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EPISODIC RESPONSE PROJECT:
WET DEPOSITION AT WATERSHEDS IN
THREE REGIONS OF THE EASTERN UNITED STATES

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SUMMARY

During the period from August 1988 to June 1990, wet-only sampling of precipitation was carried out at three Episodic Response Project sites and at one supplemental site. This sampling supported research on the response of fish and other benthic invertebrates to episodic acidification of streams. The three watershed sites are Moss Lake, which characterizes Adirondack headwater streams; Biscuit Brook, which represents Catskill mountain streams; and Linn Run, which typifies the southwestern group of northern Appalachian streams. The supplemental site was the MAP3S site at Pennsylvania State University that characterizes the central group of northern Appalachian streams. The site operators adhered by varying degrees to the sample collection protocol based on the daily sampling protocol of the MAP3S Precipitation Chemistry Network.

Sulfate and nitrate ion together accounted for more than 80% of total anions (in $\mu\text{Eq/L}$) in the precipitation at all sites. Wet deposition of sulfate at Moss Lake, Biscuit Brook, Penn State, and Linn Run averaged 223, 230, 253, and 402 $\text{mg/m}^2/\text{month}$, respectively, whereas nitrate wet deposition averaged 197, 195, 160, and 233 $\text{mg/m}^2/\text{month}$, respectively. Sulfate deposition was a factor of 2 to 4 higher in summer than in winter. The seasonal pattern for nitrate deposition was weak; the seasonal contrast was less than a factor of 2.5 at all sites.

The association between the wet deposition and precipitation chemistry at the MAP3S monitoring site and the average for the study watersheds was dependent on the distance between the site and watershed and the intervening terrain. Precipitation chemistry at the monitoring site is representative of that at the ERP study watersheds in the Adirondack and Catskill regions and in the southwestern group of watersheds in the Appalachian region. High spatial variability in precipitation amounts makes this assumption weaker for wet deposition. Chemical input to watersheds from dry deposition has not been determined at any site but could range from a factor of 0.3 to 1.0 of the wet deposition.

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1.0 INTRODUCTION

The Episodic Response Project (ERP) of the U.S. Environmental Protection Agency (EPA) addresses the relationships between acidic inputs to watersheds, the responses of stream chemistry to those inputs, and the responses of the fish and other aquatic organisms to those changes. Specifically, the major research objectives of the ERP are to

- determine the duration, frequency, and magnitude of episodic chemical changes in streams that accompany hydrologic events
- determine whether chemical changes in streams affect fish populations and the frequency of episodes that cause those effects
- provide data to model the regional extent of episodic stream acidification and the fish population response
- estimate the number and proportion of surface waters that are likely to experience biologically relevant acidic episodes in the regions where the research is conducted
- improve the understanding of processes and factors that influence the severity of episodic chemical changes in streams and their associated effects on fish populations.

Several research groups participated in the field studies associated with the ERP. The following three groups carried out extensive hydrochemical and biological monitoring of streams in their study watersheds: the Adirondack Lakes Survey Corporation (ALSC), Adirondack region; the U.S. Geological Survey (USGS), Catskill Mountains; and the Pennsylvania State University (PSU), Northern Appalachian Plateau. A fourth group, the Pacific Northwest Laboratory (PNL), provided estimates of the wet chemical deposition from the atmosphere to the study watersheds. Other research teams dealt with the modeling and interpretive aspects of the project.

This report focuses on the work performed by PNL to provide estimates of wet chemical deposition to the study watersheds. The PNL provided equipment, supplies, and trained operators at each site to collect rain samples and measure hourly precipitation amounts. The site operators shipped the rain samples and

rainfall data to PNL. At PNL, samples were analyzed for the major ions: $\text{SO}_4^{=}$, NO_3^- , Cl^- , PO_4^{3-} , H^+ , NH_4^+ , Na^+ , K^+ , Ca^{2+} , and Mg^{2+} . The field and laboratory procedures used in the ERP study were similar to those being used in the MAP3S Precipitation Chemistry Network. An estimation of the wet deposition to the watershed was based on the rainfall amounts and ion concentrations in precipitation.

2.0 FIELD OPERATIONS

This section briefly summarizes the procedures used to collect precipitation samples and measure hourly rainfall at the study sites. Field operation procedures were essentially the same as those followed at sites in the MAP3S Precipitation Chemistry Network. Field operations for the ERP were described in detail by Baker (1988) and were based on input provided by each study group.

2.1 MONITORING SITES

For each of the three study regions, a precipitation sampling site was selected according to the following criteria:

- no surface pollutant storage facility (e.g., salt pile) located within 100 m
- no transportation sources, furnaces, or incinerators located within 100 m
- no cultivation or other agricultural activity occurring within 500 m
- no buildings, trees, power poles, etc., to impinge on the cone defined by a 45° angle above the horizontal plane and centered at the site (30° is considered optimal but 45° is the highest acceptable angle)
- no local area dusty conditions due to poor ground cover
- access to 110-120 VAC power to enhance reliable collector operation.

These criteria give some assurance that the chemistry of precipitation samples collected at each site will be representative of the precipitation falling on the study watershed. Table 1 lists the locations, the local land uses, the periods of operation of the sites, and the groups responsible for site operation (DeWalle et al. 1991; Kretser et al. 1991; Murdoch et al. 1990). The sites, selected in August 1988, were located in clearings within deciduous or mixed deciduous-coniferous forests. Site installations, coordinated and supervised by each watershed research group, were completed in early 1989. Most sites operated through June 1990 except for the Linn Run site, which ceased operation at the end of January 1990.

Figure 1 illustrates the locations of the three wet deposition monitoring sites established specifically for the ERP in relationship to other ERP rainfall measurement and stream chemistry monitoring activities being carried out in the

vicinity of those sites. A wet deposition monitoring site that was part of the U.S. Department of Energy's (DOE) MAP3S Precipitation Chemistry Network was used to provide wet deposition data for the central Pennsylvania streams in the Northern Appalachian Plateau study region.

The Moss Lake site in the Adirondacks was located about 6 km southeast of the Big Moose monitoring site in the Electric Power Research Institute's Operational Evaluation Network (OEN), 54 km west-southwest of the National Atmospheric Deposition Program's (NADP) Huntington Forest monitoring site, and 103 km southwest of the MAP3S site at Whiteface Mountain.

The Biscuit Brook site in the Catskill Mountains study area was collocated with an NADP site, which operates on a weekly sampling protocol (see more on sampling protocol in the next section). Biscuit Brook is 81 km north-northwest of West Point in the Hudson River valley, which is the only other NADP monitoring site within 100 km.

Linn Run is, respectively, 5 km east-northeast and 20 km south-southwest of the Linn Run and Baldwin Creek ERP watersheds and 45 km north-northeast of a wet deposition monitoring site in Laurel Hill State Park (elevation 616 m). The Laurel Hill State Park site is part of a statewide network of wet deposition monitoring sites operated following the NADP weekly collection protocol. This network was available for the Pennsylvania sites during the period of ERP data collection. The network is further composed of S. B. Elliott State Park (elevation 649 m), which is 6, 16, and 48 km south-southwest, respectively, of Stone, Roberts, and Benner Run ERP basins. Weekly data from Laurel Hill and S. B. Elliott State Park, with adjustments for precipitation at each specific site, could be used to supplement wet deposition data for the Pennsylvania ERP basins.

The PSU site is 15 km north of the Leading Ridge NADP site and within 100 km of 3 sites in EPA's model evaluation network: 48 km west of Decatur, 79 km south-southeast of Emporium, and 92 km southwest of Williamsport. The EPA model evaluation network was in full operation from July 1988 through December 1988, in limited operation through most of 1989, and in nearly full operation from January 1990 through June 1990. Only the 1988 data have been released.

2.2 EQUIPMENT

Each precipitation sampling site was equipped with an Aerochem Metrics automatic wet-only precipitation collector and a Belfort recording, weighing rain gauge. The collection bucket in the precipitation sampler was exposed only when rain or snow were detected. A record of the number and time of collector lid openings was kept by an electric event marker on the rain gauge strip chart.

Each site had access to 120 VAC power to operate the precipitation sampler and, during cold weather, to operate a lid heater to prevent the lid from freezing shut. If AC power failed, a rather common occurrence at the rural locations of the sampling sites, a trickle-charged storage battery provided backup power to operate the sampler (but not the lid heater).

Rainfall was recorded using an inked pen on a 1-month strip chart in the weighing rain gauge. The spring-driven chart motor had to be rewound monthly. During extended periods of either extreme heat or cold, the inked pens would occasionally dry out or freeze up and portions of the precipitation record were lost. However, the cumulative amount of precipitation for the period could be determined by reading the pen location.

Each site was visited at least once per week (even during dry periods) to check on the operation of the collector and rain gauge.

2.3 SAMPLING PROTOCOL

A daily precipitation sampling protocol was adopted for this study. Precipitation samples were recovered from the collector between 8 and 10 a.m. whenever precipitation had occurred at the site during the period since the last sample had been collected (usually around 24 h). The site operator could easily determine that precipitation had been collected by noting the presence of tick marks on the lid-opening event record.

If precipitation had collected, the sample bucket was covered with a clean lid and removed from the collector. After the lid seal was cleansed, a clean, empty bucket was installed in the collector, and the collector was reset for automatic operation. In the field laboratory, the sample bucket was weighed to determine the sample volume. The contents of the bucket were then transferred to clean, 250-mL polyethylene bottles and stored in a refrigerator at 4°C.

When the first sample of a given month was collected, all samples collected during the previous month were sent to PNL for chemical analysis and archiving.

2.4 DATA RECORDING

For each sample that was collected, the following field information was recorded on a sample log form:

- date and time [Greenwich mean time (GMT)] the sample was removed from the collector
- current weather conditions (temperature and wind direction)
- the type of precipitation collected (rain, snow, or mixed rain and snow).

In the field laboratory, each sample was given an identification number based on the date, time, and station code number. This identification number was written on the sample bottles and entered in the sample log form. Gross bucket and tare weights were recorded, and the sample volume was calculated and recorded on the sample log form.

Each month, the strip chart was removed from the rain gauge and analyzed in the field laboratory. Based on the sample removal times, the number of lid openings was determined for each sample and entered in the sample log form. Daily hour-by-hour rainfall amounts were determined from the strip chart and entered in the precipitation log form.

When samples were shipped to PNL, an embarkation form was completed to inventory both the samples that were being shipped and the supplies on hand at the site. All such forms were sent to PNL with the samples; copies of the forms were retained by the site operators.

FIGURE 1. Locations of ERP Wet Deposition Monitoring Sites and Other ERP Rainfall Measurement and Stream Chemistry Sites

TABLE 1. Episodic Response Project Site Locations

Region	Site Name	Type(a)	Latitude (Deg N)	Longitude (Deg W)	Elevation (m)	Area(b) (km ²)	Land Use	Operator
Adirondack	Moss Lake (15) (c)	PC/RF	43.7869	74.8431	555		Mixed Forest	ALSC
	Bald Mtn Brook (17)	RF	43.7450	74.9111	578			
	7th Lake Inlet (18)	RF	43.7614	74.6881	613			
	Bald Mtn Brook	SC	43.7500	74.9097	542	1.8		
	7th Lake Inlet	SC	43.7642	74.7044	555	6.4		
	Fly Pond Outlet	SC	43.7500	74.9081	540	0.9		
	Buck Creek	SC	43.7411	74.8556	549	3.1		
Catskill	Biscuit Brook (25)	PC/RF	41.9942	74.5036	634		Mixed Forest	USGS
	Biscuit Brook	SC	41.9953	74.5014	628	9.8		
	Black Brook	SC	42.0117	74.6036	681	3.6		
	High Falls	SC	41.9778	74.5225	591	7.1		
	E. Br. Neversink	SC	41.9669	74.4483	651	23.1		
Northern Appalachian Plateau	Linn Run (35)	PC/RF	40.1667	79.1444	815		Deciduous Forest	PSU
	Linn Run	SC	40.1500	79.2000	573	10.0		
	Baldwin Creek	SC	40.3333	79.0500	439	5.4		
	Penn State (30)	PC/RF	40.7883	77.9464	393		Deciduous Forest	PSU
	Benner Run	SC	40.9167	78.0333	582	11.3		
	Roberts Run	SC	41.1667	78.4000	509	10.7		
	Stone Run	SC	41.0833	78.4333	701	11.6		

(a) PC = Precipitation chemistry sampling; RF = Hourly rainfall measurement; SC = Stream chemistry sampling

(b) Watershed area upstream from SC site.

(c) Site identification number given in () is used in data base.

3.0 LABORATORY OPERATIONS

Precipitation samples received by PNL from the ERP sites were merged with other samples being analyzed as part of the MAP3S Precipitation Chemistry Network. The analytical operations of PNL's precipitation chemistry laboratory, including data entry and archiving, are described in detail in a series of Standard Operating Procedures (SOPs) in Appendix A.

3.1 SAMPLE ANALYSIS

Sample log-in and data form filing and log-in are covered in SOP-01 and SOP-02. Aliquots ranging from 10 mL to 50 mL (when available) were removed from the sample bottles for the following analyses (in priority order) according to the indicated SOP:

• anion analysis ($\text{SO}_4^{=}$, NO_3^{-} , Cl^{-} , PO_4^{3-})	SOP-04
• wet chemistry (NH_4^{+})	SOP-05
• pH (H^{+}) and conductivity	SOP-03
• cation analysis (Na^{+} , K^{+} , Ca^{2+} , Mg^{2+})	SOP-07

Table 2 lists the analysis methods.

3.2 QUALITY ASSURANCE AND CONTROL

The SOPs for the analyses carried out in the precipitation chemistry laboratory are provided in Appendix A. For each analytical procedure, measurements of blanks, known standards [Quality Control (QC) standards], and duplicate samples are used to determine the zero, accuracy, and precision of the analyses. Table 3 gives the average percentage biases found in the analyses during the period in which samples from ERP sites were analyzed. The 95% confidence interval about the mean percentage deviation is based on the assumption of a normal distribution of the biases. Except for Cl and Na, the biases are less than 10%.

The 95% confidence interval on the mean deviation of the QC samples is an indication of the precision of the measurements. For example, although the mean bias for K is small, the 95% confidence interval is very large. This suggests that the precision of the measurement of K concentrations is poor. A

statistical analysis of the results from measurements on duplicate samples (two aliquots from the same sample) in 1989 is given in Table 4. Two measures of the relative difference are given in the table. Averages of the absolute relative difference:

$$ARD = \text{Abs}(V1-V2)/(V1+V2)$$

and of the fractional relative difference:

$$FD = \text{Max}(V1/V2, V2/V1)$$

where V1 and V2 are the results from the pair of duplicate analyses for a given sample. When one value of a pair was below the quantitative detection limit (QDL, see Table 2), a value of QDL/2 was used in the calculation of ARD. The fractional relative difference was calculated only for pairs for which both measurements were above the QDL. All values were above the QDL for pH, H⁺, COND, SO₄⁼, NO₃⁻, Cl⁻, and NH₄⁺. The arithmetic average of the absolute relative difference is

$$\langle ARD \rangle = (1/N) \sum \text{Abs}(V1-V2)/(V1+V2)$$

where the sum (Σ) is either over all pairs or over all pairs with both values above the QDL, and the geometric mean of the fractional relative error is

$$\langle MFD \rangle = 10^{**}\{(1/N) \sum \log(FE)\}$$

and the sum is over all pairs of duplicate analyses with both values above the QDL.

The average relative difference is less than 5%, and the geometric mean fractional difference, expressed as $\langle FE \rangle - 1$ in Table 4, is less than 10% for all ions except K, Na, and Mg. This suggests that, as applied in this laboratory, the spectroscopic method for measuring the metallic cations (Na, K, Ca, and Mg) is less precise than the ion chromatographic method used for the anions. Additional quality assurance information is given in Appendix B.

3.3 DATA ARCHIVING

Information from the field log forms (sample and precipitation) and from the output of the various analytical instruments was transferred to a computerized data base (see SOPs 09 through 14). Separate data bases were maintained for the chemical analyses and the hourly precipitation data. Ion concentrations and precipitation amounts for each sample are presented in Appendix C.

TABLE 2. Chemical Species and Analysis Details

Species	Method(a)	Instrument	Minimum Detection Limit(b) (μM)	Quantitative Detection Limit(c) (μM)	Bias(d) (%)	Uncertainty(d,e) (Precision)
H ⁺ (free)	Electrode	Corning Model 135 pH/Ion Meter	--	--	-0.04	+0.05 pH units (f)
COND	Bridge	Markson Electromark	1.20 ^(g)	--	+1.2	+20%
SO ₄ ⁼	IC	Dionex System 2000i (Anion)	0.03	0.20	-1.8	+GO(QDL or 10%)
NO ₃ ⁻	IC	Dionex System 2000i (Anion)	0.05	0.50	-0.9	+GO(QDL or 10%)
Cl ⁻	IC	Dionex System 2000i (Anion)	0.50	1.00	+10.9	+GO(QDL or 10%)
NH ₄ ⁺	AWC	Alpkem Auto Analyzer	0.10	1.50	-1.5	+GO(QDL or 10%)
Na ⁺	ICAP	Leeman Labs Plasma- Spec. ICP 2.5	0.10	1.00	-13.0	+GO(QDL or 15%)
K ⁺	ICAP	Leeman Labs Plasma- Spec. ICP 2.5	0.20	15.0	+2.0	+GO(QDL or 40%)
Ca ²⁺	ICAP	Leeman Labs Plasma- Spec. ICP 2.5	0.05	0.20	-2.2	+GO(QDL or 10%)
Mg ²⁺	ICAP	Leeman Labs Plasma- Spec. ICP 2.5	0.08	0.60	-2.1	+GO(QDL or 10%)

(a) AWC = Automated Wet Chemistry; IC = Ion Chromatography; ICAP = Inductivity Argon Coupled Plasma.

(b) Concentrations are expressed in molar units: $\mu\text{M} = \mu\text{mol/L}$.

(c) Based on duplicate sample analyses for 1989.

(d) Based on quality control samples for 4th Quarter 1988 through 2nd Quarter 1990.

(e) GO = Greater Of; QDL = Quantitative Detection Limit.

(f) At pH = 4.

(g) COND, conductivity, is expressed in $\mu\text{Siemens}$: $\mu\text{S} = \mu\text{mho/cm}$.

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TABLE 3. The Average Percentage Bias for Ion Concentrations, pH, and Conductivity

<u>Species</u>	<u>Bias(%)</u>	<u>95% C.I.(%)</u>
pH	-0.41	0.07
H ⁺	4.65	0.84
COND	1.20	0.89
SO ₄ ⁼	-1.84	0.43
NO ₃ ⁻	-0.92	0.86
Cl ⁻	10.91	4.71
NH ₄ ⁺	-1.52	-0.51
Na ⁺	-13.21	11.68
K ⁺	1.99	11.18
Ca ²⁺	-2.19	1.15
Mg ²⁺	-2.07	1.01

TABLE 4. Duplicate Sample Analysis Results for 1989

Species	All Pairs			All Pairs > QDL			
	N	Average Relative Difference (%)	95% C.I. on ARD (%)	N	Average Relative Difference (%)	95% C.I. on ARD (%)	Geo. Mean Fractional Difference (%)
pH	67	0.31	0.13	67	0.31	0.13	
H ⁺	67	3.23	1.35	67	3.23	1.35	6.75
COND	66	2.34	0.71	66	2.34	0.71	4.80
SO ₄ ⁼	68	1.75	1.11	68	1.75	1.11	3.61
NO ₃ ⁻	68	2.14	0.74	68	2.14	0.74	4.39
Cl ⁻	68	3.59	1.39	68	3.59	1.39	7.54
NH ₄ ⁺	43	3.43	1.35	43	3.43	1.35	7.13
Na ⁺	68	16.39	5.03	56	11.10	2.90	25.49
K ⁺	68	43.78	9.14	26	41.13	9.95	165.59
Ca ²⁺	68	2.73	2.10	63	1.82	0.71	3.71
Mg ²⁺	68	11.93	5.41	52	6.77	3.20	15.31

Absolute relative difference (RE) = $\text{Abs}(V1-V2)/(V1+V2)$

Average absolute relative difference (ARD) = $(1/N)\text{Sum}[RE]$

95% Confidence Interval (C.I.) on ARD = $1.96 \text{ StdDev}[RE]/\text{Sqrt}[N]$

Absolute fraction difference (FD) = $\text{Max}(V1/V2, V2/V1)$

Geometric mean absolute fractional difference (MFD) = $10^{**}\{(1/N)\text{Sum}[\text{Log}(FD)]\}-1$

95% C.I. on MFD = $10^{**}\{1.96 \text{ StdDev}[\text{Log}(FD)]/\text{Sqrt}[N]\}-1$

4.0 RESULTS

Time series of many measured and calculated parameters for the samples collected at the four ERP wet deposition monitoring sites are shown in Figures 2 through 21. Variables are plotted according to the dates on which the samples were retrieved from the field. The first set of time series for each site (Figures 2, 7, 12, and 17) presents the following information on the physical characteristics of the sample:

- Time Removed is a record of the time (GMT=EST+5) of sample retrieval from the collector.
- Lid Openings is a record of the number of times the collection bucket lid was opened after the bucket was placed in the collector.
- Rain, Sample, and Predicted Volumes are based, respectively, on the hourly rainfall data as provided on the monthly rainfall log forms, the volume determined by weighing the sample bucket, and the volume calculated from the rainfall amount for that sample. An area of 682 cm² is used for the sample bucket.
- Precipitation is the rainfall amount ascribed to the sample. Following the convention used in the MAP3S network, it is the larger of the rain volume and sample volume. If there is no rain volume (because of missing data or no rainfall data), the predicted volume (if available) is used in place of the rain volume.

