Appendix D1

TABLE D1-1
SPRING AND STREAM FLOW RATES AND GROUNDWATER ELEVATIONS
UCSC SPRING AND STREAM FLOW MONITORING

Location	BAY STREET SPRING	WEST LAKE OUTLET	MESSIAH LUTHERAN SPRING	KALKAR SPRING QUARRY	HIGH-LONGVIEW SPRING	WAGNER GROVE SEEP	HARVEY WEST SEEP	POGONIP CREEK SYSTEM	POGONIP SPRING #1	POGONIP SPRING #2	UPPER CAVE GULCH	LOWER CAVE GULCH	WILDER CREEK SPRING	MOORE CREEK SPRING	Total Q per date	MW-1A	MW-1B	WSW 1
(surface elev)	235 ft MSL	255 ft MSL	255 ft MSL	310 ft MSL	250 ft MSL	200 ft MSL	110 ft MSL (approx)	150 ft MSL	435 ft MSL	500 ft MSL	540 ft MSL	330 ft MSL	330 ft MSL	410 ft MSL (approx)		424.10 *(TOC, ft MSL)*	417.90 *(TOC, ft MSL)*	416.20 *(TOC, ft MSL)*
(flow rate) DATE	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*			
09/11/84	95	4	**	**	**	**	**	**	**	**	**	**	**	**	99	**	**	**
09/25/84	110	4	**	**	**	**	**	**	**	**	**	**	**	**	114	**	**	**
10/02/84	120	1	**	**	**	**	**	**	**	**	**	**	**	**	121	**	**	**
10/09/84	95	1	**	**	**	**	**	**	**	**	**	**	**	**	96	**	**	**
10/18/84	135	**	**	**	**	**	**	**	**	**	**	**	**	**	135	**	**	**
10/25/84	105	35	**	**	**	**	**	**	**	**	**	**	**	**	140	**	**	**
11/09/84	170	65	**	**	**	**	**	**	**	**	**	**	**	**	235	**	**	**
11/21/84	190	190	**	**	**	**	**	**	**	**	**	**	**	**	380	**	**	**
11/26/84	175	190	**	**	**	**	**	**	**	**	**	**	**	**	365	**	**	**
12/02/84	165	**	**	**	**	**	**	**	**	**	**	**	**	**	165	**	**	**
12/10/84	170	190	**	**	**	**	**	**	**	**	**	**	**	**	360	**	**	**
01/23/85	140	**	**	**	**	**	**	**	**	**	**	**	**	**	140	**	**	**
02/11/85	141	140	**	190	**	**	**	**	**	**	**	**	**	**	471	**	**	**
02/28/85	142	140	**	150	**	**	**	**	**	**	**	**	500	**	932	**	**	**
04/08/85	143	80	**	140	**	**	**	**	**	**	**	**	500	**	863	**	**	**
06/18/85	144	40	**	**	**	**	**	**	**	**	**	**	**	**	184	**	**	**
07/24/85	145	20	**	50	**	**	**	**	**	**	**	**	**	**	215	**	**	**
11/11/85	146	40	**	20	**	**	**	**	**	**	**	**	100	**	306	**	**	**
04/13/87	147	50	**	120	**	**	**	**	**	**	**	**	500	**	817	**	**	**
08/12/87	120	25	**	60	**	**	**	**	**	**	**	**	300	**	505	**	**	**
10/12/87	130	16	**	70	**	**	**	**	**	**	**	**	200	**	416	**	**	**
12/18/87	165	130	**	90	**	**	**	**	**	**	**	**	500	**	885	**	**	**
01/26/88	180	130	**	240	**	**	**	**	**	**	**	**	800	**	1350	**	**	**
03/09/88	155	50	**	170	**	**	**	**	**	**	**	**	400	**	775	**	**	**
06/15/88	130	13	**	85	**	**	**	**	**	**	**	**	270	**	498	**	**	**
09/26/88	120	1	**	50	**	**	**	**	**	**	**	**	60	**	231	**	**	**
11/13/88	118	**	**	20	**	**	**	**	**	**	**	**	**	**	138	**	**	**
12/06/88	116	**	**	71	**	**	**	**	**	**	**	**	**	**	187	**	**	**
12/30/88	155	**	**	45	**	**	**	**	**	**	**	**	**	**	200	**	**	**
01/07/89	147.7	**	**	**	**	**	**	**	**	**	**	**	**	**	147.7	**	**	**
01/11/89	137	**	**	**	**	**	**	**	**	**	**	**	**	**	137	**	**	**
01/13/89	**	**	**	**	**	**	**	**	**	**	**	**	**	**	0	319.92	**	321.02
01/17/89	**	**	58.4	**	40.6	**	**	**	**	**	**	**	**	**	99	**	**	**
01/18/89	134	53.3	**	**	38.7	**	**	**	**	**	**	**	**	**	226	**	**	**
01/29/89	**	65.3	**	**	**	**	**	161.6	**	**	**	**	161.6	**	388.5	**	**	**
02/02/89	**	**	51.4	**	43.4	**	**	**	**	**	**	**	**	**	94.8	**	**	**
02/03/89	146.2	62.8	**	89.8	**	**	**	**	**	**	**	**	**	**	298.8	**	**	**
02/11/89	133.9	58.4	61.4	98.7	54.1	**	**	170.5	**	**	**	**	193	**	770	**	**	**
02/12/89	132.4	58.3	59.1	103.2	42.9	**	**	193	**	**	**	**	197.5	**	786.4	**	**	**
02/13/89	132.7	53.3	57.6	98.7	52.1	**	**	197.5	**	**	**	**	**	**	591.9	319.6	**	319.86
02/14/89	129.6	43.1	56.2	103.2	46.3	**	**	197.5	**	**	**	**	193	**	768.9	**	**	**
02/15/89	129.9	44.6	56.5	112.2	47.4	**	**	193	**	**	**	**	179.5	**	763.1	**	**	**
02/16/89	128.3	47.8	54.8	103.2	39.1	**	**	188.5	**	**	**	**	197.5	**	759.2	**	**	**
02/17/89	133.7	49.9	56.1	94.2	34.5	**	**	193	**	**	**	**	166.1	**	727.5	**	**	**
02/18/89	140.9	58.1	79.4	125.7	48.5	**	**	233.4	**	**	**	**	152.6	**	838.6	**	**	**
02/19/89	131.4	57.9	58.4	107.7	24.4	**	**	224.4	**	**	**	**	179.5	**	783.7	**	**	**
02/20/89	134	43.6	55.8	98.7	12.6	**	**	206.5	**	**	**	**	215.4	**	766.6	**	**	**
02/21/89	132	48.2	52.3	103.2	17.3	**	**	**	**	**	**	**	**	**	353	318.88	**	317.2
02/22/89	128	43.6	53.1	103.2	9.2	**	**	**	**	**	**	**	**	**	337.1	**	**	**
02/23/89	127.3	30.1	53	98.7	20.8	**	**	193	**	**	**	**	139.1	**	662	**	**	**
02/24/89	131	43.3	53.3	94.2	13.2	**	**	**	**	**	**	**	**	**	335	**	**	**
02/25/89	131.7	36.4	53.1	107.7	11.9	**	**	**	**	**	**	**	**	**	340.8	**	**	**
02/26/89	127.1	37.5	53.7	107.7	37	**	**	**	**	**	**	**	**	**	363	**	**	**
02/27/89	**	**	**	**	18.6	**	**	**	**	**	**	**	**	**	18.6	**	**	**
02/28/89	**	**	**	**	30.1	**	**	**	**	**	**	**	**	**	30.1	**	**	**
03/04/89	130.1	43.6	67.9	125.7	**	**	**	224.4	**	**	**	**	857	**	1448.7	**	**	**
03/11/89	147.3	175.9	108.2	161.6	**	**	**	**	**	**	**	**	**	**	593	**	**	**
03/12/89	**	**	**	**	70.4	**	**	**	**	**	**	**	1207	**	1277.4	**	**	**
04/03/89	131.4	61.3	61	4 162	52	**	**	**	**	**	**	**	**	**	305.7	**	**	**
04/04/89	**	**	**	**	**	**	**	184	**	**	**	**	485	**	669	**	**	**
04/24/89	**	**	**	**	**	**	**	180	**	**	**	**	**	**	180	**	**	**
05/01/89	121.7	**	**	135	**	**	**	**	**	**	**	**	171	**	427.7	**	**	**
05/02/89	**	30.6	52.4	**	43.5	**	**	211	**	**	**	**	**	**	337.5	**	**	**
05/06/89	**	**	**	**	**	**	**	**	7.8	21.6	**	**	**	**	29.4	**	**	**
06/04/89	**	**	**	**	**	**	**	**	**	**	**	**	103	**	103	**	**	**
06/05/89	121.2	22.5	22.5	4 148	17.5	**	**	**	**	**	**	**	**	**	183.7	**	**	**
06/06/89	**	**	**	**	**	**	**	189	**	**	**	**	**	**	189	**	**	**
06/07/89	**	**	**	**	**	**	**	**	5	17.7	**	**	**	**	22.7	**	**	**
06/23/89	**	**	45.6	81	**	**	**	**	**	**	**	**	108	**	234.6	**	**	**
06/26/89	**	**	**	**	**	**	**	**	3.5	9.4	**	**	**	**	12.9	**	**	**
07/10/89	115.7	5.8	**	85	17.7	**	**	162	**	**	**	**	81	**	467.2	**	**	**
07/11/89	**	**	44.7	**	**	**	**	**	2.8	16.8	**	**	**	**	64.3	**	**	**
07/20/89	**	**	**	**	**	**	**	**	3	6	**	**	**	**	9	**	**	**
08/11/89	114.5	**	**	85	**	**	**	**	**	**	**	**	**	**	199.5	**	**	**
08/12/89	**	**	**	**	**	**	**	**	3	**	**	**	**	**	3	**	**	**
08/18/89	118.8	4.7	48	81	32.1	**	**	175	**	**	**	**	63	**	522.6	**	**	**
10/04/89	123.6	1.1	43.7	67.5	1.9	**	**	**	**	**	**	**	**	**	237.8	**	**	**
11/01/89	143.4	27.8	57.7	94.5	**	**	**	**	**	**	**	**	**	**	323.4	**	**	**
11/22/89	139.8	35.8	51.4	53.5	**	**	**	**	**	**	**	**	**	**	280.5	**	**	**
01/03/90	138.3	42.9	50.4	33.3	**	**	**	**	**	**	**	**	**	**	264.9	**	**	**
01/29/90	140.4	48	52.1	42.5	**	**	**	**	**	**	**	**	**	**	283	**	**	**
02/23/90	147.1	43.3	58.7	48.8	**	**	**	**	**	**	**	**	**	**	297.9	**	**	**
04/04/90	135.4	17.8	47	31.7	**	**	**	**	**	**	**	**	**	**	231.9	**	**	**
04/20/90	130.7	14.2	39.2	26.9	**	**	**	**	**	**	**	**	**	**	211	**	**	**
05/12/90	131.7	**	26	17.3	**	**	**	**	**	**	**	**	**	**	175	**	**	**
05/20/90	**	4.3	**	**	**	**	**	**	**	**	**	**	**	**	4.3	**	**	**
06/02/90	121	40.9	52.7	15.5	**	**	**	**	**	**	**	**	**	**	230.1	**	**	**
06/08/90	124	21.1	39.5	23.6	**	**	**	**	**	**	**	**	**	**	208.2	**	**	**
07/05/90	130.7	0	36	**	**	**	**	**	**	**	**	**	**	**	166.7	312.07	367.83	**
07/20/90	129	0	33	5	**	**	**	**	**	**	**	**	**	**	167	312.07	367.52	**
08/12/90	124	0	38	0	**	**	**	**	**	**	**	**	**	**	162	**	**	**
09/05/90	109.1	0	3.6	0	0.75	0	0	137	13.5	2.22	**	5	40.4	**	311.57	311.04	367.29	**
09/28/90	103.8	0	29.2	0	**	**	**	113.1	**	**	**	**	28.7	**	274.8	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	**	315.78	310.08	367.18	**
10/29/90	101.1	0	27.6	0	**	**	**	132.6	**	**	**	**	19.3	**	280.6	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	**	300.9	309.35	366.98	322.2
11/28/90	107.9	0	28.63	0	**	**	**	147.8	**	**	**	**	14.6	**	298.93	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	**	331.33	308.8	366.84	323.099
01/03/91	127.5	0	33	0	**	**	**	157.5	**	**	**	**	20.7	**	338.7	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	**	341.93	308.34	366.56	322.175
01/31/91	113.1	0	31	0	**	**	**	167.7	**	**	**	**	24.6	**	336.4	308.13	366.43	321.251
02/07/91	120.2	**	**	0	**	**	**	**	**	**	**	**	**	**	120.2	**	**	**
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	**	376.18	308.45	366.24	321.251
02/26/91	114.6	0	34.4	0	**	**	**	149.9	**	**	**	**	23.7	**	322.6	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	**	683.93	310.74	366.12	323.792
03/30/91	165	151.1	82.7	87.3	15	**	**	183.4	**	**	**	**	945.3	**	1629.8	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	**	776.7	316.13	367.33	328.874
05/08/91	127	53	47.5	70.8	18.5	**	**	147	**	**	**	**	124.3	**	588.1	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	**	546.5	315.19	367.38	327.95
06/05/91	121.2	30.7	44	45.2	**	**	**	154.2	**	**	**	**	86.1	**	481.4	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	**	476.89	314.27	367.45	327.257
07/05/91	118.1	8.96	39.1	38.6	**	**	**	156.8	**	**	**	**	93.1	**	454.66	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	**	438.25	313.29	367.575	326.102
08/12/91	112.1	0	34.77	32.69	**	**	**	114.5	**	**	**	**	58.3	**	352.36	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	**	362.594	312.41	367.6	325.409
09/05/91	105.5	0	33.79	2.3	**	**	**	150.8	**	**	**	**	33.52	**	325.91	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	**	353.373	311.76	367.55	324.023
10/09/91	107.3	0	32.34	0	0	**	**	131.2	**	**	**	**	26.14	**	296.98	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	**	354.137	310.875	367.35	323.792
11/08/91	109.3	0	37.25	0	0	**	**	150	**	**	**	**	30.03	**	326.58	310.83	367.25	323.792

TABLE D1-1
SPRING AND STREAM FLOW RATES AND GROUNDWATER ELEVATIONS
UCSC SPRING AND STREAM FLOW MONITORING

Location	BAY STREET SPRING	WEST LAKE OUTLET	MESSIAH LUTHERAN SPRING	KALKAR SPRING QUARRY	HIGH-LONGVIEW SPRING	WAGNER GROVE SEEP	HARVEY WEST SEEP	POGONIP CREEK SYSTEM	POGONIP SPRING #1	POGONIP SPRING #2	UPPER CAVE GULCH	LOWER CAVE GULCH	WILDER CREEK SPRING	MOORE CREEK SPRING	Total Q per date	MW-1A	MW-1B	WSW 1
(surface elev)	235 ft MSL	255 ft MSL	255 ft MSL	310 ft MSL	250 ft MSL	200 ft MSL	110 ft MSL (approx)	150 ft MSL	435 ft MSL	500 ft MSL	540 ft MSL	330 ft MSL	330 ft MSL	410 ft MSL (approx)		424.10 *(TOC, ft MSL)*	417.90 *(TOC, ft MSL)*	416.20 *(TOC, ft MSL)*
(flow rate)	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*			
DATE																		
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	**	375.485	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	**	360.759	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	**	693.279	311.56	366.86	324.023
01/14/92	144.8	93.86	62.88	21.38	11.82	**	**	152.9	**	**	**	**	187.8	**	675.44	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	**	508.526	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	**	4600.46	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	**	2147.86	323.55	368.12	335.111
04/28/92	118.3	86.82	60.7	214.8	116	**	**	160.7	**	**	**	**	218.7	**	976.02	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	**	952.782	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	**	684.789	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	**	634.612	320.4	369.81	334.187
07/25/92	78.27	40.35	7.765	121.1	Discontinued	**	**	146.8	**	**	**	5.731	77.23	**	477.246	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	**	**	411.182	318.4	369.56	333.956
08/28/92	81.59	33.82	47.45	83.2	Discontinued	**	**	143.4	**	**	**	**	**	**	389.46	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	**	**	**	387.725	316.7	369.37	333.032
09/28/92	72	32.56	40.53	81.76	Discontinued	**	**	138.5	2.9	2.73	1	**	**	**	371.98	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	**	397.293	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	**	843.854	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	**	3497.32	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	**	850.455	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	2895.33	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	722.921	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	2693.83	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	525.49	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	2123.65	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	608.22	*>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	4844.59	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	1015.7	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		2849.36	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	1610.54	327.43	370.35	330.26
01/07/00	**	**	**	**	Discontinued	**	**	**** 294.87	**	**	**	**	**		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	3463.63	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	1094.51	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	1431.14	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	503.86	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	1017.91	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	558.65	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	1579.31	328.46	359.68	*****
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	602.61	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	1653.94	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	528.11	319.30	369.06	*****

