92-e58

CHRISTINE O. GREGOIRE
Director

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

7171 Cleanwater Lane, Building 8, LH-14 • Olympia, Washington 98504-6814

April 17, 1992

TO: Dick Wallace and Kahle Jennings, WQP

FROM: Keith Seiders, EILS KS

SUBJECT: Interim Report on the Moxee BMP Demonstration Project

Please find attached the Interim Report for the water quality monitoring program associated with North Yakima Conservation Distict's Moxee BMP Demonstration Project (319 Funds).

The project is on schedule. The first year's monitoring (1991 irrigation season) was accomplished as planned and the second year's monitoring (1992 irrigation season) is scheduled to begin this April. This Interim Report essentially presents data collected during the first irrigation season. Data analysis will be addressed in the final report, which is scheduled for April 1993.

Please feel free to contact me at (206) 586-5337 if you have any questions or comments.

KS:krc
Attachment

cc: Janie Civille (WQFAP)
Bob Barwin (CRO)
Jim Prudente (CRO)
Harold Porath (CRO)
Will Kendra (EILS)
Lynn Singleton (EILS)
Ken King (NYCD)
Mike Tobin (NYCD)
Stu McKenzie (USGS)
Elbert Moore (EPA R10)
Gerald Montgomery (EPA R10)

MOXEE BMP DEMONSTRATION REPORT
1991 WATER QUALITY MONITORING INTERIM REPORT

by Keith Seiders
April 1992

Washington State Department of Ecology
Environmental Investigations and Laboratory Services Program
Watershed Assessments Section
Olympia, Washington 98504-7710

Water Body No. WA-37-1048
(Segment No. 18-37-02)

INTRODUCTION

Water quality monitoring within the North Yakima Conservation District's Moxee Sub-Basin BMP Demonstration Project has been completed for the pre-BMP irrigation season. BMPs are planned for implementation prior to and during the 1992 irrigation season. Monitoring activities were carried out by Conservation District and Ecology personnel. Pre-BMP monitoring data are presented in this interim report. Data analysis and detailed methodology will be included in the final report, after the second sampling season is completed. Additional information regarding the study area, background, roles, and funding is contained in Seiders (1991a).

Survey objectives are:

1. Evaluate the effectiveness of BMP implementation on the quality of irrigation tailwater and receiving waters;

2. characterize pesticides in sediments from a tailwater drain;

3. provide data for longer-term assessment of BMP effectiveness related to water quality and transport of sediments, nutrients, and pesticides; and

4. provide information regarding water quality to the agricultural community in the study area and within the North Yakima Conservation District.

STUDY DESIGN AND RATIONALE

Irrigation and crop cultural practices in the study area vary throughout the growing season and likely have different impacts on water quality. Three different phases of the growing season and one off-season period are of interest during this water quality evaluation program. Each phase, or "window," is monitored during a three week period. Two samples per week for each of the three weeks yields six samples per window (18 samples per station each irrigation season). This sampling schedule allows characterization of sample variability during each period as well as comparisons between periods. Growing season phases are described below:

The first period begins in April and continues through early May. This is when irrigation of crops begins. Irrigation requirements for hops and other crops are relatively low at this time of the year. Sediment loading in tailwater (and ultimately the receiving water) is believed to be high during this initial start-up period due to various field preparation activities such as discing, furrowing, and first-flush irrigations.

The next period of interest is from about mid-May to the end of June. Irrigation requirements are much greater than the previous month. Crops are irrigated on a regular cycle and a significant portion of growing season cultural practices occurs. These practices involve the use of equipment on fields and the potential for continued sediment loading to irrigation tailwater.

The third period begins after July 4th and runs until the harvest of hops during the first or second week of August. This period is characterized by heavy irrigation and absence of equipment on the fields. Tailwater flows may be highest during this period.

Hops irrigation continues after harvest until September. Minimal irrigation of other crops continues until mid-October, when irrigation supply water is discontinued.

Sample station locations are shown in Figure 1. Brief station descriptions are listed below. Sampling at the Selah-Moxee Canal sites was discontinued after the first seasonal period.

M1 - Moxee Drain upstream of study area influence.
M2 - Moxee Drain downstream of study area influence.
SM1 - Selah/Moxee Canal upstream of study area influence.
SM2 - Selah/Moxee Canal downstream of study area influence.
R1 - Roza Canal upstream of study area influence.
R2 - Roza Canal downstream of study area influence.
D1 - Major tailwater drain for lower hops fields.
RCE, RCM, RCW - Intermittent tailwater drains to the Roza Canal.

METHODS

Sample collection followed procedures detailed in Seiders (1991b). All samples were subsurface grabs (depth from 4-12 inches) from the central portion of the stream. For flowing pipes, samples were obtained from a representative portion of the flow.

Samples were collected for laboratory analysis of: total suspended solids (TSS), turbidity (nephelometric method), ammonia-nitrogen, nitrate-nitrite nitrogen, and total phosphorus. Quality assurance involved duplicating one set of samples on nearly all sample dates.

Parameters determined in the field were pH, conductivity, temperature, turbidity (absorptometric method), and settleable solids. Settleable solids were determined using the Imhoff Cone Method at various settling times (15, 20, 25, 30, and 45 minutes). Results from the 15 minute settling time were used in data tabulation.

Routine sample dates during the 1991 irrigation season were:

1st window	2nd window	3rd window
4/9	5/29	7/24
4/10	5/30	7/25
4/15	6/4	7/30
4/16	6/5	7/31
4/24	6/10	8/5
4/25	6/11	8/6

Conservation District personnel also determined field turbidity, settleable solids, temperature, and flow at select stations on the following dates: 7/11, 8/22, 9/11, 10/2, 10/9, 10/24, 11/6, 11/20, 12/5, 12/18, and 1/16/92.

Suspended sediment samples for pesticides were collected in June and July by filling 6 5-gallon stainless steel buckets from D1, and allowing sediment to settle out for a period of six hours. The water was then gently decanted and the sediment collected for analysis.

Flow was determined for sites R1, M1, and D1 during most sampling visits. Flow rating tables were developed for D1 and R1 and were subsequently used in data tabulation. Flow for site M2 was determined by summing the flows for D1 and M1.