The second set of time series for each site (Figures 3, 8, 13, and 18) presents information on pH, conductivity, and anion concentrations. The bars for the pH of a sample are shown descending from a pH of 7. The calculated conductivity is based on the following expression:

$$\begin{aligned} \text{COND}_{\text{calc}} = & 0.35[\text{H}^+] + 0.2228/[\text{H}^+] + 0.1478[\text{SO}_4^-] + \\ & 0.104[\text{Ca}^{2+}] + 0.0932[\text{Mg}^{2+}] + 0.0759[\text{Cl}^-] + \\ & 0.0745[\text{NH}_4^+] + 0.0710[\text{NO}_3^-] + 0.0489[\text{Na}^+] \end{aligned}$$

It is computed only when the analysis includes all ions. If an ion is present but the concentration is below the QDL, the QDL is used in the calculation.

Plots (and data) are shown only for SO_4^{2-} , NO_3^- , and Cl^- . Although results are obtained for the phosphate ion (PO_4^{3-}), its concentration is seldom above the quantitatively detectable level (QDL) of $0.2 \mu\text{Mol/L}$. Therefore, phosphate concentrations are not reported.

The third set of time series for each site (Figures 4, 9, 14, and 19) presents the following information on ion sums and balances and anion wet deposition. Anion and cation sums are valid if valid analyses are available for all species. For samples of small volume, the order of analytical priority is anions, NH_4^+ , pH (with conductivity), remaining cations. Ion deposition for a single sample is given by

$$D = [\text{ion}] * \text{Ppt} * M * 10. (\text{mg/m}^2)$$

where $[\text{ion}]$ = concentration of the ion ($\mu\text{Mol/L}$)

Ppt = deposition of precipitation associated with the sample (cm)

M = molecular weight of the ion (g/Mol)

10 = factor to convert to the units mg/m^2 .

The fourth (Figures 5, 10, 15, and 20) and fifth (Figures 6, 11, 16, and 21) sets of time series for each site present, respectively, the concentration and deposition of the cations. The measured pH of the sample is the basis of H^+ .

These time series by sample are the basis for all other derived statistics on wet deposition at a site. The sections that follow will report on the monthly precipitation-weighted average (PWA) ion concentrations and monthly precipitation amounts and ion deposition. The PWA concentration is calculated as

$$\langle \text{ion} \rangle = \frac{\sum [\text{ion}]_i \text{Ppt}_i}{\sum \text{Ppt}_i}$$

where $[\text{ion}]_i$ and Ppt_i are the ion concentration and precipitation amount associated with each sample and there are N samples. Figures 22 to 25 present the

monthly PWA ion concentrations. Figures 26 to 29 show the monthly ion depositions along with the monthly precipitation as measured by the rain gauge and the rain deposition that is used in the calculation of monthly deposition and the PWA concentration.

FIGURE 2. Time Series of Time Removed, Lid Openings, Rain, Sample and Predicted Volumes, and Rain Deposition by Sample for the Moss Lake Precipitation Chemistry Site

FIGURE 3. Time Series of Sample pH, Measured and Calculated Conductivity, and Anion Concentrations by Sample for the Moss Lake Precipitation Chemistry Site

FIGURE 4. Time Series of Cation and Anion Sums, Ion Balances, and Anion Depositions by Sample for the Moss Lake Precipitation Chemistry Site

FIGURE 5. Time Series of Cation Concentrations by Sample for the Moss Lake Precipitation Chemistry Site

FIGURE 6. Time Series of Cation Depositions by Sample for the Moss Lake Precipitation Chemistry Site

FIGURE 7. Time Series of Time Removed, Lid Openings, Rain, Sample and Predicted Volumes, and Rain Deposition by Sample for the Biscuit Brook Precipitation Chemistry Site

FIGURE 8. Time Series of Sample pH, Measured and Calculated Conductivity, and Anion Concentrations by Sample for the Biscuit Brook Precipitation Chemistry Site

FIGURE 9. Time Series of Cation and Anion Sums, Ion Balances, and Anion Depositions by Sample for the Biscuit Brook Precipitation Chemistry Site

FIGURE 10. Time Series of Cation Concentrations by Sample for the Biscuit Brook Precipitation Chemistry Site

FIGURE 11. Time Series of Cation Depositions by Sample for the Biscuit Brook Precipitation Chemistry Site

FIGURE 12. Time Series of Time Removed, Lid Openings, Rain, Sample and Predicted Volumes, and Rain Deposition by Sample for the Penn State Precipitation Chemistry Site

FIGURE 13. Time Series of Sample pH, Measured and Calculated Conductivity, and Anion Concentrations by Sample for the Penn State Precipitation Chemistry Site

FIGURE 14. Time Series of Cation and Anion Sums, Ion Balances, and Anion Depositions by Sample for the Penn State Precipitation Chemistry Site

FIGURE 15. Time Series of Cation Concentrations by Sample for the Penn State Precipitation Chemistry Site

FIGURE 16. Time Series of Cation Depositions by Sample for the Penn State Precipitation Chemistry Site

FIGURE 17. Time Series of Time Removed, Lid Openings, Rain, Sample and Predicted Volumes, and Rain Deposition by Sample for the Linn Run Precipitation Chemistry Site

FIGURE 12. Time Series of Sample pH, Measured and Calculated Conductivity, and Anion Concentrations by Sample for the Linn Run Precipitation Chemistry Site

FIGURE 19. Time Series of Cation and Anion Sums, Ion Balances, and Anion Depositions by Sample for the Linn Run Precipitation Chemistry Site

FIGURE 20. Time Series of Cation Concentrations by Sample for the Linn Run Precipitation Chemistry Site

FIGURE 21. Time Series of Cation Depositions by Sample for the Linn Run Precipitation Chemistry Site

FIGURE 22. Monthly Precipitation-Weighted Average pH and Anion and Cation Concentrations for the Moss Lake Precipitation Chemistry Site

FIGURE 23. Monthly Precipitation-Weighted Average pH and Anion and Cation Concentrations for the Biscuit Brook Precipitation Chemistry Site

FIGURE 24. Monthly Precipitation-Weighted Average pH and Anion and Cation Concentrations for the Penn State Precipitation Chemistry Site

FIGURE 25. Monthly Precipitation-Weighted Average pH and Anion and Cation Concentrations for the Linn Run Precipitation Chemistry Site

FIGURE 26. Monthly Precipitation-Weighted Average Precipitation and Anion and Cation Depositions for the Moss Lake Precipitation Chemistry Site

FIGURE 27. Monthly Precipitation-Weighted Average Precipitation and Anion and Cation Depositions for the Biscuit Brook Precipitation Chemistry Site

FIGURE 28. Monthly Precipitation-Weighted Average Precipitation and Anion and Cation Depositions for the Penn State Precipitation Chemistry Site

FIGURE 29. Monthly Precipitation-Weighted Average Precipitation and Anion and Cation Depositions for the Linn Run Precipitation Chemistry Site

5.0 DISCUSSION

5.1 SAMPLE COLLECTION

The following distributions for each site appear in Figure 30:

- Hours in sample - the time interval between placing the bucket in the collector and removing the bucket from the collector, the sample period.
- Hours with no rain - the total number of hours, as determined from the hourly rainfall data, in which it was not raining during the sampling period.
- Hours since first rain - the time interval between the first hour with rain (≥ 0.01 in.) after the bucket was placed in the collector and the time the bucket was removed from the collector.
- Hours since last rain - the time interval since the last hour for which rain (≥ 0.01 in.) was recorded before the bucket was removed from the collector.
- Hours with rain - the number of hours in which more than a trace of precipitation (rain or snow ≥ 0.01 in.) was received during the sample period (hours during cumulative rain periods are counted as hours with rain).

The sample collection protocol called for sample removal if precipitation had occurred in the previous 24 h. However, many circumstances arose that prevented site operators from retrieving the sample bucket within 24 h of precipitation. When the protocol was closely followed (see Penn State in Figure 30d), the curve for hours in sample should show a series of sharp steps at 24-h intervals, and the fraction of samples should be very low for hours with rain, hours since first rain, and hours since last rain exceeding 24 h. Table 5 presents those five parameters for the 90th percentile sample. That is, for 90% of the samples, the value of those parameters was less than or equal to that given in the table, and 10% of the samples had larger values. The composition could change in those samples for which there are more than 24 h since the last rain, especially during warm weather.

5.2 PRECIPITATION

Precipitation occurrence statistics are summarized in Table 6. A period from the beginning of September 1988 through the end of June 1990 is used as the base for the rainfall data. The hours of no data were associated with times for

which no data were available from the site or when the site had not yet started or had already ceased operation. The 7th Lake Inlet ancillary rainfall recording station in the Adirondacks had the most frequent (19.1%) occurrence of hourly rainfall exceeding a trace amount (≥ 0.01 in.); Penn State, in the Northern Appalachian Plateau region, had the least (7.7%). The large percentage of wet hours at 7th Lake Inlet is the result of a comparatively large number of periods for which a cumulative precipitation amount was given since all of the hours in those periods are counted as wet hours. The infrequent occurrence of a "trace" amount of precipitation is probably the result of the difficulty of resolving small rainfall amounts on the rain gauge strip chart.

The monthly distributions of the amounts and hours of occurrence of precipitation are given in Table 7. This table is based on the hours included in all samples collected during a particular month. Thus, some hours of the previous month may be included and some hours near the end of the month may be excluded from the total hours shown for a month. Wet hours have more than a trace of precipitation (≥ 0.01 in.) or are within a cumulative precipitation period as noted on the hourly precipitation log form. Months with an incomplete data record (precipitation sample collection or rainfall amount) because the site was not operational (or the data are unavailable) are highlighted in bold print. The column "Precipitation" lists the rainfall amount as determined from the rain gauge. The "Rain Deposition" column is the rain amount used to calculate the monthly wet deposition and PWA ion concentration. May 1989 was the wettest month at Biscuit Brook (26.1 cm) and Linn Run (18.6 cm), whereas September 1989 and June 1989 were the wettest months at Moss Lake (19.2 cm) and at Penn State (16.3 cm), respectively. December 1989 was the driest month (with complete data) at Moss Lake (4.0 cm), Biscuit Brook (2.1 cm), and Linn Run (1.5 cm), while August 1989 was the driest at Penn State (0.8 cm).

Peak sample rainfall occurrences are summarized in Table 8. The samples with the largest volumes were usually multiday samples in which the wet period (the time interval between the first and last hour with rain during the sample period) was long. The highest average rain rate (rain amount divided by hours with rain) usually occurred for a small number of hours with rain. Only a few samples at each site were associated with rain rates above 0.5 cm/h: 3 at Moss Lake, 4 at Biscuit Brook, 3 at Penn State, and 2 at Linn Run.

The Biscuit Brook precipitation chemistry site is the best situated with respect to the catchment area of the streams being studied in the project. The stream chemistry site is only 220 m from the precipitation sampling site. Thus, the precipitation amounts and precipitation chemistry measured at this site are as representative of the input to the watershed as possible, given the constraints on the number and locations of sites. However, because precipitation amount frequently increases with elevation in hilly terrain, the rainfall input to the Biscuit Brook watershed is likely to be higher than that estimated from the rainfall at the monitoring site.

The Biscuit Brook watershed and the High Falls watershed stream study site (2.4 km southwest of Biscuit Brook) are on the same side of the valley of the west branch of the Neversink River. But the exposure of the Biscuit Brook watershed is north-south, whereas the High Falls watershed is northwest to southeast. This difference in exposure will probably lead to small differences in rainfall amounts for the two watersheds.

The other Catskill study sites, Black Brook (8.5 km west-northwest), and the east branch of the Neversink River (5.5 km east-southeast) are located in different valleys than Biscuit Brook with significant vertical relief separating the valleys. The frequency, timing, and amount of precipitation at sites separated by major topographic features can be significantly different because of local storms and differences in the general orientation of the watersheds to the prevailing rain-bearing winds. However, the relative proximity of the Catskill stream study sites suggests that differences in precipitation chemistry should be small and that differences in deposition will be driven mainly by differences in precipitation amount.

The Linn Run site is also situated relatively close to the stream chemistry site (5.1 km). However, with the catchment for Linn Run being on the north-western side of the Laurel Mountain ridge, it is likely that the rainfall amount at the precipitation chemistry site on the top of the ridge will be slightly higher than that averaged over the watershed. This is also likely to occur for the Baldwin Creek watershed located on the southeastern flank of the same ridge but 20 km north-northeast of the Linn Run precipitation chemistry monitoring site.

The situation is significantly poorer for the other Northern Appalachian Plateau study sites. The Benner Run site is on the northwestern side of Bald Eagle Ridge, whereas the Penn State precipitation chemistry site is 16 km south-southeast of Benner Run in the valley southeast of the ridge. The Roberts Run and Stone Run sites, 57 km and 52 km northwest, respectively, from the Penn State site, are also northwest of Bald Eagle Ridge. Because of Bald Eagle Ridge, it is to be expected that the frequency, timing, and amount of precipitation at those stream study sites will be significantly different from that at Penn State. Furthermore, because this area (central Pennsylvania) has significant spatial gradients in ambient pollutant concentrations and in ion concentrations in precipitation, the precipitation chemistry at those stream study sites will differ from that at the Penn State site in ways that cannot easily be specified.

The effects of local variability in precipitation can be documented in the Adirondack study area. The hours of simultaneous occurrence of precipitation at the Moss Lake, Bald Mountain Brook, and 7th Lake Inlet rainfall monitoring sites are shown in Table 9. The rainfall amounts are totals for the period December 1988 through June 1990 when both sites in each pair had valid rainfall data. Trace amounts of rain were not included in the count of wet hours but cumulative periods were included. For the Moss Lake-Bald Mountain Brook pair, 63% of the hours with rain at Bald Mountain Brook also had rain at Moss Lake, and those hours produced 80% of the total precipitation at Bald Mountain Brook. For the Moss Lake-7th Lake Inlet pair, 54% of the hours with rain at 7th Lake Inlet also had rain at Moss Lake, and those hours produced 76% of the total precipitation at 7th Lake Inlet. The percentage of rain that occurred at one site while not occurring at the other site ranged from 20% to 26%.

5.3 ION CONCENTRATIONS

Time series of the concentrations of ions by sample reveal that a wide range in ion concentrations occurred at each site during the period of site operation. This range is graphically displayed in the cumulative distribution curves shown in Figure 31. Curves for species with a QDL that is relatively large compared to the range of measured concentrations are offset from the origin along the abscissa. Step-like kinks in the curves (see K^+) indicate the

precision of the concentration measurement is low. The distribution curves for Moss Lake and Biscuit Brook, usually above and to the left of those for the other sites for most ions, indicate more samples from those sites have lower concentrations than those from the other sites. The distance of those sites from major pollution sources is a factor that contributes to the lower concentrations there.

High sample-to-sample variability masks longer-term seasonal patterns in the ion concentrations. These are better shown in the monthly PWA ion concentrations displayed in Figures 22 to 25 and presented in Table 10. Months having incomplete data records (either missing precipitation samples or hourly rainfall amount) are emphasized in bold print. The monthly PWA ion concentrations for the Moss Lake site show the most distinct seasonal patterns of all sites. Seasonal trends are similar for H^+ , NO_3^- , Cl^- , and Na^+ with the highest concentrations in the colder months and the lowest in the warmer months. In contrast, $SO_4^{=}$ concentrations are highest in the summer months and lowest in winter. Although similar seasonal patterns can be discerned at the other sites, large month-to-month variations make those patterns less distinct.

The monthly PWA ion concentration is more strongly correlated with the monthly average rate of rainfall (monthly rainfall divided by hours with more than a trace of rain) than with the monthly rain deposition. For those sites and ions for which the correlation is high, the monthly PWA ion concentration decreases as the monthly mean rainfall rate increases.

The effect of the spatial variability in precipitation on PWA ion concentration is shown in Figure 32 for the three Adirondack sites for which hourly rainfall data are available. PWA ion concentrations are based on the concentrations in precipitation samples collected at the Moss Lake site and on the hourly precipitation that fell at each site during the period of sample collection at Moss Lake. Except for July 1989, the differences in PWA concentrations among the three sites are usually small for most ions.

The large difference in PWA concentration for a few ions at the Moss Lake and 7th Lake Inlet sites is the result of large differences in precipitation at those two sites when the ion concentration was relatively large. Large differences in precipitation amounts over small spatial scales are not unusual during

summertime convective precipitation events. Figure 33 shows how each of the samples collected during July 1989 contributed to the PWA for that month for $\text{SO}_4^{=}$ ($37.6 \mu\text{M/L}$ at Moss Lake and $45.7 \mu\text{M/L}$ at 7th Lake Inlet). The number at the top of the column gives the day of the month that the sample was collected. The large difference between the $\text{SO}_4^{=}$ PWA for Moss Lake and 7th Lake Inlet occurs because 7th Lake Inlet had more precipitation on days with higher ion concentrations than did Moss Lake.

As noted in the discussion of the spatial variability of precipitation, the monthly PWA ion concentrations may be representative of the precipitation occurring at other sites if those sites are relatively close to the precipitation chemistry site and if there are no major terrain barriers or strong spatial gradients in ion concentration. The validity of this assumption will be greatest in late fall, winter, and early spring when precipitation is derived mainly from synoptic-scale storm systems and weakest in the summer when convective precipitation events dominate. The assumption should be reasonably applicable to the Adirondack sites, the Catskill sites, and the Linn Run and Baldwin Creek sites. However, the uncertainty in this assumption must be large for the relationship of the PWAs at Penn State and the Benner Run, Roberts Run, and Stone Run sites.

5.4 ION DEPOSITION

The time series indicate that ion deposition is also highly variable from sample to sample. Even the monthly ion depositions (Figures 26 to 29 and Table 11) show large month-to-month changes. Months with incomplete precipitation chemistry sampling or rainfall data are again emphasized in bold print. Clear seasonal patterns are obvious for only a few ions at Penn State and Linn Run. This large variability is more closely correlated to the month-to-month variability in rain deposition than to ion concentration. Only for K^+ does the variability in ion concentration appear to contribute significantly to the variability in ion deposition. This is perhaps related to the large uncertainty associated with the K^+ concentration measurement.

Spatial variability in monthly ion deposition for the Adirondack sites is illustrated in Figure 34. The solid bar indicates the deposition at the Moss Lake precipitation chemistry site. The striped side bars indicate the monthly

deposition at Bald Mountain Brook and 7th Lake Inlet based on the hourly rain gauge data at those sites and the ion concentrations at Moss Lake. For most months, the differences in ion deposition among those sites are relatively small. The largest difference occurred in July 1989: 337 mg/m² at Moss Lake and 537 mg/m² at 7th Lake Inlet. Figure 35 illustrates how the various samples collected during July 1989 contributed to the monthly deposition at the two sites. Higher rainfall amounts at 7th Lake Inlet coupled with relatively high concentrations at Moss Lake on the 10th, 11th, 23rd, and 8th of the month contributed the most to the differences in SO₄⁼ ion deposition at those two sites.

The spatial variability in monthly deposition among the watersheds in the other study areas is likely to be as large or larger than that in the Adirondacks because of the more complicated terrain in those areas and, in central Pennsylvania, because there may be additional variability in ion concentrations caused by spatial gradients in ambient pollutant concentrations. Without rainfall data for these other watersheds, the uncertainty in the estimate of monthly wet deposition will probably be on the order of 25%.

5.5 DEPOSITION EPISODICITY

As noted in the discussion above, the contribution to the monthly deposition can vary greatly by sample. Figure 36 reports the contribution to the total deposition of a given percentage of samples for the period of site operation. The curves were produced by ranking the samples in descending order of deposition and forming a running sum of the depositions. The deposition was normalized by the total deposition for the period at each site. The abscissa was normalized by the number of valid samples from each site. If all samples contributed the same amount to the total deposition, the curves would be a straight line from the origin to the point for 100% deposition and 100% of the number of samples. However, when a relatively small percentage of the samples contributes a large portion of the total deposition, the curves are bowed. A measure of the episodicity of deposition is given by the percentage of deposition produced by the largest 10% of the samples (Fowler and Cape 1984; Dana and Slinn 1988).

Although none of these curves suggests that wet deposition at ERP sites is highly episodic (more than 50% of the deposition from less than 10% of the

samples), the pronounced bow of the curves illustrates that more than 50% of the wet deposition came from less than 25% of the samples. The differences between the precipitation-amount curves for Penn State and the other sites are primarily caused by the uneven (and frequently longer) sampling period at the other sites compared to Penn State (see Figure 30). The more deeply bowed curve for Cl^- and Na^+ at Biscuit Brook may have been caused by the more episodic deposition of marine aerosols at this site because of its closer proximity to the Atlantic coast.

5.6 DRY DEPOSITION

Dry deposition is an important atmospheric pathway for chemical input to a watershed. Because techniques for routinely measuring dry deposition are still being developed, no measurements of either air concentrations or the meteorological variables necessary to estimate dry-deposition velocities were taken at ERP precipitation chemistry sites. However, some estimate of the magnitude of dry deposition of sulfate and nitrate can be made by using information from a few dry-deposition research sites operated by the National Atmospheric and Oceanic Administration (NOAA). At these sites, air concentrations of key pollutants are measured on a daily (or more frequent) basis. Meteorological variables such as wind speed and direction, temperature, humidity, net radiation, and surface wetness are concurrently measured. The meteorological variables and information pertaining to the condition of the vegetative ground cover in the vicinity of the sites are used to model the dry-deposition velocity for the various pollutants of interest. Dry deposition is the product of the air concentration and deposition velocity.