Statistical Analysis	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	*gpm*	**Total Q** *gpm*	*ft MSL*	*ft MSL*	*ft MSL*
Average	122.70	57.68	49.08	115.50	23.05	6.63	11.54	196.61	24.78	9.16	27.98	36.98	318.42	6.49	1006.61	317.96	366.98	327.21
Std Dev (average only)	24.67	73.45	18.75	180.69	23.17	43.02	32.99	102.66	26.74	12.75	67.07	64.81	452.15	7.62	80.75	8.31	7.18	8.56
Maximum	192.30	350.00	129.00	1370.40	116.00	298.30	172.20	719.58	132.50	64.61	379.27	247.78	3040.62	29.20	NA	344.90	373.90	369.12
Minimum	61.12	0	3.6	0	0	0	0	80.27	2.8	1.23	0	1.9	14.2	0.5	NA	308.13	321.12	311.78
Same Day Maximum (4/13/98)	116.00	287.19	73.33	1370.40	Discontinued	7.80	13.80	646.87	96.67	49.80	379.27	247.78	1526.48	29.20	4844.59	NA	NA	NA
Same Day Minimum (9/28/90)******	103.8	0	29.2	0	**	**	**	113.1	**	**	**	**	28.7	**	274.80	NA	NA	NA
June-October Average	107.18	17.92	37.83	68.74	7.02	0.00	2.45	181.71	15.03	5.03	4.21	9.33	122.10	4.17	582.72	316.57	368.27	326.70
Annual Flow	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	*acre-feet/year*	**Total Q** *acre-feet/year*	*NA*	*NA*	*NA*
Average	197.96	93.05	79.18	186.33	37.19	10.70	18.61	317.18	39.98	14.78	45.13	59.67	513.71	10.48	1623.96	NA	NA	NA

Notes:

* = Solinst groundwater level meter was not long enough to reach groundwater.
** = Not measured this monitoring period.
*** = Flow rate incorrect (calculation/field measurement error)
**** = Corrected flow rate measurement due to error in previous round of measurement or calculations
***** = Air line used to measure pressure head is clogged. Unable to record a PSI measurement, therefore no groundwater elevation recorded.
****** = Data prior to 9/90 not used. Monitoring of 7 additional offsite springs began 9/2/90, with 1 more on 10/15/90 and 1 more on 3/30/95. Data from 2/7/91 and 1/7/00 not used because only 1 spring was monitored.
gpm = gallons per minute.
ft MSL = Feet above Mean Sea Level
TOC = Top of Casing elevation
NA = Not Applicable
Q = Discharge Flow

TABLE D1-2
UCSC Water Quality Monitoring Results & Statistical Analysis
Water Supply Well #1

Analysis	Analytical Results***														Statistical Analysis***				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	8.3	7.5	7.3	7.2	7.5	7.1	6.9	7.4	7.4	7.3	7.4	7.2	7.6	7.3	7.3857	8.3000	6.9000	0.3183			7.0 - 8.5		
Conductivity (micromhos/cm)	440	420	425	430	420	440	440	440	410	420	390	420	410	440	424.6429	440.0000	390.0000	14.9954			750		
Carbonate Alk. (as CaCO3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)	190	180	185	175	180	190	180	185	180	180	185	190	190	190	184.2857	190.0000	175.0000	5.1355					
Total Alkalinity (as CaCO3)	190	180	185	175	180	190	180	185	180	180	185	190	190	190	184.2857	190.0000	175.0000	5.1355					200
Total Hardness (as CaCO3)	200	200	205	205	210	210	200	200	205	200	190	110	200	230	197.5000	230.0000	110.0000	26.7287					
Total Dissolved Solids	280	315	275	305	300	320	310	300	290	270	280	290	270	290	292.5000	320.0000	270.0000	16.3789			250		
Nitrate (as NO3)	6.6	11	12	12	11	14	13	13	12	12	12	11	9.3	9.6	11.3214	14.0000	6.6000	1.8556			5*		10
Chloride (Cl)	20	16	13	15	14	14	14	14	12	12	16	16	15	15	14.7143	20.0000	12.0000	2.0164			30	860	230
Sulfate (SO4)	27	17	17	18	17	16	17	16	15	15	20	18	18	18	17.7857	27.0000	15.0000	2.9659			60		
Flouride (F)	0.22	0.2	0.12	0.12	0.05	0.1	0.1	0.1	0.16	0.4	0.16	0.14	0.10	0.11	0.1486	0.4000	0.0500	0.0848			1.0		
Calcium (Ca)	70	66	71	72	73	74	70	71	72	70	66	29	69	80	68.0714	80.0000	29.0000	11.7569					
Magnesium (Mg)	7.1	8.3	6.2	6.5	6.2	6.4	5.4	5.4	6.2	6.2	5.9	9.4	6.5	7.1	6.6286	9.4000	5.4000	1.0845					
Potassium (K)	2.6	1.1	1.2	0.8	1.3	1.3	1.2	1.2	1.3	1.3	1.4	7.5	1.2	1.5	1.7786	7.5000	0.8000	1.6940					
Sodium (Na)	18	13	13	13	13	13	13	7.5	13	12	12	23	12	13	13.4643	23.0000	7.5000	3.4556			25		
Total Iron (Fe)	0.27	0.41	0.17	0.025	0.025	0.13	0.13	0.055	0.36	0.46	0.14	1.4	0.15	0.085	0.2721	1.4000	0.0250	0.3532					0.300
Manganese (Mn)	0.08	0.06	0.0075	0.015	0.015	0.0075	0.02	0.0075	0.026	0.03	0.0075	0.06	0.01	0.01	0.0254	0.0800	0.0075	0.0239					
Arsenic (As)	0.018	0.018	0.0025	0.018	0.001	0.015	0.016	0.018	0.013	0.014	0.017	0.014	0.013	0.012	0.0135	0.0180	0.0010	0.0054	0.34	0.15		0.34	0.15
Barium (Ba)	0.05	0.18	0.31	0.2	0.12	0.22	0.22	0.05	0.19	0.22	0.17	0.05	0.22	0.24	0.1743	0.3100	0.0500	0.0791					
Boron (B)	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.24	0.05	0.05	0.0618	0.2400	0.0250	0.0517			0.2		
Cadmium (Cd)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.00475	0.00241		0.00475	0.00241
Chromium (Cr III)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0018	0.0016	0.0045	0.0050	0.0016	0.0012	0.59376	0.19246		0.59376	0.19246
Copper (Cu)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0250	0.0250	0.0250	0.0000	0.0147	0.0097	0.050	0.0147	0.0097
Cyanide (CN)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.025	0.025	0.025	0.025	0.025	NA	0.0158	0.0250	0.0100	0.0076	0.022	0.0052		0.022	0.0052
Lead (Pb)	0.011	0.035	0.027	0.0025	0.0025	0.0025	0.0025	0.0025	0.009	0.009	0.0025	0.0059	0.0025	0.0025	0.0084	0.0350	0.0025	0.0102	0.0729	0.00284	0.05	0.0729	0.00284
Mercury (Hg)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0002	0.0005	0.0001	0.0002				0.0014	0.0007
Selenium (Se)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000		0.005			0.005
Silver (Ag)	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0038	0.0050	0.0025	0.0013	0.00406			0.00406	
Zinc (Zn)	0.06	0.84	0.09	<0.05	<0.05	0.08	0.06	0.08	0.13	0.09	0.08	0.08	<0.05	0.055	0.1495	0.8400	0.0550	0.2299	0.127	0.128		0.127	0.128
MBAS (Surfactants)	0.1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0125	0.0125	0.0168	0.1000	0.0100	0.0240			0.2		
Aluminum (Al)	0.5	0.25	0.21	0.5	0.12	0.5	0.5	0.5	0.25	0.11	0.025	0.052	0.025	0.025	0.2548	0.5000	0.0250	0.2041			5.0	0.750	0.087
Antimony (sb)	NR	NR	NR	NR	NR	0.003	0.003	0.0085	0.006	0.006	0.003	0.003	0.003	0.003	0.0043	0.0085	0.0030	0.0020					
Beryllium (Be)	NR	NR	NR	NR	NR	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000			0.1		
Nickel (Ni)	NR	NR	NR	NR	NR	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0050	0.0050	0.0050	0.0000	0.508	0.056		0.508	0.056
Thallium (Tl)	NR	NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0010	0.0005	0.0003					
Nitrite (as NO2)	NR	NR	NR	NR	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.2500	0.2500	0.2500	0.0000			5		
Temperature	NR	NR	NR	NR	NR	--	--	--	--	--	--	--	--	--	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)	1.5	1.5	1.5	1.5	1.5	4	1.5	1.5	1.5	90	1.5	1.5	1.5	1.5	8.0000	90.0000	1.5000	23.6106			15	15	
Odor (Threshold Number)	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.6429	2.0000	0.5000	0.4127					
Turbidity (NTU)	10	14	4.8	1.9	6.6	5.1	2.0	0.75	6.5	30	1.2	3.1	1.9	1.4	6.3750	30.0000	0.7500	7.7791	5				
Petroleum Hydrocarbons (ppm)****	0.1	0.175	0.175	0.3	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	--	0.1788	0.3000	0.1000	0.0419			10**	0.1***	

NOTES:

All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise

The highlighted columns are the columns for which the analytical results of WSW1 are compared against

Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set

[1] 40 CFR Part 131, Water Quality Standards; Establishement of Numeric Criteria for Priority Toxic Pollutants for the State of Californoa; Rule [mg/L]

[2] Central Coast Regional Water Quality Control Board Basin Plan Water Quality Objectives; Rule [mg/L]

[3] US EPA National Recommended Water Quality Criteria; Rule [mg/L]

[4] "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects

[5] "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects

NR = Not Recorded

NA = Not Analyzed; insufficient sample for analysis

-- Not Analyzed during this sampling event

* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops

** The CRWQCB Central Coast Region guidance value of <10 ppm for oil and grease, or <10,000 parts per billion (ppb)

*** Value extracted from the Narrative Statement presented in the Red Book (EPA440/9-76-023, July, 1976) on "Oil and Grease" as harmful to aquatic animals

*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values

**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis

TABLE D1-3

UCSC Water Quality Monitoring Results & Statistical Analysis

Elfland Spring

Analysis	Analytical Results***														Statistical Analysis***				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	6.6	7.1	6.4	6	6	6.2	6.2	6.3	6.2	7.6	7.3	6.1	7.6	7.3	**6.6357**	7.6000	6.0000	0.6071			**7.0 - 8.5**		
Conductivity (micromhos/cm)	170	260	230	150	190	105	155	165	150	205	160	155	170	170	173.9286	260.0000	105.0000	37.9361			**750**		
Carbonate Alk. (as CaCO3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)	31	34	24	21	36	21	31	31	33	28	33	33	38	34	30.5714	38.0000	21.0000	5.2582					
Total Alkalinity (as CaCO3)	31	34	24	21	36	21	31	31	33	28	33	33	38	34	30.5714	38.0000	21.0000	5.2582					**200**
Total Hardness (as CaCO3)	67	44	57	46	58	29	37	38	38	58	44	38	41	50	46.0714	67.0000	29.0000	10.6009					
Total Dissolved Solids	106	170	150	99	125	65	95	105	90	130	100	100	110	110	111.0714	170.0000	65.0000	26.0487			**250**		
Nitrate (as NO3)	0.5	1.3	4.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8357	4.4000	0.5000	1.0478			**5***		**10**
Chloride (Cl)	30	26	45	21	25	14	25	25	23	34	29	28	25	26	26.8571	45.0000	14.0000	6.9377			**30**	**860**	**230**
Sulfate (SO4)	13	10	13	18	28	7	6.2	6.9	6.5	10	13	7.1	7.2	7.4	10.9500	28.0000	6.2000	6.0171			**60**		
Flouride (F)	0.11	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.05	0.26	0.05	0.05	0.05	0.05	0.0800	0.2600	0.0500	0.0572			**1.0**		
Calcium (Ca)	21	10	15	13	17	8	11	11	10.1	16	12	10	11	13	12.7214	21.0000	8.0000	3.4677					
Magnesium (Mg)	3.5	4.7	4.8	3.5	4	2.3	2.5	2.7	3.3	4.3	3.6	3.4	3.3	4.2	3.5786	4.8000	2.3000	0.7648					
Potassium (K)	1.1	0.9	1.2	1.5	0.8	1.6	1	0.9	0.99	1.3	1.4	1.2	1.1	2	1.2136	2.0000	0.8000	0.3260					
Sodium (Na)	30	16	22	13	17	10	16	9.5	16	18	14	17	16	17	16.5357	30.0000	9.5000	5.0095			**25**		
Total Iron (Fe)	0.1	0.78	1.9	0.85	0.6	0.14	0.18	0.19	0.23	0.29	0.31	0.2	0.19	6.7	**0.9043**	6.7000	0.1000	1.7354					**0.300**
Manganese (Mn)	0.015	0.04	0.12	0.12	0.04	0.0075	0.016	0.0075	0.0075	0.015	0.0075	0.005	0.01	0.2	0.0436	0.2000	0.0050	0.0597					
Arsenic (As)	0.005	0.005	0.0025	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.001	0.0042	0.0021	0.0050	0.0010	0.0016	**0.34**	**0.15**		**0.34**	**0.15**
Barium (Ba)	0.05	0.05	0.16	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0579	0.1600	0.0500	0.0294					
Boron (B)	0.05	0.025	0.05	0.05	0.05	0.05	0.31	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0668	0.3100	0.0250	0.0703			**0.2**		
Cadmium (Cd)	0.0005	0.0005	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0005	0.0001	0.00106	0.00085		0.00106	0.00085
Chromium (Cr)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0005	0.007	0.0048	0.0070	0.0005	0.0014	0.19926	0.06459		0.19926	0.06459
Copper (Cu)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0250	0.0250	0.0250	0.0000	0.0042	0.0031	**0.050**	0.0042	0.0031
Cyanide (CN)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.025	0.025	0.025	0.025	0.025	0.025	0.0164	0.0250	0.0100	0.0077	**0.022**	**0.0052**		**0.022**	**0.0052**
Lead (Pb)	0.005	0.0025	0.011	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	**0.0033**	0.0110	0.0025	0.0023	0.0134	0.00052	**0.05**	0.0134	0.00052
Mercury (Hg)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0002	0.0005	0.0001	0.0002				**0.0014**	**0.0007**
Selenium (Se)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000		**0.005**			**0.005**
Silver (Ag)	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.0025	0.0025	0.007	0.005	0.005	0.005	**0.0039**	0.0070	0.0025	0.0015	0.00041			0.00041	
Zinc (Zn)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0250	0.0250	0.0250	0.0000	0.041	0.041		0.041	0.041
MBAS (Surfactants)	0.05	0.01	0.025	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0125	0.0125	0.0143	0.0500	0.0100	0.0110			**0.2**		
Aluminum (Al)	0.25	0.25	1.59	1	0.56	0.05	0.05	0.05	0.25	0.05	0.09	0.19	0.025	2.5	0.4932	2.5000	0.0250	0.7300			**5.0**	**0.750**	**0.087**
Antimony (sb)	NR	NR	NR	NR	NR	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.0030	0.0030	0.0030	0.0000					
Beryllium (Be)	NR	NR	NR	NR	NR	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000			**0.1**		
Nickel (Ni)	NR	NR	NR	NR	NR	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0050	0.0050	0.0050	0.0000	0.164	0.018		0.164	0.018
Thallium (Tl)	NR	NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0010	0.0005	0.0003					
Nitrite (as NO2)	NR	NR	NR	NR	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.2500	0.2500	0.2500	0.0000			**5**		
Temperature	NR	NR	NR	NR	NR	–	–	–	–	–	–	–	–	–	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)	9	40	88	150	130	150	7	15	1.5	60	25	12	12	17	**51.1786**	150.0000	1.5000	55.2851			**15**	**15**	
Odor (Threshold Number)	0.5	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5714	1.0000	0.5000	0.1816					
Turbidity (NTU)	12	11	390	225	105	21	2.4	4.5	2	4.5	2.5	13	10	38	**60.0643**	390.0000	2.0000	112.9048	**5**				
Petroleum Hydrocarbons (ppm)**	0.175	1.2	0.175	0.3	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	–	**0.2635**	1.2000	0.1750	0.2835			**10****	**0.1*****	

