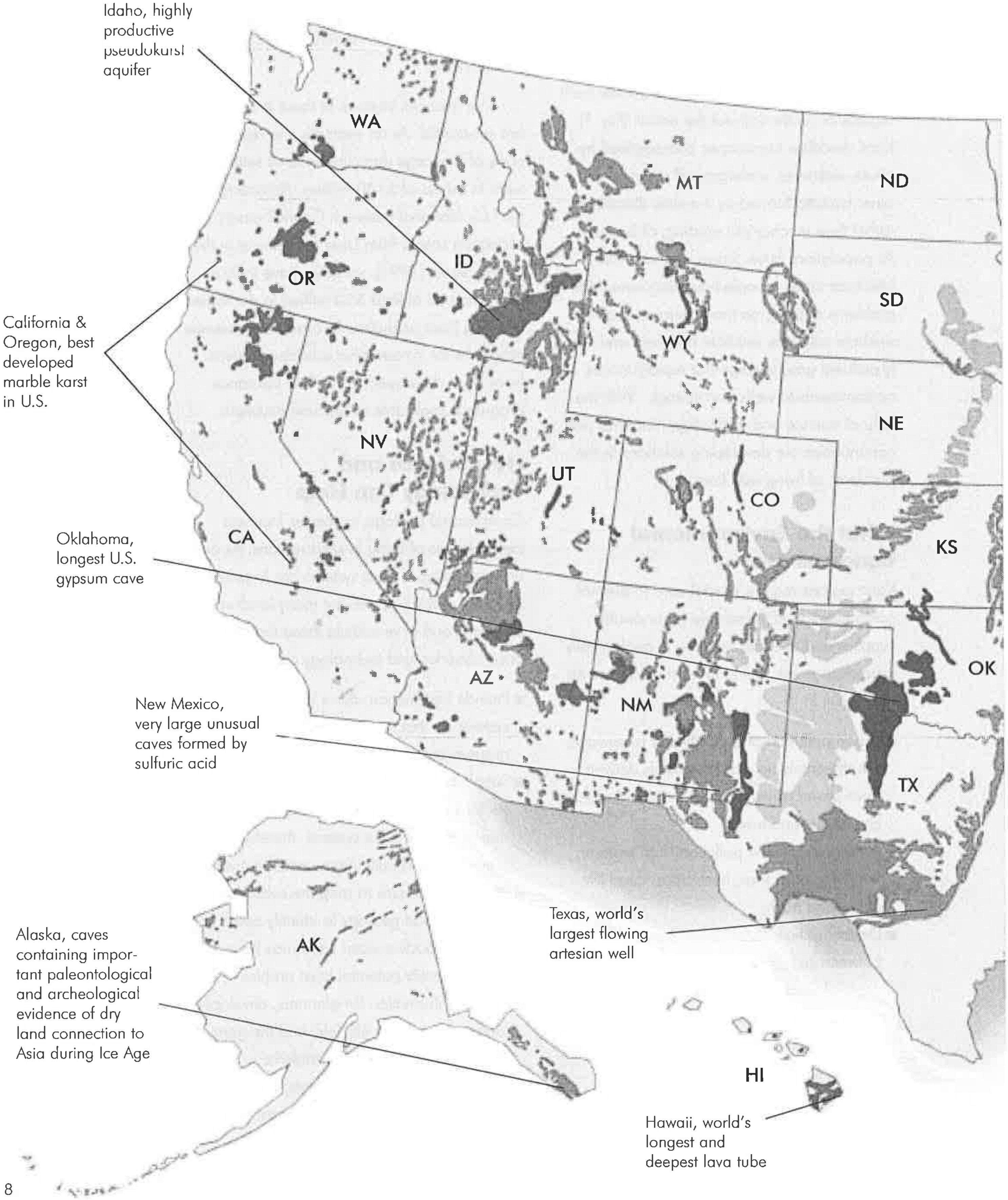
How Science and Technology Can Help

Complicated geologic processes increase the problems of living in karst regions. As our understanding of karst systems has improved, so has our ability to prevent many land-use problems and to remediate those that do occur. Science and technology can

- Provide information about karst aquifer systems so that residents can better protect groundwater supplies from pollution;
- Supply information on geological hazards such as areas with the potential for collapse due to shallow cave systems, thereby helping planners avoid building in unstable areas;
- Provide the means to map the subsurface hydrology and geology to identify areas where productive water wells may be located and to identify potential karst problems;
- Provide information for planners, developers, land management officials, and the general public about the special problems of living in karst environments; and
- Provide solutions for environmental problems when they do occur.

KARST

Karst is landforms and landscapes formed primarily through the dissolving of rock.


Idaho, highly productive pseudokarst aquifer
California & Oregon, best developed marble karst in U.S.
Oklahoma, longest U.S. gypsum cave
New Mexico, very large unusual caves formed by sulfuric acid
Alaska, caves containing important paleontological and archeological evidence of dry land connection to Asia during Ice Age
Texas, world's largest flowing artesian well
Hawaii, world's longest and deepest lava tube
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U.S. Karst Map

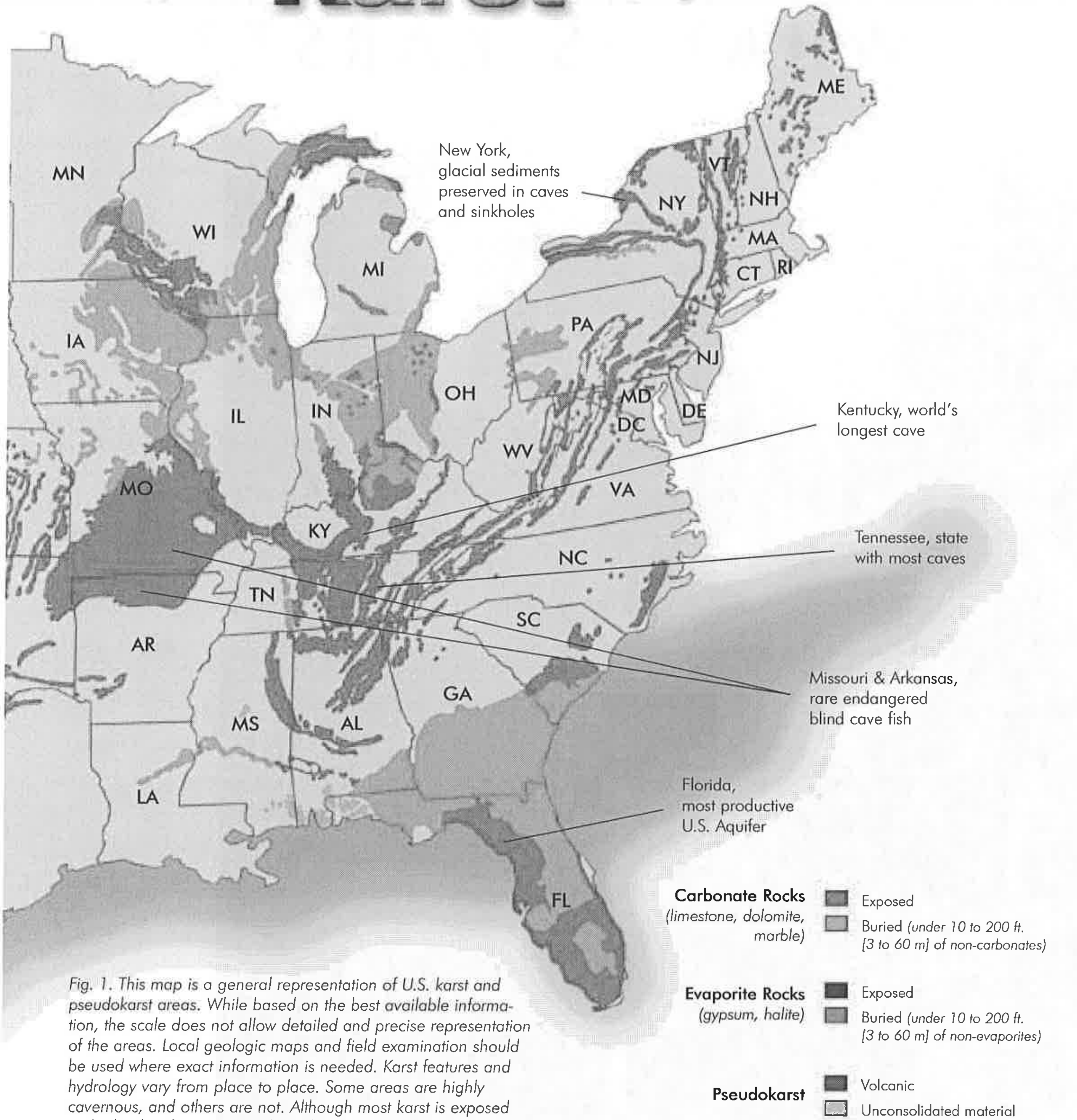
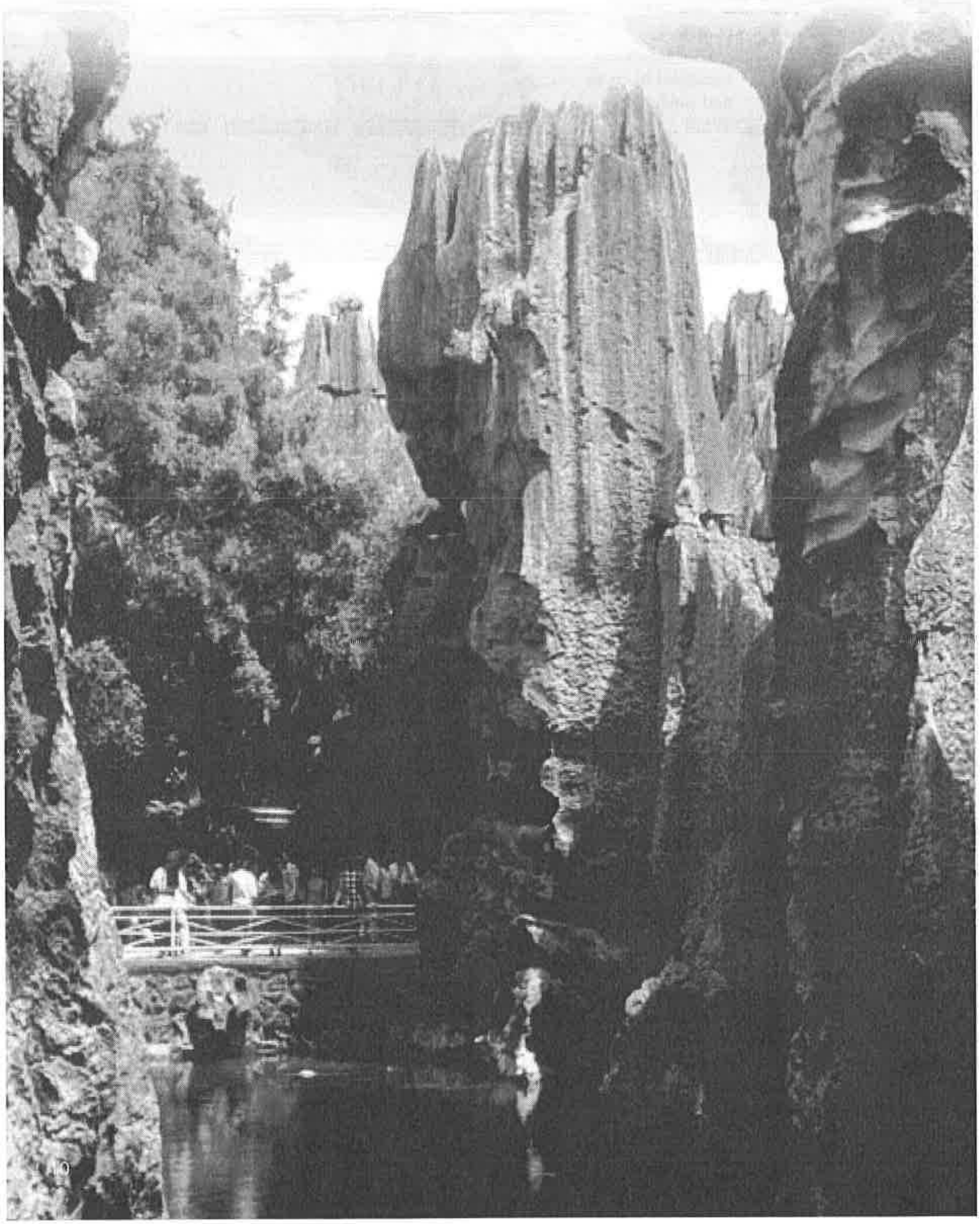


Fig. 1. This map is a general representation of U.S. karst and pseudokarst areas. While based on the best available information, the scale does not allow detailed and precise representation of the areas. Local geologic maps and field examination should be used where exact information is needed. Karst features and hydrology vary from place to place. Some areas are highly cavernous, and others are not. Although most karst is exposed at the land surface, some is buried under layers of sediment and rock, and still affects surface activities.

2
WHAT IS KARST?



Tourist trails through large karst pinnacles in Lunan Stone Forest, China.

Landforms produced primarily through the dissolving of rock, such as limestone, dolomite, marble, gypsum, and salt, are collectively known as karst. Features of karst landscapes include sinkholes, caves, large springs, dry valleys and sinking streams. These landscapes are characterized by efficient flow of groundwater through conduits that become larger as the bedrock dissolves. In karst areas, water commonly drains rapidly into the subsurface at zones of recharge and then through a network of fractures, partings, and caves, emerges at the surface in zones of discharge at springs, seeps, and wells.

The appearance of karst varies from place to place, with different features having greater or lesser prominence according to local hydrogeologic factors. Even ancient or "paleokarst" that is buried under other rocks and sediments and is not exposed at the surface can have an effect on surface land use. Several false or "pseudokarst" areas also occur, especially in the western United States (Fig. 1). These regions contain karst-like features which have developed in poorly soluble rocks. Although formed by different processes, pseudokarst areas are often similar to karst areas in how they are used and affected by human activities.

How Karst Forms

Karst forms as water dissolves soluble bedrock. Although water alone can dissolve salt and gypsum, limestone, dolomite, and marble are less soluble and require acidic water. Carbonic acid is a mild, naturally occurring acid that is very common in groundwater. This acid is created when water falling through the atmosphere takes on a small amount of carbon dioxide. As the slightly acidic rainwater passes through soil, the water absorbs additional carbon dioxide and becomes more acidic. Acidic water readily dissolves calcite, the principal mineral in limestone and marble, and an important mineral in dolomite.

Acidic groundwater moving through fractures and other spaces within the rock gradually alters small openings creating large passages and networks of interconnected conduits. Solution sinkholes form by dissolving the bedrock at the surface downward as surface water is captured and diverted underground (Fig. 2). Most flow and enlargement take place at or just below the water table, the level below which the ground is saturated with water. The circulation of water and bedrock dissolution are greatest there because fractures are connected and most open, whereas underground spaces tend to become progressively narrower and smaller with depth. Where these openings are dissolved large enough to allow human entry, they are called "caves."

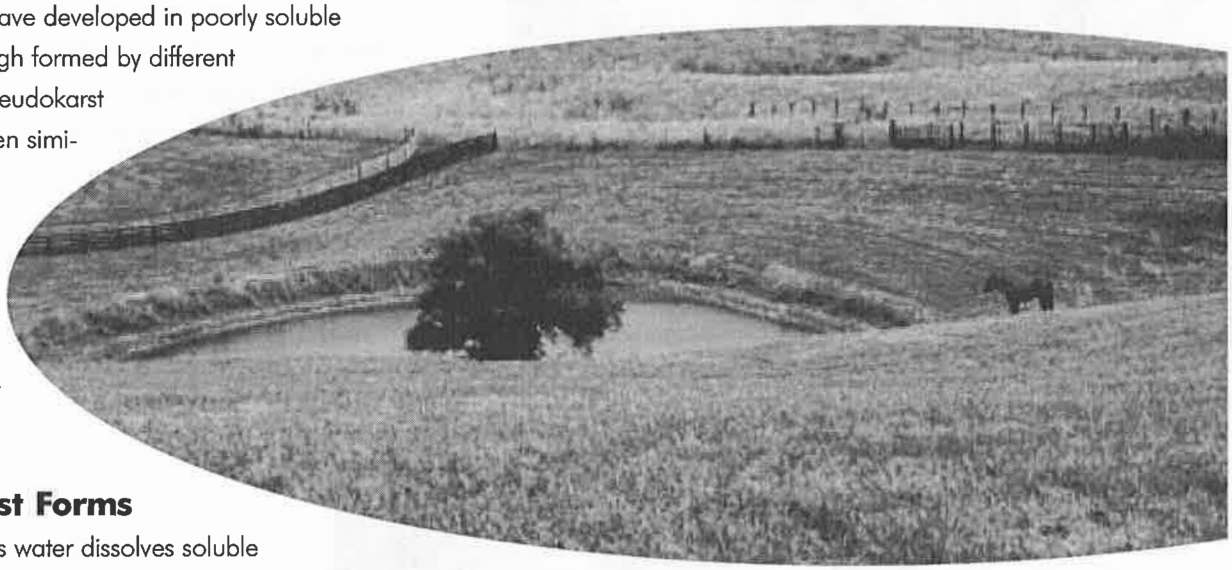
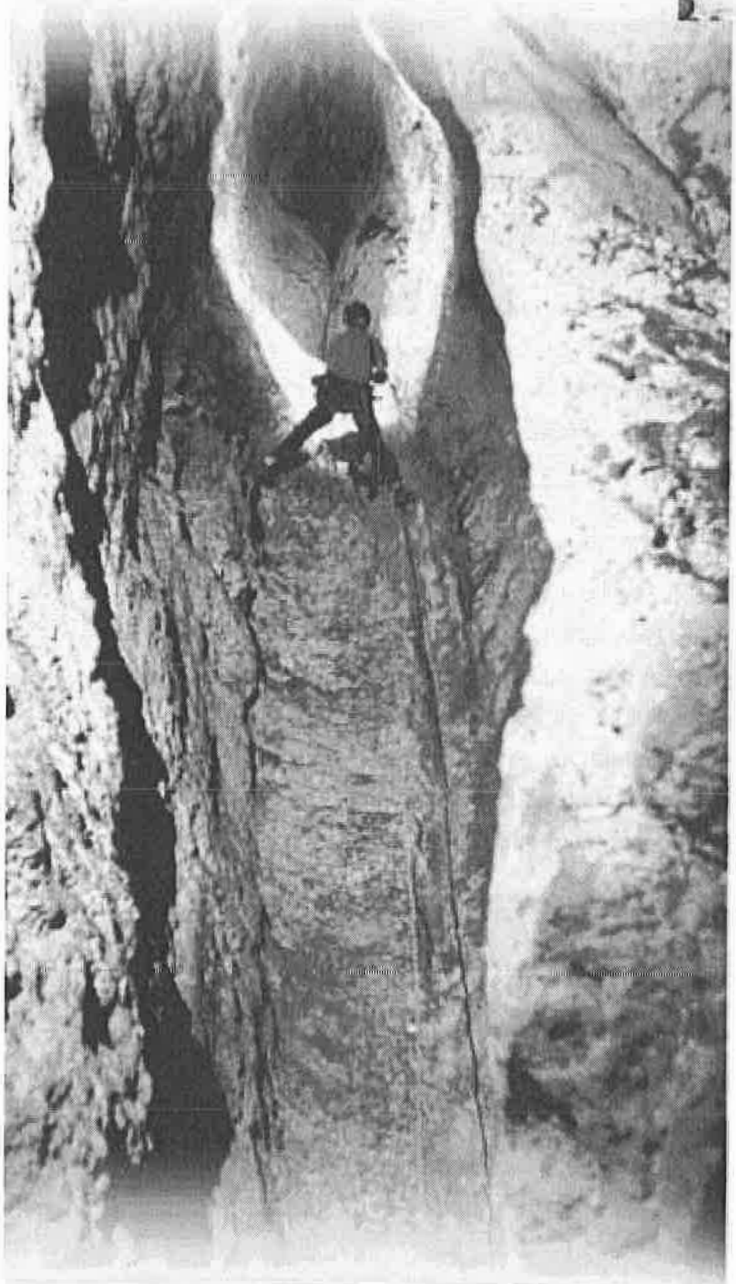


Fig. 2. This solution sinkhole holds water above the water table. Although most sinkholes drain rapidly, some like this one, have natural plugs and may hold water for many years.

Fig. 3. (Right) Horizontal cave passages form below the water table, and they usually have a smooth, rounded to elliptical shape. The water table has since dropped below this Mexican cave, and recent floods washed in the boulders.



Most caves form at or just below the water table, and consequently cave passages are generally horizontal. In cross section, these cave passages are elliptical tubes usually developed in soluble beds of rock (Fig. 3). In contrast, passages formed above the water table are canyon-like corridors that have been formed by dissolution and physical erosion as water cut down through the rock. Cross sections of cave passages formed above the water table are narrow and tall, and pits are common (Fig. 4).

Caves above the water table are tributaries to caves below the water table. Over time, small channels and conduits merge to form large cave passages in the downstream direction. In a mature cave system, an underground branching, tree-like drainage network develops that resembles surface stream systems (Fig. 5). The flow of water is concentrated in large conduits and typically emerges at a few springs with high rates of discharge. At this stage, the karst groundwater system

Fig. 5. (Below) Flow patterns for underground water in karst commonly have a branching shape. Small branches, which begin by capturing surface water from sinkholes and fractures, gain in size and water volume as they flow downstream, merge, and eventually discharge at springs.

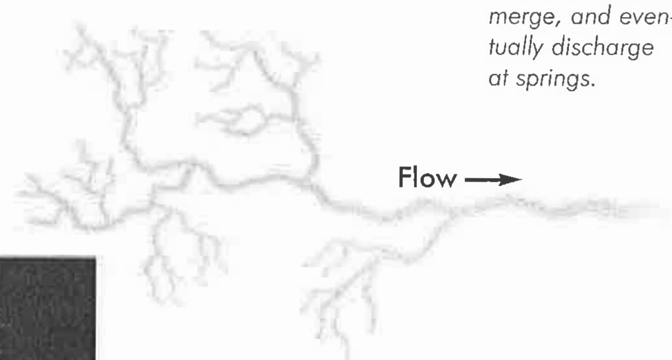


Fig. 4. (Above) Vertical cave passages, like this one, typically form above the water table, usually along fractures, and they efficiently channel water that enters caves down to the aquifers below.

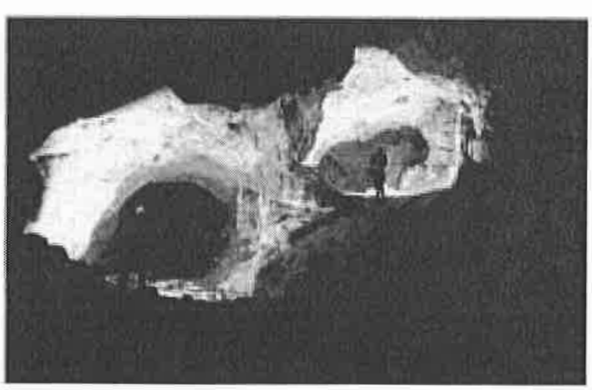
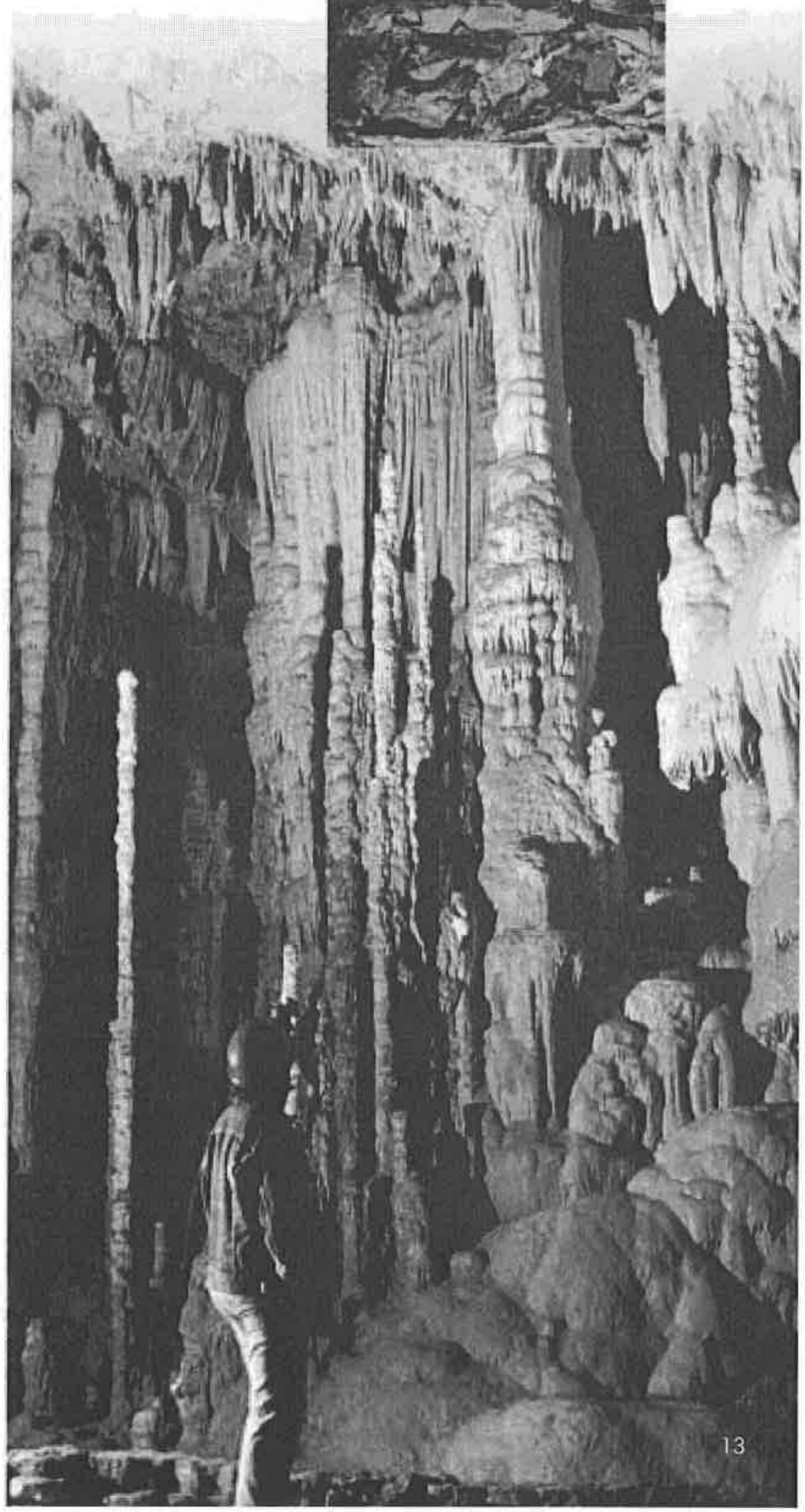


Fig. 6. (Left) This split-level cave in Mexico formed by water first flowing through the dry upper passage, which was abandoned as the water table dropped and groundwater cut a new route through the lower passage to reach the current water table.

Fig. 8. (Right) The sharp edges along the walls and the tell-tale angular rocks on the floor are evidence that this passage formed by the collapse of a deeper passage.

Fig. 9. (Below) On rare occasions, a collapsing cave room or passage may extend high enough that a collapse sinkhole forms in bedrock on the surface.

Fig. 7. (Right) A "speleothem" is a mineral deposit formed in caves by precipitation from mineral-rich water. Common examples are stalactites hanging from the ceiling, stalagmites growing up from the floor, and columns where the two join. Natural Bridge Caverns is a show cave in Texas.



is a coherent part of the hydrologic cycle. Water passes downward from the surface, through this efficient system of natural "pipes" and emerges elsewhere at the surface as seeps and springs.

Because springs usually discharge into valleys that are continually deepened by surface streams, water tables gradually fall and springs migrate to lower elevations. Consequently, newer cave passages form at lower elevations, while previously formed upper-level passages and rooms are drained (Fig. 6). These caves are relatively dry except for dripping water and an occasional stream making its way from the surface to the water table. Water dripping or flowing into passages may deposit calcite speleothems, such as stalactites, stalagmites, and columns (Fig. 7). Ceilings of rooms and passages collapse when passages become too wide to support the bedrock overlying them (Fig. 8). The danger of collapse increases when water is drained from the cave and its buoyant force is not present to help support ceilings. Some collapse sinkholes develop where collapse of the cave roof reaches the surface of the Earth (Fig. 9). More commonly, they develop when soil collapses after deeper soils wash into underlying caves.

Fig. 11. The fractures and pits in this limestone have become larger as the surrounding rock dissolved by solution.

Fig. 10. When it rains, this New York swallet "swallows" all of the water that flows down the creek bed.

Unlike other landscapes, groundwater recharge into karst aquifers carries substantial amounts of dissolved and suspended earth materials underground. First, the water contains ions that are produced naturally as the rock is dissolved. Second, water conveys particles that range in size from submicroscopic clay particles to boulders. Great volumes of sediment are transported underground in karst areas, sometimes resulting in openings becoming clogged. The mechanical and chemical removal of material in karst occurs throughout the zone between the land surface and the bedrock. Unlike other terrains, where weathering forms a soil that may thickly blanket the bedrock and retard erosion, in karst, the continual removal of material into the subsurface allows high, sustained rates of erosion. Many karst areas, especially in the western United States where soil production is slow, are covered with only thin or patchy soils.

Hydrologic Characteristics

Karst features may or may not be easily recognizable on the surface, but areas where the surface bedrock is limestone or gypsum have a high probability of karst development. Karst areas commonly lack surface water and have numerous stream beds that are dry except during periods of high runoff. These regions have internal drainage; streams flow into the closed depressions called sinkholes where there is no surface outlet. A typical sinkhole is bowl shaped, with one or more low spots along its bottom. In some cases a swallow hole, or swallet, may be present at the bottom of the sinkhole where surface water flows underground into fractures or caves (Fig. 10). Water may also enter a karst aquifer along streams that flow over karst areas and disappear from the surface. A stream of this type is known as a sinking stream and in some cases it may lose water along a substantial part of its length. In the subsurface, the storage and flow of groundwater is controlled by the porosity and permeability of the rock.

Porosity and Permeability

All rock contains pore spaces. Porosity is the percentage of the bulk volume of a rock that is occupied by pores (Fig. 11).

For example, a porosity of 20% means that bedrock is 80% solid material (rock) and 20% open spaces (pores or fractures). Voids in the bedrock are the openings where groundwater can be stored. Where voids are connected, they also provide the paths for groundwater flow.

Permeability is a measure of how well groundwater flows or migrates through an aquifer. A rock may be porous, but unless those pores are connected, permeability will be low. Generally speaking, the permeability of rocks in well-developed karst areas is very high when networks of fractures have been enlarged and connected by solution (Fig.12).

In most limestones, the primary porosity and permeability, or hydrologic characteristics created as the rock formed, are generally low. However in karst areas, large cavernous porosities and high permeability are common. These hydrologic characteristics, including fractures and openings enlarged by solution, are almost always secondary or tertiary features that were created or enhanced after the rock was formed.

The Hydrologic Cycle

The source of groundwater for all aquifers is precipitation. When rain falls, plants and soil absorb some of the rain water, some of it drains into streams, some evaporates, and the remainder moves downward into aquifers recharging them (Fig. 13). Groundwater moves through the hydrologic cycle as part of a dynamic flow system from recharge areas to discharge areas that flow into streams, lakes, wetlands, or the oceans. Streams that flow during periods of little rainfall are fed by groundwater.

Fig. 12. The bedrock surface in karst terrains is often highly fissured and permeable. In areas lacking soil, this surface can be directly viewed and is called karst pavement (Fig. 52).

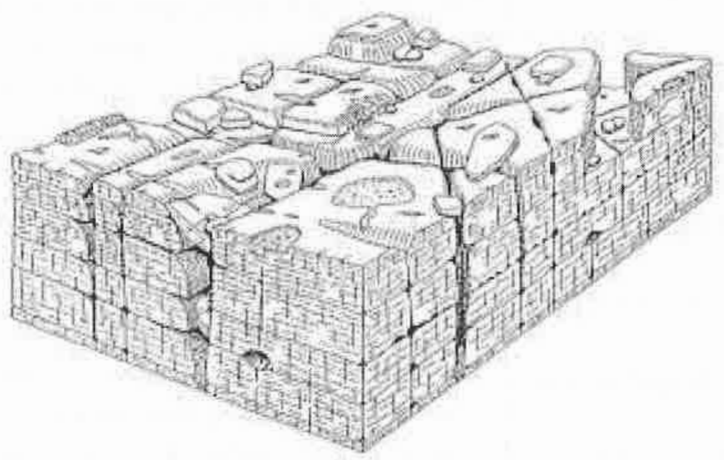
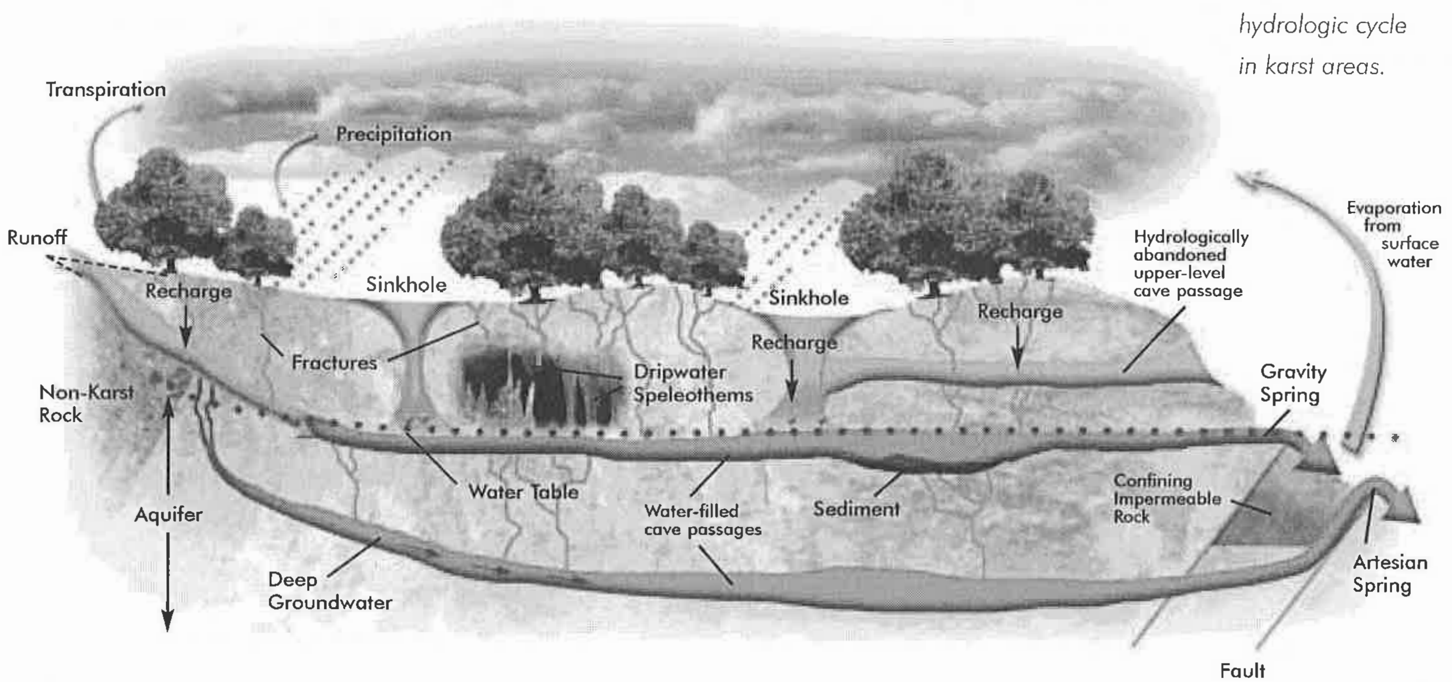


Fig. 13. The hydrologic cycle in karst areas.



Once sufficient permeability is established through the bedrock, water circulates freely from places of recharge to areas of discharge.

The Karst Aquifer

An aquifer is a zone within the ground that serves as a reservoir of water and that can transmit the water to springs or wells. Karst aquifers are unique because the water exists and flows within fractures or other openings that have been enlarged by natural dissolution processes. However, water flow in karst aquifers is commonly localized within conduits, with little or no flow in the adjacent rock. This situation means that successful wells must intersect one or more voids where the water is flowing. In a karst region, drilling for water may be a hit-or-miss endeavor; in contrast to drilling in porous media aquifers where flow conditions are more uniform and the probability of finding adequate water is higher.

Vadose and Phreatic Zones

The area between the surface of the land and the water table, which is called the vadose zone, contains air within the pore spaces or fractures. In the vadose zone, groundwater migrates downward from the surface to the phreatic zone, in which pore spaces are filled with water. The boundary between the vadose and phreatic zones is the water table (Fig. 14). The vertical position of the water table fluctuates in response to storms or seasonal changes in weather, being lower during dry times and higher during wetter periods. In non-karst aquifers, the vadose and phreatic zones are called the unsaturated and saturated zones. The use of those terms in regard to karst aquifers is not recommended, because chemical saturation of the water with dissolved minerals is a critical factor in aquifer flow and development.

Karst aquifers may contain perched water, which is groundwater that is temporarily pooled or flowing in the vadose zone. Although perched water generally occurs in relatively small volumes, it can provide water to wells and springs.

Groundwater Recharge and Discharge

The process of adding water to an aquifer is known as recharge. Where surface water enters an aquifer at specific spots, such as sinkholes and swallets, discrete recharge occurs. When water infiltrates into underlying bedrock through small fractures or granular material over a wide area, the recharge process is referred to as diffuse recharge. Where water comes to the surface at specific springs (Fig. 15) or wells, it is known as discrete discharge, but where water flows out of the ground over a larger area, such as a series of small springs or seeps, the discharge is diffuse. While recharge and discharge vary in magnitude in all aquifers, they vary the most in karst aquifers by allowing the greatest rates of water flow. Large springs tend to be most commonly reported. Thus, those states with the greatest number of recorded springs, including more than 3,000 each in Alabama, Kentucky, Missouri, Tennessee, Texas, Virginia, and West Virginia, also have significantly large karst areas.

Once sufficient permeability is established through the bedrock, water circulates freely from places of recharge to areas of discharge. In karst areas where the water table is near the surface, such as Florida's Suwannee River basin, declines in the water table can change springs into recharge sites, and rises in the water table can convert sinkholes into springs. Features that sometimes discharge water and other times recharge water are known as estavelles.

In areas where groundwater in karst flows through open conduits, the aquifers

Fig. 14. The surface of this cave stream marks the water table of this karst aquifer. The area above the water table is called the "vadose zone" and the area below, where all voids are filled with water, is the "phreatic zone."

respond very quickly to surface events such as storms and stream flooding. This response is typically many times greater and faster than would occur in non-karst aquifers. Therefore, interactions between surface and groundwater processes are greatly enhanced in karst.

It is important to know that even in the absence of surface streams, a karst region is a zone of drainage into the aquifer; the entire area can be a recharge zone. Surface water over the whole area, not just within sinkholes, carries sediment and pollutants into the subsurface. Removal of vegetation from surrounding areas through farming, forestry, or urbanization may significantly change drainage conditions leading to alteration of the aquifer by clogging of openings, ponding, and flooding, as well as contamination of groundwater resources. As the world's population grows and continues expanding onto karst areas, people are discovering the problems of living on karst. Potential problems and environmental concerns include sinkhole flooding, sinkhole collapse, and easily polluted groundwater supplies, where contaminants move rapidly to wells and springs. The following chapters discuss assets of karst as well as some of the challenging aspects of living in karst areas.

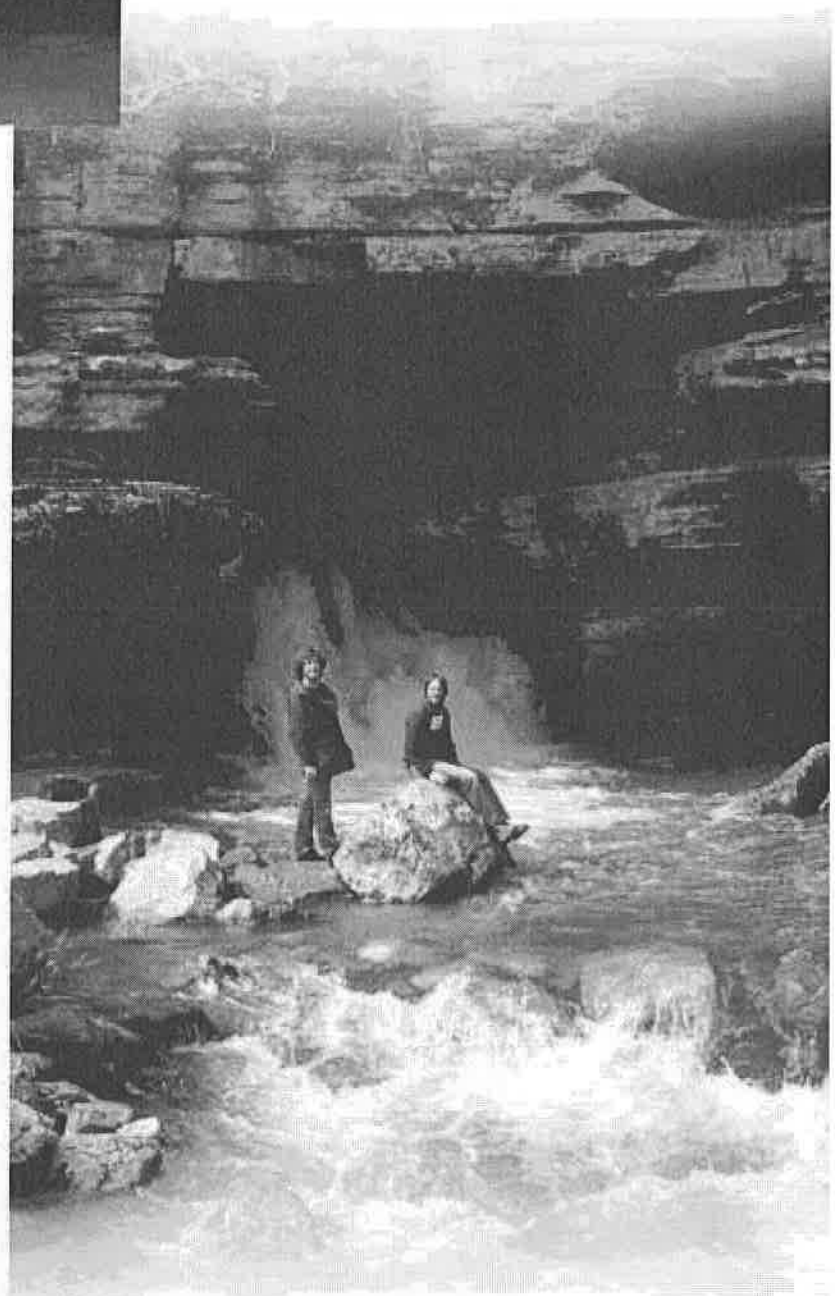
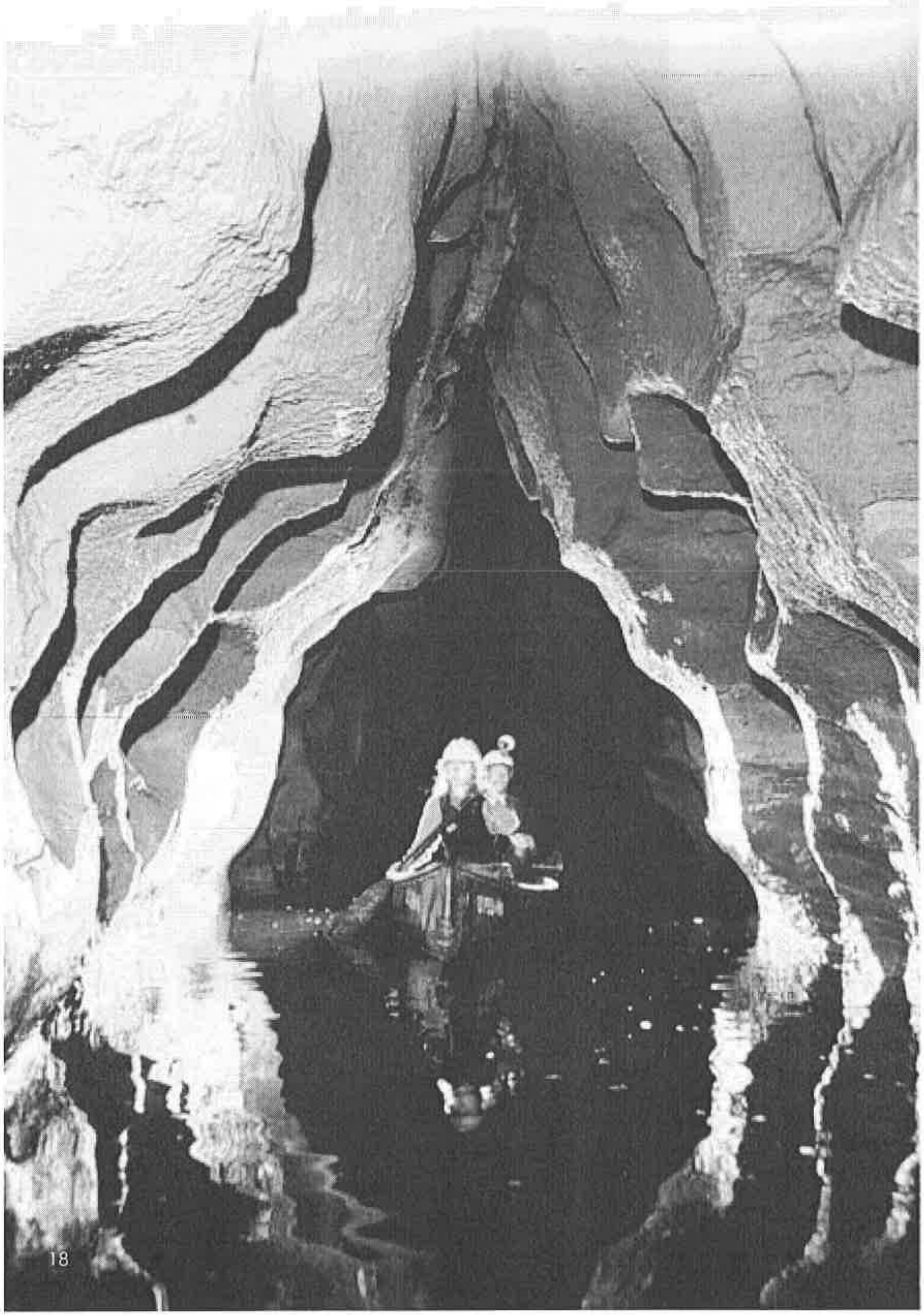


Fig. 15. Some springs rise from streambeds while others pour out of bedrock. Blanchard Springs Caverns, Arkansas.

3 WHY KARST AREAS ARE IMPORTANT



Karst areas are rich in water and mineral resources and they provide unique habitats and spectacular scenery.

Karst areas are among the most varied of Earth's landscapes with a wide array of surface and subsurface terrains and resources. Some of their features are unique to karst, and others tend be most abundant in karst regions. The following sections describe the most frequently used or encountered karst resources.

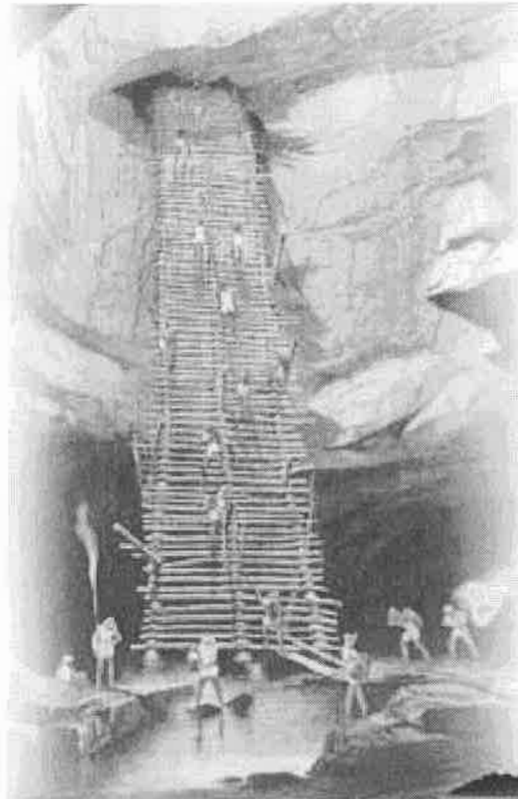


Fig. 16. Until recently, many Maya of Mexico and Central America would walk long distances each day to a nearby cave, then climb down inside to retrieve water, as shown in this 1844 drawing by Frederick Catherwood.

Water Resources

Without a doubt, water is the most commonly used resource in karst areas. Although the lack of surface water is commonly characteristic of karst areas, they also contain some of the largest water-producing wells and springs in the world. Until the development of well-drilling technologies, communities generally were located along the margins of karst areas, downstream from large springs that provided water for drinking, agriculture, and other uses.

Historical accounts describe the vital role of karst groundwater for communities as far back as pre-Biblical times in Europe and the Middle East. Assyrian King Salmanassar III recognized the importance of karst springs as early as 852 B.C., as recorded in the description of his study of the cave spring at the head of the Tigris River. For centuries throughout the world, water has been channeled from springs toward towns and fields, or collected from caves and sinkholes in vessels (Fig.16) or by hand or wind-powered pumps. These methods are still used in parts of the world where drilling technology is not affordable or practical.

Water-well drilling has allowed more people to move into karst areas. However, water yield from karst aquifers can range from zero to abundant, depending on the number of fractures and voids penetrated by a well bore and the amount of water they carry. The world's largest flowing artesian well intersected a cave passage in Texas' Edwards Aquifer estimated to be 8 ft (2.4 m) high, and tapped water under such pressure that it shot a 3-ft (1 m) diameter, 30 ft (9 m) high fountain into the air and flowed at a rate of 35,000 gallons/minute (2.2 cubic meters/second) (Fig. 17).

Fig. 17. Before it was capped, the record-setting "Catfish Farm Well" shot water 30 ft (9 m) into the air from the Edward Aquifer in Texas.

The cavernous nature of karst aquifers allows considerable volumes of water to be stored underground. This is especially valuable in arid climates where evaporation is high. In some parts of the world, cave streams are large enough to economically merit damming to store water for direct usage, mechanical water-wheel power, hydroelectric power, and to limit downstream flooding. The Floridan Aquifer in Florida yields over 250 million gallons/day (947,500 m^3/day) to wells, and Figeh Spring, in Syria, which is the 3rd largest spring in the world, on average discharges 63,200 gallons/minute (4.0 m^3/sec) and supplies the entire city of Damascus with water.

Fig. 19. Vats used in the 1800s to leach saltpeter for gunpowder. Mammoth Cave, Mammoth Cave National Park, KY.

Fig. 18. (Above) Ice speleothems are present year-round in this Swiss cave.

Fig. 20. (Right) Cinnabar and other hydrothermally deposited minerals in a cave intersected by a mine.

Earth History

Karst plays an important role in increasing our understanding of the history of past climates and environments on Earth. Sediments and speleothem or mineral deposits in caves are among the richest sources of paleoclimate information, providing detailed records of fluctuations in regional temperature, atmospheric gases, rainfall, ice ages, sea-level changes, and plants and animals that once inhabited the areas during the past several hundred thousand years.

Mineral Resources

Prehistoric peoples found shelter and mineral resources in caves. It is well-documented that they mined caves for flint (also known as chert) to make stone tools and for sulfate minerals and clays for medicines and paint pigment. In Europe, a soft speleothem known as moonmilk was used as a poultice, an antacid, to induce mother's milk, and to remedy other medical woes. Prior to refrigeration, cold caves were mined for ice (Fig. 18), and in the early 1800s, the beer brewing industry of St. Louis, Missouri, was based on the availability of caves as places of cold storage.

In the United States during the Revolutionary War, War of 1812, and Civil War, over 250 caves were mined for saltpeter, which was used in the production of gunpowder (Fig. 19). Like saltpeter, phosphate-rich bat guano deposits used to enrich agricultural soils are mined in caves. Bat guano was the most highly rated fertilizer of the 19th and early 20th centuries until it was supplanted by cheaper and more easily obtained chemical fertilizers.

The most common mineral resource extracted from karst areas is the quarried rock itself. Limestone, dolomite, marble, gypsum, travertine, and salt are all mined in large quantities throughout the world. Quarry operators prefer mining non-cavernous rock, but in many areas this is not available and many caves are lost. Unfortunately, sometimes the exotic mineral deposits called speleothems are also mined from caves, despite such collecting being an illegal activity in many states. The removal of speleothems results in the loss of thousands of years of information on Earth's history and the vandalism of beautiful natural landscapes.

Karst areas, including ancient or paleokarst, may contain large reserves of lead, zinc, aluminum, oil, natural gas, and other valuable commodities. Paleokarst is karst terrain that has been buried beneath younger sediments. Significant economic ore deposits accumulate in the large voids in paleokarst rocks, especially where mineral-bearing thermal or sulfide-rich solutions have modified the bedrock. In some areas, lead and zinc deposits are common, forming large economically valuable mineral deposits like those in Arkansas and Missouri (Fig. 20). Many oil and gas fields throughout the world tap highly porous and permeable paleokarst reservoirs where tremendous volumes of petroleum are naturally stored. Abundant deposits of aluminum occur in laterite soils composed of the insoluble residue derived from limestone that has been dissolved in humid climates.

Ecology

Many species of bats, including those that form some of the world's largest colonies, roost in caves (Fig. 21). Nectar feeding bats are important pollinators, and a number of economically and ecologically important plants might not survive without them. Insectivorous bats make up the largest known colonies of mammals in the world. Populations from some of these colonies may eat nearly a million pounds (454,000 kg) of insects per night, including moths, mosquitoes, beetles, and related agricultural pests. Fruit-eating bats eat ripe fruit on the branch, scatter the seeds, and thereby contribute to the propagation of trees. In Pacific islands, the regenreation of at least 40% of tree species are known to depend on bats, and in western Africa, bats carry 90-98% of the seeds that initiate reforestation of cleared lands.

Because caves lack sunlight, they create highly specialized ecosystems that have evolved for survival in low-energy and lightless environments. Troglobites are animals that are adapted to living their entire lives underground. They have no eyes, often lack pigment, and have elongated legs and antennae. Some have specialized organs that detect smell and movement to help them navigate in a totally dark environment and find food. Fish, salamanders, spiders, beetles, crabs, and many other animals have evolved such species (Fig. 22). Since cave habitats are

Fig. 21. Mexican free-tailed bats flying out from Bracken Cave, Texas, at night to feed. Each spring, about 20 million pregnant bats migrate to this maternity colony from Mexico. On average, each gives birth to one pup and by the fall the population swells to 40 million — the largest bat population and greatest known concentration of mammals in the world. During a typical night, they will eat roughly 1,000,000 pounds (454,000 kg) of insects, including many agricultural pests.

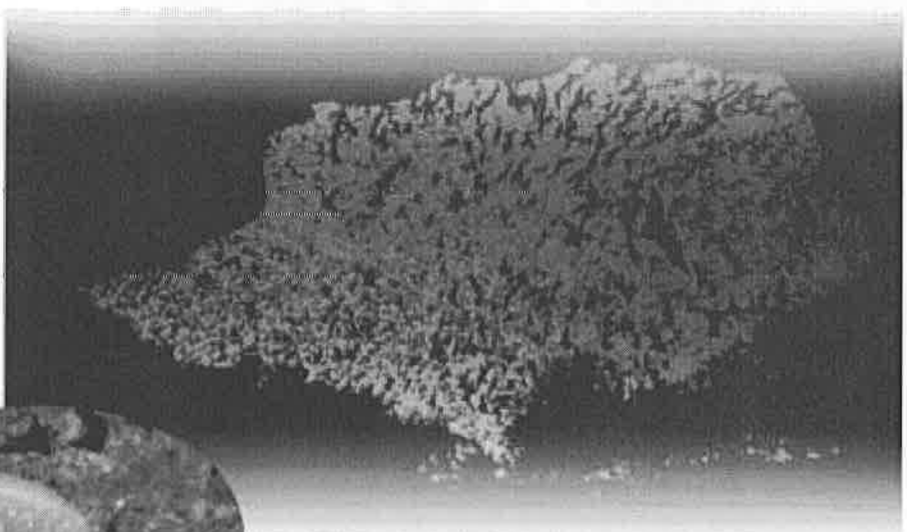


Fig. 22. (Left) These blind shrimp-like animals, which live in many karst aquifers, are an example of a troglobite species. These animals have adapted to their food-poor, lightless environment by loss of sight and lack of pigmentation.

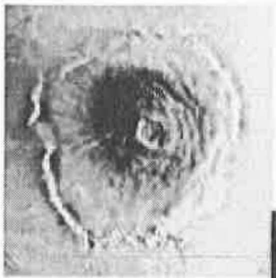


Fig. 23. (Left) The study of microbes in biologically extreme cave environments is teaching scientists how and where to search for life on Mars and other planets.

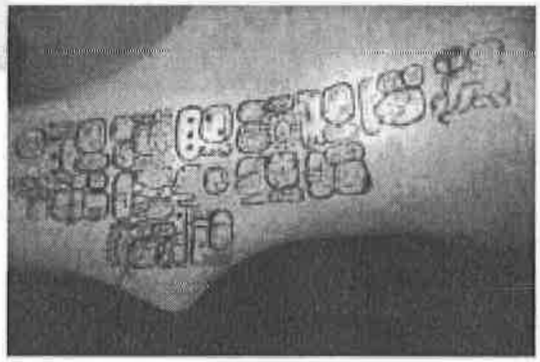


Fig. 24. (Right) Thirteen hundred year old Mayan hieroglyphic paintings preserved in a Guatemalan cave.

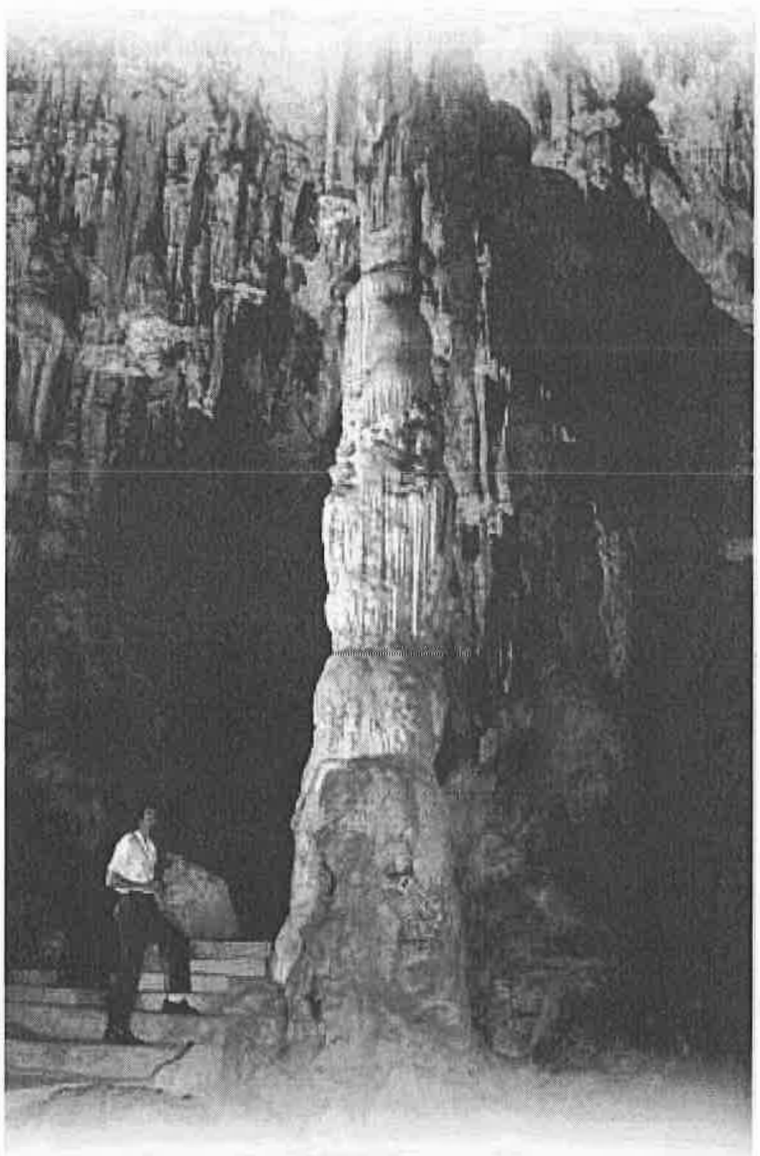


Fig. 25. A tourist enjoying the splendors of Bailong Dong (White Dragon Cave), a show cave in China.

far less complex than those on the surface, biologists study these animals for insights into evolution and ecosystem development. An extreme example of an isolated karst ecosystem is in Movile Cave, Romania. Geologic evidence indicates that the cave was blocked-off from the surface for an estimated 5 million years until a hand-dug well accidentally created an entrance in 1986. This cave has a distinct ecosystem based on sulfur bacteria that are the base of a food chain that supports 33 invertebrate species known only from that site.

Microbial organisms in caves have only recently been studied, but they are important contributors to biological and geological processes in karst environments. Microbes accelerate dissolution by increasing the rate of limestone erosion in some circumstances. In other cases, they may contribute to the deposition of speleothems. Changes in the number and types of certain bacteria are indicators that have been used to trace groundwater flow paths and to identify pollution sources. Several cave microbes are promising candidates for cancer medicines, and others may be useful for bioremediation of toxic wastes spilled into the environment. Certain sulfur-based microorganisms are being studied as possible analogs for life in outer space (Fig. 23).

Archaeology and Culture

From early times in human development, caves have served, first as shelters, and later, as resource reservoirs and religious sites. Many of the world's greatest archaeological sites have been found in caves, where fragile materials that would easily be destroyed in other settings have been preserved. Caves were reliable sources of water when other sources went dry, and minerals and clays were mined for both practical and ceremonial use. Generations of habitation resulted in deep accumulations of bones, ash, food scraps, burials, wastes, and other materials. The archaeological importance of caves stems not only from the volume of cultural material, but also from the degree of preservation. Fragile and ephemeral items such as footprints, woven items of clothing and delicate paintings are examples of these rare artifacts (Fig. 24).

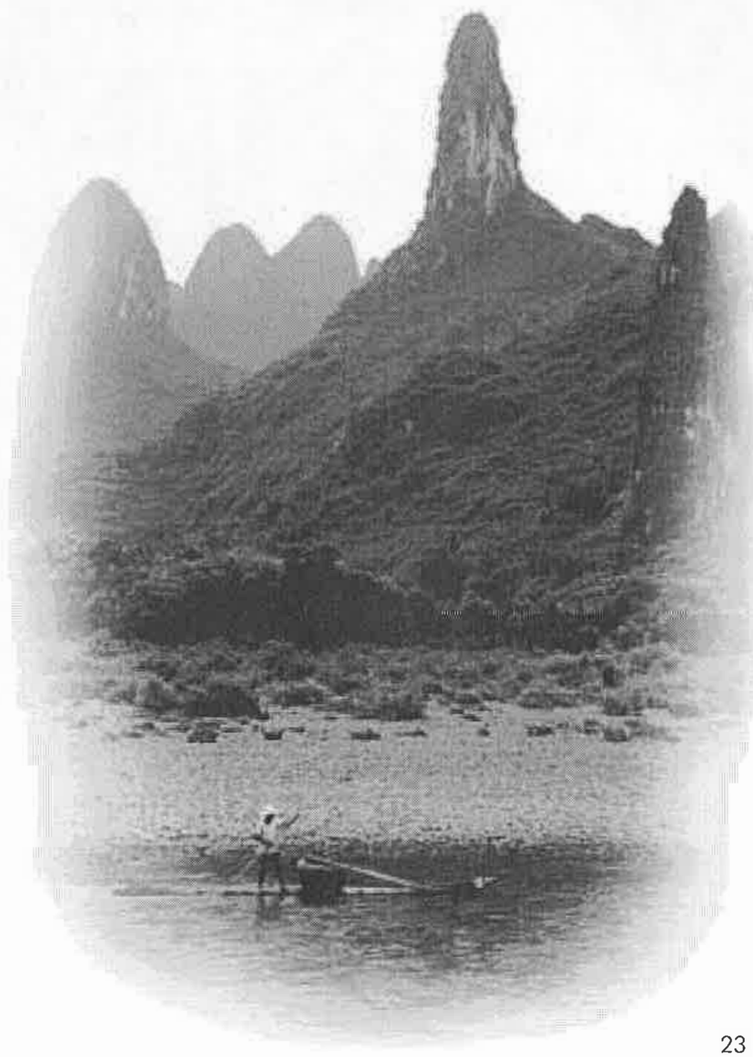
Recreation

Karst areas provide three main types of recreational settings: show or commercial caves, wild caves, and scenic areas. For many people, their only exposure to the karst environment occurs when they visit show caves. There, they can view delicate and grand mineral displays, vaulted chambers, hidden rivers, and other underground wonders (Fig. 25). Some of the world's most outstanding caves are open to the public in the United States. Mammoth Cave, Kentucky, is the world's longest cave with over 355 miles (572 km) mapped. Carlsbad Caverns, New Mexico, which like Mammoth Cave, is a U.S. national park, contains some of the world's largest rooms and passages. Caverns of Sonora, a privately owned cave in Texas, is internationally recognized as one of the world's most beautiful show caves.

"Wild" caves remain in their natural state, and they are located throughout the country on public and private land. For most people, a visit to a wild cave is a one-time adventure, but for thousands of "cavers" worldwide, it is a regular pastime. Caving is a sport that contributes to science, because many cavers create detailed maps as they explore and note features that may be of scientific importance.

The above-ground portions of karst areas form some of the most unusual landscapes in the world, epitomized by the impressive Tower Karst region of southeast China (Fig. 26). Other exceptionally scenic karst regions occur in, but are not limited to, Brazil, Croatia, Cuba, France, Malaysia, Slovenia, Thailand, the United States, and Vietnam. Recreational activities in scenic karst areas include car touring, boating, hiking, fishing, camping, swimming, backpacking, nature watching, photography, and, of course, exploring wild and show caves.

Fig. 26. The spectacular tower karst along the Li River in China.



4

ENVIRONMENTAL & ENGINEERING CONCERNS

Sinkhole collapse in Winter Park, Florida.

When karst landscapes are sites of urban development, their particular structural and hydrological characteristics must be understood. The occurrence of cavities in the rock and the soil requires special engineering considerations to provide stable foundations for the construction of roads and buildings. Because groundwater moves very rapidly in karst regions, pollutants can be spread long distances in a short period of time. Adequate supplies of drinking water may be difficult to locate and are at risk of contamination. Sinkhole collapse, drainage problems, and groundwater contamination are engineering and environmental concerns associated with development on karst terrains.

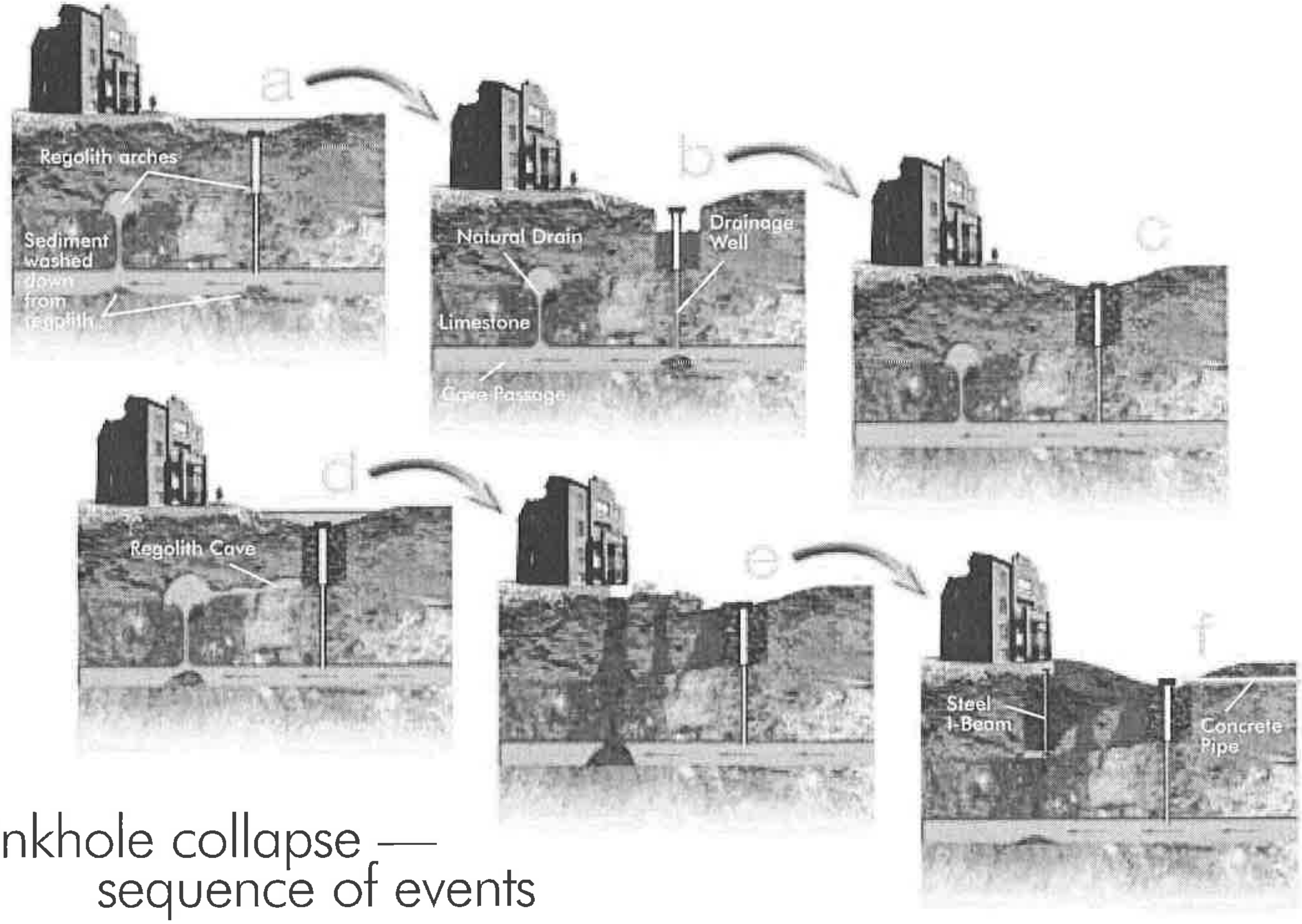
Sinkhole Collapse

Although collapse of cave passages within solid limestone bedrock is part of the normal process of landscape development in karst areas, it is a very rare event over human time scales. Most observed collapses occur in soils and sediments overlying the bedrock. In some karst areas, such sinkhole collapses reach spectacular proportions and cause considerable damage. For example, many catastrophic sinkhole collapses, such as the one on the opposite page have occurred within the relatively young, soil-covered karst of north-central Florida. This sinkhole developed in Winter Park, Florida, in 1981. Within a few days it had grown to over 330 ft (100 m) long by 300 ft (90 m) wide, swallowing cars, buildings, trees, a road, and part of a swimming pool.

Probably the most catastrophic sinkhole event in recorded history occurred in December 1962, in West Driefontein, South Africa. Twenty-nine lives were lost by the sudden disappearance of a building into a huge collapse that measured over 180 ft (55 m) across. This event, along with an additional 10 fatalities and a great deal of property damage from sinkhole collapse during the 1960s and 1970s, caused the government of South Africa to establish an intensive research program addressing the problems and mechanisms of sinkhole collapse. Collapses in the "dolomite land" areas of the country result from water entering the ground from failed water and sewer systems, poorly designed drainage, and ground vibrations. In one study in suburban Pretoria, it was determined that 96% of nearly 400 sinkholes were induced by human activities. Rapid lowering of the area's water table by dewatering deep gold mines caused a loss of buoyant support and resulted in especially large collapses.

Sinkhole collapses occur naturally; they also may be induced by human activities (Fig. 27). Natural sinkholes and induced sinkholes can generally be separated on the basis of physical characteristics, frequency and density of occurrence, and environmental setting. Induced sinkholes generally develop much faster than natural sinkholes, although all collapse sinkholes require some dissolution of the underlying bedrock.

Fig. 27. Catastrophic sinkhole collapses have occurred in karst areas around the world and have proven costly in both dollars and lives.



Sinkhole collapse — sequence of events

Fig. 28. (Above) ***(a)*** *In the layer of unconsolidated rock material, or regolith, arches form at a drainage well below a retention basin and at a natural drain under a building.* ***(b)*** *During a flood, collapse occurs at the drainage well.* ***(c)*** *The collapse is excavated to bedrock and filled with rocks (large at the bottom and smaller toward the top) to allow drainage into the well yet block sediment flow. In this example, that remediation is not adequate.* ***(d)*** *Water and sediment begin to flow to the natural drain, enlarging that regolith arch and forming a horizontal regolith cave.* ***(e)*** *Surface collapse occurs in three places due to collapse of the regolith arch over the natural drain and collapse of the regolith cave.* ***(f)*** *The collapses are excavated to bedrock under the building and a concrete slab poured over the natural drain in the bedrock. Steel I-beams are installed to support a new steel reinforced building foundation. The excavation is then filled with compacted soil, the retention basin is graded over, and a concrete pipe laid to direct storm-water runoff to a stream, storm sewer, or another retention basin.*

Fig. 30. Sinkhole collapse commonly results where the casings of drainage wells are not properly sealed to the bedrock.

Urbanization increases the risk of induced sinkhole collapse. The risk of collapse may increase because of 1) land-use changes, stream bed diversions, and impoundments that locally increase the downward movement of water into bedrock openings beneath the soil, and 2) greater frequency and magnitude of water-table fluctuations caused by urban groundwater withdrawal and injection.

Induced sinkhole collapses typically form by the collapse of the regolith, a general term for the layer of unconsolidated material near the surface of the land, including soil, sediment, and loose rocks (Fig. 28). Collapses are especially catastrophic when the soils and sediments are at least 20-30 ft (6-9 m) thick. These collapses result from soil washing into an underlying cave system, leaving voids in the unconsolidated material above the bedrock. In some cases, collapses occur as slow subsidence of the land surface over periods of weeks to years, rather than sudden collapses that occur over periods of minutes to days.

In areas where the water table is normally above the soil-bedrock contact, soil collapses occur when the water table drops below the soil zone, either during droughts or due to high pumping rates (Fig. 29). These collapses are caused by loss of buoyant support above the voids, or by upward propagation as saturated soil falls or washes downward. Eventually, the surface subsides gradually or abruptly collapses. Soil collapses also occur in situations where the water table is below the soil-bedrock contact. Construction and land-use changes that concentrate surface runoff in drains and impoundments will locally increase the downward movement of water. The rapidly moving water causes soil to be washed into holes in the bedrock, leaving voids behind. Increasing the load on these voids by construction or by accumulation of impounded water can initiate collapse. Collapses can also be caused by water leaking from drainage wells, pipelines, septic tanks, and drainage ditches (Fig. 30).

Although many sinkholes collapse with little or no advance warning, other collapses can be recognized by features at the land surface that indicate their development. Some of the more common features include

- Circular and linear cracks in soil, asphalt, and concrete paving and floors;
- Depressions in soil or pavement that commonly result in the ponding of water;
- Slumping, sagging, or tilting of trees, roads, rails, fences, pipes, poles, sign boards, and other vertical or horizontal structures;
- Downward movement of small-diameter vertical structures such as poles or posts;
- Fractures in foundations and walls, often accompanied by jammed doors and windows;
- Small conical holes that appear in the ground over a relatively short period of time;
- Sudden muddying of water in a well that has been producing clear water; or
- Sudden draining of a pond or creek.

Fig. 29. Water well drilling near this Florida home triggered a sinkhole collapse beneath both the drill rig and the house.

Drainage Problems

Most of the rain that falls in a karst area drains into the ground rather than flowing to a surface stream. Sinkholes may provide drains where water enters the underground flow system (Fig. 31). Cave entrances may also serve as drains. In many cases, the drains may be buried under the soil. In undisturbed karst areas, the capacity of a sinkhole drain is more or less in balance with the long-term climate and it can drain the water produced by most storms. Water backs up only during large storms when input exceeds outflow (Fig. 32).

Problems occur when the landscape is altered by urban development. Erosion is a common side effect of construction, transporting soil to the lowest part of the sinkhole where it clogs the drain. Thereafter, smaller, more frequent storms are capable of flooding the sinkhole. Impermeable ground covers such as roads, parking lots, and buildings increase the rate at which water collects and flows on the surface, flooding homes and businesses in the sinkhole (Fig. 33). Some flood-prone areas are miles from the nearest surface stream or flood-plain, and property owners may not realize that they are at risk until a flood occurs.

Fig. 31. A sinkhole plain, typical of many well developed karst land-scapes.

Storm-water drainage systems can be constructed to direct runoff away from urban centers. Where sinkholes are common, the shape of the landscape complicates construction of these systems. Storm-water sewers are expensive to build where soils are thin and simple gravity drainage isn't possible without extensive trenching and/or zig-zagging the sewers around sinkholes.

One moderately effective solution is the installation of storm-water drainage wells, sometimes called "drywells." The U.S. Environmental Protection Agency classifies these drainage wells as Class V, group 5 injection wells. They are constructed in sink-hole bottoms, ditches, and storm-water retention structures where water collects after heavy rains. Drainage wells may be constructed by drilling, or by placing a pipe into a hole made by a backhoe. At some locations, the effectiveness of a drainage well can be enhanced by modifications to cave entrances, sinkhole drains, and sinkhole collapses (Fig. 34). A drainage well will function as intended if it intersects at least one unclogged crevice of sufficient size to direct storm-water into the subsurface.

Unfortunately, water directed into drainage wells is similar to water flowing directly into caves and most sinkholes, because it bypasses natural filtration and goes directly into the aquifer (Fig. 35). Runoff water should be sent to drainage wells only after incorporating Best Management Practices (page 37) to reduce the introduction of refuse and contaminants into groundwater (Fig. 36). In some commercial and industrial areas, storm-water runoff may be diverted into

drainage

Fig. 33. (Left) A shopping center parking lot built in a Kentucky sinkhole floods parked cars.

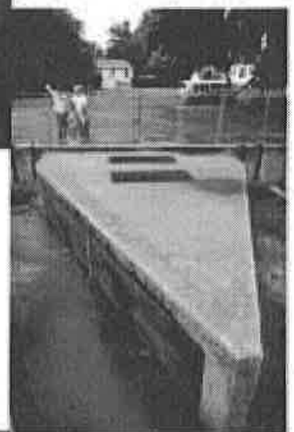


Fig. 34. (Left) This cave entrance has been modified to accept drainage and prevent clogging from debris to minimize flooding of an urban Kentucky neighborhood.

Fig. 35. (Below) Unfiltered storm-water runoff from an urban area floods into a normally dry cave entrance.

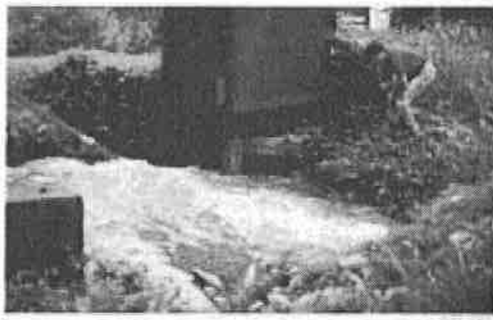


Fig. 32. (Below) A rural roadway covered by sinkhole floodwaters.

Fig. 36. (Below) This sinkhole has been modified to drain storm-water runoff. Two drainage wells have been drilled into the floor of the sinkhole. Rocks and hemispherical metal grates provide some filtration of sediments and organic debris.

Fig. 37. (Above) A large sinkhole collapse around a poorly installed drainage well.

*Fig. 38. (Below) During normal flow in a shallow karst aquifer, **(a)**, water is captured from sinkholes and fractures and moves downstream. A collapse in the cave passage restricts the flow, but not significantly. When flooding occurs, **(b)**, the collapse acts like a leaky dam, allowing the normal flow to pass but holding back most water, raising the water table to flood Sinkholes 2 and 3. Sinkhole 1 is above the water table, but holds water due to a constriction that prevents rapid flow down into the cave stream. When a drainage well is placed in Sinkhole 1 to breach the constriction and relieve sinkhole flooding, **(c)**, more water reaches the flooding cave system so the water table and flood levels in Sinkholes 2 and 3 rise even higher. At such times, buildings that would normally be above flood levels might get flooded. The same result occurs when Sinkhole 1 does not have a constriction, but receives more water as impervious material from urbanization covers the surrounding area.*

Drainage well-induced sinkhole flooding

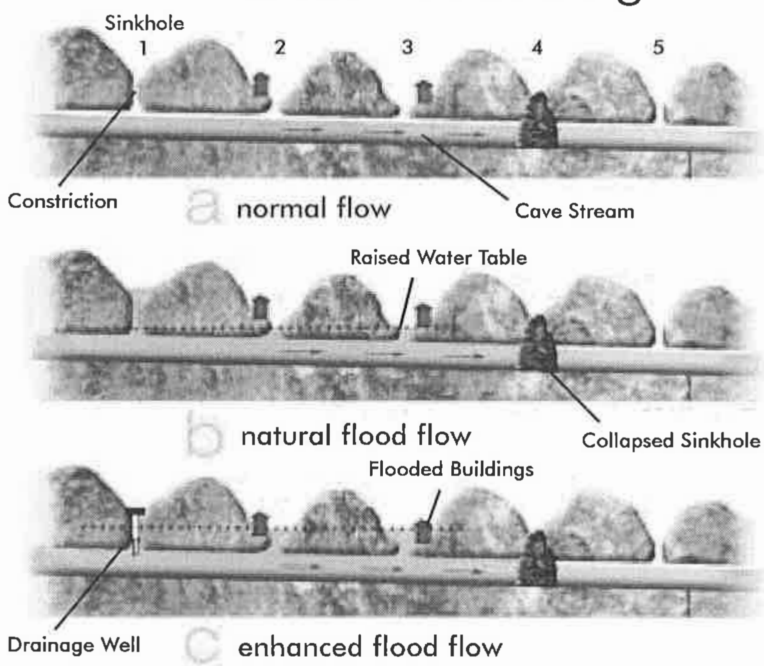


Fig. 39. Sewage, fuels, and other chemicals leave a black stain on the floor of this Kentucky cave stream.

sanitary sewers, or pretreated on site before being disposed into drainage wells. Even if good quality recharge can be maintained, the increased flooding could harm rare or endangered ecosystems within the aquifer.

Induced sinkhole collapse is a potentially severe problem associated with poor drainage well installation (Fig. 37). The casings of many old wells only extend through the soil and rest on uneven bedrock surfaces. This situation allows water to flow out from the gaps between the casings and bedrock to saturate the surrounding soil each time the well fills with water. When the water level drops below the gap, saturated soil flows into the well, leaving a void in the soil that expands upward to the surface. Extending and sealing the casings of wells into the bedrock can alleviate this problem.

Drainage wells, while meant to relieve sinkhole flooding, can cause other sinkholes to flood. Sinkholes can flood from the bottom, as water rises upward through the drain. When the capacity of the underground drainage system is exceeded, it causes any excess water in the ground to flow up into a sinkhole. This type of flooding is sometimes made worse by urban development in the headwaters of a karst drainage system and the injection of storm water into drainage wells (Fig. 38).

Groundwater Contamination

Urban and Industrial

Contamination is common in karst aquifers beneath urban areas with high population densities. Pollutants include septic tank effluent, runoff that contains metals, oil and grease, solid trash and wastes, and accidental or intentional dumping of chemical wastes by industrial facilities and homeowners. Karst aquifers in the United States have been

Fig. 41. Runoff into this sinkhole is polluted by livestock manure.

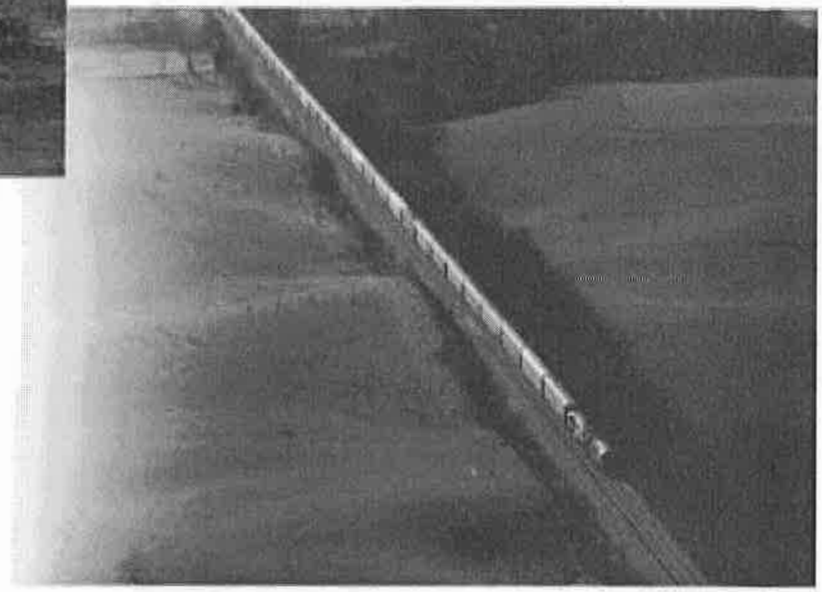


Fig. 40. A railroad runs through a sinkhole plain. Leaks and spills along transportation and pipeline corridors have introduced significant contaminants into karst aquifers.

contaminated by toxic metals, polychlorinated byphenols (PCBs), radioactive chemicals, organic solvents, and many other pollutants (Fig. 39). Although these contaminants are common in any developed area, it is the ease with which they can enter karst aquifers and the rapid rates at which they can be spread that makes karst groundwater especially vulnerable.

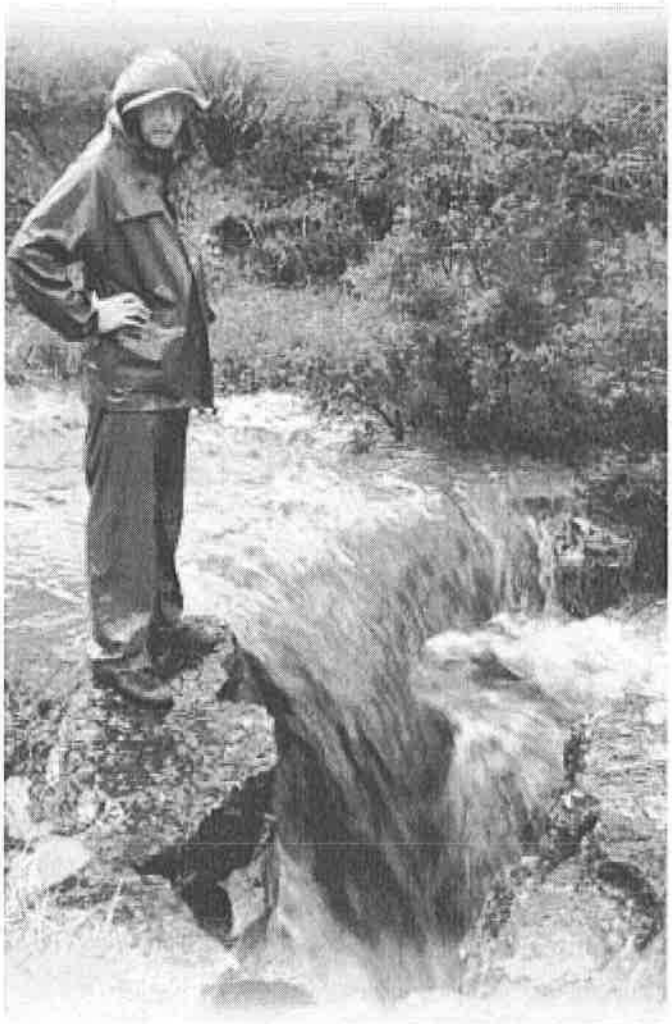
Accidental spills and intentional dumping of waste rapidly contaminate karst aquifers because chemicals travel easily through the soil and limestone bedrock. Spills along roads and railroads, leaking oil and gas wells, pipelines, and especially underground storage tanks have harmed many karst aquifers (Fig. 40). Gasoline has been the cause of some notable contamination problems in Hick's Cave, Kentucky, and Howard's Waterfall Cave in Georgia, where one person lost his life when the flame from a carbide miner's lamp ignited gasoline fumes. In the mid-1980s, the U.S. Environmental Protection Agency declared a "Health Advisory" for Bowling Green, Kentucky, when gasoline fumes from leaking underground storage tanks collected in the Lost River Cave System beneath the town. With time, the fumes rose into homes and schools where they posed serious health and safety problems. Eventually the source of the leak was cut off, and the underground river was able to flush the explosive material from the system.

In karst areas, landfills present special challenges. Throughout the world, landfills leak into karst aquifers and cause severe contamination problems with greater frequency, speed, and severity than in non-karst aquifers, even with modern pollution prevention methods. Part of the problem is the ease with which contaminants move through karst. Another important problem is how soils can wash into underlying voids below landfills, causing collapses that can breach liners meant to hold landfill waste in place.

Rural and Agricultural

In rural and agricultural areas, karst aquifers are subject to environmental degradation from a variety of sources including chemical fertilizers, pesticides, and herbicides, along with their breakdown products. Levels of these contaminants are high following seasonal application periods, and increase during storms. Elevated concentrations of pathogens can also be flushed through soils into aquifers beneath animal pastures and feedlots (Fig. 41). Bacterial concentrations within karst aquifers in these areas can increase thousands of times as a result of such flushing. Well and spring waters in karst are commonly contaminated, yet in rural areas there may not be an alternative water supply. Municipal water treatment and distribution facilities

Fig. 42. Soils eroded from a housing development run unfiltered into a karst aquifer.



are not available in sparsely populated karst landscapes, especially in developing areas of the world.

Another problem in karst regions is the transport of sediment into the aquifer by flowing water, making soil and other sediment washed from rural and urban land use and mining operations a significant contaminant (Fig. 42-43). Sediments can also impact the flow of groundwater by filling in conduits and modifying underground drainage. Programs to minimize soil loss are critically important for many karst areas. The impact of herbicides associated with no-till farming practices on groundwater quality should also be carefully evaluated.

A common practice in many rural landscapes is the dumping of household refuse, construction materials, and dead livestock into sinkholes. Karst aquifers have been found to contain automobile tires, car parts (Fig. 44), and in one underground river in Kentucky, a park bench and refrigerator. The amount of contamination that enters an aquifer is related to the volume and types of materials that are dumped into the sinkholes. Common harmful products include bacteria from dead animals; used motor oil and antifreeze; and "empty" herbicide, solvent, and paint containers (Fig. 45). These substances readily enter the aquifer and rapidly travel to nearby water wells and springs. Few people would throw a dead cow into a sinkhole if they realized that the water flowing over the carcass might be coming out of their kitchen faucet a few days later.

Fig. 43. Mining in and near karst aquifers poses threats of contamination from sediments and toxic metals, and destroys caves and any resources they contain.

Sewage Disposal

Ideally, a rigorously maintained sewage treatment system is best for communities located on karst, including suburban and rural subdivisions. This solution is not always financially or practically possible, especially when dealing with isolated rural home or farm sites where individual septic systems are the norm. Properly designed, constructed, and, most importantly, maintained small septic systems can and have been successfully installed on karst. However, this is commonly not the case. Most karst areas have thin, rocky soils that are inadequate to reduce bacteria levels effectively. Older systems may leak from years of use without repair, or be overloaded from initially poor design or later changes to the household. Owners of failing systems often state that they have had minimal or no problems even though they have provided no maintenance! These systems can contribute significant pollutants to the groundwater. The U.S. Environmental Protection Agency has noted that the failure of septic systems is a major source of karst groundwater pollution.

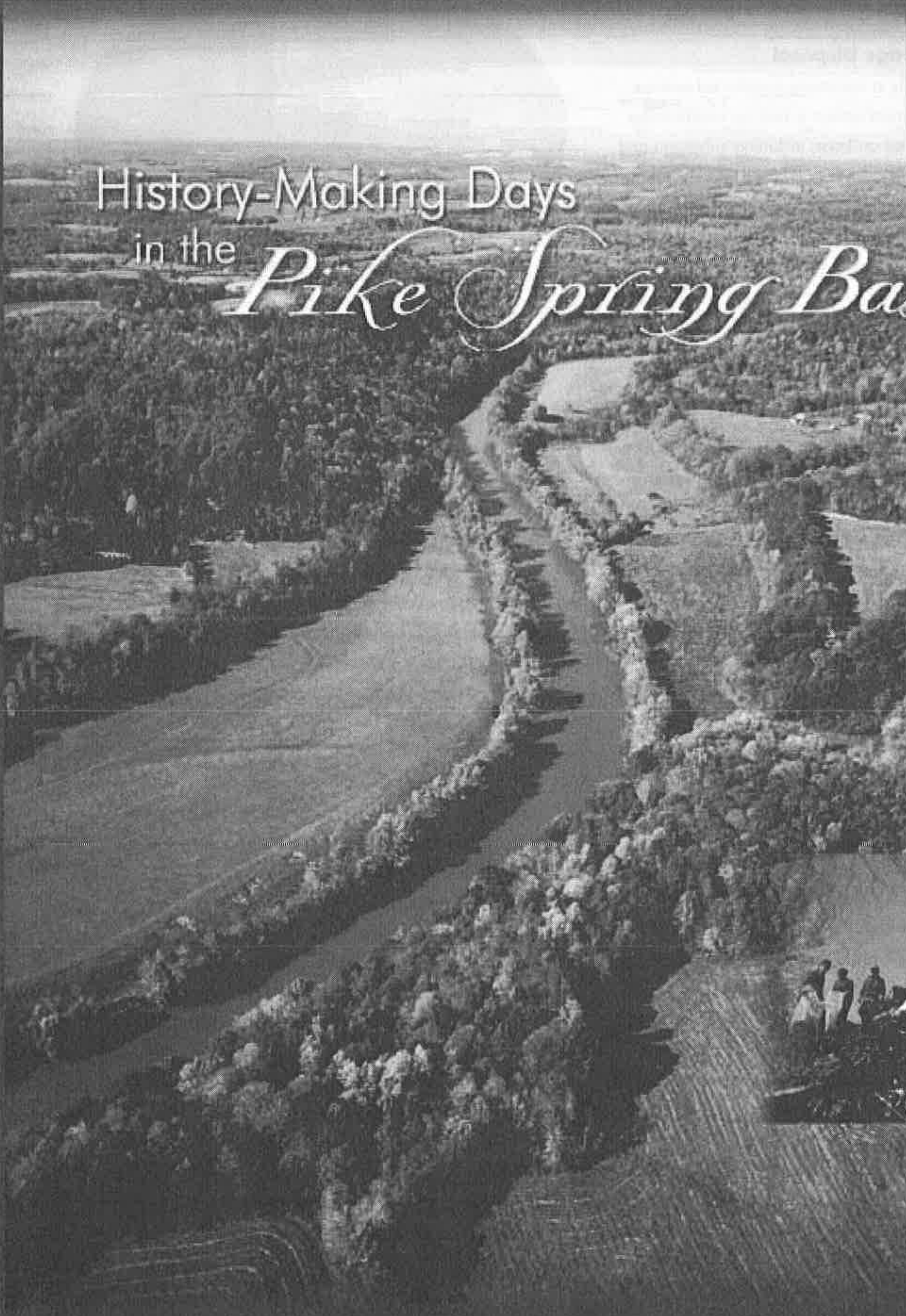
Residential sewage disposal systems generally consist of a septic tank designed and constructed to hold raw sewage, separate solids from liquids, digest organic matter through anaerobic bacterial action, and allow clarified effluent to discharge to a buried soil absorption system. After effluent leaves the septic tank, it flows through a series of buried perforated pipes and is discharged into the soil. Here, pathogens are removed by microbial plant and animal life, filtration, chemical decomposition, and bonding within the soil. Septic tank effluent must be fully purified before it passes to the water table and becomes drinkable water. In non-karst areas, effluent continues to be processed after it leaves the soil as it slowly flows through the small pores and fine cracks of the aquifer. The slow movement of the effluent provides time for pathogenic bacteria and other microbial organisms to die.

Fecal coliform bacteria are organisms that live in the intestines of humans and warm-blooded animals. They have a limited life span after leaving the body so that even one colony of these bacteria indicates that water has recently been in contact with human or animal waste. Bacteria levels in wells, cave streams, and springs in karst areas may increase by thousands of times during storms. These high levels are caused when runoff from fields and septic-tank leach fields rapidly percolates through thin soils and into the bedrock. In areas where soils are too thin to effectively reduce bacteria levels, associated shallow karst aquifers should be considered unsuitable water sources. Shallow aquifers can contaminate deeper aquifers by leakage along natural fractures and conduits and through poorly designed or maintained wells. Municipal water treatment facilities should be developed in urban, residential, business, and industrial areas. Significant advances in sewage and septic system technology have recently been made and should be examined for their potential use.

Fig. 44. This Texas cave was used was a rural dump and is filled with car parts and other trash.

Fig. 45. Household trash fills the sinkhole leading into a cave in West Virginia.

History-Making Days in the *Pike Spring Basin*



The landscape near Mammoth Cave National Park in central Kentucky is characterized by sinkholes, underground drainage via a karst aquifer, and intimately connected ecosystems above and below ground. A portion of the park lies within the Pike Spring Groundwater Basin, with groundwater and cave passages freely crossing the park boundary. Aquatic cave life in this basin includes blind fish, crayfish, and the largest known population of the Kentucky Cave Shrimp, which is on the federal Endangered Species List (Fig. 46). Mammoth Cave, with more than 355 mi (572 km) of charted passages, supports diverse ecosystems and is connected with and ultimately drained by the Green River (facing page).

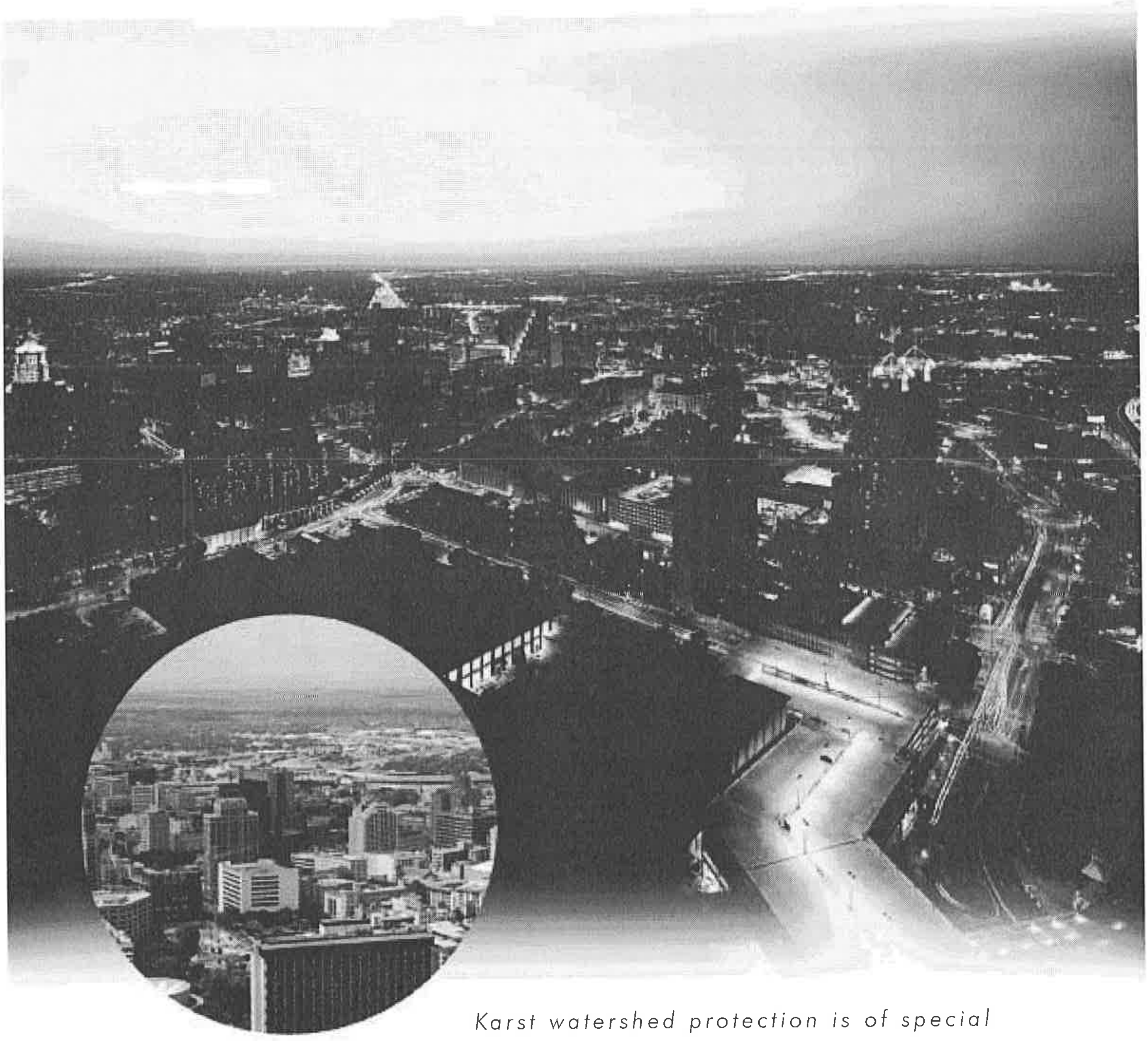
Over the past two centuries in this rural area, residents have dumped refuse into sinkholes on their properties. Until recently, trash pickup and sanitary landfills were unavailable, and sinkholes were seen as convenient dump sites. This misplaced waste has washed into the underlying caves over time, and trash has been reported by survey teams near the park under Hamilton Valley in the Salts Cave section of Mammoth Cave.

In an effort to mitigate the environmental hazards of trash-filled sinkholes, a volunteer cooperative project called *Don't Mess With Mammoth Days* was organized in the mid-1990s. The Cave Research Foundation, Mammoth Cave National Park, and Hart County Solid Waste have been the primary organizers, with crucial assistance from the National Speleological Society, and the American Cave Conservation Association.

On the first field day, which was held in March 1996, more than 30 volunteers removed tangles of wire, sheet metal, broken glass, appliances, and automobile parts that had been discarded in sinkholes (Fig. 47). Seven truckloads of rubbish and recyclable metal were removed, and remedial work was performed on gullies to stop erosion. Subsequently, participation in *Don't Mess With Mammoth Days* events has varied from 25 to 45 volunteers, with similar impressive outcomes. To date, approximately 150 tons of rubbish, and 30 tons of recyclable metals have been recovered from dumps within the Pike Spring Basin. Although much of this waste is non-toxic, many agricultural chemical containers with residual product have been recovered as well. Ecologically, sinkholes funnel food into caves, and when they are clogged with trash, the organic matter needed by wildlife such as the Kentucky Cave Shrimp cannot get into the caves.

How long will it take to clean up Pike Spring Basin? Nobody knows. We need to learn how many dumps exist, and how many landowners within the basin would welcome the clean-up effort. Changing the way people dispose of solid waste will take time, because proper disposal of trash also costs money. Dumping trash into sinkholes may not cost money today, but the costs in terms of groundwater pollution, loss of ecosystems, and risks to public health are far greater. Cooperative efforts like *Don't Mess With Mammoth Days* provide a much-needed service, help clean up the environment, and educate by example. In the long term, education is the best tool for cleaning up and maintaining karst environments.

5 GUIDELINES FOR LIVING WITH KARST



Karst watershed protection is of special concern to residents of San Antonio, Texas.

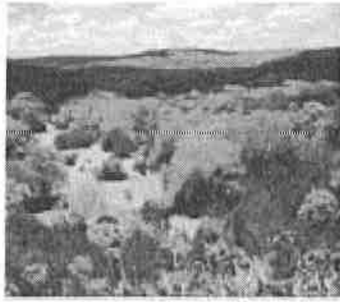


*Fig. 48.
As San Antonio, Texas, grows, it is purchasing and preserving undeveloped sensitive karst areas to protect its groundwater supply.*

The proper management of a groundwater basin is more important on karst than any other terrain. Management planning must consider all of the natural resources found within the basin, as well as interactions with adjacent areas. In this way, the quality of land, water, and subterranean environments and resources will be maintained.

The following guidelines provide a template for avoiding and solving problems encountered by people who live in karst environments.

Best Management Practices

The goal of Best Management Practices (BMPs) is to conserve natural resources, including prevention of soil erosion and minimizing the amount of contaminants that reach the groundwater system. BMPs cover a wide range of topics such as irrigation water recovery, land reclamation, nutrient management, and the sealing of abandoned wells. Many BMPs are mandated by federal, state, county and other regulatory agencies, but not all are specific to karst and thus may not adequately address karst issues. In some karst areas, best management will require exceeding the mandated BMPs with more effective actions.

Urban, Industrial, and Road Development

Industrial and urban developments commonly produce a greater variety and toxicity of contaminants than do rural areas. Communities located along the margins of karst areas should limit development in karst and encourage development in other directions. Some cities near karst regions have gone as far as purchasing aquifer areas for permanent protection. In May 2000, the citizens of San Antonio, Texas, voted for a 1/8 cent sales tax increase to raise $65 million over four years for the purchase of critical portions of the Edwards Aquifer as well as other important watershed and biological areas (Fig. 48). Where communities are located within extensive karst areas and prohibition of development in karst is not feasible, regulations may be needed to satisfactorily protect karst resources, particularly as related to the location of landfills, underground storage tanks, oil and gas wells and pipelines, and facilities that manufacture and/or store hazardous materials.

Protection of stream watersheds is vital to protecting biological and water quality. Studies examining the relationship of stream water quality to impervious cover, such as roads, buildings, and parking lots, show increased degradation when impervious cover exceeds 15% of the watershed area. Since the extent of impervious cover is a measure of urban impact that can be correlated to pollutant-load levels in urban runoff, aquifer water-quality ordinances in Austin and San Antonio, Texas, require that the percentage of impervious cover be kept low in growing urban areas. Other land-management measures that can help protect watersheds include

- Identifying and studying highly vulnerable karst features, such as caves, sinkholes,

Fig. 49. A road being built over and sealing a cave runs the risk of collapse and problems with water quality and quantity.

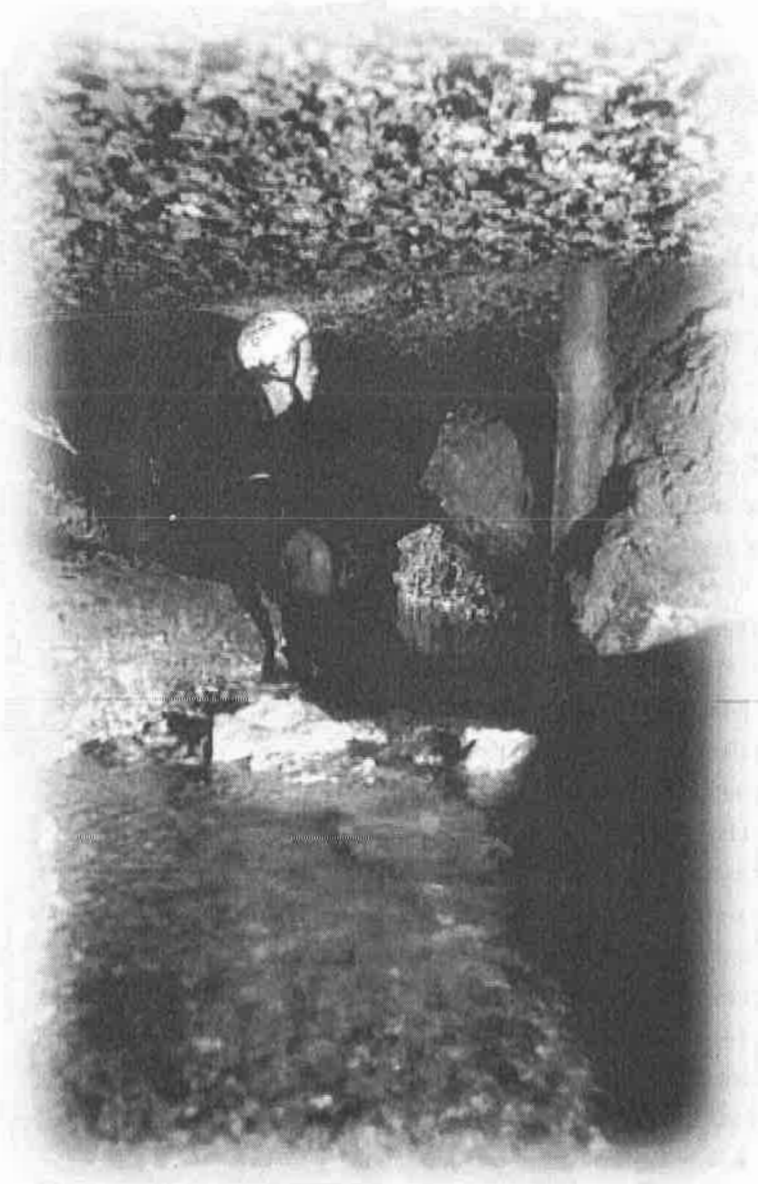


Fig. 50. Possible contaminants at higher elevations cannot directly reach the well because of the casing, but the well draws water from a cave stream that is exceptionally vulnerable to contamination.

and fractures enlarged by solution, prior to development. Construction may then be planned to avoid the features and preserve natural drainage into them (Fig. 49). These areas could be developed into educational neighborhood parks that increase the value of adjoining land and of the overall developments. It is important to remember that protection of these features alone will not protect karst aquifers.

- Leaving low traffic roads without curbs so that contaminants in the runoff will be diluted over broad areas and filtered through vegetated areas and soils.
- Channeling curbed runoff from major roads into storm-water sedimentation and filtration basins with hazardous materials traps. Vegetated wetland basins are the most effective at removing contaminants from the water. For such basins to be effective, they must be properly maintained and the filter material changed regularly. Runoff that may enter caves or sinkholes should either be diverted or treated through filtration systems. In 1993, the Indiana Department of Transportation established landmark guidelines for the planning, design, construction, and maintenance of roads in karst areas.
- Minimizing the use of pesticides, fertilizers, and de-icing salts on roads and urban landscapes on karst. Plants native to the area and tolerant to local pests, diseases, and climatic conditions can be grown to reduce the need for chemical support and treatment.
- Monitoring the groundwater quality of springs and wells to determine the effectiveness of the groundwater protection measures enacted. Wells are important to a monitoring plan, but not nearly as important as nearby springs that drain the area. Contaminants in karst aquifers can easily

flow past and be missed by monitoring wells, giving a false sense of security. Springs, however, capture essentially all flow (and contaminants) within their drainage basins. Sampling during high flows after storms is a good time to determine if significant levels of contaminants are present in the aquifer.

Water Supplies

Wells

As a general rule, wells should be placed where there is little or no surface drainage toward the well site. They should be located away from, and at a higher elevation than, any nearby source of contamination. Wells should be constructed to prevent contaminated water from the surface or upper level aquifers from leaking into the drinking-water aquifer. Where necessary, casing should be installed through any contaminated zone and into the productive aquifer to protect the drinking water supply from contamination. The spacing between the casing in a well and the wall of the borehole should be cemented to prevent leakage and downward migration of contaminated water (Fig. 50).

Wells should be tested for coliform bacteria and nitrates at least once a year, more often in areas of thin soil cover, and especially following storms when bacteria are most likely to be washed into the aquifer. County extension agents, community and county health agencies, water well contractors or private laboratories can provide information and assistance for well testing.

When a well is no longer used it should be disconnected from existing water systems, kept clean and, if possible, its casing should be removed. The well bore should be sealed with clean rock and a sand-cement grout to produce a continuous plug from the bottom of the well to the surface. When all abandonment procedures are complete, the well should be permanently capped. These actions are designed to prevent surface water from migrating down the well bore and polluting the aquifer.

Water well requirements vary from state to state, so it is necessary to check with the regulatory agency in your area for minimum setback distances for wellhead protection and other regulations. As an example, Minnesota requires that

- Wells must be located at least 75 ft (23 m) from cesspools, leaching pits, and dry wells, and 100 ft (30 m) or more from below-ground manure storage areas (i.e., manure lagoons), and large petroleum tanks which are protected with a containment dike, etc. They must be a minimum 150 ft (46 m) from a chemical preparation or storage area, large unprotected petroleum tanks, wastewater treatment pond or wastewater treatment plant, and they must be at least 50 ft (15 m) from septic tanks, subsurface sewage disposal fields, graves, livestock yards and buildings, and manure storage piles.
- Wells with casings less than 50 ft (15 m) deep and penetrating less than 10 ft (3 m) of clay or shale must be at least 150 ft (46 m) from cesspools, leaching pits, and dry wells, and at least 100 ft (30 m) from a subsurface sewage disposal field or manure storage pile.

Regulators and well owners must understand that although such guidelines are helpful, commonly, they are not written for karst areas. General guidelines cannot assure protection from contamination given how easily pollutants can flow long distances through

Fig. 51. Water flowed abundantly and forcefully from the first wells drilled into Texas' Edwards Aquifer in 1897. Now, with large water withdrawals from the aquifer, water discharge is restricted.

karst aquifers. Where greater assurance against pollution is needed, a detailed, site-specific hydrogeologic study, possibly to include a dye tracing test, pumping test, and test drilling may be necessary.

Groundwater Mining

While water quality issues receive most attention in the management of karst aquifers, water quantity can pose equally significant problems in arid and semi-arid climates. The large and open conduits that make karst aquifers so prone to contamination also allow massive volumes of water to be pumped out by wells (Fig. 51). If average water withdrawal exceeds the average recharge of the aquifer, the groundwater is being mined, meaning it is removed without being fully replenished. Long-term continuation of such practices is not sustainable. Springs will run dry, as will wells. Some wells can be deepened, with increased energy costs of raising water greater distances to the surface. Taken to the extreme, the aquifer would no longer yield useful quantities of water and would be abandoned.

Several methods can be used to prevent groundwater mining

- Develop a groundwater budget for the aquifer to determine its sustainable yield.
- Monitor major spring flows as rough estimates of balanced water use; extended periods or low or no flow may indicate overuse of the aquifer.
- Apply water conservation and water reuse measures.
- Consider enhancing recharge into the aquifer through dams and diversion of uncontaminated surface water into sinkholes; enhanced recharge will tend to quickly flow out of the aquifer and should only be considered for karst aquifers with high storage and relatively low velocities.
- Develop limits for the amount of water that can be withdrawn from the aquifer. Set the limits so that the water used, whether discharged from wells or springs, does not exceed average aquifer recharge. To meet these limits may require limiting community growth within the aquifer's region. Florida has developed legislation and regulations that require strict adherence to defining the impact of groundwater withdrawals on surface water, shallow aquifers, and the Floridan Aquifer. The regulations require the development of a "regional impact statement" and an application for a "consumptive use permit" based upon detailed surface water and groundwater studies.

Septic and Sewage Systems

Standard septic systems should not be placed near sinkholes, caves, springs, fractured bedrock, crevices, bedding planes, or areas of thin soil cover. There should be a minimum of 3 ft (0.9 m) of aerated soil (i.e., soils that show no mottling) below the bottom of drain field trenches. Less than that amount could result in pathogens reaching the groundwater system (Fig. 52). Soils underlying these septic systems should have percolation rates between 1 and 60 minutes/inch (0.4 to 24 minutes/cm). If the minimum parameters cannot be met, a mound system is the next preference. Other possible systems would include a designed active wetland or other experimental system with frequent groundwater monitoring results to check water treatment efficacy.

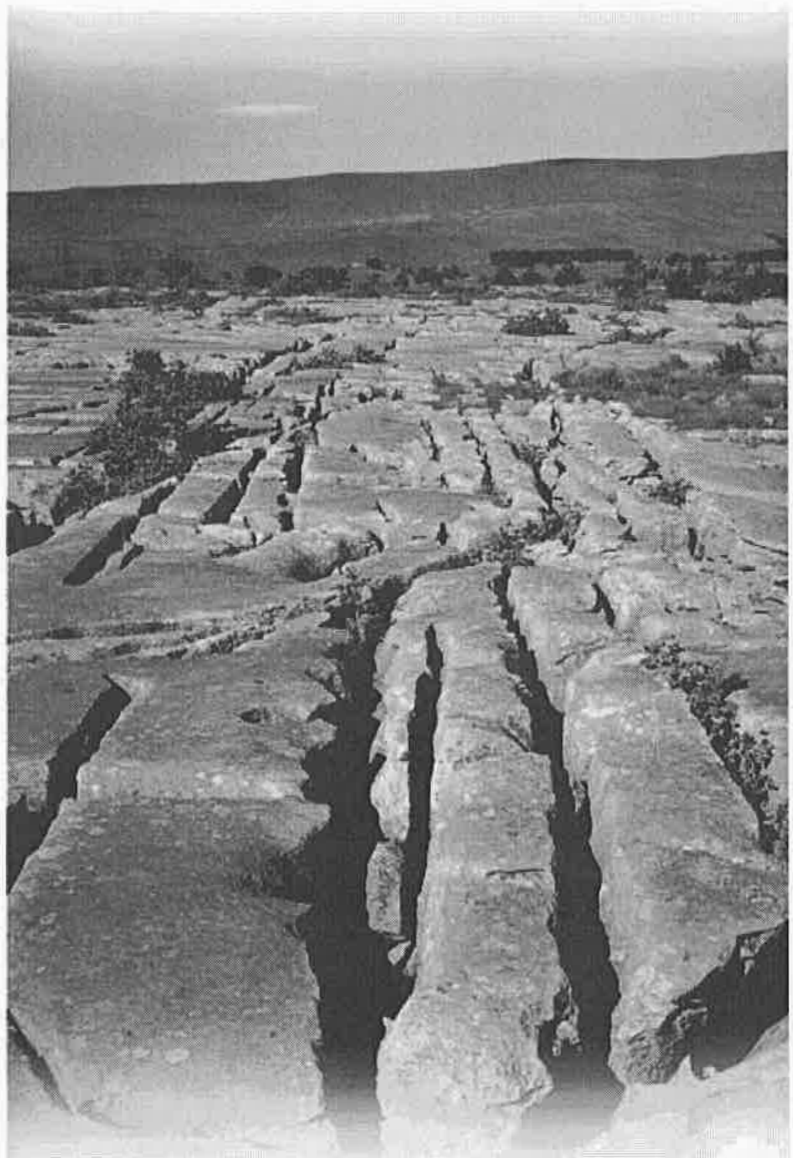
Continued maintenance is critical to the proper performance of a septic system. Maintenance is probably the most ignored BMP of operating a home septic system. Unfortunately, if the drainage does not back-up into the house it is assumed that the system is operating properly. The holding tank needs to be pumped at regular intervals (depending on the size of the tank and the number of people served) or sewage will clog the system, and untreated waste may discharge into the karst. This can happen without noticeable effects in the house. If the septic tank has not been pumped for several years and the system appears to be operating properly, suspect a leak from the tank into the karst aquifer.

Good septic-system operating practices include

- Having the system inspected regularly and pumped annually if possible, but at least every three years.

(continued on page 44)

Fig. 52. Establishing non-polluting septic systems is difficult in karst due to thin or absent soils, such as this karst pavement in Great Britain, or soils underlain by such highly dissolved limestone that promote soil collapses and rapid movement of contaminants into aquifers.



Hidden River Cave

Back from the Brink

The largest spring in Kentucky is fed by water flowing through Hidden River Cave, and the best-known entrance to the cave is located in the city of Horse Cave (Fig. 53). Beginning in 1887 the cave served as an important water supply and attraction for the city. Tours and boat rides were offered in the cave for 27 years. However, in 1931 an oil refinery began dumping its wastes into a sinkhole that drained into the cave stream. About the same time, residential sewage began to be disposed directly into the ground. By the early 1930s, the cave was abandoned as a water supply and in 1943 the cave was closed to the public due to the stench that rose from its waters out of the entrance and up to the city streets.

Eventually, water from a spring 20 miles (32 km) away was tapped for the community, and a sewage treatment plant was built in 1964. Unfortunately, the treatment plant increased pollution of the aquifer, by gathering all of the city's wastes, providing only a low level of treatment, and discharging the treated wastes into a sinkhole. Toxic heavy metals escaped treatment at the plant, and increased agricultural and urban runoff bypassed the plant and flowed directly into the cave.

In 1989, a new regional waste-water plant was built that treated the effluent to a higher standard and discharged the treated water into the Green River and away from the karst. As a result, the aquifer is slowly recovering; rare species thought lost have begun to repopulate the cave from refuges in small, unpolluted areas. Hidden River Cave is again open to the public, and it now houses the American Cave and Karst Center and Museum. Hidden River Cave is a model that shows both how severe sewage and general groundwater contamination problems can become in karst terrains, and the methods to solve those problems.

- Avoid putting excess water through the system;
- Repairing or replacing malfunctioning systems quickly;
- Never pumping out of an inspection riser. (Report any contractor who pumps from an inspection port to the state licensing or health board);
- Putting only sewage into the system. Do not put hazardous material in the system and never put any chemical down your drain that you would not drink (e.g., paints, thinners, solvents, oils, etc.);
- Protecting the land over the septic tank and leach field. Do not build over it. Do not allow any vehicles, including garden tractors, snowmobiles, all-terrain vehicles, etc., to drive across it. Plant lawn or native grasses and other ground covers to reduce soil erosion;
- Avoiding septic tank additives. Additives can destroy the biomat, which is formed by bacteria that naturally treat and purify the wastewater; and
- Using a reputable, licensed, and bonded septic-system contractor. If your state does not license such contractors, compare the education and apprenticeship credentials among different contractors, and request information from a county extension agent or a community or county health agency, on county- and state-level septic pumping standards. At a minimum, choose a contractor who is bonded.

Fig. 54. Some sinkhole ponds in Bowling Green, Kentucky, are used in innovative ways to capture and treat urban runoff for non-potable uses.

Sewage systems can be effective at minimizing impacts to karst aquifers if they are properly built and maintained. If not, their large flows of effluent can easily pollute major sections of aquifers. Sewer lines should be inspected regularly. In areas where sinkhole collapse is common, annual inspections and/or closely-spaced flow meters are needed to detect loss of effluent; double-walled pipelines with leak detectors in the outer pipe may be warranted in some cases. Wherever possible, sewage treatment facilities should be located off karst areas. If the treated wastewater cannot be released away from the karst, it should be treated to as near drinking-water quality standards as possible before release, especially if the aquifer is used as a potable water supply.

Sinkhole Flooding and Collapse

An effective way of dealing with sinkhole flooding in the hard-rock karst areas of the mid-continental U.S. is by building storm water retention basins. These are constructed depressions where runoff from streets, parking lots and other impermeable areas is stored until it can slowly drain through the soil. Retention basins alleviate local flooding problems and provide a means of filtering storm water through the soil, thus protecting the karst system from silt, trash, and some pollutants. Basins designed and maintained to filter sediments and pollutants are known as sedimentation and filtration basins.

Bowling Green, Kentucky, a city of over 50,000 residents, is built almost entirely on a sinkhole plain (Fig. 54). Building codes there require flood easements below a line 12 inches (30 cm) above the standing water level produced by a 100-year storm of 3 hours duration where there is effectively no drainage through a sinkhole. The area below this line has been defined as a "sinkhole flood plain." Storm-water retention basins are required to accommodate drainage produced by changes in land-use accompanying development. Although the city has been successful in reducing flood losses, the numerous storm water retention basins have taken valuable urban land out of production and are expensive for developers to build and maintain. Land uses that affect the hydrologic system, such as filling of sinkholes with debris, are illegal in some areas.

Sinkhole Collapse

The most important tool in preventing and repairing sinkhole collapse is site-specific knowledge of the karst system, as well as an understanding of how karst processes affect engineered structures through time (Fig. 55). Sinkhole collapse is difficult to predict even in well-studied karst regions. Dangerous areas such as the floors of large karst valleys may be easily recognized, but buried sinkholes and fracture trends are harder to detect. When combined with large withdrawal of groundwater and a dropping water table, these areas have the greatest potential for collapse. The seemingly random nature of collapse events dictates that a special knowledge of karst is needed to guide urban and suburban development in these areas.

A variety of approaches can help avoid sinkhole collapse problems associated with urban development of karst areas.

- Karst areas should be mapped thoroughly to help identify buried sinkholes and fracture trends. Geophysical methods, aerial photography, and digitally enhanced multi-spectral scanning can identify hidden soil drainage patterns, stressed vegetation, and moisture anomalies in soils over sinkholes.
- Sinkhole collapses are commonly "repaired" by dumping any available material into the hole. This technique usually diverts water to other locations and promotes collapse. Mitigate by excavating collapses to the bedrock drain, then refilling the dug hole with material graded upward from coarse rocks to finer sediments to allow natural flow through the bedrock drain without the loss of sediments that cause collapse. If a storm-water drainage well is needed, its casing should extend into and be tightly sealed along the bedrock.
- In large sinkholes, use bridges, pilings, pads of rock, concrete, special textiles, paved ditches, curbs, grouting, flumes, overflow channels, or a combination of methods to provide support for roads and other structures.
- Large buildings should not be built above domes in caves. In areas where caves have collapsed in the past, a test-drilling program is needed prior to construction to avoid building on unstable bedrock.
- In less severe cases and in rural areas, place fences around sinkholes to keep animals out and discourage dumping. Construct berms to divert polluted runoff, and establish natural vegetation buffer zones to help filter pollutants and sediment.

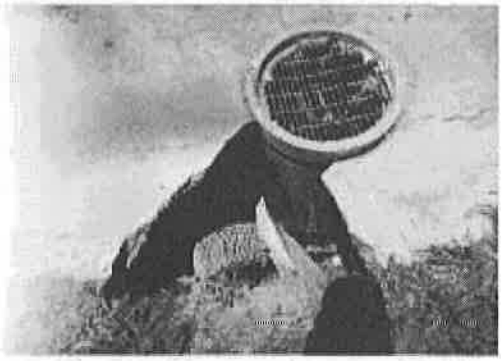


Fig. 55. A small sinkhole collapse has formed around a poorly installed drainage well.

Fig. 56. Animal wastes are stored on a concrete pad until they can be applied onto fields when plants will most readily take up nutrients, breakdown bacteria, and reduce the contaminants washed down into the aquifer. This process also saves farmers money on commercial fertilizers.

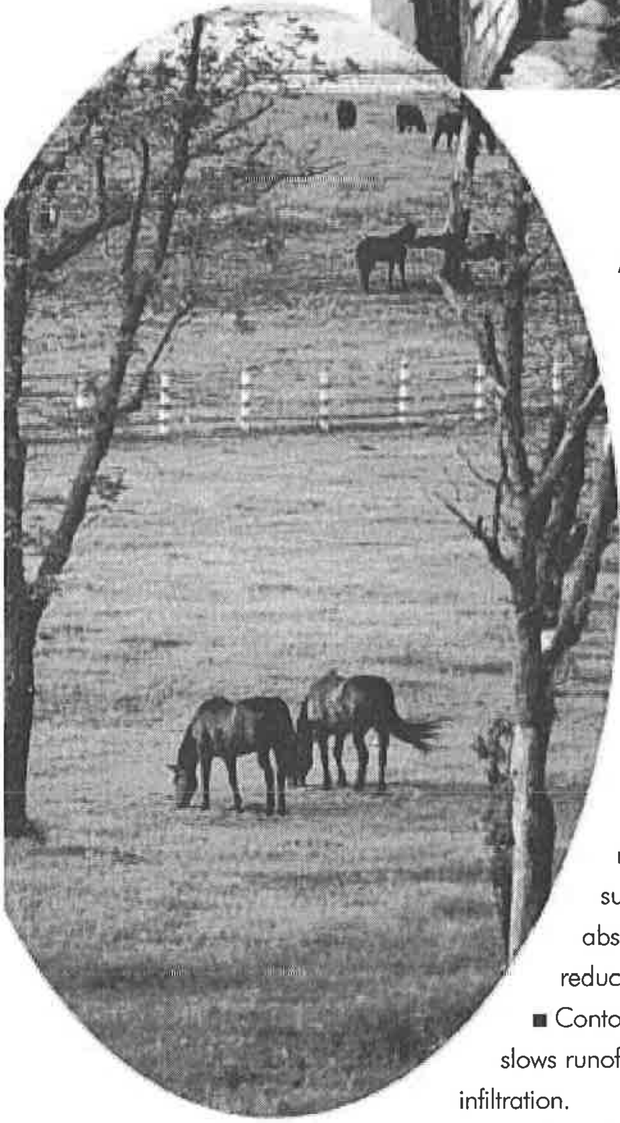


Fig. 57. Livestock can be well-maintained in karst pastures by following best management practices.

Agriculture

An important objective in managing agricultural lands in karst regions is to keep polluted surface water out of the groundwater system.

Some methods to help achieve this goal are

- "No till" cultivation, where plant residue is kept on the surface of the soil to absorb water and reduce erosion.
- Contour tillage, which slows runoff and increases soil infiltration.
- Reseeding cleared areas as quickly as possible to reduce erosion.
- Using fertilizers wisely and only in necessary amounts.
- Minimizing the use of pesticides, and using less toxic and biodegradable types.
- Not dumping waste material into sinkholes.
- Creating a long-term plan for living on karst by conducting a whole-farm and /or household evaluation of all land uses, including application or disposal of nutrients, pesticides, and hazardous materials as well as maintenance of the groundwater system.

Livestock Production

An important part of the Best Management Practices concept is recognition of the social and economic needs of the landowners and farmers whose land use practices directly impact the health of the aquifer. In karst regions, a general goal of livestock management is to keep runoff and livestock away from waterways, sinkholes, springs, crevices, and caves. On demonstration farms in the Midwestern United States, specially constructed cattle feedlots have been built where solid cattle waste is stored on a concrete stack pad (Fig. 56), with liquid waste channeled into a lined lagoon. The solid and liquid wastes are applied to fields during active phases of the growing cycle so that the plant uptake of the nutrients in these substances is maximized.

Some guidelines for keeping effluent from pastures and feedlots out of karst aquifers are

- Maintaining a herd size within the carrying capacity of the soil and water resources.
- Resting heavily grazed fields (Fig. 57).
- Using movable paddock-style pasturing when possible.
- Surrounding waterways, caves, springs, crevices, and sinkholes with strips of vegetation and fences.
- Frequently moving salt licks and watering tanks to reduce soil compaction and mini-

mize the concentration of waste products.

- Constructing sealed manure-holding tanks that are well maintained and regularly inspected.
- Cleaning abandoned manure storage sites and basins, and applying residual manure and stained soils to cropland.
- Using downspouts, gutters, berms, and storm water culverts to divert runoff away from farm buildings, feedlots and manure storage areas.

Timber Harvesting

Some methods of timber harvesting remove much of the vegetation from an area and can cause significant soil erosion unless mitigating steps are taken. In karst areas, soils and plant debris can be washed into sinkholes and caves resulting in pollution of groundwater (Fig. 58). Some suggestions for a timber harvest plan in karst areas are

- Locating roads, skid trails, and work areas away from places where storm water enters the groundwater system.
- Maintaining an unharvested buffer zone around streams, springs, sinkholes, and caves (Fig. 59).
- Using bridges or culverts where roads and skid trails cross streams to minimize erosion and turbidity.
- Stabilizing cut areas quickly to prevent erosion. Slopes should be seeded and protected.
- Leaving some waste wood on the land to help stabilize it further, and to return nutrients to the soil as the waste decays.
- Not dumping waste cuttings into sinkholes or cave entrances because the debris reduces water quality, hinders drainage, and damages the habitat of cave species.
- Using selective harvesting rather than clear-cutting techniques when feasible.

timber

Fig. 58. Timber harvest debris clogs this Canadian sinkhole, resulting in flooding and less water to replenish the aquifer.

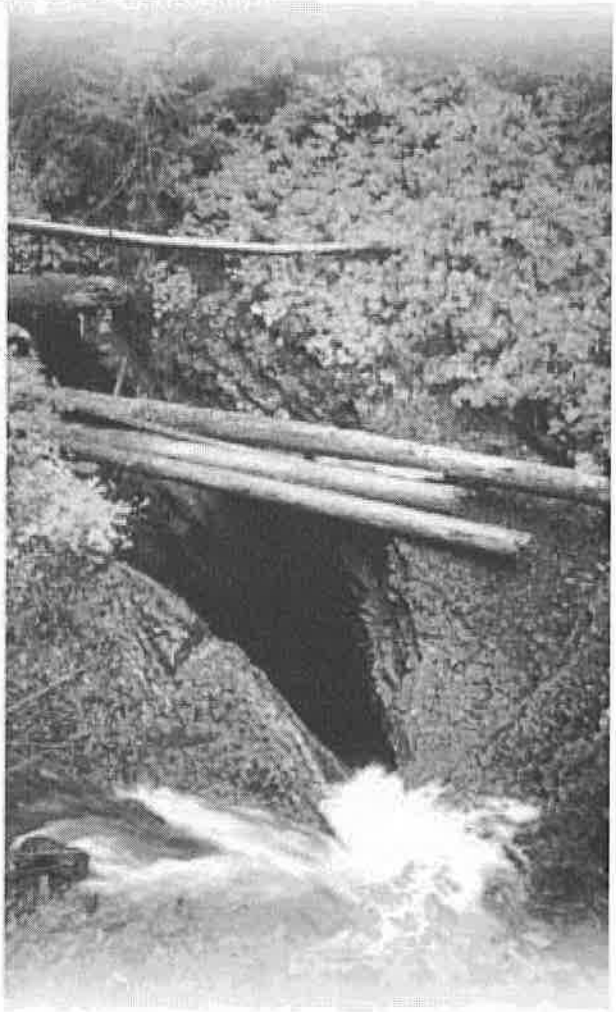


Fig. 59. This Canadian sinkhole is in a forested area, but with an appropriate buffer area to allow unrestricted clean water to enter the aquifer.

Laws and Regulations

Because karst areas are extremely vulnerable to environmental impacts, laws and regulations that are effective in other terrains may not be as effective in karst settings. Human development and exploitation of karst aquifers can trigger catastrophic events and result in numerous legal actions that go beyond property boundaries. Few laws provide direct, significant levels of protection for karst and caves, yet substantial indirect protection may exist depending on local rules and jurisdictions. With increased awareness of the ways cave protection also protects groundwater and other resources, many existing statutes are likely to be strengthened. The following section gives examples of laws and regulations that can apply to development and use of karst areas. For a more thorough consideration of laws that may be of some benefit in the protection of karst, the reader should refer to the 1997 article in *Environmental Geology* by LaMoreaux and others (facing page).

Caves and Karst The Federal Cave Resources Protection Act of 1988 directed the secretaries of the interior and agriculture to inventory and list significant caves on federal lands, and provides a basis for protecting caves. Public Law 101-578, enacted in 1990, directed the Secretary of the Interior to work through the National Park Service to establish and administer a cave research program and to prepare a proposal for Congress that examined the feasibility of a centralized national cave research institute. The Lechuguilla Cave Protection Act, passed in 1993, recognized the international significance of the scientific and environmental values of the cave. In 1998, Congress passed the National Cave and Karst Research Institute Act that mandated the National Park Service to establish and operate the institute.

Puerto Rico, the Cherokee Nation, and 22 U.S. states have cave protection statutes in effect. Typically, they focus on protecting speleothems and placing gates on caves. Some include prohibitions against dumping trash or hazardous materials into caves, and protection for cave fauna and archeological and historic materials. A number of states have laws protecting paleontological, archaeological and historic sites, and some of these include specific mention of caves. Even without the mention of caves as such in these laws they are likely protected by being significant sites. In addition, caves may be protected as critical habitat under the provisions of some state endangered species acts. Unfortunately, in many states violation of these laws are considered misdemeanors or low-level felonies and the penalties are often slight. State cave-protection laws commonly apply on state land only, and damage can be done in a privately owned cave if the landowner gives permission. More information on state cave and karst protection laws can be found in Huppert's 1995 article on the topic (facing page).

Aquifers The Safe Drinking Water Act (SDWA), the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) aim to protect non-karst and karst aquifers. SDWA sets drinking water standards that are used to protect groundwater, to include provisions for sole-source aquifers and wellhead protection. RCRA gives the U.S. Environmental Protection Agency authority to set up programs to prevent hazardous wastes from leaching into groundwater from landfills, surface impoundments, and underground tanks. CERCLA is often called the "Superfund" because it set up a fund to support federal and state responses to hazardous waste problems.

Water quality Probably the most influential regulations that protect karst, albeit indirectly in most cases, are the many federal, state, and local laws established to protect surface and groundwater quality. Caves and karst features are seldom addressed in most water rules. However, in order to adequately protect their highly vulnerable karst areas and features, municipalities, counties, and water management agencies can pass local ordinances that provide higher levels of protection than broad-sweeping state and federal regulations. For example, New Castle County, Delaware, has passed subdivision, zoning, and building codes dealing with water-resources protection in that karst area, including amending the building code to require special procedures in "subsidence areas."

Wildlife Some caves and karst springs provide habitat for species that are listed as endangered or threatened by the U.S. Fish and Wildlife Service or equivalent state agencies (Fig. 60). Regulations to protect caves and karst areas in order to preserve their species commonly include measures that protect water quality, and sometimes require standards more stringent than those in some water laws. For example, Texas has no state pumping limits for groundwater. However, sustainable pumping of Texas' Edwards Aquifer is required by federal statute to preserve adequate flows for endangered species living in the springs, which in turn protects local communities from overpumping and depleting their primary water supply.

Fig. 60. Protection of Rhadine beetles and other endangered species living in caves and karst aquifers has provided protection for those resources where laws to provide for human needs have sometimes been inadequate.

Antiquities The Federal Archaeological Resources Protection Act can be of significant use in the conservation of caves on federal land. Most states also have regulations protecting historic and prehistoric materials. Cave specific rules are rare, but caves are included within the usual scope of these laws.

Insurance While insurance policies don't fall under the category of laws and regulations, they can be legally and financially useful or required. In Florida, insurance is available to cover personal and property damages as a result of a catastrophic sinkhole collpase. In the sinkhole plain of central Kentucky, federal flood insurance has been made available to people living in sinkholes that flood from rises in underground streams.

References

Huppert, George N. 1995. "Legal Protection for Caves." *Environmental Geology,* Vol. 26, No. 2, pp. 121-123.

LaMoreaux, P. E., W. J. Powell and H. E. LeGrand. 1997. "Environmental and Legal Aspects of Karst Areas." *Environmental Geology,* Vol. 29, No. 1/2, pp. 23-36.

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Fig. 60. Protection of Rhadine *beetles and other endangered species living in caves and karst aquifers has provided protection for those resources where laws to provide for human needs have sometimes been inadequate.*

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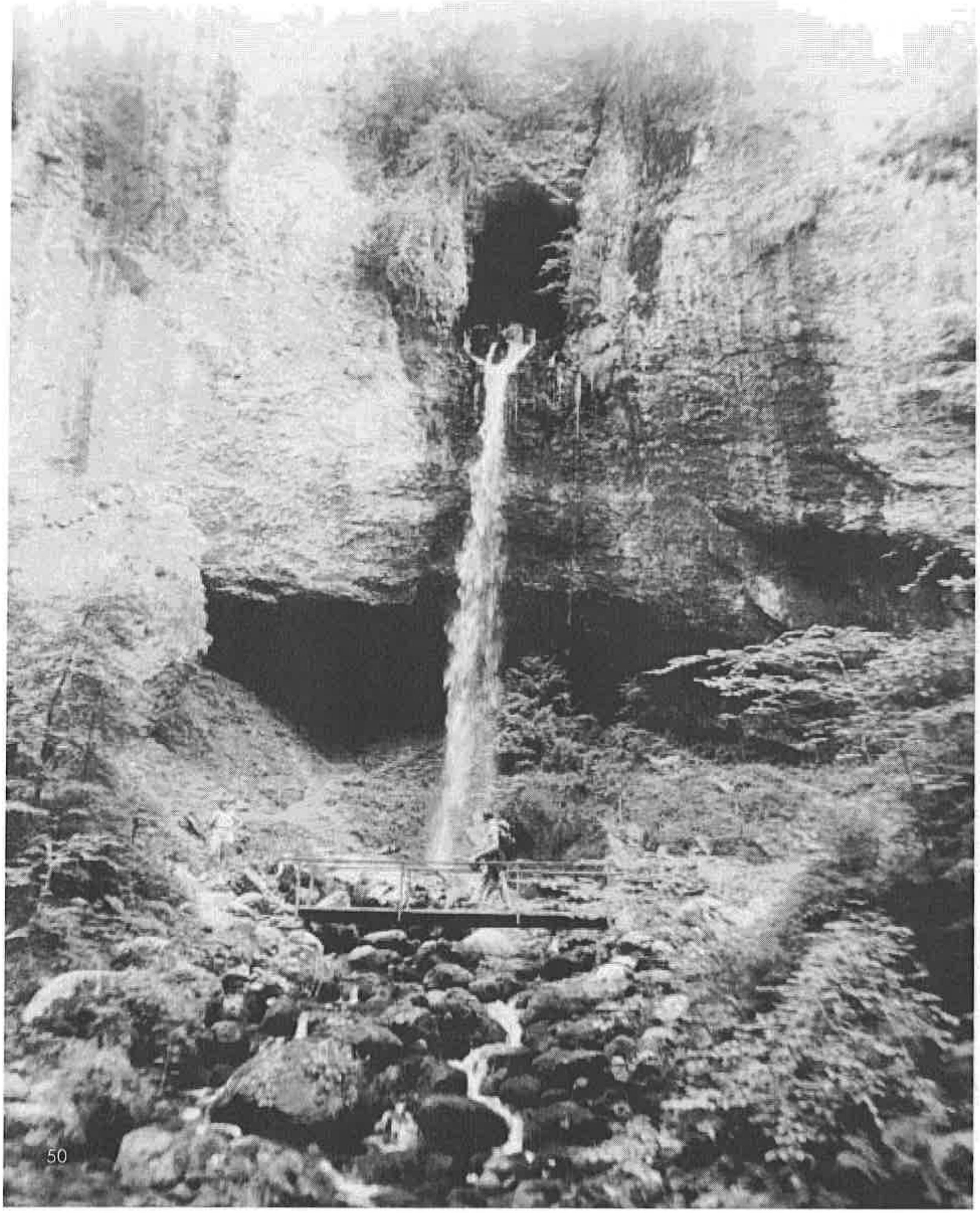
Huppert, George N. 1995. "Legal Protection for Caves." *Environmental Geology,* Vol. 26, No. 2, pp. 121-123.

LaMoreaux, P. E., W. J. Powell and H. E. LeGrand. 1997. "Environmental and Legal Aspects of Karst Areas." *Environmental Geology,* Vol. 29, No. 1/2, pp. 23-36.

6 LOOKING TO THE FUTURE



Karst regions, like this one in Norway, provide water resources, environmental challenges, habitats, and recreation.

This booklet has provided an overview of karst areas, what they are, and how we can benefit from their resources while minimizing our impact on them. Karst terrains are so complex that it has been impossible to cover all of their aspects and issues in a booklet of this size. However, we have aimed to provide you with a good starting point for understanding and appreciating karst, as well as some directions toward sound management. As understanding of karst areas has grown, we are thrilled to see increasing interest in these regions. We hope that this booklet and the enclosed poster will greatly increase the numbers of people who understand the meaning of the word "karst" and how it affects their daily lives.

Where to Find Help

This section covers organizations that are likely to have useful information about karst and karst hydrogeology. In addition, some university departments of geology, geography, civil engineering, biology, and agricultural science offer courses related to karst issues, and may have karst experts. Local soil conservation agents are another possible source of information and assistance in some karst areas. Karst hydrogeology is a highly specialized field. Unless you are dealing with a karst-specific organization, remember that karst experts, while growing in number, are still relatively few across the country.

Land-use planners in karst areas commonly find themselves without skilled individuals for carrying out the fieldwork needed to resolve a problem or situation. The following organizations may be able to provide information and assistance about caves and karst. Nearly every state in the United States has a cave or speleological association and several state and regional cave conservancies also exist, including in Indiana, Texas, Virginia, and the southeastern United States.

American Cave Conservation Association

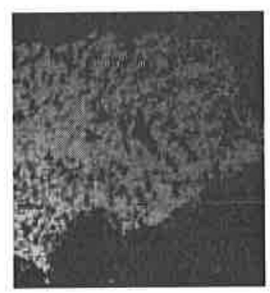
www.cavern.org

The American Cave Conservation Association (ACCA) is a national organization dedicated to the conservation and management of caves and karst resources. ACCA operates the American Cave and Karst Center and Museum in Horse Cave, Kentucky. It sponsors cave management workshops and symposia, provides curricula and training programs for teachers and students, operates public-education programs, designs and constructs cave gates, and provides technical assistance and public information on cave management issues.

American Cave Conservation Association
American Cave and Karst Center
P.O. Box 409
Horse Cave, Kentucky 42749
Tel: (270) 786-1466
e-mail: acca@caveland.net

Bat Conservation International

www.batcon.org



If a development plan involves bats, Bat Conservation International should be contacted for information. It is headquartered in Austin, Texas, and works closely with the public and local to international levels of government to promote understanding, research, and conservation of bats.

Bat Conservation International
P.O. Box 162603
Austin, Texas 78716
Tel: (512) 327-9721

Bureau of Land Management

www.blm.gov/nhp/

The Bureau of Land Management (BLM), an agency within the U.S. Department of the Interior, administers 264 million acres of America's public lands — about one-eighth of the land in the United States — and about 300 million additional acres of subsurface mineral resources. Most of the lands the BLM manages are located in the western United States, including Alaska, and are dominated by extensive grasslands, forests, high mountains, arctic tundra, and deserts. The BLM manages a wide variety of resources and uses, including energy and minerals; timber; forage; wild horse and burro populations; fish and wildlife habitat; wilderness areas; archaeological, paleontological, and historical sites; and other natural heritage values.

Bureau of Land Management
Office of Public Affairs
1849 C Street, N.W., Room 406-LS
Washington, D.C. 20240
Tel: (202) 452-5125

Center for Cave and Karst Studies

caveandkarst.wku.edu/

The Center for Cave and Karst Studies is located on the campus of Western Kentucky University in Bowling Green, which sits virtually in the center of a large karst landscape that extends from southern Indiana, through central Kentucky and Tennessee, and into northern Alabama. The Center, founded by Dr. Nicholas Crawford, is the only university program in the United States dedicated to karst studies. Its focus is on karst environmental management issues and it offers research assistantships for students, consultations and research for the public, and summer courses at Mammoth Cave National Park on topics such as, karst geology, hydrogeology, geomorphology, ecology, and archaeology.

Center for Cave and Karst Studies
Department of Geography and Geology
Western Kentucky University
Bowling Green, Kentucky 42101-3576
Tel: (502) 745-4555

IAH Karst Commission

www.iah.org/

The IAH Karst Commission activities are in full agreement with the principal aims of the International Association of Hydrogeologists to advance hydrogeological science by international cooperation between hydrogeologists and specialists in other disciplines with an interest in this field. Thus, the Karst Commission tries by focusing on karst groundwater to initiate, encourage and promote relevant studies; to cooperate with other relevant organizations; to promote or organize meetings or joint meetings with other appropriate organizations; to publish the proceedings of its special studies and scientific meetings; and to promote a better understanding of karst hydrogeological principles.

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David Drew, Vice-chairman
Department of Geography
Trinity College Dublin
Dublin 2, Ireland
Tel: 353 1 608 1888
e-mail: ddrew@mail.tcd.ie

Karst Waters Institute

www.uakron.edu/geology/karstwaters

The Karst Waters Institute is a group of leading researchers in the fields of karst geology, biology, and engineering. Although headquartered in West Virginia, its members are distributed throughout the United States. The Institute hosts international symposia on karst and has published several reports.

Karst Waters Institute
P.O. Box 490
Charles Town, West Virginia 25414
Tel: (304) 725-1211/ (202) 885-2180
e-mail: karst@american.edu

National Park Service

www.aqd.nps.gov/

Caves and karst features occur in about 77 units of the National Park System (NPS). The number of caves ranges from as few as 10 to 15 caves per unit — as in the Chesapeake & Ohio Canal National Historic Park — to more than 400 caves per unit — as in the Grand Canyon National Park. At this time, there are over 3600 known caves in the National Park System.

National Park System units may solicit the assistance of the Geologic Resources Division with the management and preservation of caves and karst. Recent management included the placement of gates on caves in Mammoth Cave National Park, Kentucky; assessments of cave resources at Petroglyphs National Monument, New Mexico; inventories of the culturally sensitive and important caves of Hawaii Volcanoes National Park; the generation of recommendations for the protection, development, and interpretation of Cathedral Caverns State Park, Alabama; and the development of cave management and protection in China, Mexico, and the Ukraine, including the Crimean peninsula.

Ron Kerbo, Cave Specialist
NPS Geologic Resources Division
P. O. Box 25287
Denver, CO 80225-0287
e-mail: ron_kerbo@nps.gov

National Speleological Society

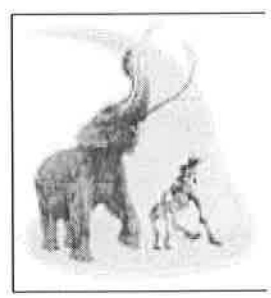
www.caves.org

The National Speleological Society (NSS), a member organization of the American Geological Institute, is an 11,000-member group dedicated to exploration, research, and conservation of caves and karst. The NSS has a history of helping to resolve problems uniquely associated with karst. An extensive library and bookstore are available at the NSS headquarters in Huntsville, Alabama. About 180 NSS chapters, called "grottos" are located throughout the country. Some of the Society's internal and affiliated organizations are specifically geared toward assisting with the management of caves and karst areas, and NSS has published some major books on cave and karst science.

National Speleological Society
2813 Cave Avenue
Huntsville, Alabama 35810-4431
Tel: (256) 852-1300
e-mail: nss@caves.org

USDA Forest Service

www.fs.fed.us/



The Forest Service recreation, geology, and watershed programs have key roles in cave and karst management, helping the agency administer 192 million acres to effectively achieve its mission of "Caring for the Land and Serving People." The Forest Service recognizes that caves are a sensitive resource and must be protected. Caves can be locations of sensitive wildlife or cultural resources. In order to protect this valuable resource, the Forest Service does not release information about the locations of specific caves under Forest Service management. In 1996, the oldest human skeletal remains (9,300 years old) in Alaska and Canada were discovered in a Prince of Wales Island (POW) cave, in the Tongass National Forest. This cave, which is one of 500 inventoried caves on POW and its outlying westerly islands, is the focus of a significant international multidisciplinary effort to study the Ice Age and post-Ice Age environment and earliest occupation of northern Prince of Wales Island. In addition to the human skeleton discovery at the cave, black bear bones dating back to over 41,000 years were excavated at the cave.

USDA Forest Service (Headquarters)
P.O. Box 96090 (RHWR)
201 14th Street, S.W.
Washington, D.C. 20090-6090

U.S. Fish and Wildlife Service
www.fws.gov

The U.S. Fish and Wildlife Service's major responsibilities are for migratory birds, endangered species, certain marine fish and mammals, and freshwater fish. The Service helps citizens learn about fish, wildlife, plants, and their habitats. Its National Conservation Training Center in West Virginia is the Nation's premier site for fish and wildlife conservation education, where people from government, industry, and non-profit groups all come for the latest in professional conservation training. The Service provides an array of electronic Web sites, where their most popular publications and hundreds of wildlife photographic images are posted and may be downloaded. The U.S. Fish and Wildlife Service has offices in every state and many territories. You can find contact information for each office and, in some cases, find office numbers and individuals listed in online phone directories. For the Refuges Visitor Guide, please call (800) 344-9453.

U.S. Fish and Wildlife Service (Headquarters)
1849 C Street N.W.
Washington, D.C. 20240

U.S. Geological Survey
www.usgs.gov

The U.S. Geological Survey (USGS) collects and disseminates information about the Earth and its resources. USGS groundwater programs encompass regional studies of groundwater systems, multidisciplinary studies of critical groundwater issues, access to groundwater data, and research and methods development.

The Learning Web, on the USGS web site, is dedicated to K-12 education, exploration, and life-long learning. Information and activities there help visitors learn how biology, geology, hydrology, and geography can help them understand our changing world. A USGS publication of particular interest to students and teachers is Open-file Report 97-536-A, *Karst Topography,* Paper model by Tau Rho Alpha, John P. Galloway, and John C. Tinsley III.

U.S. Geological Survey (Headquarters)
12201 Sunrise Valley Drive
Reston, Virginia 20192
Tel: 1 (888) ASK-USGS
e-mail: ask@usgs.gov

American Geological Institute
www.agiweb.org

The American Geological Institute is a nonprofit federation of 37 geoscientific and professional associations that represent more than 120,000 geologists, geophysicists, and other earth scientists. Founded in 1948, AGI provides information services to geoscientists, serves as a voice of shared interests in our profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in mankind's use of resources and interaction with the environment.

State Geological Surveys

Karst occurs in almost every U.S. state. Alabama, Florida, Kentucky, Illinois, Indiana, Missouri, Tennessee, Texas, Virginia, and West Virginia are just a few of the states containing large karst areas. In states having lesser amounts, karst may still be a significant resource. South Dakota, for example, has little karst, but its karst resources include Wind Cave National Park and Jewel Cave National Monument. Some state geological surveys, including the members of the Illinois Basin Consortium (Kentucky, Indiania, and Illinois), have karst specialists on staff. To learn more about the natural resources — including karst — and natural history of your state, contact its geological survey.

Geological Survey of Alabama
Tuscaloosa, AL
(205) 349-2852
www.gsa.state.al.us

Alaska State Geological Survey
Fairbanks, AK
(907) 451-5001
www.dggs.dnr.state.ak.us/

Arizona Geological Survey
Tucson, AZ
(520) 770-3500
www.azgs.state.az.us

Arkansas Geological Commission
Little Rock, AR
(501) 296-1877
www.state.ar.us/agc/agc.htm

Division of Mines & Geology
Sacramento, CA
(916) 323-5336
www.consrv.ca.gov./dmg

Colorado Geological Survey
Denver, CO
(303) 866-2611
www.dnr.state.co.us/geosurvey

Geological and Natural History Survey of Connecticut
Hartford, CT
(860) 424-3540
dep.state.ct.us/cgnhs/index.htm

Delaware Geological Survey
Newark, DE
(302) 831-2833
www.udel.edu/dgs/dgs.html

Florida Geological Survey
Tallahassee, FL
(904) 488-4191
www.dep.state.fl.us/geo/

Georgia Geologic Survey
Atlanta, GA
(404) 656-3214
www.dnr.state.ga.us/dnr/environ/aboutepd _ files/branches _ files/gsb.htm

Hawaii Geological Survey
Honolulu, HI
(808) 587-0230
kumu.icsd.hawaii.gov/dlnr/Welcome.html

Idaho Geological Survey
Moscow, ID
(208) 885-7991
www.idahogeology.org/

Illinois State Geological Survey
Champaign, IL
(217) 333-5111
www.inhs.uiuc.edu/isgsroot/isgshome/isgshome.html

Indiana Geological Survey
Bloomington, IN
(812) 855-5067
www.indiana.edu/~igs

State Geological Surveys

Iowa Department of Natural Resources
Iowa City, IA
(319) 335-1575
www.state.ia.us/government/dnr/index.html

Kansas Geological Survey
Lawrence, KS
(785) 864-3965
www.kgs.ukans.edu

Kentucky Geological Survey
Lexington, KY
(859) 257-5500
www.uky.edu/KGS

Louisiana Geological Survey
Baton Rouge, LA
(225) 388-5320
www.lgs.lsu.edu

Maine Geological Survey
Augusta, ME
(207) 287-2801
www.state.me.us/doc/nrimc/mgs/mgs.htm

Maryland Geological Survey
Baltimore, MD
(410) 554-5500
www.mgs.md.gov/

Massachusetts Executive Office of Environmental Affairs
Boston, MA
(617) 727-5830 (Ext. 305)
www.state.ma.us/envir/eoea.htm

Michigan Department of Environmental Quality
Lansing, MI
(517) 334-6923
www.deq.state.mi.us/gsd/

Minnesota Geological Survey
St. Paul, MN
(612) 627-4780
www.geo.umn.edu/mgs/index.html

Mississippi Office of Geology
Jackson, MS
(601) 961-5500
www.deq.state.ms.us/newweb/homepages.nsf

Missouri Department of Natural Resources
Rolla, MO
(573) 368-2160
www.dnr.state.mo.us/dgls/homedgls.htm

Montana Bureau of Mines & Geology
Butte, MT
(406) 496-4180
mbmgsun.mtech.edu

Nebraska Geological Survey
Lincoln, NE
(402) 472-3471
csd.unl.edu/csd.html

Nevada Bureau of Mines and Geology
Reno, NV
(775) 784-6691
www.nbmg.unr.edu/

New Hampshire Department of Environmental Services
Concord, NH
(603) 271-3503
www.des.state.nh.us

New Jersey Geological Survey
Trenton, NJ
(609) 292-1185
www.state.nj.us/dep/njgs

New Mexico Bureau of Mines & Mineral Resources
Socorro, NM
(505) 835-5420
www.geoinfo.nmt.edu/

New York State Geological Survey
Albany, NY
(518) 474-5816
www.nysm.nysed.gov/geology.html

State Geological Surveys

North Carolina Geological Survey
Raleigh, NC
(919) 733-2423
www.geology.enr.state.nc.us

North Dakota Geological Survey
Bismarck, ND
(701) 328-8000
www.state.nd.us/ndgs

Ohio Department of Natural Resources
Columbus, OH
(614) 265-6988
www.dnr.state.oh.us/odnr/geo _ survey/

Oklahoma Geological Survey
Norman, OK
(405) 325-3031
www.ou.edu/special/ogs-pttc

Oregon Department of Geology & Mineral Industries
Portland, OR
(503) 731-4100
sarvis.dogami.state.or.us

Pennsylvania Bureau of Topographic & Geologic Survey
Harrisburg, PA
(717) 787-2169
www.dcnr.state.pa.us/topogeo/indexbig.htm

Geological Survey of Puerto Rico
San Juan, PR
(809) 724-8774
www.kgs.ukans.edu/AASG/puertorico.html

Geological Survey of Rhode Island
Kingston, RI
(401) 874-2265

South Carolina Geological Survey
Columbia, SC
(803) 896-7700
water.dnr.state.sc.us/geology/geohome.htm

South Dakota Geological Survey
Vermillion, SD
(605) 677-5227
www.sdgs.usd.edu/

Tennessee Division of Geology
Nashville, TN
(615) 532-1500
www.state.tn.us/environment/tdg/index.html

Bureau of Economic Geology
Austin, TX
(512) 471-1534
www.beg.utexas.edu

Utah Geological Survey
Salt Lake City, UT
(801) 537-3300
www.ugs.state.ut.us

Vermont Geological Survey
Waterbury, VT
(802) 241-3608
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GLOSSARY

anaerobic bacteria Bacteria that can live in the absence of free oxygen.

aquifer A body of rocks or sediments, such as cavernous limestone and unconsolidated sand, which stores, conducts, and yields water in significant quantities.

berm A relatively narrow, horizontal shelf, ledge, or bench designed and constructed to deflect water.

best management practices (BMPs) State and/or Federal land-use regulations designed to conserve natural resources and minimize the amount of contaminants that reach the groundwater system

bioremediation The use of biological agents to clean up chemical pollutants.

calcite Calcium carbonate, $CaCO_3$, the principal mineral in limestone.

carbonic acid A mild, naturally occurring acid, H_2CO_3, that dissolves limestone, dolomite, and marble to form karst landscapes.

casing Pipe inserted and cemented into a borehole to prevent collapse and to prevent contaminated water from leaking into or out of a well.

cave A natural underground open space, generally with a connection to the surface and large enough for a person to enter. Caves in karst areas are dissolved out of soluable rock, such as limestone, dolomite, marble, gypsum, or halite.

chert A hard mineral composed mainly of microscopic silica crystals. It commonly occurs in limestone and is also called flint.

dendritic drainage A drainage pattern in which the streams branch in a tree-like pattern.

dissolution In karst, the process of dissolving rock to make landforms.

dolomite A carbonate sedimentary rock composed chiefly of the mineral dolomite, $CaMg(CO_3)_2$.

drainage well A type of well used to drain excess surface water, where the aquifer is permeable enough and the water table far enough below the land surface, to remove water at a satisfactory rate.

dry well A storm-water drainage well.

ecosystem A community of organisms and the environment in which they live including the non-living factors that exist in and affect the community.

effluent A liquid discharged as waste, such as contaminated water from a sewage works or a factory; water discharged from a storm sewer or from land after irrigation.

fecal coliform bacteria Organisms that live in the intestines of humans and other warm-blooded animals.

graded fill Material used to fill and stabilize a collapsed sinkhole. The material grades from coarse at the bottom to fine at the top of the stabilized area.

groundwater (a) That part of the subsurface water that is in the phreatic (saturated) zone, including underground streams. (b) Loosely, all subsurface water including water in both the vadose (unsaturated) and phreatic zones.

grout A cement or bentonite slurry of high water content, fluid enough to be poured or injected into spaces and thereby fill or seal them.

guano Accumulations of dung in caves, generally from bats.

gypsum A widely distributed mineral composed of calcium sulfate and water, $Ca(SO_4) \cdot 2H_2O$.

hydrologic cycle The circulation of water from the atmosphere as precipitation onto the land, where it flows over and through the land to the sea, and its eventual return to the atmosphere by way of evaporation from the sea and land surfaces and by transpiration from plants.

karst A type of topography that is formed on limestone, gypsum, and other soluble rocks, primarily by dissolution. Karst landscapes are characterized by sinkholes, caves, and underground drainage.

karst aquifer A body of rock in a karst area that contains sufficient saturated permeable material to conduct groundwater and to yield significant quantities of water to springs and wells.

limestone A sedimentary rock consisting chiefly of calcium carbonate, $CaCO_3$, primarily in the form of the mineral calcite.

marble A metamorphic rock consisting predominantly of recrystalized calcite or dolomite.

mitigation The process minimizing or eliminating the effects of a problem.

paleoclimate The climate of a given period of time in the geologic past.

paleokarst Ancient karst features that have subsequently been buried under sediments.

pathogen Any microorganism or virus that can cause disease.

permeability The property or capacity of a rock, sediment, or soil to transmit fluid.

phreatic zone The subsurface zone below the water table in which all spaces are filled with water. Also known as the saturated zone.

pit A vertical cavity extending down into the bedrock; usually a site for recharge, but sometimes associated with collapse.

porosity The percentage of a rock that is occupied by pores, whether isolated or connected.

potable water Water that is safe and palatable for human use.

pseudokarst A landscape that has features similar to those found in karst landscapes, but which are formed in relatively non-soluble rocks by non-karst processes.

regolith A general term for the layer of unconsolidated fragmented rock and soil that nearly everywhere forms the surface of the land and overlies the bedrock.

retention basin Constructed depressions where runoff from streets, parking lots, and other impermeable areas is stored until it can slowly drain through soil into the bedrock.

saltpeter Naturally occurring sodium nitrate or potassium nitrate. Found in floor sediments of some caves, and formerly used in the manufacture of gunpowder.

sinkhole A funnel-shaped depression in a karst area, commonly with a circular or oval pattern. Sinkhole drainage is subterranean and sinkhole size is usually measured in meters or tens of meters. Common sinkhole types include those formed by dissolution, where the land is dissolved downward into the funnel shape, and by collapse where the land falls into an underlying cave.

sinkhole plain A plain on which most of the local relief is due to sinkholes and nearly all drainage is subterranean.

sinking stream A surface stream that loses water to the underground in a karst region.

speleothem Any secondary mineral deposit that is formed in a cave. Common forms include narrow cone-shaped stalactites that hang from ceilings, usually broader cone-shaped stalagmites that build up from the floors, and columns where stalactites and stalagmites have joined.

swallet The opening through which a sinking stream loses its water to the subsurface.

swallow hole A closed depression or cave into which all or part of a stream disappears underground.

terrain A tract or region of the earth's surface considered as a physical feature.

troglobite An organism that must live its entire life underground.

vadose zone The subsurface zone between the surface of the land and the water table. Also known as the unsaturated zone

water table The subsurface boundary between the vadose (unsaturated) and phreatic (saturated) zones.