The relationship between wet and dry deposition at the NOAA sites can be used to roughly indicate the additional contribution dry deposition may make to the watersheds at the ERP study sites. The seasonal and average wet sulfate and nitrate deposition rates at the four study sites are recorded in Table 12. For four of the NOAA dry deposition research sites located near the ERP sites, the ratio of dry to wet deposition is also given (Sisterson et al. 1990). Sulfate and nitrate dry deposition includes the dry deposition of SO_2 and $\text{SO}_4^{=}$ aerosol and of HNO_3 and NO_3^- aerosol, respectively. The Whiteface Mountain and Oak Ridge sites represent extremes of the ratio of dry to wet deposition. Dry

deposition at Moss Lake is probably a higher fraction of wet deposition than that shown for the Whiteface Mountain site in the northeastern Adirondacks. On the other hand, dry deposition at Linn Run is probably a smaller fraction of wet deposition than that shown for the Oak Ridge site. The West Point NOAA site should be reasonably representative of the conditions at Biscuit Brook. In general, as the distance from sources of pollutants increases, the ratio of dry to wet deposition of those pollutants decreases.

FIGURE 30. The Distribution of the Number of Hours in Sample, Hours With and Without Rain, and Hours Since First and Last Hour With Rain for All Samples Collected During the Period of Site Operation at Moss Lake, Biscuit Brook, Linn Run, and Penn State Precipitation Chemistry Sites

FIGURE 31. Cumulative Distributions of pH and Cation and Anion Concentrations over the Entire Period of Operation at ERP Precipitation Chemistry Monitoring Sites

FIGURE 32. Monthly Precipitation-Weighted Average pH and Anion and Cation Concentrations for the Moss Lake Precipitation Chemistry Site and for the Bald Mountain Brook and 7th Lake Inlet Rain Gauge Sites Based on the Ion Concentrations at Moss Lake and Hourly Rainfall Amounts at the Rain Gauge Sites

S04 PWA by Sample Day, July 1989

Moss Lake & 7th Lake Inlet

FIGURE 33. The Contribution by Sample to the Precipitation-Weighted Average Concentration for July 1989 at the Moss Lake and 7th Lake Inlet Sites

FIGURE 34. Monthly Precipitation Amount and Anion and Cation Depositions for the Moss Lake Precipitation Chemistry Site and for the Bald Mountain Brook and 7th Lake Inlet Rain Gauge Sites Based on the Ion Concentrations at Moss Lake and Hourly Rainfall Amounts at the Rain Gauge Sites

S04 Deposition by Sample Day, July 1989

Moss Lake & 7th Lake Inlet

FIGURE 35. The Contribution by Sample to the Ion Depositions for July 1989 at the Moss Lake and 7th Lake Inlet Sites

FIGURE 36. The Episodicity of Rain and Ion Deposition at the ERP Precipitation Chemistry Sites

TABLE 5. Sample Collection Statistics for the 90th Percentile Sample at ERP Precipitation Chemistry Sites

	<u>Moss Lake</u>	<u>Biscuit Brook</u>	<u>Penn State</u>	<u>Linn Run</u>
Number of samples	195	210	284	93
Hours in sample	73	144	96	170
Hours with no rain	59	135	72	151
Hours since first rain	39	62	24	72
Hours since last rain	12	21	16	31
Hours with rain	11	24	9	30

TABLE 6. Hours with Rain at the ERP Sites and Ancillary Stations from August 1988 Through June 1990 (16,032 h)

	<u>Moss Lake</u>	<u>Bald Mtn Br</u>	<u>7th Lake Inlet</u>	<u>Biscuit Brook</u>	<u>Penn State</u>	<u>Linn Run</u>
Rain > Trace	2043	2198	2459	1935	841	1202
Trace	0	0	0	49	0	0
Dry	11805	10906	10404	13284	10079	6406
Valid Data	13848	13104	12863	15268	10920	7608
Missing, ppt likely	0	0	215	44	0	408
Missing, ppt unlikely	0	0	26	0	0	0
No data	2184	2928	2928	720	5112	8016
% Valid Hours Rain > Trace	17.3	16.8	19.1	12.7	7.7	15.8

TABLE 7. Monthly Precipitation and Hours of Rainfall Occurrence at the ERP Precipitation Chemistry Sites

YYMM	Number of Samples	Precipitation ^(a) (cm)	Rain Deposition ^(b) (cm)	Hours ^(c)						
				Dry	Wet	Tr	MI	Mu	ND	Total
<u>Moss Lake</u>										
8812	7	5.45	5.61	319	66	0	0	0	0	385
8901	15	8.18	8.97	619	151	0	0	0	0	770
8902	13	5.79	5.79	557	113	0	0	0	0	670
8903	13	6.44	6.53	606	90	0	0	0	0	696
8904	13	9.05	9.27	684	88	0	0	0	0	772
8905	12	13.61	15.02	624	123	0	0	0	0	747
8906	12	8.29	9.79	585	82	0	0	0	0	667
8907	12	9.54	9.70	746	48	0	0	0	0	794
8908	10	11.16	12.41	687	58	0	0	0	0	745
8909	6	19.19	19.78	559	87	0	0	0	0	646
8910	9	8.27	8.57	556	76	0	0	0	0	632
8911	13	17.71	18.49	699	162	0	0	0	0	861
8912	8	4.05	4.05	603	88	0	0	0	0	691
9001	12	14.56	14.85	613	202	0	0	0	0	815
9002	9	12.17	12.23	543	151	0	0	0	0	694
9003	9	6.66	6.94	533	101	0	0	0	0	634
9004	9	12.57	12.68	697	144	0	0	0	0	841
9005	8	17.67	17.77	566	153	0	0	0	0	719
9006	5	3.53	3.61	343	31	0	0	0	0	374
<u>Biscuit Brook</u>										
8808	3	0.00	7.82	0	0	0	0	0	0	0
8809	8	2.61	5.62	543	20	1	0	0	0	564
8810	14	7.36	8.42	775	62	8	44	0	0	889
8811	13	15.28	20.16	597	83	16	0	0	0	696
8812	8	4.23	4.58	694	25	3	0	0	0	722
8901	11	5.35	6.12	691	75	0	0	0	0	766
8902	14	3.56	8.88	639	57	1	0	0	0	697
8903	7	8.59	9.13	659	85	0	0	0	0	744
8904	9	6.35	7.27	612	109	0	0	0	0	721
8905	12	26.11	27.52	584	167	0	0	0	0	751
8906	12	12.57	13.52	492	175	0	0	0	0	667
8907	8	8.67	9.20	681	41	0	0	0	0	722
8908	7	8.75	9.39	688	106	0	0	0	0	794
8909	7	17.92	18.27	549	67	0	0	0	0	616
8910	8	16.94	17.27	579	95	4	0	0	0	678
8911	14	12.04	12.62	744	107	8	0	0	0	859
8912	6	2.14	2.20	672	46	6	0	0	0	724
9001	9	16.65	16.96	625	169	0	0	0	0	794
9002	7	10.69	11.28	523	123	0	0	0	0	646
9003	8	8.05	8.79	686	85	1	0	0	0	772
9004	13	12.81	13.21	639	100	0	0	0	0	739
9005	12	22.24	22.62	577	138	1	0	0	0	716

TABLE 7. (Contd)

YYMM	Number of Samples	Precipitation ^(a) (cm)	Rain Deposition ^(b) (cm)	Hours ^(c)						Total
				Dry	Wet	Tr	MI	Mu	ND	
<u>Penn State</u>										
8901	16	3.67	4.98	628	45	0	0	0	0	673
8902	14	4.76	5.62	622	50	0	0	0	0	672
8903	15	8.49	10.98	698	70	0	0	0	0	768
8904	16	0.95	1.65	705	14	0	0	0	0	719
8905	23	14.03	15.80	613	131	0	0	0	0	744
8906	20	16.29	18.10	608	88	0	0	0	0	696
8907	15	14.97	16.60	717	51	0	0	0	0	768
8908	10	0.84	1.39	712	8	0	0	0	0	720
8909	13	8.66	9.55	561	40	0	0	0	0	601
8910	13	7.60	8.49	835	53	0	0	0	0	888
8911	20	7.36	8.46	660	60	0	0	0	0	720
8912	18	1.81	2.24	714	30	0	0	0	0	744
9001	15	7.42	8.16	642	78	0	0	0	0	720
9002	15	4.67	5.59	620	76	0	0	0	0	696
9003	13	2.86	3.98	698	47	0	0	0	0	745
9004	16	0.00	6.64	10	0	0	0	0	708	718
9005	19	0.00	15.28	0	0	0	0	0	720	720
9006	13	0.00	10.42	0	0	0	0	0	745	745
<u>Linn Run</u>										
8902	2	0.05	4.99	148	1	0	0	0	0	149
8903	8	10.06	17.96	587	155	0	0	0	0	742
8904	10	5.63	9.88	619	111	0	0	0	0	730
8905	14	18.61	23.24	486	254	0	0	0	0	740
8906	10	17.32	21.77	498	195	0	0	0	0	693
8907	7	10.66	13.01	704	87	0	0	0	0	791
8908	5	5.94	9.15	680	41	0	0	0	0	721
8909	6	9.65	11.32	498	105	0	0	0	0	603
8910	8	13.67	14.35	562	108	0	0	0	0	670
8911	10	8.69	9.79	775	111	0	0	0	0	886
8912	4	1.47	3.06	370	20	0	353	0	0	743
9001	9	0.00	14.04	0	0	0	55	0	741	796

(a) Based on hourly rainfall data and time of sample collection.

(b) Based on greater of rain volume or sample volume.

(c) Dry = No rain during the hour;

Wet = Rain during hour, includes hours in cumulative periods;

MI = Missing data, rain likely;

Mu = Missing data, rain unlikely;

ND = No data (site not operating or data unavailable);

Total = Total hours in month based on date and time of sample collection.

TABLE 8. Occurrences of Peak Rainfall Amounts and Rates at ERP Precipitation Chemistry Sites

<u>Site Sample Date</u>	<u>Rain Amount (cm)</u>	<u>Rain Rate (cm/h)</u>	<u>Rain Hours (h)</u>	<u>Wet Period (h)</u>
<u>Moss Lake</u>				
890805	6.7*	0.32	18	22
890624	1.9	0.64*	3	3
<u>Biscuit Brook</u>				
890920	9.8*	0.41	24	39
891015	2.2	1.28*	1	1
<u>Penn State</u>				
890705	4.3*	0.26	16	17
890526	2.2	1.10*	2	5
<u>Linn Run</u>				
891019	6.9*	0.18	39	56
891101	2.2	0.73*	3	5

* Peak value.

TABLE 9. Coincidence Statistics for Dry and Wet Hours at the Adirondack Hourly Rainfall Measurement Sites

<u>Moss Lake (15)</u>	<u>Bald Mountain Brook (16)</u>			<u>Total (15)</u>
	<u>Dry (h)</u>	<u>Wet (h)</u>	<u>Rain (cm)</u>	
Dry (h)	10317	821	39.17	11138
Wet (h)	589	1377	152.53	1966
Rain (cm)	42.45	151.52		193.98
TOTAL(16)	10906	2198	191.70	13104

<u>Bald Mountain Brook (16)</u>	<u>7th Lake Inlet (17)</u>			<u>Total(16)</u>
	<u>Dry (h)</u>	<u>Wet (h)</u>	<u>Rain (cm)</u>	
Dry (h)	9590	1129	46.97	10719
Wet (h)	814	1330	136.30	2144
Rain (cm)	42.06	146.33		188.39
TOTAL(17)	10404	2459	183.27	12863

<u>7th Lake Inlet (17)</u>	<u>Moss Lake (15)</u>			<u>Total(17)</u>
	<u>Dry (h)</u>	<u>Wet (h)</u>	<u>Rain (cm)</u>	
Dry (h)	9805	599	42.16	10404
Wet (h)	1139	1320	148.56	2459
Rain (cm)	44.51	138.76		183.27
TOTAL(15)	10944	1919	190.73	12863

TABLE 10. Monthly Precipitation-Weighted Average pH and Ion Concentrations ($\mu\text{M/L}$) at ERP Precipitation Chemistry Sites

YYMM	N	pH	H	SO ₄	NO ₃	Cl	NH ₄	Na	K	Ca	Mg
<u>Moss Lake</u>											
8812	7	4.34	45.24	12.47	36.30	11.33	16.90	2.24	0.76	2.85	0.86
8901	15	4.20	63.00	16.99	38.71	14.89	21.75	1.72	6.34	2.80	0.76
8902	13	4.14	72.80	19.13	49.70	19.72	22.01	1.42	17.88	4.12	1.26
8903	13	4.18	65.96	23.27	44.51	16.69	22.16	3.16	4.62	6.69	1.35
8904	13	4.23	59.28	19.79	31.43	2.10	10.67	1.02	1.53	1.52	0.57
8905	12	4.40	39.57	17.14	18.42	9.07	9.44	0.64	2.80	2.00	0.69
8906	12	4.34	45.50	30.94	34.04	8.17	11.82	1.21	3.07	3.00	0.84
8907	12	4.30	49.80	37.60	28.32	7.59	36.05	1.14	2.22	9.49	1.80
8908	10	4.43	37.10	25.70	20.60	4.49	14.34	0.75	0.40	3.33	0.63
8909	6	4.44	36.22	14.07	14.23	7.21	10.15	0.97	12.59	1.27	0.73
8910	9	4.57	26.72	11.51	19.09	7.54	10.36	1.01	6.05	5.34	0.92
8911	13	4.38	41.39	16.82	31.67	10.98	13.72	1.37	9.81	3.48	0.83
8912	8	4.28	52.75	7.66	47.52	14.69	9.10	1.66	2.96	4.41	0.77
9001	12	4.19	64.71	15.57	34.92	17.62	8.57	1.89	5.64	1.91	0.75
9002	9	4.18	65.35	16.97	32.94	12.44	11.59	2.33	1.90	1.37	0.59
9003	9	4.21	62.29	18.23	29.89	15.61	11.97	1.49	5.67	1.43	0.78
9004	9	4.30	50.09	19.07	23.90	11.76	10.79	1.18	10.00	2.04	0.65
9005	8	4.24	57.51	20.91	21.25	3.78	11.56	0.68	10.78	1.04	0.53
9006	5	4.21	61.39	27.93	29.02	5.72	18.44	2.81	10.00	2.05	0.64
<u>Biscuit Brook</u>											
8808	3	4.76	17.27	10.18	7.92	8.18	5.87	2.91	0.99	2.35	0.76
8809	8	4.26	55.29	23.55	25.91	8.87	13.91	3.47	8.68	1.85	0.91
8810	14	4.29	50.75	22.33	29.25	4.54	21.00	3.85	1.33	2.67	0.97
8811	13	4.34	45.82	18.81	28.75	9.57	18.23	3.08	4.66	2.02	0.95
8812	8	4.33	46.36	17.43	18.78	12.38	12.21	4.97	2.84	1.95	1.18
8901	11	4.19	64.42	23.48	30.26	9.71	15.72	5.81	6.27	2.06	1.06
8902	14	4.28	52.14	15.39	31.40	15.17	9.54	2.32	1.11	1.29	0.56
8903	7	4.30	50.63	17.54	28.49	8.92	13.11	2.74	6.01	2.05	0.72
8904	9	4.06	87.16	35.61	49.22	7.93	25.26	5.09	6.10	3.82	1.20
8905	12	4.43	36.90	15.46	17.65	6.88	9.82	1.01	7.27	1.38	0.58
8906	12	4.17	66.92	29.47	31.02	8.25	16.93	1.39	0.98	4.00	0.75
8907	8	4.40	39.67	18.75	19.81	6.86	15.34	0.94	27.86	2.13	0.70
8908	7	4.24	57.83	22.25	20.01	9.61	10.70	1.57	2.76	2.05	0.72
8909	7	4.50	31.50	13.84	14.95	18.84	5.42	9.27	9.45	1.85	1.71
8910	8	4.43	36.82	14.78	24.73	12.20	23.45	2.56	6.09	2.38	1.25
8911	14	4.23	58.73	19.42	28.60	18.81	14.41	6.25	3.23	2.70	1.49
8912	6	4.13	74.20	9.88	51.49	12.35	12.92	2.39	9.27	2.25	0.83
9001	9	4.19	64.06	13.35	26.34	10.24	7.22	1.86	3.80	1.73	0.75
9002	7	4.16	68.59	19.72	35.24	13.02	10.64	4.28	5.48	2.31	0.90
9003	8	4.06	87.28	25.67	50.41	11.40	20.05	6.44	2.21	1.32	0.94
9004	13	4.16	68.68	27.87	32.77	15.60	20.91	3.49	13.27	2.18	0.81
9005	12	4.32	47.51	20.04	20.07	7.25	16.12	1.55	10.49	1.15	0.50

TABLE 10. (Contd)

<u>YYMM</u>	<u>N</u>	<u>pH</u>	<u>H</u>	<u>SO₄</u>	<u>NO₃</u>	<u>Cl</u>	<u>NH₄</u>	<u>Na</u>	<u>K</u>	<u>Ca</u>	<u>Mg</u>
<u>Penn State</u>											
8901	16	4.27	54.28	19.70	26.62	13.32	9.63	4.15	10.41	2.54	0.75
8902	14	4.27	54.10	17.93	19.58	4.71	9.49	0.99	0.70	1.01	0.40
8903	15	4.28	52.35	21.67	29.85	12.12	17.29	2.31	1.59	3.22	0.76
8904	16	3.95	112.56	42.82	66.12	16.73	34.95	2.57	15.13	5.51	1.45
8905	23	4.13	74.78	37.42	39.91	11.07	26.91	1.99	4.65	4.90	1.25
8906	20	4.08	82.36	43.25	31.61	7.98	26.16	1.09	3.76	3.62	0.85
8907	15	4.33	47.31	23.28	19.61	9.55	13.81	0.99	4.90	3.06	0.70
8908	10	3.86	136.94	74.44	49.68	13.19	26.34	4.08	12.09	9.71	2.45
8909	13	4.12	76.73	46.42	31.65	13.64	23.87	3.18	3.42	1.99	1.02
8910	13	4.47	34.16	13.21	18.75	7.48	17.84	0.97	4.46	2.86	1.01
8911	20	4.34	45.36	15.91	21.16	9.48	10.27	1.81	4.06	2.98	0.87
8912	18	4.14	72.65	13.89	55.99	17.11	14.09	3.47	5.92	5.18	1.26
9001	15	4.17	67.92	20.07	30.37	13.61	8.32	2.06	3.74	0.97	0.53
9002	15	4.03	93.98	33.05	46.76	14.91	75.31	6.04	22.62	22.73	5.56
9003	13	4.08	83.03	23.19	48.28	10.27	15.10	3.53	3.34	2.15	0.87
9004	16	4.04	91.59	34.37	45.24	19.23	24.06	3.91	10.32	1.72	0.95
9005	19	4.31	49.45	21.25	21.99	7.81	10.79	2.52	10.00	2.27	0.84
9006	13	3.95	112.26	50.53	33.70	9.46	27.24	1.74	10.34	3.97	1.41
<u>Linn Run</u>											
8902	2	4.25	56.28	18.41	19.82	12.62	12.35	0.96	0.40	1.29	0.40
8903	8	4.26	55.12	22.80	22.97	13.71	16.97	1.88	1.93	2.36	0.74
8904	10	4.02	94.78	31.97	43.17	13.69	26.32	1.57	4.49	4.31	1.00
8905	14	4.05	88.31	38.13	36.18	11.33	23.46	1.69	5.91	3.62	0.99
8906	10	4.13	74.91	38.40	20.49	7.01	16.74	1.59	10.14	2.51	0.56
8907	7	3.92	119.45	59.66	38.19	13.98	27.05	1.11	8.20	3.87	0.94
8908	5	4.16	69.37	39.88	29.12	10.15	21.11	0.51	5.73	3.48	0.72
8909	6	3.95	113.32	46.45	37.67	9.74	22.60	1.29	5.25	4.58	0.74
8910	8	4.38	41.49	18.49	18.87	8.18	13.20	1.19	3.46	4.87	1.14
8911	10	4.40	40.03	19.02	24.70	12.85	11.32	1.23	2.19	4.38	1.28
8912	4	3.87	134.49	29.82	70.46	23.09	27.86	5.10	5.03	7.79	1.86
9001	9	4.19	65.26	19.22	26.20	13.33	14.55	1.86	1.28	1.79	0.62