NOTES:

All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise

The highlighted columns are the columns for which the analytical results of WSW1 are compared against

Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set

[1] 40 CFR Part 131, Water Quality Standards; Establishement of Numeric Criteria for Priority Toxic Pollutants for the State of Californoa; Rule [mg/L]

[2] Central Coast Regional Water Quality Control Board Basin Plan Water Quality Objectives; Rule [mg/L]

[3] US EPA National Recommended Water Quality Criteria; Rule [mg/L]

[4] "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects

[5] "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects

NR = Not Recorded

NA = Not Analyzed; insufficient sample for analysis

-- Not Analyzed during this sampling event

* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops

** The CRWQCB Central Coast Region guidance value of <10 ppm for oil and grease, or <10,000 parts per billion (ppb)

*** Value extracted from the Narrative Statement presented in the Red Book (EPA440/9-76-023, July, 1976) on "Oil and Grease" as harmful to aquatic animals

*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values

**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis

TABLE D1-4

UCSC Water Quality Monitoring Results & Statistical Analysis

College 9/10 Spring

Analysis	Analytical Results***														Statistical Analysis***				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	No Analysis for 1989-90	6.1	6.1	6	6.6	6.4	6.8	6.8	6.9	6.3	6.8	6.6	6.3	6.6	6.4846	6.9000	6.0000	0.3051			7.0 - 8.5		
Conductivity (micromhos/cm)		290	260	130	170	140	140	235	210	210	180	210	180	190	195.7692	290.0000	130.0000	47.3395			750		
Carbonate Alk. (as CaCO3)		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)		38	35	21	26	32	38	38	39	18	26	36	35	38	32.3077	39.0000	18.0000	7.1576					
Total Alkalinity (as CaCO3)		38	35	21	26	32	38	38	39	18	26	36	35	38	32.3077	39.0000	18.0000	7.1576					200
Total Hardness (as CaCO3)		100	75	36	56	44	38	58	59	59	51	59	51	56	57.0769	100.0000	36.0000	16.4086					
Total Dissolved Solids		190	170	88	110	90	90	150	150	140	120	140	120	120	129.0769	190.0000	88.0000	31.4284			250		
Nitrate (as NO3)		0.9	2.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	0.5	0.5	0.7615	2.5000	0.5000	0.5966			5*		10
Chloride (Cl)		32	31	21	26	18	18	35	29	32	33	36	27	26	28.0000	36.0000	18.0000	6.0415			30	860	230
Sulfate (SO4)		40	39	11	14	8.5	4.5	19	18	18	21	19	16	13	18.5385	40.0000	4.5000	10.4032			60		
Flouride (F)		0.2	0.05	0.05	0.05	0.1	0.1	0.1	0.11	0.26	0.05	0.05	0.05	0.05	0.0938	0.2600	0.0500	0.0663			1.0		
Calcium (Ca)		25	20	10	16	13	12	15	14	14	12	14	12	14	14.6923	25.0000	10.0000	3.9240					
Magnesium (Mg)		9.2	5.9	2.7	4	3	2	5.1	5.7	5.8	5.3	5.9	5	5.2	4.9846	9.2000	2.0000	1.8216					
Potassium (K)		1.9	2.3	1.3	3.3	1.5	1	1.7	1.8	1.9	2	3.3	1.7	2.9	2.0462	3.3000	1.0000	0.7207					
Sodium (Na)		16	20	11	14	12	14	15	20	18	15	20	16	19	16.1538	20.0000	11.0000	3.0509			25		
Total Iron (Fe)		1.3	0.33	1.65	0.88	1.15	0.57	0.19	0.3	1.2	0.43	0.71	4.9	0.78	1.1069	4.9000	0.1900	1.2209					0.300
Manganese (Mn)		0.27	0.06	0.015	0.13	0.035	0.03	0.0075	0.02	0.11	0.022	0.02	0.16	0.038	0.0706	0.2700	0.0075	0.0772					
Arsenic (As)		0.005	0.0025	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0038	0.001	0.0016	0.0050	0.0010	0.0013	0.34	0.15		0.34	0.15
Barium (Ba)		0.05	0.16	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0585	0.1600	0.0500	0.0305					
Boron (B)		0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0481	0.0500	0.0250	0.0069			0.2		
Cadmium (Cd)		0.0005	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0005	0.0001	0.00135	0.00100		0.00135	0.00100
Chromium (Cr)		0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0037	0.001	0.0046	0.0050	0.0010	0.0011	0.23786	0.07710		0.23786	0.07710
Copper (Cu)		0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0250	0.0250	0.0250	0.0000	0.0051	0.0037	0.050	0.0051	0.0037
Cyanide (CN)		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.025	0.025	0.025	0.025	0.025	0.025	0.0169	0.0250	0.0100	0.0078	0.022	0.0052		0.022	0.0052
Lead (Pb)		0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000	0.0176	0.00069	0.05	0.0176	0.00069
Mercury (Hg)		0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0002	0.0005	0.0001	0.0002				0.0014	0.0007
Selenium (Se)		0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000		0.005			0.005
Silver (Ag)		0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0038	0.0050	0.0025	0.0013	0.00060			0.00060	
Zinc (Zn)		0.025	0.025	0.025	0.025	0.025	0.053	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0272	0.0530	0.0250	0.0078	0.049	0.050		0.049	0.050
MBAS (Surfactants)		0.01	0.025	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0125	0.0125	0.0115	0.0250	0.0100	0.0042			0.2		
Aluminum (Al)		0.5	0.61	0.7	2.1	0.05	0.05	0.05	0.25	0.16	0.2	0.16	1.5	0.11	0.4954	2.1000	0.0500	0.6295			5.0	0.750	0.087
Antimony (sb)		NR	NR	NR	NR	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.0030	0.0030	0.0030	0.0000					
Beryllium (Be)		NR	NR	NR	NR	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000			0.1		
Nickel (Ni)		NR	NR	NR	NR	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0050	0.0050	0.0050	0.0000	0.197	0.022		0.197	0.022
Thallium (Tl)		NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0010	0.0005	0.0003					
Nitrite (as NO2)		NR	NR	NR	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.2500	0.2500	0.2500	0.0000			5		
Temperature		NR	NR	NR	NR	--	--	--	--	--	--	--	--	--	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)		9	45	150	70	120	20	20	7	45	25	50	13	24	46.0000	150.0000	7.0000	43.9147			15	15	
Odor (Threshold Number)		0.5	1	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	3	0.5	0.5	0.8462	3.0000	0.5000	0.7742					
Turbidity (NTU)		4.2	18	29	68	26	4.0	4	2.4	1.9	2.5	2.7	12	4.9	13.8154	68.0000	1.9000	18.7624	5				
Petroleum Hydrocarbons (ppm)**		0.4	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	--	0.1938	0.4000	0.1750	0.0650			10**	0.1***	

NOTES:

All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise

The highlighted columns are the columns for which the analytical results of WSW1 are compared against

Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set

[1] 40 CFR Part 131, Water Quality Standards; Establishement of Numeric Criteria for Priority Toxic Pollutants for the State of Califonoa; Rule [mg/L]

[2] Central Coast Regional Water Quality Control Board Basin Plan Water Quality Objectives; Rule [mg/L]

[3] US EPA National Recommended Water Quality Criteria; Rule [mg/L]

[4] "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects

[5] "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects

NR = Not Recorded

NA = Not Analyzed; insufficient sample for analysis

-- Not Analyzed during this sampling event

* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops

** The CRWQCB Central Coast Region guidance value of <10 ppm for oil and grease, or <10,000 parts per billion (ppb)

*** Value extracted from the Narrative Statement presented in the Red Book (EPA440/9-76-023, July, 1976) on "Oil and Grease" as harmful to aquatic animals

*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values

**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis

TABLE D1-5

UCSC Water Quality Monitoring Results & Statistical Analysis

Environmental Preserve Spring

Analysis	Analytical Results***														Statistical Analysis***				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	No Analysis for 1989-90	6.2	6.4	6.1	6.5	7.1	6.9	6.3	6.3	6.4	6.3	6.2	6.3	6.3	6.4077	7.1000	6.1000	0.2842			7.0 - 8.5		
Conductivity (micromhos/cm)		530	145	100	145	150	145	220	250	220	160	190	250	230	210.3846	530.0000	100.0000	107.0331			750		
Carbonate Alk. (as CaCO3)		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)		66	15	13	14	22	30	23	25	30	19	24	30	35	26.6154	66.0000	13.0000	13.6537					
Total Alkalinity (as CaCO3)		66	15	13	14	22	30	23	25	30	19	24	30	35	26.6154	66.0000	13.0000	13.6537					200
Total Hardness (as CaCO3)		205	31	25	38	38	79	44	61	52	40	43	59	60	59.6154	205.0000	25.0000	46.0336					
Total Dissolved Solids		350	94	67	94	95	100	140	170	140	100	125	160	150	137.3077	350.0000	67.0000	70.9558			250		
Nitrate (as NO3)		0.87	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5285	0.8700	0.5000	0.1026			5*		10
Chloride (Cl)		57	20	20	27	24	24	38	34	34	31	35	40	36	32.3077	57.0000	20.0000	9.9949			30	860	230
Sulfate (SO4)		110	15	7.9	12	13	6.6	16	37	19	19	20	30	23	25.2692	110.0000	6.6000	26.8002			60		
Flouride (F)		0.13	0.05	0.05	0.05	0.1	0.1	0.1	0.05	0.28	0.05	0.05	0.05	0.05	0.0854	0.2800	0.0500	0.0649			1.0		
Calcium (Ca)		52	7	6.3	9.5	9	24	11	13	11	8.6	9.3	12	13	14.2846	52.0000	6.3000	12.1509					
Magnesium (Mg)		18	3.1	2.4	3.5	4	4.8	4.2	6.9	5.8	4.5	5	7	6.7	5.8385	18.0000	2.4000	3.9322					
Potassium (K)		2.4	1.6	1.7	2.4	2	2.1	2.3	2.1	2	2	2.1	1.8	3	2.1154	3.0000	1.6000	0.3602					
Sodium (Na)		32	15	10	15	14	15	16	26	21	15	22	24	26	19.3077	32.0000	10.0000	6.3428			25		
Total Iron (Fe)		0.61	0.61	0.53	0.76	0.45	4.3	0.36	1.1	0.79	0.4	1.6	1.3	25	2.9085	25.0000	0.3600	6.7188					0.300
Manganese (Mn)		0.09	0.015	0.015	0.02	0.0075	0.2	0.0075	0.043	0.015	0.016	0.05	0.028	0.04	0.0421	0.2000	0.0075	0.0526					
Arsenic (As)		0.005	0.0025	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0014	0.0050	0.0010	0.0012	0.34	0.15		0.34	0.15
Barium (Ba)		0.05	0.05	0.05	0.05	0.05	0.31	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0700	0.3100	0.0500	0.0721					
Boron (B)		0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0481	0.0500	0.0250	0.0069			0.2		
Cadmium (Cd)		0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.00089	0.00075		0.00089	0.00075
Chromium (Cr)		0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0013	0.0036	0.0046	0.0050	0.0013	0.0011	0.17645	0.05719		0.17645	0.05719
Copper (Cu)		0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0250	0.0250	0.0250	0.0000	0.0036	0.0027	0.050	0.0036	0.0027
Cyanide (CN)		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.025	0.025	0.025	0.025	0.025	0.025	0.0169	0.0250	0.0100	0.0078	0.022	0.0052		0.022	0.0052
Lead (Pb)		0.0025	0.0025	0.0025	0.0025	0.0025	0.0088	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0030	0.0088	0.0025	0.0017	0.0111	0.00043	0.05	0.0111	0.00043
Mercury (Hg)		0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0002	0.0005	0.0001	0.0002				0.0014	0.0007
Selenium (Se)		0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000		0.005			0.005
Silver (Ag)		0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0038	0.0050	0.0025	0.0013	0.00032			0.00032	
Zinc (Zn)		0.06	0.06	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0304	0.0600	0.0250	0.0131	0.036	0.036		0.036	0.036
MBAS (Surfactants)		0.01	0.025	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0125	0.0125	0.0115	0.0250	0.0100	0.0042			0.2		
Aluminum (Al)		0.25	1.17	0.7	0.49	0.61	1.8	0.05	0.25	0.13	0.37	0.16	0.23	1.7	0.6085	1.8000	0.0500	0.5879			5.0	0.750	0.087
Antimony (sb)		NR	NR	NR	NR	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.0030	0.0030	0.0030	0.0000					
Beryllium (Be)		NR	NR	NR	NR	0.0005	0.0038	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0009	0.0038	0.0005	0.0011			0.1		
Nickel (Ni)		NR	NR	NR	NR	0.005	0.049	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0099	0.0490	0.0050	0.0147	0.145	0.016		0.145	0.016
Thallium (Tl)		NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0010	0.0005	0.0003					
Nitrite (as NO2)		NR	NR	NR	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.2500	0.2500	0.2500	0.0000			5		
Temperature		NR	NR	NR	NR	–	–	–	–	–	–	–	–	–	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)		22	125	250	170	110	45	75	30	80	45	40	55	72	86.0769	250.0000	22.0000	64.5968			15	15	
Odor (Threshold Number)		0.5	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	5	0.5	0.5	0.9615	5.0000	0.5000	1.2823					
Turbidity (NTU)		4.7	81	40	98	14	2000.0	2.6	6.4	5.3	3.4	19	15	3.1	176.3462	2000.0000	2.6000	548.8163	5				
Petroleum Hydrocarbons (ppm)****		0.175	0.175	0.2	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	–	0.1771	0.2000	0.1750	0.0072			10**	0.1***	

NOTES:

All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise

The highlighted columns are the columns for which the analytical results of WSW1 are compared against

Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set

[1] 40 CFR Part 131, Water Quality Standards; Establishement of Numeric Criteria for Priority Toxic Pollutants for the State of Californoa; Rule [mg/L]

[2] Central Coast Regional Water Quality Control Board Basin Plan Water Quality Objectives; Rule [mg/L]

[3] US EPA National Recommended Water Quality Criteria; Rule [mg/L]

[4] "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects

[5] "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects

NR = Not Recorded

NA = Not Analyzed; insufficient sample for analysis

-- Not Analyzed during this sampling event

* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops

** The CRWQCB Central Coast Region guidance value of <10 ppm for oil and grease, or <10,000 parts per billion (ppb)

*** Value extracted from the Narrative Statement presented in the Red Book (EPA440/9-76-023, July, 1976) on "Oil and Grease" as harmful to aquatic animals

*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values

**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis

TABLE D1-6
UCSC Water Quality Monitoring Results & Statistical Analysis
Environmental Preserve Gully

