NUTRIENT LOADING AND FLAMING GORGE RESERVOIR

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ABSTRACT

Data and analyses are presented for approximately 400 water samples collected at eight locations in the drainage basin of Flaming Gorge Reservoir. Up to 24 chemical parameters were analzyed from each sample (cations: calcium, magnesium, sodium, potassium; anions: bicarbonate, carbonate, sulfate, chloride, fluoride, total alkalinity; nutrients: ortho-phosphorus, total phosphorus, sodium hydroxide extractable phosphorus, ammonium, nitrate, total kjelkahl nitrogen, iron, manganese; miscellaneous: conductivity, total dissolved solids, suspended solids, pH, chemical oxygen demand, biochemical oxygen demand).

In SW Wyoming, NaOH-extractable phosphorus (NaOH-P) is correlated with biologically available phosphorus (bioassays). Data on NaOH-P, ortho-P and suspended solids (N=541) were obtained from a sewage treatment plant and seven streams. Scatter plots, cluster analyses and regression analysis indicated the eight locations could be aggregated into four GROUPs. Regressions were developed to predict ln(NaOH-P) (LNaOH-P) from ln(suspended solids) (LSS), ln(ortho-P) (LOP), GROUP, presence/absence of high flow, and presence/absence of beaver dams. While the percent of explained variation attributable to LOP and LSS exceeded by 5-8 times that attributable to other variables, the effects of other variables were significant; both intercepts and slopes were affected. The explained variance in LNaOH-P for streams ranged from 55-87%, but was only 21% for the treatment plant. The 95% confidence limits on the mean value of NaOH-P (X - 0.8X; X + 7X) indicate that precision generally was poor; the best obtainable precision was X $\pm$ 0.5X. Precision always tended to be poor when LOP was more influential in affecting LNaOH-P than was LSS, but but only in some cases where LSS was highly influential was precision good.

CONTENTS

I. INTRODUCTION

We listed five tasks in our proposal. The first and second of these were i) to subcontract with the Water Quality Laboratory at Western Wyoming College to collect and analyze water samples from several locations in the Green River Basin, and ii) to compile and disseminate the data. Results from this effort, and other data collected from years previous, are presented in Chapter II.

The third task was to analyze the chemical data from one year only, the intention being to evaluate loadings to Flaming Gorge Reservoir for the time covered by the grant. Interpretation was to be performed in conjunction with the fourth task, extending inferences which can made with data from only one year. Finally, we were to participate in an effort to evaluate the relative importance of internal and external loading to eutrophication problems in Flaming Gorge Reservoir.

Because, in the best sense, successful completion of these tasks is dependent on work still being performed elsewhere (e.g., Utah Water Research Laboratory, Bureau of Reclamation, U.S. Army Corps of Engineers Waterways Experiment Station), the emphasis in this report will diverge somewhat from that outlined by our five tasks. In so doing we concentrate on blocks of reportable, complete work, and defer some analysis and interpretation to the final report of the ongoing Wyoming Water Center project, "Techniques for Augmenting Water Quality Data: Application to Flaming Gorge Reservoir and to Sampling Protocols."

Thus in Chapter III we present and discuss results of statistical analyses for cations, anions, nutrients and miscellaneous chemical variables using data collected in 1984, 1985 and part of 1986. This work has set the stage for additional multivariate statistical analyses which will be of more general interest, and publishable in the open literature (e.g., Chapter IV).

Chapter IV reports on a detailed multivariate statistical analysis designed to determine whether an index of biologically available phosphorus - sodium hydroxide extractable phosphorus (NaOH-P) - can be predicted from data on suspended solids (SS) and ortho-phosphorus (OP). This is an important question because, in terms of eutrophication, the ultimate measure of phosphorus is that which is biologically available, but bioassays are exceedingly expensive. And, because there are existing data on SS and OP which could be used to predict NaOH-P for years past, we might be able to evaluate the importance for eutrophication of NaOH-P versus other measures of phosphorus using existing data (Flaming Gorge and elsewhere). Or, we might be able less expensively to index biologically available phosphorus in the future by measuring NaOH-P rather than by performing bioassays.

For analyses in this chapter the data from Chapter II are combined with data collected under previous Water Center grants (e.g., "Mitigation of Non-Point Source Water Quality Pollution Using Riparian Restoration"), and several other sources. We hoped originally to evaluate the effects of storm events on export of nutrients, but appropriate data were difficult to find in the open literature and an attempt to obtain proprietary data was unsuccessful. However, we were able to evaluate the effect of high flow on the concentration of NaOH-P via regression analyses with indicator variables.

II. COLLECTION OF WATER SAMPLES AND CHEMICAL ANALYSES

During the course of this and previous grants, 390 water samples were collected from eight locations (Figure IV-1). In most cases analyses were made for 24 variables, categorized for this report as follows:

Cations: calcium, magnesium, sodium, potassium

Anions: bicarbonate (HCO_3), carbonate (CO_3), sulfate (SO_4), chloride (Cl), fluoride (F), total alkalinity (tot alk)

Nutrients: ortho-phosphorus (OP-P), total phosphorus (TP-P), sodium hydroxide extractable phosphorus (NaOH-P), ammonium (NH_4-N), nitrate (NO_3-N), total kjelkahl nitrogen (TKN), iron (Fe), manganese (Mn)

Miscellaneous: conductivity (cond), total dissolved solids (TDS), suspended solids (SS), pH, chemical oxygen demand (COD), biochemical oxygen demand (BOD)

These data are presented in tabular form in Tables II-1 and II-2. The information is arranged chronologically for each category (cations, anions, etc.), with a separate table for each of the eight sampling locations. Upon request, the data also are are available from us in ASCII format on a 5.25 inch floppy disk for use on an IBM PC computer. Information was entered into an electronic data base (KnowledgeMan) using a double-entry verification system to minimize errors of transcription.

In addition, the data should be obtainable on nine-track magnetic tape from the Bureau of Reclamation, Salt Lake City (William Vernieu UC-762, U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, UT 84147)

Table II-1. Concentrations of cations and anions. Data are arranged by site (alphabetically), year, month and day. Abbreviations for sites are: BC, Bitter Creek; BF, Blacks Fork; BS, Big Sandy; CC, Currant Creek; FM, Green River at FMC bridge; JA, Green River at Green River; SC, Sage Creek; TP, effluent from the Green River sewage treatment plant. Units are mg/L (as $CaCO_3$ for total alkalinity); zeros indicate an analysis was not performed.

SITE	YEAR	MONTH	DAY	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	Tot Alk
BC	84	6	18	120.0	120.0	370.0	11.0	280.00	28.00	876.00	280.0	0.52	280.0
			25	110.0	120.0	440.0	14.0	290.00	13.00	915.00	350.0	0.68	260.0
		7	2	110.0	140.0	530.0	15.0	230.00	37.00	1010.00	450.0	0.60	250.0
			9	120.0	140.0	820.0	17.0	340.00	0.10	1160.00	820.0	0.63	280.0
			16	130.0	160.0	650.0	16.0	310.00	20.00	1240.00	590.0	0.62	290.0
			23	140.0	120.0	730.0	18.0	210.00	0.10	1100.00	750.0	0.57	180.0
			30	110.0	93.0	330.0	13.0	240.00	0.10	821.00	280.0	0.53	200.0
		8	6	150.0	110.0	340.0	14.0	190.00	0.10	944.00	260.0	0.47	160.0
			13	89.0	45.0	250.0	16.0	150.00	0.10	490.00	230.0	0.51	120.0
			20	140.0	76.0	250.0	13.0	150.00	0.10	785.00	183.0	0.42	120.0
			27	130.0	59.0	320.0	22.0	190.00	0.10	720.00	250.0	0.49	160.0
		9	4	140.0	130.0	840.0	20.0	340.00	18.00	1300.00	780.0	0.64	300.0
			10	120.0	89.0	460.0	13.0	250.00	0.10	970.00	345.0	0.52	200.0
			27	86.0	66.0	310.0	11.0	180.00	0.10	593.00	260.0	0.39	150.0
		10	1	130.0	150.0	500.0	16.0	330.00	9.80	1160.00	410.0	0.51	290.0
			9	130.0	170.0	640.0	16.0	230.00	49.00	1330.00	520.0	0.56	270.0
		11	5	140.0	170.0	540.0	14.0	400.00	0.10	1260.00	430.0	0.51	330.0
	85	3	19	110.0	89.0	280.0	9.4	230.00	0.10	802.00	190.0	0.47	190.0
		4	9	140.0	120.0	340.0	13.0	330.00	0.10	1000.00	230.0	0.52	270.0
			22	160.0	180.0	500.0	13.0	410.00	0.10	1310.00	350.0	0.50	340.0
		5	6	260.0	110.0	630.0	15.0	300.00	39.00	1430.00	450.0	0.62	310.0
			21	140.0	210.0	800.0	17.0	290.00	44.00	1680.00	630.0	0.60	310.0
		6	3	140.0	250.0	1170.0	22.0	320.00	65.00	1950.00	1100.0	0.70	370.0
			18	110.0	160.0	1200.0	21.0	300.00	90.00	1500.00	1200.0	0.77	400.0
		7	1	95.0	140.0	1000.0	19.0	180.00	110.00	1310.00	870.0	0.63	330.0
			15	88.0	91.0	790.0	18.0	390.00	0.10	872.00	730.0	0.67	320.0
			30	150.0	120.0	670.0	18.0	290.00	14.00	1210.00	580.0	0.61	260.0
		8	13	84.0	98.0	870.0	20.0	230.00	70.00	928.00	820.0	0.61	310.0
			27	220.0	66.0	1000.0	20.0	400.00	55.00	1180.00	1000.0	0.66	390.0
		9	10	200.0	49.0	980.0	21.0	290.00	59.00	1050.00	980.0	0.67	340.0
	86	2	4	240.0	160.0	1100.0	21.0	420.00	0.10	1640.00	1000.0	0.56	350.0
		3		240.0	43.0	330.0	9.0	240.00	0.10	956.00	230.0	0.44	200.0
			26	170.0	180.0	570.0	14.0	370.00	0.10	1550.00	390.0	0.57	300.0
		4	8	290.0	150.0	750.0	17.0	400.00	0.10	1710.00	620.0	0.59	330.0
			15	230.0	170.0	750.0	16.0	410.00	0.10	1580.00	612.0	0.59	330.0
			22	190.0	100.0	460.0	10.0	260.00	0.10	1310.00	250.0	0.67	210.0
			28	110.0	110.0	420.0	9.4	330.00	11.00	1030.00	200.0	0.63	290.0
		5	5	150.0	170.0	680.0	14.0	420.00	0.10	1250.00	570.0	0.63	340.0
			12	130.0	160.0	560.0	13.0	400.00	11.00	1290.00	470.0	0.68	350.0
			20	140.0	180.0	710.0	15.0	390.00	0.10	1350.00	680.0	0.61	320.0
			27	130.0	180.0	850.0	17.0	360.00	17.00	1540.00	770.0	0.63	320.0
		6	2	130.0	190.0	900.0	18.0	290.00	57.00	1530.00	810.0	0.62	330.0
			11	140.0	150.0	440.0	13.0	230.00	0.10	1220.00	250.0	0.43	190.0
			17	130.0	160.0	860.0	16.0	340.00	11.00	1530.00	690.0	0.72	300.0

Table II-1 (continued)

SITE	YEAR	MONTH	DAY	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	Tot Alk
			24	110.0	160.0	1100.0	20.0	250.00	56.00	1510.00	1200.0	0.67	300.0
BF	84		18	92.0	34.0	83.0	4.7	230.00	21.00	230.00	53.0	0.31	220.0
			25	80.0	26.0	61.0	3.7	260.00	0.10	173.00	33.0	0.31	210.0
		7	2	100.0	31.0	83.0	3.9	240.00	2.80	266.00	46.0	0.39	200.0
			9	97.0	33.0	78.0	3.1	260.00	0.10	262.00	49.0	0.37	210.0
			16	120.0	43.0	120.0	4.7	270.00	2.80	416.00	65.0	0.48	230.0
			23	76.0	25.0	140.0	5.9	290.00	0.10	300.00	68.0	0.48	240.0
			30	120.0	40.0	210.0	6.6	270.00	0.10	409.00	71.0	0.49	220.0
		8	6	110.0	39.0	110.0	4.3	250.00	0.10	371.00	52.0	0.46	200.0
			13	110.0	43.0	120.0	5.5	240.00	0.10	0.00	57.0	0.46	200.0
			20	97.0	36.0	130.0	3.9	240.00	0.10	364.00	60.0	0.46	200.0
		9	4	110.0	42.0	150.0	3.9	220.00	2.50	488.00	67.0	0.47	180.0
			10	110.0	38.0	180.0	4.0	220.00	0.10	498.00	78.0	0.47	180.0
			17	100.0	44.0	140.0	4.7	230.00	0.10	449.00	68.0	0.44	190.0
		10	1	100.0	40.0	120.0	5.1	220.00	2.50	468.00	58.0	0.39	190.0
			8	95.0	39.0	120.0	3.9	200.00	0.10	397.00	61.0	0.39	160.0
		11	5	82.0	33.0	110.0	3.9	180.00	0.10	314.00	52.0	0.31	150.0
	85	3	18	65.0	27.0	120.0	4.3	190.00	0.10	298.00	56.0	0.39	150.0
		4	9	60.0	23.0	62.0	4.7	230.00	0.10	160.00	38.0	0.29	190.0
			22	53.0	18.0	37.0	2.7	220.00	0.10	89.00	23.0	0.18	180.0
		5	6	80.0	7.3	51.0	3.5	190.00	0.10	117.00	30.0	0.23	160.0
			21	85.0	33.0	92.0	4.7	260.00	0.10	241.00	53.0	0.33	210.0
		6	3	110.0	40.0	120.0	4.7	280.00	0.10	357.00	57.0	0.50	230.0
			18	130.0	55.0	170.0	5.9	290.00	0.10	553.00	73.0	0.60	240.0
		7	1	120.0	56.0	200.0	7.0	270.00	24.00	580.00	89.0	0.54	260.0
			15	130.0	56.0	200.0	5.9	260.00	0.10	653.00	67.0	0.61	210.0
			29	110.0	42.0	160.0	4.7	250.00	10.00	460.00	55.0	0.58	220.0
		8	13	150.0	67.0	270.0	5.9	250.00	5.40	885.00	88.0	0.65	210.0
			27	97.0	36.0	130.0	3.5	240.00	3.70	390.00	57.0	0.43	200.0
				190.0	88.0	350.0	7.4	240.00	0.10	1200.00	140.0	0.58	200.0
		9	10	180.0	54.0	300.0	5.9	200.00	12.00	977.00	100.0	0.67	190.0
	86	2	4	150.0	31.0	110.0	3.5	280.00	0.10	384.00	57.0	0.38	230.0
		3		110.0	24.0	110.0	5.1	230.00	0.10	320.00	72.0	0.31	190.0
			25	75.0	27.0	64.0	3.1	230.00	4.00	186.00	41.0	0.24	200.0
		4	8	140.0	18.0	110.0	4.7	260.00	4.00	302.00	72.0	0.30	220.0
			15	130.0	6.4	69.0	3.9	240.00	4.50	189.00	45.0	0.25	200.0
			22	110.0	92.0	55.0	3.9	230.00	10.00	153.00	38.0	0.25	200.0
			28	59.0	21.0	39.0	3.1	200.00	3.40	105.00	23.0	0.21	170.0
		5	5	54.0	20.0	41.0	3.5	210.00	0.10	88.80	26.0	0.24	170.0
			12	62.0	22.0	64.0	3.9	230.00	1.70	133.00	36.0	0.27	190.0
			20	66.0	24.0	41.0	4.3	220.00	4.00	115.00	28.0	0.26	190.0
			27	60.0	21.0	30.0	3.5	210.00	0.10	88.30	18.0	0.23	170.0
		6	2	51.0	17.0	25.0	2.3	180.00	0.10	75.80	14.0	0.21	150.0
			11	62.0	20.0	51.0	3.5	210.00	0.10	134.00	21.0	0.24	170.0
			17	62.0	20.0	41.0	3.1	200.00	0.10	136.00	19.0	0.27	170.0
			24	69.0	21.0	46.0	2.7	210.00	0.10	158.00	17.0	0.28	170.0
BS	84		18	180.0	96.0	440.0	3.9	230.00	20.00	1400.00	43.0	0.63	220.0
			25	160.0	87.0	390.0	5.1	240.00	0.10	1190.00	41.0	0.68	200.0

Table II-1 (continued)