TABLE 11. Monthly Wet Deposition (mg/m²) at ERP Precipitation Chemistry Sites

YYMM	N	H	SO ₄	NO ₃	Cl	NH ₄	Na	K	Ca	Mg
<u>Moss Lake</u>										
8812	7	2.56	67.20	126.23	22.53	17.07	2.89	1.67	6.40	1.17
8901	15	5.70	146.39	215.24	47.33	35.14	3.55	22.22	10.07	1.66
8902	13	4.25	106.40	178.37	40.47	22.95	1.90	40.46	9.56	1.77
8903	13	4.34	146.01	180.21	38.65	26.07	4.75	11.80	17.52	2.14
8904	13	5.54	176.12	180.56	6.90	17.80	2.18	5.54	5.63	1.29
8905	12	5.99	247.25	171.51	48.28	25.53	2.22	16.47	12.06	2.54
8906	12	4.49	290.98	206.61	28.36	20.86	2.72	11.73	11.79	1.99
8907	12	4.87	350.57	170.39	26.13	63.03	2.55	8.42	36.92	4.25
8908	10	4.64	306.48	158.49	19.76	32.07	2.13	1.94	16.55	1.90
8909	6	7.22	267.45	174.55	50.57	36.18	4.39	97.41	10.08	3.51
8910	9	2.31	94.79	101.48	22.93	16.01	1.99	20.29	18.36	1.91
8911	13	7.71	298.76	363.02	71.97	45.71	5.83	70.93	25.82	3.75
8912	8	2.15	29.84	119.40	21.12	6.64	1.54	4.69	7.17	0.76
9001	12	9.69	222.20	321.60	92.82	22.92	6.45	32.78	11.36	2.71
9002	9	8.06	199.40	249.87	53.96	25.54	6.56	9.07	6.72	1.75
9003	9	4.36	121.57	128.64	38.43	14.97	2.38	15.39	3.97	1.32
9004	9	6.40	232.34	187.96	52.89	24.66	3.44	49.59	10.39	2.00
9005	8	10.30	356.98	234.15	23.84	37.02	2.79	74.93	7.43	2.27
9006	5	2.23	96.86	64.94	7.32	11.99	2.33	14.11	2.97	0.56
<u>Biscuit Brook</u>										
8808	3	1.36	76.44	38.36	22.66	8.27	5.22	3.01	7.36	1.44
8809	8	3.13	127.12	90.26	17.68	14.08	4.49	19.08	4.16	1.25
8810	14	4.31	180.71	152.75	13.55	31.87	7.45	4.39	9.02	1.99
8811	13	9.31	364.28	359.31	63.43	66.21	14.26	36.72	16.35	4.64
8812	8	2.14	76.66	53.33	20.09	10.08	5.23	5.09	3.58	1.31
8901	11	3.97	137.97	114.75	21.06	17.33	8.17	14.99	5.05	1.58
8902	14	4.67	131.25	172.80	47.75	15.26	4.73	3.87	4.59	1.20
8903	7	4.66	153.96	161.38	28.90	21.57	5.75	21.48	7.51	1.60
8904	9	6.39	248.76	221.89	20.43	33.09	8.51	17.35	11.12	2.12
8905	12	10.24	408.68	301.23	67.12	48.67	6.40	78.27	15.19	3.90
8906	12	9.12	382.72	260.04	39.57	41.23	4.33	5.20	21.68	2.46
8907	8	3.68	165.75	113.03	22.39	25.43	1.98	100.24	7.86	1.58
8908	7	5.48	200.78	116.53	32.02	18.11	3.39	10.14	7.71	1.65
8909	7	5.80	242.98	169.39	122.02	17.84	38.93	67.47	13.55	7.59
8910	8	6.41	245.19	264.82	74.74	72.96	10.18	41.15	16.49	5.26
8911	14	7.47	235.45	223.85	84.18	32.77	18.13	15.97	13.66	4.58
8912	6	1.64	20.83	70.07	9.61	5.11	1.21	7.96	1.98	0.44
9001	9	10.95	217.57	277.07	61.57	22.08	7.27	25.21	11.74	3.09
9002	7	7.80	213.66	246.36	52.04	21.62	11.10	24.16	10.45	2.46
9003	8	7.74	216.79	274.79	35.54	31.76	13.03	7.59	4.66	2.01
9004	13	9.15	353.82	268.49	73.11	49.78	10.61	68.57	11.53	2.60
9005	12	10.83	435.47	281.44	58.11	65.69	8.04	92.82	10.43	2.74

TABLE 11. (Contd)

YYMM	N	H	SO ₄	NO ₃	Cl	NH ₄	Na	K	Ca	Mg
<u>Penn State</u>										
8901	16	2.73	94.29	82.23	23.53	8.64	4.75	20.27	5.06	0.91
8902	14	3.06	96.79	68.18	9.38	9.61	1.28	1.55	2.28	0.55
8903	15	5.79	228.52	203.15	47.18	34.20	5.82	6.81	14.17	2.04
8904	16	1.87	67.97	67.74	9.80	10.41	0.97	9.77	3.65	0.58
8905	23	11.91	568.19	391.06	62.05	76.63	7.24	28.71	31.03	4.80
8906	20	15.03	752.27	354.83	51.22	85.31	4.54	26.63	26.26	3.72
8907	15	7.91	371.30	201.84	56.20	41.30	3.79	31.80	20.35	2.81
8908	10	1.92	99.71	42.94	6.52	6.61	1.31	6.59	5.43	0.83
8909	13	7.39	425.87	187.39	46.19	41.06	6.98	12.77	7.60	2.37
8910	13	2.92	107.74	98.68	22.51	27.28	1.90	14.80	9.71	2.08
8911	20	3.87	129.34	111.01	28.45	15.65	3.53	13.43	10.11	1.80
8912	18	1.64	29.86	77.67	13.57	5.68	1.79	5.18	4.65	0.68
9001	15	5.59	157.38	153.67	39.39	12.23	3.87	11.93	3.17	1.06
9002	15	5.30	177.51	162.07	29.55	75.86	7.76	49.46	50.93	7.56
9003	13	3.33	88.64	119.13	14.50	10.83	3.23	5.20	3.43	0.85
9004	16	6.13	219.25	186.21	45.26	28.78	5.97	26.79	4.57	1.54
9005	19	7.61	311.86	208.26	42.30	29.69	8.84	59.73	13.91	3.10
9006	13	11.79	505.81	217.69	34.95	51.14	4.18	42.14	16.59	3.56

Linn Run

8902	2	2.83	88.18	61.27	22.30	11.09	1.10	0.78	2.57	0.48
8903	8	9.98	393.45	255.77	87.29	54.93	7.76	13.57	17.00	3.21
8904	10	9.44	303.49	264.53	47.97	46.87	3.56	17.35	17.06	2.41
8905	14	20.69	851.45	521.29	93.41	98.24	9.03	53.70	33.70	5.57
8906	10	16.44	803.31	276.56	54.11	65.68	7.96	86.32	21.94	2.97
8907	7	15.66	745.46	307.93	64.47	63.39	3.33	41.72	20.15	2.97
8908	5	6.40	350.50	165.16	32.94	34.80	1.08	20.49	12.76	1.59
8909	6	12.93	505.17	264.40	39.08	46.10	3.36	23.24	20.79	2.04
8910	8	6.00	255.03	167.93	41.62	34.14	3.93	19.43	28.04	3.99
8911	10	3.95	178.98	150.01	44.64	19.98	2.77	8.38	17.18	3.06
8912	4	4.15	87.80	133.88	25.09	15.38	3.59	6.03	9.57	1.38
9001	9	9.24	259.23	228.04	66.36	36.81	6.02	7.04	10.04	2.10

TABLE 12. Seasonal Average Wet Deposition at ERP Sites and the Ratio of Dry to Wet Deposition at Selected NOAA CORE Dry Deposition Research Sites

Sulfate Deposition

ERP Site	Wet $\text{SO}_4^{=}$ Deposition ($\text{mg}/\text{m}^2/\text{month}$)				
	Winter	Spring	Summer	Fall	Annual
Moss Lake	141	213	316	220	223
Biscuit Brook	133	303	250	233	230
Penn State	111	247	432	221	253
Linn Run	145	516	633	313	402

NOAA CORE Site	Ratio of Dry ^(a) to Wet Deposition				
	Winter	Spring	Summer	Fall	Annual
Whiteface Mtn.	0.64	0.33	0.20	0.34	0.30
West Point	0.61	0.71	0.37	0.42	0.56
Penn State	0.94	0.44	0.56	0.58	0.53
Oak Ridge	1.10	1.47	0.91	1.30	1.00

Nitrate Deposition

ERP Site	Wet $\text{NO}_3^{=}$ Deposition ($\text{mg}/\text{m}^2/\text{month}$)				
	Winter	Spring	Summer	Fall	Annual
Moss Lake	217	181	178	213	197
Biscuit Brook	156	252	163	210	195
Penn State	109	196	204	132	160
Linn Run	141	347	250	194	233

NOAA CORE Site	Ratio of Dry ^(b) to Wet Deposition				
	Winter	Spring	Summer	Fall	Annual
Whiteface Mtn.	0.36	0.53	0.48	0.51	0.48
West Point	0.38	1.08	0.41	0.46	0.68
Penn State	0.74	0.75	0.53	0.78	0.68
Oak Ridge	0.65	1.15	0.44	0.67	0.81

(a) Based on SO_2 and $\text{SO}_4^{=}$ aerosol dry deposition expressed as $\text{SO}_4^{=}$.

(b) Based on HNO_3 and NO_3^{-} aerosol dry deposition expressed as NO_3^{-} .

6.0 CONCLUSIONS

6.1 SITE OPERATIONS

The most important aspect of the field operations is the protection of the chemical integrity of the collected samples. The analytical results suggest that sample handling protocols were adequately followed at all sites. However, timely sample retrieval from the field within 24 h after rainfall began was the most poorly adhered to aspect of the sampling protocol at the three ERP study sites (Moss Lake, Biscuit Brook, and Linn Run). If the sample retrieval protocol was not closely followed, the date associated with the sample no longer indicates when the precipitation occurred. Operators of the Moss Lake and Biscuit Brook sites were assigned many other duties besides the collection of precipitation samples. At times, those duties justifiably took priority over precipitation sample collection. The sampling protocol was best followed at the PSU MAP3S site, which has had an active research program in precipitation sampling for more than 10 years and has had the experience of following the sampling protocols of several precipitation sampling networks and studies.

6.2 LABORATORY OPERATIONS

Laboratory operations are defined by a set of detailed standard operating procedures that prescribe how each step of every analytical procedure should be carried out. These procedures were developed during many years of operating the precipitation chemistry laboratory for the MAP3S Precipitation Chemistry Network. Samples collected at ERP sites were included (without differentiation by sample identification numbers) with the samples from the 9 MAP3S sites. Quality control results suggest that anions, pH, and NH_4^+ were being reliably measured during this project. The results for the cations, especially K^+ , appear to be much less reliable.

6.3 FINDINGS

Precipitation sampling began in August 1988, December 1988, and February 1989, respectively, at Biscuit Brook, Moss Lake, and Linn Run. The periods of continuous sampling ended in January 1990, May 1990, and June 1990, respectively, at Linn Run, Biscuit Brook, and Moss Lake. Data from the Penn State

MAP3S site were collected during the period January 1989 through June 1990. Ion concentrations and depositions at these four sites are being used by the aquatics effects and modeling research groups to define one component of chemical input to their respective study watersheds. Some of those watersheds are in proximity to the precipitation sampling site; others were quite distant and separated by significant terrain features. For the watersheds studied in the Adirondack and Catskill regions and the Linn Run and Baldwin Run watersheds of the Northern Appalachian Plateau study region, the monthly PWA ion concentrations obtained at their respective precipitation chemistry sites can be assumed to be reasonably representative of the precipitation input to the study watersheds. This assumption is much weaker for the Benner, Roberts, and Stone Run watersheds in central Pennsylvania, and for the PSU site. As applied to wet deposition from summertime convective storms, the assumption is weak for all the study areas because of the strong dependence of wet deposition on precipitation amount and the greater likelihood of high spatial variability in precipitation amount.

Distinct seasonal fluctuations in ion concentrations were clearly evident only at Moss Lake. At the other sites, large month-to-month changes in concentrations masked the seasonal variation. In general, sulfate concentrations were highest during the warmer months and smallest during winter. In contrast, nitrate concentrations were often highest during the winter months. As shown in Figure 37, sulfate and nitrate ion together accounted for more than 80% of the anions (in $\mu\text{Eq/L}$) at all sites. Sulfate contributed a higher percentage of the total anion during summer than winter. Of the cations, excluding hydrogen ion, Figure 38 suggests that ammonium was the most abundant (in $\mu\text{Eq/L}$) in nearly all months with its contribution to total cation being generally higher during the warm months. The contributions of chloride and sodium to total anion and cation, respectively, were greatest in the winter and least in the summer. Potassium made the most variable contribution to the ionic strength of precipitation.

Wet deposition events were not distributed uniformly in time and ranged widely in magnitude. The apparent episodicity, based on rainfall during a sampling period, was enhanced at sites at which the irregular sampling period allowed a few samples to accumulate large amounts of precipitation over several

days. Potassium deposition showed the greatest episodicity among all the ions; 20% of the samples produced from 60% to 80% of potassium deposition. The slightly enhanced episodicity of chloride, sodium, and magnesium deposition at the Biscuit Brook site was probably caused by deposition events that occurred in air of marine origin.

Wet deposition, which occurs intermittently, is one of two atmospheric pathways for chemical inputs to watersheds. The other pathway, dry deposition, occurs continuously. This study did not address the measurement of chemical dry deposition to the study watersheds. Research at NOAA dry-deposition sites near some of the ERP sites suggests that over an annual period dry deposition of sulfur (SO_2 and SO_4^- aerosol) and nitrogen (HNO_3 and NO_3^-) species is a factor of 0.30 to 1.00 and 0.48 to 0.81, respectively, of the wet deposition rate. As the distance from sources increases, the relative contribution of dry deposition to total deposition decreases.

FIGURE 37. The Monthly Relative Contribution of Sulfate, Nitrate, and Chloride Ion to the Sum of These Cations at the ERP Precipitation Chemistry Sites

FIGURE 36. The Monthly Relative Contribution of Ammonium, Sodium, Potassium, Calcium, and Magnesium Ion to the Sum of These Cations at the ERP Precipitation Chemistry Sites

7.0 REFERENCES

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APPENDIX A

SOPs FOR THE PRECIPITATION CHEMISTRY LABORATORY

APPENDIX A

SOPs FOR THE PRECIPITATION CHEMISTRY LABORATORY

Precipitation samples collected at the ERP sites were analyzed in the precipitation chemistry laboratory (PCL) following the Standard Operating Procedures (SOP) used for the MAP3S precipitation chemistry network (MAP3S/PCN). The following SOPs apply to the samples analyzed for the ERP:

<u>PCL-SOP</u>	<u>Description</u>
1	Sample receipt and login
2	Field data receipt, filing, and login
3	pH and conductivity - automated and manual analysis
4	Anion analysis ($\text{SO}_4^{=}$, NO_3^{-} , Cl^{-} , PO_4^{3-})
5	Automated wet chemistry (SO_2 , $\text{SO}_4^{=}$, NH_4^{+})
7	Cation analysis (Na^{+} , Ca^{2+} , K^{+} , Mg^{2+})
9	Analytical results login, sample QC checks, and clearance
10	PCL data procedures
11	Computer data checks
13	Computer data reporting
14	Equipment supply for MAP3S/PCN
15	Shipping procedure for MAP3S/PCN
21	Precleaning of sample collection and shipping containers

Copies of these SOPs are provided in this appendix. Official, signed copies are on file with the Quality Programs Department at PNL.

PNL TECHNICAL PROCEDURE

PCL-SOP-1 SAMPLE RECEIPT AND LOGIN

1.0 APPLICABILITY

This procedure applies to the receipt and login of samples from the collection sites.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURES

- a. Remove samples from shipping container and arrange in chronological order. Check packing material to be sure no samples are missed.
- b. Fill out "Sample Batch Chronology" form (Attachment 1).
 1. Site - site number, two character identification code.
 2. By - person filling out form - initials.
 3. Arrival Date - date samples arrived at lab.
 4. Shipping Date - date samples were shipped, if available, from receiving report.
 5. Number of Events - the number of different dates from the sample bottles. This number should be followed, in parenthesis, by the total number of bottles excluding the tetachloromercurate (TCM) samples. If there is a TCM sample with an exclusive date it should be counted as an event.
 6. Event Dates - From: Date of first sample
To: Date of last sample
 7. Assigned to Groups - the PC Group or Groups that the samples are assigned to. See item 4 (computer ID) below.

QAD Approval CD Taylor		Approved (Line Manager) CM Berkowitz	
Prepared by GL Laws		Technical Review	
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PNL TECHNICAL PROCEDURE

8. Analysis Dates - Start - the date of the first analysis.
End - the date of the last analysis
9. When the Sample Batch Chronology form has been completed, sign and date at the bottom.
- c. Fill out "Analysis Check List and Record" form (Attachment 2). List samples in chronological order.
 1. Group No. - Group numbers are sequential and will be in the form PCXXX.
 2. By - person filling out form.
 - 3 Date - date form started.
 4. Computer I.D. - Sample number is in the form MMDDHHMMS.
 MM = Month
 DD = Day
 HHMM = Time Taken Off (i.e., HH = hour, MM = minute)
 S = Site number
 5. Arrival Date - date sample arrived at lab.
 6. Analysis Volume - volume of sample - full bottle is 250 ml.
 7. PAR volume - If two bottles have the same sample number, label the second "PAR", date, and store in the freezer with other PAR samples. The PAR volume is any sample volume in excess of 250 mls, up to a maximum of 500 mls. If no PAR sample was sent put a "-" in the column.
 8. TCM - if a TCM sample was sent, put a "✓" in the TCM column; if no sample, leave blank.
- d. Samples for which field data have been received but no sample shipped to the MAP3S laboratory are recorded on page 2 of Attachment 2, Analysis Check List and Record. Comments accounting for this discrepancy should be provided by field personnel on the MAP3S Precipitation Chemistry Network Data Log (Attachment 3). If none is received, it is the responsibility of personnel transcribing field data to the Analysis Check List and Record form to contact the corresponding field site and obtain an explanation. When secured, this information is added to the analysis check list along with a note identifying the source of this information, the date and the method of transmittal.
- e. Label sample bottles with the Lab I.D. from the "Analysis Checklist and Record" form. Lab ID is in the form PCXXX-XX where the first three digits are the group number and the last two digits are 01 through 20.

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PNL TECHNICAL PROCEDURE

- f. Each sample group will contain 20 samples and be stored in the refrigerator in one of the plastic dishpans which holds exactly 20 samples. Return samples to the refrigerator after removing an aliquot for analysis.
- g. When all analysis and reruns are done, the sample may be boxed up and stored in the walk-in cooler on the Sigma V dock. Label the boxes with the Group numbers contained within the box. For samples having a PAR sample, the PAR is retained and the remainder of the bottle used for analysis is thrown away. When sample results have been reported in a quarterly report, any leftover samples may be taken to the Hanford Meteorological Station (Bldg. 622R) and stored in the sample storage freezer.

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Sample Batch Chronology Form^(a)

[illegible]

Form Date: 8/95

Signature _____ Date _____

MAP3S Precipitation Chemistry Network Data Log

Page ____ of ____

Site #:		Date:		Site Operator:	
Sample Number (MDDST)					
Date/Time ^(a) Setout (A)					
Date/Time ^(a) Recovered (B)					
Sample Time (hrs) ^(b)					
Number of Lid Openings					
Sample Volume Collected (ml)					
Predicted Volume (ml)					
pH Temperature (°C)					
pH					
0.2M TCM (ml) Total TCM Aliquot (ml)					
Ambient Temperature at Collection (°C)					
Approximate Storm (Wind) Direction					
Precip. Type ^(c)					
Group # (Lab Use)					
<p>Codes: NA = not applicable; ISA = insufficient sample volume; NAP = no measurement. LEAVE NO BLANK SPACES.</p> <p>(a) Use GMT and mark "Z"</p> <p>(b) (B)-(A); Time collector is in place.</p> <p>(c) Use standard codes (R, RW, S, SW, etc. -- see operator's manual)</p>					

Remarks (Include down time, missed events (if any), possible contamination, unusual events, equipment needs):

Form Date: 6/98

PNL TECHNICAL PROCEDURE

PCL-SOP-2 FIELD DATA RECEIPT, FILING AND LOGIN

1.0 APPLICABILITY

This procedure describes the receipt and entry of the field collection data on the required forms.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURES

Field data from the MAP3S/PCN are mailed to the Precipitation Chemistry Laboratory (PCL). The field data are entered by site operators on three forms described below. Other projects, for which PCL is performing analytical services, may employ other forms, or these may be handled completely by the other project personnel. In any case, assurance of sample arrival is required (Step f).

Concurrent with sample shipment (immediately following the first sample collection of each month), the site operators mail the following three forms:

Shipping Embarkation Form (Attachment 1)
Network Data Log (Attachment 2)
Precipitation Log (Attachment 3)

The forms contain all field data for the preceding month. The Network Coordinator (or representative) follows the steps below.

- a. Forms received are gathered on a clipboard in a designated place until all sites' forms have arrived.
- b. Forms are arranged in site numerical order and checked to ensure that all three forms from each site are present.
- c. Messages or requests from sites in addition to required information are noted, dealt with, and filed in the Site Correspondence File located in Sigma V, Room 1416.

QAD Approval CD Taylor		Approved (Line Manager) CM Berkowitz	
Prepared by GL Laws		Technical Review	
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PNL TECHNICAL PROCEDURE

- d. If any forms are missing or late (usually they should arrive by the end of the month), the Coordinator communicates directly with the site to correct the problem. This "problem" and its resolution should be recorded in the Site Correspondence File.
- e. The site supply person notes any equipment or supply needs from the Shipping Embarkation forms, and fills them in accordance with PCL-SOP-15, Shipping Procedures for MAP3S/PCM.
- f. Embarkation forms are delivered to the laboratory, where sample login personnel verify that all samples noted on the forms have actually arrived (see PCL-1). The forms are then filed by site in the PCL field data file.
- g. Group numbers are assigned to samples and entered in the appropriate rows on the Network Data Logs.
- h. Page 2 of the Analysis Checklist and Record (see PCL-1) forms for the appropriate groups are filled in, with information from the Network Data Logs. Page 1 of the form has been started in the sample login process (PCL-1). The following data are entered onto page 2:
 - Sample ID
 - Time Sample Recovered
 - Site ID
 - Lab ID
 - Lid Openings
 - Arrival Date
 - Sample Volume
 - Predicted Volume

The predicted volume is calculated from the total precipitation recorded during the sample time period (date and time of present sample to date and time of previous sample) (cm), and multiplied by collector area (640 cm² for current ACM-brand collectors).

If there is any ambiguity about the start and/or end of the sample collection period with respect to precipitation record, communication with the site should be initiated to resolve the problem. It should also be noted whether the precipitation ended prior to 24 hours before collection. If there are > 24 hour gaps in the precipitation record within an event, or if precipitation appears to be missing or a predicted volume doesn't agree closely with sample volume ($\pm 50\%$), a reason should be noted on the Network Data Log, or obtained from the site.