Analysis	Analytical Results***														Statistical Analysis***				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	No Analysis for 1989-90	6.1	6.6	6.5	6.5	6.5	6.7	7.05	7.3	3.7	6.7	7.0	6.3	7.1	6.4654	7.3000	3.7000	0.8975			7.0 - 8.5		
Conductivity (micromhos/cm)		330	200	125	160	150	120	220	180	210	160	300	180	190	194.2308	330.0000	120.0000	61.6389			750		
Carbonate Alk. (as CaCO3)		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)		19	19	14	17	20	22	29	34	0	21	44	26	28	22.5385	44.0000	0.0000	10.4930					
Total Alkalinity (as CaCO3)		19	19	14	17	20	22	29	34	0	21	44	26	28	22.5385	44.0000	0.0000	10.4930					200
Total Hardness (as CaCO3)		100	50	32	45	39	23	49	44	54	39	94	44	52	51.1538	100.0000	23.0000	22.0448					
Total Dissolved Solids		210	130	85	105	95	73	140	120	140	100	200	120	120	126.0000	210.0000	73.0000	40.4310			250		
Total Suspended Solids		--	--	--	--	--	--	--	--	--	--	--	--	5.4	5.4000	5.4000	5.4000	#DIV/0!					
Nitrate (as NO3)		0.05	2.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.7	0.5	0.5	0.7038	2.4000	0.0500	0.6267			5*		10
Chloride (Cl)		35	22	21	26	24	19	34	24	31	28	39	20	23	26.6154	39.0000	19.0000	6.3316			30	860	230
Sulfate (SO4)		84	33	12	18	13	5.9	19	14	17	21	44	29	26	25.8385	84.0000	5.9000	20.1612			60		
Flouride (F)		0.18	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.26	0.05	0.12	0.05	0.05	0.0969	0.2600	0.0500	0.0628			1.0		
Calcium (Ca)		22	12	8.2	11.5	10	7	13	11	13	9.4	23	11	13	12.6231	23.0000	7.0000	4.7557					
Magnesium (Mg)		12	4.9	2.9	4	3.5	1.5	4.2	4.2	5.3	4	9	4.0	4.7	4.9385	12.0000	1.5000	2.7131					
Potassium (K)		2.8	1.8	1.4	2	2	1.1	2	1.7	2	2	5.7	1.4	2.1	2.1538	5.7000	1.1000	1.1435					
Sodium (Na)		23	18	12	15	15	14	16	19	20	14	24	17	18	17.3077	24.0000	12.0000	3.5446			25		
Total Iron (Fe)		0.025	0.44	0.86	0.97	0.27	0.11	0.25	0.2	0.97	0.3	1.9	0.17	0.77	0.5565	1.9000	0.0250	0.5243					0.300
Manganese (Mn)		0.015	0.0075	0.015	0.05	0.02505	0.0075	0.0075	0.0075	0.06	0.0075	0.13	0.025	0.075	0.0333	0.1300	0.0075	0.0368					
Arsenic (As)		0.05	0.0025	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0049	0.0500	0.0010	0.0136	0.34	0.15		0.34	0.15
Barium (Ba)		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0500	0.0500	0.0500	0.0000					
Boron (B)		0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0481	0.0500	0.0250	0.0069			0.2		
Cadmium (Cd)		0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.00081	0.00071		0.00081	0.00071
Chromium (Cr)		0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0005	0.0013	0.0044	0.0050	0.0005	0.0015	0.16480	0.05342		0.16480	0.05342
Copper (Cu)		0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0250	0.0250	0.0250	0.0000	0.0034	0.0026	0.050	0.0034	0.0026
Cyanide (CN)		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.025	0.025	0.025	0.025	0.025	0.025	0.0169	0.0250	0.0100	0.0078	0.022	0.0052		0.022	0.0052
Lead (Pb)		0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000	0.0099	0.00039	0.05	0.0099	0.00039
Mercury (Hg)		0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0002	0.0005	0.0001	0.0002				0.0014	0.0007
Selenium (Se)		0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.01	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0031	0.0100	0.0025	0.0021		0.005			0.005
Silver (Ag)		0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0037	0.0050	0.0025	0.0013	0.00028			0.00028	
Zinc (Zn)		0.0025	0.06	0.0025	0.0025	0.0025	0.0025	0.0005	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0068	0.0600	0.0005	0.0160	0.034	0.034		0.034	0.034
MBAS (Surfactants)		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0125	0.0125	0.0104	0.0125	0.0100	0.0009			0.2		
Aluminum (Al)		0.25	0.77	1.2	0.71	0.05	0.05	0.05	0.25	0.051	0.2	0.25	0.025	0.28	0.3182	1.2000	0.0250	0.3580			5.0	0.750	0.087
Antimony (sb)		NR	NR	NR	NR	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.0030	0.0030	0.0030	0.0000					
Beryllium (Be)		NR	NR	NR	NR	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000			0.1		
Nickel (Ni)		NR	NR	NR	NR	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0050	0.0050	0.0050	0.0000	0.135	0.015		0.135	0.015
Thallium (Tl)		NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0010	0.0005	0.0003					
Nitrite (as NO2)		NR	NR	NR	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.2500	0.2500	0.2500	0.0000			5		
Temperature		NR	NR	NR	NR	--	--	--	--	--	--	--	--	--	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)		8	125	175	100	125	18	55	40	100	40	90	13	24	70.2308	175.0000	8.0000	52.6089			15	15	
Odor (Threshold Number)		0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	3	0.5	0.5	0.7308	3.0000	0.5000	0.6957					
Turbidity (NTU)		1.3	77	29	94	13	3.4	2.6	2.6	10	2.4	2.8	2.4	6.0	18.9615	94.0000	1.3000	30.6636	5				
Petroleum Hydrocarbons (ppm)****		0.175	1	0.2	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	--	0.2458	1.0000	0.1750	0.2376			10**	0.1***	

NOTES:
All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise
The highlighted columns are the columns for which the analytical results of WSW1 are compared against
Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set
[1] 40 CFR Part 131, Water Quality Standards;
[2] Central Coast Regional Water Quality
[3] US EPA National Recommended Water
[4] "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects
[5] "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects
NR = Not Recorded
NA = Not Analyzed; insufficient sample for analysis
-- Not Analyzed during this sampling event
* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops
guidance value of <10 ppm for oil and grease,
Statement presented in the Red Book
*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values
**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis

TABLE D1-7

UCSC Water Quality Monitoring Results & Statistical Analysis

Moore Creek

Analysis	Analytical Results***														Statistical Analysis***				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	7.3	7.2	7	6.5	7.1	7	6.6	7.1	7	6.9	7.2	7.0	7.3	7.4	7.0429	7.4000	6.5000	0.2533			7.0 - 8.5		
Conductivity (micromhos/cm)	370	355	345	185	120	310	335	305	350	340	310	370	400	400	321.0714	400.0000	120.0000	78.3527			750		
Carbonate Alk. (as CaCO3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)	86	115	98	58	30	105	85	87	110	97	100	110	110	110	92.9286	115.0000	30.0000	23.5616					
Total Alkalinity (as CaCO3)	86	115	98	58	30	105	85	87	110	97	100	110	110	110	92.9286	115.0000	30.0000	23.5616					200
Total Hardness (as CaCO3)	130	135	120	76	42	125	125	105	160	140	120	105	150	190	123.0714	190.0000	42.0000	35.6402					
Total Dissolved Solids	240	240	225	135	79	205	230	200	250	220	200	240	260	260	213.1429	260.0000	79.0000	50.3050			250		
Total Suspended Solids	–	–	–	–	–	–	–	–	–	–	–	–	–	220	220.0000	220.0000	220.0000	#DIV/0!					
Nitrate (as NO3)	0.5	1.8	2.6	0.5	3.1	1	0.5	1.3	1.1	0.5	0.5	1.7	0.5	1.6	1.2286	3.1000	0.5000	0.8471			5*		10
Chloride (Cl)	26	26	27	15	12	20	25	23	20	20	24	31	28	26	23.0714	31.0000	12.0000	5.1808			30	860	230
Sulfate (SO4)	50	30	28	13	9.2	21	45	26	41	43	41	44	59	49	35.6571	59.0000	9.2000	14.6985			60		
Flouride (F)	0.2	0.21	0.05	0.05	0.05	0.1	0.1	0.1	0.17	0.42	0.05	0.12	0.05	0.11	0.1271	0.4200	0.0500	0.1008			1.0		
Calcium (Ca)	46	44	40	26	14	42	43	37	54	46	40	30	49	60	40.7857	60.0000	14.0000	11.6036					
Magnesium (Mg)	4.3	6.2	5.2	2.8	1.9	4.5	4.2	3.5	6.1	5.6	5	7.4	6.2	10.0	5.2071	10.0000	1.9000	2.0140					
Potassium (K)	5	1.1	1	1.5	3.3	1	1.6	1.3	2.7	1.9	1.7	5.9	2.1	6.9	2.6429	6.9000	1.0000	1.9302					
Sodium (Na)	23	20	21	10	8	17	21	12	21	20	18	20	23	22	18.2857	23.0000	8.0000	4.8426			25		
Total Iron (Fe)	2.2	0.92	2.4	0.6	2.4	1.4	14.7	1.6	18	8.1	0.39	1.2	3.8	69	**9.0507**	69.0000	0.3900	18.0980					0.300
Manganese (Mn)	0.1	0.16	0.12	0.035	0.71	0.11	0.22	0.1	0.61	0.26	0.03	0.12	0.2	0.4	0.2268	0.7100	0.0300	0.2077					
Arsenic (As)	0.005	0.005	0.0025	0.001	0.001	0.001	0.105	0.016	0.007	0.046	0.005	0.016	0.022	0.2	0.0309	0.2000	0.0010	0.0561	0.34	0.15		0.34	0.15
Barium (Ba)	0.05	0.05	0.12	0.05	0.05	0.05	0.19	<0.1	0.35	0.19	0.05	0.05	0.15	0.76	0.1623	0.7600	0.0500	0.2009					
Boron (B)	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.23	0.05	0.05	0.05	0.23	0.05	0.21	0.0854	0.2300	0.0250	0.0752			0.2		
Cadmium (Cd)	0.0005	0.0005	0.0016	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0018	0.0007	0.0018	0.0005	0.0004	0.00160	0.00113		0.00160	0.00113
Chromium (Cr)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0035	0.1	0.0117	0.1000	0.0035	0.0254	0.26987	0.08747		0.26987	0.08747
Copper (Cu)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0250	0.0250	0.0250	0.0000	0.0059	0.0043	0.050	0.0059	0.0043
Cyanide (CN)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.025	0.025	0.025	0.025	0.025	0.025	0.0164	0.0250	0.0100	0.0077	0.022	0.0052		0.022	0.0052
Lead (Pb)	0.005	0.0025	0.013	0.0025	0.011	0.0025	0.00275	0.0025	0.0025	0.005	0.005	0.0025	0.0051	0.33	**0.0280**	0.3300	0.0025	0.0870	0.0214	0.00083	0.05	0.0214	0.00083
Mercury (Hg)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	0.0005	0.00029	0.00094	0.0003	0.0009	0.0001	0.0003				0.0014	0.0007
Selenium (Se)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000		0.005			0.005
Silver (Ag)	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0038	0.0050	0.0025	0.0013	0.00078			0.00078	
Zinc (Zn)	0.025	0.025	0.025	0.025	0.08	0.025	0.025	0.025	0.062	0.025	0.025	0.025	0.025	0.24	0.0469	0.2400	0.0250	0.0581	0.056	0.057		0.056	0.057
MBAS (Surfactants)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0125	0.0125	0.0104	0.0125	0.0100	0.0009			0.2		
Aluminum (Al)	0.6	0.25	0.5	0.4	0.71	0.05	0.05	0.05	1.7	0.25	0.25	0.1	3.7	69	**5.5436**	69.0000	0.0500	18.2900			5.0	0.750	0.087
Antimony (sb)	NR	NR	NR	NR	NR	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.0030	0.0030	0.0030	0.0000					
Beryllium (Be)	NR	NR	NR	NR	NR	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.0006	0.0010	0.0005	0.0002			0.1		
Nickel (Ni)	NR	NR	NR	NR	NR	0.005	0.005	0.005	0.02	0.005	0.005	0.005	0.005	0.005	0.0067	0.0200	0.0050	0.0050	0.225	0.025		0.225	0.025
Thallium (Tl)	NR	NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0010	0.0005	0.0003					
Nitrite (as NO2)	NR	NR	NR	NR	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.2500	0.2500	0.2500	0.0000			5		
Temperature	NR	NR	NR	NR	NR	–	–	–	–	–	–	–	–	–	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)	40	28	45	150	130	50	15	100	35	30	8	10	7	30	**48.4286**	150.0000	7.0000	45.5204			15	15	
Odor (Threshold Number)	0.5	0.5	0.5	0.5	1	0.5	0.5	2	0.5	3	0.5	2	0.5	0.5	0.9286	3.0000	0.5000	0.8052					
Turbidity (NTU)	31	6.3	20	100	81	45	41	9	16	6.3	1.4	23	7.8	230.0	**44.1286**	230.0000	1.4000	60.9373	5				
Petroleum Hydrocarbons (ppm)**	0.175	0.175	0.175	0.2	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	–	**0.1769**	0.2000	0.1750	0.0069			10**	0.1***	

NOTES:

All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise

The highlighted columns are the columns for which the analytical results of WSW1 are compared against

Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set

1 40 CFR Part 131, Water Quality Standards; Establishement of Numeric Criteria for Priority Toxic Pollutants for the State of Californoa; Rule [mg/L]

2 Central Coast Regional Water Quality Control Board Basin Plan Water Quality Objectives; Rule [mg/L]

3 US EPA National Recommended Water Quality Criteria; Rule [mg/L]

4 "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects

5 "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects

NR = Not Recorded

NA = Not Analyzed; insufficient sample for analysis

-- Not Analyzed during this sampling event

* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops

** The CRWQCB Central Coast Region guidance value of <10 ppm for oil and grease, or <10,000 parts per billion (ppb)

*** Value extracted from the Narrative Statement presented in the Red Book (EPA440/9-76-023, July, 1976) on "Oil and Grease" as harmful to aquatic animals

*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values

**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis

TABLE D1-8
UCSC Water Quality Monitoring Results & Statistical Analysis
Faculty Housing Parking Lot Runoff