CREDITS

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Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Study Session Comment

2 messages

Joe Serrano <Joe.Serrano@santacruzcounty.us> Thu, Mar 12, 2020 at 12:48 PM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

Hello,

I apologize if this comment has already been noted…

The Draft EIR should analyze how municipal services (ex. water, sewer, fire) will be provided to the new developments and clearly indicate whether those identified service providers have capacity.

Thank you.

-Joe

Joe A. Serrano

Executive Officer
Local Agency Formation Commission of Santa Cruz County

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LAFCO

Parker Welch <pawelch@ucsc.edu> Thu, Mar 12, 2020 at 12:50 PM
To: Jolie Kerns <kernsj@ucsc.edu>, Erika Carpenter <escarpen@ucsc.edu>, gary.jakobs@ascentenvironmental.com

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March 27, 2020

Erika Carpenter, Senior Environmental Planner
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1156 High Street
Santa Cruz, California 95064

RE: Notice of Preparation of a Draft Program Environmental Impact Report (EIR) for the Proposed UC Santa Cruz Long Range Development Plan

Dear Ms. Carpenter:

Thank you for this opportunity to comment on the Notice of Preparation (NOP) of a Draft EIR for the Long Range Development Plan (LRDP), which is expected to replace the current version that was established back in 2005. The proposed LRDP envisions adding 8,500 student housing beds, up to 550 employee housing units, and approximately 2.8 million assignable square feet (ASF) of academic and administrative building space. These developments are scheduled to be built within the campus area. However, it appears that some development sites are located outside the City of Santa Cruz's jurisdictional and sphere boundaries (refer to attached Vicinity Map). These boundaries are designated by the Local Agency Formation Commission of Santa Cruz County (LAFCO). Development of currently unincorporated territory would be subject to LAFCO's approval for the delivery of municipal services, such as water, at a future date.

Under the California Environmental Quality Act (CEQA), LAFCO is a Responsible Agency for this proposal, and will have regulatory authority towards future applications involving boundary changes for the delivery of municipal services. It is in this role that LAFCO is commenting on this NOP for the anticipated Draft EIR.

Initial Comments on Scope of the Draft Program Environmental Impact Report:

1. Conformance to State LAFCO Law and Locally Adopted LAFCO Policies
(Please provide an analysis in the Draft EIR)

LAFCO's statutory authority is derived from the Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000 (Government Code Section 56000, et seq.). Among LAFCO's purposes are: discouraging urban sprawl, preserving open space and prime agricultural lands, efficiently providing government services, and encouraging the orderly formation and development of local agencies based upon local conditions and circumstances (Government Code Section 56301). The Cortese-Knox-Hertzberg Act identifies factors that must be considered, and determinations that must be made, as part of LAFCO's review of boundary changes requesting the delivery of municipal services.

These provisions of law are the legislative basis for LAFCO's locally adopted Policies and Procedures Relating to Spheres of Influence and Changes of Organization and Reorganization ("LAFCO Policies") which guide LAFCO's review and consideration of requests for annexation and other boundary changes. The full text of LAFCO's adopted Policies is available on LAFCO's web site: https://www.santacruzlafco.org/policies-rules/.

If the LRDP is approved, LAFCO will likely be requested to consider the approval of one or more applications requesting the delivery of municipal services for any unincorporated territory in the LRDP, in accordance with the Cortese-Knox-Hertzberg Act and local LAFCO policies. As a CEQA Responsible Agency, LAFCO plans to use the University's environmental document to fulfill CEQA clearance for such applications, and to support the evaluation of the proposal's consistency with the applicable LAFCO laws and policies, including the adopted "Water" and "Standards for Evaluating Proposals" policies.

The University's Notice of Preparation does recognize that the EIR will evaluate "the potential for implementation of the LRDP to necessitate the construction of new or modified public facilities, including fire and police stations, which could result in environmental impacts as a result of their construction" and "the potential increases in demand for utilities and service systems as a result of implementation of the LRDP" (NOP - Attachment B; page B-2).

LAFCO requests that the Draft EIR currently being prepared evaluate the service provisions of all municipal services, including but not limited to sewer and water. The Draft EIR should also include an analysis of the LRDP's conformance to the full range of LAFCO's adopted policies and related State laws, to the extent such analysis is possible based on information currently available about future development in unincorporated territory.

A more detailed, site-specific, and updated analysis to LAFCO laws and policies should also be anticipated as a required part of subsequent, project-level CEQA documents when future proposals are brought forward to LAFCO. Provisions of this information in current and future CEQA documents will help ensure that the Commission will have adequate information to act in its role as a CEQA Responsible Agency when future boundary changes for areas within the LRDP are submitted to LAFCO.

2. Conformance to the County Urban Services Line (USL)
(Please address the LRDP's consistency with the USL)

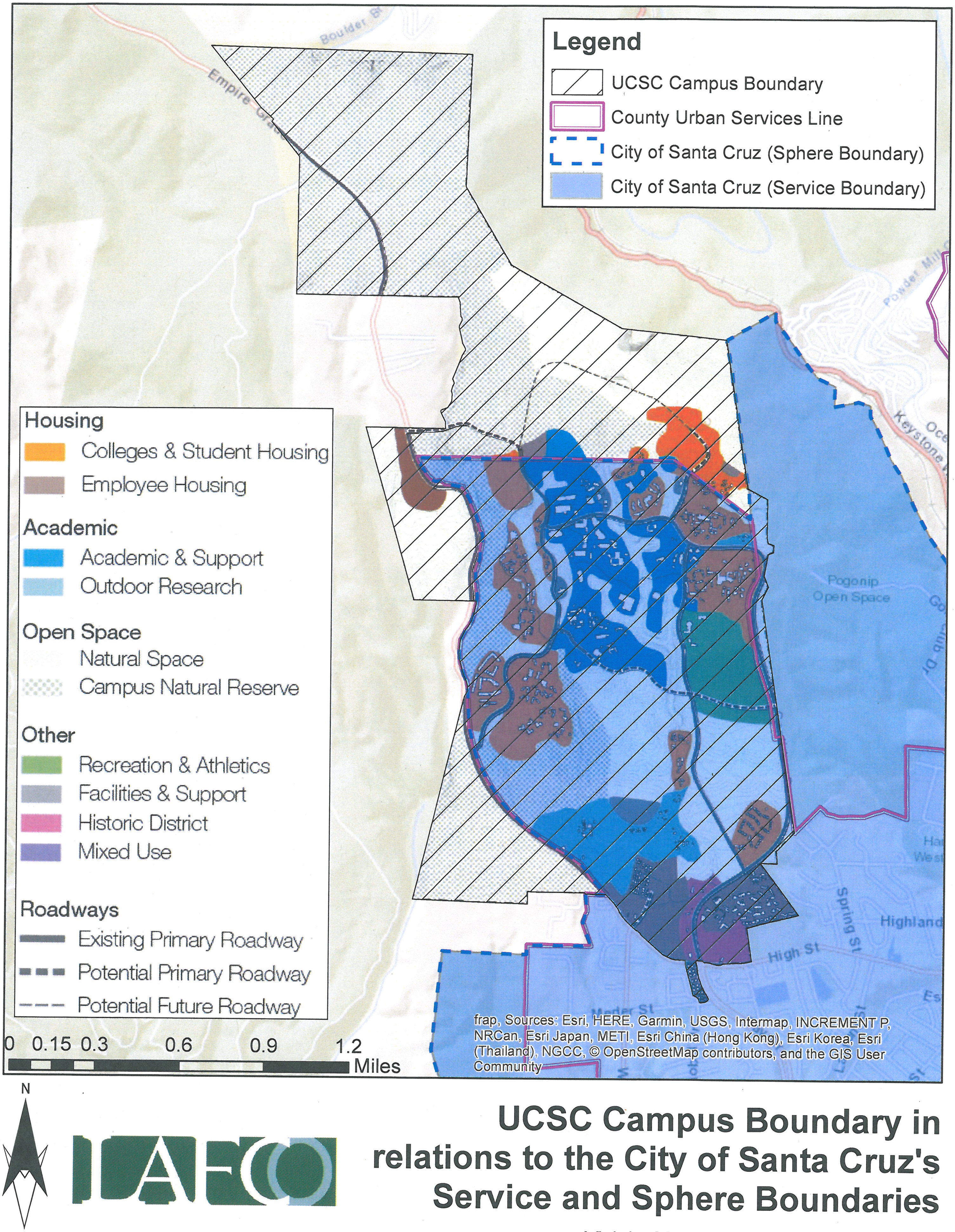
Please include in the Draft EIR an analysis of the LRDP's consistency with the established County USL, which does not appear to be discussed in the Notice of Preparation. The attached vicinity map depicts the USL in relation to the City of Santa Cruz and the University's campus area. Implementation of the LRDP may require revisions to the established USL. Because such revisions would likely involve the potential for future sphere amendments or other boundary changes, and would directly pertain to LAFCO's legislative purposes, LAFCO would like to have a role in any future modifications to the established USL.

Thank you again for this opportunity to comment on this proposal. Please continue to keep us informed throughout your process. I would be happy to meet with you and your staff for more detailed discussions.

Sincerely,

JOE A. SERRANO
Executive Officer

Attachment: Vicinity Map



UCSC Campus Boundary in relations to the City of Santa Cruz's Service and Sphere Boundaries

Vicinity Map created on March 24, 2020

LEAGUE OF WOMEN VOTERS OF SANTA CRUZ COUNTY

April 6, 2020

Erika Carpenter
Senior Environmental Planner
Physical Planning
Development and Operations
University of California at Santa Cruz
1156 High Street, Santa Cruz, CA 95064

Subject: Comments on the Scope of the Draft Environmental Impact Report (DEIR) for UCSC's 2020-2040 Long Range Development Plan (LRDP)

Dear Ms. Carpenter:

Thank you for the opportunity to comment on the scope of work for the DEIR for the UCSC LRDP. Although we appreciate UCSC's mission to provide an excellent university education and value the contributions UCSC has made to the intellectual and cultural assets of the Santa Cruz community, we're disappointed that UCSC also has created serious negative impacts, particularly by exacerbating the critical shortage of affordable housing and unbearable commuter traffic. How does the University plan to mitigate the negative impacts of the current level of student enrollment with its concomitant population of faculty and staff? Will the University commit to mitigating its current negative impacts before considering future growth? And, as an alternative to growing the Santa Cruz campus, will the University consider expanding student enrollment at other UC campuses in communities that are geographically better equipped to accommodate future growth?

The Notice of Preparation (NOP) lists the following environmental impact areas that will be analyzed in the DEIR. We offer the following comments pertaining to these areas of potential impact.

Aesthetics
The DEIR should describe and illustrate any changes to the various vistas looking toward the campus and away from the campus as well as within the campus and how the placement of buildings and roads would seek to mitigate degradation of such vistas. The DEIR should describe how the placement of buildings and roads will protect and preserve the majestic trees, the Great Meadow and native plants.

Agricultural and Forestry Resources
The DEIR should describe whether the LRDP will protect and maintain the Farm and Garden and the Arboretum programs as campus assets which have also been enjoyed by the larger community. Will grazing lands be protected? Will trees be preserved as an important source of carbon sequestration to the maximum extent possible?

Air Quality
The DEIR should analyze how air quality could be impacted by development of the LRDP during construction phases as well as long-term. In particular, the analysis should take into account impacts on the surrounding residential neighborhoods and schools as a result of increased commuter traffic to and from campus as well as on campus. The LRDP should also take into consideration additional community growth required to serve the needs of the campus.

Biological Resources
Describe how building locations and construction projects could impact flora and fauna unique to this area, especially endangered, threatened or sensitive species, and what mitigation measures would be employed to protect biological resources.

Cultural and Tribal Cultural Resources
Describe how building locations and construction projects could impact known and potential locations of Native American historic sites as well as those of early settlers. What measures would be taken to protect and preserve these sites? Will an anthropologist be employed to provide consultation and guidance during the planning, architectural and construction phases of UCSC's LRDP?

Energy
Will building design and construction employ best practices in energy efficiency?
How will renewable energy sources be used instead of fossil fuels?

Geology
How will building design and construction protect and preserve important geologic formations, such as the karst formations that help feed local streams, ponds and lagoons?

Soils
How will the design and construction of buildings and roads protect soils from erosion and prevent pollution?

Paleontology
Will a paleontologist be employed to provide consultation and guidance during the planning, architectural and construction phases of UCSC's LRDP?

Greenhouse Gas Emissions/Climate Change
Will the placement of buildings and roads and footpaths encourage of use of non-motorized modes of on-campus transportation?
How will modes of on-campus transportation minimize or eliminate greenhouse gas emissions?
Will all on-campus service vehicles be electric as opposed to using fossil fuels?
Will solar and other renewable energy sources be incorporated into building design where possible?

Hazards & Hazardous Materials
How will existing and potential hazards be identified and handled appropriately?
How will students, faculty, staff and visitors be protected during the construction phases?
How will trees and other vegetation be protected during construction? How will tree protection zones be determined? Will the long-term health of trees and other plants be considered when paths and pavements are designed?

How will the effluent of campus laboratories and maintenance shops be handled? To what extent could this impact the feasibility of wastewater recycling both on-campus and through the City's Wastewater Treatment Facility?

Hydrology & Water Quality
What measures will be employed to encourage water conservation?
What measures will be employed to protect groundwater recharge, particularly into the karst formations?
What measures will be taken to control storm water runoff to prevent erosion and pollution?

Land Use & Planning
In what ways is the LRDP consistent with or in conflict with the City's and County's general plans, local coastal programs and climate action plans?

Noise
The DEIR should describe the potential noise impacts (both on and off-campus) of both the construction phases and ongoing activities as a result of campus growth and identify measures to mitigate such impacts on humans as well as other animal species.

Population & Housing
The DEIR should provide an analysis of the potential housing impacts (both on and off-campus) for students, faculty, staff and the public in general. The analysis should describe how the construction of new on-campus housing will occur concurrently with campus growth. The DEIR also should describe what incentives will be provided to encourage habitation of on-campus housing, such as affordability and convenience. The DEIR also should address how campus growth will increase the demand for off-campus housing and the potential effect this would have on cost of housing.

Public Services
The DEIR should describe how campus growth would increase the demand for public services, such as police, fire protection, recreation, health care services, municipal services (water supply, sewer treatment, refuse and recycling) and identify what measures would be employed to mitigate these impacts.

Recreation
The DEIR should describe how the increase or decrease in on-campus recreation facilities would impact the larger community and how that might contribute to an increase in vehicle miles traveled (VMT).

Transportation
The design of campus roads should provide safety for bicyclists and pedestrians as well as motor vehicle drivers.
What incentives will the University provide to encourage the use of public transportation and car-pooling to and from the campus?

Utilities & Service Systems
Will utility lines be undergrounded to maximize safety and minimize interruption?
What is the potential for a micro grid on campus?

Wildfire
What measures will be employed to prevent and react to potential wildfires?
Does the campus have an effective evacuation plan in the event of a wildfire?

We hope that our comments have been helpful in your preparation of a DEIR.

Sincerely,

Barbara Lewis
President
League of Women Voters of Santa Cruz County
P.O. Box 1745
Capitola, CA 95010
league@lwvscc.org
lwvscc.org
831-325-4140

LEAGUE OF WOMEN VOTERS® OF SANTA CRUZ COUNTY

April 6, 2020

Erika Carpenter
Senior Environmental Planner
Physical Planning
Development and Operations
University of California at Santa Cruz
1156 High Street, Santa Cruz, CA 95064

Subject: Comments on the Scope of the Draft Environmental Impact Report (DEIR) for UCSC's 2020-2040 Long Range Development Plan (LRDP)

Dear Ms. Carpenter:

Thank you for the opportunity to comment on the scope of work for the DEIR for the UCSC LRDP. Although we appreciate UCSC's mission to provide an excellent university education and value the contributions UCSC has made to the intellectual and cultural assets of the Santa Cruz community, we're disappointed that UCSC also has created serious negative impacts, particularly by exacerbating the critical shortage of affordable housing and unbearable commuter traffic. How does the University plan to mitigate the negative impacts of the current level of student enrollment with its concomitant population of faculty and staff? Will the University commit to mitigating its current negative impacts before considering future growth? And, as an alternative to growing the Santa Cruz campus, will the University consider expanding student enrollment at other UC campuses in communities that are geographically better equipped to accommodate future growth?

The Notice of Preparation (NOP) lists the following environmental impact areas that will be analyzed in the DEIR. We offer the following comments pertaining to these areas of potential impact.

Aesthetics
The DEIR should describe and illustrate any changes to the various vistas looking toward the campus and away from the campus as well as within the campus and how the placement of buildings and roads would seek to mitigate degradation of such vistas. The DEIR should describe how the placement of buildings and roads will protect and preserve the majestic trees, the Great Meadow and native plants.

Agricultural and Forestry Resources
The DEIR should describe whether the LRDP will protect and maintain the Farm and Garden and the Arboretum programs as campus assets which have also been enjoyed by the larger community. Will grazing lands be protected? Will trees be preserved as an important source of carbon sequestration to the maximum extent possible?

Air Quality
The DEIR should analyze how air quality could be impacted by development of the LRDP during construction phases as well as long-term. In particular, the analysis should take into account impacts on the surrounding residential neighborhoods and schools as a result of increased commuter traffic to and from campus as well as on campus. The LRDP should also take into consideration additional community growth required to serve the needs of the campus.

Biological Resources
Describe how building locations and construction projects could impact flora and fauna unique to this area, especially endangered, threatened or sensitive species, and what mitigation measures would be employed to protect biological resources.

Cultural and Tribal Cultural Resources
Describe how building locations and construction projects could impact known and potential locations of Native American historic sites as well as those of early settlers. What measures would be taken to protect and preserve these sites? Will an anthropologist be employed to provide consultation and guidance during the planning, architectural and construction phases of UCSC's LRDP?

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Sincerely,

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831-325-4140

NATIVE AMERICAN HERITAGE COMMISSION

NAHC HEADQUARTERS
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Suite 100
West Sacramento,
California 95691
(916) 373-3710
nahc@nahc.ca.gov
NAHC.ca.gov

February 25, 2020

Erika Carpenter
University of California, Santa Cruz
1156 High Street, Barn G
Santa Cruz, CA 95064

Re: 2020029086, UC Santa Cruz Long Range Development Plan Project, Santa Cruz County

Dear Ms. Carpenter:

The Native American Heritage Commission (NAHC) has received the Notice of Preparation (NOP), Draft Environmental Impact Report (DEIR) or Early Consultation for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code §21000 et seq.), specifically Public Resources Code §21084.1, states that a project that may cause a substantial adverse change in the significance of a historical resource, is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, §15064.5 (b) (CEQA Guidelines §15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) shall be prepared. (Pub. Resources Code §21080 (d); Cal. Code Regs., tit. 14, § 5064 subd.(a)(1) (CEQA Guidelines §15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources within the area of potential effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a separate category of cultural resources, "tribal cultural resources" (Pub. Resources Code §21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. (Pub. Resources Code §21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code §21084.3 (a)). **AB 52 applies to any project for which a notice of preparation, a notice of negative declaration, or a mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements.** If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. §800 et seq.) may also apply.

The NAHC recommends consultation with California Native American tribes that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments.

Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a lead agency shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:

- **a.** A brief description of the project.
- **b.** The lead agency contact information.
- **c.** Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code §21080.3.1 (d)).
- **d.** A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code §21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A lead agency shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code §21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or Environmental Impact Report. (Pub. Resources Code §21080.3.1(b)).

- **a.** For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code §65352.4 (SB 18). (Pub. Resources Code §21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:

- **a.** Alternatives to the project.
- **b.** Recommended mitigation measures.
- **c.** Significant effects. (Pub. Resources Code §21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:

- **a.** Type of environmental review necessary.
- **b.** Significance of the tribal cultural resources.
- **c.** Significance of the project's impacts on tribal cultural resources.
- **d.** If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code §21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code §6254 (r) and §6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code §21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:

- **a.** Whether the proposed project has a significant impact on an identified tribal cultural resource.
- **b.** Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code §21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code §21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:

a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or

b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code §21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code §21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code §21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code §21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code §21084.3 (b). (Pub. Resources Code §21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:

a. Avoidance and preservation of the resources in place, including, but not limited to:

i. Planning and construction to avoid the resources and protect the cultural and natural context.

ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.

b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:

i. Protecting the cultural character and integrity of the resource.

ii. Protecting the traditional use of the resource.

iii. Protecting the confidentiality of the resource.

c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.

d. Protecting the resource. (Pub. Resource Code §21084.3 (b)).

e. Please note that a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code §815.3 (c)).

f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code §5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An Environmental Impact Report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:

a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code §21080.3.1 and §21080.3.2 and concluded pursuant to Public Resources Code §21080.3.2.

b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.

c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code §21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code §21082.3 (d)).

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires local governments to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code §65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf.

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code §65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code §65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code §5097.9 and §5097.993 that are within the city's or county's jurisdiction. (Gov. Code §65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
    - **a.** The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
    - **b.** Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/.

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
    - **a.** If part or all of the APE has been previously surveyed for cultural resources.
    - **b.** If any known cultural resources have already been recorded on or adjacent to the APE.
    - **c.** If the probability is low, moderate, or high that cultural resources are located in the APE.
    - **d.** If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
    - **a.** The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
    - **b.** The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:

   a. A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.

   b. A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.

   a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, §15064.5(f) (CEQA Guidelines §15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.

   b. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.

   c. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code §7050.5, Public Resources Code §5097.98, and Cal. Code Regs., tit. 14, §15064.5, subdivisions (d) and (e) (CEQA Guidelines §15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

If you have any questions or need additional information, please contact me at my email address: Nancy.Gonzalez-Lopez@nahc.ca.gov.

Sincerely,

Nancy Gonzalez

Nancy Gonzalez-Lopez
Staff Services Analyst

cc: State Clearinghouse

SUBJECT: LRDP EIR SCOPING PERIOD

Dear Chancellor Larive:

As you know, UCSC staff have postponed the LRDP EIR public Scoping Meetings until the first week of April and have extended the Scoping period one week until April 8.

We understand and completely support the decision to delay this week's public meetings. The health emergency is clearly serious and is currently and for the foreseeable future disrupting the lives of everyone in the Santa Cruz community and elsewhere.

Because of this uncertainty regarding the future impact of the health crisis, we are greatly dismayed by the revised Scoping period schedule. The fundamental purpose of the Scoping period is for the University to hear comments from the general public and concerned public agencies regarding the draft LRDP. It is clearly difficult for this to occur when both citizens and institutions are focused on a health crisis that seems to be worsening, at least in this country, on a daily basis.

The proposed University Scoping schedule seems to be based on the assumption that everything will be back to normal in a few weeks. This may or may not occur but, even if it does, the community needs to a reasonable period of time to refocus on issues like the LRDP EIR.

The California Environmental Quality Act (CEQA) requires meaningful public participation and which is a central component in the EIR process, including the Scoping period. To extend the 30 day scoping period only one week in the middle of an international health crisis will not allow for the kind of robust public engagement called for by the law.

Therefore, we respectfully request that you extend the Scoping period for at least three weeks after the end of the declared local health emergency, that open public sessions for public input per normal practice then be held, and that this decision be announced as soon as possible.

Sincerely,

Santa Cruz City-County Task Force To Address UCSC Growth Plans
Ryan Coonerty, Supervisor - Santa Cruz County
Justin Cummings, Mayor – City of Santa Cruz
Sandy Brown, Councilmember – City of Santa Cruz
Cynthia Mathews, Councilmember – City of Santa Cruz

Advisory Group, Santa Cruz City-County Task Force To Address University Growth Plans
John Aird, CLUE: Committee to Limit University Growth
Ted Benhari: CLUE: Committee to Limit University Growth
Danny Drysdale: Democratic Socialists of America, political organizer
Charlie Eadie: Past President UCSC Alumni Assoc, Land Use consultant
Deb Elston: Santa Cruz Neighbors
Zav Hershfield: UCSC alumnus, Tenant organizer
Denise Holbert: Retired, Save Santa Cruz
Jan Karwin: League of Women Voters
Ronnie Lipschutz: UCSC Professor of Politics

SUBJECT: LRDP EIR SCOPING PERIOD

Robert Orrizzi, Santa Cruz Neighbors, City Transportation/Public Works Commission
Gary Patton, Attorney, former county supervisor, Save Santa Cruz
Mike Rotkin, UCSC Lecturer, former City Councilmember and Mayor
Krisna Supatra-Campbell, UCSC Student
Bill Tysseling: Former CEO, Santa Cruz Area Chamber

SANTA CRUZ CITY-COUNTY TASK FORCE TO ADDRESS UNIVERSITY GROWTH PLANS

COMMENTS PREPARED IN RESPONSE TO THE NOTICE OF PREPARATION OF THE DRAFT ENVIRONMENTAL IMPACT REPORT (DEIR) FOR UCSC'S 2020 - 2040 LONG RANGE DEVELOPMENT PLAN (LRDP)

Dear Erika Carpenter;

Thank you for the opportunity to provide our comments on the 2020-2040 Long Range Development Plan (LRDP) Environmental Impact Report (EIR). In our view, the proposed increase in student enrollment will have numerous significant impacts on both the UCSC campus as well as the surrounding community.

In fact, the many unmitigated and insufficiently mitigated impacts caused by enrollment growth under the current LRDP justify a moratorium on future enrollment increases until the needed on-campus infrastructure and off-campus mitigations are provided.

However, as a minimum, the LRDP EIR needs to include a complete and adequate analysis, based on substantial evidence, of the LRDP's potential environmental impacts, the imposition of feasible mitigation measures to reduce the potential impacts to a less than significant level, and detailed consideration of reasonable alternatives. The purpose of the comments provided below is to help achieve these objectives. We hope and expect the University to fully consider and respond to them in the Draft EIR and to revise the draft LRDP as appropriate.

PROJECT DESCRIPTION

- The DEIR should specify the total amount (in acres or square footage) of the campus currently developed with structures and the total land area to be developed under the proposed LRDP for each of the potential uses.

- The 2020-2040 LRDP DEIR needs to identify the role of the Coastal Commission in the adoption of the LRDP for the 2300 Delaware Avenue facility. The relevant policies from the City of Santa Cruz's Local Coastal Program (LCP) should also be discussed and any inconsistencies identified and mitigated.

-The Notice of Preparation (NOP) states that "… natural space would protect wildlife corridors and scenic views". On page A-5 "natural space" is defined as "land preserved as open space to maintain special campus landscapes due to scenic value, special vegetation, and wildlife continuity." However, the map in Attachment C depicts "Potential Future Roadway" and "Potential Primary Roadway" through lands the Open Space lands designated "Natural Space" and "Campus Natural Reserve". The EIR needs to clarify this apparent inconsistency in the

Project Description. The Project should include a map clearly depicting the boundaries of the City of Santa Cruz in the north campus area.

AESTHETICS

- The 2020 - 2040 LRDP DEIR should contain simulations of possible building masses at all the sites identified for development in the LRDP. Using existing buildings on campus, general mass and scale parameters should be prepared and applied in analyzing the potential aesthetic impacts of the Plan in the various areas slated for development. Since the proposed LRDP land use map designates specific areas for housing and academic uses and the Draft LRDP projects the amount of square footage for each of them, an analysis of the potential aesthetic impacts of structures in these areas is not speculative and should be provided.

- The DEIR should include mitigation measures to minimize the loss of trees, particularly those with special aesthetic and biotic value. The DEIR should contain a definition for "significant trees" based on size, type, visual characteristics, etc. and enumerate how many such trees (as well as non-significant trees) will potentially be lost in each area proposed for development.

- Portions of campus are visible not only from the City but also from adjoining areas of the County, including the north coast and through the Highway 1 corridor east of the City of Santa Cruz. These vistas are important and should be analyzed in the LRDP. Potential visual impacts to Empire Grade and other applicable County General Plan-designated scenic County roads, as listed in Policy 5.10.10 of the County General Plan, should be addressed in the DEIR, with mitigations proposed as appropriate. Special attention should be paid to the potential visual impacts from the proposed development, especially in the lower campus, that could impact views from off-campus vantage points. Photo simulations showing the visual impact of all significant new proposed development as viewed from various public roads and other viewpoints should be included in the DEIR

- The NOP indicates that the EIR will evaluate the "potential changes in the visual characteristics and quality of the main residential campus and westside research park and surrounding area." It does not specify that the DEIR must also evaluate the potential impacts in visual character and quality to the surrounding area that will result from the development proposed in the Draft LRDP. This includes west-campus, the development in the previously designated campus habitat reserve at the main entrance, etc.

AGRICULTURAL RESOURCES – CONVERSION OF FARMLAND

- Continued development of the campus may reduce the viability of maintaining a grazing program, an important historical agricultural practice on campus. This should be analyzed and any issues that arise should be mitigated.

- The Draft Land Use Plan in Attachment C of the NOP shows Employee housing development in a portion of the County's Local Coastal Program (LCP) area, which is currently designated as Agricultural Land. The EIR should be consistent with the proposed Land Use Plan with the Coastal Commission approved County LCP as well as the potential impacts of converting this land to non-agricultural uses.

AIR QUALITY

- The 2020-2040 LRDP DEIR should include a worst-case analysis of all the emissions that might result from development and construction under the proposed 2020-2040 LRDP.

- The air quality analysis should include the impacts resulting from off-campus traffic, not only from the increased campus growth provided for under the 2020-2040 LRDP but the additional growth induced by the campus growth (the multiplier effect).

- Given the current high traffic volumes on High Street, Storey, Bay, Mission, Western, and King that will increase substantially under the proposed LRDP, the DEIR should consider the potential public health impact on nearby residents, and specifically on Westlake and Bay View schools, from the increased air emissions resulting from this increased traffic.

- The DEIR should ensure that the analysis of traffic impacts is consistent with the analysis of air pollution impacts.

- On page B-1 of the NOP, the University acknowledges that construction will require additional energy and result in significant increases in greenhouse gas releases. However, the Campus Sustainability Plan contains a commitment to achieve net-zero emissions for all new capital projects. The EIR needs to reconcile the differences between this commitment in the Campus Sustainability Plan.

ODORS

- Given that manufacturing is an allowed use at the 2300 Delaware Avenue Facility and such activity could generate odors, the DEIR should consider this potential impact and include a mitigation measure prohibiting the location of any odor generating use at the site.

BIOLOGICAL RESOURCES

- The analysis of potential biotic impacts of the LRDP should include detailed and area-specific consideration of habitat connectivity issues.

  - SPECIAL STATUS SPECIES:

    - UCSC's campus contains many special status species. These include species identified by Roy Buck in surveys cited in the 1988 LRDP & the 2005 LRDP. All species identified as sensitive in previous EIRs for all projects at UCSC should be specifically reviewed in the Draft EIR and any inconsistencies fully explained.

    - A number of species previously identified as sensitive have disappeared from UCSC; analysis of these campus extinctions should be included in the LRDP DEIR including a discussion of the reasons for the disappearance of these species and mitigation measures to assure that similar results will not occur with additional campus development.

    - Baseline surveys conducted over a full year and no more than one year old should be completed for all sensitive species and should include population numbers as well as distribution. The environmental analysis also should include identification of critical population numbers for the sensitive species and mitigation measures where appropriate to ensure that future campus planners prevent sustainable thresholds from being exceeded.

    - Special attention should be given to the cave organisms endemic to the Empire Cave System. Experts in these organisms are associated with the California Academy of Sciences; they have expressed concern with regard to campus activities, including changes in hydrology that could alter moisture and humidity levels critical to the sensitive species. Also, the Pacific Giant Salamander population in that cave system may be a distinct race or subspecies, pending scientific analysis: this species should be included in the LRDP DEIR analysis. Baseline population studies should be completed to detect the abundance, distribution, and health of these species. The environmental analysis should include identification of critical population numbers for these species and mitigation measures where appropriate to ensure that future campus planners prevent sustainable thresholds from being exceeded.

    - Other sensitive species that require analysis include mountain lion, raptors, grasshopper sparrow, dusky footed woodrat, red-legged frog, and Ohlone tiger beetle. Baseline surveys for these species should include nesting pair numbers and location for bird species, and corridor use for mammals, red-legged frog, and the Ohlone tiger beetle. The environmental analysis should identify critical population numbers for the sensitive species so that future campus planners can prevent sustainable thresholds from being exceeded.

- SENSITIVE HABITATS:
    - The DEIR should include a detailed but comprehensible definition (including scientific citations) for "sensitive habitat" and the sensitive habitat types.

    - The following sensitive habitats should be included: purple needlegrass stands, seeps, and springs, coast live oak woodland, dwarf redwood forest, Shreve oak forest, freshwater wetland, wet meadow, and caves. These habitat types have variously been designated by UCSC, the California Department of Fish and Wildlife or local biologists as requiring CEQA analysis.

    - Cumulative impacts to these habitats in the region should be analyzed with regard to potential off-campus development and construction impacts over the timeline of the LRDP.

    - Maritime chaparral requires additional levels of analysis. Cumulative impacts analysis should include loss of this habitat throughout the region due to fire suppression as well as development over the timeline of the LRDP.

    - The DEIR analysis should identify and propose mitigations for any reduction in the potential to continue the campus' past practices of prescribed fire to manage this and other habitat types because of the increased proximity of students and facilities.

    - Ecotones are specific types of habitat for a number of species and require analysis, including baseline studies and system-specific potential for cumulative impacts.

    - All sensitive habitats may continue to increasingly be impacted by UCSC's overpopulation of deer. The decimation of forest understory may lead to increased erosion and sedimentation of surrounding wetlands and watercourses. Deer overpopulation is triggered by access to irrigated landscaping during the summer months and because of a lack of predation by mountain lions, which are driven away by human encroachment on natural habitat. The Campus has access to studies by its own Natural Reserve on impacts of deer overpopulation; moreover, it has made several attempts to plan for this crisis. Increased development may lead to additional impacts to sensitive habitats and species in and around UCSC (including on adjoining land set aside for conservation of these) by deer overpopulation. These potential impacts should specifically be identified and analyzed in the DEIR. A baseline inventory of forest understory and the deer population is required to adequately assess impacts by additional campus growth. Fecal coliform bacteria levels resulting from deer overpopulation threatens surface and groundwater quality and should also be enumerated in a baseline study. Cumulative impacts analysis should include the potential for additional build-out under the County and City's existing general plans and the potential for that to further increase the effects of deer overpopulation. While deer are not themselves a special status species, the potential/y significant impact of their overpopulation on special status species justifies analysis in the DEIR

- Campus development has failed to adequately plan for or mitigate the profusion of ad hoc pedestrian and bicycle trails that connect buildings and illegal homeless encampments in campus natural areas. Recreational use of the natural areas of the campus has increased with additional student population, with off-road bicyclists increasingly using and creating trails for which there is no maintenance. These trails degrade sensitive habitat and further imperil at-risk species. In the past, the campus has been largely unable to fund activities outside of the immediate building envelope because of perceived limitations to funding. A baseline study of these trails is required in the DEIR as well as an analysis of their potential impacts. This should include the projection of additional trails that are likely to occur because of the campus growth proposed by the proposed LRDP.

- Increased campus growth will also increase the chance for the further introduction of non-native, invasive species including plants, animals, and pathogenic microorganisms (e.g., sudden oak death). A baseline of existing levels of impact from these species should be completed to inform an analysis of the potential impacts from additional introductions and/or disturbances that will allow for more invasions. The DEIR must include effective mitigation measures to prevent any further introduction of invasive species to the campus resulting from the proposed LRDP

- Recent studies indicate potentially significant impacts due to nitrogen from automobile exhaust on adjoining ecosystems. These impacts include increased growth of weeds that have impacted sensitive species. The campus includes soils that are very low in nitrogen so that additional nitrogen may constitute a significant threat to species associated with those soils. A baseline of atmospheric nitrogen deposition in sensitive habitats needs to be completed to inform an analysis of the potential for additional impacts associated with campus growth.

- Campus growth into adjoining natural areas will require additional fire safety measures which may entail additional fire breaks, vegetation clearing, etc.. The

DEIR must analyze campus-wide impacts of fire safety measures and their cumulative impacts on sensitive species and habitats.

- WETLANDS:
    - - The project description in the NOP neglects to mention several areas of jurisdictional wetlands; a campus-wide baseline study delineating wetlands should be completed and summarized in the draft EIR Furthermore, since development proposed by the draft LRDP, including runoff from roads and parking lots, may create additional jurisdictional wetlands, the Draft EIR must analyze this potentially significant impact and provide adequate mitigation measures. In past projects, catchment basins constructed to prevent runoff have become filled with potentially polluted sediments and often have not been maintained so that these polluted sediments are then transported downstream in the water bodies they were meant to protect. A mitigation measure proposed that includes basins should detail how these will be maintained in financial, technical, and regulatory frameworks as informed by past practices, including similar projects that have been successful.

- NATIVE FISH, WILDLIFE CORRIDORS, NURSERY SITES
    - Wilder Creek contains resident and migratory native fish directly downstream of the proposed campus development that will impact the Cave Gulch drainage. A baseline study of the hydrology that affects Wilder Creek from UCSC is necessary to determine the degree of impact to this important fish population in the Draft EIR's analysis of the proposed project's potentially significant impacts on these populations.
    - The Draft EIR should analyze whether the UCSC upper campus contains corridor habitat for Marbled Murrelet, which may pass over the band of native habitat when traveling between the ocean and old-growth redwood groves at Henry Cowell State Park. If such habitat is found to exist, the Draft EIR should contain mitigation measures to ensure its protection.
    - In order to ensure the accuracy of data collected on wildlife species, surveys using radar or other sensitive detection devices should be employed to establish baseline use by these species.
    - Proceeding along the spine of Ben Lomond Mountain from the City of Santa Cruz to the Lockheed site, it is evident that there are very few wildlife corridors connecting the east and west slopes, including substantial protected natural areas. The upper campus of UCSC may provide the most substantial corridor between Henry Cowell State Park and Wilder Ranch State Park. A landscape-level baseline of wildlife corridors for mountain lions, deer, and mesopredators needs to be completed in order for the Draft EIR to adequately analyze the impacts of the proposed expansion of development northward.

- A baseline study is required to inform the analysis of the impacts of sedimentation and altered hydrology on the wildlife corridors for cave organisms and the Pacific Giant Salamander between the caves of the Empire Cave system.
- UCSC contains nursery sites for a number of endemic cave organisms, the Ohlone tiger beetle, and a number of sensitive raptors and other bird species. A baseline of these should be completed to inform the analysis of the proposed project's potentially significant impacts on these species.

- HABITAT CONSERVATION PLAN
  - The University will be required to prepare a Habitat Conservation Plan (HCP) as part of the LRDP process. The DEIR should discuss the status of this HCP and how it will relate to and be incorporated in the LRDP.

- CONFLICT WITH HCP:
  - As detailed above (and below), campus growth will impact adjoining protected areas by increased deer herbivory, the spread of non-native, invasive species, changed hydrology, deposition of nitrogen associated with vehicle exhaust, and proliferation of ad hoc and recreational trails. All of these impacts could affect provisions in the HCP and therefore require analysis in the Draft EIR.

- SENSITIVE NATURAL COMMUNITY:
  - In analyzing the potential impacts of the proposed LRDP on sensitive natural communities, their effect on the adopted Sensitive Habitat maps and General Plan policies of the County need to be identified and mitigations proposed.

- 2300 DELAWARE:
  - The DEIR should analyze how the LRDP may impact Antonelli Pond. The DEIR should evaluate the potential impact from the use of chemical fertilizers and pesticides and require, as a mitigation, avoidance of such chemicals.

- One of the planning principles in the NOP is the commitment to "preserve open space to maintain special campus landscapes due to scenic value, special vegetation, and wildlife continuity". The DEIR needs to evaluate the potential impacts of the construction and implementation of developments proposed in the draft LRDP on wildlife movement and fragmentation of habitats and propose mitigations that provide specific protection. The Draft EIR should also discuss the consistency of this planning principle with the amount and location of development proposed in the LRDP Land Use Map.

CULTURAL RESOURCES

- The 2020-2040 LRDP DEIR should analyze the potential impact of nearby on and off-campus developments on on-campus archeological, historical, or cultural (tribal disputes are of particular concern) resources.

GEOLOGY

- UNIQUE GEOLOGICAL FEATURE:

    - Karst topography that supports the extensive Empire Cave system is inextricably linked with campus hydrology. In order to establish a baseline for the links between the campus and the cave system, the following studies need to be performed and made available as part of the Draft EIR: die testing, seasonal flow monitoring, water quality, sedimentation rates, residence time, rock dissolution rate, and humidity.
    - The DEIR should recognize past failures to address the dangers of building on the campus, including the experience that led to the pumping of ~200 cubic yards of concrete into a void beneath Applied Sciences during the construction of that facility. A baseline would include collapse rates. The costs to date of mitigating the potential for collapse should also be included. The DEIR should expressly indicate the amount of uncertainty and the potential risks involved with campus construction in and around karst areas.

- SOIL EROSION AND LOSS OF TOPSOIL:

    - A thorough baseline of existing rates of soil erosion on the campus is necessary to adequately analyze the potential impacts of development proposed in the LRDP.

EROSION

- The 2020-2040 LRDP DEIR should contain a detailed evaluation of potential erosion impacts in each specific area proposed for development under the LRDP.

- Construction creates the potential for significant soil erosion. This should be evaluated.

- An increase in impermeable surfaces (roofs, walkways, roadways) results in increased runoff and potentially increases erosion, which should be evaluated in detail in the DEIR, including if applicable any effect on off-campus properties.

HAZARDS & HAZARDOUS MATERIALS

- The baseline fire risk rate should be assessed by mapping historic fires. The current baseline fire risk should be assessed also by using fire models in conjunction with consultation with CalFire. The baseline data should be used to inform the analysis of the potential impacts of proposed campus development on fire safety.
- Given the ever-increasing risk of fires in California, particularly in densely forested areas, the University must consider emergency access in their plans for enrollment growth and development. Because there are only three viable ways to get off campus (Western Ave, Bay St., and High St.) which are all already gridlocked during certain periods of the day, UCSC is already vulnerable to inept fire-safety routes. With increased populations on campus, the LRDP EIR must identify and analyze evacuation routes in the case of a natural disaster, heeding the advice of safety experts, and evaluate the potentially significant impacts.

DRAINAGE AND FLOOD CONTROL

- The DEIR should include Federal and State regulations for wastewater management and evaluate UCSC's current level of compliance. The Draft EIR should include a mitigation measure to prohibit construction or additional enrollment, or staff or faculty hiring until the impacts of current wastewater and runoff are assessed and adequately mitigated.

- STORM DRAINAGE

    - The drainage analysis in the 2020-2040 LRDP DEIR should be specific and should not simply identify the need for additional drainage plans. Moreover, it should contain specific performance measures to ensure that any potentially significant impacts are reduced to a less than significant level.

LAND USE PLANNING

- The evaluation in the DEIR of potential conflicts between development under the proposed LRDP and related City and County plans should contain a detailed analysis of the relationship between the proposed development and the specific policies in the local general plans, climate action plans, and other relevant plans.

- The DEIR should address the role of the California Coastal Commission and Coastal Act policies as they impact the proposed LRDP.

- The DEIR should analyze the consistency of the development proposed in the draft LRDP with existing UCSC planning and land use policies and guidelines regarding sustainable development, including but not limited to the UCSC Campus Sustainability Plan, UC Sustainability Policy, and the prerequisites for the Laboratories for the 21st Century (Labs21) and LEED IV.

- On page A-4 of the 2020 Notice of Preparation, UCSC acknowledges the differences between the land use categories identified in the 2005 LRDP and the current 2020 NOP. The University claims "Under the proposed LRDP, these types [those identified in the 2005 LRDP] of land use categories would be maintained, but have been further refined through the LRDP planning process to reflect campus needs and functions today." Notable differences include the exclusion of any area that is "protected from development" or a "habitat reserve". The Draft EIR must state the specific differences between the two LRDPs and specify the potential for development in the newly-defined "Campus Natural Reserve and Open Space" – neither of which include an explicit exemption from development under the 2020 -2040 LRDP. In addition, the Draft EIR must identify and analyze the potentially significant impacts from development in these formally protected areas.

NOISE

- Construction proposed in the Draft LRDP in west-campus will create an unprecedented intrusion of noise into a residential neighborhood, i.e., the Cave Gulch Neighborhood. The noise is likely to continue for several years. The DEIR must evaluate the potential significance of this impact and propose adequate mitigations to reduce this impact to a less than significant level.

- The location of recreational facilities, housing, and academic buildings as proposed in the Draft LRDP will significantly increase the current number of hikers, walkers, bikers, etc. to the campus. This will likely increase the amount of activity and noise generated by these individuals. The DEIR should evaluate this impact.

POPULATION & HOUSING

- The Notice of Preparation indicates that the DEIR will analyze the increase in the "regional" population resulting from the Plan's implementation. This is inadequate. Given the already overwhelming impact that the University is having on the population in the City of Santa Cruz and, to a lesser extent, the County of Santa Cruz, the DEIR must evaluate the impacts on the City and County both separately and combined. In addition, this analysis should not only include direct campus growth, but the indirect community growth induced by the campus growth (the multiplier effect) and be both comprehensive and detailed.

HOUSING

- In the NOP the University commits to housing one-hundred percent of the net growth of students on-campus under the proposed LRDP. The 1988 LRDP contained a commitment to house 75% of the new students on-campus. At the end of the LRDP's term, the percentage of students housed on campus had not increased. A policy commitment, such as the one proposed, is insufficient to ensure that significant impacts from the housing of new students off-campus won't occur. The provision of on-campus housing must be tied to enrollment levels so that enrollment cannot increase beyond certain levels until identified amounts of housing are provided. The Comprehensive Settlement Agreement approved under the current LRDP includes this binding commitment and it has been implemented successfully. In order to ensure that the potentially significant impacts of housing net new students off-campus are avoided, the Draft EIR needs to include a mitigation measure that ties any actual enrollment growth, and its timing, to the provision of already available on-campus housing.

- The 2020-2040 LRDP DEIR should contain a detailed analysis of the on and off-campus housing impacts of the proposed LRDP, for students, faculty, and staff. It should include consideration of potentially significant impacts from the campus community as well as the increased housing demand induced by campus growth. The increased housing demand will have physical environmental effects both on and off-campus. Moreover, since the demand for housing impacts the price of housing, which in turn impacts the amount of housing constructed in a community, there is a direct nexus between the proposed LRDP and housing prices. The DEIR should evaluate this nexus and identify mitigations to address its negative effects.

- Housing demands in the City of Santa Cruz have grown steadily and made housing unaffordable for an increasingly large fraction of the non-University population. The result has been crowding in houses, changes in the character of neighborhoods, and deterioration of the quality of life for families. Mitigation of these impacts must be identified, including providing housing for all new students (as described above) as well as for faculty and staff through specifically identified University-funded programs, subsidies, land contributions, and other measures.

- On page A-4 of the NOP, the University states that it will include employee housing in places that will allow residents to "strategically access community resources". We ask that you demonstrate this. The Draft EIR needs to define and provide examples of strategic access to community resources, and identify which community resources will be accessed, and the impact on those community resources from the increase in employees and students. This evaluation should include an analysis of potentially significant impacts from the increased access and use, including traffic, aesthetics, and biology.

- On page A-4 of the NOP, the University states that it "plans to accommodate 100% percent of the increase in students and up to 25 percent of the increase of...anticipated..faculty/staff members in on-campus housing." However, the implementation of past LRDP's have fallen short of these goals, with the explanation that because campus housing is "self-funded, adequate demand must be substantiated to produce on-campus housing". If this is the case, the University must identify through revisions to the draft LRDP or as mitigation measures in the LRDP EIR, the resources, including funding, demographic information and projections, that will substantiate this growth. The LRDP EIR must include the mitigation measure of providing critical infrastructure, such as housing and academic buildings, prior to enrollment increases because this measure is feasible and necessary to adequately reduce the impact.

RECREATION

- On page B-2 of the NOP, under "Recreation", the University acknowledges that the DEIR will evaluate the potential of the implementation of the proposed LRDP to increase the use of current athletic and recreational on-campus facilities, resulting in a "substantially and adversely affected" condition. Additionally, the NOP states that the EIR will evaluate "whether the construction and/operation of any additional modified recreational facilities resulting from the implementation of the LRDP could result in similar effects." However, in Attachment C, the map does not include any additional recreation facilities and instead removes a "PE (Physical Education and Recreation)" facility that is identified on the west side of the campus in the 2005 LRDP Land Use Map. While the proposed Land Use Map shows a large area on the east side of campus designated for recreation, it isn't clear whether this is an expansion of the existing recreation area or whether additional facilities are planned in this area. Additionally, the DEIR should identify what new recreational facilities, if any, are planned, and where they and additional recreational services will be located. The Draft EIR needs to analyze the potentially significant impacts of the construction and implementation of the proposed facilities and services.

- If the proposed LRDP does not anticipate an expansion of on-campus recreational facilities, the DEIR should evaluate the potential impact of proposed growth on community recreational resources and propose adequate mitigations.

- The 2020-2040 LRDP DEIR should consider opening recreational facilities at 2300 Delaware Avenue and, if there are no recreational uses intended under the proposed LRDP at 2300 Delaware, the Draft EIR needs to analyze the potentially significant impacts of the lack of recreational facilities on the surrounding community.

TRAFFIC & SAFETY

- The DEIR should assess traffic and safety potentially significant impacts of construction proposed in the draft LRDP on the campus, taking into account VMT, congestion, and environmental (visual, noise, etc.) disruptions.

- The Notice of Preparation contains information regarding the location and necessity of new roads to "improve circulation". As a result, the DEIR should contain a detailed analysis of the potentially significant impacts of these roads not only on traffic and public safety but on other campus resources, such as wildlife, vegetation, erosion, etc.

- The 2020-2040 LRDP DEIR should analyze in considerable and specific detail potential impacts of construction and implementation of the proposed LRDP on Highway 1 traffic, major County arterial intersections, as well as intersections in the City.

- VMT impacts are not directly proportional to the number of trips and should be calculated by type of vehicle, travel speed, and stops. This should be done fully considering size, acceleration during a level, downhill, and uphill grades, timing, weather (more students ride the buses during rainy weather), and specific roads. The direction of travel on grades, the width of the road at stopping points, and other factors significantly affect traffic impacts. The DEIR should incorporate these factors in its analysis of traffic impacts. Baseline traffic data should be collected at different times of the year and days of the week.

- The DEIR should consider that all data on traffic impacts are consistent with the air quality findings.
- Additionally, the DEIR should consider UCSC initiatives to "Reduce commute travel mode impacts relative to a 2017 baseline by reducing Scope 3 commuter greenhouse gas emissions 10 percent by 2022; reducing commute vehicle miles traveled (VMT) five percent by 2022, and reducing per capita parking demand 10 percent by 2022." (UCSC Campus Sustainability Plan) The Draft EIR should include mitigation measures to ensure the successful implementation of this initiative.

- The Notice of Preparation identifies that the EIR will assess the need for "enhanced alternative transportation throughout the main residential campus". However, the Draft EIR must address the need for alternative transportation beyond the main residential campus. For example, additional Metro buses will be necessary to accommodate peak loads, and it will be important to perform an hour or even 30-minute interval analyses in the DEIR of the impacts of additional students, staff, and faculty traveling to campus. And all other alternative transportation options should be assessed in similar detail.

- Traffic eastbound-southbound on High Street in the afternoon has long been a motivation for drivers to seek alternative routes, specifically, Bay Street and some of the other Westside streets such as Escalona and King. The lengthy delay in reaching the Mission and King intersection on both the High Street route and along Mission will further encourage travel on Laurel and Walnut through the downtown area and onto Broadway and Soquel for eastbound traffic. Detailed computer modeling will be necessary to adequately analyze and accurately characterize these impacts and should be included in the DEIR.

- Traffic northbound on Empire Grade to the proposed new Cave Gulch Bridge entrance will include construction vehicles and construction and maintenance materials deliveries. Heavy vehicles carrying capacity loads traveling up the steep grade to the proposed Cave Gulch Bridge entrance will sometimes have velocities as low as 5 or at most 10 mph. This will make the entrance less attractive to all users since the mile from the West Entrance to the proposed new Cave Gulch Bridge Entrance will then take between 8 and 12 minutes to travel as compared with the 40 mph speed limit travel time of approximately 1.5 minutes. This slow traffic should be analyzed in terms of the actual projected usage of this new entrance.

- The safety of the road between the West Entrance and the Cave Gulch Neighborhood is currently considered unacceptable by area residents. Numerous vehicles park along the roadway on both sides and directions of travel each year. There are a number of reasons for this dangerous condition, including the curves and incline as well as the very limited surface area adjacent to the road over most of this 1+ mile distance. Numerous heavily-laden vehicles will significantly increase the hazardous travel conditions resulting in a dramatic increase in accidents, injuries, and, perhaps, fatalities. It is unreasonable to expect the present road to support the proposed increased traffic without considerably increased safety hazards as well as vehicle damage to the canyon as vehicles leave the roadway and impact the hillside on the west side of the road or tumble into the canyon on the east side. The potentially significant impacts of development under the proposed LRDP and, particularly the new entrance on Empire Grade, on public safety should be analyzed in detail and mitigations imposed to reduce these impacts to a less than significant level. Increasing roadway width would have significant environmental impacts and should be evaluated thoroughly if it is to be considered as a mitigation.

- The Draft EIR should evaluate the feasibility of a mitigation measure whereby the University would provide alternative transportation to reduce or eliminate increased impacts on traffic. This could include ride-sharing and enhanced access for bikes.

- The DEIR should identify the projected summer school population and evaluate the traffic impacts of this increase, especially since it occurs during the busy tourist season.

- SAFETY:

    - Northbound traffic of heavy vehicles carrying full capacity loads from the West Entrance to the proposed corporate yard and Cave Gulch Bridge Entrance to campus will impose significant weight on the roadway. The downhill lane (east side of road) adjacent to the Cave Gulch Canyon washed out in the early 1980s during a period when the ground was heavily saturated. The stability of the road should be evaluated and necessary improvements should be identified as well as alternatives to the proposed increased uses. The costs of improvements and other mitigations should be identified and be part of the plan itself. Approval of the plan should include approval of the funds for implementation of the mitigations of negative impacts.

    - There are already more than a dozen locations on Empire Grade between the West Entrance and the proposed Cave Gulch Entrance where there is very little distance between the roadway and the edge of the canyon where there are clearly visible cracks in the pavement indicating that the downhill side of the road has sunken or that the earth below has been compacted. These cracks are an ominous foreboding of landslides to come. The addition of numerous heavily burdened construction materials transport vehicles as well as other construction vehicles on the road suggests that the campus planners have simply not examined this road and its capacity to carry more vehicles. There are also frequent tree falls on this road, both closing the road and taking out of service the power and communications lines that run alongside and over it. The DEIR should evaluate the potentially significant impacts of these dangers in light of the growth proposed in the LRDP.

    - The geologic underpinnings, the history of slides, the narrowness of the road, the steepness of the grade, and steepness of the slopes above and below the road, and other factors should be thoroughly investigated to determine the suitability of Empire Grade between the West Entrance and the proposed new entrance at Cave Gulch for the increased volume and weight of traffic proposed in the plan.

    - In addition to the above-mentioned impacts, the development under the proposed LRDP, especially during construction, will cause the physical deterioration of City and County roads leading to the campus, with a resulting increase in danger to the public. The Draft EIR should analyze the potentially significant impacts to public safety due to this deterioration of roads. In addition, the costs of improvements and other mitigations should be identified in detail in the Draft EIR and performance measures provided to ensure their implementation. Mitigations in the Draft EIR should require that approval of the proposed LRDP includes approval of the funds for implementation of the mitigation measures.

    - Emergency egress for the private school and the neighborhood immediately above the proposed new entrance and road on Empire Grade in the Cave Gulch Neighborhood will be threatened by the planned new uses of the road and should be evaluated in the DEIR.

- Current access to the University via Mission St, Bay St, and High St will not accommodate the increased traffic. University furnished transit must be provided, bicycle access and usage must be increased, and public transit systems must be supported for increased usage. The DEIR should contain specific mitigations including performance measures to reduce the potential impacts to a less than significant level.

HYDROLOGY & WATER QUALITY

- The 2020 - 2040 LRDP DEIR should contain a detailed evaluation of potential drainage impacts in each specific area proposed for development under the LRDP. On page B-2 of the NOP, the university states that the EIR will evaluate "the potential for construction and operational activities associated with the LRDP to… modify existing drainage patterns." This is inadequate. Given the size and topography of the campus, each drainage area impacted by the LRDP should be analyzed separately and in detail.

- The NOP does not mention specific water quality standards with which the campus is required to adhere; the LRDP DEIR should list all water quality standards applicable to the campus or standards that the campus itself will propose. Additional analysis should include standards developed for municipalities in areas of karst topography as the use of these standards may mitigate potentially significant impacts of proposed campus development.

- The LRDP DEIR should recognize that sinkholes and swallow-holes drain directly into the groundwater; standards for runoff should take into account the potential to pollute and become concentrated in groundwater. This is especially important as the University proposes to use well water as a mitigation for campus growth impacts and campus runoff could impact local water systems.

- Baseline studies of erosion and siltation rates on and off-site should be completed for the DEIR analysis.

- A hydrological model should be prepared for the entire campus and its sub-watersheds to analyze the baseline conditions under various scenarios. This baseline model would be useful in analyzing any impacts resulting from the proposed LRDP. Cumulative impacts are of particular concern in this area and must be addressed in the DEIR.

- Existing methods of draining stormwater from developed areas of campus may be illegal or overstressed; baseline discharge rates from campus including into each individual karst feature should be included in the DEIR. The DEIR should evaluate alternative methods of disposing of stormwater runoff.

- According to the Campus Sustainability Plan, as part of the proposed LRDP planning process, the campus is exploring opportunities for purple pipe (recycled water) connections across campus. Specifically, Porter has installed purple pipe and is ready to utilize recycled water when it becomes available and Kresge is designed to collect stormwater into a treatment facility to feedback into its water closets. The possibility of using these stormwater collection methods should be evaluated on each site proposed for development under the LRDP. In addition, the Draft EIR should contain mitigation measures to ensure compliance with the UC Office of The President's Sustainability Policy Practices Goal to reduce potable water usage by 36% weighted by campus users by 2025.

- Additional sources of pollution would include parking lots, roads, construction sites, and newly constructed facilities (which are sources of heavy metals, according to the EPA). The 2004 Mitigation and Monitoring Report details high levels of toxins from parking lot runoff long after the 'first flush,' which would have carried even higher levels of toxins. The DEIR analysis of impacts as well as the mitigation measures imposed should include citations of reports documenting the efficacy of such an analysis and proposed practices.

- The University has at least three dams near the Arboretum that may trap runoff if either the karst or the manufactured drainages fail to drain them. If these dams do trap runoff, any dam failure may endanger structures and people downstream of them as well as cause significant environmental damage. The DEIR should evaluate this risk and include mitigations to adequately reduce the potential impacts should the failure of a dam occur.

- Because campus development proposed under the LRDP could create potentially significant impacts in the areas surrounding the campus, the DEIR should analyze potential impacts on Cave Gulch Neighborhood groundwater and wells, impacts on Cave Gulch Creek, impacts on Moore Creek, impacts on Wilder Canyon and Wilder Creek, and impacts on streams and creeks on and below the east side of campus.

- Every water quality impact on campus, however slight, contributes to cumulative impacts on water quality in Monterey Bay, which is a Marine Sanctuary. This is a primary natural resource for the community, marine ecosystem, and vital to any economic sustainability. Recreation is centered around the ocean. People of all ages swim and play in the Bay. The DEIR should evaluate and mitigate this cumulative impact.

WASTEWATER

- Additional population growth resulting from growth in the proposed LRDP will contribute to additional wastewater burdens at the municipal treatment plant. The capital plus the operating costs of the additional burden must be evaluated in the DEIR as potentially significant impacts and mitigation measures included to reduce the impacts to a less than significant level.
- Any increase in carrying capacity of the wastewater piping resulting from growth proposed in the LRDP must be determined in the DEIR and the environmental impacts of any construction, as well as the impacts on water leaving the outfall, must be addressed.

- The UCSC Campus Sustainability Plan indicates that the university will meet the UC Office of the President's Sustainable Practices Policy goal to reduce potable water usage by 36 percent by weighted campus user by 2025 from a 2005-2008 baseline. The strategy commits the university to explore the feasibility of all non-potable water sources for the campus as part of the LRDP planning process. The DEIR should discuss the University's efforts to implement this policy and analyze, as possible mitigation measures, feasible methods for achieving the policy's goal.

PUBLIC SERVICES

- The University's growth target in the proposed LRDP would overwhelm the city. The city's ability to provide public services such as Water, Public Works, Police, Fire, etc… to support the additional campus population will be severely taxed. For example, "Student Houses" often require special police attention, landlords often neglect student houses, and student houses are often overcrowded to afford rents. These all tax city services as well as disturb, and in some cases endanger, families living in neighborhoods. The DEIR needs to analyze these potentially significant impacts.
- The Draft EIR should identify the potential impacts from the increased strain on police resources due to the increase in activity that will be associated with the proposed increase in student populations, such as responses to noise violations, public intoxication, etc. Feasible mitigation measures must be provided.

- NEW STORMWATER DRAINAGE FACILITIES

    - The proposed hydrologic model (above section) should be used to establish acreage figures for any additional stormwater retention facilities. The DEIR should analyze offsite impacts of these retention facilities, including changed hydrology (adjoining areas will be more moist, affecting habitat quality) and new sources of polluted sediment and runoff should these facilities be incorrectly maintained. Such facilities may also attract red-legged frogs; if the water is polluted it would affect the frogs directly or indirectly. These basins may also be sources for the many amphibian diseases affecting red-legged frogs and the Pacific giant salamander. The DEIR should analyze all these potentially significant impacts.

CUMULATIVE IMPACTS

- In Attachment B-2 of the NOP, the University commits to evaluating the "potential for implementation of the LRDP to induce (directly or indirectly) unplanned substantial population growth or displace substantial housing or residents". Given the built-out condition of the City and the likelihood that, if housing is not tied to enrollment growth, an increased number of members of the campus population will live further from campus, the cumulative impact analysis of off-campus impacts should be countywide.

- The cumulative impact analysis in the DEIR should include worst-case assumptions in order to calculate total cumulative impacts.

- The lack of details in the draft LRDP should not result in failure to consider potentially significant impacts even in a Program EIR where information regarding developments proposed in the LRDP is available. For example, total vehicle trips and linear extrapolation of impacts for traffic, drainage, and air quality can be determined based on the NOP and the attached Land Use Map. The Cumulative Impact analysis in the Draft EIR should not understate the draft LRDP's impacts or lead to inadequate mitigation measures.

- The Draft EIR analysis here and throughout should be as specific as possible based on all the information available

SUSTAINABILITY

- According to UC Santa Cruz's Campus Sustainability Plan, UCSC has identified a goal of zero-emissions for new capital projects. The Draft EIR should ensure that this goal is met through the provision of relevant mitigation measures. For example, as of 2018, the UC Office of the President enacted a mandate for the use of all-electric construction equipment in capital projects. The DEIR should include this as a mitigation measure for all construction projects.

GREENHOUSE GASES

- The NOP acknowledges that the DEIR will have to address that the " implementation of the LRDP may result in the generation of additional greenhouse gas emissions during construction and operational activities." The DEIR should document the exact increase in greenhouse gas emissions, the source of the emissions, and state why it would not be feasible to adhere to the UCSC policy of zero-emissions on new capital projects.

- In 2013, the UC adopted the Sustainable Practices Policy which commits UC to emitting net zero greenhouse gases from its buildings and vehicle fleet by 2025. The DEIR should indicate how the university will adhere to this policy.

ECONOMIC IMPACTS

- An EIR must include an analysis of economic impacts where there is a nexus between such impacts and physical impacts. The erosion of the City's tax base resulting from the University's growth under the proposed LRDP due to, for example, the sponsoring of non-education activities on campus without paying the relevant taxes. Streets and parks are deteriorating as a result of this erosion of local tax revenues.

- Another example is the University's purchase of a major manufacturing facility at 2300 Delaware Avenue. When in operation, this facility was one of the largest property taxpayers in the City. It is now off the tax rolls. The University has done nothing to compensate the City for revenue lost. The draft LRDP proposes to expand the use of this facility.

    - As a minimum, the DEIR should consider the economic impacts of the University's expanded use of 2300 Delaware on the decline of the City's streets and parks as a result of inadequate property tax revenues. The Draft EIR should include a mitigation measure to compensate the City for these losses.

- In addition, while the LRDP doesn't speak to additional off-campus acquisitions, it doesn't prevent them either. The Draft EIR should either include analysis of the potential impacts from the use of off-campus properties related to growth projected in the draft LRDP or should contain a mitigation measure to prohibit such uses.
- When selling houses, you have to disclose traffic impacts, the University should evaluate

MITIGATIONS

- The Draft EIR should not use budget limitations for mitigations to determine that a mitigation measure is infeasible. By deciding to grow, the University must recognize its need to budget sufficiently to adequately mitigate the significant impacts caused by that growth. As a major State institution with a large annual budget, the University must adopt a planning principle that UCSC shall not grow unless it has the budget needed to fully support such growth.

- In order for the Draft EIR to be adequate, it must contain clear, accountable, and measurable mitigations and performance standards. Ambiguous "goals" in previous plans have proven unsuccessful in the past and should not be repeated.

- Mitigation measures included in the DEIR should include timelines for implementation and be tied to enrollment levels. Concurrency requirements that tie growth to implementation of mitigation measures are not only feasible under CEQA but, given the experience in the implementation of some of the mitigation measures under past LRDP EIRs are necessary to assure that the mitigation measures occur at the appropriate time.

- The costs of improvements and all mitigations should be identified and be included in the EIR. Subsequently, approval of the LRDP should include commitments to approve the funds for implementation of the mitigation measures as well as the developments proposed in the LRDP. Thereafter, no approval of any proposed enrollment growth or construction or mitigations should occur without the availability of the funds needed for their implementation.

- The DEIR must include information specifying the timing of mitigations, which should directly relate to the timing of impacts.

ALTERNATIVES

- The Draft EIR should fully analyze the following reasonable alternatives:
    - Several lower enrollment increases should be analyzed - 1,000 additional students, 3,000 additional students and 5,000 additional students, and with locating increased UCSC enrollment to other campuses.

    - Providing for the proposed additional student growth by building new campuses in larger communities that can more easily absorb the impacts.

    - Delaying all additional enrollment and construction of new facilities to support additional growth until all mitigations of existing impacts are implemented.

    - Delaying enrollment increases until the resources are identified and committed to meet 100 percent of the academic and housing needs of students, faculty and staff

- The No Project Alternative should assume no enrollment growth beyond the 2005 LRDP enrollment level and no increase in the development of campus facilities to support the current campus population.

- There should be a no project alternative that assumes no additional enrollment growth but does include the development of the infrastructure proposed in the 2005 LRDP.

Based on the likely impacts resulting from the implementation of the draft LRDP, which should be documented in an adequate Draft EIR the City-County Task Force once again strongly urges the University to reconsider the 8,500 FTE enrollment increase contained in the NOP and to significantly reduce or eliminate it. However, we expect the University in their preparation of the DEIR to adequately meet the requirements of CEQA and to fully incorporate the comments contained in this letter. Thank you again for your consideration.

Santa Cruz Metropolitan Transit District

Santa Cruz METRO UCSC 2020-2040 LRDP EIR Scoping Comments:

Thank you for the opportunity to provide comments on scoping of the UCSC 2020-2040 Long Range Development Plan EIR.

Santa Cruz METRO (METRO) has had a long-standing partnership with the University, providing transit service to students, staff, and faculty to and from campus funded primarily by the student transportation fee. METRO transit service is one of the primary tools employed to reduce vehicle trips to and around campus, which is vitally important for preservation of the environment, and for limiting traffic congestion in and around a campus that has severely limited access routes.

Historically, METRO has increased service to UCSC as enrollment has grown so that the University can continue to limit on-campus parking and limit automobile trips.
However, if the University were to increase enrollment by an additional 50% from 19,500 to 28,000 FTE students (and associated growth in staff, faculty and student families) by 2040, this would present a formidable hurdle to METRO to grow UCSC service by up to 50%, one that may not be financially sustainable for METRO.

The University pays METRO an annual fee based primarily on the number of trips provided to students/staff/faculty, but METRO bears the majority of the operations and maintenance cost for each trip (subsidy), with the exception of a limited amount of supplemental service that UCSC purchases by the hour. Furthermore, METRO must purchase the buses. As Federal assistance for bus purchases has dwindled, and as the State of California Air Resources Board (CARB) has instituted requirements for a transition to zero-emissions buses, the cost of acquiring buses has become a major financial hurdle to transit agencies.

Traffic congestion on and near campus is reaching untenable levels. METRO continues to have to add time to UCSC routes due to increasing congestion, in order to stay somewhat close to published schedules. The result is that METRO incurs ever-increasing operational costs, even before adding service due to growth.

As the number of students riding METRO has increased, METRO has responded by acquiring four 60 foot articulated buses, which can accommodate more passengers than the standard 40 foot buses. However, that presents a problem at on-campus bus stops, which were not built large enough to accommodate multiple articulated buses. In order to increase the number of articulated buses to accommodate ridership growth, campus bus stops would need to be expanded. In addition, METRO's bus storage yard and maintenance facility would also require expansion; METRO does not have funding for such an expansion.

Uncontrolled pedestrian crossings are a major source of delay for transit vehicles. This was identified as a problem in the 2005 LRDP, and the mitigation plan called out the need for mitigating this problem, but it continues to this day, and would only worsen with 50% more students, unless successful mitigations are completed.

METRO requests that the EIR analyze:

- the increase in trip run time on METRO UCSC routes due to additional vehicle delay if LRDP enrollment and staff growth of up to 50% proceeds under current transportation mode splits

- a scenario in which additional housing is built on campus that not only accommodates 100% of proposed student growth, it exceeds that number, so that the off-campus housing burden on the community is reduced, thereby reducing trips to/from campus at peak times
- the potential reduction of vehicle trips and vehicle delay on campus if the University were to make permanent the use of online classes and tests (entirely or partially) for classes where appropriate, as was implemented as an emergency measure in response to the COVID-19 crisis.
- the potential reduction of vehicle trips and vehicle delay on campus if the University were to expand work-from-home for those staff functions for which it is feasible.

Please analyze mitigations that could free up circulation on and around campus for METRO vehicles (some were identified in the prior LRDP, but have yet to be implemented):

- Dedicated HOV or transit-only lanes and/or queue jumps at select locations on and around campus
- Transit-signal priority on campus and along campus gateways such as Bay Ave
- A potential Meyer Drive through street between Heller Drive and Hagar Drive that could serve as the METRO campus transit center, from which passengers would walk, bike, or transfer to campus shuttles to reach their on-campus destination
- Pedestrian channelization, traffic signals, and pedestrian overcrossings, to reduce delays to transit caused by unmanaged pedestrian crossings
- For safety and operational efficiency purposes, when the campus reaches a growth of 10% in student enrollment or METRO revenue service hours from the 2019-2020 baseline academic year, all on-campus stops must be expanded at UCSC's expense to support additional use of 60 foot articulated buses.

Please analyze mitigations that are necessary to maintain METRO financial sustainability while continuing to meet the growing transit needs caused by an increase in student enrollment and resulting increase to staff population:

- All growth beyond the academic year 2019-2020 baseline of 19,500 full-time equivalent (FTE) enrolled students will trigger a UCSC responsibility to cover 100% of the annual operating cost of the additional bus revenue service hours needed to respond to said growth.
- All growth beyond the academic year 2019-2020 baseline of 19,500 full-time equivalent (FTE) enrolled students will trigger a UCSC responsibility to purchase METRO buses for METRO use, as needed to respond to the additional revenue service hours needed beyond the 2019-2020 academic year baseline (Fall & Winter service prior to COVID-19 service reductions).
- Pursuant to California Air Resources Board regulations requiring METRO to have a 100% zero-emissions bus fleet by no later than 2040, in the event that in-route zero-emissions bus infrastructure (e.g. electric charging) is needed in order to serve UCSC, UCSC will provide a suitable site and infrastructure on its property.

Thank you in advance for review and consideration of these comments.

Pete Rasmussen
Transportation Planner

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Ecological Services
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

IN REPLY REFER TO:
08EVEN00-2020-CPA-0020

April 8, 2020

Erika Carpenter
Senior Environmental Planner
University of California, Santa Cruz
1156 High Street
Santa Cruz, California 95064

Subject: Notice of Preparation for a Draft Environmental Impact Report for the Long Range Development Plan for University of California, Santa Cruz, Santa Cruz County, California

Dear Ms. Carpenter:

This letter provides the U.S. Fish and Wildlife Service's (Service) comments on the Notice of Preparation (NOP), dated February 25, 2020, and received in our office on February 27, 2020, of a draft Environmental Impact Report (EIR) for the University of California, Santa Cruz (UCSC) Long Range Development Plan (LRDP). UCSC requests that the input regarding the scope of the EIR analysis to include the following recommendations: 1) the significant environmental issues, reasonable alternatives, and reasonable mitigation measures that should be explored in the draft EIR; and 2) whether the agency will be a responsible or trustee agency for the project pursuant to the California Environmental Quality Act (CEQA). Regarding the latter, because the Service is not a State or local agency, we are not able to assume the role of a responsible or trustee agency under CEQA.

As it is not our primary responsibility to comment on documents prepared pursuant to CEQA, our comments on the NOP do not constitute a full review of project impacts. Instead, we provide comments on project activities that have the potential to affect federally listed species, and our concerns for listed species within our jurisdiction related to our mandates under the Endangered Species Act of 1973, as amended (Act). The Service's responsibilities include administering the Act, including sections 7, 9, and 10. Section 9 of the Act prohibits the taking of any endangered or threatened species. Section 3(18) of the Act defines take to mean to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Service regulations (50 CFR 17.3) define harm to include significant habitat modification or degradation which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. The Act provides for civil and criminal penalties for the unlawful taking of federally listed species. Such taking may be authorized by the Service in two ways: through interagency consultation for projects with Federal involvement pursuant to section 7, or through the issuance of an incidental take permit under section 10(a)(1)(B) of the Act.

The UCSC proposes to develop the LRDP, a comprehensive land use plan, which would guide the physical development of the UCSC campus until 2040. The LRDP would supersede the previous land use plan (UCSC 2006). The University of California is the lead agency under CEQA and will prepare an EIR that can be used to tier the environmental review of subsequent campus development projects during implementation of the LRDP.

According to the figure titled Attachment C (UCSC 2020) and the overview slides of the new development (UCSC 2017), the LRDP will include development plans to accommodate and house the proposed increase of students, faculty, and staff members in need of on-campus housing. Sixty-five percent of the new development will occur in already developed areas on campus. However, UCSC has proposed to change the land-use designation of campus resource land, campus habitat reserve, and site research and support to development for housing and academic support (UCSC 2019). As a reminder, UCSC designated the campus habitat reserve, known as "Inclusion Area D Preserve," as protected habitat for the federally listed Ohlone tiger beetle (*Cicindela ohlone*) and the California red-legged frog (*Rana draytonii*) in the Ranch View Terrace Habitat Conservation Plan (HCP) (Jones and Stokes 2005, p. 5.11; UCSC 2006, p. 69). The Service authorized incidental take of the Ohlone tiger beetle and California red-legged frog for the Ranch View Terrace Project by issuing an incidental take permit under section 10(a)(1)(B) of the Act. The Service's authorization was based on UCSC's compliance with, and implementation of the HCP (Service 2005, Permit No.TE089916-0). If UCSC proceeds, as currently proposed, and changes the land-use designation of the Inclusion Area D Preserve, this action would be in violation of the terms and conditions in the incidental take permit. Therefore, UCSC should maintain the current land use designation of Inclusion Area D Preserve in the LRDP.

During the development of the LRDP and draft EIR, we recommend that UCSC consider past Service comment letters regarding proposed UCSC campus development (Service 2006, Service 2008, Service 2010, Service 2017, Service 2018). Additionally, we offer the following recommendations that the Service believes should be thoroughly addressed in the LRDP and draft EIR:

1. A complete discussion of the purpose and need for the project.

2. Specific acreage and detailed descriptions of the amount and types of habitat that may be affected by the proposed project or project alternatives. Of particular concern will be the acreage of wetland and riparian habitats to be affected. We recommend avoiding project activities within Ohlone tiger beetle habitat. Additionally, we recommend preserving and enhancing coastal prairie, known and potential Ohlone tiger beetle habitat, and California red-legged frog habitat. Maps and tables should be included to assist in the evaluation of project-related effects.

3. A list of sensitive species that are present at or near the project site including candidate, proposed, and federally listed species, State listed species, and locally declining or sensitive species. A detailed discussion of these species, focusing on their site-related distribution and abundance and the anticipated effects of the project on these species, should be included in the draft EIR. A detailed report that provides the results of protocol surveys of Ohlone tiger beetle, California red-legged frog, and other possible listed species that could potentially occur within the project area.

4. An analysis of the effects of the project on the hydrology of associated drainages and any other riparian or wetland communities within the sphere of influence of the project. The effects of alteration of natural flows within the affected creeks and rivers should be thoroughly examined.

5. Specific mitigation plans to offset project-related effects, including cumulative habitat loss, degradation, and modification resulting from the direct, indirect, and cumulative effects of the action. The objective of the mitigation plan should be to offset qualitative and quantitative project-induced loss of habitat values and avoid project effects through project modification. In particular, the Service recommends that impacts to wetlands, riparian corridors, and grasslands, which provide an important habitat to many species of wildlife, be avoided.

6. Clearly reflect land-use changes by creating a comprehensive and current land-use map in the LRDP.

7. Identification of construction methods to be employed to prevent soil erosion, along with specific erosion and sedimentation control plans to be carried out throughout the life of the project.

We appreciate the opportunity to provide comments on the NOP. If you have any questions regarding these comments or would like our assistance in ensuring compliance under the Act, please contact Karen Sinclair of my staff at (805) 677-3315.

Sincerely,

Stephen P. Henry
Field Supervisor

LITERATURE CITED

Jones and Stokes. 2005. Habitat Conservation Plan for the Ranch View Terrace, University of California, Santa Cruz. Prepared for University of California, Santa Cruz. Dated May 2005.

[UCSC] University of California, Santa Cruz. 2006. 5. University of Santa Cruz Long-Range Development Plan 2005-2020.

[UCSC] University of California, Santa Cruz. 2017. University of California Santa Cruz, Long-Range Development Plan, overview slides. Dated April 17, 2017.

[UCSC] University of California, Santa Cruz. 2019. Land-Use Map from the 2005 Long-range Development Plan. Amended March 2019.

[UCSC] University of California, Santa Cruz. 2020. Notice of Preparation of an Environmental Impact Report for the UC Santa Cruz Long Range Development Plan. Dated February 24, 2020.

[Service] U.S. Fish and Wildlife Service. 2005. Federal Fish and Wildlife Permit Issued to University of California, Santa Cruz. Permit Number TE089916-0. Dated October 27, 2005.

[Service] U.S. Fish and Wildlife Service. 2006. Letter addressed to John Barnes, Director of Campus Planning, University of California, Santa Cruz. Dated January 11, 2006. Subject: Comment Letter for the Draft Environmental Impact Report for the Draft 2005 Long Range Development Plan, University of California Santa Cruz, Santa Cruz County, California.

[Service] U.S. Fish and Wildlife Service. 2008. Letter addressed to Ken Thomas, Principal Planner, City of Santa Cruz. Dated December 2, 2008. Subject: Comment Letter for the Notice of Preparation of an Environmental Impact Report Regarding the City of Santa Cruz Sphere of Influence Amendment at the University of California Santa Cruz, Santa Cruz County, California.

[Service] U.S. Fish and Wildlife Service. 2010. Letter addressed to Ken Thomas, Principal Planner, City of Santa Cruz. Dated January 19, 2010. Subject: Comment Letter for the Notice of Availability of a Draft Environmental Impact Report for the City of Santa Cruz Sphere of Influence Amendment and Provision of Extraterritorial Water and Sewer Service, Santa Cruz County, California.

[Service] U.S. Fish and Wildlife Service. 2017. Letter addressed to Dean Fitch, Director of Campus Planning, State of California. Dated May 11, 2017. Subject: Comment Letter for the Notice of Preparation of a Draft Subsequent Environmental Impact Report for the University of California, Santa Cruz Main Campus, Santa Cruz County, California.

[Service] U.S. Fish and Wildlife Service. 2018. Letter addressed to Alisa Klaus, Senior Environmental Planner, State of California. Dated March 1, 2018. Subject: Concurrence Request for Student Housing West Project in University of California, Santa Cruz in Santa Cruz County, California.

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] FW: [lrdp] UCSC Long Range Plans

Jolie Kerns <kernsj@ucsc.edu> Mon, Mar 30, 2020 at 8:49 AM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

From: Alayne Meeks
Sent: Monday, March 30, 2020 8:26 AM
To: lrdp@ucsc.edu
Subject: [lrdp] UCSC Long Range Plans

I'm a 50 year resident of Santa Cruz, moving here from San Jose before it was Silicon Valley. I moved here because it was less crowded, valued its open space, and had a university presence. We still have the university presence but we're more crowded with our open space less valued as the need for housing keeps increasing. Santa Cruz itself has limited resources for a continuing pattern of growth at UCSC. I would have a hard time with a neighbor who built a house next door to me but who runs hoses to their house because there isn't enough water, or who asks if some of his family could live in my house because they hadn't built enough rooms. And if this person built in an open space that had been used for research and teaching purposes I'd be downright wishing that person would leave as they obviously had no respect for what they moved into.

UCSC is potentially this bad neighbor, and there's no reason for it. Planning, thinking ahead, respecting the community in which you live, asking your neighbors to help decide important issues that will impact the community are all ways to mitigate being the neighbor we hope will leave or who we wish hadn't moved here in the first place.

The University has enriched the Santa Cruz community, but it's also put undo pressure on its housing, water, and open space. Consider these issues carefully in your long range plans as we all share a unique community in Santa Cruz, and we don't want it spoiled by uncaring neighbors.

Thank you, Alayne Meeks

owner Meeks' Honey in Soquel, CA

--

Please respond to meekshoney@gmail.com, my old account alayne@meekshoney.com no longer exists.
Thank you!

3 April 2020

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development and Operations
University of California, Santa
Cruz 1156 High St.
Santa Cruz, CA 95064

Dear Erika,

I am writing as Manager of the UCSC Campus Natural Reserve (CNR) with comments regarding the Notice of Preparation (NOP): Environmental Impact Report (EIR) for the 2020-2040 Long Range Development Plan (LRDP). I am grateful for the continued opportunity to work with you on this topic and am pleased with the designation of the Campus Natural Reserve lands in the LRDP's Draft Land Use Map. I am writing with the following comments pertaining to potential impacts to the CNR and other campus natural lands that I hope will be addressed within the scope and content of the forthcoming EIR. I will focus these comments on a few of the many CEQA issue areas identified Attachment B of the NOP.

1. Biological Resources

- Permanent protection of the CNR
    - I would like to see the EIR discuss permanent protection of the CNR. This topic crosses over into other CEQA issue areas, including but not limited to wildfire, recreation, greenhouse gas emissions, and noise. Additionally, permanent protection of the CNR would allow for secure access to intact natural lands that help fulfill the university's teaching and research missions.

- Campus-wide Habitat Conservation Plan
    - The campus has threatened and endangered species and the LRDP proposes development in some areas of designated critical habitat for the California re-legged frog. A discussion of the establishment of a campus-wide HCP that could prescribe mitigation, management, and monitoring requirements for development within these areas should be considered in the EIR.

- Impacts to California giant salamander from development of Colleges and Student Housing area to west of North Perimeter parking lot.
    - I have found adult California giant salamander (*Dicamptodon ensatus*) several times within the CNR and surrounding non-CNR lands in the uplands east of Cave Gulch and along the tributary stream that passes below the West Rd culvert just NW of the top of the North Perimeter parking lot. The species breeds in Cave Gulch stream, within the CNR, where larva can be found year-round (larva can also be found in the tributary I mentioned). The California Department of Fish and Wildlife designates this species as a Species of Special Concern. Although dispersal distance of the terrestrial form of this species is unknown in our region, members of this species have been shown to migrate several hundred meters from aquatic habitat. The impacts of development on this species should be considered in the EIR.

- Empire Cave organisms
    - Several rare and endemic invertebrate species have been identified in Empire Cave, a karst formation along the Cave Gulch stream just west of Porter Meadow. These species include the Santa Cruz Telemid spider (*Telemid* sp.); *Meta dolloff; Stygobromus mackenziei*, an amphipod; and *Fissilicreagris imperialis*, a pseudoscorpion. In a 2002 report of the cave's biological

diversity, Dr. Darrell Ubick of the California Academy of Sciences lists several ongoing impacts from human use of the cave, including well-intentioned cave clean-ups that remove important habitat (wood, other natural debris) and introduction of chemicals via smoke, campfires, and spray paint, as a threat to these rare organisms and their habitat. Increased density of students living in close proximity will likely increase potential impacts to the cave and associated fauna.

    - Current mitigation includes installation and maintenance of an interpretive sign by the cave entrance, which CNR staff currently maintain. Proximity to Empire Grade and parking areas makes management difficult, as the cave is very visible and accessible. Further mitigation could include increased enforcement of parking restrictions near the cave and installation of a permanent, wildlife-permeable gate that would limit human entrance of the cave to researchers and very limited class use.

- <u>Outdoor lighting</u>
  - Outdoor lighting can have an effect on animal behavior. The proposed developments will surely have outdoor lighting for safety and general use. Analysis of the potential developments' lighting design should be incorporated into the EIR.
    - Potential mitigations: Outdoor lighting could be eliminated on the outer, wildland-facing edges of proposed developments, and if necessary, dimmer, downward-facing lights, the use of motion sensors, and late night off-periods are recommended strategies to minimize the intensity of impact that the lights may have on the surrounding habitats.

- <u>Restoration/invasive species issues</u>
  - Construction and staging areas of developments will be disturbed and will need restoration. Restoration of these areas should be done with native species from local seed sources. Additionally, establishment of invasive plant species is a concern for adjacent CNR lands, as well as other-designated natural areas near potential project sites.
    - Mitigation measures could include, but not be limited to, the following:
      - Surveying for invasive species in construction and staging areas pre and post project construction
      - Rumble-strips to reduce transport of seeds within soil on truck tires
      - Revegetating construction and staging areas with native plants from local sources
      - Landscaping the any new developments with native plants from local sources
      - Pre and post photo documentation of sites
      - Specific language pertaining to continued weed abatement if invasive species are introduced to the site.

2. Cultural and Tribal Cultural Resources
   - The EIR should consider how permanent protection of the CNR would protect important tribal cultural resources in perpetuity.

3. Hydrology & Water Quality
   - Management of stormwater runoff from project development sites (including construction and staging areas, as well as the completed development and parking areas) and associated erosion potential should be incorporated into the EIR.

I ask that these potential impacts of the 2020-2040 LRDP on the Campus Natural Reserve and surrounding natural lands be included within the scope and content of the upcoming EIR. I would be happy to assist with creating education-related mitigation measures and guidance for issues surrounding biological resources.

Respectfully,

Alex Jones
UCSC Campus Natural Reserve Manager
1156 High St
Santa Cruz, CA
95064
831.459.5798
asjones@ucsc.edu

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Preserve the integrity of CNR and make them a permanent reserve

1 message

Alex Krohn <arkrohn@ucsc.edu> Wed, Mar 11, 2020 at 9:04 AM
To: eircomment@ucsc.edu

Hi there,

I am a staff member of UCSC and would like to comment on the LRDP EIR. I would like it known that I strongly support permanent protection of the Campus Natural Reserve, a maintenance of CNR's existing boundaries, an expansion of CNR's land in the future, and to minimize habitat destruction wherever possible. Not only does CNR provide an excellent learning and research opportunity for the campus, but the protection that CNR offers lets UCSC steward its natural resources (including multiple protected species) in perpetuity. Permanent protection of CNR will allow for simpler EIRs in the future.

Thank you,

Alex Krohn

--
Alex Krohn
Assistant Director
Kenneth S. Norris Center for Natural History
Office: 239 Nat Sci II
he/him/his

Mailstop: ENVS
University of California, Santa Cruz
1156 High St, Santa Cruz, CA, 95064

Norris Center for Natural History

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] 9000 students , an infrastructure nightmare

1 message

Bonnie Cho <bonnie.cho@mindspring.com> Mon, Apr 6, 2020 at 8:12 PM
To: eircomment@ucsc.edu

To whom it my concern ,
I do not understand the mandate to enlarge the student body I do not want to beat a dead horse but it is so very obvious the campus will and has been Stretching the infrastructure and resources of this community to its limits. Perhaps you should consider other communities that have the room for growth . To date California has more colleges and Universities than a great number of states . I mean hundreds of them .!!!!
Is this absolutely necessary!!!
Consider the English town planning regulations .

Sent from my iPad

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP EIR Scoping Session

Brian Smith <brian@cre8ivsales.com>
To: eircomment@ucsc.edu

Wed, Apr 1, 2020 at 3:15 PM

Proposal for an alternate west side access to campus be placed on the agenda
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Hello,

I'm writing to propose that UCSC add an alternative access road to the LRDP agenda to the campus via Hwy 9/Harvey west. The current LDRP has an additional road added to feed into Felton Empire Grade; this will only continue to add more traffic to High Street, Bay Street and to a lesser degree Western, all of which are already impacted by UCSC's growth.

It is time for UCSC to redistribute access to the campus and mitigate traffic and emergency evacuation routes to and from the campus.

A new access road does not mean it must be a road for conventional cars, but it could be for dedicated shuttles to move students and faculty to the Harvey West side industrial area or alternatively an "electric/clean air" vehicle only access (*no doubt there are many other permutations to this*) that would minimize impact to the surrounding area.

I hope to see this on a revised LDRP plan in the near future for UCSC.

Respectfully,

William Brian Smith

Creative design & manufacturing
P: +1 831.621.4996 F: +1 831.426.0530

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Public Comments - LRDP 2020

1 message

Candace Brown <clbrown23@gmail.com> Wed, Apr 1, 2020 at 7:19 PM
To: eircomment@ucsc.edu

Anyone who has lived here for the last 30-40 years and who attended UCSC know of the degradation of the UCSC educational experience, the increased rents especially in the last 5 years of 40-100% and several thousand families leaving and hundreds of small businesses, entrepreneurs and artisans that cannot compete with the never-ending increase of students that now seem like locust to the Santa Cruz Community.

The growth of UCSC must stop until the existing growth impacts are stabilized in the area of:
1. Independent measures of the quality of UCSC education and retention includes reduced administrators to professor ratios, increased professor to student ratios and increased student success measures,
2. Plan B watering sourcing for the Santa Cruz community planned but not established in the next 10-years
3. The cost of rentals in town that cannot exceed 5% per year
4. A budget of Santa Cruz that does not have a deficit growing to over $20 million+ within next 4-5 years.
5. A budget for Public Works and Transportation to handle degrading existing infrastructure let alone impacts of population expansion.
6. Significant reduction in bicycle and pedestrian accidents that are some of the worst in the state exacerbated by the significant traffic in Santa Cruz.
7. A vote of the people of Santa Cruz that would require at least 67% acceptance of further UCSC expansion.

There is a growing cultural shift between the UCSC administration and the Santa Cruz Community that has reduced access to cultural events such as the Shakespeare Festival in the last 5-years. Additional neighborly efforts with the Santa Cruz Community that is closer than campuses such as Santa Barbara would show some gesture of integration with Santa Cruz but instead there is a growing separation while dealing with unbearable traffic and metro impacts and significant housing shortage.

Finally, to consider ruining the iconic Great Meadow and ignore the petition of now 88,577, is a final slap in the face to the Santa Cruz Community and former alumni of UCSC.

You can consider other alternatives including expansion of campuses such as UC Merced, the use of property at the Ford Ord for campus expansion and the possible opening of campuses in less served areas than the Bay Area.

Sincerely, Candace Brown
Resident since 1974 and UCSC alumni

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Plan for proposed growth

1 message

Carola Barton <carolab@sbcglobal.net> Mon, Apr 13, 2020 at 12:49 PM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

I am writing to encourage you to extend your comment period, given the extraordinary circumstances in which we find ourselves. The growth of UCSC will have enormous impact on the already stretched resources of Santa Cruz County, and it would be to the benefit of all to have adequate time for discussion of UCSC expansion in all of its ramifications.

Thank you for your kind attention.

Carola M. Barton
831.419.1471

---

eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

[eircomment] LRDP NOP Comments

2 messages

Christopher Reithel <creithel@ucsc.edu> Thu, Mar 12, 2020 at 1:33 PM
To: eircomment@ucsc.edu

Comment:
Students are concerned about the university's vision for the LRPD. Many of the plans in the LRDP have solely focused on the preservation of natural areas, not on preserving the wellbeing of students and the community. While the university has been successful in preserving our meadows and forests, they have failed to provide students with their basic needs such as housing, food, transportation, health services, and livable incomes.

If the university can propose increasing enrollment targets, then it is crucial to recognize the overlooked social and environmental justice issues that are at the forefront of student life on campus.

Student health and belonging should not be a small portion of the EIR, but rather a guiding lens through which we can analyze and plan further campus development.

Christopher G. Reithel

Undergraduate Student | University of California, Santa Cruz
Business Management/Economics

Parker Welch <pawelch@ucsc.edu> Thu, Mar 12, 2020 at 1:36 PM
To: Jolie Kerns <kernsj@ucsc.edu>, Erika Carpenter <escarpen@ucsc.edu>, Gary Jakobs <gary.jakobs@ascentenvironmental.com>

[Quoted text hidden]

--
Parker Welch
Pronouns: he, him, his

GIS/CAD Programmer Analyst
University of California Santa Cruz
Physical Planning, Development, & Operations
Physical and Environmental Planning Services
Tel: (831) 502-7043 | **Email:** pawelch@ucsc.edu
UC SANTA CRUZ

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comments

1 message

Chryssi Ladas <cladas@ucsc.edu> Wed, Apr 8, 2020 at 3:23 PM
To: eircomment@ucsc.edu

Dear Erika Carpenter,
My name is Chryssi Ladas and I am a 4th year undergraduate student here at UCSC who is currently involved in the Natural Resource Management IDEASS lab. With the EIR soon under way for the 2020 LRDP, I'd like to use this opportunity to comment to explain why the Campus Natural Reserve should have permanent protection established as part of an increased need for management of the unique open spaces we have on campus. The CNR is also home to some endangered and/or threatened species as is the campus at large. That is why there should also be a campus-wide Habitat Conservation Plan so that these species, their habitats, and the intrinsic value of the open and natural spaces of the campus can be properly protected and managed.
Considering that the LRDP includes such large increases in student size that means increasing academic, recreational, and residential areas, as well as transportation, to accommodate, the surrounding habitat and species present risk being ignored, or at worst, harmed, without a proper plan that considers them. Lastly, the LRDP means recreational land use will inevitably expand, formally or not. With hundreds of non-UCSC-affiliated community members visiting the campus every week currently (pre-quarantine) to hike, mountain bike, and generally just appreciate the campus' unique beauty and green spaces, in addition to the actual students and faculty who use the upper campus to commute in addition to recreational activities, there must be a Recreational Land Use plan that includes officially sanctioned and properly managed trails, especially with the inevitably growing activity of mountain biking that has such murky campus legality surrounding it on the campus trails. With a growing campus and a new LRDP, this should absolutely be included, especially since a Recreational Land Use plan has its own environmental impact considerations as well. The "Recreation" CEQA issue area does not stop at just the OPERS facilities and fields: the upper campus, that includes countless and popular (albeit neglectfully managed) trails, plays a large part in campus recreation for both the student population and the surrounding community as well.
As a student who chose to attend UCSC partly for its natural beauty and inclusion of its CNR and vast open spaces teeming with life, I hope that these factors receive the proper protections, management, and considerations in such an important plan and report.
Sincerely-
Chryssi Ladas

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Please include mountain biking in plan

1 message

'David Sawaya' via eircomment@ucsc.edu <eircomment@ucsc.edu> Tue, Mar 10, 2020 at 6:59 PM
Reply-To: David Sawaya <dbsawaya@yahoo.com>
To: eircomment@ucsc.edu

Thanks for accepting comments on the UCSC LRDP. I urge you to consider mountain biking in the plan. Santa Cruz is home to a vibrant mountain biking community. Considering mountain biking as a core activity within the LRDP at the early stages of development will ensure support for that community and its integration with other activities on campus.

Thank you.

Google @ UCSC

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Remarks from a Stevenson graduate.

Diane Cohan <diane@tricountylegal.com> Tue, Mar 31, 2020 at 2:56 PM
To: "EIRCOMMENT@UCSC.EDU" <EIRCOMMENT@ucsc.edu>

As a 1969 Graduate of Stevenson college who stayed and thrived in Santa Cruz since then, I have strong feelings about the obligation of the decision makers to understand that there is not enough infrastructure available to house students; let alone apparently to feed them ..I buy double items at Trader Joes and hand that bag over for the food pantry. I am very blessed in part, due to my amazing education which was actually jump started at Foothill in Los Altos. And of course, I have worked hard all my life to do the right thing … Please do not expand in the near future.. Please. Diane Cohan MA MPA LMFT Private Investigator and Psychotherapist (principally to law enforcement)

[eircomment] No more growth at UCSC says Dohna owner of Made in Santa Cruz

1 message

Dohna <dohna@madeinsantacruz.com> Tue, Mar 31, 2020 at 2:22 PM
To: eircomment@ucsc.edu
Cc: Deborah Elston <elston13@earthlink.net>, Dohna <dohna@madeinsantacruz.com>

I love UCSC and the students it brings to Santa Cruz every fall and lets them go every summer.

I honor the education that it gives to the students as well as the community.

Yes the community of Santa Cruz California has been very generous with growth of UCSC in the past

But now 2020 your growth of UCSC has to stop.

You take up so much space in Santa Cruz that the People who live here and make up the Community of Santa Cruz say

“No More”.

You got the best land in the whole entire county, so be grateful UCSC.

Our rentals are occupied by the students because YOU UCSC do not provide enough housing for all your students.

Please make this your first project, housing your crew, which will release some of the rental property back to Santa Cruz residents so our family’s can live here.

Why are the students protesting? Because they do not like your selfish policy and greed

and either do the people of Santa Cruz.

No more expansion for you 2020.

And we should add that you must house all of your students and facility and workers who support your UCSC Campus.

Help the County with Road Repair.

I love the University and so do the residents of Santa Cruz, I am sure I speak for many, No more growth for the University, No more students, No More.

No More increasing student population. That is my vote.

Preserve Santa Cruz,

Keep Santa Cruz, Santa Cruz

Dohna Dunderdale

Resident, Tax Payer since 1973

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] question for EIR tonight

1 message

Elaine Sullivan <easulliv@ucsc.edu> Wed, Apr 1, 2020 at 5:37 PM
To: eircomment@ucsc.edu

Based on the 2040 plan, the campus will potentially host 32,000 students and faculty. According to your 2016 water usage report posted at your website here: https://lrdp.ucsc.edu/2040/files/forums/water.pdf, **46%** of our campus water usage comes from **residential student housing**, with an additional **8% from dining facilities** and **5% from faculty housing**. Considering all of these three, which make up almost **60% of our campus water** use will be increased significantly if the campus adds the thousands of planned students, staff and faculty - especially as the campus is committed to building significant new student housing, meaning that water usage will happen on campus - what is the increase in water supply that we will need to supply the campus at this rate?

Considering the increasing levels of drought impacting the state of California, as documented at US government websites like Drought.gov: https://www.drought.gov/drought/states/california, how can UCSC justify so dramatically increasing the number of students, faculty and staff brought to campus?

Sincerely,

Elaine Sullivan

--
Elaine A. Sullivan, Ph.D.
UC Santa Cruz
Associate Professor, History
https://constructingthesacred.org
https://people.ucsc.edu/easulliv
Affiliated Faculty, Anthropology
831-459-3109

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UCSC's proposed LRDP

1 message

Mike & Elizabeth Saint <m6e3saint@gmail.com>
To: eircomment@ucsc.edu
Sat, Apr 4, 2020 at 4:41 PM

This is what we need, at minimum:

Getting to Zero New Car Trips---

1. UCSC: Commit to zero new vehicle trips to campus and make growth contingent on achieving this goal.
2. UCSC: In light of the large externalized environmental and social costs of auto travel, reform the parking permit program to charge per-day rates. Raise the price of parking and use parking proceeds to support:
   a. a significant share of the cost of campus shuttles and UCSC's contribution to METRO, allowing a reduction in student fees for transit
   b. free transit passes for all faculty and staff
   c. vigorous marketing of alternative commutes
3. UCSC: Stop building more parking capacity and begin to repurpose parking lots for infill development.

Recommendations for the City of Santa Cruz

1. City of Santa Cruz: Instead of spending limited resources on building new parking facilities and widening intersections, use parking revenue and traffic impact fees to fund:
   a. safe pedestrian and bicycling routes to campus
   b. bus prioritization on City streets
2. City of Santa Cruz: Collaborate with UCSC in implementing a charge on ride service companies (e.g. Uber/Lyft) and a congestion pricing program for all vehicle trips to campus, with proceeds going to transit and transportation demand management measures.

Additionally, the current COVID-19 crisis should show us that remote learning is a very viable option that doesn't tax our infrastructure.

Sincerely,

Elizabeth Saint

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] I support campus expansion

1 message

'Evan Siroky' via eircomment@ucsc.edu <eircomment@ucsc.edu> Mon, Apr 13, 2020 at 8:03 AM
Reply-To: Evan Siroky <evan.siroky@yahoo.com>
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

To Whom it May Concern,

I support growth at UCSC because I think it's a good idea to provide higher education for future generations. In the EIR comment, I'm sure you're getting a bunch of negative feedback fo people complaining about the lack of infrastructure nearby. They are partly right, but I worry that they are imposing an undue burden on the UC system and thus making things more expensive.

I went to school at the University of Washington in Seattle from 2003-2006 and again in 2007-2008. In the time since then, the entire region has supported the growth of that university in a variety of ways such as the city allowing dozens of large student housing projects - both on and off-campus - both private and university-associated to get built. The region built a subway to the campus and is in the process of extending it further. In this case it is clear that regional cooperation to facilitate higher education has resulted in highly positive outcomes.

In Santa Curz, the city and county could do a better job of facilitating growth, but instead are using their resources to act like NIMBYs. It is totally unrealistic to expect the UC to mitigate everything, and why should they? Shouldn't we as a society be encouraging students to get a higher education and providing the needed facilities even if it might slightly inconvenience some with increased traffic? Therefore, since you have legislative powers to grow and it is the right thing to do to provide higher education, I encourage you to do it anyways.

Evan Siroky

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UCSC LRDP EIR NOP

1 message

Frank Barron <fcxbarron@gmail.com> Wed, Apr 8, 2020 at 3:42 PM
To: eircomment@ucsc.edu

April 8, 2020

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development and Operations
University of California, Santa Cruz

Re: UCSC LRDP EIR NOP

Dear Ms. Carpenter,

Please ensure that the LRDP EIR addresses the concerns/issues contained in this email.

I am a retired land use planner from the County of Santa Cruz. In that role, I was the primary author and coordinator of the County of Santa Cruz comment letter on UCSC's previous LRDP EIR NOP. Please incorporate the comments contained in that letter by reference, as most of the issues are the same this time around.

In particular, the following issues should be fully evaluated in the EIR:

Water: Please ensure that water supply, taking into account the city and county's future growth and future droughts (accounting for likely increased droughts due to climate change), is fully evaluated.

Transportaion/Traffic: Please ensure that transportaion/traffic impacts are fully evaluated, particularly impacts (and cumulative impacts) to the Mission St./Laurel St. corridor, as this route is regularly at Level F on weekeday afternnons during the UCSC school year already, without any additional university growth.

Housing: Please ensure that the housing impacts (and cumulative impacts) are fully addressed, particularly affordabilty and supply impacts to the City's rental housing stock.

Rare/Endangered and other Species: Please ensure that all impacts to potentially effected flora, fauna and ecosystems are fully addressed, particularly to possible impacts on cave fauna in the cave systems on or adjacent to campus.

Recreational Facilities: Please ensure that impacts to recreational facilities are fully evaluated, in particular overcrowding impacts to the limited surfing locations in the City and County.

Alternatives Analaysis: Please ensure that the alternative of reducing foreign and out-of-state enrollment as a means of reducing UCSC enrollment growth is fully evaluated. Also, please ensure that the alternative of shifting the proposed future UCSC student enrollment increase to other UC campuses, particularly the newer, growing UC Merced campus.

Thank you for this opportunity to comment on the UCSC LRDP EIR NOP.

Sincerely,

Frank Barron, AICP
Santa Cruz, CA
50-year County resident

Frank Zwart, FAIA, FAUA

530 Spring Street
Santa Cruz, California 95060

April 8, 2020

Senior Environmental Planner Erika Carpenter
Physical Planning, Development, and Operations
University of California, Santa Cruz
1156 High Street
Santa Cruz, California 95064

Re: Notice of Preparation - Environmental Impact Report
UC Santa Cruz Long Range Development Plan

Dear Erika:

This letter is in response to the February 25, 2020, Notice of Preparation of an Environmental Impact Report for the UC Santa Cruz Long Range Development Plan. To begin, I note that the campus has so far released very little information to the public about the proposed LRDP. The most recent information, on the UCSC 2040 LRDP web page, is limited to three slides in the PowerPoint presentations used in recent NOP Scoping Sessions: one titled "Planning Considerations"; a second titled "Proposed Land Use Strategies," and a Draft Land Use Map. Providing potential respondents to the Notice of Preparation with such limited information about such an ambitious plan puts them at a significant disadvantage in preparing their comments.

The following issues, organized by CEQA resource area, should be addressed by the Environmental Impact Report for UCSC's LRDP:

1. Aesthetics: The EIR should include accurate, detailed, and realistic visual simulations of the denser development proposed in the 2040 LRDP, particularly in those areas of the campus typically referred to the "ecotone" (i.e., those areas where the campus meadows meet the forest areas to the north).

2. Aesthetics and Land Use and Planning: Campus development is guided, in large part, by UCSC's *Physical Design Framework*, a document which was accepted formally by the University's Board of Regents in March 2010 and with which, under University policy, all projects are to be consistent prior to approval of design. The relationship between the development proposed in the 2040 LRDP and the guidelines of the *Physical Design Framework* should be described and analyzed by the EIR.

3. Cultural Resources: In 2007, a significant portion of the southern part of the campus, the Cowell Lime Works Historic District, was listed in the National Register of

Historic Places and the California Register of Historical Resources. The impact of development under the 2040 LRDP on those resources should be analyzed in the EIR.

4. Land Use and Planning: The Draft Land Use Plan presented in Scoping Sessions PowerPoint presentation cited above eliminates the land use category "Protected Landscape" used by both the 1988 and 2005-2020 Long Range Development Plans. That latter document states: "To the extent feasible, Protected Landscape will be retained in an undeveloped state as the campus grows." The EIR should analyze the environmental impacts of this proposed elimination.

The Alternatives section of the EIR should include thorough analysis of a land use plan with more development north of the existing campus core, and less to the south, thus lessening the visual impact of new development along the tree line or ecotone.

Sincerely yours,

Frank L Zwart

Frank Zwart, FAIA, FAUA
Campus Architect Emeritus
University of California, Santa Cruz

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] the campus is already beyond MAXED out

Blissful One <blissfulone2day@gmail.com> Mon, Apr 6, 2020 at 7:13 AM
To: eircomment@ucsc.edu

submitted by GA Brewer

---------- Forwarded message ---------
From: **Blissful One** <blissfulone2day@gmail.com>
Date: Mon, Apr 6, 2020 at 7:11 AM
Subject: the campus is already beyond MAXED out
To: <eircomment@ucsc.edu>

do NOT build more buildings
do NOT enroll more students
do NOT contribute to the over crowding of Santa Cruz
do NOT continue to pay TA staff sub standard wages
do NOT use more water
do NOT cut down more trees

Erika Carpenter <escarpen@ucsc.edu>

LRDP NOP Comments

Gage Dayton <ghdayton@ucsc.edu> Mon, Apr 6, 2020 at 3:15 PM
To: Erika Carpenter <escarpen@ucsc.edu>

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development and Operations
University of California, Santa Cruz
1156 High Street, Santa Cruz, CA 95064
Email: eircomment@ucsc.edu

Dear Erika,

Thank you for the opportunity to provide input on the scope of the UCSC LRDP EIR analysis. A tremendous amount of work has gone into the planning and I appreciate the opportunity to continue to provide input and work with you, the UCSC team, and consultants during its preparation. I have a few items that I would like to be sure are included in the EIR scope:

1. Evaluate the impacts that increased recreational use (as a result of increased population) will have on academic and environmental resources (e.g. research sites, areas used for teaching, sensitive species, storm water runoff, etc.). Assess the efficacy of existing recreational planning documents and management actions and update as necessary.

2. Assess permanently protecting the Campus Natural Reserve (CNR) in a manner that ensures perpetual protection and support of field research and teaching sites, cultural resources, sensitive species, and species listed under the Federal and State Endangered Species Acts. To do this, I would like the scope of the EIR to explore 1) working with USFWS and CDFW to create a campus wide HCP and 2) designating the CNR as a UC Natural Reserve.

3. Address impacts development will have on upland and dispersal habitat of sensitive species that occur on campus.

4. Assess impacts to connectivity to adjacent natural lands and how growth may impact movement of species across campus lands.

5. Examine how undeveloped campus lands adjacent to campus development will be managed for fire. Assess the potential academic and environmental (positive and negative) impacts this will have.

6. Explore ways to reduce campus water and energy demand from non-campus supply sources. E.g., creating on-campus water treatment and re-use infrastructure and placing solar panels on all built structures that have adequate sun exposure.

7. For transportation, examine how meeting the majority of current and future parking demands by moving some of the current parking, and most of (if not all) new parking, into underground parking facilities (e.g. beneath future buildings) or building up or beneath existing parking lots so that there are no single level parking structures on campus could reduce the overall footprint of development.

8. Assess current campus wide land management plans and evaluate the need for creating or updating plans in order to achieve goals and objectives established in the EIR.

Again, I appreciate the significant effort that has gone into the LRDP and am grateful for how you have engaged faculty and staff in the process. I look forward to working with you on the next steps. Please let me know if you have any questions, I am ready to help.

Sincerely,

Gage

--

Admin. Director, UCSC Natural Reserves
Wilton W. Webster Jr. Presidential Chair
1156 High Street, ENVS
Santa Cruz, CA 95062
Of: (831) 459-4867
Cell: (831) 227-5887
https://naturalreserves.ucsc.edu/
https://www.facebook.com/ucscnaturalreserves

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UC Merced has plenty of room to grow.

Gregg Herken <greggherken@gmail.com> Wed, Apr 1, 2020 at 12:11 PM
To: eircomment@ucsc.edu

Dear UCSC: Your campus already has a higher percentage of students to residents than any other; including Berkeley's, I believe. Your impact, not surprisingly, has therefore been disproportionate--on the town's infrastructure, basic resources, and, not least of all--politics. (I know UCSC has been very good at using water; thanks and congratulations for that. But do not tell me that nearly doubling the student enrollment will have no impact on water consumption during the coming droughts.) In short, there is no reason that the "city on the hill" should become "Ohio State on the hill." There is a natural limit to all growth--as has long been observed, trees don't grow to the sky. UCSC has hit or even exceeded that limit. While I understand that California's Constitution gives UC free rein to do what it wants, the poisoning of town-gown relations is not worth it to the University. And the local option still exists to refuse water/sewer hookups for new construction on campus; I understand Santa Barbara did just that at UCSB. And, finally, UC Merced has plenty of room to grow and could use the resources. I speak from experience.
--Gregg Herken, Emeritus Professor of History, University of California, Merced
PS: And the public will not forever be fooled by the argument that you want to expand to educate more young Californians. The real reason you want more students is so that you will be able to add faculty and administrators, in the expectation that the state will eventually reinstate the old enrollment/hiring formula in UC's budget.

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP

1 message

Grif Tmesc <griftmesc@gmail.com> Wed, Apr 1, 2020 at 6:54 PM
To: eircomment@ucsc.edu

I don't understand why all the old codgers who moved here decades ago continue to pull up the ladder on students and future residents.

The UC planners have no control over enrollment growth. They're trying to build housing for the people and a beautiful campus for the future. Creating housing doesn't create people, sex does.

Thank you for holding this session regardless of the current lockdown.

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] 1-APR-2020 meeting

Howard Schwartz <howards2002@gmail.com> Wed, Apr 1, 2020 at 12:05 PM
To: eircomment@ucsc.edu

Why hold a meeting when you know the attendance will be negligible?
Is this an April Fool's joke?
I recommend rescheduling to a more appropriate time.

Howard Schwartz
howards2002@gmail.com

Erika Carpenter <escarpen@ucsc.edu>

Re: [eircomment] EIR Comment

1 message

Ilan Zur <ilanjzur@gmail.com> Wed, Apr 1, 2020 at 7:24 PM
To: eircomment@ucsc.edu

Dear UCSC,

I am a recent UCSC graduate and I am reaching out to request that UCSC extend the public comment period due to this public health crisis.

This is a very significant proposal with the potential to create significant negative impacts for our community, and it feels highly inappropriate to end the scoping period at a time when our community's energy and focus is focused primarily on surviving this health crisis. I know many current students are unable to meaningfully participate in this process as they are no longer residing in the community due to remote courses. Please re-consider extending the public comment period.

[eircomment] Local, alumni etc

Iris Weaver <irisweaver@gmail.com> Wed, Apr 1, 2020 at 6:44 PM
To: eircomment@ucsc.edu

Hello,
>
> I have lived in Santa Cruz since 1995. I moved here for my first job as a young adult. It is a dream come true living here including have UCSC here. I went to graduate school at UCSC in 2000. It was wonderful but it was terrible traveling to campus from the Eastside each day. It was actually almost impossible to park, go to school and work.
>
> Class sizes are already too big. I love UCSC but it needs to get smaller not larger.
> Make your school smaller.
> House all students on campus.
>
> I currently live close to Bay Street. Students speed up and down it. I was recently hit by a car on Bay Street so I take this even more seriously. I don't allow my child to bike to school any longer.
>
> Please reconsider your plan. What about expanding your remote classes?
>
> Best,
> Iris Weaver, MA, MAT
>
>
> Sent from my iPhone

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRPD NOP Comments

1 message

Isabella Brown <isbrown@ucsc.edu> Wed, Apr 8, 2020 at 4:01 PM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

Dear Ms. Carpenter,

Hello! My name is Isabella Brown and I am writing to let you know my thoughts about the LRDP Notice of Preparation. This year I have been working as an undergraduate Sustainability Fellow in an IDEASS lab focused on natural resource management. Our class is in the process of proposing a recreational land use plan for the campus Natural Reserve system. We have conducted stakeholder outreach and trail assessments to create this plan. We identified over 50 stakeholders to contact for their opinion and experiences of recreation in the Natural Reserves. We surveyed trail damage and evaluated trail camera data to determine how these trails are being used. Based on stakeholder input and our own experiences doing fieldwork and camera analysis, the Natural Reserves are clearly a valuable asset of the community. The Natural Reserves have also provided an opportunity to myself, other students, and faculty to perform research, fieldwork, and improve our campus and school. I would like to recommend permanent protection of the Natural Reserves to preserve its beautiful ecosystems and incredible opportunities that it provides. Additionally, due to the extensive environmental damage trails have caused, and the continually increasing amounts of recreators, I would recommend a Habitat Conservation plan for our campus. Conservation measures are necessary to protect threatened and endangered habitats and species on our campus that are negatively impacted by recreation and other development.

Thank you for your time!

Sincerely,
Isabella Brown

[eircomment] LRDP NOP Comments

1 message

Scott Family <imscott@cruzio.com>
To: eircomment@ucsc.edu
Tue, Apr 7, 2020 at 3:42 PM

Erika Carpenter, Senior Environmental Planner
Physical Planning, Development and Operations
University of California, Santa Cruz

Re: LRDP NOP Comments

I do not support a UCSC student growth increase from 19,500 to 28,000 students in the UCSC 2040 LRDP. As a long time resident of Santa Cruz and retired UCSC employee, I think the highest priority for UCSC should be to have a student body which can be supported within its current infrastructure and within our city. This priority will promote the goal of academic excellence the university embraces.

Santa Cruz cannot accommodate such a huge increase in the number of college students. Here are some reasons why:

Santa Cruz is the smallest host city of any UC campus. We are situated on a narrow band of land between the mountains and the sea with limited room to grow. We also have limited emergency routes for both the campus and the community as well as major water supply constraints.

We are under extreme growth pressure now. We are a popular tourist town and recently we have become a giant magnet for high income workers, second-homers, and others escaping the astronomical housing market and congestion in the San Francisco Bay Area. Long-time residents of low-to-moderate income and their families can no longer afford to live here. Many UCSC students and employees experience these problems also. We no longer have affordable rentals or adequate public transportation for our existing population and certainly not for such a huge increase in UCSC students and employees.

College students are suffering, many without adequate housing and food. Such an environment cannot support a quality education at one of the world's premium public universities. Students need to be in an affordable community, not one that is already overcrowded and has one of the highest costs of living in the nation.

The UCSC administration should reduce the LRDP 2040 growth projections to a more sustainable level. Further, it should recommend that the UC Regents direct more growth to those campuses which have adequate room for expansion and larger communities to absorb them.

Sincerely,
Isabelle Scott
Santa Cruz

eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Google @ UCSC

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] AGAINST INCREASE IN STUDENT ENROLLMENT

1 message

Jaime Snyder <jaime.lawrence.snyder@gmail.com> Mon, Apr 6, 2020 at 1:01 PM
To: eircomment@ucsc.edu

To Whom it may concern.

This plan makes no sense at all, other than funds for building and construction companies as well as financial interests unconcerned with the well-being and sustainability of the Santa Cruz community. It is ironic and ill founded that at just the moment when the world is making a large shift online—in response to the epidemic — which will undoubtedly push us in the inexorably from on-site education that UCSC is pursuing this step. Santa Cruz is already operating outside of its ecological footprint and a viable and sustainable Santa Cruz community for the people who live in Santa Cruz. Downgrading the viability of the community is bad economic news for the community itself. It is clear that interests other than the City of Santa Cruz and the SC Community, are driving this inadvisable move.

With great concern,

Jaime Snyder

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP EIR Scoping Session

1 message

'Jan Karwin' via eircomment@ucsc.edu <eircomment@ucsc.edu> Wed, Apr 1, 2020 at 6:57 PM
Reply-To: Jan Karwin <jankarwin@yahoo.com>
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

Although I appreciate UCSC's mission to provide an excellent university education and I value the contributions UCSC has made to the intellectual and cultural assets of the Santa Cruz community, I'm disappointed that UCSC also has created serious negative impacts, particularly by exacerbating the critical shortage of affordable housing and unbearable commuter traffic. How does the University plan to mitigate the negative impacts of the current level of student enrollment with its concomitant population of faculty and staff? Will the University commit to mitigating its current negative impacts before considering future growth? And, as an alternative to growing the Santa Cruz campus, will the University consider expanding student enrollment at other UC campuses in communities that are geographically better equipped to accommodate future growth?

Jan Karwin
UCSC Alumna
Santa Cruz City resident

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP IER Scoping Session April 1st

2 messages

Jennifer Gonzalez <jag@ucsc.edu> Wed, Apr 1, 2020 at 5:39 PM
To: eircomment@ucsc.edu

One of the greatest assets of this campus is its natural beauty. It is one reason that people are attracted to living here, matriculating here, and staying here on the staff and faculty. Of course we are a wonderful university for other reasons too: our research and teaching have world-wide impact; and we are growing.

There are good ways and bad ways to grow, however. Careful stewardship of our natural resources has made this not only a beautiful campus, but a regional treasure and international destination. Unfortunately, some cannot see the forest or the meadow for the trees; they believe that we can build housing indiscriminately on our grasslands and push roads through the middle of our meadows without permanently losing what makes our campus unique. Or they might not care about these rare and precious qualities. Dollars and cents are not the only, nor often the best, way to make judgements about how or why to do something.

I am a UCSC faculty member, and a mother with a child in school. I, too, care deeply about high quality, non-commercial university daycare services and high quality affordable family student housing. This is, and must be, a campus priority. However, these needs do not have to be met following the current LRDP. In fact, it has been shown that other locations are feasible alternatives to building on or creating roads across our spectacular grasslands. We must remember to think about the future of this campus with visionary wisdom, not with short-sighted profit-hungry construction models. Let's work together to find alternatives that are not about lining the pockets of out-of-state developers.

Thank you for this opportunity to express my views.

--
Jennifer A. González
Professor
History of Art and Visual Culture
University of California, Santa Cruz
1156 High Street
Santa Cruz, CA 95064
jag@ucsc.edu

pronouns: she/her/hers

We have more possibilities available in each moment than we realize.
-Thich Nhat Hanh

Parker Welch <pawelch@ucsc.edu> Wed, Apr 1, 2020 at 5:43 PM

To: Erika Carpenter <escarpen@ucsc.edu>, Jolie Kerns <kernsj@ucsc.edu>, Oxo Slayer <oslayer@ucsc.edu>, Gary Jakobs <gary.jakobs@ascentenvironmental.com>, Claudia Garcia <Claudia.Garcia@ascentenvironmental.com>, Chris Mundhenk <chris.mundhenk@ascentenvironmental.com>

[Quoted text hidden]

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

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Parker Welch
Surqrxqv=#kh/#klp /#klv
JLV2FDG#Surjudp p hu#Dqdo|vw
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Sk|vlfdo#dqg#Hqylurqp hqwdo#Sodqqlqj#Vhuylfhv
Tel: +;64,#8350:376#¡#**Email:** pawelch@ucsc.edu
UC SANTA CRUZ

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UCSC Long Range Development Plan EIR

1 message

Jessica Evans <jessevansfiddler@gmail.com> Tue, Apr 7, 2020 at 11:41 PM
To: eircomment@ucsc.edu

Dear Ms. Carpenter:

Thank you for the opportunity to comment on the scope of the upcoming UCSC Long Range Development Plan EIR.

Because of the current Climate Emergency and the Governor's directive that all transportation and land use planning take greenhouse gas emissions into consideration, UCSC growth mitigation will need to reduce VMT as a mitigation for impact rather than planning to accommodate increased VMT.

One major way to reduce VMT is to increase transit options. METRO bus capacity to UCSC may be already close to maxed out. However, there are some historic transportation planning studies that recommended fixed guideway transit options connecting the Santa Cruz Branch Rail Line with UCSC.. Those options are not currently included in University, municipal or regional planning documents. Since the Santa Cruz RTC is at this moment conducting a study to choose a transit mode to implement on the branch line, I encourage you to revisit the 1993 "Santa Cruz fixed guideway/rail corridor refinement study : final report" by Parsons, Brinckerhoff, Quade & Douglas, which is in both the McHenry collection and the downtown Santa Cruz library collection.

Beyond significantly increasing transit options, the two primary ways to accomplish reducing VMT are by using parking management and by incorporating mixed use development into land use planning.

UCSC already does a good job with parking management. This will need to be extended and increased in order to reduce VMT. Mitigation measures in the LRDP EIR need to specify mandatory parking management policies and programs that will reduce VMT and shift demand to non-auto modes, These policies will need to cover parking availability, location and pricing.

Planning for mixed use in high density communities is fundamental to modern urban planning, since mixed use development improves quality of life, equity, and accessibility, and reduces GHG emissions. Mixed use land development will be an essential component for reducing potential future VMT caused by this LRDP, and will be especially important as the campus expands undeveloped areas. On-campus mixed use development is badly needed to reduce VMT and improve residential quality of life on campus. Right now there is little or no land at the main UCSC campus designated for mixed use development. .

Respectfully, Jessica Evans

Vice Chair, Friends of the Rail and Trail
UCSC Alumna and resident of the City of Santa Cruz

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UC Santa Cruz Enrollment Expansion

'Jodi King' via eircomment@ucsc.edu <eircomment@ucsc.edu> Wed, Apr 8, 2020 at 9:45 AM
Reply-To: Jodi King <jodimking@yahoo.com>
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

As a lifelong resident of Santa Cruz and UC Santa Cruz alum, I am writing to voice my objection of proposed student enrollment expansion of 9,000 additional students. As a person who values education and community, I strongly believe increasing the number of students at UC Santa Cruz should only be considered if the university will provide additional on campus housing for the additional student population. The size of Santa Cruz, the infrastructure and most importantly housing places an unfair burden on long time residents. My family has lived in Santa Cruz for over 40 years and our children and grand children are unable to find decent, affordable housing. In addition, lack of On Campus housing is a disservice to the students attending the University denigrating their college experience.

Thank you for your consideration.

Sincerely,
Jodi King

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] eir comment

1 message

Joe De Meo <joedblues1@gmail.com> Mon, Apr 13, 2020 at 8:38 AM
To: eircomment@ucsc.edu

Hello, I read a opinion in today's paper. Once again locals against the university growing. YouNeed to grow as there is a great demand for higher education. I live close to the university. I'm not thrilled at the prospect of growth but feel it is necessary.

The only thing I ask is that with the new growth can more housing (both student and faculty)be added. Possibly through partnership with the private sector. Housing in the community is the main problem we must over come.

Regards Joe De Meo

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UCSC LRDP

1 message

John Hall <jhall5@ucsc.edu> Mon, Apr 6, 2020 at 1:39 PM
To: eircomment@ucsc.edu

I am not opposed to UCSC campus expansion to serve the needs of the people of California. However, any such development has to be done in a way that does not further exacerbate problems already manifest in the layout of the campus. In a nutshell, the campus sprawls more than any other I have ever visited, to the detriment of its students, faculty, and academic mission, and with sad consequences for the environment in a time of climate crisis.

It seems to me that two fundamental principles should guide any future development.

1. All additional student and faculty growth should be accommodated by housing on campus.

2. Future development of both housing and academic facilities should be as compact as possible, hopefully, not going beyond the perimeter of campus buildings already established. In particular, it makes absolutely no sense to create housing on the so-called “upper” or northern portion of the campus.

Thank you for your consideration and best wishes for your work,

John Hall

John R. Hall
Research Professor of Sociology
University of California - Santa Cruz and Davis
The Ways Out: Utopian Communal Groups in an Age of Babylon, 2nd edition
https://sociology.ucsc.edu/about/directory-emeriti.php?uid=jhall5
https://ucdavis.academia.edu/JohnHall

[eircomment] Growth and water

1 message

John McGuire <johnandcarol@att.net>
Mon, Apr 13, 2020 at 8:26 AM
To: eircomment@ucsc.edu

Sir:

Student population increases planned for the campus must include their demand for water. The City Water Director has stated that there is insufficient water to provide temporary service to the Soquel Creek Water District. How can UCSC assume that water will be available to an increased student population? The EIR must address this issue without the assumption that increased water will somehow appear from nowhere. At present there are no significant water projects on the horizon that will give the City drought protection much less for the new students at UCSC.

John McGuire

Sent from my iPad

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comments

1 message

Joseph Gutierrez <id8jpg@gmail.com> Sat, Apr 4, 2020 at 3:32 PM
To: eircomment@ucsc.edu

Hello Erika Carpenter,

After review of your presentation of the LRDP, I have the following comments:

The original plans had fully developed traffic considerations, including rerouting Empire Grade around the University. Your current plans neglect improvements to Bay Avenue and Empire Grade. In my opinion, Bay Avenue should be four-lanes from Mission Avenue all the way up to the main entrance. Empire Grade should be four-lanes from Bay Avenue to the West Entrance. The traffic impacts from the University paralyze traffic in my neighborhood, or Level of Service F. Please include the University plans to mitigate LOS F in my neighborhood?! I hear comments about secondary access from time to time, however, the University doesn't have primary access established yet, and it should. Secondary access through Pogonip is not feasible, and should not be considered. Further, trolly access to the University from Downtown would be another welcome consideration for access, and there are many ways to do this.

The City of Santa Cruz as a whole is built-out for it's water supply. It is naive to think any more loads can be put on our water supply. Any plan to add 10,000 students must also consider adding to the water supply. Any plan the does not consider adding to the water supply is incomplete, and does not bear further consideration. It's great to have expansion visions, but you must be practical about how you wish to expand. There simply isn't enough water for 10,000 more people in Santa Cruz. Although, the water conservation statistics of the University are impressive since your presentation shows that water use has remained constant even with expansion of students.

The original plans circa 1963 in your presentation had buildings everywhere, but none in the lower meadows. It is fair to say that our founding visionaries who first proposed the University never wanted to build in the meadows. Yet now we have folks who are ignorant of the original visions of the University, and are proposing something that no one wants, or ever wanted. Building in the meadows is a disgrace to the majestic views, and the original vision of the campus. Your LRDP is incomplete without restrictions to building in the meadows.

Please consider the above comments in your EIR process and LRDP. Thank you.

Joseph P. Gutierrez, PE
117 Allegro Dr.
Santa Cruz, CA 95060

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judiriva@hotmail.com

Hello,

I have lived near UCSC (off Nobel Dr.) for almost 30 years. I worked at UCSC for about 4 years and my daughter earned her BA there. I appreciate the benefits that UCSC brings, but increasing enrollment beyond the previously legal limit of 19,500 students will have irreversible negative impacts on our small city that is in a geographically constrained location between the Monterey Bay and the Santa Cruz Mountains.

I attended some previous "scoping sessions" and reviewed the university's slick handouts on what they are doing to address environmental concerns, etc. It looks great on paper, but the reality is that this community CANNOT bear the influx of students beyond the legally agreed upon number of 19,500. Overcrowded classrooms and dorms coupled with the difficulty in finding housing brings additional stress to students.

Cramming students into single family homes drives up the cost of rental housing, and takes those homes off the market for families. Students often disrupt neighborhoods when they have loud parties well past what the noise ordinance permits, and consumption of alcohol results in unsafe operation of cars, vomiting or damage to neighbors' yards or homes. I know UCSC has attempted to smoothe "town-gown" relationships but police are not always able to respond to neighborhood calls for service.

Residents have had to ration water in drought years, and that will likely happen in the future. A new entrance on the Empire Grade side of campus is not going to relieve traffic on Bay Ave. or on over-loaded Mission St., High Street, or other routes through westside neighborhoods, and subsequently the rest of the city and county.

The university should build housing for students, staff and faculty that is at the base of campus, and not build on the Great Meadow. The proposed number of housing units will still leave thousands struggling to find scarce housing in the community.

Additionally, the Covid 19 pandemic will impact the public's input, regardless of "attending" online.

Other communities have the capacity to expand their campuses. UCSC does not. The Regents MUST heed what Santa Cruz voters said - no expansion beyond 19,500.

Judi Grunstra

220 McMillan Dr.

Santa Cruz, CA 95060

Memorandum

To: Erika Carpenter, Senior Environmental Planner, Physical Planning, Development, and Operations

From: Karen Holl, Professor of Environmental Studies

Date: 27 March 2030

RE: Notice of Preparation for Environmental Impact Report for the 2020 LRDP

I write as one of the faculty representatives to the 2020 Long Range Development Plan (LRDP) Committee to ask that the following two topics be discussed in the Environmental Impact Report for the 2020 LRDP. Both are issues that I have raised at multiple LRDP meeting over the past 2.5 years.

The first regards permanently protecting at least some portions of the Campus Natural Reserves, which falls under several EIR topics, including but not limited to biological resources, cultural resources, recreation, greenhouse gas emissions, and wildfire. It is also a critical resource for the campus teaching and research mission, as the Campus Natural Reserve serve as a living laboratory for both teaching and research. We are fortunate to have these open spaces sufficiently near to the built areas of campus to conduct experiential learning exercises outdoors, which are important for classes in a number of fields. Numerous faculty also use these lands for research. The boundaries of the CNR have changed over the past couple of EIRs. For faculty to invest in long-term research projects that involve students they need to know that certain areas of land are protected and managed by knowledgeable land stewards, such as the UC Natural Reserves staff. Moreover, permanent protection of certain lands is needed to protect listed species and various ecosystem services such as hydrologic cycling and erosion control on the campus.

The UC Natural Reserves staff have spent extensive time consulting with PPDO staff and UCSC faculty to prioritize areas for protection under the CNR. I greatly appreciate the work the LRDP consultants and PPDO staff have done to designate many of the recommended environmentally sensitive lands as Campus Natural Reserve in the current LRDP map. However, one topic that has been repeatedly postponed is the designation of permanent protection. In the final LRDP committee meeting in October and in my correspondence with PPDO staff it has been suggested that this would be addressed during the EIR process. I am writing now to once again ask that CNR be designated for permanent protection as part of the EIR process. As I have stated before the choice of lands for permanent protection should not only consider the location of listed species and areas that are undevelopable for other reasons (e.g. steep slopes) but should also consider their value for teaching and research.

Second, the EIR should not only consider a growth envelope of 28,000 students but should also address what resources are needed for the campus to increase enrollments to specific increments (e.g., 22,000, 24,000 etc.). If those conditions are not met, enrollments should not increase. I was also a faculty representative on the 2005 LRDP committee for which the EIR carefully reviewed the environmental impacts and needed construction and mitigation to grow to an enrollment of 19,500 students. The campus has now nearly reached that enrollment figure but much of the proposed housing, classrooms, lab space, and mitigation for cumulative environmental impacts has not happened. This means that student housing is overcrowded, we cannot get classroom space and class times have been shortened, and campus lands have become increasingly degraded. So, we are going into the 2020 LRDP with an existing deficit of building space and land management capacity. The March 2020 state bond measure to fund public education facilities did not pass and, to my knowledge, there is currently no available public funding for academic building construction. Budgets are extremely limited for the extensive deferred maintenance on campus. I am well aware that the LRDP is a plan to allow for growth rather than a mandate for growth. But as the last LRDP shows, the student population growth can happen without the resources outlined in the LRDP being available. Therefore, I consider it essential that the 2020 LRDP EIR include discussion of the resource requirements necessary not just for 28,000 students, but specific intermediate limits beyond which UCSC cannot grow without adequate resources.

[eircomment] Proposed Development on the East Meadow

1 message

Kathy Haber <dannynor@cruzio.com> Mon, Mar 23, 2020 at 6:55 PM
To: eircomment@ucsc.edu

Hello UCSC Planners,

I am writing to express my opposition to the proposed placement of student housing (or any building) on the area of the campus known as the East Meadow. I am a UCSC graduate and have lived in Santa Cruz continuously since graduating in 1970. I have watched the campus grow and have watched the complications this has produced for the town. Crowded neighborhoods, sky-high rents, traffic nightmares. I oppose the further increase in student numbers, as do many members of the community, who can also be faculty and staff. They live in the town and have conflicted loyalties. But the proposal to build on the iconic meadow, that is the gateway to the campus, is especially egregious and viscous. It almost seems like retaliation against opponents of UCSC growth for daring to oppose anything the U wants to do.

Here are more considerations:

—The location is far from any place that students need to be. Classrooms, dining halls, libraries. Will they have to board a LOOP bus to get breakfast?

—Previous undergrad housing has been organized around the “College” system. What College will these students be affiliated with? How will they identify?

—The distances students must travel on campus by foot. bike or bus is often voiced as a hardship for them Those housed so far from services may resist that placement and choose to live off campus. These residences may become “Outer Mongolia” and be partially uninhabited. There is already a high vacancy rate on campus.

The East Meadow is a beautiful gateway to our campus. Building on it would be both shortsighted and cruel. I have no idea where these ideas fit within the highly arcane structure of the EIR - LRDP jargon, the main purpose of which seems to be to exclude democratic voicing of concerns and ideas.

Sincerely
Kathy Russell Haber Merrill “70

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Long range plan

1 message

Kathy Blackwood <kathylblackwood@gmail.com> Wed, Apr 1, 2020 at 3:51 PM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

Dear all,

I hope that the magnitude of changes in our society and in the realm of higher education prompt you to seriously look at the kind of growth you can expect, and the way in which instruction will be delivered. If you are to remain a viable —and desirable— institution of higher education, you will need to have a majority of not supermajority of your classes online. Those elementary, junior high and high school students who are currently receiving all their education online will expect to receive it that way when they go to college.

Also, if you are to remain a desirable place to work, you will need to provide both the flexibility and resources for for faculty to teach remotely. Why pay Santa Cruz costs to teach online when you could pay much less anywhere else with a good internet connection.

Both of these changes will mean fewer people on campus. You need infrastructure changes to support your remote students, faculty and staff, but probably not academic and residential buildings.

Thank you for listening.

Kathy Blackwood
Santa Cruz resident and retired Executive Vice Chancellor, San Mateo County Community College District

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comments

1 message

Katie Collins <kocollin@ucsc.edu> Wed, Apr 8, 2020 at 3:47 PM
To: eircomment@ucsc.edu

Erika Carpenter
Senior Environmental Planner
Physical Planning, Development and Operations
Email: eircomment@ucsc.edu

Hello, my name is Katie Collins, and I am a second year undergrad at UC Santa Cruz. As I have lived and worked on campus, I have come to admire the UC's devotion to maintaining natural spaces and lessening the environmental footprint of campus. As the Long Range Development Plan begins an Environmental Impact Report, however, I would like to highlight some aspects that I believe should be taken into consideration in the EIR.

I am a part of the Natural Resource Management IDEASS Lab Practicum, which for the past school year has sought to develop a recreational land use plan for trails in Upper Campus. As it stands right now, the majority of trails in Upper Campus, apart from the fire roads, are unsanctioned and unmanaged, and many go through particularly sensitive areas of the reserve. Since these trails were not officially constructed, they are not maintained and have the potential to cause damage to the landscape. As UC Santa Cruz moves forward with the LRDP, it will be essential to develop a Recreational Land Use Plan for Upper Campus, as these trails are far-reaching and will impact many areas of the LRDP.

On a similar note, I firmly believe that the development of permanent protection of the Campus Natural Reserve and a campus-wide Habitat Conservation Plan, should be incorporated in the EIR analysis. With new construction taking place in Upper Campus, it would be wise to ensure that these developments do not have a major impact on the threatened and endangered species on campus.

The EIR provides a wonderful opportunity to lay down the foundations for meaningful policy surrounding the Campus Natural Reserve, which will undoubtedly influence its management for years to come. I hope that these developments will solidify UCSC's position as a center for environmental conservation and sustainability. Thank you for your time and consideration.

Sincerely,
Katie Collins
kocollin@ucsc.edu

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] some perspectives from nearby neighbors

1 message

Kenneth Coale <coale@mlml.calstate.edu> Wed, Apr 1, 2020 at 6:35 PM
To: eircomment@ucsc.edu

Dear UCSC planners,
I am writing as the President of the Cave Gulch Neighborhood Association.
We have not been contacted or informed by your group. We heard about this Town Hall by a neighbor who is an employee.
Our concern is that the interests of our neighborhood and organization have neither been solicited nor considered in your planning process.
We are very concerned about the increased activity in our neighborhood.
We are in support of your environmental concerns, but the overall impact will be significant to our neighborhood.
We are specifically concerned about increased traffic,
We are concerned about historical use.
We are concerned about access to the trails now being blocked due to reserve concerns when historical use has been active on this property for one hundred years.

Kenneth

____

[eircomment] Please do not Expand UCSC

1 message

Kim <kymster@sbcglobal.net>
To: eircomment@ucsc.edu
Wed, Apr 8, 2020 at 7:35 AM

To: UCSC

I am not in support of the planned UCSC addition of 9,000 additional students.

Santa Cruz is not the appropriate campus to expand. Our infrastructure and resources cannot keep up with UCSC's rapid growth. Our small city is already bursting at the seams with only 15.8 mi.^{2} (12.7 mi.^{2} of land). UC Merced would be more appropriate; or spread the growth across 6 other UC campuses. Santa Cruz is at Maximum capacity.

Additionally, Santa Cruz is in a Housing Crisis. We have a very large homeless population, appx 1,000 people in the City alone. We don't have enough housing for local long-term residents. Many of whom are being pushed out of the area. This includes our Families, Teachers, Police Officers, Service Workers and Senior citizens.

Please protect our small town, natural resources and the hardworking residents who make Santa Cruz home.

Respectfully,
Kim Salisbury
Local resident since 1976

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Question

2 messages

Krisna Supatra-Campbell <ksupatra@ucsc.edu> Thu, Mar 12, 2020 at 12:17 PM
To: eircomment@ucsc.edu

For the 28,000 students that you are proposing to house on campus how long is their housing guarantee?

eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Parker Welch <pawelch@ucsc.edu> Thu, Mar 12, 2020 at 12:42 PM
To: Jolie Kerns <kernsj@ucsc.edu>, Erika Carpenter <escarpen@ucsc.edu>

[Quoted text hidden]

eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

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Parker Welch
Pronouns: he, him, his
GIS/CAD Programmer Analyst
University of California Santa Cruz
Physical Planning, Development, & Operations
Physical and Environmental Planning Services
Tel: (831) 502-7043 | **Email:** pawelch@ucsc.edu
UC SANTA CRUZ

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Lrdp

1 message

Kurt & Melissa Workman <kurtmelworkman@gmail.com> Wed, Apr 1, 2020 at 6:49 PM

To: eircomment@ucsc.edu

The traffic generated by UCSC is, and has been for a long time, unbearable for those of us who live on the West Side. The City of Santa Cruz promised an eastern access to campus before it was even built knowing that the traffic traveling through two lane neighborhood streets would be a problem and negatively affect the quality of life. The amount of gasoline burned and pollution generated by daily bumper to bumper gridlock, even with the current campus population, is not sustainable or healthy. Why is there absolutely nothing in the LRDP to mitigate this problem? Even with no new growth we need an eastern access to campus.

Sent from my iPad

From: Parker Welch
To: Jolie Kerns; Erika Carpenter; Gary Jakobs; Claudia Garcia
Subject: Fwd: [eircomment] EIR comments
Date: Thursday, March 12, 2020 4:31:39 PM

---------- Forwarded message ---------
From: **Linda Werner** <llwerner@ucsc.edu>
Date: Thu, Mar 12, 2020 at 2:58 PM
Subject: [eircomment] EIR comments
To: <EIRCOMMENT@ucsc.edu>

I object to increasing student enrollment by 50% without commitment to add to housing or academic resources. Building on up to 700 acres of currently designated campus natural reserve open space is not the answer. Well thought out plans for growth involving the entire community is needed to add to the housing and academic resources instead of pushing through quickly devised development using contract workers and outside companies for the management of these resources.

--
Linda Werner, Ph.D.
Adjunct Professor, Computer Science and Engineering
University of California, Santa Cruz

--
Parker Welch
Pronouns: he, him, his
GIS/CAD Programmer Analyst
University of California Santa Cruz
Physical Planning, Development, & Operations
Physical and Environmental Planning Services
Tel: (831) 502-7043 | **Email:** pawelch@ucsc.edu

Google @ UCSC Erika Carpenter <escarpen@ucsc.edu>

[eircomment] NOTICE OF PREPARATION ENVIRONMENTAL IMPACT REPORT, UC Santa Cruz Long Range Development Plan

1 message

Linda Wilshusen <l-j-w@pacbell.net> Tue, Apr 7, 2020 at 3:32 PM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

April 7, 2020

Dear Ms. Carpenter:

Thank you for the opportunity to comment on the scope of the upcoming UCSC Long Range Development Plan EIR.

My comments pertain to Land Use and Transportation considerations in the LRDP EIR, specifically parking and mixed land uses as they relate to the need to reduce vehicle miles traveled (VMT) to/from and within the UCSC campus.

1. It will be necessary to *reduce VMT* as a mitigation for UCSC growth rather than planning with an intention to accommodate increased VMT.

There will be few infrastructure solutions available to address the additional VMT that would be caused by implementation of this LRDP. The location of the campus and its geography will continue to present challenges for infrastructure approaches to the problems of UCSC-related automobile traffic and attendant greenhouse gas (GHG) emissions both on and off the campus. While the 'Eastern Access' road will no doubt be raised again during this process, it's highly unlikely that this or any similar roadway lanes will be able to be agreed to, financed or constructed. Existing local streets and highways are similarly constrained and not available for easy widening. Furthermore, mandates to reduce GHG will preclude most road and highway expansion into the future.

METRO and UCSC transit serve many on-campus as well as off-campus trips, but their capacity will be stretched by the very significant student, staff, and overall campus-related travel demand stimulated by this LRDP. A high proportion of METRO bus service is already dedicated to serving UCSC: UCSC enjoys 15-minute headways from downtown Santa Cruz while most other routes countywide run on hourly (or even less frequent) headways. UCSC students pay a quarterly transit fee which helps reduce (but doesn't eliminate) the public subsidy for METRO service to UCSC compared with other local, intercity and rural routes; this fee results in pretty good service to/from and through the campus, but also means that when METRO experiences financial stress, which is often due to perennial structural deficits and METRO's reliance on sales tax revenues, non-UCSC routes bear the brunt of necessary service cuts. This is an impact to the greater Santa Cruz community that should be considered in the EIR.

Planning is underway for future multimodal transportation uses along the existing Santa Cruz Branch Coast Rail Line connecting the primary urbanized areas of our county; operational improvements to the Highway 1 freeway are also in early design phases. Past transportation planning studies point to modern fixed guideway transit options connecting the Coast Rail Line with UCSC, but those studies are now decades old; also, those options, while feasible and desirable from my point of view, are not currently included in University, municipal or regional planning documents. These documents should be dusted off and reviewed again in light of LRDP growth objectives.

Therefore, transportation mitigations proposed in the EIR will of necessity need to focus on *reducing VMT* rather than attempting to accommodate increased VMT. Beyond significantly increasing transit options, the two primary ways to accomplish this are via parking management and by adjusting campus land use plans to accommodate a robust and comprehensive array of mixed uses in UCSC residential neighborhoods, the colleges, and the academic core.

2. Parking management will continue to be the most cost-effective and successful way to mitigate potential traffic impacts and reduce VMT.

UCSC should be lauded for embracing parking management on campus, and will need to continue and increase the effectiveness of its parking management strategies into the future. Parking availability, location and pricing are key to successful transportation management strategies.

Mitigation measures in the LRDP EIR should specify mandatory parking management policies and programs that will demonstrably and significantly reduce VMT and shift demand to non-auto modes.

3. On-campus mixed use development is necessary to both reduce VMT and enhance livability.

While it's not clear in the Draft Land Use Plan shown on Attachment C of the Notice of Preparation, it seems that outside of the Delaware location, there is little or no land at the main UCSC campus designated for mixed use development, including commercial uses that would serve both the anticipated 20,000+ on-campus residents as well as commuting students and employees.

Planning for mixed use (commercial uses in addition to employment, educational, and residential uses) in high density communities is fundamental to modern urban planning. Mixed uses increase livability and community engagement in urban neighborhoods by designing for easy, non-auto-dependent access to daily-life services and activities such as markets, pharmacies, restaurants, childcare, parks, recreation and entertainment venues. Increasing the livability quotient of UCSC residential neighborhoods will improve on-campus residential retention and reduce residential housing demand in the greater Santa Cruz area. Mixed use also plays well with parking management.

The paucity of commercial services at UCSC contributes to, and, if not mitigated, will further contribute to significant and increased VMT. Mixed use land development will be an essential component for reducing potential future VMT caused by this LRDP, and will be especially important as the campus expands into heretofore undeveloped areas further from existing (albeit inadequate) college services. Because of the unique location of UCSC in relation to its host community and commercial areas, this consideration is more relevant for our campus than it may be at other UC locations; if there are UC-wide rules that limit on-campus commercial uses, they should be waived for UCSC. Furthermore, local businesses should have priority for on-campus leases related to new commercial services.

Therefore, the LRDP EIR should include alternative land use plans which fundamentally incorporate mixed use design and which are accompanied by concrete policies and programs for how to enhance campus-wide, non-auto dependent activity via mixed use strategies.

Please add me to your email list for future notifications about the LRDP, and thank you very much for considering these comments.

Sincerely,

Linda Wilshusen
Anthropology '72
Executive Director, Santa Cruz County Regional Transportation Commission 1985-2005
l-j-w@pacbell.net

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comments

1 message

Mariam Moazed <mmoazed@ucsc.edu> Tue, Apr 7, 2020 at 12:26 PM
To: eircomment@ucsc.edu

LRDP NOP Comment
My name is Mariam Moazed. I am a fifth-year Ecology and Evolutionary Biology major at UCSC. I have held positions and internships through the Campus Natural Reserve that have been invaluable to my undergraduate education and to my career, not to mention to the long-term research I have helped with. I urge those empowered in planning the LRDP to adhere to the reasonable mitigation measures discussed in the draft EIR to protect the CNR land. I am in strong support of permanent protection for the CNR land to support the learning, employment, and research opportunities I have had the privilege of exploring for future students. I am grateful for the conversation that continues to happen transparently between CNR and the LRDP, and would like the LRDP's Environmental Impact Report to cover the significant environmental issues, reasonable alternatives, and reasonable mitigation measures that should be explored in the Draft EIR.

Thank you,
Mariam

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Comment for University Expansion for tonight's meeting 4-1-20

2 messages

'Marianne Franks' via eircomment@ucsc.edu <eircomment@ucsc.edu> Wed, Apr 1, 2020 at 4:46 PM

Reply-To: Marianne Franks <mariannefranks@yahoo.com>
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>, Marianne Franks <mariannefranks@yahoo.com>

I am writing to ask that UCSC not expand to increase the number of students by 9,000 students which will make 28,000 students. This expansion directly impacts Delaware Ave., Swift Ave, Mission St., Western Dr., Empire Grade, Bay St, and High St. as well as the full town of Santa Cruz's water supply, pollution, and traffic.

Even though you state you will provide housing for these new students, you are not able to provide housing for the students you have now. The housing that is provided is expensive and many students find it cheaper to crowd several students into a small apartment in town. This increases rent in Santa Cruz and decreases the supply of affordable housing.

More importunately, it impacts the existing students and potential new students. Santa Cruz is one of the most expensive communities to live in within the United States and communities like Merced would have more affordable conditions for students to live. UC Merced only has 8,884 students enrolled. It makes no sense to increase UCSC when Merced can more easily increase enrollment at a lower cost to the UC and a lower cost to students and their families. UCSC already has 19,457 students enrolled. This is sufficient to have a first class University that will continue to make us proud.

Thank you for your consideration.
Marianne Franks

Please read without identification

Marianne Franks mariannefranks@yahoo.com

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Parker Welch <pawelch@ucsc.edu> Wed, Apr 1, 2020 at 5:09 PM
To: Erika Carpenter <escarpen@ucsc.edu>, Jolie Kerns <kernsj@ucsc.edu>, Oxo Slayer <oslayer@ucsc.edu>, Gary Jakobs <gary.jakobs@ascentenvironmental.com>, Claudia Garcia <Claudia.Garcia@ascentenvironmental.com>, Chris Mundhenk <chris.mundhenk@ascentenvironmental.com>

[Quoted text hidden]

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

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Parker Welch
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Sk|vlfdo#dqg#Hqylurqp hqwdo#Sodqqlqj#Vhuylfhv
Tel: +;64,#8350:376#¡#**Email:** pawelch@ucsc.edu
UC SANTA CRUZ

[eircomment] Postpone Public Comment session

Martha Seaver <mseaver999@gmail.com> Tue, Mar 31, 2020 at 4:13 PM
To: EIRCOMMENT@ucsc.edu, Home <mseaver999@gmail.com>

It seems inappropriate to hold a public comment session at this time, on such an important topic that has such a big affect on the Santa Cruz community...at a time when we are "staying in place" for the health of the community. I ask that you postpone the session to a time when we are not focused on keeping our families safe.

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Martha Seaver ..·´¯`·...¸><((((º>.¸,.·´¯`·...¸><((((º>

Google @ UCSC Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comments

1 message

Martha Brown <mtbrown@ucsc.edu> Wed, Apr 8, 2020 at 3:43 PM
To: eircomment@ucsc.edu

To: Erika Carpenter, Senior Environmental Planner, Physical Planning, Development, and Operations

From: Martha Brown, UCSC alumna (1982), Principal Editor (retired June 2019)

RE: Notice of Preparation for Environmental Impact Report for the 2020 LRDP

I am writing to comment on the Notice of Preparation for the EIR for the 2020 LRDP. I am a graduate of UC Santa Cruz (biology, sociology, science communications) and served as editor for the Environmental Field Program (EFP) and the Center for Agroecology & Sustainable Food Systems. As part of my work for the EFP, I helped Professor Ken Norris survey the UC Santa Cruz campus open spaces and identify critical biotic sites for the Campus Natural Reserve. I also edited the initial *Academic Plan for the UCSC Campus Natural Reserves* and co-edited *The Natural History of the UCSC Campus* (Haff, Brown, and Tyler, eds., 2008).

In light of the tremendous value that UCSC Campus Natural Reserve (CNR) provides to the campus's research, education, and public service missions, I request that the topic of permanently protecting the UCSC Campus Natural Reserve be included in the EIR process. Since the CNR's establishment, I have watched it develop into a popular "outdoor classroom" for myriad courses, as well as an easily accessible resource for student and faculty research projects, and campus and community natural history outings.

The CNR is one of UCSC's unique and valuable attributes, which can't be duplicated in a laboratory or classroom. Ideally, the LRDP should consider both enlarging and permanently protecting the CNR, as planned enrollment increases will bring both further development pressures on undeveloped and unprotected land, and an increase in the use of campus lands for education and research. Campus reserve managers and staff of the Norris Center for Natural History have done an outstanding job of creating unique educational and research opportunities for undergraduate and graduate students on the CNR; enlarging and permanently protecting the CNR will enhance this work and ensure its continuity.

In addition, intensive survey work over the decades has identified unique and endangered wildlife species on campus, both on the CNR and on other campus lands. Given these findings, the LRDP should include a Habitat Management Plan to address ways to protect and enhance populations of these species as the campus continues to develop.

I appreciate this opportunity to comment on the LRDP process. If you have any questions, please let me know (mtbrown@ucsc.edu).

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP EIR Scoping Session

1 message

'Matthew Wilbur' via eircomment@ucsc.edu <eircomment@ucsc.edu> Fri, Apr 3, 2020 at 2:27 PM
Reply-To: Matthew Wilbur <mjwilbur@me.com>
To: eircomment@ucsc.edu

Dear LRDP team,

Thank you for holding these public input sessions and reading public comments live during this complicated and uncertain time with the Corona pandemic. Firstly, I am a 2015 Slug Alumnus who benefitted both academically and socially by living on campus. Now I live and work full time in Santa Cruz. I would like to echo support for the goal of housing 100% of students and staff on campus. This will help reduce the housing crisis and traffic congestion on the city and eliminate the hassle of commuting for students who would otherwise live off campus.

That being said, I would like to focus my comments on Land Use and Planning for the upper campus reserve. Historically, UCSC has taken a mostly hands-off approach to the large unofficial recreational trail network in upper campus. For decades, this user-created trail network has been enjoyed by hikers, trail runners, and especially mountain bikers. As a former member of the UCSC Cycling Team, the quick and open access I had to upper campus and its trail systems was invaluable to my physical and psychological health. Santa Cruz is home to a thriving cycling community and to major companies in the cycling industry. Over the years, UCSC trails have quite literally become world famous for mountain biking and their popularity only continues to grow. However, the trail system has always been technically illegal and UCSC has not wanted to take part in any effort to legitimize and maintain it in an environmentally sustainable way. This has lead to many trails being built unsustainably for both the environment and user safety. I have heard that it is actually more illegal to be caught out there with a shovel than with a bike. The encouraging news is that recently UCSC officials have finally started to engage in talks with local non-profit organizations like Mountain Bikers of Santa Cruz. I think a recreation ecology focused approach is a good way to protect the upper campus reserve for research, ecological preservation, and public recreation. Trail stewardship is a key part of sustaining our open spaces and preserving our recreational ways of life and MBoSC has a highly experienced team of professional trail builders and an army of volunteers eager to give back to their community. Thus, I encourage you to include in the EIR a plan to work with organizations like MBoSC to design, build, and maintain a public use trail system in upper campus that will last for generations as well as protect designated sensitive habitats. Thank you for you time and consideration.

Best,
Matthew Wilbur
EPS Class of 2015

Google @ UCSC

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] scoping considerations

1 message

'Melissa Hart' via eircomment@ucsc.edu <eircomment@ucsc.edu> Wed, Apr 1, 2020 at 7:57 PM
Reply-To: Melissa Hart <mjhraim@aol.com>
To: eircomment@ucsc.edu

The long range development plan seems to have been developed in a vacuum. No mention is made in the project description of the city and community of Santa Cruz. This failure to recognize the unmitigated Class 1 impacts of on campus development on the surrounding community as the true effect of on-campus development is what perpetuates the adversarial relationship quaintly referred to as the town gown divide in this city. Meanwhile, the coastal campus has it's own LRDP that has deferred analysis and mitigation of Class 1 transportation impacts on the City without coordinating with this LRDP, the annexed property on the lower west side that is slated for mixed use is apparently going to be incorporated in the main campus LRDP in a way that does not require it to be permitted by the City or to be in compliance with the City of Santa Cruz comprehensive plans. This piecemeal approach and flagrant disregard for the community surrounding the university will perpetuate the degredation of the quality of life on the west side of Santa Cruz until UCSC acknowledges the interconnectedness of the university with the town and voluntarily submits to joint planning/permitting and environmental impact mitigation with the City, the County, and the Coastal Commission in order to best serve the needs of the university while preserving the quality of life for the precious and unique community and residents of Santa Cruz.

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] “LRDP NOP Comments

1 message

'Melissa Hart' via eircomment@ucsc.edu <eircomment@ucsc.edu> Wed, Apr 8, 2020 at 4:50 PM
Reply-To: Melissa Hart <mjhraim@aol.com>
To: eircomment@ucsc.edu

Erika Carpenter, Senior Environmental Planner
Physical Planning, Development, and Operations
University of California Santa Cruz
1156 High Street, Santa Cruz, CA 95064

Dear Erika Carpenter;

Thank you for the opportunity to provide comments on the scope of the 2020-2040 Long Range Development Plan (LRDP) Environmental Impact Report (EIR). I agree with the joint City County Measure U task force that the proposed development and accompanying increase in student enrollment will have numerous significant impacts on both the UCSC campus as well as the surrounding community, in particular the burden that growth at UCSC will place on the existing transportation and housing resources on the westside of the City of Santa Cruz, These impacts are clearly Class 1 in significance and are presented without any attempt at identifying potential mitigations as part of the project description. In fact, the many unmitigated and insufficiently mitigated impacts caused by enrollment growth under the proposed LRDP probably justify a moratorium on future enrollment increases until the needed on-campus infrastructure and off-campus mitigations are identified and implemented. It is particularly concerning that the University may be attempting to trying to get permission to develop first with a promise of delivering on mitigation at a later date in an attempt to avoid being told NO! A dangerous precedent would be to continue to allow UCSC to go forward with this LRDP without having completed its assessment and mitigation of the Class 1 transportation impacts inflicted on the westside of Santa Cruz due to development and expansion of UCSC facilities on its coastal campus. The halting of this pattern needs to be addressed in the assessment of the new LRDP.

The growth proposed in the new LRDP will exacerbate already unbearable Class 1 significant and unmitigated impacts on the transportation routes on the west side of Santa Cruz, particularly Western Drive, Bay Street, Mission Street and High Street. The University needs to include potential alternative transportation plans such as an eastern entrance, and non road based means of transportation such as a train, tram or gondola between its coastal and main campuses as part of its overall transportation mitigation program to reduce traffic on roads that serve the west side of the City. The University also needs to consider requiring all undergrads to complete at least half of their program through distance learning along with limiting undergrads to 2 years of on campus housing in order to limit its impact on the rental housing stock of the surrounding communities, particularly the westside of the City of Santa Cruz. The University also needs to consider banning non-laboratory classes from the coastal campus and instead require all lecture classes to be held on main campus. This would cause a shift from many students needing to commute between the coastal campus and the main campus to one professor needing to commute to deliver the lecture at main campus.