RESULTS

Field and laboratory data for conventional parameters are presented in Appendix A. Results of duplicate sample analyses are tabulated in Appendix B.

A cursory review of quality assurance/quality control data (Appendix B) indicates that most data are acceptable. However, some variables show poor precision (for example, laboratory turbidity on the April 25, 1991, sample and total phosphorus on the July 24, 1991, sample).

Although review of pesticide data is incomplete, the organochlorine pesticides 4,4'-DDE and 4,4'-DDT were detected in suspended sediment samples collected from D1 in both June and July. 4,4'-DDE was also detected in the June sample. These results are preliminary.

In general, variability of pollutant concentrations for all parameters appears to be high throughout the entire irrigation season. However, it also appears that pollutant loadings increase as the irrigation season progresses. Figures 2 and 3 illustrate total suspended solids and total phosphorus loading throughout the irrigation season. These results demonstrate the importance of considering the timing of specific land practices in water quality monitoring programs.

SUMMARY

The first year, pre-BMP water quality monitoring proceeded as planned and should provide an adequate data base for evaluating the effectiveness of project BMPs during subsequent years of monitoring.

Off-season sampling at three sites (M1, D1, and M2) was performed in late February and early March of 1992 as planned. Sampling for the 1992 irrigation season will proceed as originally planned.

REFERENCES

Seiders, K. 1991a. Revised Water Quality Monitoring Plan Proposal for the Moxee BMP Demonstration Project (319 Funds). Memo to Will Kendra on June 12, 1991.

Seiders, K. 1991b. Moxee BMP Demonstration Project Field Sampling Summary. June 28, 1991.

FIGURES

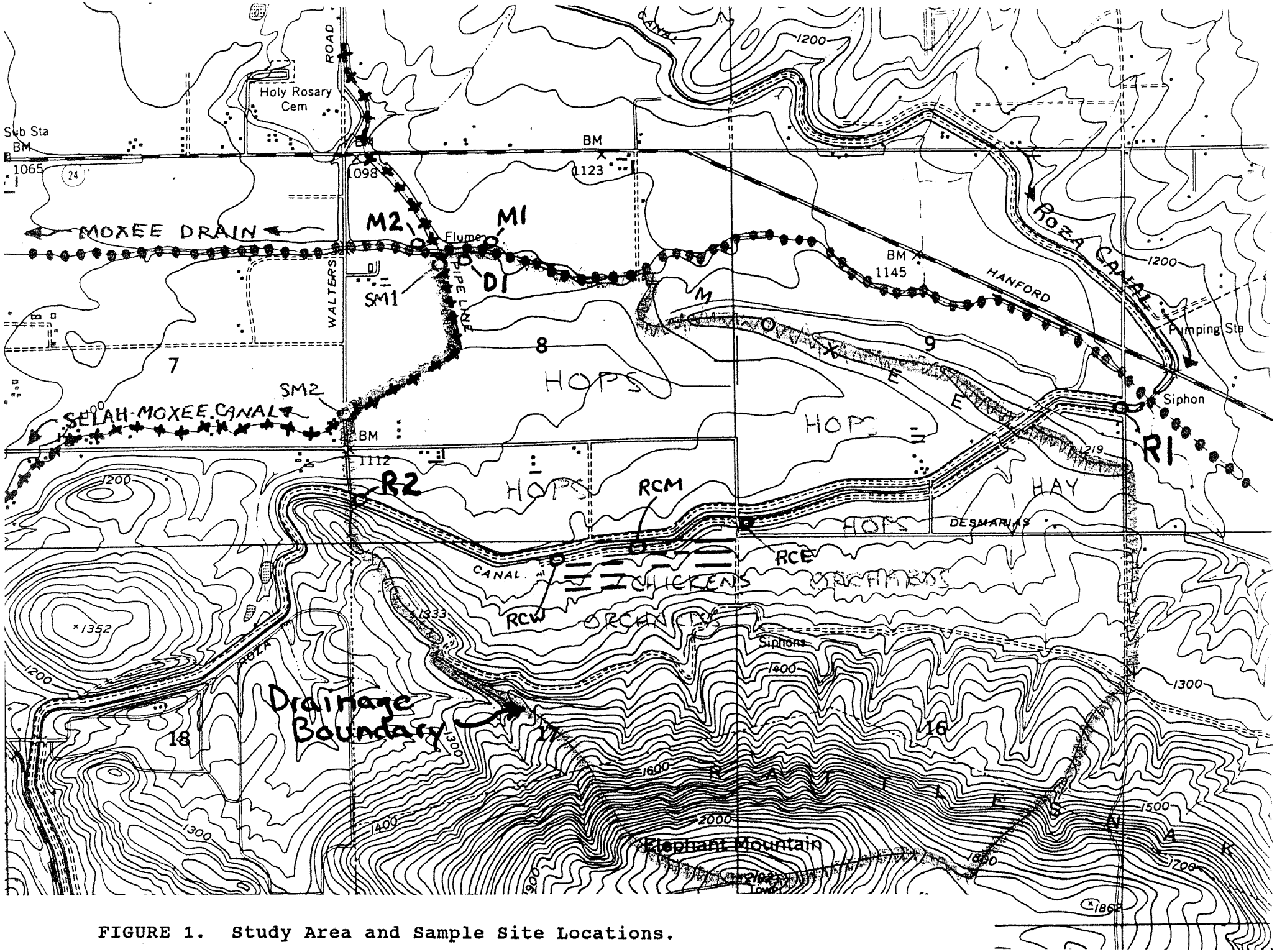

FIGURE 1. Study Area and Sample Site Locations.