The remaining data to be entered on this form are:

- pH Temperature
- pH
- Comments (includes deposition type, precipitation type, and field notes)

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PNL TECHNICAL PROCEDURE

All written notes on the Network Data Log should be translated into ADS Note Codes (see PCL-10), if appropriate or significant.

- i. Missing or ambiguous information should be noted, and site communication initiated to resolve the problems.
- j. The Network Data Log forms and Precipitation Log forms are filed in the PCL site data files.
- k. Page 2 of the Analysis Checklist and Record is now attached to Page 1, pending computer data entry for field data.

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MAP3S Precipitation Chemistry Network Shipping Embarkation Form
(Attach Copy of Logbook Entries)

Site Name and Number: _____ Date Sent: _____

Name of Shipper: _____ Carrier: _____

	Shipping Boxes	Buckets	Lids	Bottles (8 oz)	TCM	Syringe	Funnels	Blue Ice	White Tape	pH Test	Field Blanks	Labels	Comments (Other)
Sent													
Remaining													
Site Needs													

Period Covered by Samples: _____

Sample ID (MMDDST)	Sample Volume (ml)	Volume of Aliquot (ml)	TCM Vial (✓)	Remarks

Form Date 6/98

MAP3S Precipitation Chemistry Network Data Log

Page ____ of ____

Site #:		Date:		Site Operator:	
Sample Number (MDDST)					
Date/Time ^(a) Setout (A)					
Date/Time ^(a) Recovered (B)					
Sample Time (hrs) ^(b)					
Number of Lid Openings					
Sample Volume Collected (ml)					
Predicted Volume (ml)					
pH Temperature (°C)					
pH					
0.2M TCM (ml) Total TCM Aliquot (ml)					
Ambient Temperature at Collection (°C)					
Approximate Storm (Wind) Direction					
Precip. Type ^(c)					
Group # (Lab Use)					
<p>Codes: NA = not applicable; ISA = insufficient sample volume; NAP = no measurement. LEAVE NO BLANK SPACES.</p> <p>(a) Use GMT and mark "Z"</p> <p>(b) (B)-(A); Time collector is in place.</p> <p>(c) Use standard codes (R, RW, S, SW, etc. -- see operator's manual)</p>					

Remarks (Include down time, missed events (if any), possible contamination, unusual events, equipment needs):

Form Date: 6/98

MAP3S/PCN Precipitation Log

Site: _____ Operator: _____ Month/Year: _____

Day	Time																								
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
01																									
02																									
03																									
04																									
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31																									

Form Date: 6/99

PNL TECHNICAL PROCEDURE

PCL-SOP-3a

pH AND CONDUCTIVITY - MANUAL

1.0 APPLICABILITY

This procedure describes the analysis procedure for measuring pH and conductivity by manual measurement method.

2.0 DEFINITIONS

MQ - Type I grade reagent water (ASTM D 1193).

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURE

a. Sample Preparation

1. Pour 10-20 ml of sample into a clean, new polyethylene pH vial.
2. Bring the sample to 25°C using a constant temperature water bath. Calibration, quality control standards, and samples should all be at the same temperature.

b. Standardization of pH Meter

1. Standardize pH meter each time a pH measurement is made or once every 10 samples if many are measured on one day.
2. Use pH 3.00 and pH 5.00 buffers for standardization. Buffers of pH 4.00 and pH 7.00 will work if 3.00 and 5.00 are unobtainable.
3. Allow at least two minutes for stable readings on the buffers before adjusting the meter.
4. Recheck each buffer, allowing two minutes for stabilization, after the final meter adjustments.

QAD Approval
CD Taylor

Approved (Line Manager)
CM Berkowitz

Prepared by
RN Lee

Technical Review

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PNL TECHNICAL PROCEDURE

c. Measurement of Sample pH

1. Method I

- Place the rinsed (DI water) standardized electrode into sample. DO NOT STIR.
- Take pH reading after allowing electrode to stabilize - at least two minutes.

2. Method 2

- Add a solution of KCl sufficient to obtain 1.5 mg KCl/20 ml sample. (0.2 ml of 0.1 M KCl/20 ml sample)
- Place the standardized electrode into sample. DO NOT STIR.
- Take pH reading after allowing electrode to stabilize, usually about two minutes.

3. Remeasure at least one of the standard buffer solutions every 10th sample to verify that no drift has occurred in the meter or the electrode.
4. Take temperature of the sample (not the room) if a constant temperature water bath is not used.
5. Remeasure one of each ten samples (generally first, eleventh, etc.), and measure pH of QC standard once per ten samples.

d. Standardization of Conductivity Meter

1. Be sure temperature of standard is $25 \pm 2^\circ\text{C}$. If this range cannot be met, an adjustment to the conductivity is necessary.
2. Place electrode in conductivity calibration solution (in new vial as for samples).
3. Adjust calibration knob to match standard value.

e. Measurement of Sample Conductivity

1. Place the rinsed electrode into the sample vial. Rattle electrode to remove all bubbles.
2. Record reading after stabilization - usually about a minute.
3. Measure conductivity of QC Standard once for each 10 samples.
4. Check calibration after each 20 samples.

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PNL TECHNICAL PROCEDURE

f. Record Results

Record results on the Performance Chart for pH and Conductivity form
(Attachment 1).

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Precipitation Chemistry Lab Performance Chart

Standard ID: _____

Analyst: _____

Date of Preparation: _____

QC Sample: pH = _____ $\mu\text{mol/l}$ = _____ (a) Conductivity = _____ (b)

$$[\text{H ion}], \mu\text{mol/l} = (10)^{-\text{pH}}$$

[illegible]

Form Date 7/90

PNL TECHNICAL PROCEDURE

PCL-SOP-3b

PH AND CONDUCTIVITY - AUTOMATED

1.0 APPLICABILITY

This procedure describes the determination of pH and conductivity of aqueous samples using the Metrohm Auto Analysis System with Nelson Analytical 760 Series Interface and IBM/PC personal computer.

2.0 DEFINITIONS

MQ - Type I grade reagent water (ASTM D 1193).

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURE

4.1 Prepare for Analysis and Calibration

Turn on the computer and load the program used to control the autosampler and record pH and conductivity data. The following computer commands prepare the system for calibration and analysis.

- a. [Ctrl] C (return to > prompt)
- b. DM [Enter]
- c. BASICA (run Basic A language or initiate language)
- d. [F3] = load PHX.BAS (Basic program used to control pH instrument through the Nelson controller)

Use the manual setting for calibration. Rinse the pH and conductivity probes with 5% HNO₃ followed by deionized water. Buffer solutions and the pH QC check solution are used to calibrate the conductivity meter. Sample cups are filled with the respective solutions and placed in the autosampler, with deionized water rinses, as indicated in Table 1.

QAD Approval CD Taylor		Approved (Line Manager) CM Berkowitz	
Prepared by RN Lee		Technical Review	
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TABLE 1. Sample Sequence for Calibration of the pH and Conductivity Meters

Position	Solution	Position	Solution
1	DI Water	4	pH 4 buffer
2	pH 7 buffer	5	DI water
3	DI water	6	pH check solution

The following manipulations are made from the keyboard. Place the pH probe in H₂O, stir and let set for 1 minute before replacing with pH7 buffer. Stir the buffer and allow 1 minute for the meter to stabilize before reading, adjust meter to read 7.0 if necessary. Move water into buffer, stir and again wait 1 minute for meter to stabilize. After removing the probe from the buffer, place it, and the conductivity probe, in a deionized water rinse for 1 minute. After rinsing, place both probes in the pH check solution and measure the pH and conductivity after allowing 1 minute for the meters to stabilize. If meter readings require adjustment, repeat this process. When calibration is completed, push [ESC] to return to the main menu and construct the Sample Table.

4.2 Analysis

All samples to be analyzed (field sample and QC samples) are hand recorded in the Sample Log in the sequence to be run. Construct a computer listing of the samples by first entering the total number of samples to be run following by their IDs when prompted. The sample sequence should start with 2 aliquots of the QC check solution before the introduction of field samples. Field samples should be run in groups of five separated by a pH buffer and a deionized water rinse before the next set of five samples. The buffer solution, identified as "buffer" in the Sample Table, shall be the pH 4 buffer. (The name in lower case letters will cause the autosampler to rinse the pH probe twice with deionized water after completing a measurement). After loading the autosampler and filling the rinse water container, start the analysis. The autosampler will automatically stir, rinse and record the results. When analysis is completed, the following commands return to the computer to the main menu:

[F7] - Exit
System
CD/DM
Menu

This procedure assumes the operator has read and understands the operating manual for the Metrohm Conductivity Meter Model 660, and the Metrohm pH meter model 605.

Record pH and conductivity QC samples on the performance chart (see Figure 1).

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PCL-SOP-4 ANION ANALYSIS

1.0 APPLICABILITY

This procedure describes anion analysis using the Dionex 4000i Ion Chromatograph. The Ion Chromatograph is connected to a Waters WISP Model 710B Sample Changer and is controlled by an IBM-PC/AT through a Nelson Analytical 760 series interface.

This procedure assumes that the instrument operator has been trained on, and is familiar with, the operation of the Dionex 4000i Ion Chromatograph. In addition to this procedure, the operator must be familiar with the instrument operating manual.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURES

General laboratory safety procedures apply per PNL-MA-43.

This method conforms to ASTM D4327-84, Test Method for Anions in Water by Ion Chromatography.

4.1 Reagent Makeup

All reagents should be ASTM reagent grade or better and water for dilution should be ASTM Type II or better (reference ASTM D1193). The identity of bulk reagents and solutions prepared for anion analysis are recorded in a PNL laboratory record book (LRB), maintained for this information, and kept in the Precipitation Chemistry Laboratory.

a. Eluent for AS4A Column

1.3 g NaHCO_3 Sodium bicarbonate (CAS RN 144-55-8)

4.3 g Na_2CO_3 Sodium carbonate (CAS RN 497-19-8)

Add above chemicals to approximately 5 l of deionized water (Type I grade reagent water, ASTM D 1193) in a 25 l polypropylene carboy dedicated to eluent storage, dissolve and dilute to 20 l.

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Record the date of preparation in the LRB and on the carboy. Discard after one month and remake.

b. Eluent Spike

1.3 g NaHCO_3
4.3 g Na_2CO_3

Make up in 2 l deionized water (as above)

c. Solution for continuous membrane suppressor

- Fill a 20 l carboy to approximately 15 l with Type I grade reagent water (ASTM D 1193)
- Add 12.5 ml Ultrex H_2SO_4 (36 N) and mix
- Fill to 18 l and mix well

d. Stock Solutions

NaCl 0.1200 g/l (CAS RN 7647-14-5)
 NaNO_3 0.3500 g/l (CAS RN 7631-99-4)
 KH_2PO_4 0.5500 g/l (CAS RN 7757-82-6)

Na_2SO_4 0.5500 g/l

e. Standards (Typical Dilutions)

A set of 5 standards is prepared by diluting measured volumes of each of the above stock solutions to 100 ml with ASTM Type I water. These solutions are used to calibrate the ion chromatograph before starting the analysis of precipitation samples. One of the standards also serves as the QC check solution and is analyzed periodically to verify in-control performance of the ion chromatograph during the analysis of precipitation samples. The procedure for preparing standards is summarized in Table 1. Analyte concentrations in solutions, prepared as described in Table 1, are listed in Table 2.

TABLE 1. Preparation of Ion Chromatograph Calibration Standards

Standard	Volume of Stock Solutions, μl ^(a)	Final Solution Volume, ml
1	2000	100
2	1000	100
3	750	100
4	500	100
5	250	100

(a) The volume of each anion stock solution (Cl^- , NO_3^- , SO_4^{2-} , and PO_4^{3-}) used to prepare the respective calibration standards.

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Volumetric flasks used for the preparation and storage of calibration standards are dedicated to this use. Preparation is recorded in the LRB dedicated to chemical reagent and solution identification and individual containers are labelled to identify the standard, its date of preparation and initialed. Standards shall be discarded after 5 days and replaced with fresh solutions. Analyte concentrations, in $\mu\text{mol/L}$, for standards prepared as described above are listed in Table 2.

TABLE 2. Concentration of the Respective Analytes in Standards Prepared as Described

Analyte	Std. 1	Std. 2	Std. 3	Std. 4	Std. 5
Chloride	40	20	15	10	5
Nitrate	80	40	30	20	10
Sulfate	80	40	30	20	10
Phosphate	80	40	30	20	10

4.2 Sample Analysis

- a. Turn on compressed air supply to regenerant bottle, set pressure at 10 psi, flow rate should be approximately 3 ml per minute.
- b. Turn on pump and set flow at 2 ml/min (Refer to Dionex operation manual)
- c. Develop a new, or load an existing method file (see Appendix 1).
- d. All samples and standards to be included in the IC analysis session are recorded in the Spectra-Physics Sample Run Sheet (Appendix 2). Each is spiked with 0.2 ml eluent spike solution per 2 ml of solution prior to analysis.
- e. After spiking an aliquot of standard 1 with the eluent spike, analyze this solution to check analyte retention times. If they differ from those in the method file by more than 5%, make corrections in the method file.
- f. Load the (WISP) sample tray with a set of standards to generate calibration plots for Cl^- , NO_3^- , SO_4^{2-} , and PO_4^{3-} . These samples are identified as AUTOCAL1RE, AUTOCAL2RE, AUTOCAL3RE, etc. in the SEQUENCE FILE.
- g. The standard selected to serve as the QC sample is loaded into the sample tray after the calibration standards. The measured analyte concentrations should agree with the known concentrations within $\pm 10\%$. If any of the measured anion concentrations are outside of this limit, the calibration process shall be repeated.
- h. After completing the calibration and checking analyzer response to the QC check solution, continue with the analysis of samples. Samples are placed in the sample tray and identified in the SEQUENCE FILE (Appendix 3) in the order in which they are run. AUTOCAL and QC samples are rerun as indicated in the sample Spectra-Physics Sample Run Sheet (Appendix 2). The AUTOCAL rerun

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updates the detector response facts and the QC sample provides periodic verification of in-control performance of the IC.

- i. After entering sample IDs in the SEQUENCE FILE and loading the sample changer, set to auto and press "start" to initiate analysis.

If during the course of analysis, the concentration of any analyte in a field sample exceeds that of the highest concentration standard, a new standard shall be prepared to verify the linearity of detector response. Alternatively, the sample may be diluted with Type I water to bring its concentration into the range of the standards.

- j. When the analysis run is completed, fill out the Performance Data Table (see attached table) and complete the necessary calculations. Sign and date the form before filing.

Column 3 (% Recovery) compares the calculated with the measured concentration, based on the response factor from the most recent AUTOCAL sample. If it is outside of the limits $100 \pm 10\%$, the previous 5 field samples must be rerun.

- k. System shut down

1. Turn off pump
2. Turn off nitrogen to regenerant bottle
3. Remove sample tray from WISP

- l. For additional information see:

1. Nelson Analytical Operators Manual
2. WISP Operators Manual
3. Dionex Operators Manual

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Precipitation Chemistry Lab Performance Chart

Primary Standard on Page: _____

Notebook #: _____

Dilution: _____

Performance Chart for: _____

Date: _____

Analyst: _____

[illegible]

Reviewed by: _____

Date: _____

Form Date 7/90

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APPENDIX 1

METHOD FILE ACQUISITION PARAMETERS

Method file Name: C:MAPS
 Default Sample Name: OMAPS
 Operator: SPD

Date 08-27-1986

Acquisition Parameters

SINGLE OR DUAL CHANNEL (1 or 2)	1.00
RUN TIME (minutes)	8.00
END TIME FOR PLOTS (default=RUN TIME)	8.00
SOLVENT DELAY TIME (minutes)	0.00
PEAK DETECTION THRESHOLD (microv/sec)	1.00
MINIMUM PEAK WIDTH (seconds)	10.00
TIME FOR ONE SAMPLE (seconds)	1.00
NUMBER OF REAL TIME CRT PAGES TO PLOT (0 to 99)	1.00
REAL TIME PLOT FULL SCALE FOR CH.0 (millivolts)	200.00
REAL TIME FULL SCALE FOR CH.1 (millivolts)	200.00
HARD COPY REAL TIME PLOT	NO
AUTO ZERO REAL TIME PLOT	YES
<hr/>	
RECORD AREA TABLES ON DISK	NO
RECORD RAW DATA	YES
NUMBER OF CRT PAGES FOR REPLOT (1 TO 99)	1.00
VERTICAL SCALE FACTOR FOR REPLOT (units of largest peak)	1.00
OFFSET FOR THE REPLOT (millivolts)	0.00
PUT NAMES ON REPLOT?	YES
<hr/>	
PRINT AREA PERCENT REPORT	NO
PRINT EXTERNAL STANDARD REPORT	YES
PRINT INTERNAL STANDARD REPORT	NO
FINAL REPORT AREA REJECT (microvolt-sec)	0.00
LINK TO USER PROGRAM	NO
FORCE DROP LINE INTEGRATION	NO
FORCE COMMON BASE LINE	YES
FULL SCALE RANGE FOR A.D.C. (3=1VOLT, 1=2VOLT, 0=10VOLT)	3.00
<hr/>	
AREA REJECT FOR REFERENCE PEAKS?	10000.00
% RET TIME WINDOW FOR REFERENCE PEAKS	5.00
RET TIME WINDOW IN SECONDS FOR REF. PEAKS	5.00
AREA OR PEAK HEIGHT QUANTITATION (0 OR 1)	0.00
PRINT GROUP REPORT	NO
NUMBER OF CALIBRATION LEVELS (1 TO 6)	1.00
FIT TYPE FOR MULTILEVEL CALIBRATION (0=PT-TO-PT, 1=LINEAR)	1.00

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APPENDIX 1 (Cont'd)

LIST COMPONENTS NOT FOUND IN SAMPLE?	NO
INCLUDE UNKNOWN PEAKS IN REPORTS?	NO
UPDATE RESPONSE FACTORS WITH REPLACEMENT (0) OR AVERAGE (1)	0.00
DEFAULT DILUTION FACTOR	1.00
DEFAULT SAMPLE AMOUNT	1.00
DEFAULT AMOUNT OF INTERNAL STANDARD	1.00
PRINT GPC MW DISTRIBUTION	0.00
PRINT SIMULATED DISTILLATION REPORT	0.00

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APPENDIX 2

Spectra-Physics Sample Run Sheet

TRAY #1 Slot # Sample ID		TRAY #2 Slot # Sample ID		TRAY #3 Slot # Sample ID		TRAY #4 Slot # Sample ID	
1.01	AC-1-RE ^(a)	2.01	Sample ID ^(b)	3.01	Sample ID	4.01	Sample ID
1.02	AC-2-RE	2.02	Sample ID	3.02	Sample ID	4.02	Sample ID
1.03	AC-3-RE	2.03	Sample ID	3.03	Sample ID	4.03	Sample ID
1.04	AC-4-RE	2.04	AC-3-RE	3.04	Sample ID	4.04	Sample ID
1.05	AC-5-RE	2.05	Sample ID	3.05	Sample ID	4.05	Sample ID
1.06	QC	2.06	Sample ID	3.06	Sample ID	4.06	QC
1.07	Sample ID	2.07	Sample ID	3.07	Sample ID	4.07	Sample ID
1.08	Sample ID	2.08	Sample ID	3.08	AC-3-RE	4.08	Sample ID
1.09	Sample ID	2.09	Sample ID	3.09	Sample ID	4.09	Sample ID
1.10	Sample ID	2.10	QC	3.10	Sample ID	4.10	Sample ID
1.11	Sample ID	2.11	Sample ID	3.11	Sample ID	4.11	Sample ID
1.12	AC-3-RE	2.12	Sample ID	3.12	Sample ID	4.12	AC-3-RE
1.13	Sample ID	2.13	Sample ID	3.13	Sample ID	4.13	Sample ID
1.14	Sample ID	2.14	Sample ID	3.14	QC	4.14	Sample ID
1.15	Sample ID	2.15	Sample ID	3.15	Sample ID	4.15	Sample ID
1.16	Sample ID	2.16	AC-3-RE	3.16	Sample ID	4.16	Sample ID
1.17	Sample ID	2.17	Sample ID	3.17	Sample ID	4.17	Sample ID
1.18	QC	2.18	Sample ID	3.18	Sample ID	4.18	QC
1.19	Sample ID	2.19	Sample ID	3.19	Sample ID	4.19	Sample ID
1.20	Sample ID	2.20	Sample ID	3.20	AC-3-RE	4.20	Sample ID

(a) AC-1-RE: abbreviated form of sample name that must be entered into the SEQUENCE FILE, AUTOCAL

(b) Sample ID: three character group number-sample number (i.e., 378-5)

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APPENDIX 3

TYPICAL SEQUENCE FILE

<u>Sample Name</u>	<u>Method Name</u>	<u>Data File</u>	<u>Amount Injected</u>	<u>Int. Std. Amount</u>	<u>Dilution Factor</u>
1 AUTOCAL1RE	MAPS	3CP0	1.0000	1.0000	1.10
2 AUTOCAL2RE	MAPS	3CP0	1.0000	1.0000	1.10
3 AUTOCAL3RE	MAPS	3CP0	1.0000	1.0000	1.10
4 AUTOCAL4RE	MAPS	3CP0	1.0000	1.0000	1.10
5 AUTOCAL5RE	MAPS	3CP0	1.0000	1.0000	1.10
6 QC	MAPS	3CP0	1.0000	1.0000	1.10
7 378-1	MAPS	3XP0	1.0000	1.0000	1.10
8 378-2	MAPS	3CP0	1.0000	1.0000	1.10
9 378-3	MAPS	3CP0	1.0000	1.0000	1.10
10 378-4	MAPS	3CP0	1.0000	1.0000	1.10
11 378-5	MAPS	3CP0	1.0000	1.0000	1.10
12 AUTOCAL3RE	MAPS	3CP0	1.0000	1.0000	1.10
13 378-6	MAPS	3CP0	1.0000	1.0000	1.10

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PNL TECHNICAL PROCEDURE

PCL-SOP-5 AUTOMATED WET CHEMISTRY - ANALYSIS OF SULFUR DIOXIDE AND AMMONIUM ION

1.0 APPLICABILITY

This procedure describes the analysis of samples for SO₂ and NH₄ using the Alpkem G., RFA Model 300 Dual Channel Analyzer. It assumes that the instrument operator has been trained on, and is familiar with, the operation of the Alpkem G, RFA Model 300 Dual Channel Analyzer. In addition to this procedure, the operator must be familiar with the instrument operation manual.