During the scoping meeting, mention was made of looking at opportunities to use the historic corridor at the entrance to campus to foster more positive town/university activities and interactions. Specific examples of what the University has in mind were not described. These should be spelled out in the project description so that potential impacts can be identified and mitigations can be considered. Community gatherings for purposes of entertainment and interaction, while having possible positive outcomes could also cause noise, traffic and safety impacts on the residential areas surrounding the historic corridor and need to be considered for scope and mitigation purposes. In light of recent strikes at the main entrance to campus, a plan to mitigate disruption and safety impacts to off campus residents in the event of labor disputes also needs to be included in the new LRDP.

The University needs to pay more than lip service to aligning the use of its properties with the goals of the Parks, Recreation and Open Space portions of the City of Santa Cruz Comprehensive Plan by formalizing and protecting the uses such as walking, running and mountain biking that have gone on for many years on an ad hoc basis and are an important consideration for quality of life impacts on the adjacent community.

The 2020-2040 draft LRDP seems to have been developed in a vacuum. No mention was made in the project description of the city and community of Santa Cruz during the scoping meetings, or of the cumulative effect of growth on the coastal campus, main campus and auxillary properties owned by UCSC. This failure to recognize the unmitigated Class 1 impacts of the cumulative effect of UCSC and of on campus development on the surrounding community as the true Class 1 impacts on the environment is what perpetuates the adversarial relationship between the University and the city. Meanwhile, the coastal campus has it's own CLRDP that has deferred analysis and mitigation of Class 1 transportation impacts on the City without coordinating with this LRDP. The annexed property on the lower west side that is slated for mixed use including housing is apparently going to be incorporated in the main campus LRDP in a way that does not require it to be permitted by the City or to be in compliance with the City of Santa Cruz comprehensive plans. This piecemeal approach and flagrant disregard for the community surrounding the university will perpetuate the degredation of the quality of life on the west side of Santa Cruz until UCSC acknowledges the interconnectedness of the university with the town and voluntarily submits to joint planning/permitting and environmental impact mitigation with the City, the County, and the Coastal Commission in order to best serve the needs of the university while preserving the quality of life for the precious and unique community and residents of Santa Cruz.

Thank you for your attention to these concerns. Please add my name to your notification list for any further actions regarding this process.

Sincerely,

Melissa Hart
1226 Laurent Street
Santa Cruz, CA 95060

Google @ UCSC

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UC Santa Cruz LRDP EIR NOP Scoping Sessions on March 12, 2020
1 message

Michael Pisano <mpisano@ucsc.edu>   Wed, Mar 11, 2020 at 1:14 PM
Reply-To: mpisano@ucsc.edu
To: eircomment@ucsc.edu

Hi EIR Comments,

Campus Scoping Session:

As a P3 Opportunity; Can money be quickly set aside to pay for a Construction Project Manager to put together those faculty & staff that have equity with those that don't have equity - to gain a larger combined equity base, to build on-campus & off-campus housing - to include faculty/staff opportunities to help them build Auxiliary Dwelling Units (ADU's) in the County (to assist those current property owners build ADU's, or as tenants-in-common with those that don't have property (like a duplex))?

If UC Santa Cruz is already doing this where do I sign up at?

Thank you for your time and consideration

Common Acronyms : EE=Employee, PPE=Pay Period End, PD=Pay Day, BW=Bi-Weekly, QW=Quadra-Weekly, MO=Monthly, CP=CruzPay, TS=Timesheet, LOA=Leave of Absence, LNP=Leave No Pay.

Direct Deposit Sign-Up: https://financial.ucsc.edu/Pages/Payroll_Direct_Deposit.aspx

Michael Pisano
UCSC – BAS/SHR/ELR – Leave of Absence Assistant
Tel:831-459-1867-Fax:831-459-2661– **Confidential LOA FAX:831-401-2322**

MAC Appointee (METRO Advisory Committee) & E&D TAC Appointee

Eml: mpisano@ucsc.edu / Mail Stop: Staff Human Resources

Work Schedule/Plan de trabajo: Days/Dias; Mon thru Fri – Hrs; 8am to 5pm
TKWeb: http://shr.ucsc.edu/ops/index.html

SHR = Services, Solutions, Success! Servicios, Soluciones, éxito

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Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Community Scoping Session - UC Santa Cruz LRDP EIR NOP Scoping Sessions on March 12, 2020

1 message

Michael Pisano <mpisano@ucsc.edu>
Reply-To: mpisano@ucsc.edu
To: eircomment@ucsc.edu

Thu, Mar 12, 2020 at 2:32 PM

Community Scoping Session:

-

Please Read the Following Aloud

As a P3 Opportunity; Can money be quickly set aside to pay for a UCSC Construction Project Manager to put together those faculty & staff that have equity with those that don't have equity - to gain a larger combined equity base, to build on-campus & off-campus housing for themselves and co-workers - to include faculty/staff opportunities to help them build Auxiliary Dwelling Units (ADU's) in the County – to assist those current property owners to help build ADU's, or build as tenants-in-common with those that don't have property (like a duplex)? If UC Santa Cruz is already doing this where do I sign up at?

We need more access to affordable housing for faculty, staff & students. The on-campus quantity & size of housing leans heavily for faculty - as staff with & without families & students with & without families are in smaller units. According to Past SHR-AVC Lori Castro we spent $20 Million dollars on recruitment & retention in 2014 (This might be an ongoing yearly expense). The $20 million in retention & recruitment dollars can go a long way to build affordable campus housing (to keep those employed that might leave for housing costs). This accounting exercise may have come from a presentation at a UC Regent meeting in November of 2013.

Some at UCSC seems to have a message of "that an institution is not responsible for housing its workers, but is partly responsible and should do its part to affordably house workers in Santa Cruz County". They are also saying if you can't afford to live here, then move (but if nobody in that appointment can afford to live here - then who else can afford to live here to perform those duties??). If UCSC can find replacements that can afford to live here then "Bravo to Us", but If we are back hiring again & again every few months or every few years - Then we have gained nothing. I say we need to lean-in more to assist with more campus housing for our co-workers (This would be the most fiscally responsible option for us on spending tax dollars sustainably).

I have also asked for State Legislation to allow Detached Bedrooms to be added to the already existing policy on ADU's & Efficiency ADU's in Santa Cruz County.

I am doing my part by volunteering my time at the Metro & SCCRTC on the E&D Tac, a local housing Measure H, and now for the Rail/Trail to gain matching funds to have a demo of the TIG/M hydrogen fueled light rail train to demo in our County this October.

Sustainable Transportation;

On-campus housing is a sustainable transportation solution - If one lives on-campus you can take a shuttle, bike, or walk to work.

Please Do Not Read the following, but Please place it in the record.

As an example to institutional housing;

My Great Grandparents & Grandparents & my mom lived in factory housing for Libby's Cannery in the 40's - my Great Grandparents lived there till the 60's. My Grandparents were successful crop farmers in Missouri and Granny insisted that they move to California. They lived on the Creek on Dana Street & Hwy85 in Mt. View, CA for several months' until Libby's came into play. My Grandfather also used sweat equity to build the house they lived in till the past. So - Yes, an Institution is responsible for housing. Several School Districts are instituting housing for teachers, and some local companies are trying to do the same - such as local Bay Photo. The controversial Circles church is a group made up of local teachers, & local public service employees using their combined equity to build housing for themselves.

I think I am either doing something wrong, or talking to the wrong people? What else can I do? I have asked for more affordable housing on campus & to improve sustainable transportation needs for almost eight years now - to no avail. I have talked to the UC Regents, Chancellors, UC Vice President of Human Resources, AVC, Unions, Managers, Supervisors, Local Supervisors, City Council, Planning Departments, and community members. I am afraid that there is one person that can make the decision to build more campus housing, but I have not talked to them yet (to have a better work/life balance). I am doing my part by volunteering my time at the Metro & SCCRTC, a local housing Measure H, & now for the Rail/Trail to gain matching funds to have a demo of the TIG/M hydrogen fueled light rail train to demo in our County this October.

To note;

Over 38,000 new cars are purchased each day in the United States and those cars last between 10 to 20 years - so to trade in your new car after 5-years for an electric car is not a sustainable solution. The downtown garage will open up an area used for parking for mixed-use retail & affordable housing.

<u>My opinion on an Interesting Phenomenon;</u>

Ever Trumpers see no wrong, never Trumpers see all wrong. Nimby's always saying no to building anywhere, and Yimby's always says build more everywhere. Then the false compromise is when they agree to support affordable or student housing, but not here - then they never show up there to support there. The Westcliff only walks - and does not want Jump bikes, and the Eastside only drives and is concerned with traffic over mixed-use buildings. Downtown won't close Pacific avenue to cars but does not support a parking garage. Why is every new building over two stories is considered ugly - as too are orange sustainable bikes. We are the best at saying "No" - We need to learn to say "Yes". Another interesting thought - So when are we considered a Santa Cruz Local - day one, or forty years from now?

Thank you for your time and consideration

Common Acronyms : EE=Employee, PPE=Pay Period End, PD=Pay Day, BW=Bi-Weekly, QW=Quadra-Weekly, MO=Monthly, CP=CruzPay, TS=Timesheet, LOA=Leave of Absence, LNP=Leave No Pay.

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Michael Pisano
UCSC – BAS/SHR/ELR – Leave of Absence Assistant
Tel:831-459-1867-Fax:831-459-2661– **Confidential LOA FAX:831-401-2322**

MAC Appointee (METRO Advisory Committee)

Eml: mpisano@ucsc.edu / Mail Stop: Staff Human Resources

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TKWeb: http://shr.ucsc.edu/ops/index.html

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Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comments

Michael Pisano <mpisano@ucsc.edu>
Reply-To: mpisano@ucsc.edu
To: eircomment@ucsc.edu

Mon, Mar 30, 2020 at 1:49 PM

Hello EIR 4/1/20 Scoping Session,

Please read aloud…

Can we expedite the building of campus faculty and staff housing.

There are several state legislations that have passed or in-process to provide possible grant money for us to build housing near transit - especially for building higher density housing for those buildings with-in a ¼ mile of a transit stop with headways of 15-minutes (which our campus is mostly consisting of).

Grant money availability such as;

MPO Planning Grants,

MPO Project Grants,

Caltrans Sustainable County's Planning Grants,

SGC Sustainable Community Planning Grants.

There may be other opportunities for UC Santa Cruz to acquire properties along our County's proposed 30 mile Rail/Trail for Faculty, Staff, & Student housing.

I have been patiently asking everyone for more available campus housing for faculty & staff for almost seven years now to no avail.

Please place more emphasis on balancing our retention & recruitment efforts to lower the possibly 20 Million dollars spent each year on recruitment & retention (based on past SHR AVC Lori Castro's 2014 numbers).

Please can we all help our co-workers & students with local affordable adequate campus housing.

Thank you for your time and consideration

Common Acronyms : EE=Employee, PPE=Pay Period End, PD=Pay Day, BW=Bi-Weekly, QW=Quadra-Weekly, MO=Monthly, CP=CruzPay, TS=Timesheet, LOA=Leave of Absence, LNP=Leave No Pay.

Direct Deposit Sign-Up is in Your UCPath Dashboard Under View Paycheck.

Michael Pisano – Working Remotely from 3/13 to 4/3.
UCSC – BAS/SHR/ELR – Leave of Absence Assistant
Tel:831-459-1867-Fax:831-459-2661– **Confidential LOA FAX:831-401-2322**

MAC Appointee (METRO Advisory Committee)

Eml: mpisano@ucsc.edu / Mail Stop: Staff Human Resources

Work Schedule/Plan de trabajo: Days/Dias; Mon thru Fri – Hrs; 8am to 5pm
TKWeb: http://shr.ucsc.edu/ops/index.html

SHR = Services, Solutions, Success! Servicios, Soluciones, éxito

---

Google @ UCSC

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] I'm not in favor of student expansion in our small community

1 message

Mike Kalashian <makalashian@gmail.com>
Sun, Apr 5, 2020 at 6:07 PM

To: eircomment@ucsc.edu

Santa Cruz is not the right UC to expand.   UC Merced or Marina would be more appropriate or spread around the increase to at least 6 of your other campuses.

Regards,

Mike

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] EIR scoping

1 message

Mike Munson <mikecmunson@gmail.com> Mon, Apr 13, 2020 at 1:42 PM
To: eircomment@ucsc.edu

Please analyze the impacts on loss of undeveloped land on viewscape, no building to be visible from town, traffic on west side streets, over crowding of buses, real estate costs and benefits of more on-campus housing.

Sent from my iPad

---

eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] DO NOT ADD 9,000 ADDITIONAL STUDENTS

1 message

'Milena Carothers' via eircomment@ucsc.edu <eircomment@ucsc.edu> Sat, Apr 4, 2020 at 9:07 PM

Reply-To: Milena Carothers <milenarose@mac.com>
To: eircomment@ucsc.edu

To whom it may concern,

I'm writing to say I'm shocked that you think adding more students to UCSC is a good idea. Affordable housing for current students (and lifelong Santa Cruz residents) is already nearly impossible to find. Current UCSC students don't want even more peers in their classes or housing competition. Professors don't want to cram more students in. The town doesn't want them and you can't build huge new buildings on the gorgeous fields that make your campus so special. Please reconsider in favor of a different UC campus, such as Merced. The people of Santa Cruz and the surrounding towns are sick of your system's greed. Please don't do this.
Thank you,
Milena C.

Erika Carpenter <escarpen@ucsc.edu>

Fw: UCSC Long Range Development Plan Notice

1 message

Nadene Thorne <nadenetd@yahoo.com> Tue, Apr 7, 2020 at 5:48 PM
To: "escarpen@ucsc.edu" <escarpen@ucsc.edu>

Please accept - had difficulties forwarding prior to deadline due to virus constraints.
-Nadene

----- Forwarded Message -----
From: Nadene Thorne <nadenetd@yahoo.com>
To: eircomment@uscsc.edu <eircomment@uscsc.edu>
Sent: Tuesday, April 7, 2020, 05:33:31 PM PDT
Subject: UCSC Long Range Development Plan Notice

Ms Carpenter:

I write as a Cowell College alumna to echo the full remarks of the East Meadow Action Committee (letter dated 3/27/20) regarding the LRDP NOP and particularly in opposing any construction on the East Meadow. Surely it has not escaped your notice that in much of the University's communications, the view of this meadow has been prominently exhibited. That the University, for any reason including budgetary constraints, would contemplate building there - and for so few beds and far less than essential occupation - is hardly to be believed.

Others have written extensively and intelligently about the faults with the University's present Long Range Development Plan. If this extent of opposition, a lawsuit, and a number of endowment prospects extinguished (including mine) in the face of this proposition have not convinced you of the many viable reasons not to proceed, then I have little hope that my poor letter will do much more to bring reconsideration into the field.

Nevertheless, I feel compelled to add my voice. Yes, the University must take substantive steps to house its students - including the ones it has today - affordably, and not increase its population until it can do so. It must not proceed with further development except with the involvement of Santa Cruz County's civic leaders. And above all, and perhaps now most pressingly as we face the upcoming personal and economic fallout from the current corona virus pandemic, the University needs to reconsider its Development Plan in light of not just diminished financial support but also the direction of its guiding principles.

Thank you for your time,

Nadene Thorne
Cowell '72

140 Averitt Street
Santa Cruz 95060

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] No to additional students

1 message

nancy maynard <scrippsmom@gmail.com> Sat, Apr 4, 2020 at 1:16 PM
To: eircomment@ucsc.edu

I am a UC alum and live in Santa Cruz.
I do not support the additional 9,000 students for this campus.
It is not only more students, but also more staff.
Our town is the smallest campus town. There is no room for growth.
Mercedes is more appropriate.
The birthrate is going down and there are more online classes.
Housing here is impossible. If you care about your host towns do not expand UCSC.
Thank You
Nancy Maynard

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comment

1 message

Neil Smith <neosmith@ucsc.edu> Thu, Mar 12, 2020 at 12:30 PM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

What is the plan for student involvement in the development of the EIR?

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UCSC growth

1 message

Nola <nomike2767@comcast.net> Sat, Apr 4, 2020 at 7:16 PM
To: eircomment@ucsc.edu

There is not enough water to support any future growth of UCSC. No expansion. UCSC already has too great of an environmental impact on our county.
Brick and Mortat campuses will be a thing of the past in the next 5-10 years.

Sent from my iPhone

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LDRP NOP comment

2 messages

Pam Newbury <pknewbury@earthlink.net> Thu, Mar 12, 2020 at 1:20 PM
To: eircomment@ucsc.edu

The increase in students and staff will cause a similar increase in the need for supporting businesses and services in the surrounding areas. This expansion will cause a need more employees and the housing and transportation they require. Many of those employees will likely end up traveling a long distance to get to their place of employment. These are impacts that should be considered along with what happens on campus.

Traffic has just as much of an impact on the environment as auto trips per day, since idle cars sitting in traffic emit greenhouse gasses and create excess and unnecessary use of fuel resources. It is important to consider idle traffic as well as trips per day, regardless of what the legislature has put into law.

Geological considerations of the campuses' unique karst geological underpinnings is a key consideration when considering siting of buildings and drainage. These karst formations caused many problems on campus in the past. Consideration of storm runoff and its effect on the surrounding areas is important.

Unchecked use by mountain bikes on the forested upper campus has caused serious environmental degradation from unregulated trail making. Any expansion should include a thought of how a higher density of population and increased recreation will impact erosion and damage done by increased mountain bike use and how that will be mitigated and controlled.

Recreational use of surrounding parks and beaches by an increased student body should be considered.

Control of invasive species should also be considered.

Thank you,
Pam Newbury
543 Ice Cream Grade, Santa Cruz, CA 95060

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Parker Welch <pawelch@ucsc.edu> Thu, Mar 12, 2020 at 1:23 PM
To: Jolie Kerns <kernsj@ucsc.edu>, Erika Carpenter <escarpen@ucsc.edu>, Gary Jakobs <gary.jakobs@ascentenvironmental.com>

[Quoted text hidden]

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

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Parker Welch
Pronouns: he, him, his
GIS/CAD Programmer Analyst
University of California Santa Cruz
Physical Planning, Development, & Operations
Physical and Environmental Planning Services
Tel: (831) 502-7043 | **Email:** pawelch@ucsc.edu
UC SANTA CRUZ

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP EIR Scoping Session

1 message

paeobrien via eircomment@ucsc.edu <eircomment@ucsc.edu> Wed, Apr 1, 2020 at 12:39 PM
Reply-To: paeobrien@aol.com
To: eircomment@ucsc.edu

Pat OBrien: Anonymous: doesn't matter

Legal Name: Remain Anonymous?: Comments Read Aloud?: ---- Leave comments below this line ----

High Street, Bay Avenue and Western Drive cannot support additional traffic to UCSC. High Street is congested in both directions for more than three hours each day making access for emergency vehicles almost physically impossible. Increased enrollment should be limited to online classes only. Proposed on-campus housing development does not match proposed enrollment.

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] eircomment@ucsc.edu

'Jim Weber' via eircomment@ucsc.edu <eircomment@ucsc.edu> Sun, Apr 5, 2020 at 7:12 PM
Reply-To: Jim Weber <jimpatweber@yahoo.com>
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

UCSC needs to build on-campus housing for every new student they accept. They should not exaggerate our housing and transportation problems further.

Pat Weber
1833 Dolphin Dr.
Aptos, CA 95003

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Please do not develop the East Meadow

1 message

Tricia K <tricia@princeypie.com>
Tue, Apr 7, 2020 at 9:05 AM
To: eircomment@ucsc.edu

Hello,
This is at least the third time I've written to encourage the LRDP to NOT develop the East Meadow. So much time has been wasted where other more prudent and expeditious housing proposals could have been implemented that it would probably be completed by now. Please, please explore the other housing options that have already been proposed that do not include developing the East Meadow.
Additionally, I think that UCSC will now find after this whole COVID19 pandemic that enrollment UC system wide will decrease. No one is going to have the money to afford the housing and tuition costs. Instead new prospective students will probably steer toward an online instruction platform to receive their education at a much lower cost.
I have seen the errors over the years watching all the dorm buildings that were built at Crown college have to undergo expensive renovations after they were built poorly in the first place. This is not the first time UCSC has tried to do something quickly and cheaply only to have it completely fail anyway. Please do not do this to the East Meadow. Once it is ruined, you will not be able to go back.
Sincerely,
Patricia Knowles

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] EIR Scoping Session

2 messages

Paula Sanford <paula.sanford@gmail.com> Wed, Apr 1, 2020 at 5:24 PM
To: eircomment@ucsc.edu

Thank you for the opportunity to express our concerns for the increased population of UCSC.

An important issue to resolve is water accessibility and reclamation. As a "City on a Hill" the university should be as self-sufficient as possible.The school should have water to maintain itself without drawing from the city and county of Santa Cruz systems.

Any increase of population should be absorbed by the campus area. Santa Cruz is already overpriced and under-housed.

Sincerely,

Paula Sanford

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Parker Welch <pawelch@ucsc.edu> Wed, Apr 1, 2020 at 5:28 PM
To: Erika Carpenter <escarpen@ucsc.edu>, Jolie Kerns <kernsj@ucsc.edu>, Oxo Slayer <oslayer@ucsc.edu>, Gary Jakobs <gary.jakobs@ascentenvironmental.com>, Claudia Garcia <Claudia.Garcia@ascentenvironmental.com>, Chris Mundhenk <chris.mundhenk@ascentenvironmental.com>

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

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Parker Welch
Surqrxqv=#kh/#klp /#klv
JLV2FDG#Surjudp p hu#Dqdo|vw
Xqlyhuvlw|#ri#Fdolirucld#Vdqwd#Fux}
Sk|vlfdo#Sodqqlqj/#Ghyhorsp hqw/#) #Rshudwlrqv
Sk|vlfdo#dqg#Hqylurqp hqwdo#Sodqqlqj#Vhuylfhv
Tel: +;64,#8350:376#¡#**Email:** pawelch@ucsc.edu

UC SANTA CRUZ

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Too Much Growth for Santa Cruz

Peter Cook <peter@lighthouserealty.net>
To: eircomment@ucsc.edu

Tue, Mar 31, 2020 at 3:27 PM

Dear UCSC,

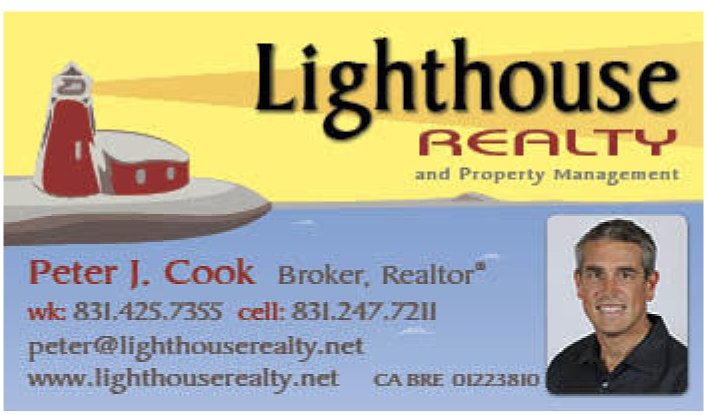
An increase of 50% enrollment at UCSC is simply too much growth for our small city to accommodate. Bay, High, Mission and Laurel streets are already overwhelmed with university traffic. Our city's water supply is extremely vulnerable already. Our city infrastructure is overwhelmed. Our city's parks, beaches and amenities are already overtaxed. Our local housing supply is woefully insufficient. A final capacity of 20,000-24,000 students at UCSC would be far more reasonable given the size of the city that hosts UCSC, and a much slower growth path to reach this final number is needed.

Please reconsider growing UCSC to 28,000 students, it is simply too much growth for our city to reasonably accommodate.

Sincerely,

Peter Cook

Crown '95



Erika Carpenter <escarpen@ucsc.edu>

[eircomment] EIR

1 message

Pierluigi Oliverio <pierluigi.oliverio@gmail.com> Mon, Apr 13, 2020 at 7:30 AM
To: eircomment@ucsc.edu

Please close scoping period and build dense housing on campus to meet the housing demand enrollment creates whixh also eliminate vehicle trips.

Sent from my iPhone

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Scoping Session for UCSC

1 message

Priscilla Williams <prwilliams4@outlook.com> Wed, Apr 1, 2020 at 7:23 PM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

Adding students means adding population density, housing density, increased use of infrastructure, increased use of water.

Every living system in nature grows up to a certain point and stops growing. You are not growing anymore, nor he nor me. But we continue developing ourselves.

Instead of adding students, we need to house our low income workers and our homeless. A good idea for this is building a mobile home park restricted to the homeless, for example. The City would control rents, connects with nonprofits who would provide services the homeless need.

Sincerely,

P.R. Williams
Aptos, CA

i

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP EIR comments

Rafa Sonnenfeld <rsonn27@gmail.com> Wed, Apr 1, 2020 at 6:48 PM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

The EIR should include all environmental impacts for both the on-campus development of housing to accommodate 100% of enrollment and staff/faculty growth, as well as environmental impacts of transportation and off-campus privately developed housing that would be necessary to accommodate the planned increase in enrollment and faculty/staffing.

There will be environmental impacts regardless of where the development for planned growth is physically located, and that development, as well as transportation impacts, needs to be accounted for even if the physical building development does not occur on campus or under the control of UCSC.

It is likely that on-campus physical development will fail to completely house all of the planned campus population growth due to lawsuits, settlements, and/or local government intervention. Therefore it is critical for the EIR to include the off-campus real estate development and necessary transportation that must occur for any planned growth in enrollment and staffing, even if the intention of the LRDP is for that development to occur on campus.

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Comment for live meeting

Rick Longinotti <Longinotti@baymoon.com> Wed, Apr 1, 2020 at 2:46 PM
To: eircomment@ucsc.edu, Morgan Bostic <advocate.morganbostic@gmail.com>

Dear Staff,

Is there any reason why UCSC cannot commit to zero growth in vehicle trips to campus as part of the LRDP? Stanford has successfully implemented zero growth in vehicle trips since 2001. Unfortunately, the draft LRDP includes plans for increased parking on campus, indicating an expectation for more vehicle trips.

Is there any reason why UCSC cannot tie its growth in student enrollment to benchmarks of new housing built on campus? The LRDP goal is to house 100% of new students. Why not make that legally binding and win the credibility of the community?

Thanks,

Rick Longinotti, Co-chair, Campaign for Sustainable Transportation

Fwd: [eircomment] Campaign for Sustainable Transportation

Parker Welch <pawelch@ucsc.edu> Mon, Mar 2, 2020 at 3:29 PM
To: Oxo Slayer <oslayer@ucsc.edu>, Jolie Kerns <kernsj@ucsc.edu>, Erika Carpenter <escarpen@ucsc.edu>

---------- Forwarded message ---------
From: **Rick Longinotti** <Longinotti@baymoon.com>
Date: Fri, Feb 28, 2020 at 7:49 AM
Subject: [eircomment] Campaign for Sustainable Transportation
To: <eircomment@ucsc.edu>

Dear Erika,

Thanks for accepting the attached comments from the Campaign for Sustainable Transportation. To summarize, we request that the scope of the EIR for the Long Range Development Plan include the following:

1. UCSC: Commit to zero new vehicle trips to campus and make growth contingent on achieving
this goal.
2. UCSC: In light of the large externalized environmental and social costs of auto travel, reform
the parking permit program to charge per-day rates. Raise the price of parking and use
parking proceeds to support:
a. a significant share of the cost of campus shuttles and UCSC's contribution to METRO,
allowing a reduction in student fees for transit
b. free transit passes for all faculty and staff
c. vigorous marketing of alternative commutes
3. UCSC: Stop building more parking capacity and begin to repurpose parking lots for infill
development.

Thank you,

Rick Longinotti, Co-Chair, Campaign for Sustainable Transportation

--
Parker Welch
GIS/CAD Programmer Analyst
University of California Santa Cruz
Physical Planning, Development, & Operations
Physical and Environmental Planning Services

Tel: (831) 502-7043 | **Email:** pawelch@ucsc.edu

UC SANTA CRUZ

Zero New Vehicle Trips for LRDP.pdf
182K

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Campaign for Sustainable Transportation

2 messages

Rick Longinotti <Longinotti@baymoon.com> Wed, Mar 11, 2020 at 6:34 PM
To: eircomment@ucsc.edu

Hi Erika,

Could you please reply if you receive this?

Thanks,

Rick

Dear Erika,

Thanks for accepting the attached comments from the Campaign for Sustainable Transportation. To summarize, we request that the scope of the EIR for the Long Range Development Plan include the following:

1. UCSC: Commit to zero new vehicle trips to campus and make growth contingent on achieving this goal.
2. UCSC: In light of the large externalized environmental and social costs of auto travel, reform the parking permit program to charge per-day rates. Raise the price of parking and use parking proceeds to support:
a. a significant share of the cost of campus shuttles and UCSC's contribution to METRO, allowing a reduction in student fees for transit
b. free transit passes for all faculty and staff
c. vigorous marketing of alternative commutes
3. UCSC: Stop building more parking capacity and begin to repurpose parking lots for infill development.

Thank you,

Rick Longinotti, Co-Chair, Campaign for Sustainable Transportation

Zero New Vehicle Trips for LRDP.pdf
182K

Erika Carpenter <escarpen@ucsc.edu> Thu, Mar 12, 2020 at 8:50 AM
To: Rick Longinotti <Longinotti@baymoon.com>

Thank you for your comment, Rick. Your written email and attachment will be included as a comment on the Notice of Preparation and has been placed in the record.

Due to COVID-19, our EIR scoping meeting will now be online (see attachment). We are reading comments during the live broadcast of our scoping meeting today, which will also be captured by our court reporter. However, we wanted to respect the privacy of those that may not want it read during the on-line meeting. If you would **not** like your comment read aloud, please let me know.

Thank you again for commenting.

Best Regards,
Erika

[Quoted text hidden]

> [Quoted text hidden]
>
> ---
> eircomment mailing list
> eircomment@ucsc.edu
> https://lists.ucsc.edu/mailman/listinfo/eircomment

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Erika Carpenter
Senior Environmental Planner
Physical & Environmental Planning Services
Physical Planning, Development & Operations
University of California, Santa Cruz
Tel: 831.212.0187 | email: escarpen@ucsc.edu

UCSC_LRDP_MARCHSCOPINGSESSIONS_MODIFICATION_ANNOUNCEMENT.pdf
223K

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP

1 message

Roland Saher <rolandsaher@gmail.com> Sat, Apr 4, 2020 at 2:52 PM
To: eircomment@ucsc.edu

As a resident of Santa Cruz, I feel burdened by the policies on housing and transportation of students and staff UCSC has implemented over the last four decades. As a taxpayer, I am irritated over the misuse of my tax dollars. We deserve better! Luckily, there are alternatives that have proven to work. Therefore, I urge you in the strongest terms to implement the following, which will, if adhered to, bring light to UCSC and Santa Cruz:

1. Commit to zero new vehicle trips to campus and make growth contingent on achieving this goal.
2. In light of the large externalized environmental and social costs of auto travel, reform the parking permit program to charge per-day rates. Raise the price of parking and use parking proceeds to support:
a. a significant share of the cost of campus shuttles and UCSC's contribution to METRO, allowing a reduction in student fees for transit
b. free transit passes for all faculty and staff
c. vigorous marketing of alternative commutes
3. Stop building more parking capacity and begin to repurpose parking lots for infill development.
4. Collaborate with UCSC in implementing a charge on ride service companies (e.g. Uber/Lyft) and a congestion pricing program for all vehicle trips to campus, with proceeds going to transit and transportation demand management measures.

Roland Saher

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Questions to be read during campus scoping session, March 12

1 message

Ronnie Lipschutz <rlipsch@ucsc.edu> Thu, Mar 12, 2020 at 11:45 AM
To: eircomment@ucsc.edu

1. The transportation impacts on the city of an increase in students enrollments to 28,000 (plus accompanying increases in faculty and staff) will materially affect access to campus and the surrounding neighborhood far beyond current, already-significant effects. During "rush hours," there are traffic jams on the campus and streets adjacent to the campus, especially down High and Bay Streets. Student using Uber and Lyft to get to, from and around campus are adding to congestion, as well. The EIR must explain how these impacts will be addressed and whether the current road configuration can handle the increased traffic load.

2. The current emergency evacuation plan for the campus is wholly inadequate and quite dangerous. Those with cars on campus are told to drive off; others, to walk off or shelter in place. Whether this will work in the event of, say, a wildfire north of campus, has never been tested. The addition of 10,000+ people to the main campus, and limited egress from the campus, require an updating of the evacuation plan, which should be addressed in the EIR.

3. Finally, as an alternative to the proposed "map" of the main campus, the EIR should also consider alternative plans, such as moving offices and even teaching to locations elsewhere in the city and county (as has been done with the Coastal Campus and Scotts Valley). This will make instruction difficult and access to faculty much more problematic, and is likely to be opposed by the city, in particular, but it will spread out the impacts of growth and lower the risk of having so many people on the main campus.

-

Ronnie D. Lipschutz, Professor of Politics
UC Santa Cruz,1156 High St. Santa Cruz, CA 95064
e-mail: rlipsch@ucsc.edu; phone: 831-459-3275; web site: http://tinyurl.com/zeatctr
Codirector, Sustainable Systems Research Foundation
Host, "Sustainability Now!" every other Sunday on KSQD 90.7FM & KSQD.org
(archived at: https://sustainablesystemsfoundation.org/sustainability-now-broadcasts-on-ksqd-90-7-fm-ksqd-org/

"I have to die. If it is now, well, then, I die now; if later, then now I will take my lunch, since the hour for lunch has arrived — and dying I will tend to later." --Epictetus--

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Immediate question for Jolie

2 messages

Ronnie Lipschutz <rlipsch@ucsc.edu> Thu, Mar 12, 2020 at 12:17 PM
To: eircomment@ucsc.edu

Does a finding of an adverse impact require a change in the proposed plan? Or is that only for informational purposes?

--

Ronnie D. Lipschutz, Professor of Politics
UC Santa Cruz,1156 High St. Santa Cruz, CA 95064
e-mail: rlipsch@ucsc.edu; phone: 831-459-3275; web site: http://tinyurl.com/zeatctr
Codirector, Sustainable Systems Research Foundation
Host, "Sustainability Now!" every other Sunday on KSQD 90.7FM & KSQD.org
(archived at: https://sustainablesystemsfoundation.org/sustainability-now-broadcasts-on-ksqd-90-7-fm-ksqd-org/

"I have to die. If it is now, well, then, I die now; if later, then now I will take my lunch, since the hour for lunch has arrived — and dying I will tend to later." --Epictetus--

Parker Welch <pawelch@ucsc.edu> Thu, Mar 12, 2020 at 12:42 PM
To: Jolie Kerns <kernsj@ucsc.edu>, Erika Carpenter <escarpen@ucsc.edu>

[Quoted text hidden]

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Parker Welch
Pronouns: he, him, his
GIS/CAD Programmer Analyst
University of California Santa Cruz
Physical Planning, Development, & Operations
Physical and Environmental Planning Services
Tel: (831) 502-7043 | **Email:** pawelch@ucsc.edu

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP EIR Scoping Session

Russell Weisz <russweisz1@gmail.com> Tue, Mar 31, 2020 at 8:13 PM
To: eircomment@ucsc.edu

The UCSC LRDP is misguided and inadequate. Despite a vote by the majority of citizens in the host city, Santa Cruz, to keep UCSC from expanding and overwhelming city services, supplies and resources, the LRDP plans for overwhelming growth. Despite agreeing to a lawsuit settlement stating that UCSC will study growing at alternate campuses instead of Santa Cruz, the LRDP omits this requirement. Despite claims that currently proposed new on-campus housing developments are not sized to handle LRDP student growth, they are in line with LRDP growth plans and these developments do have negative environmental impacts. This LRDP is not supported by the majority of Santa Cruz residents, UCSC students or faculty. It is apparently supported by administrators and out of town regents because it is seen as cheaper and more expedient than expanding the UC at locations that welcome the growth. UCSC should instead focus on maximizing the quality of its education and the availability of classes for the current number of students. The campus environment should be preserved not degraded. These points are the proper focus of the LRDP rather than student growth and on-campus real estate development schemes.

Sincerely,
Russell Weisz
319 Laguna St
Santa Cruz CA 95060
russweisz1@gmail.com

[eircomment] April 1st meeting

1 message

Ruth Garland <rockttn@cruzio.com> Tue, Mar 31, 2020 at 4:33 PM
To: eircomment@ucsc.edu

Wait!
This is totally unethical for your to hold a meeting during the Covid virus and expect it will have any integrity.
Please wait until we can have an honest meeting about your plans.
Thank you,
Ruth Garland

Oxo Slayer <oslayer@ucsc.edu>

[lrdp] Concerns about LRDP UCSC growth

1 message

Ruth Rabinowitz <rnrabinowitz@gmail.com> Tue, Mar 10, 2020 at 10:47 PM
Reply-To: lrdp+managers@ucsc.edu
To: lrdp@ucsc.edu

Hello

I attended the LRDP meeting last year at Long Marine Lab. The amount of growth is scary to me as a next door neighbor on High Street. What are your plans for the traffic on Bay and High? The traffic is already gridlock now on High Street and bumper to bumper at peak times. I just don't think the road infrastructure supports the level of growth you are seeking. Please reconsider the arteries of High and Bay, is there another route or can you slow this growth down?

I am UCSC alumni and very concerned.

Ruth N. Rabinowitz
Regenerative Farm Management
Permaculture Design Certificate (PDC)
Cell: 831-566-0426
facebook.com/Oxbowfarmsiowa

Farms in Iowa and South Dakota since 1978

"The most fundamental law is to recognize that we share the planet with other beings, and we have a duty to care for our common home." - Vendana Shiva

To: Erika Carpenter, Senior Environmental Planner, Physical Planning, Development, and Operations

From: Ryan Carle, Lecturer, Environmental Studies Department, UCSC

RE: Notice of Preparation for Environmental Impact Report for the 2020 LRDP

I am writing to comment on the Notice of Preparation for the EIR for the 2020 LRDP. I am a lecturer (since 2016) with the UCSC Environmental Studies department, where I teach field- and classroom-based natural history classes. I am also an alumnus of UCSC. My first request is that the topic of permanently protecting the UCSC Campus Natural Reserve be included in the EIR process.

The Campus Natural Reserve is a unique and valuable campus resource that provides many benefits, from ecosystem services to recreation and quality of life for students. I believe the open spaces on campus are one of the primary attractants for new students to come to UCSC—they certainly were for me, as a student. The Campus Natural Reserve protects that unique feel and quality of life for students of being able to quickly access the outdoors. The Campus Natural Reserve, however, is not just a pretty space for recreation and renewal—it is also an amazing teaching resource and a living laboratory for research. Many faculty conduct cutting edge ecological research on the Campus Natural Reserve, and it is critical for research projects to know that the Campus Natural Reserve boundaries will not be changed, or the Reserve developed, as they pursue long-term ecological research.

I can speak most directly to the value of the Campus Natural Reserve from a teaching perspective. In all of my natural history classes, we regularly visit the Reserve, which serves as an incredibly unique teaching resource—having the Reserve right on campus means that in a short class period we can make a meaningful visit to a variety of ecosystems right out the door of the classroom. My Natural History of the UCSC Campus class relies entirely on the natural spaces of UCSC, and especially the Reserve, as the basis to introduce students to natural history, which is a gateway for many students toward more deeply pursuing academic and career paths in biology, ecology, and policy. In my other classes, Natural History Field Quarter and the Natural History of Birds, we likewise regularly venture out to the Campus Natural Reserve for lessons. The Reserve offers a rich array of subjects to teach about, and I have taught lessons on geology, insects, lichens, botany, birds, fire ecology, and indigenous and contemporary land management, and more, on the Reserve. I cannot over-emphasize the uniqueness and value of having the Reserve right on campus—we do not need to rent vehicles, plan extensively, and spend travel time to arrive in an ecological-intact outdoor classroom; we can simply walk 5-10 minutes and arrive. However, without permanent protection of the Reserve, these teaching resources could be lost, along with a one-of-a-kind learning opportunity for UCSC's students. Once again I urge you to include the theme of protecting the CNR permanently as part of the proposed EIR; it is clearly relevant to many EIR topics including biological resources, cultural and tribal cultural resources, greenhouse gas emissions, noise, recreation, and wildlife. The lands chosen for protection in the reserve should include the values of teaching and research, and not just be areas where development cannot occur due to other reasons.

My second request is that, instead of only planning for 28,000 students, that the EIR should also assess resources needed for specific increments of growth below the 28,000 number (i.e., 22,000, 24,000 students). The 2005 LRDP planned for 19,500 students, which we have nearly reached; however, many of the steps outlined in the 2005 LRDP have not happened, such as construction of new housing and classrooms, and mitigation for environmental impacts. As a result, dorms and classrooms are over-crowded, class periods have been shortened, and traffic and parking issues are worsening. I would argue that student quality of life and education has gone down as a result. Thus, the current EIR process should consider evaluation of resources for incremental numbers of students, and if resources are not met, then growth should be delayed until resources are available. Increasing student enrollment to 28,000 without the resources to do so responsibly will worsen already existing problems with traffic, class sizes, and dorm space.

Thank you,

Ryan Carle
Lecturer, UC Santa Cruz Environmental Studies Department
760-709-1179

[eircomment] Fwd: UCSC Expansion

Sarah Olson <7saraholson777@gmail.com>
To: eircomment@ucsc.edu

Wed, Apr 1, 2020 at 5:05 PM

---------- Forwarded message ---------
From: **Sarah Olson** <7saraholson777@gmail.com>
Date: Wed, Apr 1, 2020 at 5:01 PM
Subject: UCSC Expansion
To: <lrdp@ucsc.edu>

I am definitely against the expansion of 10,000 more students on the UCSC campus for the following 7 reasons:

1. It is very important UCSC understands the Coronavirus has made a difference in education. Colleges will have more classes online which will help save money for the colleges which will alleviate some of the need for more students on campus.
2. There are fewer students coming to college in the next number of years due to the decrease in the birthrate.
3. The city of Santa Cruz does not have wide enough roads to accommodate 10,000 more students without a heavy impact of traffic. Even with a bus too and from the Delaware Ave UCSC location the impact will be too large.
4. The regents need to make plans to increase the enrollment of their UC in a town that is less costly to live in. Even if more campus housing is built some students will live within the town of Santa Cruz. Santa Cruz has some of the most expensive housing in the nation.
5. UC Merced would be a more affordable location due to a lower cost of housing.
6. UC Merced has room within their campus because there are less than 9,000 students enrolled there.
7. For 2019 UCSC's yield rate was lower than in 2018 this indicates it is not a good idea to expand.

Please take the recommendation of the citizens of Santa Cruz and do not expland UCSC.
Respectfully submitted.

Google @ UCSC

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comments

1 message

Seth Levy <seth@rtpacific.com>   Wed, Apr 1, 2020 at 9:28 AM
To: eircomment@ucsc.edu

To: Erika Carpenter
Senior Environmental Planner
Physical Planning, Development and Operations
University of California, Santa Cruz
1156 High Street, Santa Cruz, CA 95064

I live in santa cruz in a neighborhood already negatively affected by UCSC growth in many ways including:

1. Traffic at all hours of the day and night that is 5 times worse when UCSC is in session, this makes it unsafe for pedestrians and children. UCSC students illegally park on our street and routinely violate the speed limits and traffic laws. Any increase in enrollment would be intolerable.

2. Housing, the family house next door to us has been turned into an 9+ student rental with students using all the parking, living in the garage, loud parties, garbage etc. 2 years ago it had 2 people living in it. It rents for $7000 a month. Any increase in enrollment would only exacerbate a terrible housing situation. UCSC has not fulfilled its commitments to house the current population, and UCSC housing is too expensive.

3. Water, sewage and garbage santa cruz is short of water already and cannot handle any more growth.

4. Pressure on parks and recreation, our area parks and beaches are negatively impacted by UCSC students, we can't handle any more.

Mitigation measures:

1. Reduce enrollment don't increase it.
2. House students on campus, provide parking on campus, both need to be affordable and plentiful. Require students to live on campus.
3. Provide grocery or shopping on our adjacent to campus to reduce trips.
4. Open all UCSC facilities to residents of santa cruz free of charge.
5. Increase payments to santa cruz city for maintenance of streets, water, garbage and police.
6. Actually do something about these comments rather than just paying lip service to the community and going thru the motions of an EIR as has happened in the past.

Sincerely,

Seth Levy
316 Alta Vista Drive
Santa Cruz, CA 95060

Google @ UCSC

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Please no more students!!

1 message

SJ G <sirleen@hotmail.com> Sun, Apr 5, 2020 at 7:18 AM
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

Our little county is already over crowded. Be responsibe.

Regards,

Sirleen Ghileri

Aptos

Sent from Mail for Windows 10

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] EIR

1 message

Smaura <smaura108@comcast.net>
To: eircomment@ucsc.edu

Thu, Mar 12, 2020 at 12:31 PM

Everything I am hearing regarding issues seems to concern ONLY issues within the boundaries of campus and Westside Research Project and nothing regarding how this plan impacts OFF-CAMPUS neighborhoods that are SEVERELY NEGATIVELY AFFECTED, i.e., RENTALS, TRAFFIC FLOW and PARKING !!

Traffic on Western Drive, High Street and Bay is impossible now; I can't imagine any further increase in traffic without causing even more hardship (and resentment) for those of us who must share the roads with overflow from campus as we travel to jobs and appointments that have nothing to do with UCSC.

Thank you

[eircomment] No UCSC student growth

1 message

'steve mccarthy' via eircomment@ucsc.edu <eircomment@ucsc.edu> Sun, Apr 5, 2020 at 6:06 PM
Reply-To: steve mccarthy <smccart001@icloud.com>
To: eircomment@ucsc.edu

I do not support additional USSC student expansion.

Steve McCarthy

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] UCSC expansion

1 message

Susan Bruckner <subruckn@cabrillo.edu> Fri, Apr 3, 2020 at 11:20 PM
To: eircomment@ucsc.edu

To Whom It May Concern:

I am writing to say that I am against UCSC enrolling 9,000 more students. Santa Cruz is the smallest community of the UC system and it simply does not have the infrastructure to support such a large population increase. Our town has rising rents due to UC students and they are starting to fan out all across the city, not just the westside any longer. I have had students moving into my neighborhood more recently in Seabright where I have lived for 26 years. There are suddenly noise ordinance issues, and longtime neighbors who have been evicted to make room for students whose parents can pay higher rents, apparently. Student renters who leave after one or two years are taking the place of our stable long-term renting neighbors who were part of the fabric of our community, now dissolving. We have issues such as water provisions which will be stretched to the limit or beyond with 9,000 more residents. UCSC does not build affordable housing on the large, open campus, but expects the residential neighborhoods to bear the brunt of having student housing take the place of permanent homeowners and long term renters in our community.

I feel very strongly that the problem has already gotten out of hand and any more will bring us to a clear breaking point. Please join the community in deciding against this increase.

Sincerely,

Susan Bruckner
Director of Piano Studies
Cabrillo College
Aptos CA 95003
831-423-7025

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] tonight's meeting

1 message

Susan Coale <slcoale@ucsc.edu> Wed, Apr 1, 2020 at 8:00 PM
To: eircomment@ucsc.edu

Thanks, looking forward to working with you to come up with a reasonable and sustainable LRDP-one that enhances UCSC's status in the community and fosters scholarship at the highest level.

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Timetable for 2020 LRDP

2 messages

Ted Benhari <tbenhari@sbcglobal.net> Wed, Apr 1, 2020 at 6:33 PM
To: eircomment@ucsc.edu

In light of the present pandemic, any urgency about preparing the DEIR has dissipated. For one, the ability to forecast when the social distancing situation will end means that many aspects of working on the DEIR will have to be put off to an unknown future time. In addition, the economic effects on the state's budget will be serious and long-lasting, and are likely to negatively affect UC funding for several years. How this will affect the timetable for implementing any of the growth is unknowable, but it certainly is likely to be considerable. In short, when the nation and state are in the midst of a dire crisis, there is no reason to rush this forward. Let's put this on hold until our state and nation recover from this historic crisis.

Ted Benhari
Coalition for Limiting University Expansion

____
eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

Parker Welch <pawelch@ucsc.edu> Wed, Apr 1, 2020 at 6:37 PM
To: Erika Carpenter <escarpen@ucsc.edu>, Jolie Kerns <kernsj@ucsc.edu>, Oxo Slayer <oslayer@ucsc.edu>, Gary Jakobs <gary.jakobs@ascentenvironmental.com>, Claudia Garcia <Claudia.Garcia@ascentenvironmental.com>, Chris Mundhenk <chris.mundhenk@ascentenvironmental.com>

[Quoted text hidden]

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Parker Welch

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Tel: +;64,#8350:376#¡#**Email:** pawelch@ucsc.edu

UC SANTA CRUZ

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] I am not in support of UCSC growing 9, 000 additional students.

1 message

Tina Andreatta <tina.marieotr@gmail.com> Wed, Apr 8, 2020 at 12:07 AM
To: eircomment@ucsc.edu

To Whom It May Concern,

The town of Santa Cruz is the smallest host town of any UC. Tourism makes our already impacted town swell on the weekends. The weekends are when students are not in class. 9,000 additional students in Santa Cruz is too many people.

UC Merced would be more appropriate or spread the student enrollments to at least 6 of your other campuses.

The noise and congestion of adding more students in the town of Santa Cruz is not supported at all by the local community. Too many cars on our congested streets.

Care about your host towns!

Sincerely,

Tina Andreatta

Sent from my iPhone

To Whom it May Concern, 4/1/2020

This is a response to the Long Range Development Plan for UCSC.
I would like to say that I value highly the thought thats gone into the archetectural planning and the unique vegetation zones on the campus. I highly value the concept of maintaining our wonderful open space meadows by building in the forrest zones This campus is unique in this way. I (and many other local residents) would like to see this primary building concept continue. Please leave the meadows for all future generations to enjoy and gain inspiration from!

My final request is that UCSC does not increase the student body count in the years to come. As a renter in Santa Cruz County I can say that we are in a dire situation. Our rents have increased to the point that it is no longer viable for a medium income single person to rent a home (my rent is more than my salary @ UCSC ea. month!) The pressure from Silicon Valley workers moving to our county has made it almost impossible for middle income wage earners to live here. Currently the UCSC students are experiencing this pressure as well!

If this pressure continues to increase the middle income labor force will be driven away and the students needing housing off. campus will not be able to afford it!

Finally, our natural resources ~~will~~ continue to feel the pressure. Our parks became too crowded our beaches are too polluted and at some point our water will become more limited and more costly.

It is my opinion that this particular UC Campus should not be forced ~~to~~ to grow in population and it is my opinion that the Meadows should Never be destroyed by any construction.

Thank you for your time and consideration.

Tracy Reynolds Maxwell
UCSC Employee
County resident of 25 years.

Memorandum

To: Erika Carpenter, Senior Environmental Planner, Physical Planning, Development and Operations, University of California, Santa Cruz

From: Tsim D. Schneider, Assistant Professor of Anthropology, UCSC
Diane Gifford-Gonzalez, Distinguished Research Professor, Anthropology, UCSC
Jon Daehnke, Associate Professor of Anthropology, UCSC

Date: April 8, 2020

RE: UCSC LRDP Notice of Preparation Comments

We write to comment on the Notice of Preparation of the Environmental Impact Review (EIR) for the 2020 Long Range Development Plan (LRDP) at UCSC. We have previously shared our views on what we recognize as a convergence of campus planning processes for the LRDP and a commitment to protect Amah Mutsun ancestors in a letter delivered to Sarah Latham (Vice Chancellor of Business and Administrative Services at UCSC) on November 14, 2019. We write to you to strongly recommend the enhancement of a Campus Natural Reserve (CNR) ***and*** the permanent protection of at least some parts of the reserve containing sensitive Native American cultural resources.

We are all archaeologists and members of the Department of Anthropology. Two of us (Gifford-Gonzalez and Schneider) serve as members of the CNR faculty planning group, offering feedback on the campus's cultural resources. Daehnke is UCSC's representative to UCOP's Advisory Group on Cultural Affiliation and Repatriation of Human Remains and Cultural Items and participates in discussions of the reburial of ancestral remains. Daehnke and Schneider are members of the Amah Mutsun Speaker Series Board. Gifford-Gonzalez is the campus contact on repatriation with the National NAGPRA Program (NNP), gave UCSC's presentation to the NNP Review Committee for returning the campus's human remains to the Amah Mutsun. We have longstanding relations with Chairman Valentin Lopez and other members of the Amah Mutsun Tribal Band.

We are sensitive both to the LRDP process and the planned reburial of repatriated ancestral remains removed in the mid-1960s from lands now included in the CNR. It is the wish of the Amah Mutsun Tribal Band that the remains of ancestors be reburied as close to their point of origin as possible and remain undisturbed in perpetuity. The long-term security and inviolability of these reburials would best be served by the LRDP planning process moving to designate some portions of CNR land (unidentified in this memo to ensure their confidentiality) as permanently protected. This would assure the Amah Mutsun that UCSC has done all that it can to protect in perpetuity their ancestral remains.

This is a matter of social justice, a core theme woven into the fabric of the UCSC community and its identity. Designating permanent Campus Natural Reserve would ensure the continued survival and accessibility for scholarly study of natural resources. We trust that all of the campus's identified cultural heritage, both indigenous and historic, will also be considered carefully when making plans for the future development of campus areas. However, the most pressing need is for the permanent protection of the CNR, which is both home to endangered plant and animal species and sensitive Native American cultural resources.

Thank you for your consideration. Please do not hesitate to contact any of us if you have any questions.

Erika Carpenter <escarpen@ucsc.edu>

Re: [eircomment] UCSC expansion

1 message

tutti hacking <tuttihacking@gmail.com> Wed, Apr 1, 2020 at 5:34 PM
To: eircomment@ucsc.edu

Regarding the proposed UCSC expansion:

As a longtime resident and property owner in the City of Santa Cruz, I believe those of us in the community should be heard - the proposed UCSC expansion makes no sense and endangers my community. Santa Cruz is a small city, relatively. The new proposed expansion to 30K students would impact our small town disproportionately than an expansion at UC Merced, which has room to grow. Our housing shortages, water needs, and traffic concerns need to be addressed: WE HAVE RUN OUT OF OPTIONS. How is it that the UC Regents can make decisions that affect our community so drastically? Santa Cruz simply cannot appease the demands of the Regents, and the Regents need to listen.

I am a former UCSC student. Back in 1985 when I was a freshman, there were barely 6000 students. Now, with almost 20K students, the charm and individual attention of a small liberal arts school is gone. All three of my daughters attend or graduated from UCSC. I know it is a good school, but it has lost much of what it was when I attended. My daughters who transferred this year from Cabrillo have complained that Cabrillo was a much better school than UCSC - classes were smaller, teachers more attentive and available, and costs much lower. It is hard to hear this, when I am shelling out so much for tuition (and, I might add, getting no financial break when my girls can't even attend live classes).

The Regents should reconsider this failed policy of continued growth. Santa Cruz residents deserve better.

Thank you,
Tutti Hacking (class of 1990)

Google @ UCSC

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP

1 message

Valerie Bengal <vbengal@ucsc.edu> Tue, Apr 7, 2020 at 6:06 PM
To: eircomment@ucsc.edu

Dear Regents,

I am a graduate of UC, having studied at UCD, UCB, and UCSF, I was also a faculty member at UCSF School of Medicine, Department of Family and Community Medicine for 27 years.
Currently I work as a family physician at the Cowell Student Health Center. I have four decades experience caring for vulnerable and underserved populations in the US and in developing countries.

I have reviewed the LRDP and recommend no increased enrollment beyond the 19,500 students we currently have. I was struck, reading the report, by the lack of understanding of what is really happening to students and employees here, as well as residents of Santa Crua County.

I would rather see increased academic services via remote online learning, collaboration with high schools and community colleges, and work-study programs elsewhere in California. The catastrophic realities and consequences of the current SARS CoV-2 pandemic is unfortunately and painfully a great opportunity to reconsider the paradigms of higher education.

My reasons for opposition are as follows:

1) Resources:The University has already exceeded or is near the limit of the carrying capacity of its campus and the City and County of Santa Cruz, including water supply, transportation capacity, utilities, land use, risk of damage to the local environment, and of course waste and sewer systems. We are in the midst of a climate and environmental emergency and must act accordingly. Santa Cruz County has well-documented limits to growth, as well as a unique and fragile local ecosystem.

2) Safety: The campus was built with only two exits, leading into residential city streets. An emergency evacuation, for example, in case of wildfire, would be unmanageable. Outbreaks of infectious disease are already difficult to contain and mitigate. We conduct active shooter, fire, and earthquake drills, but it is unlikely that we could face the worst.

3) Health Care: The student population is diverse and deserving of an excellent education, but have many more psychological and medical needs than in the past. Our clinic cannot expand services. We cannot recruit and retain personnel partly because the salaries are below the community standard. The commute to UCSC is a disincentive to working here as well.

4) Housing was not a problem in the 1960s, when Santa Clara County was the "Valley of Heart's Delight", full of orchards and small towns. Now students compete with commuters, investors, speculators, and vacation rentals for a place to live, at great cost. The University can build housing, but it is extremely expensive, owing to the private-public partnership model.

5) Financial: We are in the midst of a nationwide massive transfer of wealth from young people to banks and corporations, via student debt.. It is not reasonable to further burden students with the cost of expansion. The State of California provides much less funding to the UC System now than in the past. I have seen figures of less than 20% of the budget. The financial hardships of students send them to the student health center as much as any physical condition.

6) Relationships with the surrounding community: Compared to Berkeley, Davis, and San Francisco, UCSC does not have a healthy connection with the city and county. This may be partly why local residents are

even more incensed that their city is at the mercy of outside forces. We cannot control Silicon Valley or the real estate market, but we should have a voice in the decision making process of a public university.

I certainly hope that the Regents and the LRDP committee will not continue the tradition of expedient development and damage already visited on California and its inhabitants for 250 years. We need to look much farther than 2040 and examine a multitude of scenarios with responses which will maintain our resilience and natural resources.

Thank you for reviewing my comments.

Valerie Bengal, MD, FAAFP
A.B. UC Berkeley
Residency in Family and Community Medicine, UCSF
Former Associate Clinical Professor UCSF/FCM

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LDRP EIR Scoping Session

2 messages

'Veronica' via eircomment@ucsc.edu <eircomment@ucsc.edu> Wed, Apr 1, 2020 at 6:04 PM
Reply-To: Veronica <ladyvkt@yahoo.com>
To: "eircomment@ucsc.edu" <eircomment@ucsc.edu>

(1) As I understand it, it's the UC Regents who set enrollment goals and limits, not individual campuses. Please clarify.
(2) If COVID19 is teaching higher education anything, it's that most classes can go online. As a former UCSC teacher, with my husband teaching at SJSU, I believe one way to mitigate environmental impacts and town-gown issues (including the housing crunch) might be to require all first-year or third-year students to stay at home and take that year online. That would represent a 25% reduction in students on campus. I believe ideas like this are likely to be adopted across the country. It would save the UC an enormous amount of money in classrooms and housing. Students in the hard sciences could take their lab classes during their resident years. Students in humanities and social sciences could take their smaller, more interactive courses as residents.

-V Macramalla

Parker Welch <pawelch@ucsc.edu> Wed, Apr 1, 2020 at 6:09 PM
To: Erika Carpenter <escarpen@ucsc.edu>, Jolie Kerns <kernsj@ucsc.edu>, Oxo Slayer <oslayer@ucsc.edu>, Gary Jakobs <gary.jakobs@ascentenvironmental.com>, Claudia Garcia <Claudia.Garcia@ascentenvironmental.com>, Chris Mundhenk <chris.mundhenk@ascentenvironmental.com>

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eircomment mailing list
eircomment@ucsc.edu
https://lists.ucsc.edu/mailman/listinfo/eircomment

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Parker Welch
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Tel: +;64,#8350:376#¡#**Email:** pawelch@ucsc.edu
UC SANTA CRUZ

[eircomment] Increased enrollment at UCSC

1 message

Vikki Erickson <vikkierickson@comcast.net> Thu, Apr 9, 2020 at 3:49 PM
To: eircomment@ucsc.edu

I live in Santa Cruz County and I am concerned that you are considering increasing enrollment at UCSC. This community cannot house people who work in the area and it's an ongoing struggle to find decent housing for students. This is a small county and we can't absorb any more students. Water and housing are both critical issues for this county. Please reconsider this decision and increase enrollment at campuses that can handel the increase.

Thanks for your consideration,
Victoria Erickson
Aptos, California

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP NOP Comments

1 message

Vincent Molina <vtmolina@ucsc.edu> Wed, Apr 8, 2020 at 2:01 PM
To: eircomment@ucsc.edu

To whom it may concern:

I am a student enrolled in Kristen Kusic Heady's Natural Resources and Land Management IDEASS Lab. Here are some things I had to say about the LRDP NOP:

"The UCSC LRDP Environmental Impact Report NOP does a good job in addressing the overarching goals of the University, while also integrating relevant stakeholder input and historical context. While it covers many, if not all, potential development issues, I believe it is especially significant to emphasize the importance of an improved transportation system, an increased campus natural reserve area, and an efficient implementation of a recreational land use plan for Upper Campus.

As a current student, traversing across campus can be a difficult commute under the current impacted transportation system. A spatially larger campus natural reserve enables the freedom of research, most notably temporally and spatially sensitive studies; furthermore, sensitive biological resources are better protected. Lastly, the Upper Campus space currently does not have a particular recreation system, proper enforcement, and regulation, allowing for the unsanctioned use of many users. A dedicated recreational land use plan for Upper Campus in conjunction with the UCSC LRDP must be considered."

Thank you for your time and consideration.

All the best,

Vince

--
Vincent T. Molina
Environmental Economics Undergraduate, Class of 2020
University of California, Santa Cruz
Tel: (805) 234-6134
E-mail: vtmolina@ucsc.edu

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] Comment

Woutje Swets <woutje.swets@gmail.com> Thu, Mar 12, 2020 at 7:16 PM
To: eircomment@ucsc.edu

I am flabbergasted by UCSC's plans to add thousands more students.
You don't even have room for the present students - there are now 3 students per teensy weensy dorm rooms at even higher rents than the rents are in town!
Traffic congestion on High, Bay and Western is gridlocked. How are you proposing to alleviate that?
Fix the current problems first before you even consider anything else! Oh, wait. the current problems are not fixable - well, in that case, just soldier on as if they are fixed. Good grief.
You don't even have mitigating plans in place right now for wild fires or earthquakes, or god forbid a disaster like the Corona virus. All of these are imminent threats in Santa Cruz and all you provide is lip service.
When (- to be sure - NOT IF!!!) such a disaster strikes, you are wholly unprepared as it is right now, leave alone adding even more students. I would not dream of sending my kids up there to school. It's only a matter of time before disaster strikes which will not only endanger the kids, but also endanger out firefighters and other rescuers.
Why is the University of California refusing to build a new campus elsewhere?
Which part of "There is no water, no roads, no room in Santa Cruz" do the regents not understand?
Get real, Regents!
Thank you.

Erika Carpenter <escarpen@ucsc.edu>

[eircomment] LRDP

1 message

Z P <zacharyp32@gmail.com> Sat, Apr 4, 2020 at 4:48 PM
To: eircomment@ucsc.edu

"For every ten people that move to the Santa Cruz area, only one additional housing option is added to existing housing inventory." (1)

The above quotation is from those wishing to increase UCSC's student enrollment by about 50% over the next 20 years. Santa Cruz has a supply and demand problem, the quotation explains that. So why would you increase supply and exasperate the problem? I understand part of LRDP is providing new sources of housing, but why not first get the supply and demand problem under control before trying to grow 50%? It's like if you have a wounded leg that needs to heal, but you also want to workout and build muscle, so you go for a run instead of resting, finding solace in the fact that you bandaged the wound really well.

Do we wish to force students into a situation where they have to brake building codes and risk their health by forcing several of them to find a cheap, moldy, cramped building to try and call home, living from hand to mouth? This is already happening. Let's not exasperate this inhumanity.

UCSC should respect the wishes of Santa Cruz. They do not wish to grow on the level the UC wishes to, which is why they set their population growth to 1% per year decades ago.

It's a display of greed on the part of UCSC to try and bring in more students against the wishes of the community they reside in. While being profitable for the UC, this imprudent growth will inevitably lead to more suffering for lower income individuals who will have to bare the cost of higher rent and congested living environments.

(1) https://ucscstudenthousingwest.org/background/

UCSC LONG-RANGE DEVELOPMENT PLAN

McHENRY LIBRARY

1156 High Street, Room 1350

Santa Cruz, California

REPORTER'S TRANSCRIPT OF PUBLIC COMMENTS

March 12, 2020; 12:00 p.m.

Court Reporter: Cary Blue LaTurno, CSR #9681

Santa Cruz, California

March 12, 2020; 12:00 p.m.

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JOLIE KERNS: I'll walk through the schedule in our process so far.

We started this process back in the fall of 2017. We began with data gathering and stakeholder interviews both on campus and out in the community.

We've been working with our LRDP planning community, which consists of faculty staff, community members to help steer this process.

We've also been meeting regularly with our, kind of, CAG group, our Community Advisory Group. This is made up of representatives from the community and various agencies to provide feedback throughout the process.

We've met with Santa Cruz neighborhood groups on specific topics; and then other specific topics, we've set up, kind of, work groups, including one on infrastructure, environment and ecology, transportation and housing and residential life. These work groups are made up of technical staff from the university, faculty from the campus, and community representatives as well.

We've also worked with specific internal groups on topics, such as the natural reserve. So we've worked with those folks coordinating with committees, natural reserve committees to understand, early on in the process, where long-term research was being conducted and how we can continue to balance supporting the campus's mission with both the built environment and critical open space.

In March 2018, we held open forums to share information on specific topics with the public and get feedback; and in winter 2018, we shared three land-use scenarios with the public. We developed a visioning tool and survey online and got a lot of, kind of, broad feedback that way on those three scenarios. That feedback then directly informed the two land-use scenarios we went out to the public with in the fall of 2019.

We held six public workshops in person and meetings -- these were open to all -- and presented these two land-use scenarios and related issues surrounding them, including sustainability, transportation, housing, open space, community amenities.

And then in December, we presented a draft of the proposed land-use plan. Both of these presentations are available on our LRDP website.

We are now beginning the CEQA process with issuance of the Notice of Preparation, or NOP, and the start of our scoping period.

After our scoping period, we anticipate issuing the Draft Environmental Impact Report in winter 2020 with another comment period and public meetings to follow.

We'll review the comments we receive and anticipate issuing the Final EIR in spring 2021, which would be certified and approved by the Regents. The Final LRDP document will be issued at that time as well.

So this LRDP concerns itself with two sites: our main residential campus, which is approximately 2,000 acres -- it is adjacent to the west side of Santa Cruz and substantially surrounded by open space -- and our Westside Research Park, which is approximately 8-1/2 acres. It includes the former Texas Instruments building, which is currently used for research and academic purposes, and it is located on the west side near the Coastal Science Campus.

This LRDP does not look at physical development on our Coastal Science Campus. That is guided by a separate LRDP that is already in effect. We do, however, look at the, kind of, critical adjacencies between our Westside Research Park and Coastal Campus and think about that as we, kind of, plan -- do this long-term planning.

This LRDP will look at physical development -- potential physical development until 2040, so from now until 2040. And, yeah, that's the, kind of, understanding for this LRDP.

So our planning considerations that went into this process really, kind of, centered around academic evolution and maturity of the campus, ideas about sustainability and resilience, student success, our diverse student body, and just physical campus functionality. So with our academic evolution and maturity, how can we support our college structure and relationship to academics; how can we best support research growth as we look to the future, improve quality and availability of teaching and research space, and right-size existing spaces throughout campus.

Sustainability and resilience is a driver in a way that really hasn't been in the last, kind of, 10, 15 years. We are modeling sustainability and resilience leadership within the region through our, kind of, teaching and operations; developing disaster relief strategies for fire, earthquake, and other hazards. We look to meet or exceed our State and UC system goals for energy, water, and carbon, and minimize or increase in water -- in water use on campus.

We also are looking to support a diverse student body, including first-time college students and regional underserved communities, addressing basic needs, such as affordable housing and food security, providing appropriate housing types to support the student experience, and creating an environment of equity and inclusion across campus.

And then, finally, really looking at sort of what is working on our campus and what's not in terms of, kind of, physical functionality, you know, what can we improve with this long-term planning. So enhancing circulation infrastructure to improve accessibility, encouraging efficient use of the land and buildings, and instilling ecological teaching and cultural assets throughout.

So I am going to walk through our proposed land-use strategies for the draft plan. We have multiple monitors. So I'll be, kind of, looking in different places.

So our first strategy, really thinking about a compact academic core, also considering an adjacent ring of student housing. These ideas are consistent with how the campus was planned from the very beginning, and we are looking to, kind of, build on that in this comprehensive vision for the next 20 years.

As we think about transportation, it's more an issue now than ever before. With this compact plan, we have an opportunity to, kind of, improve and make more efficient our roadway network with peripheral parking and the inclusion of extension, the Meyer Drive extension, kind of, through the arts area -- this has been looked at for some time now -- and then enhancing shuttle, pedestrian, and bicycle networks to and throughout campus. So we are looking for alternative transportation strategies to minimize the impact of singular-vehicle use.

The flip side of developing in a compact way is that we are able to designate significant areas for reserve, for ecological, cultural, and educational resources.

We are looking at additional employee housing located with access to community resources and enhancing our historic district with improved community interface.

And then our Westside Research Park is looking at a mixed-use land-use designation that would include academic research and housing uses.

So our draft land-use map looks at a proposed student population -- the outer limits of proposed student population up to 28,000 by the year 2040. The plan supports the physical development that would be necessary to support the campus. And this is the basis for analyzing, again, these, kind of, outer limits of any associated environmental impacts.

The land-use plan designates land use for specific types of use. It does not mandate growth. It's not prescriptive about specific projects.

I am going to walk through the intent and primary uses of the land-use designations now. We really have, kind of, four broad areas: so academic land use, open-space land use, residential, and then our, kind of, campus facilities and support through operations, oriented functions.

So under academic, you can see the, kind of, blue of our academic core. The primary use here would be structures that facilitate teaching, research, student support, and public-service-mission activities.

Outdoor research is -- let's see. It's this -- yeah -- is the lighter blue and looks at specific research programs, such as our arboretum, our farm, and the Chadwick Garden.

And then the historic district, we have a new land-use designation of mixed use there, looking at what types of uses would be appropriate at the, kind of, entryway to our campus. So uses that have a, kind of, community friendly or community-facing purpose and would be intended to express unique historic and cultural context of this area.

Our open-land-use designations are shown in various, sort of, shades of green.

Our campus natural reserve is land preserved to protect natural features and processes for the purposes of teaching and research.

Recreation and athletics is indoor and outdoor athletic buildings and facilities.

And then natural space. So this is land that would be preserved as open space to maintain special campus landscapes due to their scenic value, special vegetation, and wildlife continuity.

And, finally, our residential land-use designations. We are looking to include student housing for 100 percent of the new enrollment up to 28,000. So this includes colleges and student housing and student-support spaces.

And then because our colleges are a unique feature and include our living-and-learning environments, we have academic included in this designation as well.

Employee housing. We are looking to provide 25 percent of housing for new-employee growth. This would be staff and faculty housing and support space. And it's shown as brown. We typically concentrate that land use around the entries to campus where there are different types of, kind of, trips on and off campus, different than what students experience.

And then at Delaware, we have a, kind of, academic core area with the existing buildings surrounded by the potential for mixed-use development.

And then, finally, some campus-support functions shown in light gray.

And let's see. With that, we are gonna move on to the CEQA process of this and explain that process. And it's, kind of, a scoping session, a little bit more what we look at analyzing, and I'll let Erika walk through that.

ERIKA CARPENTER: Thank you, Jolie.

Is this working right? Correct. All right. Thank you.

So the California Environmental Quality Act. The California Environmental Quality Act, or CEQA, was enacted in 1970, and it requires public agencies to evaluate a project's physical effect on the environment. And so when I say "environment," I mean physical conditions like air and water and historic resources and resources like that. Essentially it provides public involvement and disclosure throughout the process. It discloses impacts in any EIR to the public and interested agencies.

An EIR is required if a project has the potential to result in a significant impact as required in the CEQA guidelines.

For those that are not familiar with the term "significant impact," it is a substantial and adverse change in the environment -- physical environment with implementation of a specific project.

So UC Santa Cruz is going to be preparing an environmental impact report for the Long-range Development Plan.

An environmental impact report, as I mentioned, is an informational document. It discloses information about a project's environmental effects; it identifies mitigation measures that would reduce potential environmental effects where feasible; it also evaluates feasible alternatives to a proposed project and their environmental effects.

A program-level EIR is appropriate when a CEQA project like a large planning document, such as the LRDP, is proposed. And so it can be used to potentially tier future environmental review of subsequent campus projects, and it provides a more holistic view of the potential impacts of the entire campus or the entire LRDP, which is both our main residential campus and the Westside Research Park.

The final actions related to the program EIR is when the Regents consider whether the EIR represents an objective and accurate analysis of the potential physical environmental effects of that LRDP, and if it does, they will certify the EIR prior to approving the LRDP.

So now we are going to talk a little bit more -- Jolie spoke a little bit about our schedule and the potential to participate in the process, but this is another overview of the EIR process and the ways that the public and the agencies can participate throughout the process.

So right now we are at the beginning of the process. We've -- you know, as Jolie mentioned, we issued our Notice of Preparation on February 25, and now we are here at our public scoping session. And the public can provide comments during this session, or they can also -- or you can also provide comments -- agencies and the public can provide written comments via e-mail or written comments in US mail that you mail to UC Santa Cruz. And we'll provide that address a little bit later.

So what we will do with those comments is we will review all of the comments that we receive during this period, and we will take a look at our scope of work and adjust it where necessary based on any comments while we prepare our Draft Environmental Impact Report.

Based on that, we will proceed with our technical analysis and prepare a Draft EIR, and we will issue a Draft EIR later this year.

And then that document will go out for a 45-day public-review period, and during that 45-day public-review period, agencies and members of the public can also provide additional comments on the technical analysis that was in the EIR.

We will also have another public hearing during that time, where members of the public and agencies can participate during those public meetings.

After that period is over, there will be a time where we will review all of the comments and we will prepare written responses to each comment that we receive on the Draft EIR.

And then those comments, as well as any changes to the Draft EIR, will become the Final EIR, and that Final EIR will go to the UC Regents for consideration prior to approval of the Long-range Development Plan.

And there will be another hearing at the UC Regents.

So there's a number of opportunities. This is the first opportunity, and there will be a number of opportunities throughout the process.

So the Environmental Impact Report we are preparing is a full-scope EIR, and that essentially means that we are addressing every environmental issue in Appendix G of the California Environmental Quality Act Guidelines. And Appendix G, essentially, is a -- lists parameters to consider for the range of environmental issues that can be addressed in the EIR.

And so I will just take a minute and just briefly read these 2020 issue areas that we are addressing. And we are addressing all of these issues in our EIR: aesthetics, agricultural and forestry resources, air quality, biological resources, cultural resources, energy, geology and soils, greenhouse gas and climate change, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, population and housing, public services, recreation, transportation, tribal cultural resources, utilities and service systems, and also wildfire.

So we have been talking throughout our presentation about scoping comments. So essentially the best way for us to receive scoping comments is essentially to focus on technical issues that we will be addressing in the EIR or to address any appropriate range of alternatives that you would like us to consider as we prepare our environmental document.

And the comments should focus on the potential physical environmental impacts of the Long-range Development Plan. For example, the EIR should analyze -- if you feel that viewsheds is a specific issue that you are concerned with, then you would specifically note that in your comment. But it can range, obviously, from any of the 20 issues that I just mentioned as far as environmental issues that we will be addressing in the Environmental Impact Report.

As Jolie mentioned, the scoping period has been extended for an additional nine days. The scoping period will now end on April 8, 2020.

Comments can be sent via e-mail or US mail. And this is the address that comments can be sent via US mail. And it would be very helpful if you could put in your subject line "LRDP comments" when you send your e-mail to us.

We also have an additional scoping period the first week of April. And the details of that are being finalized, but we will send out an announcement of when that scoping period is going to be, the date of that particular scoping period and any additional details about that.

JOLIE KERNS: I think at this point -- again, this is new to us. So thank you for participating. We've asked that if you would like comments to be read allowed, to send them in to "EIR comment." We have several comments, and we'll be starting to read those comments out in just a few minutes. We are looking at comments that we received from when the memo was distributed on COVID-19 and this format changed up to the end of this period. So up until about 2:00 p.m.

As with any of our, kind of, CEQA processes, if -- we want to make sure that we hear from as many of you as possible. If we are getting a lot of comments, we may need to impose a two- or three-minute limit to make sure that we hear from as many as possible.

But I think right now we are gonna just start, kind of, reading through the comments. Again, we are not going to read any names. And we will start hearing from all of you.

GARY JAKOBS: Okay. I'll start with the first comment that we received. It states:

"I attended the LRDP meeting last year at the Long Marine Lab. The amount of growth is scary to me as a next-door neighbor on High Street. What are your plans for the traffic on Bay and High? The traffic is already gridlocked now on High Street and bumper to bumper at peak times. I just don't think the road infrastructure supports the level of growth you are seeking. Please reconsider the arteries of High and Bay. Is there another route, or can you slow this growth down?"

And I do want to make one comment about a change in the California Environmental Quality Act that was enacted in the last year for those who are familiar with environmental impact reports. One of the issues that we've traditionally looked at is congestion of traffic, and the legislature changed the way that CEQA evaluates these issues now with the focus being on vehicle miles traveled and with a prohibition of looking at congestion as a significant impact. That does not mean that the EIR will not evaluate traffic, but that the focus will be different. I just want to make sure that commenters are aware of that.

JOLIE KERNS: And I'll add, the purpose, again, of the scoping session is for us to receive your input. This helps inform our approach to the EIR. We do not respond directly to your comments at this time, but they are all part of the record, and they help inform our analysis. So I just wanted to be clear that we will not be responding if we get this, but we are reading the concerns and comments out loud for all to hear.

Okay. We'll move to our next comment.

GARY JAKOBS: I get to go again. Okay.

"As a P3 opportunity, can money be quickly set aside to pay for a construction project manager to put together those faculty and staff that have equity with those that do not have equity to gain a larger combined equity base to build on campus and on-campus housing to include faculty, staff opportunities to help them build auxiliary dwelling units in the county and to assist those current property owners building those auxiliary dwelling units or as tenants in common with those that don't have property like a duplex."

ERIKA CARPENTER: Thank you, Gary.

Okay. So I have another comment here:

"The transportation impacts on the city of an increase in student enrollments to 28,000, plus accompanying increases in faculty and staff, will materially affect access to campus and the surrounding neighborhood far beyond current already significant effects during rush hours.

"There are traffic jams on the campus and streets adjacent to the campus, especially down High and Bay Streets.

"Students using Uber and Lyft to get to and from and around the campus are adding to congestion as well.

"The EIR must explain how these impacts will be addressed and whether the current road configuration can handle the increased traffic load.

"The current emergency evacuation plan for the campus is wholly inadequate and quite dangerous. Those with cars on campus are told to drive off, others to walk off or shelter in place. Whether this will work in the event of, say, a wildfire north of campus has never been tested. The addition of 10,000 people to the main campus and limited egress from the campus require an updating of the evacuation plan, which should be addressed in the EIR.

"And, finally, as an alternative to the proposed map of the main campus, the EIR should also consider alternative plans, such as moving offices and even teaching to locations elsewhere in the city and county, as has been done with the Coastal Campus and Scotts Valley. This will make construction difficult and access to faculty much more problematic and is likely to be opposed by the City in particular, but it will spread out the impacts of growth and lower the risk of having so many people on the main campus."

JOLIE KERNS: Okay. We have our next comment:

"To summarize, we request that the scope of the EIR for the Long-range Development Plan include the following: UCSC commit to zero new vehicle trips to campus and make growth contingent on achieving this goal. Number two, UCSC. In light of the large externalized environmental and social costs of auto travel, reform the parking permit program to charge per-day rates; raise the price of parking and use parking proceeds to support, A, a significant share of the cost of campus shuttles and UCSC's contribution to METRO, allowing a reduction in student fees for transit; B, free transit passes for all faculty and staff; C, vigorous marketing of alternative commutes; and, No. 3, UCSC, stop building more parking capacity and begin to repurpose parking lots for infield development.

"Thank you."

GARY JAKOBS: Comment thanks us for accepting the comments on the Long-range Development Plan.

"I urge you to consider mountain biking in the plan. Santa Cruz is home to a vibrant mountain-biking community. Consider mountain biking as a core activity within LRDP at the early stages of development, and this will ensure support for that community and its integrity with other activities on campus."

ERIKA CARPENTER: So I think with that, we have read through all of the comments thus far. If there's anyone else that would like to comment, we will be here today until 2:00, and if you would like to send a comment to us at eircomment@ucsc.edu, we will be happy to record it on our live broadcast and record it here for the record.

(A recess was taken.)

ERIKA CARPENTER: Hi. We are back. Thank you. We received a couple more comments. This is a very quick one, but it said:

"What is the plan for student involvement and the development of the EIR?"

Okay. And the second comment, Jolie, I don't know if you want -- I can go ahead and read it.

"Everything I am hearing regarding issues seems to concern only issues within the boundaries of the campus and the Westside Research Park and nothing regarding how this plan impacts off-campus neighborhoods that are severely negatively affected. Example: rentals, traffic flow, and parking. Traffic on Western Drive, High Street, and Bay is impossible now. I can't imagine any further increase in traffic without causing even more hardship and resentment for those of us who must share the roads with overflow from campus as we travel to jobs and appointments that have nothing to do with UCSC."

GARY JAKOBS: And I just want to remind everybody that the scoping meetings -- meeting is intended for us to receive comments, not to reply to them. This helps inform the scope of the Environmental Impact Report. So that's why we are reading the comments and also why we are not responding to them.

JOLIE KERNS: We can maybe wait another minute and see if any come in, and then we'll pause and continue to be waiting for comments until 2:00, but we'll maybe give it one more minute in case anyone else is sending any comments right now.

So we will be standing by. As soon as we get comments, we'll go ahead and, kind of, read them in real time as they come in, especially as we have, I think, a number of people on the line right now. So -- but we are going to mute ourselves until more comments come in.

Thank you.

(A recess was taken.)

JOLIE KERNS: We are going to read one more comment. We received one more comment. I am going to go ahead and read this. The comment states:

"The college system currently receives inadequate support from the administration to operate properly. It would seem prudent to expect that new colleges would not be any better off.

"Will the EIR consider the option of not building any new colleges and focusing only on required student housing?

"Thank you."

We are going to check if we've received any more and, kind of, back -- I think we have a couple more here. This is a short one. And the comment is:

"For the 28,000 students that you are proposing to house on campus, how long is their housing guarantee?

"Thank you."

And it looks like we have another comment. I am going to read that now.

"Does a finding of an adverse impact require a change in the proposed plan, or is that only for informational purposes?

"Thank you."

We are not seeing any more right now. I think we'll stay online for just another minute in case others are listening and want to send, and then we'll, kind of, go mute again and see if we get another batch of comments.

GARY JAKOBS: Jolie, before we go on mute, if I may, the last commenter did request whether or not there is a mandate for a change if there's a significant effect. And so that, I can help -- we can help commenters form their questions and comments.

CEQA is an informational document and a disclosure document. It mandates that impacts -- significant impacts are mitigated when it's feasible to do so. "Feasibility" is defined as able to be achieved economically, technically, legally, or in consideration of other social factors. So these will be considered when there is a significant impact from the project. So this should help you in your commentary.

JOLIE KERNS: And we'll give it just maybe one more minute in the interest of trying to batch some of these if we get any more, and then we'll go to mute and wait until we get a few more.

Maybe we should go to mute. We are here. We are here until 2:00, and we will await any additional comments, and once we get those, we'll continue to, kind of, read them out loud.

Thank you again for participating.

(A recess was taken.)

JOLIE KERNS: Okay. Hi, everyone. We are back on. We just have one comment, but we are going to go ahead and read that now. One more comment.

"The Draft EIR should analyze how municipal services -- for example, water, sewer, fire -- will be provided to the new developments and clearly indicate whether those identified service providers have capacity.

"Thank you."

Great. Thank you.

We are checking to see if we have any other comments while we are on right now. And it looks like we don't, but we'll stay, kind of, on for another minute and then go mute again until we get some more comments.

Thanks again for your participation.

Maybe we should go on mute and wait until we have any other comment. We'll be here until 2:00.

(A recess was taken.)

GARY JAKOBS: Okay. We do have a new comment. We'll give everybody a moment to come back online with us.

Okay. The new comment reads:

"The increase in students and staff will cause a similar increase in the need for supporting business and services in the surrounding areas. This expansion will cause a need for more employees and the housing and transportation they require.

"Many of those employees will likely end up traveling a long distance to get to their place of employment. These are impacts that should be considered along with what happens on campus.

"Traffic has just as much of an impact on the environment as auto trips per day since idle cars sitting in traffic emit greenhouse gases and create excess and unnecessary use of fuel resources. It is important to consider idle traffic as well as trips per day regardless of what the legislature has put into law.

"Geologic considerations of the campus's unique karst geological underpinnings is a key consideration when considering siting of businesses and --" "or buildings and drainage. These karst formations have caused many problems on campus in the past.

"Consideration of storm runoff and its effect on the surrounding areas is important.

"Unchecked use of mountain bikes on the forested upper campus has caused serious environmental degradation from unregulated trail-making. Any expansion should include a thought of how a higher density of population and increased recreation will impact erosion and damage done by increased mountain-bike use and how that will be mitigated and controlled.

"Recreational use of surrounding parks and beaches by an increased student body should be considered.

"Control of invasive species should also be considered."

And that's the end of that comment.

One note I will give in terms of the comment about traffic emitting greenhouse gases and this sort is there was no change in how we look at the effects of driving vehicles, including the pollution that they generate. The only change that the legislature made was in the requirement that congestion -- vehicle congestion shall no longer be considered a significant impact on the environment. So it's only the vehicle congestion; it's only the effect of sitting in cars for a longer period of time, but the effect of the vehicles idling and driving and sitting in traffic, the effects on the environment, on air quality, on noise, on things like that are still considered in the environmental analysis.

And that's the conclusion to that comment.

JOLIE KERNS: We are not seeing any more right now. So we'll go ahead and, kind of, mute ourselves. But, again, we are here until 2:00, and we'll be reading any comments we get until that time allowed. Comments are still welcomed through the end of the comment period, the end of the scoping period, which is Wednesday, April 8, at 5:00 p.m., and all comments, whether we read them are not, are part of our record.

(A recess was taken.)

ERIKA CARPENTER: Hi there. We are back. Thank you. Thank you again for staying on.

We have another comment. This comment states:

"Students are concerned about the university's vision for the LRDP. Many of the plans in the LRDP have solely focused on the preservation of natural areas, not on preserving the well-being of students and the community.

"While the university has been successful in preserving our meadows and forests, they have failed to provide students with their basic needs, such as housing, food, transportation, health services, and liveable incomes.

"If the university can propose increasing enrollment targets, then it is crucial to recognize the overlooked social and environmental justice issues that are at the forefront of student life on campus.

"Student health and belonging should not be a small portion of the EIR, but rather a guiding lens through which we can analyze and plan further campus development."

Thank you for your comment. We really appreciate your participating in this process.

And I think we just have this one comment, and we will be here standing by if anyone else would like to participate. We have, I think, just a little over 20 minutes or so. And feel free to write us an EIR comment at ucsc.edu.

(A recess was taken.)

JOLIE KERNS: Hi, everyone. Thanks so much for your participation. We are right at about 2:00 p.m. We haven't received any comments since the last one, around 1:40 or so. So we are going to go ahead and close out.

As a reminder, we are accepting comments via e-mail and mail until April 8 at 5:00 p.m.

We have another scoping session tonight. We will be live here again, and we will be reading any comments that come in during that time. That's 6:00 to 8:00 p.m. And you can click on the link that's on the website and on the memo that went out the last day.

And, otherwise, thanks again for your participation. And we are going to sign out. Thanks.

(Proceedings in the above-entitled matter were concluded at 2:00 p.m.)

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REPORTER'S CERTIFICATE

I, CARY BLUE LATURNO, do hereby certify:

That said proceedings were taken before me at said time and place and were taken down in shorthand by me, a Certified Shorthand Reporter of the State of California, and were thereafter transcribed into typewriting; and that the foregoing transcript constitutes a full, true, and correct report of said proceedings which took place;

IN WITNESS WHEREOF, I have hereunder subscribed my hand this 18th day of March 2020.

Cary Blue LaTurno

Cary Blue LaTurno, RMR, CRR

CSR No. 9681

UCSC LONG-RANGE DEVELOPMENT PLAN

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1156 High Street, Room 1350

Santa Cruz, California

REPORTER'S TRANSCRIPT OF PUBLIC COMMENTS

March 12, 2020; 6:00 p.m.

Court Reporter: Cary Blue LaTurno, CSR #9681

Santa Cruz, California

March 12, 2020; 6:00 p.m.

--oooOooo--

JOLIE KERNS: Hi, everyone. Welcome to our scoping session for the UC Santa Cruz Long-range Development Plan, Environmental Impact Report. Thanks for joining us tonight. We are broadcasting from McHenry Library.

And we'll go ahead and introduce ourselves. I am Jolie Kerns. I am the director of physical and environmental planning at UC Santa Cruz.

ERIKA CARPENTER: Hi. Good evening. Oops. I'm sorry about that. I forgot the mike. Hi. Good evening. My name is Erika Carpenter, and I am senior environmental planner for UC Santa Cruz.

GARY JAKOBS: Good evening. I am Gary Jakobs, and I am with the environmental consulting firm preparing the environmental report for the Long-range Development Plan.

JOLIE KERNS: Before we get started, we just want to remind everyone to turn the audio up on your computers. If you have any trouble hearing us, you can send a note to eircomment@ucsc.edu and let us know.

Okay. So on February 26, we issued a Notice of Preparation that we would begin preparing an Environmental

Impact Report for the Long-range Development Plan. As part of the California Environmental Quality Act process, we've provided a scoping period where public agencies and the public can comment on the scope of the EIR that they would like to see analyzed. The scoping period was recently extended to Wednesday, April 8, at 5:00 p.m., and we will be accepting comments until this date. We'll provide more detail on the CEQA process, including the scoping sessions and how to comment, at the end of the presentation.

But the purpose of this scoping session is for us to receive your input. So this helps inform our approach to the EIR. And we do not respond to your comments directly at this time. They are all part of the EIR record.

A few more logistics before we get started. We've structured this public meeting via video feed to encourage social distancing. If you'd like your comment to be read during this session, please e-mail eircomment@ucsc.edu at any time until the end of this session. So until 8:00 p.m.

And with that, I think we'll move on to our next slide.

So with our presentation tonight, we are going to begin with a brief introduction to the proposed project.

We'll walk through our processing schedule, planning considerations and strategies, and then the proposed land-use plan.

We started this process back in the fall of 2017. We began with data gathering and stakeholder interviews both on campus and out in the community.

We've been working with our LRDP planning committee, consisting of faculty, staff, students, and community members, to help steer this process. We've also been meeting regularly with a committee advisory group made up of representatives from the community to provide feedback throughout this process.

We've had a number of meetings with the Santa Cruz neighborhood groups. We have set up work groups on specific topics, including infrastructure, environment, and ecology, transportation and housing and residential life. These groups have been made up of technical experts, including campus staff and faculty and, again, kind of, community representatives.

We've also worked with internal groups on specific topics, including our natural reserve folks, to understand, early on in the process, where long-term research was being conducted and how we can continue to balance those interests with the built environment.

In March 2018, we held open forums to share information on specific topics with the public and get feedback, and in winter 2018, we came out with three land-use scenarios for the public to provide feedback on. These were shared via a visioning tool and survey that was online.

And then last fall, we held six public workshops and meetings open to all, which presented two land-use scenarios and related issues surrounding sustainability, transportation, housing, open space, and community amenities, and then presented a draft of the proposed land-use map in December.

Both of these presentations are on the LRDP website.

We are now beginning the CEQA process with the issuance of the NOP and the scoping period. After the scoping period, we anticipate issuing the Draft Environmental Impact Report in winter 2020 with a comment period and public meetings to follow. We will review the comments we receive and anticipate issuing the Final EIR in spring 2021, which would be certified and approved by the Regents.

The Final LRDP document will be issued at that time as well.

So looking at this LRDP, we are including in this LRDP two separate sites. The first is our residential campus. This is about 2,000 acres and adjacent to the west side of Santa Cruz and substantially surrounded by open-space and park areas.

And then it also includes our Westside Research Park, down at 2300 Delaware. This is about 8-1/2 acres. It's a former Texas Instruments building located on that site, which is currently used for academic and, and the general location is on the west side adjacent to the Coastal Science Campus.

This LRDP does not include the Coastal Science Campus as the physical development for that land as guided by its own LRDP. However, since it's adjacent to the Westside Research Park, it's definitely still, kind of, considered relevant in how we think through program adjacencies and land use in a more comprehensive way.

So some of the planning considerations throughout this process have included these, kind of, primary drivers, thinking about academic evolution and maturity, sustainability and resilience, student success, and our diverse student body and the physical functionality of our campus.

So for our, kind of, academic mission, we intend to support the college structure in relationship to academics with this plan, support research growth, improve quality and availability of teaching and research space, and right-size existing faculty, staff, and support spaces throughout campus.

Our sustainability-and-resilience understanding is to really, kind of, model sustainability and resilience leadership within the region through teaching and operations; develop disaster-resilient strategies for fire, earthquake, and other hazards; meet or exceed State and UC system goals for energy, water, carbon; and minimize increase in water use on campus.

We've spoken to a lot of students throughout this process and thinking through how we can, kind of, best support their needs with our plan. So we've thought about addressing basic needs, such as affordability for housing and issues surrounding food insecurity, providing appropriate housing types to support the student experience, and creating an environment of equity and inclusion.

And then we've also been thinking about how can we improve our campus and really, kind of, make it work better for everybody. So circulation is certainly at the -- a key driver to our plan: how can we enhance that infrastructure to improve accessibility to and from all parts of campus; how can we encourage efficient use of the land and buildings; and then continue to steward ecological, teaching, and cultural assets.

So with this, I am going to, kind of, look at a, kind of -- our comprehensive approach that is really made up of a number of strategies. We see these as knitted together in a way that respects the environment while simultaneously addressing, kind of, circulation, housing, and supporting our academic mission.

So first we are really looking at a compact academic core. This includes building on infill sites. Infill sites are sites that are between existing buildings. Some of these include existing surface lots, for example. Continuing to build with an adjacent ring of student housing around the periphery of the academic core, where we locate our colleges and noncollege-affiliated housing. The plan provides 100 percent -- provides housing for 100 percent of new-student enrollment.

We are looking at how we can improve circulation. So improving in making a more efficient roadway network; continuing to build on parking around the periphery so we can encourage a pedestrian environment in the academic core; and thinking about a Meyer Drive extension, connecting the end of Meyer Drive over to Hagar at the East Remote, which would allow us to have, kind of, a more efficient internal loop around that academic core.

We are thinking about enhanced shuttle, pedestrian, and bicycle networks. So alternative transportation strategies that would reduce our dependence on vehicles.

And then the flipside of a compact -- building compactly is that we are able to designate significant areas as natural reserve and open space for ecological, cultural, and educational resources.

Our employee housing. We are adding additional employee housing. This would be located with access to community resources, and the plan provides housing for 25 percent of new employees.

Thinking about our historic district and how we can enhance that area with the land use in that area with improved community interface.

And then, finally, thinking about our Westside Research Park as a, kind of, mixed-use land-use designation that would continue to have academic as its, kind of, core and as a, kind of, central magnet but opening up to some housing use as well.

So our proposed land-use map looks at how we would develop the built environment through 2040. It serves at the basis for the Environmental Impact Report to study the outer limits of environmental impacts of that, kind of, physical planning up to 2040. And it would accommodate a potential student enrollment of up to 28,000 and then potential employee population up to 5,000.

The land-use plan designates land use for specific types of uses. It does not mandate growth, and it is not prescriptive about specific projects.

So with that, I am going to walk through the intent and primary uses of some of these land-use designations now. I am going to start just with circulation. This is not indicated as a land use, per se, but you can see some of the, kind of, thinking of what I had mentioned earlier, the Meyer Drive extension that would create a, kind of, east-west access on the south side of the academic core, creating a more, kind of, efficient loop around that academic core for transit.

So we have four broad categories looking at, kind of, academic and support uses, housing, and open space, and then facilities and support.

So for academic and support, we are looking in blue, looking at structures that facilitate teaching, research, student support, and public-service-mission activities. Outdoor research includes specific research programs like our arboretum and farm and the Chadwick Garden.

The historic district is now its own, kind of, land use. In the previous LRDP, it was just an overlay, but the intent here would be land and structures that are intended to express the unique historic and cultural context for academic and support facilities, community-facing programs, and visitor resources.

Our open-space designations include natural space, campus natural reserve, and recreation and athletics.

With the campus natural reserve, the land would be preserved to protect natural features and processes for the purposes of teaching and research; recreation and athletics would be land used for indoor and outdoor athletic fields and facilities; and the natural space would be land preserved as open space to maintain special campus landscapes due to their scenic value, special vegetation, and wildlife continuity.

Our residential land-use designations include colleges and student housing, shown in orange around the periphery; employee housing, shown in brown and located adjacent to, kind of, campus entries to help facilitate different types of daily trips that families take. They are very different than the, kind of, student activities day to day.

And then our facilities and support, which is really just, kind of, operations-oriented functions.

And with that, I am going to turn it over Erika Carpenter, our senior environmental planner, who is going to walk through the CEQA process.

ERIKA CARPENTER: Thank you, Jolie.

So we -- I thought we'd start with just giving everyone an overview of what the California Environmental Quality Act is. CEQA was -- it's also called "CEQA" in its acronym, but it was enacted in 1970, and it requires public agencies to evaluate a project's potential physical effects on the environment. And when I say "environment," I am mainly speaking about physical conditions, such as air, water, climate change, noise, historic buildings, et cetera. And it includes both direct and indirect impacts both on the campus, as well as in the community that they occur.

The CEQA process really provides an opportunity for both public involvement and disclosure. It discloses impacts in an EIR to the public and interested agencies.

An EIR is required if a project has the potential to result in significant impacts as required by the CEQA guidelines. For those that are not familiar with the term "significant impact," it is a substantial and adverse change in the physical environment with implementation of a project.

And so for this project, UC Santa Cruz, we will be preparing an EIR for the LRDP due to the nature and size of the project.

An Environmental Impact Report, it is essentially an informational document, as I just mentioned, and it discloses information about the project's environmental impacts; and then it also, on top of that, identifies mitigation measures that reduce significant effects where feasible. It also evaluates feasible alternatives to the project and their environmental effects.

The university is preparing a program-level EIR for the LRDP, which, per the CEQA Guidelines, is appropriate for a large planning document like the LRDP. They provide a higher level of evaluation than a typical EIR for, like, a project-specific development, and it's also a more holistic view of the potential environmental impacts.

The program EIR can then be used for subsequent review of future development projects, and you can potentially tier off -- tier off the program-level EIR for future development.

The final action associated with the program EIR is when the UC Regents would consider that EIR prior to -- they would essentially, you know -- they would essentially consider the EIR prior to taking action on the LRDP. So if they determine that the EIR presents an objective, an accurate analysis of the potential impacts, then they would certify the EIR.

So I'd like to talk a little bit more about the

EIR process and how the public and the agencies can get involved throughout the entire process.

We are in the very beginning of things, basically at the second step. We released our Notice of Preparation on February 25, and tonight we are having our online public scoping meetings. And we are receiving comments this evening, as well as written comments, through April 8. And then following that, we will review all of the comments we've received on the Notice of Preparation, and we will adjust our scope based on any comments as needed. And then we will prepare a Draft Environmental Impact Report.

Sometime towards the end of this year, we'll be issuing a Draft EIR for public review. And it will be a 45-day public-review period, where agencies and members of the public can also comment on the Draft EIR. And each of those comments following the close of the public-review period, we will respond to each one of those individually, and then we'll take a look at those comments and determine if any changes need to be made to the draft, and then that will be the Final Environmental Impact Report.

Although I should back up one second. We will also have one public meeting during the public-review period for the Draft EIR, or maybe two, but we will have several meetings during that time to receive comments from the public and from agencies during the public-review period.

And then, finally, we will have a -- the document will go to the UC Regents for consideration, and there will be a meeting at that point as well.

So the EIR will be a full-scope EIR, meaning that we will evaluate all 20 topics and Appendix G of the CEQA guidelines. And, essentially, for those who are not familiar with Appendix G of the CEQA guidelines, it's environmental issues that are evaluated that we have to potentially consider. And so I will just briefly list those for you. We are evaluating each one of these in our Environmental Impact Report.

So we are addressing aesthetics, agricultural and forestry resources, air quality, biological resources, cultural resources. Excuse me. Cultural resources. Energy, geology and soils, greenhouse gas emissions and climate change, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, population and housing, public services, recreation, transportation, tribal cultural resources, utilities and service systems, and wildfire.

Scoping comments. So we are interested in hearing from all of you. We would like to receive public comments on any technical issues you would like to be addressed in the EIR. And that can be from either a range of technical issues, from environmental issues, or whether or not it might be an alternative that you feel that we should be evaluating.

Comments that are submitted should really focus on the potential environmental effects or impacts of the proposed LRDP. For example, if historic resources on the campus are important to you, it would be beneficial in your comments on the Notice of Preparation that you noted which area or what historic resources on campus are important to you.

So as Jolie mentioned, we have extended the scoping period for an additional nine days. I think it's a total of 44 days. The CEQA requires that we have a 30-day Notice of Preparation comment period.

We've also -- we are also providing an additional scoping session, which will be added the first week of April, which will likely also be a live-stream video for additional participation by agencies and members of the public.

We would like to see all comments by 5:00 p.m. on Wednesday, April 8. And we look forward to hearing from you. We have -- I've provided my address. You can mail a hard-copy comment letter to us. You can e-mail. You can e-mail us at eircomment@usc.edu, which Jolie mentioned earlier. And we really would appreciate hearing from everyone.

So I will -- maybe, Jolie, do you want to --

JOLIE KERNS: Yeah. I think with that, what we've intended to do tonight is to read comments aloud that we have received from you. So we are going to read comments aloud. If you'd like to comment and for us to read it aloud, please feel free to send comments to us now by 8:00 p.m. We are here to receive them, and we will read them as they come in. We will start with a couple comments, and then -- and see if any others come in and, kind of, take it from there. We will not read names out loud unless you specifically indicate in your e-mail that that's okay with you. And -- yeah. We plan to be here until 8:00 p.m.

So I am going to start with the first comment:

"As a P3 opportunity, can money be quickly set aside to pay for a UCSC construction project manager to put together those faculty and staff that have equity with those that don't have equity to gain a larger combined equity base to build on-campus and off-campus housing for themselves and coworkers to include faculty-staff opportunities to help them build auxiliary dwelling units in the county to assist those current property owners to help build ADUs or build as tenants in common with those who don't have property like a duplex.

"If UC Santa Cruz is already doing this, where do I sign up? We need more access to affordable housing for faculty, staff, and students. The on-campus quantity and size of housing leans heavily for faculty as staff with and without families and students with and without families are in smaller units.

"According to past AVC Lori Castro, we spent $20 million on recruitment and retention in 2014. This might be an ongoing yearly expense. The $20 million in retention and recruitment dollars can go a long way to build affordable campus housing to keep those employed that might leave for housing costs. This accounting exercise may have come from a presentation at a UC Regent meeting in November of 2013.

"Some at UC Santa Cruz seem to have a message of 'that an institution is not responsible for housing its workers but is partly responsible and should do its part to affordably house workers in Santa Cruz County.' They are also saying if you can't afford to live here, then move, but if nobody in that appointment can afford to live here, then who else can afford to live here and perform those duties?

"If UC Santa Cruz can find replacements that can afford to live here, then bravo to us, but if we are back-hiring again and again every few months or every few years, then we have gained nothing.

"I say we need to lean in more to assist with more campus housing for our coworkers. This would be the most fiscally responsible option for us on spending tax dollars sustainably.

"I've also asked for State legislation to allow detached bedrooms to be added to the already existing policy on ADUs and efficiency ADUs in Santa Cruz County.

"I am doing my part by volunteering my time at the METRO on the END tack, a local housing Measure H, and now for the Rail Trail to gain matching funds to have a demo of the TIG/m hydrogen-fueled light rail train to demo in our county this October.

"On sustainable transportation, on-campus housing is a sustainable transportation solution. If one lives on campus, you can take a shuttle, bike, or walk to work.

"Thank you."

GARY JAKOBS: Okay. I am going to read the second comment. It's actually much shorter.

But I do want to remind everybody that we are not responding to comments tonight. These comments that you are providing are helping us develop the scope of work for the Environmental Impact Report. So you won't hear any responses from us. Every now and again, we might provide a clarification, but that's about it. So that's how CEQA wants us to act.

Okay. Comment:

"I object to increased student enrollment by 50 percent without commitment to add to housing or academic resources.

"Building on up to 700 acres of currently designated campus natural resource open space is not the answer.

"Well-thought-out plans for growth involving the entire community is needed to add to the housing and academic resources instead of pushing through quickly devised development using contract workers and outside companies for the management of these resources."

JOLIE KERNS: Thank you, Gary.

So we held an earlier session today from 12:00 to 2:00 p.m. This was originally intended to be on campus, and the evening session was intended to be out in the community at Louden. We read a number of comments at that earlier session. We've received only two comments since that session, but we thought, since we are here, we are happy to take an opportunity to read some of those comments again for anyone that may not have attended the previous session. We'll read through those and then, kind of, see where we are at, see if we have any new comments, and go from there.

ERIKA CARPENTER: Okay. So this was a comment from this afternoon:

"Students are concerned about the university's vision for the LRDP. Many of the plans in the LRDP have solely focused on the preservation of natural areas, not on preserving the well-being of students and the community.

"While the university has been successful in preserving our meadows and forests, they have failed to provide students with their basic needs, such as housing, food, transportation, health services, and liveable incomes.

"If the university can propose increasing enrollment targets, then it is crucial to recognize the overlooked social and environmental justice issues that are at the forefront of student life on campus.

"Student health and belonging should not be a small portion of the EIR, but rather a guiding lens through which we can analyze and plan future campus development --" "or further campus development." Excuse me.

JOLIE KERNS: Our next comment:

"Thanks for accepting comments on the UC Santa Cruz LRDP.

"I urge you to consider mountain biking in the plan. Santa Cruz is home to a vibrant mount-biking community. Considering mountain biking as a core activity within the LRDP at the early stages of development will ensure support for that community and its integration with other activities on campus.

"Thank you."

GARY JAKOBS: Okay.

"The Draft EIR should analyze how municipal services -- example: water, sewer, fire -- will be provided to the new developments and clearly indicate whether those identified service providers have capacity."

ERIKA CARPENTER: "For the 28,000 students that you are proposing to house on campus, how long is their housing guaranteed?"

JOLIE KERNS: And our next comment:

"I object to increasing student enrollment by 50 percent without commitment to add to housing or academic resources.

"Building on up to 700 acres of currently designated campus natural reserve open space is not the answer.

"Well-thought-out plans for growth involving the entire community is needed to add to the housing and academic resources instead of pushing through quickly devised development using contract workers and outside companies for the management of these resources."

We are just looking through our next comments.

GARY JAKOBS: Right. The next comment is:

"What is the plan for student involvement in the development of the EIR?"

And to this, I just want to say that a lot of the scoping meetings and the calendar under which the Environmental Impact Report is being prepared is intended to be during periods of time when students have an opportunity to comment on the document. So I just want to make sure everybody is aware of that.

ERIKA CARPENTER: Okay. Our next comment:

"The increase in students and staff will cause a similar increase in the need for supporting businesses and services in the surrounding areas. The expansion will cause a need for more employees and the housing and transportation they require.

"Many of those employees will likely end up traveling a long distance to get to their place of employment. These are impacts that should be considered along with what happens on campus.

"Traffic has just as much of an impact on the environment as auto trips per day since idle cars sitting in traffic emit greenhouse gases and create excess and unnecessary use of fuel resources. It is important to consider idle traffic as well as trips per day regardless of what the legislature has put into law.

"Geologic consideration of the campus's unique karst geological underpinnings is a key consideration when considering siting of buildings and drainage. These karst formations caused many problems on the campus in the past.

"Consideration of storm runoff, its effect on the surrounding areas is important.

"Unchecked use by mountain bikes on the forested upper campus has caused serious environmental degradation from unregulated trail-making. Any expansion should include a thought of how a higher density of population and increased recreation will impact erosion and damage done by increased mountain-bike use and how that will be mitigated and controlled.

"Recreational use of surrounding parks and beaches by an increased student body should be considered.

"Control of invasive species should also be considered."

GARY JAKOBS: May I just add something?

ERIKA CARPENTER: Oh, sure. Please do.

GARY JAKOBS: This comment makes a reference to a change of legislation, and I just want to provide clarification as to what the commenter was referring to.

The California Environmental Quality Act recently changed. Previously environmental impact reports and other environmental studies looked at the issue of traffic congestion as a potential significant environmental effect.

The legislation has changed recently and has now mandated that congestion that includes overcrowding of streets is no longer considered a significant environmental impact under CEQA. It's not allowed to be considered as a significant environmental impact. That does not mean that environmental analyses ignore the effects of traffic like greenhouse gases, air pollution, or noise. The focus instead now is on vehicle miles traveled. That's now the focus of significance under CEQA. But I wanted to make sure that this change of law, that we provided some clarification on it.

JOLIE KERNS: Okay. And our next comment:

"Thanks for accepting the attached comments from the campaign for sustainable transportation.

"To summarize, we request that the scope of the EIR, the Long-range Development Plan include the following:

"UCSC, No. 1: Commit to zero new vehicle trips to campus and make growth contingent on achieving this goal.

"No. 2, UCSC: In light of the large externalized environmental and social costs of auto travel, reform the parking permit program to charge per-day rates, raise the price of parking, and use parking proceeds to support, A, a significant share of the cost of campus shuttles and UCSC's contribution to METRO allowing a reduction in student fees for transit; B, free transit passes for all faculty and staff; C, vigorous marketing of alternative commutes.

"And, No. 3, stop building more parking capacity and begin to repurpose parking lots for infill development.

"Thank you."

GARY JAKOBS: Okay. The next comment:

"The transportation impacts on the city of an increase in student enrollment to 28,000 plus accompanying increases in faculty and staff will materially affect access to campus and the surrounding neighborhood far beyond current already significant effects.

"During rush hours, there are traffic jams on the campus and streets adjacent to the campus, especially down High and Bay Streets.

"Students using Uber and Lyft to get to and from and around campus are adding to congestion as well.

"The EIR must explain how these impacts will be addressed and whether the current road configuration can handle the increased traffic load.

"Two, the current emergency evacuation plan for the campus is wholly inadequate and quite dangerous. Those with cars on campus are told to drive off; others, to walk off or shelter in place. Whether this will work in the event of a wildfire north of campus has never been tested. The addition of 10,000-plus people to the main campus and limited egress from the campus requiring an updating of the evacuation plan should be addressed in the EIR.

"Three, finally, as an alternative to the proposed map of the main campus, the EIR should also consider alternative plans, such as moving offices and even teaching locations elsewhere in the city and county, as has been done with the Coastal Campus and Scotts Valley. This will make construction difficult and access to faculty much more problematic and is likely to be opposed by the County --" "by the City in particular, but it will spread out the impacts of growth and lower the risk of having so many people on the main campus."

ERIKA CARPENTER: Okay. We have another comment. It's a shorter comment:

"Does a finding of an adverse impact require a change in the proposed plan, or is that only for informational purposes?"

GARY JAKOBS: So this is -- I'd like to provide some clarification on how the California Environmental Quality Act works when it comes to identifying significant environmental impacts.

Environmental impact reports are informational documents. They are reviewed by the Regents, in this case, to determine whether or not the project should be approved, which is a Long-range Development Plan.

When there are significant impacts, the California Environmental Quality Act requires that those impacts are mitigated when feasible. And by mitigated, that means compensated for, avoided, reduced. Something is done to try to eliminate or reduce that effect so that it is no longer significant, including coming up with an alternative.

The word "feasible" is very important in the California Environmental Quality Act. It's defined as being able to be achieved economically or socially or technologically or legally.

Sometimes there are constraints that get in the way of being able to implement a mitigation measure. So these are the things that must be considered in determining how to reduce or avoid significant impacts and how they might change the plan or provide conditions in the plan that surround how development may occur.

JOLIE KERNS: Okay. We have our next comment:

"Hello. I attended the LRDP meeting last year at Long Marine Lab. The amount of growth is scary to me as a next-door neighbor on High Street. What are your plans for the traffic on Bay and High? The traffic is already gridlocked now on High Street and bumper to bumper at peak times. I just don't think the road infrastructure supports the level of growth you are seeking. Please reconsider the arteries of High and Bay. Is there another route, or can you slow this growth down? I am UCSC alumni and very concerned. Everything I am hearing regarding issues seems to concern only issues within the boundaries of campus and the Westside Research Park and nothing regarding how this plan effects off-campus neighborhoods that are severely negatively affected: for example, rentals, traffic flow, and parking. Traffic on Western Drive, High Street, and Bay is impossible now. I can't imagine any further increase in traffic without causing even more hardship and resentment for those of us who must share the roads with overflow from campus as we travel to jobs and appointments that have nothing to do with UCSC.

"Thank you."

And thank you for your comment.

GARY JAKOBS: The comment here is asking about not only how we address impacts on the campus, but also impacts on the community. And the Environmental Impact Report is required to look at all the effects of the project, whether they occur on campus or off campus within the limitations of the issues that are required to be addressed under the California Environmental Quality Act.

JOLIE KERNS: Okay. With that comment, that is what we have received to date. I think what we can do is we will plan to check in in perhaps a 15-minute increment. So we are here until 8:00 p.m. If you would like to send a comment, please send one to EIR at eircomment@ucsc.edu, and we would be happy to read that out loud. You are still able to comment through April 8, 2020, until 5:00 p.m. with any concerns. If you would like it to be read aloud, we are here until 8:00 p.m. to do that. So we are going to go ahead and go on mute, and then we will check back at 7:00, and if we have some new comments, we'll plan to read those then.

Thank you for participating tonight.

ERIKA CARPENTER: Thank you.

(A recess was taken.)

JOLIE KERNS: Hi, everyone. We are here from UC Santa Cruz as part of the scoping sessions. I'm sorry. You are probably having difficulty hearing me. We are here from UC Santa Cruz as part of the EIR for the

Long-range Development Plan scoping sessions.

We have not received any new comments since we went off, but we are checking back. We are here until 8:00 p.m. If you have any comments, we will read them out loud during this scoping session. You can e-mail comments to eircomment@ucsc.edu. We'll also be taking comments on the scope of the EIR through Wednesday, April 8, at 5:00 p.m. Those also can be e-mailed to eircomment@ucsc.edu or sent by mail to our senior environmental planner. And the address is online. We will be here until 8:00. We'll plan to check back in in 15 minutes, at 7:15, and we will read any new comments that may have come in at that time.

Thank you, and thanks so much for participating with us tonight.

(A recess was taken.)

JOLIE KERNS: Hi. This is Jolie Kerns here at UC Santa Cruz, director of planning. We are checking back in. It's 7:15. We have not received any other EIR comments. We'll continue to be here until 8:00 tonight. And we can plan to check back in at 7:30 and read anything aloud that we may have received at that time.

As a reminder, you can send any comments to eircomment@ucsc.edu at any time until April 8 at 5:00 p.m. Those comments can also be mailed to the address that's provided on the Notice of Preparation. And we will check back in at 7:30. Thank you.

(A recess was taken.)

ERIKA CARPENTER: Okay. Hi. We have one additional comment tonight, and so I will just go ahead and start and jump right in.

"I am flabbergasted by UCSC's plans to add thousands more students. We don't even have room for the present students. There are now three students per teeny-weeny dorm room at even higher rents than the rents that are in town.

"Traffic congestion on High, Bay, and Western is gridlocked. How are you proposing to alleviate that?

"Fix the current problems first before you even consider anything else. Oh, wait. The current problems are not fixable. Well, in that case, just soldier on as if they are fixed.

"Good grief. You don't even have mitigating plans in place right now for wildfires or earthquakes or, God forbid, a disaster like the coronavirus.

"All of these are imminent threats in Santa Cruz, and all you provide is lip service. When, to be sure, not if, such a disaster strikes, you are wholly unprepared as it is right now, let alone adding even more students.

"I would not dream of sending my kids up there to school. It's only a matter of time before disaster strikes, which will not only endanger the kids, but also endanger our firefighters and other rescuers.

"Why is the University of California refusing to build a new campus elsewhere? Which part of 'there is no water, no roads, no room in Santa Cruz' do the Regents not understand? Get real, Regents.

"Thank you."

JOLIE KERNS: Thanks for the comment and for continuing to participate. That was the only one that came in. And we will check in next at 7:45. Again, if you would like to comment and for your comment to be read aloud, please feel free to e-mail eircomment@ucsc.edu. We will be here until 8:00. Thank you.

(A recess was taken.)

JOLIE KERNS: Hi. This is Jolie Kerns with UC Santa Cruz, director of physical environmental planning. We are here for the scoping session for the Long-range Development Plan, EIR.

And we have not received any new comments since 7:30. It's 7:45 right now. And we will plan to close this out at 8:00. Actually, we'll check in at 7:55, in about ten minutes, in case we do receive any comments. It will give us a few minutes to read those aloud and then close out. So we will be back at 7:55.

Thank you for your participation.

(A recess was taken.)

JOLIE KERNS: Hi, everyone. Jolie Kerns here again for our scoping session. It is 7:55. We have not received any new comments. So I think we are going to go ahead and close this out.

As a reminder, we would love to hear from you, any comments on what you might be concerned with, what you want to see analyzed in the EIR. You can send them to eircomment@ucsc.edu. You can mail them in. That information is on our website on the Notice of Preparation. And the due date for that is April 8 at 5:00 p.m.

Thank you so much for participating tonight, and we will hope to hear from you soon. Thank you.

(Proceedings in the above-entitled
matter were concluded at 8:00 p.m.)

--oooOooo--

REPORTER'S CERTIFICATE

I, CARY BLUE LATURNO, do hereby certify:

That said proceedings were taken before me at said time and place and were taken down in shorthand by me, a Certified Shorthand Reporter of the State of California, and were thereafter transcribed into typewriting; and that the foregoing transcript constitutes a full, true, and correct report of said proceedings which took place;

IN WITNESS WHEREOF, I have hereunder subscribed my hand this 18th day of March 2020.

Cary Blue LaTurno, RMR, CRR

CSR No. 9681

Appendix C

Land Evaluation and Site Assessment Model Evaluation

NOTES

Calculation of the Land Evaluation (LE) Score

Part 1. Land Capability Classification (LCC) Score:

(1) Determine the total acreage of the project.
(2) Determine the soil types within the project area and enter them in **Column A** of the **Land Evaluation Worksheet** provided on page 2-A.
(3) Calculate the total acres of each soil type and enter the amounts in **Column B**.
(4) Divide the acres of each soil type (**Column B**) by the total acreage to determine the proportion of each soil type present. Enter the proportion of each soil type in **Column C**.
(5) Determine the LCC for each soil type from the applicable Soil Survey and enter it in **Column D**.
(6) From the LCC Scoring Table below, determine the point rating corresponding to the LCC for each soil type and enter it in **Column E**.

LCC Scoring Table

LCC Class	I	IIe	IIs,w	IIIe	IIIs,w	IVe	IVs,w	V	VI	VII	VIII
Points	100	90	80	70	60	50	40	30	20	10	0

(7) Multiply the proportion of each soil type (**Column C**) by the point score (**Column E**) and enter the resulting scores in **Column F**.
(8) Sum the LCC scores in **Column F**.
(9) Enter the LCC score in box <1> of the **Final LESA Score Sheet** on page 10-A.

Part 2. Storie Index Score:

(1) Determine the Storie Index rating for each soil type and enter it in **Column G**.
(2) Multiply the proportion of each soil type (**Column C**) by the Storie Index rating (**Column G**) and enter the scores in **Column H**.
(3) Sum the Storie Index scores in **Column H** to gain the Storie Index Score.
(4) Enter the Storie Index Score in box <2> of the **Final LESA Score Sheet** on page 10-A.

Land Evaluation Worksheet

Land Capability Classification (LCC) and Storie Index Scores

A	B	C	D	E	F	G	H
Soil Map Unit	Project Acres	Proportion of Project Area	LCC	LCC Rating	LCC Score	Storie Index	Storie Index Score
Totals		(Must Sum to 1.0)		***LCC Total Score***		***Storie Index Total Score***	

Site Assessment Worksheet 1.

Project Size Score

	I	J	K
	LCC Class I - II	LCC Class III	LCC Class IV - VIII
		2	
		0.2	
Total Acres	0	2.2	0
Project Size Scores	0	0	0

Highest Project Size Score 0

Notes: Soil Map Unit, LCC, LCC Rating, LCC Class and Storie Index were derived from the NRCS Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

NOTES

Calculation of the Site Assessment (SA) Score

Part 1. Project Size Score:.

(1) Using **Site Assessment Worksheet 1** provided on page 2-A, enter the acreage of each soil type from **Column B** in the **Column - I, J or K** - that corresponds to the LCC for that soil. (Note: While the Project Size Score is a component of the Site Assessment calculations, the score sheet is an extension of data collected in the Land Evaluation Worksheet, and is therefore displayed beside it).
(2) Sum **Column I** to determine the total amount of class I and II soils on the project site.
(3) Sum **Column J** to determine the total amount of class III soils on the project site.
(4) Sum **Column K** to determine the total amount of class IV and lower soils on the project site.
(5) Compare the total score for each LCC group in the Project Size Scoring Table below and determine which group receives the highest score.

Project Size Scoring Table

Class I or II		**Class III**		**Class IV or Lower**	
Acreage	Points	Acreage	Points	Acreage	Points
>80	100	>160	100	>320	100
60-79	90	120-159	90	240-319	80
40-59	80	80-119	80	160-239	60
20-39	50	60-79	70	100-159	40
10-19	30	40-59	60	40-99	20
10<	0	20-39	30	40<	0
		10-19	10		
		10<	0		

(6) Enter the **Project Size Score** (the highest score from the three LCC categories) in box <3> of the **Final LESA Score Sheet** on page 10-A.

NOTES

Part 2. Water Resource Availability Score:

(1) Determine the type(s) of irrigation present on the project site, including a determination of whether there is dryland agricultural activity as well.

(2) Divide the site into portions according to the type or types of irrigation or dryland cropping that is available in each portion. Enter this information in **Column B** of **Site Assessment Worksheet 2. - Water Resources Availability**.

(3) Determine the proportion of the total site represented for each portion identified, and enter this information in **Column C**.

(4) Using the Water Resources Availability Scoring Table, identify the option that is most applicable for each portion, based upon the feasibility of irrigation in drought and non-drought years, and whether physical or economic restrictions are likely to exist. Enter the applicable Water Resource Availability Score into **Column D**.

(5) Multiply the Water Resource Availability Score for each portion by the proportion of the project area it represents to determine the weighted score for each portion in **Column E**.

(6) Sum the scores for all portions to determine the project's total Water Resources Availability Score

(7) Enter the Water Resource Availability Score in box <4> of the **Final LESA Score Sheet** on page 10-A.

Site Assessment Worksheet 2. - Water Resources Availability

A	B	C	D	E
Project Portion	Water Source	Proportion of Project Area	Water Availability Score	Weighted Availability Score (C x D)
1	irrigation district and groundwater	1	50	50
2				
3				
4				
5				
6				
		(Must Sum to 1.0)	***Total Water Resource Score***	50

Notes: It was assumed that the site is currently irrigated because the site is located within the Center for Agroecology and Sustainable Food Systems. No information was available regarding groundwater resources. Thus, it was conservatively assumed that the site could potentially be fed by groundwater. The Water Availability Score was based on irrigation production not being feasible during drought years and the presence of no physical or economic restrictions to irrigation during non-drought years.

Water Resource Availability Scoring Table

Option	Non-Drought Years			Drought Years			WATER RESOURCE SCORE
	RESTRICTIONS			RESTRICTIONS			
	Irrigated Production Feasible?	Physical Restrictions ?	Economic Restrictions ?	Irrigated Production Feasible?	Physical Restrictions ?	Economic Restrictions ?	
1	YES	NO	NO	YES	NO	NO	100
2	YES	NO	NO	YES	NO	YES	95
3	YES	NO	YES	YES	NO	YES	90
4	YES	NO	NO	YES	YES	NO	85
5	YES	NO	NO	YES	YES	YES	80
6	YES	YES	NO	YES	YES	NO	75
7	YES	YES	YES	YES	YES	YES	65
8	YES	NO	NO	NO	-- --	-- --	50
9	YES	NO	YES	NO	-- --	-- --	45
10	YES	YES	NO	NO	-- --	-- --	35
11	YES	YES	YES	NO	-- --	-- --	30
12	Irrigated production not feasible, but rainfall adequate for dryland production in both drought and non-drought years						25
13	Irrigated production not feasible, but rainfall adequate for dryland production in non-drought years (but not in drought years)						20
14	Neither irrigated nor dryland production feasible						0

Updated 2011

NOTES

Part 3. Surrounding Agricultural Land Use Score:

(1) Calculate the project's Zone of Influence (ZOI) as follows:

(a) a rectangle is drawn around the project such that the rectangle is the smallest that can completely encompass the project area.

(b) a second rectangle is then drawn which extends one quarter mile on all sides beyond the first rectangle.

(c) The ZOI includes all parcels that are contained within or are intersected by the second rectangle, less the area of the project itself.

(2) Sum the area of all parcels to determine the total acreage of the ZOI.

(3) Determine which parcels are in agricultural use and sum the areas of these parcels

(4) Divide the area in agriculture found in step (3) by the total area of the ZOI found in step (2) to determine the percent of the ZOI that is in agricultural use.

(5) Determine the Surrounding Agricultural Land Score utilizing the Surrounding Agricultural Land Scoring Table below.

Surrounding Agricultural Land Scoring Table

Percent of ZOI in Agriculture	Surrounding Agricultural Land Score
90-100	100
80-89	90
75-79	80
70-74	70
65-69	60
60-64	50
55-59	40
50-54	30
45-49	20
40-44	10
<40	0

(5) Enter the Surrounding Agricultural Land Score in box <5> of the **Final LESA Score Sheet** on page 10-A.

Site Assessment Worksheet 3.
Surrounding Agricultural Land and Surrounding Protected Resource Land

A	B	C	D	E	F	G
Zone of Influence					Surrounding Agricultural Land Score (From Table)	Surrounding Protected Resource Land Score (From Table)
Total Acres	Acres in Agriculture	Acres of Protected Resource Land	Percent in Agriculture (A/B)	Percent Protected Resource Land (A/C)		
211	10	11	5	5	0	0

Notes: The total acres value for the Zone of Influence (ZOI) was calculated using Google Earth. The acres in agriculture value was calculated by identifying and measuring agrigultural patches located within the ZOI using Google Earth. The acres of protected resource land value was calculated by identifying and measuring the portion of the Ranch View Terrace Habitat Conservation Plan (HCP) located within the ZOI using Google Earth.

NOTES

Part 4. Protected Resource Lands Score:

The Protected Resource Lands scoring relies upon the same Zone of Influence information gathered in Part 3, and figures are entered in Site Assessment Worksheet 3, which combines the surrounding agricultural and protected lands calculations.

(1) Use the total area of the ZOI calculated in Part 3. for the Surrounding Agricultural Land Use score.

(2) Sum the area of those parcels within the ZOI that are protected resource lands, as defined in the California Agricultural LESA Guidelines.

(3) Divide the area that is determined to be protected in Step (2) by the total acreage of the ZOI to determine the percentage of the surrounding area that is under resource protection.

(4) Determine the Surrounding Protected Resource Land Score utilizing the Surrounding Protected Resource Land Scoring Table below.

Surrounding Protected Resource Land Scoring Table

Percent of ZOI Protected	Protected Resource Land Score
90-100	100
80-89	90
75-79	80
70-74	70
65-69	60
60-64	50
55-59	40
50-54	30
45-49	20
40-44	10
<40	0

(5) Enter the Protected Resource Land score in box <6> of the **Final LESA Score Sheet** on page 10-A.

LESA Worksheet (cont.)

NOTES

Based on the Final LESA Score of 46.4, the LE Subtotal of 38.9, and the SA Subtotal of 7.5, the site would not be considered significant.

Final LESA Scores between 40 and 59 points are considered significant only if the LE and SA Subtotal scores are each greater than or equal to 20 points.

Final LESA Score Sheet

Calculation of the Final LESA Score:

(1) Multiply each factor score by the factor weight to determine the weighted score and enter in Weighted Factor Scores column.
(2) Sum the weighted factor scores for the LE factors to determine the total LE score for the project.
(3) Sum the weighted factor scores for the SA factors to determine the total SA score for the project.
(4) Sum the total LE and SA scores to determine the Final LESA Score for the project.

	Factor Scores	**Factor Weight**	**Weighted Factor Scores**
LE Factors			
Land Capability Classification	<1> 70	0.25	17.5
Storie Index	<2> 85.7	0.25	21.4
LE Subtotal		***0.50***	38.9
SA Factors			
Project Size	<3> 0	0.15	0
Water Resource Availability	<4> 50	0.15	7.5
Surrounding Agricultural Land	<5> 0	0.15	0
Protected Resource Land	<6> 0	0.05	0
SA Subtotal		***0.50***	7.5
		Final LESA Score	46.4

For further information on the scoring thresholds under the California Agricultural LESA Model, consult Section 4 of the Instruction Manual.

Appendix D

Air Quality Modeling

Appendix D1 – Criteria Pollutant Modeling Results

Road Construction Emissions Model Version 9.0.0
Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells D10 through D24, E28 through G35, and D38 through D41 for all project types.
Please use "Clear Data Input & User Overrides" button first before changing the Project Type or begin a new project.

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name		
Construction Start Year	2022	Enter a Year between 2014 and 2040 (inclusive)
Project Type	3	1) New Road Construction : Project to build a roadway from bare ground, which generally requires more site preparation than widening an existing roadway 2) Road Widening : Project to add a new lane to an existing roadway 3) Bridge/Overpass Construction : Project to build an elevated roadway, which generally requires some different equipment than a new roadway, such as a crane 4) Other Linear Project Type: Non-roadway project such as a pipeline, transmission line, or levee construction
Project Construction Time	5.00	months
Working Days per Month	22.00	days (assume 22 if unknown)
Predominant Soil/Site Type: Enter 1, 2, or 3 (for project within "Sacramento County", follow soil type selection instructions in cells E18 to E20 otherwise see instructions provided in cells J18 to J22)	2	1) Sand Gravel : Use for quaternary deposits (Delta/West County) 2) Weathered Rock-Earth : Use for Laguna formation (Jackson Highway area) or the Ione formation (Scott Road, Rancho Murieta) 3) Blasted Rock : Use for Salt Springs Slate or Copper Hill Volcanics (Folsom South of Highway 50, Rancho Murieta)
Project Length	0.07	miles
Total Project Area	0.03	acres
Maximum Area Disturbed/Day	0.03	acres
Water Trucks Used?	2	1. Yes 2. No

Please note that the soil type instructions provided in cells E18 to E20 are specific to Sacramento County. Maps available from the California Geologic Survey (see weblink below) can be used to determine soil type outside Sacramento County.

http://www.conservation.ca.gov/cgs/information/geologic_mapping/Pages/googlemaps.aspx#regionalseries

Material Hauling Quantity Input

Material Type	Phase	Haul Truck Capacity (yd^3) (assume 20 if unknown)	Import Volume (yd^3/day)	Export Volume (yd^3/day)
Soil	Grubbing/Land Clearing	20.00		
	Grading/Excavation	20.00		
	Drainage/Utilities/Sub-Grade	0.00		
	Paving	0.00		
Asphalt	Grubbing/Land Clearing	20.00		
	Grading/Excavation	20.00		
	Drainage/Utilities/Sub-Grade	0.00		
	Paving	0.00		

Mitigation Options

On-road Fleet Emissions Mitigation	2010 and Newer On-road Vehicles Fleet	Select "2010 and Newer On-road Vehicles Fleet" option when the on-road heavy-duty truck fleet for the project will be limited to vehicles of model year 2010 or newer
Off-road Equipment Emissions Mitigation	20% NOx and 45% Exhaust PM reduction	Select "20% NOx and 45% Exhaust PM reduction" option if the project will be required to use a lower emitting off-road construction fleet. The SMAQMD Construction Mitigation Calculator can be used to confirm compliance with this mitigation measure (http://www.airquality.org/Businesses/CEQA-Land-Use-Planning/Mitigation). Select "Tier 4 Equipment" option if some or all off-road equipment used for the project meets CARB Tier 4 Standard

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

LRDP Construction Emissions Modeling Results Summary - Combined

2022-2039			Max Daily Emissions											
Unmitigated			Total				Exhaust		Fugitive Dust		Annual GHG Emissions			
			lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Year	**Project Components**	**Model**	**ROG**	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
2022	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2023	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2024	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2025	Buildings + Roadways + trails + bridges	CalEEMod + RCEM + trails	45.33	238.08	49.01	27.38	9.64	8.80	39.37	18.58	2,056.44	0.51	0.02	2,073.74
2026	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2027	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2028	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2029	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2030	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2031	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2032	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2033	Buildings + Roadways + trails + bridges	CalEEMod + RCEM + trails	45.33	238.08	49.01	27.38	9.64	8.80	39.37	18.58	2,056.44	0.51	0.02	2,073.74
2034	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2035	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2036	Buildings + Roadways + trails + bridges	CalEEMod + RCEM + trails	45.33	238.08	49.01	27.38	9.64	8.80	39.37	18.58	2,056.44	0.51	0.02	2,073.74
2037	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2038	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
2039	Buildings + Roadways + trails	CalEEMod + RCEM + trails	37.11	167.79	46.38	25.43	7.60	6.98	38.77	18.45	1,459.12	0.34	0.01	1,469.68
		MBARD Threshold	137	137	82	55							**MT-CO2e Total**	**28,266**
		Exceed Threshold?	No	Yes	No	No							Average Annual	1,570
													30-year Amortized	942

2022-2039			Max Daily Emissions											
Mitigated (CalEEMod mitigation results)			Total				Exhaust		Fugitive Dust		Annual GHG Emissions			
			lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Year	**Max Construction Phase**	**Model**	**ROG**	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
2022	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.2	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2023	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2024	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2025	Buildings + Roadways + trails + bridges	CalEEMod + RCEM + trails	43.41	210.04	34.43	19.33	8.57	8.07	25.86	11.26	2,056.44	0.51	0.02	2,073.74
2026	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2027	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2028	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2029	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2030	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2031	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2032	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2033	Buildings + Roadways + trails + bridges	CalEEMod + RCEM + trails	43.41	210.04	34.43	19.33	8.57	8.07	25.86	11.26	2,056.44	0.51	0.02	2,073.74
2034	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2035	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2036	Buildings + Roadways + trails + bridges	CalEEMod + RCEM + trails	43.41	210.04	34.43	19.33	8.57	8.07	25.86	11.26	2,056.44	0.51	0.02	2,073.74
2037	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2038	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
2039	Buildings + Roadways + trails	CalEEMod + RCEM + trails	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13	1,459.12	0.34	0.01	1,469.68
		MBARD Threshold	137	137	82	55							**MT-CO2e Total**	**28,266**
		Maximum Day without Bridge Construction	35.20	139.75	31.79	17.38							Average Annual	1,570
		Exceed Threshold?	No	Yes	No	No							30-year Amortized	942

Quantified Construction Mitigation Measures

1. 80% of equipment are Tier 3 (in table above)
2. Renewable Diesel used in all construction equipment (calculated below)
3. Non-concurrent bridgework (calculated below)

Final Mitigation Calculations								
	Total				Exhaust		Fugitive Dust	
	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
	ROG	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**
Construction emissions w/o bridgework (w/80% Tier 3)	35.20	139.75	31.79	17.38	6.53	6.25	25.26	11.13
Additional % reduction in emissions with Renewable Diesel	5%	10%	n/a	n/a	30%	30%	0%	0%
Construction emissions w/o bridgework + Renewable Diesel	33.44	125.77	29.83	15.51	4.57	4.37	25.26	11.13
Percent reduction from unmitigated	-26%	-47%	-39%	-43%	-53%	-50%	-36%	-40%

LRDP Land Use Construction Emissions Modeling Results for One Year of Construction

Unmitigated			Max Daily Emissions								Annual GHG Emissions			
			Total				Exhaust		Fugitive Dust					
			lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Year	**Max Construction Phase**	**Model**	**ROG**	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
1	Building Construction	CalEEMod	31.81	112.81	31.91	18.70	5.20	4.82	26.71	13.88	1,082.39	0.25	0.00	1,088.59
		MBARD Threshold	137	137	82	55							Total	1,088.59
		Exceed Threshold?	No	No	No	No								

Mitigated					Max Daily Emissions						Annual GHG Emissions			
			Total				Exhaust		Fugitive Dust					
			lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Year	**Max Construction Phase**	**Model**	**ROG**	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
1	Building Construction	CalEEMod	30.47	88.38	17.50	10.79	4.30	4.23	13.20	6.56	1,082.39	0.25	0.00	1,088.59
		MBARD Threshold	137	137	82	55							Total	1,088.59
		Exceed Threshold?	No	No	No	No								

LRDP Roadways & Bridges Construction Emissions Modeling Results Summary for One Year of Construction
(Results from the Roadway Construction Emissions Model [RCEM])

Unmitigated

			Max Daily Emissions								Annual GHG Emissions			
			Total				Exhaust		Fugitive Dust					
			lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Year	**Max Construction Phase**	**Model**	**ROG**	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
1	Roadways (2 miles/year)	RCEM	4.47	46.49	7.99	3.03	1.99	1.78	6.00	1.25	371.86	0.10	0.01	376.18
1	Bridge (1 bridge from 2022-2031, 2 bridges from 2032-2039)	RCEM	8.21	70.29	2.64	1.94	2.04	1.82	0.60	0.12	597.32	0.17	0.01	604.05
		MBARD Threshold	137	137	82	55								
		Exceed Threshold?	No	No	No	No								

Mitigated

			Max Daily Emissions								Annual GHG Emissions			
			Total				Exhaust		Fugitive Dust					
			lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Year	**Max Construction Phase**	**Model**	**ROG**	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
1	Roadways (2 miles/year)	RCEM	4.47	46.49	7.99	3.03	1.99	1.78	6.00	1.25	371.86	0.10	0.01	376.18
1	Bridge (1 bridge from 2022-2031, 2 bridges from 2032-2039)	RCEM	8.21	70.29	2.64	1.94	2.04	1.82	0.60	0.12	597.32	0.17	0.01	604.05
		MBARD Threshold	137	137	82	55								
		Exceed Threshold?	No	No	No	No								

LRDP Trails Construction Emissions Modeling Results Summary for One Year of Construction

			Max Daily Emissions											
Unmitigated			Total				Exhaust		Fugitive Dust		Annual GHG Emissions			
			lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Year	**Max Construction Phase**	**Model**	**ROG**	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
1	Building Construction	CalEEMod	0.83	8.49	6.47	3.70	0.41	0.38	6.06	3.32	4.87	0.00	0.00	4.91
		MBARD Threshold	137	137	82	55							Total	4.91
		Exceed Threshold?	No	No	No	No								

Paste CalEEMod outputs below

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
2022	0.8283	8.4885	5.1365	0.0101	6.0632	0.4113	6.4744	3.3211	0.3784	3.6995	0.0000	977.4090	977.4090	0.3047	0.0000	985.0275
	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	4.56E-03	0.0467	0.0282	6.00E-05	0.0333	2.26E-03	0.0356	0.0183	2.08E-03	0.0204	0.0000	4.8676	4.8676	1.52E-03	0.0000	4.9056

			Max Daily Emissions											
Mitigated			Total				Exhaust		Fugitive Dust		Annual GHG Emissions			
			lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Year	**Max Construction Phase**	**Model**	**ROG**	**NOx**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
1	Building Construction	CalEEMod	0.26	4.89	6.30	3.56	0.24	0.24	6.06	3.32	4.87	0.00	0.00	4.91
		MBARD Threshold	137	137	82	55							Total	4.91
		Exceed Threshold?	No	No	No	No								

Due to the limited number of equipment used for trail construction, assume all equipment would be Tier 3 under mitigation.

Operational Emissions Modeling Results Summary at Buildout

Unmitigated		Max Daily Emissions								Annual GHG Emissions			
		Total				**Exhaust**		**Fugitive Dust**					
		lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Source	**Model**	**ROG**	**NOX**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
Area	CalEEMod	121.9	0.2	0.1	0.1	0.12	0.12	0.00	0.00	4.3	0.00	0.00	4.43
Electricity	CalEEMod	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	1,139	0.07	0.01	1,145
Natural Gas	CalEEMod	2.6	23.3	1.8	1.8	1.78	1.78	0.00	0.00	4,663	0.09	0.09	4,690
Laboratories	Permit Data/HRA	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline Storage Tank	Permit Data/HRA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mobile - LRDP	CalEEMod	26.6	55.3	105.8	28.5	0.43	0.41	105.32	28.10	11,464	0.43	0.00	11,475
Waste	CalEEMod	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	1,000	59.11	0.00	2,478
Water/wastewater processes	CalEEMod	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	285	17.39	0.41	843
	Total	152	79	108	30	2.33	2.31	105.32	28.10	18,556	77.09	0.51	20,636
	MBARD Threshold	137	137	82	55							w/o mobile	9,161
	Exceed Threshold?	Yes	No	Yes	No							w/o water and mobile	8,318
	Total Stationary Source Emissions	3.6	23.3	1.8	1.8	1.8	1.8	0.0	0.0			Tree loss	2,160

Mitigated		Max Daily Emissions								Annual GHG Emissions			
		Total				**Exhaust**		**Fugitive Dust**					
		lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	MT/Year	MT/Year	MT/Year	MT/Year
Source	**Model**	**ROG**	**NOX**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2e**
Area	CalEEMod	101.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Electricity	CalEEMod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1139.24	0.07	0.01	1,145
Natural Gas	CalEEMod	2.6	23.3	1.8	1.8	1.78	1.78	0.00	0.00	4662.71	0.09	0.09	4,690
Laboratories	Permit Data/HRA	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline Storage Tank	Permit Data/HRA	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mobile - LRDP*	CalEEMod	22.8	47.4	95.9	25.8	0.4	0.3	95.6	25.5	9818.03	0.37	0.00	9,827
Waste	CalEEMod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1000.11	59.11	0.00	2,478
Water/wastewater processes	CalEEMod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	169.20	17.39	0.41	727
	Total	128	71	98	28	2.16	2.13	95.56	25.50	16789.28	77.02	0.51	18,867
	MBARD Threshold	137	137	82	55							w/o mobile	9,040
	Exceed Threshold?	No	No	Yes	No							w/o water and mobile	8,314
	Total Stationary Source Emissions	3.6	23.3	1.8	1.8	1.8	1.8	0.0	0.0			Tree loss	2,160

*Includes 100% electric campus fleet

	lbs/day	lbs/day	lbs/day	lbs/day
	ROG	**NOX**	**PM10**	**PM2.5**
Reduction from unmitigated	24.32	8.19	9.95	2.78

Percent of LRDP Mobile emissions from fleet	6%
Total LRDP mobile emissions	11,475

GHG Forecasts without additional reductions or carbon offsets

Emissions Source	1990 Reference Emissions	Existing 2018 (Baseline LRDP EIR Emissions)	Existing + LRDP (2025) (Interpolated)	Existing + LRDP (2030) (Interpolated)	Existing + LRDP -2040	1990 Source	2018 Source	2025/2030 Source	2040 Source
Scopes 1 & 2 [2]									
Stationary Sources (existing campus)	16,989	28,917	28,917	28,917	28,917	CES 2017	Second Nature Annual Report	Interpolated	no change from 2018
Purchased Electricity [3] (existing campus)	4,136	1,595	2,068	1,654	517	CES 2017	Second Nature Annual Report	Interpolated	scaled down by electricity efs. SB 100 state goal of 50 percent of electricity to be powered by renewable resources by 2025, 60 percent by 2030, and 100 percent zero-carbon electricity by 2045 (interpolated to 88 percent by 2040).
Mobile Fleet (existing campus)	1,701	2,032	1,785	1,609	1,257	CES 2017	Second Nature Annual Report	Interpolated	scaled down by mobile emission factors in EMFAC 2017
Stationary Sources (LRDP growth)	0	0	1,494	2,561	4,695			Interpolated	CalEEMod
Purchased Electricity [3] (LRDP growth)	0	0	364	625	1,145			Interpolated	CalEEMod
Mobile Fleet (LRDP growth)	0	0	205	351	644			Interpolated	scaled by growth in student pop
Total Scope 1 and 2 Emissions	22,826	32,544	34,833	35,717	37,175			Interpolated	
Scope 3 (excluding air emissions)									
Non-Fleet Mobile Sources from Existing Campus [4]	26,830	22,780	19,616	17,355	12,835	CES 2017	Second Nature Annual Report	Interpolated	scaled down by mobile emission factors in EMFAC 2017
Non-Fleet Mobile Sources from LRDP Growth [5]	0	0	3,446	5,908	10,832		zero	Interpolated	CalEEMod results minus campus fleet emissions attributed to LRDP growth
LRDP Construction [6]	0	0	942	942	942		zero	Interpolated	CalEEMod
Changes to on-campus vegetation from existing [7]	0	0	687	1,178	2,160		zero	Interpolated	CalEEMod
Total Scope 3 Emissions	26,830	22,780	24,692	25,384	26,769				
Totals									
Total Emissions from Existing Campus operations	**49,656**	**55,324**	**52,386**	**49,536**	**43,526**				
Total Emissions from New Development under LRDP	**0**	**0**	**7,139**	**11,565**	**20,418**				
Total Emissions without Additional Reductions	**49,656**	**55,324**	**59,525**	**61,101**	**63,944**				
Process and Fugitive Emissions (existing campus)	N/A	395	395	395	395		Second Nature Annual Report		
Process and Fugitive Emissions (LRDP Growth)	N/A	0	39	67	124		zero	Scaled by growth in research and development sf from existing	
Water/Wastewater (LRDP Growth)	N/A	0	268	460	843		zero	Interpolated	CalEEMod
Solid Waste (LRDP Growth)	N/A	0	788	1,351	2,478		zero	Interpolated	CalEEMod
Electricity transmission and distribution losses	N/A	0	0	0	0.001		zero	Interpolated	Based on 1.90E-11 MTSF5/kWh via CARB's GHG Inventory Query.

Comparison to UC Carbon Neutrality Initiative Target

Emissions Source	1990 Reference Emissions	Existing 2018 (Baseline LRDP EIR Emissions)	Existing + LRDP (2025) (Interpolated)	Existing + LRDP (2030) (Interpolated)	Existing + LRDP -2040
Scope 1 and 2 Emissions without Reductions	22,826	32,544	34,833	35,717	37,175
Scope 1 Emissions Reductions (e.g., carbon offsets and on-site emission reduction projects)	0	2,161	12,773	20,353	35,513
Scope 2 Emissions Reductions (e.g., renewable energy credits)	0	0	529	907	1,662
Total Scope 1 and 2 Reductions	0	0	13,302	21,260	37,175
Scope 1 and 2 Emissions with Reductions	22,826	32,544	21,532	14,458	0
UC Carbon Neutrality Initiative Target (Scopes 1 and 2) [8] ($MTCO_2e$)			0	0	0
Meets UC Carbon Neutrality Initiative Target?			No	No	Yes

Comparison to State GHG Reduction Targets

Scope 1, 2, and 3 Emissions without reductions	49,656	55,324	59,525	61,101	63,944
Percent Change of Total Emissions(1) from 1990 (without reductions)	—	11%	20%	23%	29%
Scope 1, 2, and 3 Emissions with reductions	49,656	55,324	46,223	39,842	26,769
Percent Change of Total Emissions(1) from 1990 (with reductions)		11%	-7%	-20%	-46%
State GHG Reduction Targets (Percent Change from 1990)				-40%	-60%
Targetted Scope 1,2, and 3 Emissions under State Targets				29,794	19,862
Meets State GHG Reduction Targets?				No	No
Additional Reductions Needed to Meet State Targets				10,048	6,907

VMT forecasts from Fehr and Peers 12/14/2020

Metric	2019 Existing	2019 + Project	2019 + Project (mitigated)	2040 Cumulative	2040 + Project
Total Trips	28,900	44,700	*NA*	25,400	38,900
Total VMT Daily	298,000	439,000	425,926	257,000	372,000
Total VMT Annual*	85,619,444	126,130,658	122,374,320	73,839,588	106,880,649
VMT per Capita	*9.1*	*7.9*	*7.7*	*7.1*	*6.5*
Residential VMT per Capita	*5.3*	*5.6*	*NA*	*5.2*	*5.4*
Employment VMT per Capita	*12.6*	*12.5*	*NA*	*11.3*	*11.2*

* Calculated based on average full academic day equivalents in a year (287.31 days per year).

	Difference between 2019+Project and 2019 Existing (For CalEEMod Modeling)	
	unmitigated	mitigated
Total VMT Daily	141,000	127,926
Total VMT Annual*	40,511,214	36,754,876

Source: EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: Santa Cruz
Calendar Year: 2018, 2040
Season: Annual
Vehicle Classification: EMFAC2007 Categories

Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HOTSOAK and RUNLOSS, g/vehicle/day for IDLEX, RESTLOSS and DIURN

Region	Calendar Y	Vehicle Cat	Model Yea	Speed	Fuel	Population	VMT	Trips	CO_2_RUNEX	
Santa Cruz	2018	HHDT	Aggregate	Aggregate	Gasoline	0.51606786	24.04264	10.32549	2095.961566	50392.45701
Santa Cruz	2018	HHDT	Aggregate	Aggregate	Diesel	630.700055	46568.57	4931.95	1820.052819	84757251.32
Santa Cruz	2018	LDA	Aggregate	Aggregate	Gasoline	74528.2798	2680311	342844.7	301.5835797	808337871.6
Santa Cruz	2018	LDA	Aggregate	Aggregate	Diesel	1489.1187	53878.65	6803.499	242.7201712	13077434.5
Santa Cruz	2018	LDT1	Aggregate	Aggregate	Gasoline	8770.98749	320402.8	39798.33	346.8293734	111125102.4
Santa Cruz	2018	LDT1	Aggregate	Aggregate	Diesel	25.637933	429.3999	85.5632	454.9344345	195348.7938
Santa Cruz	2018	LDT2	Aggregate	Aggregate	Gasoline	35527.2906	1250589	159603	399.811047	499999468.4
Santa Cruz	2018	LDT2	Aggregate	Aggregate	Diesel	135.545773	5959.323	654.2663	323.2397153	1926290.027
Santa Cruz	2018	LHDT1	Aggregate	Aggregate	Gasoline	3311.42118	110084.5	49335.24	1051.256109	115727029.3
Santa Cruz	2018	LHDT1	Aggregate	Aggregate	Diesel	2607.13311	93051.11	32794.45	587.5293308	54670257.45
Santa Cruz	2018	LHDT2	Aggregate	Aggregate	Gasoline	412.174125	13739.54	6140.78	1203.175832	16531078.4
Santa Cruz	2018	LHDT2	Aggregate	Aggregate	Diesel	777.781864	29533.66	9783.517	656.3298113	19383821.56
Santa Cruz	2018	MCY	Aggregate	Aggregate	Gasoline	6371.94438	45221.11	12743.89	219.8818672	9943301.936
Santa Cruz	2018	MDV	Aggregate	Aggregate	Gasoline	23354.4596	808457.7	105431.1	470.389888	380290304
Santa Cruz	2018	MDV	Aggregate	Aggregate	Diesel	408.742747	18089.25	1983.16	420.0236976	7597912.635
Santa Cruz	2018	MH	Aggregate	Aggregate	Gasoline	835.459103	6665.799	83.57933	1875.664927	12502804.59
Santa Cruz	2018	MH	Aggregate	Aggregate	Diesel	247.366923	2402.82	24.73669	1073.234563	2578789.197
Santa Cruz	2018	MHDT	Aggregate	Aggregate	Gasoline	273.484357	11191.31	5471.875	1861.640559	20834197.69
Santa Cruz	2018	MHDT	Aggregate	Aggregate	Diesel	1833.90457	106762.5	19351.96	1134.653339	121138428.7
Santa Cruz	2018	OBUS	Aggregate	Aggregate	Gasoline	93.9549961	4792.477	1879.852	1877.049511	8995716.736
Santa Cruz	2018	OBUS	Aggregate	Aggregate	Diesel	60.3349921	3229.951	538.9084	1306.167835	4218858.096
Santa Cruz	2018	SBUS	Aggregate	Aggregate	Gasoline	8.94174799	480.0104	35.76699	903.8463557	433855.6636
Santa Cruz	2018	SBUS	Aggregate	Aggregate	Diesel	193.568376	6197.157	2233.752	1174.817225	7280526.286
Santa Cruz	2018	UBUS	Aggregate	Aggregate	Gasoline	6.89483309	211.336	27.57933	2249.988683	475503.618
Santa Cruz	2018	UBUS	Aggregate	Aggregate	Diesel	32.9288771	3192.217	131.7155	1365.313623	4358377.817
						Total VMT	**5621466**		**Total grams**	**2306429923**
									Composite g/mile	**410.3**
Santa Cruz	2040	HHDT	Aggregate	Aggregate	Gasoline	0.81033393	97.20906	16.21316	1536.460977	149357.9319
Santa Cruz	2040	HHDT	Aggregate	Aggregate	Diesel	675.562918	59175.39	5779.155	1161.637206	68740331.64
Santa Cruz	2040	LDA	Aggregate	Aggregate	Gasoline	113967.917	3426703	526435.1	198.3541072	679700663.5
Santa Cruz	2040	LDA	Aggregate	Aggregate	Diesel	1460.01911	43362.35	6709.903	161.3215249	6995279.732
Santa Cruz	2040	LDT1	Aggregate	Aggregate	Gasoline	11983.2613	351220.1	53737.41	234.1956714	82254229.8
Santa Cruz	2040	LDT1	Aggregate	Aggregate	Diesel	1.87935142	51.03231	8.085919	322.2715899	16446.26454
Santa Cruz	2040	LDT2	Aggregate	Aggregate	Gasoline	38959.2343	1162779	175845.4	233.3550034	271340199.7
Santa Cruz	2040	LDT2	Aggregate	Aggregate	Diesel	384.012399	11858.75	1764.076	214.7072723	2546160.712
Santa Cruz	2040	LHDT1	Aggregate	Aggregate	Gasoline	2168.92369	65254.76	32313.73	841.094575	54885423.68
Santa Cruz	2040	LHDT1	Aggregate	Aggregate	Diesel	1851.17272	57471.12	23285.42	451.7229854	25961025.14
Santa Cruz	2040	LHDT2	Aggregate	Aggregate	Gasoline	270.673202	8479.669	4032.627	954.6620799	8095218.727
Santa Cruz	2040	LHDT2	Aggregate	Aggregate	Diesel	767.477883	22842.36	9653.906	510.8701691	11669481.65
Santa Cruz	2040	MCY	Aggregate	Aggregate	Gasoline	5633.56482	28943.96	11267.13	219.060641	6340481.73
Santa Cruz	2040	MDV	Aggregate	Aggregate	Gasoline	24178.7218	707986.4	108568.5	284.6813118	201550507.1
Santa Cruz	2040	MDV	Aggregate	Aggregate	Diesel	839.234626	25371.43	3840.206	277.8829775	7050288.357
Santa Cruz	2040	MH	Aggregate	Aggregate	Gasoline	300.928377	2700.541	30.10487	1454.212142	3927159.206
Santa Cruz	2040	MH	Aggregate	Aggregate	Diesel	184.259395	1360.392	18.42594	892.9204349	1214722.176
Santa Cruz	2040	MHDT	Aggregate	Aggregate	Gasoline	216.359211	10537.96	4328.915	1417.117587	14933530.96
Santa Cruz	2040	MHDT	Aggregate	Aggregate	Diesel	1775.77994	98958.27	18598.51	826.1254576	81751949.15
Santa Cruz	2040	OBUS	Aggregate	Aggregate	Gasoline	60.3457219	2280.617	1207.397	1447.953196	3302226.068
Santa Cruz	2040	OBUS	Aggregate	Aggregate	Diesel	36.218967	1984.255	349.1387	1108.077953	2198709.716
Santa Cruz	2040	SBUS	Aggregate	Aggregate	Gasoline	31.9721434	1413.407	127.8886	708.6415428	1001599.098
Santa Cruz	2040	SBUS	Aggregate	Aggregate	Diesel	146.889424	4616.392	1695.084	937.3298951	4327082.589
Santa Cruz	2040	UBUS	Aggregate	Aggregate	Gasoline	8.13914523	249.4759	32.55658	1733.876922	432560.4406
Santa Cruz	2040	UBUS	Aggregate	Aggregate	Diesel	54.7542497	5787.757	219.017	1421.379554	8226599.106
						Total VMT	**6101485**		**Total grams**	**1548611234**
									Composite g/mile	**253.8**
									% Reduction	**-38.14%**

Assumptions

Category	Value	Notes	Source
Conversions			
g/MT	1,000,000		
lb/MT	2,205		
kg/MT	1,000		
kWh/MWh	1,000		
MWh/GWh	1,000		
kWh/MMBTU	293		
Btu/therm	99,976		
kBTU/therm	100		
MMBtu/therm	0.10		
kWh/therm	29.30		
kWh/kBTU	0.29307		
LPG Gallons/GGE	1.34		
LNG Gallons/GGE	1.57		
gal/cubic foot	7.48		
gal/Liter	3.79		
gallon/acrefoot	325,851.43		
sqft/acre	43,560.00		
sqft to square meter	0.09		
Energy Emission Factors			
eGRID2014 CAMX Emission Factors			
lb CO2/MWh	568.600	https://www.epa.gov/sites/production/files/2017-02/documents/egrid2014_summarytables_v2.pdf	
lb CH4/GWh	33.100		
lb N2O/GWh	4.000		
2014 CAMX percent renewable	27%		
GWP			
CO2	1		
CH4	25	100 year horizon. With climate carbon feedbacks.	4th Assessment Report
N2O	298	100 year horizon. With climate carbon feedbacks.	4th Assessment Report

Pick IPCC Assessment Version GWP Factors	**4th**

Note: The program's estimates of construction period phase length can be overridden in cells D50 through D53, and F50 through F53.

Construction Periods	User Override of Construction Months	Program Calculated Months	User Override of Phase Starting Date	Program Default Phase Starting Date
Grubbing/Land Clearing		0.50		1/1/2022
Grading/Excavation		2.25		1/17/2022
Drainage/Utilities/Sub-Grade		1.50		3/27/2022
Paving		0.75		5/12/2022
Totals (Months)		5		

Note: Soil Hauling emission default values can be overridden in cells D61 through D64, and F61 through F64.

Soil Hauling Emissions / **User Input**	User Override of Miles/Round Trip	Program Estimate of Miles/Round Trip	User Override of Truck Round Trips/Day	Default Values Round Trips/Day	Calculated Daily VMT
Miles/round trip: Grubbing/Land Clearing		30.00		0	0.00
Miles/round trip: Grading/Excavation		30.00		0	0.00
Miles/round trip: Drainage/Utilities/Sub-Grade		30.00		0	0.00
Miles/round trip: Paving		30.00		0	0.00

2010+ Model Year Mitigation Option Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grading/Excavation (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Draining/Utilities/Sub-Grade (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Paving (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grubbing/Land Clearing (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hauling Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Asphalt Hauling emission default values can be overridden in cells D91 through D94, and F91 through F94.

Asphalt Hauling Emissions / **User Input**	User Override of Miles/Round Trip	Program Estimate of Miles/Round Trip	User Override of Truck Round Trips/Day	Default Values Round Trips/Day	Calculated Daily VMT
Miles/round trip: Grubbing/Land Clearing		30.00		0	0.00
Miles/round trip: Grading/Excavation		30.00		0	0.00
Miles/round trip: Drainage/Utilities/Sub-Grade		30.00		0	0.00
Miles/round trip: Paving		30.00		0	0.00

2010+ Model Year Mitigation Option Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grading/Excavation (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Draining/Utilities/Sub-Grade (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Paving (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grubbing/Land Clearing (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Worker commute default values can be overridden in cells D121 through D126.