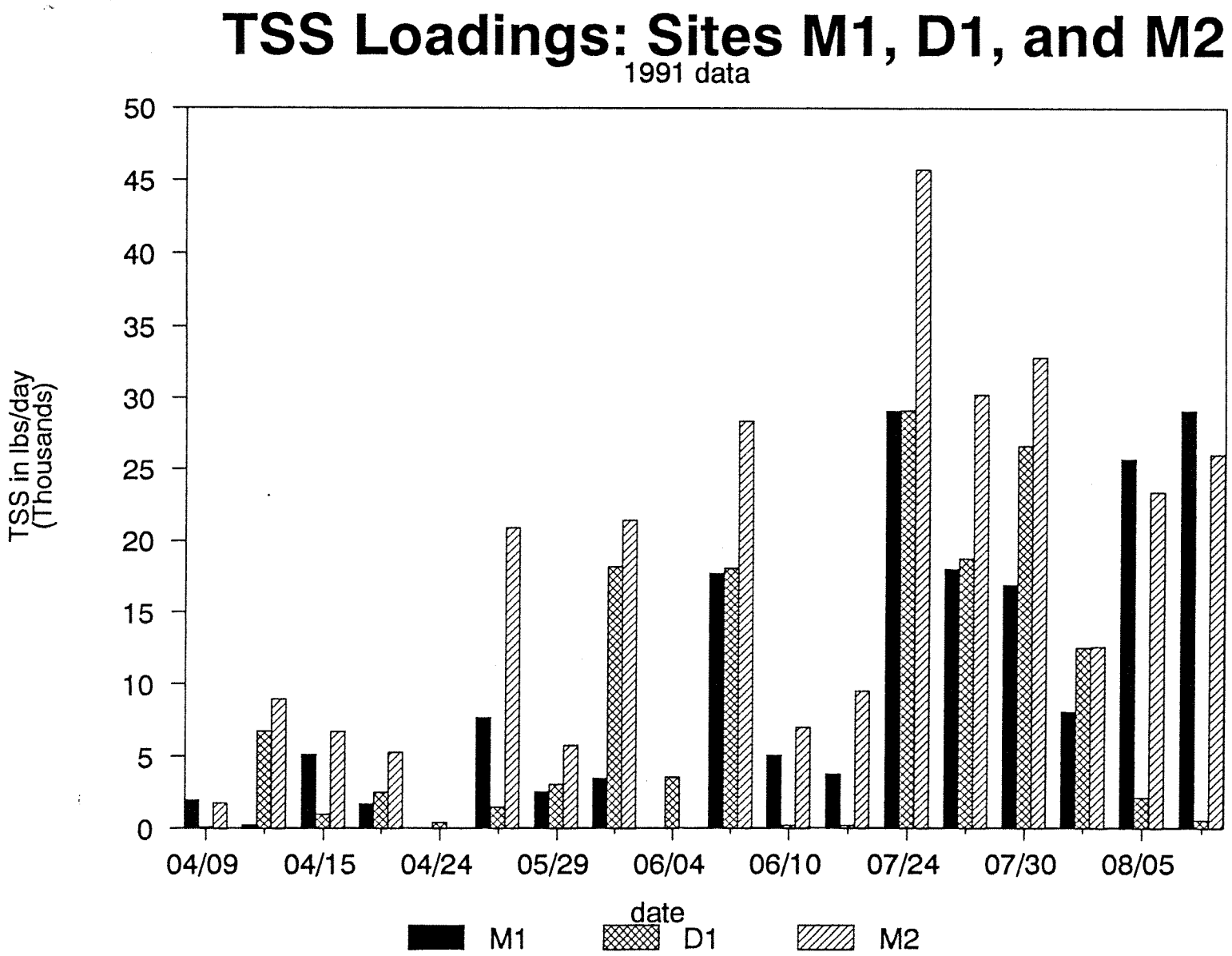

FIGURE 2. Total Suspended Solids (TSS) Loadings for Sites M1, D1, and M2.