Analysis	Analytical Results*****															Statistical Analysis*****				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999 (1st event)	1998-1999 (2nd event)	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	5.4	6	6.2	6.6	6.5	5.7	6.6	7.1	6.3	6.7	6	6.3	6.8	6.1	6.8	6.3400	7.1000	5.4000	0.4548			7.0 - 8.5		
Conductivity (micromhos/cm)	20	41	35	41	25	16	28	545	46	34	28	24	98	150	140	84.7333	545.0000	16.0000	134.2484			750		
Carbonate Alk. (as CaCO3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)	2.2	6	9	<5	2	3	9	245	5	9	6	6	19	17	35	26.6571	245.0000	2.0000	63.4553					
Total Alkalinity (as CaCO3)	2.2	6	9	<5	2	3	9	245	5	9	6	6	19	17	35	26.6571	245.0000	2.0000	63.4553					200
Total Hardness (as CaCO3)	4.9	11	7	7	8	5.5	10	250	12	11	12	6	28	35	45	30.1600	250.0000	4.9000	61.9746					
Total Dissolved Solids	12.8	27	23	41	15	10	18	380	34	22	18	15	65	99	91	58.0533	380.0000	10.0000	93.3867			250		
Total Suspended Solids	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1740	1740.0000	1740.0000	1740.0000	#DIV/0!					
Nitrate (as NO3)	2.8	2.1	2.9	0.5	0.5	0.5	1.1	0.5	0.5	0.5	0.5	0.5	1.9	2.5	1.5	1.2533	2.9000	0.5000	0.9418			5*		10
Chloride (Cl)	2.5	3.6	4.2	9.1	2.7	2.8	1.5	27	5.8	2.7	2.7	4.3	13	12	11	6.9933	27.0000	1.5000	6.7249			30	860	230
Sulfate (SO4)	5	4.9	5.3	4.9	1	1	1.8	7.7	2.3	2.4	2.2	1	12	29	10	6.0333	29.0000	1.0000	7.1789			60		
Flouride (F)	0.05	0.26	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.05	0.13	0.05	0.25	0.28	0.05	0.1113	0.2800	0.0500	0.0832			1.0		
Calcium (Ca)	1.5	3.3	5	1.3	2.6	2.5	2.5	79	2.5	3.7	0	2.5	6.6	8.9	14	9.0600	79.0000	0.0000	19.6647					
Magnesium (Mg)	0.29	0.9	0.5	0.5	0.6	0.5	0.5	13	0.5	0.62	0	0.5	2.7	3.1	2.4	1.7740	13.0000	0.0000	3.2469					
Potassium (K)	0.82	1	0.25	0.7	0.5	0.25	0.5	22	0.5	0.96	1.3	0.6	7.6	6.8	5.4	3.2787	22.0000	0.2500	5.7441					
Sodium (Na)	1.5	2.1	4	6	2	2.5	2.5	21	2.5	3.2	0	2.5	6.1	8.9	8.1	4.8600	21.0000	0.0000	5.1174			25		
Total Iron (Fe)	0.28	0.3	0.11	0.13	0.26	0.21	0.07	10.5	0.07	0.68	0.45	0.3	0.37	0.88	0.61	1.0147	10.5000	0.0700	2.6344					0.300
Manganese (Mn)	0.03	0.015	0.015	0.02	0.02	0.0075	0.0075	1.2	0.0075	0.056	0.09	0.016	0.19	0.24	0.099	0.1342	1.2000	0.0075	0.3032					
Arsenic (As)	0.005	0.005	0.025	0.001	0.001	0.001	0.001	0.011	0.0025	0.001	0.001	0.003	0.0027	0.001	0.0024	0.0042	0.0250	0.0010	0.0063	0.34	0.15		0.34	0.15
Barium (Ba)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.24	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0627	0.2400	0.0500	0.0491					
Boron (B)	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.19	0.05	–	0.05	0.05	0.05	0.17	0.05	0.0668	0.1900	0.0250	0.0486			0.2		
Cadmium (Cd)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.00014	0.00021		0.00014	0.00021
Chromium (Cr)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0022	0.0048	0.0050	0.0022	0.0007	0.04645	0.01506		0.04645	0.01506
Copper (Cu)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.05	0.025	0.025	0.025	0.025	0.025	0.0267	0.0500	0.0250	0.0065	0.0008	0.0007	0.050	0.0008	0.0007
Cyanide (CN)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.055	0.01	0.025	0.025	0.025	0.025	0.025	0.025	0.0190	0.0550	0.0100	0.0124	0.022	0.0052		0.022	0.0052
Lead (Pb)	0.02	0.0025	0.014	0.0025	0.0025	0.0025	0.0025	0.045	0.0025	0.029	0.017	0.0025	0.015	0.011	0.0025	0.0114	0.0450	0.0025	0.0125	0.0014	0.00005	0.05	0.0014	0.00005
Mercury (Hg)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0002	0.0005	0.0001	0.0002				0.0014	0.0007
Selenium (Se)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000		0.005			0.005
Silver (Ag)	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0038	0.0050	0.0025	0.0013	0.00002			0.00002	
Zinc (Zn)	0.08	0.14	0.17	0.025	0.025	0.025	0.18	0.41	0.07	0.14	0.06	0.025	0.27	0.12	0.35	0.1393	0.4100	0.0250	0.1209	0.009	0.009		0.009	0.009
MBAS (Surfactants)	0.12	0.03	0.025	0.02	0.03	0.02	0.035	0.6	0.2	0.2	0.28	0.01	0.05	0.14	0.84	0.1733	0.8400	0.0100	0.2412			0.2		
Aluminum (Al)	<0.5	0.5	0.2	0.05	0.16	0.05	0.05	0.05	0.05	0.54	0.32	0.38	0.49	0.62	0.21	0.2621	0.6200	0.0500	0.2100			5.0	0.750	0.087
Antimony (sb)	NR	NR	NR	NR	NR	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.0030	0.0030	0.0030	0.0000					
Beryllium (Be)	NR	NR	NR	NR	NR	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000			0.1		
Nickel (Ni)	NR	NR	NR	NR	NR	0.005	0.005	0.027	0.005	0.005	0.01	0.01	0.005	0.005	0.005	0.0082	0.0270	0.0050	0.0069	0.037	0.004		0.037	0.004
Thallium (Tl)	NR	NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0008	0.0010	0.0005	0.0003					
Nitrite (as NO2)	NR	NR	NR	NR	NR	0.25	0.25	0.25	0.25	0.5	0.25	0.25	0.25	0.25	0.25	0.2750	0.5000	0.2500	0.0791			5		
Temperature	NR	NR	NR	NR	NR	–	–	–	–	–	–	–	–	–	–	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)	20	50	12	1.5	35	50	25	850	30	60	40	85	80	55	120	100.9000	850.0000	1.5000	209.4779			15	15	
Odor (Threshold Number)	0.5	0.5	0.5	0.5	2	0.5	1	25	1	0.5	0.5	0.5	0.5	0.5	0.5	2.3000	25.0000	0.5000	6.2929					
Turbidity (NTU)	23	24	18	1.6	15	18	13	92	7.4	58	43	23	18	20	47.0	28.0667	92.0000	1.6000	23.1875	5				
Petroleum Hydrocarbons (ppm) ****@**	1.5	0.2	0.175 ******	0.2	0.6	0.175 ******	0.34 ***	0.175 ******	0.175 ******	0.092 ***	0.674 ***	0.516 ***	1.83 ***	1.24 ****	0.175 ******	0.5378	1.8300	0.0920	0.5501			10**	0.1^	

NOTES:

CRITERIA VALUES ARE NOT REQUIRED TO BE MET FOR PARKING LOT RUNOFF. VALUES ARE LISTED FOR COMPARISON PURPOSES ONLY.

All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise

The highlighted columns are the columns for which the analytical results of WSW1 are compared against

Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set

[1] 40 CFR Part 131, Water Quality Standards; Establishement of Numeric Criteria for Priority Toxic Pollutants for the State of Californoa; Rule [mg/L]

[2] Central Coast Regional Water Quality Control Board Basin Plan Water Quality Objectives; Rule [mg/L]

[3] US EPA National Recommended Water Quality Criteria; Rule [mg/L]

[4] "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects

[5] "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects

NR = Not Recorded

NA = Not Analyzed; insufficient sample for analysis

-- Not Analyzed during this sampling event

^ Value extracted from the Narrative Statement presented in the Red Book (EPA440/9-76-023, July, 1976) on "Oil and Grease" as harmful to aquatic animals

* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops

** The CRWQCB Central Coast Region guidance value of <10 ppm for oil and grease, or <10,000 parts per billion (ppb)

*** Total Petroleum Hydrocarbons were quantified as either Diesel, Kerosene, Motor Oil, or, a combination of these extractables. See Certified Analytical Results in the appropriate Appendix for details.

*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values

**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis

****** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis

@ NPDES General Permit No. CAS000001 Waste Discharge Requirements for Discharges of Storm Water Associated With Industrial Activities requires that Total Organic Carbon (TOC), or Oil and Grease (O&G) be analyzed for. Between 1989 and 1997 O&G was analyzed. Since 1997, a test for semi-to non-volatile range hydrocarbons by standard method 8015M has been used. This hydrocarbon testing method is a gas chromatograph based method, which is more accurate and less prone to false positive detection than general O&G screening method. Starting with 2004-05 sampling year, the method has changed to Total Oil & Grease (TOG-EPA Method 413.2) and Total Recoverable Petroleum Hydrocarbons (TRPH-EPA Method 418.1).

TABLE D1-9

UCSC Water Quality Monitoring Results & Statistical Analysis

East Remote Parking Lot Runoff

Analysis	Analytical Results*****														
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999 (1st event)	1998-1999 (2nd event)	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
pH value	5.1	4.8	6	5.8	6.1	6.55	5.7	5	5.9	5.7	6	6.1	5.9	5.7	6.4
Conductivity (micromhos/cm)	31	32	44	105	13	18	55	700	55	18	14	21	60	150	140
Carbonate Alk. (as CaCO3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicarbonate Alk. (as CaCO3)	2	15	2.5	2.5	2	6	7	18	6	2.5	0	5	5	13	25
Total Alkalinity (as CaCO3)	2	15	2.5	2.5	2	6	7	18	6	2.5	0	5	5	13	25
Total Hardness (as CaCO3)	7.6	6	11	11	4	9.6	13	180	14	5	0	5	14	45	55
Total Dissolved Solids	20	21	29	55	8	12	35	450	35	11	9	13	39	98	92
Total Suspended Solids	–	–	–	–	–	–	–	–	–	–	–	–	–	–	19
Nitrate (as NO3)	0.5	1.6	3	1.2	0.5	0.5	0.5	24	0.5	0.5	0.5	0.5	1.8	4.8	2.6
Chloride (Cl)	1.7	1.2	5.7	26	2	2.5	5.4	110	8.2	1.9	0	5.5	7.5	14	12
Sulfate (SO4)	5	4.9	9.5	6.7	1	1	4.5	81	3.6	1	0	1	8.2	18	16
Flouride (F)	0.05	0.25	0.05	0.05	0.05	0.1	0.1	3.2	0.1	0.05	0.1	0.05	0.05	0.52	0.21
Calcium (Ca)	2.4	1.6	5	2.5	0.9	2.5	2.5	45	2.5	1.3	0	2.5	2.5	12	17
Magnesium (Mg)	0.4	0.5	0.5	1.3	0.5	0.5	0.5	16	1.2	0.42	0	0.5	1.2	3.7	3.1
Potassium (K)	1.4	0.4	0.74	0.7	0.4	0.7	2.5	25	2.7	0.62	0.5	0.25	3.1	7	4.6
Sodium (Na)	1.7	1.3	4	14	1.4	2.5	2.5	58	2.5	1.8	0	2.5	4.1	8.6	7.3
Total Iron (Fe)	0.14	0.18	0.33	0.07	0.09	0.42	0.59	0.8	0.06	0.32	0.05	0.16	0.35	0.54	0.7
Manganese (Mn)	0.07	0.06	0.07	0.04	0.015	0.08	0.09	1.4	0.06	0.044	0.05	0.03	0.17	0.52	0.081
Arsenic (As)	0.005	0.005	0.0025	0.001	0.001	0.001	0.001	0.0095	0.0025	0.001	0.001	0.0025	0.001	0.0025	0.0026
Barium (Ba)	0.05	0.05	0.05	0.05	0.05	0.11	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Boron (B)	0.05	0.025	0.05	0.05	0.05	0.05	0.12	0.27	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Cadmium (Cd)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0013	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Chromium (Cr)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0026
Copper (Cu)	0.025	0.025	0.025	0.025	0.025	.	0.025	0.05	0.05	0.025	0.025	0.025	0.025	0.057	0.025
Cyanide (CN)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.025	0.025	0.025	0.025	0.025	0.025
Lead (Pb)	0.005	0.0025	0.011	0.0025	0.0025	0.0025	0.0025	0.011	0.0025	0.0025	0.0025	0.0025	0.034	0.0025	0.0025
Mercury (Hg)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	<0.001	0.0001	0.0001
Selenium (Se)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Silver (Ag)	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0025	0.0025	0.005	0.005	0.005	0.005
Zinc (Zn)	0.06	0.07	0.025	0.025	0.025	0.025	0.08	0.52	0.05	0.059	0.025	<0.05	0.09	0.28	0.094
MBAS (Surfactants)	0.3	0.1	0.025	0.01	0.02	0.01	0.04	3	0.2	0.03	0.2	<0.02	0.2	0.38	0.48
Aluminum (Al)	0.25	0.25	1.29	0.05	0.11	0.83	0.58	1.55	0.05	0.25	0.46	0.29	0.55	1.3	0.66
Antimony (sb)	NR	NR	NR	NR	NR	0.003	0.003	0.003	0.042	0.006	0.003	0.003	0.003	0.003	0.003
Beryllium (Be)	NR	NR	NR	NR	NR	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Nickel (Ni)	NR	NR	NR	NR	NR	0.005	0.005	0.035	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Thallium (Tl)	NR	NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005
Nitrite (as NO2)	NR	NR	NR	NR	NR	0.25	0.25	0.25	0.25	0.5	0.25	0.25	0.25	1.8	0.25
Temperature	NR	NR	NR	NR	NR	–	–	–	–	–	–	–	–	–	–
Color (Co/Pt) (Units)	60	50	38	5	15	225	100	550	50	25	25	60	100	200	280
Odor (Threshold Number)	0.5	0.5	3	0.5	0.5	0.5	2	5	2	2	0.5	0.5	0.5	0.5	0.5
Turbidity (NTU)	3.6	19	185	1.5	7.2	82	25	77	5.1	16	41	11	7.4	41	20.0
Petroleum Hydrocarbons (ppm)******@	1.2	0.7	0.175	0.175	0.175	0.175	1.48 ***	0.175	0.175	0.92 ***	0.97 ***	0.18 ***	1.63 ***	0.29 ***	0.175 ****

Analysis	Statistical Analysis*****				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	5.7833	6.5500	4.8000	0.4898			7.0 - 8.5		
Conductivity (micromhos/cm)	97.0667	700.0000	13.0000	172.5483			750		
Carbonate Alk. (as CaCO3)	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)	7.4333	25.0000	0.0000	7.1311					
Total Alkalinity (as CaCO3)	7.4333	25.0000	0.0000	7.1311					200
Total Hardness (as CaCO3)	25.3467	180.0000	0.0000	45.4093					
Total Dissolved Solids	61.8000	450.0000	8.0000	111.0136			250		
Total Suspended Solids	19.0000	19.0000	19.0000	#DIV/0!					
Nitrate (as NO3)	2.8667	24.0000	0.5000	5.9808			5*		10
Chloride (Cl)	13.5733	110.0000	0.0000	27.4981			30	860	230
Sulfate (SO4)	10.7600	81.0000	0.0000	20.1653			60		
Flouride (F)	0.3287	3.2000	0.0500	0.8042			1.0		
Calcium (Ca)	6.6800	45.0000	0.0000	11.5325					
Magnesium (Mg)	2.0213	16.0000	0.0000	4.0037					
Potassium (K)	3.3740	25.0000	0.2500	6.2795					
Sodium (Na)	7.4800	58.0000	0.0000	14.4311			25		
Total Iron (Fe)	0.3200	0.8000	0.0500	0.2450					0.300
Manganese (Mn)	0.1853	1.4000	0.0150	0.3575					
Arsenic (As)	0.0026	0.0095	0.0010	0.0023	0.34	0.15		0.34	0.15
Barium (Ba)	0.0540	0.1100	0.0500	0.0155					
Boron (B)	0.0677	0.2700	0.0250	0.0593			0.2		
Cadmium (Cd)	0.0006	0.0013	0.0005	0.0002	0.00011	0.00018		0.00011	0.00018
Chromium (Cr)	0.0048	0.0050	0.0026	0.0006	0.03934	0.01275		0.03934	0.01275
Copper (Cu)	0.0309	0.0570	0.0250	0.0117	0.0006	0.0006	0.050	0.0006	0.0006
Cyanide (CN)	0.0160	0.0250	0.0100	0.0076	0.022	0.0052		0.022	0.0052
Lead (Pb)	0.0059	0.0340	0.0025	0.0083	0.0011	0.00004	0.05	0.0011	0.00004
Mercury (Hg)	0.0002	0.0005	0.0001	0.0002				0.0014	0.0007
Selenium (Se)	0.0025	0.0025	0.0025	0.0000		0.005			0.005
Silver (Ag)	0.0038	0.0050	0.0025	0.0013	0.00001			0.00001	
Zinc (Zn)	0.1020	0.5200	0.0250	0.1370	0.008	0.008		0.008	0.008
MBAS (Surfactants)	0.3568	3.0000	0.0100	0.7754			0.2		
Aluminum (Al)	0.5647	1.5500	0.0500	0.4809			5.0	0.750	0.087
Antimony (sb)	0.0072	0.0420	0.0030	0.0123					
Beryllium (Be)	0.0005	0.0005	0.0005	0.0000			0.1		
Nickel (Ni)	0.0080	0.0350	0.0050	0.0095	0.031	0.003		0.031	0.003
Thallium (Tl)	0.0008	0.0010	0.0005	0.0003					
Nitrite (as NO2)	0.4300	1.8000	0.2500	0.4877			5		
Temperature	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)	118.8667	550.0000	5.0000	145.0935			15	15	
Odor (Threshold Number)	1.2667	5.0000	0.5000	1.3211					
Turbidity (NTU)	36.1200	185.0000	1.5000	48.2412	5				
Petroleum Hydrocarbons (ppm)******@	0.5730	1.6300	0.1750	0.5326			10**	0.1^	

NOTES:
CRITERIA VALUES ARE NOT REQUIRED TO BE MET FOR PARKING LOT RUNOFF. VALUES ARE LISTED FOR COMPARISON PURPOSES ONLY.
All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise
The highlighted columns are the columns for which the analytical results of WSW1 are compared against
Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set
[1] 40 CFR Part 131, Water Quality Standards; Establishement of Numeric Criteria for Priority Toxic Pollutants for the State of Californoa; Rule [mg/L]
[2] Central Coast Regional Water Quality Control Board Basin Plan Water Quality Objectives; Rule [mg/L]
[3] US EPA National Recommended Water Quality Criteria; Rule [mg/L]
[4] "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects
[5] "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects
NR = Not Recorded
NA = Not Analyzed; insufficient sample for analysis
-- Not Analyzed during this sampling event
^ Value extracted from the Narrative Statement presented in the Red Book (EPA440/9-76-023, July, 1976) on "Oil and Grease" as harmful to aquatic animals
* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops
** The CRWQCB Central Coast Region guidance value of <10 ppm for oil and grease, or <10,000 parts per billion (ppb)
*** Total Petroleum Hydrocarbons were quantified as either Diesel, Kerosene, Motor Oil, or, a combination of these extractables. See Certified Analytical Results in the appropriate Appendix for details.
*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values
**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis
****** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis
@ NPDES General Permit No. CAS000001 Waste Discharge Requirements for Discharges of Storm Water Associated With Industrial Activities requires that Total Organic Carbon (TOC), or Oil and Grease (O&G) be analyzed for. Between 1989 and 1997 O&G was analyzed. Since 1997, a test for semi-to non-volatile range hydrocarbons by standard method 8015M has been used. This hydrocarbon testing method is a gas chromatograph based method, which is more accurate and less prone to false positive detection than general O&G screening method. Starting with 2004-05 sampling year, the method has changed to Total Oil & Grease (TOG-EPA Method 413.2) and Total Recoverable Petroleum Hydrocarbons (TRPH-EPA Method 418.1).