Worker Commute Emissions	User Override of Worker			
User Input	Commute Default Values	Default Values		
Miles/ one-way trip		20	Calculated	Calculated
One-way trips/day		2	Daily Trips	Daily VMT
No. of employees: Grubbing/Land Clearing		5	10	200.00
No. of employees: Grading/Excavation		28	56	1,120.00
No. of employees: Drainage/Utilities/Sub-Grade		18	36	720.00
No. of employees: Paving		8	16	320.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.02	1.00	0.08	0.05	0.02	0.00	328.72	0.00	0.01	330.96
Grading/Excavation (grams/mile)	0.02	1.00	0.08	0.05	0.02	0.00	328.72	0.00	0.01	330.96
Draining/Utilities/Sub-Grade (grams/mile)	0.02	1.00	0.08	0.05	0.02	0.00	328.72	0.00	0.01	330.96
Paving (grams/mile)	0.02	1.00	0.08	0.05	0.02	0.00	328.72	0.00	0.01	330.96
Grubbing/Land Clearing (grams/trip)	1.11	2.85	0.32	0.00	0.00	0.00	70.54	0.08	0.03	82.43
Grading/Excavation (grams/trip)	1.11	2.85	0.32	0.00	0.00	0.00	70.54	0.08	0.03	82.43
Draining/Utilities/Sub-Grade (grams/trip)	1.11	2.85	0.32	0.00	0.00	0.00	70.54	0.08	0.03	82.43
Paving (grams/trip)	1.11	2.85	0.32	0.00	0.00	0.00	70.54	0.08	0.03	82.43
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.03	0.50	0.04	0.02	0.01	0.00	146.50	0.00	0.00	147.74
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.81
Pounds per day - Grading/Excavation	0.18	2.82	0.25	0.11	0.05	0.01	820.38	0.02	0.02	827.37
Tons per const. Period - Grading/Excavation	0.00	0.07	0.01	0.00	0.00	0.00	20.30	0.00	0.00	20.48
Pounds per day - Drainage/Utilities/Sub-Grade	0.12	1.81	0.16	0.07	0.03	0.01	527.39	0.01	0.01	531.88
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.03	0.00	0.00	0.00	0.00	8.70	0.00	0.00	8.78
Pounds per day - Paving	0.05	0.81	0.07	0.03	0.01	0.00	234.39	0.01	0.01	236.39
Tons per const. Period - Paving	0.00	0.01	0.00	0.00	0.00	0.00	1.93	0.00	0.00	1.95
Total tons per construction project	0.01	0.11	0.01	0.00	0.00	0.00	31.75	0.00	0.00	32.02

Note: Water Truck default values can be overridden in cells D153 through D156, I153 through I156, and F153 through F156.

Water Truck Emissions	User Override of	Program Estimate of	User Override of Truck	Default Values	Calculated	User Override of	Default Values	Calculated
User Input	Default # Water Trucks	Number of Water Trucks	Round Trips/Vehicle/Day	Round Trips/Vehicle/Day	Trips/day	Miles/Round Trip	Miles/Round Trip	Daily VMT
Grubbing/Land Clearing - Exhaust		0		5	0		8.00	0.00
Grading/Excavation - Exhaust		0		5	0		8.00	0.00
Drainage/Utilities/Subgrade		0		5	0		8.00	0.00
Paving		0		5	0		8.00	0.00

2010+ Model Year Mitigation Option Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grading/Excavation (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Draining/Utilities/Sub-Grade (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Paving (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grubbing/Land Clearing (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Fugitive dust default values can be overridden in cells D183 through D185.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0.03	0.60	0.00	0.12	0.00
Fugitive Dust - Grading/Excavation		0.03	0.60	0.01	0.12	0.00
Fugitive Dust - Drainage/Utilities/Subgrade		0.03	0.60	0.01	0.12	0.00

Off-Road Equipment Emissions

Emissions reflect reduction due to 20% NOx and 45% Exhaust PM reduction Mitigation Option Selected

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Crawler Tractors	0.49	2.31	4.81	0.12	0.11	0.01	759.03	0.25	0.01	767.22
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Excavators	0.40	6.51	2.84	0.09	0.09	0.01	1,000.03	0.32	0.01	1,010.81
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Signal Boards	0.06	0.30	0.29	0.01	0.01	0.00	49.31	0.01	0.00	49.56
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing	pounds per day	0.95	9.13	7.94	0.23	0.21	0.02	1,808.38	0.57	0.02	1,827.60
Grubbing/Land Clearing	tons per phase	0.01	0.05	0.04	0.00	0.00	0.00	9.95	0.00	0.00	10.05

Emissions reflect reduction due to 20% NOx and 45% Exhaust PM reduction Mitigation Option Selected

Grading/Excavation Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Cranes	0.37	1.89	3.35	0.10	0.09	0.01	558.83	0.18	0.01	564.85
	2		Model Default Tier	Crawler Tractors	0.98	4.63	9.61	0.25	0.23	0.02	1,518.07	0.49	0.01	1,534.44
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4		Model Default Tier	Excavators	0.81	13.02	5.69	0.19	0.17	0.02	2,000.06	0.65	0.02	2,021.63
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Graders	0.83	3.44	8.41	0.18	0.17	0.01	1,282.56	0.41	0.01	1,296.37
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3		Model Default Tier	Rollers	0.50	5.58	4.14	0.16	0.15	0.01	762.31	0.25	0.01	770.53
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3		Model Default Tier	Rubber Tired Loaders	0.87	4.59	7.26	0.17	0.15	0.02	1,816.99	0.59	0.02	1,836.61
	4		Model Default Tier	Scrapers	3.28	25.50	28.62	0.77	0.71	0.06	5,881.18	1.90	0.05	5,944.58
	1		Model Default Tier	Signal Boards	0.06	0.30	0.29	0.01	0.01	0.00	49.31	0.01	0.00	49.56
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Tractors/Loaders/Backhoes	0.33	4.48	2.68	0.10	0.09	0.01	602.48	0.19	0.01	608.96
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment

If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grading/Excavation	pounds per day	8.03	63.44	70.05	1.92	1.77	0.15	14,471.80	4.67	0.13	14,627.53
Grading/Excavation	tons per phase	0.20	1.57	1.73	0.05	0.04	0.00	358.18	0.12	0.00	362.03

Emissions reflect reduction due to 20% NOx and 45% Exhaust PM reduction Mitigation Option Selected

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option: Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Air Compressors	0.27	2.42	1.50	0.06	0.06	0.00	375.26	0.02	0.00	376.72
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Generator Sets	0.33	3.68	2.34	0.08	0.08	0.01	623.04	0.03	0.00	625.17
	2		Model Default Tier	Graders	0.83	3.44	8.41	0.18	0.17	0.01	1,282.56	0.41	0.01	1,296.37
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Plate Compactors	0.04	0.21	0.20	0.01	0.01	0.00	34.48	0.00	0.00	34.65
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Pumps	0.35	3.73	2.38	0.09	0.09	0.01	623.04	0.03	0.00	625.23
			Model Default Tier	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Rough Terrain Forklifts	0.11	2.29	1.18	0.03	0.03	0.00	333.75	0.11	0.00	337.35
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4		Model Default Tier	Scrapers	3.28	25.50	28.62	0.77	0.71	0.06	5,881.18	1.90	0.05	5,944.58
	1		Model Default Tier	Signal Boards	0.06	0.30	0.29	0.01	0.01	0.00	49.31	0.01	0.00	49.56
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Tractors/Loaders/Backhoes	0.33	4.48	2.68	0.10	0.09	0.01	602.48	0.19	0.01	608.96
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment

If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Drainage/Utilities/Sub-Grade	pounds per day	5.60	46.05	47.61	1.32	1.23	0.10	9,805.10	2.71	0.09	9,898.60
Drainage/Utilities/Sub-Grade	tons per phase	0.09	0.76	0.79	0.02	0.02	0.00	161.78	0.04	0.00	163.33

Emissions reflect reduction due to 20% NOx and 45% Exhaust PM reduction Mitigation Option Selected

Paving Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Pavers	0.21	2.88	1.68	0.05	0.05	0.00	455.26	0.15	0.00	460.17
	1		Model Default Tier	Paving Equipment	0.18	2.55	1.39	0.05	0.04	0.00	394.47	0.13	0.00	398.73
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Rollers	0.17	1.86	1.38	0.05	0.05	0.00	254.10	0.08	0.00	256.84
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Signal Boards	0.06	0.30	0.29	0.01	0.01	0.00	49.31	0.01	0.00	49.56
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Tractors/Loaders/Backhoes	0.33	4.48	2.68	0.10	0.09	0.01	602.48	0.19	0.01	608.96
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment

If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Paving	pounds per day	0.94	12.07	7.42	0.26	0.24	0.02	1,755.62	0.56	0.02	1,774.26
Paving	tons per phase	0.01	0.10	0.06	0.00	0.00	0.00	14.48	0.00	0.00	14.64
Total Emissions all Phases (tons per construction period) =>		0.30	2.48	2.62	0.07	0.07	0.01	544.39	0.17	0.00	550.05

Equipment default values for horsepower and hours/day can be overridden in cells D403 through D436 and F403 through F436.

Equipment	User Override of Horsepower	Default Values Horsepower	User Override of Hours/day	Default Values Hours/day
Aerial Lifts		63		8
Air Compressors		78		8
Bore/Drill Rigs		221		8
Cement and Mortar Mixers		9		8
Concrete/Industrial Saws		81		8
Cranes		231		8
Crawler Tractors		212		8
Crushing/Proc. Equipment		85		8
Excavators		158		8
Forklifts		89		8
Generator Sets		84		8
Graders		187		8
Off-Highway Tractors		124		8
Off-Highway Trucks		402		8
Other Construction Equipment		172		8
Other General Industrial Equipment		88		8
Other Material Handling Equipment		168		8
Pavers		130		8
Paving Equipment		132		8
Plate Compactors		8		8
Pressure Washers		13		8
Pumps		84		8
Rollers		80		8
Rough Terrain Forklifts		100		8
Rubber Tired Dozers		247		8
Rubber Tired Loaders		203		8
Scrapers		367		8
Signal Boards		6		8
Skid Steer Loaders		65		8
Surfacing Equipment		263		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		97		8
Trenchers		78		8
Welders		46		8

END OF DATA ENTRY SHEET

Road Construction Emissions Model, Version 9.0.0

Daily Emission Estimates for -> Project Phases (Pounds)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	SOx (lbs/day)	CO2 (lbs/day)	CH4 (lbs/day)	N2O (lbs/day)	CO2e (lbs/day)
Grubbing/Land Clearing	0.99	9.63	7.98	0.85	0.25	0.60	0.34	0.22	0.12	0.02	1,954.87	0.58	0.02	1,975.34
Grading/Excavation	8.21	66.26	70.29	2.64	2.04	0.60	1.94	1.82	0.12	0.16	15,292.18	4.69	0.15	15,454.91
Drainage/Utilities/Sub-Grade	5.72	47.86	47.76	1.99	1.39	0.60	1.39	1.26	0.12	0.11	10,332.49	2.73	0.10	10,430.48
Paving	0.99	12.87	7.49	0.30	0.30	0.00	0.26	0.26	0.00	0.02	1,990.02	0.56	0.02	2,010.65
Maximum (pounds/day)	8.21	66.26	70.29	2.64	2.04	0.60	1.94	1.82	0.12	0.16	15,292.18	4.69	0.15	15,454.91
Total (tons/construction project)	0.31	2.59	2.63	0.11	0.08	0.03	0.08	0.07	0.01	0.01	576.14	0.17	0.01	582.06

Notes:
Project Start Year -> 2022
Project Length (months) -> 5
Total Project Area (acres) -> 0
Maximum Area Disturbed/Day (acres) -> 0
Water Truck Used? -> No

	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
Phase	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	0	0	0	0	200	0
Grading/Excavation	0	0	0	0	1,120	0
Drainage/Utilities/Sub-Grade	0	0	0	0	720	0
Paving	0	0	0	0	320	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H. Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively. Total CO2e is then estimated by summing CO2e estimates over all GHGs.

Total Emission Estimates by Phase for -> Project Phases (Tons for all except CO2e. Metric tonnes for CO2e)	ROG (tons/phase)	CO (tons/phase)	NOx (tons/phase)	Total PM10 (tons/phase)	Exhaust PM10 (tons/phase)	Fugitive Dust PM10 (tons/phase)	Total PM2.5 (tons/phase)	Exhaust PM2.5 (tons/phase)	Fugitive Dust PM2.5 (tons/phase)	SOx (tons/phase)	CO2 (tons/phase)	CH4 (tons/phase)	N2O (tons/phase)	CO2e (MT/phase)
Grubbing/Land Clearing	0.01	0.05	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.75	0.00	0.00	9.86
Grading/Excavation	0.20	1.64	1.74	0.07	0.05	0.01	0.05	0.05	0.00	0.00	378.48	0.12	0.00	347.01
Drainage/Utilities/Sub-Grade	0.09	0.79	0.79	0.03	0.02	0.01	0.02	0.02	0.00	0.00	170.49	0.05	0.00	156.13
Paving	0.01	0.11	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.42	0.00	0.00	15.05
Maximum (tons/phase)	0.20	1.64	1.74	0.07	0.05	0.01	0.05	0.05	0.00	0.00	378.48	0.12	0.00	347.01
Total (tons/construction project)	0.31	2.59	2.63	0.11	0.08	0.03	0.08	0.07	0.01	0.01	576.14	0.17	0.01	528.05

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H. Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively. Total CO2e is then estimated by summing CO2e estimates over all GHGs.

The CO2e emissions are reported as metric tons per phase.

Road Construction Emissions Model **Version 9.0.0**
Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells D10 through D24, E28 through G35, and D38 through D41 for all project types.
Please use "Clear Data Input & User Overrides" button first before changing the Project Type or begin a new project.

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name	UC Santa Cruz LRDP - Roads	
Construction Start Year	2022	Enter a Year between 2014 and 2040 (inclusive)
Project Type	1	1) New Road Construction : Project to build a roadway from bare ground, which generally requires more site preparation than widening an existing roadway 2) Road Widening : Project to add a new lane to an existing roadway 3) Bridge/Overpass Construction : Project to build an elevated roadway, which generally requires some different equipment than a new roadway, such as a crane 4) Other Linear Project Type: Non-roadway project such as a pipeline, transmission line, or levee construction
Project Construction Time	5.00	months
Working Days per Month	22.00	days (assume 22 if unknown)
Predominant Soil/Site Type: Enter 1, 2, or 3 (for project within "Sacramento County", follow soil type selection instructions in cells E18 to E20 otherwise see instructions provided in cells J18 to J22)	1	1) Sand Gravel : Use for quaternary deposits (Delta/West County) 2) Weathered Rock-Earth : Use for Laguna formation (Jackson Highway area) or the Ione formation (Scott Road, Rancho Murieta) 3) Blasted Rock : Use for Salt Springs Slate or Copper Hill Volcanics (Folsom South of Highway 50, Rancho Murieta)
Project Length	2.00	miles
Total Project Area	0.30	acres
Maximum Area Disturbed/Day	0.30	acres
Water Trucks Used?	2	1. Yes 2. No

Please note that the soil type instructions provided in cells E18 to E20 are specific to Sacramento County. Maps available from the California Geologic Survey (see weblink below) can be used to determine soil type outside Sacramento County.

http://www.conservation.ca.gov/cgs/information/geologic_mapping/Pages/googlemaps.aspx#regionalseries

Material Hauling Quantity Input

Material Type	Phase	Haul Truck Capacity (yd^3) (assume 20 if unknown)	Import Volume (yd^3/day)	Export Volume (yd^3/day)
Soil	Grubbing/Land Clearing	20.00		
	Grading/Excavation	20.00		38.67
	Drainage/Utilities/Sub-Grade	20.00		22.21
	Paving	20.00		
Asphalt	Grubbing/Land Clearing	20.00		
	Grading/Excavation	20.00		
	Drainage/Utilities/Sub-Grade	20.00		
	Paving	20.00	103.11	

Mitigation Options

On-road Fleet Emissions Mitigation		Select "2010 and Newer On-road Vehicles Fleet" option when the on-road heavy-duty truck fleet for the project will be limited to vehicles of model year 2010 or newer
Off-road Equipment Emissions Mitigation		Select "20% NOx and 45% Exhaust PM reduction" option if the project will be required to use a lower emitting off-road construction fleet. The SMAQMD Construction Mitigation Calculator can be used to confirm compliance with this mitigation measure (http://www.airquality.org/Businesses/CEQA-Land-Use-Planning/Mitigation). Select "Tier 4 Equipment" option if some or all off-road equipment used for the project meets CARB Tier 4 Standard

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells D50 through D53, and F50 through F53.

Construction Periods	User Override of Construction Months	Program Calculated Months	User Override of Phase Starting Date	Program Default Phase Starting Date
Grubbing/Land Clearing		0.50		1/1/2022
Grading/Excavation		2.00		1/17/2022
Drainage/Utilities/Sub-Grade		1.75		3/19/2022
Paving		0.75		5/12/2022
Totals (Months)	5			

Note: Soil Hauling emission default values can be overridden in cells D61 through D64, and F61 through F64.

Soil Hauling Emissions **User Input**	User Override of Miles/Round Trip	Program Estimate of Miles/Round Trip	User Override of Truck Round Trips/Day	Default Values Round Trips/Day	Calculated Daily VMT
Miles/round trip: Grubbing/Land Clearing	40.00	30.00		0	0.00
Miles/round trip: Grading/Excavation	40.00	30.00		2	80.00
Miles/round trip: Drainage/Utilities/Sub-Grade	40.00	30.00		2	80.00
Miles/round trip: Paving	40.00	30.00		0	0.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grading/Excavation (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Draining/Utilities/Sub-Grade (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Paving (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grubbing/Land Clearing (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hauling Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.01	0.07	0.56	0.02	0.01	0.00	308.40	0.00	0.05	322.85
Tons per const. Period - Grading/Excavation	0.00	0.00	0.01	0.00	0.00	0.00	6.78	0.00	0.00	7.10
Pounds per day - Drainage/Utilities/Sub-Grade	0.01	0.07	0.56	0.02	0.01	0.00	308.40	0.00	0.05	322.85
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.01	0.00	0.00	0.00	5.94	0.00	0.00	6.21
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.00	0.02	0.00	0.00	0.00	12.72	0.00	0.00	13.32

Note: Asphalt Hauling emission default values can be overridden in cells D91 through D94, and F91 through F94.

Asphalt Hauling Emissions **User Input**	User Override of Miles/Round Trip	Program Estimate of Miles/Round Trip	User Override of Truck Round Trips/Day	Default Values Round Trips/Day	Calculated Daily VMT
Miles/round trip: Grubbing/Land Clearing		30.00		0	0.00
Miles/round trip: Grading/Excavation		30.00		0	0.00
Miles/round trip: Drainage/Utilities/Sub-Grade		30.00		0	0.00
Miles/round trip: Paving		30.00		6	180.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grading/Excavation (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Draining/Utilities/Sub-Grade (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Paving (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grubbing/Land Clearing (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Paving	0.02	0.17	1.27	0.04	0.02	0.01	693.89	0.00	0.11	726.41
Tons per const. Period - Paving	0.00	0.00	0.01	0.00	0.00	0.00	5.72	0.00	0.00	5.99
Total tons per construction project	0.00	0.00	0.01	0.00	0.00	0.00	5.72	0.00	0.00	5.99

Note: Worker commute default values can be overridden in cells D121 through D126.

Worker Commute Emissions User Input	User Override of Worker Commute Default Values	Default Values	Calculated Daily Trips	Calculated Daily VMT
Miles/ one-way trip		20		
One-way trips/day		2		
No. of employees: Grubbing/Land Clearing		8	16	320.00
No. of employees: Grading/Excavation		20	40	800.00
No. of employees: Drainage/Utilities/Sub-Grade		18	36	720.00
No. of employees: Paving		14	28	560.00

Emission Rates	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing (grams/mile)	0.02	1.00	0.08	0.05	0.02	0.00	328.72	0.00	0.01	330.96
Grading/Excavation (grams/mile)	0.02	1.00	0.08	0.05	0.02	0.00	328.72	0.00	0.01	330.96
Draining/Utilities/Sub-Grade (grams/mile)	0.02	1.00	0.08	0.05	0.02	0.00	328.72	0.00	0.01	330.96
Paving (grams/mile)	0.02	1.00	0.08	0.05	0.02	0.00	328.72	0.00	0.01	330.96
Grubbing/Land Clearing (grams/trip)	1.11	2.85	0.32	0.00	0.00	0.00	70.54	0.08	0.03	82.43
Grading/Excavation (grams/trip)	1.11	2.85	0.32	0.00	0.00	0.00	70.54	0.08	0.03	82.43
Draining/Utilities/Sub-Grade (grams/trip)	1.11	2.85	0.32	0.00	0.00	0.00	70.54	0.08	0.03	82.43
Paving (grams/trip)	1.11	2.85	0.32	0.00	0.00	0.00	70.54	0.08	0.03	82.43
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.05	0.81	0.07	0.03	0.01	0.00	234.39	0.01	0.01	236.39
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	1.29	0.00	0.00	1.30
Pounds per day - Grading/Excavation	0.13	2.02	0.18	0.08	0.03	0.01	585.99	0.01	0.02	590.98
Tons per const. Period - Grading/Excavation	0.00	0.04	0.00	0.00	0.00	0.00	12.89	0.00	0.00	13.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.12	1.81	0.16	0.07	0.03	0.01	527.39	0.01	0.01	531.88
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.03	0.00	0.00	0.00	0.00	10.15	0.00	0.00	10.24
Pounds per day - Paving	0.09	1.41	0.12	0.06	0.02	0.00	410.19	0.01	0.01	413.69
Tons per const. Period - Paving	0.00	0.01	0.00	0.00	0.00	0.00	3.38	0.00	0.00	3.41
Total tons per construction project	0.01	0.10	0.01	0.00	0.00	0.00	27.72	0.00	0.00	27.95

Note: Water Truck default values can be overridden in cells D153 through D156, I153 through I156, and F153 through F156.

Water Truck Emissions User Input	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Round Trips/Vehicle/Day	Default Values Round Trips/Vehicle/Day	Calculated Trips/day	User Override of Miles/Round Trip	Default Values Miles/Round Trip	Calculated Daily VMT
Grubbing/Land Clearing - Exhaust		0		5	0		8.00	0.00
Grading/Excavation - Exhaust		0		5	0		8.00	0.00
Drainage/Utilities/Subgrade		0		5	0		8.00	0.00
Paving		0		5	0		8.00	0.00

Emission Rates	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grading/Excavation (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Draining/Utilities/Sub-Grade (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Paving (grams/mile)	0.04	0.42	3.08	0.11	0.05	0.02	1,748.57	0.00	0.27	1,830.52
Grubbing/Land Clearing (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving (grams/trip)	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Fugitive dust default values can be overridden in cells D183 through D185.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0.30	6.00	0.03	1.25	0.01
Fugitive Dust - Grading/Excavation		0.30	6.00	0.13	1.25	0.03
Fugitive Dust - Drainage/Utilities/Subgrade		0.30	6.00	0.12	1.25	0.02

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Crawler Tractors	0.49	2.31	6.01	0.23	0.21	0.01	759.03	0.25	0.01	767.22
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1		Model Default Tier	Excavators	0.20	3.26	1.78	0.09	0.08	0.01	500.02	0.16	0.00	505.41
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tier	Rubber Tired Dozers	0.84	3.58	8.79	0.42	0.38	0.01	827.04	0.27	0.01	835.94
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4		Model Default Tier	Signal Boards	0.23	1.20	1.44	0.06	0.06	0.00	197.25	0.02	0.00	198.26
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment

If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing	pounds per day	1.76	10.36	18.02	0.79	0.73	0.02	2,283.34	0.70	0.02	2,306.83
Grubbing/Land Clearing	tons per phase	0.01	0.06	0.10	0.00	0.00	0.00	12.56	0.00	0.00	12.69

Grading/Excavation Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0		Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Crawler Tractors	0.49	2.31	6.01	0.23	0.21	0.01	759.03	0.25	0.01	767.22
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3		Model Default Tier	Excavators	0.61	9.77	5.33	0.26	0.24	0.02	1,500.05	0.49	0.01	1,516.22
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Graders	0.41	1.72	5.26	0.17	0.15	0.01	641.28	0.21	0.01	648.19
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Rollers	0.33	3.72	3.45	0.20	0.18	0.01	508.21	0.16	0.00	513.68
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Rubber Tired Loaders	0.29	1.53	3.02	0.10	0.09	0.01	605.66	0.20	0.01	612.20
	2		Model Default Tier	Scrapers	1.64	12.75	17.89	0.70	0.64	0.03	2,940.59	0.95	0.03	2,972.29
	4		Model Default Tier	Signal Boards	0.23	1.20	1.44	0.06	0.06	0.00	197.25	0.02	0.00	198.26
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Tractors/Loaders/Backhoes	0.33	4.48	3.35	0.18	0.17	0.01	602.48	0.19	0.01	608.96
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation		pounds per day		4.34	37.49	45.75	1.89	1.74	0.08	7,754.56	2.46	0.07	7,837.02
Grading/Excavation		tons per phase		0.10	0.82	1.01	0.04	0.04	0.00	170.60	0.05	0.00	172.41

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Air Compressors	0.27	2.42	1.88	0.11	0.11	0.00	375.26	0.02	0.00	376.72
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Generator Sets	0.33	3.68	2.93	0.15	0.15	0.01	623.04	0.03	0.00	625.17
	1		Model Default Tier	Graders	0.41	1.72	5.26	0.17	0.15	0.01	641.28	0.21	0.01	648.19
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Plate Compactors	0.04	0.21	0.25	0.01	0.01	0.00	34.48	0.00	0.00	34.65
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Pumps	0.35	3.73	2.97	0.16	0.16	0.01	623.04	0.03	0.00	625.23
			Model Default Tier	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Rough Terrain Forklifts	0.11	2.29	1.48	0.05	0.05	0.00	333.75	0.11	0.00	337.35
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Scrapers	1.64	12.75	17.89	0.70	0.64	0.03	2,940.59	0.95	0.03	2,972.29
	4		Model Default Tier	Signal Boards	0.23	1.20	1.44	0.06	0.06	0.00	197.25	0.02	0.00	198.26
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Tractors/Loaders/Backhoes	0.33	4.48	3.35	0.18	0.17	0.01	602.48	0.19	0.01	608.96
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Drainage/Utilities/Sub-Grade	pounds per day	3.72	32.48	37.44	1.57	1.49	0.07	6,371.17	1.57	0.05	6,426.82
Drainage/Utilities/Sub-Grade	tons per phase	0.07	0.63	0.72	0.03	0.03	0.00	122.65	0.03	0.00	123.72

Paving	Default Number of Vehicles	Mitigation Option Override of	Default		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Override of Default Number of Vehicles	*Program-estimate*	Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Equipment Tier	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1		Model Default Tier	Pavers	0.21	2.88	2.10	0.10	0.09	0.00	455.26	0.15	0.00	460.17
	1		Model Default Tier	Paving Equipment	0.18	2.55	1.74	0.08	0.08	0.00	394.47	0.13	0.00	398.73
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3		Model Default Tier	Rollers	0.50	5.58	5.18	0.30	0.27	0.01	762.31	0.25	0.01	770.53
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4		Model Default Tier	Signal Boards	0.23	1.20	1.44	0.06	0.06	0.00	197.25	0.02	0.00	198.26
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2		Model Default Tier	Tractors/Loaders/Backhoes	0.33	4.48	3.35	0.18	0.17	0.01	602.48	0.19	0.01	608.96
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
				pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

			ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
	Paving	pounds per day	1.44	16.69	13.80	0.72	0.67	0.03	2,411.77	0.74	0.02	2,436.64
	Paving	tons per phase	0.01	0.14	0.11	0.01	0.01	0.00	19.90	0.01	0.00	20.10
Total Emissions all Phases (tons per construction period) =>			0.19	1.64	1.94	0.08	0.08	0.00	325.70	0.09	0.00	328.92

Equipment default values for horsepower and hours/day can be overridden in cells D403 through D436 and F403 through F436.

Equipment	User Override of Horsepower	Default Values Horsepower	User Override of Hours/day	Default Values Hours/day
Aerial Lifts		63		8
Air Compressors		78		8
Bore/Drill Rigs		221		8
Cement and Mortar Mixers		9		8
Concrete/Industrial Saws		81		8
Cranes		231		8
Crawler Tractors		212		8
Crushing/Proc. Equipment		85		8
Excavators		158		8
Forklifts		89		8
Generator Sets		84		8
Graders		187		8
Off-Highway Tractors		124		8
Off-Highway Trucks		402		8
Other Construction Equipment		172		8
Other General Industrial Equipment		88		8
Other Material Handling Equipment		168		8
Pavers		130		8
Paving Equipment		132		8
Plate Compactors		8		8
Pressure Washers		13		8
Pumps		84		8
Rollers		80		8
Rough Terrain Forklifts		100		8
Rubber Tired Dozers		247		8
Rubber Tired Loaders		203		8
Scrapers		367		8
Signal Boards		6		8
Skid Steer Loaders		65		8
Surfacing Equipment		263		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		97		8
Trenchers		78		8
Welders		46		8

END OF DATA ENTRY SHEET

Roadway Construction Modeling

Road Construction Emissions Model, Version 9.0.0

Daily Emission Estimates for -> UC Santa Cruz LRDP - Roads

Project Phases (Pounds)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	SOx (lbs/day)	CO2 (lbs/day)	CH4 (lbs/day)	N2O (lbs/day)	CO2e (lbs/day)
Grubbing/Land Clearing	1.81	11.16	18.09	6.82	0.82	6.00	1.99	0.74	1.25	0.03	2,517.73	0.70	0.03	2,543.22
Grading/Excavation	4.47	39.58	46.49	7.99	1.99	6.00	3.03	1.78	1.25	0.09	8,648.94	2.48	0.13	8,750.85
Drainage/Utilities/Sub-Grade	3.84	34.37	38.16	7.67	1.67	6.00	2.77	1.53	1.25	0.08	7,206.95	1.58	0.12	7,281.55
Paving	1.55	18.27	15.20	0.82	0.82	0.00	0.71	0.71	0.00	0.04	3,515.85	0.75	0.14	3,576.73
Maximum (pounds/day)	4.47	39.58	46.49	7.99	1.99	6.00	3.03	1.78	1.25	0.09	8,648.94	2.48	0.14	8,750.85
Total (tons/construction project)	0.20	1.74	1.98	0.37	0.09	0.28	0.14	0.08	0.06	0.00	371.86	0.10	0.01	376.18

Notes: Project Start Year -> 2022
Project Length (months) -> 5
Total Project Area (acres) -> 0
Maximum Area Disturbed/Day (acres) -> 0
Water Truck Used? -> No

	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
Phase	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	0	0	0	0	320	0
Grading/Excavation	39	0	80	0	800	0
Drainage/Utilities/Sub-Grade	22	0	80	0	720	0
Paving	0	103	0	180	560	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H. Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively. Total CO2e is then estimated by summing CO2e estimates over all GHGs.

Total Emission Estimates by Phase for -> UC Santa Cruz LRDP - Roads

Project Phases (Tons for all except CO2e. Metric tonnes for CO2e)	ROG (tons/phase)	CO (tons/phase)	NOx (tons/phase)	Total PM10 (tons/phase)	Exhaust PM10 (tons/phase)	Fugitive Dust PM10 (tons/phase)	Total PM2.5 (tons/phase)	Exhaust PM2.5 (tons/phase)	Fugitive Dust PM2.5 (tons/phase)	SOx (tons/phase)	CO2 (tons/phase)	CH4 (tons/phase)	N2O (tons/phase)	CO2e (MT/phase)
Grubbing/Land Clearing	0.01	0.06	0.10	0.04	0.00	0.03	0.01	0.00	0.01	0.00	13.85	0.00	0.00	12.69
Grading/Excavation	0.10	0.87	1.02	0.18	0.04	0.13	0.07	0.04	0.03	0.00	190.28	0.05	0.00	174.65
Drainage/Utilities/Sub-Grade	0.07	0.66	0.73	0.15	0.03	0.12	0.05	0.03	0.02	0.00	138.73	0.03	0.00	127.16
Paving	0.01	0.15	0.13	0.01	0.01	0.00	0.01	0.01	0.00	0.00	29.01	0.01	0.00	26.77
Maximum (tons/phase)	0.10	0.87	1.02	0.18	0.04	0.13	0.07	0.04	0.03	0.00	190.28	0.05	0.00	174.65
Total (tons/construction project)	0.20	1.74	1.98	0.37	0.09	0.28	0.14	0.08	0.06	0.00	371.86	0.10	0.01	341.27

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H. Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively. Total CO2e is then estimated by summing CO2e estimates over all GHGs.

The CO2e emissions are reported as metric tons per phase.

UCSC - 2020 LRDP - Construction Trails Only

Santa Cruz County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
User Defined Recreational	2.00	User Defined Unit	0.00	110,000.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	1.8	**Precipitation Freq (Days)**	61
Climate Zone	4			**Operational Year**	2023
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics - Construction only

Land Use - Construct 2 miles of trails per year at 1000 ft/day (10 ft wide) = 11 days and 110,000 sq ft. Assume Construction for 1 year = 1/18 of total construction (2022-2039).

Construction Phase - 1 year construction schedule (2022).

Off-road Equipment - Only 1 phase, Site Prep. Assume 1 Dozer and 1 Excavator.

Off-road Equipment - Only 1 phase, Site Prep. Assume 1 Dozer and 1 Excavator.

Trips and VMT - Assume 5 worker trips per day. Default trip lengths.

On-road Fugitive Dust -

Demolition -

Grading -

Architectural Coating -

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Woodstoves -

Area Coating -

Energy Use -

Water And Wastewater -

Solid Waste -

Construction Off-road Equipment Mitigation - Mitigation - Due to the limited number of equipment, assume all trail equipment are Tier 3

Energy Mitigation -

Fleet Mix -

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstructionPhase	NumDays	0.00	11.00
tblLandUse	LandUseSquareFeet	0.00	110,000.00
tblOffRoadEquipment	HorsePower	158.00	97.00
tblOffRoadEquipment	HorsePower	247.00	187.00
tblOffRoadEquipment	LoadFactor	0.38	0.37
tblOffRoadEquipment	LoadFactor	0.40	0.41
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	4.5600e-003	0.0467	0.0282	6.0000e-005	0.0333	2.2600e-003	0.0356	0.0183	2.0800e-003	0.0204	0.0000	4.8676	4.8676	1.5200e-003	0.0000	4.9056
Maximum	**4.5600e-003**	**0.0467**	**0.0282**	**6.0000e-005**	**0.0333**	**2.2600e-003**	**0.0356**	**0.0183**	**2.0800e-003**	**0.0204**	**0.0000**	**4.8676**	**4.8676**	**1.5200e-003**	**0.0000**	**4.9056**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	1.4200e-003	0.0269	0.0331	6.0000e-005	0.0333	1.3200e-003	0.0347	0.0183	1.3200e-003	0.0196	0.0000	4.8676	4.8676	1.5200e-003	0.0000	4.9056
Maximum	**1.4200e-003**	**0.0269**	**0.0331**	**6.0000e-005**	**0.0333**	**1.3200e-003**	**0.0347**	**0.0183**	**1.3200e-003**	**0.0196**	**0.0000**	**4.8676**	**4.8676**	**1.5200e-003**	**0.0000**	**4.9056**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**68.86**	**42.42**	**-17.15**	**0.00**	**0.00**	**41.59**	**2.64**	**0.00**	**36.54**	**3.73**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	**1-3-2022**	**4-2-2022**	0.0499	0.0276
		Highest	0.0499	0.0276

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.5061	0.0000	3.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	5.0000e-005	5.0000e-005	0.0000	0.0000	5.0000e-005
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.5061**	**0.0000**	**3.0000e-005**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**5.0000e-005**	**5.0000e-005**	**0.0000**	**0.0000**	**5.0000e-005**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.5061	0.0000	3.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	5.0000e-005	5.0000e-005	0.0000	0.0000	5.0000e-005
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.5061**	**0.0000**	**3.0000e-005**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**5.0000e-005**	**5.0000e-005**	**0.0000**	**0.0000**	**5.0000e-005**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Site Preparation	Site Preparation	1/10/2022	1/24/2022	5	11	Trails

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Site Preparation	Excavators	1	8.00	97	0.37
Site Preparation	Graders	0	8.00	187	0.41
Site Preparation	Rubber Tired Dozers	1	8.00	187	0.41
Site Preparation	Tractors/Loaders/Backhoes	0	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Site Preparation	2	5.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

3.2 Site Preparation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0331	0.0000	0.0331	0.0182	0.0000	0.0182	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	4.4500e-003	0.0466	0.0274	5.0000e-005		2.2600e-003	2.2600e-003		2.0800e-003	2.0800e-003	0.0000	4.6791	4.6791	1.5100e-003	0.0000	4.7170
Total	**4.4500e-003**	**0.0466**	**0.0274**	**5.0000e-005**	**0.0331**	**2.2600e-003**	**0.0354**	**0.0182**	**2.0800e-003**	**0.0203**	**0.0000**	**4.6791**	**4.6791**	**1.5100e-003**	**0.0000**	**4.7170**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.1000e-004	9.0000e-005	8.4000e-004	0.0000	2.2000e-004	0.0000	2.2000e-004	6.0000e-005	0.0000	6.0000e-005	0.0000	0.1885	0.1885	1.0000e-005	0.0000	0.1887
Total	**1.1000e-004**	**9.0000e-005**	**8.4000e-004**	**0.0000**	**2.2000e-004**	**0.0000**	**2.2000e-004**	**6.0000e-005**	**0.0000**	**6.0000e-005**	**0.0000**	**0.1885**	**0.1885**	**1.0000e-005**	**0.0000**	**0.1887**

3.2 Site Preparation - 2022

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0331	0.0000	0.0331	0.0182	0.0000	0.0182	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	1.3100e-003	0.0268	0.0322	5.0000e-005		1.3200e-003	1.3200e-003		1.3200e-003	1.3200e-003	0.0000	4.6791	4.6791	1.5100e-003	0.0000	4.7170
Total	**1.3100e-003**	**0.0268**	**0.0322**	**5.0000e-005**	**0.0331**	**1.3200e-003**	**0.0344**	**0.0182**	**1.3200e-003**	**0.0195**	**0.0000**	**4.6791**	**4.6791**	**1.5100e-003**	**0.0000**	**4.7170**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.1000e-004	9.0000e-005	8.4000e-004	0.0000	2.2000e-004	0.0000	2.2000e-004	6.0000e-005	0.0000	6.0000e-005	0.0000	0.1885	0.1885	1.0000e-005	0.0000	0.1887
Total	**1.1000e-004**	**9.0000e-005**	**8.4000e-004**	**0.0000**	**2.2000e-004**	**0.0000**	**2.2000e-004**	**6.0000e-005**	**0.0000**	**6.0000e-005**	**0.0000**	**0.1885**	**0.1885**	**1.0000e-005**	**0.0000**	**0.1887**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
User Defined Recreational	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
User Defined Recreational	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
User Defined Recreational	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.5061	0.0000	3.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	5.0000e-005	5.0000e-005	0.0000	0.0000	5.0000e-005
Unmitigated	0.5061	0.0000	3.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	5.0000e-005	5.0000e-005	0.0000	0.0000	5.0000e-005

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0765					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.4296					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	3.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	5.0000e-005	5.0000e-005	0.0000	0.0000	5.0000e-005
Total	**0.5061**	**0.0000**	**3.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**5.0000e-005**	**5.0000e-005**	**0.0000**	**0.0000**	**5.0000e-005**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0765					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.4296					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	3.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	5.0000e-005	5.0000e-005	0.0000	0.0000	5.0000e-005
Total	**0.5061**	**0.0000**	**3.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**5.0000e-005**	**5.0000e-005**	**0.0000**	**0.0000**	**5.0000e-005**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
User Defined Recreational	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
User Defined Recreational	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

UCSC - 2020 LRDP - Construction Trails Only

Santa Cruz County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
User Defined Recreational	2.00	User Defined Unit	0.00	110,000.00	0

1.2 Other Project Characteristics

Urbanization Urban **Wind Speed (m/s)** 1.8 **Precipitation Freq (Days)** 61

Climate Zone 4 **Operational Year** 2023

Utility Company Pacific Gas & Electric Company

CO2 Intensity (lb/MWhr) 641.35 **CH4 Intensity (lb/MWhr)** 0.029 **N2O Intensity (lb/MWhr)** 0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics - Construction only

Land Use - Construct 2 miles of trails per year at 1000 ft/day (10 ft wide) = 11 days and 110,000 sq ft. Assume Construction for 1 year = 1/18 of total construction (2022-2039).

Construction Phase - 1 year construction schedule (2022).

Off-road Equipment - Only 1 phase, Site Prep. Assume 1 Dozer and 1 Excavator.

Off-road Equipment - Only 1 phase, Site Prep. Assume 1 Dozer and 1 Excavator.

Trips and VMT - Assume 5 worker trips per day. Default trip lengths.

On-road Fugitive Dust -

Demolition -

Grading -

Architectural Coating -

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Woodstoves -

Area Coating -

Energy Use -

Water And Wastewater -

Solid Waste -

Construction Off-road Equipment Mitigation - Mitigation - Due to the limited number of equipment, assume all trail equipment are Tier 3

Energy Mitigation -

Fleet Mix -

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstructionPhase	NumDays	0.00	11.00
tblLandUse	LandUseSquareFeet	0.00	110,000.00
tblOffRoadEquipment	HorsePower	158.00	97.00
tblOffRoadEquipment	HorsePower	247.00	187.00
tblOffRoadEquipment	LoadFactor	0.38	0.37
tblOffRoadEquipment	LoadFactor	0.40	0.41
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2022	0.8283	8.4885	5.1365	0.0101	6.0632	0.4113	6.4744	3.3211	0.3784	3.6995	0.0000	977.4090	977.4090	0.3047	0.0000	985.0275
Maximum	**0.8283**	**8.4885**	**5.1365**	**0.0101**	**6.0632**	**0.4113**	**6.4744**	**3.3211**	**0.3784**	**3.6995**	**0.0000**	**977.4090**	**977.4090**	**0.3047**	**0.0000**	**985.0275**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2022	0.2576	4.8862	6.0162	0.0101	6.0632	0.2409	6.3040	3.3211	0.2408	3.5620	0.0000	977.4090	977.4090	0.3047	0.0000	985.0275
Maximum	**0.2576**	**4.8862**	**6.0162**	**0.0101**	**6.0632**	**0.2409**	**6.3040**	**3.3211**	**0.2408**	**3.5620**	**0.0000**	**977.4090**	**977.4090**	**0.3047**	**0.0000**	**985.0275**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**68.90**	**42.44**	**-17.12**	**0.00**	**0.00**	**41.44**	**2.63**	**0.00**	**36.35**	**3.72**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	2.7731	0.0000	2.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000		4.4000e-004	4.4000e-004	0.0000		4.7000e-004
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**2.7731**	**0.0000**	**2.0000e-004**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**4.4000e-004**	**4.4000e-004**	**0.0000**	**0.0000**	**4.7000e-004**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	2.7731	0.0000	2.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000		4.4000e-004	4.4000e-004	0.0000		4.7000e-004
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**2.7731**	**0.0000**	**2.0000e-004**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**4.4000e-004**	**4.4000e-004**	**0.0000**	**0.0000**	**4.7000e-004**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Site Preparation	Site Preparation	1/10/2022	1/24/2022	5	11	Trails

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Site Preparation	Excavators	1	8.00	97	0.37
Site Preparation	Graders	0	8.00	187	0.41
Site Preparation	Rubber Tired Dozers	1	8.00	187	0.41
Site Preparation	Tractors/Loaders/Backhoes	0	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Site Preparation	2	5.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

3.2 Site Preparation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					6.0221	0.0000	6.0221	3.3102	0.0000	3.3102			0.0000			0.0000
Off-Road	0.8089	8.4739	4.9782	9.6800e-003		0.4109	0.4109		0.3781	0.3781		937.7924	937.7924	0.3033		945.3749
Total	**0.8089**	**8.4739**	**4.9782**	**9.6800e-003**	**6.0221**	**0.4109**	**6.4330**	**3.3102**	**0.3781**	**3.6883**		**937.7924**	**937.7924**	**0.3033**		**945.3749**

3.2 Site Preparation - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0194	0.0146	0.1583	4.0000e-004	0.0411	3.2000e-004	0.0414	0.0109	3.0000e-004	0.0112		39.6166	39.6166	1.4400e-003		39.6526
Total	**0.0194**	**0.0146**	**0.1583**	**4.0000e-004**	**0.0411**	**3.2000e-004**	**0.0414**	**0.0109**	**3.0000e-004**	**0.0112**		**39.6166**	**39.6166**	**1.4400e-003**		**39.6526**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					6.0221	0.0000	6.0221	3.3102	0.0000	3.3102			0.0000			0.0000
Off-Road	0.2382	4.8716	5.8579	9.6800e-003		0.2405	0.2405		0.2405	0.2405	0.0000	937.7924	937.7924	0.3033		945.3749
Total	**0.2382**	**4.8716**	**5.8579**	**9.6800e-003**	**6.0221**	**0.2405**	**6.2626**	**3.3102**	**0.2405**	**3.5508**	**0.0000**	**937.7924**	**937.7924**	**0.3033**		**945.3749**

3.2 Site Preparation - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0194	0.0146	0.1583	4.0000e-004	0.0411	3.2000e-004	0.0414	0.0109	3.0000e-004	0.0112		39.6166	39.6166	1.4400e-003		39.6526
Total	**0.0194**	**0.0146**	**0.1583**	**4.0000e-004**	**0.0411**	**3.2000e-004**	**0.0414**	**0.0109**	**3.0000e-004**	**0.0112**		**39.6166**	**39.6166**	**1.4400e-003**		**39.6526**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
User Defined Recreational	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
User Defined Recreational	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
User Defined Recreational	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

<u>Unmitigated</u>

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	2.7731	0.0000	2.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000		4.4000e-004	4.4000e-004	0.0000		4.7000e-004
Unmitigated	2.7731	0.0000	2.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000		4.4000e-004	4.4000e-004	0.0000		4.7000e-004

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.4191					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	2.3540					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	2.0000e-005	0.0000	2.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000		4.4000e-004	4.4000e-004	0.0000		4.7000e-004
Total	**2.7731**	**0.0000**	**2.0000e-004**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**4.4000e-004**	**4.4000e-004**	**0.0000**		**4.7000e-004**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.4191					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	2.3540					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	2.0000e-005	0.0000	2.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000		4.4000e-004	4.4000e-004	0.0000		4.7000e-004
Total	**2.7731**	**0.0000**	**2.0000e-004**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**4.4000e-004**	**4.4000e-004**	**0.0000**		**4.7000e-004**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

UCSC - 2020 LRDP - Construction Only

Santa Cruz County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Research & Development	62.63	1000sqft	1.44	62,631.83	0
University/College (4Yr)	527.00	Student	2.22	71,691.00	0
General Light Industry	3.22	1000sqft	0.07	3,216.83	0
Parking Lot	2.39	Acre	2.39	104,237.50	0
Health Club	33.78	1000sqft	0.78	33,783.89	0
Apartments Low Rise	25.00	Dwelling Unit	1.56	24,444.40	31
Apartments Mid Rise	70.00	Dwelling Unit	1.84	69,833.30	473

1.2 Other Project Characteristics

Urbanization Urban **Wind Speed (m/s)** 1.8 **Precipitation Freq (Days)** 61

Climate Zone 4 **Operational Year** 2023

Utility Company Modesto Irrigation District

CO2 Intensity (lb/MWhr) 833.46 **CH4 Intensity (lb/MWhr)** 0.029 **N2O Intensity (lb/MWhr)** 0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics - UCSC Electricity Emission Factors for 2022 reflect State averages

Land Use - Values specified in Project Description. Assume Construction for 1 year = 1/18 of total construction (2022-2039).

Construction Phase - Condensed to 1 year construction schedule (2022).

Off-road Equipment -

Off-road Equipment - Equipment associated with building construction increased to reflect condensed schedule.

Off-road Equipment -

Trips and VMT -

On-road Fugitive Dust -

Demolition -

Grading -

Architectural Coating -

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied. (EMFAC2017 2022)

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied. (EMFAC2017 2022)

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied. (EMFAC2017 2022)

Woodstoves -

Area Coating -

Energy Use -

Water And Wastewater -

Solid Waste -

Construction Off-road Equipment Mitigation - Mitigation: approximatedly 80% of equipment will meet Tier 3 Final standards.

Area Mitigation - Mitigation: Use no- or low-solids content (i.e., no- or low-VOC) architectural coatings with a maximum VOC content of 50 g/L.

Energy Mitigation -

Fleet Mix -

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	ConstArea_Nonresidential_Exterior	85,662.00	57,108.00

tblArchitecturalCoating	ConstArea_Nonresidential_Interior	256,985.00	171,323.00
tblAreaCoating	Area_Nonresidential_Exterior	85662	57108
tblAreaCoating	Area_Nonresidential_Interior	256985	171323
tblAreaMitigation	UseLowVOCPaintNonresidentialExteriorValue	150	50
tblAreaMitigation	UseLowVOCPaintNonresidentialInteriorValue	150	50
tblAreaMitigation	UseLowVOCPaintParkingCheck	False	True
tblAreaMitigation	UseLowVOCPaintParkingValue	150	50
tblAreaMitigation	UseLowVOCPaintResidentialExteriorValue	100	50
tblAreaMitigation	UseLowVOCPaintResidentialInteriorValue	100	50
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	3.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	2.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	5.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	9.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3

tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstructionPhase	NumDays	20.00	101.00
tblConstructionPhase	NumDays	300.00	230.00
tblConstructionPhase	NumDays	20.00	100.00
tblConstructionPhase	NumDays	30.00	100.00
tblConstructionPhase	NumDays	20.00	172.00
tblConstructionPhase	NumDays	10.00	73.00
tblGrading	AcresOfGrading	50.00	10.00
tblLandUse	LandUseSquareFeet	62,630.00	62,631.83
tblLandUse	LandUseSquareFeet	96,861.27	71,691.00
tblLandUse	LandUseSquareFeet	3,220.00	3,216.83
tblLandUse	LandUseSquareFeet	104,108.40	104,237.50
tblLandUse	LandUseSquareFeet	33,780.00	33,783.89
tblLandUse	LandUseSquareFeet	25,000.00	24,444.40
tblLandUse	LandUseSquareFeet	70,000.00	69,833.30
tblLandUse	Population	72.00	31.00
tblLandUse	Population	200.00	473.00

tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	3.00
tblSolidWaste	SolidWasteGenerationRate	3.99	2.65
tblSolidWaste	SolidWasteGenerationRate	192.55	128.36
tblSolidWaste	SolidWasteGenerationRate	4.76	3.17
tblTripsAndVMT	VendorTripNumber	55.00	46.00
tblTripsAndVMT	WorkerTripNumber	178.00	156.00
tblTripsAndVMT	WorkerTripNumber	36.00	31.00
tblWater	IndoorWaterUseRate	744,625.00	494,875.00
tblWater	IndoorWaterUseRate	1,997,855.41	1,331,903.60
tblWater	IndoorWaterUseRate	30,794,791.91	20,533,139.24
tblWater	OutdoorWaterUseRate	1,224,492.02	816,328.02

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	2.1138	6.6456	6.1565	0.0122	1.1716	0.3008	1.4723	0.5818	0.2793	0.8611	0.0000	1,082.3880	1,082.3880	0.2482	0.0000	1,088.5940
Maximum	**2.1138**	**6.6456**	**6.1565**	**0.0122**	**1.1716**	**0.3008**	**1.4723**	**0.5818**	**0.2793**	**0.8611**	**0.0000**	**1,082.3880**	**1,082.3880**	**0.2482**	**0.0000**	**1,088.5940**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	1.8002	5.5268	6.8452	0.0122	0.6301	0.2688	0.8989	0.2895	0.2640	0.5535	0.0000	1,082.3870	1,082.3870	0.2482	0.0000	1,088.5930
Maximum	**1.8002**	**5.5268**	**6.8452**	**0.0122**	**0.6301**	**0.2688**	**0.8989**	**0.2895**	**0.2640**	**0.5535**	**0.0000**	**1,082.3870**	**1,082.3870**	**0.2482**	**0.0000**	**1,088.5930**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**14.84**	**16.83**	**-11.19**	**0.00**	**46.22**	**10.61**	**38.95**	**50.23**	**5.49**	**35.72**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	**1-3-2022**	**4-2-2022**	2.5711	1.8364
2	**4-3-2022**	**7-2-2022**	2.7059	2.1477
3	**7-3-2022**	**9-30-2022**	1.6921	1.6139
		Highest	2.7059	2.1477

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.2149	0.0114	0.9880	5.0000e-005		5.4500e-003	5.4500e-003		5.4500e-003	5.4500e-003	0.0000	1.6159	1.6159	1.5800e-003	0.0000	1.6554
Energy	0.0281	0.2533	0.1963	1.5300e-003		0.0194	0.0194		0.0194	0.0194	0.0000	968.1008	968.1008	0.0293	0.0101	971.8349
Mobile	1.0663	3.7022	12.5310	0.0325	2.4785	0.0348	2.5133	0.6749	0.0326	0.7075	0.0000	2,970.2066	2,970.2066	0.1364	0.0000	2,973.6169
Waste						0.0000	0.0000		0.0000	0.0000	55.6317	0.0000	55.6317	3.2877	0.0000	137.8252
Water						0.0000	0.0000		0.0000	0.0000	9.4154	69.2888	78.7042	0.9695	0.0233	109.8941
Total	**2.3093**	**3.9668**	**13.7153**	**0.0341**	**2.4785**	**0.0597**	**2.5382**	**0.6749**	**0.0574**	**0.7324**	**65.0471**	**4,009.2122**	**4,074.2593**	**4.4245**	**0.0334**	**4,194.8266**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.1310	0.0114	0.9880	5.0000e-005		5.4500e-003	5.4500e-003		5.4500e-003	5.4500e-003	0.0000	1.6159	1.6159	1.5800e-003	0.0000	1.6554
Energy	0.0281	0.2533	0.1963	1.5300e-003		0.0194	0.0194		0.0194	0.0194	0.0000	968.1008	968.1008	0.0293	0.0101	971.8349
Mobile	1.0663	3.7022	12.5310	0.0325	2.4785	0.0348	2.5133	0.6749	0.0326	0.7075	0.0000	2,970.2066	2,970.2066	0.1364	0.0000	2,973.6169
Waste						0.0000	0.0000		0.0000	0.0000	55.6317	0.0000	55.6317	3.2877	0.0000	137.8252
Water						0.0000	0.0000		0.0000	0.0000	9.4154	69.2888	78.7042	0.9695	0.0233	109.8941
Total	**2.2254**	**3.9668**	**13.7153**	**0.0341**	**2.4785**	**0.0597**	**2.5382**	**0.6749**	**0.0574**	**0.7324**	**65.0471**	**4,009.2122**	**4,074.2593**	**4.4245**	**0.0334**	**4,194.8266**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**3.63**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/3/2022	5/21/2022	5	100	
2	Site Preparation	Site Preparation	1/24/2022	5/4/2022	5	73	
3	Grading	Grading	2/7/2022	6/25/2022	5	100	
4	Building Construction	Building Construction	2/28/2022	11/18/2022	5	230	
5	Paving	Paving	4/21/2022	12/18/2022	5	172	
6	Architectural Coating	Architectural Coating	8/12/2022	12/30/2022	5	101	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 10

Acres of Paving: 2.39

Residential Indoor: 190,912; Residential Outdoor: 63,637; Non-Residential Indoor: 171,323; Non-Residential Outdoor: 57,108; Striped Parking Area: 6,254 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	158	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	1	8.00	158	0.38
Grading	Graders	1	8.00	187	0.41
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Building Construction	Welders	1	8.00	46	0.45
Paving	Pavers	2	8.00	130	0.42
Paving	Paving Equipment	2	8.00	132	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	6.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	175.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	156.00	46.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	31.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

3.2 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0187	0.0000	0.0187	2.8300e-003	0.0000	2.8300e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1320	1.2860	1.0297	1.9400e-003		0.0621	0.0621		0.0578	0.0578	0.0000	169.9511	169.9511	0.0477	0.0000	171.1446
Total	**0.1320**	**1.2860**	**1.0297**	**1.9400e-003**	**0.0187**	**0.0621**	**0.0808**	**2.8300e-003**	**0.0578**	**0.0606**	**0.0000**	**169.9511**	**169.9511**	**0.0477**	**0.0000**	**171.1446**

3.2 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	6.3000e-004	0.0256	5.9100e-003	7.0000e-005	1.4700e-003	1.0000e-004	1.5600e-003	4.0000e-004	9.0000e-005	4.9000e-004	0.0000	6.7189	6.7189	2.7000e-004	0.0000	6.7257
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.9400e-003	2.5000e-003	0.0230	6.0000e-005	5.9400e-003	5.0000e-005	5.9900e-003	1.5800e-003	4.0000e-005	1.6200e-003	0.0000	5.1408	5.1408	1.9000e-004	0.0000	5.1455
Total	**3.5700e-003**	**0.0281**	**0.0289**	**1.3000e-004**	**7.4100e-003**	**1.5000e-004**	**7.5500e-003**	**1.9800e-003**	**1.3000e-004**	**2.1100e-003**	**0.0000**	**11.8597**	**11.8597**	**4.6000e-004**	**0.0000**	**11.8712**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					8.4200e-003	0.0000	8.4200e-003	1.2700e-003	0.0000	1.2700e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0597	0.9709	1.1927	1.9400e-003		0.0464	0.0464		0.0456	0.0456	0.0000	169.9509	169.9509	0.0477	0.0000	171.1444
Total	**0.0597**	**0.9709**	**1.1927**	**1.9400e-003**	**8.4200e-003**	**0.0464**	**0.0548**	**1.2700e-003**	**0.0456**	**0.0468**	**0.0000**	**169.9509**	**169.9509**	**0.0477**	**0.0000**	**171.1444**

3.2 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	6.3000e-004	0.0256	5.9100e-003	7.0000e-005	1.4700e-003	1.0000e-004	1.5600e-003	4.0000e-004	9.0000e-005	4.9000e-004	0.0000	6.7189	6.7189	2.7000e-004	0.0000	6.7257
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.9400e-003	2.5000e-003	0.0230	6.0000e-005	5.9400e-003	5.0000e-005	5.9900e-003	1.5800e-003	4.0000e-005	1.6200e-003	0.0000	5.1408	5.1408	1.9000e-004	0.0000	5.1455
Total	**3.5700e-003**	**0.0281**	**0.0289**	**1.3000e-004**	**7.4100e-003**	**1.5000e-004**	**7.5500e-003**	**1.9800e-003**	**1.3000e-004**	**2.1100e-003**	**0.0000**	**11.8597**	**11.8597**	**4.6000e-004**	**0.0000**	**11.8712**

3.3 Site Preparation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.6594	0.0000	0.6594	0.3625	0.0000	0.3625	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1157	1.2076	0.7190	1.3900e-003		0.0589	0.0589		0.0542	0.0542	0.0000	122.0538	122.0538	0.0395	0.0000	123.0406
Total	**0.1157**	**1.2076**	**0.7190**	**1.3900e-003**	**0.6594**	**0.0589**	**0.7183**	**0.3625**	**0.0542**	**0.4166**	**0.0000**	**122.0538**	**122.0538**	**0.0395**	**0.0000**	**123.0406**

3.3 Site Preparation - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.5700e-003	2.1900e-003	0.0201	5.0000e-005	5.2000e-003	4.0000e-005	5.2400e-003	1.3800e-003	4.0000e-005	1.4200e-003	0.0000	4.5033	4.5033	1.6000e-004	0.0000	4.5075
Total	**2.5700e-003**	**2.1900e-003**	**0.0201**	**5.0000e-005**	**5.2000e-003**	**4.0000e-005**	**5.2400e-003**	**1.3800e-003**	**4.0000e-005**	**1.4200e-003**	**0.0000**	**4.5033**	**4.5033**	**1.6000e-004**	**0.0000**	**4.5075**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.2967	0.0000	0.2967	0.1631	0.0000	0.1631	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0470	0.7835	0.8189	1.3900e-003		0.0390	0.0390		0.0383	0.0383	0.0000	122.0536	122.0536	0.0395	0.0000	123.0405
Total	**0.0470**	**0.7835**	**0.8189**	**1.3900e-003**	**0.2967**	**0.0390**	**0.3357**	**0.1631**	**0.0383**	**0.2014**	**0.0000**	**122.0536**	**122.0536**	**0.0395**	**0.0000**	**123.0405**

3.3 Site Preparation - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.5700e-003	2.1900e-003	0.0201	5.0000e-005	5.2000e-003	4.0000e-005	5.2400e-003	1.3800e-003	4.0000e-005	1.4200e-003	0.0000	4.5033	4.5033	1.6000e-004	0.0000	4.5075
Total	**2.5700e-003**	**2.1900e-003**	**0.0201**	**5.0000e-005**	**5.2000e-003**	**4.0000e-005**	**5.2400e-003**	**1.3800e-003**	**4.0000e-005**	**1.4200e-003**	**0.0000**	**4.5033**	**4.5033**	**1.6000e-004**	**0.0000**	**4.5075**

3.4 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.3064	0.0000	0.3064	0.1661	0.0000	0.1661	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0974	1.0428	0.7636	1.4800e-003		0.0470	0.0470		0.0433	0.0433	0.0000	130.2738	130.2738	0.0421	0.0000	131.3272
Total	**0.0974**	**1.0428**	**0.7636**	**1.4800e-003**	**0.3064**	**0.0470**	**0.3535**	**0.1661**	**0.0433**	**0.2094**	**0.0000**	**130.2738**	**130.2738**	**0.0421**	**0.0000**	**131.3272**

3.4 Grading - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.9400e-003	2.5000e-003	0.0230	6.0000e-005	5.9400e-003	5.0000e-005	5.9900e-003	1.5800e-003	4.0000e-005	1.6200e-003	0.0000	5.1408	5.1408	1.9000e-004	0.0000	5.1455
Total	**2.9400e-003**	**2.5000e-003**	**0.0230**	**6.0000e-005**	**5.9400e-003**	**5.0000e-005**	**5.9900e-003**	**1.5800e-003**	**4.0000e-005**	**1.6200e-003**	**0.0000**	**5.1408**	**5.1408**	**1.9000e-004**	**0.0000**	**5.1455**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1379	0.0000	0.1379	0.0747	0.0000	0.0747	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0439	0.7730	0.9316	1.4800e-003		0.0391	0.0391		0.0387	0.0387	0.0000	130.2737	130.2737	0.0421	0.0000	131.3270
Total	**0.0439**	**0.7730**	**0.9316**	**1.4800e-003**	**0.1379**	**0.0391**	**0.1770**	**0.0747**	**0.0387**	**0.1134**	**0.0000**	**130.2737**	**130.2737**	**0.0421**	**0.0000**	**131.3270**

3.4 Grading - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.9400e-003	2.5000e-003	0.0230	6.0000e-005	5.9400e-003	5.0000e-005	5.9900e-003	1.5800e-003	4.0000e-005	1.6200e-003	0.0000	5.1408	5.1408	1.9000e-004	0.0000	5.1455
Total	**2.9400e-003**	**2.5000e-003**	**0.0230**	**6.0000e-005**	**5.9400e-003**	**5.0000e-005**	**5.9900e-003**	**1.5800e-003**	**4.0000e-005**	**1.6200e-003**	**0.0000**	**5.1408**	**5.1408**	**1.9000e-004**	**0.0000**	**5.1455**

3.5 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1621	1.4835	1.5545	2.5600e-003		0.0769	0.0769		0.0723	0.0723	0.0000	220.1390	220.1390	0.0527	0.0000	221.4575
Total	**0.1621**	**1.4835**	**1.5545**	**2.5600e-003**		**0.0769**	**0.0769**		**0.0723**	**0.0723**	**0.0000**	**220.1390**	**220.1390**	**0.0527**	**0.0000**	**221.4575**

3.5 Building Construction - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0143	0.5063	0.1307	1.1700e-003	0.0286	1.5200e-003	0.0301	8.2600e-003	1.4600e-003	9.7100e-003	0.0000	112.1806	112.1806	4.3600e-003	0.0000	112.2896
Worker	0.0581	0.0494	0.4540	1.1300e-003	0.1173	9.6000e-004	0.1183	0.0312	8.8000e-004	0.0321	0.0000	101.5822	101.5822	3.7200e-003	0.0000	101.6752
Total	**0.0723**	**0.5557**	**0.5847**	**2.3000e-003**	**0.1459**	**2.4800e-003**	**0.1484**	**0.0395**	**2.3400e-003**	**0.0418**	**0.0000**	**213.7628**	**213.7628**	**8.0800e-003**	**0.0000**	**213.9648**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0736	1.3689	1.6947	2.5600e-003		0.0860	0.0860		0.0853	0.0853	0.0000	220.1387	220.1387	0.0527	0.0000	221.4572
Total	**0.0736**	**1.3689**	**1.6947**	**2.5600e-003**		**0.0860**	**0.0860**		**0.0853**	**0.0853**	**0.0000**	**220.1387**	**220.1387**	**0.0527**	**0.0000**	**221.4572**

3.5 Building Construction - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0143	0.5063	0.1307	1.1700e-003	0.0286	1.5200e-003	0.0301	8.2600e-003	1.4600e-003	9.7100e-003	0.0000	112.1806	112.1806	4.3600e-003	0.0000	112.2896
Worker	0.0581	0.0494	0.4540	1.1300e-003	0.1173	9.6000e-004	0.1183	0.0312	8.8000e-004	0.0321	0.0000	101.5822	101.5822	3.7200e-003	0.0000	101.6752
Total	**0.0723**	**0.5557**	**0.5847**	**2.3000e-003**	**0.1459**	**2.4800e-003**	**0.1484**	**0.0395**	**2.3400e-003**	**0.0418**	**0.0000**	**213.7628**	**213.7628**	**8.0800e-003**	**0.0000**	**213.9648**

3.6 Paving - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0948	0.9567	1.2539	1.9600e-003		0.0488	0.0488		0.0449	0.0449	0.0000	172.2370	172.2370	0.0557	0.0000	173.6296
Paving	3.1300e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0980**	**0.9567**	**1.2539**	**1.9600e-003**		**0.0488**	**0.0488**		**0.0449**	**0.0449**	**0.0000**	**172.2370**	**172.2370**	**0.0557**	**0.0000**	**173.6296**

3.6 Paving - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.0500e-003	4.3000e-003	0.0395	1.0000e-004	0.0102	8.0000e-005	0.0103	2.7200e-003	8.0000e-005	2.7900e-003	0.0000	8.8422	8.8422	3.2000e-004	0.0000	8.8503
Total	**5.0500e-003**	**4.3000e-003**	**0.0395**	**1.0000e-004**	**0.0102**	**8.0000e-005**	**0.0103**	**2.7200e-003**	**8.0000e-005**	**2.7900e-003**	**0.0000**	**8.8422**	**8.8422**	**3.2000e-004**	**0.0000**	**8.8503**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0715	0.9641	1.3707	1.9600e-003		0.0506	0.0506		0.0487	0.0487	0.0000	172.2368	172.2368	0.0557	0.0000	173.6294
Paving	3.1300e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0747**	**0.9641**	**1.3707**	**1.9600e-003**		**0.0506**	**0.0506**		**0.0487**	**0.0487**	**0.0000**	**172.2368**	**172.2368**	**0.0557**	**0.0000**	**173.6294**

3.6 Paving - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.0500e-003	4.3000e-003	0.0395	1.0000e-004	0.0102	8.0000e-005	0.0103	2.7200e-003	8.0000e-005	2.7900e-003	0.0000	8.8422	8.8422	3.2000e-004	0.0000	8.8503
Total	**5.0500e-003**	**4.3000e-003**	**0.0395**	**1.0000e-004**	**0.0102**	**8.0000e-005**	**0.0103**	**2.7200e-003**	**8.0000e-005**	**2.7900e-003**	**0.0000**	**8.8422**	**8.8422**	**3.2000e-004**	**0.0000**	**8.8503**

3.7 Architectural Coating - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	1.4057					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0103	0.0711	0.0916	1.5000e-004		4.1300e-003	4.1300e-003		4.1300e-003	4.1300e-003	0.0000	12.8939	12.8939	8.4000e-004	0.0000	12.9149
Total	**1.4161**	**0.0711**	**0.0916**	**1.5000e-004**		**4.1300e-003**	**4.1300e-003**		**4.1300e-003**	**4.1300e-003**	**0.0000**	**12.8939**	**12.8939**	**8.4000e-004**	**0.0000**	**12.9149**

3.7 Architectural Coating - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	6.1300e-003	5.2100e-003	0.0480	1.2000e-004	0.0124	1.0000e-004	0.0125	3.3000e-003	9.0000e-005	3.3900e-003	0.0000	10.7306	10.7306	3.9000e-004	0.0000	10.7404
Total	**6.1300e-003**	**5.2100e-003**	**0.0480**	**1.2000e-004**	**0.0124**	**1.0000e-004**	**0.0125**	**3.3000e-003**	**9.0000e-005**	**3.3900e-003**	**0.0000**	**10.7306**	**10.7306**	**3.9000e-004**	**0.0000**	**10.7404**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	1.4057					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	3.0000e-003	0.0685	0.0925	1.5000e-004		4.8000e-003	4.8000e-003		4.8000e-003	4.8000e-003	0.0000	12.8939	12.8939	8.4000e-004	0.0000	12.9149
Total	**1.4087**	**0.0685**	**0.0925**	**1.5000e-004**		**4.8000e-003**	**4.8000e-003**		**4.8000e-003**	**4.8000e-003**	**0.0000**	**12.8939**	**12.8939**	**8.4000e-004**	**0.0000**	**12.9149**

3.7 Architectural Coating - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	6.1300e-003	5.2100e-003	0.0480	1.2000e-004	0.0124	1.0000e-004	0.0125	3.3000e-003	9.0000e-005	3.3900e-003	0.0000	10.7306	10.7306	3.9000e-004	0.0000	10.7404
Total	**6.1300e-003**	**5.2100e-003**	**0.0480**	**1.2000e-004**	**0.0124**	**1.0000e-004**	**0.0125**	**3.3000e-003**	**9.0000e-005**	**3.3900e-003**	**0.0000**	**10.7306**	**10.7306**	**3.9000e-004**	**0.0000**	**10.7404**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	tons/yr										MT/yr					
Mitigated	1.0663	3.7022	12.5310	0.0325	2.4785	0.0348	2.5133	0.6749	0.0326	0.7075	0.0000	2,970.2066	2,970.2066	0.1364	0.0000	2,973.6169
Unmitigated	1.0663	3.7022	12.5310	0.0325	2.4785	0.0348	2.5133	0.6749	0.0326	0.7075	0.0000	2,970.2066	2,970.2066	0.1364	0.0000	2,973.6169

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Low Rise	164.75	179.00	151.75	475,141	475,141
Apartments Mid Rise	465.50	447.30	410.20	1,310,804	1,310,804
General Light Industry	22.44	4.25	2.19	49,489	49,489
Health Club	1,112.38	704.99	902.94	1,769,576	1,769,576
Parking Lot	0.00	0.00	0.00		
Research & Development	507.93	119.00	69.52	976,779	976,779
University/College (4Yr)	901.17	685.10	0.00	1,872,918	1,872,918
Total	3,174.17	2,139.64	1,536.60	6,454,706	6,454,706

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Low Rise	10.80	7.30	7.50	44.00	18.80	37.20	86	11	3
Apartments Mid Rise	10.80	7.30	7.50	44.00	18.80	37.20	86	11	3
General Light Industry	9.50	7.30	7.30	59.00	28.00	13.00	92	5	3
Health Club	9.50	7.30	7.30	16.90	64.10	19.00	52	39	9
Parking Lot	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0
Research & Development	9.50	7.30	7.30	33.00	48.00	19.00	82	15	3
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Low Rise	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Apartments Mid Rise	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Apartments Mid Rise	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
General Light Industry	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Health Club	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Parking Lot	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Research & Development	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
University/College (4Yr)	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	689.6515	689.6515	0.0240	4.9600e-003	691.7309
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	689.6515	689.6515	0.0240	4.9600e-003	691.7309
NaturalGas Mitigated	0.0281	0.2533	0.1963	1.5300e-003		0.0194	0.0194		0.0194	0.0194	0.0000	278.4493	278.4493	5.3400e-003	5.1000e-003	280.1040
NaturalGas Unmitigated	0.0281	0.2533	0.1963	1.5300e-003		0.0194	0.0194		0.0194	0.0194	0.0000	278.4493	278.4493	5.3400e-003	5.1000e-003	280.1040

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Low Rise	254971	1.3700e-003	0.0118	5.0000e-003	7.0000e-005		9.5000e-004	9.5000e-004		9.5000e-004	9.5000e-004	0.0000	13.6062	13.6062	2.6000e-004	2.5000e-004	13.6871
Apartments Mid Rise	604762	3.2600e-003	0.0279	0.0119	1.8000e-004		2.2500e-003	2.2500e-003		2.2500e-003	2.2500e-003	0.0000	32.2724	32.2724	6.2000e-004	5.9000e-004	32.4642
General Light Industry	84860	4.6000e-004	4.1600e-003	3.4900e-003	2.0000e-005		3.2000e-004	3.2000e-004		3.2000e-004	3.2000e-004	0.0000	4.5285	4.5285	9.0000e-005	8.0000e-005	4.5554
Health Club	891219	4.8100e-003	0.0437	0.0367	2.6000e-004		3.3200e-003	3.3200e-003		3.3200e-003	3.3200e-003	0.0000	47.5588	47.5588	9.1000e-004	8.7000e-004	47.8415
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	1.65223e+006	8.9100e-003	0.0810	0.0680	4.9000e-004		6.1600e-003	6.1600e-003		6.1600e-003	6.1600e-003	0.0000	88.1692	88.1692	1.6900e-003	1.6200e-003	88.6931
University/College (4Yr)	1.7299e+006	9.3300e-003	0.0848	0.0712	5.1000e-004		6.4400e-003	6.4400e-003		6.4400e-003	6.4400e-003	0.0000	92.3143	92.3143	1.7700e-003	1.6900e-003	92.8628
Total		**0.0281**	**0.2533**	**0.1963**	**1.5300e-003**		**0.0194**	**0.0194**		**0.0194**	**0.0194**	**0.0000**	**278.4493**	**278.4493**	**5.3400e-003**	**5.1000e-003**	**280.1040**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Low Rise	254971	1.3700e-003	0.0118	5.0000e-003	7.0000e-005		9.5000e-004	9.5000e-004		9.5000e-004	9.5000e-004	0.0000	13.6062	13.6062	2.6000e-004	2.5000e-004	13.6871
Apartments Mid Rise	604762	3.2600e-003	0.0279	0.0119	1.8000e-004		2.2500e-003	2.2500e-003		2.2500e-003	2.2500e-003	0.0000	32.2724	32.2724	6.2000e-004	5.9000e-004	32.4642
General Light Industry	84860	4.6000e-004	4.1600e-003	3.4900e-003	2.0000e-005		3.2000e-004	3.2000e-004		3.2000e-004	3.2000e-004	0.0000	4.5285	4.5285	9.0000e-005	8.0000e-005	4.5554
Health Club	891219	4.8100e-003	0.0437	0.0367	2.6000e-004		3.3200e-003	3.3200e-003		3.3200e-003	3.3200e-003	0.0000	47.5588	47.5588	9.1000e-004	8.7000e-004	47.8415
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	1.65223e+006	8.9100e-003	0.0810	0.0680	4.9000e-004		6.1600e-003	6.1600e-003		6.1600e-003	6.1600e-003	0.0000	88.1692	88.1692	1.6900e-003	1.6200e-003	88.6931
University/College (4Yr)	1.7299e+006	9.3300e-003	0.0848	0.0712	5.1000e-004		6.4400e-003	6.4400e-003		6.4400e-003	6.4400e-003	0.0000	92.3143	92.3143	1.7700e-003	1.6900e-003	92.8628
Total		**0.0281**	**0.2533**	**0.1963**	**1.5300e-003**		**0.0194**	**0.0194**		**0.0194**	**0.0194**	**0.0000**	**278.4493**	**278.4493**	**5.3400e-003**	**5.1000e-003**	**280.1040**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Low Rise	108720	41.1017	1.4300e-003	3.0000e-004	41.2256
Apartments Mid Rise	288985	109.2509	3.8000e-003	7.9000e-004	109.5803
General Light Industry	26571	10.0452	3.5000e-004	7.0000e-005	10.0755
Health Club	279055	105.4970	3.6700e-003	7.6000e-004	105.8151
Parking Lot	36483.1	13.7925	4.8000e-004	1.0000e-004	13.8341
Research & Development	517339	195.5805	6.8100e-003	1.4100e-003	196.1703
University/College (4Yr)	567076	214.3836	7.4600e-003	1.5400e-003	215.0300
Total		**689.6515**	**0.0240**	**4.9700e-003**	**691.7309**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Low Rise	108720	41.1017	1.4300e-003	3.0000e-004	41.2256
Apartments Mid Rise	288985	109.2509	3.8000e-003	7.9000e-004	109.5803
General Light Industry	26571	10.0452	3.5000e-004	7.0000e-005	10.0755
Health Club	279055	105.4970	3.6700e-003	7.6000e-004	105.8151
Parking Lot	36483.1	13.7925	4.8000e-004	1.0000e-004	13.8341
Research & Development	517339	195.5805	6.8100e-003	1.4100e-003	196.1703
University/College (4Yr)	567076	214.3836	7.4600e-003	1.5400e-003	215.0300
Total		**689.6515**	**0.0240**	**4.9700e-003**	**691.7309**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Low VOC Paint - Residential Interior

Use Low VOC Paint - Residential Exterior

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	1.1310	0.0114	0.9880	5.0000e-005		5.4500e-003	5.4500e-003		5.4500e-003	5.4500e-003	0.0000	1.6159	1.6159	1.5800e-003	0.0000	1.6554
Unmitigated	1.2149	0.0114	0.9880	5.0000e-005		5.4500e-003	5.4500e-003		5.4500e-003	5.4500e-003	0.0000	1.6159	1.6159	1.5800e-003	0.0000	1.6554

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.1406					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.0440					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0303	0.0114	0.9880	5.0000e-005		5.4500e-003	5.4500e-003		5.4500e-003	5.4500e-003	0.0000	1.6159	1.6159	1.5800e-003	0.0000	1.6554
Total	**1.2149**	**0.0114**	**0.9880**	**5.0000e-005**		**5.4500e-003**	**5.4500e-003**		**5.4500e-003**	**5.4500e-003**	**0.0000**	**1.6159**	**1.6159**	**1.5800e-003**	**0.0000**	**1.6554**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0567					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.0440					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0303	0.0114	0.9880	5.0000e-005		5.4500e-003	5.4500e-003		5.4500e-003	5.4500e-003	0.0000	1.6159	1.6159	1.5800e-003	0.0000	1.6554
Total	**1.1310**	**0.0114**	**0.9880**	**5.0000e-005**		**5.4500e-003**	**5.4500e-003**		**5.4500e-003**	**5.4500e-003**	**0.0000**	**1.6159**	**1.6159**	**1.5800e-003**	**0.0000**	**1.6554**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	78.7042	0.9695	0.0233	109.8941
Unmitigated	78.7042	0.9695	0.0233	109.8941

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Low Rise	1.62885 / 1.02688	5.2075	0.0532	1.2900e-003	6.9221
Apartments Mid Rise	4.56078 / 2.87528	14.5811	0.1491	3.6000e-003	19.3818
General Light Industry	0.494875 / 0	1.1693	0.0162	3.9000e-004	1.6890
Health Club	1.3319 / 0.816328	4.2273	0.0435	1.0500e-003	5.6291
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Research & Development	20.5331 / 0	48.5175	0.6705	0.0161	70.0789
University/College (4Yr)	1.12836 / 1.76487	5.0014	0.0369	9.0000e-004	6.1933
Total		**78.7042**	**0.9695**	**0.0233**	**109.8941**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Low Rise	1.62885 / 1.02688	5.2075	0.0532	1.2900e-003	6.9221
Apartments Mid Rise	4.56078 / 2.87528	14.5811	0.1491	3.6000e-003	19.3818
General Light Industry	0.494875 / 0	1.1693	0.0162	3.9000e-004	1.6890
Health Club	1.3319 / 0.816328	4.2273	0.0435	1.0500e-003	5.6291
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Research & Development	20.5331 / 0	48.5175	0.6705	0.0161	70.0789
University/College (4Yr)	1.12836 / 1.76487	5.0014	0.0369	9.0000e-004	6.1933
Total		**78.7042**	**0.9695**	**0.0233**	**109.8941**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	55.6317	3.2877	0.0000	137.8252
Unmitigated	55.6317	3.2877	0.0000	137.8252

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Low Rise	11.5	2.3344	0.1380	0.0000	5.7834
Apartments Mid Rise	32.2	6.5363	0.3863	0.0000	16.1934
General Light Industry	2.65	0.5379	0.0318	0.0000	1.3327
Health Club	128.36	26.0559	1.5399	0.0000	64.5524
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Research & Development	3.17	0.6435	0.0380	0.0000	1.5942
University/College (4Yr)	96.18	19.5237	1.1538	0.0000	48.3691
Total		**55.6317**	**3.2877**	**0.0000**	**137.8252**

8.2 Waste by Land Use

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Low Rise	11.5	2.3344	0.1380	0.0000	5.7834
Apartments Mid Rise	32.2	6.5363	0.3863	0.0000	16.1934
General Light Industry	2.65	0.5379	0.0318	0.0000	1.3327
Health Club	128.36	26.0559	1.5399	0.0000	64.5524
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Research & Development	3.17	0.6435	0.0380	0.0000	1.5942
University/College (4Yr)	96.18	19.5237	1.1538	0.0000	48.3691
Total		**55.6317**	**3.2877**	**0.0000**	**137.8252**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

UCSC - 2020 LRDP - Construction Only

Santa Cruz County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Research & Development	62.63	1000sqft	1.44	62,631.83	0
University/College (4Yr)	527.00	Student	2.22	71,691.00	0
General Light Industry	3.22	1000sqft	0.07	3,216.83	0
Parking Lot	2.39	Acre	2.39	104,237.50	0
Health Club	33.78	1000sqft	0.78	33,783.89	0
Apartments Low Rise	25.00	Dwelling Unit	1.56	24,444.40	31
Apartments Mid Rise	70.00	Dwelling Unit	1.84	69,833.30	473

1.2 Other Project Characteristics

Urbanization Urban **Wind Speed (m/s)** 1.8 **Precipitation Freq (Days)** 61

Climate Zone 4 **Operational Year** 2023

Utility Company Modesto Irrigation District

CO2 Intensity (lb/MWhr) 833.46 **CH4 Intensity (lb/MWhr)** 0.029 **N2O Intensity (lb/MWhr)** 0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics - UCSC Electricity Emission Factors for 2022 reflect State averages

Land Use - Values specified in Project Description. Assume Construction for 1 year = 1/18 of total construction (2022-2039).

Construction Phase - Condensed to 1 year construction schedule (2022).

Off-road Equipment -

Off-road Equipment - Equipment associated with building construction increased to reflect condensed schedule.

Off-road Equipment -

Trips and VMT -

On-road Fugitive Dust -

Demolition -

Grading -

Architectural Coating -

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied. (EMFAC2017 2022)

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied. (EMFAC2017 2022)

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied. (EMFAC2017 2022)

Woodstoves -

Area Coating -

Energy Use -

Water And Wastewater -

Solid Waste -

Construction Off-road Equipment Mitigation - Mitigation: approximatedly 80% of equipment will meet Tier 3 Final standards.

Area Mitigation - Mitigation: Use no- or low-solids content (i.e., no- or low-VOC) architectural coatings with a maximum VOC content of 50 g/L.

Energy Mitigation -

Fleet Mix -

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	ConstArea_Nonresidential_Exterior	85,662.00	57,108.00

tblArchitecturalCoating	ConstArea_Nonresidential_Interior	256,985.00	171,323.00
tblAreaCoating	Area_Nonresidential_Exterior	85662	57108
tblAreaCoating	Area_Nonresidential_Interior	256985	171323
tblAreaMitigation	UseLowVOCPaintNonresidentialExteriorValue	150	50
tblAreaMitigation	UseLowVOCPaintNonresidentialInteriorValue	150	50
tblAreaMitigation	UseLowVOCPaintParkingCheck	False	True
tblAreaMitigation	UseLowVOCPaintParkingValue	150	50
tblAreaMitigation	UseLowVOCPaintResidentialExteriorValue	100	50
tblAreaMitigation	UseLowVOCPaintResidentialInteriorValue	100	50
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	3.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	2.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	5.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	9.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	1.00
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3

tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstructionPhase	NumDays	20.00	101.00
tblConstructionPhase	NumDays	300.00	230.00
tblConstructionPhase	NumDays	20.00	100.00
tblConstructionPhase	NumDays	30.00	100.00
tblConstructionPhase	NumDays	20.00	172.00
tblConstructionPhase	NumDays	10.00	73.00
tblGrading	AcresOfGrading	50.00	10.00
tblLandUse	LandUseSquareFeet	62,630.00	62,631.83
tblLandUse	LandUseSquareFeet	96,861.27	71,691.00
tblLandUse	LandUseSquareFeet	3,220.00	3,216.83
tblLandUse	LandUseSquareFeet	104,108.40	104,237.50
tblLandUse	LandUseSquareFeet	33,780.00	33,783.89
tblLandUse	LandUseSquareFeet	25,000.00	24,444.40
tblLandUse	LandUseSquareFeet	70,000.00	69,833.30
tblLandUse	Population	72.00	31.00
tblLandUse	Population	200.00	473.00

tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	3.00
tblSolidWaste	SolidWasteGenerationRate	3.99	2.65
tblSolidWaste	SolidWasteGenerationRate	192.55	128.36
tblSolidWaste	SolidWasteGenerationRate	4.76	3.17
tblTripsAndVMT	VendorTripNumber	55.00	46.00
tblTripsAndVMT	WorkerTripNumber	178.00	156.00
tblTripsAndVMT	WorkerTripNumber	36.00	31.00
tblWater	IndoorWaterUseRate	744,625.00	494,875.00
tblWater	IndoorWaterUseRate	1,997,855.41	1,331,903.60
tblWater	IndoorWaterUseRate	30,794,791.91	20,533,139.24
tblWater	OutdoorWaterUseRate	1,224,492.02	816,328.02

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2022	31.8143	112.8138	94.8507	0.1874	26.7080	5.2048	31.9127	13.8836	4.8179	18.7016	0.0000	18,264.5070	18,264.5070	4.6173	0.0000	18,379.9406
Maximum	**31.8143**	**112.8138**	**94.8507**	**0.1874**	**26.7080**	**5.2048**	**31.9127**	**13.8836**	**4.8179**	**18.7016**	**0.0000**	**18,264.5070**	**18,264.5070**	**4.6173**	**0.0000**	**18,379.9406**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2022	30.4667	88.3779	107.0399	0.1874	13.1953	4.3045	17.4998	6.5637	4.2264	10.7901	0.0000	18,264.5070	18,264.5070	4.6173	0.0000	18,379.9406
Maximum	**30.4667**	**88.3779**	**107.0399**	**0.1874**	**13.1953**	**4.3045**	**17.4998**	**6.5637**	**4.2264**	**10.7901**	**0.0000**	**18,264.5070**	**18,264.5070**	**4.6173**	**0.0000**	**18,379.9406**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**4.24**	**21.66**	**-12.85**	**0.00**	**50.59**	**17.30**	**45.16**	**52.72**	**12.28**	**42.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	6.7332	0.0910	7.9036	4.2000e-004		0.0436	0.0436		0.0436	0.0436	0.0000	14.2501	14.2501	0.0139	0.0000	14.5984
Energy	0.1542	1.3877	1.0757	8.4100e-003		0.1065	0.1065		0.1065	0.1065		1,681.8512	1,681.8512	0.0322	0.0308	1,691.8456
Mobile	7.0723	21.7074	77.2331	0.2090	16.1097	0.2148	16.3246	4.3656	0.2010	4.5666		21,043.2841	21,043.2841	0.9351		21,066.6607
Total	**13.9596**	**23.1861**	**86.2123**	**0.2179**	**16.1097**	**0.3650**	**16.4747**	**4.3656**	**0.3511**	**4.7168**	**0.0000**	**22,739.3854**	**22,739.3854**	**0.9812**	**0.0308**	**22,773.1047**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	6.2735	0.0910	7.9036	4.2000e-004		0.0436	0.0436		0.0436	0.0436	0.0000	14.2501	14.2501	0.0139	0.0000	14.5984
Energy	0.1542	1.3877	1.0757	8.4100e-003		0.1065	0.1065		0.1065	0.1065		1,681.8512	1,681.8512	0.0322	0.0308	1,691.8456
Mobile	7.0723	21.7074	77.2331	0.2090	16.1097	0.2148	16.3246	4.3656	0.2010	4.5666		21,043.2841	21,043.2841	0.9351		21,066.6607
Total	**13.5000**	**23.1861**	**86.2123**	**0.2179**	**16.1097**	**0.3650**	**16.4747**	**4.3656**	**0.3511**	**4.7168**	**0.0000**	**22,739.3854**	**22,739.3854**	**0.9812**	**0.0308**	**22,773.1047**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**3.29**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/3/2022	5/21/2022	5	100	
2	Site Preparation	Site Preparation	1/24/2022	5/4/2022	5	73	
3	Grading	Grading	2/7/2022	6/25/2022	5	100	
4	Building Construction	Building Construction	2/28/2022	11/18/2022	5	230	
5	Paving	Paving	4/21/2022	12/18/2022	5	172	
6	Architectural Coating	Architectural Coating	8/12/2022	12/30/2022	5	101	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 10

Acres of Paving: 2.39

Residential Indoor: 190,912; Residential Outdoor: 63,637; Non-Residential Indoor: 171,323; Non-Residential Outdoor: 57,108; Striped Parking Area: 6,254 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	158	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	1	8.00	158	0.38
Grading	Graders	1	8.00	187	0.41
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Building Construction	Welders	1	8.00	46	0.45
Paving	Pavers	2	8.00	130	0.42
Paving	Paving Equipment	2	8.00	132	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	6.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	175.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	156.00	46.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	31.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

3.2 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3741	0.0000	0.3741	0.0566	0.0000	0.0566			0.0000			0.0000
Off-Road	2.6392	25.7194	20.5941	0.0388		1.2427	1.2427		1.1553	1.1553		3,746.781 2	3,746.781 2	1.0524		3,773.092 0
Total	**2.6392**	**25.7194**	**20.5941**	**0.0388**	**0.3741**	**1.2427**	**1.6168**	**0.0566**	**1.1553**	**1.2119**		**3,746.781 2**	**3,746.781 2**	**1.0524**		**3,773.092 0**

3.2 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0124	0.5031	0.1158	1.3900e-003	0.0303	1.9000e-003	0.0322	8.2800e-003	1.8100e-003	0.0101		148.9811	148.9811	5.9200e-003		149.1291
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0581	0.0438	0.4749	1.1900e-003	0.1232	9.7000e-004	0.1242	0.0327	9.0000e-004	0.0336		118.8499	118.8499	4.3100e-003		118.9577
Total	**0.0705**	**0.5469**	**0.5907**	**2.5800e-003**	**0.1535**	**2.8700e-003**	**0.1564**	**0.0410**	**2.7100e-003**	**0.0437**		**267.8310**	**267.8310**	**0.0102**		**268.0868**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.1683	0.0000	0.1683	0.0255	0.0000	0.0255			0.0000			0.0000
Off-Road	1.1946	19.4185	23.8542	0.0388		0.9280	0.9280		0.9115	0.9115	0.0000	3,746.7812	3,746.7812	1.0524		3,773.0920
Total	**1.1946**	**19.4185**	**23.8542**	**0.0388**	**0.1683**	**0.9280**	**1.0963**	**0.0255**	**0.9115**	**0.9370**	**0.0000**	**3,746.7812**	**3,746.7812**	**1.0524**		**3,773.0920**

3.2 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0124	0.5031	0.1158	1.3900e-003	0.0303	1.9000e-003	0.0322	8.2800e-003	1.8100e-003	0.0101		148.9811	148.9811	5.9200e-003		149.1291
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0581	0.0438	0.4749	1.1900e-003	0.1232	9.7000e-004	0.1242	0.0327	9.0000e-004	0.0336		118.8499	118.8499	4.3100e-003		118.9577
Total	**0.0705**	**0.5469**	**0.5907**	**2.5800e-003**	**0.1535**	**2.8700e-003**	**0.1564**	**0.0410**	**2.7100e-003**	**0.0437**		**267.8310**	**267.8310**	**0.0102**		**268.0868**

3.3 Site Preparation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					18.0663	0.0000	18.0663	9.9307	0.0000	9.9307			0.0000			0.0000
Off-Road	3.1701	33.0835	19.6978	0.0380		1.6126	1.6126		1.4836	1.4836		3,686.0619	3,686.0619	1.1922		3,715.8655
Total	**3.1701**	**33.0835**	**19.6978**	**0.0380**	**18.0663**	**1.6126**	**19.6788**	**9.9307**	**1.4836**	**11.4143**		**3,686.0619**	**3,686.0619**	**1.1922**		**3,715.8655**

3.3 Site Preparation - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0697	0.0525	0.5698	1.4300e-003	0.1479	1.1600e-003	0.1490	0.0392	1.0700e-003	0.0403		142.6199	142.6199	5.1800e-003		142.7493
Total	**0.0697**	**0.0525**	**0.5698**	**1.4300e-003**	**0.1479**	**1.1600e-003**	**0.1490**	**0.0392**	**1.0700e-003**	**0.0403**		**142.6199**	**142.6199**	**5.1800e-003**		**142.7493**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					8.1298	0.0000	8.1298	4.4688	0.0000	4.4688			0.0000			0.0000
Off-Road	1.2869	21.4651	22.4346	0.0380		1.0683	1.0683		1.0483	1.0483	0.0000	3,686.0619	3,686.0619	1.1922		3,715.8655
Total	**1.2869**	**21.4651**	**22.4346**	**0.0380**	**8.1298**	**1.0683**	**9.1981**	**4.4688**	**1.0483**	**5.5172**	**0.0000**	**3,686.0619**	**3,686.0619**	**1.1922**		**3,715.8655**

3.3 Site Preparation - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0697	0.0525	0.5698	1.4300e-003	0.1479	1.1600e-003	0.1490	0.0392	1.0700e-003	0.0403		142.6199	142.6199	5.1800e-003		142.7493
Total	**0.0697**	**0.0525**	**0.5698**	**1.4300e-003**	**0.1479**	**1.1600e-003**	**0.1490**	**0.0392**	**1.0700e-003**	**0.0403**		**142.6199**	**142.6199**	**5.1800e-003**		**142.7493**

3.4 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					6.1281	0.0000	6.1281	3.3217	0.0000	3.3217			0.0000			0.0000
Off-Road	1.9486	20.8551	15.2727	0.0297		0.9409	0.9409		0.8656	0.8656		2,872.0464	2,872.0464	0.9289		2,895.2684
Total	**1.9486**	**20.8551**	**15.2727**	**0.0297**	**6.1281**	**0.9409**	**7.0690**	**3.3217**	**0.8656**	**4.1873**		**2,872.0464**	**2,872.0464**	**0.9289**		**2,895.2684**

3.4 Grading - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category						lb/day								lb/day		
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0581	0.0438	0.4749	1.1900e-003	0.1232	9.7000e-004	0.1242	0.0327	9.0000e-004	0.0336		118.8499	118.8499	4.3100e-003		118.9577
Total	**0.0581**	**0.0438**	**0.4749**	**1.1900e-003**	**0.1232**	**9.7000e-004**	**0.1242**	**0.0327**	**9.0000e-004**	**0.0336**		**118.8499**	**118.8499**	**4.3100e-003**		**118.9577**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category						lb/day								lb/day		
Fugitive Dust					2.7577	0.0000	2.7577	1.4948	0.0000	1.4948			0.0000			0.0000
Off-Road	0.8785	15.4598	18.6324	0.0297		0.7828	0.7828		0.7733	0.7733	0.0000	2,872.046 4	2,872.046 4	0.9289		2,895.268 4
Total	**0.8785**	**15.4598**	**18.6324**	**0.0297**	**2.7577**	**0.7828**	**3.5405**	**1.4948**	**0.7733**	**2.2680**	**0.0000**	**2,872.046 4**	**2,872.046 4**	**0.9289**		**2,895.268 4**

3.4 Grading - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0581	0.0438	0.4749	1.1900e-003	0.1232	9.7000e-004	0.1242	0.0327	9.0000e-004	0.0336		118.8499	118.8499	4.3100e-003		118.9577
Total	**0.0581**	**0.0438**	**0.4749**	**1.1900e-003**	**0.1232**	**9.7000e-004**	**0.1242**	**0.0327**	**9.0000e-004**	**0.0336**		**118.8499**	**118.8499**	**4.3100e-003**		**118.9577**

3.5 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.7062	15.6156	16.3634	0.0269		0.8090	0.8090		0.7612	0.7612		2,554.3336	2,554.3336	0.6120		2,569.6322
Total	**1.7062**	**15.6156**	**16.3634**	**0.0269**		**0.8090**	**0.8090**		**0.7612**	**0.7612**		**2,554.3336**	**2,554.3336**	**0.6120**		**2,569.6322**

3.5 Building Construction - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1461	5.2728	1.2935	0.0124	0.3101	0.0157	0.3258	0.0892	0.0150	0.1042		1,313.4343	1,313.4343	0.0490		1,314.6602
Worker	0.6037	0.4554	4.9386	0.0124	1.2815	0.0101	1.2916	0.3399	9.3100e-003	0.3492		1,236.0388	1,236.0388	0.0449		1,237.1604
Total	**0.7499**	**5.7282**	**6.2320**	**0.0248**	**1.5916**	**0.0258**	**1.6174**	**0.4291**	**0.0243**	**0.4534**		**2,549.4731**	**2,549.4731**	**0.0939**		**2,551.8205**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.7746	14.4092	17.8385	0.0269		0.9051	0.9051		0.8975	0.8975	0.0000	2,554.3336	2,554.3336	0.6120		2,569.6322
Total	**0.7746**	**14.4092**	**17.8385**	**0.0269**		**0.9051**	**0.9051**		**0.8975**	**0.8975**	**0.0000**	**2,554.3336**	**2,554.3336**	**0.6120**		**2,569.6322**

3.5 Building Construction - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1461	5.2728	1.2935	0.0124	0.3101	0.0157	0.3258	0.0892	0.0150	0.1042		1,313.434 3	1,313.434 3	0.0490		1,314.660 2
Worker	0.6037	0.4554	4.9386	0.0124	1.2815	0.0101	1.2916	0.3399	9.3100e-003	0.3492		1,236.038 8	1,236.038 8	0.0449		1,237.160 4
Total	**0.7499**	**5.7282**	**6.2320**	**0.0248**	**1.5916**	**0.0258**	**1.6174**	**0.4291**	**0.0243**	**0.4534**		**2,549.473 1**	**2,549.473 1**	**0.0939**		**2,551.820 5**

3.6 Paving - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.1028	11.1249	14.5805	0.0228		0.5679	0.5679		0.5225	0.5225		2,207.660 3	2,207.660 3	0.7140		2,225.510 4
Paving	0.0364					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**1.1392**	**11.1249**	**14.5805**	**0.0228**		**0.5679**	**0.5679**		**0.5225**	**0.5225**		**2,207.660 3**	**2,207.660 3**	**0.7140**		**2,225.510 4**

3.6 Paving - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0581	0.0438	0.4749	1.1900e-003	0.1232	9.7000e-004	0.1242	0.0327	9.0000e-004	0.0336		118.8499	118.8499	4.3100e-003		118.9577
Total	**0.0581**	**0.0438**	**0.4749**	**1.1900e-003**	**0.1232**	**9.7000e-004**	**0.1242**	**0.0327**	**9.0000e-004**	**0.0336**		**118.8499**	**118.8499**	**4.3100e-003**		**118.9577**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8319	11.2101	15.9381	0.0228		0.5886	0.5886		0.5659	0.5659	0.0000	2,207.6603	2,207.6603	0.7140		2,225.5104
Paving	0.0364					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**0.8683**	**11.2101**	**15.9381**	**0.0228**		**0.5886**	**0.5886**		**0.5659**	**0.5659**	**0.0000**	**2,207.6603**	**2,207.6603**	**0.7140**		**2,225.5104**

3.6 Paving - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0581	0.0438	0.4749	1.1900e-003	0.1232	9.7000e-004	0.1242	0.0327	9.0000e-004	0.0336		118.8499	118.8499	4.3100e-003		118.9577
Total	**0.0581**	**0.0438**	**0.4749**	**1.1900e-003**	**0.1232**	**9.7000e-004**	**0.1242**	**0.0327**	**9.0000e-004**	**0.0336**		**118.8499**	**118.8499**	**4.3100e-003**		**118.9577**

3.7 Architectural Coating - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	27.8365					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Off-Road	0.2045	1.4085	1.8136	2.9700e-003		0.0817	0.0817		0.0817	0.0817		281.4481	281.4481	0.0183		281.9062
Total	**28.0410**	**1.4085**	**1.8136**	**2.9700e-003**		**0.0817**	**0.0817**		**0.0817**	**0.0817**		**281.4481**	**281.4481**	**0.0183**		**281.9062**

3.7 Architectural Coating - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1200	0.0905	0.9814	2.4700e-003	0.2547	2.0100e-003	0.2567	0.0676	1.8500e-003	0.0694		245.6231	245.6231	8.9200e-003		245.8460
Total	**0.1200**	**0.0905**	**0.9814**	**2.4700e-003**	**0.2547**	**2.0100e-003**	**0.2567**	**0.0676**	**1.8500e-003**	**0.0694**		**245.6231**	**245.6231**	**8.9200e-003**		**245.8460**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	27.8365					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Off-Road	0.0594	1.3570	1.8324	2.9700e-003		0.0951	0.0951		0.0951	0.0951	0.0000	281.4481	281.4481	0.0183		281.9062
Total	**27.8959**	**1.3570**	**1.8324**	**2.9700e-003**		**0.0951**	**0.0951**		**0.0951**	**0.0951**	**0.0000**	**281.4481**	**281.4481**	**0.0183**		**281.9062**

3.7 Architectural Coating - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1200	0.0905	0.9814	2.4700e-003	0.2547	2.0100e-003	0.2567	0.0676	1.8500e-003	0.0694		245.6231	245.6231	8.9200e-003		245.8460
Total	**0.1200**	**0.0905**	**0.9814**	**2.4700e-003**	**0.2547**	**2.0100e-003**	**0.2567**	**0.0676**	**1.8500e-003**	**0.0694**		**245.6231**	**245.6231**	**8.9200e-003**		**245.8460**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	7.0723	21.7074	77.2331	0.2090	16.1097	0.2148	16.3246	4.3656	0.2010	4.5666		21,043.2841	21,043.2841	0.9351		21,066.6607
Unmitigated	7.0723	21.7074	77.2331	0.2090	16.1097	0.2148	16.3246	4.3656	0.2010	4.5666		21,043.2841	21,043.2841	0.9351		21,066.6607

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Low Rise	164.75	179.00	151.75	475,141	475,141
Apartments Mid Rise	465.50	447.30	410.20	1,310,804	1,310,804
General Light Industry	22.44	4.25	2.19	49,489	49,489
Health Club	1,112.38	704.99	902.94	1,769,576	1,769,576
Parking Lot	0.00	0.00	0.00		
Research & Development	507.93	119.00	69.52	976,779	976,779
University/College (4Yr)	901.17	685.10	0.00	1,872,918	1,872,918
Total	3,174.17	2,139.64	1,536.60	6,454,706	6,454,706

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Low Rise	10.80	7.30	7.50	44.00	18.80	37.20	86	11	3
Apartments Mid Rise	10.80	7.30	7.50	44.00	18.80	37.20	86	11	3
General Light Industry	9.50	7.30	7.30	59.00	28.00	13.00	92	5	3
Health Club	9.50	7.30	7.30	16.90	64.10	19.00	52	39	9
Parking Lot	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0
Research & Development	9.50	7.30	7.30	33.00	48.00	19.00	82	15	3
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Low Rise	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Apartments Mid Rise	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Apartments Mid Rise	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
General Light Industry	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Health Club	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Parking Lot	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
Research & Development	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058
University/College (4Yr)	0.575986	0.028505	0.206594	0.118540	0.020331	0.004884	0.021052	0.012380	0.001237	0.002682	0.005754	0.000999	0.001058

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.1542	1.3877	1.0757	8.4100e-003		0.1065	0.1065		0.1065	0.1065		1,681.8512	1,681.8512	0.0322	0.0308	1,691.8456
NaturalGas Unmitigated	0.1542	1.3877	1.0757	8.4100e-003		0.1065	0.1065		0.1065	0.1065		1,681.8512	1,681.8512	0.0322	0.0308	1,691.8456

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Low Rise	698.551	7.5300e-003	0.0644	0.0274	4.1000e-004		5.2000e-003	5.2000e-003		5.2000e-003	5.2000e-003		82.1825	82.1825	1.5800e-003	1.5100e-003	82.6709
Apartments Mid Rise	1656.88	0.0179	0.1527	0.0650	9.7000e-004		0.0124	0.0124		0.0124	0.0124		194.9272	194.9272	3.7400e-003	3.5700e-003	196.0855
General Light Industry	232.493	2.5100e-003	0.0228	0.0192	1.4000e-004		1.7300e-003	1.7300e-003		1.7300e-003	1.7300e-003		27.3521	27.3521	5.2000e-004	5.0000e-004	27.5147
Health Club	2441.7	0.0263	0.2394	0.2011	1.4400e-003		0.0182	0.0182		0.0182	0.0182		287.2584	287.2584	5.5100e-003	5.2700e-003	288.9654
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	4526.65	0.0488	0.4438	0.3728	2.6600e-003		0.0337	0.0337		0.0337	0.0337		532.5472	532.5472	0.0102	9.7600e-003	535.7119
University/College (4Yr)	4739.46	0.0511	0.4647	0.3903	2.7900e-003		0.0353	0.0353		0.0353	0.0353		557.5838	557.5838	0.0107	0.0102	560.8973
Total		**0.1542**	**1.3877**	**1.0757**	**8.4100e-003**		**0.1065**	**0.1065**		**0.1065**	**0.1065**		**1,681.8512**	**1,681.8512**	**0.0323**	**0.0308**	**1,691.8456**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Low Rise	0.698551	7.5300e-003	0.0644	0.0274	4.1000e-004		5.2000e-003	5.2000e-003		5.2000e-003	5.2000e-003		82.1825	82.1825	1.5800e-003	1.5100e-003	82.6709
Apartments Mid Rise	1.65688	0.0179	0.1527	0.0650	9.7000e-004		0.0124	0.0124		0.0124	0.0124		194.9272	194.9272	3.7400e-003	3.5700e-003	196.0855
General Light Industry	0.232493	2.5100e-003	0.0228	0.0192	1.4000e-004		1.7300e-003	1.7300e-003		1.7300e-003	1.7300e-003		27.3521	27.3521	5.2000e-004	5.0000e-004	27.5147
Health Club	2.4417	0.0263	0.2394	0.2011	1.4400e-003		0.0182	0.0182		0.0182	0.0182		287.2584	287.2584	5.5100e-003	5.2700e-003	288.9654
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	4.52665	0.0488	0.4438	0.3728	2.6600e-003		0.0337	0.0337		0.0337	0.0337		532.5472	532.5472	0.0102	9.7600e-003	535.7119
University/College (4Yr)	4.73946	0.0511	0.4647	0.3903	2.7900e-003		0.0353	0.0353		0.0353	0.0353		557.5838	557.5838	0.0107	0.0102	560.8973
Total		**0.1542**	**1.3877**	**1.0757**	**8.4100e-003**		**0.1065**	**0.1065**		**0.1065**	**0.1065**		**1,681.8512**	**1,681.8512**	**0.0323**	**0.0308**	**1,691.8456**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Low VOC Paint - Residential Interior

Use Low VOC Paint - Residential Exterior

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	6.2735	0.0910	7.9036	4.2000e-004		0.0436	0.0436		0.0436	0.0436	0.0000	14.2501	14.2501	0.0139	0.0000	14.5984
Unmitigated	6.7332	0.0910	7.9036	4.2000e-004		0.0436	0.0436		0.0436	0.0436	0.0000	14.2501	14.2501	0.0139	0.0000	14.5984

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.7703					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	5.7208					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.2421	0.0910	7.9036	4.2000e-004		0.0436	0.0436		0.0436	0.0436		14.2501	14.2501	0.0139		14.5984
Total	**6.7332**	**0.0910**	**7.9036**	**4.2000e-004**		**0.0436**	**0.0436**		**0.0436**	**0.0436**	**0.0000**	**14.2501**	**14.2501**	**0.0139**	**0.0000**	**14.5984**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.3106					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	5.7208					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.2421	0.0910	7.9036	4.2000e-004		0.0436	0.0436		0.0436	0.0436		14.2501	14.2501	0.0139		14.5984
Total	**6.2735**	**0.0910**	**7.9036**	**4.2000e-004**		**0.0436**	**0.0436**		**0.0436**	**0.0436**	**0.0000**	**14.2501**	**14.2501**	**0.0139**	**0.0000**	**14.5984**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

UCSC - 2020 LRDP - Operational Only

Santa Cruz County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Research & Development	1,127.37	1000sqft	25.88	1,127,373.00	0
University/College (4Yr)	9,482.00	Student	40.01	1,290,438.00	0
General Light Industry	57.90	1000sqft	1.33	57,903.00	0
Parking Lot	43.07	Acre	43.07	1,876,275.00	0
Health Club	608.11	1000sqft	13.96	608,110.00	0
Apartments Low Rise	440.00	Dwelling Unit	27.50	660,000.00	550
Apartments Mid Rise	1,257.00	Dwelling Unit	33.08	1,885,000.00	8500

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	1.8	**Precipitation Freq (Days)**	61
Climate Zone	4			**Operational Year**	2040
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	77.8	**CH4 Intensity (lb/MWhr)**	0.005	**N2O Intensity (lb/MWhr)**	0.001

1.3 User Entered Comments & Non-Default Data

Project Characteristics - UCSC Electricity Emission Factors for 2040 reflect State averages.

Land Use - Values specified in Project Description

Construction Phase - This file is for operational emissions, so construction phases are removed.

Off-road Equipment -

Off-road Equipment - This file is for operational emissions, so construction phases are removed.

Off-road Equipment -

Trips and VMT -

On-road Fugitive Dust -

Demolition -

Architectural Coating -

Vehicle Trips - Adjusted trip rates so that avg annual VMT matches Traffic Study.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Woodstoves -

Consumer Products -

Area Coating -

Energy Use - Energy intensity rates adjusted 2019 Title 24 standards.

Water And Wastewater -

Solid Waste -

Sequestration - Using Pine as subsititute for redwood trees. 22 trees/acre.

Construction Off-road Equipment Mitigation -

Area Mitigation - Zero-VOC paints and coatings (5 g/L), low-VOC cleaning supplies. 100% electric lawn and garden equipment.

Energy Mitigation -

Fleet Mix -

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	ConstArea_Nonresidential_Exterior	1,541,912.00	1,027,942.00
tblArchitecturalCoating	ConstArea_Nonresidential_Interior	4,625,736.00	3,083,825.00
tblArchitecturalCoating	ConstArea_Residential_Exterior	1,717,875.00	1,145,475.00
tblArchitecturalCoating	ConstArea_Residential_Interior	5,153,625.00	3,436,425.00
tblAreaMitigation	UseLowVOCPaintNonresidentialExteriorValue	150	5
tblAreaMitigation	UseLowVOCPaintNonresidentialInteriorValue	150	5
tblAreaMitigation	UseLowVOCPaintParkingCheck	False	True
tblAreaMitigation	UseLowVOCPaintParkingValue	150	5
tblAreaMitigation	UseLowVOCPaintResidentialExteriorValue	100	5
tblAreaMitigation	UseLowVOCPaintResidentialInteriorValue	100	5
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstructionPhase	NumDays	220.00	0.00
tblConstructionPhase	NumDays	3,100.00	1.00
tblConstructionPhase	NumDays	200.00	0.00
tblConstructionPhase	NumDays	310.00	0.00
tblConstructionPhase	NumDays	220.00	0.00
tblConstructionPhase	NumDays	120.00	0.00
tblEnergyUse	T24E	365.68	244.86
tblEnergyUse	T24E	332.81	222.85
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	2.73	2.59
tblEnergyUse	T24NG	7,043.85	4,716.56

tblEnergyUse	T24NG	5,484.45	3,672.39
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	20.83	19.79
tblGrading	AcresOfGrading	0.00	775.00
tblLandUse	LandUseSquareFeet	1,127,370.00	1,127,373.00
tblLandUse	LandUseSquareFeet	1,742,767.59	1,290,438.00
tblLandUse	LandUseSquareFeet	57,900.00	57,903.00
tblLandUse	LandUseSquareFeet	1,876,129.20	1,876,275.00
tblLandUse	LandUseSquareFeet	440,000.00	660,000.00
tblLandUse	LandUseSquareFeet	1,257,000.00	1,885,000.00
tblLandUse	Population	1,258.00	550.00
tblLandUse	Population	3,595.00	8,500.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblProjectCharacteristics	CH4IntensityFactor	0.029	0.005
tblProjectCharacteristics	CO2IntensityFactor	641.35	77.8
tblProjectCharacteristics	N2OIntensityFactor	0.006	0.001
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblSequestration	NumberOfNewTrees	0.00	-3,386.00
tblSolidWaste	SolidWasteGenerationRate	71.80	47.86
tblSolidWaste	SolidWasteGenerationRate	3,466.23	2,310.84
tblSolidWaste	SolidWasteGenerationRate	85.67	57.11

tblTripsAndVMT	VendorTripNumber	994.00	826.00
tblTripsAndVMT	WorkerTripNumber	3,192.00	2,798.00
tblTripsAndVMT	WorkerTripNumber	638.00	560.00
tblVehicleEF	HHD	0.24	0.19
tblVehicleEF	HHD	0.06	0.04
tblVehicleEF	HHD	0.06	0.00
tblVehicleEF	HHD	1.31	54.39
tblVehicleEF	HHD	1.00	0.41
tblVehicleEF	HHD	3.88	7.9690e-003
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tblVehicleEF	HHD	19.32	3.06

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tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
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tblVehicleEF	LDA	7.7480e-003	0.06

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tblVehicleEF	LDT1	0.01	0.12
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tblVehicleEF	LDT1	2.2040e-003	2.3280e-003
tblVehicleEF	LDT1	4.6000e-004	4.5400e-004

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tblVehicleEF	LDT1	0.02	0.24
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tblVehicleEF	LHD1	1.2360e-003	0.01
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	8.0900e-004	9.2900e-003
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.15	0.24
tblVehicleEF	LHD1	0.12	0.04
tblVehicleEF	LHD1	3.7210e-003	0.05
tblVehicleEF	LHD1	5.3890e-003	4.0070e-003
tblVehicleEF	LHD1	7.7400e-003	6.7790e-003
tblVehicleEF	LHD1	0.14	2.44
tblVehicleEF	LHD1	0.47	0.38
tblVehicleEF	LHD1	1.18	0.70
tblVehicleEF	LHD1	8.78	107.82
tblVehicleEF	LHD1	634.75	658.76
tblVehicleEF	LHD1	27.02	8.57
tblVehicleEF	LHD1	0.05	0.55
tblVehicleEF	LHD1	0.41	0.19
tblVehicleEF	LHD1	0.53	0.17
tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003

tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	2.3600e-003	0.03
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	1.5530e-003	0.02
tblVehicleEF	LHD1	0.09	0.06
tblVehicleEF	LHD1	0.14	0.22
tblVehicleEF	LHD1	0.10	0.03
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
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tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	1.5530e-003	0.02
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.14	0.22
tblVehicleEF	LHD1	0.11	0.03
tblVehicleEF	LHD1	3.7210e-003	0.05
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tblVehicleEF	LHD1	634.75	658.75
tblVehicleEF	LHD1	27.02	8.78
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tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003
tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	6.2900e-004	7.2020e-003
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	3.1500e-004	3.5920e-003
tblVehicleEF	LHD1	0.08	0.06
tblVehicleEF	LHD1	0.17	0.27
tblVehicleEF	LHD1	0.12	0.04
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
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tblVehicleEF	LHD1	6.2900e-004	7.2020e-003
tblVehicleEF	LHD1	0.07	0.05

tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	3.1500e-004	3.5920e-003
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.17	0.27
tblVehicleEF	LHD1	0.13	0.04
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7450e-003	5.0520e-003
tblVehicleEF	LHD2	2.1760e-003	3.0390e-003
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tblVehicleEF	LHD2	0.10	0.33
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tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
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tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
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tblVehicleEF	LHD2	0.01	0.02

tblVehicleEF	LHD2	0.01	0.16
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tblVehicleEF	LHD2	0.03	0.09
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tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
tblVehicleEF	LHD2	6.4320e-003	6.0800e-003
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tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	2.4200e-004	3.8700e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.09
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7720e-003	5.0740e-003
tblVehicleEF	LHD2	2.1430e-003	2.8520e-003
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tblVehicleEF	LHD2	0.44	0.50
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tblVehicleEF	LHD2	0.10	0.32
tblVehicleEF	LHD2	0.19	0.08

tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
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tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	4.7800e-004	7.5310e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.08
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
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tblVehicleEF	LHD2	2.2300e-004	4.9000e-005
tblVehicleEF	LHD2	7.3200e-004	0.01
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	4.7800e-004	7.5310e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.08
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	2.1810e-003	0.03
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tblVehicleEF	LHD2	2.2020e-003	3.1870e-003
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tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.90	0.41
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.01
tblVehicleEF	LHD2	21.05	5.03
tblVehicleEF	LHD2	0.05	0.89
tblVehicleEF	LHD2	0.10	0.34
tblVehicleEF	LHD2	0.20	0.09
tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	1.8500e-004	2.9740e-003
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	9.3000e-005	1.4940e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.10
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
tblVehicleEF	LHD2	6.4320e-003	6.0800e-003

tblVehicleEF	LHD2	2.2500e-004	5.0000e-005
tblVehicleEF	LHD2	1.8500e-004	2.9740e-003
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	9.3000e-005	1.4940e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.10
tblVehicleEF	LHD2	0.03	0.02
tblVehicleEF	MCY	0.53	0.36
tblVehicleEF	MCY	0.17	0.26
tblVehicleEF	MCY	18.33	18.38
tblVehicleEF	MCY	10.94	9.75
tblVehicleEF	MCY	182.27	219.06
tblVehicleEF	MCY	43.71	61.12
tblVehicleEF	MCY	1.18	1.19
tblVehicleEF	MCY	0.32	0.28
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	0.75	1.56
tblVehicleEF	MCY	0.74	0.77
tblVehicleEF	MCY	0.37	0.77
tblVehicleEF	MCY	2.48	2.49
tblVehicleEF	MCY	0.47	1.31
tblVehicleEF	MCY	2.26	2.01
tblVehicleEF	MCY	2.1980e-003	2.1680e-003

tblVehicleEF	MCY	6.8200e-004	6.0500e-004
tblVehicleEF	MCY	0.75	1.56
tblVehicleEF	MCY	0.74	0.77
tblVehicleEF	MCY	0.37	0.77
tblVehicleEF	MCY	3.10	3.11
tblVehicleEF	MCY	0.47	1.31
tblVehicleEF	MCY	2.46	2.19
tblVehicleEF	MCY	0.51	0.35
tblVehicleEF	MCY	0.14	0.21
tblVehicleEF	MCY	16.96	17.00
tblVehicleEF	MCY	9.17	8.10
tblVehicleEF	MCY	182.27	216.52
tblVehicleEF	MCY	43.71	57.27
tblVehicleEF	MCY	1.05	1.05
tblVehicleEF	MCY	0.30	0.25
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	1.84	3.79
tblVehicleEF	MCY	0.88	0.92
tblVehicleEF	MCY	0.88	1.82
tblVehicleEF	MCY	2.39	2.39
tblVehicleEF	MCY	0.41	1.15
tblVehicleEF	MCY	1.86	1.64
tblVehicleEF	MCY	2.1730e-003	2.1430e-003
tblVehicleEF	MCY	6.4100e-004	5.6700e-004

tblVehicleEF	MCY	1.84	3.79
tblVehicleEF	MCY	0.88	0.92
tblVehicleEF	MCY	0.88	1.82
tblVehicleEF	MCY	2.98	2.99
tblVehicleEF	MCY	0.41	1.15
tblVehicleEF	MCY	2.02	1.78
tblVehicleEF	MCY	0.54	0.37
tblVehicleEF	MCY	0.19	0.30
tblVehicleEF	MCY	19.75	19.80
tblVehicleEF	MCY	12.83	11.48
tblVehicleEF	MCY	182.27	221.65
tblVehicleEF	MCY	43.71	65.04
tblVehicleEF	MCY	1.26	1.26
tblVehicleEF	MCY	0.35	0.30
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	0.22	0.45
tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	0.11	0.22
tblVehicleEF	MCY	2.57	2.58
tblVehicleEF	MCY	0.58	1.61
tblVehicleEF	MCY	2.65	2.36
tblVehicleEF	MCY	2.2240e-003	2.1930e-003
tblVehicleEF	MCY	7.2500e-004	6.4400e-004
tblVehicleEF	MCY	0.22	0.45

tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	0.11	0.22
tblVehicleEF	MCY	3.21	3.22
tblVehicleEF	MCY	0.58	1.61
tblVehicleEF	MCY	2.88	2.57
tblVehicleEF	MDV	4.6980e-003	1.3630e-003
tblVehicleEF	MDV	6.0110e-003	0.03
tblVehicleEF	MDV	0.64	0.51
tblVehicleEF	MDV	1.36	2.26
tblVehicleEF	MDV	339.26	305.96
tblVehicleEF	MDV	73.02	62.75
tblVehicleEF	MDV	0.07	0.03
tblVehicleEF	MDV	0.12	0.17
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.13	0.09
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.01	4.9950e-003
tblVehicleEF	MDV	0.08	0.29
tblVehicleEF	MDV	0.08	0.15
tblVehicleEF	MDV	3.3930e-003	2.7170e-003
tblVehicleEF	MDV	7.5300e-004	5.5600e-004
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.13	0.09

tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.02	7.1990e-003
tblVehicleEF	MDV	0.08	0.29
tblVehicleEF	MDV	0.09	0.16
tblVehicleEF	MDV	5.0540e-003	1.4900e-003
tblVehicleEF	MDV	5.0610e-003	0.03
tblVehicleEF	MDV	0.70	0.56
tblVehicleEF	MDV	1.10	1.76
tblVehicleEF	MDV	355.62	315.48
tblVehicleEF	MDV	73.02	61.81
tblVehicleEF	MDV	0.06	0.03
tblVehicleEF	MDV	0.11	0.15
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.09	0.43
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.09	0.39
tblVehicleEF	MDV	0.01	5.3540e-003
tblVehicleEF	MDV	0.07	0.26
tblVehicleEF	MDV	0.07	0.12
tblVehicleEF	MDV	3.5580e-003	2.8010e-003
tblVehicleEF	MDV	7.4800e-004	5.4800e-004
tblVehicleEF	MDV	0.09	0.43
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.09	0.39

tblVehicleEF	MDV	0.02	7.7230e-003
tblVehicleEF	MDV	0.07	0.26
tblVehicleEF	MDV	0.07	0.13
tblVehicleEF	MDV	4.6150e-003	1.3220e-003
tblVehicleEF	MDV	6.8120e-003	0.04
tblVehicleEF	MDV	0.64	0.51
tblVehicleEF	MDV	1.56	2.64
tblVehicleEF	MDV	338.97	305.81
tblVehicleEF	MDV	73.02	63.49
tblVehicleEF	MDV	0.07	0.03
tblVehicleEF	MDV	0.13	0.18
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.02	0.10
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.02	0.07
tblVehicleEF	MDV	0.01	4.9120e-003
tblVehicleEF	MDV	0.10	0.35
tblVehicleEF	MDV	0.09	0.17
tblVehicleEF	MDV	3.3900e-003	2.7150e-003
tblVehicleEF	MDV	7.5700e-004	5.6300e-004
tblVehicleEF	MDV	0.02	0.10
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.02	0.07
tblVehicleEF	MDV	0.02	7.0780e-003

tblVehicleEF	MDV	0.10	0.35
tblVehicleEF	MDV	0.10	0.18
tblVehicleEF	MH	5.4220e-003	4.1740e-003
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.26	0.23
tblVehicleEF	MH	3.31	1.50
tblVehicleEF	MH	1,176.44	1,266.18
tblVehicleEF	MH	55.59	14.09
tblVehicleEF	MH	0.77	1.12
tblVehicleEF	MH	0.58	0.24
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.14	0.01
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	3.9420e-003	0.24
tblVehicleEF	MH	0.20	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.1400e-004	1.3900e-004
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.02
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tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	3.9420e-003	0.24
tblVehicleEF	MH	0.22	0.08
tblVehicleEF	MH	5.6040e-003	4.2710e-003
tblVehicleEF	MH	0.01	0.02
tblVehicleEF	MH	0.27	0.23
tblVehicleEF	MH	3.00	1.37
tblVehicleEF	MH	1,176.44	1,266.19
tblVehicleEF	MH	55.59	13.86
tblVehicleEF	MH	0.73	1.08
tblVehicleEF	MH	0.53	0.22
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.54	0.04
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	3.7600e-003	0.23
tblVehicleEF	MH	0.19	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.0800e-004	1.3700e-004
tblVehicleEF	MH	0.54	0.04
tblVehicleEF	MH	0.03	0.02

tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	3.7600e-003	0.23
tblVehicleEF	MH	0.21	0.07
tblVehicleEF	MH	5.3060e-003	4.1110e-003
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.26	0.22
tblVehicleEF	MH	3.62	1.65
tblVehicleEF	MH	1,176.44	1,266.18
tblVehicleEF	MH	55.59	14.33
tblVehicleEF	MH	0.78	1.14
tblVehicleEF	MH	0.62	0.25
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.15	0.01
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.06	4.9680e-003
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	4.3120e-003	0.26
tblVehicleEF	MH	0.22	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.1900e-004	1.4200e-004
tblVehicleEF	MH	0.15	0.01

tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.06	4.9680e-003
tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	4.3120e-003	0.26
tblVehicleEF	MH	0.24	0.08
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2480e-003	7.7200e-004
tblVehicleEF	MHD	0.03	3.1220e-003
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tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	1.99	0.30
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tblVehicleEF	MHD	1,157.71	883.00
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tblVehicleEF	MHD	5.8000e-005	9.6200e-004
tblVehicleEF	MHD	3.0680e-003	7.5170e-003
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tblVehicleEF	MHD	0.02	5.0230e-003
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tblVehicleEF	MHD	2.1000e-004	1.1250e-003

tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	7.1260e-003	0.03
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tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	4.0000e-004	2.9000e-005
tblVehicleEF	MHD	3.1900e-004	1.7150e-003
tblVehicleEF	MHD	0.02	5.0230e-003
tblVehicleEF	MHD	0.03	0.21
tblVehicleEF	MHD	2.1000e-004	1.1250e-003
tblVehicleEF	MHD	0.05	0.01
tblVehicleEF	MHD	7.1260e-003	0.03
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tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2610e-003	7.8700e-004
tblVehicleEF	MHD	0.03	2.9270e-003
tblVehicleEF	MHD	0.17	3.16
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tblVehicleEF	MHD	1.81	0.27
tblVehicleEF	MHD	189.21	587.50
tblVehicleEF	MHD	1,157.71	883.00
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tblVehicleEF	MHD	0.50	3.07
tblVehicleEF	MHD	1.05	1.44
tblVehicleEF	MHD	14.05	1.96
tblVehicleEF	MHD	4.9000e-005	8.4500e-004
tblVehicleEF	MHD	3.0680e-003	7.5170e-003

tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	4.7000e-005	8.0900e-004
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tblVehicleEF	MHD	6.2200e-004	3.3590e-003
tblVehicleEF	MHD	0.02	5.1730e-003
tblVehicleEF	MHD	0.02	0.15
tblVehicleEF	MHD	4.1100e-004	2.2120e-003
tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	6.6650e-003	0.02
tblVehicleEF	MHD	0.12	0.01
tblVehicleEF	MHD	1.8120e-003	5.5700e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	3.9700e-004	2.9000e-005
tblVehicleEF	MHD	6.2200e-004	3.3590e-003
tblVehicleEF	MHD	0.02	5.1730e-003
tblVehicleEF	MHD	0.02	0.20
tblVehicleEF	MHD	4.1100e-004	2.2120e-003
tblVehicleEF	MHD	0.05	0.01
tblVehicleEF	MHD	6.6650e-003	0.02
tblVehicleEF	MHD	0.13	0.02
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2400e-003	7.6200e-004
tblVehicleEF	MHD	0.03	3.2720e-003
tblVehicleEF	MHD	0.33	4.16
tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	2.16	0.32

tblVehicleEF	MHD	163.98	600.32
tblVehicleEF	MHD	1,157.71	883.00
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tblVehicleEF	MHD	14.09	1.96
tblVehicleEF	MHD	7.1000e-005	1.1240e-003
tblVehicleEF	MHD	3.0680e-003	7.5170e-003
tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	6.8000e-005	1.0750e-003
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tblVehicleEF	MHD	1.6100e-004	8.6100e-004
tblVehicleEF	MHD	0.02	5.1140e-003
tblVehicleEF	MHD	0.02	0.15
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tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	8.0270e-003	0.03
tblVehicleEF	MHD	0.14	0.02
tblVehicleEF	MHD	1.5730e-003	5.6900e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	4.0300e-004	2.9000e-005
tblVehicleEF	MHD	1.6100e-004	8.6100e-004
tblVehicleEF	MHD	0.02	5.1140e-003
tblVehicleEF	MHD	0.03	0.21
tblVehicleEF	MHD	8.1000e-005	4.3200e-004
tblVehicleEF	MHD	0.05	0.01

tblVehicleEF	MHD	8.0270e-003	0.03
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tblVehicleEF	OBUS	4.4180e-003	3.2250e-003
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tblVehicleEF	OBUS	0.29	0.33
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tblVehicleEF	OBUS	1.75	1.20
tblVehicleEF	OBUS	1.7000e-005	1.8470e-003
tblVehicleEF	OBUS	2.5170e-003	7.3860e-003
tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
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tblVehicleEF	OBUS	9.8300e-004	1.3100e-004
tblVehicleEF	OBUS	1.1160e-003	0.02
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.79
tblVehicleEF	OBUS	5.5400e-004	0.01
tblVehicleEF	OBUS	0.03	0.02
tblVehicleEF	OBUS	0.05	0.24
tblVehicleEF	OBUS	0.28	0.08

tblVehicleEF	OBUS	8.5000e-004	0.01
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.5600e-004	1.2200e-004
tblVehicleEF	OBUS	1.1160e-003	0.02
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.05	1.03
tblVehicleEF	OBUS	5.5400e-004	0.01
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tblVehicleEF	OBUS	0.01	0.12
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tblVehicleEF	OBUS	1.69	1.18
tblVehicleEF	OBUS	1.5000e-005	1.6410e-003
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tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
tblVehicleEF	OBUS	1.4000e-005	1.5700e-003
tblVehicleEF	OBUS	2.3760e-003	7.0390e-003

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tblVehicleEF	OBUS	0.03	0.81
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tblVehicleEF	OBUS	0.05	1.06
tblVehicleEF	OBUS	1.1070e-003	0.02
tblVehicleEF	OBUS	0.04	0.03
tblVehicleEF	OBUS	0.05	0.23
tblVehicleEF	OBUS	0.29	0.08
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tblVehicleEF	SBUS	8.3700e-004	1.7300e-004
tblVehicleEF	SBUS	1.9700e-004	3.1360e-003
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tblVehicleEF	SBUS	0.01	0.03

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tblVehicleEF	UBUS	0.05	3.9600e-003
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tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	3.2160e-003	9.2000e-005
tblVehicleEF	UBUS	0.06	3.2100e-004
tblVehicleEF	UBUS	2.1090e-003	5.1000e-005
tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.02	1.9470e-003
tblVehicleEF	UBUS	0.90	7.5660e-003
tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.5900e-003	1.2000e-005
tblVehicleEF	UBUS	3.2160e-003	9.2000e-005

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tblVehicleEF	UBUS	2.1090e-003	5.1000e-005
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.02	1.9470e-003
tblVehicleEF	UBUS	0.99	8.2830e-003
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.06	1.4450e-003
tblVehicleEF	UBUS	3.31	27.63
tblVehicleEF	UBUS	6.96	0.12
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.21
tblVehicleEF	UBUS	2.65	0.55
tblVehicleEF	UBUS	12.22	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	5.9070e-003	1.9800e-004
tblVehicleEF	UBUS	0.07	3.5800e-004
tblVehicleEF	UBUS	4.1490e-003	1.2400e-004
tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.02	1.6760e-003
tblVehicleEF	UBUS	0.79	6.6320e-003

tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.5600e-003	1.2000e-005
tblVehicleEF	UBUS	5.9070e-003	1.9800e-004
tblVehicleEF	UBUS	0.07	3.5800e-004
tblVehicleEF	UBUS	4.1490e-003	1.2400e-004
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.02	1.6760e-003
tblVehicleEF	UBUS	0.86	7.2610e-003
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.07	1.7860e-003
tblVehicleEF	UBUS	3.29	27.63
tblVehicleEF	UBUS	10.37	0.17
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.30
tblVehicleEF	UBUS	2.79	0.55
tblVehicleEF	UBUS	12.42	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	1.7240e-003	3.8000e-005
tblVehicleEF	UBUS	0.06	3.4400e-004
tblVehicleEF	UBUS	9.9800e-004	2.0000e-005

tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.03	2.4500e-003
tblVehicleEF	UBUS	0.99	8.3520e-003
tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.6200e-003	1.3000e-005
tblVehicleEF	UBUS	1.7240e-003	3.8000e-005
tblVehicleEF	UBUS	0.06	3.4400e-004
tblVehicleEF	UBUS	9.9800e-004	2.0000e-005
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.03	2.4500e-003
tblVehicleEF	UBUS	1.09	9.1440e-003
tblVehicleTrips	CC_TTP	88.60	0.00
tblVehicleTrips	CNW_TTP	5.00	0.00
tblVehicleTrips	CW_TTP	6.40	0.00
tblVehicleTrips	HO_TL	7.90	0.00
tblVehicleTrips	HO_TL	7.90	0.00
tblVehicleTrips	HO_TL	0.00	6.89
tblVehicleTrips	HO_TTP	0.00	5.00
tblVehicleTrips	HS_TL	7.10	0.00
tblVehicleTrips	HS_TL	7.10	0.00
tblVehicleTrips	HS_TL	0.00	11.65
tblVehicleTrips	HS_TTP	0.00	88.00
tblVehicleTrips	HW_TL	16.80	0.00
tblVehicleTrips	HW_TL	16.80	0.00
tblVehicleTrips	HW_TL	0.00	15.00
tblVehicleTrips	HW_TTP	0.00	7.00
tblVehicleTrips	ST_TR	7.16	0.00

tblVehicleTrips	ST_TR	6.39	0.00
tblVehicleTrips	ST_TR	1.32	0.00
tblVehicleTrips	ST_TR	20.87	0.00
tblVehicleTrips	ST_TR	1.90	0.00
tblVehicleTrips	ST_TR	1.30	0.46
tblVehicleTrips	SU_TR	6.07	0.00
tblVehicleTrips	SU_TR	5.86	0.00
tblVehicleTrips	SU_TR	0.68	0.00
tblVehicleTrips	SU_TR	26.73	0.00
tblVehicleTrips	SU_TR	1.11	0.00
tblVehicleTrips	SU_TR	0.00	0.46
tblVehicleTrips	WD_TR	6.59	0.00
tblVehicleTrips	WD_TR	6.65	0.00
tblVehicleTrips	WD_TR	6.97	0.00
tblVehicleTrips	WD_TR	32.93	0.00
tblVehicleTrips	WD_TR	8.11	0.00
tblVehicleTrips	WD_TR	1.71	1.33
tblWater	IndoorWaterUseRate	13,389,375.00	8,926,250.00
tblWater	IndoorWaterUseRate	35,965,537.32	23,977,222.02
tblWater	IndoorWaterUseRate	554,321,005.26	369,547,336.84
tblWater	OutdoorWaterUseRate	22,043,393.84	14,695,716.72

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	0.0000	0.0000	0.0000	0.0000	1.1100e-003	0.0000	1.1100e-003	2.7000e-004	0.0000	2.7000e-004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024	7.7700e-003	0.0431	0.0621	2.5000e-004	0.0197	2.0000e-004	0.0199	5.2900e-003	1.8000e-004	5.4700e-003	0.0000	23.2139	23.2139	7.7000e-004	0.0000	23.2331
2036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**7.7700e-003**	**0.0431**	**0.0621**	**2.5000e-004**	**0.0197**	**2.0000e-004**	**0.0199**	**5.2900e-003**	**1.8000e-004**	**5.4700e-003**	**0.0000**	**23.2139**	**23.2139**	**7.7000e-004**	**0.0000**	**23.2331**

2.1 Overall Construction

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	0.0000	0.0000	0.0000	0.0000	1.1100e-003	0.0000	1.1100e-003	2.7000e-004	0.0000	2.7000e-004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024	7.7700e-003	0.0431	0.0621	2.5000e-004	0.0197	2.0000e-004	0.0199	5.2900e-003	1.8000e-004	5.4700e-003	0.0000	23.2139	23.2139	7.7000e-004	0.0000	23.2331
2036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**7.7700e-003**	**0.0431**	**0.0621**	**2.5000e-004**	**0.0197**	**2.0000e-004**	**0.0199**	**5.2900e-003**	**1.8000e-004**	**5.4700e-003**	**0.0000**	**23.2139**	**23.2139**	**7.7000e-004**	**0.0000**	**23.2331**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
10	**4-3-2024**	**7-2-2024**	0.1064	0.1064
		Highest	0.1064	0.1064

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	26.4146	0.2024	17.5672	9.3000e-004		0.0976	0.0976		0.0976	0.0976	0.0000	28.8678	28.8678	0.0279	0.0000	29.5661
Energy	0.4711	4.2477	3.3380	0.0257		0.3255	0.3255		0.3255	0.3255	0.0000	5,801.9438	5,801.9438	0.1626	0.1001	5,835.8460
Mobile	3.2717	8.6315	35.1242	0.1131	15.0196	0.0642	15.0838	4.0195	0.0602	4.0796	0.0000	11,464.4699	11,464.4699	0.4289	0.0000	11,475.1927
Waste						0.0000	0.0000		0.0000	0.0000	1,000.1141	0.0000	1,000.1141	59.1051	0.0000	2,477.7405
Water						0.0000	0.0000		0.0000	0.0000	169.1976	116.1847	285.3822	17.3857	0.4118	842.7497
Total	**30.1574**	**13.0816**	**56.0294**	**0.1397**	**15.0196**	**0.4873**	**15.5069**	**4.0195**	**0.4832**	**4.5027**	**1,169.3117**	**17,411.4663**	**18,580.7780**	**77.1102**	**0.5120**	**20,661.0950**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	20.8954	0.1607	13.3210	6.1000e-004		0.0726	0.0726		0.0726	0.0726	0.0000	20.1552	20.1552	0.0146	0.0000	20.5188
Energy	0.4711	4.2477	3.3380	0.0257		0.3255	0.3255		0.3255	0.3255	0.0000	5,801.9438	5,801.9438	0.1626	0.1001	5,835.8460
Mobile	3.2717	8.6315	35.1242	0.1131	15.0196	0.0642	15.0838	4.0195	0.0602	4.0796	0.0000	11,464.4699	11,464.4699	0.4289	0.0000	11,475.1927
Waste						0.0000	0.0000		0.0000	0.0000	1,000.1141	0.0000	1,000.1141	59.1051	0.0000	2,477.7405
Water						0.0000	0.0000		0.0000	0.0000	169.1976	116.1847	285.3822	17.3857	0.4118	842.7497
Total	**24.6382**	**13.0399**	**51.7832**	**0.1394**	**15.0196**	**0.4624**	**15.4820**	**4.0195**	**0.4583**	**4.4778**	**1,169.3117**	**17,402.7536**	**18,572.0653**	**77.0968**	**0.5120**	**20,652.0477**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	18.30	0.32	7.58	0.23	0.00	5.12	0.16	0.00	5.16	0.55	0.00	0.05	0.05	0.02	0.00	0.04

2.3 Vegetation

Vegetation

	CO2e
Category	MT
New Trees	-2,160.2680
Total	**-2,160.2680**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/3/2022	1/2/2022	5	0	
2	Site Preparation	Site Preparation	10/8/2022	10/7/2022	5	0	
3	Grading	Grading	3/25/2023	3/24/2023	5	0	
4	Building Construction	Building Construction	6/1/2024	6/3/2024	5	1	
5	Paving	Paving	4/19/2036	4/18/2036	5	0	
6	Architectural Coating	Architectural Coating	2/21/2037	2/20/2037	5	0	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 775

Acres of Paving: 43.07

Residential Indoor: 3,436,425; Residential Outdoor: 1,145,475; Non-Residential Indoor: 3,083,825; Non-Residential Outdoor: 1,027,942; Striped Parking Area: 112,577 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	158	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	2	8.00	158	0.38
Grading	Graders	1	8.00	187	0.41
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Building Construction	Cranes	0	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	0	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Paving	Pavers	2	8.00	130	0.42
Paving	Paving Equipment	2	8.00	132	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	6.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	175.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	0	2,798.00	826.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	560.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.2 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.2 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction - 2024

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction - 2024

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	9.6000e-004	0.0375	9.9300e-003	1.0000e-004	2.4400e-003	7.0000e-005	2.5100e-003	7.1000e-004	7.0000e-005	7.7000e-004	0.0000	9.5338	9.5338	3.5000e-004	0.0000	9.5426
Worker	6.8100e-003	5.5800e-003	0.0522	1.5000e-004	0.0172	1.3000e-004	0.0174	4.5800e-003	1.2000e-004	4.7000e-003	0.0000	13.6800	13.6800	4.2000e-004	0.0000	13.6905
Total	**7.7700e-003**	**0.0431**	**0.0621**	**2.5000e-004**	**0.0197**	**2.0000e-004**	**0.0199**	**5.2900e-003**	**1.9000e-004**	**5.4700e-003**	**0.0000**	**23.2139**	**23.2139**	**7.7000e-004**	**0.0000**	**23.2331**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction - 2024

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	9.6000e-004	0.0375	9.9300e-003	1.0000e-004	2.4400e-003	7.0000e-005	2.5100e-003	7.1000e-004	7.0000e-005	7.7000e-004	0.0000	9.5338	9.5338	3.5000e-004	0.0000	9.5426
Worker	6.8100e-003	5.5800e-003	0.0522	1.5000e-004	0.0172	1.3000e-004	0.0174	4.5800e-003	1.2000e-004	4.7000e-003	0.0000	13.6800	13.6800	4.2000e-004	0.0000	13.6905
Total	**7.7700e-003**	**0.0431**	**0.0621**	**2.5000e-004**	**0.0197**	**2.0000e-004**	**0.0199**	**5.2900e-003**	**1.9000e-004**	**5.4700e-003**	**0.0000**	**23.2139**	**23.2139**	**7.7000e-004**	**0.0000**	**23.2331**

3.6 Paving - 2036

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Paving - 2036

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Paving - 2036

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	3.2717	8.6315	35.1242	0.1131	15.0196	0.0642	15.0838	4.0195	0.0602	4.0796	0.0000	11,464.4699	11,464.4699	0.4289	0.0000	11,475.1927
Unmitigated	3.2717	8.6315	35.1242	0.1131	15.0196	0.0642	15.0838	4.0195	0.0602	4.0796	0.0000	11,464.4699	11,464.4699	0.4289	0.0000	11,475.1927

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Low Rise	0.00	0.00	0.00		
Apartments Mid Rise	0.00	0.00	0.00		
General Light Industry	0.00	0.00	0.00		
Health Club	0.00	0.00	0.00		
Parking Lot	0.00	0.00	0.00		
Research & Development	0.00	0.00	0.00		
University/College (4Yr)	12,609.15	4,344.33	4344.33	40,511,214	40,511,214
Total	12,609.15	4,344.33	4,344.33	40,511,214	40,511,214

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Low Rise	0.00	0.00	0.00	44.00	18.80	37.20	86	11	3
Apartments Mid Rise	0.00	0.00	0.00	44.00	18.80	37.20	86	11	3
General Light Industry	14.70	6.60	6.60	59.00	28.00	13.00	92	5	3
Health Club	14.70	6.60	6.60	16.90	64.10	19.00	52	39	9
Parking Lot	14.70	6.60	6.60	0.00	0.00	0.00	0	0	0
Research & Development	14.70	6.60	6.60	33.00	48.00	19.00	82	15	3
University/College (4Yr)	14.70	6.60	6.60	0.00	0.00	0.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Low Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Apartments Mid Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Apartments Mid Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
General Light Industry	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Health Club	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Parking Lot	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Research & Development	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
University/College (4Yr)	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

UCSC - 2020 LRDP - Operational Only - Santa Cruz County, Annual

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	1,139.2384	1,139.2384	0.0732	0.0146	1,145.4325
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	1,139.2384	1,139.2384	0.0732	0.0146	1,145.4325
NaturalGas Mitigated	0.4711	4.2477	3.3380	0.0257		0.3255	0.3255		0.3255	0.3255	0.0000	4,662.7054	4,662.7054	0.0894	0.0855	4,690.4135
NaturalGas Unmitigated	0.4711	4.2477	3.3380	0.0257		0.3255	0.3255		0.3255	0.3255	0.0000	4,662.7054	4,662.7054	0.0894	0.0855	4,690.4135

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Low Rise	3.46349e+006	0.0187	0.1596	0.0679	1.0200e-003		0.0129	0.0129		0.0129	0.0129	0.0000	184.8248	184.8248	3.5400e-003	3.3900e-003	185.9232
Apartments Mid Rise	8.58203e+006	0.0463	0.3955	0.1683	2.5200e-003		0.0320	0.0320		0.0320	0.0320	0.0000	457.9698	457.9698	8.7800e-003	8.4000e-003	460.6913
General Light Industry	1.47016e+006	7.9300e-003	0.0721	0.0605	4.3000e-004		5.4800e-003	5.4800e-003		5.4800e-003	5.4800e-003	0.0000	78.4532	78.4532	1.5000e-003	1.4400e-003	78.9194
Health Club	1.54399e+007	0.0833	0.7569	0.6358	4.5400e-003		0.0575	0.0575		0.0575	0.0575	0.0000	823.9326	823.9326	0.0158	0.0151	828.8288
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	2.8624e+007	0.1544	1.4031	1.1786	8.4200e-003		0.1066	0.1066		0.1066	0.1066	0.0000	1,527.4857	1,527.4857	0.0293	0.0280	1,536.5628
University/College (4Yr)	2.97962e+007	0.1607	1.4606	1.2269	8.7600e-003		0.1110	0.1110		0.1110	0.1110	0.0000	1,590.0394	1,590.0394	0.0305	0.0292	1,599.4882
Total		**0.4712**	**4.2477**	**3.3380**	**0.0257**		**0.3255**	**0.3255**		**0.3255**	**0.3255**	**0.0000**	**4,662.7054**	**4,662.7054**	**0.0894**	**0.0855**	**4,690.4136**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Low Rise	3.46349e+006	0.0187	0.1596	0.0679	1.0200e-003		0.0129	0.0129		0.0129	0.0129	0.0000	184.8248	184.8248	3.5400e-003	3.3900e-003	185.9232
Apartments Mid Rise	8.58203e+006	0.0463	0.3955	0.1683	2.5200e-003		0.0320	0.0320		0.0320	0.0320	0.0000	457.9698	457.9698	8.7800e-003	8.4000e-003	460.6913
General Light Industry	1.47016e+006	7.9300e-003	0.0721	0.0605	4.3000e-004		5.4800e-003	5.4800e-003		5.4800e-003	5.4800e-003	0.0000	78.4532	78.4532	1.5000e-003	1.4400e-003	78.9194
Health Club	1.54399e+007	0.0833	0.7569	0.6358	4.5400e-003		0.0575	0.0575		0.0575	0.0575	0.0000	823.9326	823.9326	0.0158	0.0151	828.8288
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	2.8624e+007	0.1544	1.4031	1.1786	8.4200e-003		0.1066	0.1066		0.1066	0.1066	0.0000	1,527.4857	1,527.4857	0.0293	0.0280	1,536.5628
University/College (4Yr)	2.97962e+007	0.1607	1.4606	1.2269	8.7600e-003		0.1110	0.1110		0.1110	0.1110	0.0000	1,590.0394	1,590.0394	0.0305	0.0292	1,599.4882
Total		**0.4712**	**4.2477**	**3.3380**	**0.0257**		**0.3255**	**0.3255**		**0.3255**	**0.3255**	**0.0000**	**4,662.7054**	**4,662.7054**	**0.0894**	**0.0855**	**4,690.4136**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Low Rise	1.86031e +006	65.6494	4.2200e-003	8.4000e-004	66.0064
Apartments Mid Rise	5.05112e +006	178.2513	0.0115	2.2900e-003	179.2205
General Light Industry	474226	16.7352	1.0800e-003	2.2000e-004	16.8262
Health Club	4.98042e +006	175.7565	0.0113	2.2600e-003	176.7121
Parking Lot	656696	23.1745	1.4900e-003	3.0000e-004	23.3005
Research & Development	9.23318e +006	325.8344	0.0209	4.1900e-003	327.6059
University/College (4Yr)	1.00267e +007	353.8372	0.0227	4.5500e-003	355.7610
Total		**1,139.2384**	**0.0732**	**0.0147**	**1,145.4325**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Low Rise	1.86031e +006	65.6494	4.2200e-003	8.4000e-004	66.0064
Apartments Mid Rise	5.05112e +006	178.2513	0.0115	2.2900e-003	179.2205
General Light Industry	474226	16.7352	1.0800e-003	2.2000e-004	16.8262
Health Club	4.98042e +006	175.7565	0.0113	2.2600e-003	176.7121
Parking Lot	656696	23.1745	1.4900e-003	3.0000e-004	23.3005
Research & Development	9.23318e +006	325.8344	0.0209	4.1900e-003	327.6059
University/College (4Yr)	1.00267e +007	353.8372	0.0227	4.5500e-003	355.7610
Total		**1,139.238 4**	**0.0732**	**0.0147**	**1,145.432 5**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Electric Lawnmower

Use Electric Leafblower

Use Electric Chainsaw

Use Low VOC Paint - Residential Interior

Use Low VOC Paint - Residential Exterior

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

Use Low VOC Cleaning Supplies

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	20.8954	0.1607	13.3210	6.1000e-004		0.0726	0.0726		0.0726	0.0726	0.0000	20.1552	20.1552	0.0146	0.0000	20.5188
Unmitigated	26.4146	0.2024	17.5672	9.3000e-004		0.0976	0.0976		0.0976	0.0976	0.0000	28.8678	28.8678	0.0279	0.0000	29.5661

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	3.7756					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	22.1047					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.5343	0.2024	17.5672	9.3000e-004		0.0976	0.0976		0.0976	0.0976	0.0000	28.8678	28.8678	0.0279	0.0000	29.5661
Total	**26.4146**	**0.2024**	**17.5672**	**9.3000e-004**		**0.0976**	**0.0976**		**0.0976**	**0.0976**	**0.0000**	**28.8678**	**28.8678**	**0.0279**	**0.0000**	**29.5661**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.1524					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	20.4610					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.2820	0.1607	13.3210	6.1000e-004		0.0726	0.0726		0.0726	0.0726	0.0000	20.1552	20.1552	0.0146	0.0000	20.5188
Total	**20.8954**	**0.1607**	**13.3210**	**6.1000e-004**		**0.0726**	**0.0726**		**0.0726**	**0.0726**	**0.0000**	**20.1552**	**20.1552**	**0.0146**	**0.0000**	**20.5188**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	285.3822	17.3857	0.4118	842.7497
Unmitigated	285.3822	17.3857	0.4118	842.7497

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Low Rise	28.6678 / 18.0732	16.8014	0.9346	0.0222	46.7698
Apartments Mid Rise	81.8986 / 51.6317	47.9985	2.6701	0.0633	133.6128
General Light Industry	8.92625 / 0	4.5364	0.2910	6.8900e-003	13.8638
Health Club	23.9772 / 14.6957	14.0005	0.7817	0.0185	39.0652
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Research & Development	369.547 / 0	187.8059	12.0462	0.2852	573.9628
University/College (4Yr)	20.3019 / 31.7543	14.2396	0.6620	0.0157	35.4753
Total		**285.3823**	**17.3857**	**0.4118**	**842.7497**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Low Rise	28.6678 / 18.0732	16.8014	0.9346	0.0222	46.7698
Apartments Mid Rise	81.8986 / 51.6317	47.9985	2.6701	0.0633	133.6128
General Light Industry	8.92625 / 0	4.5364	0.2910	6.8900e-003	13.8638
Health Club	23.9772 / 14.6957	14.0005	0.7817	0.0185	39.0652
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Research & Development	369.547 / 0	187.8059	12.0462	0.2852	573.9628
University/College (4Yr)	20.3019 / 31.7543	14.2396	0.6620	0.0157	35.4753
Total		**285.3823**	**17.3857**	**0.4118**	**842.7497**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	1,000.114 1	59.1051	0.0000	2,477.740 5
Unmitigated	1,000.114 1	59.1051	0.0000	2,477.740 5

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Low Rise	202.4	41.0854	2.4281	0.0000	101.7873
Apartments Mid Rise	578.22	117.3734	6.9366	0.0000	290.7877
General Light Industry	47.86	9.7152	0.5742	0.0000	24.0689
Health Club	2310.84	469.0796	27.7218	0.0000	1,162.125 0
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Research & Development	57.11	11.5928	0.6851	0.0000	28.7207
University/College (4Yr)	1730.46	351.2677	20.7593	0.0000	870.2510
Total		**1,000.114 1**	**59.1051**	**0.0000**	**2,477.740 5**

8.2 Waste by Land Use

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Low Rise	202.4	41.0854	2.4281	0.0000	101.7873
Apartments Mid Rise	578.22	117.3734	6.9366	0.0000	290.7877
General Light Industry	47.86	9.7152	0.5742	0.0000	24.0689
Health Club	2310.84	469.0796	27.7218	0.0000	1,162.1250
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Research & Development	57.11	11.5928	0.6851	0.0000	28.7207
University/College (4Yr)	1730.46	351.2677	20.7593	0.0000	870.2510
Total		**1,000.1141**	**59.1051**	**0.0000**	**2,477.7405**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

	Total CO2	CH4	N2O	CO2e
Category	MT			
Unmitigated	-2,160.2680	0.0000	0.0000	-2,160.2680

11.2 Net New Trees

Species Class

	Number of Trees	Total CO2	CH4	N2O	CO2e
		MT			
Pine	-3386	-2,160.2680	0.0000	0.0000	-2,160.2680
Total		**-2,160.2680**	**0.0000**	**0.0000**	**-2,160.2680**

UCSC - 2020 LRDP - Operational Only - with Mitigated VMT

Santa Cruz County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Research & Development	1,127.37	1000sqft	25.88	1,127,373.00	0
University/College (4Yr)	9,482.00	Student	40.01	1,290,438.00	0
General Light Industry	57.90	1000sqft	1.33	57,903.00	0
Parking Lot	43.07	Acre	43.07	1,876,275.00	0
Health Club	608.11	1000sqft	13.96	608,110.00	0
Apartments Low Rise	440.00	Dwelling Unit	27.50	660,000.00	550
Apartments Mid Rise	1,257.00	Dwelling Unit	33.08	1,885,000.00	8500

1.2 Other Project Characteristics

Urbanization Rural **Wind Speed (m/s)** 1.8 **Precipitation Freq (Days)** 61

Climate Zone 4 **Operational Year** 2040

Utility Company Pacific Gas & Electric Company

CO2 Intensity (lb/MWhr) 77.8 **CH4 Intensity (lb/MWhr)** 0.005 **N2O Intensity (lb/MWhr)** 0.001

1.3 User Entered Comments & Non-Default Data

Project Characteristics - UCSC Electricity Emission Factors for 2040 reflect State averages.

Land Use - Values specified in Project Description

Construction Phase - This file is for operational emissions, so construction phases are removed.

Off-road Equipment -

Off-road Equipment - This file is for operational emissions, so construction phases are removed.

Off-road Equipment -

Trips and VMT -

On-road Fugitive Dust -

Demolition -

Architectural Coating -

Vehicle Trips - Adjusted trip length so that avg annual VMT matches VMT in Traffic Study per MM 3.16-1.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Woodstoves -

Consumer Products -

Area Coating -

Energy Use - Energy intensity rates adjusted to 2019 Title 24 standards.

Water And Wastewater -

Solid Waste -

Sequestration - Using Pine as subsititute for redwood trees. 22 trees/acre.

Construction Off-road Equipment Mitigation -

Area Mitigation - Zero-VOC paints and coatings (5 g/L), low-VOC cleaning supplies. 100% electric lawn and garden equipment.