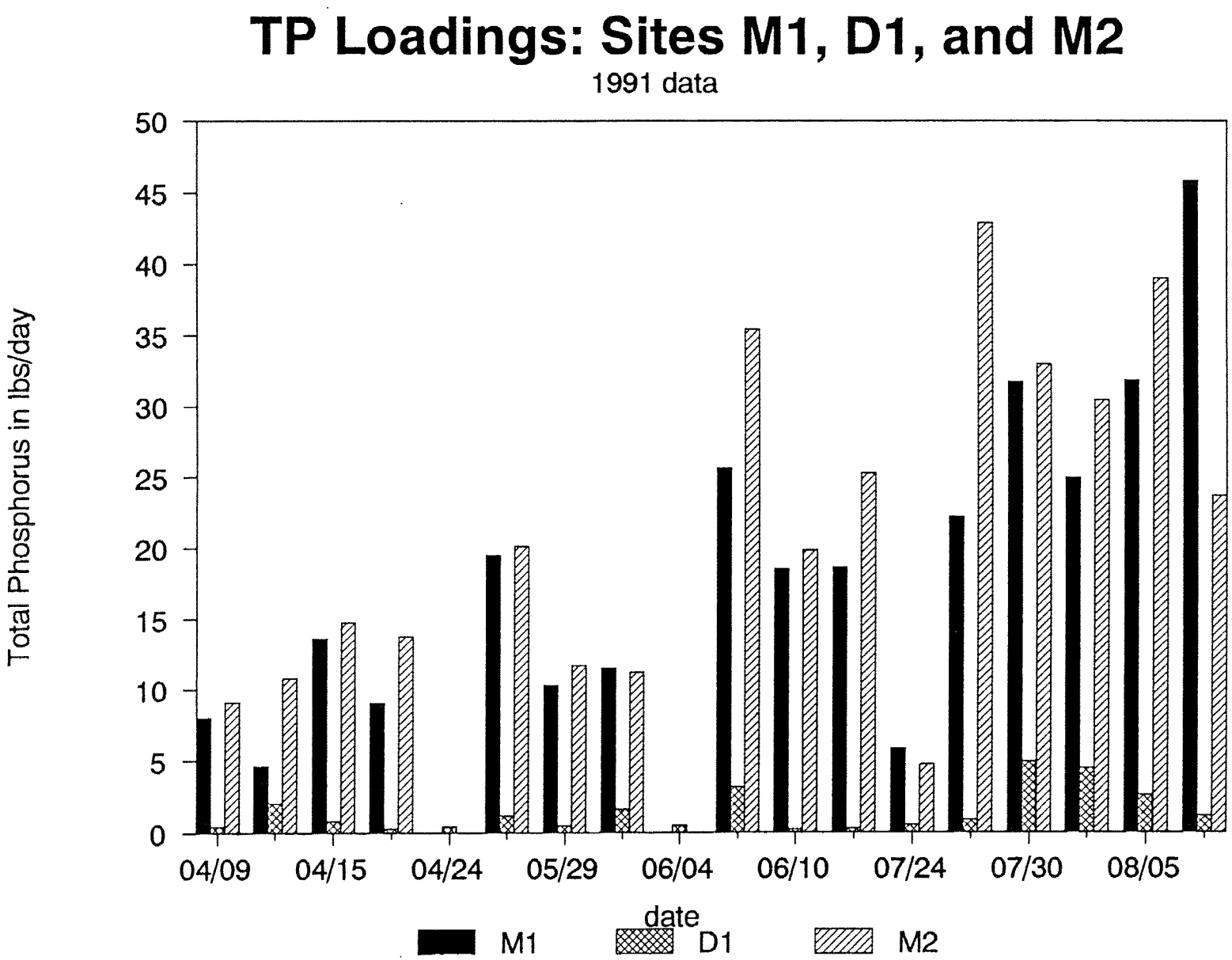

FIGURE 3. Total Phosphorus (TP) Loadings for Sites M1, D1, and M2.

APPENDICES

APPENDIX A. MOXEE BMP DEMONSTRATION PROJECT 1991 WATER QUALITY MONITORING DATA

				Field Measurements									Laboratory Analyses				
sta.	date	time	lab #	pH SU	temp1 deg.C	temp2 deg.C	temp3 deg.C	cond. uS/cm	Imhoff mL/L	turb. FTU	flow cfs	flow gpm	turb. NTU	TSS mg/L	NH3-N mg/L	NO2/3-N mg/L	Tphos mg/L
M2	04/09	12:55	158402	8.49	9.8	10.0		365		35	10.22	4587	6.8	33	0.022	0.7	0.168
M2	04/10	11:10	158412	8.32	9.1	9.5		360		225	5.39	2419	102	315	0.086	0.847	0.378
M2	04/15	14:25	168422	8.46	11.6	11.1		348		88	12.27	5504	30	104	0.034	0.593	0.227
M2	04/16	10:55	168432	8.42	10.5	10.6		354	LB	57	12.92	5796	22	78	0.041	0.592	0.201
M2	04/24	13:35	178442	8.83	14.9	14.9		337	0.01 t	94			31	135	0.052	0.528	0.275
M2	04/25	10:40	178452	8.30	10.1	10.8		400	0.06	215	10.62	4768	43.5	371	0.044	0.831	0.357
M2	05/29	15:15	228502					368	0.01 t	52	14.85	6662	22	73	0.046	0.643	0.148
M2	05/30	12:39	228512	8.59	15.2	15.4		343	0.1	124	16.15	7246	46	250	0.074	0.605	0.131
M2	06/04	14:30	238522	8.64	17.4	17.6		350	0.01 t	55			22	69	0.024	0.604	0.294
M2	06/05	12:15	238532	8.15	12.9	12.9		334	0.13	145	14.31	6420	49	374	0.061	0.61	0.467
M2	06/10	11:50	248542	8.15	14.2	14.4		330	0.04	43	15.66	7028	18	85	0.011	0.514	0.239
M2	06/11	10:30	248552	8.25	16.9	16.9		334	0.02	45	16.62	7458	18	108	0.01 U	0.522	0.287
M2	07/11	13:15				19.8	19.8		0.3	120							
M2	07/24	14:05	308402			22.2		315	0.57	300	15.70	7044	130	550	0.048	0.868	0.057
M2	07/25	10:15	308412			17.4		320	0.27	155	18.64	8365	50	306	0.017	0.729	0.434
M2	07/30	13:15	318422			20.2		320	0.33	150	19.19	8611	50	323	0.036	0.75	0.324
M2	07/31	10:25	318432			17.0		330	0.2	144	16.22	7279	40	146	0.038	0.875	0.354
M2	08/05	13:10	328442	8.07	17.2	17.5		325	0.27	100	23.82	10688	37	185	0.075	0.817	0.309
M2	08/06	10:20	328452	8.05	17.4	17.8	17.7	338	0.2	100	24.52	11006	39	200	0.037	0.755	0.182
M2	08/22	11:55					21.8		0.22								
M2	09/11	12:00					17		0.07	55							
M2	10/02	14:00					16.5		0.04	90							
M2	10/09	14:40					14.0		0.01 t	50							
M2	10/24	15:00					12.3		0.01 t	13							
M2	11/06	09:10					8.3		0.01 t	12							
M2	11/20	11:40					10		0.01 t	5							
M2	12/05	10:00					9.3		0.01 t	5							
M2	12/18	09:00					9		0.01 t	6							
M2	01/16	10:00					7.3		0.01 t	12							

APPENDIX A. Continued.