SITE	YEAR	MONTH	DAY	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	Tot Alk
		7	2	140.0	69.0	290.0	3.9	210.00	2.80	977.00	32.0	0.59	180.0
			9	150.0	79.0	310.0	3.1	240.00	0.10	1100.00	35.0	0.60	200.0
			16	155.0	77.0	300.0	3.5	230.00	0.10	1070.00	38.0	0.59	190.0
			23	120.0	58.0	270.0	3.1	190.00	0.10	900.00	30.0	0.53	150.0
			30	190.0	97.0	380.0	4.3	260.00	0.10	1340.00	44.0	0.64	200.0
		8	6	190.0	99.0	390.0	3.1	280.00	0.10	1390.00	41.0	0.67	230.0
			13	190.0	100.0	400.0	4.3	270.00	0.10	1410.00	40.0	0.65	220.0
			20	170.0	82.0	300.0	3.9	250.00	0.10	1100.00	32.0	0.55	210.0
			27	180.0	87.0	370.0	3.1	280.00	0.10	1360.00	40.0	0.61	230.0
		9	4	180.0	84.0	350.0	3.9	250.00	0.10	1240.00	36.0	0.60	200.0
			10	180.0	84.0	370.0	3.9	250.00	0.10	1310.00	37.0	0.62	200.0
			17	190.0	110.0	420.0	4.3	290.00	0.10	1520.00	41.0	0.66	240.0
		10	1	220.0	120.0	460.0	4.7	300.00	0.10	1660.00	44.0	0.72	250.0
			8	220.0	120.0	470.0	4.3	310.00	0.10	1740.00	45.0	0.71	250.0
		11	5	230.0	130.0	4900.0	4.3	320.00	0.10	1770.00	44.0	0.72	260.0
	85	3	18	220.0	160.0	570.0	4.3	330.00	0.10	2090.00	45.0	0.93	270.0
		4	9	61.0	29.0	140.0	3.5	150.00	0.10	449.00	19.0	0.41	120.0
			22	76.0	40.0	180.0	2.7	170.00	0.10	579.00	22.0	0.38	140.0
		5	6	180.0	46.0	300.0	3.5	220.00	0.10	993.00	29.0	0.52	180.0
			21	180.0	110.0	450.0	3.9	290.00	0.10	1530.00	44.0	0.70	240.0
		6	3	160.0	86.0	370.0	3.5	250.00	0.10	1200.00	36.0	0.70	210.0
			18	160.0	100.0	420.0	4.0	270.00	0.10	1430.00	42.0	0.77	220.0
		7	1	190.0	110.0	450.0	4.5	280.00	15.00	1520.00	43.0	0.70	250.0
			15	180.0	110.0	400.0	5.1	290.00	0.10	1420.00	36.0	0.66	240.0
			29	180.0	110.0	420.0	3.9	260.00	0.10	1530.00	39.0	0.70	220.0
		8	13	1780.0	97.0	390.0	4.3	270.00	9.00	1390.00	34.0	0.65	230.0
			27	230.0	100.0	420.0	4.3	280.00	0.10	1580.00	38.0	0.67	230.0
		9	9	260.0	85.0	430.0	3.9	270.00	5.40	1590.00	39.0	0.68	230.0
	86	2	4	430.0	120.0	640.0	4.3	360.00	0.10	2440.00	52.0	0.86	300.0
		3		290.0	56.0	440.0	4.7	270.00	0.10	1560.00	48.0	0.66	220.0
			25	170.0	96.0	470.0	3.5	290.00	0.10	1500.00	48.0	0.75	240.0
		4	8	170.0	10.0	280.0	3.1	220.00	0.10	787.00	34.0	0.62	180.0
			15	230.0	23.0	350.0	3.9	260.00	0.10	1080.00	37.0	0.63	210.0
			22	210.0	100.0	520.0	4.7	340.00	0.10	1670.00	59.0	0.81	280.0
			28	150.0	92.0	420.0	4.7	290.00	2.80	1320.00	33.0	0.68	240.0
		5	5	210.0	130.0	580.0	4.3	370.00	0.10	1650.00	45.0	0.87	300.0
			12	190.0	120.0	560.0	4.3	360.00	2.80	1630.00	41.0	0.87	300.0
			20	86.0	47.0	220.0	2.7	170.00	0.10	601.00	40.0	0.47	140.0
			27	65.0	32.0	140.0	2.4	130.00	0.10	446.00	11.0	0.35	110.0
		6	2	130.0	73.0	320.0	2.3	230.00	0.10	1060.00	28.0	0.59	190.0
			11	37.0	12.0	60.0	2.0	89.00	0.10	168.00	8.7	0.20	73.0
			17	38.0	15.0	67.0	1.8	93.00	0.10	218.00	9.0	0.24	76.0
			24	42.0	17.0	74.0	2.0	98.00	0.10	233.00	6.3	0.25	81.0
CC	84		19	74.0	40.0	44.0	2.3	270.00	25.00	145.00	13.0	0.26	260.0
			26	64.0	38.0	51.0	2.0	330.00	2.80	146.00	13.0	0.31	270.0
		7	3	67.0	40.0	51.0	3.5	260.00	15.00	158.00	14.0	0.27	240.0
			10	72.0	39.0	46.0	2.7	320.00	0.10	157.00	15.0	0.28	260.0
			18	72.0	40.0	51.0	2.7	300.00	2.80	151.00	16.0	0.28	250.0

Table II-1 (continued)

SITE	YEAR	MONTH	DAY	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	Tot Alk
			24	68.0	39.0	46.0	2.7	290.00	0.10	150.00	14.0	0.26	240.0
			31	75.0	39.0	46.0	3.5	290.00	0.10	150.00	16.0	0.27	240.0
		8	7	58.0	41.0	46.0	3.1	250.00	2.80	165.00	12.0	0.30	250.0
			14	62.0	41.0	53.0	2.7	320.00	0.10	0.00	14.0	0.30	260.0
			21	78.0	42.0	48.0	3.1	340.00	0.10	155.00	13.0	0.29	280.0
			28	63.0	39.0	54.0	2.3	320.00	0.10	166.00	12.0	0.29	260.0
		9	5	65.0	40.0	59.0	2.0	330.00	0.10	175.00	11.0	0.30	270.0
			11	69.0	41.0	57.0	2.3	300.00	0.10	176.00	12.0	0.30	250.0
			18	52.0	45.0	61.0	2.7	330.00	0.10	183.00	12.0	0.30	270.0
		10	1	56.0	41.0	58.0	4.3	280.00	4.90	179.00	12.0	0.29	240.0
			9	72.0	45.0	62.0	3.1	310.00	9.80	180.00	13.0	0.32	270.0
		11	6	67.0	43.0	62.0	3.9	340.00	0.10	186.00	12.0	0.29	280.0
	85	3	19	65.0	37.0	51.0	4.3	310.00	0.10	166.00	13.0	0.35	260.0
		4	10	61.0	35.0	53.0	3.5	330.00	0.10	148.00	12.0	0.33	270.0
			22	63.0	36.0	53.0	2.3	360.00	0.10	143.00	10.0	0.28	290.0
		5	6	120.0	15.0	51.0	3.1	310.00	12.00	148.00	11.0	0.30	270.0
			20	62.0	40.0	48.0	2.0	320.00	0.10	142.00	13.0	0.32	260.0
		6	3	66.0	38.0	51.0	2.7	330.00	0.10	141.00	9.7	0.36	270.0
			18	52.0	41.0	55.0	2.7	270.00	12.00	158.00	12.0	0.36	240.0
		7	1	53.0	40.0	44.0	2.0	240.00	36.00	143.00	11.0	0.27	260.0
			15	72.0	43.0	51.0	3.1	340.00	0.10	155.00	11.0	0.30	280.0
			30	63.0	43.0	53.0	2.7	320.00	8.50	162.00	11.0	0.32	280.0
		8	13	56.0	46.0	67.0	4.3	300.00	15.00	184.00	11.0	0.35	270.0
			27	100.0	31.0	71.0	3.5	350.00	11.00	201.00	12.0	0.39	300.0
		9	10	93.0	28.0	6.9	3.1	300.00	17.00	199.00	12.0	0.38	270.0
	86	2	4	120.0	32.0	69.0	2.4	360.00	6.80	196.00	11.0	0.37	310.0
		3		100.0	24.0	55.0	2.7	330.00	10.00	160.00	10.0	0.33	290.0
			26	67.0	39.0	55.0	1.9	340.00	9.00	159.00	9.8	0.32	290.0
		4	8	110.0	25.0	55.0	2.3	330.00	3.40	158.00	9.5	0.33	270.0
			15	100.0	28.0	55.0	2.7	330.00	8.50	147.00	8.8	0.33	280.0
			22	92.0	25.0	48.0	2.0	300.00	14.00	147.00	12.0	0.34	270.0
			28	68.0	35.0	44.0	2.7	300.00	7.90	116.00	5.3	0.27	260.0
		5	5	65.0	34.0	37.0	20.0	310.00	0.10	97.40	6.5	0.28	260.0
			12	67.0	35.0	41.0	2.4	310.00	6.70	125.00	7.2	0.28	260.0
			20	70.0	37.0	44.0	2.4	300.00	4.50	125.00	6.2	0.29	250.0
			27	67.0	36.0	41.0	2.7	310.00	0.10	127.00	7.8	0.27	250.0
		6	2	66.0	34.0	40.0	1.6	300.00	6.80	113.00	7.2	0.26	260.0
			11	65.0	35.0	41.0	2.0	300.00	6.80	113.00	9.9	0.47	270.0
			17	65.0	35.0	41.0	2.3	290.00	10.00	123.00	8.9	0.29	260.0
			24	56.0	35.0	41.0	1.6	280.00	14.00	123.00	6.4	0.30	250.0
FM	84		18	41.0	13.0	16.0	2.3	110.00	15.00	58.00	10.0	0.13	110.0
			25	40.0	13.0	22.0	1.5	130.00	2.80	57.20	9.0	0.15	110.0
		7	2	36.0	12.0	16.0	2.3	100.00	9.80	48.00	8.3	0.13	100.0
			9	35.0	12.0	21.0	2.0	130.00	0.10	59.20	16.0	0.14	110.0
			16	35.0	12.0	23.0	2.0	130.00	0.10	67.10	10.0	0.14	110.0
			23	38.0	13.0	41.0	2.3	130.00	0.10	102.00	9.7	0.17	110.0
			30	38.0	13.0	23.0	3.1	130.00	0.10	66.70	10.0	0.16	110.0
		8	6	39.0	14.0	23.0	2.7	140.00	0.10	70.40	8.3	0.16	110.0

Table II-1 (continued)

SITE	YEAR	MONTH	DAY	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	Tot Alk
			13	43.0	17.0	37.0	2.7	150.00	0.10	108.00	13.0	0.19	130.0
			20	46.0	18.0	39.0	2.7	160.00	0.10	132.00	12.0	0.18	130.0
			27	47.0	17.0	45.0	2.0	140.00	8.60	132.00	15.0	0.18	130.0
		9	4	44.0	16.0	45.0	1.6	140.00	7.40	129.00	12.0	0.18	120.0
			10	47.0	18.0	48.0	1.9	160.00	0.10	144.00	12.0	0.18	130.0
			17	55.0	25.0	80.0	2.0	170.00	2.50	232.00	22.0	0.21	140.0
		10	1	48.0	18.0	41.0	3.1	170.00	0.10	133.00	9.5	0.19	140.0
			8	48.0	19.0	44.0	2.3	160.00	0.10	141.00	12.0	0.19	130.0
		11	5	51.0	20.0	48.0	2.3	170.00	0.10	162.00	11.0	0.19	140.0
	85	3	18	61.0	33.0	97.0	4.3	180.00	0.10	285.00	47.0	0.28	150.0
		4	9	52.0	19.0	41.0	3.1	180.00	0.10	134.00	14.0	0.25	150.0
			22	40.0	15.0	35.0	3.1	160.00	0.10	105.00	9.0	0.16	130.0
		5	6	56.0	15.0	21.0	3.1	180.00	0.10	69.00	7.4	0.17	150.0
			9	55.0	11.0	21.0	3.1	170.00	0.10	80.00	6.5	0.17	140.0
			13	52.0	9.3	23.0	2.0	150.00	0.10	99.00	7.6	0.14	120.0
			16	45.0	13.0	25.0	2.7	140.00	0.10	104.00	8.5	0.15	120.0
			21	46.0	16.0	34.0	2.0	150.00	0.10	121.00	11.0	0.16	120.0
			24	46.0	16.0	30.0	1.6	160.00	0.10	116.00	9.5	0.17	130.0
			28	42.0	14.0	23.0	1.9	150.00	0.10	83.00	7.1	0.15	120.0
			31	37.0	12.0	23.0	2.3	140.00	0.10	76.00	5.8	0.14	120.0
		6	3	37.0	13.0	28.0	1.6	130.00	0.10	89.00	6.2	0.17	110.0
			10	44.0	16.0	34.0	1.9	150.00	0.10	119.00	11.0	0.15	120.0
			18	36.0	12.0	28.0	1.6	130.00	0.10	85.20	6.8	0.18	110.0
		7	1	39.0	13.0	28.0	2.0	110.00	21.00	83.90	8.3	0.17	130.0
			15	46.0	18.0	44.0	3.1	180.00	0.10	131.00	9.1	0.21	150.0
			29	50.0	19.0	45.0	2.3	170.00	6.80	126.00	7.6	0.22	150.0
		8	13	51.0	20.0	58.0	2.7	160.00	12.00	186.00	12.0	0.23	150.0
			27	83.0	14.0	85.0	2.7	160.00	7.80	286.00	17.0	0.26	140.0
	86	2	4	94.0	21.0	67.0	2.0	210.00	0.10	266.00	15.0	0.25	180.0
		3		90.0	7.1	71.0	2.3	190.00	0.10	217.00	20.0	0.23	150.0
			25	53.0	22.0	67.0	2.3	170.00	0.10	200.00	15.0	0.21	140.0
		4	8	76.0	7.1	53.0	2.0	180.00	0.10	164.00	13.0	0.20	140.0
			15	70.0	18.0	53.0	3.1	200.00	3.40	145.00	11.0	0.20	170.0
			22	78.0	18.0	60.0	2.7	200.00	10.00	183.00	23.0	0.23	180.0
			28	50.0	18.0	34.0	3.1	180.00	2.30	101.00	6.3	0.18	150.0
		5	5	53.0	18.0	30.0	2.4	200.00	0.10	85.20	5.7	0.18	160.0
			12	49.0	17.0	30.0	2.0	180.00	2.30	82.70	6.4	0.17	150.0
			20	53.0	17.0	30.0	2.4	180.00	3.40	93.60	6.3	0.19	150.0
			27	45.0	14.0	18.0	2.0	160.00	0.10	66.60	4.0	0.16	130.0
		6	2	37.0	12.0	14.0	2.8	140.00	0.10	41.10	2.9	0.14	120.0
			11	33.0	12.0	18.0	2.7	130.00	0.10	53.00	6.5	0.14	110.0
			17	33.0	11.0	14.0	2.3	140.00	0.10	45.70	3.7	0.14	110.0
			24	31.0	10.0	12.0	1.6	130.00	0.10	33.90	2.1	0.14	110.0
JA		6	18	40.0	12.0	12.0	2.0	110.00	13.00	50.00	5.6	0.12	110.0
			25	38.0	12.0	17.0	1.4	130.00	0.10	45.70	5.1	0.13	110.0
		7	2	36.0	11.0	14.0	1.2	120.00	1.40	48.00	6.0	0.13	100.0
			9	35.0	11.0	14.0	1.6	130.00	0.10	46.50	6.8	0.14	100.0
			16	35.0	11.0	18.0	2.0	120.00	4.20	58.00	7.0	0.14	100.0

Table II-1 (continued)

SITE	YEAR	MONTH	DAY	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	Tot Alk
			23	37.0	12.0	30.0	2.3	130.00	0.10	88.50	9.9	0.16	100.0
			30	38.0	12.0	18.0	2.7	130.00	0.10	49.40	7.5	0.15	110.0
		8	6	38.0	13.0	18.0	2.3	140.00	0.10	60.90	5.3	0.16	110.0
			13	43.0	15.0	28.0	1.6	150.00	0.10	91.30	7.0	0.17	120.0
			20	44.0	16.0	30.0	2.0	150.00	0.10	102.00	618.0	0.17	120.0
			27	44.0	15.0	36.0	1.6	140.00	3.70	105.00	7.0	0.17	120.0
		9	4	45.0	16.0	38.0	1.2	140.00	2.50	122.00	6.0	0.18	120.0
			10	46.0	16.0	40.0	1.2	150.00	0.10	126.00	6.0	0.18	120.0
			17	51.0	21.0	63.0	2.0	160.00	0.10	206.00	9.4	0.22	130.0
		10	1	49.0	18.0	37.0	2.7	160.00	0.10	130.00	7.3	0.20	130.0
			8	47.0	17.0	37.0	2.3	140.00	0.10	132.00	7.3	0.19	120.0
		11	5	51.0	19.0	44.0	2.3	160.00	0.10	153.00	8.4	0.19	130.0
	85	3	18	27.0	11.0	39.0	1.6	100.00	3.40	100.00	5.2	0.18	87.0
		4	9	49.0	16.0	32.0	2.7	190.00	0.10	113.00	9.2	0.24	150.0
			22	30.0	15.0	32.0	2.7	140.00	0.10	99.00	7.7	0.16	120.0
		5	6	56.0	12.0	21.0	3.1	180.00	0.10	69.00	7.0	0.17	150.0
			9	57.0	8.7	21.0	3.1	170.00	0.10	76.00	6.9	0.15	140.0
			13	49.0	10.0	23.0	2.0	150.00	0.10	96.00	6.4	0.15	120.0
			16	48.0	11.0	25.0	2.3	140.00	0.10	100.00	7.4	0.14	110.0
			21	46.0	16.0	32.0	2.0	140.00	0.10	117.00	8.9	0.14	120.0
			24	47.0	15.0	28.0	1.9	150.00	0.10	106.00	7.2	0.17	120.0
			28	41.0	13.0	21.0	2.3	140.00	0.10	82.00	5.4	0.15	120.0
			31	37.0	12.0	23.0	1.9	130.00	0.10	76.00	5.3	0.14	110.0
		6	3	37.0	13.0	28.0	1.9	130.00	0.10	89.00	5.5	0.14	100.0
			10	44.0	15.0	30.0	1.9	160.00	0.10	109.00	6.2	0.15	130.0
			18	36.0	12.0	25.0	1.9	100.00	8.00	84.00	5.5	0.16	99.0
		7	1	39.0	13.0	23.0	2.0	110.00	20.00	80.20	5.6	0.16	120.0
			15	46.0	18.0	39.0	3.1	130.00	18.00	126.00	7.1	0.20	140.0
			29	50.0	18.0	41.0	2.3	170.00	6.30	123.00	6.7	0.22	150.0
		8	13	53.0	21.0	53.0	2.7	160.00	7.20	176.00	8.2	0.23	140.0
			27	69.0	24.0	76.0	2.7	160.00	3.60	284.00	11.0	0.26	140.0
		9	10	71.0	19.0	71.0	3.1	160.00	7.20	247.00	11.0	0.28	140.0
	86	2	4	95.0	18.0	76.0	2.4	220.00	3.40	256.00	10.0	0.25	190.0
		3		79.0	11.0	5.5	2.3	180.00	0.10	186.00	16.0	0.22	140.0
			25	53.0	21.0	60.0	2.3	170.00	3.40	185.00	12.0	0.20	140.0
		4	8	72.0	9.7	53.0	2.0	170.00	0.10	164.00	11.0	0.19	140.0
			15	75.0	13.0	53.0	3.1	200.00	5.70	145.00	10.0	0.20	170.0
			22	82.0	9.7	48.0	2.3	190.00	11.00	152.00	13.0	0.21	170.0
			28	52.0	18.0	30.0	3.1	180.00	2.30	97.90	5.2	0.17	150.0
		5	5	52.0	17.0	28.0	2.4	190.00	0.10	81.20	4.7	0.18	160.0
			12	48.0	16.0	28.0	2.0	180.00	2.80	84.30	6.0	0.17	150.0
			20	53.0	17.0	28.0	2.4	170.00	3.40	91.60	5.4	0.18	150.0
			27	45.0	14.0	16.0	2.0	160.00	0.10	72.40	3.3	0.16	130.0
		6	2	40.0	12.0	14.0	2.3	140.00	0.10	39.70	12.0	0.14	110.0
			11	32.0	10.0	14.0	2.3	130.00	0.10	39.30	4.0	0.13	110.0
			17	33.0	11.0	11.0	2.3	130.00	0.10	42.40	2.9	0.13	110.0
			24	32.0	10.0	12.0	2.0	130.00	0.10	33.50	1.8	0.13	110.0
SC		6	19	85.0	76.0	0.0	0.0	290.00	25.00	438.00	18.0	0.28	280.0

Table II-1 (continued)