An Alpkem sample sheet to record the location of individual samples in the sample tray and calibration record sheets for sulfur (IV) and ammonia analysis are included in this SOP.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURE

The NH₄ analysis requires the use of phenol and the SO₂ analysis requires the use of mercury. The waste from both analyses must be classified as hazardous and retained for disposal through PNL's Lab Safety section

4.1 References

NH₄: *Methods for Chemical Analysis of Water and Wastewater*, March 1984, EPA-600/4-79-020, "Nitrogen, Ammonia" Methods 350.1 (Colorimetric, Automated Phenate) STORET NO. Total 00610, Dissolved 00608.

SO₂: 1 West, P. W. and Gaeke, G. C.; *Anal. Chem.*, Vol. 28, No. 12. December 1956, pg. 1816-1819.

2 Scaringelli, B. P. and Saltzman, B. E.; *Anal. Chem.*, Vol 39, No. 14, 1967, pg. 1709-1719.

4.2 Reagent Makeup

All reagents used to perform analyses described in this must be ASTM Reagent Grade or better. In response to waste minimization concerns, many solutions

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Prepared by RN Lee		Technical Review	
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described below have been designed for same day use. Solution volumes are consequently adequate for approximately 8 hours of autoanalyzer operation. Container labels should identify their contents, the technician preparing the solution and the date of preparation. When a reagent solution is prepared which has a shelf life greater than 1 day, the following information must appear on the label affixed to the bottle in which it is stored:

1. date of preparation,
2. initials of technician preparing solution,
3. laboratory record book (LRB) reference to its preparation and identification of reagents used and
4. the date of expiration.

a. Reagents for SO₂ Analysis

• Stock Pararosanine (100 ml)

Pararosanine Hydrochloride 0.2 g
 $(\text{NH}_2\text{C}_6\text{H}_4)_2\text{C}:\text{C}_6\text{H}_4:\text{NH}\cdot\text{NH}\cdot\text{HCl}^-$ (FW 323.8)
 Deionized Water

Dissolve 0.2 g pararosanine hydrochloride in 100 ml of deionized water. Allow to stand for 2-3 days. Filter and store in amber bottle. Shelf life = 6 months.

• Working Pararosanine (100 ml)

Stock Pararosanine 8 ml
 Hydrochloric Acid 5 ml
 HCl - Concentrated (12 N)
 Deionized Water
 Triton X-100 (50% in Methanol) 500 µl

Place 8 ml of stock pararosanine in to a 100 ml volumetric flask. Cautiously add (while mixing) 5 ml concentrate hydrochloric acid. Allow to stand for 5 minutes and dilute to 100 ml with deionized water. Add 500 µl of Triton X-100 (diluted 1:1 with absolute methanol). Store in an amber container. Prepare fresh daily.

• Sulfamic Acid (1 l)

Sulfamic Acid 1.725 g
 $\text{H}_2\text{NSO}_3\text{H}$ (FW 97.10)
 Deionized Water

Dissolve 1.725 g sulfamic acid in 700 ml deionized water contained in a 1 l volumetric flask. Dilute the solution into the mark with deionized water. Store in a labelled container. Shelf life = 2 months.

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- Formaldehyde (100 ml)

Formaldehyde	.5 ml
HCHO	
Deionized Water	

Dilute 1.0 ml formaldehyde to 200 ml with deionized water. Prepare fresh daily.

- Rinse Solutions for SO₂ Reagent Tubing

Pre-start rinse: Triton-X Surfactant Solution

Post-analysis Plumbing Rinse: KemWash (ALPKEM P/N A01-5555-26)

b. Reagents for NH₄ Analysis

All reagents and calibrants are prepared with ammonia free deionized water. Ammonia free water is prepared as required by passing deionized water through an ion exchange column comprised of a mixture of both strongly acidic cation and strongly basic anion exchange resins.

- Stock Complexing Reagent (1 l)

Disodium (Ethylendinitrilo) Tetraacetate (EDTA)	50 g
Deionized Water	1000 ml
Deionized Water	
Sulfuric Acid	As required
H ₂ SO ₄ concentrated (36 N)	

Dissolve 33 g of potassium sodium tartrate and 24 g of sodium citrate in approximately 800 ml of deionized water contained in a 1 l beaker. Place the beaker on top of a magnetic stirrer. Insert a magnetic stirring bar and a pH electrode in to the solution. Adjust the pH of the solution to pH 5.0 with the sulfuric acid. Transfer the complexing reagent to a 1 l volumetric flask and dilute it to the 1 l mark with deionized water. Shelf life -

- Working Complexing Reagent (100 ml)

Stock Complexing Reagent	100 ml
Brij-35 [®] (30% w/v)	0.5 ml (10 drops)

Add 10 drops of Brij-35 for each 100 ml of complexing reagent.

- Stock 5 N Sodium Hydroxide (2 l)

Sodium Hydroxide	400 g
NaOH (FW 40.00)	
Deionized Water	

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CAUTION: THE DISSOLUTION OF SODIUM HYDROXIDE IN WATER RELEASED A GREAT AMOUNT OF HEAT.

Cautiously add 400 g of sodium hydroxide to approximately 700 ml of deionized water contained in a 1 l volumetric flask. Cool the solution when adding the sodium hydroxide. When the solution is cool, dilute it to the 1 l mark with deionized water. Shelf life = 6 months.

- Alkaline Phenol (100 ml)

5 N Sodium Hydroxide

Phenol, C_6H_5OH , (FW 94.11), crystalline or liquified phenol, 88%

Deionized Water

Place a 100 ml volumetric flask that contains approximately 600 ml of deionized water and a magnetic stirring bar into an ice bath positioned on top of a magnetic stirrer. While stirring, add 17 ml of 5 N sodium hydroxide. When the solution is cold, slowly add 8.3 g of crystalline phenol (or 1.2 ml of liquified phenol) in small quantities, cooling after each addition. After removing the stirring bar, dilute the solution to the mark with deionized water and mix it well. The resulting solution should be a light straw color. Store the reagent in a brown bottle and refrigerate it at 2 - 6°C. Prepare fresh daily.

- Sodium Hypochlorite (100 ml)

Sodium Hypochlorite Solution

20 ml

NaOCl, 5.25% solution, household bleach

Deionized Water

Add 2.5 ml of sodium hypochlorite solution to approximately 75 ml of deionized water contained in a 100 ml volumetric flask. Dilute the solution to the mark with deionized water. This reagent is not stable; prepare it daily.

- Sodium Nitroferricyanide (1 l)

Sodium Nitroferricyanide

0.5 g

$Na_2Fe(CN)_5NO \cdot 2H_2O$ (FW 297.97)

Deionized Water

Add 0.5 g of sodium nitroferricyanide (Nitroprusside) to approximately 800 ml of deionized water contained in a 1 l volumetric flask. Dilute the solution to the mark with deionized water. Store this solution in an amber bottle at room temperature where it is stable for at least one month. Dispose of after 1 month.

- Diluent for Ammonia Analysis (100 ml)

Brij-35 (30% w/v)

Deionized Water

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PNL TECHNICAL PROCEDURE

- Pre-Rinse Solution for NH₄ Plumbing

Brij-35 (Registered Trademark of ICI Americas Inc.)

c. **Summary of Method**

Ammonia reacts with alkaline phenol and hypochlorite form indophenol blue. Sodium nitroferricyanide intensifies the blue color formed which is measured at 640 nm.

Sulfite reacts with acidified p-Rosaniline hydrochloride and formaldehyde to form a red violet color which is measured at 560 nm.

4.3 Operation of RFA 300

- Replace any tubing showing signs of wear before starting.
- Set up tubing as shown in Figure 1 for SO₂ or Figure 2 for NH₄.
- Put all reagent tubes into respective pre-rinse solution for 15 minutes.
- Turn on regulated power supply.
- Turn on light source and heat bath.
- Turn on recorder.
- Turn on colorimeter and set as follows:

- NH₄

Set absorbance to 1
Set damp to 2
Set coarse gain to 0.1

Using the fine gain control adjust the reference cell gain to 5.00 then switch to the absorbance cell and adjust the gain to 5.00. Switch back and forth until both cells read 5.00.

- SO₂

Set absorbance to 0.5
Set damp to 2
Set coarse gain to 1.0

Adjust the reference and absorbance cells to 5.00 as above for NH₄.

- Switch the colorimeter to "sample".
- Turn on pump and allow system to stabilize.

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- j. Load sample tray and fill out sample sheet (Figure 3) and calibration record (Figure 4).
- k. Run five QC standards and a blank two times and calculate the slope and % recovery for the QC samples.
- l. If the QC samples are within $\pm 10\%$, start running samples; if not within $\pm 10\%$ remake standards and start over.
- m. A QC standard and a blank should be run after each 5 samples.
- n. Mark the sample numbers on the chart, sign and date the chart.
- o. After the last sample has come out on the chart rinse the system with distilled water for 15 to 30 minutes before shut down.
- p. One copy of the calibration record should go in a PNL record book and one copy in the QA file.
- q. Enter results on data sheets.

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SULFUR(IV) WET CHEMISTRY CALIBRATION RECORD- ALPKEM

Stock sulfur(IV) solution Date: _____
ID: BNW-

Date _____

ID: BNW-

Operator _____

 g $\text{Na}_2\text{S}_2\text{O}_5 \cdot 1000 \cdot 128/190 =$ mg SO_2/L

$$(\text{mg SO}_2/\text{L} + 64) \cdot 1000 = \text{ } \mu\text{mol/L SO}_2$$

Checked by _____

Dilution of stock standard

std. #1 μL to ml = $\mu\text{mol/L}$

Corrected Peak Height = Peak Height- baseline

$$(c) = (a) - (b)$$

Soln. ID **BNW-**

std. #2 μL to mL = $\mu\text{mol/L}$

Slope = $\mu\text{mol/L}$ Std., calc'd from stock soln. conc. / Corr'd Peak Ht.

Soln. ID **BNW-**
$$(e) = (d) / (c)$$

std. #3 μL to ml = $\mu\text{mol/L}$

Soln. ID **BNW-**

std. #4	μL to	$\text{mL} =$	$\mu\text{mol/L}$
1	10	0.01	100
2	20	0.02	50
3	30	0.03	33.3
4	40	0.04	25
5	50	0.05	20
6	60	0.06	16.7
7	70	0.07	14.3
8	80	0.08	12.5
9	90	0.09	11.1
10	100	0.1	10

Measured concentration = Slope(average, all stds.) * Corr'd Peak Ht.

$$(d) = (e) \cdot (c)$$

Soln. ID **BNW-**

QC soln. μL to mL = $\mu\text{mol/L}$ Soln. ID **BNW-**[illegible]

ALPKEM SAMPLE SHEET
 $\text{NH}_4^+/\text{SO}_2^-$

Date: _____

Species: _____

Operator: _____

Group: _____

Cup #	Sample	Cup #	Sample	Cup #	Sample	Cup #	Sample	Cup #	Sample	Cup #	Sample
1		36		71		16		51		86	
2		37		72		17		52		87	
3		38		73		18		53		88	
4		39		74		19		54		89	
5		40		75		20		55		90	
6		41		76		21		56		1	
7		42		77		22		57		2	
8		43		78		23		58		3	
9		44		79		24		59		4	
10		45		80		25		60		5	
11		46		81		26		61		6	
12		47		82		27		62		7	
13		48		83		28		63		8	
14		49		84		29		64		9	
15		50		85		30		65		10	
16		51		86		31		66		11	
17		52		87		32		67		12	
18		53		88		33		68		13	
19		54		89		34		69		14	
20		55		90		35		70		15	
21		56		1		36		71		16	
22		57		2		37		72		17	
23		58		3		38		73		18	
24		59		4		39		74		19	
25		60		5		40		75		20	
26		61		6		41		76		21	
27		62		7		42		77		22	
28		63		8		43		78		23	
29		64		9		44		79		24	
30		65		10		45		80		25	
31		66		11		46		81		26	
32		67		12		47		82		27	
33		68		13		48		83		28	
34		69		14		49		84		29	
35		70		15		50		85		30	

AMMONIUM WET CHEMISTRY CALIBRATION RECORD- ALPKEM

Stock ammonium solution Date: _____
ID: BNW-

Date _____

ID: BNW-

Operator

[_____ g (NH₄)₂SO₄ * 1000°36.1/132] = _____ mg NH₄/L, when dissolved in 1000 ml water

$$(\text{mg NH}_4\text{L} + 18) \cdot 1000 = \text{ }\mu\text{mol/L NH}_4$$

Checked by _____

Dilution of stock standard

std. #1 μL to mL = $\mu\text{mol/L}$

Corrected Peak Height = Peak Height- baseline

(c) = (a) - (b)

Soln. ID BNW-

std. #2	μL to	ml =	$\mu\text{mol/L}$
---------	------------------	------	-------------------

Slope = $\mu\text{mol/L Std., calc'd from stock soln. conc.} / \text{Corr'd Peak Ht.}$

Soln. ID **BNW-**

$$(e) = (d) / (c)$$
std. #3 μL to mL = $\mu\text{mol/L}$ Soln. ID: **BNW-**

std. #4 μL to mL = $\mu\text{mol/L}$

Measured concentration = Slope(average, all stds.) * Corr'd Peak Ht.

$$(d) = (e) \cdot (c)$$

Soln. ID BNW-

QC Soln. _____ μL to _____ mL = _____ $\mu\text{mol/L}$ Soln. ID **BNW-**[illegible]

Sulfite
2-20 m SO₂
(Water/Wastewater)

Photometer Parameters
Filter: 560 nm
Flowcell: 15 mm
Absorbance Range: 0.5 AUFS
Damping (RC): 2s

Sampler Parameters
Analysis Range: 80/hr
Sample Time: 25 sec
Wash Time: 20 sec
Pecking: Off
Probe: Stainless Steel

+ Coil
0 5 turns
* Air solenoid valve
** See Engineering Bulletin A0487

Manifold Start-up Solution:
Deionized Water with 1 ml Triton X-100
(diluted 1:1 with absolute Methanol) 1⁻¹
Cleaning Solution:
KemWash (Alpkem P/N A01-555-26). Daily cleaning is recommended.

NH₄
2.0-100 µg l⁻¹
(Water/Wastewater)

Photometer Parameters

Filter: 640 nm
Flowcell: 15 mm
Absorbance Range: 0.1 AUFS
Damping (RC): 2 sec

Sampler Parameters

Analysis Range: 51/hr
Sample Time: 25 sec
Wash Time: 35 sec
Pecking: Off
Probe: Stainless Steel

Manifold Start-up Solution:

Deionized Water with Brij-35™ (1 ml l⁻¹)

Cleaning Solution:

KemWash (Alpkem P/N A01-555-26). Daily cleaning is recommended.

+ Coil
o 5 turns
* Air solenoid valve

PNL TECHNICAL PROCEDURE

PCL-SOP-7 CATION ANALYSIS

1.0 APPLICABILITY

This procedure describes the use of a Leeman Plasma Spectrometer Model 2.5 for the analyses of Na, K, Ca and Mg. The Spectrometer is located in the 3720 Building, Room 210, 300 area.

This procedure assumes that the instrument operator has been trained on, and is familiar with, the operation of the Leeman Plasma Spectrometer, Model 2.5. In addition to this procedure, the operator must be familiar with the instrument's operating manual.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURE

a. Cation Standards

Use commercially available 1000 mg/l standard solutions for Ca, Mg, Na, and K. The concentrations of the final calibration standard solutions are:

Ca = 24.9 $\mu\text{mol/l}$
Mg = 41.1 $\mu\text{mol/l}$
Na = 217 $\mu\text{mol/l}$
K = 128 $\mu\text{mol/l}$

1. Ca and Mg Standard. Pipette 1.0 ml of each solution into a 1 l volumetric flask and dilute to 1 l with ASTM Type II water.
2. Na and K standard. Pipette 5.0 ml of each solution into a 1 l volumetric flask and dilute to 1 l with ASTM Type II water.

Copies of vendor supplied documentation on the composition of bulk standard solutions must be affixed to the Laboratory Record Book (LRB) dedicated to the identification of chemicals and reagents utilized in the performance of all Precipitation Chemistry Laboratory analytical activities. This LRB is also used to record the preparation of all reagent solutions and standards.

QAD Approval CD Taylor		Approved (Line Manager) CM Berkowitz	
Prepared by GL Laws		Technical Review	
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b. Pre-Ignition Checks

1. Inspect screen on sample uptake tube to insure that it is not plugged.
2. Check peristaltic pump tubing to determine its ability to smoothly introduce sample without aspiration.
3. Check torch for proper alignment prior to ignition.
4. Tilt mirror in burner compartment forward and center burner in coil.

c. Start-Up

1. Turn cold water line on full.
2. Turn on Argon at tank.
3. Turn on the on/off rocker switch at the lower left front of the instrument. Switch glows red when on.
4. Turn on main power switch at lower right front of the instrument (red switch).
5. Turn on main switch at upper right hand corner. This should start the Argon flow.
6. All interlock lights should be off.
7. Control Switch should be in the "Auto" position.
8. Auxiliary switch should be in the "off" position.
9. Pump switch should be in the "off" position.
10. Coolant should read approximately 15 psi.
11. Nebulizer should be "off".
12. Power control should be "off", full counter clockwise.

d. Ignition

1. Power Control approximately straight up.
2. Push Ignite button, burner tube should glow.
3. Adjust Power Control to .5 amps.
4. If the instrument will not ignite, the operator may have to repeat the three steps above a number of times.

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5. Turn on Nebulizer as slow as possible. If flame goes out start over at Power Control. Allowing the burner to heat up for approximately 2 minutes before turning on the Nebulizer decreases the chance of flame out.
6. Fill rinse water tray at the back of the sample changer with ASTM Type II water (ASTM D1193).
7. Adjust Coolant, Nebulizer, and Power Control for the program you are going to use (see following).

	<u>Coolant</u>	<u>Nebulizer</u>	<u>Power</u>
Programme A Ca, Mg	5	35	.50
Programme C Na, K	5	60	.43

8. Turn on Pump (slowly).

e. Pre-Analysis

1. Press [Seg Mult] - Screen will read programme ABC.
2. Press [A](Ca,Mg) or [C](Na,K) - [Enter]
3. Screen will read programme Ca,Mg.
4. Press [Peak] and select option 2, "wavelength". This option will print out the Hg reference values which should be approximately $x = 130$, $y = 115$. The screen will then show the Ca and Mg peaks which should be centered on the P value on the baseline.
5. The sample changer rack contains 6 positions for standards, labeled S1 through S6. The blank, ASTM Type II water should be placed in position number 1 and the standard solution in position number 2.
6. Press [Update] and the screen will prompt "Update Sample No?". Press [1] [ENTER] and the instrument will sample Standard Number 1. Proceed with Update Standard Number 2. If the corrected values on the print out agree with the known value of the standards proceed with analysis.

f. Analysis

1. Be sure the Standard 1 and 2 cups have enough standard in them for a complete run. Both standards are sampled after every four samples.
2. Run a QC sample after every 10th sample and run a duplicate sample for every 20 samples analyzed. A QC sample may be a designated standard, or a separate solution prepared from the same bulk standard solution, used to demonstrate stable analyzer operation.

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3. Load in sample cups and fill out sample sheet (Figure 1). The instrument, in the Auto mode, will print out the sample sequence as Sample 1 through Sample 40. The sample log sheet will indicate which sample is in which cup.
 4. Push [Sample], the screen prompts, "Start at Cup Number?". Enter the first cup number you want sampled, i.e., [1][Enter]. The screen then prompts "End at Sample Number ____?". Enter the sample number of the last cup you want sampled, i.e., [40][Enter].
 5. Data are reported on a print-out from the Plasma Spectrometer and hand recorded by the analyst on the ICAP Log Sheet. After completing data entry, the analyst, or a laboratory technician, checks to confirm accurate data transfer, signs the sample log and references the analyzer data report from which the data was taken. The analyzer report (print-out) is filed with the results of other analyses in the PCN Group File and the ICAP Log Sheet is filed in the MAP3S QA File. Data transfer to the MAP3S data base is performed by the Laboratory Supervisor using the ICAP Log Sheet.
- f. Shut Down
1. Turn Power Control off.
 2. Turn off Main Switch at top right of instrument.
 3. Turn off Main Switch at lower right of instrument (red switch).
 4. Turn off switch at lower left front of instrument.
 5. Turn off Argon at tank.
 6. Turn off cold water at sink.
 7. Remove sample tray and rinse water tray.