				Field Measurements									Laboratory Analyses				
sta.	date	time	lab #	pH SU	temp1 deg.C	temp2 deg.C	temp3 deg.C	cond. uS/cm	Imhoff mL/L	turb. FTU	flow cfs	flow gpm	turb. NTU	TSS mg/L	NH3-N mg/L	NO2/3-N mg/L	Tphos mg/L
D1	04/09	13:10	158403	8.72	13.1	13.4		920		48	0.430	193	7.9	47	0.045	1.79	0.186
D1	04/10	11:55	158413	8.28	11.5	11.6		540		1700	0.430	193	620 J	2980 J	0.097	2.17	0.904
D1	04/15	15:05	168423	8.79	11.9	11.7		600		120	0.535	240	44	358	0.073	3.77	0.283
D1	04/16	11:20	168433	8.80	11.7	11.7		520	LB	650	0.535	240	224	893	0.13 d	3.07	0.096
D1	04/24	16:10	178443	8.42	17.0	17.2		900	0.01 t	300	0.190	85	68	416	0.113	5.79	0.412
D1	04/25	11:20	178453	8.31	12.0	12.0		690	1.47	680	0.223	100	290 J	1290	0.083	4.13	1.01
D1	05/29	16:40	228503	8.16	15.5	15.8		680	0.47	676	0.535	240	164	1090	0.137	5.06	0.178
D1	05/30	14:10	228513	8.07	21.4	21.5		390	2.87	1500	1.086	487	252	3160	0.258	2.67	0.281
D1	06/04	14:40	238523	8.27	20.7	20.8		750	1	1440	0.337	151	360	2020	0.108	6.33	0.282
D1	06/05	08:40	238562	8.18	11.4	11.6		415		1000	0.783	351	236	3690	0.137	2.6	0.712
D1	06/05	12:25	238533	8.24	12.7	12.7		382	3.23	756	1.086	487	195	3140	0.164	2.38	0.544
D1	06/10	09:00	248565	8.25	14.5	13.5		925		100	0.259	116	39	191	0.017	7.22	0.218
D1	06/10	12:00	248543	8.25	17.9	18.0		910	0.02	120	0.190	85	46	224	0.03	7.12	0.242
D1	06/11	10:40	248553	8.46	15.8	15.6		880	0.02	100	0.259	116	37	174	0.017	7.3	0.222
D1	07/11	13:30				24.7	24.7		0.7	914	0.925	415					
D1	07/24	14:15	308403	7.97	23.9	23.7		260	2.5	910	2.348	1053	330	2340	0.144	1.4	0.042
D1	07/25	10:25	308413			19.6		245	2.5	760	1.650	740	320	2140	0.123	1.21	0.105
D1	07/30	13:25	318423			24.5		245	2.5	700	2.348	1053	230	2140	0.094	0.96	0.395
D1	07/31	08:35	318468	7.84	17.1	17.4		250		570	1.650	740	200	2230	0.087	1.1	0.498
D1	07/31	10:35	318433			18.9		253	1.9	650	1.650	740	200	1430	0.098	1.24	0.509
D1	08/05	13:20	328443	7.74	18.4	18.5		275	0.38	340	1.086	487	120	378	0.13	1.63	0.452
D1	08/06	10:30	328453	7.92	17.9	18.1	18.2	460	0.01 t	130	0.783	351	47	137	0.136	3.03	0.287
D1	08/22	12:05					22.8		0.53	220	2.611	1171					
D1	09/11	12:10					17.3		0.5	2100	0.783	351					
D1	10/02	14:10					20		1.5	950	2.611	1171					
D1	10/09	14:50					16.8		0.53	420	2.098	941					
D1	10/24	15:05					13.3		0.01 t	180	0.651	292					
D1	11/06	09:20					8.5		0.01 t	50	0.591	265					
D1	11/20	11:50					10.5		0.01 t	40	0.716	321					
D1	12/05	10:10					9.5		0.01 t	35	0.535	240					
D1	12/18	09:10					9		0.01 t	42	0.651	292					
D1	01/16	10:10					7		0.01 t	35	0.297	133					

APPENDIX A. Continued.

				Field Measurements									Laboratory Analyses				
sta.	date	time	lab #	pH SU	temp1 deg.C	temp2 deg.C	temp3 deg.C	cond. uS/cm	Imhoff mL/L	turb. FTU	flow cfs	flow gpm	turb. NTU	TSS mg/L	NH3-N mg/L	NO2/3-N mg/L	Tphos mg/L
M1	04/09	13:20	158401	8.57	10.3	10.6		335		34	9.79	4394	6.5	39	0.022	0.412	0.154
M1	04/10	11:40	158411	8.40	9.0	9.3		350		20	4.96	2226	6	10	0.013	0.62	0.175
M1	04/15	14:35	168421	8.46	10.4	10.9		338		92	11.73	5264	32	83	0.04	0.426	0.219
M1	04/16	11:10	168431	8.32	10.0	10.1		344	LB	21	12.38	5556	8.6	26	0.01 U	0.434	0.138
M1	04/24	16:30	178441	8.83	14.8	14.7		320	0.01 t	82			29.5	117	0.05	0.37	0.26
M1	04/25	10:55	178451	8.33	10.6	10.8		389	0.01 t	440	10.40	4668	82	140	0.042	0.675	0.354
M1	05/29	15:55	228501	8.46	15.3	15.7		350	0.01 t	31	14.31	6422	12	34	0.037	0.479	0.135
M1	05/30	13:55	228511	8.69	15.8	16.1		342	0.01 t	33	15.06	6759	14	44	0.03	0.453	0.144
M1	06/04	14:35	238521	8.67	17.0	17.1		335	0.01 t	19			11	26	0.014	0.422	0.173
M1	06/05	12:20	238531	8.21	12.7	12.7		322	0.17	94	13.22	5933	39	253	0.052	0.519	0.366
M1	06/10	11:55	248541	8.10	17.6	17.9		310	0.01 t	35	15.47	6943	15	62	0.012	0.45	0.226
M1	06/11	10:35	248551	8.27	17.0	16.8		330	0.01 t	28	16.36	7342	11.5	44	0.01 U	0.484	0.215
M1	07/11	13:25				19.4	19.4		0.17	109							
M1	07/24	14:10	308401			21.0		330	0.4	160	13.35	5991	75	411	0.036	0.834	0.082
M1	07/25	10:20	308411	8.09	17.7	17.9		322	0.2	100	16.99	7625	37	200	0.013	0.689	0.246
M1	07/30	13:20	318421			18.9		330	0.2	107	16.84	7558	37	189	0.039	0.717	0.355
M1	07/31	10:30	318431	8.01	17.4	17.6		340	0.1	78	14.57	6539	30	105	0.053	0.837	0.323
M1	08/05	13:15	328441	8.03	17.1	17.2		328	0.23	90	22.73	10201	35	213	0.044	0.769	0.264
M1	08/06	10:25	328451	8.08	17.4	17.6	17.4	330	0.2	95	23.74	10655	36	231	0.051	0.7	0.364
M1	08/22	12:00					21		0.01 t	52							
M1	09/11	12:05					17		0.1	45							
M1	10/02	14:05					16.3		0.01 t	23							
M1	10/09	14:45					13.8		0.01 t	20							
M1	10/24	15:10					12.3		0.01 t	10							
M1	11/06	09:15					8.5		0.01 t	7							
M1	11/20	11:45					10		0.01 t	5							
M1	12/05	10:05					9		0.01 t	4							
M1	12/18	09:05					9.8		0.01 t	5							
M1	01/16	10:05					7		0.01 t	5							

APPENDIX A. Continued.