SITE	YEAR	MONTH	DAY	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	Tot Alk
			26	89.0	74.0	86.0	4.7	320.00	0.10	430.00	18.0	0.32	260.0
		7	3	97.0	86.0	87.0	4.7	260.00	15.00	489.00	21.0	0.28	240.0
			10	130.0	100.0	100.0	7.4	320.00	0.10	644.00	25.0	0.30	270.0
			18	95.0	78.0	90.0	4.7	300.00	0.10	460.00	19.0	0.28	250.0
			24	100.0	81.0	92.0	5.5	290.00	0.10	528.00	21.0	0.26	240.0
		8	7	72.0	82.0	92.0	4.7	280.00	0.10	490.00	23.0	0.28	230.0
			14	85.0	78.0	87.0	3.9	280.00	0.10	437.00	19.0	0.27	230.0
			21	99.0	79.0	87.0	5.1	320.00	0.10	486.00	19.0	0.29	260.0
			28	97.0	71.0	86.0	4.7	300.00	0.10	457.00	18.0	0.26	240.0
		9	5	90.0	71.0	93.0	3.9	290.00	3.70	464.00	20.0	0.26	240.0
			11	87.0	71.0	92.0	3.9	280.00	0.10	463.00	20.0	0.26	230.0
			18	80.0	84.0	97.0	3.5	280.00	4.90	512.00	20.0	0.26	240.0
		10	1	110.0	92.0	97.0	5.5	290.00	0.10	545.00	22.0	0.26	240.0
			9	110.0	91.0	99.0	4.7	280.00	0.10	563.00	21.0	0.27	230.0
		11	6	120.0	86.0	90.0	5.1	330.00	0.10	520.00	20.0	0.24	270.0
	85	3	19	78.0	47.0	41.0	5.9	160.00	0.10	300.00	13.0	0.20	130.0
		4	10	140.0	95.0	97.0	6.3	310.00	0.10	698.00	23.0	0.31	260.0
			22	120.0	90.0	97.0	5.1	350.00	0.10	602.00	22.0	0.25	290.0
		5	6	190.0	43.0	97.0	4.7	310.00	8.50	529.00	20.0	0.28	270.0
			20	88.0	94.0	120.0	3.9	310.00	0.10	562.00	21.0	0.34	250.0
		6	3	110.0	110.0	130.0	5.1	320.00	0.10	695.00	27.0	0.38	270.0
			18	81.0	110.0	140.0	4.7	280.00	15.00	644.00	27.0	0.41	250.0
		7	1	87.0	120.0	170.0	6.7	280.00	40.00	748.00	31.0	0.37	300.0
			15	90.0	110.0	130.0	6.7	270.00	0.10	654.00	25.0	0.33	220.0
			30	92.0	100.0	130.0	5.9	310.00	1.70	663.00	23.0	0.35	260.0
			31	100.0	81.0	83.0	6.6	290.00	0.10	495.00	25.0	0.27	240.0
		8	13	95.0	110.0	140.0	6.1	280.00	19.00	650.00	24.0	0.35	260.0
			27	99.0	110.0	160.0	6.7	310.00	3.60	766.00	29.0	0.43	260.0
		9	10	120.0	93.0	170.0	5.9	300.00	14.00	736.00	28.0	0.42	270.0
	86	2	4	180.0	74.0	110.0	3.9	340.00	0.10	598.00	20.0	0.27	280.0
		3		170.0	66.0	92.0	5.1	310.00	0.10	581.00	20.0	0.26	260.0
			26	130.0	110.0	110.0	4.3	310.00	0.10	691.00	22.0	0.25	260.0
		4	8	150.0	100.0	100.0	4.7	300.00	0.10	704.00	23.0	0.25	240.0
			15	160.0	99.0	99.0	5.1	300.00	0.10	674.00	21.0	0.25	250.0
			22	200.0	91.0	94.0	5.9	290.00	0.10	809.00	30.0	0.28	230.0
			28	140.0	100.0	87.0	5.5	280.00	6.20	667.00	16.0	0.23	240.0
		5	5	93.0	68.0	71.0	3.1	300.00	0.10	371.00	11.0	0.24	240.0
			12	110.0	84.0	84.0	4.7	310.00	5.10	497.00	12.0	0.25	260.0
			20	95.0	73.0	78.0	4.3	260.00	0.10	423.00	10.0	0.25	210.0
			27	90.0	72.0	81.0	3.9	300.00	0.10	423.00	14.0	0.26	250.0
		6	2	86.0	68.0	78.0	3.5	280.00	6.20	381.00	11.0	0.26	240.0
			11	130.0	99.0	94.0	6.6	320.00	4.00	613.00	16.0	0.25	270.0
			17	97.0	80.0	85.0	4.7	290.00	5.10	490.00	16.0	0.29	250.0
			24	82.0	80.0	90.0	4.3	290.00	5.70	474.00	12.0	0.30	240.0
TP	84		18	100.0	32.0	200.0	12.0	400.00	0.01	283.00	100.0	0.28	330.0
			25	79.0	32.0	290.0	13.0	630.00	0.10	188.00	130.0	0.41	520.0
		7	2	77.0	22.0	190.0	11.0	250.00	0.10	295.00	110.0	0.29	210.0
			9	63.0	23.0	190.0	11.0	310.00	0.10	260.00	110.0	0.24	250.0

Table II-1 (continued)

SITE	YEAR	MONTH	DAY	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl	F	Tot Alk
			16	180.0	36.0	190.0	14.0	350.00	0.10	456.00	110.0	0.26	290.0
			23	66.0	23.0	190.0	13.0	300.00	0.10	230.00	100.0	0.22	250.0
			30	81.0	19.0	200.0	12.0	310.00	0.10	268.00	120.0	0.33	260.0
		8	6	64.0	25.0	190.0	13.0	330.00	0.10	234.00	94.0	0.22	270.0
			13	90.0	29.0	180.0	13.0	410.00	0.10	244.00	100.0	0.23	330.0
			20	68.0	26.0	200.0	12.0	350.00	0.10	241.00	94.0	0.21	290.0
			27	51.0	21.0	180.0	11.0	290.00	0.10	219.00	91.0	0.15	230.0
		9	4	64.0	18.0	180.0	9.4	250.00	0.10	260.00	96.0	0.20	210.0
			10	79.0	25.0	180.0	11.0	270.00	0.10	273.00	95.0	0.16	240.0
			17	60.0	28.0	180.0	13.0	340.00	0.10	220.00	94.0	0.10	270.0
		10	1	84.0	29.0	170.0	14.0	260.00	0.10	275.00	87.0	0.16	220.0
			9	87.0	31.0	170.0	13.0	320.00	0.10	288.00	90.0	0.18	260.0
		11	5	61.0	27.0	160.0	13.0	340.00	0.10	253.00	81.0	0.17	280.0
	85	3	18	68.0	28.0	130.0	11.0	230.00	0.10	260.00	62.0	0.28	180.0
		4	9	46.0	19.0	120.0	8.2	230.00	0.10	198.00	47.0	0.23	190.0
			22	64.0	22.0	130.0	7.8	270.00	0.10	242.00	62.0	0.20	230.0
		5	21	94.0	30.0	150.0	9.0	320.00	0.10	250.00	82.0	0.24	260.0
		6	3	120.0	43.0	240.0	17.0	490.00	0.10	291.00	92.0	0.24	400.0
			18	56.0	19.0	170.0	11.0	230.00	0.10	222.00	92.0	0.27	190.0
		7	1	58.0	21.0	170.0	12.0	320.00	0.10	221.00	88.0	0.22	260.0
			15	67.0	22.0	170.0	14.0	340.00	0.10	224.00	89.0	0.22	280.0
			29	66.0	23.0	170.0	14.0	350.00	0.10	235.00	85.0	0.20	280.0
		8	13	60.0	24.0	170.0	13.0	320.00	0.10	249.00	81.0	0.16	260.0
			27	78.0	20.0	170.0	13.0	250.00	0.10	271.00	81.0	0.19	210.0
		9	10	120.0	12.0	190.0	14.0	330.00	0.10	313.00	85.0	0.20	270.0
	86	2	4	110.0	32.0	160.0	12.0	430.00	0.10	279.00	79.0	0.27	350.0
		3		87.0	15.0	120.0	11.0	320.00	0.10	214.00	63.0	0.26	270.0
			25	57.0	22.0	140.0	9.0	340.00	0.10	232.00	69.0	0.26	280.0
		4	8	96.0	7.6	160.0	8.6	350.00	0.10	246.00	86.0	0.24	280.0
			15	77.0	24.0	160.0	11.0	360.00	0.10	229.00	74.0	0.23	300.0
			22	110.0	36.0	160.0	12.0	310.00	0.10	332.00	84.0	0.24	260.0
			28	63.0	24.0	150.0	12.0	300.00	0.10	230.00	74.0	0.24	250.0
		5	5	63.0	22.0	150.0	9.8	290.00	0.10	209.00	70.0	0.26	240.0
			12	58.0	24.0	160.0	12.0	320.00	0.10	216.00	83.0	0.26	260.0
			20	67.0	26.0	170.0	13.0	340.00	0.10	216.00	75.0	0.29	280.0
			27	67.0	29.0	180.0	13.0	360.00	0.10	236.00	84.0	0.28	300.0
		6	2	100.0	76.0	170.0	13.0	420.00	0.10	269.00	160.0	0.30	340.0
			11	35.0	11.0	18.0	3.1	150.00	0.10	46.20	6.9	0.14	120.0
			17	34.0	12.0	16.0	2.7	150.00	0.10	49.80	7.4	0.15	120.0

Table II-2. Concentrations of nutrients and miscellaneous chemical parameters. Data are arranged by site (alphabetically), year, month and day. Abbreviations for sites (SI) are: BC, Bitter Creek; BF, Blacks Fork; BS, Big Sandy; CC, Currant Creek; FM, Green River at FMC bridge; JA, Green River at Green River; SC, Sage Creek; TP, effluent from the Green River sewage treatment plant. Units are mg/L; a "-P" or "-N" indicates units refer to elemental phosphorus or nitrogen, not the compound as a whole; zeros indicate an analysis was not performed.

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
BC	84	6	18	0.750	0.300	1.400	0.43	5.30	0.60	0.00	0.00	0	0	410	0.00	48	6.8
			25	1.200	1.200	0.320	0.10	2.70	0.44	0.10	0.05	2300	0	58	8.49	44	3.3
		7	2	0.600	1.600	0.300	0.36	3.60	0.32	0.10	0.05	2710	0	50	8.58	35	5.2
			9	2.100	3.000	1.680	0.96	4.00	2.32	1.00	0.05	3720	0	216	8.22	42	12.0
			16	1.420	1.620	1.820	0.36	1.70	0.76	0.10	0.05	3300	0	84	8.42	34	9.0
			23	0.320	20.600	2.200	1.40	4.20	35.00	0.20	0.83	3400	0	32400	7.77	0	31.0
			24	0.016	1.500	0.000	0.10	0.10	0.71	0.00	0.00	0	3380	241	0.00	0	0.0
				0.012	1.500	0.000	0.10	0.10	0.81	0.00	0.00	0	2860	228	0.00	0	0.0
			25	0.018	1.800	0.000	0.10	0.10	0.90	0.00	0.00	0	2600	348	0.00	0	0.0
				0.032	5.450	0.000	0.10	0.31	4.80	0.00	0.00	0	3530	5590	0.00	0	0.0
				0.045	11.750	0.000	0.10	0.22	12.00	0.00	0.00	0	3180	12200	0.00	0	0.0
				0.056	18.800	0.000	0.10	1.00	23.00	0.00	0.00	0	3920	20900	0.00	0	0.0
				0.050	23.800	0.000	0.18	1.40	30.00	0.00	0.00	0	4030	28100	0.00	0	0.0
				0.054	23.800	0.000	0.18	1.40	31.00	0.00	0.00	0	3470	24600	0.00	0	0.0
			26	0.046	7.150	0.000	0.10	2.00	11.00	0.00	0.00	0	2690	6960	0.00	0	0.0
				0.046	12.500	0.000	0.10	1.60	20.00	0.00	0.00	0	2800	12400	0.00	0	0.0
			27	0.048	6.250	0.000	0.10	0.78	9.10	0.00	0.00	0	2770	6380	0.00	0	0.0
			30	0.390	3.900	1.390	0.22	2.90	6.70	0.30	0.05	2400	0	3950	8.11	95	13.0
			31	0.032	0.410	0.000	0.10	0.22	1.10	0.00	0.00	0	1600	396	0.00	0	0.0
		8	6	0.753	2.790	0.076	0.14	4.90	3.40	0.40	0.05	2200	0	2240	8.04	8	7.4
			13	0.137	14.494	0.880	0.39	2.40	23.17	0.10	0.05	1800	0	20100	7.18	0	25.0
			20	0.167	1.790	0.027	0.14	2.21	12.20	0.10	0.05	2000	0	9860	7.61	180	11.1
			27	0.090	6.670	2.350	2.90	0.20	7.28	0.10	0.05	2000	1660	7460	7.90	220	13.5
		9	4	3.120	3.420	0.150	0.23	6.07	1.54	0.10	0.05	4000	2170	21	8.46	46	4.2
			5	0.006	0.151	0.000	0.10	0.10	1.56	0.00	0.00	0	0	0	0.00	0	0.0
			10	0.119	2.050	0.060	0.31	2.64	1.60	0.10	0.05	2700	2230	424	7.85	28	3.6
			27	0.460	3.300	0.850	0.18	2.50	4.30	0.10	0.05	2000	1470	2710	7.59	0	9.9
		10	1	1.200	1.600	0.950	0.27	2.70	1.00	0.10	0.05	3100	2580	94	8.54	50	3.3
			9	1.400	1.700	1.200	0.10	4.00	0.47	0.10	0.05	3200	3060	10	8.93	40	2.4
		11	5	1.270	1.800	0.950	0.56	2.30	1.30	0.10	0.05	3200	2760	294	8.19	150	12.0
	85	3	19	0.230	4.800	1.200	0.50	0.72	7.30	0.20	0.21	1700	1630	4340	8.13	0	35.0
		4	9	0.400	3.800	0.870	0.50	1.30	4.80	0.10	0.05	2300	2110	3240	7.98	80	18.0
			22	0.740	1.300	0.570	1.00	1.40	1.90	0.10	0.05	3000	2810	408	8.19	31	5.4
		5	6	1.100	1.200	0.890	0.21	2.30	1.40	0.10	0.05	3400	3230	24	8.79	34	4.0
			21	1.200	1.500	0.920	0.10	2.40	1.80	0.10	0.05	3900	3900	34	8.82	38	7.8
		6	3	1.600	1.900	1.200	0.10	1.30	2.20	0.10	0.05	5200	4990	24	8.96	84	5.7
			18	1.300	1.600	1.000	0.10	1.50	2.40	0.10	0.07	4800	4520	15	8.75	78	4.2
		7	1	1.400	2.100	1.500	0.10	1.50	2.30	0.10	0.05	4200	3650	16	8.89	51	5.7
			15	2.900	3.600	2.300	0.47	1.60	2.70	0.10	0.05	3700	2800	180	8.51	55	3.6
			30	2.050	2.300	2.040	0.10	2.80	1.80	0.10	0.05	3500	3080	56	8.55	38	0.0
		8	13	1.900	2.200	1.900	0.10	3.60	1.60	0.10	0.05	3700	3040	4	9.27	44	6.0
			27	2.300	2.400	2.100	0.10	0.10	1.90	0.10	0.05	4900	3920	10	8.92	49	0.9
		9	10	3.300	3.700	3.400	0.10	2.70	1.40	0.10	0.05	4300	3560	13	9.20	52	3.0

Table II-2 (continued)

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	HN₄-N	NO₃-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
	86	2	4	3.100	3.200	3.000	4.40	2.70	5.20	0.10	0.37	4400	4410	23	8.07	71	3.3
		3		0.160	6.500	1.200	0.74	0.58	7.60	0.10	0.05	1800	1920	5060	7.88	93	9.0
			26	0.860	2.800	1.300	1.40	1.50	4.50	0.10	0.05	3000	3290	1820	8.10	40	7.2
		4	8	1.500	2.400	2.000	2.30	2.00	4.40	0.10	0.05	3400	3890	444	7.84	46	3.9
			15	1.700	2.300	1.800	1.20	3.60	2.90	0.10	0.05	3600	3680	387	8.23	32	7.8
			22	0.073	18.000	2.400	0.14	1.10	19.00	0.10	0.05	2420	2610	22000	8.09	340	12.0
			28	0.440	4.000	0.980	0.36	1.00	4.20	0.11	0.05	2160	2040	4370	8.53	63	2.4
		5	5	1.500	2.400	1.500	0.85	2.40	2.70	0.10	0.05	2600	3280	910	8.14	33	3.6
			12	0.760	2.100	1.000	0.32	2.60	2.60	0.10	0.05	2400	2830	1390	8.46	40	4.2
			20	1.700	2.000	1.600	0.23	4.30	1.40	0.10	0.05	2900	3390	212	8.25	31	4.0
			27	1.700	2.000	1.600	0.10	3.90	0.46	0.20	0.05	3600	3920	20	8.51	47	3.6
		6	2	1.600	1.700	1.400	0.10	2.40	1.30	0.10	0.05	3800	4080	18	9.03	40	2.1
			11	0.330	16.000	1.800	0.35	1.70	19.00	0.11	0.05	3000	2410	14400	8.13	270	20.0
			17	2.100	2.300	1.900	0.10	4.50	1.10	0.10	0.05	4800	3690	188	8.48	36	8.1
			24	1.900	1.900	1.800	0.10	4.90	0.96	0.10	0.05	5700	4240	7	9.13	46	0.9
BF	84		18	0.050	0.470	0.400	0.05	0.22	0.55	0.00	0.00	0	0	330	0.00	36	1.0
			25	0.030	0.330	0.020	0.10	0.10	0.22	0.10	0.05	640	0	190	8.28	13	0.8
		7	2	0.030	0.880	0.020	0.10	0.20	0.59	0.10	0.05	810	0	530	8.19	51	0.9
			9	0.010	0.195	0.010	0.10	0.10	0.47	0.10	0.05	870	0	140	8.30	19	1.8
			16	0.390	0.025	0.045	0.10	0.10	0.77	0.10	0.05	1090	0	260	8.33	18	2.1
			23	0.044	10.900	0.059	0.10	0.21	11.30	0.20	0.05	900	0	18500	8.11	0	5.1
			30	0.020	0.980	0.014	0.10	0.10	1.30	0.10	0.05	1200	0	996	8.25	35	1.3
		8	6	0.014	0.392	0.006	0.10	0.10	0.69	0.40	0.05	1100	0	301	8.28	10	1.3
			13	0.004	0.171	0.007	0.10	0.10	0.46	0.10	0.05	1100	0	300	8.12	24	1.2
			20	0.013	1.060	0.010	0.10	0.10	1.09	0.10	0.05	1200	0	982	8.21	29	1.3
		9	4	0.004	0.164	0.010	0.10	0.10	0.37	0.10	0.05	1200	1050	104	8.33	19	1.1
			10	0.013	1.520	0.100	0.10	0.10	1.07	0.10	0.05	1300	1120	1700	8.13	30	1.9
			17	0.002	0.188	0.003	0.10	0.10	0.37	0.10	0.05	1200	940	132	8.28	10	0.7
		10	1	0.012	0.338	0.001	0.10	0.10	0.47	0.10	0.05	1100	856	272	8.28	33	0.6
			8	0.003	0.141	0.001	0.10	0.10	0.29	0.10	0.05	1000	904	91	8.28	13	0.6
		11	5	0.001	0.690	0.010	0.10	0.10	0.52	0.20	0.05	870	1310	742	8.04	150	0.9
	85	3	18	0.140	0.740	0.025	0.10	0.26	0.97	0.10	0.05	800	696	547	8.03	0	0.0
		4	9	0.025	1.900	0.006	0.10	0.18	1.80	0.10	0.05	610	464	1460	8.22	37	2.6
			22	0.029	0.570	0.003	0.10	0.10	1.10	0.10	0.05	510	324	472	8.30	26	1.1
		5	6	0.010	2.500	0.016	0.10	0.10	2.40	0.10	0.05	540	360	1650	8.22	58	2.8
			21	0.001	0.360	0.002	0.10	0.10	1.00	0.10	0.05	800	652	248	8.28	13	2.4
		6	3	0.003	0.190	0.001	0.10	0.10	0.74	0.10	0.05	1000	800	138	8.29	23	0.8
			18	0.002	0.090	0.002	0.10	0.10	0.66	0.10	0.05	1300	1240	60	8.17	22	0.9
		7	1	0.002	0.094	0.001	0.10	0.10	0.91	0.10	0.05	1400	1240	58	8.24	30	1.4
			15	0.023	0.138	0.002	0.10	0.10	0.76	0.10	0.05	1400	1250	115	8.29	20	1.7
			29	0.002	0.120	0.002	0.10	0.10	0.83	0.10	0.05	1200	928	79	8.56	26	0.0
		8	13	0.001	0.049	0.001	0.10	0.10	0.67	0.10	0.05	1800	1640	17	8.33	24	2.4
			27	0.007	0.314	0.010	0.10	0.10	0.39	0.10	0.05	1000	896	240	8.37	10	1.2
				0.001	0.040	0.001	0.10	0.10	0.50	0.10	0.05	2200	2170	20	8.30	22	1.3
		9	10	0.001	0.040	0.001	0.10	0.10	0.71	0.10	0.05	1900	1760	16	8.50	25	0.5
	86	2	4	0.008	0.047	0.001	0.10	0.20	0.41	0.10	0.05	1000	800	17	8.09	11	1.1
		3		0.024	0.990	0.007	0.10	0.18	1.40	0.10	0.05	830	792	906	8.22	3	1.9
			25	0.019	0.390	0.003	0.10	0.13	0.70	0.10	0.05	680	548	414	8.41	15	1.1