Energy Mitigation -

Fleet Mix -

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	ConstArea_Nonresidential_Exterior	1,541,912.00	1,027,942.00
tblArchitecturalCoating	ConstArea_Nonresidential_Interior	4,625,736.00	3,083,825.00
tblArchitecturalCoating	ConstArea_Residential_Exterior	1,717,875.00	1,145,475.00
tblArchitecturalCoating	ConstArea_Residential_Interior	5,153,625.00	3,436,425.00
tblAreaMitigation	UseLowVOCPaintNonresidentialExteriorValue	150	5
tblAreaMitigation	UseLowVOCPaintNonresidentialInteriorValue	150	5
tblAreaMitigation	UseLowVOCPaintParkingCheck	False	True
tblAreaMitigation	UseLowVOCPaintParkingValue	150	5
tblAreaMitigation	UseLowVOCPaintResidentialExteriorValue	100	5
tblAreaMitigation	UseLowVOCPaintResidentialInteriorValue	100	5
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstructionPhase	NumDays	200.00	0.00
tblConstructionPhase	NumDays	120.00	0.00
tblConstructionPhase	NumDays	310.00	0.00
tblConstructionPhase	NumDays	3,100.00	1.00
tblConstructionPhase	NumDays	220.00	0.00
tblConstructionPhase	NumDays	220.00	0.00
tblEnergyUse	T24E	365.68	244.86
tblEnergyUse	T24E	332.81	222.85
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	2.73	2.59
tblEnergyUse	T24NG	7,043.85	4,716.56

tblEnergyUse	T24NG	5,484.45	3,672.39
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	20.83	19.79
tblGrading	AcresOfGrading	0.00	775.00
tblLandUse	LandUseSquareFeet	1,127,370.00	1,127,373.00
tblLandUse	LandUseSquareFeet	1,742,767.59	1,290,438.00
tblLandUse	LandUseSquareFeet	57,900.00	57,903.00
tblLandUse	LandUseSquareFeet	1,876,129.20	1,876,275.00
tblLandUse	LandUseSquareFeet	440,000.00	660,000.00
tblLandUse	LandUseSquareFeet	1,257,000.00	1,885,000.00
tblLandUse	Population	1,258.00	550.00
tblLandUse	Population	3,595.00	8,500.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblProjectCharacteristics	CH4IntensityFactor	0.029	0.005
tblProjectCharacteristics	CO2IntensityFactor	641.35	77.8
tblProjectCharacteristics	N2OIntensityFactor	0.006	0.001
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblSequestration	NumberOfNewTrees	0.00	-3,386.00
tblSolidWaste	SolidWasteGenerationRate	71.80	47.86
tblSolidWaste	SolidWasteGenerationRate	3,466.23	2,310.84
tblSolidWaste	SolidWasteGenerationRate	85.67	57.11

tblTripsAndVMT	VendorTripNumber	994.00	826.00
tblTripsAndVMT	WorkerTripNumber	3,192.00	2,798.00
tblTripsAndVMT	WorkerTripNumber	638.00	560.00
tblVehicleEF	HHD	0.24	0.19
tblVehicleEF	HHD	0.06	0.04
tblVehicleEF	HHD	0.06	0.00
tblVehicleEF	HHD	1.31	54.39
tblVehicleEF	HHD	1.00	0.41
tblVehicleEF	HHD	3.88	7.9690e-003
tblVehicleEF	HHD	3,651.43	7,280.05
tblVehicleEF	HHD	1,576.81	1,181.05
tblVehicleEF	HHD	11.12	0.06
tblVehicleEF	HHD	11.60	45.97
tblVehicleEF	HHD	1.50	2.41
tblVehicleEF	HHD	19.34	3.06
tblVehicleEF	HHD	3.4070e-003	0.02
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	5.4400e-003	0.02
tblVehicleEF	HHD	1.3500e-004	1.0000e-006
tblVehicleEF	HHD	3.2590e-003	0.02
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.4960e-003	8.6080e-003
tblVehicleEF	HHD	5.2040e-003	0.02
tblVehicleEF	HHD	1.2500e-004	1.0000e-006
tblVehicleEF	HHD	8.2000e-005	2.7000e-005
tblVehicleEF	HHD	4.5610e-003	7.4000e-005

tblVehicleEF	HHD	0.34	3.69
tblVehicleEF	HHD	5.4000e-005	1.8000e-005
tblVehicleEF	HHD	0.08	0.02
tblVehicleEF	HHD	5.9400e-004	3.7800e-004
tblVehicleEF	HHD	0.07	2.0000e-006
tblVehicleEF	HHD	0.03	0.07
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.7400e-004	1.0000e-006
tblVehicleEF	HHD	8.2000e-005	2.7000e-005
tblVehicleEF	HHD	4.5610e-003	7.4000e-005
tblVehicleEF	HHD	0.39	4.21
tblVehicleEF	HHD	5.4000e-005	1.8000e-005
tblVehicleEF	HHD	0.14	0.07
tblVehicleEF	HHD	5.9400e-004	3.7800e-004
tblVehicleEF	HHD	0.07	2.0000e-006
tblVehicleEF	HHD	0.23	0.20
tblVehicleEF	HHD	0.06	0.04
tblVehicleEF	HHD	0.05	0.00
tblVehicleEF	HHD	0.95	53.65
tblVehicleEF	HHD	1.02	0.42
tblVehicleEF	HHD	3.53	7.2410e-003
tblVehicleEF	HHD	3,868.33	7,196.62
tblVehicleEF	HHD	1,576.81	1,181.06
tblVehicleEF	HHD	11.12	0.06
tblVehicleEF	HHD	11.98	43.90
tblVehicleEF	HHD	1.44	2.33
tblVehicleEF	HHD	19.32	3.06

tblVehicleEF	HHD	2.8760e-003	0.02
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	5.4400e-003	0.02
tblVehicleEF	HHD	1.3500e-004	1.0000e-006
tblVehicleEF	HHD	2.7520e-003	0.02
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.4960e-003	8.6080e-003
tblVehicleEF	HHD	5.2040e-003	0.02
tblVehicleEF	HHD	1.2500e-004	1.0000e-006
tblVehicleEF	HHD	1.6000e-004	5.3000e-005
tblVehicleEF	HHD	4.6920e-003	7.6000e-005
tblVehicleEF	HHD	0.32	3.90
tblVehicleEF	HHD	1.0600e-004	3.5000e-005
tblVehicleEF	HHD	0.08	0.02
tblVehicleEF	HHD	5.5500e-004	3.5300e-004
tblVehicleEF	HHD	0.06	2.0000e-006
tblVehicleEF	HHD	0.04	0.07
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.6800e-004	1.0000e-006
tblVehicleEF	HHD	1.6000e-004	5.3000e-005
tblVehicleEF	HHD	4.6920e-003	7.6000e-005
tblVehicleEF	HHD	0.37	4.46
tblVehicleEF	HHD	1.0600e-004	3.5000e-005
tblVehicleEF	HHD	0.14	0.07
tblVehicleEF	HHD	5.5500e-004	3.5300e-004
tblVehicleEF	HHD	0.07	2.0000e-006

tblVehicleEF	HHD	0.26	0.17
tblVehicleEF	HHD	0.06	0.04
tblVehicleEF	HHD	0.06	0.00
tblVehicleEF	HHD	1.80	55.42
tblVehicleEF	HHD	0.99	0.41
tblVehicleEF	HHD	4.21	8.6450e-003
tblVehicleEF	HHD	3,351.89	7,395.27
tblVehicleEF	HHD	1,576.81	1,181.05
tblVehicleEF	HHD	11.12	0.06
tblVehicleEF	HHD	11.09	48.82
tblVehicleEF	HHD	1.52	2.44
tblVehicleEF	HHD	19.36	3.06
tblVehicleEF	HHD	4.1390e-003	0.02
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	5.4400e-003	0.02
tblVehicleEF	HHD	1.3500e-004	1.0000e-006
tblVehicleEF	HHD	3.9600e-003	0.02
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.4960e-003	8.6080e-003
tblVehicleEF	HHD	5.2040e-003	0.02
tblVehicleEF	HHD	1.2500e-004	1.0000e-006
tblVehicleEF	HHD	4.1000e-005	1.4000e-005
tblVehicleEF	HHD	4.6400e-003	7.5000e-005
tblVehicleEF	HHD	0.37	3.39
tblVehicleEF	HHD	2.1000e-005	7.0000e-006
tblVehicleEF	HHD	0.08	0.02

tblVehicleEF	HHD	6.7000e-004	4.2700e-004
tblVehicleEF	HHD	0.07	2.0000e-006
tblVehicleEF	HHD	0.03	0.07
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.7900e-004	1.0000e-006
tblVehicleEF	HHD	4.1000e-005	1.4000e-005
tblVehicleEF	HHD	4.6400e-003	7.5000e-005
tblVehicleEF	HHD	0.42	3.87
tblVehicleEF	HHD	2.1000e-005	7.0000e-006
tblVehicleEF	HHD	0.14	0.07
tblVehicleEF	HHD	6.7000e-004	4.2700e-004
tblVehicleEF	HHD	0.08	3.0000e-006
tblVehicleEF	LDA	1.6390e-003	7.5900e-004
tblVehicleEF	LDA	9.0100e-004	0.02
tblVehicleEF	LDA	0.29	0.39
tblVehicleEF	LDA	0.44	1.56
tblVehicleEF	LDA	168.86	206.82
tblVehicleEF	LDA	36.04	41.63
tblVehicleEF	LDA	0.02	0.02
tblVehicleEF	LDA	0.02	0.12
tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	8.1950e-003	0.06
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	7.7480e-003	0.06

tblVehicleEF	LDA	4.1300e-003	2.3880e-003
tblVehicleEF	LDA	0.03	0.16
tblVehicleEF	LDA	0.01	0.08
tblVehicleEF	LDA	1.6890e-003	1.8340e-003
tblVehicleEF	LDA	3.6700e-004	3.6900e-004
tblVehicleEF	LDA	8.1950e-003	0.06
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	7.7480e-003	0.06
tblVehicleEF	LDA	6.0000e-003	3.4550e-003
tblVehicleEF	LDA	0.03	0.16
tblVehicleEF	LDA	0.01	0.09
tblVehicleEF	LDA	1.7670e-003	8.3200e-004
tblVehicleEF	LDA	7.5200e-004	0.02
tblVehicleEF	LDA	0.32	0.44
tblVehicleEF	LDA	0.34	1.23
tblVehicleEF	LDA	177.42	217.05
tblVehicleEF	LDA	36.04	41.01
tblVehicleEF	LDA	0.02	0.02
tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	0.02	0.13
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	4.4460e-003	2.5670e-003

tblVehicleEF	LDA	0.03	0.14
tblVehicleEF	LDA	0.01	0.07
tblVehicleEF	LDA	1.7750e-003	1.9240e-003
tblVehicleEF	LDA	3.6500e-004	3.6300e-004
tblVehicleEF	LDA	0.02	0.13
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	6.4610e-003	3.7160e-003
tblVehicleEF	LDA	0.03	0.14
tblVehicleEF	LDA	0.01	0.07
tblVehicleEF	LDA	1.6100e-003	7.3600e-004
tblVehicleEF	LDA	1.0270e-003	0.02
tblVehicleEF	LDA	0.29	0.40
tblVehicleEF	LDA	0.51	1.82
tblVehicleEF	LDA	168.71	206.65
tblVehicleEF	LDA	36.04	42.12
tblVehicleEF	LDA	0.03	0.02
tblVehicleEF	LDA	0.02	0.13
tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	3.5800e-003	0.03
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	2.4830e-003	0.02
tblVehicleEF	LDA	4.0590e-003	2.3470e-003
tblVehicleEF	LDA	0.03	0.20

tblVehicleEF	LDA	0.01	0.09
tblVehicleEF	LDA	1.6880e-003	1.8320e-003
tblVehicleEF	LDA	3.6800e-004	3.7300e-004
tblVehicleEF	LDA	3.5800e-003	0.03
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	2.4830e-003	0.02
tblVehicleEF	LDA	5.8960e-003	3.3960e-003
tblVehicleEF	LDA	0.03	0.20
tblVehicleEF	LDA	0.02	0.10
tblVehicleEF	LDT1	1.9070e-003	9.4600e-004
tblVehicleEF	LDT1	1.2100e-003	0.03
tblVehicleEF	LDT1	0.32	0.43
tblVehicleEF	LDT1	0.51	1.75
tblVehicleEF	LDT1	209.63	252.15
tblVehicleEF	LDT1	45.37	51.97
tblVehicleEF	LDT1	0.03	0.02
tblVehicleEF	LDT1	0.02	0.15
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	4.7310e-003	3.0380e-003
tblVehicleEF	LDT1	0.03	0.28
tblVehicleEF	LDT1	0.02	0.10

tblVehicleEF	LDT1	2.0980e-003	2.2340e-003
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	6.8990e-003	4.4320e-003
tblVehicleEF	LDT1	0.03	0.28
tblVehicleEF	LDT1	0.02	0.11
tblVehicleEF	LDT1	2.0550e-003	1.0350e-003
tblVehicleEF	LDT1	1.0090e-003	0.02
tblVehicleEF	LDT1	0.35	0.47
tblVehicleEF	LDT1	0.40	1.37
tblVehicleEF	LDT1	220.22	262.77
tblVehicleEF	LDT1	45.37	51.26
tblVehicleEF	LDT1	0.02	0.02
tblVehicleEF	LDT1	0.02	0.13
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	0.02	0.24
tblVehicleEF	LDT1	0.04	0.08
tblVehicleEF	LDT1	0.02	0.23
tblVehicleEF	LDT1	5.0950e-003	3.2690e-003
tblVehicleEF	LDT1	0.03	0.25
tblVehicleEF	LDT1	0.01	0.08
tblVehicleEF	LDT1	2.2040e-003	2.3280e-003
tblVehicleEF	LDT1	4.6000e-004	4.5400e-004

tblVehicleEF	LDT1	0.02	0.24
tblVehicleEF	LDT1	0.04	0.08
tblVehicleEF	LDT1	0.02	0.23
tblVehicleEF	LDT1	7.4310e-003	4.7690e-003
tblVehicleEF	LDT1	0.03	0.25
tblVehicleEF	LDT1	0.01	0.09
tblVehicleEF	LDT1	1.8740e-003	9.1700e-004
tblVehicleEF	LDT1	1.3790e-003	0.03
tblVehicleEF	LDT1	0.32	0.43
tblVehicleEF	LDT1	0.60	2.04
tblVehicleEF	LDT1	209.45	251.97
tblVehicleEF	LDT1	45.37	52.53
tblVehicleEF	LDT1	0.03	0.02
tblVehicleEF	LDT1	0.03	0.16
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	5.0240e-003	0.06
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	3.4640e-003	0.04
tblVehicleEF	LDT1	4.6480e-003	2.9850e-003
tblVehicleEF	LDT1	0.04	0.33
tblVehicleEF	LDT1	0.02	0.11
tblVehicleEF	LDT1	2.0960e-003	2.2330e-003
tblVehicleEF	LDT1	4.6300e-004	4.6500e-004
tblVehicleEF	LDT1	5.0240e-003	0.06

tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	3.4640e-003	0.04
tblVehicleEF	LDT1	6.7780e-003	4.3540e-003
tblVehicleEF	LDT1	0.04	0.33
tblVehicleEF	LDT1	0.02	0.13
tblVehicleEF	LDT2	2.8190e-003	1.2600e-003
tblVehicleEF	LDT2	2.3310e-003	0.03
tblVehicleEF	LDT2	0.47	0.50
tblVehicleEF	LDT2	0.79	2.20
tblVehicleEF	LDT2	252.42	252.46
tblVehicleEF	LDT2	55.17	53.02
tblVehicleEF	LDT2	0.04	0.03
tblVehicleEF	LDT2	0.05	0.15
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.02	0.15
tblVehicleEF	LDT2	0.07	0.07
tblVehicleEF	LDT2	0.02	0.16
tblVehicleEF	LDT2	7.0170e-003	4.4720e-003
tblVehicleEF	LDT2	0.05	0.28
tblVehicleEF	LDT2	0.03	0.13
tblVehicleEF	LDT2	2.5270e-003	2.2380e-003
tblVehicleEF	LDT2	5.6400e-004	4.7000e-004
tblVehicleEF	LDT2	0.02	0.15
tblVehicleEF	LDT2	0.07	0.07

tblVehicleEF	LDT2	0.02	0.16
tblVehicleEF	LDT2	0.01	6.4570e-003
tblVehicleEF	LDT2	0.05	0.28
tblVehicleEF	LDT2	0.03	0.15
tblVehicleEF	LDT2	3.0340e-003	1.3780e-003
tblVehicleEF	LDT2	1.9960e-003	0.03
tblVehicleEF	LDT2	0.52	0.55
tblVehicleEF	LDT2	0.66	1.72
tblVehicleEF	LDT2	264.93	262.08
tblVehicleEF	LDT2	55.17	52.11
tblVehicleEF	LDT2	0.03	0.02
tblVehicleEF	LDT2	0.04	0.13
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.05	0.32
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	0.04	0.29
tblVehicleEF	LDT2	7.5500e-003	4.7960e-003
tblVehicleEF	LDT2	0.05	0.25
tblVehicleEF	LDT2	0.03	0.11
tblVehicleEF	LDT2	2.6530e-003	2.3240e-003
tblVehicleEF	LDT2	5.6200e-004	4.6200e-004
tblVehicleEF	LDT2	0.05	0.32
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	0.04	0.29

tblVehicleEF	LDT2	0.01	6.9310e-003
tblVehicleEF	LDT2	0.05	0.25
tblVehicleEF	LDT2	0.03	0.12
tblVehicleEF	LDT2	2.7690e-003	1.2220e-003
tblVehicleEF	LDT2	2.6130e-003	0.04
tblVehicleEF	LDT2	0.48	0.51
tblVehicleEF	LDT2	0.90	2.58
tblVehicleEF	LDT2	252.21	252.31
tblVehicleEF	LDT2	55.17	53.73
tblVehicleEF	LDT2	0.04	0.03
tblVehicleEF	LDT2	0.05	0.16
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.01	0.07
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	7.6010e-003	0.05
tblVehicleEF	LDT2	6.8940e-003	4.3970e-003
tblVehicleEF	LDT2	0.07	0.34
tblVehicleEF	LDT2	0.04	0.15
tblVehicleEF	LDT2	2.5250e-003	2.2370e-003
tblVehicleEF	LDT2	5.6600e-004	4.7600e-004
tblVehicleEF	LDT2	0.01	0.07
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	7.6010e-003	0.05
tblVehicleEF	LDT2	0.01	6.3480e-003

tblVehicleEF	LDT2	0.07	0.34
tblVehicleEF	LDT2	0.04	0.17
tblVehicleEF	LHD1	3.7210e-003	0.05
tblVehicleEF	LHD1	5.3310e-003	3.9600e-003
tblVehicleEF	LHD1	8.2940e-003	7.2240e-003
tblVehicleEF	LHD1	0.14	2.44
tblVehicleEF	LHD1	0.47	0.37
tblVehicleEF	LHD1	1.29	0.76
tblVehicleEF	LHD1	8.78	107.82
tblVehicleEF	LHD1	634.75	658.76
tblVehicleEF	LHD1	27.02	8.68
tblVehicleEF	LHD1	0.05	0.55
tblVehicleEF	LHD1	0.42	0.20
tblVehicleEF	LHD1	0.57	0.19
tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003
tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	1.2360e-003	0.01
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	8.0900e-004	9.2900e-003
tblVehicleEF	LHD1	0.09	0.06

tblVehicleEF	LHD1	0.15	0.24
tblVehicleEF	LHD1	0.11	0.03
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
tblVehicleEF	LHD1	6.2040e-003	6.4250e-003
tblVehicleEF	LHD1	2.9400e-004	8.6000e-005
tblVehicleEF	LHD1	1.2360e-003	0.01
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	8.0900e-004	9.2900e-003
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.15	0.24
tblVehicleEF	LHD1	0.12	0.04
tblVehicleEF	LHD1	3.7210e-003	0.05
tblVehicleEF	LHD1	5.3890e-003	4.0070e-003
tblVehicleEF	LHD1	7.7400e-003	6.7790e-003
tblVehicleEF	LHD1	0.14	2.44
tblVehicleEF	LHD1	0.47	0.38
tblVehicleEF	LHD1	1.18	0.70
tblVehicleEF	LHD1	8.78	107.82
tblVehicleEF	LHD1	634.75	658.76
tblVehicleEF	LHD1	27.02	8.57
tblVehicleEF	LHD1	0.05	0.55
tblVehicleEF	LHD1	0.41	0.19
tblVehicleEF	LHD1	0.53	0.17
tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003

tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	2.3600e-003	0.03
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	1.5530e-003	0.02
tblVehicleEF	LHD1	0.09	0.06
tblVehicleEF	LHD1	0.14	0.22
tblVehicleEF	LHD1	0.10	0.03
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
tblVehicleEF	LHD1	6.2040e-003	6.4250e-003
tblVehicleEF	LHD1	2.9200e-004	8.5000e-005
tblVehicleEF	LHD1	2.3600e-003	0.03
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	1.5530e-003	0.02
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.14	0.22
tblVehicleEF	LHD1	0.11	0.03
tblVehicleEF	LHD1	3.7210e-003	0.05
tblVehicleEF	LHD1	5.2920e-003	3.9290e-003
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tblVehicleEF	LHD1	0.46	0.37

tblVehicleEF	LHD1	1.39	0.82
tblVehicleEF	LHD1	8.78	107.82
tblVehicleEF	LHD1	634.75	658.75
tblVehicleEF	LHD1	27.02	8.78
tblVehicleEF	LHD1	0.05	0.55
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tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003
tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	6.2900e-004	7.2020e-003
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	3.1500e-004	3.5920e-003
tblVehicleEF	LHD1	0.08	0.06
tblVehicleEF	LHD1	0.17	0.27
tblVehicleEF	LHD1	0.12	0.04
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
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tblVehicleEF	LHD1	6.2900e-004	7.2020e-003
tblVehicleEF	LHD1	0.07	0.05

tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	3.1500e-004	3.5920e-003
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.17	0.27
tblVehicleEF	LHD1	0.13	0.04
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7450e-003	5.0520e-003
tblVehicleEF	LHD2	2.1760e-003	3.0390e-003
tblVehicleEF	LHD2	0.12	1.69
tblVehicleEF	LHD2	0.44	0.50
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tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.02
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tblVehicleEF	LHD2	0.05	0.89
tblVehicleEF	LHD2	0.10	0.33
tblVehicleEF	LHD2	0.20	0.09
tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	3.7200e-004	5.8640e-003
tblVehicleEF	LHD2	0.01	0.02

tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	2.4200e-004	3.8700e-003
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tblVehicleEF	LHD2	0.03	0.09
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
tblVehicleEF	LHD2	6.4320e-003	6.0800e-003
tblVehicleEF	LHD2	2.2400e-004	4.9000e-005
tblVehicleEF	LHD2	3.7200e-004	5.8640e-003
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tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	2.4200e-004	3.8700e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.09
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7720e-003	5.0740e-003
tblVehicleEF	LHD2	2.1430e-003	2.8520e-003
tblVehicleEF	LHD2	0.12	1.69
tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.77	0.35
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.02
tblVehicleEF	LHD2	21.05	4.93
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tblVehicleEF	LHD2	0.10	0.32
tblVehicleEF	LHD2	0.19	0.08

tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	7.3200e-004	0.01
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	4.7800e-004	7.5310e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.08
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
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tblVehicleEF	LHD2	2.2300e-004	4.9000e-005
tblVehicleEF	LHD2	7.3200e-004	0.01
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	4.7800e-004	7.5310e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.08
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7280e-003	5.0370e-003

tblVehicleEF	LHD2	2.2020e-003	3.1870e-003
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tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.90	0.41
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.01
tblVehicleEF	LHD2	21.05	5.03
tblVehicleEF	LHD2	0.05	0.89
tblVehicleEF	LHD2	0.10	0.34
tblVehicleEF	LHD2	0.20	0.09
tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	1.8500e-004	2.9740e-003
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	9.3000e-005	1.4940e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.10
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
tblVehicleEF	LHD2	6.4320e-003	6.0800e-003

tblVehicleEF	LHD2	2.2500e-004	5.0000e-005
tblVehicleEF	LHD2	1.8500e-004	2.9740e-003
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	9.3000e-005	1.4940e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.10
tblVehicleEF	LHD2	0.03	0.02
tblVehicleEF	MCY	0.53	0.36
tblVehicleEF	MCY	0.17	0.26
tblVehicleEF	MCY	18.33	18.38
tblVehicleEF	MCY	10.94	9.75
tblVehicleEF	MCY	182.27	219.06
tblVehicleEF	MCY	43.71	61.12
tblVehicleEF	MCY	1.18	1.19
tblVehicleEF	MCY	0.32	0.28
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	0.75	1.56
tblVehicleEF	MCY	0.74	0.77
tblVehicleEF	MCY	0.37	0.77
tblVehicleEF	MCY	2.48	2.49
tblVehicleEF	MCY	0.47	1.31
tblVehicleEF	MCY	2.26	2.01
tblVehicleEF	MCY	2.1980e-003	2.1680e-003

tblVehicleEF	MCY	6.8200e-004	6.0500e-004
tblVehicleEF	MCY	0.75	1.56
tblVehicleEF	MCY	0.74	0.77
tblVehicleEF	MCY	0.37	0.77
tblVehicleEF	MCY	3.10	3.11
tblVehicleEF	MCY	0.47	1.31
tblVehicleEF	MCY	2.46	2.19
tblVehicleEF	MCY	0.51	0.35
tblVehicleEF	MCY	0.14	0.21
tblVehicleEF	MCY	16.96	17.00
tblVehicleEF	MCY	9.17	8.10
tblVehicleEF	MCY	182.27	216.52
tblVehicleEF	MCY	43.71	57.27
tblVehicleEF	MCY	1.05	1.05
tblVehicleEF	MCY	0.30	0.25
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	1.84	3.79
tblVehicleEF	MCY	0.88	0.92
tblVehicleEF	MCY	0.88	1.82
tblVehicleEF	MCY	2.39	2.39
tblVehicleEF	MCY	0.41	1.15
tblVehicleEF	MCY	1.86	1.64
tblVehicleEF	MCY	2.1730e-003	2.1430e-003
tblVehicleEF	MCY	6.4100e-004	5.6700e-004

tblVehicleEF	MCY	1.84	3.79
tblVehicleEF	MCY	0.88	0.92
tblVehicleEF	MCY	0.88	1.82
tblVehicleEF	MCY	2.98	2.99
tblVehicleEF	MCY	0.41	1.15
tblVehicleEF	MCY	2.02	1.78
tblVehicleEF	MCY	0.54	0.37
tblVehicleEF	MCY	0.19	0.30
tblVehicleEF	MCY	19.75	19.80
tblVehicleEF	MCY	12.83	11.48
tblVehicleEF	MCY	182.27	221.65
tblVehicleEF	MCY	43.71	65.04
tblVehicleEF	MCY	1.26	1.26
tblVehicleEF	MCY	0.35	0.30
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	0.22	0.45
tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	0.11	0.22
tblVehicleEF	MCY	2.57	2.58
tblVehicleEF	MCY	0.58	1.61
tblVehicleEF	MCY	2.65	2.36
tblVehicleEF	MCY	2.2240e-003	2.1930e-003
tblVehicleEF	MCY	7.2500e-004	6.4400e-004
tblVehicleEF	MCY	0.22	0.45

tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	0.11	0.22
tblVehicleEF	MCY	3.21	3.22
tblVehicleEF	MCY	0.58	1.61
tblVehicleEF	MCY	2.88	2.57
tblVehicleEF	MDV	4.6980e-003	1.3630e-003
tblVehicleEF	MDV	6.0110e-003	0.03
tblVehicleEF	MDV	0.64	0.51
tblVehicleEF	MDV	1.36	2.26
tblVehicleEF	MDV	339.26	305.96
tblVehicleEF	MDV	73.02	62.75
tblVehicleEF	MDV	0.07	0.03
tblVehicleEF	MDV	0.12	0.17
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.13	0.09
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.01	4.9950e-003
tblVehicleEF	MDV	0.08	0.29
tblVehicleEF	MDV	0.08	0.15
tblVehicleEF	MDV	3.3930e-003	2.7170e-003
tblVehicleEF	MDV	7.5300e-004	5.5600e-004
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.13	0.09

tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.02	7.1990e-003
tblVehicleEF	MDV	0.08	0.29
tblVehicleEF	MDV	0.09	0.16
tblVehicleEF	MDV	5.0540e-003	1.4900e-003
tblVehicleEF	MDV	5.0610e-003	0.03
tblVehicleEF	MDV	0.70	0.56
tblVehicleEF	MDV	1.10	1.76
tblVehicleEF	MDV	355.62	315.48
tblVehicleEF	MDV	73.02	61.81
tblVehicleEF	MDV	0.06	0.03
tblVehicleEF	MDV	0.11	0.15
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.09	0.43
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.09	0.39
tblVehicleEF	MDV	0.01	5.3540e-003
tblVehicleEF	MDV	0.07	0.26
tblVehicleEF	MDV	0.07	0.12
tblVehicleEF	MDV	3.5580e-003	2.8010e-003
tblVehicleEF	MDV	7.4800e-004	5.4800e-004
tblVehicleEF	MDV	0.09	0.43
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.09	0.39

tblVehicleEF	MDV	0.02	7.7230e-003
tblVehicleEF	MDV	0.07	0.26
tblVehicleEF	MDV	0.07	0.13
tblVehicleEF	MDV	4.6150e-003	1.3220e-003
tblVehicleEF	MDV	6.8120e-003	0.04
tblVehicleEF	MDV	0.64	0.51
tblVehicleEF	MDV	1.56	2.64
tblVehicleEF	MDV	338.97	305.81
tblVehicleEF	MDV	73.02	63.49
tblVehicleEF	MDV	0.07	0.03
tblVehicleEF	MDV	0.13	0.18
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.02	0.10
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.02	0.07
tblVehicleEF	MDV	0.01	4.9120e-003
tblVehicleEF	MDV	0.10	0.35
tblVehicleEF	MDV	0.09	0.17
tblVehicleEF	MDV	3.3900e-003	2.7150e-003
tblVehicleEF	MDV	7.5700e-004	5.6300e-004
tblVehicleEF	MDV	0.02	0.10
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.02	0.07
tblVehicleEF	MDV	0.02	7.0780e-003

tblVehicleEF	MDV	0.10	0.35
tblVehicleEF	MDV	0.10	0.18
tblVehicleEF	MH	5.4220e-003	4.1740e-003
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.26	0.23
tblVehicleEF	MH	3.31	1.50
tblVehicleEF	MH	1,176.44	1,266.18
tblVehicleEF	MH	55.59	14.09
tblVehicleEF	MH	0.77	1.12
tblVehicleEF	MH	0.58	0.24
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.14	0.01
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	3.9420e-003	0.24
tblVehicleEF	MH	0.20	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.1400e-004	1.3900e-004
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.14	0.01

tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	3.9420e-003	0.24
tblVehicleEF	MH	0.22	0.08
tblVehicleEF	MH	5.6040e-003	4.2710e-003
tblVehicleEF	MH	0.01	0.02
tblVehicleEF	MH	0.27	0.23
tblVehicleEF	MH	3.00	1.37
tblVehicleEF	MH	1,176.44	1,266.19
tblVehicleEF	MH	55.59	13.86
tblVehicleEF	MH	0.73	1.08
tblVehicleEF	MH	0.53	0.22
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.54	0.04
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	3.7600e-003	0.23
tblVehicleEF	MH	0.19	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.0800e-004	1.3700e-004
tblVehicleEF	MH	0.54	0.04
tblVehicleEF	MH	0.03	0.02

tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	3.7600e-003	0.23
tblVehicleEF	MH	0.21	0.07
tblVehicleEF	MH	5.3060e-003	4.1110e-003
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.26	0.22
tblVehicleEF	MH	3.62	1.65
tblVehicleEF	MH	1,176.44	1,266.18
tblVehicleEF	MH	55.59	14.33
tblVehicleEF	MH	0.78	1.14
tblVehicleEF	MH	0.62	0.25
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.15	0.01
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.06	4.9680e-003
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	4.3120e-003	0.26
tblVehicleEF	MH	0.22	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.1900e-004	1.4200e-004
tblVehicleEF	MH	0.15	0.01

tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.06	4.9680e-003
tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	4.3120e-003	0.26
tblVehicleEF	MH	0.24	0.08
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2480e-003	7.7200e-004
tblVehicleEF	MHD	0.03	3.1220e-003
tblVehicleEF	MHD	0.26	3.73
tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	1.99	0.30
tblVehicleEF	MHD	178.42	592.23
tblVehicleEF	MHD	1,157.71	883.00
tblVehicleEF	MHD	36.55	2.93
tblVehicleEF	MHD	0.49	3.22
tblVehicleEF	MHD	1.08	1.49
tblVehicleEF	MHD	14.07	1.96
tblVehicleEF	MHD	5.8000e-005	9.6200e-004
tblVehicleEF	MHD	3.0680e-003	7.5170e-003
tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	5.6000e-005	9.2100e-004
tblVehicleEF	MHD	2.9320e-003	7.1870e-003
tblVehicleEF	MHD	4.7700e-004	3.8000e-005
tblVehicleEF	MHD	3.1900e-004	1.7150e-003
tblVehicleEF	MHD	0.02	5.0230e-003
tblVehicleEF	MHD	0.02	0.15
tblVehicleEF	MHD	2.1000e-004	1.1250e-003

tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	7.1260e-003	0.03
tblVehicleEF	MHD	0.13	0.02
tblVehicleEF	MHD	1.7100e-003	5.6140e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	4.0000e-004	2.9000e-005
tblVehicleEF	MHD	3.1900e-004	1.7150e-003
tblVehicleEF	MHD	0.02	5.0230e-003
tblVehicleEF	MHD	0.03	0.21
tblVehicleEF	MHD	2.1000e-004	1.1250e-003
tblVehicleEF	MHD	0.05	0.01
tblVehicleEF	MHD	7.1260e-003	0.03
tblVehicleEF	MHD	0.14	0.02
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2610e-003	7.8700e-004
tblVehicleEF	MHD	0.03	2.9270e-003
tblVehicleEF	MHD	0.17	3.16
tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	1.81	0.27
tblVehicleEF	MHD	189.21	587.50
tblVehicleEF	MHD	1,157.71	883.00
tblVehicleEF	MHD	36.55	2.89
tblVehicleEF	MHD	0.50	3.07
tblVehicleEF	MHD	1.05	1.44
tblVehicleEF	MHD	14.05	1.96
tblVehicleEF	MHD	4.9000e-005	8.4500e-004
tblVehicleEF	MHD	3.0680e-003	7.5170e-003

tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	4.7000e-005	8.0900e-004
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tblVehicleEF	MHD	6.2200e-004	3.3590e-003
tblVehicleEF	MHD	0.02	5.1730e-003
tblVehicleEF	MHD	0.02	0.15
tblVehicleEF	MHD	4.1100e-004	2.2120e-003
tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	6.6650e-003	0.02
tblVehicleEF	MHD	0.12	0.01
tblVehicleEF	MHD	1.8120e-003	5.5700e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	3.9700e-004	2.9000e-005
tblVehicleEF	MHD	6.2200e-004	3.3590e-003
tblVehicleEF	MHD	0.02	5.1730e-003
tblVehicleEF	MHD	0.02	0.20
tblVehicleEF	MHD	4.1100e-004	2.2120e-003
tblVehicleEF	MHD	0.05	0.01
tblVehicleEF	MHD	6.6650e-003	0.02
tblVehicleEF	MHD	0.13	0.02
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2400e-003	7.6200e-004
tblVehicleEF	MHD	0.03	3.2720e-003
tblVehicleEF	MHD	0.33	4.16
tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	2.16	0.32

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tblVehicleEF	MHD	1,157.71	883.00
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tblVehicleEF	MHD	14.09	1.96
tblVehicleEF	MHD	7.1000e-005	1.1240e-003
tblVehicleEF	MHD	3.0680e-003	7.5170e-003
tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	6.8000e-005	1.0750e-003
tblVehicleEF	MHD	2.9320e-003	7.1870e-003
tblVehicleEF	MHD	4.7700e-004	3.8000e-005
tblVehicleEF	MHD	1.6100e-004	8.6100e-004
tblVehicleEF	MHD	0.02	5.1140e-003
tblVehicleEF	MHD	0.02	0.15
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tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	8.0270e-003	0.03
tblVehicleEF	MHD	0.14	0.02
tblVehicleEF	MHD	1.5730e-003	5.6900e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	4.0300e-004	2.9000e-005
tblVehicleEF	MHD	1.6100e-004	8.6100e-004
tblVehicleEF	MHD	0.02	5.1140e-003
tblVehicleEF	MHD	0.03	0.21
tblVehicleEF	MHD	8.1000e-005	4.3200e-004
tblVehicleEF	MHD	0.05	0.01

tblVehicleEF	MHD	8.0270e-003	0.03
tblVehicleEF	MHD	0.15	0.02
tblVehicleEF	OBUS	0.01	0.12
tblVehicleEF	OBUS	4.4180e-003	3.2250e-003
tblVehicleEF	OBUS	0.02	0.01
tblVehicleEF	OBUS	0.25	9.37
tblVehicleEF	OBUS	0.29	0.33
tblVehicleEF	OBUS	4.36	1.53
tblVehicleEF	OBUS	87.86	1,204.87
tblVehicleEF	OBUS	1,290.02	1,289.82
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tblVehicleEF	OBUS	1.75	1.20
tblVehicleEF	OBUS	1.7000e-005	1.8470e-003
tblVehicleEF	OBUS	2.5170e-003	7.3860e-003
tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
tblVehicleEF	OBUS	1.7000e-005	1.7670e-003
tblVehicleEF	OBUS	2.3760e-003	7.0390e-003
tblVehicleEF	OBUS	9.8300e-004	1.3100e-004
tblVehicleEF	OBUS	1.1160e-003	0.02
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.79
tblVehicleEF	OBUS	5.5400e-004	0.01
tblVehicleEF	OBUS	0.03	0.02
tblVehicleEF	OBUS	0.05	0.24
tblVehicleEF	OBUS	0.28	0.08

tblVehicleEF	OBUS	8.5000e-004	0.01
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.5600e-004	1.2200e-004
tblVehicleEF	OBUS	1.1160e-003	0.02
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.05	1.03
tblVehicleEF	OBUS	5.5400e-004	0.01
tblVehicleEF	OBUS	0.04	0.03
tblVehicleEF	OBUS	0.05	0.24
tblVehicleEF	OBUS	0.31	0.08
tblVehicleEF	OBUS	0.01	0.12
tblVehicleEF	OBUS	4.5470e-003	3.3510e-003
tblVehicleEF	OBUS	0.02	0.01
tblVehicleEF	OBUS	0.25	9.29
tblVehicleEF	OBUS	0.30	0.34
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tblVehicleEF	OBUS	92.09	1,190.97
tblVehicleEF	OBUS	1,290.02	1,289.84
tblVehicleEF	OBUS	67.94	12.11
tblVehicleEF	OBUS	0.19	5.22
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tblVehicleEF	OBUS	1.69	1.18
tblVehicleEF	OBUS	1.5000e-005	1.6410e-003
tblVehicleEF	OBUS	2.5170e-003	7.3860e-003
tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
tblVehicleEF	OBUS	1.4000e-005	1.5700e-003
tblVehicleEF	OBUS	2.3760e-003	7.0390e-003

tblVehicleEF	OBUS	9.8300e-004	1.3100e-004
tblVehicleEF	OBUS	2.1480e-003	0.04
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.81
tblVehicleEF	OBUS	1.1070e-003	0.02
tblVehicleEF	OBUS	0.03	0.02
tblVehicleEF	OBUS	0.05	0.23
tblVehicleEF	OBUS	0.26	0.07
tblVehicleEF	OBUS	8.9100e-004	0.01
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.4900e-004	1.2000e-004
tblVehicleEF	OBUS	2.1480e-003	0.04
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.05	1.06
tblVehicleEF	OBUS	1.1070e-003	0.02
tblVehicleEF	OBUS	0.04	0.03
tblVehicleEF	OBUS	0.05	0.23
tblVehicleEF	OBUS	0.29	0.08
tblVehicleEF	OBUS	0.01	0.12
tblVehicleEF	OBUS	4.3350e-003	3.1420e-003
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tblVehicleEF	OBUS	0.26	9.48
tblVehicleEF	OBUS	0.29	0.32
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tblVehicleEF	OBUS	0.03	0.76
tblVehicleEF	OBUS	2.4400e-004	4.9660e-003
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tblVehicleEF	OBUS	0.06	0.26
tblVehicleEF	OBUS	0.30	0.08
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tblVehicleEF	OBUS	7.6300e-004	1.2500e-004
tblVehicleEF	OBUS	5.9200e-004	0.01
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.05	0.99
tblVehicleEF	OBUS	2.4400e-004	4.9660e-003
tblVehicleEF	OBUS	0.04	0.03
tblVehicleEF	OBUS	0.06	0.26
tblVehicleEF	OBUS	0.33	0.09
tblVehicleEF	SBUS	0.84	0.59

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tblVehicleEF	SBUS	2.65	12.99
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tblVehicleEF	SBUS	14.15	1.63
tblVehicleEF	SBUS	2.0500e-004	3.2780e-003
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	2.8100e-003	9.6070e-003
tblVehicleEF	SBUS	8.3700e-004	1.7300e-004
tblVehicleEF	SBUS	1.9700e-004	3.1360e-003
tblVehicleEF	SBUS	2.7190e-003	2.7660e-003
tblVehicleEF	SBUS	2.6730e-003	9.1780e-003
tblVehicleEF	SBUS	7.7000e-004	1.5900e-004
tblVehicleEF	SBUS	2.3390e-003	5.5350e-003
tblVehicleEF	SBUS	0.03	0.01
tblVehicleEF	SBUS	0.72	2.70
tblVehicleEF	SBUS	1.1850e-003	2.7720e-003
tblVehicleEF	SBUS	0.05	0.02
tblVehicleEF	SBUS	0.01	0.11
tblVehicleEF	SBUS	0.25	0.07
tblVehicleEF	SBUS	0.01	0.03

tblVehicleEF	SBUS	0.01	8.4230e-003
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tblVehicleEF	SBUS	0.05	0.02
tblVehicleEF	SBUS	0.01	0.09
tblVehicleEF	SBUS	0.23	0.07
tblVehicleEF	SBUS	0.84	0.59
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tblVehicleEF	SBUS	0.28	0.15
tblVehicleEF	SBUS	6.14	2.35
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tblVehicleEF	SBUS	1,068.95	883.72

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tblVehicleEF	SBUS	2.8100e-003	9.6070e-003
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tblVehicleEF	SBUS	0.02	0.13
tblVehicleEF	SBUS	0.29	0.08
tblVehicleEF	SBUS	0.01	0.03
tblVehicleEF	SBUS	0.01	8.4230e-003
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tblVehicleEF	SBUS	1.2710e-003	2.9600e-003
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tblVehicleEF	SBUS	1.04	3.86
tblVehicleEF	SBUS	5.2800e-004	1.2260e-003
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tblVehicleEF	SBUS	0.02	0.13
tblVehicleEF	SBUS	0.32	0.09
tblVehicleEF	UBUS	0.55	3.62
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tblVehicleEF	UBUS	0.50	0.08
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tblVehicleEF	UBUS	0.05	3.9600e-003
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tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	3.2160e-003	9.2000e-005
tblVehicleEF	UBUS	0.06	3.2100e-004
tblVehicleEF	UBUS	2.1090e-003	5.1000e-005
tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.02	1.9470e-003
tblVehicleEF	UBUS	0.90	7.5660e-003
tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.5900e-003	1.2000e-005
tblVehicleEF	UBUS	3.2160e-003	9.2000e-005

tblVehicleEF	UBUS	0.06	3.2100e-004
tblVehicleEF	UBUS	2.1090e-003	5.1000e-005
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.02	1.9470e-003
tblVehicleEF	UBUS	0.99	8.2830e-003
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.06	1.4450e-003
tblVehicleEF	UBUS	3.31	27.63
tblVehicleEF	UBUS	6.96	0.12
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.21
tblVehicleEF	UBUS	2.65	0.55
tblVehicleEF	UBUS	12.22	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	5.9070e-003	1.9800e-004
tblVehicleEF	UBUS	0.07	3.5800e-004
tblVehicleEF	UBUS	4.1490e-003	1.2400e-004
tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.02	1.6760e-003
tblVehicleEF	UBUS	0.79	6.6320e-003

tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.5600e-003	1.2000e-005
tblVehicleEF	UBUS	5.9070e-003	1.9800e-004
tblVehicleEF	UBUS	0.07	3.5800e-004
tblVehicleEF	UBUS	4.1490e-003	1.2400e-004
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.02	1.6760e-003
tblVehicleEF	UBUS	0.86	7.2610e-003
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.07	1.7860e-003
tblVehicleEF	UBUS	3.29	27.63
tblVehicleEF	UBUS	10.37	0.17
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.30
tblVehicleEF	UBUS	2.79	0.55
tblVehicleEF	UBUS	12.42	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	1.7240e-003	3.8000e-005
tblVehicleEF	UBUS	0.06	3.4400e-004
tblVehicleEF	UBUS	9.9800e-004	2.0000e-005

tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.03	2.4500e-003
tblVehicleEF	UBUS	0.99	8.3520e-003
tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.6200e-003	1.3000e-005
tblVehicleEF	UBUS	1.7240e-003	3.8000e-005
tblVehicleEF	UBUS	0.06	3.4400e-004
tblVehicleEF	UBUS	9.9800e-004	2.0000e-005
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.03	2.4500e-003
tblVehicleEF	UBUS	1.09	9.1440e-003
tblVehicleTrips	CC_TTP	88.60	0.00
tblVehicleTrips	CNW_TTP	5.00	0.00
tblVehicleTrips	CW_TTP	6.40	0.00
tblVehicleTrips	HO_TL	7.90	0.00
tblVehicleTrips	HO_TL	7.90	0.00
tblVehicleTrips	HO_TL	0.00	6.89
tblVehicleTrips	HO_TTP	37.20	26.00
tblVehicleTrips	HO_TTP	37.20	26.00
tblVehicleTrips	HO_TTP	0.00	5.00
tblVehicleTrips	HS_TL	7.10	0.00
tblVehicleTrips	HS_TL	7.10	0.00
tblVehicleTrips	HS_TL	0.00	11.65
tblVehicleTrips	HS_TTP	18.80	50.00
tblVehicleTrips	HS_TTP	18.80	50.00
tblVehicleTrips	HS_TTP	0.00	88.00
tblVehicleTrips	HW_TL	16.80	0.00

tblVehicleTrips	HW_TL	16.80	0.00
tblVehicleTrips	HW_TL	0.00	15.00
tblVehicleTrips	HW_TTP	44.00	24.00
tblVehicleTrips	HW_TTP	44.00	24.00
tblVehicleTrips	HW_TTP	0.00	7.00
tblVehicleTrips	ST_TR	7.16	0.00
tblVehicleTrips	ST_TR	6.39	0.00
tblVehicleTrips	ST_TR	1.32	0.00
tblVehicleTrips	ST_TR	20.87	0.00
tblVehicleTrips	ST_TR	1.90	0.00
tblVehicleTrips	ST_TR	1.30	0.42
tblVehicleTrips	SU_TR	6.07	0.00
tblVehicleTrips	SU_TR	5.86	0.00
tblVehicleTrips	SU_TR	0.68	0.00
tblVehicleTrips	SU_TR	26.73	0.00
tblVehicleTrips	SU_TR	1.11	0.00
tblVehicleTrips	SU_TR	0.00	0.42
tblVehicleTrips	WD_TR	6.59	0.00
tblVehicleTrips	WD_TR	6.65	0.00
tblVehicleTrips	WD_TR	6.97	0.00
tblVehicleTrips	WD_TR	32.93	0.00
tblVehicleTrips	WD_TR	8.11	0.00
tblVehicleTrips	WD_TR	1.71	1.21
tblWater	IndoorWaterUseRate	13,389,375.00	8,926,250.00
tblWater	IndoorWaterUseRate	35,965,537.32	23,977,222.02
tblWater	IndoorWaterUseRate	554,321,005.26	369,547,336.84
tblWater	OutdoorWaterUseRate	22,043,393.84	14,695,716.72

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	0.0000	0.0000	0.0000	0.0000	1.1100e-003	0.0000	1.1100e-003	2.7000e-004	0.0000	2.7000e-004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024	7.7700e-003	0.0431	0.0621	2.5000e-004	0.0197	2.0000e-004	0.0199	5.2900e-003	1.8000e-004	5.4700e-003	0.0000	23.2139	23.2139	7.7000e-004	0.0000	23.2331
2036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**7.7700e-003**	**0.0431**	**0.0621**	**2.5000e-004**	**0.0197**	**2.0000e-004**	**0.0199**	**5.2900e-003**	**1.8000e-004**	**5.4700e-003**	**0.0000**	**23.2139**	**23.2139**	**7.7000e-004**	**0.0000**	**23.2331**

2.1 Overall Construction

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2022	0.0000	0.0000	0.0000	0.0000	1.1100e-003	0.0000	1.1100e-003	2.7000e-004	0.0000	2.7000e-004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024	7.7700e-003	0.0431	0.0621	2.5000e-004	0.0197	2.0000e-004	0.0199	5.2900e-003	1.8000e-004	5.4700e-003	0.0000	23.2139	23.2139	7.7000e-004	0.0000	23.2331
2036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**7.7700e-003**	**0.0431**	**0.0621**	**2.5000e-004**	**0.0197**	**2.0000e-004**	**0.0199**	**5.2900e-003**	**1.8000e-004**	**5.4700e-003**	**0.0000**	**23.2139**	**23.2139**	**7.7000e-004**	**0.0000**	**23.2331**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
10	**4-3-2024**	**7-2-2024**	0.1064	0.1064
		Highest	0.1064	0.1064

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	26.4146	0.2024	17.5672	9.3000e-004		0.0976	0.0976		0.0976	0.0976	0.0000	28.8678	28.8678	0.0279	0.0000	29.5661
Energy	0.4711	4.2477	3.3380	0.0257		0.3255	0.3255		0.3255	0.3255	0.0000	5,801.9438	5,801.9438	0.1626	0.1001	5,835.8460
Mobile	2.9683	7.8312	31.8673	0.1026	13.6269	0.0583	13.6852	3.6468	0.0546	3.7014	0.0000	10,401.4452	10,401.4452	0.3891	0.0000	10,411.1738
Waste						0.0000	0.0000		0.0000	0.0000	1,000.1141	0.0000	1,000.1141	59.1051	0.0000	2,477.7405
Water						0.0000	0.0000		0.0000	0.0000	169.1976	116.1847	285.3822	17.3857	0.4118	842.7497
Total	**29.8540**	**12.2813**	**52.7726**	**0.1292**	**13.6269**	**0.4814**	**14.1083**	**3.6468**	**0.4777**	**4.1244**	**1,169.3117**	**16,348.4416**	**17,517.7532**	**77.0704**	**0.5120**	**19,597.0761**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	20.8954	0.1607	13.3210	6.1000e-004		0.0726	0.0726		0.0726	0.0726	0.0000	20.1552	20.1552	0.0146	0.0000	20.5188
Energy	0.4711	4.2477	3.3380	0.0257		0.3255	0.3255		0.3255	0.3255	0.0000	5,801.9438	5,801.9438	0.1626	0.1001	5,835.8460
Mobile	2.9683	7.8312	31.8673	0.1026	13.6269	0.0583	13.6852	3.6468	0.0546	3.7014	0.0000	10,401.4452	10,401.4452	0.3891	0.0000	10,411.1738
Waste						0.0000	0.0000		0.0000	0.0000	1,000.1141	0.0000	1,000.1141	59.1051	0.0000	2,477.7405
Water						0.0000	0.0000		0.0000	0.0000	169.1976	116.1847	285.3822	17.3857	0.4118	842.7497
Total	**24.3349**	**12.2396**	**48.5263**	**0.1289**	**13.6269**	**0.4564**	**14.0834**	**3.6468**	**0.4527**	**4.0995**	**1,169.3117**	**16,339.7289**	**17,509.0406**	**77.0570**	**0.5120**	**19,588.0288**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**18.49**	**0.34**	**8.05**	**0.25**	**0.00**	**5.18**	**0.18**	**0.00**	**5.22**	**0.60**	**0.00**	**0.05**	**0.05**	**0.02**	**0.00**	**0.05**

2.3 Vegetation

Vegetation

	CO2e
Category	MT
New Trees	-2,160.268 0
Total	**-2,160.268 0**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/3/2022	1/2/2022	5	0	
2	Site Preparation	Site Preparation	10/8/2022	10/7/2022	5	0	
3	Grading	Grading	3/25/2023	3/24/2023	5	0	
4	Building Construction	Building Construction	6/1/2024	6/3/2024	5	1	
5	Paving	Paving	4/19/2036	4/18/2036	5	0	
6	Architectural Coating	Architectural Coating	2/21/2037	2/20/2037	5	0	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 775

Acres of Paving: 43.07

Residential Indoor: 3,436,425; Residential Outdoor: 1,145,475; Non-Residential Indoor: 3,083,825; Non-Residential Outdoor: 1,027,942; Striped Parking Area: 112,577 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	158	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	2	8.00	158	0.38
Grading	Graders	1	8.00	187	0.41
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Building Construction	Cranes	0	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	0	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Paving	Pavers	2	8.00	130	0.42
Paving	Paving Equipment	2	8.00	132	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	6.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	175.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	0	2,798.00	826.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	560.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.2 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.2 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction - 2024

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction - 2024

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	9.6000e-004	0.0375	9.9300e-003	1.0000e-004	2.4400e-003	7.0000e-005	2.5100e-003	7.1000e-004	7.0000e-005	7.7000e-004	0.0000	9.5338	9.5338	3.5000e-004	0.0000	9.5426
Worker	6.8100e-003	5.5800e-003	0.0522	1.5000e-004	0.0172	1.3000e-004	0.0174	4.5800e-003	1.2000e-004	4.7000e-003	0.0000	13.6800	13.6800	4.2000e-004	0.0000	13.6905
Total	**7.7700e-003**	**0.0431**	**0.0621**	**2.5000e-004**	**0.0197**	**2.0000e-004**	**0.0199**	**5.2900e-003**	**1.9000e-004**	**5.4700e-003**	**0.0000**	**23.2139**	**23.2139**	**7.7000e-004**	**0.0000**	**23.2331**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction - 2024

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	9.6000e-004	0.0375	9.9300e-003	1.0000e-004	2.4400e-003	7.0000e-005	2.5100e-003	7.1000e-004	7.0000e-005	7.7000e-004	0.0000	9.5338	9.5338	3.5000e-004	0.0000	9.5426
Worker	6.8100e-003	5.5800e-003	0.0522	1.5000e-004	0.0172	1.3000e-004	0.0174	4.5800e-003	1.2000e-004	4.7000e-003	0.0000	13.6800	13.6800	4.2000e-004	0.0000	13.6905
Total	**7.7700e-003**	**0.0431**	**0.0621**	**2.5000e-004**	**0.0197**	**2.0000e-004**	**0.0199**	**5.2900e-003**	**1.9000e-004**	**5.4700e-003**	**0.0000**	**23.2139**	**23.2139**	**7.7000e-004**	**0.0000**	**23.2331**

3.6 Paving - 2036

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Paving - 2036

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Paving - 2036

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	2.9683	7.8312	31.8673	0.1026	13.6269	0.0583	13.6852	3.6468	0.0546	3.7014	0.0000	10,401.4452	10,401.4452	0.3891	0.0000	10,411.1738
Unmitigated	2.9683	7.8312	31.8673	0.1026	13.6269	0.0583	13.6852	3.6468	0.0546	3.7014	0.0000	10,401.4452	10,401.4452	0.3891	0.0000	10,411.1738

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Low Rise	0.00	0.00	0.00		
Apartments Mid Rise	0.00	0.00	0.00		
General Light Industry	0.00	0.00	0.00		
Health Club	0.00	0.00	0.00		
Parking Lot	0.00	0.00	0.00		
Research & Development	0.00	0.00	0.00		
University/College (4Yr)	11,439.99	3,941.51	3941.51	36,754,876	36,754,876
Total	11,439.99	3,941.51	3,941.51	36,754,876	36,754,876

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Low Rise	0.00	0.00	0.00	24.00	50.00	26.00	86	11	3
Apartments Mid Rise	0.00	0.00	0.00	24.00	50.00	26.00	86	11	3
General Light Industry	14.70	6.60	6.60	59.00	28.00	13.00	92	5	3
Health Club	14.70	6.60	6.60	16.90	64.10	19.00	52	39	9
Parking Lot	14.70	6.60	6.60	0.00	0.00	0.00	0	0	0
Research & Development	14.70	6.60	6.60	33.00	48.00	19.00	82	15	3
University/College (4Yr)	14.70	6.60	6.60	0.00	0.00	0.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Low Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Apartments Mid Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Apartments Mid Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
General Light Industry	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Health Club	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Parking Lot	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Research & Development	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
University/College (4Yr)	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	1,139.238 4	1,139.238 4	0.0732	0.0146	1,145.432 5
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	1,139.238 4	1,139.238 4	0.0732	0.0146	1,145.432 5
NaturalGas Mitigated	0.4711	4.2477	3.3380	0.0257		0.3255	0.3255		0.3255	0.3255	0.0000	4,662.705 4	4,662.705 4	0.0894	0.0855	4,690.413 5
NaturalGas Unmitigated	0.4711	4.2477	3.3380	0.0257		0.3255	0.3255		0.3255	0.3255	0.0000	4,662.705 4	4,662.705 4	0.0894	0.0855	4,690.413 5

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Low Rise	3.46349e+006	0.0187	0.1596	0.0679	1.0200e-003		0.0129	0.0129		0.0129	0.0129	0.0000	184.8248	184.8248	3.5400e-003	3.3900e-003	185.9232
Apartments Mid Rise	8.58203e+006	0.0463	0.3955	0.1683	2.5200e-003		0.0320	0.0320		0.0320	0.0320	0.0000	457.9698	457.9698	8.7800e-003	8.4000e-003	460.6913
General Light Industry	1.47016e+006	7.9300e-003	0.0721	0.0605	4.3000e-004		5.4800e-003	5.4800e-003		5.4800e-003	5.4800e-003	0.0000	78.4532	78.4532	1.5000e-003	1.4400e-003	78.9194
Health Club	1.54399e+007	0.0833	0.7569	0.6358	4.5400e-003		0.0575	0.0575		0.0575	0.0575	0.0000	823.9326	823.9326	0.0158	0.0151	828.8288
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	2.8624e+007	0.1544	1.4031	1.1786	8.4200e-003		0.1066	0.1066		0.1066	0.1066	0.0000	1,527.4857	1,527.4857	0.0293	0.0280	1,536.5628
University/College (4Yr)	2.97962e+007	0.1607	1.4606	1.2269	8.7600e-003		0.1110	0.1110		0.1110	0.1110	0.0000	1,590.0394	1,590.0394	0.0305	0.0292	1,599.4882
Total		**0.4712**	**4.2477**	**3.3380**	**0.0257**		**0.3255**	**0.3255**		**0.3255**	**0.3255**	**0.0000**	**4,662.7054**	**4,662.7054**	**0.0894**	**0.0855**	**4,690.4136**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Low Rise	3.46349e+006	0.0187	0.1596	0.0679	1.0200e-003		0.0129	0.0129		0.0129	0.0129	0.0000	184.8248	184.8248	3.5400e-003	3.3900e-003	185.9232
Apartments Mid Rise	8.58203e+006	0.0463	0.3955	0.1683	2.5200e-003		0.0320	0.0320		0.0320	0.0320	0.0000	457.9698	457.9698	8.7800e-003	8.4000e-003	460.6913
General Light Industry	1.47016e+006	7.9300e-003	0.0721	0.0605	4.3000e-004		5.4800e-003	5.4800e-003		5.4800e-003	5.4800e-003	0.0000	78.4532	78.4532	1.5000e-003	1.4400e-003	78.9194
Health Club	1.54399e+007	0.0833	0.7569	0.6358	4.5400e-003		0.0575	0.0575		0.0575	0.0575	0.0000	823.9326	823.9326	0.0158	0.0151	828.8288
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	2.8624e+007	0.1544	1.4031	1.1786	8.4200e-003		0.1066	0.1066		0.1066	0.1066	0.0000	1,527.4857	1,527.4857	0.0293	0.0280	1,536.5628
University/College (4Yr)	2.97962e+007	0.1607	1.4606	1.2269	8.7600e-003		0.1110	0.1110		0.1110	0.1110	0.0000	1,590.0394	1,590.0394	0.0305	0.0292	1,599.4882
Total		**0.4712**	**4.2477**	**3.3380**	**0.0257**		**0.3255**	**0.3255**		**0.3255**	**0.3255**	**0.0000**	**4,662.7054**	**4,662.7054**	**0.0894**	**0.0855**	**4,690.4136**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Low Rise	1.86031e +006	65.6494	4.2200e-003	8.4000e-004	66.0064
Apartments Mid Rise	5.05112e +006	178.2513	0.0115	2.2900e-003	179.2205
General Light Industry	474226	16.7352	1.0800e-003	2.2000e-004	16.8262
Health Club	4.98042e +006	175.7565	0.0113	2.2600e-003	176.7121
Parking Lot	656696	23.1745	1.4900e-003	3.0000e-004	23.3005
Research & Development	9.23318e +006	325.8344	0.0209	4.1900e-003	327.6059
University/College (4Yr)	1.00267e +007	353.8372	0.0227	4.5500e-003	355.7610
Total		**1,139.238 4**	**0.0732**	**0.0147**	**1,145.432 5**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Low Rise	1.86031e +006	65.6494	4.2200e-003	8.4000e-004	66.0064
Apartments Mid Rise	5.05112e +006	178.2513	0.0115	2.2900e-003	179.2205
General Light Industry	474226	16.7352	1.0800e-003	2.2000e-004	16.8262
Health Club	4.98042e +006	175.7565	0.0113	2.2600e-003	176.7121
Parking Lot	656696	23.1745	1.4900e-003	3.0000e-004	23.3005
Research & Development	9.23318e +006	325.8344	0.0209	4.1900e-003	327.6059
University/College (4Yr)	1.00267e +007	353.8372	0.0227	4.5500e-003	355.7610
Total		**1,139.238 4**	**0.0732**	**0.0147**	**1,145.432 5**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Electric Lawnmower

Use Electric Leafblower

Use Electric Chainsaw

Use Low VOC Paint - Residential Interior

Use Low VOC Paint - Residential Exterior

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

Use Low VOC Cleaning Supplies

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	20.8954	0.1607	13.3210	6.1000e-004		0.0726	0.0726		0.0726	0.0726	0.0000	20.1552	20.1552	0.0146	0.0000	20.5188
Unmitigated	26.4146	0.2024	17.5672	9.3000e-004		0.0976	0.0976		0.0976	0.0976	0.0000	28.8678	28.8678	0.0279	0.0000	29.5661

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	3.7756					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	22.1047					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.5343	0.2024	17.5672	9.3000e-004		0.0976	0.0976		0.0976	0.0976	0.0000	28.8678	28.8678	0.0279	0.0000	29.5661
Total	**26.4146**	**0.2024**	**17.5672**	**9.3000e-004**		**0.0976**	**0.0976**		**0.0976**	**0.0976**	**0.0000**	**28.8678**	**28.8678**	**0.0279**	**0.0000**	**29.5661**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.1524					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	20.4610					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.2820	0.1607	13.3210	6.1000e-004		0.0726	0.0726		0.0726	0.0726	0.0000	20.1552	20.1552	0.0146	0.0000	20.5188
Total	**20.8954**	**0.1607**	**13.3210**	**6.1000e-004**		**0.0726**	**0.0726**		**0.0726**	**0.0726**	**0.0000**	**20.1552**	**20.1552**	**0.0146**	**0.0000**	**20.5188**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	285.3822	17.3857	0.4118	842.7497
Unmitigated	285.3822	17.3857	0.4118	842.7497

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Low Rise	28.6678 / 18.0732	16.8014	0.9346	0.0222	46.7698
Apartments Mid Rise	81.8986 / 51.6317	47.9985	2.6701	0.0633	133.6128
General Light Industry	8.92625 / 0	4.5364	0.2910	6.8900e-003	13.8638
Health Club	23.9772 / 14.6957	14.0005	0.7817	0.0185	39.0652
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Research & Development	369.547 / 0	187.8059	12.0462	0.2852	573.9628
University/College (4Yr)	20.3019 / 31.7543	14.2396	0.6620	0.0157	35.4753
Total		**285.3823**	**17.3857**	**0.4118**	**842.7497**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Low Rise	28.6678 / 18.0732	16.8014	0.9346	0.0222	46.7698
Apartments Mid Rise	81.8986 / 51.6317	47.9985	2.6701	0.0633	133.6128
General Light Industry	8.92625 / 0	4.5364	0.2910	6.8900e-003	13.8638
Health Club	23.9772 / 14.6957	14.0005	0.7817	0.0185	39.0652
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Research & Development	369.547 / 0	187.8059	12.0462	0.2852	573.9628
University/College (4Yr)	20.3019 / 31.7543	14.2396	0.6620	0.0157	35.4753
Total		**285.3823**	**17.3857**	**0.4118**	**842.7497**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	1,000.114 1	59.1051	0.0000	2,477.740 5
Unmitigated	1,000.114 1	59.1051	0.0000	2,477.740 5

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Low Rise	202.4	41.0854	2.4281	0.0000	101.7873
Apartments Mid Rise	578.22	117.3734	6.9366	0.0000	290.7877
General Light Industry	47.86	9.7152	0.5742	0.0000	24.0689
Health Club	2310.84	469.0796	27.7218	0.0000	1,162.125 0
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Research & Development	57.11	11.5928	0.6851	0.0000	28.7207
University/College (4Yr)	1730.46	351.2677	20.7593	0.0000	870.2510
Total		**1,000.114 1**	**59.1051**	**0.0000**	**2,477.740 5**

8.2 Waste by Land Use

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Low Rise	202.4	41.0854	2.4281	0.0000	101.7873
Apartments Mid Rise	578.22	117.3734	6.9366	0.0000	290.7877
General Light Industry	47.86	9.7152	0.5742	0.0000	24.0689
Health Club	2310.84	469.0796	27.7218	0.0000	1,162.125 0
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Research & Development	57.11	11.5928	0.6851	0.0000	28.7207
University/College (4Yr)	1730.46	351.2677	20.7593	0.0000	870.2510
Total		**1,000.114 1**	**59.1051**	**0.0000**	**2,477.740 5**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

	Total CO2	CH4	N2O	CO2e
Category	MT			
Unmitigated	-2,160.2680	0.0000	0.0000	-2,160.2680

11.2 Net New Trees

Species Class

	Number of Trees	Total CO2	CH4	N2O	CO2e
		MT			
Pine	-3386	-2,160.2680	0.0000	0.0000	-2,160.2680
Total		**-2,160.2680**	**0.0000**	**0.0000**	**-2,160.2680**

UCSC - 2020 LRDP - Operational Only

Santa Cruz County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Research & Development	1,127.37	1000sqft	25.88	1,127,373.00	0
University/College (4Yr)	9,482.00	Student	40.01	1,290,438.00	0
General Light Industry	57.90	1000sqft	1.33	57,903.00	0
Parking Lot	43.07	Acre	43.07	1,876,275.00	0
Health Club	608.11	1000sqft	13.96	608,110.00	0
Apartments Low Rise	440.00	Dwelling Unit	27.50	660,000.00	550
Apartments Mid Rise	1,257.00	Dwelling Unit	33.08	1,885,000.00	8500

1.2 Other Project Characteristics

Urbanization Rural **Wind Speed (m/s)** 1.8 **Precipitation Freq (Days)** 61

Climate Zone 4 **Operational Year** 2040

Utility Company Pacific Gas & Electric Company

CO2 Intensity (lb/MWhr) 77.8 **CH4 Intensity (lb/MWhr)** 0.005 **N2O Intensity (lb/MWhr)** 0.001

1.3 User Entered Comments & Non-Default Data

Project Characteristics - UCSC Electricity Emission Factors for 2040 reflect State averages.

Land Use - Values specified in Project Description

Construction Phase - This file is for operational emissions, so construction phases are removed.

Off-road Equipment -

Off-road Equipment - This file is for operational emissions, so construction phases are removed.

Off-road Equipment -

Trips and VMT -

On-road Fugitive Dust -

Demolition -

Architectural Coating -

Vehicle Trips - Adjusted trip rates so that avg annual VMT matches Traffic Study.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Woodstoves -

Consumer Products -

Area Coating -

Energy Use - Energy intensity rates adjusted 2019 Title 24 standards.

Water And Wastewater -

Solid Waste -

Sequestration - Using Pine as subsititute for redwood trees. 22 trees/acre.

Construction Off-road Equipment Mitigation -

Area Mitigation - Zero-VOC paints and coatings (5 g/L), low-VOC cleaning supplies. 100% electric lawn and garden equipment.

Energy Mitigation -

Fleet Mix -

UCSC - 2020 LRDP - Operational Only - Santa Cruz County, Summer

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	ConstArea_Nonresidential_Exterior	1,541,912.00	1,027,942.00
tblArchitecturalCoating	ConstArea_Nonresidential_Interior	4,625,736.00	3,083,825.00
tblArchitecturalCoating	ConstArea_Residential_Exterior	1,717,875.00	1,145,475.00
tblArchitecturalCoating	ConstArea_Residential_Interior	5,153,625.00	3,436,425.00
tblAreaMitigation	UseLowVOCPaintNonresidentialExteriorValue	150	5
tblAreaMitigation	UseLowVOCPaintNonresidentialInteriorValue	150	5
tblAreaMitigation	UseLowVOCPaintParkingCheck	False	True
tblAreaMitigation	UseLowVOCPaintParkingValue	150	5
tblAreaMitigation	UseLowVOCPaintResidentialExteriorValue	100	5
tblAreaMitigation	UseLowVOCPaintResidentialInteriorValue	100	5
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstructionPhase	NumDays	220.00	0.00
tblConstructionPhase	NumDays	3,100.00	1.00
tblConstructionPhase	NumDays	200.00	0.00
tblConstructionPhase	NumDays	310.00	0.00
tblConstructionPhase	NumDays	220.00	0.00
tblConstructionPhase	NumDays	120.00	0.00
tblEnergyUse	T24E	365.68	244.86
tblEnergyUse	T24E	332.81	222.85
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	2.73	2.59
tblEnergyUse	T24NG	7,043.85	4,716.56

tblEnergyUse	T24NG	5,484.45	3,672.39
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	20.83	19.79
tblGrading	AcresOfGrading	0.00	775.00
tblLandUse	LandUseSquareFeet	1,127,370.00	1,127,373.00
tblLandUse	LandUseSquareFeet	1,742,767.59	1,290,438.00
tblLandUse	LandUseSquareFeet	57,900.00	57,903.00
tblLandUse	LandUseSquareFeet	1,876,129.20	1,876,275.00
tblLandUse	LandUseSquareFeet	440,000.00	660,000.00
tblLandUse	LandUseSquareFeet	1,257,000.00	1,885,000.00
tblLandUse	Population	1,258.00	550.00
tblLandUse	Population	3,595.00	8,500.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblProjectCharacteristics	CH4IntensityFactor	0.029	0.005
tblProjectCharacteristics	CO2IntensityFactor	641.35	77.8
tblProjectCharacteristics	N2OIntensityFactor	0.006	0.001
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblSequestration	NumberOfNewTrees	0.00	-3,386.00
tblSolidWaste	SolidWasteGenerationRate	71.80	47.86
tblSolidWaste	SolidWasteGenerationRate	3,466.23	2,310.84
tblSolidWaste	SolidWasteGenerationRate	85.67	57.11

tblTripsAndVMT	VendorTripNumber	994.00	826.00
tblTripsAndVMT	WorkerTripNumber	3,192.00	2,798.00
tblTripsAndVMT	WorkerTripNumber	638.00	560.00
tblVehicleEF	HHD	0.24	0.19
tblVehicleEF	HHD	0.06	0.04
tblVehicleEF	HHD	0.06	0.00
tblVehicleEF	HHD	1.31	54.39
tblVehicleEF	HHD	1.00	0.41
tblVehicleEF	HHD	3.88	7.9690e-003
tblVehicleEF	HHD	3,651.43	7,280.05
tblVehicleEF	HHD	1,576.81	1,181.05
tblVehicleEF	HHD	11.12	0.06
tblVehicleEF	HHD	11.60	45.97
tblVehicleEF	HHD	1.50	2.41
tblVehicleEF	HHD	19.34	3.06
tblVehicleEF	HHD	3.4070e-003	0.02
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	5.4400e-003	0.02
tblVehicleEF	HHD	1.3500e-004	1.0000e-006
tblVehicleEF	HHD	3.2590e-003	0.02
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.4960e-003	8.6080e-003
tblVehicleEF	HHD	5.2040e-003	0.02
tblVehicleEF	HHD	1.2500e-004	1.0000e-006
tblVehicleEF	HHD	8.2000e-005	2.7000e-005
tblVehicleEF	HHD	4.5610e-003	7.4000e-005

tblVehicleEF	HHD	0.34	3.69
tblVehicleEF	HHD	5.4000e-005	1.8000e-005
tblVehicleEF	HHD	0.08	0.02
tblVehicleEF	HHD	5.9400e-004	3.7800e-004
tblVehicleEF	HHD	0.07	2.0000e-006
tblVehicleEF	HHD	0.03	0.07
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.7400e-004	1.0000e-006
tblVehicleEF	HHD	8.2000e-005	2.7000e-005
tblVehicleEF	HHD	4.5610e-003	7.4000e-005
tblVehicleEF	HHD	0.39	4.21
tblVehicleEF	HHD	5.4000e-005	1.8000e-005
tblVehicleEF	HHD	0.14	0.07
tblVehicleEF	HHD	5.9400e-004	3.7800e-004
tblVehicleEF	HHD	0.07	2.0000e-006
tblVehicleEF	HHD	0.23	0.20
tblVehicleEF	HHD	0.06	0.04
tblVehicleEF	HHD	0.05	0.00
tblVehicleEF	HHD	0.95	53.65
tblVehicleEF	HHD	1.02	0.42
tblVehicleEF	HHD	3.53	7.2410e-003
tblVehicleEF	HHD	3,868.33	7,196.62
tblVehicleEF	HHD	1,576.81	1,181.06
tblVehicleEF	HHD	11.12	0.06
tblVehicleEF	HHD	11.98	43.90
tblVehicleEF	HHD	1.44	2.33
tblVehicleEF	HHD	19.32	3.06

tblVehicleEF	HHD	2.8760e-003	0.02
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	5.4400e-003	0.02
tblVehicleEF	HHD	1.3500e-004	1.0000e-006
tblVehicleEF	HHD	2.7520e-003	0.02
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.4960e-003	8.6080e-003
tblVehicleEF	HHD	5.2040e-003	0.02
tblVehicleEF	HHD	1.2500e-004	1.0000e-006
tblVehicleEF	HHD	1.6000e-004	5.3000e-005
tblVehicleEF	HHD	4.6920e-003	7.6000e-005
tblVehicleEF	HHD	0.32	3.90
tblVehicleEF	HHD	1.0600e-004	3.5000e-005
tblVehicleEF	HHD	0.08	0.02
tblVehicleEF	HHD	5.5500e-004	3.5300e-004
tblVehicleEF	HHD	0.06	2.0000e-006
tblVehicleEF	HHD	0.04	0.07
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.6800e-004	1.0000e-006
tblVehicleEF	HHD	1.6000e-004	5.3000e-005
tblVehicleEF	HHD	4.6920e-003	7.6000e-005
tblVehicleEF	HHD	0.37	4.46
tblVehicleEF	HHD	1.0600e-004	3.5000e-005
tblVehicleEF	HHD	0.14	0.07
tblVehicleEF	HHD	5.5500e-004	3.5300e-004
tblVehicleEF	HHD	0.07	2.0000e-006

tblVehicleEF	HHD	0.26	0.17
tblVehicleEF	HHD	0.06	0.04
tblVehicleEF	HHD	0.06	0.00
tblVehicleEF	HHD	1.80	55.42
tblVehicleEF	HHD	0.99	0.41
tblVehicleEF	HHD	4.21	8.6450e-003
tblVehicleEF	HHD	3,351.89	7,395.27
tblVehicleEF	HHD	1,576.81	1,181.05
tblVehicleEF	HHD	11.12	0.06
tblVehicleEF	HHD	11.09	48.82
tblVehicleEF	HHD	1.52	2.44
tblVehicleEF	HHD	19.36	3.06
tblVehicleEF	HHD	4.1390e-003	0.02
tblVehicleEF	HHD	0.06	0.06
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	5.4400e-003	0.02
tblVehicleEF	HHD	1.3500e-004	1.0000e-006
tblVehicleEF	HHD	3.9600e-003	0.02
tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	8.4960e-003	8.6080e-003
tblVehicleEF	HHD	5.2040e-003	0.02
tblVehicleEF	HHD	1.2500e-004	1.0000e-006
tblVehicleEF	HHD	4.1000e-005	1.4000e-005
tblVehicleEF	HHD	4.6400e-003	7.5000e-005
tblVehicleEF	HHD	0.37	3.39
tblVehicleEF	HHD	2.1000e-005	7.0000e-006
tblVehicleEF	HHD	0.08	0.02

tblVehicleEF	HHD	6.7000e-004	4.2700e-004
tblVehicleEF	HHD	0.07	2.0000e-006
tblVehicleEF	HHD	0.03	0.07
tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.7900e-004	1.0000e-006
tblVehicleEF	HHD	4.1000e-005	1.4000e-005
tblVehicleEF	HHD	4.6400e-003	7.5000e-005
tblVehicleEF	HHD	0.42	3.87
tblVehicleEF	HHD	2.1000e-005	7.0000e-006
tblVehicleEF	HHD	0.14	0.07
tblVehicleEF	HHD	6.7000e-004	4.2700e-004
tblVehicleEF	HHD	0.08	3.0000e-006
tblVehicleEF	LDA	1.6390e-003	7.5900e-004
tblVehicleEF	LDA	9.0100e-004	0.02
tblVehicleEF	LDA	0.29	0.39
tblVehicleEF	LDA	0.44	1.56
tblVehicleEF	LDA	168.86	206.82
tblVehicleEF	LDA	36.04	41.63
tblVehicleEF	LDA	0.02	0.02
tblVehicleEF	LDA	0.02	0.12
tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	8.1950e-003	0.06
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	7.7480e-003	0.06

tblVehicleEF	LDA	4.1300e-003	2.3880e-003
tblVehicleEF	LDA	0.03	0.16
tblVehicleEF	LDA	0.01	0.08
tblVehicleEF	LDA	1.6890e-003	1.8340e-003
tblVehicleEF	LDA	3.6700e-004	3.6900e-004
tblVehicleEF	LDA	8.1950e-003	0.06
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	7.7480e-003	0.06
tblVehicleEF	LDA	6.0000e-003	3.4550e-003
tblVehicleEF	LDA	0.03	0.16
tblVehicleEF	LDA	0.01	0.09
tblVehicleEF	LDA	1.7670e-003	8.3200e-004
tblVehicleEF	LDA	7.5200e-004	0.02
tblVehicleEF	LDA	0.32	0.44
tblVehicleEF	LDA	0.34	1.23
tblVehicleEF	LDA	177.42	217.05
tblVehicleEF	LDA	36.04	41.01
tblVehicleEF	LDA	0.02	0.02
tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	0.02	0.13
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	4.4460e-003	2.5670e-003

tblVehicleEF	LDA	0.03	0.14
tblVehicleEF	LDA	0.01	0.07
tblVehicleEF	LDA	1.7750e-003	1.9240e-003
tblVehicleEF	LDA	3.6500e-004	3.6300e-004
tblVehicleEF	LDA	0.02	0.13
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	6.4610e-003	3.7160e-003
tblVehicleEF	LDA	0.03	0.14
tblVehicleEF	LDA	0.01	0.07
tblVehicleEF	LDA	1.6100e-003	7.3600e-004
tblVehicleEF	LDA	1.0270e-003	0.02
tblVehicleEF	LDA	0.29	0.40
tblVehicleEF	LDA	0.51	1.82
tblVehicleEF	LDA	168.71	206.65
tblVehicleEF	LDA	36.04	42.12
tblVehicleEF	LDA	0.03	0.02
tblVehicleEF	LDA	0.02	0.13
tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	3.5800e-003	0.03
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	2.4830e-003	0.02
tblVehicleEF	LDA	4.0590e-003	2.3470e-003
tblVehicleEF	LDA	0.03	0.20

tblVehicleEF	LDA	0.01	0.09
tblVehicleEF	LDA	1.6880e-003	1.8320e-003
tblVehicleEF	LDA	3.6800e-004	3.7300e-004
tblVehicleEF	LDA	3.5800e-003	0.03
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	2.4830e-003	0.02
tblVehicleEF	LDA	5.8960e-003	3.3960e-003
tblVehicleEF	LDA	0.03	0.20
tblVehicleEF	LDA	0.02	0.10
tblVehicleEF	LDT1	1.9070e-003	9.4600e-004
tblVehicleEF	LDT1	1.2100e-003	0.03
tblVehicleEF	LDT1	0.32	0.43
tblVehicleEF	LDT1	0.51	1.75
tblVehicleEF	LDT1	209.63	252.15
tblVehicleEF	LDT1	45.37	51.97
tblVehicleEF	LDT1	0.03	0.02
tblVehicleEF	LDT1	0.02	0.15
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	4.7310e-003	3.0380e-003
tblVehicleEF	LDT1	0.03	0.28
tblVehicleEF	LDT1	0.02	0.10

tblVehicleEF	LDT1	2.0980e-003	2.2340e-003
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	6.8990e-003	4.4320e-003
tblVehicleEF	LDT1	0.03	0.28
tblVehicleEF	LDT1	0.02	0.11
tblVehicleEF	LDT1	2.0550e-003	1.0350e-003
tblVehicleEF	LDT1	1.0090e-003	0.02
tblVehicleEF	LDT1	0.35	0.47
tblVehicleEF	LDT1	0.40	1.37
tblVehicleEF	LDT1	220.22	262.77
tblVehicleEF	LDT1	45.37	51.26
tblVehicleEF	LDT1	0.02	0.02
tblVehicleEF	LDT1	0.02	0.13
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	0.02	0.24
tblVehicleEF	LDT1	0.04	0.08
tblVehicleEF	LDT1	0.02	0.23
tblVehicleEF	LDT1	5.0950e-003	3.2690e-003
tblVehicleEF	LDT1	0.03	0.25
tblVehicleEF	LDT1	0.01	0.08
tblVehicleEF	LDT1	2.2040e-003	2.3280e-003
tblVehicleEF	LDT1	4.6000e-004	4.5400e-004

tblVehicleEF	LDT1	0.02	0.24
tblVehicleEF	LDT1	0.04	0.08
tblVehicleEF	LDT1	0.02	0.23
tblVehicleEF	LDT1	7.4310e-003	4.7690e-003
tblVehicleEF	LDT1	0.03	0.25
tblVehicleEF	LDT1	0.01	0.09
tblVehicleEF	LDT1	1.8740e-003	9.1700e-004
tblVehicleEF	LDT1	1.3790e-003	0.03
tblVehicleEF	LDT1	0.32	0.43
tblVehicleEF	LDT1	0.60	2.04
tblVehicleEF	LDT1	209.45	251.97
tblVehicleEF	LDT1	45.37	52.53
tblVehicleEF	LDT1	0.03	0.02
tblVehicleEF	LDT1	0.03	0.16
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	5.0240e-003	0.06
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	3.4640e-003	0.04
tblVehicleEF	LDT1	4.6480e-003	2.9850e-003
tblVehicleEF	LDT1	0.04	0.33
tblVehicleEF	LDT1	0.02	0.11
tblVehicleEF	LDT1	2.0960e-003	2.2330e-003
tblVehicleEF	LDT1	4.6300e-004	4.6500e-004
tblVehicleEF	LDT1	5.0240e-003	0.06

tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	3.4640e-003	0.04
tblVehicleEF	LDT1	6.7780e-003	4.3540e-003
tblVehicleEF	LDT1	0.04	0.33
tblVehicleEF	LDT1	0.02	0.13
tblVehicleEF	LDT2	2.8190e-003	1.2600e-003
tblVehicleEF	LDT2	2.3310e-003	0.03
tblVehicleEF	LDT2	0.47	0.50
tblVehicleEF	LDT2	0.79	2.20
tblVehicleEF	LDT2	252.42	252.46
tblVehicleEF	LDT2	55.17	53.02
tblVehicleEF	LDT2	0.04	0.03
tblVehicleEF	LDT2	0.05	0.15
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.02	0.15
tblVehicleEF	LDT2	0.07	0.07
tblVehicleEF	LDT2	0.02	0.16
tblVehicleEF	LDT2	7.0170e-003	4.4720e-003
tblVehicleEF	LDT2	0.05	0.28
tblVehicleEF	LDT2	0.03	0.13
tblVehicleEF	LDT2	2.5270e-003	2.2380e-003
tblVehicleEF	LDT2	5.6400e-004	4.7000e-004
tblVehicleEF	LDT2	0.02	0.15
tblVehicleEF	LDT2	0.07	0.07

tblVehicleEF	LDT2	0.02	0.16
tblVehicleEF	LDT2	0.01	6.4570e-003
tblVehicleEF	LDT2	0.05	0.28
tblVehicleEF	LDT2	0.03	0.15
tblVehicleEF	LDT2	3.0340e-003	1.3780e-003
tblVehicleEF	LDT2	1.9960e-003	0.03
tblVehicleEF	LDT2	0.52	0.55
tblVehicleEF	LDT2	0.66	1.72
tblVehicleEF	LDT2	264.93	262.08
tblVehicleEF	LDT2	55.17	52.11
tblVehicleEF	LDT2	0.03	0.02
tblVehicleEF	LDT2	0.04	0.13
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.05	0.32
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	0.04	0.29
tblVehicleEF	LDT2	7.5500e-003	4.7960e-003
tblVehicleEF	LDT2	0.05	0.25
tblVehicleEF	LDT2	0.03	0.11
tblVehicleEF	LDT2	2.6530e-003	2.3240e-003
tblVehicleEF	LDT2	5.6200e-004	4.6200e-004
tblVehicleEF	LDT2	0.05	0.32
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	0.04	0.29

tblVehicleEF	LDT2	0.01	6.9310e-003
tblVehicleEF	LDT2	0.05	0.25
tblVehicleEF	LDT2	0.03	0.12
tblVehicleEF	LDT2	2.7690e-003	1.2220e-003
tblVehicleEF	LDT2	2.6130e-003	0.04
tblVehicleEF	LDT2	0.48	0.51
tblVehicleEF	LDT2	0.90	2.58
tblVehicleEF	LDT2	252.21	252.31
tblVehicleEF	LDT2	55.17	53.73
tblVehicleEF	LDT2	0.04	0.03
tblVehicleEF	LDT2	0.05	0.16
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.01	0.07
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	7.6010e-003	0.05
tblVehicleEF	LDT2	6.8940e-003	4.3970e-003
tblVehicleEF	LDT2	0.07	0.34
tblVehicleEF	LDT2	0.04	0.15
tblVehicleEF	LDT2	2.5250e-003	2.2370e-003
tblVehicleEF	LDT2	5.6600e-004	4.7600e-004
tblVehicleEF	LDT2	0.01	0.07
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	7.6010e-003	0.05
tblVehicleEF	LDT2	0.01	6.3480e-003

tblVehicleEF	LDT2	0.07	0.34
tblVehicleEF	LDT2	0.04	0.17
tblVehicleEF	LHD1	3.7210e-003	0.05
tblVehicleEF	LHD1	5.3310e-003	3.9600e-003
tblVehicleEF	LHD1	8.2940e-003	7.2240e-003
tblVehicleEF	LHD1	0.14	2.44
tblVehicleEF	LHD1	0.47	0.37
tblVehicleEF	LHD1	1.29	0.76
tblVehicleEF	LHD1	8.78	107.82
tblVehicleEF	LHD1	634.75	658.76
tblVehicleEF	LHD1	27.02	8.68
tblVehicleEF	LHD1	0.05	0.55
tblVehicleEF	LHD1	0.42	0.20
tblVehicleEF	LHD1	0.57	0.19
tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003
tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	1.2360e-003	0.01
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	8.0900e-004	9.2900e-003
tblVehicleEF	LHD1	0.09	0.06

tblVehicleEF	LHD1	0.15	0.24
tblVehicleEF	LHD1	0.11	0.03
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
tblVehicleEF	LHD1	6.2040e-003	6.4250e-003
tblVehicleEF	LHD1	2.9400e-004	8.6000e-005
tblVehicleEF	LHD1	1.2360e-003	0.01
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	8.0900e-004	9.2900e-003
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.15	0.24
tblVehicleEF	LHD1	0.12	0.04
tblVehicleEF	LHD1	3.7210e-003	0.05
tblVehicleEF	LHD1	5.3890e-003	4.0070e-003
tblVehicleEF	LHD1	7.7400e-003	6.7790e-003
tblVehicleEF	LHD1	0.14	2.44
tblVehicleEF	LHD1	0.47	0.38
tblVehicleEF	LHD1	1.18	0.70
tblVehicleEF	LHD1	8.78	107.82
tblVehicleEF	LHD1	634.75	658.76
tblVehicleEF	LHD1	27.02	8.57
tblVehicleEF	LHD1	0.05	0.55
tblVehicleEF	LHD1	0.41	0.19
tblVehicleEF	LHD1	0.53	0.17
tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003

tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	2.3600e-003	0.03
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	1.5530e-003	0.02
tblVehicleEF	LHD1	0.09	0.06
tblVehicleEF	LHD1	0.14	0.22
tblVehicleEF	LHD1	0.10	0.03
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
tblVehicleEF	LHD1	6.2040e-003	6.4250e-003
tblVehicleEF	LHD1	2.9200e-004	8.5000e-005
tblVehicleEF	LHD1	2.3600e-003	0.03
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	1.5530e-003	0.02
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.14	0.22
tblVehicleEF	LHD1	0.11	0.03
tblVehicleEF	LHD1	3.7210e-003	0.05
tblVehicleEF	LHD1	5.2920e-003	3.9290e-003
tblVehicleEF	LHD1	8.7320e-003	7.5750e-003
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tblVehicleEF	LHD1	0.46	0.37

tblVehicleEF	LHD1	1.39	0.82
tblVehicleEF	LHD1	8.78	107.82
tblVehicleEF	LHD1	634.75	658.75
tblVehicleEF	LHD1	27.02	8.78
tblVehicleEF	LHD1	0.05	0.55
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tblVehicleEF	LHD1	0.61	0.20
tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003
tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	6.2900e-004	7.2020e-003
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	3.1500e-004	3.5920e-003
tblVehicleEF	LHD1	0.08	0.06
tblVehicleEF	LHD1	0.17	0.27
tblVehicleEF	LHD1	0.12	0.04
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
tblVehicleEF	LHD1	6.2040e-003	6.4250e-003
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tblVehicleEF	LHD1	6.2900e-004	7.2020e-003
tblVehicleEF	LHD1	0.07	0.05

tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	3.1500e-004	3.5920e-003
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.17	0.27
tblVehicleEF	LHD1	0.13	0.04
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7450e-003	5.0520e-003
tblVehicleEF	LHD2	2.1760e-003	3.0390e-003
tblVehicleEF	LHD2	0.12	1.69
tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.84	0.38
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.02
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tblVehicleEF	LHD2	0.10	0.33
tblVehicleEF	LHD2	0.20	0.09
tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	3.7200e-004	5.8640e-003
tblVehicleEF	LHD2	0.01	0.02

tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	2.4200e-004	3.8700e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.09
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
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tblVehicleEF	LHD2	3.7200e-004	5.8640e-003
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tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	2.4200e-004	3.8700e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.09
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7720e-003	5.0740e-003
tblVehicleEF	LHD2	2.1430e-003	2.8520e-003
tblVehicleEF	LHD2	0.12	1.69
tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.77	0.35
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.02
tblVehicleEF	LHD2	21.05	4.93
tblVehicleEF	LHD2	0.05	0.89
tblVehicleEF	LHD2	0.10	0.32
tblVehicleEF	LHD2	0.19	0.08

tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	7.3200e-004	0.01
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	4.7800e-004	7.5310e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.08
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
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tblVehicleEF	LHD2	2.2300e-004	4.9000e-005
tblVehicleEF	LHD2	7.3200e-004	0.01
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	4.7800e-004	7.5310e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.08
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7280e-003	5.0370e-003

tblVehicleEF	LHD2	2.2020e-003	3.1870e-003
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tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.90	0.41
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.01
tblVehicleEF	LHD2	21.05	5.03
tblVehicleEF	LHD2	0.05	0.89
tblVehicleEF	LHD2	0.10	0.34
tblVehicleEF	LHD2	0.20	0.09
tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	1.8500e-004	2.9740e-003
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	9.3000e-005	1.4940e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.10
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
tblVehicleEF	LHD2	6.4320e-003	6.0800e-003

tblVehicleEF	LHD2	2.2500e-004	5.0000e-005
tblVehicleEF	LHD2	1.8500e-004	2.9740e-003
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	9.3000e-005	1.4940e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.10
tblVehicleEF	LHD2	0.03	0.02
tblVehicleEF	MCY	0.53	0.36
tblVehicleEF	MCY	0.17	0.26
tblVehicleEF	MCY	18.33	18.38
tblVehicleEF	MCY	10.94	9.75
tblVehicleEF	MCY	182.27	219.06
tblVehicleEF	MCY	43.71	61.12
tblVehicleEF	MCY	1.18	1.19
tblVehicleEF	MCY	0.32	0.28
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	0.75	1.56
tblVehicleEF	MCY	0.74	0.77
tblVehicleEF	MCY	0.37	0.77
tblVehicleEF	MCY	2.48	2.49
tblVehicleEF	MCY	0.47	1.31
tblVehicleEF	MCY	2.26	2.01
tblVehicleEF	MCY	2.1980e-003	2.1680e-003

tblVehicleEF	MCY	6.8200e-004	6.0500e-004
tblVehicleEF	MCY	0.75	1.56
tblVehicleEF	MCY	0.74	0.77
tblVehicleEF	MCY	0.37	0.77
tblVehicleEF	MCY	3.10	3.11
tblVehicleEF	MCY	0.47	1.31
tblVehicleEF	MCY	2.46	2.19
tblVehicleEF	MCY	0.51	0.35
tblVehicleEF	MCY	0.14	0.21
tblVehicleEF	MCY	16.96	17.00
tblVehicleEF	MCY	9.17	8.10
tblVehicleEF	MCY	182.27	216.52
tblVehicleEF	MCY	43.71	57.27
tblVehicleEF	MCY	1.05	1.05
tblVehicleEF	MCY	0.30	0.25
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	1.84	3.79
tblVehicleEF	MCY	0.88	0.92
tblVehicleEF	MCY	0.88	1.82
tblVehicleEF	MCY	2.39	2.39
tblVehicleEF	MCY	0.41	1.15
tblVehicleEF	MCY	1.86	1.64
tblVehicleEF	MCY	2.1730e-003	2.1430e-003
tblVehicleEF	MCY	6.4100e-004	5.6700e-004

tblVehicleEF	MCY	1.84	3.79
tblVehicleEF	MCY	0.88	0.92
tblVehicleEF	MCY	0.88	1.82
tblVehicleEF	MCY	2.98	2.99
tblVehicleEF	MCY	0.41	1.15
tblVehicleEF	MCY	2.02	1.78
tblVehicleEF	MCY	0.54	0.37
tblVehicleEF	MCY	0.19	0.30
tblVehicleEF	MCY	19.75	19.80
tblVehicleEF	MCY	12.83	11.48
tblVehicleEF	MCY	182.27	221.65
tblVehicleEF	MCY	43.71	65.04
tblVehicleEF	MCY	1.26	1.26
tblVehicleEF	MCY	0.35	0.30
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	0.22	0.45
tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	0.11	0.22
tblVehicleEF	MCY	2.57	2.58
tblVehicleEF	MCY	0.58	1.61
tblVehicleEF	MCY	2.65	2.36
tblVehicleEF	MCY	2.2240e-003	2.1930e-003
tblVehicleEF	MCY	7.2500e-004	6.4400e-004
tblVehicleEF	MCY	0.22	0.45

tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	0.11	0.22
tblVehicleEF	MCY	3.21	3.22
tblVehicleEF	MCY	0.58	1.61
tblVehicleEF	MCY	2.88	2.57
tblVehicleEF	MDV	4.6980e-003	1.3630e-003
tblVehicleEF	MDV	6.0110e-003	0.03
tblVehicleEF	MDV	0.64	0.51
tblVehicleEF	MDV	1.36	2.26
tblVehicleEF	MDV	339.26	305.96
tblVehicleEF	MDV	73.02	62.75
tblVehicleEF	MDV	0.07	0.03
tblVehicleEF	MDV	0.12	0.17
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.13	0.09
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.01	4.9950e-003
tblVehicleEF	MDV	0.08	0.29
tblVehicleEF	MDV	0.08	0.15
tblVehicleEF	MDV	3.3930e-003	2.7170e-003
tblVehicleEF	MDV	7.5300e-004	5.5600e-004
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.13	0.09

tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.02	7.1990e-003
tblVehicleEF	MDV	0.08	0.29
tblVehicleEF	MDV	0.09	0.16
tblVehicleEF	MDV	5.0540e-003	1.4900e-003
tblVehicleEF	MDV	5.0610e-003	0.03
tblVehicleEF	MDV	0.70	0.56
tblVehicleEF	MDV	1.10	1.76
tblVehicleEF	MDV	355.62	315.48
tblVehicleEF	MDV	73.02	61.81
tblVehicleEF	MDV	0.06	0.03
tblVehicleEF	MDV	0.11	0.15
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.09	0.43
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.09	0.39
tblVehicleEF	MDV	0.01	5.3540e-003
tblVehicleEF	MDV	0.07	0.26
tblVehicleEF	MDV	0.07	0.12
tblVehicleEF	MDV	3.5580e-003	2.8010e-003
tblVehicleEF	MDV	7.4800e-004	5.4800e-004
tblVehicleEF	MDV	0.09	0.43
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.09	0.39

tblVehicleEF	MDV	0.02	7.7230e-003
tblVehicleEF	MDV	0.07	0.26
tblVehicleEF	MDV	0.07	0.13
tblVehicleEF	MDV	4.6150e-003	1.3220e-003
tblVehicleEF	MDV	6.8120e-003	0.04
tblVehicleEF	MDV	0.64	0.51
tblVehicleEF	MDV	1.56	2.64
tblVehicleEF	MDV	338.97	305.81
tblVehicleEF	MDV	73.02	63.49
tblVehicleEF	MDV	0.07	0.03
tblVehicleEF	MDV	0.13	0.18
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.02	0.10
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.02	0.07
tblVehicleEF	MDV	0.01	4.9120e-003
tblVehicleEF	MDV	0.10	0.35
tblVehicleEF	MDV	0.09	0.17
tblVehicleEF	MDV	3.3900e-003	2.7150e-003
tblVehicleEF	MDV	7.5700e-004	5.6300e-004
tblVehicleEF	MDV	0.02	0.10
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.02	0.07
tblVehicleEF	MDV	0.02	7.0780e-003

tblVehicleEF	MDV	0.10	0.35
tblVehicleEF	MDV	0.10	0.18
tblVehicleEF	MH	5.4220e-003	4.1740e-003
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.26	0.23
tblVehicleEF	MH	3.31	1.50
tblVehicleEF	MH	1,176.44	1,266.18
tblVehicleEF	MH	55.59	14.09
tblVehicleEF	MH	0.77	1.12
tblVehicleEF	MH	0.58	0.24
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.14	0.01
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	3.9420e-003	0.24
tblVehicleEF	MH	0.20	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.1400e-004	1.3900e-004
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.14	0.01

tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	3.9420e-003	0.24
tblVehicleEF	MH	0.22	0.08
tblVehicleEF	MH	5.6040e-003	4.2710e-003
tblVehicleEF	MH	0.01	0.02
tblVehicleEF	MH	0.27	0.23
tblVehicleEF	MH	3.00	1.37
tblVehicleEF	MH	1,176.44	1,266.19
tblVehicleEF	MH	55.59	13.86
tblVehicleEF	MH	0.73	1.08
tblVehicleEF	MH	0.53	0.22
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.54	0.04
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	3.7600e-003	0.23
tblVehicleEF	MH	0.19	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.0800e-004	1.3700e-004
tblVehicleEF	MH	0.54	0.04
tblVehicleEF	MH	0.03	0.02

tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	3.7600e-003	0.23
tblVehicleEF	MH	0.21	0.07
tblVehicleEF	MH	5.3060e-003	4.1110e-003
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.26	0.22
tblVehicleEF	MH	3.62	1.65
tblVehicleEF	MH	1,176.44	1,266.18
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tblVehicleEF	MH	0.78	1.14
tblVehicleEF	MH	0.62	0.25
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.15	0.01
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.06	4.9680e-003
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	4.3120e-003	0.26
tblVehicleEF	MH	0.22	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.1900e-004	1.4200e-004
tblVehicleEF	MH	0.15	0.01

tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.06	4.9680e-003
tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	4.3120e-003	0.26
tblVehicleEF	MH	0.24	0.08
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tblVehicleEF	MHD	2.2480e-003	7.7200e-004
tblVehicleEF	MHD	0.03	3.1220e-003
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tblVehicleEF	MHD	5.8000e-005	9.6200e-004
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tblVehicleEF	MHD	3.1900e-004	1.7150e-003
tblVehicleEF	MHD	0.02	5.0230e-003
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tblVehicleEF	MHD	2.1000e-004	1.1250e-003

tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	7.1260e-003	0.03
tblVehicleEF	MHD	0.13	0.02
tblVehicleEF	MHD	1.7100e-003	5.6140e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	4.0000e-004	2.9000e-005
tblVehicleEF	MHD	3.1900e-004	1.7150e-003
tblVehicleEF	MHD	0.02	5.0230e-003
tblVehicleEF	MHD	0.03	0.21
tblVehicleEF	MHD	2.1000e-004	1.1250e-003
tblVehicleEF	MHD	0.05	0.01
tblVehicleEF	MHD	7.1260e-003	0.03
tblVehicleEF	MHD	0.14	0.02
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2610e-003	7.8700e-004
tblVehicleEF	MHD	0.03	2.9270e-003
tblVehicleEF	MHD	0.17	3.16
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tblVehicleEF	MHD	1,157.71	883.00
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tblVehicleEF	MHD	1.05	1.44
tblVehicleEF	MHD	14.05	1.96
tblVehicleEF	MHD	4.9000e-005	8.4500e-004
tblVehicleEF	MHD	3.0680e-003	7.5170e-003

tblVehicleEF	MHD	5.1900e-004	4.1000e-005
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tblVehicleEF	MHD	6.2200e-004	3.3590e-003
tblVehicleEF	MHD	0.02	5.1730e-003
tblVehicleEF	MHD	0.02	0.15
tblVehicleEF	MHD	4.1100e-004	2.2120e-003
tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	6.6650e-003	0.02
tblVehicleEF	MHD	0.12	0.01
tblVehicleEF	MHD	1.8120e-003	5.5700e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	3.9700e-004	2.9000e-005
tblVehicleEF	MHD	6.2200e-004	3.3590e-003
tblVehicleEF	MHD	0.02	5.1730e-003
tblVehicleEF	MHD	0.02	0.20
tblVehicleEF	MHD	4.1100e-004	2.2120e-003
tblVehicleEF	MHD	0.05	0.01
tblVehicleEF	MHD	6.6650e-003	0.02
tblVehicleEF	MHD	0.13	0.02
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2400e-003	7.6200e-004
tblVehicleEF	MHD	0.03	3.2720e-003
tblVehicleEF	MHD	0.33	4.16
tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	2.16	0.32

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tblVehicleEF	MHD	14.09	1.96
tblVehicleEF	MHD	7.1000e-005	1.1240e-003
tblVehicleEF	MHD	3.0680e-003	7.5170e-003
tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	6.8000e-005	1.0750e-003
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tblVehicleEF	MHD	1.6100e-004	8.6100e-004
tblVehicleEF	MHD	0.02	5.1140e-003
tblVehicleEF	MHD	0.02	0.15
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tblVehicleEF	MHD	8.0270e-003	0.03
tblVehicleEF	MHD	0.14	0.02
tblVehicleEF	MHD	1.5730e-003	5.6900e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	4.0300e-004	2.9000e-005
tblVehicleEF	MHD	1.6100e-004	8.6100e-004
tblVehicleEF	MHD	0.02	5.1140e-003
tblVehicleEF	MHD	0.03	0.21
tblVehicleEF	MHD	8.1000e-005	4.3200e-004
tblVehicleEF	MHD	0.05	0.01

tblVehicleEF	MHD	8.0270e-003	0.03
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tblVehicleEF	OBUS	0.29	0.33
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tblVehicleEF	OBUS	1.75	1.20
tblVehicleEF	OBUS	1.7000e-005	1.8470e-003
tblVehicleEF	OBUS	2.5170e-003	7.3860e-003
tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
tblVehicleEF	OBUS	1.7000e-005	1.7670e-003
tblVehicleEF	OBUS	2.3760e-003	7.0390e-003
tblVehicleEF	OBUS	9.8300e-004	1.3100e-004
tblVehicleEF	OBUS	1.1160e-003	0.02
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.79
tblVehicleEF	OBUS	5.5400e-004	0.01
tblVehicleEF	OBUS	0.03	0.02
tblVehicleEF	OBUS	0.05	0.24
tblVehicleEF	OBUS	0.28	0.08

tblVehicleEF	OBUS	8.5000e-004	0.01
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.5600e-004	1.2200e-004
tblVehicleEF	OBUS	1.1160e-003	0.02
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.05	1.03
tblVehicleEF	OBUS	5.5400e-004	0.01
tblVehicleEF	OBUS	0.04	0.03
tblVehicleEF	OBUS	0.05	0.24
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tblVehicleEF	OBUS	0.01	0.12
tblVehicleEF	OBUS	4.5470e-003	3.3510e-003
tblVehicleEF	OBUS	0.02	0.01
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tblVehicleEF	OBUS	1.69	1.18
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tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
tblVehicleEF	OBUS	1.4000e-005	1.5700e-003
tblVehicleEF	OBUS	2.3760e-003	7.0390e-003

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tblVehicleEF	OBUS	0.05	0.23
tblVehicleEF	OBUS	0.29	0.08
tblVehicleEF	OBUS	0.01	0.12
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tblVehicleEF	OBUS	0.30	0.08
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tblVehicleEF	SBUS	8.3700e-004	1.7300e-004
tblVehicleEF	SBUS	1.9700e-004	3.1360e-003
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tblVehicleEF	SBUS	0.01	0.03

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tblVehicleEF	SBUS	0.01	0.03
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tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	3.2160e-003	9.2000e-005
tblVehicleEF	UBUS	0.06	3.2100e-004
tblVehicleEF	UBUS	2.1090e-003	5.1000e-005
tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.02	1.9470e-003
tblVehicleEF	UBUS	0.90	7.5660e-003
tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.5900e-003	1.2000e-005
tblVehicleEF	UBUS	3.2160e-003	9.2000e-005

tblVehicleEF	UBUS	0.06	3.2100e-004
tblVehicleEF	UBUS	2.1090e-003	5.1000e-005
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.02	1.9470e-003
tblVehicleEF	UBUS	0.99	8.2830e-003
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.06	1.4450e-003
tblVehicleEF	UBUS	3.31	27.63
tblVehicleEF	UBUS	6.96	0.12
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.21
tblVehicleEF	UBUS	2.65	0.55
tblVehicleEF	UBUS	12.22	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	5.9070e-003	1.9800e-004
tblVehicleEF	UBUS	0.07	3.5800e-004
tblVehicleEF	UBUS	4.1490e-003	1.2400e-004
tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.02	1.6760e-003
tblVehicleEF	UBUS	0.79	6.6320e-003

tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.5600e-003	1.2000e-005
tblVehicleEF	UBUS	5.9070e-003	1.9800e-004
tblVehicleEF	UBUS	0.07	3.5800e-004
tblVehicleEF	UBUS	4.1490e-003	1.2400e-004
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.02	1.6760e-003
tblVehicleEF	UBUS	0.86	7.2610e-003
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.07	1.7860e-003
tblVehicleEF	UBUS	3.29	27.63
tblVehicleEF	UBUS	10.37	0.17
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.30
tblVehicleEF	UBUS	2.79	0.55
tblVehicleEF	UBUS	12.42	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	1.7240e-003	3.8000e-005
tblVehicleEF	UBUS	0.06	3.4400e-004
tblVehicleEF	UBUS	9.9800e-004	2.0000e-005

tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.03	2.4500e-003
tblVehicleEF	UBUS	0.99	8.3520e-003
tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.6200e-003	1.3000e-005
tblVehicleEF	UBUS	1.7240e-003	3.8000e-005
tblVehicleEF	UBUS	0.06	3.4400e-004
tblVehicleEF	UBUS	9.9800e-004	2.0000e-005
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.03	2.4500e-003
tblVehicleEF	UBUS	1.09	9.1440e-003
tblVehicleTrips	CC_TTP	88.60	0.00
tblVehicleTrips	CNW_TTP	5.00	0.00
tblVehicleTrips	CW_TTP	6.40	0.00
tblVehicleTrips	HO_TL	7.90	0.00
tblVehicleTrips	HO_TL	7.90	0.00
tblVehicleTrips	HO_TL	0.00	6.89
tblVehicleTrips	HO_TTP	0.00	5.00
tblVehicleTrips	HS_TL	7.10	0.00
tblVehicleTrips	HS_TL	7.10	0.00
tblVehicleTrips	HS_TL	0.00	11.65
tblVehicleTrips	HS_TTP	0.00	88.00
tblVehicleTrips	HW_TL	16.80	0.00
tblVehicleTrips	HW_TL	16.80	0.00
tblVehicleTrips	HW_TL	0.00	15.00
tblVehicleTrips	HW_TTP	0.00	7.00
tblVehicleTrips	ST_TR	7.16	0.00

tblVehicleTrips	ST_TR	6.39	0.00
tblVehicleTrips	ST_TR	1.32	0.00
tblVehicleTrips	ST_TR	20.87	0.00
tblVehicleTrips	ST_TR	1.90	0.00
tblVehicleTrips	ST_TR	1.30	0.46
tblVehicleTrips	SU_TR	6.07	0.00
tblVehicleTrips	SU_TR	5.86	0.00
tblVehicleTrips	SU_TR	0.68	0.00
tblVehicleTrips	SU_TR	26.73	0.00
tblVehicleTrips	SU_TR	1.11	0.00
tblVehicleTrips	SU_TR	0.00	0.46
tblVehicleTrips	WD_TR	6.59	0.00
tblVehicleTrips	WD_TR	6.65	0.00
tblVehicleTrips	WD_TR	6.97	0.00
tblVehicleTrips	WD_TR	32.93	0.00
tblVehicleTrips	WD_TR	8.11	0.00
tblVehicleTrips	WD_TR	1.71	1.33
tblWater	IndoorWaterUseRate	13,389,375.00	8,926,250.00
tblWater	IndoorWaterUseRate	35,965,537.32	23,977,222.02
tblWater	IndoorWaterUseRate	554,321,005.26	369,547,336.84
tblWater	OutdoorWaterUseRate	22,043,393.84	14,695,716.72

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2022	0.0000	0.0000	0.0000	0.0000	0.0000	3.0481	0.0000	0.0000	2.8232	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	0.0000	0.0000	0.0000	0.0000	0.0000	1.4264	0.0000	0.0000	1.3123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024	15.0498	84.2498	128.7328	0.5176	40.7762	0.3898	41.1660	10.9265	0.3641	11.2905	0.0000	52,864.5421	52,864.5421	1.7237	0.0000	52,907.6355
2036	0.0000	0.0000	0.0000	0.0000	0.0000	0.1881	0.0000	0.0000	0.1880	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0357	0.0000	0.0000	0.0337	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**15.0498**	**84.2498**	**128.7328**	**0.5176**	**40.7762**	**3.0481**	**41.1660**	**10.9265**	**2.8232**	**11.2905**	**0.0000**	**52,864.5421**	**52,864.5421**	**1.7237**	**0.0000**	**52,907.6355**

2.1 Overall Construction (Maximum Daily Emission)

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2022	0.0000	0.0000	0.0000	0.0000	0.0000	3.0481	0.0000	0.0000	2.8232	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	0.0000	0.0000	0.0000	0.0000	0.0000	1.4264	0.0000	0.0000	1.3123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024	15.0498	84.2498	128.7328	0.5176	40.7762	0.3898	41.1660	10.9265	0.3641	11.2905	0.0000	52,864.5421	52,864.5421	1.7237	0.0000	52,907.6355
2036	0.0000	0.0000	0.0000	0.0000	0.0000	0.1881	0.0000	0.0000	0.1880	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0357	0.0000	0.0000	0.0337	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**15.0498**	**84.2498**	**128.7328**	**0.5176**	**40.7762**	**3.0481**	**41.1660**	**10.9265**	**2.8232**	**11.2905**	**0.0000**	**52,864.5421**	**52,864.5421**	**1.7237**	**0.0000**	**52,907.6355**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	146.0839	1.6192	140.5378	7.4800e-003		0.7805	0.7805		0.7805	0.7805	0.0000	254.5703	254.5703	0.2463	0.0000	260.7287
Energy	2.5816	23.2751	18.2905	0.1408		1.7837	1.7837		1.7837	1.7837		28,163.0297	28,163.0297	0.5398	0.5163	28,330.3885
Mobile	26.6402	55.3286	237.6382	0.7900	105.3236	0.4338	105.7574	28.1024	0.4062	28.5086		88,324.9057	88,324.9057	3.1120		88,402.7062
Total	**175.3057**	**80.2229**	**396.4665**	**0.9383**	**105.3236**	**2.9979**	**108.3215**	**28.1024**	**2.9704**	**31.0727**	**0.0000**	**116,742.5057**	**116,742.5057**	**3.8981**	**0.5163**	**116,993.8234**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	115.2060	1.2858	106.5677	4.8400e-003		0.5810	0.5810		0.5810	0.5810	0.0000	177.7380	177.7380	0.1283	0.0000	180.9450
Energy	2.5816	23.2751	18.2905	0.1408		1.7837	1.7837		1.7837	1.7837		28,163.0297	28,163.0297	0.5398	0.5163	28,330.3885
Mobile	26.6402	55.3286	237.6382	0.7900	105.3236	0.4338	105.7574	28.1024	0.4062	28.5086		88,324.9057	88,324.9057	3.1120		88,402.7062
Total	**144.4278**	**79.8895**	**362.4964**	**0.9357**	**105.3236**	**2.7984**	**108.1220**	**28.1024**	**2.7709**	**30.8733**	**0.0000**	**116,665.6733**	**116,665.6733**	**3.7801**	**0.5163**	**116,914.0397**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	17.61	0.42	8.57	0.28	0.00	6.65	0.18	0.00	6.72	0.64	0.00	0.07	0.07	3.03	0.00	0.07

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/3/2022	1/2/2022	5	0	
2	Site Preparation	Site Preparation	10/8/2022	10/7/2022	5	0	
3	Grading	Grading	3/25/2023	3/24/2023	5	0	
4	Building Construction	Building Construction	6/1/2024	6/3/2024	5	1	
5	Paving	Paving	4/19/2036	4/18/2036	5	0	
6	Architectural Coating	Architectural Coating	2/21/2037	2/20/2037	5	0	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 775

Acres of Paving: 43.07

Residential Indoor: 3,436,425; Residential Outdoor: 1,145,475; Non-Residential Indoor: 3,083,825; Non-Residential Outdoor: 1,027,942; Striped Parking Area: 112,577 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	158	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	2	8.00	158	0.38
Grading	Graders	1	8.00	187	0.41
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Building Construction	Cranes	0	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	0	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Paving	Pavers	2	8.00	130	0.42
Paving	Paving Equipment	2	8.00	132	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	6.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	175.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	0	2,798.00	826.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	560.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.2 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.2 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction - 2024

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**		**0.0000**

3.5 Building Construction - 2024

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	1.8585	74.4726	18.6518	0.2001	5.0372	0.1344	5.1716	1.4488	0.1285	1.5773		21,227.55 05	21,227.55 05	0.7498		21,246.29 59
Worker	13.1912	9.7773	110.0811	0.3175	35.7390	0.2554	35.9944	9.4776	0.2356	9.7132		31,636.99 16	31,636.99 16	0.9739		31,661.33 96
Total	**15.0498**	**84.2498**	**128.7328**	**0.5176**	**40.7762**	**0.3898**	**41.1660**	**10.9265**	**0.3641**	**11.2905**		**52,864.54 21**	**52,864.54 21**	**1.7237**		**52,907.63 55**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**

3.5 Building Construction - 2024

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	1.8585	74.4726	18.6518	0.2001	5.0372	0.1344	5.1716	1.4488	0.1285	1.5773		21,227.5505	21,227.5505	0.7498		21,246.2959
Worker	13.1912	9.7773	110.0811	0.3175	35.7390	0.2554	35.9944	9.4776	0.2356	9.7132		31,636.9916	31,636.9916	0.9739		31,661.3396
Total	**15.0498**	**84.2498**	**128.7328**	**0.5176**	**40.7762**	**0.3898**	**41.1660**	**10.9265**	**0.3641**	**11.2905**		**52,864.5421**	**52,864.5421**	**1.7237**		**52,907.6355**

3.6 Paving - 2036

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Paving - 2036

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Paving - 2036

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	26.6402	55.3286	237.6382	0.7900	105.3236	0.4338	105.7574	28.1024	0.4062	28.5086		88,324.90 57	88,324.90 57	3.1120		88,402.70 62
Unmitigated	26.6402	55.3286	237.6382	0.7900	105.3236	0.4338	105.7574	28.1024	0.4062	28.5086		88,324.90 57	88,324.90 57	3.1120		88,402.70 62

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Low Rise	0.00	0.00	0.00		
Apartments Mid Rise	0.00	0.00	0.00		
General Light Industry	0.00	0.00	0.00		
Health Club	0.00	0.00	0.00		
Parking Lot	0.00	0.00	0.00		
Research & Development	0.00	0.00	0.00		
University/College (4Yr)	12,609.15	4,344.33	4344.33	40,511,214	40,511,214
Total	12,609.15	4,344.33	4,344.33	40,511,214	40,511,214

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Low Rise	0.00	0.00	0.00	44.00	18.80	37.20	86	11	3
Apartments Mid Rise	0.00	0.00	0.00	44.00	18.80	37.20	86	11	3
General Light Industry	14.70	6.60	6.60	59.00	28.00	13.00	92	5	3
Health Club	14.70	6.60	6.60	16.90	64.10	19.00	52	39	9
Parking Lot	14.70	6.60	6.60	0.00	0.00	0.00	0	0	0
Research & Development	14.70	6.60	6.60	33.00	48.00	19.00	82	15	3
University/College (4Yr)	14.70	6.60	6.60	0.00	0.00	0.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Low Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Apartments Mid Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Apartments Mid Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
General Light Industry	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Health Club	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Parking Lot	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Research & Development	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
University/College (4Yr)	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	2.5816	23.2751	18.2905	0.1408		1.7837	1.7837		1.7837	1.7837		28,163.0297	28,163.0297	0.5398	0.5163	28,330.3885
NaturalGas Unmitigated	2.5816	23.2751	18.2905	0.1408		1.7837	1.7837		1.7837	1.7837		28,163.0297	28,163.0297	0.5398	0.5163	28,330.3885

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Low Rise	9489	0.1023	0.8745	0.3721	5.5800e-003		0.0707	0.0707		0.0707	0.0707		1,116.3534	1,116.3534	0.0214	0.0205	1,122.9873
Apartments Mid Rise	23512.4	0.2536	2.1668	0.9221	0.0138		0.1752	0.1752		0.1752	0.1752		2,766.1658	2,766.1658	0.0530	0.0507	2,782.6037
General Light Industry	4027.83	0.0434	0.3949	0.3317	2.3700e-003		0.0300	0.0300		0.0300	0.0300		473.8621	473.8621	9.0800e-003	8.6900e-003	476.6780
Health Club	42301.1	0.4562	4.1472	3.4836	0.0249		0.3152	0.3152		0.3152	0.3152		4,976.6037	4,976.6037	0.0954	0.0912	5,006.1771
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	78421.9	0.8457	7.6884	6.4583	0.0461		0.5843	0.5843		0.5843	0.5843		9,226.1081	9,226.1081	0.1768	0.1692	9,280.9343
University/College (4Yr)	81633.5	0.8804	8.0033	6.7228	0.0480		0.6083	0.6083		0.6083	0.6083		9,603.9366	9,603.9366	0.1841	0.1761	9,661.0080
Total		**2.5816**	**23.2751**	**18.2905**	**0.1408**		**1.7837**	**1.7837**		**1.7837**	**1.7837**		**28,163.0297**	**28,163.0297**	**0.5398**	**0.5163**	**28,330.3885**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Low Rise	9.489	0.1023	0.8745	0.3721	5.5800e-003		0.0707	0.0707		0.0707	0.0707		1,116.3534	1,116.3534	0.0214	0.0205	1,122.9873
Apartments Mid Rise	23.5124	0.2536	2.1668	0.9221	0.0138		0.1752	0.1752		0.1752	0.1752		2,766.1658	2,766.1658	0.0530	0.0507	2,782.6037
General Light Industry	4.02783	0.0434	0.3949	0.3317	2.3700e-003		0.0300	0.0300		0.0300	0.0300		473.8621	473.8621	9.0800e-003	8.6900e-003	476.6780
Health Club	42.3011	0.4562	4.1472	3.4836	0.0249		0.3152	0.3152		0.3152	0.3152		4,976.6037	4,976.6037	0.0954	0.0912	5,006.1771
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	78.4219	0.8457	7.6884	6.4583	0.0461		0.5843	0.5843		0.5843	0.5843		9,226.1081	9,226.1081	0.1768	0.1692	9,280.9343
University/College (4Yr)	81.6335	0.8804	8.0033	6.7228	0.0480		0.6083	0.6083		0.6083	0.6083		9,603.9366	9,603.9366	0.1841	0.1761	9,661.0080
Total		**2.5816**	**23.2751**	**18.2905**	**0.1408**		**1.7837**	**1.7837**		**1.7837**	**1.7837**		**28,163.0297**	**28,163.0297**	**0.5398**	**0.5163**	**28,330.3885**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Electric Lawnmower

Use Electric Leafblower

Use Electric Chainsaw

Use Low VOC Paint - Residential Interior

Use Low VOC Paint - Residential Exterior

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

Use Low VOC Cleaning Supplies

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	115.2060	1.2858	106.5677	4.8400e-003		0.5810	0.5810		0.5810	0.5810	0.0000	177.7380	177.7380	0.1283	0.0000	180.9450
Unmitigated	146.0839	1.6192	140.5378	7.4800e-003		0.7805	0.7805		0.7805	0.7805	0.0000	254.5703	254.5703	0.2463	0.0000	260.7287

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	20.6884					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	121.1214					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	4.2741	1.6192	140.5378	7.4800e-003		0.7805	0.7805		0.7805	0.7805		254.5703	254.5703	0.2463		260.7287
Total	**146.0839**	**1.6192**	**140.5378**	**7.4800e-003**		**0.7805**	**0.7805**		**0.7805**	**0.7805**	**0.0000**	**254.5703**	**254.5703**	**0.2463**	**0.0000**	**260.7287**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.8350					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	112.1153					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	2.2557	1.2858	106.5677	4.8400e-003		0.5810	0.5810		0.5810	0.5810		177.7380	177.7380	0.1283		180.9450
Total	**115.2060**	**1.2858**	**106.5677**	**4.8400e-003**		**0.5810**	**0.5810**		**0.5810**	**0.5810**	**0.0000**	**177.7380**	**177.7380**	**0.1283**	**0.0000**	**180.9450**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

UCSC - 2020 LRDP - Operational Only - with Mitigated VMT

Santa Cruz County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Research & Development	1,127.37	1000sqft	25.88	1,127,373.00	0
University/College (4Yr)	9,482.00	Student	40.01	1,290,438.00	0
General Light Industry	57.90	1000sqft	1.33	57,903.00	0
Parking Lot	43.07	Acre	43.07	1,876,275.00	0
Health Club	608.11	1000sqft	13.96	608,110.00	0
Apartments Low Rise	440.00	Dwelling Unit	27.50	660,000.00	550
Apartments Mid Rise	1,257.00	Dwelling Unit	33.08	1,885,000.00	8500

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	1.8	**Precipitation Freq (Days)**	61
Climate Zone	4			**Operational Year**	2040
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	77.8	**CH4 Intensity (lb/MWhr)**	0.005	**N2O Intensity (lb/MWhr)**	0.001

1.3 User Entered Comments & Non-Default Data

Project Characteristics - UCSC Electricity Emission Factors for 2040 reflect State averages.

Land Use - Values specified in Project Description

Construction Phase - This file is for operational emissions, so construction phases are removed.

Off-road Equipment -

Off-road Equipment - This file is for operational emissions, so construction phases are removed.

Off-road Equipment -

Trips and VMT -

On-road Fugitive Dust -

Demolition -

Architectural Coating -

Vehicle Trips - Adjusted trip length so that avg annual VMT matches VMT in Traffic Study per MM 3.16-1.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Vehicle Emission Factors - Updated to EMFAC2017 and SAFE Rule correction factors applied.

Woodstoves -

Consumer Products -

Area Coating -

Energy Use - Energy intensity rates adjusted to 2019 Title 24 standards.

Water And Wastewater -

Solid Waste -

Sequestration - Using Pine as subsititute for redwood trees. 22 trees/acre.

Construction Off-road Equipment Mitigation -

Area Mitigation - Zero-VOC paints and coatings (5 g/L), low-VOC cleaning supplies. 100% electric lawn and garden equipment.

Energy Mitigation -

Fleet Mix -

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	ConstArea_Nonresidential_Exterior	1,541,912.00	1,027,942.00
tblArchitecturalCoating	ConstArea_Nonresidential_Interior	4,625,736.00	3,083,825.00
tblArchitecturalCoating	ConstArea_Residential_Exterior	1,717,875.00	1,145,475.00
tblArchitecturalCoating	ConstArea_Residential_Interior	5,153,625.00	3,436,425.00
tblAreaMitigation	UseLowVOCPaintNonresidentialExteriorValue	150	5
tblAreaMitigation	UseLowVOCPaintNonresidentialInteriorValue	150	5
tblAreaMitigation	UseLowVOCPaintParkingCheck	False	True
tblAreaMitigation	UseLowVOCPaintParkingValue	150	5
tblAreaMitigation	UseLowVOCPaintResidentialExteriorValue	100	5
tblAreaMitigation	UseLowVOCPaintResidentialInteriorValue	100	5
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstructionPhase	NumDays	200.00	0.00
tblConstructionPhase	NumDays	120.00	0.00
tblConstructionPhase	NumDays	310.00	0.00
tblConstructionPhase	NumDays	3,100.00	1.00
tblConstructionPhase	NumDays	220.00	0.00
tblConstructionPhase	NumDays	220.00	0.00
tblEnergyUse	T24E	365.68	244.86
tblEnergyUse	T24E	332.81	222.85
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	1.48	1.41
tblEnergyUse	T24E	2.73	2.59
tblEnergyUse	T24NG	7,043.85	4,716.56

tblEnergyUse	T24NG	5,484.45	3,672.39
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	19.71	18.72
tblEnergyUse	T24NG	20.83	19.79
tblGrading	AcresOfGrading	0.00	775.00
tblLandUse	LandUseSquareFeet	1,127,370.00	1,127,373.00
tblLandUse	LandUseSquareFeet	1,742,767.59	1,290,438.00
tblLandUse	LandUseSquareFeet	57,900.00	57,903.00
tblLandUse	LandUseSquareFeet	1,876,129.20	1,876,275.00
tblLandUse	LandUseSquareFeet	440,000.00	660,000.00
tblLandUse	LandUseSquareFeet	1,257,000.00	1,885,000.00
tblLandUse	Population	1,258.00	550.00
tblLandUse	Population	3,595.00	8,500.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblProjectCharacteristics	CH4IntensityFactor	0.029	0.005
tblProjectCharacteristics	CO2IntensityFactor	641.35	77.8
tblProjectCharacteristics	N2OIntensityFactor	0.006	0.001
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblSequestration	NumberOfNewTrees	0.00	-3,386.00
tblSolidWaste	SolidWasteGenerationRate	71.80	47.86
tblSolidWaste	SolidWasteGenerationRate	3,466.23	2,310.84
tblSolidWaste	SolidWasteGenerationRate	85.67	57.11

tblTripsAndVMT	VendorTripNumber	994.00	826.00
tblTripsAndVMT	WorkerTripNumber	3,192.00	2,798.00
tblTripsAndVMT	WorkerTripNumber	638.00	560.00
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tblVehicleEF	HHD	0.06	0.00
tblVehicleEF	HHD	1.31	54.39
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tblVehicleEF	HHD	4.5610e-003	7.4000e-005

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tblVehicleEF	HHD	1.2500e-004	1.0000e-006
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tblVehicleEF	HHD	0.03	0.03
tblVehicleEF	HHD	5.4400e-003	0.02
tblVehicleEF	HHD	1.3500e-004	1.0000e-006
tblVehicleEF	HHD	3.9600e-003	0.02
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tblVehicleEF	HHD	8.4960e-003	8.6080e-003
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tblVehicleEF	HHD	1.2500e-004	1.0000e-006
tblVehicleEF	HHD	4.1000e-005	1.4000e-005
tblVehicleEF	HHD	4.6400e-003	7.5000e-005
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tblVehicleEF	HHD	2.1000e-005	7.0000e-006
tblVehicleEF	HHD	0.08	0.02

tblVehicleEF	HHD	6.7000e-004	4.2700e-004
tblVehicleEF	HHD	0.07	2.0000e-006
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tblVehicleEF	HHD	0.01	0.01
tblVehicleEF	HHD	1.7900e-004	1.0000e-006
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tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	8.1950e-003	0.06
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	7.7480e-003	0.06

tblVehicleEF	LDA	4.1300e-003	2.3880e-003
tblVehicleEF	LDA	0.03	0.16
tblVehicleEF	LDA	0.01	0.08
tblVehicleEF	LDA	1.6890e-003	1.8340e-003
tblVehicleEF	LDA	3.6700e-004	3.6900e-004
tblVehicleEF	LDA	8.1950e-003	0.06
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	7.7480e-003	0.06
tblVehicleEF	LDA	6.0000e-003	3.4550e-003
tblVehicleEF	LDA	0.03	0.16
tblVehicleEF	LDA	0.01	0.09
tblVehicleEF	LDA	1.7670e-003	8.3200e-004
tblVehicleEF	LDA	7.5200e-004	0.02
tblVehicleEF	LDA	0.32	0.44
tblVehicleEF	LDA	0.34	1.23
tblVehicleEF	LDA	177.42	217.05
tblVehicleEF	LDA	36.04	41.01
tblVehicleEF	LDA	0.02	0.02
tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	0.02	0.13
tblVehicleEF	LDA	0.04	0.05
tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	4.4460e-003	2.5670e-003

tblVehicleEF	LDA	0.03	0.14
tblVehicleEF	LDA	0.01	0.07
tblVehicleEF	LDA	1.7750e-003	1.9240e-003
tblVehicleEF	LDA	3.6500e-004	3.6300e-004
tblVehicleEF	LDA	0.02	0.13
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tblVehicleEF	LDA	0.02	0.11
tblVehicleEF	LDA	6.4610e-003	3.7160e-003
tblVehicleEF	LDA	0.03	0.14
tblVehicleEF	LDA	0.01	0.07
tblVehicleEF	LDA	1.6100e-003	7.3600e-004
tblVehicleEF	LDA	1.0270e-003	0.02
tblVehicleEF	LDA	0.29	0.40
tblVehicleEF	LDA	0.51	1.82
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tblVehicleEF	LDA	36.04	42.12
tblVehicleEF	LDA	0.03	0.02
tblVehicleEF	LDA	0.02	0.13
tblVehicleEF	LDA	8.1600e-004	6.9100e-004
tblVehicleEF	LDA	1.0810e-003	8.0600e-004
tblVehicleEF	LDA	7.5000e-004	6.3500e-004
tblVehicleEF	LDA	9.9300e-004	7.4100e-004
tblVehicleEF	LDA	3.5800e-003	0.03
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	2.4830e-003	0.02
tblVehicleEF	LDA	4.0590e-003	2.3470e-003
tblVehicleEF	LDA	0.03	0.20

tblVehicleEF	LDA	0.01	0.09
tblVehicleEF	LDA	1.6880e-003	1.8320e-003
tblVehicleEF	LDA	3.6800e-004	3.7300e-004
tblVehicleEF	LDA	3.5800e-003	0.03
tblVehicleEF	LDA	0.04	0.04
tblVehicleEF	LDA	2.4830e-003	0.02
tblVehicleEF	LDA	5.8960e-003	3.3960e-003
tblVehicleEF	LDA	0.03	0.20
tblVehicleEF	LDA	0.02	0.10
tblVehicleEF	LDT1	1.9070e-003	9.4600e-004
tblVehicleEF	LDT1	1.2100e-003	0.03
tblVehicleEF	LDT1	0.32	0.43
tblVehicleEF	LDT1	0.51	1.75
tblVehicleEF	LDT1	209.63	252.15
tblVehicleEF	LDT1	45.37	51.97
tblVehicleEF	LDT1	0.03	0.02
tblVehicleEF	LDT1	0.02	0.15
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	4.7310e-003	3.0380e-003
tblVehicleEF	LDT1	0.03	0.28
tblVehicleEF	LDT1	0.02	0.10

tblVehicleEF	LDT1	2.0980e-003	2.2340e-003
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	0.01	0.12
tblVehicleEF	LDT1	6.8990e-003	4.4320e-003
tblVehicleEF	LDT1	0.03	0.28
tblVehicleEF	LDT1	0.02	0.11
tblVehicleEF	LDT1	2.0550e-003	1.0350e-003
tblVehicleEF	LDT1	1.0090e-003	0.02
tblVehicleEF	LDT1	0.35	0.47
tblVehicleEF	LDT1	0.40	1.37
tblVehicleEF	LDT1	220.22	262.77
tblVehicleEF	LDT1	45.37	51.26
tblVehicleEF	LDT1	0.02	0.02
tblVehicleEF	LDT1	0.02	0.13
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	0.02	0.24
tblVehicleEF	LDT1	0.04	0.08
tblVehicleEF	LDT1	0.02	0.23
tblVehicleEF	LDT1	5.0950e-003	3.2690e-003
tblVehicleEF	LDT1	0.03	0.25
tblVehicleEF	LDT1	0.01	0.08
tblVehicleEF	LDT1	2.2040e-003	2.3280e-003
tblVehicleEF	LDT1	4.6000e-004	4.5400e-004

tblVehicleEF	LDT1	0.02	0.24
tblVehicleEF	LDT1	0.04	0.08
tblVehicleEF	LDT1	0.02	0.23
tblVehicleEF	LDT1	7.4310e-003	4.7690e-003
tblVehicleEF	LDT1	0.03	0.25
tblVehicleEF	LDT1	0.01	0.09
tblVehicleEF	LDT1	1.8740e-003	9.1700e-004
tblVehicleEF	LDT1	1.3790e-003	0.03
tblVehicleEF	LDT1	0.32	0.43
tblVehicleEF	LDT1	0.60	2.04
tblVehicleEF	LDT1	209.45	251.97
tblVehicleEF	LDT1	45.37	52.53
tblVehicleEF	LDT1	0.03	0.02
tblVehicleEF	LDT1	0.03	0.16
tblVehicleEF	LDT1	8.7200e-004	7.9700e-004
tblVehicleEF	LDT1	1.1670e-003	9.7700e-004
tblVehicleEF	LDT1	8.0200e-004	7.3300e-004
tblVehicleEF	LDT1	1.0730e-003	8.9800e-004
tblVehicleEF	LDT1	5.0240e-003	0.06
tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	3.4640e-003	0.04
tblVehicleEF	LDT1	4.6480e-003	2.9850e-003
tblVehicleEF	LDT1	0.04	0.33
tblVehicleEF	LDT1	0.02	0.11
tblVehicleEF	LDT1	2.0960e-003	2.2330e-003
tblVehicleEF	LDT1	4.6300e-004	4.6500e-004
tblVehicleEF	LDT1	5.0240e-003	0.06

tblVehicleEF	LDT1	0.04	0.07
tblVehicleEF	LDT1	3.4640e-003	0.04
tblVehicleEF	LDT1	6.7780e-003	4.3540e-003
tblVehicleEF	LDT1	0.04	0.33
tblVehicleEF	LDT1	0.02	0.13
tblVehicleEF	LDT2	2.8190e-003	1.2600e-003
tblVehicleEF	LDT2	2.3310e-003	0.03
tblVehicleEF	LDT2	0.47	0.50
tblVehicleEF	LDT2	0.79	2.20
tblVehicleEF	LDT2	252.42	252.46
tblVehicleEF	LDT2	55.17	53.02
tblVehicleEF	LDT2	0.04	0.03
tblVehicleEF	LDT2	0.05	0.15
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.02	0.15
tblVehicleEF	LDT2	0.07	0.07
tblVehicleEF	LDT2	0.02	0.16
tblVehicleEF	LDT2	7.0170e-003	4.4720e-003
tblVehicleEF	LDT2	0.05	0.28
tblVehicleEF	LDT2	0.03	0.13
tblVehicleEF	LDT2	2.5270e-003	2.2380e-003
tblVehicleEF	LDT2	5.6400e-004	4.7000e-004
tblVehicleEF	LDT2	0.02	0.15
tblVehicleEF	LDT2	0.07	0.07

tblVehicleEF	LDT2	0.02	0.16
tblVehicleEF	LDT2	0.01	6.4570e-003
tblVehicleEF	LDT2	0.05	0.28
tblVehicleEF	LDT2	0.03	0.15
tblVehicleEF	LDT2	3.0340e-003	1.3780e-003
tblVehicleEF	LDT2	1.9960e-003	0.03
tblVehicleEF	LDT2	0.52	0.55
tblVehicleEF	LDT2	0.66	1.72
tblVehicleEF	LDT2	264.93	262.08
tblVehicleEF	LDT2	55.17	52.11
tblVehicleEF	LDT2	0.03	0.02
tblVehicleEF	LDT2	0.04	0.13
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.05	0.32
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	0.04	0.29
tblVehicleEF	LDT2	7.5500e-003	4.7960e-003
tblVehicleEF	LDT2	0.05	0.25
tblVehicleEF	LDT2	0.03	0.11
tblVehicleEF	LDT2	2.6530e-003	2.3240e-003
tblVehicleEF	LDT2	5.6200e-004	4.6200e-004
tblVehicleEF	LDT2	0.05	0.32
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	0.04	0.29

tblVehicleEF	LDT2	0.01	6.9310e-003
tblVehicleEF	LDT2	0.05	0.25
tblVehicleEF	LDT2	0.03	0.12
tblVehicleEF	LDT2	2.7690e-003	1.2220e-003
tblVehicleEF	LDT2	2.6130e-003	0.04
tblVehicleEF	LDT2	0.48	0.51
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tblVehicleEF	LDT2	252.21	252.31
tblVehicleEF	LDT2	55.17	53.73
tblVehicleEF	LDT2	0.04	0.03
tblVehicleEF	LDT2	0.05	0.16
tblVehicleEF	LDT2	1.0120e-003	8.0000e-004
tblVehicleEF	LDT2	1.3740e-003	9.1700e-004
tblVehicleEF	LDT2	9.3100e-004	7.3700e-004
tblVehicleEF	LDT2	1.2640e-003	8.4300e-004
tblVehicleEF	LDT2	0.01	0.07
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	7.6010e-003	0.05
tblVehicleEF	LDT2	6.8940e-003	4.3970e-003
tblVehicleEF	LDT2	0.07	0.34
tblVehicleEF	LDT2	0.04	0.15
tblVehicleEF	LDT2	2.5250e-003	2.2370e-003
tblVehicleEF	LDT2	5.6600e-004	4.7600e-004
tblVehicleEF	LDT2	0.01	0.07
tblVehicleEF	LDT2	0.07	0.08
tblVehicleEF	LDT2	7.6010e-003	0.05
tblVehicleEF	LDT2	0.01	6.3480e-003

tblVehicleEF	LDT2	0.07	0.34
tblVehicleEF	LDT2	0.04	0.17
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tblVehicleEF	LHD1	5.3310e-003	3.9600e-003
tblVehicleEF	LHD1	8.2940e-003	7.2240e-003
tblVehicleEF	LHD1	0.14	2.44
tblVehicleEF	LHD1	0.47	0.37
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tblVehicleEF	LHD1	634.75	658.76
tblVehicleEF	LHD1	27.02	8.68
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tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
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tblVehicleEF	LHD1	1.2360e-003	0.01
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	8.0900e-004	9.2900e-003
tblVehicleEF	LHD1	0.09	0.06

tblVehicleEF	LHD1	0.15	0.24
tblVehicleEF	LHD1	0.11	0.03
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
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tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	8.0900e-004	9.2900e-003
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.15	0.24
tblVehicleEF	LHD1	0.12	0.04
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tblVehicleEF	LHD1	5.3890e-003	4.0070e-003
tblVehicleEF	LHD1	7.7400e-003	6.7790e-003
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tblVehicleEF	LHD1	0.47	0.38
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tblVehicleEF	LHD1	634.75	658.76
tblVehicleEF	LHD1	27.02	8.57
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tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
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tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
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tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
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tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	1.5530e-003	0.02
tblVehicleEF	LHD1	0.09	0.06
tblVehicleEF	LHD1	0.14	0.22
tblVehicleEF	LHD1	0.10	0.03
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
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tblVehicleEF	LHD1	0.02	0.30
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tblVehicleEF	LHD1	0.10	0.07
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tblVehicleEF	LHD1	0.11	0.03
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tblVehicleEF	LHD1	5.2920e-003	3.9290e-003
tblVehicleEF	LHD1	8.7320e-003	7.5750e-003
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tblVehicleEF	LHD1	0.46	0.37

tblVehicleEF	LHD1	1.39	0.82
tblVehicleEF	LHD1	8.78	107.82
tblVehicleEF	LHD1	634.75	658.75
tblVehicleEF	LHD1	27.02	8.78
tblVehicleEF	LHD1	0.05	0.55
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tblVehicleEF	LHD1	0.61	0.20
tblVehicleEF	LHD1	6.4300e-004	0.01
tblVehicleEF	LHD1	0.01	9.8730e-003
tblVehicleEF	LHD1	8.2610e-003	6.0220e-003
tblVehicleEF	LHD1	5.6600e-004	1.7600e-004
tblVehicleEF	LHD1	6.1500e-004	0.01
tblVehicleEF	LHD1	2.5870e-003	2.4680e-003
tblVehicleEF	LHD1	7.8720e-003	5.7180e-003
tblVehicleEF	LHD1	5.2100e-004	1.6200e-004
tblVehicleEF	LHD1	6.2900e-004	7.2020e-003
tblVehicleEF	LHD1	0.07	0.05
tblVehicleEF	LHD1	0.01	0.22
tblVehicleEF	LHD1	3.1500e-004	3.5920e-003
tblVehicleEF	LHD1	0.08	0.06
tblVehicleEF	LHD1	0.17	0.27
tblVehicleEF	LHD1	0.12	0.04
tblVehicleEF	LHD1	8.7000e-005	1.0440e-003
tblVehicleEF	LHD1	6.2040e-003	6.4250e-003
tblVehicleEF	LHD1	2.9500e-004	8.7000e-005
tblVehicleEF	LHD1	6.2900e-004	7.2020e-003
tblVehicleEF	LHD1	0.07	0.05

tblVehicleEF	LHD1	0.02	0.30
tblVehicleEF	LHD1	3.1500e-004	3.5920e-003
tblVehicleEF	LHD1	0.10	0.07
tblVehicleEF	LHD1	0.17	0.27
tblVehicleEF	LHD1	0.13	0.04
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7450e-003	5.0520e-003
tblVehicleEF	LHD2	2.1760e-003	3.0390e-003
tblVehicleEF	LHD2	0.12	1.69
tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.84	0.38
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.02
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tblVehicleEF	LHD2	0.10	0.33
tblVehicleEF	LHD2	0.20	0.09
tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	3.7200e-004	5.8640e-003
tblVehicleEF	LHD2	0.01	0.02

tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	2.4200e-004	3.8700e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.09
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
tblVehicleEF	LHD2	6.4320e-003	6.0800e-003
tblVehicleEF	LHD2	2.2400e-004	4.9000e-005
tblVehicleEF	LHD2	3.7200e-004	5.8640e-003
tblVehicleEF	LHD2	0.01	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	2.4200e-004	3.8700e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.09
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7720e-003	5.0740e-003
tblVehicleEF	LHD2	2.1430e-003	2.8520e-003
tblVehicleEF	LHD2	0.12	1.69
tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.77	0.35
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.02
tblVehicleEF	LHD2	21.05	4.93
tblVehicleEF	LHD2	0.05	0.89
tblVehicleEF	LHD2	0.10	0.32
tblVehicleEF	LHD2	0.19	0.08

tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	7.3200e-004	0.01
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	4.7800e-004	7.5310e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.08
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
tblVehicleEF	LHD2	6.4320e-003	6.0800e-003
tblVehicleEF	LHD2	2.2300e-004	4.9000e-005
tblVehicleEF	LHD2	7.3200e-004	0.01
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	4.7800e-004	7.5310e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.08
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	2.1810e-003	0.03
tblVehicleEF	LHD2	4.7280e-003	5.0370e-003

tblVehicleEF	LHD2	2.2020e-003	3.1870e-003
tblVehicleEF	LHD2	0.12	1.69
tblVehicleEF	LHD2	0.44	0.50
tblVehicleEF	LHD2	0.90	0.41
tblVehicleEF	LHD2	13.35	165.21
tblVehicleEF	LHD2	662.14	631.01
tblVehicleEF	LHD2	21.05	5.03
tblVehicleEF	LHD2	0.05	0.89
tblVehicleEF	LHD2	0.10	0.34
tblVehicleEF	LHD2	0.20	0.09
tblVehicleEF	LHD2	8.7800e-004	0.02
tblVehicleEF	LHD2	0.01	0.01
tblVehicleEF	LHD2	7.4910e-003	0.01
tblVehicleEF	LHD2	3.8100e-004	8.5000e-005
tblVehicleEF	LHD2	8.4000e-004	0.02
tblVehicleEF	LHD2	2.7110e-003	2.7290e-003
tblVehicleEF	LHD2	7.1430e-003	0.01
tblVehicleEF	LHD2	3.5000e-004	7.8000e-005
tblVehicleEF	LHD2	1.8500e-004	2.9740e-003
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.16
tblVehicleEF	LHD2	9.3000e-005	1.4940e-003
tblVehicleEF	LHD2	0.09	0.10
tblVehicleEF	LHD2	0.03	0.10
tblVehicleEF	LHD2	0.03	0.01
tblVehicleEF	LHD2	1.3000e-004	1.5760e-003
tblVehicleEF	LHD2	6.4320e-003	6.0800e-003

tblVehicleEF	LHD2	2.2500e-004	5.0000e-005
tblVehicleEF	LHD2	1.8500e-004	2.9740e-003
tblVehicleEF	LHD2	0.02	0.02
tblVehicleEF	LHD2	0.01	0.21
tblVehicleEF	LHD2	9.3000e-005	1.4940e-003
tblVehicleEF	LHD2	0.10	0.11
tblVehicleEF	LHD2	0.03	0.10
tblVehicleEF	LHD2	0.03	0.02
tblVehicleEF	MCY	0.53	0.36
tblVehicleEF	MCY	0.17	0.26
tblVehicleEF	MCY	18.33	18.38
tblVehicleEF	MCY	10.94	9.75
tblVehicleEF	MCY	182.27	219.06
tblVehicleEF	MCY	43.71	61.12
tblVehicleEF	MCY	1.18	1.19
tblVehicleEF	MCY	0.32	0.28
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	0.75	1.56
tblVehicleEF	MCY	0.74	0.77
tblVehicleEF	MCY	0.37	0.77
tblVehicleEF	MCY	2.48	2.49
tblVehicleEF	MCY	0.47	1.31
tblVehicleEF	MCY	2.26	2.01
tblVehicleEF	MCY	2.1980e-003	2.1680e-003

tblVehicleEF	MCY	6.8200e-004	6.0500e-004
tblVehicleEF	MCY	0.75	1.56
tblVehicleEF	MCY	0.74	0.77
tblVehicleEF	MCY	0.37	0.77
tblVehicleEF	MCY	3.10	3.11
tblVehicleEF	MCY	0.47	1.31
tblVehicleEF	MCY	2.46	2.19
tblVehicleEF	MCY	0.51	0.35
tblVehicleEF	MCY	0.14	0.21
tblVehicleEF	MCY	16.96	17.00
tblVehicleEF	MCY	9.17	8.10
tblVehicleEF	MCY	182.27	216.52
tblVehicleEF	MCY	43.71	57.27
tblVehicleEF	MCY	1.05	1.05
tblVehicleEF	MCY	0.30	0.25
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	1.84	3.79
tblVehicleEF	MCY	0.88	0.92
tblVehicleEF	MCY	0.88	1.82
tblVehicleEF	MCY	2.39	2.39
tblVehicleEF	MCY	0.41	1.15
tblVehicleEF	MCY	1.86	1.64
tblVehicleEF	MCY	2.1730e-003	2.1430e-003
tblVehicleEF	MCY	6.4100e-004	5.6700e-004

tblVehicleEF	MCY	1.84	3.79
tblVehicleEF	MCY	0.88	0.92
tblVehicleEF	MCY	0.88	1.82
tblVehicleEF	MCY	2.98	2.99
tblVehicleEF	MCY	0.41	1.15
tblVehicleEF	MCY	2.02	1.78
tblVehicleEF	MCY	0.54	0.37
tblVehicleEF	MCY	0.19	0.30
tblVehicleEF	MCY	19.75	19.80
tblVehicleEF	MCY	12.83	11.48
tblVehicleEF	MCY	182.27	221.65
tblVehicleEF	MCY	43.71	65.04
tblVehicleEF	MCY	1.26	1.26
tblVehicleEF	MCY	0.35	0.30
tblVehicleEF	MCY	2.5480e-003	2.5190e-003
tblVehicleEF	MCY	3.1890e-003	2.7330e-003
tblVehicleEF	MCY	2.3770e-003	2.3500e-003
tblVehicleEF	MCY	2.9820e-003	2.5560e-003
tblVehicleEF	MCY	0.22	0.45
tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	0.11	0.22
tblVehicleEF	MCY	2.57	2.58
tblVehicleEF	MCY	0.58	1.61
tblVehicleEF	MCY	2.65	2.36
tblVehicleEF	MCY	2.2240e-003	2.1930e-003
tblVehicleEF	MCY	7.2500e-004	6.4400e-004
tblVehicleEF	MCY	0.22	0.45

tblVehicleEF	MCY	0.83	0.87
tblVehicleEF	MCY	0.11	0.22
tblVehicleEF	MCY	3.21	3.22
tblVehicleEF	MCY	0.58	1.61
tblVehicleEF	MCY	2.88	2.57
tblVehicleEF	MDV	4.6980e-003	1.3630e-003
tblVehicleEF	MDV	6.0110e-003	0.03
tblVehicleEF	MDV	0.64	0.51
tblVehicleEF	MDV	1.36	2.26
tblVehicleEF	MDV	339.26	305.96
tblVehicleEF	MDV	73.02	62.75
tblVehicleEF	MDV	0.07	0.03
tblVehicleEF	MDV	0.12	0.17
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.13	0.09
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.01	4.9950e-003
tblVehicleEF	MDV	0.08	0.29
tblVehicleEF	MDV	0.08	0.15
tblVehicleEF	MDV	3.3930e-003	2.7170e-003
tblVehicleEF	MDV	7.5300e-004	5.5600e-004
tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.13	0.09

tblVehicleEF	MDV	0.05	0.21
tblVehicleEF	MDV	0.02	7.1990e-003
tblVehicleEF	MDV	0.08	0.29
tblVehicleEF	MDV	0.09	0.16
tblVehicleEF	MDV	5.0540e-003	1.4900e-003
tblVehicleEF	MDV	5.0610e-003	0.03
tblVehicleEF	MDV	0.70	0.56
tblVehicleEF	MDV	1.10	1.76
tblVehicleEF	MDV	355.62	315.48
tblVehicleEF	MDV	73.02	61.81
tblVehicleEF	MDV	0.06	0.03
tblVehicleEF	MDV	0.11	0.15
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.09	0.43
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.09	0.39
tblVehicleEF	MDV	0.01	5.3540e-003
tblVehicleEF	MDV	0.07	0.26
tblVehicleEF	MDV	0.07	0.12
tblVehicleEF	MDV	3.5580e-003	2.8010e-003
tblVehicleEF	MDV	7.4800e-004	5.4800e-004
tblVehicleEF	MDV	0.09	0.43
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.09	0.39

tblVehicleEF	MDV	0.02	7.7230e-003
tblVehicleEF	MDV	0.07	0.26
tblVehicleEF	MDV	0.07	0.13
tblVehicleEF	MDV	4.6150e-003	1.3220e-003
tblVehicleEF	MDV	6.8120e-003	0.04
tblVehicleEF	MDV	0.64	0.51
tblVehicleEF	MDV	1.56	2.64
tblVehicleEF	MDV	338.97	305.81
tblVehicleEF	MDV	73.02	63.49
tblVehicleEF	MDV	0.07	0.03
tblVehicleEF	MDV	0.13	0.18
tblVehicleEF	MDV	1.0950e-003	7.8800e-004
tblVehicleEF	MDV	1.4560e-003	9.1600e-004
tblVehicleEF	MDV	1.0080e-003	7.2600e-004
tblVehicleEF	MDV	1.3390e-003	8.4200e-004
tblVehicleEF	MDV	0.02	0.10
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.02	0.07
tblVehicleEF	MDV	0.01	4.9120e-003
tblVehicleEF	MDV	0.10	0.35
tblVehicleEF	MDV	0.09	0.17
tblVehicleEF	MDV	3.3900e-003	2.7150e-003
tblVehicleEF	MDV	7.5700e-004	5.6300e-004
tblVehicleEF	MDV	0.02	0.10
tblVehicleEF	MDV	0.14	0.10
tblVehicleEF	MDV	0.02	0.07
tblVehicleEF	MDV	0.02	7.0780e-003

tblVehicleEF	MDV	0.10	0.35
tblVehicleEF	MDV	0.10	0.18
tblVehicleEF	MH	5.4220e-003	4.1740e-003
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.26	0.23
tblVehicleEF	MH	3.31	1.50
tblVehicleEF	MH	1,176.44	1,266.18
tblVehicleEF	MH	55.59	14.09
tblVehicleEF	MH	0.77	1.12
tblVehicleEF	MH	0.58	0.24
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.14	0.01
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	3.9420e-003	0.24
tblVehicleEF	MH	0.20	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.1400e-004	1.3900e-004
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.14	0.01

tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	3.9420e-003	0.24
tblVehicleEF	MH	0.22	0.08
tblVehicleEF	MH	5.6040e-003	4.2710e-003
tblVehicleEF	MH	0.01	0.02
tblVehicleEF	MH	0.27	0.23
tblVehicleEF	MH	3.00	1.37
tblVehicleEF	MH	1,176.44	1,266.19
tblVehicleEF	MH	55.59	13.86
tblVehicleEF	MH	0.73	1.08
tblVehicleEF	MH	0.53	0.22
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.54	0.04
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	3.7600e-003	0.23
tblVehicleEF	MH	0.19	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.0800e-004	1.3700e-004
tblVehicleEF	MH	0.54	0.04
tblVehicleEF	MH	0.03	0.02

tblVehicleEF	MH	0.28	0.02
tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	3.7600e-003	0.23
tblVehicleEF	MH	0.21	0.07
tblVehicleEF	MH	5.3060e-003	4.1110e-003
tblVehicleEF	MH	0.02	0.02
tblVehicleEF	MH	0.26	0.22
tblVehicleEF	MH	3.62	1.65
tblVehicleEF	MH	1,176.44	1,266.18
tblVehicleEF	MH	55.59	14.33
tblVehicleEF	MH	0.78	1.14
tblVehicleEF	MH	0.62	0.25
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	9.8580e-003	0.02
tblVehicleEF	MH	8.5700e-004	2.0300e-004
tblVehicleEF	MH	3.2250e-003	3.3350e-003
tblVehicleEF	MH	9.3920e-003	0.02
tblVehicleEF	MH	7.8800e-004	1.8700e-004
tblVehicleEF	MH	0.15	0.01
tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.06	4.9680e-003
tblVehicleEF	MH	0.03	0.04
tblVehicleEF	MH	4.3120e-003	0.26
tblVehicleEF	MH	0.22	0.07
tblVehicleEF	MH	0.01	0.01
tblVehicleEF	MH	6.1900e-004	1.4200e-004
tblVehicleEF	MH	0.15	0.01

tblVehicleEF	MH	0.03	0.02
tblVehicleEF	MH	0.06	4.9680e-003
tblVehicleEF	MH	0.04	0.05
tblVehicleEF	MH	4.3120e-003	0.26
tblVehicleEF	MH	0.24	0.08
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2480e-003	7.7200e-004
tblVehicleEF	MHD	0.03	3.1220e-003
tblVehicleEF	MHD	0.26	3.73
tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	1.99	0.30
tblVehicleEF	MHD	178.42	592.23
tblVehicleEF	MHD	1,157.71	883.00
tblVehicleEF	MHD	36.55	2.93
tblVehicleEF	MHD	0.49	3.22
tblVehicleEF	MHD	1.08	1.49
tblVehicleEF	MHD	14.07	1.96
tblVehicleEF	MHD	5.8000e-005	9.6200e-004
tblVehicleEF	MHD	3.0680e-003	7.5170e-003
tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	5.6000e-005	9.2100e-004
tblVehicleEF	MHD	2.9320e-003	7.1870e-003
tblVehicleEF	MHD	4.7700e-004	3.8000e-005
tblVehicleEF	MHD	3.1900e-004	1.7150e-003
tblVehicleEF	MHD	0.02	5.0230e-003
tblVehicleEF	MHD	0.02	0.15
tblVehicleEF	MHD	2.1000e-004	1.1250e-003

tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	7.1260e-003	0.03
tblVehicleEF	MHD	0.13	0.02
tblVehicleEF	MHD	1.7100e-003	5.6140e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	4.0000e-004	2.9000e-005
tblVehicleEF	MHD	3.1900e-004	1.7150e-003
tblVehicleEF	MHD	0.02	5.0230e-003
tblVehicleEF	MHD	0.03	0.21
tblVehicleEF	MHD	2.1000e-004	1.1250e-003
tblVehicleEF	MHD	0.05	0.01
tblVehicleEF	MHD	7.1260e-003	0.03
tblVehicleEF	MHD	0.14	0.02
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2610e-003	7.8700e-004
tblVehicleEF	MHD	0.03	2.9270e-003
tblVehicleEF	MHD	0.17	3.16
tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	1.81	0.27
tblVehicleEF	MHD	189.21	587.50
tblVehicleEF	MHD	1,157.71	883.00
tblVehicleEF	MHD	36.55	2.89
tblVehicleEF	MHD	0.50	3.07
tblVehicleEF	MHD	1.05	1.44
tblVehicleEF	MHD	14.05	1.96
tblVehicleEF	MHD	4.9000e-005	8.4500e-004
tblVehicleEF	MHD	3.0680e-003	7.5170e-003

tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	4.7000e-005	8.0900e-004
tblVehicleEF	MHD	2.9320e-003	7.1870e-003
tblVehicleEF	MHD	4.7700e-004	3.8000e-005
tblVehicleEF	MHD	6.2200e-004	3.3590e-003
tblVehicleEF	MHD	0.02	5.1730e-003
tblVehicleEF	MHD	0.02	0.15
tblVehicleEF	MHD	4.1100e-004	2.2120e-003
tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	6.6650e-003	0.02
tblVehicleEF	MHD	0.12	0.01
tblVehicleEF	MHD	1.8120e-003	5.5700e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	3.9700e-004	2.9000e-005
tblVehicleEF	MHD	6.2200e-004	3.3590e-003
tblVehicleEF	MHD	0.02	5.1730e-003
tblVehicleEF	MHD	0.02	0.20
tblVehicleEF	MHD	4.1100e-004	2.2120e-003
tblVehicleEF	MHD	0.05	0.01
tblVehicleEF	MHD	6.6650e-003	0.02
tblVehicleEF	MHD	0.13	0.02
tblVehicleEF	MHD	0.02	0.03
tblVehicleEF	MHD	2.2400e-003	7.6200e-004
tblVehicleEF	MHD	0.03	3.2720e-003
tblVehicleEF	MHD	0.33	4.16
tblVehicleEF	MHD	0.23	0.13
tblVehicleEF	MHD	2.16	0.32

tblVehicleEF	MHD	163.98	600.32
tblVehicleEF	MHD	1,157.71	883.00
tblVehicleEF	MHD	36.55	2.98
tblVehicleEF	MHD	0.47	3.41
tblVehicleEF	MHD	1.10	1.51
tblVehicleEF	MHD	14.09	1.96
tblVehicleEF	MHD	7.1000e-005	1.1240e-003
tblVehicleEF	MHD	3.0680e-003	7.5170e-003
tblVehicleEF	MHD	5.1900e-004	4.1000e-005
tblVehicleEF	MHD	6.8000e-005	1.0750e-003
tblVehicleEF	MHD	2.9320e-003	7.1870e-003
tblVehicleEF	MHD	4.7700e-004	3.8000e-005
tblVehicleEF	MHD	1.6100e-004	8.6100e-004
tblVehicleEF	MHD	0.02	5.1140e-003
tblVehicleEF	MHD	0.02	0.15
tblVehicleEF	MHD	8.1000e-005	4.3200e-004
tblVehicleEF	MHD	0.04	0.01
tblVehicleEF	MHD	8.0270e-003	0.03
tblVehicleEF	MHD	0.14	0.02
tblVehicleEF	MHD	1.5730e-003	5.6900e-003
tblVehicleEF	MHD	0.01	8.4030e-003
tblVehicleEF	MHD	4.0300e-004	2.9000e-005
tblVehicleEF	MHD	1.6100e-004	8.6100e-004
tblVehicleEF	MHD	0.02	5.1140e-003
tblVehicleEF	MHD	0.03	0.21
tblVehicleEF	MHD	8.1000e-005	4.3200e-004
tblVehicleEF	MHD	0.05	0.01

tblVehicleEF	MHD	8.0270e-003	0.03
tblVehicleEF	MHD	0.15	0.02
tblVehicleEF	OBUS	0.01	0.12
tblVehicleEF	OBUS	4.4180e-003	3.2250e-003
tblVehicleEF	OBUS	0.02	0.01
tblVehicleEF	OBUS	0.25	9.37
tblVehicleEF	OBUS	0.29	0.33
tblVehicleEF	OBUS	4.36	1.53
tblVehicleEF	OBUS	87.86	1,204.87
tblVehicleEF	OBUS	1,290.02	1,289.82
tblVehicleEF	OBUS	67.94	12.35
tblVehicleEF	OBUS	0.19	5.49
tblVehicleEF	OBUS	0.65	1.10
tblVehicleEF	OBUS	1.75	1.20
tblVehicleEF	OBUS	1.7000e-005	1.8470e-003
tblVehicleEF	OBUS	2.5170e-003	7.3860e-003
tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
tblVehicleEF	OBUS	1.7000e-005	1.7670e-003
tblVehicleEF	OBUS	2.3760e-003	7.0390e-003
tblVehicleEF	OBUS	9.8300e-004	1.3100e-004
tblVehicleEF	OBUS	1.1160e-003	0.02
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.79
tblVehicleEF	OBUS	5.5400e-004	0.01
tblVehicleEF	OBUS	0.03	0.02
tblVehicleEF	OBUS	0.05	0.24
tblVehicleEF	OBUS	0.28	0.08

tblVehicleEF	OBUS	8.5000e-004	0.01
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.5600e-004	1.2200e-004
tblVehicleEF	OBUS	1.1160e-003	0.02
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.05	1.03
tblVehicleEF	OBUS	5.5400e-004	0.01
tblVehicleEF	OBUS	0.04	0.03
tblVehicleEF	OBUS	0.05	0.24
tblVehicleEF	OBUS	0.31	0.08
tblVehicleEF	OBUS	0.01	0.12
tblVehicleEF	OBUS	4.5470e-003	3.3510e-003
tblVehicleEF	OBUS	0.02	0.01
tblVehicleEF	OBUS	0.25	9.29
tblVehicleEF	OBUS	0.30	0.34
tblVehicleEF	OBUS	3.96	1.39
tblVehicleEF	OBUS	92.09	1,190.97
tblVehicleEF	OBUS	1,290.02	1,289.84
tblVehicleEF	OBUS	67.94	12.11
tblVehicleEF	OBUS	0.19	5.22
tblVehicleEF	OBUS	0.62	1.06
tblVehicleEF	OBUS	1.69	1.18
tblVehicleEF	OBUS	1.5000e-005	1.6410e-003
tblVehicleEF	OBUS	2.5170e-003	7.3860e-003
tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
tblVehicleEF	OBUS	1.4000e-005	1.5700e-003
tblVehicleEF	OBUS	2.3760e-003	7.0390e-003

tblVehicleEF	OBUS	9.8300e-004	1.3100e-004
tblVehicleEF	OBUS	2.1480e-003	0.04
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.81
tblVehicleEF	OBUS	1.1070e-003	0.02
tblVehicleEF	OBUS	0.03	0.02
tblVehicleEF	OBUS	0.05	0.23
tblVehicleEF	OBUS	0.26	0.07
tblVehicleEF	OBUS	8.9100e-004	0.01
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.4900e-004	1.2000e-004
tblVehicleEF	OBUS	2.1480e-003	0.04
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.05	1.06
tblVehicleEF	OBUS	1.1070e-003	0.02
tblVehicleEF	OBUS	0.04	0.03
tblVehicleEF	OBUS	0.05	0.23
tblVehicleEF	OBUS	0.29	0.08
tblVehicleEF	OBUS	0.01	0.12
tblVehicleEF	OBUS	4.3350e-003	3.1420e-003
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.26	9.48
tblVehicleEF	OBUS	0.29	0.32
tblVehicleEF	OBUS	4.78	1.68
tblVehicleEF	OBUS	82.02	1,224.08
tblVehicleEF	OBUS	1,290.02	1,289.81
tblVehicleEF	OBUS	67.94	12.60

tblVehicleEF	OBUS	0.18	5.87
tblVehicleEF	OBUS	0.66	1.12
tblVehicleEF	OBUS	1.79	1.21
tblVehicleEF	OBUS	2.1000e-005	2.1310e-003
tblVehicleEF	OBUS	2.5170e-003	7.3860e-003
tblVehicleEF	OBUS	1.0690e-003	1.4300e-004
tblVehicleEF	OBUS	2.0000e-005	2.0390e-003
tblVehicleEF	OBUS	2.3760e-003	7.0390e-003
tblVehicleEF	OBUS	9.8300e-004	1.3100e-004
tblVehicleEF	OBUS	5.9200e-004	0.01
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.03	0.76
tblVehicleEF	OBUS	2.4400e-004	4.9660e-003
tblVehicleEF	OBUS	0.03	0.02
tblVehicleEF	OBUS	0.06	0.26
tblVehicleEF	OBUS	0.30	0.08
tblVehicleEF	OBUS	7.9500e-004	0.01
tblVehicleEF	OBUS	0.01	0.01
tblVehicleEF	OBUS	7.6300e-004	1.2500e-004
tblVehicleEF	OBUS	5.9200e-004	0.01
tblVehicleEF	OBUS	0.02	0.02
tblVehicleEF	OBUS	0.05	0.99
tblVehicleEF	OBUS	2.4400e-004	4.9660e-003
tblVehicleEF	OBUS	0.04	0.03
tblVehicleEF	OBUS	0.06	0.26
tblVehicleEF	OBUS	0.33	0.09
tblVehicleEF	SBUS	0.84	0.59

tblVehicleEF	SBUS	3.2920e-003	1.4860e-003
tblVehicleEF	SBUS	0.06	0.01
tblVehicleEF	SBUS	5.90	27.54
tblVehicleEF	SBUS	0.28	0.15
tblVehicleEF	SBUS	4.75	1.82
tblVehicleEF	SBUS	1,123.21	2,870.44
tblVehicleEF	SBUS	1,068.95	883.72
tblVehicleEF	SBUS	40.19	9.64
tblVehicleEF	SBUS	2.65	12.99
tblVehicleEF	SBUS	1.03	1.50
tblVehicleEF	SBUS	14.15	1.63
tblVehicleEF	SBUS	2.0500e-004	3.2780e-003
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	2.8100e-003	9.6070e-003
tblVehicleEF	SBUS	8.3700e-004	1.7300e-004
tblVehicleEF	SBUS	1.9700e-004	3.1360e-003
tblVehicleEF	SBUS	2.7190e-003	2.7660e-003
tblVehicleEF	SBUS	2.6730e-003	9.1780e-003
tblVehicleEF	SBUS	7.7000e-004	1.5900e-004
tblVehicleEF	SBUS	2.3390e-003	5.5350e-003
tblVehicleEF	SBUS	0.03	0.01
tblVehicleEF	SBUS	0.72	2.70
tblVehicleEF	SBUS	1.1850e-003	2.7720e-003
tblVehicleEF	SBUS	0.05	0.02
tblVehicleEF	SBUS	0.01	0.11
tblVehicleEF	SBUS	0.25	0.07
tblVehicleEF	SBUS	0.01	0.03

tblVehicleEF	SBUS	0.01	8.4230e-003
tblVehicleEF	SBUS	4.8400e-004	9.5000e-005
tblVehicleEF	SBUS	2.3390e-003	5.5350e-003
tblVehicleEF	SBUS	0.03	0.01
tblVehicleEF	SBUS	1.04	3.88
tblVehicleEF	SBUS	1.1850e-003	2.7720e-003
tblVehicleEF	SBUS	0.05	0.02
tblVehicleEF	SBUS	0.01	0.11
tblVehicleEF	SBUS	0.28	0.08
tblVehicleEF	SBUS	0.84	0.59
tblVehicleEF	SBUS	3.3440e-003	1.5120e-003
tblVehicleEF	SBUS	0.05	0.01
tblVehicleEF	SBUS	5.85	27.39
tblVehicleEF	SBUS	0.28	0.15
tblVehicleEF	SBUS	3.52	1.35
tblVehicleEF	SBUS	1,178.17	2,850.52
tblVehicleEF	SBUS	1,068.95	883.73
tblVehicleEF	SBUS	40.19	8.86
tblVehicleEF	SBUS	2.73	12.48
tblVehicleEF	SBUS	0.99	1.44
tblVehicleEF	SBUS	14.12	1.62
tblVehicleEF	SBUS	1.7300e-004	2.8970e-003
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	2.8100e-003	9.6070e-003
tblVehicleEF	SBUS	8.3700e-004	1.7300e-004
tblVehicleEF	SBUS	1.6600e-004	2.7720e-003
tblVehicleEF	SBUS	2.7190e-003	2.7660e-003

tblVehicleEF	SBUS	2.6730e-003	9.1780e-003
tblVehicleEF	SBUS	7.7000e-004	1.5900e-004
tblVehicleEF	SBUS	4.4490e-003	0.01
tblVehicleEF	SBUS	0.03	0.02
tblVehicleEF	SBUS	0.72	2.72
tblVehicleEF	SBUS	2.3340e-003	5.5170e-003
tblVehicleEF	SBUS	0.05	0.02
tblVehicleEF	SBUS	0.01	0.09
tblVehicleEF	SBUS	0.21	0.06
tblVehicleEF	SBUS	0.01	0.03
tblVehicleEF	SBUS	0.01	8.4230e-003
tblVehicleEF	SBUS	4.6400e-004	8.8000e-005
tblVehicleEF	SBUS	4.4490e-003	0.01
tblVehicleEF	SBUS	0.03	0.02
tblVehicleEF	SBUS	1.04	3.89
tblVehicleEF	SBUS	2.3340e-003	5.5170e-003
tblVehicleEF	SBUS	0.05	0.02
tblVehicleEF	SBUS	0.01	0.09
tblVehicleEF	SBUS	0.23	0.07
tblVehicleEF	SBUS	0.84	0.59
tblVehicleEF	SBUS	3.2550e-003	1.4670e-003
tblVehicleEF	SBUS	0.06	0.02
tblVehicleEF	SBUS	5.97	27.75
tblVehicleEF	SBUS	0.28	0.15
tblVehicleEF	SBUS	6.14	2.35
tblVehicleEF	SBUS	1,047.32	2,897.95
tblVehicleEF	SBUS	1,068.95	883.72

tblVehicleEF	SBUS	40.19	10.52
tblVehicleEF	SBUS	2.53	13.69
tblVehicleEF	SBUS	1.04	1.51
tblVehicleEF	SBUS	14.17	1.64
tblVehicleEF	SBUS	2.5000e-004	3.8030e-003
tblVehicleEF	SBUS	0.01	0.01
tblVehicleEF	SBUS	2.8100e-003	9.6070e-003
tblVehicleEF	SBUS	8.3700e-004	1.7300e-004
tblVehicleEF	SBUS	2.3900e-004	3.6390e-003
tblVehicleEF	SBUS	2.7190e-003	2.7660e-003
tblVehicleEF	SBUS	2.6730e-003	9.1780e-003
tblVehicleEF	SBUS	7.7000e-004	1.5900e-004
tblVehicleEF	SBUS	1.2710e-003	2.9600e-003
tblVehicleEF	SBUS	0.03	0.02
tblVehicleEF	SBUS	0.72	2.69
tblVehicleEF	SBUS	5.2800e-004	1.2260e-003
tblVehicleEF	SBUS	0.05	0.02
tblVehicleEF	SBUS	0.02	0.13
tblVehicleEF	SBUS	0.29	0.08
tblVehicleEF	SBUS	0.01	0.03
tblVehicleEF	SBUS	0.01	8.4230e-003
tblVehicleEF	SBUS	5.0700e-004	1.0400e-004
tblVehicleEF	SBUS	1.2710e-003	2.9600e-003
tblVehicleEF	SBUS	0.03	0.02
tblVehicleEF	SBUS	1.04	3.86
tblVehicleEF	SBUS	5.2800e-004	1.2260e-003
tblVehicleEF	SBUS	0.05	0.02

tblVehicleEF	SBUS	0.02	0.13
tblVehicleEF	SBUS	0.32	0.09
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.07	1.6310e-003
tblVehicleEF	UBUS	3.30	27.63
tblVehicleEF	UBUS	8.69	0.15
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.26
tblVehicleEF	UBUS	2.76	0.55
tblVehicleEF	UBUS	12.33	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	3.2160e-003	9.2000e-005
tblVehicleEF	UBUS	0.06	3.2100e-004
tblVehicleEF	UBUS	2.1090e-003	5.1000e-005
tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.02	1.9470e-003
tblVehicleEF	UBUS	0.90	7.5660e-003
tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.5900e-003	1.2000e-005
tblVehicleEF	UBUS	3.2160e-003	9.2000e-005

tblVehicleEF	UBUS	0.06	3.2100e-004
tblVehicleEF	UBUS	2.1090e-003	5.1000e-005
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.02	1.9470e-003
tblVehicleEF	UBUS	0.99	8.2830e-003
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.06	1.4450e-003
tblVehicleEF	UBUS	3.31	27.63
tblVehicleEF	UBUS	6.96	0.12
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.21
tblVehicleEF	UBUS	2.65	0.55
tblVehicleEF	UBUS	12.22	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	5.9070e-003	1.9800e-004
tblVehicleEF	UBUS	0.07	3.5800e-004
tblVehicleEF	UBUS	4.1490e-003	1.2400e-004
tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.02	1.6760e-003
tblVehicleEF	UBUS	0.79	6.6320e-003

tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.5600e-003	1.2000e-005
tblVehicleEF	UBUS	5.9070e-003	1.9800e-004
tblVehicleEF	UBUS	0.07	3.5800e-004
tblVehicleEF	UBUS	4.1490e-003	1.2400e-004
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.02	1.6760e-003
tblVehicleEF	UBUS	0.86	7.2610e-003
tblVehicleEF	UBUS	0.55	3.62
tblVehicleEF	UBUS	0.07	1.7860e-003
tblVehicleEF	UBUS	3.29	27.63
tblVehicleEF	UBUS	10.37	0.17
tblVehicleEF	UBUS	1,814.40	1,710.45
tblVehicleEF	UBUS	142.68	1.30
tblVehicleEF	UBUS	2.79	0.55
tblVehicleEF	UBUS	12.42	0.01
tblVehicleEF	UBUS	0.50	0.08
tblVehicleEF	UBUS	0.01	0.03
tblVehicleEF	UBUS	0.05	3.9600e-003
tblVehicleEF	UBUS	1.5360e-003	1.5000e-005
tblVehicleEF	UBUS	0.21	0.03
tblVehicleEF	UBUS	3.0000e-003	7.2700e-003
tblVehicleEF	UBUS	0.04	3.7870e-003
tblVehicleEF	UBUS	1.4130e-003	1.4000e-005
tblVehicleEF	UBUS	1.7240e-003	3.8000e-005
tblVehicleEF	UBUS	0.06	3.4400e-004
tblVehicleEF	UBUS	9.9800e-004	2.0000e-005

tblVehicleEF	UBUS	0.13	0.05
tblVehicleEF	UBUS	0.03	2.4500e-003
tblVehicleEF	UBUS	0.99	8.3520e-003
tblVehicleEF	UBUS	0.01	5.0760e-003
tblVehicleEF	UBUS	1.6200e-003	1.3000e-005
tblVehicleEF	UBUS	1.7240e-003	3.8000e-005
tblVehicleEF	UBUS	0.06	3.4400e-004
tblVehicleEF	UBUS	9.9800e-004	2.0000e-005
tblVehicleEF	UBUS	0.70	3.69
tblVehicleEF	UBUS	0.03	2.4500e-003
tblVehicleEF	UBUS	1.09	9.1440e-003
tblVehicleTrips	CC_TTP	88.60	0.00
tblVehicleTrips	CNW_TTP	5.00	0.00
tblVehicleTrips	CW_TTP	6.40	0.00
tblVehicleTrips	HO_TL	7.90	0.00
tblVehicleTrips	HO_TL	7.90	0.00
tblVehicleTrips	HO_TL	0.00	6.89
tblVehicleTrips	HO_TTP	37.20	26.00
tblVehicleTrips	HO_TTP	37.20	26.00
tblVehicleTrips	HO_TTP	0.00	5.00
tblVehicleTrips	HS_TL	7.10	0.00
tblVehicleTrips	HS_TL	7.10	0.00
tblVehicleTrips	HS_TL	0.00	11.65
tblVehicleTrips	HS_TTP	18.80	50.00
tblVehicleTrips	HS_TTP	18.80	50.00
tblVehicleTrips	HS_TTP	0.00	88.00
tblVehicleTrips	HW_TL	16.80	0.00

tblVehicleTrips	HW_TL	16.80	0.00
tblVehicleTrips	HW_TL	0.00	15.00
tblVehicleTrips	HW_TTP	44.00	24.00
tblVehicleTrips	HW_TTP	44.00	24.00
tblVehicleTrips	HW_TTP	0.00	7.00
tblVehicleTrips	ST_TR	7.16	0.00
tblVehicleTrips	ST_TR	6.39	0.00
tblVehicleTrips	ST_TR	1.32	0.00
tblVehicleTrips	ST_TR	20.87	0.00
tblVehicleTrips	ST_TR	1.90	0.00
tblVehicleTrips	ST_TR	1.30	0.42
tblVehicleTrips	SU_TR	6.07	0.00
tblVehicleTrips	SU_TR	5.86	0.00
tblVehicleTrips	SU_TR	0.68	0.00
tblVehicleTrips	SU_TR	26.73	0.00
tblVehicleTrips	SU_TR	1.11	0.00
tblVehicleTrips	SU_TR	0.00	0.42
tblVehicleTrips	WD_TR	6.59	0.00
tblVehicleTrips	WD_TR	6.65	0.00
tblVehicleTrips	WD_TR	6.97	0.00
tblVehicleTrips	WD_TR	32.93	0.00
tblVehicleTrips	WD_TR	8.11	0.00
tblVehicleTrips	WD_TR	1.71	1.21
tblWater	IndoorWaterUseRate	13,389,375.00	8,926,250.00
tblWater	IndoorWaterUseRate	35,965,537.32	23,977,222.02
tblWater	IndoorWaterUseRate	554,321,005.26	369,547,336.84
tblWater	OutdoorWaterUseRate	22,043,393.84	14,695,716.72