					Field Measurements								Laboratory Analyses					
sta.	date	time	lab #	pH	temp1	temp2	temp3	cond.	Imhoff	turb.	flow	flow	turb.	TSS	NH3-N		NO2/3-N	Tphos
				SU	deg.C	deg.C	deg.C	uS/cm	mL/L	FTU	cfs	gpm	NTU	mg/L	mg/L		mg/L	mg/L
R1	04/09	10:35	158406	8.13	6.7	7.2		88		18	599	268831	5.3	8	0.01	U	0.014	0.018
R1	04/10	09:15	158416	8.29	6.7	7.0		92		17	599	268831	5.6	7	0.01	U	0.01	0.017
R1	04/15	12:15	168426	8.02	8.6	8.8		84		18	688	308774	6.1	14	0.01	U	0.01	0.019
R1	04/16	09:00	168436	7.82	8.7	8.6		78	LB	14	688	308774	6	15	0.01	U	0.019	0.019
R1	04/24	13:05	178446	8.33	10.5	11.0		88		24	688	308774	10	24	0.01	U	0.047	0.038
R1	04/25	09:50	178456	7.99	8.9	8.8		79		24	688	308774	10	20	0.01	U	0.054	0.043
R1	05/29	13:40	228504	8.08	15.0	15.4		130		14	706	316853	2.5	25	0.01	U	0.084	0.031
R1	05/30	10:30	228514	8.60	12.8	13.0		112		11	725	325380	2.4	9	0.01	U	0.121	0.032
R1	06/04	12:05	238524	8.11	14.0	14.1		106		12	764	342883	3.9	11	0.01	U	0.089	0.031
R1	06/05	10:00	238534	8.29	12.8	12.9		101		11			4.1	11	0.01	U	0.09	0.037
R1	06/10	10:00	248544	7.98	16.0	16.2		100		17	783	351410	5.9	17	0.01	U	0.148	0.053
R1	06/11	08:45	248554	8.02	16.1	16.2		102		13	764	342883	5.1	17	0.01	U	0.157	0.051
R1	07/11	11:35				18.9	18.9			14	865	388212						
R1	07/24	11:15	308404	7.88	19.4	17.0		90		10			5	15	0.01	U	0.166	0.019
R1	07/25	08:25	308414	7.84	16.1	16.4		84		13	865	388212	5.8	17	0.01	U	0.172	0.026
R1	07/30	11:00	318424	7.89	17.2	17.4		85		10	865	388212	5.3	12	0.013		0.165	0.032
R1	07/31	09:10	318434	8.06	16.1	16.9		82		12	865	388212	5	16	0.01	U	0.15	0.034
R1	08/05	10:55	328444	7.59	15.3	15.8		88		6	1114	499963	4.9	9	0.01	U	0.14	0.029
R1	08/06	08:40	328454	7.80	16.7	16.9	17.3	85		9	886	397637	4.6	10	0.01	U	0.15	0.028
R1	08/22	11:00					19.3			11	824	369811						
R1	09/11	11:00					18.3			10	652	292618						
R1	10/02	13:00					16.8			6	517	232030						
R1	10/09	13:30					13.3			6	502	225298						

APPENDIX A. Continued.

				Field Measurements									Laboratory Analysis					
sta.	date	time	lab #	pH	temp1	temp2	temp3	cond.	Imhoff	turb.	flow	flow	turb.	TSS	NH3-N		NO2/3-N	Tphos
				SU	deg.C	deg.C	deg.C	uS/cm	mL/L	FTU	cfs	gpm	NTU	mg/L	mg/L		mg/L	mg/L
R2	04/09	11:15	158407	8.24	7.3	7.2		93		19			5	9	0.01	U	0.01	0.016
R2	04/10	09:40	158417	8.35	7.5	7.3		87		18			5.5	9	0.01	U	0.01	0.018
R2	04/15	12:50	168427	8.02	9.0	8.8		83		19			7.3	18	0.01	U	0.01	0.017
R2	04/16	09:30	168437	7.78	8.6	8.9		78.2	LB	15			5.4	17	0.01	U	0.01	0.016
R2	04/24	13:30	178447	8.34	11.5	10.9		84		24			11	26	0.01	U	0.042	0.045
R2	04/25																	
R2	05/29	14:25	228505	8.09	14.9	15.3		114		14			5.6	35	0.01	U	0.088	0.034
R2	05/30	11:45	228515	8.40	13.4	13.6		114		12			3	11	0.01	U	0.121	0.031
R2	06/04	13:25	238525	8.11	14.9	14.4		103		11			3.9	11	0.01	U	0.092	0.035
R2	06/05	11:05	238535	8.12	13.2	13.0		105		12			3.4	13	0.01	U	0.094	0.032
R2	06/10	10:35	248545	7.98	16.9	17.0		101		14			4.9	19	0.01	U	0.147	0.053
R2	06/11	09:20	248555	7.96	16.3	16.4		101		14			4.2	16	0.01	U	0.154	0.048
R2	07/11	12:25				18.8	18.8			12								
R2	07/24	12:25	308405	7.92	20.3	19.3		80		12			4.6	14	0.01	U	0.156	0.023
R2	07/25	09:20	308415	7.80	16.5	16.9		84		15			6.4	18	0.01	U	0.173	0.027
R2	07/30	11:55	318425	7.94	17.4	17.6		78		10			3.9	11	0.012		0.144	0.033
R2	07/31	09:45	318435	7.66	17.2	16.8		75		11			4.8	12	0.01		0.138	0.037
R2	08/05	11:50	328445	7.67	15.6	15.9		76		7			5.6	13	0.012		0.149	0.03
R2	08/06	09:45	328455	7.75	16.2	16.4	16.8	85		10			4.1	9	0.01	U	0.152	0.027
R2	08/22	11:35					19.5			9								
R2	09/11	11:40					18.5			10								
R2	10/02	13:40					17			8								
R2	10/09	14:15					14			7								

APPENDIX A. Continued.