Table II-2 (continued)

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	HN4-N	NO3-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
		4	8	0.009	0.510	0.005	0.10	0.11	1.20	0.10	0.05	850	752	444	8.35	17	1.7
			15	0.013	0.410	0.003	0.10	0.10	0.88	0.10	0.05	700	540	316	8.38	18	1.8
			22	0.001	0.410	0.003	0.10	0.10	1.10	0.10	0.05	622	536	357	8.46	18	3.2
			28	0.029	0.730	0.008	0.10	0.15	1.20	0.10	0.05	496	372	678	8.38	13	1.5
		5	5	0.023	2.200	0.011	0.10	0.14	2.30	0.10	0.05	450	368	1710	8.12	44	2.3
			12	0.017	1.900	0.004	0.10	0.20	1.40	0.10	0.05	540	460	1320	8.32	27	1.6
			20	0.019	0.520	0.005	0.10	0.17	0.68	0.10	0.05	490	392	193	8.38	12	1.6
			27	0.031	0.880	0.009	0.10	0.12	1.30	0.10	0.05	420	316	792	8.04	31	1.8
		6	2	0.025	1.100	0.014	0.10	0.11	1.40	0.31	0.05	400	316	880	8.22	19	1.8
			11	0.034	0.950	0.003	0.10	0.10	1.20	0.10	0.05	590	420	634	8.11	25	1.6
			17	0.025	0.490	0.005	0.10	0.10	0.71	0.22	0.05	590	404	392	8.23	20	1.1
			24	0.022	0.250	0.001	0.10	0.10	0.50	0.10	0.05	650	452	191	8.33	16	0.4
BS	84		18	0.050	0.050	0.040	0.05	0.23	0.23	0.00	0.00	0	0	23	0.00	12	0.6
			25	0.020	0.025	0.020	0.10	0.10	0.14	0.10	0.05	2000	0	14	8.26	15	0.8
		7	2	0.010	0.102	0.010	0.10	0.10	0.34	0.10	0.05	1620	0	49	8.22	10	0.9
			9	0.010	0.061	0.010	0.10	0.10	0.31	0.10	0.05	1890	0	48	8.25	20	1.2
			16	0.010	0.085	0.010	0.10	0.10	0.41	0.10	0.05	1930	0	40	8.21	16	1.8
			23	0.014	0.770	0.002	0.10	0.27	0.91	0.10	0.05	1500	0	644	7.71	16	2.6
			30	0.015	0.095	0.007	0.10	0.20	0.64	0.10	0.05	2500	0	68	8.24	19	0.8
		8	6	0.037	0.195	0.012	0.10	0.39	0.36	0.20	0.05	2400	0	128	8.12	9	1.1
			13	0.005	0.060	0.004	0.10	0.10	0.32	0.10	0.05	1600	0	118	7.93	18	0.6
			20	0.006	0.096	0.010	0.10	0.25	0.37	0.10	0.05	2300	0	51	8.14	24	1.0
			27	0.007	0.039	0.010	0.10	0.20	0.31	0.10	0.05	2200	2300	16	8.21	15	0.5
		9	4	0.002	0.021	0.010	0.10	0.18	0.18	0.10	0.05	2200	2210	11	8.05	9	0.6
			10	0.003	0.032	0.010	0.10	0.22	0.26	0.10	0.05	2300	7070	11	8.09	16	1.1
			17	0.001	0.020	0.002	0.10	0.40	0.15	0.10	0.05	2600	2550	12	8.09	10	0.1
		10	1	0.001	0.035	0.001	0.10	0.35	0.25	0.10	0.05	2800	2800	12	8.11	10	0.8
			8	0.001	0.010	0.001	0.10	0.33	0.16	0.10	0.05	2100	2820	5	7.94	10	0.2
		11	5	0.001	0.028	0.010	0.10	0.50	0.36	0.10	0.05	2800	2790	12	7.92	10	0.7
	85	3	18	0.002	0.047	0.001	0.10	0.40	0.32	0.10	0.05	2200	3610	27	8.11	0	0.0
		4	9	0.073	1.100	0.032	0.10	0.15	1.20	0.30	0.05	910	792	720	8.01	30	3.3
			22	0.087	0.330	0.002	0.10	0.13	0.79	0.10	0.05	1200	964	146	8.10	16	0.8
		5	6	0.120	0.240	0.001	0.10	0.10	0.64	0.10	0.05	1700	1680	62	8.19	16	0.7
			21	0.015	0.050	0.001	0.10	0.10	0.39	0.10	0.05	2400	2560	16	8.15	10	0.1
		6	3	0.001	0.030	0.001	0.10	0.10	0.42	0.20	0.05	2000	2030	14	8.23	14	1.1
			18	0.001	0.030	0.004	0.10	0.10	0.52	0.10	0.05	2200	2460	13	8.06	12	0.6
		7	1	0.003	0.029	0.001	0.10	0.10	0.41	0.10	0.05	2300	2500	10	8.14	12	0.6
			15	0.004	0.026	0.002	0.10	0.10	0.88	0.10	0.05	2300	2370	8	8.21	18	0.7
			29	0.001	0.023	0.001	0.10	0.10	0.31	0.10	0.05	2500	2530	14	8.30	16	0.0
		8	13	0.001	0.027	0.001	0.10	0.18	0.42	0.10	0.05	2000	2330	12	8.41	11	1.8
			27	0.001	0.020	0.001	0.10	0.21	0.12	0.10	0.05	2400	2690	12	8.28	14	0.6
		9	9	0.001	0.020	0.001	0.10	0.10	0.27	0.10	0.05	2500	2540	6	8.33	11	0.7
	86	2	4	0.007	0.035	0.001	0.10	0.26	0.41	0.10	0.05	3200	3800	11	7.87	18	1.2
		3		0.017	0.100	0.001	0.10	0.24	0.57	0.10	0.05	2300	2500	56	8.11	20	1.6
			25	0.013	0.240	0.001	0.10	0.32	0.82	0.10	0.05	2100	2550	183	8.30	17	1.3
		4	8	0.041	1.000	0.007	0.10	0.13	1.30	0.10	0.05	1300	1320	766	8.08	35	2.7
			15	0.045	0.450	0.003	0.10	0.14	0.89	0.10	0.05	1900	1820	270	8.23	21	1.5
			22	0.038	0.180	0.003	0.10	0.21	0.50	0.10	0.05	2440	2850	90	8.31	15	1.0

Table II-2 (continued)

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	HN_4-N	NO_3-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
			28	0.034	0.310	0.003	0.10	0.23	0.76	0.10	0.05	2110	2240	206	8.32	8	0.8
		5	5	0.006	0.130	0.001	0.10	0.15	0.61	0.10	0.05	2300	3140	68	8.25	22	1.2
			12	0.010	0.060	0.001	0.10	0.11	0.47	0.10	0.05	2300	3010	39	8.33	15	1.0
			20	0.013	0.210	0.001	0.10	0.10	0.20	0.10	0.05	1100	1160	136	8.29	14	1.6
			27	0.008	0.170	0.001	0.10	0.12	0.64	0.10	0.05	2100	772	137	7.87	30	1.7
		6	2	0.008	0.050	0.003	0.10	0.10	0.43	0.10	0.05	1700	1800	20	8.27	13	1.0
			11	0.036	0.170	0.019	0.10	0.10	0.50	0.33	0.05	490	380	72	7.93	15	1.0
			17	0.033	0.180	0.017	0.10	0.10	0.44	0.90	0.05	570	408	94	7.88	19	1.2
			24	0.022	0.120	0.010	0.10	0.12	0.37	0.15	0.05	640	464	57	7.91	15	0.5
CC	84		19	0.050	0.550	0.460	0.05	2.30	0.00	0.00	0.00	0	0	520	0.00	40	1.0
			26	0.040	0.900	0.030	0.10	1.20	0.36	0.10	0.05	640	0	280	8.33	18	0.7
		7	3	0.030	0.530	0.020	0.10	0.90	0.46	0.10	0.05	630	0	200	8.16	33	0.8
			10	0.030	0.658	0.030	0.10	1.50	0.73	0.10	0.05	670	0	336	8.25	15	1.1
			18	0.025	0.285	0.037	0.10	0.98	0.66	0.10	0.05	710	0	180	8.33	16	2.0
			24	0.060	0.305	0.015	0.10	1.10	0.64	0.10	0.05	650	0	203	8.35	15	0.9
			31	0.037	0.280	0.014	0.10	1.00	0.85	0.10	0.05	690	0	200	8.38	12	1.0
		8	7	0.031	0.186	0.016	0.10	0.85	0.46	0.30	0.05	690	0	138	8.28	6	0.8
			14	0.021	0.282	0.009	0.10	0.71	0.41	0.10	0.05	800	0	186	8.13	17	0.8
			21	0.042	0.477	0.009	0.10	0.84	0.86	0.10	0.05	850	0	309	8.13	22	1.0
			28	0.020	0.218	0.010	0.10	0.60	0.51	0.10	0.05	730	524	148	8.30	20	0.8
		9	5	0.016	0.123	0.010	0.10	0.70	0.27	0.10	0.05	670	584	68	8.10	20	0.6
			11	0.014	0.070	0.010	0.10	0.64	0.28	0.20	0.05	720	536	46	8.11	16	0.9
			18	0.008	0.040	0.004	0.10	0.33	0.18	0.10	0.05	760	544	22	8.24	10	0.3
		10	1	0.001	0.060	0.001	0.10	0.16	0.37	0.10	0.05	800	532	47	8.54	10	0.7
			9	0.001	0.038	0.002	0.10	0.14	0.10	0.10	0.05	760	612	15	8.05	10	0.5
		11	6	0.001	0.048	0.010	0.10	0.65	0.27	0.10	0.05	760	500	17	8.04	10	1.0
	85	3	19	0.290	1.200	0.015	0.10	0.52	1.70	0.50	0.05	690	492	1140	8.36	0	3.5
		4	10	0.017	1.800	0.032	0.14	0.61	2.40	0.10	0.05	650	492	1590	8.40	61	1.7
			22	0.022	0.740	0.015	0.20	0.77	1.20	0.10	0.05	670	476	536	8.32	22	0.6
		5	6	0.011	0.830	0.013	0.10	0.41	1.40	0.10	0.05	710	448	896	8.53	33	1.9
			20	0.013	0.400	0.013	0.10	0.19	0.68	0.10	0.05	600	480	322	8.28	16	0.1
		6	3	0.002	0.200	0.006	0.10	0.25	0.89	0.26	0.05	620	468	214	8.30	13	1.9
			18	0.006	0.110	0.003	0.10	0.10	0.47	0.20	0.05	630	496	82	8.41	12	1.1
		7	1	0.007	0.069	0.003	0.10	0.10	0.49	0.10	0.05	590	1380	43	8.46	10	1.2
			15	0.030	0.226	0.010	0.10	0.31	0.81	0.10	0.05	650	484	142	8.41	16	1.3
			30	0.015	0.120	0.008	0.10	0.13	0.69	0.11	0.05	720	548	65	8.45	18	0.0
		8	13	0.009	0.032	0.001	0.10	0.10	0.35	0.10	0.05	720	516	9	8.59	9	2.0
			27	0.013	0.060	0.003	0.10	0.10	0.27	0.10	0.05	780	588	37	8.40	15	0.7
		9	10	0.001	0.020	0.001	0.10	0.10	0.46	0.10	0.05	720	560	6	8.60	11	0.9
	86	2	4	0.026	0.340	0.009	0.10	0.39	0.68	0.10	0.05	730	608	278	8.38	1	1.1
		3		0.021	0.720	0.180	0.10	0.40	1.40	0.10	0.05	570	560	697	8.35	24	2.0
			26	0.023	0.720	0.009	0.10	0.10	1.40	0.10	0.05	650	520	1290	8.43	8	2.9
		4	8	0.015	0.570	0.012	0.10	0.11	1.00	0.10	0.05	620	512	506	8.33	16	1.0
			15	0.009	0.600	0.120	0.10	0.13	0.90	0.10	0.10	650	500	495	8.40	22	1.4
			22	0.012	0.800	0.012	0.10	0.15	1.30	0.10	0.05	622	508	662	8.48	25	1.8
			28	0.021	0.980	0.016	0.10	0.30	1.60	0.10	0.05	580	436	1020	8.47	15	0.8
		5	5	0.017	1.400	0.017	0.10	0.49	2.20	0.10	0.05	500	436	1000	8.24	40	1.7
			12	0.017	1.100	0.012	0.10	0.50	1.50	0.10	0.05	520	456	640	8.46	19	1.4

Table II-2 (continued)

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	HN_4-N	NO_3-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
			20	0.018	0.800	0.016	0.44	0.10	1.20	0.12	0.05	490	424	646	8.39	16	1.3
			27	0.015	1.300	0.018	0.10	0.71	1.60	0.10	0.05	520	424	1060	8.21	32	1.8
		6	2	0.021	0.430	0.011	0.10	0.75	0.82	0.25	0.05	550	444	296	8.45	9	0.8
			11	0.023	0.410	0.010	0.10	0.71	0.86	0.10	0.05	660	424	322	8.43	16	1.2
			17	0.020	0.280	0.006	0.10	0.65	0.63	0.24	0.05	680	448	210	8.46	19	0.9
			24	0.017	0.170	0.006	0.10	0.53	0.46	0.10	0.05	690	420	139	8.59	9	0.3
FM	84		18	0.050	0.050	0.050	0.05	0.16	0.21	0.00	0.00	0	0	20	0.00	12	1.0
			25	0.020	0.050	0.020	0.10	0.10	0.11	0.10	0.05	320	0	15	8.30	9	0.9
		7	2	0.010	0.060	0.010	0.10	0.10	0.13	0.10	0.05	290	0	14	8.12	5	0.6
			9	0.020	0.060	0.010	0.10	0.10	0.30	0.10	0.05	330	0	26	8.26	5	2.3
			16	0.012	0.065	0.010	0.10	0.10	0.17	0.10	0.05	340	0	16	8.30	11	2.0
			23	0.029	0.424	0.035	0.10	0.10	0.57	0.10	0.05	390	0	608	8.14	9	1.4
			30	0.014	0.040	0.020	0.10	0.10	0.38	0.20	0.05	340	0	72	8.27	7	1.1
		8	6	0.014	0.079	0.008	0.10	0.10	0.18	0.20	0.05	350	0	53	8.25	6	0.9
			13	0.042	0.615	0.060	0.10	0.10	1.20	0.10	0.05	270	0	632	7.93	31	2.2
			20	0.019	0.396	0.018	0.10	0.10	0.66	0.10	0.05	600	0	374	8.23	14	1.0
			27	0.027	0.233	0.027	0.10	0.10	0.46	0.10	0.05	480	384	148	8.60	3	1.2
		9	4	0.018	0.037	0.010	0.10	0.10	0.27	0.10	0.05	440	416	9	8.34	4	1.0
			10	0.015	0.061	0.010	0.10	0.10	0.41	0.10	0.05	510	324	32	8.15	10	1.9
			17	0.020	0.118	0.003	0.10	0.10	0.27	0.10	0.05	680	500	72	8.33	30	1.1
		10	1	0.006	0.048	0.001	0.10	0.10	0.23	0.10	0.05	600	376	18	8.33	10	1.1
			8	0.010	0.044	0.004	0.10	0.10	0.16	0.10	0.05	480	424	1	8.26	10	1.6
		11	5	0.014	0.050	0.010	0.10	0.10	0.31	0.10	0.05	540	368	12	8.29	12	1.0
	85	3	18	0.094	0.300	0.005	0.10	0.22	0.81	0.10	0.05	750	588	163	8.21	0	0.0
		4	9	0.008	0.300	0.002	0.10	0.10	1.70	0.10	0.05	470	360	276	8.13	18	3.2
			22	0.020	0.070	0.006	0.10	0.10	0.49	0.30	0.05	420	284	36	8.20	14	1.4
		5	6	0.006	0.090	0.001	0.10	0.10	0.60	0.10	0.05	370	216	76	8.17	15	1.5
			9	0.011	0.100	0.009	0.10	0.10	0.50	0.60	0.05	370	260	45	7.97	8	1.0
			13	0.027	0.200	0.019	0.18	0.10	0.78	0.10	0.05	380	248	100	8.27	8	1.3
			16	0.022	0.180	0.020	0.27	0.10	0.72	0.40	0.05	420	272	74	8.12	10	1.4
			21	0.014	0.120	0.013	0.10	0.10	0.73	0.27	0.05	420	328	62	7.96	6	1.6
			24	0.010	0.100	0.006	0.10	0.10	0.14	0.20	0.05	400	308	53	8.46	7	2.0
			28	0.013	0.150	0.011	0.10	0.16	0.60	0.10	0.05	380	260	100	8.48	10	2.9
			31	0.023	0.150	0.014	0.10	0.16	0.66	0.20	0.05	330	232	68	7.85	10	2.5
		6	3	0.026	0.120	0.017	0.10	0.10	0.52	0.21	0.05	350	236	88	8.16	8	1.2
			10	0.010	0.050	0.001	0.10	0.10	0.43	0.10	0.05	450	324	18	8.39	10	0.7
			18	0.007	0.060	0.005	0.10	0.10	0.51	0.20	0.05	340	280	26	8.30	10	1.7
		7	1	0.009	0.059	0.005	0.10	0.10	0.50	0.10	0.05	370	216	23	8.51	10	1.3
			15	0.013	0.061	0.008	0.10	0.10	0.52	0.10	0.05	490	312	16	8.52	9	1.3
			29	0.008	0.070	0.002	0.10	0.10	0.48	0.10	0.05	490	276	43	8.66	12	0.0
		8	13	0.009	0.053	0.001	0.10	0.10	0.35	0.10	0.05	560	384	12	8.57	9	1.3
			27	0.013	0.050	0.001	0.10	0.10	0.10	0.00	0.05	730	568	13	8.50	6	1.1
	86	2	4	0.085	0.120	0.004	0.10	0.14	0.60	0.10	0.05	660	508	13	8.22	10	1.1
		3		0.040	0.310	0.004	0.10	0.14	0.43	0.10	0.05	620	512	254	8.21	12	1.7
			25	0.034	0.090	0.002	0.10	0.10	0.50	0.10	0.05	580	460	38	8.31	7	1.1
		4	8	0.011	0.090	0.006	0.10	0.10	0.49	0.10	0.05	490	388	49	8.25	10	1.3
			15	0.006	0.120	0.001	0.10	0.10	0.65	0.15	0.05	550	412	62	8.34	14	1.9
			22	0.010	0.760	0.012	0.10	0.11	1.30	0.10	0.05	610	552	844	8.48	10	2.8