TABLE D1-10
UCSC Water Quality Monitoring Results & Statistical Analysis
Crown/Merrill Parking Lot Runoff

Analysis	Analytical Results															Statistical Analysis*****				California Toxics Rule[1]		Central Coast Basin Objectives[2]	Natl WQ Criteria[3]	
	1989-1990	1991-1992	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average	Maximum	Minimum	Std Dev	CMC[4]	CCC[5]		CMC	CCC
pH value	6.2	6.6	6.8	4.1	6.2	6	6.2	5.6	6	6	5.9	7.1	6.5	5.4	7.7	**6.1533**	7.7000	4.1000	0.8132			**7.0 - 8.5**		
Conductivity (micromhos/cm)	47	65	135	120	21	19	130	145	37	19	18	150	130	150	340	101.7333	340.0000	18.0000	85.3961			**750**		
Carbonate Alk. (as CaCO3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000	0.0000	0.0000	0.0000					
Bicarbonate Alk. (as CaCO3)	7.3	16	29	0	5	4.3	12	9	2.5	2.5	0	43	13	9	86	15.9067	86.0000	0.0000	22.5689					
Total Alkalinity (as CaCO3)	7.3	16	29	0	5	4.3	12	9	2.5	2.5	0	43	13	9	86	15.9067	86.0000	0.0000	22.5689					**200**
Total Hardness (as CaCO3)	14.5	20	43	10	7	7.6	57	39	12	7	0	51	31	47	130	31.7400	130.0000	0.0000	32.9378					
Total Dissolved Solids	30	42	85	79	11	12	80	92	22	12	11	100	85	100	220	65.4000	220.0000	11.0000	55.7261			**250**		
Total Suspended Solids	–	–	–	–	–	–	–	–	–	–	–	–	–	–	29	29.0000	29.0000	29.0000	#DIV/0!					
Nitrate (as NO3)	6.7	2.3	8.7	30	2.3	0.5	2.8	4.2	0.5	0.5	1	4.6	9.1	6.3	1.7	**5.4133**	30.0000	0.5000	7.3939			**5***		**10**
Chloride (Cl)	2.8	2.3	9.6	27	0.5	2.1	19	23	5.4	1.5	1.1	14	17	18	24	11.1533	27.0000	0.5000	9.5641			**30**	**860**	**230**
Sulfate (SO4)	5	6.4	15	6.6	1	1	13	13	1.8	1	0	16	7.6	12	52	10.0933	52.0000	0.0000	12.8519			**60**		
Flouride (F)	0.11	0.25	0.05	0.05	0.05	0.1	0.1	0.22	0.1	0.05	0.1	0.05	0.11	0.43	0.23	0.1333	0.4300	0.0500	0.1065			**1.0**		
Calcium (Ca)	4	6.2	13	2.2	2.2	0.5	18	11	<5	2.3	0	15	9.2	12	42	9.8286	42.0000	0.0000	10.9154					
Magnesium (Mg)	1.1	1.1	2.6	1.2	0.6	0.5	3	3	<1	0.42	0	3.3	2.1	4.2	7.2	2.1657	7.2000	0.0000	1.9320					
Potassium (K)	2.2	1.6	1.7	1.7	1.3	1.1	3.1	5.4	1.7	0.93	1.1	2	9	8.8	3.7	3.0220	9.0000	0.9300	2.6586					
Sodium (Na)	2.6	3.2	4	13	1.9	2.5	4	12	2.5	1.4	0	9.7	9.4	9.1	20	6.3533	20.0000	0.0000	5.6052			**25**		
Total Iron (Fe)	0.6	0.32	0.52	0.05	0.53	0.41	0.22	0.54	0.2	0.32	0.29	0.33	1	0.94	0.26	**0.4353**	1.0000	0.0500	0.2630					**0.300**
Manganese (Mn)	0.03	0.09	0.0075	0.035	0.03	0.025	0.17	0.24	0.04	0.04	0.04	0.0075	0.13	0.7	0.068	0.1102	0.7000	0.0075	0.1758					
Arsenic (As)	0.005	0.005	0.0025	0.001	0.001	0.011	0.012	0.005	0.0025	0.012	0.001	0.003	0.017	0.001	0.001	0.0053	0.0170	0.0010	0.0052	**0.34**	**0.15**		**0.34**	**0.15**
Barium (Ba)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0500	0.0500	0.0500	0.0000					
Boron (B)	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0483	0.0500	0.0250	0.0065			**0.2**		
Cadmium (Cd)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.00021	0.00028		0.00021	0.00028
Chromium (Cr)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.0013	**0.0468**	0.0500	0.0013	0.0126	0.06221	0.02016		0.06221	0.02016
Copper (Cu)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.0250	0.0250	0.0250	0.0000	0.0011	0.0009	**0.050**	0.0011	0.0009
Cyanide (CN)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.025	0.025	0.025	0.025	0.025	0.025	0.0160	0.0250	0.0100	0.0076	**0.022**	**0.0052**		**0.022**	**0.0052**
Lead (Pb)	0.005	0.0025	0.017	0.0025	0.0025	0.0025	0.0025	0.01	0.008	0.0025	0.0025	0.0025	0.007	0.0055	0.0025	**0.0050**	0.0170	0.0025	0.0041	0.0022	0.00009	**0.05**	0.0022	0.00009
Mercury (Hg)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0001	0.0001	0.0001	<0.001	0.0001	0.0001	0.0002	0.0005	0.0001	0.0002				**0.0014**	**0.0007**
Selenium (Se)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0000		**0.005**			**0.005**
Silver (Ag)	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.0025	0.0025	0.0025	0.005	0.005	0.005	0.005	0.0037	0.0050	0.0025	0.0013	0.00004			0.00004	
Zinc (Zn)	0.06	0.05	0.16	0.025	0.71	<0.05	0.12	0.22	0.11	0.073	0.08	0.1	0.06	0.29	0.11	**0.1549**	0.7100	0.0250	0.1748	0.012	0.012		0.012	0.012
MBAS (Surfactants)	0.02	0.04	0.025	0.025	0.025	0.025	0.035	0.3	0.53	0.01	0.15	0.01	0.01	0.14	0.069	0.0943	0.5300	0.0100	0.1440			**0.2**		
Aluminum (Al)	1.7	0.25	0.71	0.05	1	0.93	0.05	0.95	0.05	0.67	0.34	0.51	1.7	0.96	0.11	**0.6653**	1.7000	0.0500	0.5503			**5.0**	**0.750**	**0.087**
Antimony (sb)	NR	NR	NR	NR	NR	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.0030	0.0030	0.0030	0.0000					
Beryllium (Be)	NR	NR	NR	NR	NR	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000			**0.1**		
Nickel (Ni)	NR	NR	NR	NR	NR	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0050	0.0050	0.0050	0.0000	0.049	0.005		0.049	0.005
Thallium (Tl)	NR	NR	NR	NR	NR	0.001	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0008	0.0010	0.0005	0.0003					
Nitrite (as NO2)	NR	NR	NR	NR	NR	0.025	0.025	0.025	0.025	0.5	0.25	0.25	0.25	3.7	0.25	0.5300	3.7000	0.0250	1.1246			**5**		
Temperature	NR	NR	NR	NR	NR	–	–	–	–	–	–	–	–	–	–	#DIV/0!	0.0000	0.0000	#DIV/0!					
Color (Co/Pt) (Units)	120	60	85	50	50	100	130	250	75	50	55	170	275	350	22	**122.8000**	350.0000	22.0000	97.1326			**15**	**15**	
Odor (Threshold Number)	0.5	0.5	3	0.5	2	0.5	1	2	0.5	1	0.5	0.5	0.5	0.5	0.5	0.9333	3.0000	0.5000	0.7761					
Turbidity (NTU)	10.3	41	33	7.8	32	35	18	44	15.5	42	16	20	20	20	3.6	**23.8800**	44.0000	3.6000	12.9981	**5**				
Petroleum Hydrocarbons (ppm)****@**	0.4	1	6.2	0.7	0.175	0.175	1.51 ***	0.175	0.175	0.55 ***	1.1 ***	0.13 ***	1.32 ***	1.55 *** & ****	0.175	**1.0223**	6.2000	0.1300	1.5241			**10****	**0.1^**	

NOTES:
CRITERIA VALUES ARE NOT REQUIRED TO BE MET FOR PARKING LOT RUNOFF. VALUES ARE LISTED FOR COMPARISON PURPOSES ONLY.
All units are in milligrams per liter, parts per million (ppm), unless expressed otherwise
The highlighted columns are the columns for which the analytical results of WSW1 are compared against
Criteria in pink are derived from "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent", and using the lowest non-zero hardness value taken from the data set
[1] 40 CFR Part 131, Water Quality Standards; Establishement of Numeric Criteria for Priority Toxic Pollutants for the State of Californoa; Rule [mg/L]
[2] Central Coast Regional Water Quality Control Board Basin Plan Water Quality Objectives; Rule [mg/L]
[3] US EPA National Recommended Water Quality Criteria; Rule [mg/L]
[4] "CMC" = Criteria Maximum Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for a short time without deleterious effects
[5] "CCC" = Criteria Continuous Concentration - maximum concentration of a pollutant to which aquatic life can be exposed to for 4 days without deleterious effects
NR = Not Recorded
NA = Not Analyzed; insufficient sample for analysis
-- Not Analyzed during this sampling event
^ Value extracted from the Narrative Statement presented in the Red Book (EPA440/9-76-023, July, 1976) on "Oil and Grease" as harmful to aquatic animals
* Value taken from Table 3-3 "Water Quality Guidelines for Irrigation" for sensitive crops
** The CRWQCB Central Coast Region guidance value of <10 ppm for oil and grease, or <10,000 parts per billion (ppb)
*** Total Petroleum Hydrocarbons were quantified as either Diesel, Kerosene, Motor Oil, or, a combination of these extractables. See Certified Analytical Results in the appropriate Appendix for details.
*** Analytical results below detection limit are shown in green font at 1/2 the detection limit value, which is used in statistical analysis; Statistical analysis results in green font are derived entirely from 1/2 the analytical detection limit values
**** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis
****** Analytical results below detection limit are in green font: 1/2 the combined detection limit value for TPH diesel, kerosene & motor oil is used in statistical analysis
@ NPDES General Permit No. CAS000001 Waste Discharge Requirements for Discharges of Storm Water Associated With Industrial Activities requires that Total Organic Carbon (TOC), or Oil and Grease (O&G) be analyzed for. Between 1989 and 1997 O&G was analyzed. Since 1997, a test for semi-to non-volatile range hydrocarbons by standard method 8015M has been used. This hydrocarbon testing method is a gas chromatograph based method, which is more accurate and less prone to false positive detection than general O&G screening method. Starting with 2004-05 sampling year, the method has changed to Total Oil & Grease (TOG-EPA Method 413.2) and Total Recoverable Petroleum Hydrocarbons (TRPH-EPA Method 418.1).

Appendix D2

Storm Water Runoff Analysis Methodology

The effects of increased impervious surfaces on storm water runoff were estimated using the US Army Corps of Engineers' (USACE) hydrologic modeling software program HEC-HMS. HEC-HMS is a hydrologic modeling system that provides several methods for analyzing rainfall runoff. Within HEC-HMS, the United States Soil Conservation Service (SCS) Curve Number method was used to determine how much of the precipitation would run off from each major watershed on campus. This is the same method used in the *Stormwater and Drainage Master Plan* for the modeling of the East Fork of Moore Creek (Kennedy/Jenks 2004). The SCS Curve Number method is an empirical method to calculate runoff from a rainfall event based on the soil type, land cover, and percentage of impervious surfaces. A runoff curve number (with higher values associated with increased runoff) is assigned based on the watershed properties. Inputs to the model include the rainfall data for a particular storm event and the watershed properties.

Rainfall Event

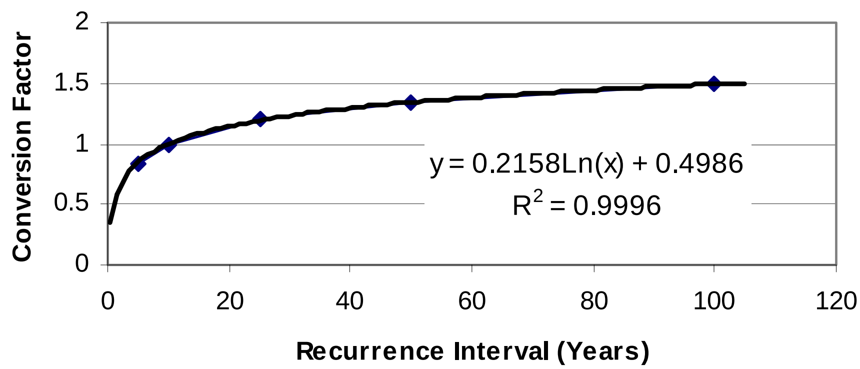
Increasing the amount of impervious surfaces increases the percentage of rainfall that is converted to runoff. This effect tends to be more pronounced during smaller storms since in larger storms, as the ground becomes saturated, an increasing percentage of the precipitation becomes runoff. Two hypothetical precipitation events were chosen for this analysis to demonstrate how increasing the impervious area within the watershed affects runoff in a smaller storm and a larger storm. Specifically, precipitation events with 2-year and 25-year recurrence intervals were chosen for this analysis.