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2022	0.0000	0.0000	0.0000	0.0000	0.0000	3.0481	0.0000	0.0000	2.8232	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	0.0000	0.0000	0.0000	0.0000	0.0000	1.4264	0.0000	0.0000	1.3123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024	15.0498	84.2498	128.7328	0.5176	40.7762	0.3898	41.1660	10.9265	0.3641	11.2905	0.0000	52,864.5421	52,864.5421	1.7237	0.0000	52,907.6355
2036	0.0000	0.0000	0.0000	0.0000	0.0000	0.1881	0.0000	0.0000	0.1880	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0357	0.0000	0.0000	0.0337	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**15.0498**	**84.2498**	**128.7328**	**0.5176**	**40.7762**	**3.0481**	**41.1660**	**10.9265**	**2.8232**	**11.2905**	**0.0000**	**52,864.5421**	**52,864.5421**	**1.7237**	**0.0000**	**52,907.6355**

2.1 Overall Construction (Maximum Daily Emission)

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2022	0.0000	0.0000	0.0000	0.0000	0.0000	3.0481	0.0000	0.0000	2.8232	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2023	0.0000	0.0000	0.0000	0.0000	0.0000	1.4264	0.0000	0.0000	1.3123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024	15.0498	84.2498	128.7328	0.5176	40.7762	0.3898	41.1660	10.9265	0.3641	11.2905	0.0000	52,864.5421	52,864.5421	1.7237	0.0000	52,907.6355
2036	0.0000	0.0000	0.0000	0.0000	0.0000	0.1881	0.0000	0.0000	0.1880	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0357	0.0000	0.0000	0.0337	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	**15.0498**	**84.2498**	**128.7328**	**0.5176**	**40.7762**	**3.0481**	**41.1660**	**10.9265**	**2.8232**	**11.2905**	**0.0000**	**52,864.5421**	**52,864.5421**	**1.7237**	**0.0000**	**52,907.6355**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	146.0839	1.6192	140.5378	7.4800e-003		0.7805	0.7805		0.7805	0.7805	0.0000	254.5703	254.5703	0.2463	0.0000	260.7287
Energy	2.5816	23.2751	18.2905	0.1408		1.7837	1.7837		1.7837	1.7837		28,163.0297	28,163.0297	0.5398	0.5163	28,330.3885
Mobile	24.1700	50.1983	215.6035	0.7167	95.5577	0.3935	95.9512	25.4966	0.3686	25.8652		80,135.1190	80,135.1190	2.8235		80,205.7056
Total	**172.8356**	**75.0927**	**374.4319**	**0.8650**	**95.5577**	**2.9577**	**98.5153**	**25.4966**	**2.9327**	**28.4293**	**0.0000**	**108,552.7190**	**108,552.7190**	**3.6096**	**0.5163**	**108,796.8228**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	115.2060	1.2858	106.5677	4.8400e-003		0.5810	0.5810		0.5810	0.5810	0.0000	177.7380	177.7380	0.1283	0.0000	180.9450
Energy	2.5816	23.2751	18.2905	0.1408		1.7837	1.7837		1.7837	1.7837		28,163.0297	28,163.0297	0.5398	0.5163	28,330.3885
Mobile	24.1700	50.1983	215.6035	0.7167	95.5577	0.3935	95.9512	25.4966	0.3686	25.8652		80,135.1190	80,135.1190	2.8235		80,205.7056
Total	**141.9577**	**74.7592**	**340.4617**	**0.8624**	**95.5577**	**2.7582**	**98.3159**	**25.4966**	**2.7332**	**28.2299**	**0.0000**	**108,475.8867**	**108,475.8867**	**3.4915**	**0.5163**	**108,717.0391**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	17.87	0.44	9.07	0.31	0.00	6.74	0.20	0.00	6.80	0.70	0.00	0.07	0.07	3.27	0.00	0.07

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/3/2022	1/2/2022	5	0	
2	Site Preparation	Site Preparation	10/8/2022	10/7/2022	5	0	
3	Grading	Grading	3/25/2023	3/24/2023	5	0	
4	Building Construction	Building Construction	6/1/2024	6/3/2024	5	1	
5	Paving	Paving	4/19/2036	4/18/2036	5	0	
6	Architectural Coating	Architectural Coating	2/21/2037	2/20/2037	5	0	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 775

Acres of Paving: 43.07

Residential Indoor: 3,436,425; Residential Outdoor: 1,145,475; Non-Residential Indoor: 3,083,825; Non-Residential Outdoor: 1,027,942; Striped Parking Area: 112,577 (Architectural Coating – sqft)

OffRoad Equipment

UCSC - 2020 LRDP - Operational Only - with Mitigated VMT - Santa Cruz County, Summer

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	158	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	2	8.00	158	0.38
Grading	Graders	1	8.00	187	0.41
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Building Construction	Cranes	0	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	0	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Paving	Pavers	2	8.00	130	0.42
Paving	Paving Equipment	2	8.00	132	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	6.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	175.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	0	2,798.00	826.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	560.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.2 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.2 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Site Preparation - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Grading - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Building Construction - 2024

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**		**0.0000**

3.5 Building Construction - 2024

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	1.8585	74.4726	18.6518	0.2001	5.0372	0.1344	5.1716	1.4488	0.1285	1.5773		21,227.55 05	21,227.55 05	0.7498		21,246.29 59
Worker	13.1912	9.7773	110.0811	0.3175	35.7390	0.2554	35.9944	9.4776	0.2356	9.7132		31,636.99 16	31,636.99 16	0.9739		31,661.33 96
Total	**15.0498**	**84.2498**	**128.7328**	**0.5176**	**40.7762**	**0.3898**	**41.1660**	**10.9265**	**0.3641**	**11.2905**		**52,864.54 21**	**52,864.54 21**	**1.7237**		**52,907.63 55**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**

3.5 Building Construction - 2024

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	1.8585	74.4726	18.6518	0.2001	5.0372	0.1344	5.1716	1.4488	0.1285	1.5773		21,227.5505	21,227.5505	0.7498		21,246.2959
Worker	13.1912	9.7773	110.0811	0.3175	35.7390	0.2554	35.9944	9.4776	0.2356	9.7132		31,636.9916	31,636.9916	0.9739		31,661.3396
Total	**15.0498**	**84.2498**	**128.7328**	**0.5176**	**40.7762**	**0.3898**	**41.1660**	**10.9265**	**0.3641**	**11.2905**		**52,864.5421**	**52,864.5421**	**1.7237**		**52,907.6355**

3.6 Paving - 2036

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Paving - 2036

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Paving - 2036

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.7 Architectural Coating - 2037

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	lb/day										lb/day					
Mitigated	24.1700	50.1983	215.6035	0.7167	95.5577	0.3935	95.9512	25.4966	0.3686	25.8652		80,135.1190	80,135.1190	2.8235		80,205.7056
Unmitigated	24.1700	50.1983	215.6035	0.7167	95.5577	0.3935	95.9512	25.4966	0.3686	25.8652		80,135.1190	80,135.1190	2.8235		80,205.7056

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Low Rise	0.00	0.00	0.00		
Apartments Mid Rise	0.00	0.00	0.00		
General Light Industry	0.00	0.00	0.00		
Health Club	0.00	0.00	0.00		
Parking Lot	0.00	0.00	0.00		
Research & Development	0.00	0.00	0.00		
University/College (4Yr)	11,439.99	3,941.51	3941.51	36,754,876	36,754,876
Total	11,439.99	3,941.51	3,941.51	36,754,876	36,754,876

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Low Rise	0.00	0.00	0.00	24.00	50.00	26.00	86	11	3
Apartments Mid Rise	0.00	0.00	0.00	24.00	50.00	26.00	86	11	3
General Light Industry	14.70	6.60	6.60	59.00	28.00	13.00	92	5	3
Health Club	14.70	6.60	6.60	16.90	64.10	19.00	52	39	9
Parking Lot	14.70	6.60	6.60	0.00	0.00	0.00	0	0	0
Research & Development	14.70	6.60	6.60	33.00	48.00	19.00	82	15	3
University/College (4Yr)	14.70	6.60	6.60	0.00	0.00	0.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Low Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Apartments Mid Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Apartments Mid Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
General Light Industry	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Health Club	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Parking Lot	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
Research & Development	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515
University/College (4Yr)	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.004540	0.000840	0.000515

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	2.5816	23.2751	18.2905	0.1408		1.7837	1.7837		1.7837	1.7837		28,163.0297	28,163.0297	0.5398	0.5163	28,330.3885
NaturalGas Unmitigated	2.5816	23.2751	18.2905	0.1408		1.7837	1.7837		1.7837	1.7837		28,163.0297	28,163.0297	0.5398	0.5163	28,330.3885

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Low Rise	9489	0.1023	0.8745	0.3721	5.5800e-003		0.0707	0.0707		0.0707	0.0707		1,116.3534	1,116.3534	0.0214	0.0205	1,122.9873
Apartments Mid Rise	23512.4	0.2536	2.1668	0.9221	0.0138		0.1752	0.1752		0.1752	0.1752		2,766.1658	2,766.1658	0.0530	0.0507	2,782.6037
General Light Industry	4027.83	0.0434	0.3949	0.3317	2.3700e-003		0.0300	0.0300		0.0300	0.0300		473.8621	473.8621	9.0800e-003	8.6900e-003	476.6780
Health Club	42301.1	0.4562	4.1472	3.4836	0.0249		0.3152	0.3152		0.3152	0.3152		4,976.6037	4,976.6037	0.0954	0.0912	5,006.1771
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	78421.9	0.8457	7.6884	6.4583	0.0461		0.5843	0.5843		0.5843	0.5843		9,226.1081	9,226.1081	0.1768	0.1692	9,280.9343
University/College (4Yr)	81633.5	0.8804	8.0033	6.7228	0.0480		0.6083	0.6083		0.6083	0.6083		9,603.9366	9,603.9366	0.1841	0.1761	9,661.0080
Total		**2.5816**	**23.2751**	**18.2905**	**0.1408**		**1.7837**	**1.7837**		**1.7837**	**1.7837**		**28,163.0297**	**28,163.0297**	**0.5398**	**0.5163**	**28,330.3885**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Low Rise	9.489	0.1023	0.8745	0.3721	5.5800e-003		0.0707	0.0707		0.0707	0.0707		1,116.3534	1,116.3534	0.0214	0.0205	1,122.9873
Apartments Mid Rise	23.5124	0.2536	2.1668	0.9221	0.0138		0.1752	0.1752		0.1752	0.1752		2,766.1658	2,766.1658	0.0530	0.0507	2,782.6037
General Light Industry	4.02783	0.0434	0.3949	0.3317	2.3700e-003		0.0300	0.0300		0.0300	0.0300		473.8621	473.8621	9.0800e-003	8.6900e-003	476.6780
Health Club	42.3011	0.4562	4.1472	3.4836	0.0249		0.3152	0.3152		0.3152	0.3152		4,976.6037	4,976.6037	0.0954	0.0912	5,006.1771
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Research & Development	78.4219	0.8457	7.6884	6.4583	0.0461		0.5843	0.5843		0.5843	0.5843		9,226.1081	9,226.1081	0.1768	0.1692	9,280.9343
University/College (4Yr)	81.6335	0.8804	8.0033	6.7228	0.0480		0.6083	0.6083		0.6083	0.6083		9,603.9366	9,603.9366	0.1841	0.1761	9,661.0080
Total		**2.5816**	**23.2751**	**18.2905**	**0.1408**		**1.7837**	**1.7837**		**1.7837**	**1.7837**		**28,163.0297**	**28,163.0297**	**0.5398**	**0.5163**	**28,330.3885**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Electric Lawnmower

Use Electric Leafblower

Use Electric Chainsaw

Use Low VOC Paint - Residential Interior

Use Low VOC Paint - Residential Exterior

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

Use Low VOC Cleaning Supplies

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	115.2060	1.2858	106.5677	4.8400e-003		0.5810	0.5810		0.5810	0.5810	0.0000	177.7380	177.7380	0.1283	0.0000	180.9450
Unmitigated	146.0839	1.6192	140.5378	7.4800e-003		0.7805	0.7805		0.7805	0.7805	0.0000	254.5703	254.5703	0.2463	0.0000	260.7287

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	20.6884					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	121.1214					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	4.2741	1.6192	140.5378	7.4800e-003		0.7805	0.7805		0.7805	0.7805		254.5703	254.5703	0.2463		260.7287
Total	**146.0839**	**1.6192**	**140.5378**	**7.4800e-003**		**0.7805**	**0.7805**		**0.7805**	**0.7805**	**0.0000**	**254.5703**	**254.5703**	**0.2463**	**0.0000**	**260.7287**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.8350					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	112.1153					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	2.2557	1.2858	106.5677	4.8400e-003		0.5810	0.5810		0.5810	0.5810		177.7380	177.7380	0.1283		180.9450
Total	**115.2060**	**1.2858**	**106.5677**	**4.8400e-003**		**0.5810**	**0.5810**		**0.5810**	**0.5810**	**0.0000**	**177.7380**	**177.7380**	**0.1283**	**0.0000**	**180.9450**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Appendix D2 – Health Risk Assessment

Health Risk Assessment

for the University of California – Santa Cruz

2021 Long Range Development Plan

Prepared for:
University of California - Santa Cruz
1156 High Street
Santa Cruz, CA 95064
December 2020

Health Risk Assessment for the

University of California – Santa Cruz

2021 Long Range Development Plan

Prepared For:

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December 2020

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1 INTRODUCTION

The University of California, Santa Cruz (UC Santa Cruz) is preparing the 2021 Long Range Development Plan for UC Santa Cruz (LRDP) to guide future land use development. As part of the LRDP, UC Santa Cruz proposes provide an additional 8,500 student housing beds, up to 550 employee housing units, and approximately 3.1 million square feet of assignable square feet of academic and administrative building space.

This health risk assessment (HRA) evaluates the potential risks associated with construction activities and operation of new campus facilities developed under the LRDP. Air pollutants of concern for this analysis are toxic air contaminants (TACs), primarily diesel particulate matter (diesel PM), from UC Santa Cruz-operated natural gas boilers, generators, and turbines; diesel-powered equipment and vehicles; and gaseous byproducts from laboratory and research fume hoods, and gasoline fuel storage. The HRA also estimates the levels of cancer risk throughout the campus for students and workers as well as for off-site sensitive receptors, such as residential areas, places of worship, and schools. The scope of this HRA is limited to the emissions within campus boundaries and along High Street and Bay Street up to Highway (Hwy) 1.

The HRA was conducted in accordance with Monterey Bay Air Resources District's (MBARD) *Guidelines for Preparing Air Toxics Emission Inventory Plans and Reports*, California Office of Environmental Health and Hazard Assessment (OEHHA) *Air Toxic Hot Spot Program Guidance Manual for Preparation of Health and Risk Assessments*, and guidance from UC Santa Cruz and MBARD staff (OEHHA 2015, MBARD 2019, Kim, pers. comm., 2020a). This report is organized in two primary sections, the first discusses the methodology used in analyzing the health risks and the second presents the results of the HRA.

2 METHODOLOGY

This section is organized by first discussing the overall approach used to conduct the construction and operational HRAs, then addressing the specific inputs and calculation methods used to quantify the risks from the construction and operation of the LRDP.

2.1 HEALTH RISK ASSESSMENT METHODOLOGY AND APPROACH

To determine the public health impacts of TACs emitted during the construction and operation of the LRDP, the emissions sources of concern were first inventoried. The various emissions source parameters (e.g., stack flow rates, exhaust temperatures, and locations) were used to model the dispersion of pollutants into the atmosphere based on local meteorological conditions.

Air dispersion modeling was conducted using California Air Resources Board (CARB)-approved American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee modeling system (AERMOD) Version 9.9.0. AERMOD was used to obtain ground level concentrations (GLCs) over a receptor grid surrounding the campus. The resulting GLCs of each pollutant were input into the Hotspots Analysis and Reporting Program Version 19121 (HARP2) software, to match the GLCs with known pollutant risk values to determine the spatial distribution of cancer and non-cancer health risks at each receptor. Results are presented graphically on maps including risk isopleths and aerial imagery.

The specific TACs analyzed in this HRA are based on the list provided in the *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values* (Consolidated Table) (CARB 2020a). Any substances in this table that did not have risk values were excluded from the analysis. The Consolidated Table includes diesel PM in the list of TACs. According to Appendix D of OEHHA's 2003 HRA guidance, referred to in the Consolidated Table, PM_{10} is the basis for

OEHHA's potential risk calculations for diesel PM (OEHHA 2003, CARB 2020a). Thus, estimated emissions of PM_{10} from diesel combustion sources were used as a proxy for diesel PM in the risk assessment.

Details pertaining to each component of the HRA (e.g., source inventory, air dispersion modeling, emission rate calculations, and risk calculations) are discussed in further detail below.

2.2 SOURCE INVENTORY

For this HRA, construction-related emissions sources include on-site diesel equipment, including diesel-powered woodchippers, performing various activities and off-site diesel hauling and vendor trucks that travel to and from the project site.

Emissions sources during operation include new and increased existing operations of on-campus natural gas boilers, turbines, and generators; laboratory fume hoods; gasoline storage tanks, and diesel mobile sources (e.g., buses, delivery trucks). The selection of sources modeled for operational health risks was based on sources evaluated in MBARD's Prioritization Score Assessment of UC Santa Cruz for Assembly Bill [AB] 2588 Hot Spot's program and in the previous 2005 LRDP HRA (Kim, pers. comm., 2020b, UC Santa Cruz 2005). MBARD's assessment evaluated operation of natural gas boilers, natural gas turbines, gasoline storage tank, a portable gasoline sewer pump, and portable diesel-powered woodchippers. The 2005 LRDP HRA also included emissions from laboratory fume hoods. Except for the excluded sources noted below, these existing sources were used as a basis for estimating new or increased existing emissions sources that would occur under LRDP operations. Diesel-powered woodchippers were assumed to be associated with site preparation activities under construction.

Under the University of California Office of the President's Sustainability Practices Policy, new buildings are prohibited from combusting natural gas or other fossil fuels onsite. However, the UC Sustainable Practices Policy states "Projects unable to meet this requirement shall document the rationale for this decision…" (UCOP 2020:9). Due to this flexibility in the policy, it is conservatively assumed that the additional buildings would use natural gas.

EXCLUDED SOURCES

The following sources are excluded from this analysis:

- Existing (non-modified) on-site sources;
- Off-site generated traffic-related TACs;
- Permitted stationary sources outside of the LRDP boundary;
- Unpermitted natural gas furnaces and water heaters;
- Portable gasoline sewer pumps; and
- Paint booths.

Existing sources are not evaluated due to the purpose of this HRA to inform impacts related to new sources generated under the LRDP in relation to MBARD health risk thresholds. Consistent with CARB guidance (2005) for siting sensitive receptors near TAC sources, traffic-related TACs are excluded because the project site is located more than 500 feet from the nearest freeway (CARB 2005). Hwy 1 is located approximately one mile the southern border of the plan area. No major permitted stationary sources, such as power plants or factories, are located within 1,000 feet of the project boundary.

Natural gas furnaces and water heaters are small stationary sources that emit small amounts of TACs that are not required to have permits and are excluded from MBARD's analysis of health risks generated by UC Santa Cruz. Additionally, although the operation of a portable gasoline sewer pump is included in MBARD's AB 2588 evaluation, this equipment can operate at any sewer access on campus, as needed, and is estimated to use no more than nine gallons of gasoline per year. Due to the relatively small usage rate compared to other permitted sources and the fact that this source would not operate at a single location for extended periods of time, emissions from any additional usage of this equipment under the LRDP are excluded from this analysis.

Although the campus currently operates two permitted paint booths, which were both modeled in the 2005 LRDP HRA, UC Santa Cruz noted that these facilities are used sparingly and does not anticipate the campus's growth to result in any new paint booths to be operated (Carpenter, pers. comm., 2020a).

EMISSION RATES

The emission rates from each emissions source, measured as mass over time, were used to calculate the TAC GLCs at receptor locations, measured in micrograms per cubic meter ($\mu g/m^3$). Average annual and hourly emission rates were calculated based on 1) the operation schedule of each emissions source and 2) the emission factors of each source based on the type of equipment and amount of fuel combusted or evaporation factors associated with the use and storage of laboratory chemicals. The methods used to estimate the individual emission rates vary by the type of TAC source (e.g., construction equipment, stationary sources, and laboratories), and are discussed separately in further detail below for the construction and operational analyses.

2.3 AIR DISPERSION MODELING

MODELING APPROACH

Dispersion modeling was conducted using AERMOD Version 9.9.0 for two scenarios: construction and proposed operation of the LRDP. Emissions source data, receptor locations and parameters, on-site buildings, terrain data, and meteorological data were the primary inputs into AERMOD to determine how emissions would be dispersed and the resulting GLCs. Most of these inputs varied depending on the scenario being modeled. However, all modeled scenarios used the same receptor locations, terrain data, and meteorological data.

Terrain, meteorology, and buildings close to the emissions sources greatly influence the dispersion of pollutants. The presence of on-site buildings was modeled to account for the effect of the buildings by emissions sources to divert the dispersion of pollutants, also referred to as building downwash. Existing building footprints and heights were provided by UC Santa Cruz. Local terrain data were obtained from CARB's digital elevation files for the Felton and Santa Cruz areas (CARB 2020b). Meteorology data were obtained from MBARD. It was assumed that the surrounding area would have a general dispersion coefficient representative of urban areas, due to the location of the campus in a wooded area, which has significant surface terrain. Modeling was conducted using the Universal Transverse Mercator coordinate system for zone 11 north and the geographic datum from the World Geodetic System (WGS) in 1984. Relative concentrations were averaged over a 4-year period, based on the meteorological data available (2014-2018).

Air dispersion modeling was conducted using a unit emission rate of 1.0 gram per second (g/s) for all modeled point and area sources. Area and volume sources were modeled as having an emission rate of 1.0 g/s for each building or construction area that was represented. This resulted in GLC values per unit emission rate (χ/Q) ($[\mu g/m^3]/[g/s]$), that were then multiplied in HARP2 by emission rates calculated for each source. This approach enabled the AERMOD output files to be assigned appropriate emission rates and cancer and non-cancer risk values to estimate concentrations and health risk levels from each individual source at each receptor location. Apart from these inputs and assumptions, AERMOD's default dispersion options were selected.

METEOROLOGICAL DATA

The Santa Cruz, Watsonville Airport meteorological station was identified by MBARD staff to have the most representative data for the project site due to its proximity to the campus and similarity in geography and meteorological conditions. Watsonville Airport Station is approximately 16 miles west of the campus. (Kim, pers. comm., 2020c).

Ascent obtained preprocessed 4-year meteorological data (2014-2018) from MBARD for the Watsonville Airport station for use in the air dispersion modeling. A wind rose displaying the wind speed and wind direction is shown in Figure 1. The wind primarily blows from the southwest and northwest directions. Dispersion modeling applied the time-averaged, simplified representation of turbulent, atmospheric transport to approximate how pollutants are carried, mixed, dispersed, and diluted by the local winds based on data from the Watsonville Airport station.

RECEPTOR GRID

MBARD recommends using modeling guidance provided by South Coast Air Quality Management District (SCAQMD) for developing the receptor grid. In accordance with SCAQMD guidance for conducting HRAs and air dispersion modeling, a receptor grid with a 100-meter (m) grid spacing was used based on the overall size of the project area (>2 kilometers [km]). Due to the orientation of the campus with the majority of buildings and source concentrated over 1 km north from the nearest off-site receptors (e.g., residential land uses to the south of the campus), the receptor grid covers the entire campus area and 400 m along either side of major routes approaching the campus (High Street and Bay Street). The grid also excludes areas where no receptors are located (e.g., meadows, wooded areas). Per SCAQMD guidance, each receptor was assumed to have heights at elevation to represent risks at the ground level. Along this receptor grid, several additional discrete receptors were identified within 1 km of the campus based on their sensitive land use type (i.e., school, daycare, place of worship). The locations and identity of these receptors are shown in Table 1.

Table 1 Additional Sensitive Receptors

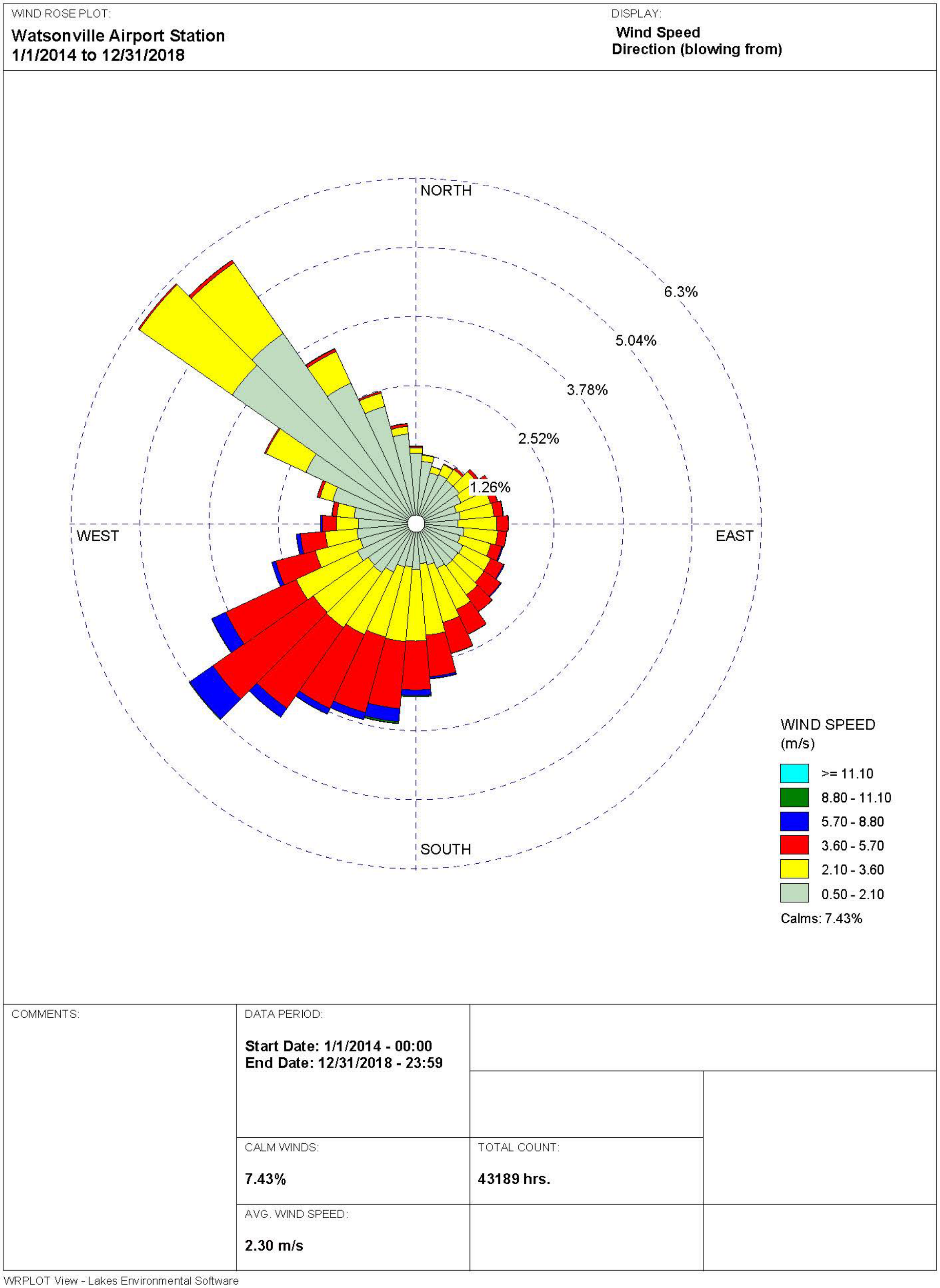
Receptor	Receptor Type	Easting (m)[1]	Northing (m)[1]
Westlake School	Elementary School	584593.9	4092970.3
First Congregational Church	Place of Worship	584793.9	4092970.3
High Street Community Church	Place of Worship	584893.9	4092970.3
Messiah Lutheran Church	Place of Worship	585093.9	4092870.3
UC Santa Cruz Early Education Services	Daycare	582893.9	4094370.3
Student Health Services	Medical Clinic	583893.9	4095270.3

Notes: UC Santa Cruz = University of California – Santa Cruz; K-12 = kindergarten through 12th grade

1. Based on Universal Transverse Mercator coordinates.

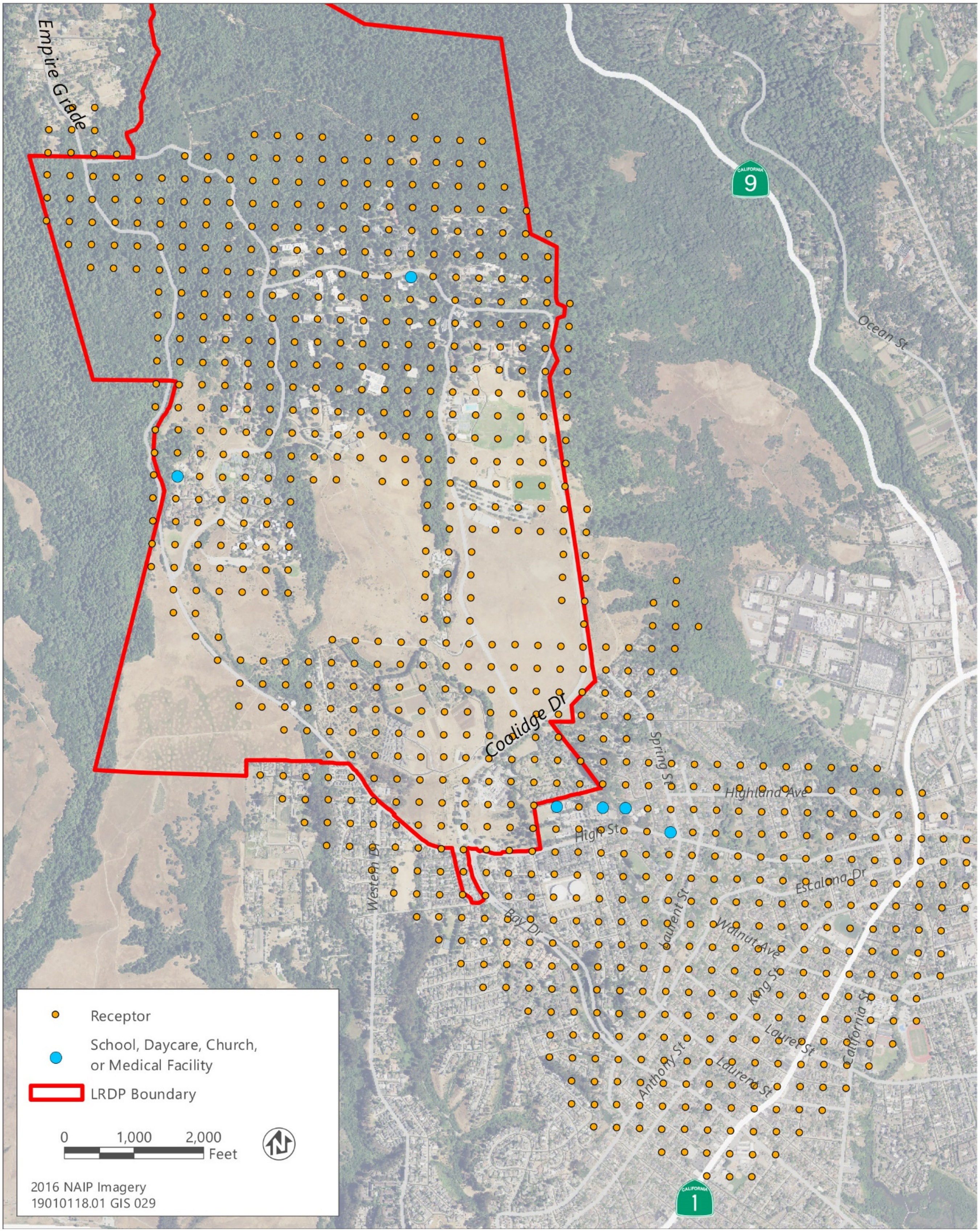
Source: Data provided by Ascent Environmental, Inc., in 2020

The receptor grid and identified discrete receptors used for the construction and operational HRA are shown in Figure 2.



Source: Figure created by Ascent Environmental in 2020 using WRPLOT View Version 9.9.0
Data provided by the Monterey Bay Air Resources District in 2020

Figure 1 Wind Rose for Watsonville Airport Station (2014-2018)



Note: The receptor grid generally excludes areas where no receptors would be located under the LRDP (e.g., meadows, wooded areas)
Source: Adapted by Ascent in 2020

Figure 2 Receptor Grid and Sensitive Receptors

2.4 CANCER AND NON-CANCER RISK CALCULATION

Cancer and non-cancer risks were modeled in HARP2 using relative GLC outputs from AERMOD and calculated emission rates from each source. HARP2 was used to calculate absolute GLCs from each source at each receptor and determine the cancer and non-cancer risks based on the pollutant. Receptor exposure rates and parameters varied depending on the scenario being analyzed. For example, operational scenarios assumed a longer exposure duration in comparison with the construction scenario that assumed the exposure duration would last as long as the construction activity would occur (i.e., 18 years).

CARB developed HARP2 as a tool to implement risk assessments and incorporates requirements from the OEHHA Air Toxics Hot Spot Program Risk Assessment Guidelines: Guidance Manual for Preparation of Health Risk Assessments (OEHHA 2015). HARP2 uses the most current OEHHA potency factors for cancer and reference exposure levels for acute and chronic non-cancer risks.

The HRA follows the OEHHA Tier 1 level of evaluation to calculate the health risk impacts at all receptors, including the residential and childcare facilities. Risk modeling was performed in HARP2 to estimate cancer and non-cancer health risks for residential and worker receptors types (sensitive receptors are analyzed as residential receptors types). The assessment of cancer risk and chronic non-cancer health indices use the long-term period (annual) average emissions, while the assessment of acute non-cancer health effects use the maximum short-term 1-hour emissions.

Based on OEHHA guidance, cancer risk is calculated by multiplying the daily inhalation or oral dose (i.e., to characterize non-inhalation risk) by a cancer potency factor, the age sensitivity factor, the frequency of time spent at home (for residents), and the exposure duration divided by averaging time, to yield the excess cancer risk. Then, excess cancer risk is calculated separately for each age grouping and summed to yield cancer risk at the receptor location. The residential and worker daily breathing rates (DBR) were based on the OEHHA Derived Method. These assumptions were used to calculate the cancer risk in HARP2 based on the mandatory minimum pathways included in the model (i.e., inhalation, soil, dermal, and mother's milk) for residential cancer risks and worker pathways (i.e., inhalation, soil, and dermal) for worker cancer risks.

For receptors, residential cancer risks were calculated based on the HARP default residential exposure period of 30 years starting from the 3rd trimester. Although most undergraduate residents on campus may only stay for approximately four years, this exposure period would also capture habitation characteristics of on-campus faculty housing and off-campus residential receptors. These conservative parameters were also used to model risks at receptors such as schools, churches, and daycare centers. For worker receptors, cancer risks were based on the HARP default exposure duration of 25 years.

Non-cancer risks are measured in terms of health hazard indices (HHI). Chronic and acute HHIs are the sum of the individual substance chronic and acute hazard indices for all TACs affecting the same target organ system, respectively. Individual substance indices are calculated as the ratio of the calculated ground-level concentration to the reference exposure levels (REL), which are regularly published by OEHHA (OEHHA 2015:6-7). If the reported concentration of a given chemical is less than its REL, then the hazard index would be less than 1.0. Acute risks were calculated from a 1-hour exposure using HARP2. Chronic risks were calculated for both long term exposure (30 years for resident and 25 years for worker receptors) in HARP2. Note that 8-hour chronic risks were not analyzed because all chronic risks HHIs were found to be less than significant and chronic risks are lower under an 8-hour exposure duration than a long-term duration (See Section 3).

The point of maximum impact (PMI), the maximally exposed individual resident (MEIR), and the maximally exposed individual worker (MEIW) were calculated for cancer risk and non-cancer health indices. The PMI is a location within the modeling grid where the model calculates the highest (worst-case) health risk. The PMI may or may not be in a habitable location.

2.5 HEALTH RISK CEQA THRESHOLDS OF SIGNIFICANCE

According to MBARD, a project's impact on health risks would be considered significant under CEQA if the project-related increase in risks would exceed the following thresholds shown in Table 2. Results of this HRA are compared to the MBARD-adopted thresholds of significance.

Table 2 Significant Health Risk Levels

	Significant Risk Threshold
Maximum Incremental Cancer Risk[1]	10.0 in a million
Total Chronic Non-Cancer Health Hazard Index[2]	1.0
Total Acute Non-Cancer Health Hazard Index[3]	1.0

Notes:

1. Maximum Incremental Cancer Risk is the maximum lifetime excess cancer risk estimate (per million) at residential or worker receptor (whichever is greater). The maximum estimated risk generally is possible at only one location. All other locations show lower risks. Actual cancer risk would likely be less.

2. Total Chronic Health Hazard Index (THI) is the sum of the ratios of the average annual exposure level of each compound to the compound's Reference Exposure Level (REL). Actual chronic THI would likely be less.

3. Total Acute Health Hazard Index (THI) is the sum of the ratios of the maximum one-hour exposure level of each compound to the compound's REL. Actual acute THI would likely be less.

Source: MBARD 2008

2.6 CONSTRUCTION HEALTH RISK ASSESSMENT METHODS

This section provides additional details specific to the construction HRA, including air dispersion model setup, emission rate calculations, and risk calculations.

The construction HRA focuses primarily on exposure to sensitive receptors from emissions of diesel PM. Risks from diesel PM far outweigh those associated with other pollutants generated during construction activities and; therefore, is the TAC of primary concern. diesel PM from construction activities results from the combustion of diesel fuel in on-site off-road construction equipment and from hauling and vendor trucks traveling between off-site material sources and the project area. diesel PM emissions were based on estimated construction mass emissions and risks associated with the diesel PM emissions were based on air dispersion modeling associated with the areas in which construction activity would occur. Methods for these procedures are described in further detail herein.

2.6.1 Source Inventory and Air Dispersion Modeling Parameters

Diesel PM generated from diesel-powered heavy-duty construction equipment and on-road diesel trucks is the main source of TACs from construction. Annual PM_{10} emissions, used by OEHHA as the basis for diesel PM risk estimates, were estimated based on results from the California Emissions Estimator Model (CalEEMod) Version 2016.3.2 computer program and the Road Construction Emissions Model (RCEM) (See Appendix C1 of the DEIR for the air quality modeling outputs). Construction emissions results from both models were based on project-specific information (e.g., average annual building square footage) where available, reasonable assumptions based on typical activities, and model default values that are based on the project's location, land use types, and construction duration. Modeled construction activities include demolition of existing structures, site preparation/grading activities, and building construction associated with the potential new facilities to be developed under the LRDP.

Use of on-site heavy-duty diesel equipment was modeled in AERMOD using adjacent volume sources. Due to the large size of the modeling area and to facilitate modeling run time, volume sources with 100-foot sides were drawn within designated development areas where construction could occur (See Figure 2-4 of Section 2.0 *Project*

Description in the DEIR). These volume sources and development areas are shown in Figure 3. Plume heights were set at 12 feet (3 meters) to represent exhaust pipes of construction equipment and emission rates were entered as 1 g/s for each set of volume sources. AERMOD automatically calculated the plume height based on the release height and volume side length.

To model emissions from truck hauling activity, three sets of volume line sources were drawn. The first set was drawn along major roadways within the main campus boundary and is identical to the set used in UC Santa Cruz's 2005 LRDP Health Risk Assessment (2005 LRDP HRA) (UC Santa Cruz 2005). The second and third set were drawn along High Street and Bay Drive, respectively, between the campus's southern boundary and the on-ramp to Hwy 1. To facilitate modeling run times, volume source lengths of 43 m were assumed for each volume source along the modeled haul routes. This allowed fewer sources to be modeled while still covering the area in which haul truck travel would occur. AERMOD automatically calculated the plume height based on the release height and volume side length. Both on-site equipment emissions and off-site truck hauling emissions sources are shown in Figure 3.

2.6.2 Emission Rates

Emissions rates for construction activity were based on on-site equipment operations and off-site hauling activity near the plan area. Total construction PM_{10} exhaust emissions, the proxy for diesel PM, for each year of the LRDP buildout period are shown in Table 3.3-6 in Section 3.3 *Air Quality* of the DEIR. Hourly emissions were based on a 9-hour period during which construction is anticipated to occur (8:00 AM to 5:00 PM) and 5-day work weeks, consistent with the operation assumptions in CalEEMod and RCEM. This is shorter than the 14-hour allowed construction work period allowed under Mitigation Measure 3.12-1 in Section 3.12, *Noise,* of the DEIR. As such, the 9-hour workday assumption results in a more conservative maximum hourly emission rate estimate as total emissions are divided across the estimated work hours.

ON-SITE HEAVY-DUTY CONSTRUCTION EQUIPMENT

Based on construction emissions modeling, on-site diesel construction equipment (under the unmitigated scenario) would emit an average of 9.6 pounds (lb) per day, or 1,187 lb per year, of PM_{10} from diesel exhaust during the 18-year buildout period. Annual emissions are based on the annual results from modeling and construction scheduling inputs. Based on a 9-hour workday, on-site equipment would emit an estimated maximum of 1.1 lb of PM_{10} per hour. These emissions are assumed to represent average annual construction activity across all LRDP development areas.

OFF-SITE HAULING AND VENDOR DIESEL TRUCK TRIPS

In addition to the use of on-site diesel construction equipment, diesel trucks used for material hauling and vendor deliveries were also evaluated in the construction HRA. Similar to the methods described above for on-site equipment, CalEEMod and RCEM modeling also included the anticipated number of truck trips and associated diesel PM emissions.

Access to campus construction sites would occur throughout major roadways on campus and along High Street and Bay Drive, which connect the campus to Hwy 1. Thus, for purposes of calculating health risks associated with receptors located near these routes, the estimated total mass diesel PM emissions associated with truck trips were adjusted based on the length of the access roads modeled in AERMOD, as compared to the assumed trip lengths modeled in CalEEMod and RCEM. Specifically, 74 percent of total hauling and vendor diesel PM emissions modeled in CalEEMod and RCEM were used in the risk calculations. Annual emissions were converted to lb/hour for input into HARP2 to estimate cancer risk based on a 9-hour workday and 5-day workweek. The adjusted emissions rate for off-site hauling and vendor trips was estimated at 7.8 lb of PM_{10} per year. Table 3 shows the adjustments made to estimate the hauling/vendor trip diesel PM emissions for risk calculations.

Table 3 Diesel PM Emissions Adjustments based on Trip Lengths

Average CalEEMod and RCEM Default Trip Lengths (mi)[1]	19
Modeled Haul/Vendor Combined Route Lengths in AERMOD (mi)	13
Percent Difference	74%
Annual Haul and Vendor Truck PM_{10} Emissions from CalEEMod and RCEM (lb/year)	10.5
Adjusted Annual Haul and Vendor Truck PM_{10} Emissions for health risk modeling (lb/year)	7.8

Notes: lb=pounds, CalEEMod = California Emissions Estimator Model; RCEM = Roadway Construction Emissions Model; AERMOD =

[1.] Weighted by modeled truck vehicle miles travelled between haul and vendor truck trips

Source: Data adapted by Ascent Environmental, Inc., in 2020

2.6.3 Cancer and Non-Cancer Risk Assumptions

Diesel PM does not have an acute reference exposure level; therefore, cancer and chronic risk were the only scenarios modeled. Table 4 summarizes the parameters and assumptions used for construction-related risks, accounting for the 18-year buildout period of the LRDP.

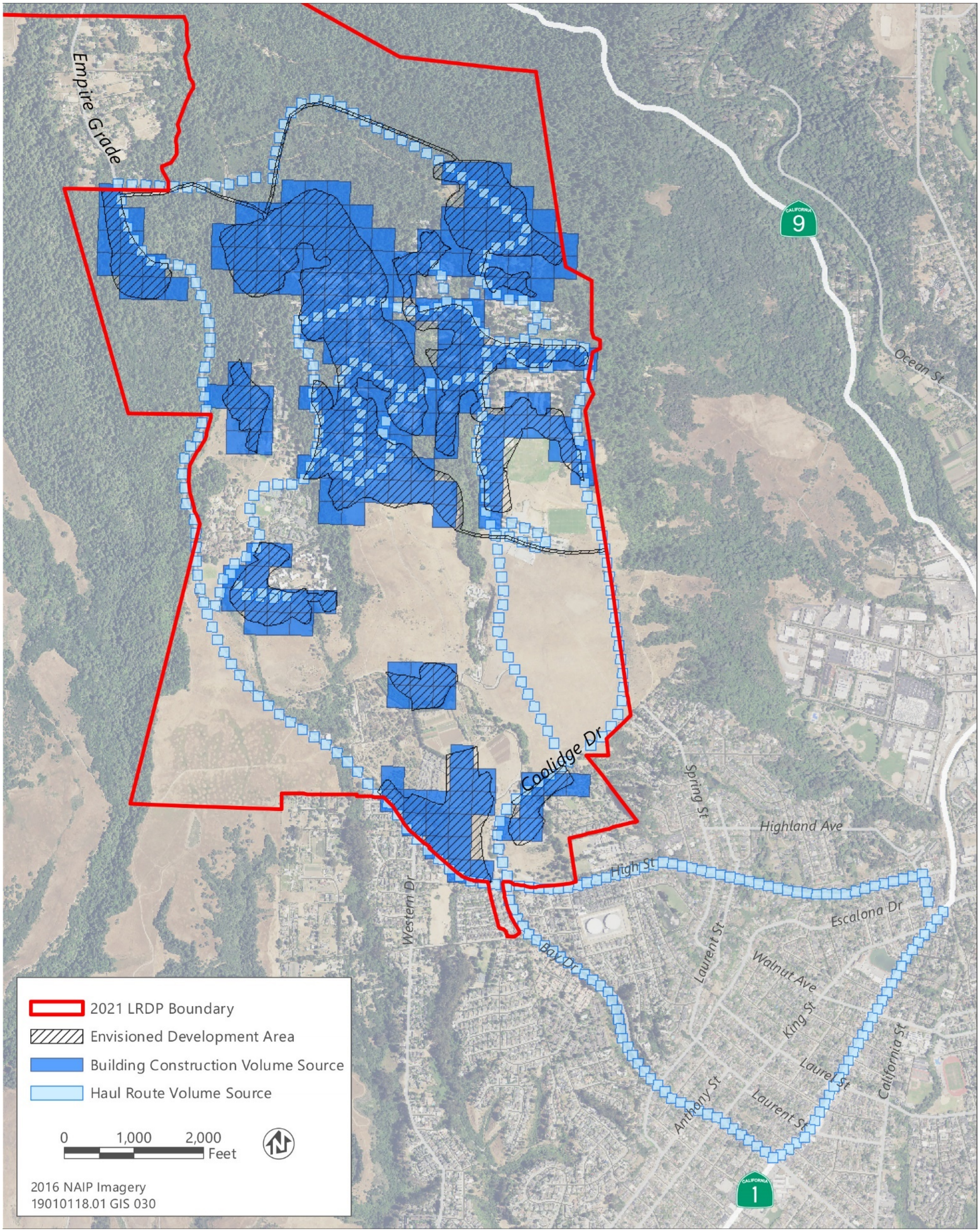
Table 4 Risk Parameters for Cancer and Non-Cancer Risk for Construction[1]

Risk Parameters	Residential and Sensitive Receptors		Worker Receptors	
Analysis Type	Cancer Risk	Chronic Risk (Non-cancer)	Cancer Risk	Chronic Risk (Non-cancer)
Receptor Type	Residential	Residential	Worker	Worker
Exposure Duration	18 years	N/A	18 years	N/A
Starting Age	3rd Trimester	N/A	16	N/A
Intake Rate Percentile	OEHHA Derived Method	OEHHA Derived Method	OEHHA Derived Method	OEHHA Derived Method
Risk Pathways Evaluated	Mandatory Minimum Pathways	Mandatory Minimum Pathways	Worker Pathways	Worker Pathways
Deposition Rate	0.05 m/s	0.05 m/s	0.05 m/s	0.05 m/s
8-Hour Breathing Rates	Off	Off	Yes, Moderate	Yes, Moderate
FAH	Off	Off	Off	Off
Climate	Warm	Warm	Warm	Warm

Notes: N/A = not applicable; OEHHA = Office of Environmental Health Hazard Assessment; RMP = Risk Management Policy; m/s = meters per second; FAH = fraction of time at home; Note: no acute parameters are shown because Diesel PM does not have acute risk factors.

[1.] Analysis was prepared consistent with OEHHA Guidance (OEHHA 2015).

Source: Prepared by Ascent Environmental, Inc., in 2020



Source: AERMOD Version 9.9.0 using data provided by Ascent in 2020

Figure 3 Modeled Construction Emission Sources (On-Site Construction Activity and Off-Site Haul Routes)

2.7 OPERATIONAL HEALTH RISK ASSESSMENT METHODS

This HRA evaluates health risks associated with new and modified/expanded existing sources that would occur as part of LRDP buildout. The LRDP does not identify specific sources that would be operated under the plan. As such, potential new and modified existing sources were generated, located, modeled based on the existing types of TAC sources; the anticipated growth in energy use, building area, and vehicle miles travelled under the LRDP; and the location of LRDP envisioned development areas. Modeled sources include emissions from new boilers, generators, and laboratory buildings with fume hoods and emissions from anticipated increased usage of the campus's existing natural gas turbines, gasoline storage tank, and roadways. The following discussion explains the scaling factors and air dispersion modeling parameters used to model the new and modified existing sources. The results of the air dispersion modeling were used to calculate health risks due to the LRDP buildout. Methods specific to operational risk sources are described below.

2.7.1 Source Inventory and Air Dispersion Modeling Parameters

The LRDP would add new TAC sources and increase emissions at existing TAC sources as part of the planned envisioned development of new academic, support, and residential facilities. Modeled operational sources consist of new natural gas boilers, new natural gas emergency and standby generators, new laboratory buildings with fume hoods, increased emissions at the existing natural gas cogeneration turbines, increased emissions from the existing gasoline storage tank, and increased mobile emissions on existing nearby roadways. Except for four proposed standby generators, the exact number, size, and placement of new TAC sources that would operate under the LRDP are not currently known at this time. For modeling purposes, the number and placement of new sources, other than the standby generators, were based on the number and placement of similar existing sources and the anticipated growth in energy and building square footage.

Table 5 summarizes the approach used to determine the number of new TAC sources and whether existing sources would have increased emissions. Table 6 shows the energy growth anticipated under the LRDP, based on results from Section 3.6, Energy, of the DEIR and existing energy use reports. The rationale behind Tables 5 along with an explanation of the placement of new sources and assumed modeling parameters are discussed by the source type below. Emission rate assumptions are discussed in Section 2.7.1. Based on these scaling methods and anticipated locations, the modeled sources are mapped in Figure 4.

With respect to the modeling parameters needed for air dispersion modeling in AERMOD, data from existing sources were used to the extent feasible. Boilers, generators, and turbines were modeled as point sources; laboratory buildings with fume hoods and the existing gasoline storage tank as area sources; and mobile sources as volume sources. For point sources, the stack parameters required include stack height, stack diameter, exit temperature, and exit velocity or flow rate. These values were taken from model specification documentation, where available; and reasonable assumptions were made for the other missing parameters. Data from the 2005 LRDP HRA were used when no reasonable assumptions could be made and where existing data was unavailable. For area sources, areas were modeled based on building footprints from preliminary building drawings and from aerial imagery of the existing gasoline storage tank (UC Santa Cruz 2020a). The assumed modeling parameters are summarized in Tables 7 and 8 for point and area sources, respectively. The same modeling parameters used for construction diesel truck trips were also used for operational mobile sources, which were modeled as volume sources.

Table 5 Develop New and Modified Existing Source Development

Source Type	Equipment Number Factor	Percent growth from Existing Conditions	Existing Number of Sources [c]	Estimated Number of New Sources under LRDP
Boilers	Growth in Natural Use	18% [a]	17	3
Turbine	Growth in Total Energy Use	30% [a]	1	No new sources. Assume existing turbines will generate 30% more emissions.
Emergency Generators	Growth in Electricity Use	67% [a]	41	27[d]
Standby Generators	N/A	N/A	N/A	4
Laboratory Building with Fume Hoods	Growth in Instruction and Research Building Area	31% [b]	11	3
Gasoline Storage Tank	Growth in Total Building Area	50% [b]	1	No new sources. Assume existing source will generate 50% more emissions
Mobile Sources	N/A	N/A	See Figure 4	No new roadways. Increased mobile emissions would occur from existing roadways.

Notes: VMT = vehicle miles travelled, N/A = not applicable

[a] Based on energy growth estimated shown in Table 6.

[b] Based on growth in building space proposed under the LRDP in Table 2-2 of Section 2.0, *Project Description*, of the DEIR.

[c] For boilers, turbines, and generators, this number refers to permitted sources recognized by MBARD.

[d] Up to approximately 27 new permitted generators could be installed, assuming a direct scaling of the total number of existing generators by the anticipated growth in electricity demand.

Source: Welch, pers. comm., 2020, Carpenter, pers. comm., 2020b

Table 6 UC Santa Cruz Existing and New Energy Use under the LRDP

Source Type	Electricity Use (MWh)[a]	Natural Gas Use (therms)	Total Energy Use (MMBTU)
Existing[b]	48,480	4,954,650	660,884
Net new under LRDP[c]	32,283	873,967	197,529
Existing + LRDP	80,763	5,828,617	858,413
Percent Growth from Existing	67%	18%	30%

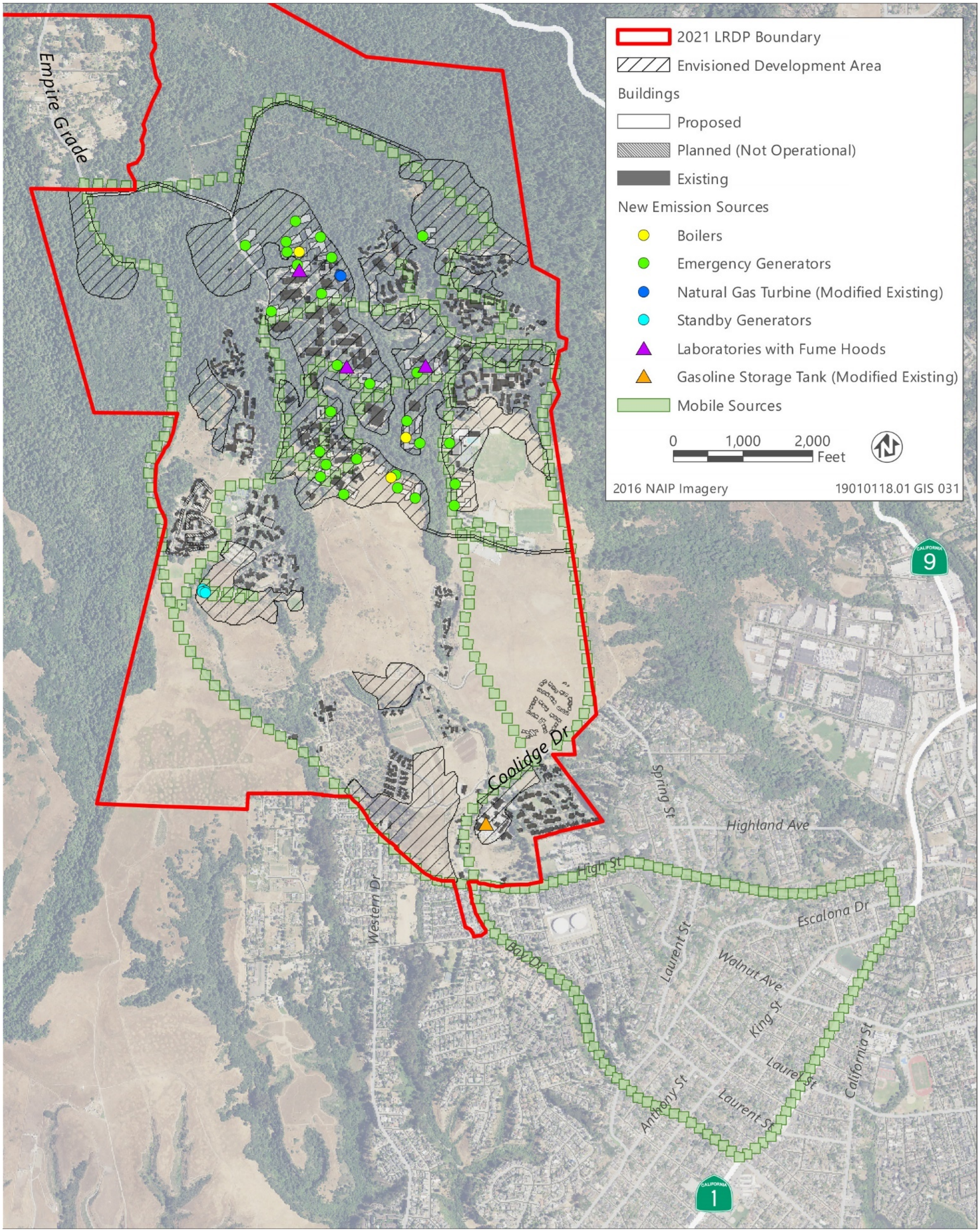
Notes: VMT = vehicle miles travelled, MWh = megawatt-hours, MMBTU = million British Thermal Units

[a] Includes use from both on-site solar- and grid-based electricity.

[b] Based on 2018 energy reports from UC Santa Cruz.

[c] Based on results from Table 3.6-2 in Section 3.6, *Energy*, of the DEIR

Source: UC Santa Cruz 2020b



Note: Triangles represent area sources. Dots represent point sources. Mobile sources are modeled as volume sources
Source: Adapted by Ascent in 2020

Figure 4 Proposed Building Scenario and Emission Sources

Table 7 Air Dispersion Modeling Parameters for Point Sources

Source Type	Release Height (m)	Stack Diameter (m)	Stack Exit Velocity (m/s)	Stack Temperature (K)	UTM X	UTM Y
Boiler 1	7.62 [a]	0.31	9	408	583826.68	4094541.43
Boiler 2	7.62 [a]	0.31	9	408	583399.31	4095519.58
Boiler 3	7.62 [a]	0.31	9	408	583884.39	4094719.01
Natural Gas Turbine 1	7.62 [a]	1.22 [a]	0.46 [a]	650 [a]	583571.87	4095413.56
Natural Gas Turbine 2	7.62 [a]	1.22 [a]	0.46 [a]	650 [a]	583573.81	4095410.46
Emergency Generator 1	1.57	0.08	158.9	866	583924.77	4094448.76
Emergency Generator 2	1.57	0.08	158.9	866	583612.42	4094457.53
Emergency Generator 3	1.57	0.08	158.9	866	583507.29	4094530.56
Emergency Generator 4	1.57	0.08	158.9	866	584099.41	4094514.17
Emergency Generator 5	1.57	0.08	158.9	866	583500.93	4094639.05
Emergency Generator 6	1.57	0.08	158.9	866	583548.18	4094815.99
Emergency Generator 7	1.57	0.08	158.9	866	583713.03	4094941.27
Emergency Generator 8	1.57	0.08	158.9	866	583939.42	4094688.51
Emergency Generator 9	1.57	0.08	158.9	866	583918.54	4094997.32
Emergency Generator 10	1.57	0.08	158.9	866	583274.54	4095245.68
Emergency Generator 11	1.57	0.08	158.9	866	583385.11	4095455.04
Emergency Generator 12	1.57	0.08	158.9	866	583929.55	4095594.51
Emergency Generator 13	1.57	0.08	158.9	866	583480.06	4095576.34
Emergency Generator 14	1.57	0.08	158.9	866	583155.02	4095532.05
Emergency Generator 15	1.57	0.08	158.9	866	583839.79	4094548.41
Emergency Generator 16	1.57	0.08	158.9	866	584071.54	4094692.37
Emergency Generator 17	1.57	0.08	158.9	866	583368.25	4095645.10
Emergency Generator 18	1.57	0.08	158.9	866	583568.75	4095019.85
Emergency Generator 19	1.57	0.08	158.9	866	584099.45	4094419.46
Emergency Generator 20	1.57	0.08	158.9	866	583532.45	4095490.15
Emergency Generator 21	1.57	0.08	158.9	866	583665.05	4094611.44
Emergency Generator 22	1.57	0.08	158.9	866	583533.15	4094585.60
Emergency Generator 23	1.57	0.08	158.9	866	583491.61	4095329.67
Emergency Generator 24	1.57	0.08	158.9	866	583881.33	4094785.17
Emergency Generator 25	1.57	0.08	158.9	866	583338.44	4095509.28
Emergency Generator 26	1.57	0.08	158.9	866	583331.52	4095553.27
Emergency Generator 27	1.57	0.08	158.9	866	583849.75	4094488.65
Standby Generator 1	4	0.25	0.247	639	583006.63	4094027.05
Standby Generator 2	4	0.25	0.247	639	583019.33	4094018.86
Standby Generator 3	4	0.25	0.247	639	583007.97	4094014.69
Standby Generator 4	4	0.25	0.247	639	583020.50	4094008.34

Notes: VMT = vehicle miles travelled. UTM = Universal Transverse Mercator. Parameters are shown in metric units per default units used in AERMOD.

[a] Based on 2005 LRDP HRA parameters

Source: UC Santa Cruz 2005, Data compiled by Ascent Environmental in 2020

Table 8 Air Dispersion Modeling Parameters for Area Sources

Source Type	Release Height (m)	Area Source Polygon Vectors (UTM X,Y) (m)				
		1	2	3	4	5
Laboratory 1	7.62	583349.96, 4095418.81	583440.87, 4095429.40	583433.18, 4095477.15	583389.20, 4095471.92	583390.44, 4095452.81
Laboratory 2	7.62	583624.81, 4094971.92	583638.91, 4094993.07	583609.47, 4095010.49	583609.88, 4095030.81	583579.61, 4095030.40
Laboratory 3	7.62	583907.57, 4095001.02	583958.56, 4095007.28	583955.90, 4095026.83	NA	NA
Gasoline Storage Tank	1	584264.03, 4093020.69	584270.60, 4093015.53	584278.58, 4093026.48	NA	NA

Notes: m = meter, UTM = Universal Transverse Mercator, NA = not applicable

Source: Data compiled by Ascent Environmental in 2020

BOILERS

Natural gas boilers provide space and water heating to buildings. To obtain the number of new natural gas boilers, the existing number of natural gas boilers was scaled up by the percent growth anticipated in natural gas demand on campus. As shown in Table 5, the anticipated growth in overall natural gas demand is assumed to result in the addition of three new boilers. The location of the new boilers was scattered across new envisioned development areas in areas similar to where existing boilers are located (e.g., dormitories, research facilities) and generally centralized around clusters of buildings, based on preliminary new building drawings. The modeled stack parameters associated with the boilers were based a combination of available data for existing boilers and parameters typical for boilers of similar size and application as existing boilers.

With respect to modeling parameters for the boilers, vent diameters of existing boilers were determined to be based on average vent diameters of existing permitted boilers, weighted by annual energy use. Stack heights were assumed to be 25 feet, based on 2005 LRDP boiler assumptions. Exhaust flow rates were based on typical values for one step and two step boilers. Exhaust temperatures are proportional to boiler efficiency and were taken from a boiler flue gas/temperature table assuming a typical 85 percent efficiency rating (Cleaver Brooks 2010). Boilers were assumed to run 24 hours per day. The assumed stack parameters for the boilers are shown in Table 7.

EMERGENCY GENERATORS

Emergency generators provide electricity to buildings in emergency situations. At UC Santa Cruz, all emergency generators are powered by natural gas. To obtain the number of new emergency natural gas generators, the existing number of generators was scaled up by the percent growth anticipated in electricity demand on campus. As shown in Table 5, the anticipated growth in overall electricity demand is assumed to result in the addition of 27 new generators. The location of the new generators was scattered across new development areas and generally centralized around clusters of buildings, based on preliminary new building drawings, and were determined exclusive of the type of building it would serve.

The modeled stack parameters were based on the GENERAC 150 kW natural gas emergency generators (GENERAC 2017). This size was selected based on the average size of existing generators, weighted by annual energy use. The model was selected due to the stack parameter data available for this model. This model is also one of the more recent models installed by the university. Stack heights are independent of the buildings served by the generators because the generators are generally standalone units. Generators were assumed to operate one hour four times per year to account for maintenance and testing. All stack parameters for the new generators are shown in Table 7.

STANDBY GENERATORS

UC Santa Cruz proposes to install and operate four 5-MW natural gas standby generators. Standby generators differ from emergency generators in that they support more building systems and functions during a power outage. The new standby generators would be located on a half-acre lot southwest of the West Remote parking lot. Based on the campus's historical standby generator run hours between 2013 and 2019, standby generators have run an average of 18 hours per year per generator (Clothier, pers. comm., 2020). Conservatively rounding up this average annual run time, the new standby generators are assumed to operate 20 hours per year.

The modeled stack parameters were based on Solar Turbines Mercury 50, a 4.6 MW Solar Turbines Mercury 50 recuperated gas turbine generator set, which is used as a proxy for the proposed standby generators based on the similar size and application. Required stack specifications, such as exhaust temperature, were also more readily available for this generator model.

This generator was selected as a proxy the proposed standby generators were modeled as an area source with a release height equivalent to that assumed for the emergency generators (1.57 meters). The polygon associated with the area was based on the half-acre lot drawing provided by UC Santa Cruz (Carpenter, pers. comm., 2020c).

NATURAL GAS COGENERATION TURBINES

Existing natural gas turbines provide both heat and electricity through cogeneration. It was assumed that the two existing turbines at the Central Plant would increase emissions by 25 percent in line with the expected percent increase in energy demand. The stack parameters for the existing turbines was based on the assumptions used for the same facilities in the 2005 LRDP HRA and are shown in Table 7. The turbines were assumed to run 24 hours per day.

LABORATORIES WITH FUME HOODS

Laboratories, especially those with fume hoods, store and actively use a variety of chemicals that can become airborne through chemical evaporative losses during storage and normal chemical handling. Many of these chemicals are considered TACs by OEHHA. UC Santa Cruz staff provided an inventory of all chemicals currently stored for each existing facility (as of 2020) and also provided a list of buildings with fume hoods. For modeling purposes, only buildings with fume hoods were considered in this analysis, due to the higher likelihood of TAC emissions associated with the need for fume hoods.

Currently, 11 laboratory buildings on campus operate fume hoods; however, the exact number and location of new laboratory buildings to be built under the LRDP is not known at this time. As shown in Table 2-2 of Section 2.0, *Project Description*, of the DEIR, Instruction and Research building area would increase by 31 percent under the LRDP. Assuming the average existing laboratory building size remains constant and that laboratory emissions are proportional to laboratory building size, it is assumed that three new laboratory buildings with fume hoods would be operated under the LRDP. For modeling purposes, the new buildings were scattered across the LRDP envisioned development areas based on preliminary building drawings.

Area sources were used to represent emissions from all possible stacks and vents that would emit the evaporative losses from the chemicals used in these facilities. It was assumed that each area source would be emitted at the height of the building it represents. For the new buildings, building height is not yet known, so an approximate release height of 30 ft was used to represent two to three-story buildings. The assumed areas in which these emissions would occur were based on building footprints available from preliminary building drawings. These assumptions are summarized in Table 8.

GASOLINE STORAGE TANK

The campus stores and dispenses gasoline at its Fleet Services' Central Garage at the south end of the campus. Although MBARD requires the facility to have vapor recovery systems in place, fugitive emissions from the storage of gasoline is inevitable during dispensing and storage. Because the use of gasoline is related to campus fleet activity and assuming campus fleet activity scales in proportion to the total number of facilities on campus, the growth in gasoline storage tank use under the LRDP is assumed to be proportional to the anticipated increase total building area. As mentioned previously, the campus's total building area is expected to grow by 50 percent. It is likely that any increases in gasoline storage and dispensing would continue to occur at the Central Garage due to the consolidated fleet services there. It is possible that a new tank could be constructed in the vicinity of the existing tank or the existing tank could be refueled more frequently. As such, and because of the various locations on-site from which TAC vapor gases could be emanated, the emissions from this source were modeled as an area source. Area sources represent emissions all possible stacks and vents that would emit the evaporative losses from the gasoline vapors at this facility. It was assumed that this area source would be emitted at a height of one meter. These assumptions are summarized in Table 8.

MOBILE SOURCES

New vehicle trips would result from the implementation of the LRDP compared to existing conditions. Diesel PM emissions from diesel vehicle trips, such as those used for delivery trucks, would be the primary source of TACs from mobile sources during operations. The same methods, location of sources, and modeling input parameters used for construction hauling and vendor trips were used to model diesel PM from mobile sources during operations. (See Section 2.6.1).

2.7.2 Emission Rates

Emissions rates for operations were based on a combination of data from MBARD's AB 2588 assessment for UC Santa Cruz, the campus's chemical inventory for laboratories, assumptions used in the 2005 LRDP HRA, and results from the DEIR air quality analysis. MBARD's AB 2588 assessment included a health risk Prioritization Score Assessment spreadsheet for the campus that lists the TACs, emission factors (e.g., pounds of 1,3-Butadiene per gallon of fuel), and annual fuel consumption for existing boilers, emergency generators, gasoline storage tank, and natural gas turbines as of 2017 (Kim, pers. comm., 2020b). It was assumed that the equipment usage rates would remain unchanged in 2018, the baseline year evaluated in the DEIR. Emission rates from laboratories were based on the campus's chemical inventory and annual evaporative loss factors used in other similar university HRAs (UC Davis, UC San Francisco [UCSF], UC San Diego).

BOILERS

The annual and maximum hourly emission rates (lb/year and lb/hr) from these sources were calculated based on MBARD's Prioritization Score Assessment. Maximum hourly emission rates for were calculated from annual emission rates by dividing total annual emissions by 24 hours per day and 365 days per year. Average boiler TAC emission factors across all existing boilers were used to represent the emission factors associated with each of the three new boilers modeled in AERMOD. The final calculated annual and hourly emission rates assumed for each new boiler are shown in Table 9.

Table 9 Annual and Maximum Hourly Emission Rates for Individual Proposed Natural Gas Boilers

Pollutant	Annual TAC Emission Rates (lb/year)	Max Hourly TAC Emissions Rates (lb/hr)
Acetaldehyde	1.27E-06	1.11E-02
Benzene	2.36E-06	2.06E-02

Table 9 Annual and Maximum Hourly Emission Rates for Individual Proposed Natural Gas Boilers

Pollutant	Annual TAC Emission Rates (lb/year)	Max Hourly TAC Emissions Rates (lb/hr)
Formaldehyde	5.01E-06	4.38E-02
Toluene	1.08E-05	9.44E-02
Xylenes (mixed)	8.01E-06	7.02E-02

Notes: lb = pound, TAC = toxic air contaminants

Source: Data provided by Ascent Environmental, Inc. in 2020 based on modeling using data from MBARD's Prioritization Score Assessment for UC Santa Cruz (Kim, pers. comm., 2020b).

EMERGENCY GENERATORS

The annual and maximum hourly emission rates (lb/year and lb/hr) from these sources were calculated based on MBARD's Prioritization Score Assessment for UC Santa Cruz and scaled up based on the anticipated net energy increase under the LRDP (Kim, pers. comm., 2020b). Maximum hourly emission rates for were calculated from annual emission rates by dividing total annual emissions by four to represent a quarterly maintenance schedule. Average generator TAC emission factors across all existing generators were used to represent the emission factors associated with each of the 27 new emergency generators modeled in AERMOD. The final calculated annual and hourly emission rates assumed for each new generator are shown in Table 10.

Table 10 Annual and Maximum Hourly Emission Rates for Individual Proposed Natural Gas Emergency Generators

Pollutant	Annual TAC Emission Rates (lb/year)	Max Hourly TAC Emissions Rates (lb/hr)
1,3-Butadiene	3.45E-05	8.61E-06
Acetaldehyde	1.08E-03	2.70E-04
Benzene	5.68E-05	1.42E-05
Carbon tetrachloride	4.74E-06	1.18E-06
Chloroform	3.68E-06	9.19E-07
Formaldehyde	6.81E-03	1.70E-03
Methanol	3.23E-04	8.06E-05
Methylene chloride {Dichloromethane}	2.58E-06	6.45E-07
Phenol	3.10E-06	7.74E-07
Styrene	3.05E-06	7.61E-07
Toluene	5.26E-05	1.32E-05
Vinyl chloride	1.92E-06	4.81E-07
Xylenes (mixed)	2.37E-05	5.94E-06

Notes: lb = pound, TAC = toxic air contaminants

Source: Data provided by Ascent Environmental, Inc. in 2020 based on modeling using data from MBARD's Prioritization Score Assessment for UC Santa Cruz (Kim, pers. comm., 2020b).

STANDBY GENERATORS

The annual and maximum hourly emission rates for the four proposed standby generators were assumed to have the same emission factors (lb of TAC per million standard cubic feet [MMSCF] of natural gas) as emergency generators. These factors were available in MBARD's Prioritization Score Assessment and are shown below in Table 11 (Kim, pers. comm., 2020b).

Table 11 Emission Factors for Natural Gas Engines

Pollutant	TAC Emission Factors (lb/MMSCF)
1,3-Butadiene	2.67E-01
Acetaldehyde	8.36E+00
Benzene	4.40E-01
Carbon tetrachloride	3.67E-02
Chloroform	2.85E-02
Formaldehyde	5.28E+01
Methanol	2.50E+00
Methylene chloride {Dichloromethane}	2.00E-02
Phenol	2.40E-02
Styrene	2.36E-02
Toluene	4.08E-01
Vinyl chloride	1.49E-02
Xylenes (mixed)	1.84E-01

Notes: lb = pound, TAC = toxic air contaminants, MMSCF = million standard cubic feet

Source: Kim, pers. comm., 2020b.

The annual energy use (in MMSCF) in the standby generators was calculated based on a run time of 20 hours. For modeling purposes, the calculation of the annual energy use based on the heat rate of a 4.6 MW Solar Turbines Mercury 50 recuperated gas turbine generator set, which is used as a proxy for the proposed standby generators based on the similar size and application. This generator set has a heat rate of 8,865 BTU/kWh, which means that 8,865 BTU of natural gas is needed to generate 1 kWh of electricity and a 38 percent efficiency rate (Solar Turbines 2018). (UC Santa Cruz has not yet determined the exact models that would be used as the proposed standby generators.) Based on this heat rate and conservativity assuming the generators are run at full load, running the 5-MW generators for 20 hours per year would generate 400 MWh and require 3,546 million BTU, or 3.48 MMSCF of natural gas. Table 12 shows the resulting emission rates for the area source modeled for the four standby generators. Maximum hourly emission rates assume all four generators are run simultaneously for one-hour.

Table 12 Annual and Maximum Hourly Emission Rates for Individual Proposed Natural Gas Standby Generators

Pollutant	Annual TAC Emission Rates (lb/year)	Max Hourly TAC Emissions Rates (lb/hr)
1,3-Butadiene	2.32E-01	1.16E-02
Acetaldehyde	7.27E+00	3.63E-01
Benzene	3.82E-01	1.91E-02
Carbon tetrachloride	3.19E-02	1.59E-03
Chloroform	2.48E-02	1.24E-03

Table 12 Annual and Maximum Hourly Emission Rates for Individual Proposed Natural Gas Standby Generators

Pollutant	Annual TAC Emission Rates (lb/year)	Max Hourly TAC Emissions Rates (lb/hr)
Formaldehyde	4.59E+01	2.29E+00
Methanol	2.17E+00	1.09E-01
Methylene chloride {Dichloromethane}	1.74E-02	8.69E-04
Phenol	2.09E-02	1.04E-03
Styrene	2.05E-02	1.03E-03
Toluene	3.55E-01	1.77E-02
Vinyl chloride	1.29E-02	6.47E-04
Xylenes (mixed)	1.60E-01	8.00E-03

Notes: lb = pound, TAC = toxic air contaminants

Source: Data provided by Ascent Environmental, Inc. in 2020 based on modeling using data from MBARD's Prioritization Score Assessment for UC Santa Cruz (Kim, pers. comm., 2020b).

NATURAL GAS COGENERATION TURBINES

The annual and maximum hourly emission rates (lb/year and lb/hr) from these sources were calculated based on MBARD's Prioritization Score Assessment, which provided emissions estimates for one turbine permit. This permit covers two turbine equipment pieces that operate at the campus's Central Plant. Thus, emissions from the assessment were distributed to each turbine stack then multiplied by 25 percent to obtain the emissions associated with LRDP operations. Maximum hourly emission rates for were calculated from annual emission rates by dividing total annual emissions by 24 hours per day and 365 days per year. The net new annual and hourly emission rates associated with the increased emissions from existing turbines are shown in Table 13.

Table 13 Net New Annual and Maximum Hourly Emission Rates for Individual Existing Natural Gas Turbine

Pollutant	Annual TAC Emission Rates (lb/year)	Max Hourly TAC Emissions Rates (lb/hr)
1,3-Butadiene	1.84E-02	8.35E-06
Acetaldehyde	1.71E+00	7.77E-04
Benzene	3.90E-02	1.77E-05
Formaldehyde	8.56E-01	3.88E-04
Propylene oxide	1.24E+00	5.63E-04
Toluene	5.56E+00	2.52E-03
Xylenes (mixed)	2.74E+00	1.24E-03

Notes: lb = pound, TAC = toxic air contaminants

Source: Data provided by Ascent Environmental, Inc. in 2020 based on modeling using data from MBARD's Prioritization Score Assessment for UC Santa Cruz (Kim, pers. comm., 2020b).

LABORATORIES WITH FUME HOODS

For the existing laboratories, a total of 63 individual TACs were identified from UC Santa Cruz's chemical inventory. These TACs were assumed to represent the emissions profile of all proposed new laboratory buildings. It was assumed that the rate of chemical usage per square foot would stay the same as existing buildings. To apply this rate to the three identified potential new laboratory buildings, an average emissions of laboratory chemicals per building footprint area was developed. This was done because, while the number of floors and total building square footage is not yet known for the new buildings, preliminary building drawings have building footprint areas. This approach reasonably assumes that the new buildings have the same average number of floors as the existing laboratory buildings. The existing and new building footprints from which these building area calculations are made are shown in Table 14, and the polygon vectors corresponding to the building footprints for the new laboratories are shown in Table 8.

Table 14 Existing and Proposed Laboratory Building Footprint Area (sf)

Building	Building Footprint (sf)
Existing Laboratories	
Biomedical Building	20,912
Earth and Marine Sciences	42,301
Jack Baskin Engineering	39,729
Natural Sciences II	19,455
Physical Sciences Building	32,457
Sinsheimer	21,396
Social Science 1	12,573
Thimann	23,149
Thimann II Lecture Hall	5,652
TOTAL	217,624
New Laboratories	
Laboratory 1	37,620
Laboratory 2	19,966
Laboratory 3	10,931

Notes: sf = square foot

Source: Data compiled by Ascent Environmental in 2020

To develop emission rates based on the existing chemical inventory, the recorded quantities of 63 different chemicals identified as TACs by OEHHA were each divided by the total building footprint of the existing laboratory buildings, shown in Table 14, to generate average chemical emissions factors per building square foot. Annual loss factors were then applied to these emission factors, assuming a conservative annual loss factor from a chemical inventory of 5 percent for chemicals of general experimentation, 10 percent for formaldehyde, 20 percent for ethanol and isopropanol, and 100 percent for methyl bromide. These loss factors were taken from the HRA for UC San Diego's 2004 LRDP and UC San Diego's Hillcrest Campus 2019 LRDP, but are also conservative relative to factors used in the HRAs for UC Davis's 2018 LRDP and UCSF's 2014 LRDP (UC San Diego 2004, UC San Diego 2019, UC Davis 2014, UC San Francisco 2014). The resulting annual emission rates were divided by 365 days and 24 hours per day to obtain maximum hourly emission rates. The emission rates per building square foot were then multiplied by the estimated building footprints of the new potential laboratories that would be operated under the LRDP. The applied annual and maximum hourly emission rates per building square foot are shown in Table 15.

Table 15 Proposed Laboratory Chemical Inventory and Emission Rates per Building Square Foot

Chemical	Annual Emission Rate per Building Square Foot (lb/year-sf)	Maximum Hourly Emission Rate per Building Square Foot (lb/hr-sf)
1,1,2,2-Tetrachloroethane	2.01E-06	2.30E-10
1,1,2-Trichloroethane	2.53E-06	2.89E-10
1,2-Dichloroethylene	1.44E-05	1.64E-09
1,2-Epoxybutane	2.10E-08	2.40E-12
1,3-Butadiene	5.07E-08	5.78E-12
1,4-Dioxane	3.57E-06	4.08E-10
Acetaldehyde	2.93E-07	3.35E-11
Acrolein	3.49E-07	3.98E-11
Acrylonitrile	5.33E-07	6.09E-11
Allyl chloride	4.76E-08	5.44E-12
Ammonia	5.08E-05	5.80E-09
Aniline	1.87E-06	2.14E-10
Arsenic compounds (inorganic)	5.95E-07	6.79E-11
Benzene	1.97E-05	2.25E-09
Benzyl chloride	5.58E-07	6.37E-11
Bromine	4.60E-06	5.25E-10
Cadmium	3.29E-06	3.75E-10
Carbon disulfide	9.57E-07	1.09E-10
Carbon monoxide	5.40E-06	6.16E-10
Carbon tetrachloride	2.37E-06	2.71E-10
Chlorobenzene	4.78E-06	5.46E-10
Chloroform	2.05E-04	2.34E-08
Di(2-ethylhexyl) phthalate	7.52E-07	8.59E-11
Diethanolamine	2.37E-07	2.71E-11
Ethyl benzene	6.07E-07	6.93E-11
Ethylene dibromide {EDB}	1.55E-06	1.77E-10
Ethylene glycol	6.53E-05	7.45E-09
Ethylene glycol dimethyl ether	1.62E-06	1.85E-10
Formaldehyde	5.79E-05	6.61E-09
Glutaraldehyde	7.35E-06	8.39E-10
Hexane	7.80E-05	8.91E-09
Hydrazine	1.79E-07	2.05E-11
Hydrochloric acid	4.11E-04	4.70E-08
Hydrogen fluoride	1.91E-05	2.18E-09
Isopropyl alcohol	2.60E-04	2.97E-08
Lead	1.35E-06	1.54E-10

Table 15 Proposed Laboratory Chemical Inventory and Emission Rates per Building Square Foot

Chemical	Annual Emission Rate per Building Square Foot (lb/year-sf)	Maximum Hourly Emission Rate per Building Square Foot (lb/hr-sf)
Manganese	2.94E-06	3.35E-10
m-Cresol	5.24E-07	5.98E-11
Mercuric chloride	5.50E-07	6.28E-11
Mercury	1.24E-06	1.42E-10
Methanol	2.19E-03	2.50E-07
Methyl chloroform {1,1,1-Trichloroethane}	2.67E-06	3.05E-10
Methyl ethyl ketone {2-Butanone}	1.04E-05	1.19E-09
m-Xylene	6.53E-07	7.46E-11
Nickel	9.89E-07	1.13E-10
Nitric acid	1.78E-04	2.03E-08
o-Cresol	1.27E-07	1.45E-11
Oleum	2.53E-07	2.89E-11
o-Xylene	6.69E-07	7.63E-11
p-Cresol	1.27E-08	1.45E-12
Perchloroethylene {Tetrachloroethene}	3.69E-06	4.22E-10
Phenol	4.94E-06	5.63E-10
Phosphoric acid	7.13E-05	8.13E-09
Propylene glycol monomethyl ether	2.33E-08	2.66E-12
Propylene oxide	1.99E-07	2.27E-11
p-Xylene	4.36E-06	4.98E-10
Sodium hydroxide	4.32E-05	4.93E-09
Styrene	1.43E-06	1.63E-10
Sulfuric acid	1.57E-04	1.79E-08
t-Butyl acetate	3.97E-07	4.53E-11
Toluene	1.07E-04	1.22E-08
Triethylamine	9.75E-06	1.11E-09
Xylenes (mixed)	5.99E-05	6.84E-09

Notes: kg/yr = kilograms per year; g /s = grams per second; OEHHA = Office of Environmental Health Hazard Assessment; CARB = California Air Resources Board

Source: Data compiled by Ascent Environmental, Inc., in 2020

GASOLINE STORAGE TANK

The annual and maximum hourly emission rates (lb/year and lb/hr) from these sources were calculated based on annual emission rates for the existing gasoline storage tank in MBARD's Prioritization Score Assessment. MBARD's annual emission rates were multiplied by 50 percent to obtain the rates associated with the net increase in anticipated evaporative emissions from the tank and gasoline dispensing. Maximum hourly emission rates for were calculated from annual emission rates by dividing total annual emissions by 24 hours per day and 365 days per year. The final calculated annual and hourly emission rates assumed for the gasoline storage tank are shown in Table 16.

Table 16 Net New Annual and Maximum Hourly Emission Rates for Existing Gasoline Storage Tank

Pollutant	Annual TAC Emission Rates (lb/year)	Max Hourly TAC Emissions Rates (lb/hr)
Benzene	8.95E-01	2.04E-04
Ethyl Benzene	1.43E+00	3.27E-04
Toluene	7.16E+00	1.63E-03
Xylenes	2.15E+00	4.90E-04

Notes: lb = pound, TAC = toxic air contaminants

Source: Data provided by Ascent Environmental, Inc. in 2020 based on modeling using data from MBARD's Prioritization Score Assessment for UC Santa Cruz (Kim, pers. comm., 2020b).

MOBILE SOURCES

The diesel PM emission rates associated with new vehicle trips under the LRDP were derived from the net new annual PM_{10} exhaust emissions related to mobile sources as part of the modeling done for Section 3.3, *Air Quality,* of the DEIR. Appendix C1 of the DEIR reports that the LRDP would result in 0.064 tons of PM_{10} exhaust per year and a maximum of 0.43 lb of PM_{10} exhaust per day from new mobile sources. These emissions estimates were based on CalEEMod modeling using forecasted vehicle trip data from Fehr and Peers (See Table 6 of Appendix I of the UC Santa Cruz LRDP Draft EIR). Because mobile sources are comprised of both gasoline and diesel vehicles, the percentage of PM_{10} emissions associated with diesel exhaust (7.92%) was applied to the annual and daily emissions to obtain the diesel portion of the PM_{10} estimates. This percentage was calculated by combining the vehicle mix assumed in CalEEMod with the percent distribution of PM_{10} emissions by vehicle type assumed in EMFAC2017 for 2040; this is demonstrated in Table 17.

Table 17 Percent of LRDP Mobile PM_{10} Exhaust Emissions from Diesel Vehicles

EMFAC Vehicle Class	CalEEMod Vehicle Mix [1] (Percent of Total Vehicle Population)	Percent of PM_{10} Exhaust Emissions from Each Vehicle Class that is from Diesel Combustion [2]
Light Duty Autos	60.78%	1.93%
Light Duty Trucks 1	2.29%	0.12%
Light Duty Trucks 2	20.59%	5.17%
Medium Duty Vehicles	10.39%	5.15%
Light Heavy Duty Trucks 1	0.99%	80.91%
Light Heavy Duty Trucks 2	0.38%	95.90%
Medium Heavy Duty Trucks	2.26%	97.87%
Heavy Heavy Duty Trucks	1.46%	99.81%
Other Bus	0.13%	88.06%
Urban Bus	0.13%	50.36%
School Bus	0.08%	95.94%
Medium Heavy Duty Truck	0.05%	97.87%
Average percent of PM_{10} exhaust emissions from all vehicles associated with diesel vehicles, weighted by the project-specific vehicle mix assumed in CalEEMod.		7.92%

Notes: PM_{10} = particulate matter less than 10 micrometers in diameter

[1] See the CalEEMod outputs for LRDP operational emissions in Appendix C1 of the DEIR.

Table 17 Percent of LRDP Mobile PM_{10} Exhaust Emissions from Diesel Vehicles

[2] Based on EMFAC2017 data queried for Santa Clara County and Calendar Year 2040.

Source: Data compiled by Ascent Environmental in 2020

The resulting annual and maximum hourly emissions are shown in Table 18. Maximum hourly emissions were calculated by dividing the adjusted maximum daily emissions by 24 hours per day.

Table 18 Annual and Maximum Hourly Emission Rates for New Mobile Sources

Pollutant	Annual TAC Emission Rates (lb/year)	Max Hourly TAC Emissions Rates (lb/hr)
Diesel PM	10.17	1.43E-03

Notes: lb = pound

Source: Data provided by Ascent Environmental, Inc. in 2020 based on data from UC Santa Cruz's 2005 LRDP HRA. (UC Santa Cruz 2005)

2.7.3 Cancer and Non-Cancer Risk Assumptions

Table 19 summarizes the parameters and assumptions used to estimate health risks by receptor type for operation-related risks. These parameters are used for operation-related risks and for both existing and proposed scenarios.

Table 19 Risk Parameters for Cancer and Non-Cancer Risk for Operation-Related Risks[1]

Risk Parameters	Residential and Sensitive Receptors			Worker Receptors		
Analysis Type	Cancer Risk	Chronic Risk (Non-cancer)	Acute Risk (Non-cancer)	Cancer Risk	Chronic Risk (Non-cancer)	Acute Risk (Non-cancer)
Receptor Type	Residential	Residential	Residential	Worker	Worker	Worker
Exposure Duration	30 years	N/A	N/A	25 years	N/A	N/A
Starting Age	3rd Trimester	N/A	N/A	16 years	N/A	N/A
Intake Rate Percentile	OEHHA Derived Method	OEHHA Derived Method	N/A	OEHHA Derived Method	OEHHA Derived Method	N/A
Risk Pathways Evaluated	Mandatory Minimum Pathways	Mandatory Minimum Pathways	Inhalation Pathway	Worker Pathways	Worker Pathways	Inhalation Pathway
Deposition Rate	0.05 m/s	0.05 m/s	N/A	0.05 m/s	0.05 m/s	N/A
FAH	Off	Off	Off	Off	Off	Off
8-Hour Breathing Rates	Off	Off	Off	Yes, Moderate	Yes, Moderate	Yes, Moderate
Climate	Warm	Warm	N/A	Warm	Warm	N/A

Notes: N/A = not applicable; OEHHA = Office of Environmental Health Hazard Assessment; m/s = meters per second; FAH = fraction of time at home

1. Analysis was prepared consistent with OEHHA Guidance (OEHHA 2015).

Source: Data compiled by Ascent Environmental, Inc., in 2020

3 RESULTS

3.1 CANCER RISK

3.1.1 Construction

Table 20 shows the modeled cancer risks at the PMI and the MEIR receptors associated with emissions resulting from the construction of the LRDP. Both the PMI and MEIR occur on campus. The construction scenario column in Table 20 represents the cancer risks at the PMI and MEIR under the construction scenario. These receptors are also identified in Figure 5.

Table 20 Modeled Cancer Risks from Construction Emissions Sources

Receptor[1]	Location Description	Construction Scenario Cancer Risk (Chances in a million)	Easting (m)[2]	Northing (m)[2]
PMI (On-Site)[3]	Approximately 40 feet northeast of the Central Plant	8.4	583593.91	4095470.34
MEIR (On-Site)	College Nine/Ten Apartments	7.2	583693.91	4095570.34
Maximally Exposed Sensitive Receptor	Student Health Services	6.2	583893.91	4095270.34
	MBARD Significance Threshold	10.0	N/A	N/A
	Threshold Exceeded?	Yes	N/A	N/A

Notes: MEIR = maximally exposed individual resident; MEIW = maximally exposed individual worker; N/A = not applicable. Risks exceeding threshold are underlined.

1. Receptors selected based on occurrence under Proposed Scenario.

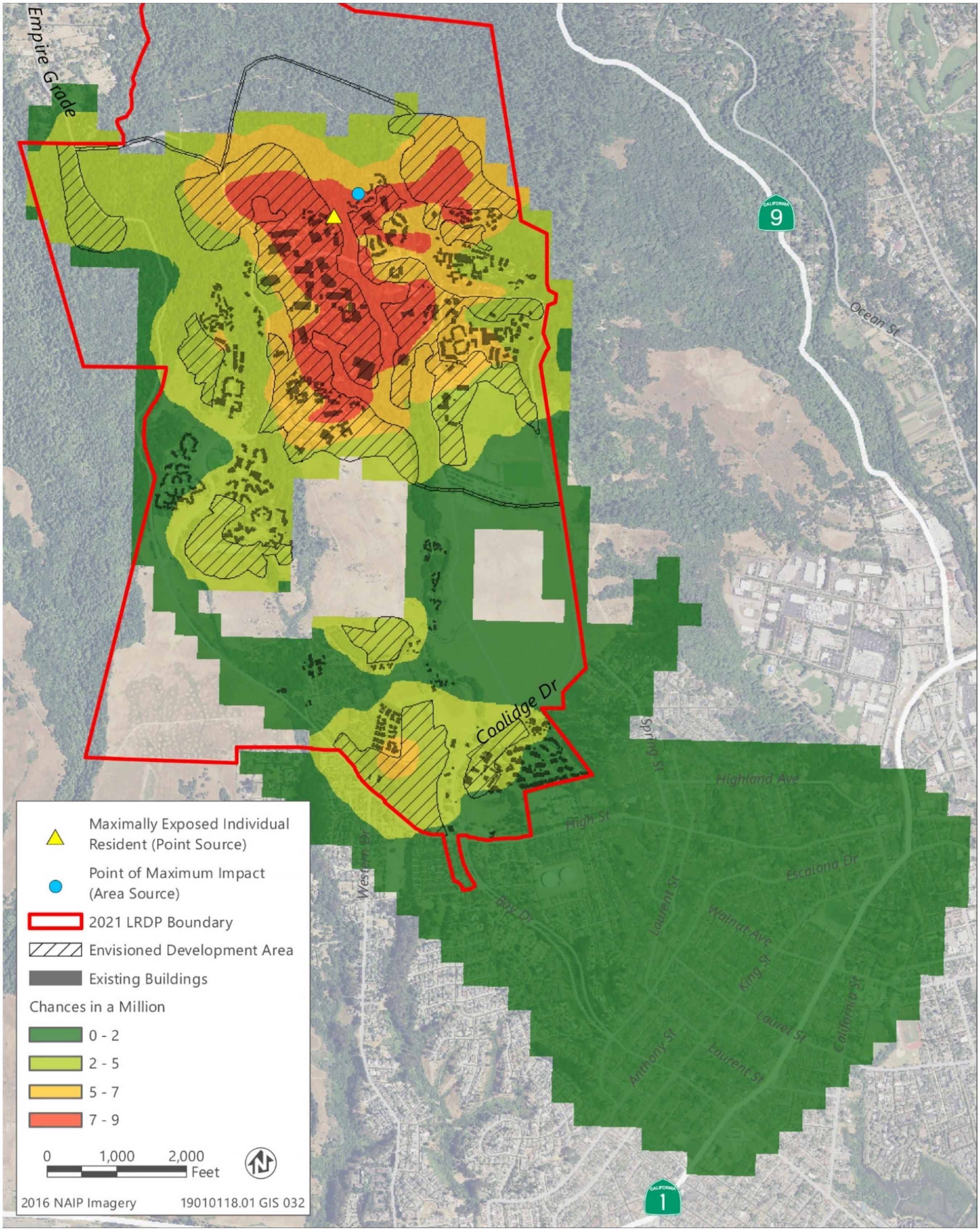
2. Based on Universal Transverse Mercator coordinates.

3. Based on residential exposure assumptions.

Source: Data provided by Ascent Environmental, Inc., in 2020

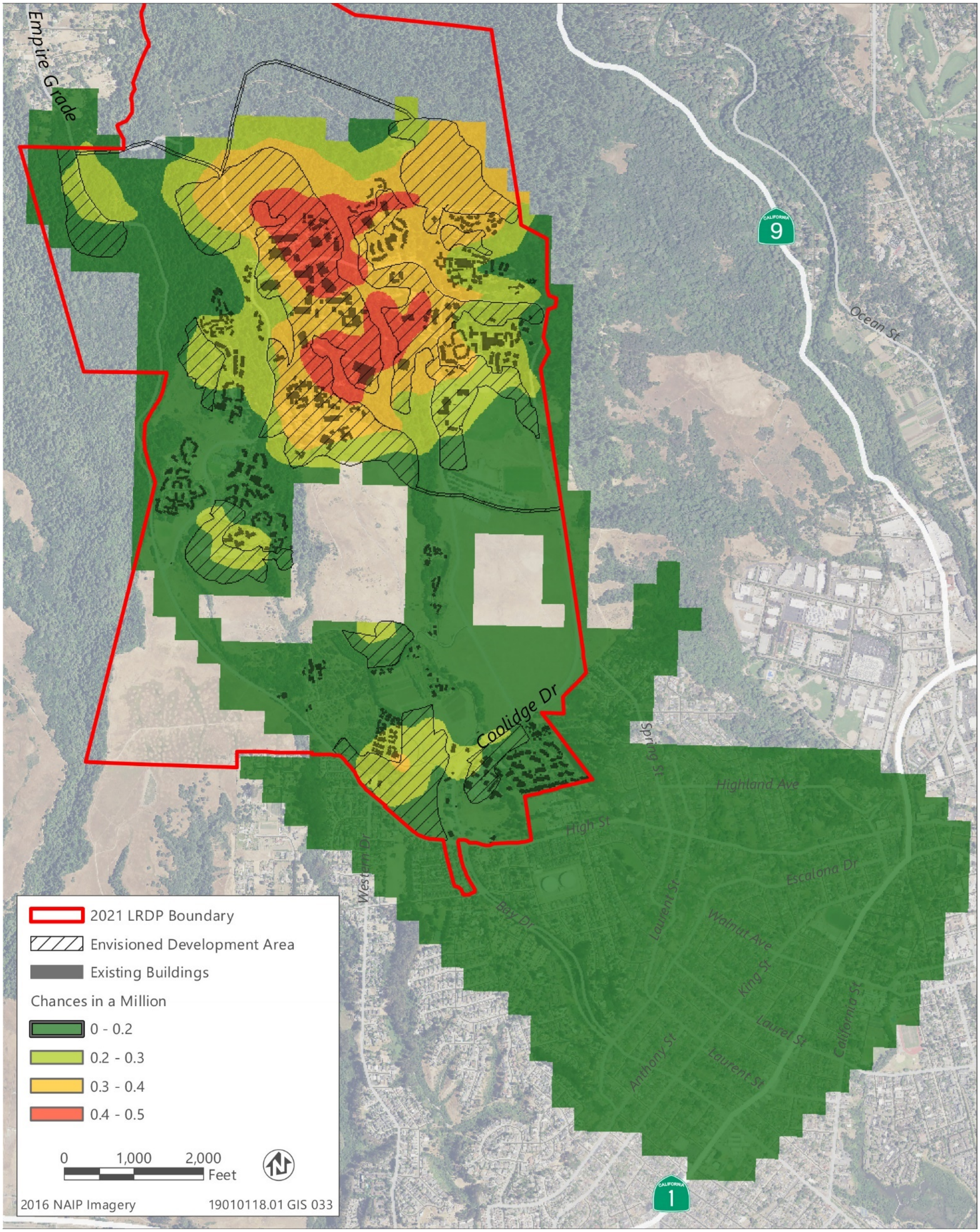
As shown in Table 20, based on the exposure and construction emission assumptions discussed above, construction of the LRDP would not result in an incremental increase in cancer risk that exceeds MBARD's significance threshold of 10.0 in a million. At the PMI, the incremental increase in cancer risk from construction of the LRDP would be 8.4 in a million; and at the MEIR, the incremental increase cancer risk would be 7.2 in a million. The maximally exposed sensitive receptor would be subject to an incremental increase in cancer risk of 6.2 in a million. Worker cancer risks, as shown in Figure 6, would not exceed the threshold of 10.0 in a million.

Figure 5 shows that the receptors with greatest cancer risks are generally located in the center of the proposed envisioned development areas, in the north central area of the campus. For the sensitive receptors identified in Table 1, risks would not exceed the threshold of 10.0 in a million, based on 30-year residential exposure rates.



Source: Adapted by Ascent in 2020

Figure 5 Residential Cancer Risk Contours for Construction (Unmitigated)



Source: Adapted by Ascent in 2020

Figure 6 Worker Cancer Risk Contours for Construction

3.1.1.1 Operation

Based on the modeled locations of new and modified existing sources under the LRDP, assumed modeling parameters, and estimated emission rates, Figures 6 and 7 show that, LRDP operations would not result in residential and worker cancer risks exceeding an incremental increase of 1.79 and 0.30 chances in a million at any receptor, respectively. The highest incremental increase in risks is located within 100 m of Engineering 2 and Communications buildings, in the north part of the campus. These results are shows in Table 21. Estimated operational cancer risks for all receptors are below MBARD's cancer risk thresholds.

Table 21 Modeled Chronic Risks from Operational Emissions Sources

	Maximum Cancer Risk (Chance in a Million)	Easting (m)[4]	Northing (m)[4]
MEIW[1]	0.30	583493.91	4095370.34
MEIR[2]	1.79	584093.91	4094870.34
PMI[1,3]	4.82	583493.91	4095370.34
MBARD Significance Threshold	1.0	N/A	N/A
Threshold Exceeded?	No	N/A	N/A

Notes: PMI = point of maximum impact; maximally exposed individual resident; MEIW = maximally exposed individual worker; N/A = not applicable; HHI = health hazard index

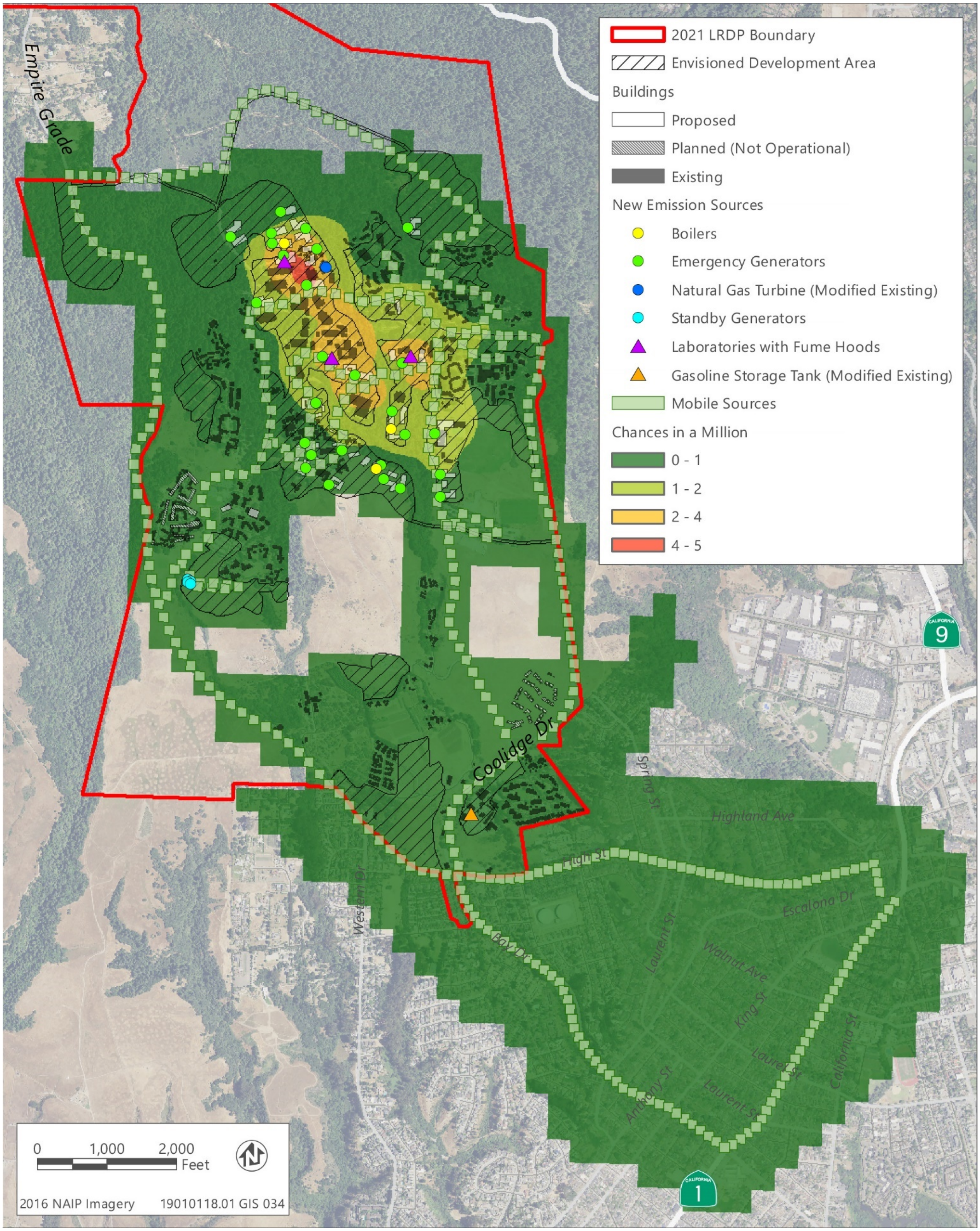
[1] Located at the Communications Buildings

[2] Located at Cowell Apartments

[3] Modeled with residential risk parameters.

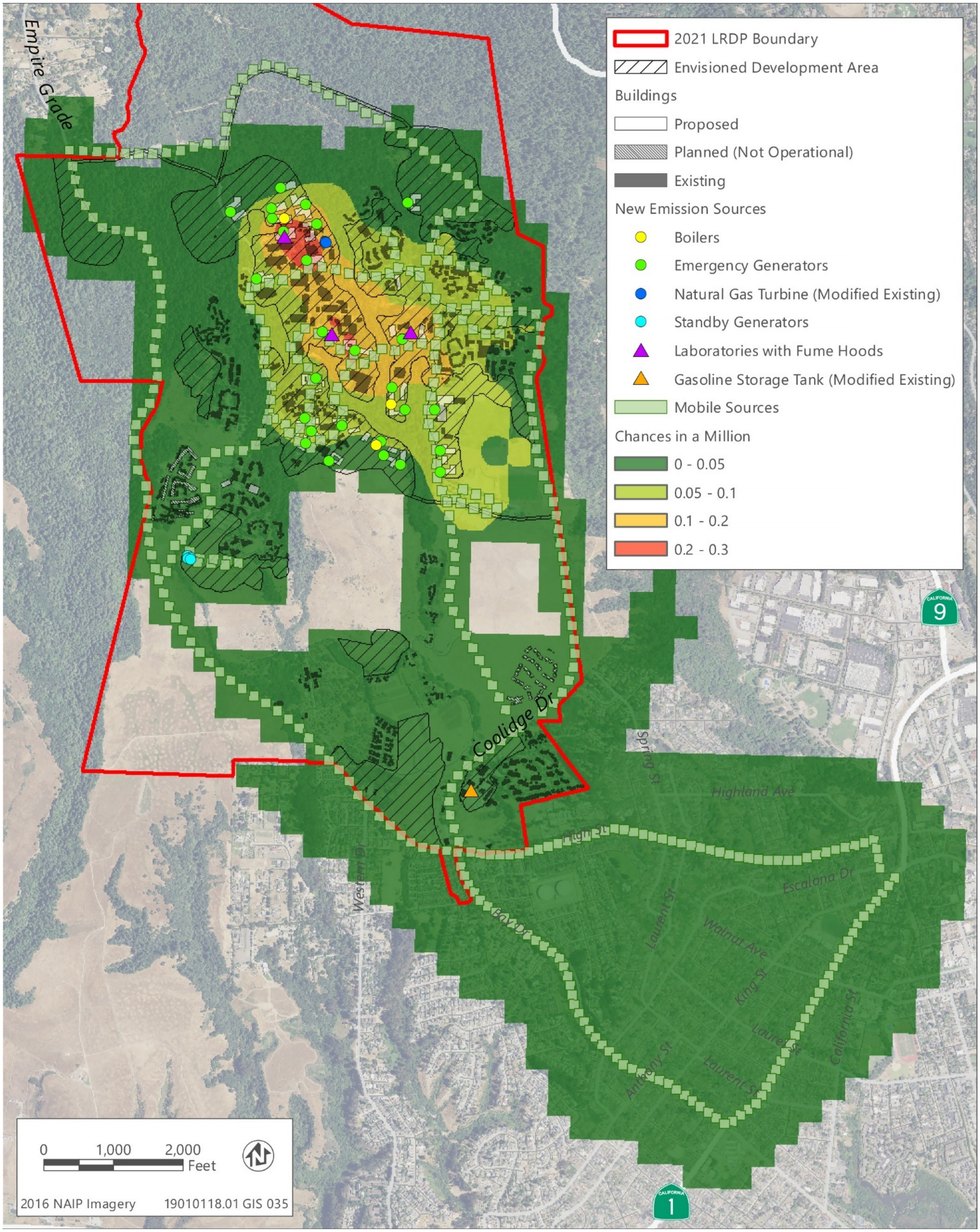
[4] Based on Universal Transverse Mercator coordinates.

Source: Data provided by Ascent Environmental, Inc., in 2020



Source: Adapted by Ascent in 2020

Figure 7 Contours of Incremental Increase in Residential Cancer Risk for Proposed Operations



Source: Adapted by Ascent in 2020

Figure 8 Contours of Incremental Increase in Worker Cancer Risk for Proposed Operations

3.2 NON-CANCER RISKS

3.2.1 Construction

Construction non-cancer chronic risks were estimated for the modeled receptors. During construction, both worker and residential non-cancer chronic risks would not exceed an HHI of 0.002. No acute risks are available for construction activities because diesel PM, the only pollutant modeled for construction, does not currently have an acute risk factor. No isopleth contours are shown because all modeled construction non-cancer chronic risks are below MBARD thresholds. These results are shown in Table 22.

Table 22 Modeled Chronic Risks from Construction Emissions Sources

	Maximum Non-Cancer Chronic HHI	Easting (m)[2]	Northing (m)[2]
MEIW/MEIR/PMI[1]	0.002	583593.91	4095470.34
MBARD Significance Threshold	1.0	N/A	N/A
Threshold Exceeded?	No	N/A	N/A

Notes: PMI = point of maximum impact; maximally exposed individual resident; MEIW = maximally exposed individual worker; N/A = not applicable; HHI = health hazard index

1. All occurrences of these receptors are at the same location. Located 30 m east of the UCO/Lick Building.

2. Based on Universal Transverse Mercator coordinates.

Source: Data provided by Ascent Environmental, Inc., in 2020

As shown in Table 22, based on the exposure and the construction emission rates assumptions discussed in above, construction of the LRDP would not result in an HHI for chronic risk that exceeds MBARD's significance threshold of 1.0. At the PMI, the chronic risk from construction of the LRDP would have an HHI of 0.002, which does not exceed MBARD's chronic risk threshold. Thus, all other receptors would not have an HHI that exceeds MBARD's chronic risk threshold resulting from construction activity.

3.2.2 Operation

Operational non-cancer chronic and acute risks were estimated for the modeled receptors. During operations, worker and residential non-cancer chronic risks would not exceed an incremental increase of HHI of 0.11 and 0.05, respectively, which are below MBARD's chronic threshold of 1.0 for the HHI. The non-cancer chronic results are shown in Table 23.

Table 23 Modeled Chronic Risks from Operational Emissions Sources

	Maximum Non-Cancer Chronic HHI	Easting (m)[4]	Northing (m)[4]
MEIW[1]	0.11	583493.91	4095370.34
MEIR[2]	0.05	584093.91	4094870.34
PMI[1,2]	0.17	583493.91	4095370.34
MBARD Significance Threshold	1.0	N/A	N/A
Threshold Exceeded?	No	N/A	N/A

Notes: PMI = point of maximum impact; maximally exposed individual resident; MEIW = maximally exposed individual worker; N/A = not applicable; HHI = health hazard index

1 Located at the Communications Building

[2] Located at Cowell Apartments

[3] Modeled with residential risk parameters.

[4] Based on Universal Transverse Mercator coordinates.

Source: Data provided by Ascent Environmental, Inc., in 2020

For acute risks, acute risks for all receptor types would not exceed an incremental increase in HHI of 0.12 at the PMI, 0.10 at the MEIW, and 0.07 at the MEIR, which are below MBARD's acute threshold of 1.0 for the HHI. Table 24 shows the modeled anticipated increase in acute risks associated with LRDP operation.

Table 24 Modeled Acute Risks from Operational Emissions Sources

	Maximum Acute HHI	Easting (m)[4]	Northing (m)[4]
MEIW[1]	0.10	583693.91	4094870.34
MEIR[2]	0.07	584093.91	4094870.34
PMI[3]	0.12	583893.91	4094770.34
MBARD Significance Threshold	1.0	N/A	N/A
Threshold Exceeded?	No	N/A	N/A

Notes: PMI = point of maximum impact; maximally exposed individual resident; MEIW = maximally exposed individual worker; N/A = not applicable; HHI = health hazard index

[1] Located at McHenry Library

[2] Located at Cowell Apartments

[3] Located at Hanh Student Services Parking Lot

[4] Based on Universal Transverse Mercator coordinates.

Source: Data provided by Ascent Environmental, Inc., in 2020

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Appendix E

Cultural Resources Information

Appendix E1 – Archaeological Resources Report

Pacific Legacy Historic Preservation
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Phone: 510.524.3991
Fax: 510.524.4419
www.pacificlegacy.com

Date: July 3, 2020

To: Claudia Garcia, Ascent Environmental.

From: John Holson

Subject: Technical Memo For Cultural Resource Studies, UC Santa Cruz, Long Range Development Plan.

Pacific Legacy has prepared this memo to assist Ascent Environmental in preparing the Cultural Resources Section of the UC Santa Cruz, Long Range Development Plan (LRDP) Environmental Impact Report. Below are our findings and sections for the LRDP.

ENVIRONMENTAL SETTING

Regional Prehistory
The earliest confirmed evidence of prehistoric occupation in the Santa Cruz region comes from an archaeological site (CA-SCR-177) located 4 miles northeast of the campus in the Santa Cruz Mountains near Scotts Valley. Cartier (1993) postulated that CA-SCR-177 may date to approximately 10,000 years before present (BP). This is supported by the California Central Coast Chronology (Jones et al. 2007), which posits prehistoric life in the region extending to 10,000 years BP or earlier. While few sites have been identified from the Paleoindian through the Early Archaic (8000 to 5000 BP) periods in the Santa Cruz area, numerous sites have been dated to the Middle Archaic (5000 BP to 3000 BP) and Late Archaic (3000 BP to 1000 AD) periods. The Late Prehistoric Period (1000 to about 1600 AD) has been identified from at least one site near Santa Cruz (Fitzgerald and Ruby 1997; Hylkema 1991). Archaeological evidence indicates that Native groups in the region participated in extensive trade networks. They successfully pursued a wide range of subsistence practices in hunting large and small terrestrial and marine animals, fishing and shell fishing, and plant food gathering and processing and had extensive technological expertise in bow making (after about 500 AD), basketry, and the use of boats. As throughout much of Central California, acorns were an important plant food staple.

Archaeological testing at several sites on the UCSC campus in the 1960s (Edwards et al. 1983, Eastman, Stafford, and Buckman 1973) reportedly resulted in the recovery of two human burials and nearly 1,300 artifacts. Artifact types and radiocarbon dates suggest campus lands were occupied by Native inhabitants as early as 5,500 BP (3550 BC) to as recently as 200 BP (1750 AD).

The Monterey Bay area provided a wide range of resources that were important to Native

Americans. In addition to well-known plant and animal foods, important locally available resources included Monterey banded chert, which was used for the manufacture of chipped stone tools such as arrowheads. The bay was also an exceptional source of abalone (*Haliotis* sp.) and olive snail (*Olivella* sp.) shells. These served as raw material for the manufacture of shell ornaments and beads that were traded throughout California and much of the West, and they were important wealth items that were often deposited in graves.

Jones et al. (2007) acknowledged the importance of subsistence, settlement, and ecology in developing models of culture change for the Central Coast and adjacent inland areas, but employed a chronological system that focused on the significant variability and stylistic/typological transitions seen in artifact assemblages across the region. Their synthetic study included sites from Ano Nuevo, Santa Cruz, and the broader Monterey Bay south to Pismo Beach, and their chronological system relied on six key periods (Paleo-Indian, pre-8000 BC; Millingstone, or Early Archaic, 8000 to 3500 BC; Early, 3500 to 600 BC; Middle, 600 BC to AD 1000; Middle/Late Transition, AD 1000 to 1250; and Late, AD 1250 to 1769). Three cultures (the Millingstone Culture, the Hunting Culture, and the Late Period) were used to describe broader social patterns (Jones et al. 2007).

The Millingstone Culture is the earliest well-established sequence and dates to the Millingstone or Early Archaic Period (8000 to 3500 BC). This period is defined by the presence of large numbers of handstones, millingslabs, expedient core tools, and lesser quantities of flaked stone tools and large side-notched projectile points. Contracting stemmed points, lanceolate points, and crescents have also been recovered from Millingstone levels. Artifactual and faunal evidence indicates a wide variety of mammals, shellfish, birds, and to a lesser degree fish were collected. The Millingstone groundstone assemblage also suggests vegetal matter was processed on rock slabs rather than in shaped bowl mortars. However, preservation of faunal and floral remains is poor. Millingstone occupations have been located in a variety of settings from the coast to nearshore interior valleys. Faunal remains indicate a varied diet that included shellfish, fish, birds, and mammals, especially deer and rabbits.

The Hunting Culture spans the Early and Middle Periods (3500 to AD 1000) and is defined by an abundance of stemmed and notched projectile points and large bifaces. The Early Period is marked by the presence of contracting stemmed, Rossi square-stemmed, and large side-notched projectile points generally thought indicate dart or spear hunting of large and small mammals. Groundstone assemblages include handstones, pitted stones, and portable mortars and pestles. Bipointed bone gorges used for line fishing and Class L rectangular *Olivella* beads also appear in the Early Period. Middle Period sites indicate stylistic changes in stone technology from the earlier square stemmed and large side-notched projectile points. Middle Period stone tools include contracting-stemmed and large-stemmed points, but no square-stemmed or large side-notched points. Groundstone artifacts consist of slabs, handstones, portable mortars, and pestles. *Olivella* G2 saucer beads replace earlier Class L beads. Bone gorges are still present along with circular shell fishhooks. Pitted stones and grooved stone net sinkers are common. Hunting Culture sites occur mainly in coastal areas but extend into nearby valleys as well. Faunal remains include deer, rabbits, sea otters, birds, and fish with preferences dependent on locale. Acorns may also have been part of the Hunting Culture diet.

The Middle/Late Transition Period (AD 1000 to 1250) exhibits increasing numbers of arrow points and decreasing numbers of stemmed points indicating more reliance on the bow and arrow which was gradually replacing the use of spears for hunting. The Late Period AD 1250 to 1769) is defined by the abundance of Desert side-notched and Cottonwood arrow points. Small serrated points and contracting-stemmed points are present at some sites. Other artifacts include bedrock mortars, hopper mortars, several bead types (Class E lipped, Class K cupped, steatite disk, and Class M rectangular), small bifacial bead drills, and circular fishhooks. Unlike earlier periods, Late Period sites are more common in the interior than on the coast.

The historic period began in earnest when early Spanish explorers made extensive forays up the Central Coast (Jones et al. 2007). Sebástian Vizacaíno landed in the area of Monterey in 1602. Long term contact with Native American inhabitants intensified with the Portolá overland expedition in 1769-1770, which camped along the San Lorenzo River, and the establishment of Mission Santa Cruz in 1771. The Spanish referred to the indigenous population in this region as Costaño or "coast people." Historically, they have become known as Costanoan. Levy (1978:485) suggests that in 1770, just before missionization, the Costanoan group was made up of approximately 50 politically autonomous nations and tribelets. At that time, the UCSC area was occupied by a tribal group identified as the Uypi which occupied the mouth of the San Lorenzo River (Milliken 1995: Appendix 1).

Mission life, non-Native diseases, and cultural disruption took a severe toll on the Costanoan population. One effect was that groups of mixed ethnicities congregated in a few Native communities. In many cases, these individuals are identified in records (such as those of the Indian Land Claims Act) only as “Mission Indian.” Thus, it is now often difficult or impossible to trace descendants from a specific locale. Many descendants of the San Francisco Bay and Monterey Bay regions identify themselves as Ohlone.

Ethnography

The Costanoan language group comprises seven closely related languages (Shipley 1978). These languages were spoken throughout a large area extending from the San Francisco Bay southward along the coast to Point Sur and inland to the Diablo Range and portions of the northern San Joaquin Valley (Milliken 1995). The term "Costanoan" is misleading, however as it amalgamates the 10,000 or more people who lived in the region into a single ethnolinguistic unit. In reality, the term "Costanoan" subsumes as many as 40 or 50 politically independent groups, some of which spoke mutually unintelligible but genetically related languages.

Many present-day Native descendants prefer the term Ohlone, which is said to have derived from the name of a coastal village in San Mateo County (Levy 1978). Knowledge of Ohlone culture is largely based on information gathered from Spanish expeditions between 1769 and 1776, documents maintained at missions, the works of ethnographers and linguists, and from Ohlone descendants. Primary ethnographic sources include Harrington (1933, 1942) and Kroeber (1925), while overviews are provided in Heizer (1974), Levy (1978), Margolin (1978), and Milliken (1983, 1991, 1995). Galvan (1968) and Williams (1890) offer Native accounts of Ohlone history, and an excellent example of contemporary ethnohistory can be found in Cambra et al. (1996).

The 18th century Ohlone tribelet that lived the vicinity of Mission Santa Cruz was recorded in mission records as Uypi (King 1994; Milliken 1994). Other linguistic dialect groups of Ohlone peoples in the vicinity included the Cotoni (Davenport area), Achistaca (Boulder Creek area), Sayanta (Zayante area), and Aptos (Aptos area) (Millikin 1988). The precise population of the contact period Uypi is uncertain, but Millikin noted that around 500 to 700 Native Americans from the Santa Cruz County area were taken to Mission Santa Cruz between 1791 and 1797 (Dietz in Rodrigues et al. 1992:6; Millikin 1985). Demographic studies by R.H. Jackson (1983) estimated an Ohlone population in the Santa Cruz area at around 1,700 persons at the time of contact. Given what is known about population demographics in the area, this suggests that at least one pre-contact or contact period village was present in the UCSC vicinity.

Spanish missionization, and the introduction of European diseases for which most Native American inhabitants had little natural resistance, resulted in rapid and dramatic Native population declines. Subsequent persecution and suppression of Native cultural expressions by Spanish, Mexican, and American colonizers contributed to the transformation of traditional culture. Today, a number of Ohlone tribes remain active in Santa Cruz County, including the Amah Mutsun Tribal Band, the Costanoan Ohlone Rumsen-Mutsen Tribe, and the Indian Canyon Mutsun Band of Costanoan, among others.

REGIONAL HISTORY

Regional Overview

In 1769, the Portolá expedition was the first non-Native exploration party to visit the area between the San Lorenzo River and Wilder Creek. A mission, *La Misión de la Exaltación de la*

Santa Cruz, was established in Santa Cruz near the San Lorenzo River in 1791 as part of Spanish colonization efforts in Alta California. Campus lands likely were used by the mission for grazing and/or agricultural fields (Rodrigues et al. 1992; Hoover et al. 1990; Edwards and Kimbro 1986). It is possible that lime for plaster and whitewash may have been produced locally as well, since high quality limestone and wood for firing were readily available at that time (Rodrigues et al. 1992; Piwarzyk 1994), though this has not been documented.

After Mexico won its independence from Spain in the 1820s, the Mexican government began the secularization of church lands. Starting in 1834, mission properties were distributed among Spanish and Mexican immigrants, though rarely among Native American citizens. The lands that became the UCSC campus made up portions of three Mexican-era land grants: *Rancho de la Cañada del Rincon en el Rio San Lorenzo de Santa Cruz* (Rancho Rincon), *Rancho Zayante*, and *Rancho Rufugio*. Rancho Rincon was granted to Pierre "Pedro" Sansevain in 1843 (Rodrigues et al. 1992; Hoover et al. 1990; Pierce 1990). Pierre Sansevain was a French immigrant who married into the Suñol family and built a lumber and milling business. By the 1850s, there were also two lime kilns producing quicklime on the rancho (Perry et al. 2007:20). In the 1840s, relations between Mexico and the US became strained as the US expanded westward towards the Pacific Ocean. Political stresses erupted into the Mexican-American War of 1846-1848. At the close of the war, Alta California became part of the US with the signing of the Treaty of Guadalupe Hidalgo.

In 1848, Mexico ceded California to the US, and California quickly attained statehood in 1850. This was due in part to the discovery of gold near Sacramento in 1848. The major influx of settlers resulted in a rapid increase in demand for goods and services, including house-building supplies. At that time, quicklime, a principal ingredient in mortar, plaster, and stucco, was shipped from the east around Cape Horn, making it very expensive. In 1851, entrepreneurs Isaac Davis and Albion Jordan discovered that high-quality limestone was available in Santa Cruz, and they bought a 160-acre parcel on the future campus site near High and Bay Streets. There they constructed three lime kilns for the production of quicklime. Davis and Jordan produced 21,000 barrels of lime in 1855, one third of Santa Cruz County's production in that year (Rodrigues et al. 1992).

When Albion Jordan retired in 1863, Isaac Davis entered a partnership with Henry Cowell. The lime business flourished, and by 1865 the Cowell and Davis Lime Company was operating eight lime kilns, including the original kilns near the main campus entrance, the Upper Quarry Kiln on the Upper Quarry rim, the Bridge Kiln near McLaughlin Drive, and the Elfland Kiln near College Ten. By 1880, the company had become one of the three largest lime companies in California (Rodrigues et al. 1992; Eselius 2003). The business included quarrying and lumbering operations, a wooden tramway for hauling limestone and lumber, a cooperage to manufacture barrels for shipping, a drayage operation to transport the barrels to the warehouse and wharf, and company schooners to transport the material to San Francisco for shipping. A ranch home, workmen's houses, a carriage house, and other facilities also were established on the campus site along with agricultural operations in support of the lime production business.

In 1888, when Davis died, Henry Cowell took control of the entire lime company operation and land holdings, renaming it the Henry Cowell Company (later, the Henry Cowell Lime and Cement Company). When Henry Cowell died in 1903, his son Ernest Cowell took over management of the family business. Because much of the easily accessible redwood had been logged, and in response to improved quicklime production technology, Ernest introduced a new oil-burning lime kiln, which was constructed adjacent to the other kilns. The demand for quicklime, however, had already begun to decline. The Santa Cruz Portland Cement Company, which opened in Davenport in 1905, began producing cement with superior building qualities. In 1906, the devastating San Francisco earthquake demonstrated that brick and mortar were not the best building materials for this region. The Cowell quicklime operations began a major decline, and the lime kiln complex near the main campus entrance was shut down during the early decades of the 20th century, though the Upper Quarry and other kilns on the campus site continued to operate until 1946 (ESA 2001:25, 30; Rodrigues et al. 1992).

During the first decades of the 20th century, agricultural operations on the Cowell property became more important as quicklime mining declined and the Cowells started leasing grazing land, though quarrying continued sporadically for several decades (Rodrigues et al. 1992). Ernest Cowell died in 1955, and the subsequent S.H. Cowell Foundation continued to manage the property (MacDougall 1989:14). The property became known as Cowell Ranch, and leases for agricultural and grazing persisted into the 1960s. One lessee was local rancher Les Strong, who leased Cowell land from 1950 into the early 1960s. Strong raised cattle and grew hay and flax for livestock feed (Perry 2015:1, 5-6; 2020:4-5).

Another use of the ranch lands was community oriented. The City of Santa Cruz built a reservoir on the western side of Cowell Ranch in 1890 as part of its first public water system. The reservoir, which dammed off Moore Creek with three earthen dams, leaked badly and was abandoned in 1948. Land ownership reverted to the Cowell Ranch at that time (Clark 1986:85). The reservoir later became the site of the UCSC Arboretum and Botanical Gardens in the mid-1960s (UCSC Arboretum 2020).

City of Santa Cruz

Father Junípero Serra and Captain Gaspar de Portolá began land-based exploration and settlement of Alta California in 1769. While the Portolá party rested at the Pajaro River, a group of scouts headed by Sergeant José Francisco Ortega discovered the San Lorenzo River. Mission Santa Cruz, founded in 1791, was the first permanent European settlement in the Santa Cruz area (Clark 1986; Hoover et al. 1990). The first site of the mission was flooded by the San Lorenzo River in the winter of 1791 and was rebuilt over the next several years on the hillside above it. Diego de Borcia, then the Governor of Alta California, selected the Santa Cruz area as the best location to fortify Spanish holdings against the colonial interests of Russia, France, and Great Britain and established *Pueblo de Branciforte* in 1797 on a bluff across the San Lorenzo River from the mission. Branciforte remained a separate settlement until 1905 when it was incorporated into the City of Santa Cruz (Clark 1986:42). After Mexico became independent from Spain and secularized the missions (1833 to 1834), the site of Mission Santa Cruz (at the mission's second location, completed in 1794) became Holy Cross Church. The Mission Hill community surrounding it was a center of commercial, political, and religious activity during the Spanish and Mexican periods and transitioned into the American Period (Tunheim 1975).

Santa Cruz County (first called Branciforte County) was established in 1850 as one of California's original 27 counties. The Gold Rush of 1848 caused a huge influx of settlers to northern California, and Santa Cruz County grew and enjoyed a prosperous economy based on logging, lime processing, agriculture, and commercial fishing. The City of Santa Cruz was granted a legislative charter in 1866 and was incorporated in 1876 (Hoover et al. 1990). The city soon became a prominent resort community in California. One of the first saltwater baths west of the Mississippi was established there by Mary Lidell in 1864, followed by the Neptune Baths in the 1890s (Gaudinski 2015). In 1904 to 1907, Fred Swanton developed his boardwalk at the same location, which included a casino, heated indoor pool, and 500 dressing rooms. In 1912, a carousel was added, and the Giant Dipper roller coaster was installed in 1924, which continues to draw summer crowds to this day (Gaudinski 2015).

University of California, Santa Cruz

In 1951, plans were begun for the construction of a new campus within the University of California system in the southern Central Coast region. By 1961, The Board of Regents of the University of California system had chosen Santa Cruz as the location of the new campus. The campus was planned by architect John Carl Warnecke and landscape architect Thomas Church, and the design was based on the Oxford and Cambridge University model of small, independent liberal arts colleges (Garret 1967:67, Fischer 1968:12). The campus was conceived as a group of "scholarly villages," with each village representing a different academic discipline. The colleges were designed to be semi-autonomous in function and distinct in architectural and academic style. Each college and its associated libraries, walkways, and dormitories were all designed to appear and function as integral parts of the immediate natural landscape (Carter 1971:154).

The 2300 Delaware Avenue parcel had a different focus. In the 19th to the early 20th century, the future UCSC property was owned by the Woolf, Chace, and Leek families just north of the Hall dairy farm and east of Moore Creek (Hatch 1889; Punnett Brothers 1906). In 1908, the San Vicente Lumber Company sawmill dammed Moore Creek where it now passes into Natural Bridges State Beach and formed a log pond that the Ocean Shore Railroad also used as a trestle. The sawmill shipped its lumber using the Ocean Shore Railroad from 1909 to 1923, when the lumber company moved to Plumas County. The rails were removed, and the rail grade eventually became Delaware Avenue (Griggs 2019; Whaley 2014). The pond and the surrounding land then became the Antonelli Brothers' begonia gardens and farm during the ca. 1930s through ca. 1980 (Griggs 2019; Taylor 2009). Between 1982 and 1994, the Land Trust of Santa Cruz County acquired the pond and land to the west (Land Trust of Santa Cruz County 2020). The land to the east of the pond, between Delaware Avenue and the Southern Pacific Railroad tracks, was acquired by UCSC in the early 1980s. By 1982, the current building complex was erected (NETROnline 2020). In 2019, the UCSC Westside Research Park became the home of the UCSC Genomics Institute, based in the Baskin School of Engineering (Stephens 2019).

ARCHAEOLOGY ON CAMPUS

Archaeological and Historical Resource Inventories

The first archaeological sites identified on the UCSC campus were recorded in 1956, though the first formal archaeological survey of the campus was not conducted until 1974. Between 1975 and 2004, at least 48 cultural resource studies were completed on the campus, at least 22 of which included archaeological surveys. At various intensities, these surveys covered much of the lower portion of the campus, scattered areas in the central campus, and one area in the north campus.

In 2005, Pacific Legacy conducted a mixed-strategy cultural resource survey of the entire campus (*see* Appendix A.) (Pacific Legacy 2005b). The objectives of the survey were to provide screening-level data on the archaeological and historical resource base for the entire campus; assess current conditions and update the records of previously recorded sites; and formally record resources that had been previously identified but not recorded (*see* Appendix B.). A total of 13 previously recorded sites were updated, including seven prehistoric (one further site was not relocated), and six historic period sites. The update for the Cowell Ranch Historic District (CA-SCR-198H/P-44-000200) included 10 separately recorded contributing features. During the 2005 survey, three newly identified historic period sites also were recorded (CA-SCR-359H/P-44-000586; CA-SCR-360H/P-44-000586, and CA-SCR-361H/P-44-000589), and assessments of their integrity and significance were provided to the extent permitted by surface inspection.

The 2005 study included an intensive archaeological survey (inspection of the ground in systematic pedestrian transects) of about 50 percent of the main campus and a non-intensive survey (inspection of all openings, trails and other exposed ground surfaces) of an additional 20 percent of the main campus. The majority of intensive survey has been on the lower one-third of the campus. Within the central campus, survey work focused around areas in which previously known sites and historic period features had been recorded, and areas where development was anticipated under the 2005 LRDP. About 40 percent of the north campus area was surveyed, with emphasis on known site vicinities, open areas, and areas around seeps and springs. Throughout the campus, areas that have not been intensively surveyed include steep drainages, heavily forested or densely vegetated areas, and heavily developed/paved areas. To date, a total of 114 studies focused on the campus have been completed (*see* Appendix C.). At least 40 of these were surveys, while the remainder included subsurface testing and excavations, historical research, evaluations, and/or archaeological monitoring. More recent surveys have been project-specific in limited areas of the campus.

An archaeological survey of the 2300 Delaware Avenue property was conducted in 2005 (Morgan 2005). Approximately 90 percent of the property is covered by buildings, paving, or landscaping, so the natural ground surface could be inspected only along an unpaved trail at the western margin of the property. The buildings at 2300 Delaware Avenue, because of their recent construction date (ca. 1980), were not recorded or evaluated as historical structures.

In addition to the 2005 archaeological survey, an inventory of potential historic period buildings was conducted on campus. The date or approximate date of construction of each building was determined, and each building more than 50 years of age was photographed and documented on State Park record forms. A historical context statement also was prepared as the basis for the evaluation of the Cowell Ranch Historic District and related features.

Known Resources Prehistoric and Historical Resources

Record and Literature Review

As a part of a comprehensive record and literature review, Pacific Legacy inspected internal reports and resource records that were gathered for the 2005 LRDP and for subsequent work (*see* Appendices B. and C.). Pacific Legacy also received reports from Ascent Environmental relevant to cultural resources within the study area. On March 27, 2020, Pacific Legacy requested an archival and records search of the project area though the Northwest Information Center (NWIC) of the California Historical Resources Information System (CHRIS) at Sonoma State University. A response was received on April 21, 2020 (NWIC File No. 19-1702). Sixty-eight cultural resource studies had been assigned study numbers by the NWIC. An additional 46 reports were noted from records on file with Ascent and Pacific Legacy. A listing of these studies is included as Appendix A. A total of eight prehistoric resources have been recorded within the main campus area while none have been recorded for the Delaware Street Campus. Twelve historic period resources have been recorded on the main campus and none have been recorded at the Delaware Street Campus.

The archival and records search fully encompassed the main campus parcel since the Delaware Avenue parcel was fully developed and mostly paved at the time of the previous 2005 LRDP and subject to a previous negative study. Reports collected included references to archaeological and historic period DPR forms and reports within the project survey area. While several built environment resources are addressed in a different section.

In addition to the record review, the archival and records search included a review of the following:

- The Historic Properties Directory (California Office of Historic Preservation (2013);
- The California Inventory of Historic Resources (State of California (1976);
- California Historical Landmarks (California Office of Historic Preservation (1996);
- California Points of Historical Interest listing May 1992 (State of California 1992); and
- The National Register of Historic Places (NRHP) (Directory of Determinations of Eligibility, California Office of Historic Preservation, Volumes I and II, 1990; Office of Historic Preservation Computer Listing 1990 and updates).

Historic maps and documents concerning the general area on file at the Berkeley office of Pacific Legacy along with digital archives of previously conducted studies and known cultural resources within the Project area were also reviewed.

Archaeological Sites

Prehistoric Archaeological Sites

Eight prehistoric archaeological sites and three prehistoric isolated finds (resources consisting of three or fewer artifacts) have been identified on the UCSC main campus. No prehistoric sites have been newly recorded on the main campus or on the 2300 Delaware Avenue property since 2005. Although five of the eight prehistoric sites were subject to test excavations in the 1960s and 1970s, none has been formally evaluated for listing in the California Register of Historical Resources (CRHR). Two of the sites include habitation deposits (CA-SCR-3/P-44-000011 and CA-SCR-160/P-44-000163), and burials were reportedly recovered from a third possible habitation site (CA-SCR-4/P-44-00012). These three sites have the potential to yield important information and may be eligible for listing in the CRHR.

The remaining five sites are recorded as lithic scatters (scattered chipped stone tool manufacture debris), several with Monterey-banded chert: CA-SCR-94/P-44-00098, CA-SCR-142/P-44-

000145, CA-SCR-143/P-44-000146, CA-SCR-180/P-44-000182, and CA-SCR-181/P-44-000183. The last site, CA-SCR-181/P-44-000183, was not relocated in 2005. In general, the boundaries of these sites are not well defined, it has been difficult to accurately relocate these sites in subsequent surveys, and it is unclear whether the deposits have subsurface components. These sites have been assumed eligible for listing in the CRHR, however for management and preservation purposes until their significance can be documented through archaeological testing. The prehistoric isolated finds (with field number designations only) include two with a single Monterey-banded chert flake and a third with three Monterey-banded chert flakes. Isolated finds are assumed not eligible for listing in the CRHR because they offer extremely limited data potential. Because the presence of isolated artifacts can signal an undiscovered archaeological deposit, however, these finds have been mapped on the campus confidential cultural resources map.

Human Remains

No historic period burials or cemeteries are known or have been encountered on the UCSC main campus or on the Delaware Avenue parcel. Two prehistoric burials were reportedly recovered however from site CA-SCR-4 in the 1960s, presumably during UCSC archaeological field school excavations (Edwards et al. 1983). The 1973 site records for CA-SCR-3 and adjacent CA-SCR-4 note that excavations were conducted by UCSC in 1969 (Stafford 1973), and that one deep saucer-shaped depression and one slight depression were visible (Eastman, Stafford, and Buckman 1973).

Historic Period Archaeological Sites and Features

Ten historic period sites, two historic period districts, and 19 historic period isolated finds or features have been identified on the UCSC main campus. No sites or isolated finds have been identified on the 2300 Delaware Avenue property. The historic period sites on the main campus include the Cowell Ranch site (CA-SCR-198H), an extensive complex of extant 19th and 20th century buildings, structures, and associated archaeological features, as well as several other related archaeological sites (CA-SCR-182H, CA-SCR-183H, and CA-SCR-361H) that include railroad, quarrying, and lime kiln features associated with quicklime production at Cowell Ranch between about 1851 and 1946. Other recorded sites (CA-SCR-184H, CA-SCR-185H, CA-SCR-186H, CA-SCR-277, and CA-SCR-424H) include features likely associated with the agricultural activities at Cowell Ranch in the late 19th to early 20th century. Based on their locations, two sites may not be directly associated with Cowell Ranch; these include a habitation site (CA-SCR-262H) and domestic debris dump (CA-SCR-360H). Finally, one resource (CA-SCR-359H) served as the original City of Santa Cruz reservoir and is now occupied by the Arboretum.

There are two overlapping historic districts on the lower campus. The first is the Cowell Home Ranch District (P-44-000855), which includes standing ranch buildings, kilns, and quarries. It was originally nominated to the National Register of Historic Places (NRHP) in 2003 but was not listed (Eselius 2006). During development of the 2005 LRDP, a UCSC consultant prepared a second NRHP nomination for the Cowell Lime Works Historic District (P-44000200/CA-SCR-198H). The District was clearly eligible for listing in the NRHP under Criterion A and in the CRHR under Criterion 1 for its role in the development of lime mortar manufacturing in California between 1851 and 1906. In their preliminary findings, Architectural Resources Group (ARG 2005) concluded that while the integrity of many of the buildings and features had been diminished through deterioration, physical damage from development, or adaptive reuse and thus no longer contributed to its significance, the district and many of its features retained their historical significance. UCSC and ARG completed the draft NRHP evaluation and district nomination and developed a specific historic district management plan for the resource in 2006 with the objective of maintaining the district's historical character (ARG 2006). The Cowell Lime Works Historic District was listed in the NRHP and CRHR in 2007 (NPS #07001220). In 2009, two archaeological features (P-44-000958 and UCSC-0906 in CA-SCR-198H) within the district boundaries were discovered and tested. Both features were assumed eligible for listing in the CRHR and recommended as contributing elements to the district.

Most of the other historic period sites documented on the main campus also are presumed eligible for listing in the CRHR for their potential to yield important historical data and for their association with important events, namely the economic development of Santa Cruz County, and particularly its quicklime industry. Several of the recorded sites may predate the Cowell Ranch period, such as the Elfland Kiln (CA-SCR-361H) and Upper Quarry Kiln and may offer contrasting and comparative data on the economy in Santa Cruz prior to the lime industry boom. One previously recorded site, SCR-277H (also known as CA-SCR-227H), does not appear to be eligible for listing in the CRHR. It consists of a historic period agricultural field and was recorded because it appeared on a 1931 aerial photo; today, it does not appear to retain any elements that suggest its historical character, and it has little potential to provide additional historical information beyond its recorded location.

In 2000 and 2005, 19 isolated and generally fragmentary features were recorded during surveys but were not formally recorded as archaeological sites (Beck 2000; Reese 2005a). These historic period features included four wood fence line segments; eight narrow (10-15 foot wide) unpaved ranch road segments; five stock troughs (both concrete and iron); a limestone and cement foundation with one trapezoidal pier and no associated artifacts; and a scatter of early 20th century artifacts representing at least three domestic and architectural artifacts. At the time of the recording, these were considered isolated finds rather than part of an integrated complex of ranching, agricultural, or mining features.

TRIBAL CULTURAL RESOURCES

Pacific Legacy personnel submitted requests to the Native American Heritage Commission (NAHC) for a search of the Sacred Lands File as it encompasses the two project areas on March 27, 2020 (area centered on the UCSC main campus) and May 11, 2020 (2300 Delaware Avenue) (*see* Appendix D.). Sarah Fonseca, Cultural Resources Analyst with the NAHC, responded to the first request on April 1, 2020 and to the second request on May 13, 2010. Native American cultural resources have been previously reported within both areas. The NAHC provided a list of five tribal representatives or individuals with a potential interest in and knowledge of Santa Cruz County and the project vicinity. All individuals on that list were contacted via email by Pacific Legacy on May 13, 2019. These individuals included Mr. Valentin Lopez, Chairperson of the Amah Mutsun Tribal Band; Ms. Irenne Zwierlein, Chairperson of the Amah Mutsun Tribal Band of Mission San Juan Bautista; Mr. Patrick Orozco, Chairman of the Costanoan Ohlone Rumsen-Mutsun Tribe; Ms. Ann Marie Sayers, Chairperson of the Indian Canyon Mutsun Band of Costanoan; and Ms. Monica Arellano of the Muwekma Ohlone Indian Tribe of the San Francisco Bay Area. The letter requested any information they may have regarding Native American cultural resources or areas of concern within the project area. Responses to those requests for contact are anticipated within 60 days (due to the Covid-19 proclamation by Governor Newsom) and will be forwarded to UCSC upon receipt.

To date, Mr. Lopez and Ms. Zwierlein have responded. Ms. Zwierlein responded via email on May 14, 2020. She emphasized that the NWIC should be contacted regarding any archaeological sites. Mr. Lopez, who also responded via email on May 14, 2020, requested follow-up contact to discuss the project further. All correspondence between Pacific Legacy, the NAHC, and Native American tribal representatives regarding the project is included in Appendix D.

Attachments:

Appendix A. Maps
Appendix B. Cultural Resources and Isolates Recorded on the UC Santa Cruz Campus
Appendix C. Summary of Cultural Resource Literature
Appendix D. Native American Contact

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Appendix A

Maps

Archaeological and traditional property locations are considered confidential and should not be disclosed to the general public or unauthorized persons. This document contains sensitive information regarding the nature and location of archaeological sites. Public access to information regarding the location, character, or ownership of a cultural or heritage resource is restricted by law per Section 304 of the National Historic Preservation Act; Section 9(a) of the Archaeological Resources Protection Act; Executive Order 13007; and is exempt from the California Public Records Act under Government Code Section 6254.10.

Appendix B

Cultural Resources and Isolates Recorded on the UC Santa Cruz Campus

Archaeological and traditional property locations are considered confidential and should not be disclosed to the general public or unauthorized persons. This document contains sensitive information regarding the nature and location of archaeological sites. Public access to information regarding the location, character, or ownership of a cultural or heritage resource is restricted by law per Section 304 of the National Historic Preservation Act; Section 9(a) of the Archaeological Resources Protection Act; Executive Order 13007; and is exempt from the California Public Records Act under Government Code Section 6254.10.

APPENDIX C.