Table II-2 (continued)

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
			28	0.026	0.180	0.007	0.10	0.09	0.73	0.31	0.05	428	324	124	8.34	8	1.1
		5	5	0.012	0.090	0.001	0.10	0.10	0.53	0.15	0.05	400	320	51	8.24	13	1.4
			12	0.013	0.090	0.004	0.10	0.10	0.49	0.10	0.05	370	296	56	8.36	13	1.0
			20	0.011	0.070	0.001	0.10	0.10	0.30	0.12	0.05	360	284	36	8.41	22	1.6
			27	0.010	0.930	0.006	0.10	0.10	0.41	0.13	0.05	310	196	52	8.08	25	1.5
		6	2	0.025	0.170	0.019	0.10	0.10	0.79	0.58	0.05	270	196	105	8.11	13	1.3
			11	0.031	0.190	0.022	0.10	0.11	0.59	0.24	0.05	290	212	161	8.09	16	1.3
			17	0.022	0.110	0.014	0.10	0.10	0.43	0.23	0.05	290	196	57	8.08	15	1.1
			24	0.019	0.090	0.011	0.10	0.10	0.41	0.10	0.05	270	188	51	8.18	15	0.7
JA		6	18	0.050	0.050	0.040	0.05	0.12	0.14	0.00	0.00	0	0	24	0.00	8	1.0
			25	0.020	0.040	0.020	0.10	0.10	0.02	0.10	0.05	300	0	17	8.15	9	0.9
		7	2	0.010	0.220	0.010	0.10	0.10	0.24	0.10	0.05	280	0	13	8.08	5	0.5
			9	0.010	0.030	0.010	0.10	0.10	0.02	0.10	0.05	290	0	16	8.21	8	1.3
			16	0.010	0.035	0.010	0.10	0.10	0.21	0.10	0.05	320	0	12	8.33	6	1.5
			23	0.010	0.365	0.014	0.10	0.10	0.35	0.10	0.05	340	0	292	8.18	5	1.2
			30	0.004	0.045	0.007	0.10	0.10	0.35	0.10	0.05	320	0	32	8.22	7	1.0
		8	6	0.004	0.042	0.002	0.10	0.10	0.17	0.10	0.05	330	0	28	8.26	6	1.0
			13	0.002	0.025	0.005	0.10	0.10	0.18	0.10	0.05	500	0	3	8.19	16	0.8
			20	0.001	0.027	0.010	0.10	0.10	0.27	0.10	0.05	490	0	10	8.24	20	0.8
			27	0.001	0.023	0.010	0.10	0.10	0.02	0.10	0.05	420	308	12	8.46	1	1.0
		9	4	0.003	0.017	0.010	0.10	0.10	0.06	0.10	0.05	410	348	7	8.25	8	0.9
			10	0.004	0.024	0.010	0.10	0.10	0.33	0.10	0.05	440	344	7	8.11	12	1.9
			17	0.002	0.019	0.002	0.10	0.10	0.23	0.10	0.05	620	428	6	8.30	10	1.0
		10	1	0.002	0.030	0.001	0.10	0.10	0.27	0.10	0.05	520	372	18	8.25	10	0.7
			8	0.001	0.011	0.001	0.10	0.10	0.14	0.10	0.05	460	396	6	8.17	10	0.6
		11	5	0.001	0.024	0.010	0.10	0.10	0.43	0.10	0.05	540	272	10	8.13	10	1.4
	85	3	18	0.090	0.140	0.069	0.10	0.10	0.45	0.20	0.05	320	236	13	8.49	0	0.0
		4	9	0.002	0.170	0.001	0.10	0.10	0.59	0.10	0.05	390	320	150	8.05	10	2.3
			22	0.004	0.070	0.003	0.10	0.16	0.55	0.30	0.05	400	258	32	8.14	14	1.4
		5	6	0.004	0.080	0.001	0.10	0.10	0.50	0.10	0.05	360	232	62	8.19	12	1.3
			9	0.008	0.110	0.011	0.10	0.10	0.62	0.50	0.05	360	252	57	8.13	9	1.2
			13	0.024	0.210	0.013	0.16	0.10	0.85	0.20	0.05	390	244	100	8.10	7	1.9
			16	0.020	0.180	0.015	0.14	0.10	0.68	0.25	0.05	410	268	74	8.10	10	1.6
			21	0.004	0.100	0.008	0.10	0.10	0.68	0.22	0.05	410	304	51	7.86	7	0.6
			24	0.006	0.090	0.004	0.10	0.10	0.37	0.10	0.05	400	288	56	8.38	4	1.9
			28	0.007	0.120	0.008	0.10	0.10	0.43	0.10	0.05	340	260	84	8.49	4	1.7
			31	0.014	0.140	0.017	0.10	0.10	0.66	0.30	0.05	340	228	66	7.89	7	2.2
		6	3	0.010	0.100	0.013	0.10	0.10	0.43	0.28	0.05	350	248	52	8.07	7	0.8
			10	0.009	0.040	0.001	0.10	0.10	0.29	0.10	0.05	410	300	18	8.52	9	0.6
			18	0.004	0.050	0.002	0.10	0.10	0.50	0.20	0.05	320	284	20	8.29	10	1.5
		7	1	0.002	0.054	0.003	0.10	0.10	0.54	0.10	0.05	560	168	24	8.60	7	1.3
			15	0.002	0.036	0.003	0.10	0.10	0.63	0.10	0.05	480	304	13	8.54	10	1.3
			29	0.003	0.050	0.001	0.10	0.10	0.48	0.10	0.05	480	284	39	8.57	12	0.0
		8	13	0.002	0.026	0.001	0.10	0.10	0.50	0.10	0.05	560	376	12	8.52	9	1.0
			27	0.001	0.020	0.001	0.10	0.10	0.09	0.10	0.05	670	524	11	8.33	6	0.7
		9	10	0.001	0.030	0.001	0.10	0.10	0.37	0.10	0.05	720	508	20	8.52	9	0.9
	86	2	4	0.029	0.047	0.002	0.10	0.10	0.35	0.10	0.05	670	528	5	8.25	6	1.2
		3		0.001	0.130	0.001	0.10	0.14	0.18	0.10	0.05	520	452	118	8.16	12	1.6

Table II-2 (continued)

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	HN4-N	NO3-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
			25	0.002	0.050	0.001	0.10	0.10	0.58	0.10	0.05	500	420	37	8.36	12	1.3
		4	8	0.003	0.070	0.013	0.10	0.10	0.45	0.10	0.05	470	384	44	8.27	14	1.6
			15	0.010	0.090	0.001	0.10	0.10	0.45	0.17	0.05	520	420	56	8.38	10	1.2
			22	0.002	0.060	0.002	0.10	0.10	0.58	0.10	0.05	523	468	37	8.47	12	1.8
			28	0.016	0.120	0.003	0.10	0.09	0.73	0.21	0.05	422	300	74	8.35	7	1.0
		5	5	0.005	0.070	0.002	0.10	0.10	0.33	0.20	0.05	370	280	40	8.28	11	0.5
			12	0.006	0.070	0.003	0.10	0.10	0.67	0.10	0.05	370	276	45	8.39	13	1.0
			20	0.003	0.060	0.001	0.10	0.10	0.27	0.13	0.05	360	284	35	8.41	28	1.2
			27	0.005	0.100	0.004	0.10	0.10	0.14	0.10	0.05	310	192	47	8.07	26	1.4
		6	2	0.024	0.160	0.018	0.10	0.10	0.64	0.58	0.05	250	216	98	7.70	18	1.3
			11	0.027	0.100	0.016	0.10	0.14	0.43	0.22	0.05	280	152	52	8.09	15	1.1
			17	0.017	0.100	0.011	0.10	0.10	0.30	0.24	0.05	280	204	54	8.02	15	0.8
			24	0.013	0.090	0.011	0.10	0.10	0.14	0.10	0.05	270	172	53	8.14	14	0.5
SC		6	19	0.050	0.650	0.460	0.05	1.10	0.00	0.00	0.00	0	0	1200	0.00	45	0.9
			26	0.020	0.070	0.030	0.10	0.53	0.43	0.30	0.05	1000	0	800	8.19	8	0.6
		7	3	0.020	0.850	0.020	0.10	1.10	0.64	0.10	0.05	1050	0	490	8.12	42	0.7
			10	0.040	10.800	0.430	0.10	0.31	6.80	0.10	0.05	1250	0	11400	8.08	190	1.4
			18	0.023	0.585	0.075	0.10	0.39	2.10	0.10	0.05	1100	0	1480	8.26	48	1.3
			24	0.048	1.660	0.048	0.10	0.28	2.10	0.10	0.05	1000	0	1840	8.26	36	1.6
		8	7	0.038	4.100	0.016	0.10	0.15	0.63	0.30	0.05	980	0	566	8.27	4	0.7
			14	0.018	0.197	0.010	0.10	0.10	0.29	0.10	0.05	1200	0	172	7.98	11	0.4
			21	0.030	0.699	0.015	0.10	0.21	0.90	0.10	0.05	1300	0	87	8.09	22	0.9
			28	0.021	0.659	0.011	0.10	0.10	1.23	0.10	0.05	1800	892	1010	8.26	26	1.2
		9	5	0.022	0.223	0.010	0.10	0.10	0.32	0.10	0.05	1000	952	253	8.26	35	0.6
			11	0.021	0.413	0.010	0.10	0.10	0.55	0.20	0.05	1200	956	476	8.18	18	1.2
			18	0.008	0.235	0.007	0.10	0.10	0.48	0.10	0.05	1100	980	310	8.37	40	0.3
		10	1	0.001	0.061	0.001	0.10	0.10	0.19	0.10	0.05	1400	1080	50	8.28	10	1.2
			9	0.001	0.064	0.001	0.10	0.10	0.27	0.10	0.05	1100	1120	54	8.05	17	0.4
		11	6	0.001	0.860	0.160	0.10	0.36	1.20	0.10	0.05	1200	892	1148	8.01	350	1.1
	85	3	19	0.015	5.500	0.400	0.13	0.20	5.30	0.30	0.05	690	564	7610	8.09	0	7.2
		4	10	0.018	4.400	0.035	0.10	0.29	4.60	0.10	0.05	1300	1210	6400	8.15	85	2.0
			22	0.016	3.100	0.034	0.10	0.44	3.50	0.10	0.05	1400	1110	3800	8.17	59	1.0
		5	6	0.012	1.700	0.026	0.10	0.23	1.70	0.10	0.05	1200	1030	2020	8.39	40	0.9
			20	0.009	0.270	0.005	0.10	0.10	0.27	0.10	0.05	1200	1100	278	8.24	4	0.1
		6	3	0.001	0.050	0.002	0.10	0.10	0.82	0.10	0.05	1400	1290	85	8.25	8	2.2
			18	0.002	0.040	0.001	0.10	0.10	0.41	0.10	0.05	1300	1290	37	8.14	9	1.0
		7	1	0.032	0.072	0.009	0.10	0.10	0.33	0.10	0.05	1300	414	32	8.23	10	0.7
			15	0.003	0.041	0.003	0.10	0.10	0.58	0.10	0.05	1300	1180	21	8.43	7	0.4
			30	0.009	0.110	0.004	0.10	0.10	0.60	0.10	0.05	1400	1310	114	8.35	4	0.0
			31	0.020	1.110	0.042	0.10	0.27	2.00	0.10	0.05	1200	0	1530	8.28	15	1.3
		8	13	0.004	0.021	0.001	0.10	0.10	0.31	0.10	0.05	1300	1210	3	8.53	8	1.5
			27	0.005	0.030	0.002	0.10	0.10	0.33	0.10	0.05	1400	1410	6	8.32	7	0.5
		9	10	0.001	0.020	0.001	0.10	0.10	0.35	0.10	0.05	1400	1370	5	8.53	14	0.5
	86	2	4	0.043	0.390	0.006	0.10	0.23	0.74	0.10	0.05	1100	1120	442	8.22	7	0.9
		3		0.016	2.500	0.036	0.10	0.20	2.90	0.10	0.05	1100	1120	3000	8.22	36	2.2
			26	0.018	0.960	0.011	0.10	0.18	1.30	0.10	0.05	1300	1270	1280	8.26	12	1.1
		4	8	0.012	0.610	0.012	0.10	0.11	1.20	0.10	0.05	1200	1260	684	8.16	8	1.2
			15	0.001	0.980	0.012	0.10	0.18	1.70	0.10	0.05	1300	1220	1240	8.23	18	2.4

Table II-2 (continued)

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	HN_4-N	NO_3-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
			22	0.003	2.200	0.012	0.10	0.17	2.30	0.10	0.05	3430	1390	2880	8.30	35	2.1
			28	0.016	3.700	0.030	0.10	0.30	5.00	0.10	0.05	1170	1190	5210	8.41	73	2.2
		5	5	0.015	2.000	0.022	0.10	0.25	2.30	0.10	0.05	760	852	2050	8.25	44	1.8
			12	0.011	2.900	0.016	0.10	0.24	2.30	0.10	0.05	870	1010	2180	8.38	40	1.6
			20	0.010	0.900	0.018	0.11	0.10	1.10	0.10	0.05	780	852	1050	8.28	23	1.8
			27	0.001	2.100	0.024	0.10	0.23	2.00	0.10	0.05	890	852	2210	8.11	5	2.6
		6	2	0.013	0.700	0.014	0.10	0.14	0.61	0.10	0.05	810	828	640	8.49	7	1.5
			11	0.018	2.300	0.025	0.10	0.22	3.10	0.18	0.05	1400	1190	3130	8.34	19	1.8
			17	0.012	0.620	0.009	0.10	0.11	1.10	0.10	0.05	1500	944	710	8.41	17	1.5
			24	0.012	0.310	0.007	0.10	0.10	0.67	0.10	0.05	1200	900	382	8.49	8	0.4
TP	84		18	3.700	3.700	2.900	3.40	11.00	1.75	0.00	0.00	0	0	4	0.00	100	9.0
			25	13.000	12.000	1.200	8.60	1.20	1.21	0.40	0.05	1400	0	14	7.65	74	10.4
		7	2	4.700	4.200	3.570	1.00	7.00	0.95	0.10	0.05	1120	0	9	7.25	71	7.2
			9	3.300	3.670	3.500	3.90	4.50	5.72	0.10	0.05	1110	0	4	7.79	73	22.0
			16	5.100	11.200	6.120	13.00	32.00	10.80	0.10	0.89	1550	0	26	7.65	89	30.0
			23	3.300	3.870	2.670	2.90	2.00	4.60	0.10	0.14	1000	0	2	7.47	57	3.0
			30	2.100	3.800	4.270	2.70	4.90	5.40	0.20	0.11	1300	0	4	7.93	60	5.0
		8	6	4.410	4.220	0.149	3.50	1.80	6.00	0.30	0.32	1100	0	5	7.68	55	3.2
			13	2.900	3.680	1.600	4.40	4.70	6.74	0.10	0.05	1500	0	12	7.27	55	5.4
			20	3.640	4.300	3.610	3.57	11.00	4.94	0.10	0.05	1200	0	5	7.34	63	3.6
			27	2.270	4.470	4.720	3.40	2.00	5.76	0.10	0.05	1000	764	3	7.67	40	3.6
		9	4	2.120	2.300	2.060	0.94	2.90	2.58	0.10	0.05	960	960	2	7.95	42	3.6
			10	0.050	2.750	2.480	0.88	14.00	2.79	0.10	0.15	1100	872	3	7.98	62	4.1
			17	6.900	7.500	7.250	4.30	1.90	6.90	0.10	0.05	1000	800	12	8.02	55	11.0
		10	1	7.300	8.400	8.200	10.40	7.30	12.80	0.10	0.05	1200	896	6	7.45	80	3.6
			9	6.300	6.600	6.400	8.10	14.80	8.50	0.10	0.08	1200	988	6	7.28	26	3.3
		11	5	8.460	8.800	9.100	17.00	0.97	21.00	0.10	0.12	1200	700	25	7.69	30	28.0
	85	3	18	8.600	10.000	11.000	18.00	0.97	18.00	0.50	0.62	970	762	6	7.67	0	0.0
		4	9	4.900	6.600	6.400	12.00	1.10	16.00	0.10	0.07	790	528	40	7.61	47	14.0
			22	5.200	5.200	5.200	7.20	5.90	9.90	0.10	0.10	950	668	28	7.53	59	9.1
		5	21	5.600	6.600	6.500	4.10	16.00	6.10	0.10	0.05	1100	932	6	7.54	46	12.0
		6	3	6.300	7.500	7.500	8.50	21.00	10.00	0.30	0.05	1400	1050	23	7.76	83	15.0
			18	5.900	6.500	6.300	3.90	4.10	7.30	0.40	0.05	980	808	11	7.38	80	7.3
		7	1	5.800	6.200	5.800	4.10	2.00	8.20	0.20	0.05	1000	764	11	8.18	40	11.0
			15	7.200	8.300	7.300	7.90	2.50	12.00	0.10	0.05	1100	776	5	8.23	72	5.5
			29	7.050	6.900	6.930	9.10	3.20	12.00	0.10	0.05	1100	772	9	7.80	47	0.0
		8	13	5.300	5.500	5.500	4.60	4.80	7.60	0.10	0.05	1000	784	3	7.95	57	30.0
			27	4.200	4.400	4.400	4.70	2.70	7.30	0.14	0.05	1100	792	7	7.90	40	5.1
		9	10	5.500	6.000	5.700	5.30	7.70	7.80	0.10	0.05	1200	928	4	7.82	56	3.6
	86	2	4	11.000	12.000	12.000	27.00	0.68	31.00	0.52	0.25	1200	814	9	7.52	81	17.0
		3		8.800	11.000	9.400	18.00	3.20	23.00	0.35	0.35	830	748	43	7.74	560	11.0
			25	10.000	11.000	11.000	22.00	0.27	25.00	0.10	0.40	1000	716	14	8.16	38	8.4
		4	8	8.800	21.000	9.500	18.00	0.63	22.00	0.10	0.05	970	740	24	7.79	70	11.0
			15	8.900	9.600	9.600	17.00	1.70	21.00	0.16	0.14	1000	740	35	7.79	60	19.0
			22	6.500	6.700	6.400	11.00	24.00	15.00	0.10	0.08	1200	1040	18	7.23	84	13.0
			28	7.200	7.100	7.600	12.00	4.00	15.00	0.10	0.12	984	720	9	7.85	39	6.6
		5	5	6.100	6.100	6.300	9.30	2.70	12.00	0.15	0.13	830	704	15	7.51	48	5.5
			12	6.500	7.300	7.100	10.00	2.70	10.00	0.10	0.05	870	716	15	7.64	56	5.4

Table II-2 (continued)

SI	YR	MO	DAY	OP-P	TP-P	NaOH-P	HN4-N	NO3-N	TKN-N	Fe	Mn	COND	TDS	SS	pH	COD	BOD
			20	6.700	7.000	7.000	10.00	4.30	13.00	0.30	0.12	960	772	12	7.59	77	7.8
			27	8.600	9.200	9.200	9.70	2.00	12.00	0.10	0.05	990	836	15	7.41	76	21.0
		6	2	4.800	5.800	5.600	10.00	9.30	16.00	0.48	0.59	1100	964	283	7.58	77	18.0
			11	0.320	0.460	0.350	0.47	0.33	2.00	0.15	0.05	340	212	42	7.79	23	2.4
			17	0.160	0.240	0.170	0.12	0.15	0.68	0.24	0.05	330	212	23	7.58	23	1.5

III. ANALYSES OF CHEMICAL DATA

Summary statistics for the data of Tables II-1 and II-2 are presented in Tables III-1 through III-5. Included for each variable are the maximum and minimum values, the mean, the standard error, and the number of cases. A summary table is presented for all data (Table III-1), followed by four tables with summaries by category (cations, anions, etc.) for each of the eight sampling locations (Tables III-2 through III-5).