Graphs of intensity-duration curves show how the average intensity of rainfall over a storm event (in units such as inches per hour) decreases as the duration of the storm event increases. These curves vary by geographic location and by the frequency that a particular total volume of precipitation occurs during the storm duration. The Santa Cruz County Department of Public Works (SCCDPW) has published rainfall intensity-duration curves for events with a 10-year recurrence interval. The SCCDPW provides conversion factors to obtain the intensity for other storm events, including the 5-year, 25-year, 50-year, and 100-year. The 2-year conversion factor was determined through regression between the conversion factors and the storm recurrence interval, as shown in Figure D2-1. The 10-year frequency SCCDPW intensity-duration curves are given for different P60 values, or the rainfall intensity associated with a 100-year storm with a 60-minute duration. In Figure 9 of the *Evaluation of Drainage and Erosion Issues, Southeastern UC Santa Cruz Campus* (Johnson 2003), equations are provided for the SCCDPW 10-year intensity-duration curves. The P60 values at UC Santa Cruz are shown to range from approximately 1.5 to 1.9 inches per hour (in/hr) going from lower to higher elevations on campus. For this analysis, the 10-year frequency curve corresponding to a representative P60 value of 1.7 in/hr was chosen. Using P60 = 1.7, the equation for the average 10-year rainfall intensity, I_{10}, is:

$$I_{10} = 5.8931x^{-0.4015}$$

where x is the storm duration in minutes and I_{10} is in inches per hour (Johnson 2003)

A duration for the storm events was also needed for the analysis. Although a 24-hour storm is often used for rainfall-runoff analyses for small watersheds, a shorter storm was determined to be more appropriate for analyzing the effects of the 2-year event. A shorter storm has a higher intensity, and so it provides a better measure of the maximum impacts associated with increasing the impervious surfaces. A 3-hour storm was selected as this provides a storm long enough to have the entire watershed contributing to runoff. For the 25-year event, a 24-hour storm was chosen, as this duration is more commonly used in the design of storm control measures.



Recurrence Interval (yr)	Factor
2	**0.65**
5	0.84
10	1.00
25	1.2
50	1.34
100	1.49

Note: 2-year factor calculated using equation above of line fitted to data from Johnson, 2003.

Figure D2-1 Santa Cruz County Department of Public Works Conversion Factors for Other Recurrence Intervals

By multiplying the 10-year intensity by the 2-year conversion factor, the 2-year, 3-hour rainfall intensity was determined to be 0.47 in/hr. This equates to a storm depth of 1.42 inches. A design storm was developed by assuming that the peak intensity occurs in the middle of the storm, and the remainder of the rainfall was distributed equally on both sides (see Figure D2-2).

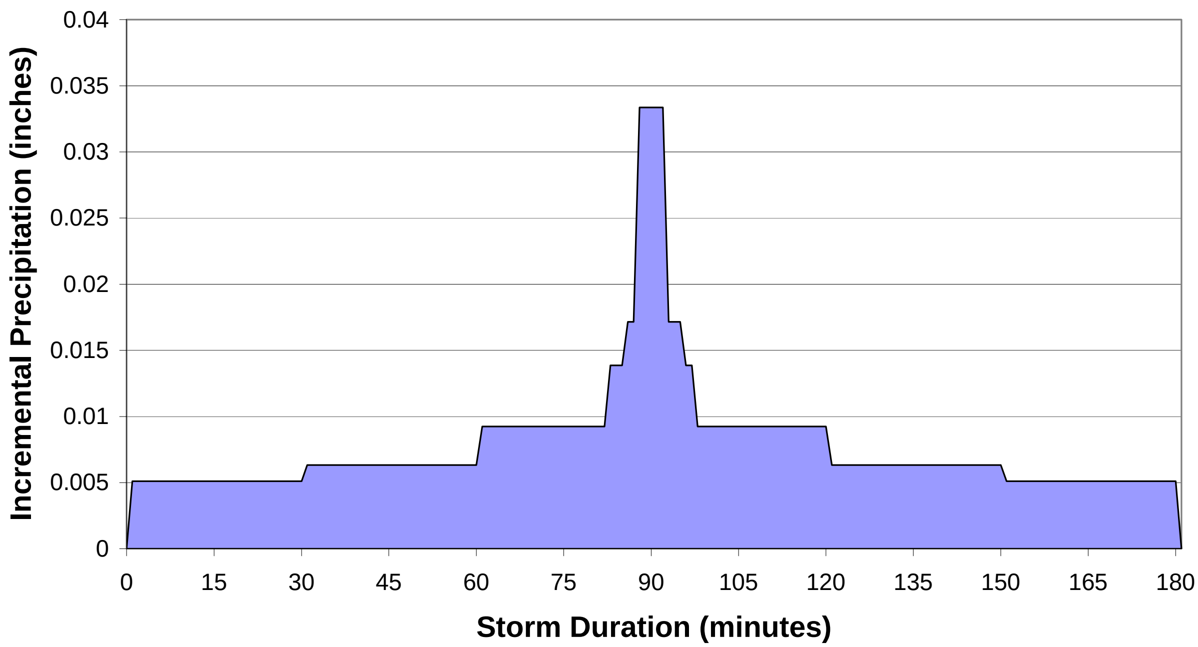


Figure D2-2 Rainfall Hyetograph for the 2-Year, 3-Hour Storm Event

Using the conversion factor for the 25-year recurrence interval, the average rainfall intensity for the 25-year, 24-hour event was determined to be 0.38 in/hr. This equates to a storm depth of 9.15 inches. The SCS developed several rainfall distributions to represent how the rainfall intensity changes over the duration of a storm for different regions in the United States. UCSC is located within the region represented by the SCS Type 1a rainfall distribution. This storm distribution was used in HEC-HMS. The plot of the incremental precipitation over the duration of the storm based on the SCS Type 1a rainfall distribution is shown in Figure D2-3.

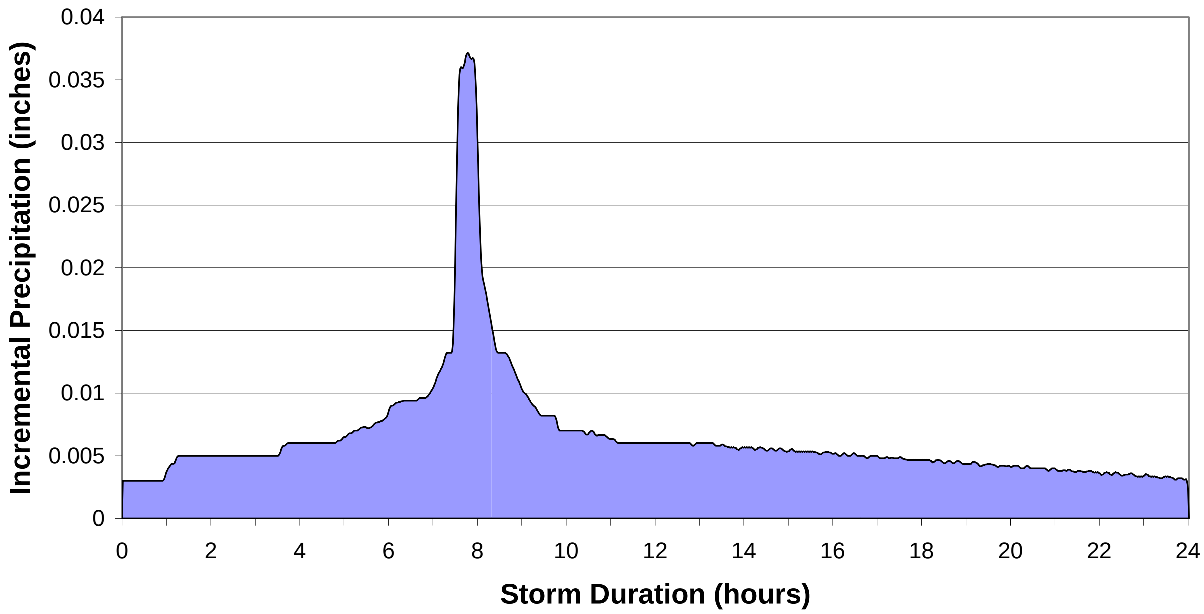


Figure D2-3 Rainfall Hyetograph for the 25-Year, 24-Hour Storm Event

Watershed Properties

The watershed properties used as input are shown in Table D2-1. The Wilder Creek and Moore Creek Western Tributary watersheds were not included in the model because there is no existing or planned development in these watersheds. The developed Employee Housing area South of Glen Coolidge Drive in the Arroyo Seco and High Street watersheds was included under existing conditions. It was also assumed that there would not be an increase in impervious area under the 2005 LRDP for the remaining portion of the High Street watershed.

The acreages of the existing and projected impervious area within each watershed were based on the LRDP land use maps showing the existing and proposed development areas. It was assumed that 60 percent of the existing developed areas were impervious, areas proposed for infill would increase the impervious area by 10 percent, and areas of new development would be 70 percent impervious. The total watershed area used as input to the HEC-HMS model was the same as the on-campus area, except for Cave Gulch, which used the total watershed area. This is because Cave Gulch is the only modeled watershed where the off-campus watershed area drains to the campus. It was assumed that the off-campus portion of Cave Gulch was 20 percent impervious, which would be typical of residential areas with one-acre lots and represents the Cave Gulch rural residential area.

The runoff curve numbers used in the SCS Method were based on the hydrologic soil group of the various Natural Resources Conservation Service (NRCS), formerly known as SCS, soil types within each watershed and the type of vegetation cover – either meadow or woods in good hydrologic condition, meaning that the vegetation has not been disturbed so that the potential for capturing rainfall is not reduced. The area-weighted curve numbers are shown in Table D2-1 (with higher curve number values associated with more runoff).

The SCS method was used in HEC-HMS for the transformation of precipitation to runoff. This method was also used in the modeling of the East Fork of Moore Creek presented in the *Stormwater and Drainage Master Plan* (Kennedy/Jenks 2004). The input parameter required for this method is the lag time of each watershed. The lag time is equal to 0.6 x T_c, where T_c is the time of concentration in minutes. The time of concentration is defined as the time required for a drop of rainwater to flow from the hydrologically most remote point in the watershed to the basin outlet. The time of concentration was calculated using the empirically derived Kirpich Formula, which is the same formula that was used in the *Stormwater and Drainage Master Plan* (Kennedy/Jenks 2004):

$$T_c = 0.0078\ L^{0.77}\ S^{-0.385}$$

where L is the length of the flow path in feet, and S is the average slope along the flow path. Table D2-2 shows the values used in the calculation of the lag time

Table D2-1
Existing and Projected On-Campus Impervious Area by Watershed

Watershed	Total Area (acres)	On Campus Watershed Area (acres)	Existing On-Campus Impervious Area (acres)	Projected Additional On-Campus Impervious Area (acres) Under 2005 LRDP	Percent Impervious for Existing Campus Watersheds	Percent Impervious for Campus Watersheds under the 2005 LRDP	Runoff Curve Number
Wilder Creek	3,000	192	0	0	NA	NA	NA
Cave Gulch	460	336	7	54	7%	19%	67
Moore Creek	920	321	65	50	20%	36%	65
Moore Creek Western Tributary	320	98	0	0	NA	NA	NA
Jordan Gulch	1,380	440	90	54	21%	33%	64
Arroyo Seco	260	44	21	1	47%	49%	66
High Street	60	24	16	0	69%	69%	68
Kalkar Quarry	60	56	1	1	2%	3%	68
San Lorenzo River	74,000	509	42	58	8%	20%	61
Total		2,020	243	218	13%	25%	64

TableD2-2
UC Santa Cruz Campus Watershed Parameter Estimates for SCS Lag Time Calculation

Watershed	Length of Flow Path (ft)	Highest Elevation (ft)	Lowest Elevation (ft)	Average Slope (ft/ft)	Time of Concentration (min)	Lag Time (min)
Moore Creek	9700	956	360	0.06	27	16
Cave Gulch	13000	1100	470	0.05	37	22
Jordan Gulch	12600	990	260	0.06	34	20
Arroyo Seco	2300	460	350	0.05	10	6
High Street	1800	380	280	0.06	8	5
Kalkar Quarry	3100	580	400	0.06	11	7
San Lorenzo River	11500	1160	700	0.04	36	22

Results of Analysis

The output from the HEC-HMS model provides the amount of rainfall that could potentially run off of each watershed under existing conditions and conditions under the 2005 LRDP for the two modeled storm events. The assumptions used for the model input will most likely overestimate the quantity of runoff because the volume of water draining through sinkholes or captured in depressions was not accounted for. It is difficult to quantify the amount of these losses because the amount draining to the subsurface depends on the infiltration rate of the sinkholes, which has not been studied in detail, and which also can change due to clogging. Also, it has been assumed that all the impervious areas within each watershed are directly connected and will contribute to runoff from the watershed. However, these results are useful on a planning level to assist in evaluating potential impacts due to the implementation of the 2005 LRDP by providing quantitative estimates of the maximum increase in runoff resulting from the proposed development. Results for the 2-year storm event are shown in Table D2-3. Results for the 25-year event are shown in Table D2-4.

Table D2-3
Results for a 2-Year, 3-Hour Storm Event Under Existing and Projected LRDP Conditions

Watershed	Watershed Area Input to HEC-HMS (acres)	Cumulative Total Depth of Input Rainfall (inches)	Percentage of Rainfall as Runoff		Peak Flow (cfs)		Volume of Runoff (acre-feet)	
			Existing	2005 LRDP	Existing	2005 LRDP	Existing	2005 LRDP
Cave Gulch	460	1.42	28%	38%	122	161	16	21
Moore Creek	321	1.42	37%	49%	125	168	14	19
Jordan Gulch	440	1.42	37%	47%	158	198	19	25
Arroyo Seco	44	1.42	58%	60%	40	41	3	3
High Street	24	1.42	76%	76%	30	30	2	2
Kalkar Quarry	56	1.42	25%	26%	22	22	2	2
San Lorenzo River	509	1.42	25%	35%	119	165	15	21
Total	**1854**						**71**	**93**

Table D2-4
Results for a 25-Year, 24-Hour Storm Event Under Existing and Projected LRDP Conditions

Watershed	Watershed Area Input to HEC-HMS (acres)	Cumulative Total Depth of Input Rainfall (inches)	Percentage of Rainfall as Runoff		Peak Flow (cfs)		Volume of Runoff (acre-feet)	
			Existing	2005 LRDP	Existing	2005 LRDP	Existing	2005 LRDP
Cave Gulch	460	9.2	68%	72%	586	622	239	254
Moore Creek	321	9.2	70%	76%	453	492	172	187
Jordan Gulch	440	9.2	70%	74%	587	626	236	251
Arroyo Seco	44	9.2	81%	82%	80	80	27	28
High Street	24	9.2	90%	90%	47	47	16	16
Kalkar Quarry	56	9.2	67%	68%	85	85	29	29
San Lorenzo River	509	9.2	63%	67%	586	634	244	263
Total	**1854**						**964**	**1028**

References

Johnson, N.M. 2003. *Evaluation of Drainage and Erosion Issues, Southeastern UC Santa Cruz Campus*. June.

Kennedy/Jenks Consultants. 2004. *Stormwater & Drainage Master Plan.* September.

Storm Water Runoff Analysis Methodology

The effects of increased impervious surfaces on storm water runoff were estimated using the US Army Corps of Engineers' (USACE) hydrologic modeling software program HEC-HMS. HEC-HMS is a hydrologic modeling system that provides several methods for analyzing rainfall runoff. Within HEC-HMS, the United States Soil Conservation Service (SCS) Curve Number method was used to determine how much of the precipitation would run off from each major watershed on campus. This is the same method used in the *Stormwater and Drainage Master Plan* for the modeling of the East Fork of Moore Creek (Kennedy/Jenks 2004). The SCS Curve Number method is an empirical method to calculate runoff from a rainfall event based on the soil type, land cover, and percentage of impervious surfaces. A runoff curve number (with higher values associated with increased runoff) is assigned based on the watershed properties. Inputs to the model include the rainfall data for a particular storm event and the watershed properties.