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ICAP Log Sheet

Analyst: _____

Group #'s: _____

Date: _____

Sample #	Cup #	CA QC Sample MG	Sample #	Cup #	NA QC Sample K
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				
	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				

Checked by: _____ Date: _____

Form Date: 9/10/90

PNL TECHNICAL PROCEDURE

PCL-SOP-9 ANALYTICAL RESULTS LOGIN, SAMPLE QC CHECKS AND CLEARANCE

1.0 APPLICABILITY

This procedure describes the entry of analytical data on the Analysis Checklist and Record Form and the required sample QC analysis of the data. Evaluation of laboratory analytical quality is described in PCL-SOP-14.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURE

4.1 Login

Upon completion of analyses described in PCL-3 to -8, concentration results (μM) and dates of analyses are entered in the appropriate spaces on the MAP3S Precipitation Network-Analysis Checklist and Record form (Attachement 1). Any special circumstances related to analyses (e.g., existence of foreign matter, substandard accuracy) are entered in the comments space of page 2 or the left margin of page 1.

4.2 QC Checks

4.2.1 Repeat Analyses

Re-analyses are performed such that 1 of 20 samples shows at least two results for all species, and that 2 of 20 samples show at least two results for pH.

4.2.2 Ion Balance

Ionic equivalent sums are calculated and entered in the appropriate columns. If the following criteria are not met, reanalyses of one or more species may be called for, or an evaluation of the reality of the ionic imbalance on the basis of objective evidence of the existence of non-analyzed species, or contamination (as indicated by field notes or "abnormal" concentrations of selected species, particularly PO_4^{3-} , NH_4^+ , H^+) should be made.

QAD Approval CD Taylor		Approved (Line Manager) CM Berkowitz	
Prepared by VR Morris		Technical Review	
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PNL TECHNICAL PROCEDURE

Ion balance IB is defined by:

$$IB = \frac{\Sigma \text{ anions} - \Sigma \text{ cations}}{\frac{\Sigma \text{ anions} + \Sigma \text{ cations}}{2}} \times 100\%$$

The criteria for reevaluation of ion balance are:

If $\Sigma(\text{anions}) + \Sigma(\text{cations})$ is:

And $|IB|$ is:

<50

≥ 120

$\geq 50 < 100$

≥ 60

≥ 100

≥ 30

IB is calculated and the criteria checked by the computer program GRPIN3 (see SOP-10). The program flags the sample with an ADS code when the reanalysis criteria are met and resets the code upon evaluation.

4.2.3 Conductivity Balance

The calculated versus measured conductivity comparison, or "conductivity balance" is defined by:

$$CB = \frac{C_c - C_m}{C_m} \times 100\%$$

where C_m is measured conductivity ($\mu\text{Mho/cm}$) and

$$C_c = 0.35 [H^+] + \frac{0.228}{[H^+]} + 0.0759[Cl^-] + 0.104[Ca^{++}] + 0.932[Mg^{++}] \\ + 0.072[K^+] + 0.0489[Na^+] + 0.071[NO_3^-] + 0.1478[SO_4^{--}] + 0.0745[NH_4^+]$$

is calculated conductivity.

The criteria for reevaluation of conductivity balance are:

If C_m is

and $|CB|$ is

<5

≥ 50

$\geq 5 < 30$

≥ 30

≥ 30

≥ 20

The reevaluation process for conductivity balance is the same as that for ion balance (4.2.2 above).

C_c is calculated and the criteria checked by the computer program GRPIN3 (see SOP-10).

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4.3 Clearance

The analytical results are considered cleared for completion of computer data base entry and reporting to clients when the above checks have been successfully completed.

In the event of two analyses for a particular species not agreeing within 10%, the value which is correct (the other value having an objective reason for being rejected) is kept and the rejected value crossed off the checklist. If no objective reason exists for rejection, the value which better satisfies the ion balance criterion is kept (if concurrent reanalyses of other species are done, the new values for those must be used for the ion balance calculation). If neither value leads to a successful ion balance calculation, a third analysis should be performed. In this case, the mean of the values which best agree are kept. If reanalysis values agree within 10%, or if the ion balance criterion is met with both, both are kept and the mean entered into the computer data base.

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PNL TECHNICAL PROCEDURE

PCL-SOP-10 PRECIPITATION CHEMISTRY LABORATORY DATA PROCEDURES

1.0 APPLICABILITY

This procedure describes data entry into the chemistry database and the hourly rain-gauge database.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURE

Chemistry and field data for the MAP3S Precipitation Chemistry Network is entered using the GRPIN program. Hourly rain-gauge data is entered using the RAININ program. To use either program, you must have authorized access to the YVAX located in Sigma 5. Using the local area network (see Guide to Data Communications at BNW), connect to PNL, enter your username and password for the YVAX. After you get the \$ prompt, enter SET PROJECT PCN. You must then enter SET DEFAULT .PCN3 to access the GRPIN3 program or SET DEFAULT .RAIN to access the RAININ program.

4.1 Instructions for Using GRPIN3

1. Enter the PCN.PCN3 directory and enter RUN GRPIN3 to start the GRPIN3 program.

GRPIN3 program allows you to enter and change MAP3S Precipitation Chemistry Network data. The program is set up to work with sample groups. You specify a group number, work with samples in that group, save the data, and move on to a new group number.
2. The program first asks for a PC group number, which you enter as an integer (then hit RETURN). The program verifies the file name with you, which is in the form 'PC***.GRP', where *** is the group number you entered.
3. The program will ask if you want automatic file backup. Answer 'YES' to this question.

QAD Approval CD Taylor		Approved (Line Manager) CM Berkowitz	
Prepared by VR Morris		Technical Review	
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4. You will be asked to enter a task name. [For example, ENTER or CHANGE data, ORDER the file, or save the data (REPLACE).] If you do not know the available tasks, any response will do here. If you type 'HELP', you will be shown the proper task names and allowed to seek further information. If you get into trouble, just hit the RETURN key a few times. This will get you out of whatever task you are in. Then you can type 'HELP' to find out about how to use the tasks.

Generally you will only use the tasks ENTER, CHANGE, and REPLACE. Use ENTER when you are entering data, CHANGE when you are changing data, and REPLACE when you are finished working with a group during the current session.

When you enter into either the CHANGE or ENTER task, the computer will ask you if you want the entries echoed back. If you answer 'YES', the computer will automatically print on the screen the value and parameter after you have entered it. It is advisable to use this option since it gives a quick check to see that you have entered the right number in the right parameter.

A description of each task is given below.

- HELP

Task HELP will explain the valid tasks in the program. You will be prompted to enter a task name, then an explanation of that task will be typed.

- CHANGE

Task CHANGE is used to change data for samples in the group. First, the IDs for all samples in the group will be listed. Then, you will be prompted to enter a sample ID. If you enter an ID, data values for the specified sample can be changed. If you enter 'ALL', the value of one parameter for all samples can be changed and you will be prompted for the number of the parameter. (Hitting RETURN here ends the task.) Next, enter the data values.

Valid entries have the forms:

1. VALUE
2. PARAM NO VALUE
3. 'SHOW'
4. 'SHOW ALL'
5. 'SHOW' PARAM NO
6. blank-line (Just RETURN key)

The first two forms enter data values. VALUE may be a number or a 1 to 4 character code. An all blank code cannot be entered directly; enter a single minus sign instead (-). If no PARAM-NO is entered, the program automatically sequences through the parameters (this saves having to

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enter the PARAM_NO). Forms 3 to 5 display current values for a particular parameter or all the parameters (form 3 uses automatic sequencing to determine which parameter). By hitting RETURN, data entry terminates for the specified sample, and you can start ENTERing another sample.

In ENTER, you cannot change the value of a parameter unless: (1) the existing value is the default initialization value, or (2) you re-enter a new value for the same parameter to which the last entry was made (i.e., you can immediately correct a mistake).

- ORDER

Task ORDER orders the samples in a group sequentially by sample ID. This must be done before the group can be merged with other groups to build report files.

- DELETE

Task DELETE allows you to delete one or more samples from a group. You will be prompted for a sample ID. If you enter an ID, that sample is deleted. If you hit RETURN, the task terminates.

- DUMP

Task DUMP allows you to list the data for one or more samples from a group. First, the IDs for all samples in the group will be listed. Then, you will be prompted for a sample ID. If you enter an ID, the data for that sample will be listed. If you enter 'ALL', the data for all samples will be listed. If you hit RETURN, the task terminates. Note that you can also view data in CHANGE or ENTER using 'SHOW'.

- ABORT

Task ABORT closes and deletes any new versions of the file for the current group. This effectively deletes any modifications or entries you have made to the group. ABORT also terminates work with the current group. (REPLACE, ABORT, and CREATE are the only ways to end working with a group and get out of the program.)

- REPLACE

Task REPLACE replaces the old version of the file for the group with the current data for the group. REPLACE also terminates work with the current group. (REPLACE, ABORT, and CREATE are the only ways to end working with a group and get out of the program.)

- BACKUP

Task BACKUP makes a backup file for the group using the current data. This task is a safeguard to avoid losing data due to terminal disconnects if you are working on a remote terminal (via phone). It isn't really necessary if you are working in the computer room.

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- CREATE

Task CREATE makes a new file for the group using the current data, while keeping the old version of the file (if one exists). CREATE also terminates work with the current group. (REPLACE, ABORT, and CREATE are the only ways to end working with a group and get out of the program.)

Following are listings of the data parameters both in their stored (and dumped) order and the automatic sequencing entry order, and ADS note codes.

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PARAMETER ORDERING^(a)

<u>P.NO.</u>	<u>PARAMETER</u>	<u>INITIALIZED VALUE</u>
1	TIME RMVD.	-300.00
2	SAMP.TIME	-300.00
3	AREA	682.00
4	SSCS	-200.00
5	LID OPEN	-300.00
6	ARR.DATE	-200.00
7	PREC. END	-300.00
8	SAMP. VOL.	-200.00
9	PRED. VOL.	-200.00
10	FIELD PH T	-200.00
11	FIELD PH	-200.00
12	LAB PH	-200.00
13	(H+)	-200.00
14	CONDUCT.	-200.00
15	(SO2)	-200.00
16	(SO4=)	-200.00
17	(NO2-)	-200.00
18	(NO3-)	-200.00
19	(CL-)	-200.00
20	(PO4---)	-200.00
21	ANION SUM	-200.00
22	(NH4+)	-200.00
23	(NA+)	-200.00
24	(K+)	-200.00
25	(AL+++)	-300.00
26	(CA++)	-200.00
27	(MG++)	-200.00
28	CATION SUM	-200.00
29	(BR-)	-300.00
30	CALC COND	-200.00
31	ADS CODE 1	(blank)
32	ADS CODE 2	(blank)
33	ADS CODE 3	(blank)
34	DEP. TYPE	W
35	PREC. TYPE	R

(a) This is the sequence used in printouts and dumps. A different sequence, corresponding to the lab data sheets, is used for data entry.

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PARAMETER ORDERING DURING AUTOMATIC SEQUENCING^(a) (When no parameter number is entered)

<u>P.NO.</u>	<u>PARAMETER</u>	<u>MINIMUM DETECTABLE LIMIT</u>
5	LID OPEN	0.00
6	ARR.DATE	1.01 MO.DA
8	SAMP. VOL.	0.10 ML
9	PRED. VOL.	0.10 ML
10	FIELD PH T	0.01 C
11	FIELD PH	0.00
35	PREC. TYPE	--
12	LAB PH	0.00
14	CONDUCT.	0.00 μ MHO/CM
15	(SO ₂)	0.20 μ MOL/L
16	(SO ₄ =)	0.20 μ MOL/L
18	(NO ₃ -)	0.30 μ MOL/L
19	(CL-)	0.60 μ MOL/L
20	(PO ₄ ---)	0.20 μ MOL/L
22	(NH ₄ +)	0.60 μ MOL/L
23	(NA+)	0.50 μ MOL/L
24	(K+)	10.00 μ MOL/L
26	(CA++)	0.50 μ MOL/L
27	(MG++)	0.40 μ MOL/L

(a) Note that some of the parameters are completely skipped during automatic sequencing. To enter a value for the skipped parameters, both the parameter number and value must be entered.

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NOTE CODES

<u>ADS(a) Note Codes</u>	<u>Explanation</u>
A21	Equipment failure - all of event missed
A22	Equipment failure - some data loss
A23	Contaminated and discarded in field
A24	Sample too aged for SO ₂ analysis
A25	Sample leaked in shipment
A26	Sample inadvertently discarded in field
A27	Sample not shipped
A28	Sample spoiled before analysis
A29	Vandalism - some data loss
A30	No explanation from operator
A99	Parameter not entered in data base at this sampling time
B05	Insects in sample
B31	Alternate rain gauge used
B32	Alternate collector used
B33	Wind problems
B34	Snowbridge or ice problems
B35	Overflow
B36	Sample frozen
B37	Late collection
B38	Organic debris in sample
B39	Unidentified debris in sample
B40	Fly ash in sample
B41	Dust/dirt in sample
B42	Bird droppings in funnel
B57	Bird droppings in sample
B58	Wet side open until sample collected
C21	Two events combined
C22	More than two events combined
C23	Weekly sample
C24	Sample leaked before volume measurement
D21	Equipment failure - part of event missing
D22	Possible operator contamination
D23	Field pH suspect due to procedure
D24	Predicted volume suspect due to rain- gauge problems
E21	Reanalysis criteria met, reevaluation pending
E22	Reanalysis criteria met, reevaluation complete

(a) Atmospheric Deposition System.

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PNL TECHNICAL PROCEDURE

4.2 Instructions for Using RAININ

1. Enter the PCN.RAIN directory and enter RUN RAININ to begin the RAININ program.

Data is entered manually, one site/month at a time. This program will also provide a listing of the data on the printer which can be used for verification. This program has a 'HELP' command to assist the user.

At this initial stage, the data are kept in individual site/month files. The file names have the form RFssXyymm.RFA where ss is the site number (10, 15, 20, ...), yy is the year (87, 88, ...), and mm is the month (01, 02, ..., 12).

2. The program first asks the user to enter a task name. The program has seven different tasks: HELP, QUIT, ENTER, TYPE, PRINT, BACKUP, and NOBACKUP.

- HELP

Task HELP presents instructions for using the program.

- ENTER

Task ENTER is used to enter or change the rain-gauge data. Within ENTER, you must first enter a site number (e.g., 10, 15, 20, ..., 90) and then a 4-digit year and month code (e.g., 8309, 8601, 8812).

You can make individual data entries in the form 'DAY, HOUR, AMT1, AMT2, AMT3, ...'. DAY and HOUR are the day and hour corresponding to AMT1. AMT1, AMT2, AMT3, ... are amounts for consecutive hours on the same date. At least one amount (AMT) must be entered, with a maximum of 24. The AMT entries must be 1- to 3-digit integers corresponding to the amount in hundredths of inches, or one of the following codes: T, ML, MU, <, or >. For a blank on the data sheet, you can enter '0' for the amount.

One or several data entries can be made for each site-year-month. Entering a blank line terminates entry for the site-year-month. You can then enter a new site-year-month, or enter a blank line to exit the task.

- TYPE

Task TYPE types rain-gauge data at the terminal. You must enter a site (as in ENTER), a year-month (as in ENTER), then two days. Rain-gauge data for that site-year-month between the two days will be listed at the terminal. You can then enter a new site-year-month-days combination, or enter a blank line to exit the task.

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PNL TECHNICAL PROCEDURE

- **PRINT**

Task PRINT prints rain-gauge data at the line printer. You must first enter one or more site numbers, or 'ALL'. Next enter one or more year-months, or a range of year-months (e.g., to get all of 1988, enter '8801 THRU 8812'). Rain-gauge data for the sites and months requested will be listed on the line printer. You can then enter new sites and year-months, or enter a blank line to exit the task.

- **QUIT**

Task QUIT terminates program execution.

- **BACKUP/NOBACKUP**

Tasks BACKUP and NOBACKUP tell the program to either backup or not backup the rain data files. NOBACKUP is assumed until you type 'BACKUP'.

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PNL TECHNICAL PROCEDURE

PCL-SOP-11 COMPUTER DATA CHECKS

1.0 APPLICABILITY

This procedure describes the method for checking the data entered in the data base against the original laboratory data forms.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURE

4.1 Chemistry and Field Data

1. Program DMPRED3 is run, which provides a printer listing of chemistry results and field data of each group, as entered.
2. These data are checked against the original checklist entries, by a person other than the one who entered the data using GRPIN3, any errors noted are resolved and the checker signs and dates the data sheets.
3. Corrections, as necessary, are made to the groups, using the CHANGE task of GRPIN3 (see SOP-10). Entry "echo" and the DUMP task are used to verify the correctness of the change for each sample.
4. Number 3 is repeated if changes result from the laboratory results QC clearance process (SOP-9).
5. The groups, with data now checked and laboratory QC data cleared, are ordered using the GRPIN3 ORDER task (see SOP-10).

4.2 Rainfall Data

1. Task PRINT of RAININ (SOP-10) is used to obtain a printed list of site/month data.
2. These data are checked against the original site hourly precipitation log forms, by a person other than the one who entered the data, any errors noted are resolved and the checker signs and dates the data listing.

QAD Approval CD Taylor		Approved (Line Manager) CM Berkowitz	
Prepared by VR Morris		Technical Review	
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PNL TECHNICAL PROCEDURE

Once the data for a site/month has been verified, the file containing the data should be renamed from RFssXyymm.RFA to RFssXyymm.RFC (use the DCL command RENAME/CONFIRM). When a file is renamed in this fashion, it can no longer be accessed (or modified) by the RAININ program (RAININ can only access the .RFA files).

Note: For the Whiteface Mountain site, after data have been verified, rename files to RFssXyymm.RFB.

3. Corrections, as necessary, are made using the ENTER task of RAININ, and are verified using "echo" and TYPE tasks.

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PNL TECHNICAL PROCEDURE

PCL-SOP-13 COMPUTER DATA REPORTING

1.0 APPLICABILITY

This procedure describes the production of the quarterly data reports.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Laboratory Supervisor
Laboratory Technician

4.0 PROCEDURE

4.1 Reporting Chemistry Data

Program REPORT accepts one input file, which has been generated by SORT3, and prepares a report in a format suitable for hard copy production. The program can produce a full data table, a general statistics table, a sample availability table, and/or a sample notes table. The output file name usually has the suffix .RPT.

The major option of REPORT is the ability to restrict the number of sites. Site numbers not to be included can be specified by the user.

4.2 Reporting Rainfall Data

Line printer listings of the precipitation data for inclusion in the quarterly and annual reports can be produced using the RDUMP program (which uses individual monthly files as input) or the RDMPANUAL program (which uses the annual data files). Note that the RDUMP program expects the monthly data files to be named RFssXyymm.RFC.

4.3 Transmitting Data to Offsite Users

4.3.1 Chemistry Data

Program DMPRED3 is used to provide a tape output file of chemistry checklist groups for delivery to other data bases. Currently, the procedure is used only for preparing tapes of annual data for the PNL data management system.

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Prepared by VR Morris		Technical Review	
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PNL TECHNICAL PROCEDURE

4.3.2 Rainfall Data

The program RTAPEFILE creates a disk file copy of the rainfall data in a form suitable for transmittal to offsite users. This disk file can be copied to magnetic tape using the MYTAPE facility, and then should be deleted. The RTAPEFILE program works from the annual data files (PRAIN19yy.RFY).

The RTAPEFILE program is simple to use. The program queries the user for the year of interest, and for the name of the file to receive the data in the transmittable form. It then writes the data to that file.

The format of the data in the transmittable file is described in file BROOKHVN.LT1.

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PNL TECHNICAL PROCEDURE

PCL-SOP-14 EQUIPMENT SUPPLY FOR MAP3S/PCN

1.0 APPLICABILITY

This procedure provides for the maintenance of inventory and the ordering of supplies necessary to keep the MAP3S/PCN sites operational.

2.0 DEFINITION

NA

3.0 RESPONSIBLE STAFF

Technical Specialist
Technician

4.0 PROCEDURE

a. Inventory

Inventory of what is currently available for use in the laboratory for shipment to all sites is important to provide continuous support for the entire network. Periodic checks of inventory levels thus provide the input to maintain this accountability. Maintaining a minimum supply as backup in storage helps prevent untimely delays. The minimum supply to be kept on hand is indicated in the first column of the *MAP3S/PCN Inventory Sheet* (attached).

b. Site Supply Needs

Monthly site needs are inventoried from the Embarkation forms and the periodic telephone conversations on the *Site Supply Needs - MAP3S/PCN* form. This form acts as a check list for preparing, and sending site supplies. A routine for the shipment of the regular supplies has been established to avoid timely lags between the time that the supplies are needed and the time needed to prepare and ship these supplies.

c. Reorder Items List

This list has been established as a resource for the purchasing process of items listed on the *MAP3S/PCN Inventory Sheet*. It lists the catalogue number and the location of items that are frequently ordered.