				Field Measurements									Laboratory Analysis				
sta.	date	time	lab #	pH SU	temp1 deg.C	temp2 deg.C	temp3 deg.C	cond. uS/cm	Imhoff mL/L	turb. FTU	flow cfs	flow gpm	turb. NTU	TSS mg/L	NH3-N mg/L	NO2/3-N mg/L	Tphos mg/L
RCE	05/30	11:00	228560	7.99	15.5	15.6		118		190	0.223	100	78	634	0.1	0.173	0.116
RCE	06/04	12:40	238561	8.60	19.3	19.3		109		132	0.008	38	60	190	0.049	0.119	0.16
RCE	06/05	10:35	238563	7.84	11.9	11.9		109		168	0.112	50	52	225	0.055	0.157	0.162
RCE	07/24	11:50	308460	7.90	25.7	26.0		80		720	0.335	150	250	823	0.102	0.272	0.027
RCE	07/25	08:50	308463	7.99	18.8	19.0		83		390	0.301	135	150	489	0.071	0.245	0.033
RCE	07/30	11:30	318465	8.13	23.4	23.5		85		270	0.290	130	75	266	0.031	0.143	0.187
RCE	07/31	09:30	318469	7.76	19.7	19.6		85		350	0.089	40	170	455	0.035	0.222	0.178
RCE	08/05	11:20	328469	7.84	19.2	19.2		95		620	0.107	48	180	493	0.123	0.557	0.172
RCE	08/06	09:20	328473	8.19	20.4	20.6	20.9	148		2400			700	1590	0.466	0.929	0.474
RCE	08/22									950							
RCM	07/24	12:55	308461	8.77	33.9	33.0		155		325	0.025	11	130	277	4.91	0.872	3.1
RCM	07/25	09:30	308464	8.84	21.8	21.8		170		450	0.013	6	140	281	5.29	1.26	1.83
RCM	07/30	12:20	318466	9.35	29.3	29.5		164		54	0.002	1	10	13	1.38	5.22	1.53
RCM	08/05	12:10	328470	7.88	21.0	21.1		430		160	0.002	1	22	33	7.57	3.11	8.05
RCW	06/10	11:00	248566	7.99	18.3	18.5		110		85	0.004	16	40	481	0.01 U	0.148	0.179
RCW	06/11	09:45	248567	8.03	16.4	16.3		101		84	0.004	16	31	476	0.01 U	0.151	0.404
RCW	07/24	13:15	308462	8.62	33.6	33.0		130		30	0.004	2	4.5	8	0.154	1.49	1.29
RCW	07/30	12:40	318467	7.88	30.5	30.7		147		25	0.007	3	3.2	3	0.353	3.39	1.07
RCW	08/05	12:30	328471	7.39	20.7	20.8		244		70	0.002	1	15	12	0.305	4.14	2.27

APPENDIX A. Continued.

				Field Measurements									Laboratory Analyses				
sta.	date	time	lab #	pH SU	temp1 deg.C	temp2 deg.C	temp3 deg.C	cond. uS/cm	Imhoff mL/L	turb. FTU	flow cfs	flow gpm	turb. NTU	TSS mg/L	NH3-N mg/L	NO2/3-N mg/L	Tphos mg/L
SM2	04/09	11:55	158405	8.49	9.4	9.7		118		30			7.1	30	0.015		0.024	0.042
SM2	04/10	10:25	158415	8.46	8.4	8.9		111		22			9.6	14	0.01		0.019	0.026
SM2	04/15	13:40	168425	9.11	11.9	11.5		94		18			5.8	11	0.01	U	0.01	0.021
SM2	04/16	10:00	168435	8.83	9.8	10.0		93.6	LB	20			7.3	21	0.01	U	0.01	0.027
SM2	04/24	13:55	178445	9.31	14.8	14.9		96		19			9.9	13	0.01	U	0.01	0.029
SM1	04/09	12:35	158404	8.44	9.1	9.6		106		30			7.1	32	0.012		0.022	0.04
SM1	04/10	10:55	158414	8.47	8.4	9.2		110		19			7.5	11	0.01	U	0.018	0.028
SM1	04/15	14:05	168424	9.03	11.3	11.0		95		17			5.9	12	0.01	U	0.012	0.021
SM1	04/16	10:25	168434	8.74	9.6	9.7		93.3	LB	25			7.6	23	0.01	U	0.019	0.026
SM1	04/24	14:20	178444	9.12	14.6	14.2		97		21			8.9	20	0.01	U	0.029	0.038

U - not detected at or above the reported result
J - the analyte was positively identified, the associated numerical result is an estimate
d - the dissolved portion of the sample was analyzed (sample was filtered prior to analysis)
LB - laboratory determined, conductivity meter malfunctioned in the field
t - trace measured, <0.05 mL/L (value of 0.01 mL/L used in averaging)
temp1 - temperature measured with a mercury thermometer
temp2 - temperature measured with a thermistor attached to the pH meter
temp3 - temperature measured with a bimetal thermometer

APPENDIX B. RESULTS OF DUPLICATE ANALYSES.