Rainfall Event

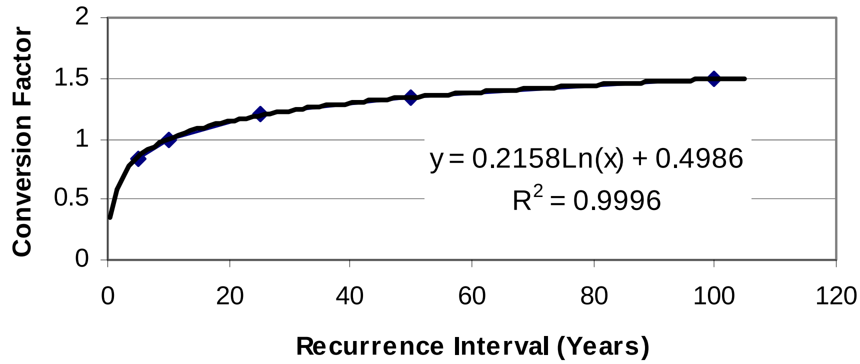
Increasing the amount of impervious surfaces increases the percentage of rainfall that is converted to runoff. This effect tends to be more pronounced during smaller storms since in larger storms, as the ground becomes saturated, an increasing percentage of the precipitation becomes runoff. Two hypothetical precipitation events were chosen for this analysis to demonstrate how increasing the impervious area within the watershed affects runoff in a smaller storm and a larger storm. Specifically, precipitation events with 2-year and 25-year recurrence intervals were chosen for this analysis.

Graphs of intensity-duration curves show how the average intensity of rainfall over a storm event (in units such as inches per hour) decreases as the duration of the storm event increases. These curves vary by geographic location and by the frequency that a particular total volume of precipitation occurs during the storm duration. The Santa Cruz County Department of Public Works (SCCDPW) has published rainfall intensity-duration curves for events with a 10-year recurrence interval. The SCCDPW provides conversion factors to obtain the intensity for other storm events, including the 5-year, 25-year, 50-year, and 100-year. The 2-year conversion factor was determined through regression between the conversion factors and the storm recurrence interval, as shown in Figure D2-1. The 10-year frequency SCCDPW intensity-duration curves are given for different P60 values, or the rainfall intensity associated with a 100-year storm with a 60-minute duration. In Figure 9 of the *Evaluation of Drainage and Erosion Issues, Southeastern UC Santa Cruz Campus* (Johnson 2003), equations are provided for the SCCDPW 10-year intensity-duration curves. The P60 values at UC Santa Cruz are shown to range from approximately 1.5 to 1.9 inches per hour (in/hr) going from lower to higher elevations on campus. For this analysis, the 10-year frequency curve corresponding to a representative P60 value of 1.7 in/hr was chosen. Using P60 = 1.7, the equation for the average 10-year rainfall intensity, I_{10}, is:

$$I_{10} = 5.8931x^{-0.4015}$$

where x is the storm duration in minutes and I_{10} is in inches per hour (Johnson 2003)

A duration for the storm events was also needed for the analysis. Although a 24-hour storm is often used for rainfall-runoff analyses for small watersheds, a shorter storm was determined to be more appropriate for analyzing the effects of the 2-year event. A shorter storm has a higher intensity, and so it provides a better measure of the maximum impacts associated with increasing the impervious surfaces. A 3-hour storm was selected as this provides a storm long enough to have the entire watershed contributing to runoff. For the 25-year event, a 24-hour storm was chosen, as this duration is more commonly used in the design of storm control measures.



Recurrence Interval (yr)	Factor
2	**0.65**
5	0.84
10	1.00
25	1.2
50	1.34
100	1.49

Note: 2-year factor calculated using equation above of line fitted to data from Johnson, 2003.

Figure D2-1 Santa Cruz County Department of Public Works Conversion Factors for Other Recurrence Intervals

By multiplying the 10-year intensity by the 2-year conversion factor, the 2-year, 3-hour rainfall intensity was determined to be 0.47 in/hr. This equates to a storm depth of 1.42 inches. A design storm was developed by assuming that the peak intensity occurs in the middle of the storm, and the remainder of the rainfall was distributed equally on both sides (see Figure D2-2).

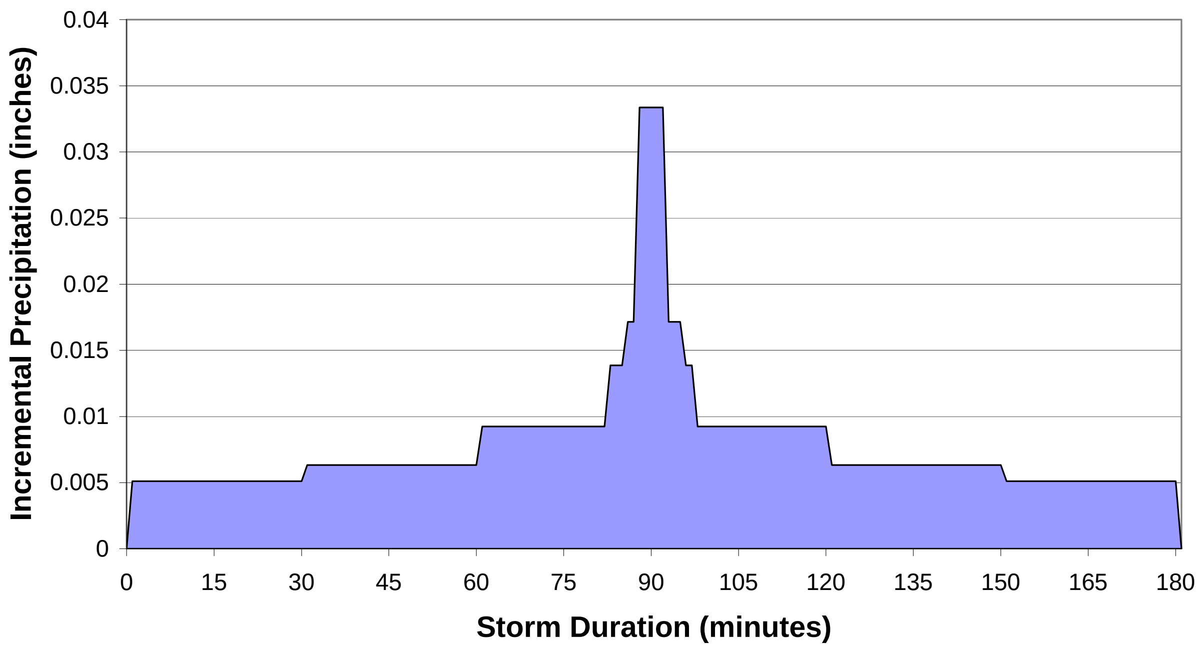


Figure D2-2 Rainfall Hyetograph for the 2-Year, 3-Hour Storm Event

Using the conversion factor for the 25-year recurrence interval, the average rainfall intensity for the 25-year, 24-hour event was determined to be 0.38 in/hr. This equates to a storm depth of 9.15 inches. The SCS developed several rainfall distributions to represent how the rainfall intensity changes over the duration of a storm for different regions in the United States. UCSC is located within the region represented by the SCS Type 1a rainfall distribution. This storm distribution was used in HEC-HMS. The plot of the incremental precipitation over the duration of the storm based on the SCS Type 1a rainfall distribution is shown in Figure D2-3.

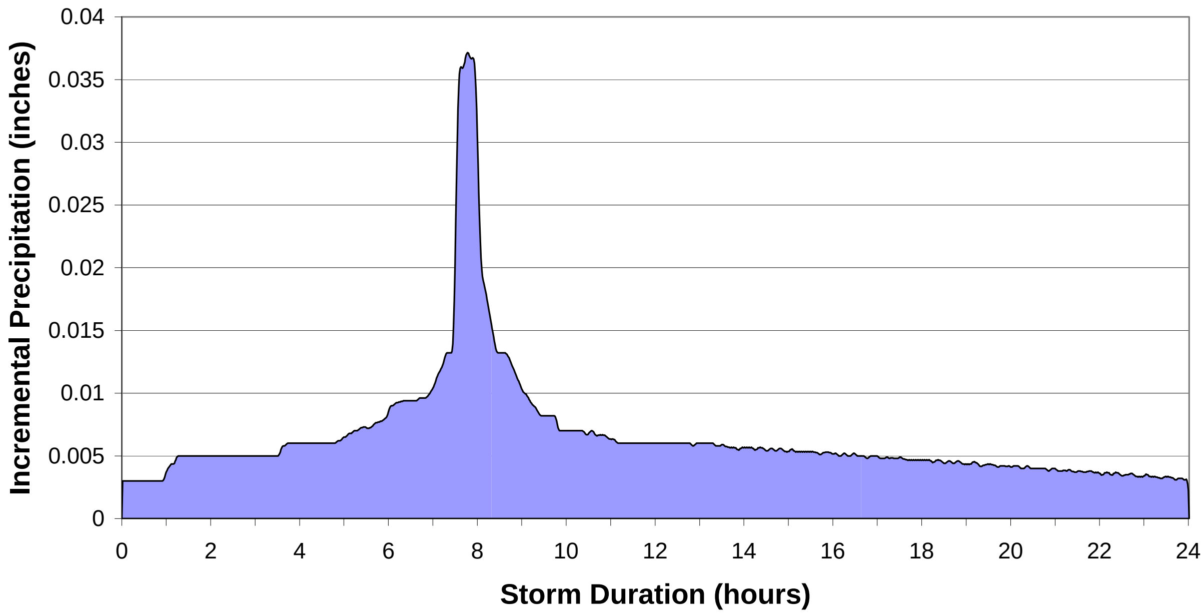


Figure D2-3 Rainfall Hyetograph for the 25-Year, 24-Hour Storm Event

Watershed Properties

The watershed properties used as input are shown in Table D2-1. The Wilder Creek and Moore Creek Western Tributary watersheds were not included in the model because there is no existing or planned development in these watersheds. The developed Employee Housing area South of Glen Coolidge Drive in the Arroyo Seco and High Street watersheds was included under existing conditions. It was also assumed that there would not be an increase in impervious area under the 2005 LRDP for the remaining portion of the High Street watershed.

The acreages of the existing and projected impervious area within each watershed were based on the LRDP land use maps showing the existing and proposed development areas. It was assumed that 60 percent of the existing developed areas were impervious, areas proposed for infill would increase the impervious area by 10 percent, and areas of new development would be 70 percent impervious. The total watershed area used as input to the HEC-HMS model was the same as the on-campus area, except for Cave Gulch, which used the total watershed area. This is because Cave Gulch is the only modeled watershed where the off-campus watershed area drains to the campus. It was assumed that the off-campus portion of Cave Gulch was 20 percent impervious, which would be typical of residential areas with one-acre lots and represents the Cave Gulch rural residential area.

The runoff curve numbers used in the SCS Method were based on the hydrologic soil group of the various Natural Resources Conservation Service (NRCS), formerly known as SCS, soil types within each watershed and the type of vegetation cover – either meadow or woods in good hydrologic condition, meaning that the vegetation has not been disturbed so that the potential for capturing rainfall is not reduced. The area-weighted curve numbers are shown in Table D2-1 (with higher curve number values associated with more runoff).

The SCS method was used in HEC-HMS for the transformation of precipitation to runoff. This method was also used in the modeling of the East Fork of Moore Creek presented in the *Stormwater and Drainage Master Plan* (Kennedy/Jenks 2004). The input parameter required for this method is the lag time of each watershed. The lag time is equal to 0.6 x T_c, where T_c is the time of concentration in minutes. The time of concentration is defined as the time required for a drop of rainwater to flow from the hydrologically most remote point in the watershed to the basin outlet. The time of concentration was calculated using the empirically derived Kirpich Formula, which is the same formula that was used in the *Stormwater and Drainage Master Plan* (Kennedy/Jenks 2004):

$$T_c = 0.0078\ L^{0.77}\ S^{-0.385}$$

where L is the length of the flow path in feet, and S is the average slope along the flow path. Table D2-2 shows the values used in the calculation of the lag time

Table D2-1
Existing and Projected On-Campus Impervious Area by Watershed

Watershed	Total Area (acres)	On Campus Watershed Area (acres)	Existing On-Campus Impervious Area (acres)	Projected Additional On-Campus Impervious Area (acres) Under 2005 LRDP	Percent Impervious for Existing Campus Watersheds	Percent Impervious for Campus Watersheds under the 2005 LRDP	Runoff Curve Number
Wilder Creek	3,000	192	0	0	NA	NA	NA
Cave Gulch	460	336	7	54	7%	19%	67
Moore Creek	920	321	65	50	20%	36%	65
Moore Creek Western Tributary	320	98	0	0	NA	NA	NA
Jordan Gulch	1,380	440	90	54	21%	33%	64
Arroyo Seco	260	44	21	1	47%	49%	66
High Street	60	24	16	0	69%	69%	68
Kalkar Quarry	60	56	1	1	2%	3%	68
San Lorenzo River	74,000	509	42	58	8%	20%	61
Total		2,020	243	218	13%	25%	64

TableD2-2
UC Santa Cruz Campus Watershed Parameter Estimates for SCS Lag Time Calculation

Watershed	Length of Flow Path (ft)	Highest Elevation (ft)	Lowest Elevation (ft)	Average Slope (ft/ft)	Time of Concentration (min)	Lag Time (min)
Moore Creek	9700	956	360	0.06	27	16
Cave Gulch	13000	1100	470	0.05	37	22
Jordan Gulch	12600	990	260	0.06	34	20
Arroyo Seco	2300	460	350	0.05	10	6
High Street	1800	380	280	0.06	8	5
Kalkar Quarry	3100	580	400	0.06	11	7
San Lorenzo River	11500	1160	700	0.04	36	22

Results of Analysis

The output from the HEC-HMS model provides the amount of rainfall that could potentially run off of each watershed under existing conditions and conditions under the 2005 LRDP for the two modeled storm events. The assumptions used for the model input will most likely overestimate the quantity of runoff because the volume of water draining through sinkholes or captured in depressions was not accounted for. It is difficult to quantify the amount of these losses because the amount draining to the subsurface depends on the infiltration rate of the sinkholes, which has not been studied in detail, and which also can change due to clogging. Also, it has been assumed that all the impervious areas within each watershed are directly connected and will contribute to runoff from the watershed. However, these results are useful on a planning level to assist in evaluating potential impacts due to the implementation of the 2005 LRDP by providing quantitative estimates of the maximum increase in runoff resulting from the proposed development. Results for the 2-year storm event are shown in Table D2-3. Results for the 25-year event are shown in Table D2-4.

Table D2-3
Results for a 2-Year, 3-Hour Storm Event Under Existing and Projected LRDP Conditions

Watershed	Watershed Area Input to HEC-HMS (acres)	Cumulative Total Depth of Input Rainfall (inches)	Percentage of Rainfall as Runoff		Peak Flow (cfs)		Volume of Runoff (acre-feet)	
			Existing	2005 LRDP	Existing	2005 LRDP	Existing	2005 LRDP
Cave Gulch	460	1.42	28%	38%	122	161	16	21
Moore Creek	321	1.42	37%	49%	125	168	14	19
Jordan Gulch	440	1.42	37%	47%	158	198	19	25
Arroyo Seco	44	1.42	58%	60%	40	41	3	3
High Street	24	1.42	76%	76%	30	30	2	2
Kalkar Quarry	56	1.42	25%	26%	22	22	2	2
San Lorenzo River	509	1.42	25%	35%	119	165	15	21
Total	**1854**						**71**	**93**

Table D2-4
Results for a 25-Year, 24-Hour Storm Event Under Existing and Projected LRDP Conditions

Watershed	Watershed Area Input to HEC-HMS (acres)	Cumulative Total Depth of Input Rainfall (inches)	Percentage of Rainfall as Runoff		Peak Flow (cfs)		Volume of Runoff (acre-feet)	
			Existing	2005 LRDP	Existing	2005 LRDP	Existing	2005 LRDP
Cave Gulch	460	9.2	68%	72%	586	622	239	254
Moore Creek	321	9.2	70%	76%	453	492	172	187
Jordan Gulch	440	9.2	70%	74%	587	626	236	251
Arroyo Seco	44	9.2	81%	82%	80	80	27	28
High Street	24	9.2	90%	90%	47	47	16	16
Kalkar Quarry	56	9.2	67%	68%	85	85	29	29
San Lorenzo River	509	9.2	63%	67%	586	634	244	263
Total	**1854**						**964**	**1028**

References

Johnson, N.M. 2003. *Evaluation of Drainage and Erosion Issues, Southeastern UC Santa Cruz Campus*. June.

Kennedy/Jenks Consultants. 2004. *Stormwater & Drainage Master Plan.* September.