Summary of Cultural Resource Literature

Appendix C. Summary of Cultural Resource Literature

Study No.	Date	Author(s)	Title	Sites	Study Type
N/A	00/67	Dong and Calciano	John Dong: The Cowell Ranch Cookhouse, an Interview Conducted by Elizabeth Spedding Calciano	N/A	Primary source interview
S-003797	03/74	R. Edwards, A. Lonnberg	A Preliminary Evaluation of an Archaeological and Historical Resources of the Quarry Settlement Development	CA-SCR-94	Survey; general
S-003810	09/74	M. H. Heicksen	An Evaluation of Archaeological Site SCr-94 (Santa Cruz County) Part A	CA-SCR-94	Excavation and Field Study
S-003810 a	00/74	M. H. Heicksen	A Report and Archaeological Evaluation of a Prehistoric Cultural Resource, CA-Scr-94 Part B	CA-SCR-94	Excavation
S-003817	00/74	M. H. Heicksen	Archaeological Field Reconnaissance of a Portion of the West Campus Unit, S.H. Cowell Foundation Lands	None	Field Study
S-011356	10/74	M. H. Heicksen	Historical Resources of the Quarry Settlement Development	P CA-SCR-94	Field Study
S-003912	10/77	S. A. Dietz	An Archaeological Reconnaissance of the Approximately 9.7 acre Allen Property at 350 Meder Street in the City of Santa Cruz, California (letter report)	None	Field Study
S-003920	10/77	R. Edwards, M. R. Farley, R. Cartier	Archaeological Evaluation of Selected Areas on the Campus of the University of California, Santa Cruz	CA-SCR-160, CA-SCR-3 (42A), CA-SCR-4 (42B), CA-SCR-142, CA-SCR-143, ranch gate/fence lines, Red Hill Rd.	Survey; controlled intuitive
S-003957	11/78	R. Edwards, P. Podzorski, J. Pryor, J. Toenjes	A Preliminary Archaeological Reconnaissance of the Lands of the University of California at Santa Cruz	CA-SCR-3 (42A), CA-SCR-4 (42B), CA-SCR-94, CA-SCR-180, CA-SCR-181, CA-SCR-182H, CA-SCR-183H, CA-SCR-184H, CA-SCR-185H, CA-SCR-186H, CA-SCR-198H	Survey; Various Intensities
S-004001	05/79	R. Edwards	Intensive Surface Survey to Determine the Boundaries of Archaeological Site CA-SCR-94, University of California, Santa Cruz	CA-SCR-94	Survey; intensive
None/Not Available	08/79	R. Edwards	Archaeological Resource Section of an Intensive Study of Faculty Housing Apartments	CA-SCR-94	Evaluation
S-004055	12/79	M. F. Fox	An Analysis of the Chipped Stone Assemblage from SCr-94	N/A	Excavation, Field Study
S-004055 a	12/79	M. F. Fox	Edge Unit Analysis of the Lithic Assemblage from CA-SCR-94, Santa Cruz, California	N/A	Excavation, Field Study
None/Not Available	10/79	R. Edwards, G. Breschini, T. Haversat, M. Fazio-Fox	Archaeological Evaluation of SCR-94 for the Proposed Faculty Housing Apartments Environmental Impact Report University of California Santa Cruz	CA-SCR-94	Testing, Evaluation
None/Not Available	03/83	R. Edwards, J. M. Cooper, T. Jones	Cultural Resource Evaluation of Several Possible Areas for a Proposed Research and Development Park and Housing, U.C.S.C. Santa Cruz County, California	CA-SCR-277H CA-SCR-262H, CA-SCR-3 (42A), CA-SCR-4 (42B)	Survey, Intensive

Study No.	Date	Author(s)	Title	Sites	Study Type
				Red Hill Rd., Chinquapin Rd.	
S-006956 a	08/84	M. Ryan	Potential Subsurface Historical Resources, Faculty Housing Area/SCR-94 and SCR-198H, Continuing Investigations, University of California Campus, Santa Cruz, California	CA-SCR-198H	Architectural/historical, Management/planning, Other research
S-006956	10/84	R. Edwards, C. Simpson-Smith	Cultural Resources Evaluation of the Faculty For-Sale Housing	CA-SCR-198H	Field Study, Evaluation
S-006956 b	11/84	R. Edwards, C. Simpson-Smith	Phase Two: Surface Reconnaissance and Subsurface Testing for the Faculty For-Sale Housing Project	CA-SCR-198H	Survey, intensive; Testing
S-009388	03/85	R. Edwards	A Preliminary Archaeological Reconnaissance of a Site Proposed for a Fifty Unit Student Housing Project at the University of California, Santa Cruz	None	Survey, general
S-006956 c	07/85	R. Edwards	Faculty For-Sale Housing Project, 7-97330	CA-SCR-94, CA-SCR-198H	Monitoring report
S-006956 d	07/85	A. Black	Field Notes of Archaeological Check of UCSC Faculty Apartment, Phase B Construction	None	Field Study
None/Not Available	11/86	R. Edwards, E. Kimbro	Mission Fields in the Great Meadow, University of California, Santa Cruz	CA-SCR-277H	Archival research, Testing
S-008884	12/86	R. Edwards	UCSC Long Range Development Plan, Review of Cultural Resources	CA-SCR-160, CA-SCR-262H, CA-SCR-182H, CA-SCR-183H, CA-SCR-184H, CA-SCR-185H, CA-SCR-186H, CA-SCR-181, CA-SCR-277H, CA-SCR-198H	Review
S-010545	06/88	R. Edwards, C. Simpson-Smith	Surface Survey and Subsurface Testing of CA-SCR-160, University of California Santa Cruz, California	CA-SCR-160	Survey, Testing
S-013385	08/89	R. Edwards, C. Simpson-Smith	Brief Report of Site Preparation Activities at CA-SCR-160 at the University of California Santa Cruz	CA-SCR-160	Field Study, Testing
S-012109	10/89	R. Edwards, C. Simpson-Smith	Preliminary Archaeological Reconnaissance and Historical Archival Research for the Proposed Parking Development at Campus Facilities, University of California, Santa Cruz	CA-SCR-198H	Survey, Archival research
None/Not Available	12/89	R. Edwards, C. Simpson-Smith	Preliminary Report on the pH Sampling at CA-SCR-160, University of California at Santa Cruz	CA-SCR-160	Testing
None/Not Available	04/90	R. Edwards	Colleges 9 and 10 letter review	CA-SCR-160	Review
S-012109	09/90	R. Edwards, C. Simpson-Smith	Preliminary Archaeological Reconnaissance of the Empire Grade Proposed Shoulder Widening, Santa Cruz County, California	CA-SCR-142 (Revised site boundary)	Survey, Site record update
S-013773 b	01/91	R. Z. Melnick, T. Keller	Review and Evaluation of Potential Impact of Proposed Development of Inclusion Area 'D' on Potential Historic Landscape Resources, University of California, Santa Cruz Campus	None	Literature Search
None/Not Available	04/91	R. Edwards, C. Simpson-Smith, D. Huelsbeck,	Archaeological Excavations at CA-SCR-160, University of California Santa Cruz, California	CA-SCR-160 (Revised site boundary)	Testing

Study No.	Date	Author(s)	Title	Sites	Study Type
		M. Macko			
S-013773 c	08/91	R. Edwards, C. Simpson-Smith	Research Evaluation and Initial Field Reconnaissance of the Historical Resources of Proposed Development of the UCSC Inclusion Area 'D'	None	Field Study
S-013773 d	09/91	R. Edwards, C. Simpson-Smith	Research Evaluation and Initial Field Reconnaissance of the Historical Resources and Recommendations for the Proposed Development of Inclusion Area 'D' and Alternate Access Routes	Adjacent to CA-SCR-198H	Survey, Review
None/Not Available	11/91	R. Edwards	Archaeological Sites on Marshall Field, CA-SCR-3 and -4. Letter report	CA-SCR-3 (42A), CA-SCR-4 (42B), Marshall Rd., Chinquapin Rd.	Survey by Cabrillo College class.
S-013773 a	03/92	R. Edwards, E. Kimbro, R. Melnick	Final Report, Potential Impact to Cultural Resources, Proposed Development of Inclusion Area "D", Campus of the University of California Santa Cruz	Adjacent to CA-SCR-198H	Review, evaluation based on 09/91 report.
S-015955	09/92	P. Rodrigues, G. Sanchez, S. Dietz	Historic Cowell Ranch Cultural Landscape Report	CA-SCR-198H, Identifies possible features.	Survey, intensive
S-014785	04/93	S. Ziegler	Archaeological and Historical Resources Survey and Impact Assessment, Smith Grade North THP, 1-93-220-SCR, (California Department of Forestry)	None	CF MOU
None/Not Available	10/93	J. Costello, Amaglio	Significance Assessment: Historic Object in Upper Quarry, Knob Removal, UC Santa Cruz, California	Upper Quarry	Feature assessment
None/Not Available	1994	R. W. Piwarzyk	The Lime Kilns of the Pogonip	Lime Kiln features	Survey
S-015899	04/94	R. Edwards, C. Simpson-Smith	UCSC Granary/Child Care Project on a Portion of CA-SCR-198H, Historic Lime Operation, Henry Cowell Ranch, Santa Cruz, California	CA-SCR-198H	Monitoring
None/Not Available?	06/94	R. Edwards	UCSC Hagar Drive Bicycle and Pedestrian Improvements: Review of Historic and Prehistoric Resources	CA-SCR-277H (Mission Field)	Review
S-028717	06/94	S. Ziegler	Archaeological and Historical Resources Survey and Impact Assessment, A Supplemental report for a Timber Harvesting Plan, Empire Grade THP, Project # 1-94-392 (California Department of Forestry)	CA-SCR-180	CF MOU
None/Not Available	10/94	G. Wolff	Faculty Housing Addition	CA-SCR-94	Review
None/Not Available	08/95	D. Rosen	Cardiff House Paint Project: Background Information	CA-SCR-198H, Cardiff House	Review
S-017590	09/95	C. Simpson-Smith, R. Edwards	Archaeological Monitoring for the Barn Theater: ADA and Path Project at University of California, Santa Cruz	CA-SCR-198H, 2 trash features, 2 foundation stones	Monitoring
S-017591	11/95	R. Edwards	Stonehouse Lot 118 Resurfacing (letter report)	CA-SCR-198H	Field Study
S-018679	05/96	R, Edwards	Stores Fire Sprinkler Trench Monitoring, University of California at Santa Cruz, Project Authorization No.: ARC 015	None	Monitoring
S-018677	05/96	C. Simpson-Smith, R. Edwards	Archaeological Monitoring for the Blacksmith 's Shop: ADA Improvements at the University of California, Santa Cruz	CA-SCR-198H, 1 trash feature, 1 wood platform	Monitoring

Study No.	Date	Author(s)	Title	Sites	Study Type
None/Not Available	09/97	S. Wee, JRP Historical Consulting Services	Historic Resources on the Historic Cowell Ranch	CA-SCR-198H	Review of Archi-tecture
None/Not Available	11/97	C. Aldecoa, Environmental Assessment Group	Historic Property Survey Report/ Finding of Effect for the Proposed Improvements to Intersection of Coolidge Drive and Campus Facilities Access Road University of California Santa Cruz	CA-SCR-198H (Proposed change in site boundary to exclude corporation yard)	Survey
None/Not Available	2/98	Brady/LSA	Draft Pogonip Master Plan Environmental Impact Report	7 historic properties and features	Research /Master Plan
None/Not Available	11/98	C. Morgan, T. Jackson	Archaeological Monitoring of the Central Garage, Removal of Underground Fuel Tanks	CA-SCR-198H, 2 redwood posts	Monitoring
None/Not Available	12/98	C. Morgan, T. Jackson	Archaeological Monitoring for the Coolidge Drive/CAMFAC Intersection Improvements, University of California Santa Cruz, Santa Cruz County, CA.	CA-SCR-198H, Limestone, ash and trash feature	Monitoring
None/Not Available	1999 ?	T. Jackson	Draft letter: Installation of Temporary Office Trailers, University of California, Santa Cruz	None	Review
None/Not Available	01/00	T. Jackson	Modular Housing Relocation Project	CA-SCR-182H, Unrecorded Lower Quarry	Review
S-023014	05/00	B. Beck	CDF Project Review Report for Archaeological and Historical Resources, Marshall Field 2000, Project #RXCZU015 (California Department of Forestry)	P-44-000456	CF MOU
None/Not Available?	05/00	C. Aldecoa, Environmental Assessment Group	Central Garage Addition letter report to State Historic Preservation Officer	Adjacent to CA-SCR-198H	Review
None/Not Available	06/00	T. Jackson	Jordan Gulch Drainage Remediation Project	CA-SCR-182H, Unrecorded pocket quarry	Survey
None/Not Available	01/01	T. Jackson	Cultural Resources Survey for College Infill Apartments Project	None; Adjacent to CA-SCR-182H	Survey
None/Not Available	02/01	ARG	Cowell Ranch Revised Draft Historic District Management Plan/ Treatment Guidelines University of California, Santa Cruz, Santa Cruz, California	CA-SCR-198H, CA-SCR-182H	Review
None/Not Available	02/01	ARG	Cowell Ranch Revised Draft Historic District Evaluation University of California, Santa Cruz, Santa Cruz, California	CA-SCR-198H, CA--182H (lower section is district contributor)	Draft Evaluation
None/Not Available	11/01	T. Jackson	Archaeological Reconnaissance for Proposed Engineering Building	None	Survey
None/Not Available	12/01	T. Jackson	Archaeological Reconnaissance for Proposed Butler Building between UCSC Power Plant and McLaughlin Drive	None	Survey
None/Not Available	06/02	ARG	Cowell Ranch Revised Draft Historic District Evaluation University of California, Santa Cruz, Santa Cruz, California	CA-SCR-198H, CA-SCR-182H (lower section is district contributor, but no longer within district boundary)	Draft Evaluation
None/Not Available	03/03	T. Jackson	Cultural Resources Inventory for the Proposed Humanities and Social Sciences Facility, University of California at Santa Cruz	None	Survey

Study No.	Date	Author(s)	Title	Sites	Study Type
None/Not Available	04/03	D. Eselius	UCSC Proposed Humanities and Social Sciences Facility EIR Assessment (letter report)	Historic kilns, Cowell Home Ranch	EIR Review
None/Not Available	09/03	T. Jackson	Emergency Response Center Project Adjacent to National Register-Eligible Cowell Ranch District	Adjacent to CA-SCR-198H in facilities area	Review
None/Not Available	01/04	T. Jackson	Cultural Resources Inventory, McHenry Library Addition and Renovation Project, UCSC	None	Survey
None/Not Available	07/04	Jones & Stokes	Draft Cultural Resources Inventory Report for the UC Santa Cruz Ranch View Terrace Project, South UCSC Campus, Santa Cruz County, California	None	Survey
None/Not Available	12/04	T. Jackson	Cultural Resources Inventory Digital Arts Facility Project, UCSC (letter report)	CA-SCR-182H (no new resources)	Inventory
None/Not Available	09/05	Kennedy/ Jenks Consultants	Stormwater and Drainage Master Plan	None	Master Plan
None/Not Available	03/05	E. Reese, T. Jackson	(In progress) Survey report for Family Student Housing.	Adjacent to CA-SCR-142	Survey, intensive
None/Not Available	05/05	E. Reese	Preliminary Cultural Resources Inventory, University of California, Santa Cruz	7 historic features, 1 prehistoric iso, 8 previously recorded sites	Survey
None/Not Available	06/05	E. Reese and T. Jackson	Cultural Resource Evaluation of the University of California, Santa Cruz Infrastructure Improvement Project	CA-SCR-142, CA-SCR-181, CA-SCR-182H, CA-SCR-183, CA-SCR-186	Survey
None/Not Available	07/05	URS/UC Santa Cruz	University of California, Santa Cruz Long-Range Development Plan	N/A	Development Plan
None/Not Available	07/05	E. Reese, T. Jackson, M. Elliott	University of California, Santa Cruz, Infrastructure Improvement Project, Santa Cruz, California	CA-SCR-181, CA-SCR-182H, CA-SCR-183H, CA-SCR-186H	Survey
S-036239	11/05	E. Reese	Cultural Resources Inventory, UCSC (letter report)	4 quarries and CA-SCR-182H	Inventory Summary
None/Not Available	02/06	Architectural Resource Group and Pacific Legacy	Getty Foundation Campus Heritage Grant, 2004, University of California, Santa Cruz	Cowell Ranch and Lime Industry Historic District	Project Overview and Evaluations
None/Not Available	01/07	E. Reese, P. Welsh, T. Jackson	Data Recovery Results for The Ranch View Terrace Project at the University of California at Santa Cruz, Ssanta Cruz County, California	CA-SCR-198H	Excavation
S-034280	03/07	S. S. Morgan	An Archaeological Survey Report for the UC Santa Cruz Timber Harvest Plan, Santa Cruz, County, California, THP # 1-07-062 SCR	CA-SCR-182H, P CA-SCR-183H	Field Study
S-034292	08/07	W. H. Bonner, J. M. Keasling	Cultural Resources Records Search Results and Site Visit for T-Mobile Wireless Candidate SF15031 (UCSC Monopole), 1156 High Street, Santa Cruz, Santa Cruz County, California (letter report)	None	Field Study
S-033875	08/07	J. C. Whatford	Archaeological Survey Report, Wilder Ranch and Marshall Field 2007 VMP, RX North-028 CZU	CA-SCR-3, CA-SCR-4, P-44-000456	Field Study
S-035233	07/08	L. Billat	New Tower ("NT") Submission Packet, FCC Form 620, Project Name: DAS Next G UCSC - The Village, Project Number: SF-11070A	None	Field Study
S-036238	04/09	E. Reese	(Arboretum) Monitoring Report and Evaluation of Historical Refuse at CA-	CA-SCR-359H	

Study No.	Date	Author(s)	Title	Sites	Study Type
			SCR-359H, the City of Santa Cruz Reservoir Site, Santa Cruz		
S-036784	05/09	W. H. Bonner, K. A. Crawford	Cultural Resources Records Search and Site Visit Results for NextG Networks, Inc. Candidate CN 3792 (UCSC Pole), Hager Drive (South), U.C.S.C. Campus, Santa Cruz, Canta Cruz County, California (letter report)	None	
S-036242	05/09	E. Reese	Data Recovery Program Report for the Blacksmith Shop Feature, CA-SCR-198H, University of California, Santa Cruz, Santa Cruz County, California	CA-SCR-198H	Excavation
S-044307	05/12	A. Travers	Archaeological Sensitivity Assessment CNU3474/ 1156 High Street, 1156 High Street, Santa Cruz, Santa Cruz County, CA, EBI Project #6113030 (letter report)	None	Field Study
S-039111	12/11	S. S. Morgan	An Archaeological Survey Report for the UC Santa Cruz Co-Gen Timber Harvest Plan/Timberland Conversion Permit, Santa Cruz County, California	CA-SCR-160, CA-SCR-182H, CA-SCR-183H, CA-SCR-360H, CA-SCR-361H	Architectural/ Historical Field Study
44-000184	02/12	P. Paramoure	Infrastructure Phase 2 Storm Water Improvements - Excavation, Trenching, and Grading Archaeological Monitoring Report, UCSC Santa Cruz County, California	None	Monitoring
S-039232	06/12	E. Reese	Archaeological Monitoring for the Barn H Loading Dock Project Excavations at the University of California, Santa Cruz	None	Monitoring
S-046358	09/12	P. Paramoure	UCSC Archaeological Resources Study, Telecommunications Infrastructure Improvements Phase A Project, Santa Cruz County, California - (letter report)	CA-SCR-359H	Field Study
S-046383	10/12	P Paramoure	Campus Corporation yard Fleet Vehicle Wash - Trenching, and Excavation Monitoring Report, Santa Cruz County, California	None	Excavation, Monitoring
S-040046	01/13	C. B. Vaughan	An Archaeological Survey Report for the UC Santa Cruz Merrill Timber Harvest Plan/Timberland Conversion Permit, Santa Cruz County, California	None	CF MOU
S-042680	04/13	C. Losee	Collocation ("CO") Submission Packet FCC Form 621 for Stevenson College - 101 McLaughlin Drive, Unversity of California, Santa Cruz	P-44-000741	Field Study
S-042681	04/13	C. Losee	Collocation ("CO") Submission Packet FCC Form 621 for Campus Fleet Garage and TSM Office Antenna Replacement - Coolidge Drive, University of California, Santa Cruz	None	Evaluation, Field Study
S-045506	09/13	M. Kaye and S. Dexter	University of California at Santa Cruz Physical Planning and Construction Archaeological Survey Report: Historic Cowell Ranch Hay Barn Reconstruction Project	None	Survey

Study No.	Date	Author(s)	Title	Sites	Study Type
S-046387	00/14	P. Paramoure	An Archaeological Survey of the Northern Portion of the Lower Quarry Field, University of Santa Cruz, Santa Cruz County, California	None	Field Study
S-046385	00/14	P. Paramoure, J. Schlagcheck	An Archaeological Investigation of a Historic Stone Foundation Site for Proposed New Recycling Yard, University of California, Santa Cruz, Santa Cruz County, California	None	Excavation, Field Study
S-046384	01/14	P. Paramoure	Campus Corporation Yard CNG Stanchion Project Archaeological Monitoring Report (letter report)	None	Monitoring
None/Not Available	02/14	P. Paramoure	Patricia Paramoure Archaeological Consulting Infrastructure Phase 2 Storm Water Improvements – Excavation, Trenching, and Grading Archaeological Monitoring Report	Possible Cowell Ranch fence remnant and historic isolates	Monitoring
S-046361	04/14	P. Paramoure	Archaeological Monitoring and Artifact Analysis, Hay Barn Renovation Project at the Cowell Lime Works Historical District, University of California, Santa Cruz	None	Monitoring
S-046289	05/14	P. Paramoure	Telecommunications Infrastructure Improvements Phase A Archaeological Monitoring Report	None	Monitoring
S-046361	08/14	P. Paramoure, J. Schlagheck	Archaeological Monitoring and Subsurface Reconnaissance of the Historic Hay Barn Site, University of California, Santa Cruz, Santa Cruz County, California	None	Excavation, Monitoring
S-046377	10/14	P. Paramoure, C. Mikulik	UCSC infrastructure Phase 2 Storm Water Improvements, Jordan Gulch Main Stem Project, Archaeological Monitoring Report, Santa Cruz County, California	CA-SCR-182H	Excavation, Monitoring
S-048801	11/15	P. Paramoure	University of California at Santa Cruz Student Life Seismic Corrections Phase 2A-Cardfiff House Project Archaeological Monitoring Report	A large number of scattered historic artifacts were observed and collected.	Monitoring
S-047398	02/16	S. Dexter and M. Fitzgerald	University of California at Santa Cruz Physical Planning and Construction Archaeological Survey Report: New Environmental Health & Safety Facility Project	CA-SCR-424H road segment	Survey
S-046361 a	04/16	P. Paramoure	Archaeological Monitoring and Artifact Analysis, Hay Barn Renovation Project at the Cowell Lime Works Historical District, University of California, Santa Cruz	None	Monitoring
None/Not Available	06/16	L. Holm	3149-01 University of California, Santa Cruz West Campus Housing Study Area, Santa Cruz County, California (letter report)	None	Survey
S-048231	08/16	Brady, R.	Cultural Resources Inventory for the UCSC Modular Student Housing Project - Santa Cruz County, CA (letter report)	CA-SCR-182H, CA-SCR-185H, P-44-000741, P-44-000855	Field Study
S-046385 a	12/16	P. Paramoure	University of California at Santa Cruz New Recycling Yard Project Archaeological Monitoring Report	None	Evaluation, Field Study, Monitoring

Study No.	Date	Author(s)	Title	Sites	Study Type
S-049040	01/17	C. B. Vaughan, S. D. Dexter, M. K. Fitzgerald	CAA Adendum for UC Santa Cruz EH&S THP/TCP Santa Cruz, California	CA-SCR-424H	Field Study
S-049916	04/17	D. Brunzell	Cultural Resources Assessment for the Santa Cruz Crown Castle DAS Project, Santa Cruz, Santa Cruz County, California (BCR Consulting Project No. SYN1609) (letter report)	None	Field Study
S-051929	08/18	H. Haas, B. Vargas	Archaeological Resources Survey Update for the Kresge College Project (letter report)	None	Field Study
None/Not Available	10/18	Architecture & History, LLC, Knapp Architects, and Watson Heritage Consulting	University of California, Santa Cruz, Kresge College Historic Resource Evaluation	Kresge College structures	Evaluation
None/Not Available	03/19	R. Brady	Cultural Resources Assessment for the UCSC Great Meadow Bike Path (letter report)	CA-SCR-182H, CA-SCR-198H, CA-SCR-277H, P-44-000855 (Cowell Home Ranch District), P-44-000958, P-44-001027	Survey

APPENDIX D.

Native American Contact

Appendix D. Native American Contact Log

UCSC LRDP 2020 (PL 3593-01)					Pacific Legacy Representative: Shanna Streich
Organization	Contact	Letter Sent	Phone	E-mail	Comments
Native American Heritage Commission (NAHC)	Sarah Fonseca, Cultural Resources Analyst	03/27/2020 (UC Main Campus)	(916) 373-3710	nahc@nahc.gov	Sacred Lands Files search request for campus-centered area. Response received via email, stating Positive results, on 04/01/2020.
		05/11/2020 (Delaware Street)			Sacred Lands File search request for 2300 Delaware Ave. Response received stating Positive results, on 05/13/2020.
Amah Mutsun Tribal Band	Valentin Lopez, Chairperson	05/13/2020	(916) 743-5833	vlopez@amahmutsun.org	Letter emailed. Email response received on 05/14/20 requesting further discussion of project.
Amah Mutsun Tribal Band of San Juan Bautista	Irenne Zwierlein, Chairperson	05/13/2020	(650) 851 - 7489	amahmutsuntribal@gmail.com	Letter emailed. Email response received on 05/14/20; Ms. Zwierlein expressed concern that NWIC should be consulted for previous sites.
Costanoan Ohlone Rumsen-Mutsun Tribe	Patrick Orozco, Chairman	05/13/2020	(831) 728 - 8471	yanapvoic97@gmail.com	Letter emailed.
Indian Canyon Mutsun Band of Costanoan	Ann Marie Sayers, Chairperson	05/13/2020	(831) 637 - 4238	ams@indiancanyon.org	Letter emailed.
Muwekma Ohlone Indian Tribe of SF Bay Area	Monica Arellano	05/13/2020	(408) 205 - 9714	marellano@muwekma.org	Letter emailed.

Appendix E2 – Historic Resources Report

UC Santa Cruz
2020 Long Range Development Plan Historic Resources Technical Memorandum

completed for:
ascent environmental, inc.
sacramento, ca

submitted by:
architecture + history, llc
in association with watson heritage consulting
san francisco, ca
415 760 4318

december 2020

Table of Contents

I. Introduction

Purpose

The purpose of this Technical Memorandum is to inform the Environmental Impact Report (EIR) for the 2020 Long Range Development Plan (LRDP) for the University of California, Santa Cruz (UCSC). This report has been compiled jointly by architecture + history, llc, and Watson Heritage Consulting (the consultant team). This effort focuses on historic architectural and built resources, a separate study focusing on archaeological and cultural resources has been undertaken by Pacific Legacy, Inc. This technical memorandum identifies previously evaluated and designated historic resources within the UCSC campus environment and provides general information on potential historic resources within the campus boundary.

Methodology

In March and May 2020, the consultant team conducted a reconnaissance-level survey of properties on the University of California, Santa Cruz campus that were built before 1980 and had not been documented previously in any historic resource assessments. Buildings constructed before 1980 would be 50 years of age in 2030 and thus may become age eligible for both the National Register of Historic Places (NRHP) and the California Register of Historical Resources (CRHR) by that time.

The consultant team conducted both primary and secondary research to inform the evaluation. This included reviewing the Long Range Development Plans prepared for UCSC in 1963, 1971, 1978, 1988, and 2005, as well as the 2005 EIR for the LRDP. The consultant team reviewed an intensive-level survey of the UCSC campus core completed in 2005 by Architectural Resources Group (ARG), prepared by two members of the current consultant team, Bridget Maley and Shayne Watson. The UCSC Physical & Environmental Planning Services department provided building databases and maps that aided in the development of a database prepared for this report. That database, which includes every building on the UCSC campus, presents construction date; architect, builder, engineer, and landscape architect; and information regarding whether or not the building was included in previous or current historic resources surveys. The database is attached as Appendix B of this report. Preliminary data sheets for buildings not previously inventoried were completed for buildings and complexes that pre-date 1980 and are included in Appendix A of this report. One property constructed in 1980, the Westside Research Park at 2300 Delaware Avenue, a site owned by UCSC, is included in the LRDP plan area. A data sheet was completed for this off-campus site for informational purposes.

II. Overview of Previous Historic Resources Studies at UCSC

2004 Getty Foundation Campus Heritage Grant Historic Context Statement and Survey

As part of a Getty Campus Heritage Grant awarded to UCSC in 2004, San Francisco-based consulting firm ARG evaluated the historical significance and integrity of the campus core of UCSC using the criteria of both the National Register of Historic Places (NRHP) and the California Register of Historical Resources (CRHR). All buildings surveyed were recorded on State of California Department of Parks and Recreation Series 523 forms (DPR forms). The survey was based on historical background and guidance developed in the *Campus Core Historic Context Statement*, prepared for UCSC by ARG in 2006.

ARG concluded in the Getty Grant survey that a majority of the original UCSC campus core, including the first six colleges, and a number of other campus buildings, are significant at the national level as a potential historic district under NRHP Criterion C/CRHR Criterion 3, as a collection of

> buildings that are associated with master architects of the Modern movement of architecture. The buildings represent an exceptional example of their type, period, and method of construction and are emblematic of an era and still possess high artistic values associated with the Bay Region Modernism movement.[1]

ARG identified the period of significance for the potential Campus Core historic district as 1964, when construction began on the UCSC campus, to 1973, the year the last prominent architect designed a residential college (Kresge College, designed by Charles Moore of Moore and Turnbull).[2]

It is important to note that at the time of the 2005 survey, the earliest buildings on the UCSC campus--completed in 1965--were only 40 years in age and did not meet the 50-year threshold required for buildings eligible for the NRHP. As such, UCSC campus buildings were identified as having the potential to contribute to a UCSC campus core historic district when they reached 50 years in age. According to ARG,

> [I]t is highly likely that when the buildings associated with the initial campus building campaign reach 50 years of age, or even before under an exceptional significance consideration, they would be strong candidates for historic designation, possibly at the highest level, National Historic Landmark, and certainly as a historic district under both the National and California Registers.[3]

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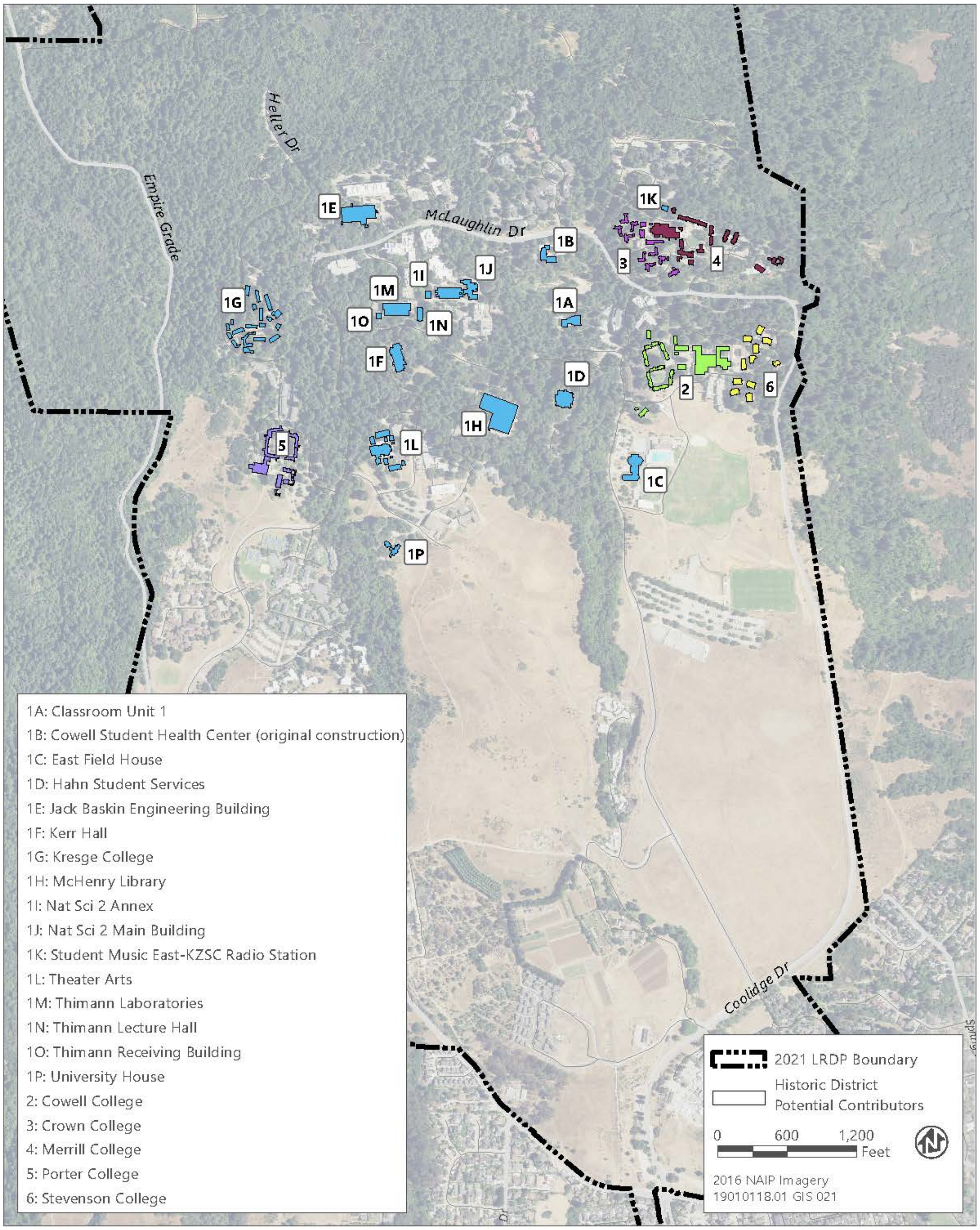
[1] Architectural Resources Group, *Campus Core Historic Context Statement* (February 2006), 13.
[2] Ibid., 13.
[3] Ibid.

The 2005 survey identified the following buildings as potential contributors to an identified UCSC campus core historic district:

Table 1 - UCSC Campus Core Historic District Potential Contributors

Building Name	**Construction Year**	**Architect**
Classroom Unit 1	1972	Marquis & Stoller
Cowell College	1966	Wurster, Bernardi & Emmons
Cowell Student Health Center (original construction)	1970	John Funk
Crown College	1967	Ernest J. Kump & Associates
East Field House	1965	Callister, Payne & Rosse
Hahn Student Services	1965	Ernest J. Kump
Jack Baskin Engineering Building	1971	Reid & Tarics
Kerr Hall	1973	Germano Milano & Associates
Kresge College	1973	MLTW Moore - Turnbull
McHenry Library	1966	John Carl Warnecke & Assoc.
Merrill College	1968-1971	Campbell & Wong & Associates
Nat Sci 2 Annex	1969	Anshen & Allen
Nat Sci 2 Main Building	1969	Anshen & Allen
Porter College	1971-1973	Hugh Stubbins & Associates
Stevenson College	1966-1968	Joseph Esherick & Assoc.
Student Music East-KZSC Radio Station	1967	UCSC staff
Theater Arts	1971	Ralph Rapson & Associates
Thimann Laboratories	1965	Anshen & Allen
Thimann Lecture Hall	1965	Anshen & Allen
Thimann Receiving Building	1965	Anshen & Allen
University House	1967	Ratcliff Slama Cadwalader

In 2020, the buildings and college complexes within the campus core are almost all 50 years in age or will be in the next few years, making the “exceptional significance” criterion not applicable to a majority of the potential district contributors. The end of the period of significance would still be under 50 years, dating to 1973. Additionally, most of these buildings and complexes have not undergone changes that would affect their significance status and should continue to be considered contributors to a potential UCSC campus core historic district. The exception is Kresge College, which is currently undergoing a renewal and expansion project. However, the remaining buildings at Kresge would still contribute to the campus core historic district. Buildings in Table 1 that were constructed from 1971 to 1973 are not yet 50 years in age. The potential UCSC campus core district, with a period of significance of 1964-1973, would likely be found significant under NRHP Criteria Consideration G: properties of exceptional importance that have achieved significance within the past 50 years (36 CFR Part 60).



Source: Data received from UCSC and Watson Heritage Consulting in 2020

10/22/2020

UCSC Campus Core Historic District Potential Contributors

The following four buildings--all located within the campus core--were recorded on DPR forms for the 2005 survey. However, the 2005 survey concluded that more information was needed to determine whether or not the buildings are contributors to a potential campus core historic district. This decision was based on lack of information at the time regarding physical exterior alterations, resulting in a limited ability to assess integrity.

Table 2 - UCSC Campus Core Historic District Properties Needing More Research

Building Name	Construction Year	Architect
Central Heating Plant	1966	Spencer, Lee & Busse
Communications Building	1968	Spencer, Lee & Busse
Hahn Art Facility	1968	UCSC staff
Student Union Redwood	1967	Henrik Bull

Cowell Lime Works National Register Historic District

The Cowell Lime Works National Register Historic District is an extensive complex of extant 19th and 20th century buildings, structures, and associated archaeological features, as well as several other related archaeological sites that include railroad, quarrying, and lime kiln features associated with quicklime production at Cowell Ranch between about 1851 and 1946. The Cowell Lime Works District is scattered over an area of about 30 acres just inside the UCSC main campus entrance. During development of the 2005 LRDP, a NRHP nomination for the Cowell Lime Works Historic District was prepared. The District was determined to be eligible for listing in the NRHP under Criterion A and in the CRHR under Criterion 1 for its role in the development of lime mortar manufacturing in California between 1851 and 1906. While the integrity of many of the buildings and features had been diminished through deterioration, physical damage from development, or adaptive reuse and thus no longer contributed to its significance, the district and many of its features retained their historical significance. A draft historic district management plan was prepared in 2006 with the objective of maintaining the district's historical character; however, this plan has not yet been finalized. As noted above, the Cowell Lime Works Historic District was listed in the NRHP and CRHR in 2007 (NPS #07001220). The following buildings are listed in the National Register as contributors to the Cowell Lime Works Historic District:

Table 3 - Cowell Lime Works National Register Historic District Contributors

Building Name	Address	Construction Year
Blacksmith Shop	93 Ranch View Road	1850s, circa
Blacksmith Shop	93 Ranch View Road	1850s, circa
Cardiff House Women's Center (Ranch House)	117 Carriage House Road	1850s, circa; expanded 1864
Cook House	109 Coolidge Drive	1850s, circa
Cooperage	113 Coolidge Drive	1854
Granary	102 Coolidge Drive	1860s, circa
Hay Barn	94 Ranch View Road	1850s, circa

Powder House	90 Ranch View Road	1850s, circa
Stone House (Paymaster's House)	100 Coolidge Drive	1860s, circa
Theater Barn	101 Coolidge Drive	1850s

The following buildings are located within the Cowell Lime Works National Register Historic District boundaries but are considered non-contributors:

Table 4 - Cowell Lime Works National Register Historic District Non-Contributors

Building Name	**Address**	**Construction Year**
Barn G	101 Ox Team Road	1860s, circa
Carriage House	105 Carriage House Road	1870s, circa
Farm Slaughter House	103 Farm Road	1900, circa
Receiving Barn (Barn H)	116 Ox Team Road	1860s, circa

Kresge College Historic District Evaluation

In October 2018, architecture+history, llc, in collaboration with Watson Heritage Consulting and Knapp Architects (consultant team), prepared a California Environmental Quality Act (CEQA) historic district evaluation of Kresge College in anticipation of the Kresge College Renewal and Expansion Project (Project). The consultant team concluded that Kresge College is eligible for the CRHR as a historic district under CRHR Criterion 1, at the statewide level of significance, in the area of education for its association with the development of UCSC. Additionally, Kresge College is eligible under CRHR Criterion 3, at the statewide level of significance, in the area of architecture as what appears to be the singular collaboration of master designers: architect Charles Moore (with MLTW) and landscape architect Dan Kiley.

An Environmental Impact Report completed in February 2019 that analyzes the potential impacts of the Kresge Project concludes that the Project will adversely affect the identified Kresge College Historic District (KCHD) through demolition of contributing buildings, renovation, and new construction (Impact CUL-1 Historic Resources).[4] Mitigation measures proposed to minimize impacts of the Project on the KCHD “do not eliminate or minimize the material impairment of KCHD...to a less than significant level. Therefore, this impact would remain significant and unavoidable.”[5] Because of these actions, the Project would demolish and adversely alter some of the physical features that convey the KCHD’s significance and justify its inclusion in the CRHR. However, Kresge College would still contribute to the larger campus core historic district.

[4] UCSC, “Kresge Findings: California Environmental Quality Act Findings in Collection with the Approval of the Kresge College Renewal and Expansion Project, Santa Cruz Campus” (n.d.), 12. Accessed at https://ppc.ucsc.edu/planning/images/kresge-findings.pdf.
[5] Rincon Consultants, Inc., *Kresge College Renewal and Expansion Project, Draft Environmental Impact Report* (November 2018), 4.6-23.

III. 2020 Reconnaissance-Level Survey

In March and May 2020, the consultant team conducted a reconnaissance-level survey of buildings on the UCSC campus that were built before 1980 and had never been documented in previous surveys--either because of their age or because they were located outside of the campus core. Preliminary data sheets for these buildings are provided in Appendix A of this report.

Table 5 - 2020 Reconnaissance Survey, Arranged by Campus Region

Campus Core

Building Name	**Construction Year**	**Architect**	**Builder**	**Engineer**	**Landscape Architect**
Astronomy Shop A	1966	UCSC Physical Planning & Construction	Unknown	Unknown	Unknown
Astronomy Shop B	1966	UCSC Physical Planning & Construction	Unknown	Unknown	Unknown
Communications Trailer 1	1979	UCSC Physical Planning & Construction	Unknown	Unknown	Unknown
Cooling Tower 1	1971	Robert Heaton	Unknown	Unknown	Unknown
Fire House	1975	William M. Gillis and Associates	Unknown	Unknown	Unknown
Physical Education Activities Building	1974	UCSC Physical Planning & Construction	Unknown	Unknown	Unknown

Main Entrance

Building Name	**Construction Year**	**Architect**	**Builder**	**Engineer**	**Landscape Architect**
Campus Fleet Garage and TSM Office	1971	Gulli & Del Campo	Unknown	Unknown	Unknown
Physical Planning & Construction Trailer 2	1978	UCSC Physical Planning &	Unknown	Unknown	Unknown

		Construction			
Sign Shop	1965	UCSC Physical Planning & Construction	Unknown	Unknown	Unknown

West Side

Building Name	Construction Year	Architect	Builder	Engineer	Landscape Architect
Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown	Unknown	Casey A. Kawamoto
Fieldhouse West	1977	Bull Field Volkmann Stockwell	G.W. Davis	Unknown	Unknown
Kiosk for West Entrance	1970	Unknown	Unknown	Unknown	Unknown
Oakes College	1976	McCue, Boone, Tomsick	Unknown	Unknown	Royston, Hanamoto, Beck & Abey

UCSC Farm and Garden

Building Name	Construction Year	Architect	Builder	Engineer	Landscape Architect
Alan Chadwick Garden Solar Greenhouse	1978	Unknown	Unknown	Unknown	Unknown
Farm Chalet	1975	Unknown	Unknown	Unknown	Unknown
Farm Equipment Barn & Sleep loft	1973	Unknown	Unknown	Unknown	Unknown
Farm Vegetable Packing & Storage	1973, circa	Unknown	Unknown	Unknown	Unknown

2300 Delaware Avenue

Building Name	Construction Year	Architect	Builder	Engineer	Landscape Architect
Westside Research Park	1980	Unknown	Unknown	Unknown	Unknown

IV. Summary Observations About Historic Resources on the UCSC Campus

Potential UCSC Campus Core Historic District

As noted above, at the time of the 2005 survey, the earliest buildings on the UCSC campus--completed in 1965--were only 40 years in age and did not meet the 50-year threshold required for buildings eligible for the NRHP. Now that the original campus core buildings have reached or are approaching 50 years in age, it is recommended that UCSC undertake a reevaluation of campus core buildings--guided by an updated and expanded historic context statement--to determine if the UCSC campus core qualifies as a discontiguous historic district under NRHP/CRHR significance criteria. This project could be modeled on the recently completed *University of California, San Diego Campus-wide Historic Context Statement and Historic Resource Survey* (Architectural Resources Group, 2018) and could be a mitigation measure in the UCSC LRDP EIR.

Kresge College

Kresge College was identified in the 2005 survey as being a contributor to a potential UCSC campus core historic district. In 2018, the Kresge College campus was determined eligible for the CRHR as a historic district under CRHR Criteria 1 and 3. As described above, the Kresge College Renewal and Expansion Project, currently underway, will adversely affect the KCHD when construction is complete. In spite of this, Kresge College would still be considered a contributor to the potential UCSC campus core historic district.

Limiting future physical interventions at the Kresge College campus would reduce further impacts on Kresge's ability to contribute to a larger campus core historic district.

Center for Agroecology & Sustainable Food Systems (Farm), Alan Chadwick Garden, and Arboretum

The 1978 LRDP discusses "A Proposed UCSC Natural Resources Management Plan" (August 1977) for the preservation and use of natural resources on the campus. The plan identifies four different natural resource areas at UCSC: the Great Meadow; research reserve and buffer zones; drainage zones; and special project zones.[6] The LRDP proposes several study areas for preservation, including the UCSC Farm, Alan Chadwick Garden, and Arboretum.[7] These areas, according to the LRDP, "are to be specifically eliminated from the preferred developable areas of the campus."[8] The 1988 LRDP designates the UCSC Farm, Garden, and Arboretum as "Site-specific Research Areas."[9]

[6] Esherick, Homsey, Dodge and Davis et al., *Long Range Development Plan, University of California, Santa Cruz* (1978), 19.
[7] Ibid.
[8] Ibid., 20.
[9] UCSC, *Long Range Development Plan, University of California, Santa Cruz* (1988), n.p.

The UCSC Farm and Alan Chadwick Garden are now recognized internationally for training and research in organic horticulture and agriculture.[10] Both sites contain age-eligible (more than 50 years old) buildings and structures that were documented in the 2020 reconnaissance-level survey. Because of the potential significance of the UCSC Farm and Garden (and possibly the Arboretum, if connected) related to organic horticultural and agricultural education and training.

It is recommended that a future project fully document and evaluate these sites under NRHP/CRHR criteria.

Oakes College

As a result of demands by the Black Liberation Front and other campus minority groups, in February 1969, the Academic Senate approved the development of UCSC's first ethnic studies college.[11] Founded in 1972, Oakes College is the first college at UCSC dedicated to the study of minority groups in California. Oakes co-founder and UCSC's only Black professor at the time, Herman J. Blake was the college's first provost.

Designed by the architecture firm of McCue, Boone, Tomsick, the buildings of Oakes College were completed in 1976. Not included in the 2005 survey because of its later construction date, Oakes College was documented in the 2020 reconnaissance-level survey.

It is recommended that Oakes College be documented and evaluated under NRHP/CRHR criteria for its potential significance as UCSC's first ethnic studies college and its history of supporting UCSC's underrepresented minority communities.

[10] UCSC, "Center for Agroecology & Sustainable Food Systems (Farm) and Alan Chadwick Garden," UCSC website. Accessed at https://casfs.ucsc.edu/about/facilities.html.
[11] UCSC, "History of Oakes," UCSC website. Accessed at https://web.archive.org/web/20051217212513/http://oakes.ucsc.edu/history.htm.

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UCSC. *Long Range Development Plans, University of California, Santa Cruz*. 1963, 1971, 1988, and 2005.

VI. Appendices

Appendix A: 2020 Reconnaissance-Level Survey Building Sheets

In March and May 2020, architecture+history, llc, and Watson Heritage Consulting conducted a reconnaissance-level survey of properties on the University of California, Santa Cruz campus that were built before 1980 and had never been documented in previous surveys. (One property constructed in 1980, the Westside Research Park at 2300 Delaware Avenue, is included because it is in the LRDP plan area.)

The following data sheets provide an overview description of properties surveyed in 2020, arranged chronologically by construction year.

SIGN SHOP

Address: 107 Ox Team Road
Construction date: 1965
Architect: UCSC Physical Planning & Construction
Builder: Unknown
Engineer: Unknown
Description: Prefabricated quonset hut with board-and-batten facade.

ASTRONOMY SHOP A

Address: 624 Red Hill Road
Construction date: 1966
Architect: UCSC Physical Planning & Construction
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Prefabricated Butler-type building.

ASTRONOMY SHOP B

Address: 622 Red Hill Road
Construction date: 1966
Architect: UCSC Physical Planning & Construction
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Prefabricated Butler-type building.

ALAN CHADWICK GARDEN

Address: 606 Merrill Road
Construction date: 1967; 1978 (Solar greenhouse)
Architect: Unknown
Landscape architect: Unknown
Description: Established in 1967, the three-acre Alan Chadwick Garden is composed of buildings, structures, and landscapes related to agricultural and horticultural education.

KIOSK FOR WEST ENTRANCE

Address: 200 Heller Drive
Construction date: 1970
Architect: UCSC Physical Planning & Construction
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Simple wood-frame kiosk building.

CAMPUS FLEET GARAGE AND TSM OFFICE

Address: 113 Ox Team Road
Construction date: 1971
Architect: Gulli & Del Campo
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Wood-frame barn-type building with diagonally-placed wood siding on the exterior walls.

STUDENT UNION

Address: 504 Steinhart Way
Construction date: 1971
Architect: Bull Field Volkmann Stockwell
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Redwood, board-and-batten-sheathed building with hipped roofs and wide, overhanging eaves.

COOLING TOWER 1

Address: 612 Red Hill Road
Construction date: 1969-1971
Architect: Robert Heaton
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Built on a 1,025 square-foot pad to support Thimann Labs.

FAMILY STUDENT HOUSING

Address: 101 Koshland Way
Construction date: 1970-71
Architect: Ratcliff Slama Cadwalader
Builder: Unknown
Engineer: Unknown
Landscape architect: Casey A. Kawamoto
Description: Large complex of multi-story residential housing characterized by boxy massings and stuccoed facades.

CENTER FOR AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS (UCSC FARM)

Address: 104 Farm Road
Construction date: 1971; 1973 (Farm Equipment Barn & Sleep Loft)
Architect: Unknown
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Established in 1971, the 30-acre Farm is composed of dozens of buildings and structures and designed landscapes related to agroecology education.

PHYSICAL EDUCATION ACTIVITIES BUILDING

Address: 403 East Field Service Road
Construction date: 1974
Architect: UCSC Physical Planning & Construction
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Prefabricated Butler-type building.

FIRE HOUSE

Address: 701 Chinquapin Road
Construction date: 1975
Architect: William M. Gillis and Associates
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Wood-sheathed exterior walls, gabled, shingle roofs.

OAKES COLLEGE

Address: 233 Oakes Road
Construction date: 1976-1977
Architect: McCue, Boone, Tomsick (1976-1977); Palmer & Rahe (1988)
Landscape architect: Royston, Hanamoto, Beck & Abey (1976-1977); Thomas Scherer (1988)
Description: Founded in 1972, Oakes College was the seventh college established at UC Santa Cruz. The campus is characterized by boxy, shingle-sheathed buildings spread across a designed landscape divided by a ravine.

FIELDHOUSE WEST

Address: 311 Rachel Carson Service Road
Construction date: 1977
Architect: Bull Field Volkmann Stockwell
Builder: G.W. Davis
Engineer: Unknown
Landscape architect: Unknown
Description: Board-and-batten exterior walls, gabled, shingle roofs; expansive window wall on east facade.

PHYSICAL PLANNING & CONSTRUCTION TRAILER 2

Address: 105 Ox Team Road
Construction date: 1978
Architect: UCSC Physical Planning & Construction
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Prefabricated modular trailer.

COMMUNICATIONS TRAILER 1

Address: 625 Red Hill Road
Construction date: 1979
Architect: UCSC Physical Planning & Construction
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: Prefabricated modular trailer.

WESTSIDE RESEARCH PARK

Address: 2300 Delaware Avenue
Construction date: 1980
Architect: Unknown
Builder: Unknown
Engineer: Unknown
Landscape architect: Unknown
Description: The 2300 Delaware Avenue site was a commercial nursery owned by Peter Antonelli through the late 1970s.[12] In 1979, Synertek, a Santa Clara-based subsidiary of Honeywell Inc., applied for permits to build a $40 million computer-chip manufacturing and research plant at the 20.3-acre site. The proposed plant was 175,000 square feet, including a central manufacturing building and an office-cafeteria complex.[13] A permit was issued for the buildings in November 1980.[14]

[12] "Synertek: Zoners Want More Time For Study," *Santa Cruz Sentinel*, October 12, 1979, 27.
[13] Ibid.
[14] "Synertek Issued Permit," *Santa Cruz Sentinel*, November 9, 1980, 30.

Appendix B: UCSC Campus Building Database

The following database includes every building on the UCSC campus with associated construction date; architect, builder, engineer, and landscape architect; and information regarding whether or not the building was included in previous or current historic resources surveys. The database was developed using various databases and information provided by the UCSC Physical & Environmental Planning Services department.

BUILDING NAME	ADDRESS	CAMPUS REGION	CONSTRUCTION YEAR	ARCHITECT	BUILDER
Academic Resource Center	408 McHenry Road	Central Core	1989	Unknown	Unknown
Academic Resource Center Multipurpose Building	410 McHenry Road	Central Core	1989	Unknown	Unknown
Agroecology Modular A1	201 Village Road	Agroecology	1997	Unknown	Unknown
Agroecology Modular A2	203 Village Road	Agroecology	1997	Unknown	Unknown
Agroecology Modular A3	205 Village Road	Agroecology	1985	Unknown	Unknown
Agroecology Trailer 4	160 Farm Road	Agroecology	1988	Unknown	Unknown
Arboretum	104 Arboretum Road	Arboretum Neighborhood	1967, 1975	UCSC Physical Planning & Construction	Unknown
Arboretum Gift Shop	104 Arboretum Road	Arboretum Neighborhood	1994	Unknown	Unknown
Arboretum Gift Shop	104 Arboretum Road	Arboretum Neighborhood	1994	Unknown	Unknown
Arboretum Horticulture 1	120 Arboretum Road	Arboretum Neighborhood	1988	Unknown	Unknown
Arboretum Horticulture 2	122 Arboretum Road	Arboretum Neighborhood	1994	Unknown	Unknown
Arboretum Kiosk	103 Arboretum Road	Arboretum Neighborhood	1994	Unknown	Unknown
Arboretum Kubota Equipment Shed	123 Arboretum Road	Arboretum Neighborhood	1988	Unknown	Unknown
Astronomy Shop A	624 Red Hill Road	Science and Engineering Hill	1966	UCSC Physical Planning & Construction	Unknown
Astronomy Shop B	622 Red Hill Road	Science and Engineering Hill	1966	UCSC Physical Planning & Construction	Unknown
Barn G	101 Ox Team Road	Main Entrance Area	1860s, circa	Unknown	Unknown
Bay Tree Bookstore	500 Steinhart Way	Quarry Plaza	2001	Esherick Homsey Dodge & Davis (EHDD)	Unknown
Biomedical Sciences	575 McLaughlin Drive	Science and Engineering Hill	2012	Esherick Homsey Dodge & Davis (EHDD)	Unknown
Blacksmith Shop	93 Ranch View Road	Main Entrance Area	1850s, circa	Unknown	Unknown
Blacksmith Shop	93 Ranch View Road	Main Entrance Area	1850s, circa	Unknown	Unknown
Campus Fleet Garage and TSM Office	113 Ox Team Road	Main Entrance Area	1971	Unknown	Unknown
Campus Fleet Washbay	104 Carriage House Road	Main Entrance Area	2013	Unknown	Unknown
Cardiff House Women's Center (Ranch House)	117 Carriage House Road	Main Entrance Area	1850s, circa; expanded 1864	Unknown	Unknown
Carriage House	105 Carriage House Road	Main Entrance Area	1870s, circa	Unknown	Unknown
Center for Adaptive Optics	540 Red Hill Road	Science and Engineering Hill	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
Center for Agroecology & Sustainable Food Systems Lab	152 Farm Road	Agroecology	1983	Unknown	Unknown
Central Heating Plant	610 Red Hill Road	Science and Engineering Hill	1966	Spencer, Lee & Busse	Unknown
Central Heating Plant 2	604 Red Hill Road	Science and Engineering Hill	2003	Unknown	Unknown
Classroom Unit 1	520 Steinhart Way	Quarry Plaza	1972	Marquis & Stoller	Unknown
Cogen Mechanical Electrical Structure	608 Red Hill Road	Science and Engineering Hill	2015	Unknown	Unknown
College Nine Apartment Building 1	715 College Ten Road	College Nine	2000	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Apartment Building 2	725 College Ten Road	College Nine	2000	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Apartment Building 3	735 College Ten Road	College Nine	2000	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Apartment Building 4	740 College Ten Road	College Nine	2000	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Apartment Building 5	750 College Ten Road	College Nine	2000	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Commons	719 College Ten Road	College Nine	2000	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Dining Hall	615 College Nine Road	College Nine	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Residence Hall 1	630 College Nine Road	College Nine	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Residence Hall 2	610 College Nine Road	College Nine	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Residence Hall 3	620 College Nine Road	College Nine	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Nine Residence Hall Lounge	608 College Nine Road	College Nine	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Ten Residence Hall 4	606 College Ten Road	College Ten	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Ten Residence Hall 5	602 College Ten Road	College Ten	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
College Ten Residence Hall 6	604 College Ten Road	College Ten	2002	Esherick Homsey Dodge & Davis (EHDD)	Unknown
Communications Building	620 Baskin Circle	Science and Engineering Hill	1968	Spencer, Lee & Busse	Unknown
Communications Trailer 1	625 Red Hill Road	Science and Engineering Hill	1979	Unknown	Unknown
Communications Trailer 3	630 Red Hill Road	Science and Engineering Hill	1984	Unknown	Unknown
Cook House	109 Coolidge Drive	Main Entrance Area	1850s, circa	Unknown	Unknown
Cooling Tower 1	612 Red Hill Road	Science and Engineering Hill	1971	Robert Heaton	Unknown
Cooling Tower 4 EMS	551 Red Hill Road	Science and Engineering Hill	2012	Unknown	Unknown
Cooperage	113 Coolidge Drive	Main Entrance Area	1854	Unknown	Unknown
Core West Parking Structure	590 Heller Drive	Science and Engineering Hill	2001	Watry Design Group	Unknown
Cowell College Academic Building	518 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Adams House	516 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Apartment Building 1	501 Cowell Service Road	Cowell College	2004	BAR Architects	Unknown
Cowell College Apartment Building 2	503 Cowell Service Road	Cowell College	2004	BAR Architects	Unknown
Cowell College Apartment Building 3	505 Cowell Service Road	Cowell College	2004	BAR Architects	Unknown

Cowell College Beard House	511 Cowell Service Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Classroom Building	518 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Commons	520 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Commons	520 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Faculty Office Addition	521 Cowell Service Road	Cowell College	1987	Unknown	Unknown
Cowell College Garage	500 Cowell Service Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College House	500 Cowell Service Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Library	523 Cowell Service Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Morison House	514 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Parkman House	510 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Parrington House	513 Cowell Service Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Prescott House	512 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Scholars House	508 Cowell-Stevenson Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell College Turner House	517 Cowell Service Road	Cowell College	1966	Wurster, Bernardi & Emmons	Branaugh or Jasper Construction Co.
Cowell Student Health Center (original construction)	525 McLaughlin Drive	Student Health Center	1970	John Funk	Unknown
Cowell Student Health Center Addition	525 McLaughlin Drive	Student Health Center	2010	Unknown	Unknown
Cowell Student Health Center Addition	525 McLaughlin Drive	Student Health Center	2010	Unknown	Unknown
Crown College Admin Building	620 Crown Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Classroom Building	624 Crown Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Descartes House	655 Crown Service Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Faculty Wing	670 Crown Service Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Galen House	618 Crown Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Galileo House	675 Crown Service Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Gatehouse	628 Crown Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Gauss House	685 Crown Service Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Harvey House	625 Crown Service Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College House	660 Crown Service Road	Crown College	1968	Ernest J. Kump & Associates	Jasper Construction
Crown College Leonardo House	605 Crown Service Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Library	680 Crown Service Road	Crown College	1968	Ernest J. Kump & Associates	Jasper Construction
Crown College Maxwell House	615 Crown Service Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown College Preceptors Apartments	602 Crown Road	Crown College	1968	Ernest J. Kump & Associates	Jasper Construction
Crown College Rutherford House	665 Crown Service Road	Crown College	1967	Ernest J. Kump & Associates	Jasper Construction
Crown-Merrill Housing Building 1	702 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 10	740 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 11	742 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 12	752 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 13	732 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 14	730 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 2	706 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 3	708 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 4	712 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 5	722 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 6	710 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 7	716 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 8	724 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Housing Building 9	750 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Multipurpose Building 15	714 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Crown-Merrill Multipurpose Building 15	714 East Road	Crown College / Merrill College	1986	Veitzer Shonkwiler	Unknown
Digital Arts Research Center	407 McHenry Road	Elena Baskin Visual Arts Center	2009	Bohlin Cywinski Jackson	Unknown
Earth & Marine Sciences	552 Red Hill Road	Science and Engineering Hill	1993	McLellan & Copenhagen	Unknown
East Field House	418 Hagar Drive	OPERS Eastside	1965	Callister, Payne & Rosse	Unknown
Elena Baskin Building A	425 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1984	Marquis & Associates	Unknown
Elena Baskin Building B	429 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1984	Marquis & Associates	Unknown
Elena Baskin Building C	431 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1984	Marquis & Associates	Unknown
Elena Baskin Building D	433 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1984	Marquis & Associates	Unknown
Elena Baskin Building E	424 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1984	Marquis & Associates	Unknown
Elena Baskin Building F	430 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1984	Marquis & Associates	Unknown
Elena Baskin Building G	432 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1984	Marquis & Associates	Unknown

Elena Baskin Building H	427 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1990	Unknown	Unknown
Elena Baskin Building I	435 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1992	Unknown	Unknown
Elena Baskin Building J	436 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1993	Unknown	Unknown
Elena Baskin Building K	434 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1993	Unknown	Unknown
Elena Baskin Building L	422 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1998	Unknown	Unknown
Elena Baskin Building M	418 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1998	Unknown	Unknown
Elena Baskin Building N	421 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1998	Unknown	Unknown
Elena Baskin Building P	423 Baskin Arts Service Road	Elena Baskin Visual Arts Center	1998	Unknown	Unknown
Emergency Response Center	114 Carriage House Road	Main Entrance Area	2007	Ross Durlis Cusenbery	Unknown
Emergency Response Storage	1456 High Street	Arboretum Neighborhood	2007	Ross Durlis Cusenbery	Unknown
Engineering Building 2	612 Engineering Loop	Science and Engineering Hill	2004	Anshen & Allen	Unknown
Environmental Health & Safety Trailer	634 Red Hill Road	Science and Engineering Hill	1991	Unknown	Unknown
Fackler Cogeneration Plant	606 Red Hill Road	Science and Engineering Hill	2015	Unknown	Unknown
Family Student Housing A 1-4	101 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 1-4	101 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 13-18	113 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 13-18	113 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 13-18	113 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 13-18	113 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 5-7	105 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 5-7	105 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 5-7	105 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 5-7	105 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 8-12	108 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 8-12	108 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing A 8-12	108 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing Affiliate	530 Koshland Way	Family Student Housing	1973	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 10-12	210 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 10-12	210 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 10-12	210 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 13-19	213 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 13-19	213 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 13-19	213 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 13-19	213 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 13-19	213 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 24-28	224 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 24-28	224 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 24-28	224 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 24-28	224 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 3-6	203 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 3-6	203 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 3-6	203 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 3-6	203 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 7-9	207 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing B 7-9	207 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 1-5	301 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 1-5	301 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 1-5	301 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 17-23	317 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 17-23	317 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 17-23	317 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 17-23	317 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 17-23	317 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 6-7 and E 19	306 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 6-7 and E 19	306 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 6-7 and E 19	306 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 6-7 and E 19	306 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 6-7 and E 19	306 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown

Family Student Housing C 6-7 and E 19	306 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 6-7 and E 19	306 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 8-16	308 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 8-16	308 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 8-16	308 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 8-16	308 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 8-16	308 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 8-16	308 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 8-16	308 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing C 8-16	308 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing Common Building	540 Koshland Way	Family Student Housing	1979	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 1-6	401 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 1-6	401 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 1-6	401 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 1-6	401 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 1-6	401 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 1-6	401 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 10-14	410 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 10-14	410 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 10-14	410 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 10-14	410 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 10-14	410 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 10-14	410 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 15-21	415 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 15-21	415 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 15-21	415 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 15-21	415 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 15-21	415 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 15-21	415 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 7-9	407 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 7-9	407 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing D 7-9	407 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing E 1-5	501 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing E 1-5	501 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing E 1-5	501 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing E 10-13	510 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing E 10-13	510 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing E 6-9	506 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing E 6-9	506 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing E 6-9	506 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 1-5	601 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 1-5	601 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 1-5	601 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 1-5	601 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 1-5	601 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 11-14	611 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 11-14	611 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 11-14	611 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 11-14	611 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 15-17	615 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 18-23	618 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 18-23	618 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 18-23	618 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 18-23	618 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 18-23	618 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 24-29	624 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 24-29	624 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 24-29	624 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown

Family Student Housing F 24-29	624 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 30-33	630 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 30-33	630 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 6-10	606 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 6-10	606 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 6-10	606 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing F 6-10	606 Koshland Way	Family Student Housing	1971	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 12-14	712 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 15-16	715 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 15-16	715 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 15-16	715 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 17-21	717 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 17-21	717 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 17-21	717 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 17-21	717 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing G 17-21	717 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 1-13	801 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 14-18	814 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 14-18	814 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 14-18	814 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 19-22	819 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 19-22	819 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 19-22	819 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 19-22	819 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 19-22	819 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 23-29	823 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 23-29	823 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 23-29	823 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 23-29	823 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 30-33	830 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 30-33	830 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing H 30-33	830 Koshland Way	Family Student Housing	1970	Ratcliff Slama Cadwalader	Unknown
Family Student Housing Maintenance	520 Koshland Way	Family Student Housing	1979	Ratcliff Slama Cadwalader	Unknown
Farm Chalet	143 Farm Road	Agroecology	1975	Unknown	Unknown
Farm Chalet	143 Farm Road	Agroecology	1975	Unknown	Unknown
Farm Equipment Barn & Sleep loft	104 Farm Road	Agroecology	1973	Unknown	Unknown
Farm Louise Cain Gatehouse	164 Farm Road	Agroecology	1986	Unknown	Unknown
Farm Slaughter House	103 Farm Road	Agroecology	1900, circa	Unknown	Unknown
Farm Vegetable Packing & Storage	150 Farm Road	Agroecology	1973, circa	Unknown	Unknown
Fieldhouse West	311 Rachel Carson Service Road	Rachel Carson College	1977	Bull Field Volkmann Stockwell	G.W. Davis
Fire House	701 Chinquapin Road	Crown College / Merrill College	1975	William M. Gillis and Associates	Unknown
Gamelan Studio	404 McHenry Road	Music Center Neighborhood	1998	Unknown	Unknown
Graduate Commons	508 Steinhart Way	Quarry Plaza	2001	Unknown	Unknown
Graduate Student Housing 1	615 Heller Drive	Graduate Student Housing	1986	Veitzer Shohkwiler	Unknown
Graduate Student Housing 2	625 Heller Drive	Graduate Student Housing	1986	Veitzer Shohkwiler	Unknown
Graduate Student Housing 3	635 Heller Drive	Graduate Student Housing	1986	Veitzer Shohkwiler	Unknown
Graduate Student Housing 4	645 Heller Drive	Graduate Student Housing	1986	Veitzer Shohkwiler	Unknown

Granary	102 Coolidge Drive	Main Entrance	1860s, circa	Unknown	Unknown
Hagar Court Offices	151 Hagar Court	Hagar Court Employee Housing	1981	Ellmore Titus	Unknown
Hahn Art Facility	521 Cowell-Stevenson Road	Stevenson College	1968	UCSC staff	Unknown
Hahn Student Services	400 Hahn Road	Quarry Plaza	1965	Ernest J. Kump	King-Hannan Corporation
Hay Barn	94 Ranch View Road	Main Entrance	1850s, circa	Unknown	Unknown
Humanities & Social Sciences Building	504 Cowell-Stevenson Road	Humanities Center	2006	Thomas Hacker	Unknown
Humanities Auditorium	502 Cowell-Stevenson Road	Humanities Center	2006	Thomas Hacker	Unknown
Humanities Building 1	506 Cowell-Stevenson Road	Humanities Center	2006	Thomas Hacker	Unknown
Infant & Toddler Care Modular Unit	550 Koshland Way	Family Student Housing	2000	Unknown	Unknown
Jack Baskin Engineering Auditorium	605 Baskin Circle	Science and Engineering Hill	2004	Anshen & Allen	Unknown
Jack Baskin Engineering Building	606 Engineering Loop	Science and Engineering Hill	1971	Reid & Tarics	Unknown
Kerr Hall	500 Kerr Road	Theater Arts Center	1973	Germano Milano & Associates	Unknown
Kiosk for East Entrance	108 Coolidge Drive	Main Entrance	2003	Unknown	Unknown
Kiosk for West Entrance	200 Heller Drive	West Entrance	1970	Unknown	Unknown
Kresge College Academic Building West Wing	500 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College Annex Building A	516 Porter-Kresge Road	Kresge College	1991	Unknown	Unknown
Kresge College Annex Building B	522 Porter-Kresge Road	Kresge College	1991	Unknown	Unknown
Kresge College Apartment Building J	417 Porter-Kresge Road	Kresge College	2004	BAR Architects	Unknown
Kresge College Apartment Building K	419 Porter-Kresge Road	Kresge College	2004	BAR Architects	Unknown
Kresge College Assembly Building	544 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College Classroom Building	524 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House	508 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House	508 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 01	506 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 02	514 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 03	518 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 04	532 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 05	536 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 06	538 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 07	540 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 08	534 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 09	526 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 10	520 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College House 11	512 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College Library	530 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College Lounge	500 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College Mini Gym	504 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Kresge College Staff Apartments ABC	502 Porter-Kresge Road	Kresge College	1973	MLTW Moore - Turnbull	Bogard Construction
Liquid Propane Gas Building	1456 High Street	Arboretum Neighborhood	1968	Unknown	Unknown
McHenry Library	414 McHenry Road	Central Core	1966	John Carl Warnecke & Assoc.	Rothschild, Raffin & Weirick, Inc.
Merrill College Academic Building	639 Merrill Road	Merrill College	1968	Campbell & Wong & Associates	Rosewall & Sons
Merrill College Administration Building	645 Merrill Road	Merrill College	1968	Campbell & Wong & Associates	Rosewall & Sons
Merrill College Common	661 Merrill Service Road	Merrill College	1968	Campbell & Wong & Associates	Rosewall & Sons
Merrill College Dining Common	630 Crown Road	Merrill College	1968	Campbell & Wong & Associates	Rosewall & Sons
Merrill College Dining Common	630 Crown Road	Merrill College	1968	Campbell & Wong & Associates	Rosewall & Sons
Merrill College Faculty Common	637 Merrill Road	Merrill College	1971	Campbell & Wong & Associates	Rosewall & Sons
Merrill College Faculty Office Annex	635 Merrill Road	Merrill College	1988	Unknown	Unknown
Merrill College Garage	622 Merrill Road	Merrill College	1970	Campbell & Wong & Associates	Rosewall & Sons
Merrill College House	620 Merrill Road	Merrill College	1970	Campbell & Wong & Associates	Rosewall & Sons
Merrill College House	620 Merrill Road	Merrill College	1970	Campbell & Wong & Associates	Rosewall & Sons
Merrill College House A	660 Merrill Service Road	Merrill College	1968	Campbell & Wong & Associates	Rosewall & Sons
Merrill College House B	650 Merrill Service Road	Merrill College	1968	Campbell & Wong & Associates	Rosewall & Sons
Merrill College House C	634 Merrill Road	Merrill College	1969	Campbell & Wong & Associates	Rosewall & Sons
Merrill College House D	632 Merrill Road	Merrill College	1969	Campbell & Wong & Associates	Rosewall & Sons
Merrill College Library	633 Merrill Road	Merrill College	1971	Campbell & Wong & Associates	Rosewall & Sons
Merrill College Plaza	655 Merrill Service Road	Merrill College	2015	Unknown	Unknown
Merrill College Recreation Room	633 Crown Road	Merrill College	1971	Campbell & Wong & Associates	Rosewall & Sons
Merrill Garden House	604 Merrill Road	Merrill College	1966	Unknown	Unknown

Merrill Material Recovery Enclosure	655 Merrill Service Road	Merrill College	2015	Unknown	Unknown
Merrill Ming Ong Computer Lab	630 Merrill Road	Merrill College	1991	Unknown	Unknown
Merrill Substation	610 Merrill Road	Merrill College	1990	Unknown	Unknown
Merrill Substation Shed	610 Merrill Road	Merrill College	2010	Unknown	Unknown
Merrill Substation Utility Trailer	610 Merrill Road	Merrill College	1990	Unknown	Unknown
Music Center	402 McHenry Road	Music Center Neighborhood	1996	Antoine Predock	Unknown
Nat Sci 2 Annex	570 Red Hill Road	Science and Engineering Hill	1969	Anshen & Allen	Unknown
Nat Sci 2 Main Building	560 Red Hill Road	Science and Engineering Hill	1969	Anshen & Allen	Unknown
Nat Sci Greenhouse	632 Red Hill Road	Science and Engineering Hill	1990	Unknown	Unknown
Nat Sci Paleo-Magnetic Lab	636 Red Hill Road	Science and Engineering Hill	1983	Unknown	Unknown
Nat Sci Storage 1	638 Red Hill Road	Science and Engineering Hill	1983	Unknown	Unknown
Nat Sci Woodshop	637 Red Hill Road	Science and Engineering Hill	1990	Unknown	Unknown
Oakes Co Recycling Ctr	248 Oakes Field Service Road	Oakes College	1987	Unknown	Unknown
Oakes College Academic Building	233 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Academic Building	233 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Dorm 1	210 Oakes Road	Oakes College	1988	Palmer & Rahe	Unknown
Oakes College Dorm 2	214 Oakes Road	Oakes College	1988	Palmer & Rahe	Unknown
Oakes College Dorm 3	216 Oakes Road	Oakes College	1988	Palmer & Rahe	Unknown
Oakes College Dorm 4	212 Oakes Road	Oakes College	1988	Palmer & Rahe	Unknown
Oakes College House	246 Oakes Field Service Road	Oakes College	1977	McCue, Boone, Tomsick	Unknown
Oakes College Residence A11-12	218 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence A13-15	220 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence A16-17	222 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence B11-15	230 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence B11-15	230 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence B16-17	228 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence C11-15	245 Oakes Field Service Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence D11-12	241 Oakes Field Service Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence D11-12	241 Oakes Field Service Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence D14-16	243 Oakes Field Service Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Residence D14-16	243 Oakes Field Service Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Service Module S1	224 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Service Module S2	226 Oakes Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Service Module S3	247 Oakes Field Service Road	Oakes College	1976	McCue, Boone, Tomsick	Unknown
Oakes College Tutorial Commons	249 Oakes Field Service Road	Oakes College	1977	McCue, Boone, Tomsick	Unknown
OPERS Fitness Center	405 East Field Service Road	OPERS Eastside	1999	Boora Architects	Unknown
OPERS Offices & Support Space	451 East Field Service Road	OPERS Eastside	1988	Worley K. Wong; Ronald G. Brocchini	Unknown
OPERS Tennis Building	425 East Field Service Road	OPERS Eastside	1988	Worley K. Wong; Ronald G. Brocchini	Unknown
Physical Education Activities Building	403 East Field Service Road	OPERS Eastside	1974	UCSC Physical Planning & Construction	Unknown
Physical Planning & Construction Trailer 1	103 Ox Team Road	Main Entrance	1986	Unknown	Unknown
Physical Planning & Construction Trailer 2	105 Ox Team Road	Main Entrance	1978	Unknown	Unknown
Physical Plant Trailer 1	102 Carriage House Road	Main Entrance	1988	Unknown	Unknown
Physical Plant Trailer 1	102 Carriage House Road	Main Entrance	1988	Unknown	Unknown
Physical Plant Trailer 2	106 Carriage House Road	Main Entrance	1990	Unknown	Unknown
Physical Sciences Building	590 Steinhart Way	Science and Engineering Hill	2006	Anshen & Allen	Unknown
Porter College Academic	405 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown
Porter College Academic	405 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown
Porter College Academic	405 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown
Porter College Academic	405 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown
Porter College Academic	405 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown
Porter College Academic	405 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown
Porter College Academic	405 Porter-Kresge Road	Porter College	1971-1973	Hugh Stubbins & Associates	Unknown
Porter College Apartment Building E	410 Porter-Kresge Road	Porter College	2004	BAR Architects	Unknown
Porter College Apartment Building F	414 Porter-Kresge Road	Porter College	2004	BAR Architects	Unknown
Porter College Apartment Building G	412 Porter-Kresge Road	Porter College	2004	BAR Architects	Unknown
Porter College Apartment Building H	416 Porter-Kresge Road	Porter College	2004	BAR Architects	Unknown
Porter College Apartments Lounge	418 Porter-Kresge Road	Porter College	2004	BAR Architects	Unknown
Porter College Dining Common	411 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown

Porter College House	415 Porter-Kresge Road	Porter College	1983	Corlett & Spackman	Unknown
Porter College House A	407 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown
Porter College House B	409 Porter-Kresge Road	Porter College	1971	Hugh Stubbins & Associates	Unknown
Powder House	90 Ranch View Road	Main Entrance	1850s, circa	Unknown	Unknown
Quarry Amphitheater	514 Steinhart Way	Quarry Plaza	1967	Robert Royston	Unknown
Quarry Amphitheater Storage	514 Steinhart Way	Quarry Plaza	1973	Unknown	Unknown
Rachel Carson College Academic Building	355 Rachel Carson Road	Rachel Carson College	1990	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Apartment Building 1	351 Rachel Carson Road	Rachel Carson College	1990	Palmer & Rahe	George Shaw
Rachel Carson College Apartment Building 2	353 Rachel Carson Road	Rachel Carson College	1990	Palmer & Rahe	George Shaw
Rachel Carson College Apartment Building 3	313 Rachel Carson Service Road	Rachel Carson College	1990	Palmer & Rahe	George Shaw
Rachel Carson College Apartment Building 4	315 Rachel Carson Service Road	Rachel Carson College	1990	Palmer & Rahe	George Shaw
Rachel Carson College Apartment Building 5	314 Rachel Carson Service Road	Rachel Carson College	1990	Palmer & Rahe	George Shaw
Rachel Carson College Apartment Building 6	312 Rachel Carson Service Road	Rachel Carson College	1990	Palmer & Rahe	George Shaw
Rachel Carson College Cafe Building	355 Rachel Carson Road	Rachel Carson College	1990	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Dorm A-Garden	308 Rachel Carson Service Road	Rachel Carson College	1989	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Dorm A-L-Building	306 Rachel Carson Service Road	Rachel Carson College	1989	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Dorm B-Garden	302 Rachel Carson Service Road	Rachel Carson College	1990	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Dorm B-L-Building	304 Rachel Carson Service Road	Rachel Carson College	1990	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Dorm C-Garden	307 Rachel Carson Service Road	Rachel Carson College	1989	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Dorm C-L-Building	305 Rachel Carson Service Road	Rachel Carson College	1989	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Dorm D-Garden	301 Rachel Carson Service Road	Rachel Carson College	1989	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Dorm D-L-Building	303 Rachel Carson Service Road	Rachel Carson College	1989	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Kitchen	354 Rachel Carson Road	Rachel Carson College	1990	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Kitchen	354 Rachel Carson Road	Rachel Carson College	1990	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Rachel Carson College Student Commons	310 Rachel Carson Service Road	Rachel Carson College	1990	Simon, Martin, Vegue, Winkelstein, Moris	Unknown
Receiving Barn (Barn H)	116 Ox Team Road	Main Entrance	1860s, circa	Unknown	Unknown
Redwood Grove Apartments Building 12	525 Heller Drive	Kresge College	1988	Unknown	Unknown
Redwood Grove Apartments Building 13	535 Heller Drive	Kresge College	1988	Unknown	Unknown
Redwood Grove Apartments Building 14	545 Heller Drive	Kresge College	1988	Unknown	Unknown
Redwood Grove Apartments Building 15	555 Heller Drive	Kresge College	1988	Unknown	Unknown
Redwood Grove Apartments Building 16	565 Heller Drive	Kresge College	1988	Unknown	Unknown
Redwood Grove Apartments Utility Building	549 Heller Drive	Kresge College	1988	Unknown	Unknown
RV Park Recreation Building	701 Leonardo Lane	North Campus	1984	Unknown	Unknown
School Age Child Care Modular Unit	560 Koshland Way	Family Student Housing	2000	Unknown	Unknown
Science and Engineering Library	580 Red Hill Road	Science and Engineering Hill	1991	Esherick Homsey Dodge & Davis (EHDD)	Unknown
Sign Shop	107 Ox Team Road	Main Entrance	1965	Unknown	Unknown
Sinsheimer Laboratories	582 Steinhart Way	Science and Engineering Hill	1989	ED2 International	Unknown
Social Sciences 1	704 College Nine Road	College Nine	1994	Unknown	Unknown
Social Sciences 2	712 College Ten Road	College Ten	1995	Esherick Homsey Dodge & Davis (EHDD)	Unknown
Solar Greenhouse by Merrill	606 Merrill Road	Chadwick Garden	1978	Unknown	Unknown
South Campus Core Building	108 Carriage House Road	Main Entrance	2014	Unknown	Unknown
Stevenson College	540 Stevenson Service Road	Stevenson College	1968	Joseph Esherick & Assoc.	William & Burrows
Stevenson College Academic Building	530 Cowell-Stevenson Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College Academic Building	530 Cowell-Stevenson Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College Apartment Building 10	553 Stevenson Service Road	Stevenson College	2004	BAR Architects	Unknown
Stevenson College Apartment Building 11	555 Stevenson Service Road	Stevenson College	2004	BAR Architects	Unknown
Stevenson College Apartment Building 9	551 Stevenson Service Road	Stevenson College	2004	BAR Architects	Unknown
Stevenson College House	537 Stevenson Service Road	Stevenson College	1967	Joseph Esherick & Assoc.	William & Burrows
Stevenson College House 1	532 Stevenson Service Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College House 2	534 Stevenson Service Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College House 3	536 Stevenson Service Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College House 4	538 Stevenson Service Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College House 5	541 Stevenson Service Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College House 6	543 Stevenson Service Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College House 7	545 Stevenson Service Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College House 8	547 Stevenson Service Road	Stevenson College	1966	Joseph Esherick & Assoc.	William & Burrows
Stevenson College Music Practice	535 Stevenson Service Road	Stevenson College	1975	Unknown	Unknown
Stevenson Preceptor House	532 Stevenson Service Road	Stevenson College	1967	Joseph Esherick & Assoc.	William & Burrows

Stone House (Paymaster's House)	100 Coolidge Drive	Main Entrance	1860s, circa	Unknown	Unknown
Student Music East-KZSC Radio Station	631 Crown Road	Crown College / Merrill College	1967	UCSC staff	Unknown
Student Union	504 Steinhart Way	Quarry Plaza	1971	Bull Field Volkmann Stockwell	Unknown
Student Union Redwood	502 Steinhart Way	Quarry Plaza	1967	Henrik Bull	Unknown
Theater Arts A Main Stage	441 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts B Drama	465 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts C Studio	463 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts D Student Production	461 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts E Classroom	459 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts F Ticket Office	457 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts Foundry	410 Foundry Road	Theater Arts Center	1975	Ralph Rapson & Associates	Unknown
Theater Arts G Toilet Room	447 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts H 2nd Stage	451 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts H 2nd Stage	451 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts J Offices	445 Kerr Road	Theater Arts Center	1971	Ralph Rapson & Associates	Unknown
Theater Arts K Costume	443 Kerr Road	Theater Arts Center	1986	Unknown	Unknown
Theater Arts L Experimental Theater	455 Kerr Road	Theater Arts Center	1998	Unknown	Unknown
Theater Arts M Media Theater	453 Kerr Road	Theater Arts Center	1998	Unknown	Unknown
Theater Barn	101 Coolidge Drive	Main Entrance	1850s	Unknown	Unknown
Thimann Laboratories	568 Steinhart Way	Quarry Plaza	1965	Anshen & Allen	Nomellini Construction Co.
Thimann Lecture Hall	562 Steinhart Way	Quarry Plaza	1965	Anshen & Allen	Nomellini Construction Co.
Thimann Receiving Building	572 Steinhart Way	Quarry Plaza	1965	Anshen & Allen	Nomellini Construction Co.
University House	400 McHenry Road	Central Core	1967	Ratcliff Slama Cadwalader	Unknown
Village Dining	259 Village Road	Lower Quarry Village Housing	2001	Unknown	Unknown
Village Housing B1	216 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing B2	212 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing B3	214 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing C1	222 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing C2	224 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing C3	226 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing C4	230 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing C5	228 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing C6	232 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing D1	241 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing D2	243 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing E1	245 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing E2	251 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing E3	249 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing E4	247 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing F1	255 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing F2	253 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing F3	257 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Housing F5	260 Village Road	Lower Quarry Village Housing	1997	Unknown	Unknown
Village Maintenance & Telecommunications	217 Village Road	Lower Quarry Village Housing	2001	Unknown	Unknown
Visual Arts Research Facility	350 Rachel Carson Road	Rachel Carson College	1982	Unknown	Unknown
Westside Research Center	2300 Delaware Avenue	South of campus	1980	Unknown	Unknown

ENGINEER	LANDSCAPE ARCHITECT	2005 GETTY GRANT SURVEY	2020 LRDP EIR SURVEY
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
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Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Non-Contributor	
Unknown	Stephen Wheeler	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Non-Contributor	
Unknown	GLS	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Kennedy Engineers	Roy Rydell	Surveyed: More info. needed to determine status	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Eric Elsesser & Associates	Eckbo, Dean, Austin & Williams; Thomas Church	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Nishita & Carter	Not surveyed	Not surveyed (post-1979)
Unknown	Nishita & Carter	Not surveyed	Not surveyed (post-1979)
Unknown	Nishita & Carter	Not surveyed	Not surveyed (post-1979)
Unknown	Nishita & Carter	Not surveyed	Not surveyed (post-1979)
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Unknown	Nishita & Carter	Not surveyed	Not surveyed (post-1979)
Unknown	Nishita & Carter	Not surveyed	Not surveyed (post-1979)
Unknown	Nishita & Carter	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Pregnoff & Matheu	Roy Rydell	Surveyed: More info. needed to determine status	
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Merrill + Befu	Not surveyed	Not surveyed (post-1979)
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)

Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Bowman & Williams	Lawrence Halprin and Thomas Church	Surveyed: Campus Core Contributor	
Toft & DeNevers	Royston Hanamoto Beck & Abey	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Clarence Rinne	Lawrence Halprin & Associates	Surveyed: Campus Core Contributor	
Unknown	Kawasaki Theiacker & Assoc.	Not surveyed	Not surveyed (post-1979)
Unknown	Kawasaki Theiacker & Assoc.	Not surveyed	Not surveyed (post-1979)
Unknown	Kawasaki Theiacker & Assoc.	Not surveyed	Not surveyed (post-1979)
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Unknown	Kawasaki Theiacker & Assoc.	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Nishita & Carter	Not surveyed	Not surveyed (post-1979)
Stephan J. Medwadowski	Unknown	Surveyed: Campus Core Contributor	
Unknown	Richard Vignolo	Not surveyed	Not surveyed (post-1979)
Unknown	Richard Vignolo	Not surveyed	Not surveyed (post-1979)
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Unknown	Joni L. Janecki	Not surveyed	Not surveyed (post-1979)
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Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Kawasaki, Theilacker	Not surveyed	Not surveyed (post-1979)
Unknown	Kawasaki, Theilacker	Not surveyed	Not surveyed (post-1979)
Unknown	Kawasaki, Theilacker	Not surveyed	Not surveyed (post-1979)
Unknown	Kawasaki, Theilacker	Not surveyed	Not surveyed (post-1979)

Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Surveyed: More info. needed to determine status	
Unknown	Lawrence Halprin	Surveyed: Campus Core Contributor	
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Anthony M. Guzzardo Associates	Surveyed: Campus Core Contributor	
T.Y. Lin, Kulka, Yang & Associates	Thomas Church	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Reconnaissance survey
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Steven H. Sassoon	Dan Kiley	Surveyed: Campus Core Contributor	
Kennedy Engineers	Unknown	Not surveyed	Not surveyed (couldn't find building)
Isadore Thompson	Thomas Church (Phase 1) / Michael Painter (Phase 2)	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
		Not surveyed (post-1979)	
Eric Elsesser & Associates	Royston, Hanamoto, Beck & Abey, Kobayashi	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed

Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Joni L. Janecki; Robin E. Parke	Not surveyed	Not surveyed (post-1979)
T.Y. Lin, Kulka, Yang & Associates	Douglas Baylis	Surveyed: Campus Core Contributor	
T.Y. Lin, Kulka, Yang & Associates	Douglas Baylis	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Royston, Hanamoto, Beck & Abey	Not surveyed	Reconnaissance survey
Unknown	Joni L. Janecki	Not surveyed	Not surveyed (post-1979)
Unknown	Worley K. Wong; Ronald G. Brocchini	Not surveyed	Not surveyed (post-1979)
Unknown	Worley K. Wong; Ronald G. Brocchini	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Joni L. Janecki; Robin E. Parke	Not surveyed	Not surveyed (post-1979)
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	

Unknown	Hugh Stubbins; Thomas Church	Not surveyed	Not surveyed (post-1979)
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Clarence E. Rinne	Thomas Church	Surveyed: Campus Core Contributor	
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Robert Royston	Not surveyed	Reconnaissance survey
Unknown	Unknown	Not surveyed	Not surveyed
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Thomas Scherer	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Wallace Roberts Todd	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Non-Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Nishita and Carter	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	SWA Group	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Reconnaissance survey
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Lawrence Halprin & Assoc.	Surveyed: Campus Core Contributor	

Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
Unknown	Unknown	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed
Unknown	Robert Royston	Surveyed: More info. needed to determine status	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Pregnoff & Matheu	Thomas Church	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Surveyed: Cowell Ranch Historic District Contributor	
T.Y. Lin, Kulka, Yang & Associates	Douglas Baylis	Surveyed: Campus Core Contributor	
T.Y. Lin, Kulka, Yang & Associates	Douglas Baylis	Surveyed: Campus Core Contributor	
T.Y. Lin, Kulka, Yang & Associates	Douglas Baylis	Surveyed: Campus Core Contributor	
Unknown	Thomas Church	Surveyed: Campus Core Contributor	
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Not surveyed (post-1979)
Unknown	Unknown	Not surveyed	Reconnaissance survey

Appendix F

Energy Modeling

Title 24 Building Energy Efficiency Standard CalEEMod Input Adjustments

Land Use Type	Factor	2013	2016	2019
Residential	Percent Improvement over previous standard	n/a	28%	7%
Commercial	Percent Improvement over previous standard	n/a	5%	0%

Title 24 References: (CEC 2015) "2016 Building Energy Efficiency Standards" https://www.calbo.org/sites/main/files/file-attachments/2015-06-10_adoption_hearing_presentation.pdf

(CEC 2018) "2019 Building Energy Efficiency Standards" https://www.energy.ca.gov/sites/default/files/2020-03/Title_24_2019_Building_Standards_FAQ_ada.pdf

CalEEMod Default (2013 Title 24)

	Title 24 electricity intensity (kWh/size)	Title 24 natural gas intensity (KBTU/size)
Apartments Low Rise	365.68	7,043.85
Apartments Mid Rise	332.81	5,484.45
General Light Industry	1.48	19.71
Health Club	1.48	19.71
Parking Lot	-	-
Research & Development	1.48	19.71
University/College (4Yr)	2.73	20.83

2019 Title 24

	Title 24 electricity intensity (kWh/size)	Title 24 natural gas intensity (KBTU/size)
Apartments Low Rise	244.86	4,716.56
Apartments Mid Rise	222.85	3,672.39
General Light Industry	1.41	18.72
Health Club	1.41	18.72
Parking Lot	-	-
Research & Development	1.41	18.72
University/College (4Yr)	2.59	19.79

Percent Reduction

	Title 24 electricity intensity (kWh/size)	Title 24 natural gas intensity (KBTU/size)
Apartments Low Rise	33%	33%
Apartments Mid Rise	33%	33%
General Light Industry	5%	5%
Health Club	5%	5%
Parking Lot	-	-
Research & Development	5%	5%
University/College (4Yr)	5%	5%

1999 Benchmarks	kWh/gsf/yr	therms/gsf/yr
Academic/Administrative Non-complex Space	11.1	0.23
Housing Non-complex	7.8	0.32
Lab/Complex Space	36	1.85

			2019 Title 24 Adjusted CalEEMod Results				UCOP Performance Target: 60% below 1999 Benchmark			
Land Use	**CalEEMod Land Use**	**gsf**	**kWh/yr**	**kWh/gsf/yr**	**therms/yr**	**therms/gsf/yr**	**kWh/yr (calculated from kWh/gsf/year)**	**kWh/gsf/yr**	**therms/yr (calculated from therms/gsf/year)**	**therms/gsf/yr**
Faculty Housing	Apts Low Rise	676,923	1,860,310.00	2.75	38,114.48	0.06	2,112,000	3.12	86,646.15	0.13
Student Housing	Apts Mid Rise	1,933,846	5,051,120.00	2.61	95,757.76	0.05	6,033,600	3.12	247,532.31	0.13
Facilities and Operations	General Light Industry	89,082	474,226.00	5.32	15,673.75	0.18	395,522	4.44	8,195.50	0.09
Student Support Svcs	Health Club	935,554	4,980,420.00	5.32	164,609.34	0.18	4,153,859	4.44	86,070.95	0.09
Parking Lot[1]	Parking Lot	1,876,275	656,696.00	0.35	0.00	0.00	656,696	0.35	0.00	0.00
Instruction & Research	Research & Development	1,734,420	9,233,180.00	5.32	305,167.94	0.18	24,975,648	14.40	1,283,470.80	0.74
Academic & Admin Support	University College (4 yr)	1,985,289	10,026,700.00	5.05	308,650.02	0.16	8,814,684	4.44	182,646.61	0.09
	Total:		**4,582,741**	3.50	**927,973**	0.10	**47,142,010**	5.11	**1,894,562**	0.21

[1] Benchmark not used. No benchmarks were available for parking lot land uses. Factor used from CalEEMod.

Operational Energy Summary at Buildout (CalEEMod Energy outputs)

Electricity Detail - Annual

	Electricity Use
Land Use	kWh/yr
Apts Low Rise	1,860,310
Apts Mid Rise	5,051,120
General Light Industry	474,226
Health Club	4,980,420
Parking Lot	656,696
Research & Development	9,233,180
University College (4 yr)	10,026,700
Total	32,282,652

Natural Gas Detail - Annual

	NaturalGas Use	
Land Use	kBTU/yr	Therms/year (calculated)
Apts Low Rise	3,463,490	34,643
Apts Mid Rise	8,582,030	85,841
General Light Industry	1,470,160	14,705
Health Club	15,439,900	154,436
Parking Lot	-	-
Research & Development	28,624,000	286,308
University College (4 yr)	29,796,200	298,033
Total	87,375,780	873,967

Construction Fuel Usage

https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf

Diesel Emission Factor	10.21	kg CO2/gallon
Gasoline Emission Factor	8.78	kg CO2/gallon

off-road/on-road	Model	Fuel	Annual MT-CO2	gallons	
off-road	CalEEMod (Building Construction)	Diesel	946.45	92,698	
on-road	CalEEMod (Building Construction)	Gasoline	135.94	15,483	(worker commute only)
off-road	CalEEMod (Trails)	Diesel	4.68	458	
on-road	CalEEMod (Trails)	Gasoline	0.19	21	(worker commute only)
off-road	RCEM (Bridges)	Diesel	493.86	48,370	
on-road	RCEM (Bridges)	Gasoline	28.80	3,281	(worker commute only)
off-road	RCEM (Roadways)	Diesel	312.20	30,578	
on-road	RCEM (Roadways)	Gasoline	25.15	2,864	(worker commute only)
		Total			
		Diesel	1,757	172,105	
		Gasoline	190	21,649	

On-Road Fuel Usage Calculations

CalEEMod Fleet Mix

	Land Use	**LDA**	**LDT1**	**LDT2**	**MDV**	**LHD1**	**LHD2**	**MHD**	**HHD**	**OBUS**	**UBUS**	**MCY**	**SBUS**	**MH**
Faculty Housing	Apartments Low Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.00454	0.00084	0.000515
Student Housing	Apartments Mis Rise	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.00454	0.00084	0.000515
Facilities and Operations	General Light Ind	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.00454	0.00084	0.000515
Student Support Svcs	Health Club	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.00454	0.00084	0.000515
Parking Lot1	Parking Lots	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.00454	0.00084	0.000515
Instruction & Research	Research & Develo	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.00454	0.00084	0.000515
Academic & Admin Support	University/College (4 yr)	0.607849	0.022927	0.205901	0.103922	0.009867	0.003828	0.022612	0.014637	0.001269	0.001293	0.00454	0.00084	0.000515

Annual VMT Attributed to LRDP 40,511,214

			EMFAC 2017 Factors for Santa Cruz County in 2040								Calculated			
	Annual VMT (Distributed)	**Fleet Comp**	**Region**	**Calendar Yr**	**Vehicle Cat**	**Fuel**	**Population**	**VMT**	**Trips**	**Fuel Consumption**	**gal/mile**	**Gal Gas**	**Gal Diesel**	**NG DEG**
	1,006	0.014637	Santa Cruz	2040	HHDT	Gasoline	0.810334	31787.36358	5301.703704	5.704833523	0.179468596	180.47		
	584,056	0.014637	Santa Cruz	2040	HHDT	Diesel	675.562918	18462720.86	1803096.378	2259.108173	0.122360523		71,465	
	7,902	0.014637	Santa Cruz	2040	HHDT	Natural Gas	19.633900	249777.2666	23890.5292	84.40697921	0.337928989			2,670
	22,779,942	0.607849	Santa Cruz	2040	LDA	Gasoline	113967.916552	1189066027	182672978.7	28298.94224	0.023799303	542,147		
	288,263	0.607849	Santa Cruz	2040	LDA	Diesel	1460.019106	15046733.96	2328336.483	238.4671962	0.015848436		4,569	
	1,556,496	0.607849	Santa Cruz	2040	LDA	Electricity	7007.354319	81245872.54	11418970.37	0	0			-
	895,260	0.022927	Santa Cruz	2040	LDT1	Gasoline	11983.261254	121873378.6	18646881.14	3425.707488	0.028108743	25,165		
	130	0.022927	Santa Cruz	2040	LDT1	Diesel	1.879351	17708.2125	2805.813748	0.560648715	0.031660379		4	
	33,410	0.022927	Santa Cruz	2040	LDT1	Electricity	395.009717	4548168.139	641920.3291	0	0			-
	8,013,215	0.205901	Santa Cruz	2040	LDT2	Gasoline	38959.234277	403484167.6	61018340.38	11305.99793	0.028020921	224,538		
	81,724	0.205901	Santa Cruz	2040	LDT2	Diesel	384.012399	4114987.62	612134.2047	86.79793081	0.021093121		1,724	
	246,361	0.205901	Santa Cruz	2040	LDT2	Electricity	1551.815624	12404843.76	2525583.538	0	0			-
	212,538	0.009867	Santa Cruz	2040	LHDT1	Gasoline	2168.923689	21338306.15	10566590.12	2116.890546	0.099206119	21,085		
	187,186	0.009867	Santa Cruz	2040	LHDT1	Diesel	1851.172717	18793055.69	7614333.648	840.6635499	0.04473267		8,373	
	41,983	0.00383	Santa Cruz	2040	LHDT2	Gasoline	270.673202	2772851.86	1318669.162	312.0355482	0.112532354	4,724		
	113,094	0.00383	Santa Cruz	2040	LHDT2	Diesel	767.477883	7469452.576	3156827.355	379.3875393	0.05079188		5,744	
	183,921	0.00454	Santa Cruz	2040	MCY	Gasoline	5633.564823	10043553.01	3909693.987	283.7973069	0.028256664	5,197		
	3,928,456	0.103922	Santa Cruz	2040	MDV	Gasoline	24178.721757	245671293	37673263.79	8401.396078	0.034197712	134,344		
	140,780	0.103922	Santa Cruz	2040	MDV	Diesel	839.234626	8803886.018	1332551.544	240.3424254	0.027299584		3,843	
	140,770	0.103922	Santa Cruz	2040	MDV	Electricity	1087.491652	8803219.102	1777679.044	0	0			-
	13,874	0.000515	Santa Cruz	2040	MH	Gasoline	300.928377	883076.838	9844.29407	149.4418932	0.169228641	2,348		
	6,989	0.000515	Santa Cruz	2040	MH	Diesel	184.259395	444848.3157	6025.282215	39.02283318	0.087721661		613	
	91,973	0.022612	Santa Cruz	2040	MHDT	Gasoline	216.359211	3445913.501	1415555.237	576.8217784	0.167392994	15,396		
	824,067	0.022612	Santa Cruz	2040	MHDT	Diesel	1775.779938	30874981.4	5802735.46	2538.921593	0.082232328		67,765	
	28,931	0.001269	Santa Cruz	2040	OBUS	Gasoline	60.345722	745761.6222	394818.8854	127.4634232	0.170917113	4,945		
	22,477	0.001269	Santa Cruz	2040	OBUS	Diesel	36.218967	579402.591	101948.4894	65.36765748	0.112819063		2,536	
	7,977	0.00084	Santa Cruz	2040	SBUS	Gasoline	31.972143	462184.1727	41819.56356	40.92455738	0.088545995	706		
	26,053	0.00084	Santa Cruz	2040	SBUS	Diesel	146.889424	1509560.309	554292.3346	153.5918754	0.101746101		2,651	
	808	0.001293	Santa Cruz	2040	UBUS	Gasoline	8.139145	81578.60705	10646.00196	16.55866316	0.202978008	164		
	18,754	0.001293	Santa Cruz	2040	UBUS	Diesel	54.754250	1892596.457	71618.55861	264.2787058	0.13963817		2,619	
	32,819	0.001293	Santa Cruz	2040	UBUS	Natural Gas	95.819937	3312043.8	125332.4776	791.2519742	0.238901422			7,840
Total VMT	40,511,214	1				Total:	216,115.2	102,453,935		all others	passenger	939,553	18,558	7,840
						Electric:	4.65%			LHDT1, LHDT2	2-axle	25,810	14,118	-
eVMT	1,977,036									MHDT, HHDT	3-axle	15,576	139,230	2,670
Electric kWh	632,651.60										**TOTAL:**	**980,939**	**171,906**	**10,511**

Gasoline (gal)	Diesel (gal)	Nat Gas (DEG)	Nat Gas (therms)
980,939	171,906	10,511	14,600

EV kWh/mi 0.32 https://afdc.energy.gov/vehicles/electric_emissions_sources.html

DEG = Diesel equivalent gallons

Appendix G

Hydrologic Conditions Technical Information

DRAFT Memorandum

To: Jered Chaney, Senior Geologist, Weber, Hayes & Associates

From: Gary Conley, Chief Scientist, 2NDNATURE

Subject: Hydrologic modeling results for the UC Santa Cruz campus

Date: September 21, 2020

2NDNATURE is pleased to provide draft results of a hydrologic analysis to estimate runoff production on the UC Santa Cruz campus. These outputs provide an update to previous analyses and incorporate the most current spatial data sets available, including recent impervious cover changes. These runoff estimates rely on the best hydrologic understanding available, well proven modeling methods, and will be useful to inform runoff mitigation planning, regulatory compliance tracking, environmental impacts assessment, and water budget accounting on the campus.

1. Conceptual modeling overview

Since all environmental models are simplifications of much more complex systems, an important initial step is to identify the compromises that will be required, and the intended use of model results should ultimately guide model selection and the necessary degree of model complexity (Leavesley et al. 2002). These choices are often driven by resource availability and the purpose of the model. The most salient question is: *What do we need to use the model to do?* The answer to this question can dictate much of what gets left in and what gets left out of the model, and there are costs on both sides of that proposition. The problem is often framed as a trade-off between the degree of model complexity and the data required to support that complexity to obtain outputs with a reasonable degree of certainty. As structural complexity increases, the framework uncertainty decreases, since more of the system detail is represented. However, complex structures require higher order parameterizations, which rely on more data to specify and verify the model, so the additional complexity tends to produce greater uncertainty associated with the underlying data. A key modeling task is to identify the best balance these two sources of uncertainty for the specific modeling purpose. If we adopt a more complex model (e.g, continuous simulation at fine-scale spatial resolution), we are challenged with gathering enough real world monitoring data to supply all needed model inputs, or left wondering whether assumptions about model inputs leads to false conclusions. Thus, we seek to achieve just the level of model complexity needed to reach the point of minimum overall uncertainty resulting from the combination of model framework uncertainty and data uncertainty.

The least complex model that reliably meets the application at the relevant scale is often the best alternative (Chandler 1994, Rauch et al. 2002, Dotto et al. 2012) and model selection often boils down to choice between a greater degree of granularity across space or detail of process representation in time. Attempting to do both is computationally expensive, resource intensive, and provides more detail than required. While detailed process representation used in continuous simulation models may improve performance over short time steps, it comes at the expense of greater structural complexity (Snowling and Kramer 2001), without necessarily increasing the usefulness of outputs (Lindenschmidt 2006). Since stormwater impact mitigation problems invariably have an important spatial component and are typically less concerned with short-term outcomes, modeling approaches that employ parsimonious process-representation in favor of greater spatial granularity make intuitive sense. The 2NDNATURE hydrologic modeling approaches reflect these concepts in order to provide robust outputs that align with the data widely available for model parameterization and scales of information required by end users of the model outputs.

2. Study area

The study area is defined by a set of watersheds and sub-basins on the UC Santa Cruz campus. Drainages were mapped in 1988 by Johnson (1988) and later digitized and modified by UCSC staff. The maps indicate surface drainage, subsurface flow paths, and areas contributing to groundwater aquifers. Karst terrain throughout the campus creates a complex hydrography that includes several sink holes, cavernous voids, and spring flows. As part of this study, 2NDNATURE reconciled sub-basin scale discrepancies between the map of Johnson (1988) and the digital data. The resulting watersheds and sub-basins shown in Figure 1 were the spatial framework used for the estimates in this study.

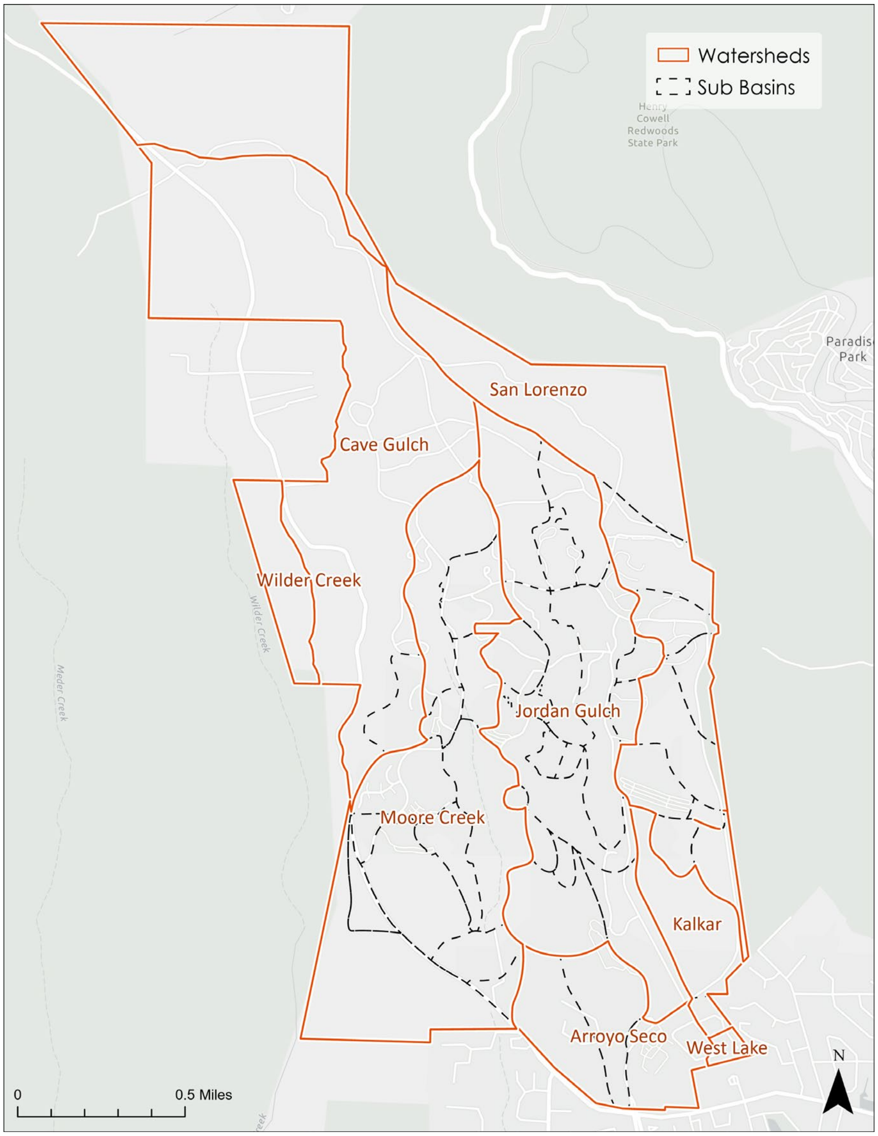

Figure 1. Study area drainages and sub-basins for the UC Santa Cruz campus

3. THE SWTELR MODEL

3.1 MODEL STRUCTURE

Typically, stormwater runoff is modeled using 1 of 2 approaches: using discrete storm events, or continuous simulation. Event-based approaches are programmatically simple but were originally designed to simulate runoff for a single storm event size. With the Stormwater Tool to Estimate Load Reductions (swTELR), we employ a hybrid event-based approach that combines a set of events drawn from a long-term precipitation distribution to bracket the range of rainfall and runoff responses probabilistically (as opposed to explicitly with continuous simulation). The efficiency of this method allows a distributed spatial approach where runoff, loading and BMP reduction calculations are discretized on a 30-meter grid so that site-specific runoff generation and pollutant loading characteristics specific to the BMP drainages are explicitly represented. The model has shown strong correspondence with continuous simulation models and with monitoring data at scales ranging from neighborhood-scale drainages (Beck et al, 2017) to small urban catchments (Conley et al. *in review*).

3.2 RAINFALL CALCULATIONS

Stormwater TELR calculates various 24-hr precipitation depths and the average annual number of days with measurable precipitation to represent the overall distribution and total average annual depths. We calculated, d, the average number of rain days per water year when daily rainfall exceeds 0.25 cm, and P(x), various 24-hr event frequency estimates, where P is the 24-hr rainfall depth for the x^{th} percentile event. On a water-year basis, we selected 24-hr event rainfall frequencies to approximate the 24-hr event cumulative distribution function, such that these events can be summed to obtain long-term average 24-hr runoff volumes for days when it rains:

$$\int_0^{100} P(x)\,dx \approx \frac{1}{2}\sum_{k=1}^{N}\left(x_{k+1}-x_k\right)*\left(P\left(x_{k+1}\right)+P\left(x_k\right)\right) \qquad \text{(EQ1)}$$

where *x* is a number between 0 and 100, and k is number in the sequence of total, N, percentile events used to estimate the integral. With this formulation, long-term average annual rainfall depth, P_{365}, is the product of the integrated 24-hr rainfall depth and the number of rain days per year, d:

$$P_{365} = d * \int P(x)\,dx \qquad \text{(EQ2)}$$

This approach to characterizing the long-term precipitation distributions was compared with several other approaches in Beck et al. (2017). Runoff and decentralized BMP reductions are calculated using the individual percentile rainfall events that correspond with common water quality permit requirements and structural BMP design criteria (85^{th} and 95^{th} percentile storm events), which also include the median and the lower quartile.

3.3 RAINFALL-RUNOFF TRANSFORMATION

For a given storm magnitude, the runoff generation module defines the fraction of flow that infiltrates over pervious surfaces and the fraction of overland runoff that is eventually discharged to the receiving waters. Stormwater TELR relies on the Soil Conservation Service (SCS) curve number (*CN*) method and the approach detailed in Technical Release 55 (TR-55) to estimate runoff from small urban catchments (USDA 1986). The SCS runoff equation is:

$$Q = \frac{\left(P - I_a\right)^2}{\left(P - I_a\right) + S} \quad \text{(EQ3)}$$

where Q is the runoff depth, P is the 24-hr rainfall depth, S is the potential maximum retention after runoff begins, and I_a is the initial abstraction depth, which incorporates all losses before runoff begins, including water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. Runoff does not begin until the initial abstraction has been met. I_a is variable across the landscape but is highly correlated to the curve number. The initial abstraction is 20% of the storage,

$$I_a = 0.2S$$

(EQ4)

and

$$S_{0.20} = \frac{1000}{CN} - 10 \quad \text{(EQ5)}$$

More recent data suggest that 0.20*S might be too high and that 0.05*S is more appropriate (Woodward et al., 2003, Lim et al., 2006, Shi et al., 2009) especially for hydrologic soil groups C and D (Jiang 2001). If 5%, rather than 20%, is used, S must also be modified. The relationship between $S_{0.05}$ and $S_{0.20}$ obtained from model fitting results is (Lim et al., 2006, Hawkins et al., 2002)

$$S_{0.05} = 1.33 * S_{0.20}{}^{1.15} \quad \text{(EQ6)}$$

We used the adjusted initial abstraction ratio (equation 6) and by substituting equation 4, modified for 5% of storage, into equation 3, we obtain

$$Q = \frac{\left(P - 0.05S_{0.05}\right)^2}{P + 0.95S_{0.05}} \quad \text{(EQ7)}$$

Thus, the model is parameterized by specifying the curve number, which ranges from 30 to 98, with lower numbers indicating low potential runoff and higher numbers indicate increasing runoff potential. The major factors that determine SCS curve numbers are the soil type, the land use (specifically, the percent impervious of the land use), the hydrologic condition and soil infiltration capability. To simply account for variations in soil permeability and infiltration, the NRCS has classified soils into 4 hydrologic soil groups (HSGs). A curve number for a given land use with impervious area can be estimated by the following (USDA 1986):

$$CN = CN_p + \frac{P_{imp}}{100}\left(98 - CN_p\right) \quad \text{(EQ8)}$$

where *CN* is the runoff curve number for the entire land use, CN_p is the pervious runoff curve number and P_{imp} is the percent imperviousness. The pervious curve numbers used are those defined for open space in poor condition (grass cover < 50%) (USDA, 1986), since urban soils are often disturbed or compacted, and are listed in Table 1. Estimates of direct runoff from curve numbers implicitly incorporate evapotranspiritive losses to the atmosphere, which is parameterized by the land cover type or impervious coverage fraction.

Table 1. Urban pervious curve numbers used in swTELR (USDA, 1986)

Soil Type	A	B	C	D
Starting Curve Number	68	79	86	89

3.4 MODEL INPUTS

Raster-based rainfall estimates from the PRISM Climate Group (2004) at Oregon State University are used to describe the distribution of 24-hour event depths to drive runoff generation. A script written in R (R core team, 2020), using functions in the *raster* package (Hijmans and Etten, 2012), is used to acquire daily rainfall raster layers for the years 1981-2016 for the study area and perform the series of processing steps outlined in Section 2.3. The 35-year daily sequence (12,775 raster layers, 800-m^2 cells), are used to create a raster coverage of rainfall percentile values and average annual days of rain for each grid cell. Soils data from NRCS is used to specify soil types throughout MS4 boundaries, used in their rasterized form, downscaled to 30-m pixels. The NRCS SSURGO database is used as the primary data source, and the STATSGO2 database (which provides coarser resolution) is used to fill in spatial gaps in coverage that occur in the SSURGO data. Impervious cover is specified using the most recent data from the National Land Cover Dataset which is provided at 30-meter grid cell resolution (NLCD, 2016).

4. Runoff estimates

Runoff estimates generated using the methods described in the previous sections are summarized for each of the campus watersheds in Table 2. Rainfall depths vary across the campus per the PRISM data, with watersheds occupying the higher reaches such as Cave Gulch and Wilder Creek showing somewhat higher annual rainfall totals. Average annual runoff ratios generally correspond to those areas of the campus with higher impervious cover and less inflatable soils. Also calculated in Table 2 is the estimated annual runoff from each watershed corresponding to all rainfall events up to the 85th

percentile rainfall event, which aligns with NPDES permit design requirements for post-construction requirements or low impact development implementation.

Table 2. Runoff modeling outputs for UC Santa Cruz campus drainages

Watershed	Area (ac)	Annual Rainfall (in)	Average Annual Runoff (in/yr)	Average Annual Runoff (ac-ft/yr)	Average annual Runoff Ratio (%)	Annual runoff up to the 85th percentile event (in/yr)
Arroyo Seco	123.4	37.7	10.2	107.4	27%	6.5
Cave Gulch	466.4	45.3	8.1	296.3	18%	4.4
Jordan Gulch	387.7	39.7	8.2	268.5	21%	5.0
Kalkar	61.5	39.7	9.7	30.3	24%	3.4
Moore Creek	421.4	43.9	10.5	339.2	24%	5.9
San Lorenzo	518.9	40.7	7	289.1	17%	3.9
West Lake (High Street)	5.9	39.7	16	7.7	40%	10.0
Wilder Creek	44.8	45.3	7.3	28.4	16%	4.4

Estimated runoff from the swTELR model are shown in Figure 2, with spatial patterns of runoff throughout the campus reflecting the various spatial factors contributing to runoff productions, largely driven by the proportion of impervious cover. Runoff estimates at the grid-cell scale (30m) showed maximum volumes of approximately 0.6 ac-ft/yr in the most densely developed areas of the campus. These patterns represent direct runoff after accounting infiltration and evapotranspiration, but do not take into account losses associated losses to groundwater via large subsurface flow pathways characteristic of karst terrains. Accounting for these losses will provide an estimate of the partitioning of runoff that results ultimately results in channel flow and that which may be lost to deep percolation.

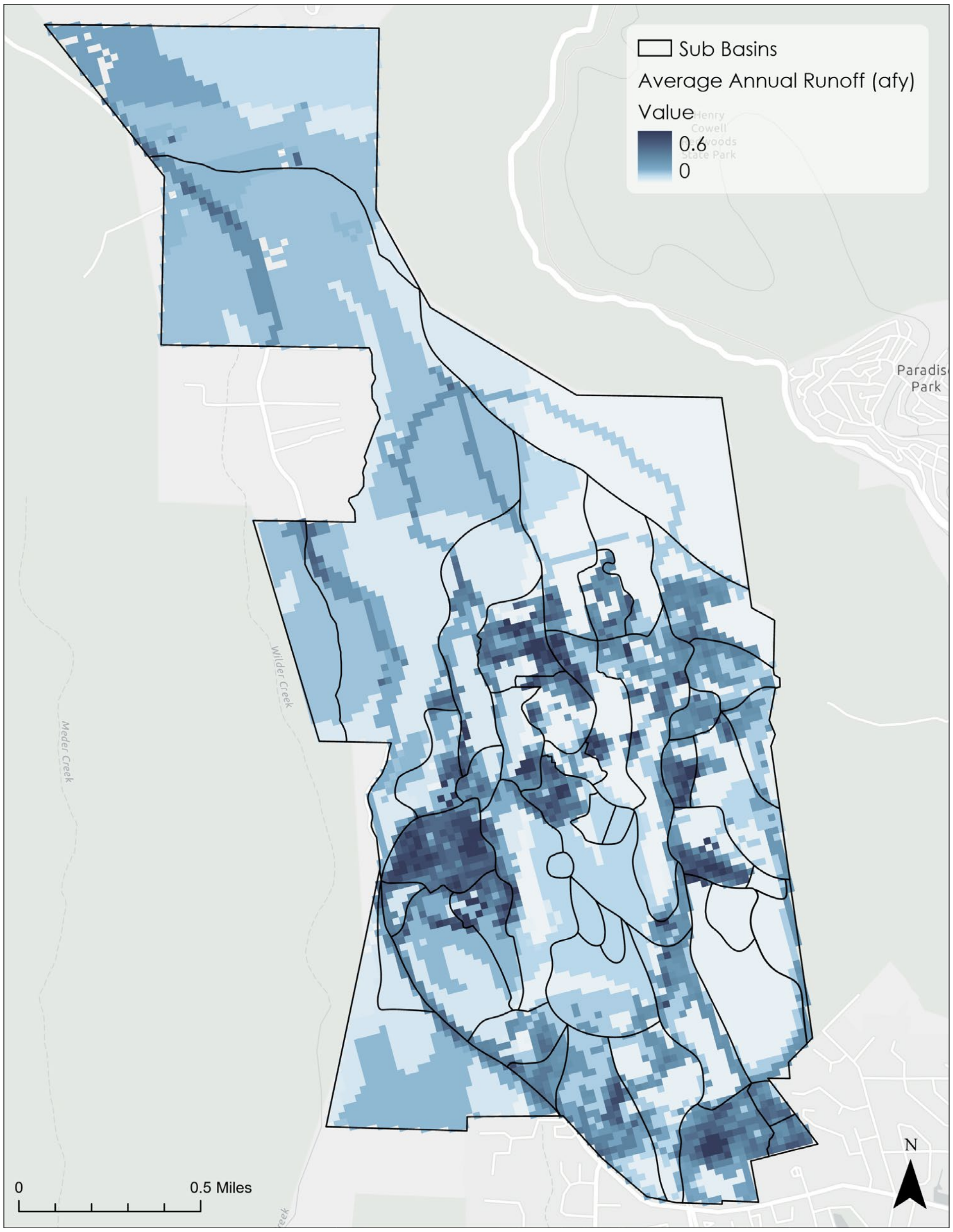

Figure 2. Runoff estimates for the UC Santa Cruz campus

Runoff ratios for the modeled sub-basins are shown in Figure 3 with most sub-basins showing from 20-30% of rainfall transformed into runoff after evapotransparitive losses. West Lake showed the highest runoff ratio of approximately 40%.

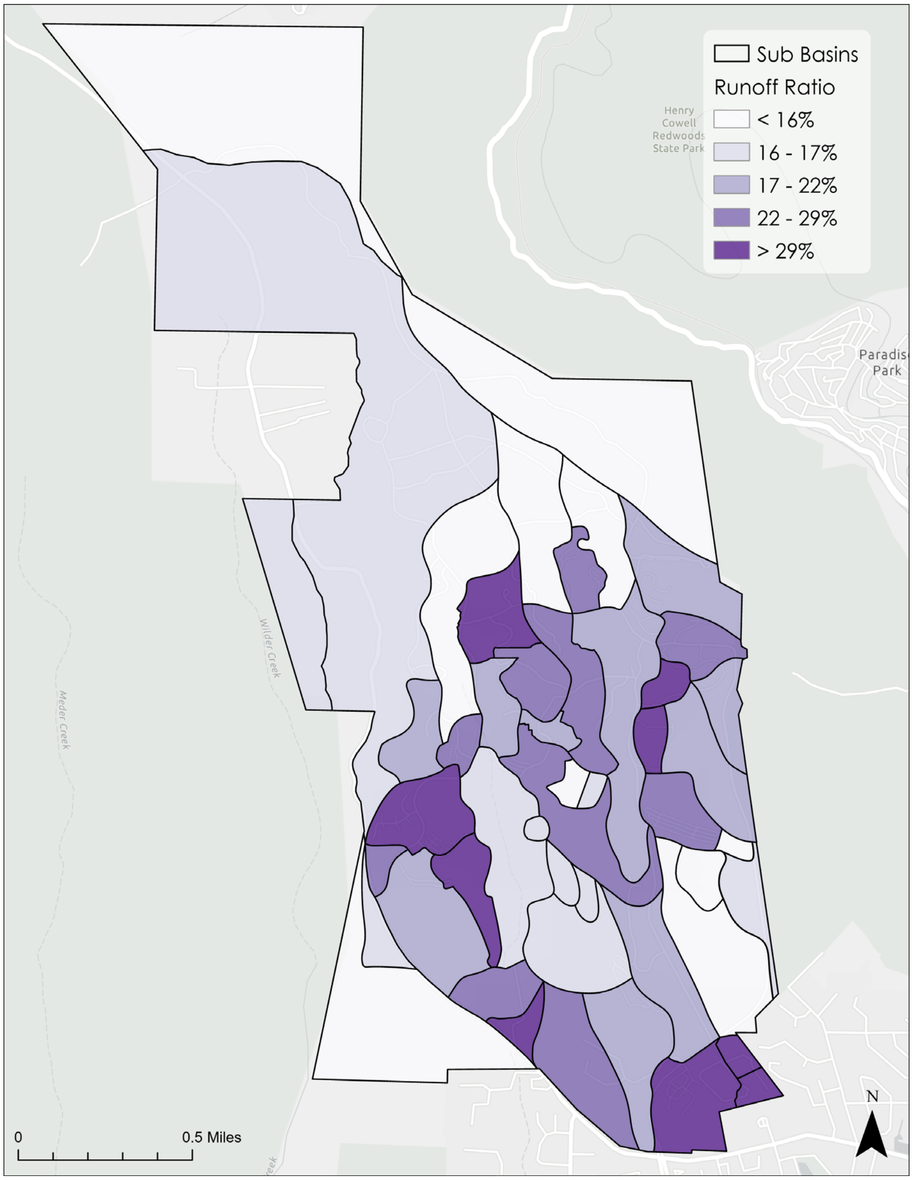

Figure 3. Sub-basin runoff ratios for the UC Santa Cruz campus

5. Conclusions

This memo communicates results of a runoff modeling analysis driven by a the spatially granular swTELR model which relies probabilistic representation of rainfall events to estimate annual runoff. Raster-based calculations provide estimates on a 30-m grid, preserving unique combinations of drainage factors that drive runoff production, hydrologic storage, and infiltration. These estimates are intended to inform planning and support environmental impact assessment for the campus and as such represent long-term average runoff given the range of rainfall conditions that are likely to occur in the coming decades. Like all model outputs, the predictions shown are subject to various sources of uncertainty that can reduce the accuracy and precision of the outputs. Not the least of these sources of error is the model input data, which does not always reflect factors such as very recent development that may have altered land use and impervious cover. Areas of complex hydrography like the UC Santa Cruz campus with abundant karst terrains present unique challenges that are also likely to contribute some ambiguity to outputs. While these sources of modeling uncertainty should always be considered, these outputs rely on the best spatial data currently available and are more than adequate for planning-level runoff estimates, assessing the relative impacts throughout the campus, and as a baseline from which to measure future changes.

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TABLE G1-1
SPRING AND STREAM FLOW RATES AND GROUNDWATER ELEVATIONS

DATE	BAY STREET SPRING *gpm*	WEST LAKE WEIR *gpm*	MESSIAH LUTHERAN SPRING *gpm*	KALKAR SPRING QUARRY *gpm*	HIGH-LONGVIEW SPRING *gpm*	WAGNER GROVE SEEP *gpm*	HARVEY WEST SEEP *gpm*	POGONIP CREEK SYSTEM *gpm*	POGONIP SPRING #1 *gpm*	POGONIP SPRING #2 *gpm*	UPPER CAVE GULCH *gpm*	LOWER CAVE GULCH *gpm*	WILDER CREEK SPRING *gpm*	MOORE CREEK SPRING *gpm*	□MW-1A *(ft, MSL)*	□MW-1B *(ft, MSL)*	WSW 1 *(ft, MSL)*
09/11/84	95	4	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
09/25/84	110	4	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
10/02/84	120	1	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
10/09/84	95	1	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
10/18/84	135	**	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
10/25/84	105	35	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
11/09/84	170	65	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
11/21/84	190	190	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
11/26/84	175	190	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
12/02/84	165	**	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
12/10/84	170	190	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
01/23/85	140	**	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/11/85	141	140	**	190	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/28/85	142	140	**	150	**	**	**	**	**	**	**	**	500	Not Obtained	**	**	**
04/08/85	143	80	**	140	**	**	**	**	**	**	**	**	500	Not Obtained	**	**	**
06/18/85	144	40	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
07/24/85	145	20	**	50	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
11/11/85	146	40	**	20	**	**	**	**	**	**	**	**	100	Not Obtained	**	**	**
04/13/87	147	50	**	120	**	**	**	**	**	**	**	**	500	Not Obtained	**	**	**
08/12/87	120	25	**	60	**	**	**	**	**	**	**	**	300	Not Obtained	**	**	**
10/12/87	130	16	**	70	**	**	**	**	**	**	**	**	200	Not Obtained	**	**	**
12/18/87	165	130	**	90	**	**	**	**	**	**	**	**	500	Not Obtained	**	**	**
01/26/88	180	130	**	240	**	**	**	**	**	**	**	**	800	Not Obtained	**	**	**
03/09/88	155	50	**	170	**	**	**	**	**	**	**	**	400	Not Obtained	**	**	**
06/15/88	130	13	**	85	**	**	**	**	**	**	**	**	270	Not Obtained	**	**	**
09/26/88	120	1	**	50	**	**	**	**	**	**	**	**	60	Not Obtained	**	**	**
11/13/88	118	**	**	20	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
12/06/88	116	**	**	71	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
12/30/88	155	**	**	45	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
01/07/89	147.7	**	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
01/11/89	137	**	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
01/13/89	**	**	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	319.92	**	321.02
01/17/89	**	**	58.4	**	40.6	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
01/18/89	134	53.3	**	**	38.7	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
01/29/89	**	65.3	**	**	**	**	**	161.6	**	**	**	**	161.6	Not Obtained	**	**	**
02/02/89	**	**	51.4	**	43.4	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/03/89	146.2	62.8	**	89.8	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/11/89	133.9	58.4	61.4	98.7	54.1	**	**	170.5	**	**	**	**	193	Not Obtained	**	**	**
02/12/89	132.4	58.3	59.1	103.2	42.9	**	**	193	**	**	**	**	197.5	Not Obtained	**	**	**
02/13/89	132.7	53.3	57.6	98.7	52.1	**	**	197.5	**	**	**	**	**	Not Obtained	319.6	**	319.86
02/14/89	129.6	43.1	56.2	103.2	46.3	**	**	197.5	**	**	**	**	193	Not Obtained	**	**	**

TABLE G1-1
SPRING AND STREAM FLOW RATES AND GROUNDWATER ELEVATIONS

DATE	BAY STREET SPRING *gpm*	WEST LAKE WEIR *gpm*	MESSIAH LUTHERAN SPRING *gpm*	KALKAR SPRING QUARRY *gpm*	HIGH-LONGVIEW SPRING *gpm*	WAGNER GROVE SEEP *gpm*	HARVEY WEST SEEP *gpm*	POGONIP CREEK SYSTEM *gpm*	POGONIP SPRING #1 *gpm*	POGONIP SPRING #2 *gpm*	UPPER CAVE GULCH *gpm*	LOWER CAVE GULCH *gpm*	WILDER CREEK SPRING *gpm*	MOORE CREEK SPRING *gpm*	□MW-1A *(ft, MSL)*	□MW-1B *(ft, MSL)*	WSW 1 *(ft, MSL)*
02/15/89	129.9	44.6	56.5	112.2	47.4	**	**	193	**	**	**	**	179.5	Not Obtained	**	**	**
02/16/89	128.3	47.8	54.8	103.2	39.1	**	**	188.5	**	**	**	**	197.5	Not Obtained	**	**	**
02/17/89	133.7	49.9	56.1	94.2	34.5	**	**	193	**	**	**	**	166.1	Not Obtained	**	**	**
02/18/89	140.9	58.1	79.4	125.7	48.5	**	**	233.4	**	**	**	**	152.6	Not Obtained	**	**	**
02/19/89	131.4	57.9	58.4	107.7	24.4	**	**	224.4	**	**	**	**	179.5	Not Obtained	**	**	**
02/20/89	134	43.6	55.8	98.7	12.6	**	**	206.5	**	**	**	**	215.4	Not Obtained	**	**	**
02/21/89	132	48.2	52.3	103.2	17.3	**	**	**	**	**	**	**	**	Not Obtained	318.88	**	317.2
02/22/89	128	43.6	53.1	103.2	9.2	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/23/89	127.3	30.1	53	98.7	20.8	**	**	193	**	**	**	**	139.1	Not Obtained	**	**	**
02/24/89	131	43.3	53.3	94.2	13.2	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/25/89	131.7	36.4	53.1	107.7	11.9	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/26/89	127.1	37.5	53.7	107.7	37	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/27/89	**	**	**	**	18.6	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/28/89	**	**	**	**	30.1	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
03/04/89	130.1	43.6	67.9	125.7	**	**	**	224.4	**	**	**	**	857	Not Obtained	**	**	**
03/11/89	147.3	175.9	108.2	161.6	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
03/12/89	**	**	**	**	70.4	**	**	**	**	**	**	**	1207	Not Obtained	**	**	**
04/03/89	131.4	61.3	61	4 162	52	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
04/04/89	**	**	**	**	**	**	**	184	**	**	**	**	485	Not Obtained	**	**	**
04/24/89	**	**	**	**	**	**	**	180	**	**	**	**	**	Not Obtained	**	**	**
05/01/89	121.7	**	**	135	**	**	**	**	**	**	**	**	171	Not Obtained	**	**	**
05/02/89	**	30.6	52.4	**	43.5	**	**	211	**	**	**	**	**	Not Obtained	**	**	**
05/06/89	**	**	**	**	**	**	**	**	7.8	21.6	**	**	**	Not Obtained	**	**	**
06/04/89	**	**	**	**	**	**	**	**	**	**	**	**	103	Not Obtained	**	**	**
06/05/89	121.2	22.5	22.5	4 148	17.5	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
06/06/89	**	**	**	**	**	**	**	189	**	**	**	**	**	Not Obtained	**	**	**
06/07/89	**	**	**	**	**	**	**	**	5	17.7	**	**	**	Not Obtained	**	**	**
06/23/89	**	**	45.6	81	**	**	**	**	**	**	**	**	108	Not Obtained	**	**	**
06/26/89	**	**	**	**	**	**	**	**	3.5	9.4	**	**	**	Not Obtained	**	**	**
07/10/89	115.7	5.8	**	85	17.7	**	**	162	**	**	**	**	81	Not Obtained	**	**	**
07/11/89	**	**	44.7	**	**	**	**	**	2.8	16.8	**	**	**	Not Obtained	**	**	**
07/20/89	**	**	**	**	**	**	**	**	3	6	**	**	**	Not Obtained	**	**	**
08/11/89	114.5	**	**	85	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
08/12/89	**	**	**	**	**	**	**	**	3	**	**	**	**	Not Obtained	**	**	**
08/18/89	118.8	4.7	48	81	32.1	**	**	175	**	**	**	**	63	Not Obtained	**	**	**
10/04/89	123.6	1.1	43.7	67.5	1.9	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
11/01/89	143.4	27.8	57.7	94.5	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
11/22/89	139.8	35.8	51.4	53.5	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
01/03/90	138.3	42.9	50.4	33.3	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**

TABLE G1-1
SPRING AND STREAM FLOW RATES AND GROUNDWATER ELEVATIONS

DATE	BAY STREET SPRING *gpm*	WEST LAKE WEIR *gpm*	MESSIAH LUTHERAN SPRING *gpm*	KALKAR SPRING QUARRY *gpm*	HIGH-LONGVIEW SPRING *gpm*	WAGNER GROVE SEEP *gpm*	HARVEY WEST SEEP *gpm*	POGONIP CREEK SYSTEM *gpm*	POGONIP SPRING #1 *gpm*	POGONIP SPRING #2 *gpm*	UPPER CAVE GULCH *gpm*	LOWER CAVE GULCH *gpm*	WILDER CREEK SPRING *gpm*	MOORE CREEK SPRING *gpm*	□MW-1A *(ft, MSL)*	□MW-1B *(ft, MSL)*	WSW 1 *(ft, MSL)*
01/29/90	140.4	48	52.1	42.5	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/23/90	147.1	43.3	58.7	48.8	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
04/04/90	135.4	17.8	47	31.7	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
04/20/90	130.7	14.2	39.2	26.9	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
05/12/90	131.7	**	26	17.3	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
05/20/90	**	4.3	**	**	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
06/02/90	121	40.9	52.7	15.5	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
06/08/90	124	21.1	39.5	23.6	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
07/05/90	130.7	0	36	**	**	**	**	**	**	**	**	**	**	Not Obtained	312.07	367.83	**
07/20/90	129	0	33	5	**	**	**	**	**	**	**	**	**	Not Obtained	312.07	367.52	**
08/12/90	124	0	38	0	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
09/05/90	109.1	0	3.6	0	0.75	0	0	137	13.5	2.22	**	5	40.4	Not Obtained	311.04	367.29	**
09/28/90	103.8	0	29.2	0	**	**	**	113.1	**	**	**	**	28.7	Not Obtained	310.51	367.27	**
10/15/90	104.4	0	21.1	0	0.33	0	1.5	155	7.4	1.85	0.1	3	21.1	Not Obtained	310.08	367.18	**
10/29/90	101.1	0	27.6	0	**	**	**	132.6	**	**	**	**	19.3	Not Obtained	309.72	367.1	**
11/14/90	99.9	0	25.2	0	0.3	0	1	136.9	10.8	1.5	1.5	4.5	19.3	Not Obtained	309.35	366.98	322.2
11/28/90	107.9	0	28.63	0	**	**	**	147.8	**	**	**	**	14.6	Not Obtained	309.1	366.96	323.175
12/12/90	111.9	0	32.2	0	0.33	0	2	152.8	10.9	1.7	1.5	3.8	14.2	Not Obtained	308.8	366.84	323.099
01/03/91	127.5	0	33	0	**	**	**	157.5	**	**	**	**	20.7	Not Obtained	308.56	366.69	321.994
01/17/91	110.5	0	34.8	0	**	0	1	154.9	10	1.23	2	1.9	25.6	Not Obtained	308.34	366.56	322.175
01/31/91	113.1	0	31	0	**	**	**	167.7	**	**	**	**	24.6	Not Obtained	308.13	366.43	321.251
02/07/91	120.2	**	**	0	**	**	**	**	**	**	**	**	**	Not Obtained	**	**	**
02/14/91	118.9	0	39.9	0	0.33	0	1.5	162.3	10.5	1.25	3	3.8	34.7	Not Obtained	308.45	366.24	321.251
02/26/91	114.6	0	34.4	0	**	**	**	149.9	**	**	**	**	23.7	Not Obtained	308.17	366.17	321.251
03/12/91	132.7	56.4	61.1	0	0.5	0	18.8	160.2	23.5	3.53	22.6	12.6	192	Not Obtained	310.74	366.12	323.792
03/30/91	165	151.1	82.7	87.3	15	**	**	183.4	**	**	**	**	945.3	Not Obtained	315.15	367.05	328.643
04/24/91	133.7	76.2	54.5	87.8	15	0	4.5	157.5	21.4	4	23.5	7.9	190.7	Not Obtained	316.13	367.33	328.874
05/08/91	127	53	47.5	70.8	18.5	**	**	147	**	**	**	**	124.3	Not Obtained	315.79	367.55	328.412
05/24/91	123.5	28.3	33.9	54.9	19.5	0	1.5	148.6	15.3	3.2	13.1	9	95.7	Not Obtained	315.19	367.38	327.95
06/05/91	121.2	30.7	44	45.2	**	**	**	154.2	**	**	**	**	86.1	Not Obtained	314.78	367.35	327.257
06/20/91	112.5	14.65	39.75	33	12.4	0	1	148.5	9.8	3.64	5.15	7.7	88.8	Not Obtained	314.27	367.45	327.257
07/05/91	118.1	8.96	39.1	38.6	**	**	**	156.8	**	**	**	**	93.1	Not Obtained	313.775	367.55	325.54
07/23/91	112.3	8.96	38.86	21.87	1.6	0	1	166.6	15.4	2.69	2.73	4.1	62.14	Not Obtained	313.29	367.575	326.102
08/12/91	112.1	0	34.77	32.69	**	**	**	114.5	**	**	**	**	58.3	Not Obtained	312.72	367.58	325.178
08/23/91	107.4	0	36.97	5.44	0	0	1	150.6	11.4	2	1.367	6.717	39.7	Not Obtained	312.41	367.6	325.409
09/05/91	105.5	0	33.79	2.3	**	**	**	150.8	**	**	**	**	33.52	Not Obtained	311.835	367.58	325.178
09/19/91	110.3	0	31.53	3.1	0	0	0.75	151	7.232	1.75	1	4.941	41.77	Not Obtained	311.76	367.55	324.023
10/09/91	107.3	0	32.34	0	0	**	**	131.2	**	**	**	**	26.14	Not Obtained	311.29	367.5	324.254
10/25/91	109.7	0	36.76	0	0	0	0.75	167.7	10.4	1.4	1	5.167	21.26	Not Obtained	310.875	367.35	323.792

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SPRING AND STREAM FLOW RATES AND GROUNDWATER ELEVATIONS

DATE	BAY STREET SPRING *gpm*	WEST LAKE WEIR *gpm*	MESSIAH LUTHERAN SPRING *gpm*	KALKAR SPRING QUARRY *gpm*	HIGH-LONGVIEW SPRING *gpm*	WAGNER GROVE SEEP *gpm*	HARVEY WEST SEEP *gpm*	POGONIP CREEK SYSTEM *gpm*	POGONIP SPRING #1 *gpm*	POGONIP SPRING #2 *gpm*	UPPER CAVE GULCH *gpm*	LOWER CAVE GULCH *gpm*	WILDER CREEK SPRING *gpm*	MOORE CREEK SPRING *gpm*	□MW-1A *(ft, MSL)*	□MW-1B *(ft, MSL)*	WSW 1 *(ft, MSL)*
11/08/91	109.3	0	37.25	0	0	**	**	150	**	**	**	**	30.03	Not Obtained	310.83	367.25	323.792
11/25/91	105.2	5.908	40.63	0	0	0	0.75	155.7	10.33	1.752	4.363	6.312	44.54	Not Obtained	310.725	367.129	323.561
12/17/91	98.43	0	38	0	0	0	0.75	158.1	6.664	1.24	1	6.725	49.85	Not Obtained	310.725	366.965	323.33
01/03/92	136	109.4	60.89	8.096	3.747	0	7.106	156.5	22.05	2.1	14.03	7.26	166.1	Not Obtained	311.56	366.86	324.023
01/14/92	144.8	93.86	62.88	21.38	11.82	**	**	152.9	**	**	**	**	187.8	Not Obtained	313.27	366.835	326.102
01/30/92	125.9	30.7	50.17	33.71	12.96	0	2	145.4	8.177	1.3	4.926	4.993	88.29	Not Obtained	313.14	336.835	326.102
02/13/92	192.3	255.5	129	223.3	52.94	298.3	< 150	408.5	**	**	**	>1000	3040.62	Not Obtained	315.8	366.835	326.102
02/27/92	166.3	221.4	88.64	218.2	22	0	157.9	164.7	54.6	25.04	47.86	13.46	967.76	Not Obtained	323.55	368.12	335.111
04/28/92	118.3	86.82	60.7	214.8	116	**	**	160.7	**	**	**	**	218.7	Not Obtained	325.055	370.015	339.038
05/15/92	120.6	65.26	57.13	346.5	Discontinued	0	2	139.5	13.8	5.566	18.84	5.086	178.5	Not Obtained	323.97	370.08	339.038
06/03/92	86.86	59.58	55.63	190.1	Discontinued	0	2	131.1	12.6	5.976	**	4.843	136.1	Not Obtained	322.68	370.09	337.652
07/09/92	81.42	48.4	46.85	172.5	Discontinued	0	1	153.4	12.75	4.352	3.548	2.992	107.4	Not Obtained	320.4	369.81	334.187
07/25/92	78.27	40.35	7.765	121.1	Discontinued	**	**	146.8	**	**	**	5.731	77.23	Not Obtained	319.31	369.7	334.649
08/12/92	74.88	27.09	44.75	108.1	Discontinued	0	1	135.8	10.15	3.794	3	2.618	**	Not Obtained	318.4	369.56	333.956
08/28/92	81.59	33.82	47.45	83.2	Discontinued	**	**	143.4	**	**	**	**	**	Not Obtained	317.45	369.47	333.263
09/15/92	74.23	21.96	42.84	93.33	Discontinued	0	1	142.1	8.571	2.694	1	**	**	Not Obtained	316.7	369.37	333.032
09/28/92	72	32.56	40.53	81.76	Discontinued	**	**	138.5	2.9	2.73	1	**	**	Not Obtained	316.11	369.22	331.877
11/10/92	73.09	19.81	38.6	66.85	Discontinued	0	1	138.7	7.621	1.992	1	6.25	42.38	Not Obtained	314.23	368.63	329.78
12/10/92	103.8	109.4	70.18	63.09	Discontinued	4	4	152.7	11.44	14.6	89.34	6.904	214.4	Not Obtained	314.04	368.43	329.798
01/26/93	158.8	350	118	516.5	Discontinued	5.73	172.2	257.4	86.78	64.61	175.6	182.7	1409	Not Obtained	329.23	370.25	344.582
04/18/94	86.48	76.2	49.77	245.8	Discontinued	0	3	175.4	20.36	7.945	16.36	10.64	158.5	Not Obtained	321.39	321.12	369.12
03/31/95	140	302.8	82.26	652.6	Discontinued	0	15	205	62.3	37.97	172	128.4	1092	5	335.22	372.98	327.95
10/04/95	87.44	97.9	49.74	145.7	Discontinued	0	2	150.7	20	6.25	15	5.891	132.3	10	323.71	370.29	316.4
03/30/96	136.6	287	77.72	488.34	Discontinued	0	10	257.1	81.62	27.18	104.09	207.79	1001.39	15	338.98	372.83	334.19
10/27/96	82.94	16.71	43.78	123.42	Discontinued	0	< 5	80.27	11.55	5.47	5	3.43	137.92	< 10	323.29	369.55	318.71
03/19/97	96	175.72	57.2	318.3	Discontinued	0	< 5	349.91	52.15	12.38	21.24	33.1	982.65	20	319.85	373.06	330.26
10/08/97	89.9	23.07	30	111.82	Discontinued	0	< 5	155.58	24	1.23	0	5.88	156.74	5	*>324.1	369.72	322.18
04/13/98	116	287.19	73.33	1370.4	Discontinued	7.8	13.8	646.87	96.67	49.8	379.27	247.78	1526.48	29.2	344.9	373.9	314.1
10/06/98	112	95.65	43.33	103.93	Discontinued	0	< 5	307.44	47.33	4.5	40	15-30	251.52	< 5	327.2	370.23	317.6
03/30/99	128.75	221.43	51.25	317.9	Discontinued	2.5	31	378.86	132.5	36	117.85	161.59	1269.73		335.95	371.92	**
08/20/99	77	40.35	44	259.18	Discontinued	**	< 5	*** 719.58	52	7	0	52.47	351.54	2.42	327.43	370.35	330.26
01/07/00	**	**	**	**	Discontinued	**	**	*** 294.87	**	**	**	**	**		**	**	**
03/22/00	107.75	309.46	63.66	1110.56	Discontinued	0	25	559.5	62	12.29	0	161.33	1044.58	7.5	340.5	372.68	338.35
09/25/00	73.59	21.96	41.62	135.58	Discontinued	0	< 5	310.12	19.86	3.52	0	15	466.68	1.58	324.27	370.02	*****
03/22/01	89.96	143.82	48	196.07	Discontinued	0	10	161.29	36.6	8.8	0	15	721	0.6	327.62	369.77	330.26
11/09/01	61.12	16.71	28	65.52	Discontinued	0	< 5	182.51	25.2	2.88	0	12	104.42	0.5	321.28	365.52	311.78
06/04/02	122.12	11.96	45.5	197.9	Discontinued	0	< 5	309.4	47.85	3.6	0	21.78	252.27	0.53	325	360	316.4
10/10/02	106.42	21.96	45.46	65.42	Discontinued	0	1	92.11	10.3	3.96	0	7.5	202.7	1.82	320.57	368.95	*****
03/19/03	117.58	114.13	61.59	260	Discontinued	0	< 5	233.38	37.44	6.96	0	175	565	3.23	328.46	359.68	*****

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SPRING AND STREAM FLOW RATES AND GROUNDWATER ELEVATIONS

DATE	BAY STREET SPRING *gpm*	WEST LAKE WEIR *gpm*	MESSIAH LUTHERAN SPRING *gpm*	KALKAR SPRING QUARRY *gpm*	HIGH-LONGVIEW SPRING *gpm*	WAGNER GROVE SEEP *gpm*	HARVEY WEST SEEP *gpm*	POGONIP CREEK SYSTEM *gpm*	POGONIP SPRING #1 *gpm*	POGONIP SPRING #2 *gpm*	UPPER CAVE GULCH *gpm*	LOWER CAVE GULCH *gpm*	WILDER CREEK SPRING *gpm*	MOORE CREEK SPRING *gpm*	□MW-1A *(ft, MSL)*	□MW-1B *(ft, MSL)*	WSW 1 *(ft, MSL)*
09/30/03	76.7	4.23	38.28	78.45	Discontinued	0	< 5	242.58	16.7	3.72	0	10.05	124.9	2	319.84	368.81	*****
03/19/04	134.87	114.13	62.77	185.11	Discontinued	0	< 3	249.33	23.48	6.67	0	117.6	753.98	3	328.07	359.15	*****
09/22/04	96.3	1	38.24	77.5	Discontinued	0	< 1	174.19	12.16	5.36	0	10	111.36	1	319.30	369.06	*****
03/18/05	156.47	186.81	86.14	702.51	Discontinued	0	6	307.83	46.62	38.24	0	277.91	887.44	1.26	320.13	369.54	*****
09/28/05	104.83	24.77	55.87	164.76	Discontinued	0	< 1	247.85	20.21	5.8	0	24.56	219.14	1	325.00	371.18	*****
03/21/06	230.89	406.79	135.35	971.49	Discontinued	115.72	181.57	574.70	153.76	55.6	1239.94	1357.45	4944.03	18.60	340.01	373.08	*****
09/18/06	108.01	114.13	71.76	160.63	Discontinued	0	< 2	480.71	76.31	15.67	0	29.40	220.41	2.00	328.79	370.77	*****
03/21/07	97.26	86.62	56.50	156.43	Discontinued	0	1	398.67	33.09	22.09	0	21.93	436.52	1	327.00	370.40	*****
09/18/07	60.35	1.07	31.92	127.35	Discontinued	0	< 1	274.70	10	4	0	5	95.95	< 2	321.96	369.18	*****
11/09/07	58.07	20.88	21.3	--	Discontinued	--	--	--	--	--	--	--	--	--	--	--	--
11/10/07	64	16.71	21.7	--	Discontinued	--	--	--	--	--	--	--	--	--	--	--	--
11/11/07	76.5	40.35	30	--	Discontinued	--	--	--	--	--	--	--	--	--	--	--	--
11/12/07	74.8	27.68	30	--	Discontinued	--	--	--	--	--	--	--	--	--	--	--	--
11/13/07	74	86.82	24	--	Discontinued	--	--	--	--	--	--	--	--	--	--	--	--
03/21/08	97.4	133.67	37	547.5	Discontinued	0	< 10	267.78	15	10	0	15	375.8	< 5	332.58	370.68	331.81
09/19/08	81	4.23	22.8	178.79	Discontinued	0	< 5	165.64	5	4	0	10	151.36	< 2	321.19	369.46	321.52
03/23/09	97.5	133.67	32	110.74	Discontinued	Discontinued	Discontinued	230.42	87.21	12	Discontinued	Discontinued	361.97	< 3	326.11	370.36	325.32
09/19/09	66	1.49	17	105.36	Discontinued	Discontinued	Discontinued	170.92	4	4	Discontinued	Discontinued	59.17	< 2	319.45	369.74	318.74
03/24/10	90.6	203.88	30	523	Discontinued	Discontinued	Discontinued	319.26	17.5	16.5	Discontinued	Discontinued	889	< 5	333.91	370.83	333.14
09/17/10	88.57	16.71	21	49.22	Discontinued	Discontinued	Discontinued	252.97	22.5	4.5	Discontinued	Discontinued	133.59	< 2	323.61	367.58	322.8
03/17/11	205	276.9	53.3	884.05	Discontinued	Discontinued	Discontinued	368.24	233.53	30	Discontinued	Discontinued	1433.02	< 10	334.49	371.53	335.13
09/16/11	70	40.35	30	151.68	Discontinued	Discontinued	Discontinued	181.31	20	8.2	Discontinued	Discontinued	198.89	< 0.5	327.83	371.34	327.29
03/16/12	95	123.77	60	207.42	Discontinued	Discontinued	Discontinued	390.70	22.5	40	Discontinued	Discontinued	2616.95	< 25	322.40	370.15	321.52
09/21/12	43	1.49	15	106.1	Discontinued	Discontinued	Discontinued	232.55	12.5	4.9	Discontinued	Discontinued	151.1	0	320.15	369.54	319.31
03/15/13	79	54.52	30	222.38	Discontinued	Discontinued	Discontinued	234.31	17.5	6.3	Discontinued	Discontinued	228.36	< 1	323.23	369.67	322.49
09/20/13	67	0	23	19.37	Discontinued	Discontinued	Discontinued	231.24	10	3.3	Discontinued	Discontinued	7.73	0	317.13	368.94	316.38
03/14/14	36	95.65	56	158	Discontinued	Discontinued	Discontinued	131.63	152	19.45	Discontinued	Discontinued	270.12	< 2	316.84	369.25	316.2
09/19/14	21	0	15	10	Discontinued	Discontinued	Discontinued	123.47	29.9	3	Discontinued	Discontinued	44.9	0	313.49	367.68	312.13
03/13/15	33	0	31.2	41.78	Discontinued	Discontinued	Discontinued	212.90	53.9	7.5	Discontinued	Discontinued	879.6	0	321.64	370.12	320.38
09/25/15	23	0	12	10	Discontinued	Discontinued	Discontinued	238.61	7	2.3	Discontinued	Discontinued	67.3	0	314.49	368.56	313.03
03/18/16	95	245.57	155.6	424.67	Discontinued	Discontinued	Discontinued	306.27	329	48.72	Discontinued	Discontinued	1871.65	5	333.03	371.80	331.83
09/23/16	36	4.23	55.5	72.8	Discontinued	Discontinued	Discontinued	223.93	58.3	4.41	Discontinued	Discontinued	260	0	321.61	370.40	320.07
03/10/17	95	451.14	236.63	1865.51	Discontinued	Discontinued	Discontinued	414.47	761.5	58.96	Discontinued	Discontinued	1991.62	8	356.23	376.44	354.79
09/22/17	36	27.68	81	155.43	Discontinued	Discontinued	Discontinued	244.30	203	10.6	Discontinued	Discontinued	294.82	0	327.81	371.48	326.6
03/19/18	36	55.13	75	124.54	Discontinued	Discontinued	Discontinued	270.55	201	12	Discontinued	Discontinued	610.89	5	322.09	370.38	321.00
08/24/18	33	12.09	19.5	94.15	Discontinued	Discontinued	Discontinued	244.30	79.3	5	Discontinued	Discontinued	256.76	1	321.89	370.10	320.66
09/20/18	26	4.27	57.3	75.64	Discontinued	Discontinued	Discontinued	286.11	44.9	4	Discontinued	Discontinued	109.4	0	320.87	370.02	319.62
10/18/18	26	0	12.7	64.28	Discontinued	Discontinued	Discontinued	189.39	56.8	4.9	Discontinued	Discontinued	200.5	0	319.92	369.90	318.65
11/20/18	21	0	14.3	63.42	Discontinued	Discontinued	Discontinued	227.67	46.4	3.8	Discontinued	Discontinued	273.8	0	318.77	369.75	317.55
12/21/18	36	63	84	77.88	Discontinued	Discontinued	Discontinued	256.26	160	8	Discontinued	Discontinued	703.1	2	319.32	369.97	317.97
01/19/19	77	189	71	135.91	Discontinued	Discontinued	Discontinued	554.42	113	45	Discontinued	Discontinued	3,077	3	322.80	370.72	321.52
02/22/19	83	300	127	885.61	Discontinued	Discontinued	Discontinued	153.80	266	60	Discontinued	Discontinued	1,761	5	337.83	--	336.59
03/15/19	72	313	107	888.25	Discontinued	Discontinued	Discontinued	352.31	149	61	Discontinued	Discontinued	2,104	5	340.22	--	338.96
04/19/19	56	125	77	431.95	Discontinued	Discontinued	Discontinued	214.71	80.44	21.5	Discontinued	Discontinued	516	3	335.85	373.24	334.65
05/18/19	52	71	94	313.15	Discontinued	Discontinued	Discontinued	265.09	127.49	19	Discontinued	Discontinued	606	3	332.50	372.64	331.29
06/21/19	48	63	43	288.07	Discontinued	Discontinued	Discontinued	295.57	175	19	Discontinued	Discontinued	196	2	330.95	372.21	329.8
07/22/19	36	48	25	256.59	Discontinued	Discontinued	Discontinued	325.22	215	15	Discontinued	Discontinued	500	2	329.24	371.90	328.1

Notes:

* = Solinst groundwater level meter not long enough to reach groundwater.

** = Not measured this monitoring period, either because flow rate was not being verified or there was no flow -dry.

*** = Flow rate incorrect (calculation/field measurement error).

**** = Corrected flow rate measurement due to error in previous round of measurement or calculation.

***** = Air line used to measure pressure head is clogged or broken. Unable to record PSI measurement, therefore no groundwater level obtained, or elevation reported.

□ = Data logging transducers were installed in wells MW-1A and MW-1B on 8/23/07 and record water levels in these wells every 12 hours. Groundwater elevation reported in this table on 9/18/07 and beginning 8/24/19 to present was interpreted from transducer data.

Data from 11/9 - 11/13 was collected during a 72-hour constant rate pump test at well WSW 1. Flow was only measured at Bay Street Spring, Messiah Lutheran Spring, and at West Lake Weir.

Top of well casing (TOC) survey was conducted by Ifland Engineers at WSW-1, MW-1A and MW-1B on 12/5/07. TOC elevations are 416.41, 424.84, and 418.69 feet relative to Mean Sea Level at wells WSW 1, MW-1A, and MW-1B, respectively.

gpm = gallons per minute. (ft, MSL) = Feet, above reference of mean sea level.

Table G1-2
UCSC Hydrogeologic Balance

Drainage Basin Areas, Rainfall Runoff and Recharge, Spring Discharge, and Water Balance

Watershed/Drainage Area Name/Type	Wilder Creek (30% runoff to subsurface-subarea W1)[5]	Cave Gulch (100% runoff to subsurface-subarea C1)[5]	Cave Gulch (30% runoff to subsurface-subarea C2)[5]	Moore Creek (100% runoff to subsurface-subarea M1, M2.2)[5]	Moore Creek (60% runoff to subsurface-subarea M2.1)[5]	Moore Creek (100% runoff to surface-subarea M3)[5]	Western Tributary Moore Creek (100% runoff to subsurface-subarea T1)[5]	Western Tributary Moore Creek (100% runoff to surface-subarea T2)	Jordan Gulch (100% runoff to subsurface-subarea J1)[5]	Jordan Gulch (100% runoff to surface-subarea J2)	Jordan Gulch (60% runoff to subsurface-subarea J3)[5]	Arroyo Seco (100% runoff to subsurface-subarea A2)[5]	Arroyo Seco (100% runoff to surface-subarea A2)	High Street (100% runoff to surface- subarea H1)	Kalkar Quarry (100% runoff to surface-subarea K1)[5]	Kalkar Quarry (100% runoff to surface-subarea K2)	Kalkar Quarry (100% runoff to subsurface-subarea K2)	San Lorenzo River (100% runoff to subsurface-subarea S1)[5]	San Lorenzo River (100% runoff to surface-subarea S1)[5]	San Lorenzo River (100% runoff to surface-subareas S2-S6)[6]	Total Karst Drainage Area (Potentially Influenced)
Off-Campus Karst Recharge Drainage Area (acres)[1]	548	0	124	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	672
On-Campus Karst Recharge Drainage Area (acres)[1]	48.8	25.4	440	116.3	130	8.6	11.9	100.2	364.1	12.5	66	22.5	98.1	5.9	5.9	46.6	9.2	51.2	42.2	78	1683.4
Rainfall (in/yr)[2]	45.3	45.3	45.3	43.7	44	40	45.3	45	39.8	39.8	39.8	37.7	37.7	39.7	39.7	39.7	39.7	39.7	39.7	41.8	41.4
Existing Undeveloped Area (%)	100%	96%	100%	88%	94%	86%	98%	99%	91%	91%	91%	86%	86%	69%	70%	98%	98%	94%	94%	95%	91%
Existing Impervious Area (%)[3]	0%	4%	0%	12%	6%	14%	2%	1%	9%	9%	9%	14%	14%	31%	30%	2%	2%	6%	6%	5%	9%
Annual Runoff % (2020 TELR matrix)[4]	16%	19%	16%	22%	24%	34%	16%	15%	21%	21%	21%	27%	27%	40%	37%	12%	12%	16%	16%	18%	22%
Total Runoff (in/yr)	7.2	8.6	7.2	9.6	10.6	13.6	7.2	6.8	8.4	8.4	8.4	10.2	10.2	15.9	10.7	4.8	4.8	6.4	6.4	7.5	8.6
Total Runoff (acre-ft/yr)	360.5	18.2	340.7	93.2	114.4	9.7	7.2	56.4	253.6	8.7	46.0	19.1	83.2	7.8	5.3	18.5	3.7	27.1	22.3	48.9	1544.4
Infiltration Recharge (in/yr)	38.1	36.7	38.1	34.1	33.4	26.4	38.1	38.3	31.4	31.4	31.4	27.5	27.5	23.8	29.0	34.9	34.9	33.3	33.3	34.3	32.8
Captured Runoff Recharge (in/yr)[6]	2.2	8.6	2.2	9.6	6.3	0.0	7.2	0.0	8.4	0.0	5.0	10.2	0.0	0.0	10.7	0.0	4.8	6.4	0.0	0.0	4.1
On-Campus Runoff Recharge Only (acre-ft/yr)	**163.6**	**95.9**	**1475.0**	**423.5**	**430.9**	**18.9**	**44.9**	**319.4**	**1207.6**	**32.8**	**200.5**	**70.7**	**225.0**	**11.7**	**19.5**	**135.7**	**30.4**	**169.4**	**117.3**	**222.8**	**5415.4**
Subarea Total Recharge (acre-ft/yr)	2000.6	95.9	1890.6	423.5	430.9	18.9	44.9	319.4	1207.6	32.8	200.5	70.7	225.0	11.7	19.5	135.7	30.4	169.4	117.3	222.8	7668.1
Drainage Area Total Recharge (acre-ft/yr)	**2000.6**	**1986.5**		**873.4**			**364.3**		**1440.9**			**295.7**		**11.7**	**185.6**			**509.5**			**7668.1**

Discharge Measuring Station	Wilder Creek Spring	Upper Cave Gulch	Lower Cave Gulch	Moore Creek Spring	No Known Spring	Bay Street Spring	West Lake Outlet	No Known Spring	No Known Spring	Messiah Lutheran Spring	High-Longview Spring	Kalkar Quarry Spring	Wagnar Grove Seep	Harvey West Seep	Pogonip Creek System	Pogonip Spring #1	Pogonip Spring #2	**Total Discharge**
With surface elevation	330 ft MSL	540 ft MSL	330 ft MSL	410 ft MSL (approx.)		235 ft MSL	255 ft MSL			255 ft MSL	250 ft MSL	310 ft MSL	200 ft MSL	110 ft MSL (approx.)	150 ft MSL	435 ft MSL	500 ft MSL	
Average Discharge (gpm)[8]	450.7	46.5	63.3	4.3		110.6	66.4			50.6	23.1	161.0	7.8	13.6	221.8	58.3	13.04	1290.7
Average Discharge (acre-ft/yr)	727.4	75.0	102.1	7.0		178.4	107.2			81.6	37.2	259.8	12.5	22.0	357.9	94.1	21.0	2083.3
Watershed Spring/Stream Discharge (acre-ft/yr)	**727.4**	**177.1**		**7.0**		**285.7**				**118.8**		**259.8**	**507.5**					**2083.3**
Water Balance																		**Total Outflow**
Total Surplus Recharge (Presumed Groundwater Outflow) (acre-ft/yr)	**1273.2**	**1809.4**		**866.4**	**364.3**	**1155.2**			**295.7**	**-107.1**		**-74.2**	**1.9**					**5584.8**

Notes:

<u>Water Balance Equation:</u> Surplus Recharge (or Presumed Groundwater Outflow) = (Precipitation x Area) + Surface Inflow + Groundwater Inflow + Captured Runoff - Surface Runoff - Evapo-Transpiration - Spring Outflow

Water balance table adopted from URS Revised UCSC Water Balance (3/14/2008)

Drainage basin areas are approximately representative of extent of the underlying karst aquifer. All are on campus except for the upper off-campus Wilder Creek and Cave Gulch drainages. The San Lorenzo River subareas S7 & S8 (348 acres), although on-campus, do not contribute to karst aquifer recharge

Surface water and groundwater inflow from outside the karst recharge drainage area are presumed to be negligible, based on the topographic setting of the UCSC campus

Discharge measuring station locations are classified within approximate geographical drainage area boundaries; however, source of groundwater surface discharge may not necessarily originate within the drainage area where located.