station	date	time	lab #	pH S.U.	temp1 deg.C	temp2 deg.C	cond. uS/cm	turb. FTU	turb. NTU	TSS mg/L	NH3-N mg/L	NO2/3-N mg/L	Tphos mg/L
M1	04/09	13:20	158401	8.57	10.3	10.6	335	34	6.5	39	0.022	0.412	0.154
QA (M1)	04/09	13:30	158400	8.57	10.2	10.5	335	34	5.8	27	0.016	0.41	0.144
RPD	04/09						0.00	0.00	11.38	36.36	31.58	0.49	6.71
RSD	04/09						0.00	0.00	0.06	0.18	0.16	0.00	0.03
M2	04/10	11:10	158412	8.32	9.1	9.5	360	225	102	315	0.086	0.847	0.378
QA (M2)	04/10	11:25	158410	8.39	9.1	9.5	400	278	117	485 J	0.054	0.973	0.486
RPD	04/10						10.53	21.07	13.70	42.50	45.71	13.85	25.00
RSD	04/10						0.05	0.11	0.07	0.21	0.23	0.07	0.12
D1	04/15	15:05	168423	8.79	11.9	11.7	600	120	44	358	0.073	3.77	0.283
QA (D1)	04/15	15:15	168420	8.82	11.4	11.6	590	120	46	362	0.065	3.75	0.25
RPD	04/15						1.68	0.00	4.44	1.11	11.59	0.53	12.38
RSD	04/15						0.01	0.00	0.02	0.01	0.06	0.00	0.06
R2	04/16	09:30	168437	7.78	8.6	8.9	78.2 LB	15	5.4	17	0.01 U	0.01 U	0.016
QA (R2)	04/16	09:40	168430	7.73	8.4	8.6	77.8 LB	14	5.4	17	0.01 U	0.01 U	0.018
RPD	04/16						0.51	6.90	0.00	0.00	0.00	0.00	11.76
RSD	04/16						0.00	0.03	0.00	0.00	0.00	0.00	0.06
M1	04/24	16:30	178441	8.83	14.8	14.7	320	82	29.5	117	0.05	0.37	0.26
QA (M1)	04/24	16:30	178440						29.5	125	0.036	0.372	0.265
RPD	04/24								0.00	6.61	32.56	0.54	1.90
RSD	04/24								0.00	0.03	0.16	0.00	0.01
M2	04/25	10:40	178452	8.30	10.1	10.8	400	215	43.5	371	0.044	0.831	0.357
QA (M2)	04/25	11:30	178450	8.38	10.9	11.2	375	212	100	329	0.048	0.801	0.423
RPD	04/25						6.45	1.41	78.75	12.00	8.70	3.68	16.92
RSD	04/25						0.03	0.01	0.39	0.06	0.04	0.02	0.08

APPENDIX B. Continued.

station	date	time	lab #	pH S.U.	temp1 deg.C	temp2 deg.C	cond. uS/cm	turb. FTU	turb. NTU	TSS mg/L	NH3-N mg/L	NO2/3-N mg/L	Tphos mg/L
M2	05/30	12:39	228512	8.59	15.2	15.4	343	124	46	250	0.074	0.605	0.131
QA (M2)	05/30	12:37	228510	8.55	15.3	15.5	346	148	42	213 H	0.085	0.565	0.123
RPD	05/30						0.87	17.65	9.09	15.98	13.84	6.84	6.30
RSD	05/30						0.00	0.09	0.05	0.08	0.07	0.03	0.03
D1	06/04	14:40	238523	8.27	20.7	20.8	750	1440	360	2020	0.108	6.33	0.282
QA (D1)	06/04	14:40	238520	8.25	20.7	20.8	750	1442	355	1700	0.126	6.45	0.289
RPD	06/04						0.00	0.14	1.40	17.20	15.38	1.88	2.45
RSD	06/04						0.00	0.00	0.01	0.09	0.08	0.01	0.01
M1	06/05	12:20	238531	8.21	12.7	12.7	322	94	39	253	0.052	0.519	0.366
QA (M1)	06/05	12:20	238530	8.17	12.8	12.8	325	108	38	266	0.057	0.52	0.359
RPD	06/05						0.93	13.86	2.60	5.01	9.17	0.19	1.93
RSD	06/05						0.00	0.07	0.01	0.03	0.05	0.00	0.01
M2	06/11	10:30	248552	8.25	16.9	16.9	334	45	18	108	0.01 U	0.522	0.287
QA (M2)	06/11	10:30	248550	8.30	17.1	17.2	333	44	20	102	0.01 U	0.54	0.268
RPD	06/11						0.30	2.25	10.53	5.71	0.00	3.39	6.85
RSD	06/11						0.00	0.01	0.05	0.03	0.00	0.02	0.03
D1	07/24	14:15	308403			26.0	260	910	330	2340	0.144	1.4	0.042
QA (D1)	07/24	14:15	308400						340	2140	0.131	1.03	0.134
RPD	07/24								2.99	8.93	9.45	30.45	104.55
RSD	07/24								0.01	0.04	0.05	0.15	0.52

APPENDIX B. Continued.

station	date	time	lab #	pH S.U.	temp1 deg.C	temp2 deg.C	cond. uS/cm	turb. FTU	turb. NTU	TSS mg/L	NH3-N mg/L	NO2/3-N mg/L	Tphos mg/L
M1	07/25	10:20	308411			16.8	322	100	37	200	0.013	0.689	0.246
QA (M1)	07/25	10:20	308410			16.8	319	109	33	218	0.018	0.674	0.232
RPD	07/25						0.94	8.61	11.43	8.61	32.26	2.20	5.86
RSD	07/25						0.00	0.04	0.06	0.04	0.16	0.01	0.03
R2	07/30	11:55	318425	7.94	17.4	17.6	78	10	3.9	11	0.012	0.144	0.033
QA (R2)	07/30	11:55	348420	8.00	17.9	18.0	85	10	6.7	16	0.012	0.135	0.035
RPD	07/30						8.59	0.00	52.83	37.04	0.00	6.45	5.88
RSD	07/30						0.04	0.00	0.26	0.19	0.00	0.03	0.03
M1	07/31	10:30	318431			16.4	340	78	30	105	0.053	0.837	0.323
QA (M1)	07/31	10:30	318430				338	80	30	105	0.046	0.824	0.336
RPD	07/31						0.59	2.53	0.00	0.00	14.14	1.57	3.95
RSD	07/31						0.00	0.01	0.00	0.00	0.07	0.01	0.02
R1	08/06	08:40	328454	7.80	16.7	16.9	85	9	4.6	10	0.01 U	0.15	0.028
QA (R1)	08/06	08:40	328450	7.77	16.3	16.5	85	8	4.7	10	0.013	0.15	0.03
RPD	08/06						0.00	11.76	2.15	0.00	26.09	0.00	6.90
RSD	08/06						0.00	0.06	0.01	0.00	0.13	0.00	0.03

RPD = relative percent difference = difference of values X 100 / mean of values
RSD = relative standard deviation = standard deviation / mean of values

U - not detected at or above the reported result
J - the analyte was positively identified, the associated numerical result is an estimate
H - the sample holding time was exceeded
LB - laboratory determined, conductivity meter malfunctioned in the field