In exploring and evaluating the data a series of analyses were performed: descriptive statistics and scatter plots; analyses of variance; correlation analyses. Relations usually were evaluated for all sites pooled, for all sites except the treatment plant (i.e., for all natural streams), and for each site. Most analyses were performed with SPSS on the CYBER, but the microcomputer software KnowledgeMan and SYSTAT also were used. In addition to the descriptive statistics of Tables III-1 to III-5, results from some of these analyses are summarized below

One-way analysis of variance was performed to test the null hypothesis, H_0: $u_{site\ 1} = u_{site\ 2} = ... = u_{site\ 8}$; the alternate hypothesis was that inequality between the means exists. When data from all eight sites were used, the alternate hypothesis was accepted ($p < 0.001$) for all parmeters except iron. However, as suggested below, data for some variables from the treatment plant were quite different from other sites.

When ANOVA was performed using data only from the natural streams (without the treatment plant), differences again existed between sites for all variables execpt iron, manganese and pH. However, large differences were seen when comparing results for some variables to results from the analyses with all sites. For example, the F statistic increased substantially for nitrate, bicarbonate and biological oxygen demand when data from the treatment plant were removed. Thus, for these variables, greater differences exist betweeen at least some of sites 2-8 when the variability attributable to the treatment plant (site 1) is removed. That is, the treatment plant is "unusual" in that data for nitrate, bicarbonate and biological oxygen demand have less variability than in natural streams.

The opposite occurred for potassium, manganese, pH, sodium hydroxide extractable phosphorus, ortho-phosphorus, total phosphorus, ammonium and total Kjeldahl nitrogen, implying lesser differences among sites 2-8 for these variables. Thus the analysis was more sensitive to differences between sites when variability from the treatment plant was not included, again suggesting that data from the treatment plant are "unusual." It is interesting to note that this occurred for many forms of nutrients, which is logical considering that sewage should be different from streams for these variables.

Results from the ANOVAs determined whether mean values differed among sites. To evaluate between which sites these differences occurred, we calculated 95% confidence limits about mean values; if these limits did not overlap between two sites, differences were considered significant.

Except for iron and manganese, data from the treatment plant usually was different from all other sites.

Variables which, with few exceptions, had the same means at all sties were carbonate, ammonium, biological oxygen demand, manganese, pH and iron. These would not be useful variables to use in attempting to distinguish between sites.

Conversely, the following variables usually were different at each site: fluoride, magnesium, sodium, sulfate, total dissolved solids, conductivity, nitrate, calcium and potassium. Thus these variables would be useful when attempting to distinguish between sites.

The remaining variables were different between some sites, but not betwen others: chloride, total phosphorus, total Kjeldahl nitrogen, chemical oxygen demand, total alkalinity, bicarbonate, sodium hydroxide extractable phosphorus and suspended solids. Not unexpectedly, total alkalinity and bicarbonate usually distinguished between the same sites. While suspended solids was not different between the Big Sandy and Blacks Fork sites, it was different at all other sites.

Correlation matricies were constructed for several combinations of data: all sites; all natural streams (i.e., without the treatment plant); and for each site. Consistently, manganese and iron were not correlated with any other variables. This is not unexpected as most often these analyses were at the limit of detection, so little variation occurred.

When data from all sites were pooled there was some intercorrelation among i) suspended solids, sodium hydroxide extractable phosphorus, ortho-phosphorus, total phosphorus, ammonium, total Kjeldahl nitrogen, chemical oxygen demand and biological oxygen demand, and ii) among cations, anions, conductivity and total dissolved solids. However, when data from all sites were pooled, variation associated with the treatment plant tends to overwhelm that from other sites, obscuring relationships. After removing data from the treatment plant, many more significant relations occurred, and all negative correlations became positive. This again reinforces the not unexpected conclusion that data from the treatment plant often are different from data at the other sites.

When data from the treatment plant were eliminated, there was increased intercorrelation among cations, anions, conductivity, total alkalinity and total dissolved solids. There was limited intercorrelation among the nutrients.

For individual sites, the following tended to show the most correlation to other variables: conductivity, total alkalinity, total dissolved solids and sodium. There was some intercorrelation among suspended solids and nutrients, but no clear pattern emerged.

Table III-1. Summary data for cations, anions, nutrients and miscellaneous parameters from all stations and all dates. Concentrations are in mg/L (as $CaCO_3$ for total alkalinity); a "-P" or "-N" indicates that units refer to elemental phosphorus or nitrogen.

CATIONS

	Ca	Mg	Na	K
MINIMUM	27.0	6.4	5.5	1.2
MAXIMUM	1780.0	250.0	4900.0	22.0
MEAN	99.0	52.1	195.7	5.8
STD. ERROR	5.3	2.3	17.3	0.2
N OF CASES	371	371	370	370

ANIONS

	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	89.00	0.01	33.50	1.80	0.10	73.00
MAXIMUM	630.00	110.00	2440.00	1200.00	0.93	520.00
MEAN	248.05	4.84	484.75	96.22	0.34	211.39
STD. ERROR	4.23	0.64	25.76	10.54	0.01	3.69
N OF CASES	371	371	369	371	371	371

NUTRIENTS

	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.001	0.010	0.001	0.050	0.090	0.020	0.100	0.050
MAXIMUM	13.000	23.800	12.000	27.000	32.000	35.000	1.000	0.890
MEAN	0.799	1.871	0.854	1.072	1.139	2.694	0.141	0.064
STD. ERROR	0.104	0.185	0.110	0.169	0.152	0.271	0.006	0.004
N OF CASES	384	384	371	384	384	382	362	363

MISCELLANEOUS

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	250	152	1	7.18	1.0	0.0
MAXIM	5700	7070	32400	9.27	560.0	35.0
MEAN	1219	1193	1041	8.19	30.8	2.9
STD. ERROR	52	65	184	0.01	2.5	0.2
N OF CASES	363	303	383	363	359	384

Table III-2. Summary data for cations arranged by station. Concentrations are in mg/L.

	Ca	Mg	Na	K
TREATMENT PLANT				
MINIMUM	34.0	7.6	16.0	2.7
MAXIMUM	180.0	76.0	290.0	17.0
MEAN	76.1	25.3	165.9	11.5
STD. ERROR	3.9	1.6	6.7	0.4
N OF CASES	43	43	43	43
GREEN RIVER AT JAMESTOWN				
MINIMUM	27.0	8.7	5.5	1.2
MAXIMUM	95.0	24.0	76.0	3.1
MEAN	47.9	14.3	31.7	2.2
STD. ERROR	1.9	0.4	2.3	0.0
N OF CASES	52	52	52	52
GREEN RIVER AT FMC BRIDGE				
MINIMUM	31.0	7.1	12.0	1.5
MAXIMUM	94.0	33.0	97.0	4.3
MEAN	48.9	15.5	37.3	2.3
STD. ERROR	1.9	0.6	2.7	0.0
N OF CASES	51	51	51	51
BITTER CREEK				
MINIMUM	84.0	43.0	250.0	9.0
MAXIMUM	290.0	250.0	1200.0	22.0
MEAN	144.9	131.2	645.1	15.7
STD. ERROR	7.0	6.9	39.7	0.5
N OF CASES	45	45	45	45
CURRANT CREEK				
MINIMUM	52.0	15.0	6.9	1.6
MAXIMUM	120.0	46.0	71.0	20.0
MEAN	71.9	36.7	50.1	3.1
STD. ERROR	2.5	0.9	1.5	0.3
N OF CASES	45	45	45	45
SAGE CREEK				
MINIMUM	72.0	43.0	41.0	3.1
MAXIMUM	200.0	120.0	170.0	7.4
MEAN	109.9	86.1	100.7	5.0
STD. ERROR	4.6	2.4	3.8	0.1
N OF CASES	45	45	44	44

Table III-2 (continued)

BIG SANDY				
	Ca	Mg	Na	K
MINIMUM	37.0	10.0	60.0	1.8
MAXIMUM	1780.0	160.0	4900.0	5.1
MEAN	207.7	82.3	464.2	3.7
STD. ERROR	37.1	5.3	102.7	0.1
N OF CASES	45	45	45	45

BLACKS FORK				
	Ca	Mg	Na	K
MINIMUM	51.0	6.4	25.0	2.3
MAXIMUM	190.0	92.0	350.0	7.4
MEAN	98.2	34.9	113.6	4.3
STD. ERROR	4.9	2.6	10.6	0.1
N OF CASES	45	45	45	45

Table III-3. Summary data for anions arranged by station. Concentrations are in mg/L (as $CaCO_3$ for total alkalinity).

TREATMENT PLANT

	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	150.0	0.01	46.20	6.90	0.10	120.0
MAXIMUM	630.0	0.10	456.00	160.00	0.41	520.0
MEAN	321.6	0.09	243.41	85.19	0.23	264.4
STD. ERROR	12.4	0.00	9.44	3.94	0.00	10.1
N OF CASES	43	43	43	43	43	43

GREEN RIVER AT JAMESTOWN

	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	100.0	0.10	33.50	1.80	0.12	87.0
MAXIMUM	220.0	20.00	284.00	618.00	0.28	190.0
MEAN	150.1	2.57	108.40	19.04	0.17	126.6
STD. ERROR	3.5	0.62	7.79	11.75	0.00	2.9
N OF CASES	52	52	52	52	52	52

GREEN RIVER AT FMC BRIDGE

	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	100.0	0.10	33.90	2.10	0.13	100.0
MAXIMUM	210.0	21.00	286.00	47.00	0.28	180.0
MEAN	156.0	2.32	117.59	10.82	0.18	131.7
STD. ERROR	3.4	0.63	8.54	0.95	0.00	2.6
N OF CASES	51	51	51	51	51	51

BITTER CREEK

	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	150.0	0.10	490.00	183.00	0.39	120.0
MAXIMUM	420.0	110.00	1950.00	1200.00	0.77	400.0
MEAN	297.3	19.69	1197.60	556.88	0.58	276.4
STD. ERROR	11.6	4.18	47.41	43.61	0.01	10.6
N OF CASES	45	45	45	45	45	45

CURRANT CREEK

	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	240.0	0.10	97.40	5.30	0.26	240.0
MAXIMUM	360.0	36.00	201.00	16.00	0.47	310.0
MEAN	310.0	6.32	153.21	11.09	0.31	265.3
STD. ERROR	4.0	1.12	3.62	0.37	0.00	2.3
N OF CASES	45	45	44	45	45	45

SAGE CREEK

	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	160.0	0.10	300.00	10.00	0.20	130.0
MAXIMUM	350.0	40.00	809.00	31.00	0.43	300.0
MEAN	294.8	4.12	556.97	20.35	0.28	248.8
STD. ERROR	4.2	1.18	17.68	0.75	0.00	3.8
N OF CASES	45	45	45	45	45	45

Table III-3 (continued)

BIG SANDY	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	89.0	0.10	168.00	6.30	0.20	73.0
MAXIMUM	370.0	20.00	2440.00	59.00	0.93	300.0
MEAN	251.1	1.36	1247.57	36.20	0.62	207.7
STD. ERROR	9.9	0.58	71.77	1.67	0.02	8.2
N OF CASES	45	45	45	45	45	45

BLACKS FORK	HCO_3	CO_3	SO_4	Cl	F	Total Alk
MINIMUM	180.0	0.10	75.80	14.00	0.18	150.0
MAXIMUM	290.0	24.00	1200.00	140.00	0.67	260.0
MEAN	234.0	2.69	339.38	53.13	0.38	196.0
STD. ERROR	4.2	0.77	36.41	3.68	0.02	3.8
N OF CASES	45	45	44	45	45	45

Table III-4. Summary data for nutrients arranged by station. Concentrations are in mg/L (as $CaCO_3$ for total alkalinity); a "-P" or "-N" indicates that units refer to elemental phosphorus or nitrogen.

TREATMENT PLANT

	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.050	0.240	0.149	0.120	0.150	0.680	0.100	0.050
MAXIMUM	13.000	21.000	12.000	27.000	32.000	31.000	0.520	0.890
MEAN	5.709	6.736	5.803	8.279	5.858	10.426	0.176	0.141
STD. ERROR	0.428	0.551	0.456	0.950	1.050	1.081	0.019	0.028
N OF CASES	43	43	43	43	43	43	42	42

GREEN RIVER AT JAMESTOWN

	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.001	0.011	0.001	0.050	0.090	0.020	0.100	0.050
MAXIMUM	0.090	0.365	0.069	0.160	0.160	0.850	0.580	0.050
MEAN	0.010	0.080	0.008	0.101	0.103	0.382	0.151	0.050
STD. ERROR	0.002	0.009	0.002	0.002	0.002	0.029	0.014	0.000
N OF CASES	52	52	52	52	52	52	51	51

GREEN RIVER AT FMC BRIDGE

	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.006	0.037	0.001	0.050	0.090	0.100	0.100	0.050
MAXIMUM	0.094	0.930	0.060	0.270	0.220	1.700	0.600	0.050
MEAN	0.020	0.159	0.011	0.104	0.108	0.506	0.159	0.050
STD. ERROR	0.002	0.025	0.002	0.004	0.003	0.042	0.016	0.000
N OF CASES	51	51	51	51	51	51	49	50

BITTER CREEK

	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.006	0.151	0.027	0.100	0.100	0.320	0.100	0.050
MAXIMUM	3.300	23.800	3.400	4.400	6.070	35.000	1.000	0.830
MEAN	0.962	4.978	1.373	0.460	2.173	6.193	0.139	0.079
STD. ERROR	0.121	0.782	0.112	0.099	0.195	1.101	0.022	0.019
N OF CASES	58	58	45	58	58	58	44	44

CURRANT CREEK

	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.001	0.020	0.001	0.050	0.100	0.100	0.100	0.050
MAXIMUM	0.290	1.800	0.460	0.440	2.300	2.400	0.500	0.100
MEAN	0.025	0.477	0.028	0.110	0.540	0.836	0.129	0.051
STD. ERROR	0.006	0.063	0.011	0.008	0.066	0.081	0.012	0.001
N OF CASES	45	45	45	45	45	44	44	44

SAGE CREEK

	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.001	0.020	0.001	0.050	0.100	0.190	0.100	0.050
MAXIMUM	0.050	10.800	0.460	0.130	1.100	6.800	0.300	0.050
MEAN	0.016	1.372	0.047	0.100	0.227	1.535	0.118	0.050
STD. ERROR	0.002	0.293	0.016	0.001	0.032	0.230	0.008	0.000
N OF CASES	45	45	45	45	45	44	44	44

Table III-4 (continued)

	BIG SANDY							
	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.001	0.010	0.001	0.050	0.100	0.120	0.100	0.050
MAXIMUM	0.120	1.100	0.040	0.100	0.500	1.300	0.900	0.050
MEAN	0.019	0.158	0.006	0.099	0.185	0.473	0.134	0.050
STD. ERROR	0.004	0.036	0.001	0.001	0.015	0.040	0.019	0.000
N OF CASES	45	45	45	45	45	45	44	44

	BLACKS FORK							
	OP-P	TP-P	NaOH-P	NH_4-N	NO_3-N	TKN-N	Fe	Mn
MINIMUM	0.001	0.025	0.001	0.050	0.100	0.220	0.100	0.050
MAXIMUM	0.390	10.900	0.400	0.100	0.260	11.300	0.400	0.050
MEAN	0.026	0.830	0.019	0.099	0.124	1.119	0.119	0.050
STD. ERROR	0.009	0.246	0.009	0.001	0.006	0.242	0.009	0.000
N OF CASES	45	45	45	45	45	45	44	44

Table III-5. Summary data for miscellaneous parameters arranged by station. Concentrations are in mg/L.