1 Source: Johnson, "Evaluation of Drainage Conditions at UCSC Under Existing and Proposed Campus Development", Figures 3 & 4, Table 3, June 1988. Onsite drainage areas updated by UCSC 2005 Draft LRDP EIR Table 4.8.1 and Appendix D2 (Table D2-1), URS, 2005 and later digitized and modified by UC Santa Cruz staff in 2018.

2 Rainfall based on Stormwater TELR modeling calculations for various 24-hr precipitation depths and the average annual number of days with measurable precipitation to represent the overall distribution and total average annual depths. Rainfall estimates obtained from the PRISM Climate Group (2004) at Oregon State University.

3 Source: 2NDNATURE (2020) Hydrologic Modeling Results for the UC Santa Cruz Campus. September 21. Impervious cover is specified using the most recent data from the National Land Cover Dataset which is provided at 30-meter grid cell resolution (NLCD,2016)

4 Source: 2NDNATURE (2020) Hydrologic Modeling Results for the UC Santa Cruz Campus. September 21. The runoff analysis embeds an Evapotranspiration estimate.

5 Assumed percentage of runoff captured by karst sinkholes in partial subsurface drainage subareas, source: Johnson, Weber & Associates "Evaluation of Groundwater resources at UCSC Parts I & II", page 57, march 1989. URS, 2008.

6 The San Lorenzo River subareas S7 & S8 (348 acres), although on-campus, do not contribute to karst aquifer recharge but recharges the shallow sandstone/schist/granitic aquifer which outflows to the San Lorenzo River north of campus, source: Johnson, Weber & Associates "Evaluation of Groundwater Resources at UCSC part I & II", Page 57, March 1989.

7 Annual average of data collected between September 1984 through July 2019. Monitoring of High-Longview Spring, Wagner Grove Seep, Harvey West Seep and Upper / Lower Cave Gulch has been discontinued due to inaccessibility or low, unmeasurable flow. Average flow rates for these locations through the period monitored are used to estimate the hydrogeologic balance.

Memorandum

TO: JERED CHANEY, SENIOR GEOLOGIST, WEBER, HAYES & ASSOCIATES

FROM: 2NDNATURE

SUBJECT: WATER YEAR CLASSIFICATION FOR THE UC SANTA CRUZ CAMPUS

DATE: 5/26/2021

In support of the Draft Environmental Impact Report (EIR) for the UC Santa Cruz Long Range Development Plan (LRDP), 2NDNATURE is pleased to present the results of a statistical analysis of historical rainfall to characterize water year types. This analysis provides context for the results of a modeling study to estimate the impacts of groundwater pumping activities on local stream flows. The outputs of this analysis will improve the interpretation of how inter-annual rainfall variance may affect rainfall-runoff relationships and groundwater pumping impacts by providing the statistical basis to characterize the monitoring data in terms of historical wetness conditions.

STUDY AREA

The study area is defined by the UC Santa Cruz campus boundary located on the northwest edge of the City of Santa Cruz, CA (figure 1). The campus spans an area of 2,000 acres and has an elevation range of 285 to 1,195 ft.

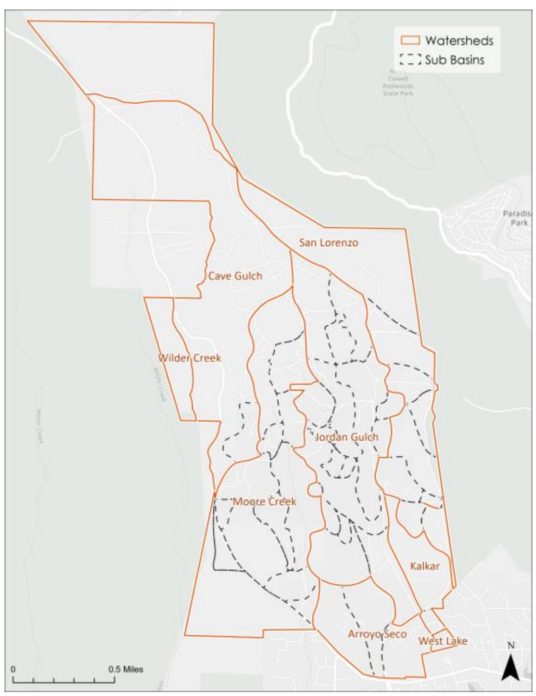

Figure 1. Study area drainages and sub-basins for the UC Santa Cruz campus

METHODS & RESULTS

A precipitation frequency analysis was conducted using 39 years of precipitation data to determine the water year precipitation thresholds that define 5 water year types (very dry, dry, normal, wet, and very wet). These data brackets a wide range of historical conditions to provide a reliable characterization of historical wetness conditions.

Data Acquisition & Processing

Precipitation data for the study area was obtained from daily rainfall raster grids from the PRISM Climate Group. PRISM datasets, widely used in climate research, are gridded spatial outputs developed from a comprehensive network of rainfall monitoring stations (Daly, 2008). These data provide a robust spatial interpolation of rainfall across the landscape from point station data, which incorporates changes in elevation, aspect, and other geographically varying factors that affect precipitation patterns. The daily rainfall raster grids (4 km resolution) for the period 1982 to 2020 were accessed and processed in the Google Earth Engine platform (Gorelick et al., 2017). PRISM grid cells along with the study area boundary are shown in Figure 2. Mean daily rainfall totals for the UCSC campus boundary were spatially weighted based on the space occupied by each grid cell within the study area, and summed by water year (October 1 – September 30) to calculate annual rainfall totals.

Water Year Designations

Annual exceedance probabilities were calculated from the 39 years of rainfall data and used to define water year type thresholds (table 1). The exceedance probability (*P*) indicates the likelihood (or percent probability) that an annual rainfall total will be equaled or exceeded in any given year and is calculated as

$$P = \frac{\mathrm{m}}{\mathrm{n}+1}$$

where *m* represents the rank of the annual rainfall total, with 1 being the largest possible value, and *n* represents the number of events on record. Points for each year define a curve that can be used to classify water year types as shown in Figure 3. The thresholds chosen are such that the 'normal' rainfall year category bracketed the middle 30% of annual rainfalls totals, and the extreme categories (very wet and very dry) are defined by less than 10% probability of occurrence. Precipitation ranges for each water year type and the exceedance probabilities that define the lower bounds of each category are provided in Table 1. Water year type recurrence interval, calculated as $n_{total}/n_{category}$, is included to characterize the number of years within which you are likely to experience a given water year type. This approach provides a simple and clear connection between annual rainfall, probability of occurrence, and relative wetness conditions expected to occur on UCSC campus.

Table 1. Classification of water year types for UC Santa Cruz based on rainfall exceedance probability breaks

Water Year Type	Precipitation Range (in/yr)	Exceedance Probability	n	Recurrence Interval (years)
Very Dry	≤ 23.5	≥ 0.90	4	10
Dry	23.5 - 33.2	≥ 0.67	9	4
Normal	33.2 - 51.1	≥ 0.33	13	3
Wet	51.1 - 71.0	≥ 0.10	9	4
Very Wet	> 71.0	< 0.10	4	10

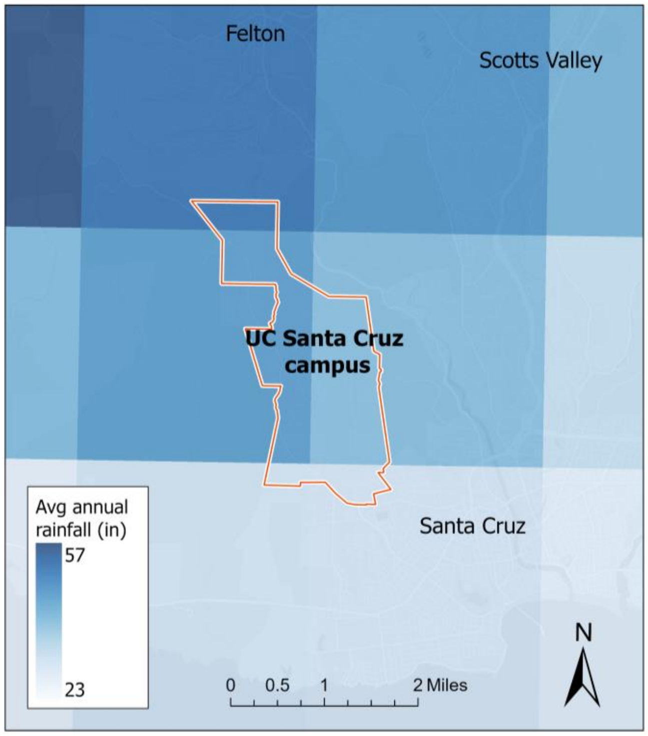

Figure 2. UC Santa Cruz study area with average annual rainfall grid extracted from PRISM

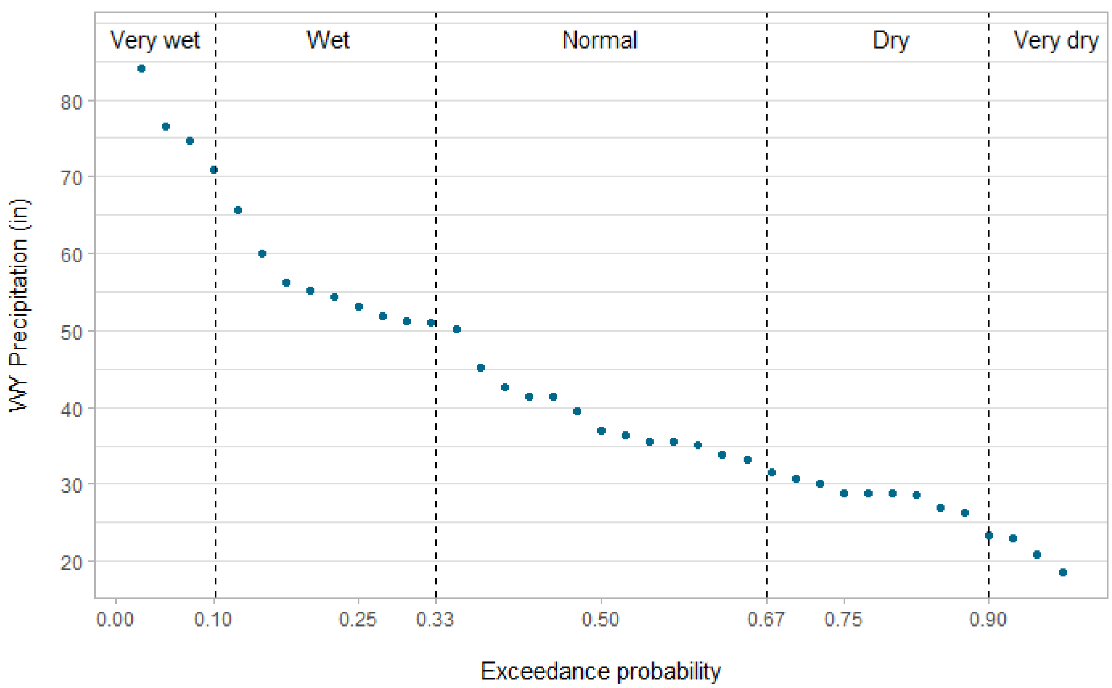

Figure 3. Water year type classification for UCSC based on probability of exceedance breaks

Rainfall Water Year Classification & Streamflow

Rainfall patterns are a primary driver of watershed streamflow conditions, and as such, rainfall-based water year type classification is expected to correspond with streamflow conditions within UCSC and in surrounding drainages (Cayan 1993). To characterize regional water supply conditions, the City of Santa Cruz uses a water year classification system with four types (very dry, dry, normal, wet) based on annual cumulative stream flow in the San Lorenzo River. We performed an analysis to verify correspondence between the rainfall-based index calculated above and the City's streamflow-based index. As shown in Figure 4, while there is some variance due to the complexities of rainfall-runoff transformation, but there is generally good agreement between the two approaches. This result is supportive that the rainfall-based classification thresholds provide meaningful context in terms of both rainfall and streamflow conditions in the watersheds within and connected to the UCSC campus.

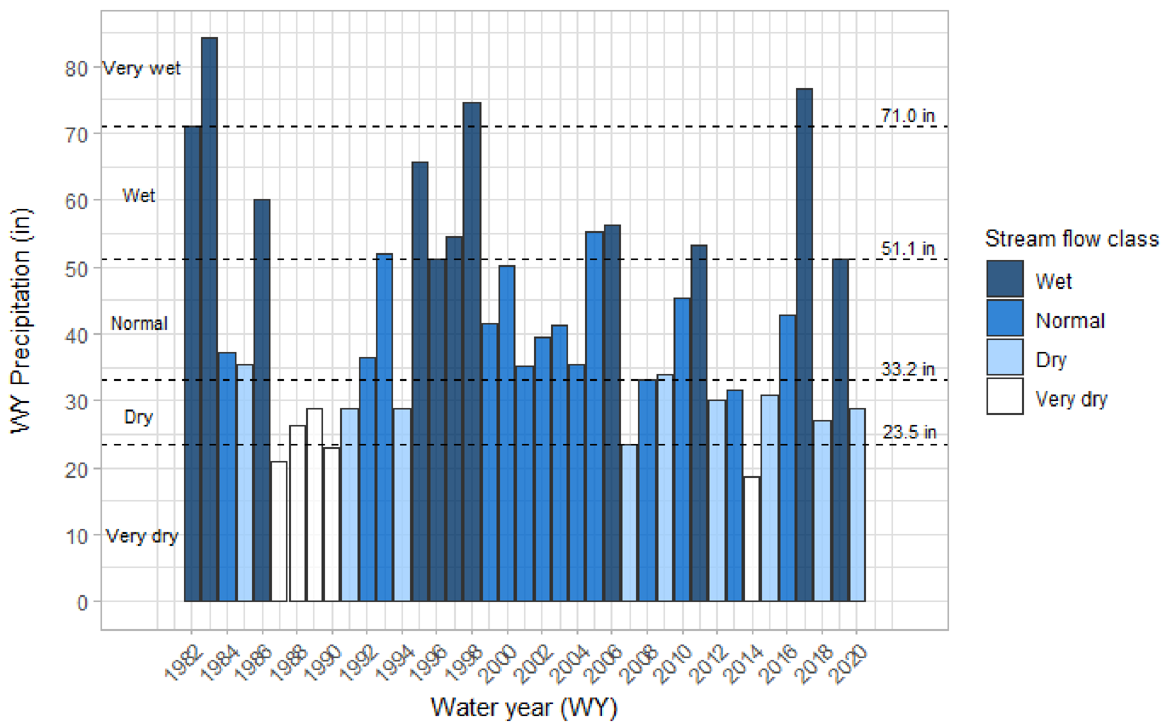

Figure 4. Comparison of rainfall-based water year types with City of Santa Cruz streamflow-based water year classification. Dashed lines represent rainfall-based water year classification from this analysis. Bar colors represent the City's streamflow-based classification approach.

REFERENCES

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Appendix H

Noise Modeling

Construction Source Noise Prediction Model

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	436	70
Threshold	138	80
Noise-sensitive receptor	50	88.8

Equipment	Reference Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Excavator	85	0.4
Dozer	85	0.4
Concrete Mixer Truck	85	0.4
Excavator	85	0.4
Dozer	85	0.4
Concrete Mixer Truck	85	0.4

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Excavator	81.0
Dozer	81.0
Concrete Mixer Truck	81.0
Excavator	81.0
Dozer	81.0
Concrete Mixer Truck	81.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)

88.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Table 4-26 from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 86).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 176 and 177).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2018: pg 86); and

D = Distance from source to receiver.

Construction Source Noise Prediction Model

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (Lmax dBA)
Threshold	1,225	65
Threshold	689	70
Noise-sensitive receptor	50	92.8

Equipment	Reference Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Excavator	85	1
Dozer	85	1
Concrete Mixer Truck	85	1
Excavator	85	1
Dozer	85	1
Concrete Mixer Truck	85	1

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Excavator	85.0
Dozer	85.0
Concrete Mixer Truck	85.0
Excavator	85.0
Dozer	85.0
Concrete Mixer Truck	85.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
92.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Table 4-26 from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 86).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 176 and 177).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2018: pg 86); and

D = Distance from source to receiver.

Distance Propagation Calculations for Stationary Sources of Ground Vibration

ASCENT ENVIRONMENTAL

KEY:
- Orange cells are for input.
- Grey cells are intermediate calculations performed by the model.
- Green cells are data to present in a written analysis (output).

STEP 1: Determine units in which to perform calculation.
— If vibration decibels (VdB), then use Table A and proceed to Steps 2A and 3A.
— If peak particle velocity (PPV), then use Table B and proceed to Steps 2B and 3B.

STEP 2A: Identify the vibration source and enter the reference vibration level (VdB) and distance.

STEP 3A: Select the distance to the receiver.

Table A. Propagation of vibration decibels (VdB) with distance

Noise Source/ID	Reference Noise Level			Attenuated Noise Level at Receptor		
	vibration level (VdB)	@	distance (ft)	vibration level (VdB)	@	distance (ft)
Vibratory Roller	94	@	25	79.7	@	75
Large Bulldozer	87	@	25	79.3	@	45
Loaded Truck	86.0	@	25	79.9	@	40
Jackhammer	79	@	25	79.0	@	25
Small Bulldozer	58	@	25	79.0	@	5
Vibratory Roller	94	@	25	64.8	@	235
Large Bulldozer	87	@	25	66.0	@	125
Loaded Truck	86.0	@	25	65.0	@	125
Jackhammer	79	@	25	64.7	@	75
Small Bulldozer	58	@	25	64.7	@	15

The Lv metric (VdB) is used to assess the likelihood for vibration to result in human annoyance.

STEP 2B: Identify the vibration source and enter the reference peak particle velocity (PPV) and distance.

STEP 3B: Select the distance to the receiver.

Table B. Propagation of peak particle velocity (PPV) with distance

Noise Source/ID	Reference Noise Level			Attenuated Noise Level at Receptor		
	vibration level (PPV)	@	distance (ft)	vibration level (PPV)	@	distance (ft)
Vibratory Roller	0.210	@	25	0.210	@	25
Large Bulldozer	0.089	@	25	0.191	@	15
Loaded Truck	0.076	@	25	0.164	@	15
Jackhammer	0.035	@	25	0.138	@	10
Small Bulldozer	0.0	@	25	0.1	@	2

The PPV metric (in/sec) is used for assessing the likelihood for the potential of structural damage.

Notes:
Computation of propagated vibration levels is based on the equations presented on pg. 185 of FTA 2018. Estimates of attenuated vibration levels do not account for reductions from intervening underground barriers or other underground structures of any type, or changes in soil type.

Sources:
Federal Transit Administration. 2018. Transit Noise and Vibration Impact Assessment. FTA Report No. 0123. Prepared by John A. Volpe National Transportation Systems Center, Cambridge, MA. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf. Accessed April 8, 2020.

Attenuation Calculations for Stationary Noise Sources

KEY: Orange cells are for input.

Grey cells are intermediate calculations performed by the model.

Green cells are data to present in a written analysis (output).

STEP 1: Identify the noise source and enter the reference noise level (dBA and distance).

STEP 2: Select the ground type (hard or soft), and enter the source and receiver heights.

STEP 3: Select the distance to the receiver.

Noise Source/ID	Reference Noise Level			Attenuation Characteristics				Attenuated Noise Level at Receptor		
	noise level (dBA)	@	distance (ft)	Ground Type (soft/hard)	Source Height (ft)	Receiver Height (ft)	Ground Factor	noise level (dBA)	@	distance (ft)
Loading Dock Activity Lmax	86.0	@	50	hard	8	5	0.00	69.9	@	320
Loading Dock Activity Lmax	86.0	@	50	hard	8	5	0.00	65.0	@	560
HVAC unit	78.0	@	3	hard	8	5	0.00	53.6	@	50
HVAC unit (Leq)	53.6	@	50	hard	8	5	0.00	50.1	@	75
HVAC unit (Leq)	53.6	@	50	hard	8	5	0.00	45.0	@	135
							0.66			
							0.66			
							0.66			
							0.66			
							0.66			
							0.66			
							0.66			
							0.66			
							0.66			

Notes:

Estimates of attenuated noise levels do not account for reductions from intervening barriers, including walls, trees, vegetation, or structures of any type.

Computation of the attenuated noise level is based on the equation presented on pg. 176 and 177 of FTA 2018.

Computation of the ground factor is based on the equation presentd in Table 4-26 on pg. 86 of FTA 2018, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

Sources:

Federal Transit Association (FTA). 2018 (September). Transit Noise and Vibration Impact Assessment. Washington, D.C. Available: <http://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-

Traffic Noise Spreadsheet Calculator

Project: UC Santa Cruz - 2020 LRDP EIR

Noise Level Descriptor: Ldn
Site Conditions: Hard
Traffic Input: ADT
Traffic K-Factor:

Number	Name (Segment Description and Location)	From	To	ADT	Speed (mph)	Distance to Directional Centerline, (feet)4: Near	Far	Traffic Distribution Characteristics: % Auto	% Medium	% Heavy	% Day	% Eve	% Night	Output: Ldn, (dBA)5,6,7	Distance to Contour, (feet)3: 70 dBA	65 dBA	60 dBA	55 dBA
Existing Conditions																		
1	Bay Street			19,657	30	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	62.1	16	51	162	512
2	Empire Grade			7,498	40	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	61.2	13	41	130	412
3	Glenn Coolidge Drive			20,764	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	60.7	12	37	117	370
4	Hagar Drive			15,484	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	62.7	19	59	187	592
5	Heller Drive			3,197	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	55.9	4	12	39	122
6	High Street			10,663	30	50	50	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	62.4	9	28	88	278
7	Highway 17			52,932	50	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	72.4	175	555	1754	5547
8	King Street			1,926	25	50	50	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	53.4	1	3	11	34
9	McLaughlin Drive			3,197	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	52.6	2	6	18	57
10	Mission Street/Cabrillo Highway			58,064	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	65.2	33	104	328	1036
11	Natural Bridges Drive			4,356	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	57.2	5	17	53	166
12	Western Drive			2,337	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	54.5	3	9	28	89
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					

*All modeling assumes average pavement, level roadways (less than 1.5% grade), constant traffic flow and does not account for shielding of any type or finite roadway adjustments. All levels are reported as A-weighted noise levels.

Traffic Noise Spreadsheet Calculator

Project: UC Santa Cruz - 2020 LRDP EIR

Noise Level Descriptor: Ldn
Site Conditions: Hard
Traffic Input: ADT
Traffic K-Factor:

	Segment Description and Location			Input										Output				
						Distance to Directional Centerline, (feet)[4]		Traffic Distribution Characteristics							Distance to Contour, (feet)[3]			
Number	Name	From	To	ADT	Speed (mph)	Near	Far	% Auto	% Medium	% Heavy	% Day	% Eve	% Night	Ldn, (dBA)[5,6,7]	70 dBA	65 dBA	60 dBA	55 dBA
Existing Conditions																		
1	Bay Street			23,972	30	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	63.0	20	62	197	624
2	Empire Grade			9,837	40	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	62.3	17	54	171	541
3	Glenn Coolidge Drive			27,477	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	61.9	15	49	155	490
4	Hagar Drive			18,340	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	63.5	22	70	222	701
5	Heller Drive			6,800	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	59.1	8	26	82	260
6	High Street			13,366	30	50	50	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	63.4	11	35	110	348
7	Highway 17			53,487	50	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	72.5	177	561	1773	5606
8	King Street			2,989	25	50	50	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	55.3	2	5	17	53
9	McLaughlin Drive			6,800	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	55.8	4	12	38	121
10	Mission Street/Cabrillo Highway			61,901	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	65.4	35	110	349	1104
11	Natural Bridges Drive			4,460	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	57.3	5	17	54	170
12	Western Drive			3,041	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	55.7	4	12	37	116
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					

*All modeling assumes average pavement, level roadways (less than 1.5% grade), constant traffic flow and does not account for shielding of any type or finite roadway adjustments. All levels are reported as A-weighted noise levels.

Traffic Noise Spreadsheet Calculator

Project: UC Santa Cruz - 2020 LRDP EIR

Noise Level Descriptor: Ldn
Site Conditions: Hard
Traffic Input: ADT
Traffic K-Factor:

				Input										Output				
	Segment Description and Location				Speed	Distance to Directional Centerline, (feet)[4]		Traffic Distribution Characteristics						Ldn,	Distance to Contour, (feet)[3]			
Number	Name	From	To	ADT	(mph)	Near	Far	% Auto	% Medium	% Heavy	% Day	% Eve	% Night	(dBA)[5,6,7]	70 dBA	65 dBA	60 dBA	55 dBA
Existing Conditions																		
1	Bay Street			7,536	30	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	57.9	6	20	62	196
2	Empire Grade			7,474	40	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	61.1	13	41	130	411
3	Glenn Coolidge Drive			19,441	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	60.4	11	35	110	347
4	Hagar Drive			14,616	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	62.5	18	56	177	559
5	Heller Drive			2,119	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	54.1	3	8	26	81
6	High Street			10,233	30	50	50	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	62.3	8	27	84	266
7	Highway 17			62,837	50	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	73.2	208	659	2083	6586
8	King Street			1,240	25	50	50	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	51.5	1	2	7	22
9	McLaughlin Drive			2,119	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	50.8	1	4	12	38
10	Mission Street/Cabrillo Highway			60,288	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	65.3	34	108	340	1075
11	Natural Bridges Drive			4,564	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	57.4	6	17	55	174
12	Western Drive			1,113	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	51.3	1	4	13	43
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					

*All modeling assumes average pavement, level roadways (less than 1.5% grade), constant traffic flow and does not account for shielding of any type or finite roadway adjustments. All levels are reported as A-weighted noise levels.

Traffic Noise Spreadsheet Calculator

Project: UC Santa Cruz - 2020 LRDP EIR

Noise Level Descriptor: Ldn
Site Conditions: Hard
Traffic Input: ADT
Traffic K-Factor:

	Segment Description and Location			Input											Output				
						Distance to Directional Centerline, (feet)[4]		Traffic Distribution Characteristics								Distance to Contour, (feet)[3]			
Number	Name	From	To	ADT	Speed (mph)	Near	Far	% Auto	% Medium	% Heavy	% Day	% Eve	% Night	Ldn, (dBA)[5,6,7]	70 dBA	65 dBA	60 dBA	55 dBA
Existing Conditions																		
1	Bay Street			9,297	30	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	58.8	8	24	77	242
2	Empire Grade			10,305	40	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	62.5	18	57	179	566
3	Glenn Coolidge Drive			26,503	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	61.7	15	47	149	473
4	Hagar Drive			18,420	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	63.5	22	70	223	704
5	Heller Drive			6,022	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	58.6	7	23	73	230
6	High Street			16,194	30	50	50	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	64.3	13	42	133	422
7	Highway 17			63,305	50	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	73.2	210	663	2098	6635
8	King Street			9,609	25	50	50	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	60.4	5	17	54	171
9	McLaughlin Drive			6,022	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	55.3	3	11	34	107
10	Mission Street/Cabrillo Highway			65,551	25	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	65.7	37	117	370	1169
11	Natural Bridges Drive			4,823	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	57.7	6	18	58	184
12	Western Drive			2,351	35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	54.5	3	9	28	90
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					
					35	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%					

*All modeling assumes average pavement, level roadways (less than 1.5% grade), constant traffic flow and does not account for shielding of any type or finite roadway adjustments. All levels are reported as A-weighted noise levels.

Appendix I

VMT Analysis Memo

FEHR & PEERS

Memorandum

Date: August 31, 2021

To: Chris Mundhenk, Ascent Environmental

From: Franziska Church, AICP and Jeff Pierson, Fehr & Peers

Subject: University of California Santa Cruz (UCSC) Long-Range Development Plan (LRDP) Santa Cruz County Regional Transportation Commission (RTC) Model Calibration Process

SJ19-1987

Introduction

As part of the UCSC LRDP EIR, Fehr & Peers conducted the vehicle miles traveled (VMT) analysis using the Santa Cruz County (SCC) Regional Travel Demand Model (SCC Travel Model). This memorandum covers the model description, the calibration and validation measures done to adjust the model for UCSC, and the results of the analyses.

Model Description

The County's travel model is a traditional four-step model that estimates daily travel behavior at the person-level for all residents and employees within the County. The inputs to model include land use data quantifying the number of persons, households, students, and jobs, as well as representations of the highway, arterial, and transit systems across the County. The model outputs provide an estimate of daily person trips for an average weekday across a range of modes: drive alone, carpool, transit, walk, and bike. The model also estimates the travel that occurs between Santa Cruz County and surrounding counties even though these areas are not included within the model's geographic boundary.

The SCC Travel Model was initially developed in 2016 and is consistent with the regional travel model developed by the Association of Monterey Bay Area Governments (AMBAG). The project team received the latest version of the SCC Travel Model from the County for use on this project. The County provided a 2019 existing scenario and a 2040 cumulative scenario. The future year cumulative scenario is presumed to be consistent with long range plans for the jurisdictions across the county. The model was run using the standard settings in TransCAD 6.0 r2 Build 9215.

Calibration and Validation

The SCC Travel Model is a subregional travel model developed to study transportation impacts of land use and multimodal transportation projects at the county or city level. The model includes a limited number of land use types that are meant to represent a broad range of the most common land uses within Santa Cruz County. For example, the model's service employment land use category is meant to capture anything from warehousing and food services uses, which individually have a wide range of trip generation characteristics and in the model is represented as an average. Thus, when looking at specific sites within a model, it is not uncommon to make adjustments at the project level to more accurately reflect the unique travel characteristics of the proposed land use; which is also known as the calibration and validation process.

The calibration and validation effort focused solely on the land uses within the campus and on roadways in the immediate vicinity. The project team did not make any modifications to land use assumptions or trip generation rates for areas outside the campus boundary.

Land Use Inputs

In the first step of the validation process the number faculty, staff, and students were updated to be consistent with existing conditions, as specified in the Project Description Chapter of the Environmental Impact Report (EIR) for the 2020 LRDP.

Travel Demand

The SCC Travel Model's estimates of travel activity to and from the UCSC campus (i.e. trip generation) was calibrated to the number of vehicles entering and exiting the campus on a typical weekday using data collected in Fall 2019 (pre-COVID). The initial model results overestimated the vehicular travel generated by the campus and the model was adjusted by changing the trip generation rates for employees and students.

Trip Generation

The trip generation results from the SCC Travel Model were compared with a trip generation tool that was previously developed in 2017 for UCSC to assist with long-range planning efforts. The tool is similar to the trip generation step within a travel model in that it estimates the volume of daily person trips coming to and from the campus based on the number of students and faculty. The tool was developed and validated with data provided by UCSC, which included survey data from residents and commuters on the type and frequency of daily campus trips, as well as, modal (vehicles, bikes, transit, shuttle, etc.) counts and vehicle parking data. **Table 1** below compares the daily person trip rates from the SCC Travel Model with the UCSC trip generation tool.

Table 1: Daily Person Trip Rate Comparison

Population	2017 Tool	SCC Model	*Percent Difference (SCC Model to 2017 Tool)*	*Final Adjusted*	*Percent Difference (Final Adjusted to 2017 Tool)*
Resident students	2.21	6.31	*186%*	*2.06*	*-7%*
Commuter students	2.01	0.22	*-89%*	*1.83*	*-9%*
Resident employees	1.93	6.88*	*265%*	*2.06*	*7%*
Commuter employees	1.42	6.88*	*385%*	*1.51*	*6%*

*The SCC Travel Model does not distinguish between resident and commuter faculty.

As shown in **Table 1** above the SCC Model overestimates by approximately 200 to 400% the number of trips generated by resident students and by both the resident and commuter employees compared with the UCSC tool. The model also underestimates by 90% the trips generated by commuter students.

Given that the model overestimates campus vehicle trips, the trip generation rates for the campus were adjusted to more consistent with the UCSC tool. <u>It should be noted, that as one of the final validation steps to assess the validity of the adjust trip generation rates, the model outputs with the adjust trip generation rates were compared to the daily vehicle driveway counts discussed on page 5 and illustrated in **Table 3**.</u>

The land use categories that are used in the model are resident students, commuter students, employees, and non-student households. Models have a set number of land use categories and you can either adjust the trip rates for a given land use, which would affect all model zones that have that land uses, or you can re-assigned your land use to a different land use categories whose model trip generation characteristics more closely match a given land use. The trip rates for resident students and commuter students on the UCSC campus were adjusted since these changes were easy to implement within the model and the changes do not affect trip generation on other college and university campus throughout the rest of the county. The employment land uses were re-classified within the model, since that land use is prevalent throughout the model and rate adjustments would invalidate the model outside of the campus model zones.

The trip rates for resident and commuter students were iteratively adjusted during the validation process to match the rates in the 2017 UCSC tool more closely as well as the vehicle driveway counts (discussed in the next section). The final student trip rates applied in the model are 2.06 daily person trips per resident student and 1.83 daily trips per commute student. Both rates are within 10 percent of the suggested rates shown in **Table 1.** Intra-campus trips for resident students are not included in the trip rate since these are primarily assumed to be walk or bike trips and any vehicle trips would general little VMT given the short distances traveled.

The trip rate for employees was adjusted by changing the land use category that these jobs are assigned to. The model initially assumed these jobs to be in the service/public administration category which has the trip rate shown in **Table 1** and representative of a land use that has many outside visitors, which the campus does not. Instead, the on-campus employment was moved to the industrial category which has a much lower trip rate of 1.51 daily person trips and is within approximately 6% of the value from the 2017 UCSC Tool.

The trip generation rates for the non-student households on campus, employees and their families, were not adjusted as part of the calibration and validation process.

Trip Distribution

The distribution of trips to and from campus was validated using anonymized cell phone GPS data, provided by Streetlight, to estimate the percentage of trips that occur within Santa Cruz County and the average lengths of those trips. The cell phone data is representative of person trips (not vehicle trips) and was sampled from March to May 2019 and September to November 2019. The Monday through Friday trips results were used to estimate an average weekday, consistent with the weekday assumptions in the travel model.

Table 2: Trip Distribution Validation with StreetLight Data

Trip Source	Streetlight Distribution	Streetlight Trip Length	Model Distribution	Model Trip Length
Intra-Campus	*Not Applicable*	1.1	*Not Applicable*	0.8
To/from Santa Cruz County	91%	4.9	93%	7.2
To/from Elsewhere	9%	58.4	7%	37.3
Total	*Not Applicable*	*5.4*	*Not Applicable*	*8.7*
Not Intra-campus	***100%***	***9.7***	***100%***	***9.4***

The StreetLight data shows that for all trips that have one end of the trip off-campus 91% are to or from somewhere within Santa Cruz County. The remaining trips are from other counties with Santa Clara County and Monterey County together accounting for 6% of those trips. The average trip length for all campus trips is 9.7 miles.

The revised version of the SCC Model used for this project estimates that for all person trips with one end of the trip off-campus, 93% of those trips start or end in Santa Cruz County. The remaining 7% are external to the County. The average trip length is 9.3 miles. While the SCC Model slightly underestimates the number of campus trips that start or end outside of Santa Cruz County, the differences are within an acceptable validation range and the parameters of the trip distribution model were not updated as part of this project.

Vehicle Assignment

As a final step, the vehicle generation and assignment model was validated using observed traffic counts collected around the UCSC campus during Fall 2019. **Table 3** shows a comparison of daily vehicle volumes at the two campus driveways after incorporating the trip generation changes described above.

Within the SCC model, the campus is presented by two transportation analysis zones (TAZs), or geographic areas. Due to the limited on-campus zonal detail within the SCC Travel Model, the model assigns most trips to the main entrance at Coolidge Drive/High Street and a smaller fraction to the west entrance. However, the total number of vehicle trips from the model accessing/leaving the campus at the two main entrances is within 10 percent of the observed data and this shows the model is reasonably estimating the daily number of trips generated by the campus. For the purpose of the VMT calculation the total number of trips accessing the campus is more important than which gate they use, since the model link distance within the campus' TAZs is about the same.

Table 3: Daily Vehicle Volumes at Campus Driveways Comparison

Location	Count	Model	*Percent*
Glenn Coolidge Drive n/o High Street	14,040	20,885	*49%*
Heller Drive e/o Empire Grade	8,662	3,275	*-62%*
Total	***22,702***	***24,160***	***6%***

Table 4 compares the daily vehicle volumes on streets surrounding the campus to validate the model's overall performance on estimating daily activity. Overall, the model is within 10 percent of the observed volumes and is reasonably estimating activity around campus. The vehicle assignment was slightly calibrated by adjusting the assumed speeds on High Street and other local roadways south of campus to shift more traffic onto Bay Drive and Mission Street.

Table 4: Daily Vehicle Volumes on Surrounding Streets Comparison

Location	Count	Model	Percent
Empire Grade n/o Heller Drive	11,875	9,521	-20%
Bay Drive s/o High Street	13,627	15,932	17%
High Street e/o Bay Drive	12,996	10,941	-16%
Total	***38,498***	***36,394***	***-5%***

Based on the trip generation, trip distribution, and assignment results, the model is considered validated to 2019 conditions for vehicular travel to and from the UCSC campus. All the calibration changes described above were incorporated into the future year scenario for consistency.

Scenario Analysis

The validated 2019 Existing SCC Travel Model was used to evaluate four scenarios for the UCSC LRDP EIR:

- 2019 Existing
- 2019 Existing plus Project
- 2040 Cumulative
- 2040 Cumulative plus Project

Compared to the 2019 Existing scenario, the 2040 Cumulative SCC Travel Model includes additional land use and transportation network changes consistent with AMBAG forecasts for population and employment growth as well as regional transportation changes per the Santa Cruz County RTC. Other than the validation adjustments discussed above, the 2040 Cumulative model was used as provided no additional adjustments were made.

The land use inputs for the campus TAZs are summarized in **Table 5**. The student enrollment and total employment is separated by on-campus residents and commuters. The total number of non-student households and the population in those households is also shown. The population was estimated using the average household size assumptions for the UCSC campus from the SCC Model.

Table 5: Land Use Inputs for Campus TAZs

Land Use	Existing	Existing plus Project	Cumulative	Cumulative plus Project
Resident Students	9,283	17,783	11,442	19,958
Commuter Students	9,235	10,217	8,058	8,042
Total Enrollment	***18,518***	***28,000***	***19,500***	***28,000***
Resident Faculty and Staff	270	828	289	867
Commuter Faculty and Staff	3,387	5,702	3,728	5,663
Non-UC Employees	640	990	640	990
Total Employment	***4,297***	***7,520***	***4,657***	***7,520***
Non-student Households	***611***	***2,027***	***701***	***2,066***
Non-student Population	***1,613***	***5,350***	***1,847***	***5,443***

No additional transportation improvement projects beyond those included in the 2040 Cumulative model were assumed in either of the project scenarios.

Results

The model results for each of the scenarios are presented in this section. The following vehicle miles traveled (VMT) metrics were calculated using the outputs from the SCC Model. Each of the metrics will be described in more detail below.

- Total Santa Cruz County VMT per capita
- Residential VMT per capita
- Employee VMT per capita
- Total USCS Campus VMT per capita

Upon reviewing the results from the 2019 and 2040 with Project scenarios, the SCC Model was generating unrealistic modal shifts from the 2019 Existing and 2040 Cumulative scenarios. For example, the percentage of off-campus walk trips was doubling under the project scenario and reducing the percentage of vehicle trips. To account for this unexpected change in travel behavior, the project team used the mode split results from the 2019 Existing and 2040 scenarios and applied those to the person trips from the With Project scenarios to generate the vehicle trip matrices. These matrices were then assigned onto the roadway networks and the results were used in the summaries below.

Santa Cruz County VMT

The total VMT on all roadways within Santa Cruz County is shown **Table 6**. The capita estimate includes the total countywide population, jobs, and UCSC enrollment. Under the project scenarios, the VMT per capita decreases by approximately 3%.

Table 6: Santa Cruz County VMT per Capita

Scenario	Existing	Existing plus Project	*Percent Change*	Cumulative	Cumulative plus Project	*Percent Change*
Capita	403,000	417,000	*3%*	469,000	482,000	*3%*
VMT	5,330,000	5,420,000	*2%*	5,750,000	5,830,000	*1%*
VMT per Capita	13.2	13.0	*-2%*	12.3	12.1	*-1%*

Residential and Employee VMT

The SCC Model was also used to calculate residential and employee VMT per capita consistent with the County's draft VMT analysis guidelines. The countywide baseline values were recalculated by the project team using the updated 2019 Existing and 2040 Cumulative scenarios from this project. The County's VMT target thresholds are 15% below the baseline values for the project generated VMT. The residential population basis includes students living on the UCSC campus and the employment VMT includes VMT generated by all job types.

The County's consultant that is helping to develop the guidelines is using a different process for estimating VMT for trips that start or end outside of Santa Cruz County. Instead of using the SCC Model's estimate of trip lengths for these external trips, the VMT thresholds are based on trip lengths derived from cell phone GPS data. Using these updated trip lengths for the UCSC campus generated data, VMT estimates would reduce by 5 to 10%, which is not consistent with the trip distribution data collected for this project. The project team continued to use the SCC Model's trip lengths to estimate project related VMT.

Table 7 shows the residential and employee VMT per capita ratios for the project compared with the countywide baseline values. The residential VMT per capita is more than 15% lower than the countywide value while the employment VMT per capita does not meet this threshold.

Table 7: Residential and Employment VMT per Capita

Scenario	Existing (Santa Cruz County)	Existing plus Project (Campus)	*Percent Difference*	Cumulative (Santa Cruz County)	Cumulative plus Project (Campus)	*Percent Difference*
Residential	10.4	5.6	*-46%*	9.8	5.4	*-45%*
Employment	10.5	12.5	*19%*	9.5	11.2	*18%*

UCSC Campus VMT

The total VMT generated by the UCSC campus is shown in **Table 8**. This estimate includes the full VMT on roadways outside of Santa Cruz County. The capita basis is the total student enrollment, employees, and non-student population. The VMT per capita decreases by 13% in the 2019 with Project scenario and by 16% in the 2040 with Project scenario.

Table 8: UCSC Campus VMT per Capita

Scenario	Existing	Existing plus Project	*Percent Change*	Cumulative	Cumulative plus Project	*Percent Change*
Capita	32,750	55,320	*69%*	36,300	57,590	*59%*
VMT	298,000	439,000	*47%*	257,000	372,000	*45%*
VMT per Capita	9.1	7.9	*-13%*	7.1	6.5	*-9%*

Appendix J

Water Supply Assessment

FINAL REPORT | DECEMBER 2020

UC Santa Cruz
2021 Long Range Development Plan
Water Supply Evaluation

PREPARED FOR

UC Santa Cruz

UC SANTA CRUZ

PREPARED BY

WEST YOST
Water. Engineered.

2021 Long Range Development Plan Water Supply Evaluation

Prepared for

UC Santa Cruz

Project No. 750-60-20-02

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WEST YOST
Water. Engineered.

FINAL REPORT | DECEMBER 2020

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LIST OF ACRONYMS AND ABBREVIATIONS

asf	Assignable Square Feet
ASR	Aquifer Storage and Recovery
CESA	California Endangered Species Act
City	City of Santa Cruz
CLRDP	Coastal Long Range Development Plan
CLUMAC	Campus Land Use and Management Action Committee
CSP	Campus Sustainability Plan
EIR	Environmental Impact Report
FEIR	Final Environmental Impact Report
FESA	Federal Endangered Species Act
FTE	Full-Time Equivalent
FY	Fiscal Year
gpd	Gallons Per Day
HCP	Habitat Conservation Plan
LAFCO	Local Area Formation Commission
LRDP	Long Range Development Plan
MBR	Membrane Bioreactor
MG	Million Gallons
mgd	Million Gallons Per Day
MGY	Million Gallons Per Year
Regents	University of California Board of Regents
SAGMC	Soquel-Aptos Groundwater Management Committee
SB 610	Senate Bill 610
SCPWD	Santa Cruz Public Works Department
SCWD	Santa Cruz Water Department

SGMA	Sustainable Groundwater Management Act
SqCWD	Soquel Creek Water District
SVWD	Scotts Valley Water District
UC	University of California
UCOP	UC Office of the President
UWMP	Urban Water Management Plan
WAP	Water Action Plan
WSA	Water Supply Assessment
WSAC	Water Supply Advisory Committee

EXECUTIVE SUMMARY

Purpose of Water Supply Evaluation

The University of California, Santa Cruz (UC Santa Cruz or University) is one of ten campuses in the University of California (UC) system. In support of its continued mission to provide a diverse array of leading academic programs, UC Santa Cruz is preparing a Long Range Development Plan (LRDP) to guide the physical development necessary to achieve the campus' mission through 2040. The LRDP establishes a land use framework for academic and administrative space needs, housing, open space, circulation, and other land uses that ultimately facilitate the appropriate siting of capital projects.

The purpose of this Water Supply Evaluation is to demonstrate that adequate water supplies are available to meet the projected UC Santa Cruz water demands under the proposed 2021 LRDP. The Water Supply Evaluation considers the existing and projected future water demands, the availability and reliability of water supplies under normal, single dry and multiple dry year conditions, and additional planned water supplies and water conservation programs to determine water supply sufficiency. For completeness and clarity, this Water Supply Evaluation has been prepared to comply with California Senate Bill 610 requirements for a Water Supply Assessment, although Senate Bill 610 does not apply to campus development under the proposed 2021 LRDP.

Existing and Projected Future Water Demands

Water demands on the UC Santa Cruz Main Campus have dropped dramatically in recent years. In Fiscal Year (FY) 12/13 water use on the Main Campus was 179 million gallons per year (MGY) and dropped to 154 MGY in FY 17/18, representing a 14 percent decrease. The downward trend in water consumption has resulted from proactive water conservation, improved water use efficiency, and drought response measures on the campus. Much of the water conservation efforts were in response to the statewide drought from 2013 to 2017. During the 2014 and 2015 drought years, the City of Santa Cruz (City) declared a Stage 3 Water Emergency and requested the campus to reduce domestic water use by 20 percent, as metered and billed by the City, compared to a 2013 baseline, which UC Santa Cruz accomplished.

The previously projected water demands for UC Santa Cruz, included in the City's 2015 Urban Water Management Plan (UWMP), were based on the previously estimated 2035 development demand of 349 MGY[1]. The 349 MGY was based on the projected future water demand estimated in the 2005 LRDP Environmental Impact Report (EIR) and the subsequent 2008 Settlement Agreement between the City and UC Santa Cruz related to the 2005 LRDP, and included existing and projected future water demand for the Main Campus, the Westside Research Park (located at and previously referred to as 2300 Delaware Avenue) and the Coastal Science Campus (previously referred to as the Marine Science Campus).

[1] This water demand estimate was based on the projected water demand for UC Santa Cruz developed for the City's Sphere of Influence Amendment EIR (339 MGY) plus 10 MGY of additional water demands for additional development beyond 2020 (Source: City of Santa Cruz Sphere of Influence Amendment EIR Table 2-4 and City of Santa Cruz 2010 UWMP (page 4-19)). This water demand estimate was the basis for the water demand estimate for UC Santa Cruz included in the City's 2015 UWMP.

Water demand for UC Santa Cruz under the proposed 2021 LRDP is projected to increase from the existing (FY 17/18) baseline of 155 MGY to 289 MGY in 2040. This increase in projected water demands represents an 87 percent increase over existing water use and includes existing water demands for the Main Campus and the Westside Research Park, but excludes the Coastal Science Campus.

The Coastal Science Campus is governed by a separate Coastal Long Range Development Plan (CLRDP) that was adopted by the University of California Board of Regents (Regents) and certified by the California Coastal Commission in 2008. As a result, the Coastal Science Campus is not a part of the proposed 2021 LRDP. The existing water demand for the Coastal Science Campus is approximately 7.4 MGY (based on 2018 water use) and is anticipated to increase by an additional 10 MGY in the future[2], for a total projected future water demand of 17.4 MGY.

Thus, the overall projected future water demand for UC Santa Cruz, including the Main Campus, the Westside Research Park, and the Coastal Science Campus, is approximately 307 MGY.

Water Supply Availability and Reliability

The projected future water demand of approximately 307 MGY for UC Santa Cruz (including the proposed 2021 LRDP and the Coastal Science Campus) is considerably lower than the 349 MGY previously projected for buildout of the 2005 LRDP, and is lower than the 2035 primary water demand projection for UC Santa Cruz included in the City's 2015 UWMP. Therefore, the water supply availability and reliability analysis, and timing of these new water system demands, as included in the City's 2015 UWMP, is still applicable.

Water Supply Evaluation Findings

Key findings of this Water Supply Evaluation are summarized as follows:

- Water demands on the UC Santa Cruz Main Campus have dropped dramatically in recent years as a result of water conservation measures in response to the recent drought. Many of the water conservation measures have resulted in permanent reductions in water use (e.g., plumbing fixture retrofits, improvements in leak detection, etc.).
- In the recent drought years, UC Santa Cruz successfully met the City's mandatory water reduction goals as a result of proactive water conservation, improved water use efficiency, and drought response measures, together with close collaboration between representatives of all sectors across campus, as well as with the City Water Department.
- The projected potable water demands for the UC Santa Cruz proposed 2021 LRDP are approximately 289 MGY by 2040, which includes the existing and projected future water demands for the Main Campus and the Westside Research Park.
- The projected potable water demands for the UC Santa Cruz Coastal Science Campus are 17.4 MGY, which includes the existing water demand and projected future water demand for the Coastal Science Campus. Although the Coastal Science Campus is not part of the proposed 2021 LRDP, it is considered part of the UC Santa Cruz overall water demand to be served by the City.

[2] Additional water demand for the Coastal Science Campus is based on growth projections for the UC Santa Cruz campus as included in the City of Santa Cruz Sphere of Influence Amendment Final EIR dated July 2010 (Section 3.0, page 3-9).

- The projected future water demand of approximately 307 MGY for UC Santa Cruz (including the proposed 2021 LRDP and the Coastal Science Campus) is considerably lower than the 349 MGY previously projected for buildout of the 2005 LRDP, and is lower than the 2035 primary water demand projection for UC Santa Cruz included in the City's 2015 UWMP.
- As described in Section 7 of this Water Supply Evaluation, the City predicts the supply and demand volumes to be in balance for 90 percent of all normal water years for 2020-2035. However, in single dry years and multiple dry years, the City does project water supply shortages. As a City water customer, UC Santa Cruz is subject to these potential water shortages and is subject to the City's water supply allocation system and demand reduction measures. As described, UC Santa Cruz has been very successful in reducing water use in recent years in response to the drought and has updated its Water Action Plan to implement additional measures to reduce potable water use.

1.0 INTRODUCTION

The purpose of this Water Supply Evaluation is to determine the sufficiency of water supplies to serve UC Santa Cruz under the proposed 2021 LRDP. The Water Supply Evaluation considers the existing and projected future water demands, the availability and reliability of water supplies under normal, single dry and multiple dry year conditions, and additional planned water supplies and water conservation programs to determine water supply sufficiency.

California Senate Bill 610 (SB 610) amended state law, effective January 1, 2002, to improve the link between information on water supply availability and certain land use decisions made by cities and counties. SB 610 sought to promote more collaborative planning between local water suppliers and cities and counties. The statute requires detailed information regarding water availability to be provided to the city and county decision-makers prior to approval of specified large development projects. The purpose of this coordination is to ensure that prudent water supply planning has been conducted, and that planned water supplies are adequate to meet existing demands, anticipated demands from approved projects and tentative maps, and the demands of proposed projects.

SB 610 amended California Water Code sections 10910 through 10915 (inclusive) to require land use lead agencies to identify any public water purveyor that may supply water for a proposed development project and request a Water Supply Assessment (WSA) from the identified water purveyor. The purpose of a WSA is to demonstrate the sufficiency of the purveyor’s water supplies to satisfy the water demands of the proposed development, while still meeting the water purveyor’s existing and planned future uses. Water Code sections 10910 through 10915 delineate the specific information that must be included in the WSA.

Although the SB 610 requirements do not specifically apply to UC Santa Cruz or the University, because it is not a city or county, the University has voluntarily elected to prepare a WSA-like Water Supply Evaluation to determine and demonstrate the sufficiency of the City’s water supplies to satisfy the water demand of the planned development under the UC Santa Cruz proposed 2021 LRDP.

Therefore, this Water Supply Evaluation has been prepared and organized to parallel and be consistent with the requirements for a WSA per Water Code sections 10910 through 10915, such that this Water Supply Evaluation provides a comprehensive evaluation of the availability and reliability of water supplies to serve the planned development.

This Water Supply Evaluation includes the following sections:

- Section 1: Introduction
- Section 2: Description of Proposed Project
- Section 3: Required SB 610 Determinations
- Section 4: City of Santa Cruz Water Service Area
- Section 5: City of Santa Cruz Water Demands
- Section 6: City of Santa Cruz Water Supplies
- Section 7: Determination of Water Supply Sufficiency Based on the Requirements of SB 610
- Section 8: Water Supply Evaluation Findings
- Section 9: References

Relevant citations of Water Code sections 10910 through 10915 are included throughout this Water Supply Evaluation in italics to demonstrate consistency with the specific requirements of SB 610.

This Water Supply Evaluation will be included as an appendix to the Draft EIR for the proposed 2021 LRDP and the findings and conclusions reached in this document will be considered in analyzing the project's potential water supply impacts.

2.0 DESCRIPTION OF PROPOSED PROJECT

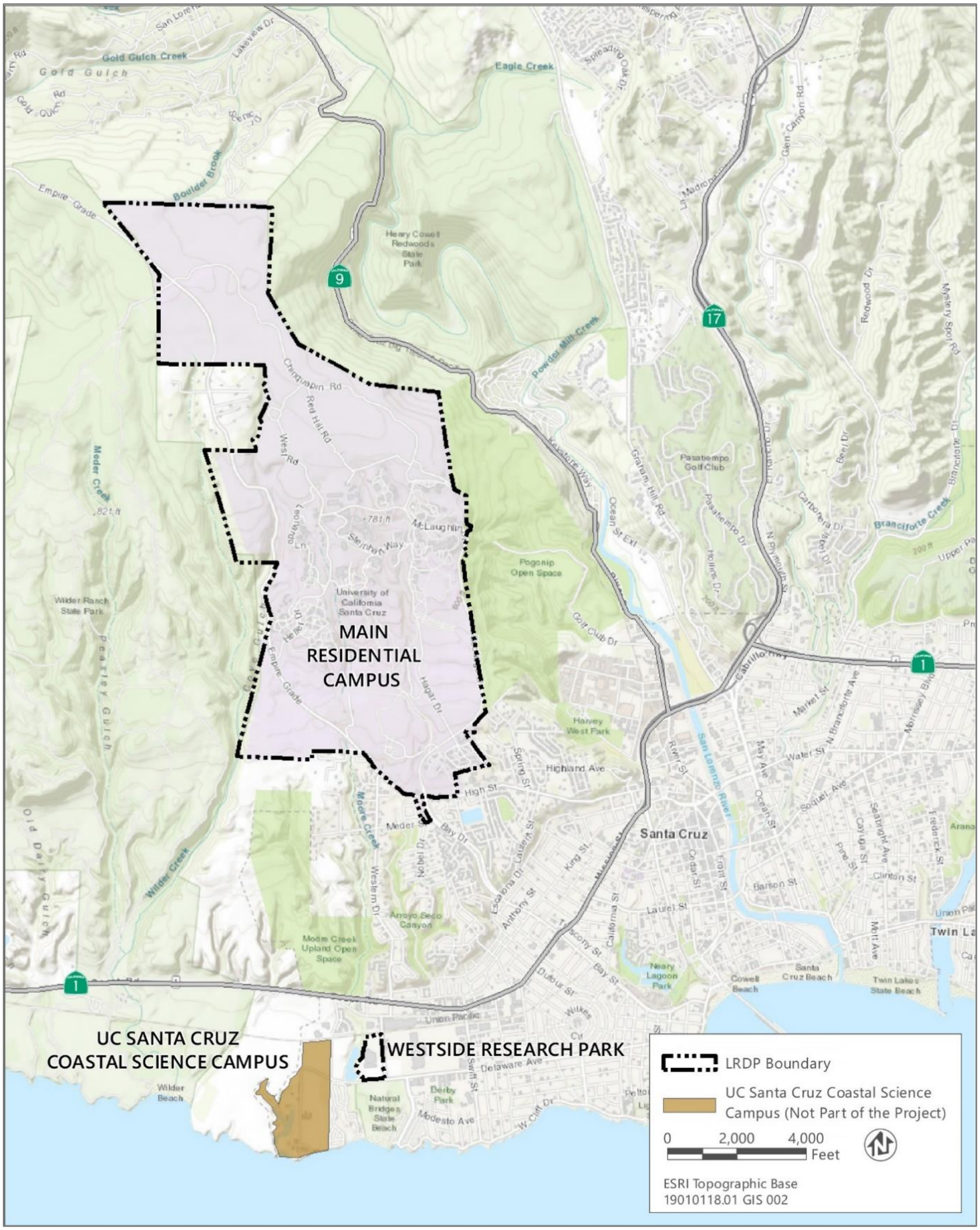
The following sections provide a description of the Proposed Project, including the proposed development plan, projected water demand, and projected water supply.

2.1 UC Santa Cruz 2021 Long Range Development Plan

UC Santa Cruz is one of 10 campuses in the University of California system. In support of its continued mission to provide a diverse array of leading academic programs, UC Santa Cruz is preparing an LRDP to guide the physical development necessary to achieve the campus's mission through 2040. The proposed 2021 LRDP establishes a land use framework for academic and administrative space needs, housing, open space, circulation and other land uses that ultimately facilitate the appropriate siting of capital projects. All UC campuses are required to prepare a LRDP to guide physical campus development. An LRDP is defined by statute (Public Resources Code 21080.09) as a "physical development and land use plan to meet the academic and institutional objectives for a particular campus or medical center of public higher education."

The Regents adopted the existing UC Santa Cruz LRDP in September of 2006 (also referred to as the 2005 LRDP), and the 2005 LRDP has served as the guide for campus growth and development since its adoption. The proposed 2021 LRDP would replace the 2005 LRDP for the campus and identifies land uses to support the academic mission of UC Santa Cruz through 2040. The 2021 LRDP campus population forecast is 28,000 Full-Time Equivalent (FTE) students and 5,000 FTE faculty and staff. To accommodate the projected increase in campus population, the 2021 LRDP provides for 8,500 student housing beds, up to 550 employee housing units, and approximately 3.1 million square feet of assignable square feet (asf) of academic and administrative building space.

The proposed 2021 LRDP land use plan supports potential growth on the UC Santa Cruz main residential campus and the Westside Research Park (located at and previously referred to as 2300 Delaware Avenue) in the City of Santa Cruz (see Figure 2-1). The third UC Santa Cruz property, the Coastal Science Campus (previously referred to as the Marine Science Campus), is a 100-acre property on the west side of the City and is governed by a separate CLRDP that was adopted by the Regents and certified by the California Coastal Commission in 2008. As a result, the Coastal Science Campus is not a part of the proposed 2021 LRDP.



Source: Ascent Environmental, July 2020.

Figure 2-1. Project Location and Plan Area

Table 2-1 summarizes the list of projects and housing proposed to be developed under the 2021 LRDP in asf and number of beds.

Table 2-1. Projected Increases in Building Space under the Proposed 2021 LRDP

	Existing Conditions (2018-2019)	Net New under 2021 LRDP	Projected Total (2040)
Academic and Support Service			
Instruction and Research, asf	858,627	1,127,373	1,986,000
Academic and Administrative Support, asf	765,368	1,290,438	2,055,806
Student Support and Public Services, asf	348,628	608,110	956,738
Facilities & Operations, asf	115,805	57,903	173,708
Residential Space			
Student Housing, asf	1,346,938	1,885,000	3,231,938
Student Housing, beds	9,283	8,500	19,958[(a)]
Faculty & Staff Housing, asf	317,622	660,000	977,622
Faculty & Staff Housing, units	270	558	867[(b)]

Source: UC Santa Cruz LRDP Program, June 2020 and Sherwood Engineers Water Demand Projections, November 2020

(a) Total includes 2,175 approved but not operational student beds.
(b) Total includes 39 approved but not operational faculty and staff housing units.

2.2 Projected Water Demand

Projected water demands for the proposed development under the 2021 LRDP for the Main Campus and the Westside Research Park have been estimated by Sherwood Design Engineers (Sherwood). The water demand analysis used the projected increases in student and employee populations (reported as full-time equivalents, FTEs), and housing capacity (reported as beds), to estimate future water demands. Water use data was analyzed by Sherwood over time and by water use category (including existing residential housing, non-residential, mechanical, and irrigation). The most recent years of data are considered a more accurate reflection of the campus's efficiency improvements, which should be sustained and improved upon into the future. Key efficiency gains noted in the UC Santa Cruz 2017 Water Action Plan included smart-metering system and leak detection, irrigation reductions, efficiency audits, fixture replacement and behavior change campaigns. Sherwood's Technical Memorandum describing the water demand projections is included as Appendix A of this Water Supply Evaluation.

Table 2-2 provides a summary of the UC Santa Cruz existing and projected future potable water demands at full development under the proposed 2021 LRDP (estimated to occur by about 2040). As shown, the total water demand is projected to be approximately 289 MGY by 2040.

Table 2-2. Projected Water Demand for the Proposed 2021 LRDP

Water User Category	Existing (FY 17/18) Annual Demand, MGY	Existing (FY 17/18) Average Daily Demand, gpd	Projected 2040 Annual Demand, MGY	Projected 2040 Average Daily Demand, gpd
Demand by Water Use Category				
Interior Water Demands				
Non-Residential	29.1	79,658	44.7	122,508
Residential	75.2	205,913	168.8	462,535
Mechanical	6.8	18,763	16.1	43,977
Irrigation				
Grounds	29.4	80,640	37.5	102,609
Non-Grounds	14.0	38,483	22.1	60,510
Total	**154.5**	**423,457**	**289.1**	**792,121**
Demand by Campus Area				
Main Campus	154.0	421,994	283.5	776,827
Westside Research Park (2300 Delaware Avenue)	0.5	1,463	5.6	15,294
Total	**154.5**	**423,457**	**289.1**	**792,121**

Source: Sherwood Design Engineers, UC Santa Cruz Long Range Development Plan Water Demand Projections, November 2020.

gpd = gallons per day

It should be noted that FY 17/18 campus water use data was used as the baseline instead of FY 18/19 because it was the most accurate full fiscal year of data available at the time of this analysis. UC Santa Cruz recently modified the way in which sub-metered water data is collected and some anomalies were found in the FY 18/19 sub-meter data. Accurate sub-meter data is needed to categorize water demands by end-use (irrigation, housing, academic buildings, etc.). Using FY 17/18 water data allows for a more reliable estimate of future water demands, projecting by each end-use category as described in Sherwood's Technical Memorandum (see Appendix A).

It should also be noted that these projections do not consider further increases in water-use efficiency and conservation. While options to increase building water-use efficiency should continue to be explored, UC Santa Cruz has been highly proactive to-date and is already achieving efficient demand factors. In addition, UC Santa Cruz plans to explore the development of non-potable water sources as a pathway to offset potable water use as the campus grows.

As described in Section 3.3 of this Water Supply Evaluation, the projected water demand for the proposed development for the 2021 LRDP, together with the projected water demand for the Coastal Science Campus, is considerably lower than the 349 MGY previously projected for buildout of the 2005 LRDP, and is lower than the primary projection for UC Santa Cruz included in the City's 2015 UWMP. Therefore, the water supply availability and reliability analysis, and timing of these new water system demands, as included in the City's 2015 UWMP, is still applicable.

2.3 Projected Water Supply

The projected water supply includes both potable water and recycled water, each is further described below.

2.3.1 Potable Water Supply

Under the terms of a 1962 Water Services Agreement between the City of Santa Cruz and UC Santa Cruz, the City agreed to provide sufficient water to meet the demands associated with the projected growth of the campus. The agreement also states that the City will provide, at no expense to UC Santa Cruz, water and sewer lines up to the boundaries of the main residential campus. An additional agreement made between UC Santa Cruz and the City in 1965 states that the City will install a water system capable of supplying 2 million gallons per day (mgd) to UC Santa Cruz for fire flow and ordinary use. Through these agreements, the University has contracted for adequate water service for the entire campus. In 1998, UC Santa Cruz also executed a Memorandum of Understanding with the City of Santa Cruz under which the University agreed to pay the cost of certain pump upgrades that could be needed in the future to serve the campus.

Most of the UC Santa Cruz main residential campus and the entire Westside Research Park are located within the boundary of the current City of Santa Cruz Water Department (SCWD) water service area. A portion of the UC Santa Cruz main residential campus, including development proposed in the LRDP, is located outside the City limit line, in Santa Cruz County. Specifically, LRDP development areas in the northernmost part of campus and to the west of Empire Grade are outside the current service boundary. However, the 1962 and 1965 agreements do not restrict water service to areas within the City limits; to the contrary, they require the City to provide water to the entire campus, irrespective of its location. Accordingly, the City is committed, by contract, to providing water to the areas both within and outside the city limits and there is no need for a service area boundary adjustment, typically approved by the Local Agency Formation Commission (LAFCO), to provide water service to those portions of the campus that lie in unincorporated Santa Cruz County.

In 2008 and as part of condition of a Settlement Agreement between the City and UC Santa Cruz related to the 2005 LRDP, UC Santa Cruz agreed to apply to the Santa Cruz County LAFCO for a Sphere of Influence amendment (City application) for extraterritorial water and sewer services (UC Santa Cruz application) for the north campus subarea. The Settlement Agreement provided that the University's application to LAFCO for extraterritorial water and sewer services was not an admission that UC Santa Cruz is subject to LAFCO jurisdiction, and did not change the underlying agreements between the City and UC Santa Cruz. Further, the terms of the Settlement Agreement were specifically related to the 2005 LRDP. The 2005 LRDP along with the Settlement Agreement will lapse once a new LRDP is adopted.

A description of the City's water supplies is provided in Section 6 of this Water Supply Evaluation. A description of the UC Santa Cruz water conservation program success is provided in Section 7 of this Water Supply Evaluation.

2.3.2 Recycled or Non-Potable Water Supply

Although the potential future use of recycled or non-potable water use to offset potable water demands is possible on the UC Santa Cruz campus, recycled or non-potable water use for potable water demand offsets are not relied upon for this Water Supply Evaluation. However, UC Santa Cruz is currently implementing site-specific non-potable water utility systems where feasible to offset the overall potable water demand of the campus.

The campus may operate an existing well (Well WSW#1) located adjacent to the Center for Agroecology and Sustainable Food Systems in Jordan Gulch to extract groundwater for non-potable use to offset irrigation demand for the Center and the Arboretum to reduce the campus demand for water from the City during drought years, or in the event that the City does not provide water to some portions of the campus. Current annual demand (i.e., based on FY 17/18) for the Center and Arboretum is approximately 4.6 MGY and 5.0 MGY, respectively, and is projected to increase to 5.7 and 6.3 MGY, respectively, by 2040 (Sherwood 2020). Well WSW#1 is capable of sustainably pumping approximately 92.5 gpm with very limited drawdown and no observable effects to off-site spring flow. This sustainable flow rate is equivalent to approximately 48.6 MGY.

Recycled water is not currently provided on Campus. As part of the Student Housing West project, currently planned under the 2005 LRDP, wastewater generated in new student housing on the Heller site will be collected and treated in a wastewater treatment facility that would be located in the southeastern portion of the Heller site. The facility would be a membrane bioreactor (MBR) plant to treat the wastewater and generate recycled water for irrigation and toilet flushing use on the Heller site and, potentially, at other areas of the Campus. An MBR plant is also planned for new family student housing that would be developed on the Hagar site as part of the Student Housing West project, which would provide recycled water for toilet flushing and irrigation use on that site.

3.0 REQUIRED DETERMINATIONS

The section describes the required determinations for an SB 610 Water Supply Assessment. Although these determinations do not specifically apply to UC Santa Cruz, they are provided here to demonstrate that this Water Supply Evaluation is consistent with SB 610 Water Supply Assessment methodology.

3.1 Does SB 610 Apply to the Proposed Project?

Cities and counties are the only lead agencies specifically required by SB 610 to prepare a water supply assessment for certain projects. Although the SB 610 requirements do not specifically apply to UC Santa Cruz or the University, because it is not a city or county, the University has voluntarily elected to prepare a WSA-like document to determine and demonstrate the sufficiency of the City's water supplies to satisfy the water demand of the planned development under the proposed 2021 LRDP.

This Water Supply Evaluation has been prepared to document the projected water demands for the UC Santa Cruz Main Campus and the Westside Research Park and to demonstrate that adequate water supplies are available from the City to meet the projected UC Santa Cruz water demands. For completeness and clarity, this Water Supply Evaluation has been prepared to comply with SB 610 requirements for a WSA, although SB 610 does not apply to campus development under the proposed 2021 LRDP.

3.2 Who is the Identified Public Water System?

10910(b) The city or county, at the time that it determines whether an environmental impact report, a negative declaration, or a mitigated negative declaration is required for any project subject to the California Environmental Quality Act pursuant to Section 21080.1 of the Public Resources Code, shall identify any water system that is, or may become as a result of supplying water to the project identified pursuant to this subdivision, a public water system, as defined by Section 10912, that may supply water for the project

10912 (c) "Public water system" means a system for the provision of piped water to the public for human consumption that has 3,000 or more service connections…

The UC Santa Cruz Main Campus and the Westside Research Park are located within the City of Santa Cruz Water Department water service area; therefore, the City of Santa Cruz Water Department is the public water system for the proposed project.

3.3 Does the City Have an Adopted Urban Water Management Plan (UWMP) and does the UWMP include the Projected Water Demand for the Proposed Project?

10910(c)(1) The city or county, at the time it makes the determination required under Section 21080.1 of the Public Resources Code, shall request each public water system identified pursuant to subdivision (b) to determine whether the projected water demand associated with a proposed project was included as part of the most recently adopted urban water management plan adopted pursuant to Part 2.6 (commencing with Section 10610).

The City's 2015 UWMP was adopted by the Santa Cruz City Council on August 23, 2016. The City's 2015 UWMP includes existing and projected future water demands for all UC Santa Cruz facilities, including the Main Campus, the Westside Research Park (located at and previously referred to as 2300 Delaware

Avenue), and the Coastal Science Campus (previously referred to as the Marine Science Campus). The potable water demand projections included in the City's 2015 UWMP are summarized in Table 3-1.

Table 3-1. Potable Water Demands Included in the City of Santa Cruz 2015 UWMP

	2015, (actual)[a]	2020	2025	2030	2035	2040[b]
Total City Demand, MGY[c]	2,452	3,327	3,225	3,205	3,220	--
UC Santa Cruz Demand, MGY[d]	**160**	**196**	**234**	**271**	**308**	**322**
UC Santa Cruz Demand, as a percent of Total City Demand	6.5%	5.9%	7.3%	8.5%	9.6%	--

(a) 2015 actual demands are from Table 4-1 of the City's 2015 UWMP.
(b) 2040 projections were not provided in the City of Santa Cruz 2015 UWMP but are provided here to show the extrapolated 2040 value for UC Santa Cruz (see Table 3-2 for additional information on the 2040 demand projection).
(c) Projected City water demands for 2020 to 2035 are from Table 4-3 of City's 2015 UWMP.
(d) Projected UC Santa Cruz water demands for 2020 to 2040 are based on the Primary Projection presented below in Table 3-2.

The water demands for UC Santa Cruz included in the City's 2015 UWMP are based on the previously estimated buildout demand for UC Santa Cruz of 349 MGY[3]. The 349 MGY is based on the projected water demand estimated for the 2005 LRDP and 2008 Settlement Agreement and included existing (based on 2007 water use) Main Campus water demand with added existing and projected water demand for the Coastal Science Campus and the Westside Research Park. The only change made by City staff to the water demand projection was to shift the previous buildout demand forecast of 349 MGY in 2030 further out into the future to reflect a lower, more realistic, rate of growth with two potential endpoints: 2035 and 2050. In the lower bound forecast (low projection), the buildout demand of 349 MGY is assumed to occur in 2050. In the upper bound forecast (high projection), the buildout demand of 349 MGY is assumed to occur in 2035. The primary projection (which was included in the City's 2015 UWMP) is the calculated midpoint between the low projection and the high projection. These demand forecasts are shown in Table 3-2. It should be noted that 2040 projections were not provided in the City's 2015 UWMP, but have been shown in Table 3-2 to show the extrapolated 2040 values for the water demand projections to coincide with the buildout of the proposed 2021 LRDP.

Table 3-2. Potable Water Demand Projections for UC Santa Cruz

	2013 (actual)	2020	2025	2030	2035	2040[a]
Low Projection, MGY[b]	182	186	213	240	268	295
Primary Projection, MGY[c]	**182**	**196**	**234**	**271**	**308**	**322**
High Projection, MGY[d]	182	207	254	302	349	349

Source: City of Santa Cruz 2015 UWMP, Appendix E.

(a) 2040 projections were not provided in the City of Santa Cruz 2015 UWMP but are provided here to show the extrapolated 2040 values for the low, high and primary projections. For the 2040 extrapolation of the High Projection, the 2040 demand is assumed to be the same as the 2035 buildout demand of 349 MGY.
(b) Under the Low Projection, buildout to a total demand of 349 MGY was assumed to occur in 2050.
(c) The Primary Projection is the calculated midpoint between the Low Projection and the High Projection.
(d) Under the High Projection, buildout to a total demand of 349 MGY was assumed to occur in 2035.

[3] Based on the projected water demand for UC Santa Cruz developed for the City's SOI Amendment EIR (339 MGY) plus 10 MGY of additional water demands for additional development at the Coastal Science Campus beyond 2020. Source: City of Santa Cruz SOI Amendment EIR Table 2-4 and City of Santa Cruz 2010 UWMP (page 4-19).

As described in Section 2.3, the projected future potable water demand for proposed development under the 2021 LRDP is approximately 289 MGY, with buildout of the 2021 LRDP currently anticipated to occur by 2040. The existing water demand for the Coastal Science Campus is approximately 7.4 MGY (based on 2018 water use) and is anticipated to increase by an additional 10 MGY in the future[4], for a total projected future water demand of 17.4 MGY. Thus, the overall projected future water demand for UC Santa Cruz, including the Main Campus, the Westside Research Park, and the Coastal Science Campus, is approximately 307 MGY (289.1 MGY + 17.4 MGY).

This combined projected future water demand is lower than the previous buildout demand forecast of 349 MGY (described above), and lower than the 2035 primary projection for UC Santa Cruz included in the City's 2015 UWMP as shown above in Table 3-2. As such, the projected water demand for proposed development under the 2021 LRDP, as well as proposed development at the Coastal Science Campus, is included in the City's 2015 UWMP.

[4] Additional water demand for the Coastal Science Campus is based on growth projections for the UC Santa Cruz campus as included in the City of Santa Cruz Sphere of Influence Amendment Final EIR dated July 2010 (Section 3.0, page 3-9).

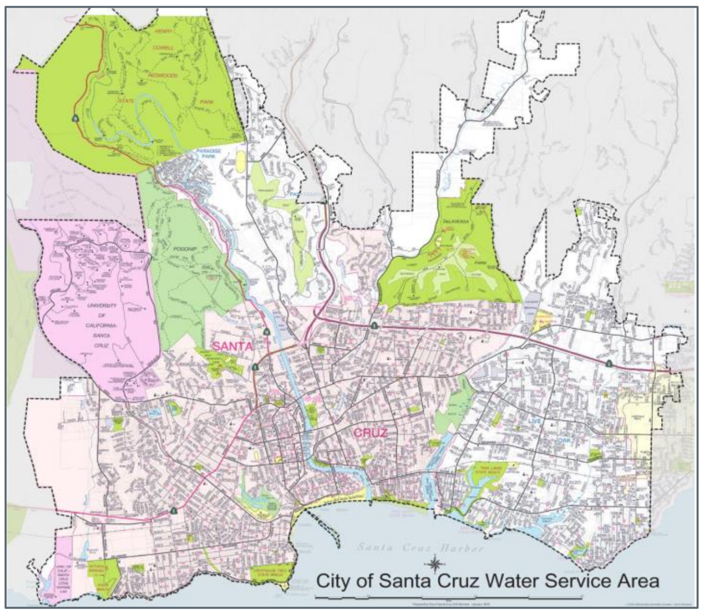
4.0 CITY OF SANTA CRUZ WATER SYSTEM

The following sections describe the City of Santa Cruz's water system, including the water service area, water system, and water supplied to UC Santa Cruz.

4.1 Water Service Area

The City of Santa Cruz provides water service to an area approximately 20 square miles in size, including the entire City of Santa Cruz, adjoining unincorporated areas of Santa Cruz County, a small part of the City of Capitola, coastal agricultural lands north of the City, and the UC Santa Cruz Main Campus, Coastal Science Campus and Westside Research Park (located in the western part of the City). A generalized map of the water service area, excluding the north coast, is provided on Figure 4-1. No significant changes to the City's service area boundary have occurred in many years.

According to the City's 2015 UWMP, the current (2015) population residing in the Santa Cruz water service area is estimated to be 95,251 people. Approximately two thirds of the total population, almost 64,000, lives inside the City limits. The UC Santa Cruz Main Campus is located on the west side of the City. About 9,900 people including students, faculty, staff, and their families reside on the UC Santa Cruz Main Campus.

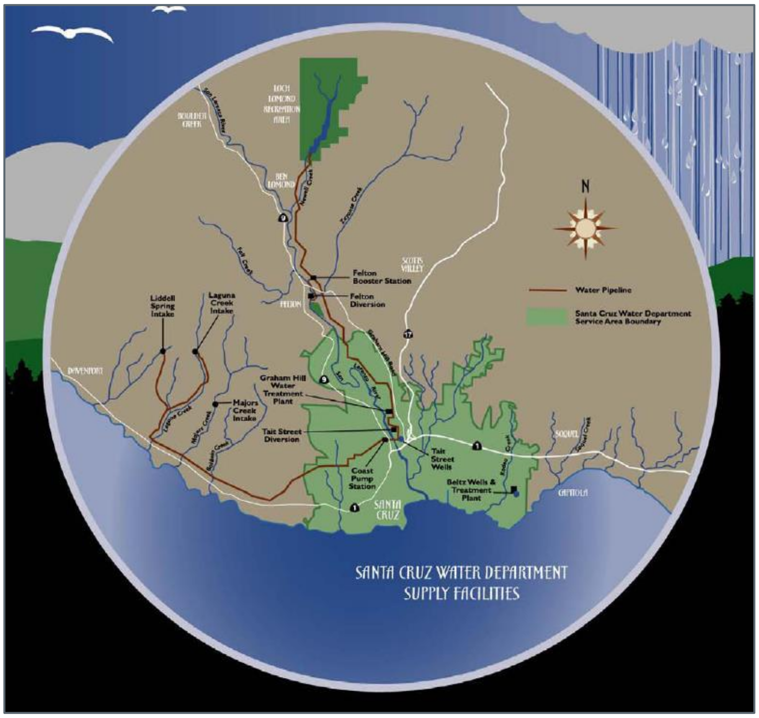


Source: City of Santa Cruz, 2015 Urban Water Management Plan, August 2016

Figure 4-1. City of Santa Cruz Water Service Area

4.2 Overview of Water Supply Sources

The Santa Cruz water system relies predominantly on local surface water supplies, which include the following: diversions from three North Coast streams (Reggiardo Creek, Laguna Creek, and Majors Creek) and one natural spring (Liddell Spring); the San Lorenzo River; and Loch Lomond Reservoir. Together, these surface water sources represent approximately 95 percent of the City's total annual water production. The balance of the City's supply comes from groundwater, all of which is extracted from wells in the Purisima Formation in the mid-County area (Live Oak Well system). These main production elements of the City's water supply system are illustrated on Figure 4-2.



Source: City of Santa Cruz 2015 Urban Water Management Plan, August 2016

Figure 4-2. City of Santa Cruz Water Supply System

All of the City's water resources are obtained from local sources. The system relies entirely on rainfall, surface runoff, and groundwater infiltration occurring within watersheds located in Santa Cruz County. No water is purchased from state or federal sources or imported to the region from outside the Santa Cruz area. In general, the City's water system is managed to use available flowing sources to meet daily demands as much as possible. Groundwater and stored water from Loch Lomond are used mainly in the summer and fall months when flows in the coast streams and river sources decline, and additional supply is needed to meet higher daily water demands. On a typical summer day, the North coast sources yield 1 to 2 mgd, the San Lorenzo River produces 7.5 mgd, groundwater makes up 0.8 mgd, and the reservoir contributes an average of 1 to 2 mgd.

4.3 Water Service to UC Santa Cruz

The City of Santa Cruz Water Department (SCWD) supplies water to UC Santa Cruz for domestic use, fire flow and irrigation on campus. As shown in Table 3-1, in 2015, UC Santa Cruz accounted for approximately 6.5 percent of the City's total annual water consumption.

The UC Santa Cruz Main Campus receives potable water through nine connections to the SCWD system (four locations each with two meters and a fifth location serving only the Barn Theater). SCWD pumps potable water to three consecutive in-line reservoirs at separate elevations ranging from 400 feet to 1,113 feet at a point in the northern campus. The Main Campus water system then distributes water to campus facilities in eight separate pressure zones.[5] The Main Campus also has an emergency water storage reservoir (a 1-million-gallon tank) in the upper campus that is available to provide the campus with an emergency water supply and to provide adequate fire flow to the Crown/Merrill Apartments.[6]

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[5] Source: UC Santa Cruz Water Action Plan, December 2017.

[6] Source: University of California Santa Cruz Long-Range Development Plan 2005 - 2020, Final Environmental Impact Report (FEIR), Volume II, October 2005.

5.0 CITY OF SANTA CRUZ WATER DEMANDS

This section describes the City's historical and existing water demands and projected future water demands. The descriptions provided below for the City's water demands have been taken, for the most part, from the City's 2015 UWMP, which was adopted by City Council in May 2016. Supplemental information from other available reports has been included to provide the most recent data available.

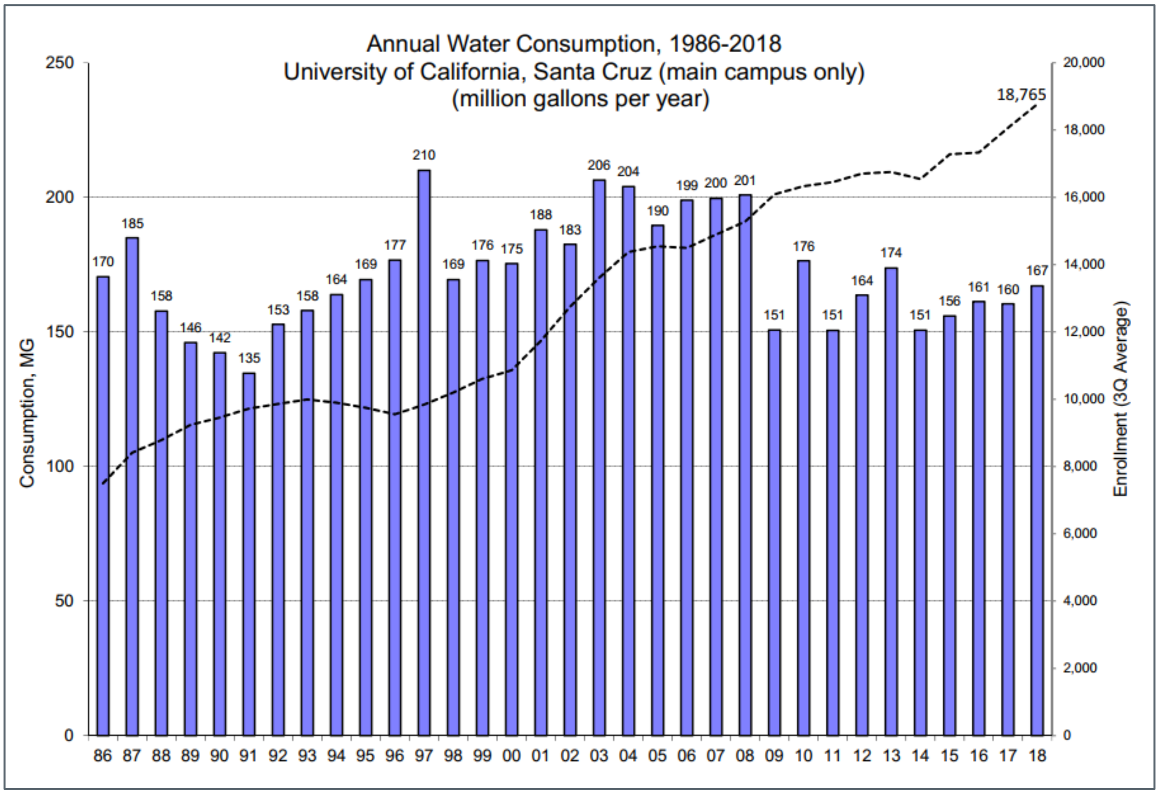
Water Code section 10910(c)(2) states the following:

> *10910(c)(2) If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f), and (g).*

5.1 Historical and Existing Water Demand

Historically, the general trend in the City's water demand was one in which water use rose roughly in parallel with account and population growth over time, except during two major drought periods in the late 1970s and the early 1990s. Around 2000, this pattern changed and system demand began a long period of decline, accelerated by pricing changes, drought, economic downturn, and other factors. In 2015, after two years of water rationing, annual water use fell to a level of about 2.45 billion gallons, similar to the level experienced during the 1970s drought.

Historical water demands for the UC Santa Cruz Main Campus have also followed similar patterns, with water demands generally increasing each year, until the recent drought years when water use on the Main Campus dropped dramatically in response to the drought. Prior to 2009, annual water use on the Main Campus was about 200 MGY. In more recent years, annual water use on the Main Campus dropped to as low as 151 MGY (in 2009, 2011 and 2014), representing an approximate 25 percent reduction in water use in response to drought conditions and associated water conservation. Water use has increased somewhat following the drought but remains considerably lower than historical water use. It is also important to note that the decreases in campus water use over the last 10 years have occurred despite increases in student enrollment over the same period. Historical annual water consumption and student enrollment on the Main Campus are shown on Figure 5-1.



Source: University Water Consumption (1986-2018) with Marine Science Campus.xls

Figure 5-1. UC Santa Cruz Main Campus Annual Water Consumption and Student Enrollment (1986-2018)

5.2 Future Water Demand

The City utilized a demand model to forecast future demands for 2020 through 2035 in its 2015 UWMP, considering numerous factors including historical data on customer class water use, weather, price of water, household income, conservation, and other economic variables driving water demand. Table 5-1 provides a summary of the City's future water demand projections for its various water use types, including the future water demand projection for UC Santa Cruz.

Table 5-1. City of Santa Cruz Projected Water Demand, MGY

Use Type	2015	2020	2025	2030	2035
Single Family	835	1,277	1,223	1,191	1,170
Multi Family	538	772	714	690	678
Commercial	485	574	541	525	519
Industrial	43	56	59	60	61
UC Santa Cruz[(a)]	**160**	**196**	**234**	**271**	**308**
Institutional/Governmental	35	46	42	40	40
Landscape (Dedicated Irrigation)	46	112	119	134	144
Landscape (Golf Irrigation)	87	58	52	47	47
Water Losses	223	236	241	247	253
Total	**2,452**	**3,327**	**3,225**	**3,205**	**3,220**

Source: City of Santa Cruz 2015 UWMP, Tables 4-1 and 4-3.

(a) Based on the Primary Projection for UC Santa Cruz shown in Table 3-2.

As described in Section 3.3, the water demands for UC Santa Cruz included in the City's 2015 UWMP are based on the previously projected buildout demand of 349 MGY[7]. The 349 MGY projection included the existing Main Campus water demand, the projected water demand estimated for the 2005 LRDP and 2008 Settlement Agreement, and existing and projected water demand for the University's Coastal Science Campus and the Westside Research Park.

As described in Section 3.3, the projected UC Santa Cruz potable water demand for proposed development under the 2021 LRDP is approximately 289 MGY; and buildout of the 2021 LRDP is anticipated to occur by 2040. The current projected water demand for the 2021 LRDP, along with the projected water demand for the Coastal Science Campus, together totaling approximately 307 MGY, is considerably lower than the previously projected buildout demand of 349 MGY.

[7] Based on the projected water demand for UC Santa Cruz developed for the City's SOI Amendment EIR (339 MGY) plus 10 MGY of additional water demands for additional development beyond 2020. Source: City of Santa Cruz SOI Amendment EIR Table 2-4 and City of Santa Cruz 2010 UWMP (page 4-19).

6.0 WATER SUPPLIES

This section describes the City's existing water supplies and planned additional water supplies to serve its existing and future water customers, including UC Santa Cruz. Also described are recycled water supplies proposed to be produced and used on the UC Santa Cruz campus. The descriptions provided below for the City's water supplies have been taken, for the most part, from the City's 2015 UWMP, which was adopted by City Council in May 2016. Although SB 610 applies only to cities and counties, and not to the University of California, supplemental information from other available reports has been included in this Water Supply Evaluation to provide the most recent data available and to meet the specific requirements of SB 610.

In 2001, the California Legislature passed Senate Bill 610 (Water Code Section 10910 et seq.) including the following provisions:

10910(c)(2) If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d), (e), (f) and (g).

10910(d)(1) The assessment required by this section shall include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project, and a description of the quantities of water received in prior years by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), under the existing water supply entitlements, water rights, or water service contracts

10910(d)(2) An identification of existing water supply entitlements, water rights, or water service contracts held by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), shall be demonstrated by providing information related to all of the following:

- *(A) Written contracts or other proof of entitlement to an identified water supply.*
- *(B) Copies of a capital outlay program for financing the delivery of a water supply that has been adopted by the public water system.*
- *(C) Federal, state, and local permits for construction of necessary infrastructure associated with delivering the water supply.*
- *(D) Any necessary regulatory approvals that are required in order to be able to convey or deliver the water supply.*

10910(e) If no water has been received in prior years by the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), under the existing water supply entitlements, water rights, or water service contracts, the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), shall also include in its water supply assessment pursuant to subdivision (c), an identification of the other public water systems or water service contract-holders that receive a water supply or have existing water supply entitlements, water rights, or water service contracts, to the same source of water as the public water system, or the city or county if either is required to comply with this part pursuant to subdivision (b), has identified as a source of water supply within its water supply assessments.

6.1 Existing City Water Supplies

The Santa Cruz water system relies predominantly on local surface water supplies, which include the North Coast sources, the San Lorenzo River, and Loch Lomond Reservoir. The balance of the City's supply comes from groundwater, all of which is extracted from wells in the Purisima Formation in the mid-County area. During the past decade, the North Coast sources represented 26 percent of the total water supply, the San Lorenzo River represented 55 percent, Newell Creek (Loch Lomond Reservoir) represented 14 percent, and Live Oak (Beltz) wells contributed the remaining 5 percent.

All of the City's water resources are obtained from local sources. The system relies entirely on rainfall, surface runoff, and groundwater infiltration occurring within watersheds located in Santa Cruz County. No water is purchased from state or federal sources or imported to the region from outside the Santa Cruz area.

6.1.1 Surface Water Supplies

The City's surface water system supplies are located both within and outside of the City of Santa Cruz with a mix of flowing sources and a storage reservoir. Each of the surface water sources are briefly described in the following sections.

6.1.1.1 North Coast Creeks and Spring

The North Coast sources consist of surface diversions from three coastal streams and a natural spring located approximately six to eight miles northwest of downtown Santa Cruz. These sources are: Liddell Spring, Laguna Creek, Reggiardo Creek, and Majors Creek. The use of these sources by the City dates back as far as 1890.

6.1.1.2 San Lorenzo River

The San Lorenzo River is the City's largest source of water supply. The main surface water diversion is located at Tait Street near the City limits just north of Highway 1. Use of this source dates back to the 1870s and was consolidated under public ownership in 1917. The Tait Street Diversion is supplemented by shallow, auxiliary wells located directly across the river. These wells are potentially hydraulically connected to the river and tied to the City's appropriative rights for surface diversion. The drainage area above the Tait Street Diversion is 115 square miles.

The other diversion on the San Lorenzo River is Felton Diversion, which is an inflatable dam and intake structure built in 1974, located about six miles upstream from the Tait Street Diversion. Water is pumped from this diversion through the Felton Booster Station to Loch Lomond Reservoir. The facility is used to augment storage in the reservoir during dry years when natural inflow from Newell Creek is low.

While the City is the largest user of water from the San Lorenzo River basin, two other water districts, several private water companies and numerous individual property owners share the San Lorenzo River watershed as their primary source for drinking water supply.

6.1.1.3 Newell Creek and Loch Lomond Reservoir

Loch Lomond Reservoir is located near the town of Ben Lomond in the Santa Cruz Mountains. The reservoir was constructed in 1960 and has a maximum capacity of 2,810 million gallons (MG). In addition to providing surface water storage, the reservoir and surrounding watershed are used for public recreation purposes, including fishing, boating, hiking, and picnicking (swimming and wading are prohibited). The Newell Creek watershed above the reservoir is about nine square miles. In addition to the City, the San Lorenzo Valley Water District is entitled by contract to receive a portion of the water stored in Loch Lomond.

6.1.2 Groundwater

Even though groundwater constitutes only up to about 5 percent of the entire City water supply on an annual basis, it has been a crucial component of the water system for meeting peak season demands, maintaining pressure in the eastern portion of the distribution system, and for weathering periods of drought since the facilities were acquired from the Beltz Water Company in 1964.

6.1.2.1 City's Groundwater Facilities

The City's Live Oak Well system consists of four production wells and two water treatment plants located in the eastern portion of the City water service area. The facilities were originally acquired by the City from the Beltz Water Company in 1964 and are still referred to as the "Beltz" wells. Wells 8 and 9 were installed in 1998 as replacement wells for Wells 1 and 2, which were damaged in the 1989 Loma Prieta earthquake. Well 7, which began operating in 1974, has been replaced by Well 10. The newest well, Beltz 12 and associated water treatment facilities, were completed in 2015.

6.1.2.2 Basin Description

The easterly area of the City is located within the Santa Cruz Mid-County Groundwater Basin (which includes the Soquel-Valley Groundwater Basin), and the westerly area is within the Santa Margarita Groundwater Basin. The geographical area from which the City pumps groundwater is identified as the West Santa Cruz Terrace Groundwater Basin (Basin Number 3-26), whose western and eastern boundaries coincide roughly with the City's water service area (CA DWR, Bulletin 118).

The entire production of the City's Live Oak well field is derived from the Purisima Formation, which is the primary groundwater aquifer underlying the entire mid-county region and makes up most of what is commonly referred to elsewhere as the "Soquel-Aptos" basin. Groundwater from the Purisima Formation is used by the City, the Soquel Creek Water District (SqCWD) and Central Water District, several small water systems, and numerous private rural water wells.

6.1.2.3 Groundwater Management

The City of Santa Cruz Water Department has not itself prepared a groundwater management plan; however, a groundwater management plan has been prepared by the SqCWD and the Central Water Districts for the Soquel-Aptos area consistent with Assembly Bill 3030. This plan was originally prepared in 1996, updated in 2007, and currently serves as a living document with the most recent update having occurred in 2013.

As part of the region's compliance with the Sustainable Groundwater Management Act (SGMA), the Soquel-Aptos Groundwater Management Committee (SAGMC) was formed in 2015 and includes representatives from the County of Santa Cruz, Central Water District, SqCWD, the City of Santa Cruz and private well owners. The SAGMC established a Groundwater Sustainability Agency Formation Subcommittee and appointed six members. Following the framework provided by the state, the subcommittee was charged with creating an approved Groundwater Sustainability Agency prior to the June 2017 deadline. Additional activities recently initiated by the SAGMC include requesting a basin boundary modification, developing quarterly monitoring reports, conducting an evaluation of shallow wells, and making progress on a comprehensive groundwater model by integrating information available for the entire management area. The request for a basin boundary modification was approved in 2016 and the new basin is called the Santa Cruz Mid-County Groundwater Basin (Basin Number 3-001). This new basin includes the following previously defined basins:

- Basin Number 3-01: Soquel Valley
- Basin Number 3-02: Pajaro Valley
- Basin Number 3-21: Santa Cruz Purisima Formation
- Basin Number 3-26: West Santa Cruz Terrace

The Santa Cruz Mid-County Groundwater Sustainability Agency (GSA) has prepared a Groundwater Sustainability Plan (GSP), which covers a broad area in Santa Cruz County, including the easterly area of the City of Santa Cruz. It describes the steps needed to eliminate the adverse effects of groundwater overdraft. Adverse effects include seawater intrusion, reduction in water quality, and a reduction in streamflow. Solutions include conservation, aquifer replenishment, winter water transfers, and, potentially, a desalination plant (in Moss Landing).

The Santa Margarita GSP, covering much of North Santa Cruz County including the westerly area of the City of Santa Cruz and UC Santa Cruz, is currently in preparation, with a planned completion date of 2022.

6.1.2.4 Overdraft Conditions

In July 2015, the Soquel-Valley Groundwater Basin (Basin Number 3-01) was identified by the California Department of Water Resources as one of 21 groundwater basins to be reclassified as critically overdrafted. This was done based on seawater intrusion detected at the coastline, and the local declaration of a Groundwater Emergency by SqCWD in 2014. The Pajaro Valley Groundwater Basin (Basin Number 3-04) was already on DWR's list of critically overdrafted basins (as identified in DWR Bulletin 118-1980). Because those basins are part of the newly defined Santa Cruz Mid-County Groundwater Basin, the newly defined Santa Cruz Mid-County Groundwater Basin is now included on DWR's list of critically overdrafted basins.

6.1.2.5 Groundwater Pumping

In 2010, the City was advised by its hydrogeologist that the yield of the Live Oak (Beltz) well field was substantially less than half the 420 MGY annual production that the City had long assumed for water supply planning purposes, and that the dry season pumping rate that can be sustained without causing seawater intrusion in average years was closer to 170 MGY. As a direct result of these findings, the City relocated pumping further inland to a new well site. This unexpected loss of drought year groundwater yield is emblematic of the continuing change and uncertainty facing the City in its effort to provide a safe, reliable, and adequate municipal water supply.

Table 6-1 shows the actual volume pumped from the City's well fields during the peak season over the last five years. Average volume over this time is 164 MGY. As a result of the hydrogeology work, the City has limited groundwater pumping to a volume far below 420 MGY level. The current agreed upon sustainable yield volume is 170 MGY and has been utilized by the City when planning for the operation of the well fields. Due to the severe drought conditions in 2014, the City did rely on groundwater for a somewhat higher volume to meet peak demand in the dry summer months.

Table 6-1. City of Santa Cruz Groundwater Volume Pumped

	2011	2012	2013	2014	2015
West Santa Cruz Terrace Groundwater Basin (Basin 3-26), MGY	163	163	160	188	145

Source: City of Santa Cruz 2015 UWMP, Table 6-1.

6.2 Additional Planned Future City Water Supplies

Below is a discussion of the City's additional planned future water supplies, including transfers and exchanges, recycled water, conservation, groundwater storage, and advanced treated recycled water or desalination.

6.2.1 Transfers and Exchanges

Following years of discussion and coordination on groundwater management, the City and the SqCWD recently signed a "Cooperative Water Transfer Pilot Project for Groundwater Recharge and Water Resource Management" agreement to transfer a small amount of water to SqCWD in the winter months when surface water from the North Coast is available. This transfer would allow the District to assess the effects of reduced pumping of the basin. The agreement is a first step in the implementation of the Water Supply Augmentation Strategy and serves to further study and determine the potential benefits of local exchanges and transfers as a groundwater management tool and supply reliability strategy.

6.2.2 Recycled Water

Over the years, the City has commissioned several engineering studies regarding the potential uses of recycled water for agricultural irrigation, landscape irrigation, groundwater recharge, direct potable reuse, and use of recycled water from neighboring water districts. The City of Santa Cruz investigated the feasibility of a recycled water program through a regional Recycled Water Facilities Planning Study published in June 2018, funded in part by a grant from the State Water Board Division of Financial Assistance, Water Recycling Funding Program. The Water Supply Advisory Committee (WSAC) agreed to water conservation measures and water supply reliability studies or non-recycled water elements to be in the Water Supply Augmentation Plan, which are being further studied. The recommended projects and reuse opportunities include the following:

- **Santa Cruz Public Works Department (SCPWD) Title 22 Project:** This project will implement a near-term non-potable reuse project to meet in-plant demands, develop a bulk water station and serve the nearby La Barranca Park and Neary Park.

- **BayCycle Project:** This project will expand SCPWD Title 22 Project to increase production and non-potable reuse to serve customers along Bay Street including UC Santa Cruz and other City customers.
- **Coordination with Pure Water Soquel:** The City will continue to work closely with SqCWD to support the evaluation of Pure Water Soquel.
- **Groundwater Reuse Replenishment in Santa Cruz Mid County Basin:** The City will explore groundwater reuse replenishment in the Santa Cruz Mid County Basin through a collaborative project with Pure Water Soquel or as an independent City led project.
- **Groundwater Reuse Replenishment in Santa Margarita Basin:** The City will explore groundwater reuse replenishment in the Santa Margarita Basin through a regional project which has the potential to make the region more resilient in the long term.

6.2.3 Conservation

In addition to existing water conservation programs, the WSAC recommends looking at new programs, such as increased rebates and better management of peak season demand. The goal of additional programs is to further reduce demand by 200 to 250 MGY by 2035, with a particular focus on producing savings during the peak season.

6.2.4 Groundwater Storage

In normal years the SCWD receives more rainfall than is needed to meet customer demand or can be stored in Loch Lomond Reservoir. Using In-Lieu Water Exchanges, available winter flows would be delivered to SqCWD and/or Scotts Valley Water District (SVWD) customers, thus enabling reduced pumping from regional aquifers and enabling the aquifer to passively rest and recharge. Using Aquifer Storage and Recovery (ASR), available winter flows would be injected into aquifers through new and existing wells owned by the SCWD, SVWD and/or SqCWD, thereby actively recharging aquifers. A portion of the water delivered using In-Lieu or ASR would be effectively banked in the aquifers to be extracted and returned to SCWD when needed in future dry years.

6.2.5 Advanced Treated Recycled Water or Desalinated Water

Advanced treated recycled water or desalinated water would be developed as a supplemental or replacement supply in the event the groundwater storage strategies described above prove insufficient to meet the plan’s goals of cost-effectiveness, timeliness or yield. If it is determined that recycled water cannot meet the City’s water demands, then desalinated seawater would be used.

For a decade or more, the City had been pursuing a 2.5 mgd desalination facility as a regional project with the SqCWD to diversify both agencies’ water supply portfolio. It remains a possible project for the City. In the completed Final Report on Agreements and Recommendations, the WSAC presented a supply strategy that includes desalinated water, but only as a last resort, and after exhausting several other preferred options (City of Santa Cruz, 2015). SqCWD is continuing to consider desalinated water through a Memorandum of Interest with a different regional “Deepwater Desal” project proposed at Moss Landing Harbor.

The City completed a Final Desalination Feasibility Study Update Review in August 2018. A City seawater desalination project would involve construction and operation of a seawater reverse osmosis desalination plant and related facilities to provide up to 3.3 mgd of potable water to the City. The water supply from the project would help the City meet its water needs during periods of water supply shortages as a result of drought and reduced surface-water diversions needed to provide improved river and stream flows for fish and to plan for climate change.

6.3 Summary of Existing and Additional Planned Future City Water Supplies

Table 6-2 provides a summary of the City's existing and projected water supplies in normal years.

Table 6-2. City of Santa Cruz Existing and Projected Normal Year Water Supplies, MGY

Supply Source	2015	2020	2025	2030	2035
North Coast Surface Water Sources	382	637	642	671	671
San Lorenzo River	1,458	1,882	1,842	1,829	1,834
Loch Lomand Reservoir	495	595	551	540	547
Groundwater (Live Oak/Beltz Wells)	145	138	129	127	128
Total	**2,480**	**3,252**	**3,164**	**3,167**	**3,180**

Source: City of Santa Cruz 2015 UWMP, Tables 6-9 and 6-10.

6.4 Proposed UC Santa Cruz Recycled Water Supplies

UC Santa Cruz is currently planning site-specific non-potable water utility systems where feasible to offset the overall potable water demand of the campus.

As described above in Section 2.3.2, as part of the Student Housing West project, currently planned under the 2005 LRDP, wastewater generated in new student housing on the Heller site will be collected and treated in a wastewater treatment facility that would be located in the southeastern portion of the Heller site. The facility would be a membrane bioreactor (MBR) plant to treat the wastewater and generate recycled water for irrigation and toilet flushing use on the Heller site and, potentially, at other areas of the Campus. An MBR plant is also planned for new family student housing that would be developed on the Hagar site as part of the Student Housing West project, which would provide recycled water for toilet flushing and irrigation use on that site.

7.0 DETERMINATION OF WATER SUPPLY SUFFICIENCY BASED ON THE REQUIREMENTS OF SB 610

This section provides an overview of water supply constraints and a summary of water supply availability under Normal, Single Dry and Multiple Dry Year conditions to meet projected City water demands, including projected water demands for UC Santa Cruz. A discussion of City and UC Santa Cruz water conservation and sustainability programs is also provided.

Water Code section 10910(c)(4) states:

> *10910(c)(4) If the city or county is required to comply with this part pursuant to subdivision (b), the water supply assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the city or county for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses.*

7.1.1 Overview of Water Supply Constraints

The City of Santa Cruz is facing several obstacles in meeting its present and future water supply needs. While each complication presents a unique set of water management challenges, the common theme is the limitation in where, when, and how much water is available to meet the area's water service needs, particularly during years when rainfall is below average. The constraints include the following:

- **Local Supply Variability:** The City water system draws almost exclusively on local surface water sources; whose yield varies from year to year depending on the amount of rainfall received during the winter season and generated runoff that provides beneficial inflows. This local variation has been a significant constraint in recent years as the Central Coast, and the State of California more generally, were held in the grip of a multi-year drought. The City's declaration of a Stage 3 Water Emergency in 2014 and 2015 underscores the effect of the drought on the City of Santa Cruz system.
- **Ecosystem Restoration and Protected Species:** Since 2002, the City of Santa Cruz has been working toward the development of a Habitat Conservation Plan (HCP) that covers operation and maintenance activities at the North Coast streams and San Lorenzo River diversions as well as other activities which may result in "take" of threatened and/or endangered species. An HCP is an operational avoidance and minimization and mitigation plan prepared under Section 10 of the Federal Endangered Species Act (FESA) and Section 2081 of the California Endangered Species Act (CESA) by nonfederal parties seeking to obtain a permit for incidental take of federally or state-listed threatened and endangered species.
- **Source Water Quality and Treatment Capacity:** The primary issues with respect to water quality are the treatment challenges posed by future changes in the source water mix driven in part by ecosystem protection requirements. The Graham Hill Water Treatment Plant is a conventional surface water treatment plant that was commissioned in 1960 as a 12 mgd plant and has undergone an expansion and a number of improvements over the last 50 years. Except for groundwater from the Live Oak wells, all water delivered through the City system is treated at this plant. In other words, it must operate properly 100 percent of the time to maintain water service throughout the entire system.

- **The Water Rights Conformance Project for Water Rights and Entitlements:** The Newell Creek and San Lorenzo River permits to divert at Felton were originally granted as "diversion to storage," rather than as "direct diversion" rights. A diversion to storage is used when the water diverted is put into storage and is retained in storage for some time prior to being used. Current State Water Resources Control Board practice, however, requires rights of "direct diversion" as well as diversion to storage for the same operations as the City originally proposed and has historically undertaken.

7.1.2 Water Supply Availability and Reliability

The City of Santa Cruz utilizes the Confluence model to analyze the variability of water supplies to determine potential water supply shortages. The City has been utilizing the Confluence model to support water supply planning activities since 2003 and this model was used to generate the results for the 2010 UWMP (City of Santa Cruz, 2011). The model takes into account the variation in demand both within and between years, the availability of water from various sources, and the capacity of infrastructure to pump and treat the water. As described in Chapter 7 of the City's 2015 UWMP, the results presented below provide perspective on the City's water supply reliability based on accepted planning criteria and projected conditions in the water system.

7.1.2.1 Normal Year Supply and Demand Comparison

Although the City has not previously seen shortages in normal water years, by adding the ecosystem protection conditions likely to begin prior to 2020 (e.g., the HCP described above) a small shortage (1 to 3 percent) can be reasonably expected in future normal years. Historically in normal water years, the City experienced a slight surplus of supply and this trend can be expected to continue until the HCP agreement is approved and higher instream flows are maintained. As the City chose to create a representative average year by using the historic record, the inclusion of the dry years and critically dry years within the average may explain the predicted small deficit. It is important to note that the City predicts the supply and demand volumes to be in balance for 90 percent of all normal water years for 2020-2035.

7.1.2.2 Single Dry Year Supply and Demand Comparison

The City's single dry year assessment in their 2015 UWMP was based on the water supply available to the City comparable to water year 2014, which was a recent critically dry year. Based on these supply assumptions, water supply during a single dry year is not sufficient to meet the demand in the near-term, although the shortage experienced is projected to decrease over time. During a single dry year, annual shortages of 16 to 21 percent are projected given the modelled supply and demand figures developed for planning and reliability purposes.

7.1.2.3 Multiple Dry Year Supply and Demand Comparison

In the City's 2015 UWMP, the City chose to present the estimated water supply available during the multiple dry water year period of a three-year drought sequence using hydrology from 1976, 1977, and a second 1977 year. In an extreme multi-year drought similar to the 1976-77 event, the estimated water supply available to the City in the first year of that event, according to the model, ranges between 2,430 and 2,377 or an average of 25 percent less water on an annual basis than is available in a normal water year. During the second year, the average shortage over time increases to 39 percent and in the third year modeled, the average reduction compared to a normal year is over 50 percent.

Table 7-1 presents a summary of the City's projected demands and available supplies under normal year, single dry year and multiple dry year conditions.

Table 7-1. City of Santa Cruz Water Supply and Demand in Normal Years, Single Dry Years and Multiple Dry Years, MGY

		2020	2025	2030	2035
Normal Year					
	Supply Totals	3,252	3,164	3,167	3,180
	Demand Totals	3,327	3,225	3,205	3,220
	Difference	(75)	(61)	(38)	(40)
	Demand Served, %	97%	97%	98%	98%
Single Dry Year					
	Supply Totals	2,619	2,658	2,692	2,692
	Demand Totals	3,327	3,225	3,205	3,220
	Difference	(708)	(567)	(513)	(528)
	Demand Served, %	79%	82%	84%	84%
Multiple Dry Years					
First Year	Supply Totals	2,430	2,377	2,377	2,381
	Demand Totals	3,327	3,225	3,205	3,220
	Difference	(897)	(848)	(828)	(839)
	Demand Served, %	73%	74%	74%	74%
Second Year	Supply Totals	1,918	1,942	1,968	1,969
	Demand Totals	3,327	3,225	3,205	3,220
	Difference	(1,409)	(1,283)	(1,237)	(1,251)
	Demand Served, %	58%	60%	61%	61%
Third Year	Supply Totals	1,597	1,567	1,580	1,581
	Demand Totals	3,327	3,225	3,205	3,220
	Difference	(1,730)	(1,658)	(1,625)	(1,639)
	Demand Served, %	48%	48%	49%	49%

Source: City of Santa Cruz 2015 UWMP, Tables 7-2, 7-3 and 7-4

7.1.3 City of Santa Cruz Water Supply Advisory Committee and Water Supply Augmentation Plan

In early 2014, City Council appointed members to the WSAC. The aim of the WSAC process was to:

- Explore the City's water profile, including supply, demand, and future risks
- Analyze potential solutions to deliver a safe, adequate, reliable, affordable, and environmentally sustainable water supply
- Develop recommendations for City Council consideration

In late 2015, consensus was achieved among WSAC members for how best to address an agreed-upon worst year gap of 1.2 billion gallons between water supply and water demand during times of extended drought. In November 2015, the City Council adopted the recommendations of the WSAC to address these challenges. These recommendations included the following:

- **Element 0 Demand Management:** Additional water conservation with a goal of achieving an additional 200 to 250 million gallons per year of demand reduction by 2035 by expanding water conservation programs.
- **Element 1 In Lieu Recharge:** Passive recharge of regional aquifers by working to develop agreements for delivering surface water as an in lieu supply to the SqCWD and/or the SVWD so they can rest their wells, help the aquifers recover, and effectively store water for use by SCWD in drought years.
- **Element 2 ASR:** Active recharge of regional aquifers by using existing infrastructure and potential new infrastructure in the regionally shared Purisima aquifer in the Soquel-Aptos Basin and/or in the Santa Margarita/Lompico/Butano aquifers in Scotts Valley area to store water that can be available for use by the City in drought years.
- **Element 3 Advanced Treatment Recycled Water or Desalination:** A potable water supply using advanced-treated recycled water as its source as a supplemental or replacement supply in the event the groundwater storage strategies described above prove insufficient to meet the goals of cost-effectiveness, timeliness, or yield. In the event advanced-treated recycled water does not meet the City's needs, desalination would become Element 3.

7.1.4 City of Santa Cruz Water Shortage Contingency Plan

The City's Water Shortage Contingency Plan has a five-stage plan to correspond with supply reductions from less than 5 percent to 50 percent. Each stage includes a set of demand reduction measures that become progressively more stringent as the shortage condition escalates.

The City's strategy for dealing with water shortages of all levels involves the following interrelated components:

- An allocation system to establish reduction goals for different customer groups
- Demand reduction measures
- Publicity and communications
- Operating actions

The City's Water Shortage Contingency Plan includes reduction goals for UC Santa Cruz under each shortage scenario. These goals were developed in consultation with UC Santa Cruz. UC Santa Cruz reached, and even exceeded its reduction targets in 2010 and 2014 when the City implemented the Plan. In 2015, UC Santa Cruz reduced its peak season water use by almost 18 percent. In addition, UC Santa Cruz has implemented water conservation measures, including improvements to irrigation systems and retrofitting restroom fixtures, which have contributed to a 50 percent reduction in per capita (per student) water use since the late 1990s. UC Santa Cruz is planning additional fixture retrofits and infrastructure improvements which will further increase the efficiency of water use on the campus.

7.1.5 UC Santa Cruz Water Conservation Measures and Water Action Plan

Over the last 30 years, annual water consumption has remained relatively steady even though UC Santa Cruz enrollment has more than doubled over the same time period. As such, UC Santa Cruz is committed to proactively managing and efficiently using limited water resources; maintaining a positive relationship with and partnering with the City of Santa Cruz Water Department; and promoting education, research, and practice on potable water use reduction and non-potable water development. While UC Santa Cruz has been a leader among the UC campuses in sustainable water systems and watershed management, the campus remains committed to sustaining efforts and practices that support water reduction in future years.

In 2016, the UC Office of the President (UCOP) called for campuses to demonstrate leadership in the area of sustainable water systems by reducing potable water use 35 percent by 2025, as compared to a 2005-2008 baseline period. Some of the actions called out in the policy included:

- Converting potable water used for irrigation to recycled water
- Implementing efficient irrigation systems
- Drought tolerant plant selections
- Phasing out unused turf
- Replacing single-pass cooling systems or constant flow laboratory equipment

UC Santa Cruz has been proactive in water conservation through infrastructural improvements, technological upgrades including leak detection and monitoring software, advanced evapotranspiration irrigation technology, and user conservation behavior including a successful coordinated campus drought response. As a result, campus potable water usage has followed a downward trend while campus population continues to increase. UC Santa Cruz's main campus average historical use over the UCOP designated three-year baseline (FY 2005-06, 2006-07, and 2007-08) was 13,924 gallons per weighted campus user. In FY 2016-17, the campus used 8,856 gallons per weighted campus user, reaching a 36.4 percent reduction from the baseline, surpassing the UCOP's 2020 20 percent reduction and marginally exceeding the 2025 36 percent reduction goals.

As described in a May 2017 City of Santa Cruz Information Report to the City Manager (included in Appendix B of this Water Supply Evaluation), UC Santa Cruz successfully met the City's mandatory water reduction goals as a result of close collaboration between the representatives of all sectors across the campus, as well as with the City Water Department. In both 2014 and 2015, a Water Working Group led by the campus planning and sustainability offices established monthly budgets and directed efforts to reduce water use by 20 percent, or about 20 million gallons, during the peak dry season. A key to the success of this effort was an investment in new cellular-based meter reading technology that allowed individual building/facility managers to view their water consumption on an hourly basis and quickly detect leaks. This technology will continue to help the University manage the campus water use well into the future. A water conservation student intern also helped communicate the conservation message to students and staff and helped identify and report leaks. For its efforts, UC Santa Cruz established itself as a leader in water conservation and water efficiency among the other UC and other college campuses across the State.

UC Santa Cruz's 2017 Water Action Plan (WAP) recognizes successes in water conservation and identifies implementable strategies to reduce UC Santa Cruz's potable water demand and to promote healthy watersheds on and around the campus. The 2017 WAP serves as an update to the 2013 WAP and identifies the following key opportunities to further reduce water demand:

- Develop water reduction targets across campus, by type of use, to further water conservation practices and usage reduction in non-drought conditions
- Evaluate the use of non-potable water sources for irrigation
- Identify and prioritize sections of aging piping infrastructure that may have to be replaced to proactively prevent future leakage
- Remove eligible turf irrigated by potable water
- Replace single-pass cooling systems, which draw large amounts of potable water

As described in previous sections, UC Santa Cruz is proposing to construct an MBR wastewater treatment facility as part of the proposed Student Housing West project that would treat wastewater and generate recycled water for use on the Heller site and, potentially, in existing student residence halls at Porter College. Recycled water (treated effluent) generated at the MBR plant would provide water for toilet flushing and landscape irrigation at the Heller site. Recycled water would also be conveyed north via a recycled water main that would be located in the utility corridor extending between the Kresge parking lot and the Heller site. The main would convey recycled water to Porter College where the residence halls are already fitted with dedicated purple pipes for toilet flushing and landscape irrigation. Use of recycled water for these purposes will offset or reduce potable water use, consistent with the University's policies for sustainable water use.

7.1.6 UC Santa Cruz Campus Sustainability Plan

In 2017, the campus developed a comprehensive Campus Sustainability Plan (CSP) that directly supports the University's core mission of teaching and research. The CSP guides water-related goals, strategies, and actions for implementation. The following are the water-related strategies included in the CSP, along with their current status:

- Develop a framework to define, identify, and prioritize built and natural infrastructure improvement projects
  - 2019 Update: UC Santa Cruz Natural Reserves spearheaded a successful effort to re-establish the CLUMAC (Campus Land Use and Management Action Committee) in partnership with Physical Planning, Development & Operations.
- Measure effects of human activity on campus lands, watersheds, and infrastructure
  - 2019 Update: UC Santa Cruz Natural Reserves partnered with a professional forester to conduct an Upper Campus Land Management Assessment with the support of a Campus Sustainability Plan grant. This resulting report contains a thorough review of Upper Campus vegetation communities, including information on their locations, species composition, historical and current conditions, desired future conditions, and identified

potential management actions. Additionally, the report includes sections on road and trail maintenance, an analysis of permitting options and treatment costs, and fire fuel reduction management locations.

- Increase the use of non-potable water on campus
  - 2018 Update: The consideration of feasible sources of non-potable water is being incorporated into the development of campus utility studies, in conjunction with the Long Range Development Planning process.
- Explore feasibility of all potential non-potable water sources for the campus as part of the Long Range Development Planning process.
  - 2019 Update: As part of the current LRDP development, the campus is exploring opportunities for purple pipe (recycled water) connections across campus. Specifically, Porter has installed purple pipe and is ready to utilize recycled water when it becomes available and Kresge is designed to collect stormwater into a treatment facility to feed back into its water closets.
- Reduce potable water use through technological innovations and physical improvements
  - 2019 Update: Multiple campus units collaborated throughout the drought response years in 2014 and 2015 to create a centralized list of water efficiency improvements and executed upgrades to reduce water consumption. Opportunities and capacity for updating the list will be considered at a future date when campus priorities align with this need.
- Improve communication about water management, use, and conservation to the campus and local community
  - 2019 Update: The campus Energy Department has developed a new process for creating work orders that swiftly address leaks as they are detected. The UC Santa Cruz Arboretum also increased utilization of the Beacon leak detection software to implement water infrastructure upgrades with the support of Campus Sustainability Plan grant funding. These improvements will save the University thousands of gallons of water annually, and new real-time texts will alert Arboretum staff to future leaks.
- Identify new sources of funding for both potable water reduction and non-potable sourced development projects
  - 2019 Update: UC Santa Cruz's sustainability staff have partnered with staff from the UCOP Design and Construction Department to create a Life Cycle Cost Analysis tool in 2019-20.

8.0 WATER SUPPLY EVALUATION FINDINGS

The purpose of this Water Supply Evaluation was to perform an evaluation of the availability and reliability of water supplies to serve the proposed development under the UC Santa Cruz 2021 LRDP based on existing UC Santa Cruz water demands and projected water demands for proposed development under the 2021 LRDP. Key findings of this Water Supply Evaluation are summarized as follows:

- Water demands on the UC Santa Cruz Main Campus have dropped dramatically in recent years as a result of water conservation measures in response to the recent drought. Many of the water conservation measures have resulted in permanent reductions in water use (e.g., plumbing fixture retrofits, improvements in leak detection, etc.).
- In the recent drought years, UC Santa Cruz successfully met the City's mandatory water reduction goals as a result of proactive water conservation, improved water use efficiency, and drought response measures, together with close collaboration between representatives of all sectors across campus, as well as with the City Water Department.
- The projected potable water demands for proposed development under the UC Santa Cruz proposed 2021 LRDP are approximately 289 MGY by 2040, which includes the existing and projected water demands for the Main Campus and the Westside Research Park.
- The projected potable water demands for the UC Santa Cruz Coastal Science Campus are 17.4 MGY, which includes the existing water demand and projected future water demand for the Coastal Science Campus. Although the Coastal Science Campus is not part of the proposed 2021 LRDP, it is considered part of the UC Santa Cruz overall water demand to be served by the City.
- The UC Santa Cruz projected future water demand of approximately 307 MGY (including the proposed 2021 LRDP and the Coastal Science Campus) is lower than the previously projected buildout demand of 349 MGY, and the 2035 primary projection for UC Santa Cruz water demands included in the City's 2015 UWMP.
- As described in Section 7 of this Water Supply Evaluation, the City predicts the supply and demand volumes to be in balance for 90 percent of all normal water years for 2020-2035. However, in single dry years and multiple dry years, the City does project water supply shortages. As a City water customer, UC Santa Cruz is subject to these potential water shortages and is subject to the City's water supply allocation system and demand reduction measures. As described, UC Santa Cruz has been very successful in reducing water use in recent years in response to the drought and has updated its Water Action Plan to implement additional measures to reduce potable water use.

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Appendix A

UC Santa Cruz Long Range Development Plan
Water Demand Projections
Sherwood Design Engineers
November 2020

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Technical Memorandum

November 3, 2020

To: Barbara Maloney, Christine Thompson—Page
Cc: Jolie Kerns, Oxo Slayer, Courtney Trask, Zachary Teske—UCSC
From: John Leys, Maika Nicholson and Kelly Archer—Sherwood
Project Name/No: UCSC Long Range Development Plan / 17-039

Subject: UC Santa Cruz Long Range Development Plan Water Demand Projections

1.0 EXECUTIVE SUMMARY

UCSC's Long-Range Development Plan (LRDP) projects increases in student enrollment, faculty and staff employment, and the associated expansion of student housing, employee housing, and academic space to accommodate this growth over the University's 2020-2040 planning horizon. The purpose of this memorandum is to provide the technical basis for the water demand projections presented in the LRDP. The analysis considers UCSC's main campus and 2300 Delaware property (West Side Research Park).[1]

The water demand analysis projects an increase from the existing (FY17/18) baseline[2] of 154.6 million gallons per year (MGY) to 289.1 MGY in 2040, representing an 87% increase over existing water-use.

2.0 LRDP PROGRAM

To accommodate the planned increase in student and employee population, the total non-residential assignable square-feet (ASF) is projected to increase from 2.09 million to 5.17 million ASF. Student housing is proposed to increase from 1.35 to 3.23 million ASF, and employee housing is proposed to increase from 0.32 to 0.98 million ASF.[3] Tables 1 and 2 provide the Baseline (FY18/19) and 2040 LRDP program assumptions for student and employee populations and housing, respectively.

The water demand analysis in Section 3 uses the projected increases in student and employee populations (reported as full-time equivalents, FTEs), and housing capacity (reported as beds), to estimate future water demands. Projecting water demand based on FTEs and population housed on campus, instead of by growth in ASF, is considered more accurate because water demand is better correlated to the number of building users than the size of a building.

[1] The UCSC Coastal Science Campus and other satellite properties are outside of the LRDP scope of work and therefore not included in the analysis.
[2] FY17/18 campus water use data was used as the baseline instead of FY18/19 because it was the most accurate full fiscal year of data available at the time of this analysis. The University recently modified the way in which sub-metered water data is collected and some anomalies were found in the FY 18/19 sub-meter data. Accurate sub-meter data is needed to categorize water demands by end-use (irrigation, housing, academic buildings, etc.). Using FY 17/18 water data allows for a more reliable estimate of future water demands, projecting by each end-use category as described in this memo.
[3] Baseline and 2040 Program is based on "200619_UCSC_LRDP_PROGRAM_CONDITIONS_FINAL_rev1.xlsx" provided via email by Oxo Slayer on 10/29/2020.

Table 1 - Student and Employee Population

Student and Employee Population[1]	Baseline (FY 18/19)	Net New	2040 LRDP
Student Enrollment FTE	18,518	9,482	28,000
Employee (Faculty + Staff) FTE	2,800	2,200	5,000
Total Campus FTE	***21,318***	***11,682***	***33,000***

1. Baseline and 2040 student enrollment and employee numbers are based on "200619_UCSC_LRDP_PROGRAM_CONDITIONS_FINAL_rev1.xlsx" provided via email by Oxo Slayer on 10/29/2020.

Table 2 - Student and Employee Housing

Employee Housing[1]	Baseline (FY 18/19)	Approved but Non-Operational	Net New	2040 LRDP
Employee (Main Campus)	270	39	358	667
Dependent (Main Campus)[2]	386	56	512	954
Main Campus Sub-Total	***656***	***95***	***871***	***1,621***
Employee (2300 Delaware)	0	0	200	200
Dependent (2300 Delaware)[2]	0	0	286	286
2300 Delaware Sub-Total	***0***	***0***	***486***	***486***
On-Campus Employee Total	270	39	558	867
On-Campus Dependent Total[2]	386	56	798	1,240
Total Employee Beds	***656***	***95***	***1,357***	***2,107***
Student Housing[1]	**Baseline (FY 18/19)**	**Approved but Non-Operational**	**Net New**	**2040 LRDP**
Student Beds	9,283	2,175	8,500	19,958

1. Baseline and 2040 housing information is based on "200619_UCSC_LRDP_PROGRAM_CONDITIONS_FINAL_rev1.xlsx" provided via email by Oxo Slayer on 10/29/2020.
2. All employee housing assumes 2.43 Residents/Unit (1.43 additional dependents per each employee)

3.0 WATER DEMAND ANALYSIS

FY17/18 campus water use data is used as the baseline instead of FY18/19 because it was the most accurate full fiscal year of data available at the time of this analysis. The University recently modified the way in which sub-metered water data is collected and some anomalies were found in the FY 18/19 sub-meter data and therefore not included in the historic campus water data analysis below. Accurate sub-meter data is needed to categorize water demands by end-use (irrigation, housing, academic buildings, etc.). Using FY 17/18 water data allows for a more reliable estimate of future water demands, projecting by each end-use category as described below.

Historic Campus Water Data Analysis

UCSC provided Sherwood with Excel spreadsheets for calendar years 2012-2018.[4] As noted above, 2019 data was not available at the time of this analysis. The spreadsheets included:

- Sub-metered data collected by the University, provided as monthly consumption data by water-use category. Table 3 provides a description of the water-use categories and sub-categories provided in the water dataset;
- Total water consumption billed by the City of Santa Cruz at the main campus water meter.

Table 3 – Water-Use Categories

Category	Sub-Category
Interior Water Demands	
Non-Residential	General Academic
	Admin
	Dining and Kitchen
	Lab
	Recreational
	OPERS
Residential	Faculty Housing
	Student Housing
Mechanical[1]	
Irrigation	
Grounds	General Landscape
	Recreation Field
	Sand Field
Non-Grounds	Arboretum
	Employee Irrigation
	Farm Irrigation
	Garden
	Greenhouse
	Landscape

1. Make-up water supplied to cooling towers

Figure 1 presents the annual Main Campus water consumption for the six years of data provided, comparing campus-collected sub-meter data against billed consumption based on City of Santa Cruz billing information. 'Main Campus' water consumption does not include the 2300 Delaware property. The data is consistent with the analysis presented in the 2017 Water Action Plan (2017 WAP), showing the downward trend in water consumption that has resulted from proactive water conservation, efficiency, and drought response measures. Much of the conservation efforts were stimulated by the statewide drought in 2013-2017. During the 2014 and 2015 drought years, the City of Santa Cruz declared a Stage 3 Water Emergency and requested the campus to reduce domestic water-use by 20%, as metered and billed by the City, compared to a 2013 baseline, which UCSC accomplished (2017 WAP).

[4] Water data was received from Patrick Testoni via email on 8/9/18. A subsequent correction to the mechanical water-use sub-category was received from Mr. Testoni via email on 1/29/19.

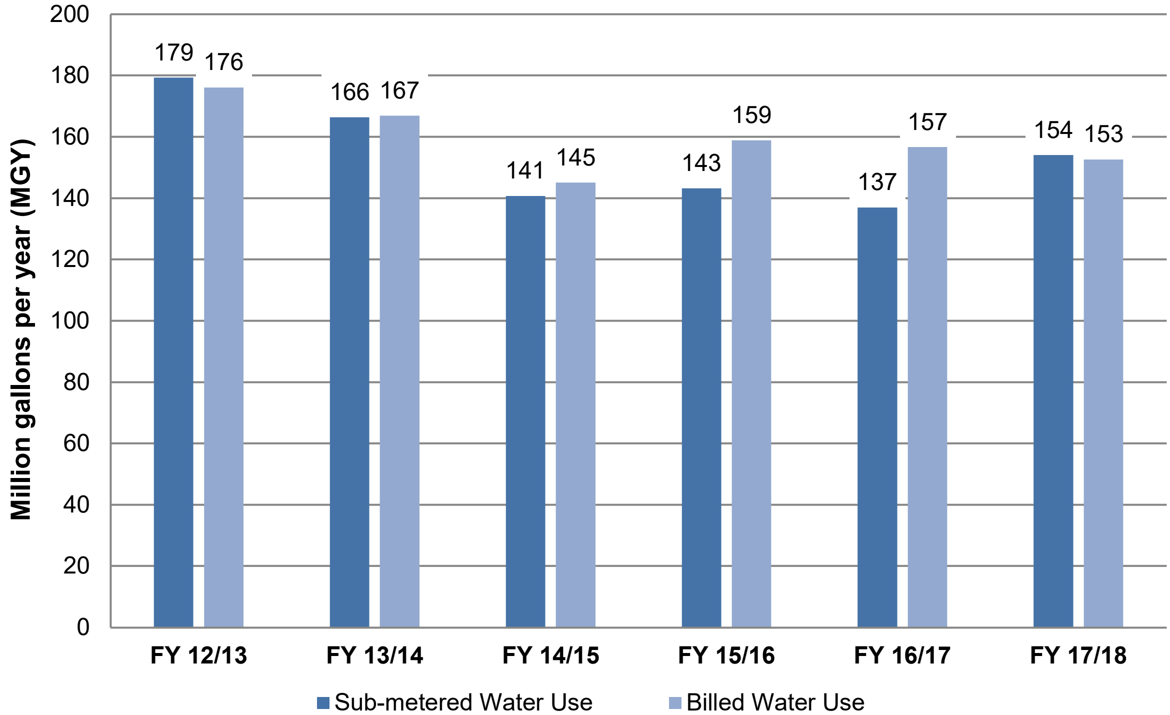

Figure 1 – Main Campus Annual Water-Use (2012-2018)

Water-use data was analyzed over time and by the water-use categories presented in Table 3. The most recent years of data are considered a more accurate reflection of the campus's efficiency improvements, which should be sustained and improved upon into the future.[5] Key efficiency gains noted in the 2017 WAP included smart-metering system and leak detection, irrigation reductions, efficiency audits, fixture replacement and behavior change campaigns.

Similar water-use patterns are observed across the two most recent years of data (FY16/17 and FY17/18). Sub-metered water data from the most recent FY17/18 is used as the baseline for projecting future water demands by category (Figure 2).

FY17/18 is a conservative but representative baseline for irrigation demands because it occurred after the primary drought years when irrigation was highly suppressed and spans a relatively dry water-year that experienced lower than average rainfall. FY16/17 is not considered because the sub-metered data was almost 13% lower than the total billed water usage (Figure 1), suggesting errors in the sub-meter data.

[5] It is noted that irrigation (outdoor) water uses were greatly restricted in the 2013-2016 multi-year drought and the University has expressed the desire to allow for more lenient irrigation practices. Further discussion is included in the demand projections section of this memorandum.

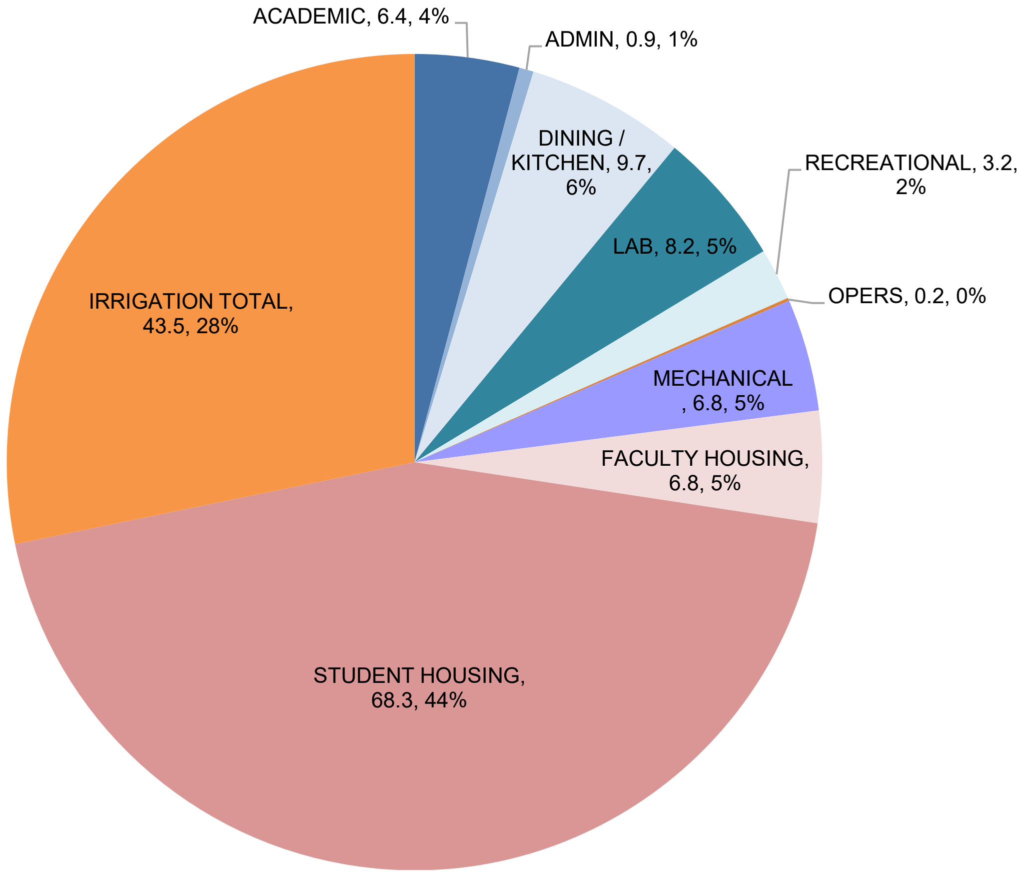

Figure 2 – Main Campus Water-Use by Category, MGY (FY 17/18)

LRDP Water Demand Projections

Non-Residential Buildings:

Interior campus water consumption from FY17/18 is used to create baseline "unit demand factors" for the non-residential water-use categories specified in Table 3. The baseline demand factor (gal/day/FTE) is determined by dividing the total water demand for non-residential buildings by the sum of student and employee FTEs. The unit demand factors are then applied to the projected 2040 program to estimate the future campus water-use based on the growth in the campus population. Water-use is conservatively projected linearly with growth (i.e., unit demand factors remain constant), which does not account for reductions that might result from efficiency retrofits to existing buildings or improved efficiency in new buildings.

Table 4 – Non-Residential Projections

NON-RESIDENTIAL INTERIOR WATER DEMANDS							
	Baseline (FY 17/18)[1]			Demand Factor (gal/d/FTE)	Projected 2040		
Category	Annual Demand (MGY)	Ave. Daily Demand (gal/d)	Existing FTE		Proposed FTE	Annual Demand (MGY)	Ave. Daily Demand (gal/d)
Main Campus, Non-Residential[2,3]	28.5	78,195	21,318	3.668	33,000	44.2	121,045
2300 Delaware[4]	0.5	1,463	-	-	-	0.5	1,463
Total	**29.1**	**79,658**	**21,318**	**-**	**33,000**	**44.7**	**122,508**

Notes:
1. Baseline annual water demands calculated from sub-metered water use data provided by Patrick Testoni by email on 8/9/18.
2. Projected water demands are scaled linearly based on increase in student and employee FTEs.
3. Non-residential includes the following categories from the 2040 LRDP Program: Classroom, Teaching Lab, Academic Student Support, Research, Offices, Library, Student Support/Health & Wellness, Athletics, Community Amenities, and Miscellaneous.
4. Demand at existing 2300 Delaware research building assumed to remain constant.

Housing:

Unit demand factors for student and employee housing are derived by dividing water-use by the number of beds or residents for each category. Employee housing assumes an average 2.43 beds per unit (1.43 dependents for each employee). As with the non-residential category, projections conservatively assume no reduction in unit demand for future conditions.

Table 5 - Housing Projections

STUDENT AND EMPLOYEE HOUSING							
	Baseline (FY 17/18)[1]			Demand Factor (gal/bed/day)	Projected 2040[2]		
Category	Annual Demand (MGY)	Ave. Daily Demand (gal/d)	Beds		Beds	Annual Demand (MGY)	Ave. Daily Demand (gal/d)
Student Housing	68.3	187,241	9,283	20.2	19,958	146.9	402,560
Employee Housing - Main Campus	6.8	18,672	656	28.5	1,621	16.8	46,145
Employee Housing - 2300 Delaware	-	-	-		486	5.0	13,831
Total	**75.2**	**205,913**	**9,939**	-	**22,065**	**168.8**	**462,535**

Notes:
1. Baseline annual water demands calculated from sub-metered water use data provided by Patrick Testoni by email on 8/9/18.
2. Projected water demands are scaled linearly based on increase in beds.

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Irrigation:

Irrigation demand projection methods vary by category and are based on program information as well as conversations with University about expected operational changes:

- Grounds irrigation is assumed to increase by 50% to accommodate the newly proposed colleges and academic infill (corresponding roughly to the ratio of future to existing FTE).
- Employee housing irrigation increases by the percent increase in total employee beds (221% increase),
- Farm and garden irrigation are assumed to increase by 25% assuming expansion facilities to new colleges.
- Arboretum irrigation is assumed to increase by 25% to allow for increasing post-drought irrigation.
- Athletic Fields (Recreation and Sand Field) are assumed to remain constant.
- Minor categories (Green House and “Non-Grounds” Landscape) are assumed to remain constant.

Table 6 - Irrigation Projections

	IRRIGATION					
		Baseline (FY 17/18)		**Projected 2040**		
	Category	**Annual Demand (MGY)[1]**	**Average Daily Demand (gal/d)**	**Increase in Irrigation Demand (%)**	**Annual Demand (MGY)**	**Average Daily Demand (gal/d)**
Grounds	Grounds Landscape[2]	16.0	43,937	50%	24.1	65,906
Grounds	Recreation Field	8.7	23,905	(None)	8.7	23,905
Grounds	Sand Field	4.7	12,798	(None)	4.7	12,798
Non-Grounds	Arboretum[3]	5.0	13,828	25%	6.3	17,285
Non-Grounds	Employee Irrigation	2.4	6,489	221%	7.6	20,839
Non-Grounds	Farm Irrigation[3]	4.6	12,502	25%	5.7	15,627
Non-Grounds	Garden[3]	1.6	4,376	25%	2.0	5,470
Non-Grounds	Green House	0.0	62	(None)	0.0	62
Non-Grounds	"Non-grounds" Landscape	0.4	1,226	(None)	0.4	1,226
	Subtotal "Grounds"	29.4	80,640		37.5	102,609
	Subtotal "Non-Grounds"	14.0	38,483		22.1	60,510
	Total	**43.5**	**119,123**		**59.5**	**163,118**

Notes:
1. Baseline demands are based on sub-metered water use data provided by Patrick Testoni by email on 8/9/18.
2. Grounds landscape projected increase is 50% based on proposed development of two new colleges.
3. Arboretum, Farm and Garden demands assumed to increase by 25% to allow for increased irrigation in post-drought years based on conversations with the University.

Mechanical:

Limited expansion of the existing central cooling system is anticipated, with approximately ten new buildings within the academic core proposed to connect to the system based on their proximity to the cooling tower loop and amount of excess cooling tower capacity. The anticipated increase in cooling tower make-up water demand is projected by linearly scaling the existing make-up water-use by the increase in building area to be served by the centralized cooling systems as, unlike other indoor water uses, spaces are cooled rather than individual occupants.

Table 7 - Mechanical Projections

MECHANICAL							
	Baseline (FY 17/18)			Projected 2040			
	Existing Building Area Served by Cooling Towers (sf)[2]	Annual Demand (MGY)[1]	Average Daily Demand (gal/d)	Future Building Area Served by Cooling Towers (sf)[2]	Increase in Area	Annual Demand (MGY)	Average Daily Demand (gal/d)
Mechanical	1,005,960	6.8	18,763	2,357,784	234%	16.1	43,977

Notes:
1. Baseline annual water demands calculated from sub-metered water use data provided by Patrick Testoni by email on 1/29/19.
2. Baseline and proposed square footage of buildings served by the central cooling towers is based on the 2020-2040 Long Range Development Plan (LRDP) Campus Cooling Water Master Plan by Stantec Consulting Services, Inc. (Draft, April 2020), provided by Zachary Teske via email on 6/22/2020.

2040 LRDP Water Demand Summary

The current and projected total annual water demand can be found in Table 8. The projected water demand for the 2040 planning horizon is 289.1 MGY, an 87% increase from the FY17/18 baseline water demand. Comparing the distribution of water demand on campus from Baseline (FY17/18) to 2040 by end-use (Figure 3), it is clear that the planned increase in on-campus housing (both student and employee) is a major driver the projected increase in water consumption by 2040.

It should be noted that these projections do not consider further increases in water-use efficiency and conservation. While options to increase building water-use efficiency should continue to be explored, the University has been highly proactive to-date and is already achieving efficient demand factors. In addition, the University plans to explore the development of non-potable water sources as a pathway to offset potable water-use as the campus grows.

Table 8 – Total Water Demand: Existing and 2040 Projection

DEMAND PROJECTION SUMMARY				
	Baseline (FY 17/18)		Projected 2040	
Category	Annual Demand (MGY)	Ave. Daily Demand (gal/d)	Annual Demand (MGY)	Ave. Daily Demand (gal/d)
Main Campus	154.0	421,994	283.5	776,827
2300 Delaware	0.5	1,463	5.6	15,294
Total	**154.6**	**423,457**	**289.1**	**792,121**

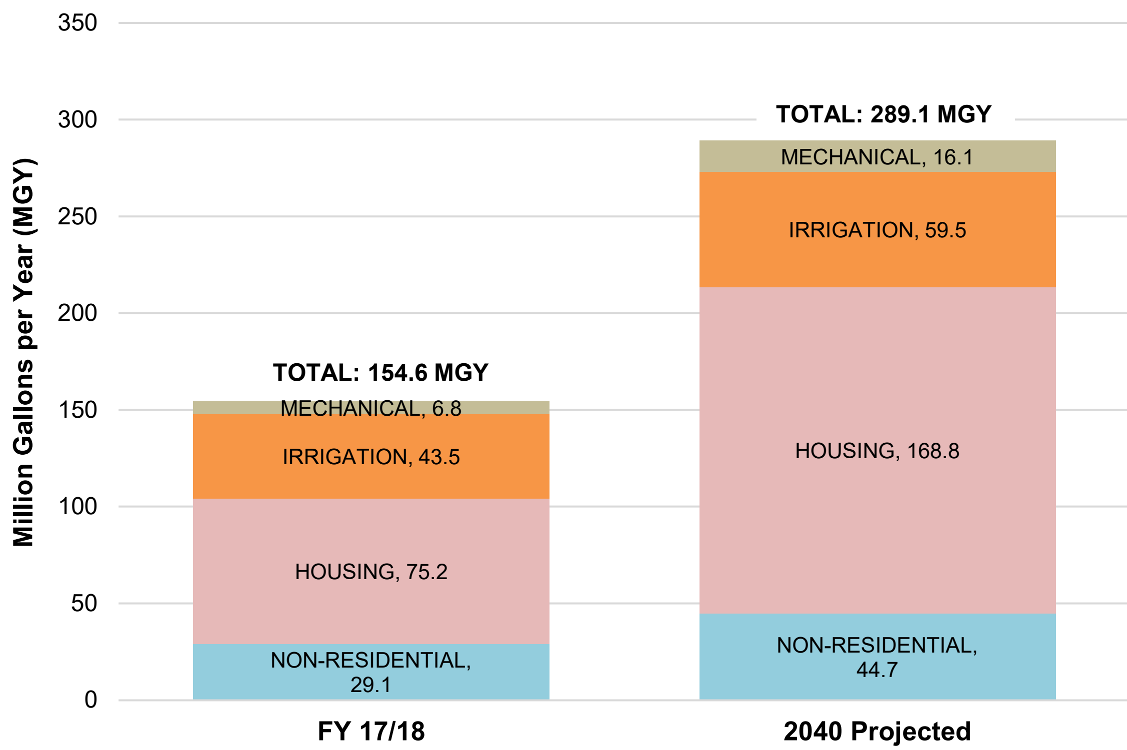


Figure 3 – Water-Use by Category, FY 17/18 and 2040

Appendix B

Water Use Efficiency at the University of California
City of Santa Cruz Information Report
May 2017

CITY OF SANTA CRUZ

INFORMATION REPORT

COUNCIL MEETING
MAY 23, 2017

DATE: May 2, 2017

TO: City Manager

DEPARTMENT: Water

SUBJECT: Water Use Efficiency at the University of California

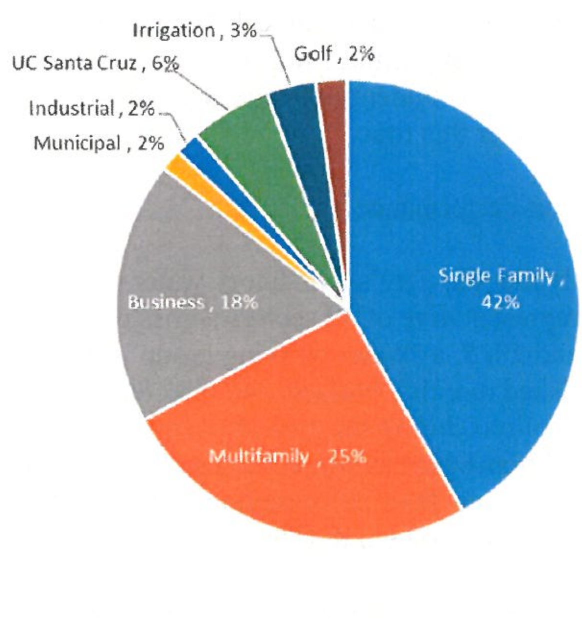
APPROVED: [signature] DATE: 5/8/17

On April 25, 2017, City Council addressed the subject of the next University Long Range Development Plan (LRDP). A few weeks before, Chancellor Blumenthal had announced that the planning process was just beginning and was inviting the community to provide its input. The next LRDP will serve as a blueprint for the future of UC Santa Cruz.

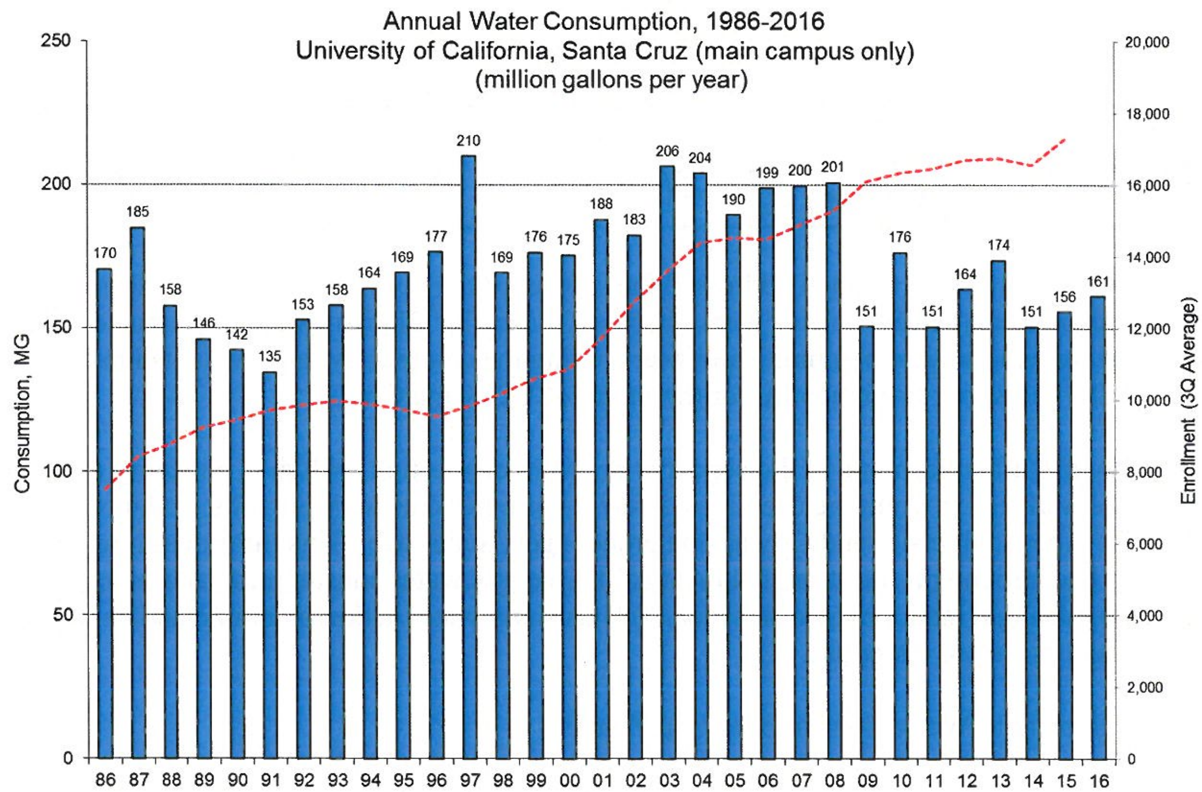
Water use has often been one of the concerns raised in connection with the University campus. Therefore, staff felt it would be useful to review the progress made through the collaborative efforts between University and City as this process gets under way. This information report provides background on four topics: 1) Annual University water consumption and trends, 2) University drought reduction performance, 3) University water action planning, and 4) Water Department projected water use.

Annual University Water Consumption and Trends

The chart below shows University water use in proportion to other City customer categories. It accounts for approximately six percent of the total annual consumption in any given year. This figure represents both the main campus as well as the Coastal Science Campus site on the west side of the City.



Annual water consumption on the main campus extending back to 1986 is illustrated in the chart below. Also shown is the change in student enrollment over this period. Note that despite a doubling in enrollment, annual water use remains relatively steady in the 30 years between 1986 and 2016. Stated another way, the amount of water use per enrolled student has declined during this period from about 60 gallons per student per day back in 1986 to about 25 gallons per student per day today.



One of the provisions of the 2008 Comprehensive Settlement Agreement was that the University would pay a fee equivalent to the City's system development charge for water used over 206 million gallons per year (mgy). This requirement to contribute funding has never been triggered since campus consumption has remained continuously below that threshold. A campus-wide efficiency survey, extensive plumbing fixtures retrofits, completion of all "high priority" conservation projects, and extensive student outreach and engagement have all helped in controlling campus water use over this time.

University Drought Reduction Performance

The campus has successfully met the City's mandatory water reduction goals because of close collaboration between the representative of all sectors across campus as well as with the Water Department. In both 2014 and 2015, a "water working group" led by the campus planning and sustainability offices established monthly budgets and directed efforts to reduce water use by 20 percent or about 20 million gallons during the peak dry season. Key to the success of this effort was an investment in new cellular-based meter reading technology that allowed individual building or facility managers to view their consumption on an hourly basis and quickly detect leaks. This technology will continue to help the University manage the campus' water use well into the future. A water conservation student intern team also helped communicate the conservation message to students and staff and helped identify and report leaks. For its efforts, the Santa Cruz campus established itself as a leader in water conservation and water efficiency among the University of California and other college campuses around the state.

University Water Action Planning

Consistent with state law that set a goal to reduce per capita water use by 20 percent in 2020, the UC Board of Regents in 2011 set a similar policy directing each campus to strive to reduce potable water consumption adjusted for campus population growth by 20 percent in 2020. To this end, the University in 2013 prepared a Water Action Plan that recognizes the limited nature of water resources in our region and the campus' role as a responsible steward in the community. The plan uses a "weighted campus user" baseline that normalizes for differences in water use between the number of on- and off-campus students, and full time vs part time students, faculty, and staff.

In 2016, the UC Office of the President adopted a more ambitious goal mirroring a 2015 Executive Order covering federal facilities. It calls for campuses to demonstrate leadership in the area of sustainable water systems by reducing potable water use 35 percent by 2025, as compared to a 2005 - 2008 baseline period, using the same weighted campus user approach. Some of the actions called out in the policy include:

- Converting potable water used for irrigation to recycled water,
- Implementing efficient irrigationsystems ,
- Drought tolerant plant selections,
- Phasing out unused turf, and
- Replacing single pass cooling systems or constant flow laboratory equipment

The campus is currently in the process of preparing this updated Water Action Plan that will address how it intends to meet this goal, and the actions included in that plan will extend through at least part of the time frame for the next LRDP.

Santa Cruz Water System 2015 – 2035 Projected Water Use

One of the first very requests made by the Water Supply Advisory Committee (WSAC) in 2014 was for the Water Department to update the system's demand forecast to reflect current information on water usage and to account for effects of conservation, water rates, and other factors expected to impact the future demand for water. Accordingly, the Water Department contracted with M.Cubed to develop two products: 1) an interim forecast to assist the early stages of the WSAC process, and 2) a separate, newly developed econometric demand forecast for the service area extending to the year 2035.

At the time of the University's last LRDP, its projected demand was estimated to be 349 million gallons per year (mgy). The 349 mgy figure was based in part on the 2005 LRDP, along with the Coastal Science Campus and Delaware Street facilities.

In developing the new long term demand forecast for the water system, an independent estimate of UCSC future demand was not made. Rather, after consulting with University staff, a decision was made to extend the University's previous forecast of 349 mgy in 2030 further out into the future to reflect a lower, more realistic rate of growth. Two endpoints were considered: a higher forecast ending with the full 349 mgy build out demand being achieved by 2035 and a lower forecast with the 349 mgy being achieved by 2050. The University demand forecast that was ultimately used for the econometric demand forecast, and later incorporated and adopted as part of the City's 2015 Urban Water Management Plan (UWMP), represents the mid-point between these two bounds.

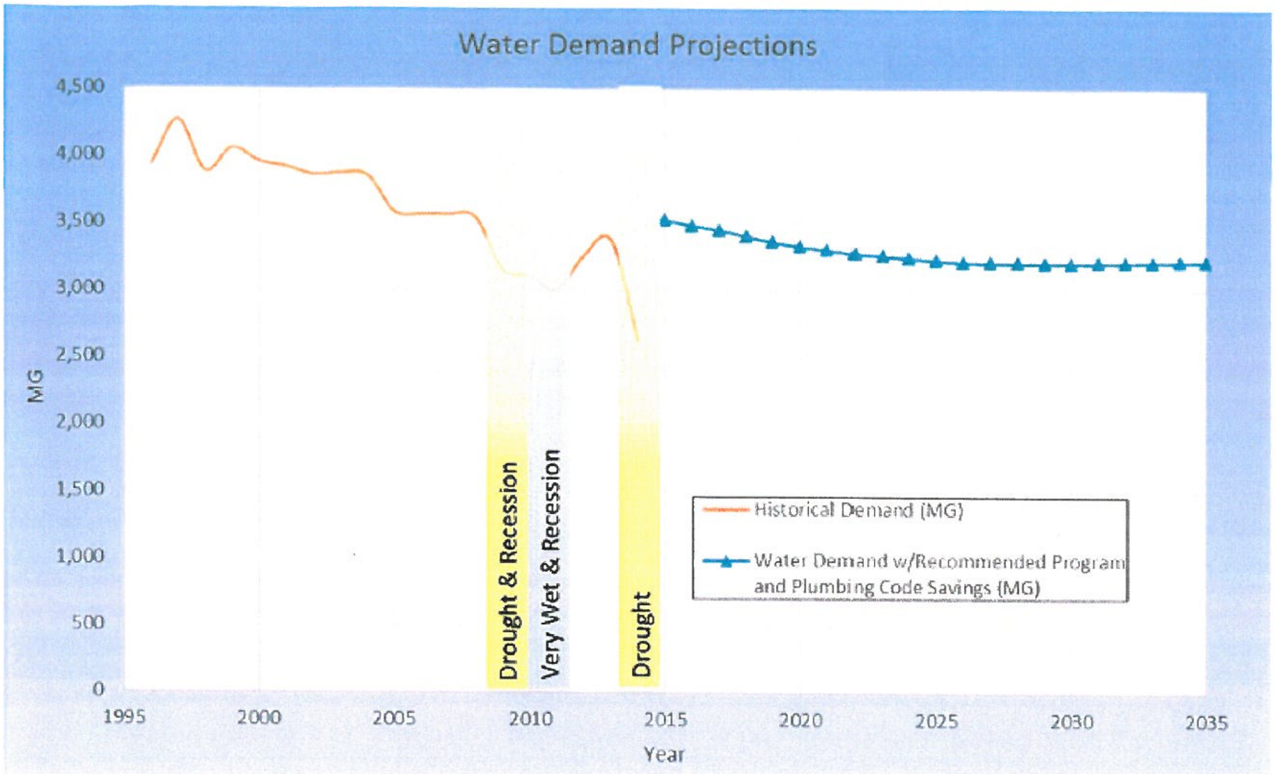
As seen in the table below taken from the 2015 UWMP, and accompanying chart, the Water Department is planning for a future in which the University water use is projected to reach 308 mgy in 2035. Even still, the overall trend in system-wide water use according to this forecast is one in which total water use is expected to decline between 2020 and 2025 and then stabilize at a level of about 3.2 billion gallons per year.

Table 4-3. Demands for Potable Water - Projected

Use Type	Additional Description	Projected Water Use (mgy)				
		2020	2025	2030	2035	2040-opt
Single Family	Individually metered dwellings	1,277	1,223	1,191	1,170	n/a
Multi-Family	2 or more dwelling units	772	714	690	678	n/a
Commercial		574	541	525	519	n/a
Industrial		56	59	60	61	n/a
Institutional/ Governmental	Municipal (city) accounts	46	42	40	40	n/a
Landscape	Dedicated Irrigation	112	119	134	144	n/a
Landscape	Golf Irrigation	58	52	47	47	n/a
Other	UC Santa Cruz	196	234	271	308	n/a
Water Losses		236	241	247	253	n/a
	TOTAL	3,327	3,225	3,205	3,220	n/a

NOTES: David Mitchell, M Cubed, October 2015, and by Maddaus Water Management, February 2016

While the next LRDP will raise legitimate concerns about the role the University plays in the community and how its plans for growth in enrollment may impact the community, it is clear that the University has a successful track record when it comes to keeping its share of the City's overall water use in check. One reason for the University's success is that many of the people that wrestle with this vital subject on a daily basis are also City residents or live within the water service area; they care about the surrounding community and share in its values for environmental stewardship and protection of our natural resources.



Staff will continue to work collaboratively with the University, in the spirit of the comprehensive settlement agreement, as the next LRPD process unfolds.

Submitted by:

Rosemary Menard

Rosemary Menard
Water Director