TREATMENT PLANT

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	330	212	2	7.23	23.0	0.0
MAXIMUM	1550	1050	283	8.23	560.0	30.0
MEAN	1053	772	19	7.68	70.7	9.6
STD. ERROR	36	31	6	0.03	12.2	1.1
N OF CASES	42	3	43	42	42	43

GREEN RIVER AT JAMESTOWN

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	250	152	3	7.70	1.0	0.0
MAXIMUM	720	528	292	8.60	28.0	2.3
MEAN	418	311	43	8.24	10.3	1.1
STD. ERROR	15	14	6	0.02	0.7	0.0
N OF CASES	51	42	52	51	51	52

GREEN RIVER AT FMC BRIDGE

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	270	188	1	7.85	3.0	0.0
MAXIMUM	750	588	844	8.66	31.0	3.2
MEAN	438	336	105	8.26	11.4	1.3
STD. ERROR	17	1	23	0.02	0.8	0.0
N OF CASES	50	41	51	50	50	51

BITTER CREEK

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	1700	1470	4	7.18	8.0	0.0
MAXIMUM	5700	4990	32400	9.27	340.0	35.0
MEAN	3232	3099	4532	8.35	70.2	6.2
STD. ERROR	148	121	1045	0.07	10.5	0.9
N OF CASES	44	47	57	44	41	58

CURRANT CREEK

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	490	420	6	8.04	1.0	0.0
MAXIMUM	850	1380	1590	8.60	61.0	3.5
MEAN	666	525	383	8.34	18.1	1.1
STD. ERROR	12	26	58	0.02	1.6	0.1
N OF CASES		44	35	45	44	
44	45					

SAGE CREEK

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	690	414	3	7.98	4.0	0.0
MAXIMUM	3430	1410	11400	8.53	350.0	7.2
MEAN	1233	1067	1563	8.25	34.6	1.3
ERROR	60	37	336	0.02	8.7	0.1
N OF CASES	44	35	45	44	44	45

Table III-5 (continued)

BIG SANDY

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	490	380	5	7.71	8.0	0.0
MAXIMUM	3200	7070	766	8.41	35.0	3.3
MEAN	1997	2280	100	8.13	15.8	1.0
STD. ERROR	90	204	26	0.02	0.8	0.1
N OF CASES	44	35	45	44	44	45

BLACKS FORK

	Conductivity	TDS	SS	pH	COD	BOD
MINIMUM	400	316	16	8.03	3.0	0.0
MAXIMUM	2200	2170	18500	8.56	150.0	5.1
MEAN	939	801	887	8.26	25.9	1.4
STD. ERROR	60	76	406	0.01	3.4	0.1
N OF CASES	44	35	45	44	43	45

IV. PREDICTING BIOLOGICALLY AVAILABLE PHOSPHORUS (NaOH-P) IN WYOMING STREAMS

INTRODUCTION

In terms of the biological effect of phosphorus in waters, the best measure is a biological response such as the biomass of algae supportable by the sample. However, because bioassays are exceedingly expensive and time consuming when compared to chemical analyses, there has been considerable interest in finding a chemical technique producing data correlating well with bioassays. One such technique which appears promising is that measuring sodium hydroxide extractable phosphorus (NaOH-P) (e.g., Dorich et al. 1984, 1985; Hegemann et al. 1983). And, in SW Wyoming, NaOH-P seems to be a good index of biologically available phosphorus (BAP), as determined with algal bioassays (J. Messer, personal communication).

Two sources of BAP are phosphorus associated with particles and phosphorus which is dissolved (e.g., Dorich et al. 1984). Thus for predicting NaOH-P, I reasoned that variables indexing these two sources would be total suspended solids (SS) and ortho-phosphorus (OP). In addition to SS and OP, other sources of variation affecting NaOH-P which I considered were sampling location, presence/absence of high flow (FLOOD) and presence/absence of beaver dams (DAMS).

If NaOH-P is a good index of biologically available phosphorus, then clearly knowledge of NaOH-P could be especially useful in relation to the process and consequences of eutrophication (Lee et al. 1980; Sonzogni et al. 1982; Williams et al. 1980; Dorich et al. 1984; Hegemann et al. 1983). For example, if we can predict BAP from SS and OP, then we might be able to use existing data on SS and OP to improve our understanding of and/or our predictions about eutrophication.

In this paper I discuss data on NaOH-P from 541 analyses at eight sites. I had four objectives: i) account for variation in NaOH-P; ii) determine factors affecting this variation; iii) develop regression equations predicting NaOH-P; and iv) evaluate the precision of the predictions. The approach used was i) determine if sampling stations could be aggregated into GROUPs for analyses, ii) determine if SS, OP, and GROUP had significant effects on the regressions, iii) evaluate the significance of FLOOD and DAMS on the regressions using appropriate subsets of data, and v) because precision generally was poor, search for a small subset of data to determine what the best possible precision might be.

METHODS

Samples were collected from eight stations, with seven of these being natural streams (Figure IV-1). Station 1 was the sewage treatment plant for the town of Green River (population ca. 13,000), from which effluent was obtained. Station 2 (Bitter Creek) drains about 6,500 km^2 into the Green River just downstream from station 3. Stations 3 and 4 were on the Green River, respectively at the town of Green River and about 40 km by road upstream from the town. The total drainage area for these two locations is about 19,000 km^2. Station 5, Big Sandy River at the confluence with the Green River, is a 4200 km^2 subbasin of the watershed contributing to stations 3 and 4. Two adjacent, smaller drainages (ca. 80-180 km^2) which discharge into Flaming Gorge Reservoir were sampled at stations 6 (Currant Creek) and 7 (Sage Creek). Currant Creek was sampled at a number of sites within a segment containing several complexes of beaver dams, as well as downstream near the confluence with Flaming Gorge. The Blacks Fork (station 8) also flows into Flaming Gorge after draining about 6,500 km^2. Lowham et al. (1982), Fannin et al. (1985) and Maret et al. (in press) provide more detailed descriptions of the watersheds.

During 1984, 1985 and 1986, 541 water samples were collected from the eight stations (Figure IV-1). All samples were placed on ice in the dark without preservatives, and analyses began within several hours. Analyzed parameters included suspended solids by the method of non-filterable residue upon evaporation at 180° C (U.S. Environmental Protection Agency 1983); ortho-phosphate, direct colorimetric-ascorbic acid method (U.S. Environmental Protection Agency 1983); and NaOH-extractable phosphorus, NaOH/NaCl extraction, colorimetric-ascorbic acid (Messer et al. 1984).

All statistical analyses were performed with the MS DOS version of the statistical package Systat (release 3.0; Systat, Inc. 1984). Natural log transformations were made for all data prior to analyses. The probability for rejecting hypotheses was $p \leq 0.05$ when multiple comparisons were not involved; for multiple comparisons p was $\leq$ (0.05)/(number of comparisons).

For regressions, I decided that the initial, complete model should include up to first-order interactions, but I also wanted the simplest model without significantly redundant information. Therefore, backward elimination regression (p to remove ≤ 0.1) was used to remove variables and produce the final regression formulae reported. All multiple regressions included the variables ln(suspended solids) (LSS) and ln(ortho-P) (LOP) as independent variables to predict ln(NaOH-P) (LNaOH-P). In addition, several indicator variables were used in some regressions (Table IV-1): i) G1, G2 and G3, variables used for four GROUPs in which up to three of the eight stations were GROUPed together; ii) FLOOD designates periods of high discharge or periods not of high discharge; iii) DAMS indicates samples were taken only from station 6 in a 6-km section containing active beaver dams, or from station 6 several kilometers downstream from this area (for a more complete description see Maret et al. in press).

I used the 95% confidence limits on the mean value of LNaOH-P as an index of predictive precision. Because precision generally was poor, to determine if it could be improved I deliberately searched for the best precision obtainable from the data. First, I divided the data into all possible subsets using criteria yielding "natural" groupings. For example, following are some of the natural subsets used: each station; each station, FLOOD only; each station, not FLOOD only; station 6, area with DAMS, samples from ponds, not FLOOD, 1984. Then, using these subsets of data, I found the one which gave the best precision.

RESULTS

Log transformation produced data which met assumptions well. Normal probability plots of residuals were quite straight, plots of residuals versus estimates were well scattered, and the density distributions for variables were approximately normal. Backward elimination regressions removed variables from the equations. However, compared to the full model, the adjusted R^2 of the final model always was altered by little (-0.002 to 0.002). For regressions involving indicator variables, the percent of explained variation attributable to LOP and LSS always exceeded by 5 to 8 times that attributable to the indicator variables.

Analyses Using the Whole Data Set

Using all data (Figure IV-2), LNaOH-P was regressed against LOP plus LSS. The multiple regression was significant and explained 78% of the variation in LNaOH-P (Table IV-2, column A). Standardized regression coefficients indicate that LOP (0.888) contributed much more to the explained variation than did LSS (0.073). The 95% confidence limits on the mean value of LNaOH-P (16 ug/L) were quite widely separated: 2 ug/L and 140 ug/L (because the limits are calculated using log-transformed data, they are asymmetric when expressed in units of ug/L).

Plotting the mean value of LOP versus the mean value of LSS for each station (Figure IV-3A) suggested that the eight stations could be represented by four GROUPs (Figure IV-3B, Table IV-1). To additionally evaluate the reasonableness of aggregating data from the eight stations into four GROUPs, I performed several cluster analyses (normalized euclidian distances, single linkage). Data were the mean values of LSS and LOP (columns), and clustering was on the eight stations (rows). Analyses were performed i) on the whole data set, ii) on three subsets obtained from splitting by year, and iii) on two subsets obtained from splitting by FLOW or not-FLOW. In all cases GROUPs 1 and 2 clustered separately. In all but two of the six cases, stations aggregated into GROUPs 3 and 4 as expected; for one of the exceptions station 6 was aggregated with GROUP 3, while for the other exception stations 3 and 6 were exchanged between GROUPs 3 and 4.

A backward elimination multiple regression to predict LNaOH-P was performed with LSS, LOP, and indicator variables for GROUP (G1, G2, G3; see Table IV-2, column B):

$$LNaOH\text{-}P = [\ -5.355 + 1.839 \cdot G1 + 4.982 \cdot G2 + 5.488 \cdot G3\ ] \quad \text{intercept}$$

$$+ [\ (0.421 - 0.426 \cdot G1 - 0.347 \cdot G2) \cdot LSS\ ] \quad \text{slope, LSS}$$

$$+ [\ 0.400 \cdot LOP\ ] \quad \text{slope, LOP}$$

The addition of GROUP increased the explained variance of LNaOH-P to 86% (Table IV-2, compare columns A and B). But more importantly, note that because the indicator variables (G1, G2, G3) assume a value of 0 or 1, four equations can be produced, one for each group (these four equations can be constructed from the information in Table IV-1, and Table IV-2 column B; see Neter et al. 1985, p. 329). The effect of GROUP produces four intercepts significantly different from zero and each other, and G1 and G2 interact with LSS to alter slope significantly. Lower and upper 95% confidence limits on the mean value of LNaOH-P (16 ug/L) were widely separated: 3 ug/L and 90 ug/L.

Aside from the treatment plant (station 1, GROUP 1), it was difficult to choose adjectives which seemed to characterize completely the four GROUPs. However, Bitter Creek (station 2, GROUP 2; flashy-turbid) might be considered hydrologically flashy and turbid. The drainage is large but, especially during summer, flow is low (until recently, flow was intermittent; see Discussion). The stream is downcut with active bank erosion along much of its length. GROUP 3 (stations 3, 4 and 5, big-clear) is comprised of stations where the streams are bigger (up to 182,500 cfs for a 15 year average) and have relatively clear water. GROUP 4 (stations 6, 7 and 8; small-turbid) contains the two smallest drainages, and active bank erosion again contributes to turbidity.

Analyses Using Subsets of the Whole Data Set

A backward elimination multiple regression with LSS, LOP, and indicator variables for GROUP and FLOOD was performed to predict LNaOH-P using data only from natural streams (Groups 2, 3 and 4). The effects of both GROUP and FLOOD were significant, and six equations can be produced (i.e., GROUPs 2, 3 and 4, each under conditions FLOOD and not-FLOOD; Table IV-2, column C). All intercepts are significantly different from each other and zero, and the effects of FLOOD and GROUP interact with LSS to alter slope significantly (see Figure IV-4). Again, the 95% confidence limits on the mean value of LNaOH-P (10 ug/L) were quite large (2-60 ug/L).

Considering only data from the treatment plant (Group 1), LSS and LOP explained only 21% of the variation in LNaOH-P (Table IV-2, column D). Confidence limits on the mean value of LNaOH-P (5,180 ug/L) were again large: 1,330 ug/L and 20,200 ug/L.

Using data from station 6 only, a backward elimination multiple regression was performed to evaluate the effects on LNaOH-P of LSS, LOP, FLOOD, and of sampling in the presence or absence of beaver dams (indicator variable DAMS). Both DAMS and FLOOD significantly affected the intercept of the regression, and both interacted with LOP to alter the slope significantly (Table IV-2, column E). Four equations can be produced (i.e., DAMS and not-DAMS, each under conditions of FLOOD and not-FLOOD). The variance explained was less (54%) than in the previous regressions involving stream sites, and the confidence limits on the mean LNaOH-P (8 ug/L) were wide: 2-31 ug/L.

A small subset of data was identified using the following criteria: area with DAMS on Currant Creek; lotic sites; periods of FLOOD; year, 1985. Regressing LNaOH-P against LSS plus LOP explained 87% of the variation in LNaOH-P, and produced smaller confidence limits about the mean value of LNaOH-P (9 ug/L) than noted previously (6 ug/L to 14 ug/L; Table IV-2, column F). LSS was more important than LOP (not significant) in explaining variation in LNaOH-P.

DISCUSSION

Variation in NaOH-P

Using all data, LSS and LOP accounted for much of the variation in LNaOH-P (Table IV-2, column A). However, comparing scatter plots for individual stations showed that while much overlap occurred between sampling stations, some stations seemed to be different from others (Figure IV-2). To determine whether sampling location should be considered as a variable in additional analyses, three approaches were used.

First, plots for each station of mean LOP versus mean LSS (Figure IV-3A) suggested reasonable aggregations of four GROUPs (Figure IV-3B): the two stations on the Green River are in the same GROUP (3); the two adjacent, small streams both are in GROUP 4; and the sewage treatment plant and the turbid-flashy stations each form separate GROUPs (1 and 2, respectively). Second, six cluster analyses were performed after splitting the data six different ways; the results supported aggregating stations into the four GROUPs.

But while results from the above analyses were reasonable, they did not allow probabilistic statements about the significance of differences. Therefore, finally I performed multiple regressions with GROUP (Table IV-2, column B), and concluded that the use of four equations produced from Table IV-2, column B, is more appropriate than the single equation resulting without GROUP (Table IV-2, column A). Including GROUP as a variable also increased the explained variance in LNaOH-P by 8.6%.

The analysis for data only from the treatment plant effluent accounted for only 21% of the variation in the data (Table IV-2, column D). Likely this reflects interferences with the chemical analyses which did not occur at other sampling locations. Data for this group were different from those of the other groups by having very large values for LNaOH-P and LOP, but uniformly small values for LSS (Figure IV-2).

FLOOD, in the sense of a natural stream's volume discharge, is inapplicable to data from the treatment plant. Therefore, to evaluate the effect of GROUP and FLOOD, only data from natural streams were used (GROUPs 2, 3 and 4; Table IV-2, column C). And while both GROUP and FLOOD had significant effects and increased the variance explained by 12%, more importantly they altered the predicted values of LNaOH-P. Thus, holding the effects of LOP constant, regression lines for the three GROUPs look somewhat like a "Z" (Figure IV-4). The upper arm represents the flashy-turbid GROUP (2). It has the largest values of LNaOH-P, with LSS having little effect on the slope. Similarly, the big-clear GROUP (3) is represented by the lower arm. The regression for the small-turbid GROUP (4) joins the other two lines, with small values of LNaOH-P when LSS is small and large values of LNaOH-P when LSS is large (the "/" portion of the Z).

Sewage effluent undoubtedly plays an important role in affecting the data of GROUP 2, the turbid-flashy stream (upper arm of the Z). Sewage effluent from the city of Rock Springs enters this stream about 19 road kilometers from the sampling station, and, prior to its introduction, the stream flowed only intermittently during the summer. This input certainly contributes to the consistently large values of LNaOH-P observed. For example, Dorich et al. (1984) noted that waters influenced by septic effluent had larger values of NaOH-P and several other forms of phosphorus.

However, it also is likely that different geology produces different types of particulates between these GROUPs. This may account for the fact that SS has much less effect on LNaOH-P in GROUP 3 (Figure IV-4, the lower arm of the Z) than in GROUP 4 (the "/" portion of the Z). Such effects would be similar to those noted by Wolf et al. (1985).

Next, consider the effect of FLOOD on these data from natural streams. When holding LSS constant, the values for LNaOH-P were greater at low flow for the flashy-turbid and big-clear GROUPs. Such an observation is consistent with dilution by snowmelt during runoff in the spring, or from rainfall during storm events.

Evaluating the effects of FLOOD and beaver DAMS on LNaOH-P involved data only from Station 6 (Currant Creek) because only there were samples taken both in and away from complexes of dams. I was interested in this comparison because it was within these data that some of the most precise predictions for LNaOH-P occurred (see below). And, it seemed that processes potentially affecting LNaOH-P might be different in the stream segment containing the dams. For example, of the smaller streams, only in this segment was a riparian area well developed, did extensive ponding or pooling occur, and did there appear to be much non-living organic matter.

Both FLOOD and DAMS had significant effects (Table IV-2, column E). Holding the effect of LSS constant, at high flow the values of LNaOH-P were greater in DAMed areas. This is primarily a consequence of different intercepts, potentially occurring if larger particles, in suspension at high flow in the stream but settled out in slower-moving areas and ponds, contribute more to LNaOH-P than smaller particles (see Wendt and Alberts 1984). And while Dorich et al. (1984) observed, in samples taken at the peak discharge of storm events, that the concentration of NaOH-P was not related to size of sediment, settling of particles can affect the amount of phosphorus available (e.g., Williams et al. 1980). Finally, note that at low flow each unit of LOP contributed more to LNaOH-P than did one unit at high flow, as indicated by significantly different slopes for the regressions. This might reflect different types of OP at high and low flows, or different opportunity for biological processing of OP at high and low flows.

General observations in the field and other data suggest the importance of erosional input of SS for several of the sampled streams (e.g., Maret et al. in press, Lowham et al. 1982). Such input greatly increases at high flow, suggesting an important influence of LSS on NaOH-P during high flow. Supporting this view is the fact that among all possible subsets of "naturally grouped" data (see below), the influence of LOP exceeded that of LSS only during i) periods not of FLOOD (lesser opportunity for input of SS), ii) in the two Green River stations of the big-clear GROUP (GROUP 2, little SS by definition), and iii) during periods not of FLOOD, 1984, at sites with DAMS and ponded or slowly moving water on Currant Creek (station 7; opportunity for SS to settle from the water).

Predicting NaOH-P

In general the derived equations do not predict LNaOH-P with much precision, using the 95% confidence limits on the mean value of LNaOH-P as our index of precision. For example, in analyses involving all data from one or more station (Table IV-2, columns A through E), in units of ug-P/L the upper limit ranges from (X + 2X) to (X + 8X), while that for the lower limit is (X - 0.7X) to (X - 0.9X). Note that because the confidence limits used were calculated for the mean value, the limits represent an optimistic or best estimate of precision; we do not expect to do better with values different from the mean.

To determine if precision could be improved, I deliberately searched for that subset of all data yielding the best possible precision (Table IV-2, column F). The best possible 95% confidence limits on the mean value of LNaOH-P were narrower than previously, especially the upper limit (ca. $X \pm 0.5X$). Note that for this subset the effect of LSS is significant, but not the effect of LOP.

Next I deliberately looked for a subset where the opposite would be true, that is, a subset where the influence of LOP exceeded that of LSS. But in no subset where the adjusted R^2 exceeded about 0.4 did the relative influence of LOP equal or exceed that of LSS. Thus in the sampled streams there is lesser explained variance and precision always tends to be poor when OP is more influential in affecting NaOH-P than is SS; the opposite is true only sometimes. That is, only in certain cases where SS is highly influential is explained variance great and precision good.

Why is the precision of predicted LNaOH-P not better? The replicability of the chemical analyses is good (C. Thompson, personal communication), and the large sample size should minimize the effect of random sampling errors. A likely reason is an inadequate choice of independent variables. That is, not all of the different types of SS contribute equally to NaOH-P, the same is true for OP, and the regressions obviously cannot account for this inadequacy. Recall that i) when I deliberately chose subsets with the best adjusted R^2 and precision, the importance of LSS exceeded that of LOP, and ii) when I deliberately chose subsets where the importance of LOP exceeded that of LSS, the values for R^2 and precision were poor. This suggests that for the sampled streams there may be more problem with the relation [NaOH-P = f(OP)] than with the relation [NaOH-P = g(SS)].

Finally, note that I have been discussing the prediction of NaOH-P. If we really are interested in predicting biologically available phosphorus (BAP) from SS and OP, then our measure of precision must account not only for variation in the relation between NaOH-P and (LSS + OP), but also between BAP and NaOH-P.

Conclusions

Others have observed and I too found that sampling location may influence markedly the concentration of NaOH-P. This effect likely is related to the influence of sewage (e.g., Dorich et al. 1984) and geology (e.g., Wolf et al. 1985). Additionally, I found the effects of hydrology and the occurrence of beaver dams to be significant. Knowledge of these significant effects is useful because they are caused by variables relatively easy and inexpensive to measure or account for, but which can improve the explained variance and sometimes the precision of predictions. Equally important, I found that predictive equations taking such variables into account could be quite different from equations not considering them.

Some of the sites I sampled are greatly influenced by erosive input from banks at higher discharge (Maret et al. in press; Lowham et al. 1982). In contrast to agricultural areas elsewhere (e.g., Lowrance et al. 1984), movement of nutrients at some of these sites can be affected in two ways by beaver dams: i) trapping of nutrients in the area with dams owing to settling of particulates; and ii) a reduction in maximum water velocity, owing to the capacity of beaver dams to produce shallow and wide flows, which decreases the potential for erosive input and export of nutrients (Parker et al. 1985). Thus while caution should be used in extrapolating some of the data presented to other areas, beaver dams may prove useful in reducing export of NaOH-P or other forms of phosphorus from watersheds (Apple 1985; Maret et al. in press; Parker 1986; Smith 1980).

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REFERENCES

Apple, L.L. 1985. Riparian habitat restoration and beavers, p. 35-38. In Johnson, R.R., C.D. Ziebell, D.R. Patton, P.F. Ffolliott and R.H. Hamre (tech. coords.), Riparian ecosystems and their management: Reconciling conflicting uses. First North American Riparian Conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Ft. Collins, CO: USDA, Forest Serv., Rocky Mt. Forest and Range Expt. Station.

Dorich R.A., D.W. Nelson and L.E. Sommers 1984. Algal availability of phosphorus in suspended stream sediments of varying particle size. J. Environ. Qual. 13:82-86.

Dorich, R.A., D.W. Nelson and L.E. Sommers. 1985. Estimating algal available phosphorus in suspended sediments by chemical extraction. J. Environ. Qual. 14:400-405.

Fannin, T.E., M. Parker and T.J. Maret. 1985. Multiple regression analysis for evaluating non-point source contributions to water quality in the Green River, Wyoming, p. 201-206. In Johnson, R.R., C.D. Ziebell, D.R. Patton, P.F. Ffolliott and R.H. Hamre (tech. coords.), Riparian ecosystems and their management: Reconciling conflicting uses. First North American Riparian Conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Ft. Collins, CO: USDA, Forest Serv., Rocky Mt. Forest and Range Expt. Station.

Hegemann, D.A., A.H. Johnson and J.A. Keenan. 1983. Determination of algal-available phosphorus on soil and sediment: A review and analysis. J. Environ. Qual. 12:12-16.

Lee, G.F., A. Jones and W. Rast. 1980. Availability of phosphorus to phytoplankton and its implications for phosphorus management strategies, p. 259-308. In Loehr, R., C. Martin and W. Rast (Eds.) Phosphorus Management Strategies for Lakes. Ann Arbor

Press, Ann Arbor, MI.

Lowham H.W., L.L. De Long, K.R. Collier and E.A. Zimmerman. 1982. Hydrology of Salt Wells Creek - a plains stream in southwestern Wyoming. U.S. Geol. Surv., Water-Resources Investigations 81-62. 59 p.

Lowrance R., R. Todd, J. Fail Jr., O. Hendrickson Jr., R. Leonard and L. Asmussen. 1984. Riparian forests as nutrient filters in agricultural watersheds. Bioscience 34(6):374-377.

Maret, T.J., M. Parker and T.E. Fannin. In press. The effect of beaver ponds on the nonpoint source water quality of a stream in southwestern Wyoming. Water Research.

Messer J.J., J.M. Ihnat and D.L. Wegner. 1984. Phosphorus release from the sediments of Flaming Gorge Reservoir, Wyoming, USA. Verh. int. Ver. Limnol. 22:1457-1464.

Neter, J. W. Wasserman and M.H. Kutner. 1985. Applied Linear Statistical Models. 2nd Ed. F.D. Irwin, Inc., Homewood, IL. 1127 p.

Parker, M., F.J. Wood, B.H. Smith and R.G. Elder. 1985. Erosional downcutting in lower order riparian ecosystems: Have historical changes been caused by removal of beaver?, p. 35-38. In Johnson, R.R., C.D. Ziebell, D.R. Patton, P.F. Ffolliott and R.H. Hamre (tech. coords.), Riparian ecosystems and their management: Reconciling conflicting uses. First North American Riparian Conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Ft. Collins, CO: USDA, Forest Serv., Rocky Mt. Forest and Range Expt. Station.

Parker, M. 1986. Beaver, water quality, and riparian systems. In Brosz, D.J. and J.D. Rodgers (Eds.) Wyoming Water 1986 and Streamside Zones Conference. Wyoming Water Research Center, Univ. Wyoming, Laramie, WY.

Smith B.H. 1980. Not all beaver are bad; or, an ecosystem approach to stream habitat management, with possible software applications, p. 32-37. In Whaley R. (ed.), Proc. 15th Annual Meeting of Colorado-Wyoming Chapter of American Fisheries Society.

Sonzogni, W., C. Chapra, D. Armstrong and T. Logan. 1982. Bioavailability of phosphorus inputs to lakes. J. Environ. Qual. 11:555-563.

Systat, Inc. 1984. Systat: The system for statistics. Systat, Inc. Evanston, IL. 383 p.

United States Environmental Protection Agency. 1983. Methods for chemical analyses of water and wastes. EPA 600/4-79-020.

Wendt, R.C. and E.E. Alberts. 1984. Estimating labile and dissolved inorganic phosphate concentrations in surface runoff. J. Environ. Qual. 13:613-618.

Williams, J.D.H., H. Shear and R. Thomas. 1980. Availability to Scenedesmus quadricaudata of different forms of phosphorus in sedimentary materials from the Great Lakes. Limnol. Oceanogr. 25:1-11.

Wolf, A.M., D.E. Baker, H.B. Pionke and H.M. Kunishi. 1985. Soil tests for estimating labile, soluble, and algae-available phosphorus in agricultural soils. J. Environ. Qual. 14(3):341-348.

Table IV-1. Indicator variables used in multiple regressions. Data are the value (0 or 1) assigned to each indicator variable. See Figure IV-1 for locations of sampling stations.

A) Indicator Variables for GROUP

No. of GROUP	Stations in GROUP	Variable Name G1	G2	G3
1	1	0	0	1
2	2	0	1	0
3	3, 4, 5	1	0	0
4	6, 7, 8	0	0	0

B) Indicator Variable for Discharge

State of Discharge	Variable Name FLOOD
High Flow	1
Not High Flow	0

C) Indicator Variable for Presence/Absence of Beaver Dams

Presence/ Absence	Variable Name DAMS
Absent	0
Present	1

Table IV-2. Results from multiple regressions. Columns represent the source of data used for each regression. Rows indicate i) the regression parameters, with interactions designated by asterisks joining the two interacting variables, ii) 95% confidence limits for the mean value of NaOH-P, iii) the sample size (N), iv) the adjusted squared multiple regression coefficient, v) the significance level of the regression. Unless noted otherwise, all regression parameters are significant at $p < 0.001$; ns means not significant; ----- means not applicable.

	(A) All Data	(B) All Data	(C) GROUPs 2-4	(D) Stn 1 = GROUP 1	(E) Stn 6	(F) Stn 6 Subset
INTERCEPT						
Constant	-0.982	-5.355	-5.193	0.665[1]	-5.244	-9.167
G1	-----	1.839	1.684	-----	-----	-----
G2	-----	4.982	4.884	-----	-----	-----
G3	-----	5.488	-----	-----	-----	-----
FLOOD	-----	-----	-1.129[2]	-----	-1.680[2]	-----
DAMS	-----	-----	-----	-----	1.055[1]	-----
SLOPE						
LSS	LSS=0.096	LSS=0.421 LSS*G1= -0.426 LSS*G2= -0.347	LSS=0.418 LSS*G1= -0.386 LSS*G2= -0.361 LSS*FLOOD= 0.147[1]	LSS= 0.265 (ns)	LSS= 0.477	LSS= 0.685
LOP	0.995	0.400	0.419	0.253(ns)	LOP=0.426 LOP*FLOOD= -0.283[1] LOP*DAMS= 0.292[1]	LOP= -0.087 (ns)
95% CONFIDENCE LIMITS						
Upper CL	140 ug/L	90 ug/L	60 ug/L	20200 ug/L	31 ug/L	14 ug/L
Mean	16 ug/L	16 ug/L	10 ug/L	5180 ug/L	8 ug/L	9 ug/L
Lower CL	2 ug/L	3 ug/L	2 ug/L	1330 ug/L	2 ug/L	6 ug/L
N	541	541	503	38	250	32
Adj. R^2	0.775	0.861	0.759	0.206	0.554	0.871
Signif. of Regression	<0.001	<0.001	<0.001	0.007	<0.001	<0.007

[1] $0.05 > p > 0.01$
[2] $0.005 > p > 0.001$

Figure IV-1. Location of sampling stations.

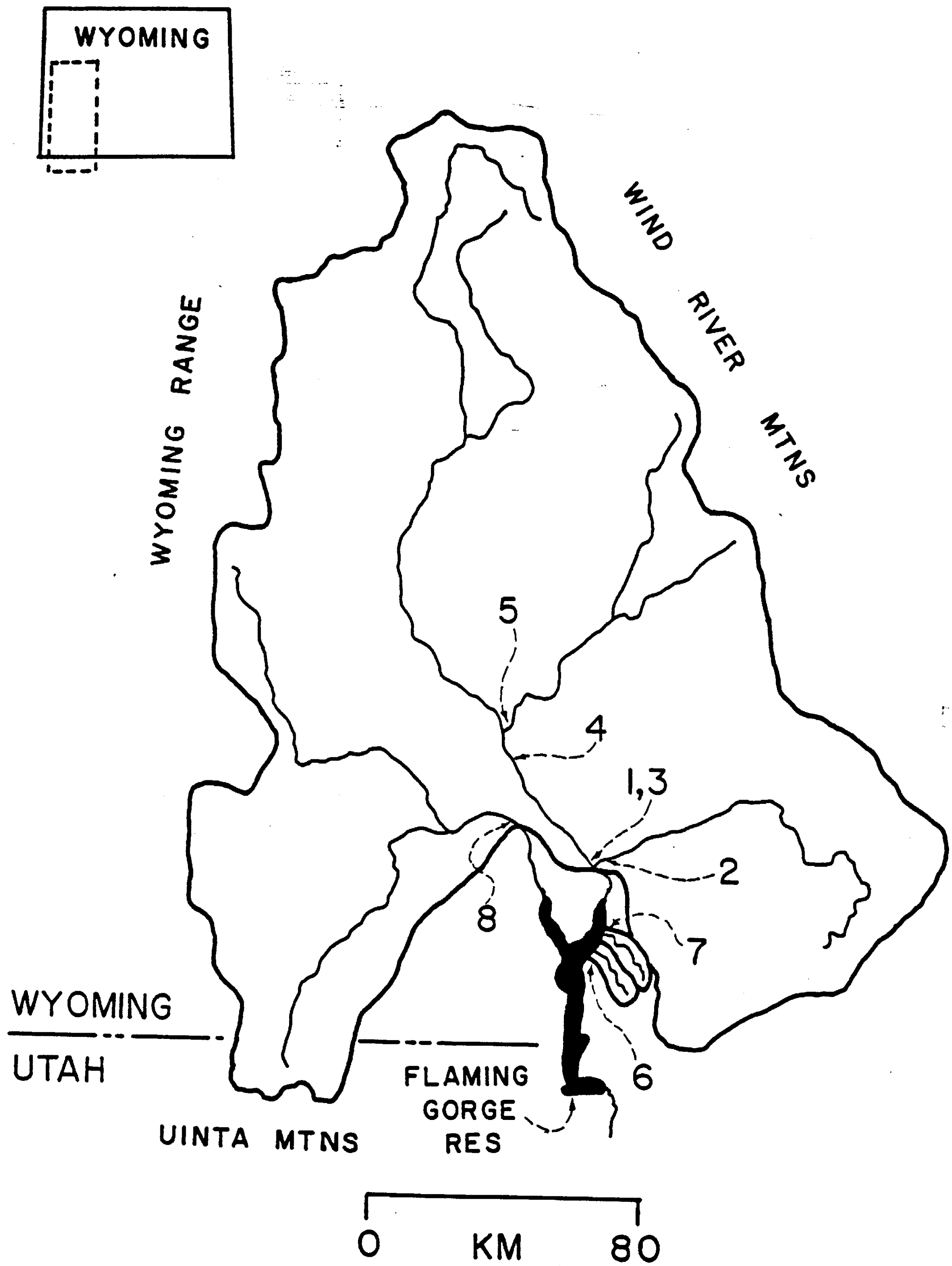

Figure IV-2. Scatter plot, using all data, of LNaOH-P versus LSS and LNaOH-P versus LOP. An asterisk indicates 1 datum point, while a number indicates points which are superimposed. Data representing the four GROUPs are outlined by shading and labeled by number.

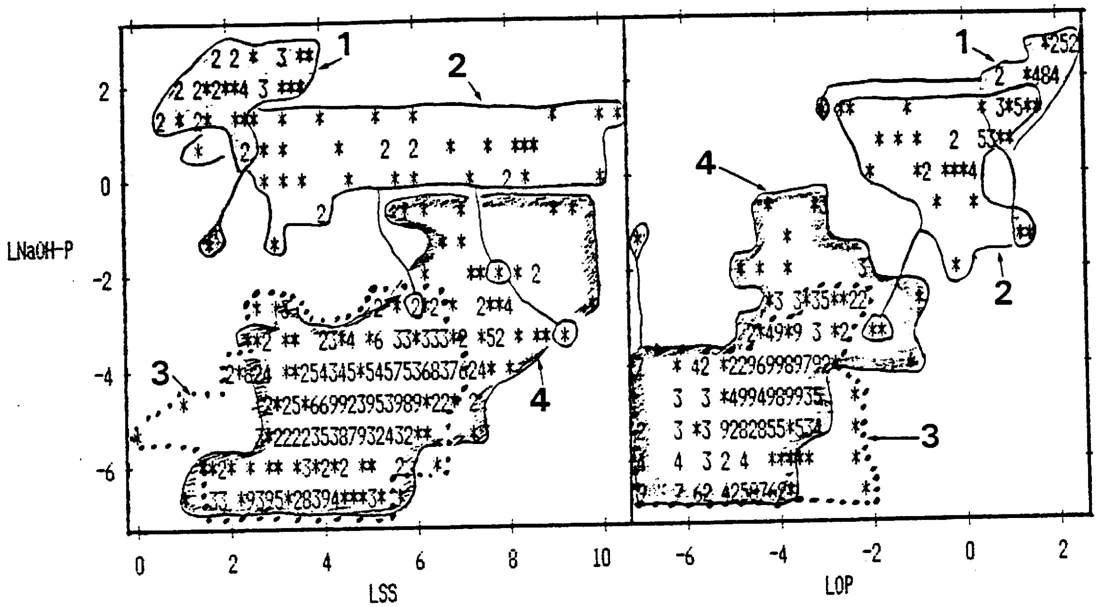

Figure IV-3. Scatter plot of mean values for LSS verses mean values for LOP. (A) Data for the eight sampling stations. (B) Data for the four GROUPs. Stations 3, 4 and 5 comprise GROUP 3, and stations 6, 7 and 8 comprise GROUP 4.

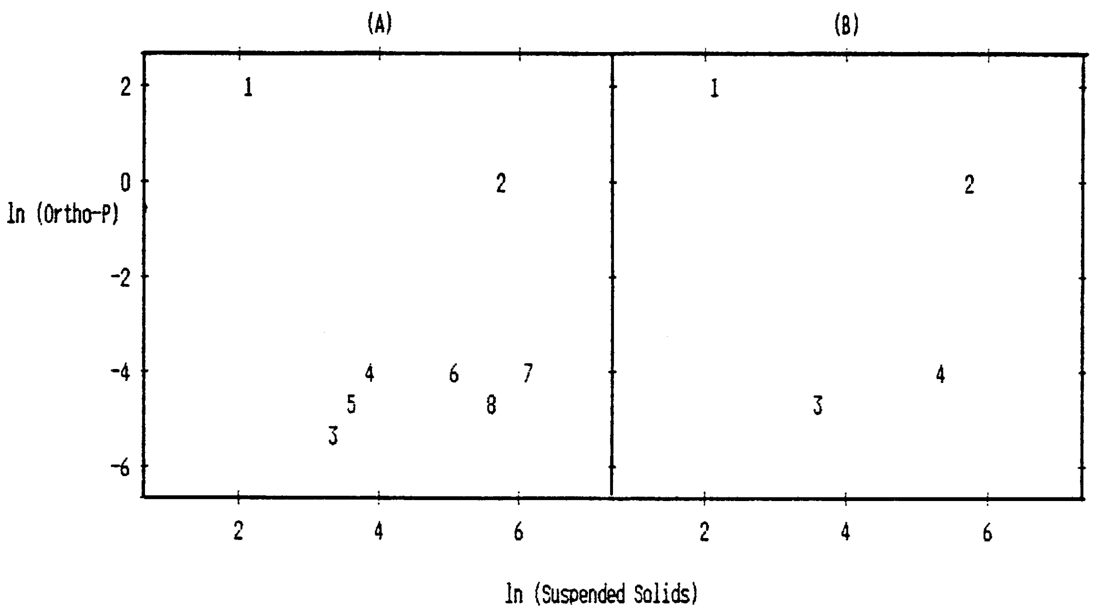

Figure IV-4. Scatter plot, for GROUPS 2, 3 and 4, of LNaOH-P versus LSS. An asterisk indicates 1 datum point, while a number indicates points which are superimposed. Regression lines for the three groups are drawn for condition of FLOOD using the mean value of LOP, and are labeled by the number of GROUP.