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Prepared by GL Laws		Technical Review	
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PNL TECHNICAL PROCEDURE

Reorder Items List

Item	Unit	Store Order # PR-Vendor		
Apron	ea	37-0350-100	--	Acid, vinylite, med. wt.
Poly Bags:				
Large (21½" x 21")	ea	37-0550-215	100	Bag Poly (21" x 21½")
Medium (12" x 16")	ea	37-0550-208	100	Bag Poly (12" x 15" x .002")
Medium (19" x 21")	ea			
Small (6" x 9")	ea	37-0550-206	100	Bag Poly (6" x 9" x .002)
Small (5" x 7")				
Poly Bottles:				
8 oz	ea	57-5155-008	225	Btl., Poly wo/sc, 8 oz.
1 gal	ea	57-5155-035	6	Btl., poly w/sc, round, 1 gal
4 oz	ea	57-5155-004	--	
1 oz (wide mouth)				
2 oz (wide mouth)				
1 oz (TCM)	ea	57-5155-001	100	
1 liter				
2 liter				
Bottle Caps:				
28 mm (wide mouth)	case	VWR	12/case	
24 mm (8 oz, 4 oz)	case	VWR #16219-029		
18 mm (TCM black)	ea	57-5350-028	100	
Boxes:				
Shipping (26x14x24)				
Freezer (9x12x8)				
Buckets (4 gal)				
Bucket Lids				
Funnels (4")	ea	57-5880-075	6/bag	Funnel polypropylene
Filter paper	box	57-7245-125	100	Paper, filter Whatman 41, double washed, dia. 12.5 cm
Gloves (no talc):				
Large	c	37-3089-200	100/c	Vinyl, dust & lint free, ultra thin, ambidextrous
Medium	c			
Small	c			No talc for clean room activity
Goggles	pr	37-3130-609	1	Acid goggles, splash guard, clear lens, fog free
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PNL TECHNICAL PROCEDURE				
Magnetic Tape (3M)	ea	53-8364-711		Tape, magnetic, 2400', 3M
Rubber Bands:				
Small (size 8)	box	53-0520-100	--	Bands Rubber = 8 size 7/8"
Large (size 33)	box	53-0520-500	--	Bands Rubber = 33 size 3½"
Syringes:				
50 cc	ea			
35 cc	ea	56-1715-300	20	Syringe - 35 cc
30 cc				
3 cc				
Tape:				
Filament				
Green	Ro1	42-6200-170	--	Tape, waterproof, sealing, 2" width
White (large, 1")	ea	57-8360-325	--	Tape, plastic, white, 1" x 36" yd
White (small, 1/2")	ea	57-08360-300	--	Tape, plastic, white, 1/2" x 36" yd
Terri Towels	pkg	38-8520-100	--	Teri Towel - all purpose
Tubing Shrinkable				
18 blk	1ft	16-6083-040	8 1ft	Tubing, 18 blk
12 blk	1ft	16-6083-070	8 1ft	Tubing, 12 blk
Tweezer	ea	57-8725-300	--	Tweezer flat tip s/s
Vial (2 dram)	ea	57-8900-500	--	2 dram vial w/cap
Chemicals:				
Hydrogen Perox. 30%	ea	51-3600-145		Hydrogen Peroxide 30% (1 lb size)
Potassium Hydroxide	ea	51-7000-725 (Haz)*		Technical (5 lb size)
Sodium Chloride	ea	51-8175-160	Reagent	(5 lb size)
Oxalic Acid	ea	51-0100-390 (Haz)*		Reagent (1 lb size);
Silica Gel	ea	51-8065-155		(6-16) mesh indicat. (5 lb)
Silica Gel	ea	51-8065-150		1 lb size
*Must be ordered separately on Hazardous Material Store Order Form.				
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MAP3S/PCN Inventory Sheet

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Date of Inventory				
Item	Minimum Qty	Qty Invntrd	Qty Invntrd	Comments
Poly Bags:				
Large (21½" x 21")	500			
Medium (12" x 16")	100			
Medium (19" x 21")	100			
Small (6" x 9")	100			
Small (5" x 7")	100			
Poly Bottles:				
8 oz.	1 box			
1 gal.	6			
4 oz.	1 box			
1 oz. (wide mouth)	As Need			
2 oz. (wide mouth)	As Need			
1 oz. (TCM)	1 box			
1 liter	1 box			
2 liter	1 box			
Bottle Caps:				
28 mm	As Need			
24 mm (8 oz, 4 oz)	3 boxes			
18 mm (TCM Black)	100			
Boxes:				
Shipping (26" x 14" x 24")	50			
Freezer (9" x 12" x 8")	12			
Buckets (4 gal.)	240			
Bucket Lids	240			
Blue Ice	As Need			

Date of Inventory				
Item	Minimum Qty	Qty Invntrd	Qty Invntrd	Comments
Forms:				
Weather Gauge Charts:				
Weekly	100			
Monthly	100			
Embarkation	100			
Hourly Data Log	100			
Off-Site Property Control	10 ea			
Network Data Log	100			
Site Supply Needs	10			
Funnels (4")	1 box			
Gloves (No Talc):				
Large	100			
Medium	100			
Small				
Labels:				
Shipping (to PNL)	25			
Site 10 (Whiteface)	10			
Site 20 (Ithaca)	10			
Site 30 (Penn State)	10			
Site 40 (Virginia)	10			
Site 50 (Illinois)	10			
Site 60 (Brookhaven)	10			
Site 70 (Lewes)	10			
Site 80 (Oxford)	10			
Site 90 (Oak Ridge)	10			
Perishable	25			

Date of Inventory				
Item	Minimum Qty	Qty Invntrd	Qty Invntrd	Comments
Rubber Bands:				
Small (size 8)	2 box			
Large (size 33)	6 box			
Syringes:				
50 cc	As Need			
35 cc	100			
30 cc	As Need			
3 cc	As Need			
Tape:				
Filament	6 rolls			
Green	6 rolls			
White (large)	6 rolls			
White (small)	6 rolls			

1991

[illegible]

PNL TECHNICAL PROCEDURE

PCL-SOP-15 SHIPPING PROCEDURE FOR MAP3S/PCN

1.0 APPLICABILITY

This procedure outlines the shipping procedures of supplies necessary to keep the MAP3S/PCN sites operational.

2.0 DEFINITION

3.0 RESPONSIBLE STAFF

Technical Specialist
Technician

4.0 PROCEDURE

- (1) Fill shipping box with materials detailed on site supply needs form. Check off each item as you put it in the box.
- (2) Seal box with green tape and plastic binding tape.
- (3) Put site shipping label on the box and fill in the Off-Site Property Control form for that site. Send air freight routing only when it is an emergency shipment. (Small item emergencies, e.g., white tape, TCM vials, labels, etc., can be directly mailed in an envelope).
- (4) Enter all shipping information into the *Outbook* (a notebook used to keep track of shipping information in the cleaning laboratory and it is labeled *Outbook*). Enter the shipping date only after the box has been picked up by Westinghouse Shipping.
- (5) Radiation monitoring is necessary to ship anything off site. MAP3S/PCN has permission to waive the radiation monitoring requirement for shipment of site supplies (see attached letter). For each shipment, the operator sending supplies must write in the description box on the *Off-Site Property Control Form*: "Certified Radiation Free", then sign and date it. It is important to note that this is not where a Radiation Monitor would sign, those blanks are to be filled with N/A. The same form can be used for more than one box going to the same site. The other way to satisfy radiation monitoring for MAP3S/PCN shipping is to call a Radiation Monitor. If for some reason the waiver is not acceptable or if something other than the usual supplies are being shipped, call Radiation Monitoring (Wade Hinkle, 376-3659 or beeper 85-646; or his boss Jon Hudspeth, 376-3155).

(a) Not a registered BNW Laboratory Record Book.

QAD Approval CD Taylor		Approved (Line Manager) CM Berkowitz	
Prepared by GL Laws		Technical Review	
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- (6) After the radiation monitoring question is satisfied, make two copies of the signed Off-Site Property Control form. The original is sent with the shipment, one of the copies is filed in the laboratory, and the other is sent to:

PM&A (MSIN P8-50)
3760 Tr1/300 area
PNL

- (7) Call Stores Delivery (at 376-6804) to pick up the box. Ask when the truck will pick up the shipment, and put it out on the east dock at the appropriate time.
- (8) After the box has left the dock, record departure date in the *Out Book*
- (9) Always inform Gail Laws or Dick Lee for any reason a shipment can not be filled to meet the schedule outlined on the site supply needs form. The *Out Book* is an essential record of what is sent to each site, and care should be made to keep it current and accurate.

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PNL TECHNICAL PROCEDURE

PCL-SOP-21 PRECLEANING OF SAMPLE COLLECTION AND SHIPPING CONTAINERS

1.0 APPLICABILITY

This procedure describes the cleaning of collection buckets and sample containers.

2.0 DEFINITIONS

NA

3.0 RESPONSIBLE STAFF

Technical Specialist
Technician

4.0 PROCEDURE

A. General

The following excerpt from *Methods for Collection and Analysis of Precipitation*, by Mark E. Peden, et al., ISWS Contract Report 381, Illinois State Water Survey, Champaign, IL, 1986, summarizes accepted philosophy and practice for sample-contact materials.

All collection buckets, liners, funnel/bottle apparatuses, and storage bottles should be constructed from a non-contaminating material that will not adsorb the inorganic ions of interest. High density (linear) polyethylene, which has been shown to be a suitable collection and storage material, is most widely used for the collection and storage of wet deposition samples. Other plastic materials such as polypropylene, conventional (low density) polyethylene, and tetrafluoroethylene have been used successfully as well. All containers that will be used for sample collection or storage should be evaluated for adsorption/desorption properties on a continual basis since the purity of plastic products can vary among manufacturers and between different production runs from the same manufacturer. The evaluation of the collection vessel should include the cap or lid that is used to seal the container after collection. Gasket materials and cap liners that are used to ensure a watertight seal are potential sources of contamination that must also be investigated.

Thoroughly rinse all collection surfaces with ASTM Type II water prior to use. Do not use strong mineral acids or alkaline detergent solutions for

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PNL TECHNICAL PROCEDURE

cleaning collection vessels. Residual acids may remain in the polyolefin matrix and be slowly leached back into the sample. Alkaline detergents may also leave residues that can affect the sample chemistry. Wear particle-free, non-contaminating gloves whenever handling clean buckets or bucket liners. Cap collection bottles after cleaning to prevent contamination from airborne contaminants. Air dry collection buckets and liners in a laminar flow clean air work station and wrap in polyethylene bags prior to use. If a laminar flow work station is not available, pour out any residual rinse water and bag the buckets immediately. Do not dry the bucket or liner interior by any method other than air drying under a clean air work station. Monitor the cleaning procedure by pouring a volume of reagent water that approximates the median sample size into the collection vessel. Allow the water to remain in the sealed or capped collection container for at least 24 hours and determine the concentrations of the parameters that will be measured in wet deposition. If any of the analyte concentrations exceed the method detection limit (MDL), a contamination problem is indicated in the cleaning procedure. Take corrective action before the sampling containers are used for the collection of wet deposition.

Additional procedural considerations particular to PCL practice are listed in the following sections.

B. Buckets

1. Keep new buckets and lids inside their protective plastic wrap or cover the top bucket of a stack with a lid prior to cleaning. (The buckets arrive factory clean, so reasonable efforts should be made to avoid contamination prior to cleaning.) Do not contact the inner surfaces during any step below, except with cleaning materials as described.
2. Remove the bail carefully and set the bucket to be cleaned separately (not stacked) on a clean table.
3. Rinse the interior twice with approximately 100 ml of deionized water (DI) from the storage tank tap, running the stream of water down along the inner vertical surface (to simulate rain drop action).
4. Fill to about 1 inch depth with DI.
5. Scrub the interior surfaces, wearing talc-free plastic gloves, with a natural sponge (which has been pre-soaked and cleaned in deionized water (DI) to remove the bulk of salts), for about 30 seconds, using the water from Step 4. Do not use bucket if there is any question of contamination or if any visible material in the bucket interior is not removed by this step.
6. Empty the water from Step 4 to waste and squeeze out the sponge to waste. Rinse and store the sponge in a covered pan with DI. Change the sponge soak DI daily, or whenever washing.
7. Rinse twice more, as in Step 3.

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8. Fill the bucket to about 3 inches depth with DI, and stand it aside on the table.

[Soak water may be reused once, if it has passed the conductivity test from Step 11, below. Keep once-used soak water in a separate bucket, marked Carboy.]

9. Cover the bucket top loosely with a clean plastic bag (approximately 21" x 21"). Be careful to place only the inside of the bag down over the interior of the bucket.
10. Let the bucket set overnight.
11. Check the contents of the bucket with a conductivity probe. If the reading is greater than about 2 μ Mho, rewash the bucket (Steps 3-10). (If the test fails again, discard the bucket.)
12. If several or all of the buckets in a batch show high conductivity, check the DI supply water. Submit a sample from the offending buckets or supply DI to the laboratory for major ion analysis and resolution of the problem before bucket wash operations are resumed. Mark the samples "DI Supply (Date)" or "Bucket Soak (Date)".
13. In any case, submit a sample of the soak water from 1 in 50 (2%) buckets washed for major ion analysis. Mark the sample "Bucket Soak (date)". If any species concentration exceeds 2 μ Mho, another, separate bucket sample should be drawn and analyzed and/or the problem resolved before resuming bucket wash operations.
14. Analytical results should be recorded on the QC checklist, filed in the laboratory QC file and reported to the site supply specialist.
15. First-used soak water may be stored in the once-used soak water Carboy, pouring carefully to avoid contact with the interior. Second-used soak water must be discarded.
16. Wash the interior surface of lids the same way as for buckets, but do not soak (do Steps 3-7).
17. Shake the water off the lids and put in a separate bag from the buckets. The same bags that were used to cover the buckets during soak can be used to bag the lids if the lower interior of the bag remained clean during the soak.
18. Weigh the bucket, without lid, and write the weight low on the side of the bucket with a permanent marker.
19. Apply a clean plastic bag to the bucket top, making sure the interior of the bag contacts the interior of the bucket. Secure the bag around the rim with two rubber bands.

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PNL TECHNICAL PROCEDURE

20. Stack the buckets five to a stack (loosening the rubber bands slightly to allow air to escape) and box for shipment along with the lids (as required) and other site supplies.

C. Bottles

1. Do not touch the interior of bottles or caps with anything but deionized water (DI), through all the following steps.
2. Select a number of caps corresponding to the number of bottles to be washed. Remove the caps from their bags and soak in fresh DI in a covered pan while the bottles are washed. The caps may be sloshed around in the water by a talc-free plastic gloved hand prior to covering the pan.
3. Rinse each bottle, under the DI tap, three times. Use approximately 100 ml water each time (for 8 oz, about half full). Include one cursory rinse of the exterior.
4. Fill the bottles with DI completely full, so that the contents will contact the bottom of the cap when it is applied.
5. Wearing a clean talc-free plastic glove, apply the soaked caps tightly to the bottles, taking care not to spill or touch the contents.
6. Check to see that there is some contact between the bottle contents and the cap surface. If not, refill and cap.
7. Let stand overnight (right side up only).
8. Perform a conductivity check as in Step 11 above, on about half of the bottles, chosen at random. Rewash or discard failures.
9. Submit 1 in 100 washed bottles (still full of soak DI) to the laboratory for major ion analysis. Mark with "Bottle Soak (date)". The analysis should be performed during the next general analysis session. Any problems should be resolved as in Step 12 above.
10. Pour the soak water to waste or the once-used soak carboy, shake out excess water, and recap immediately.
11. Bag for shipment to MAP3S/PCN sample collections sites (pristine bag not necessary).

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APPENDIX B

QUALITY CONTROL RESULTS

APPENDIX B

QUALITY CONTROL RESULTS

Information on analytical bias and precision is presented in this appendix. Analytical bias is based on an analysis of measurements of quality control check samples. Precision is determined from an analysis of duplex aliquots taken from the same samples.

SAMPLE BIAS

Some of the SOPs presented in Appendix A note that quality control check samples are routinely used to track the performance of the analytical systems. Table 4 of the text summarizes the results of all the quality control checks for the measurements relevant to the ERP. The practice in the PCL is to analyze the quality control data on a quarterly basis. Table B.1 presents the analytical bias and the 95% confidence limit on that bias for each quarter that the ERP wet deposition sites were in operation. Tables B.2 through B.8 present the actual quality control check sample results for each quarter.

Since the standard for most analytes is constant during a given quarter, the mean bias, as a percentage of the standard, is calculated from

$$Bias(\%) = 100 \times \frac{(\bar{C} - S)}{S}$$

where

$$\bar{C} = \frac{\sum_{i=1}^N C_i}{N}$$

and C_i is the measured value, S is the standard value for the QC check sample, and N is the number of QC check samples analyzed during the quarter. The 95%

confidence interval about the mean bias is calculated from the standard deviation of the QC check sample results

$$95\% \text{ C.I. } (\%) = 100 \times 1.96 \times \frac{\sigma}{S \sqrt{N}}$$

where

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (C_i - \bar{C})^2}$$

The factor of 1.96 scales the standard deviation to represent the 95% confidence interval if the departures from the mean are normally distributed. Since the distribution of departures is usually not normal, the 95% confidence interval can only be used as a guide to the variability associated with the quality control results.

When more than one standard check sample is used during the quarter, the mean bias and 95% confidence intervals are based on weighted means:

$$\overline{Bias} = \frac{\sum_{j=1}^M (M_j \times Bias_j)}{\sum_{j=1}^M M_j}$$

$$\overline{95\% \text{ C.I.}} = \frac{1}{\sum_{j=1}^M M_j} \sqrt{\sum_{j=1}^M M_j \times (95\% \text{ C.I.})_j^2}$$

where there are M_j samples for each of M groups of standards, and $Bias_j$ and $(95\% \text{ C.I.})_j$ are the respective bias and confidence interval for each group.

Figure B.1 shows the biases in various measured values by quarter of the year. The wide confidence interval on the pH and H ion concentration bias in the fourth quarter of 1988 was caused by the effect of abnormally low laboratory temperatures on the operation of the pH meter. These low interior temperatures were caused by record-setting, extremely cold ambient temperatures during that period. The wide confidence interval on K ion concentration bias in the second quarter of 1990 was caused by an unrecognized instrument error. The cause of the wide confidence interval on the Cl ion concentration bias in the second quarter of 1990 is unknown.

PRECISION

The analysis of duplicate samples is a quality control procedure that allows the precision of the measurement to be estimated. Two aliquots taken from the same rain sample are treated as though they were individual samples. By comparing the results of the measurements on the pairs of duplicated samples, the precision of the measurement can be estimated from either the mean absolute relative difference (<ARD>) or the geometric mean fractional difference (<MFD>):

$$\langle \text{ARD} \rangle = 100 \times \frac{1}{N} \sum_{i=1}^N \frac{|V_a - V_b|_i}{(V_a + V_b)_i}$$

$$\langle \text{MFD} \rangle = 10^{\frac{1}{N} \sum_{i=1}^N |\text{Log}(V_a/V_b)_i|}$$

where V_a and V_b are the independently measured values for the i -th pair of N duplicate samples. The ranges of these measures of precision are 0% to 100% for <ARD> and 1 to infinity for the <MFD>. The results given in Table 5 of the text express the mean fractional difference as $100 \times (\langle \text{MFD} \rangle - 1)$.

Confidence intervals on the estimate of precision are based on the standard deviations of the respective measures:

$$95\% \text{ C.I. on } \langle \text{ARD} \rangle = 100 \times 1.96 \times \frac{1}{N} \sqrt{\sum_1^N \left[\frac{|V_a - V_b|_i}{(V_a + V_b)_i} - \langle \text{ARD} \rangle \right]^2}$$

$$95\% \text{ C.I. on } \langle \text{MFD} \rangle = 100 \times \left[10^{1.96 \times \frac{1}{N} \sqrt{\sum_1^N [\text{Log}(V_a/V_b)_i - \langle \text{MFD} \rangle]^2}} - 1 \right]$$

Table B.9 lists the duplicate sample analyses for 1989 from which the results presented in Table 5 were derived. Table B.10 gives the distribution of the fraction of pairs of duplicate samples with an equal or smaller given absolute relative difference. For H^+ , SO_4 , NO_3 , Cl , NH_4 , and Ca , more than 90% of the duplicate samples had an average relative error less than 10%.

TABLE B.1. Analytical Bias (%) and 95% C.I. (%) with Respect to QC Standard

Species	YEAR.QUARTER						
	88.4	89.1	89.2	89.3	89.4	90.1	90.2
pH	-1.5 ±0.4	-0.2 ±0.1	-0.1 ±0.1	-0.1 ±0.1	-0.1 ±0.1	-0.8 ±0.2	0.2 ±0.1
H	17.4 ±4.8	2.5 ±0.8	0.9 ±0.8	1.5 ±1.0	0.8 ±1.0	8.0 ±1.6	-2.1 ±1.3
COND	24.8 ±3.3	1.7 ±1.1	-0.5 ±1.2	-5.2 ±5.8	-6.1 ±1.4	-10.6 ±1.3	1.5 ±1.4
SO4	-1.7 ±1.0	-0.8 ±1.1	-1.8 ±0.5	-2.7 ±1.6	1.0 ±1.9	-2.0 ±0.6	-4.9 ±1.0
NO3	-1.4 ±2.1	2.1 ±3.7	-1.0 ±1.0	-2.0 ±0.8	-0.1 ±1.4	-2.7 ±3.6	-1.7 ±1.6
Cl	5.9 ±3.2	6.4 ±6.1	13.9 ±2.7	14.4 ±2.6	5.6 ±2.4	2.5 ±3.6	26.4 ±32.9
SO2	-0.7 ±2.2	39.4 ±20.5	-2.4 ±3.1	1.9 ±1.5	1.5 ±1.4	-1.8 ±2.5	3.2 ±1.6
NH4	-3.6 ±1.2	-0.5 ±1.7	-0.4 ±0.8	-0.0 ±1.9	-2.4 ±1.0	-2.6 ±1.2	-1.5 ±1.4
Na	-3.2 ±7.6	-9.5 ±1.2	-18.0 ±4.9	-11.3 ±3.2	-19.6 ±1.6	-12.7 ±1.4	-14.0 ±6.1
K	-1.5 ±5.1	-6.0 ±5.2	8.3 ±26.3	-10.6 ±28.0	3.6 ±16.9	3.2 ±20.6	12.7 ±61.9
Ca	1.5 ±1.7	-4.0 ±5.9	-5.1 ±2.1	-1.4 ±2.8	-0.3 ±0.9	-1.0 ±1.5	-2.6 ±1.3
Mg	0.8 ±1.1	-3.7 ±5.7	-4.6 ±1.3	-3.7 ±1.5	1.5 ±1.0	0.3 ±1.4	-2.6 ±1.0

TABLE B.2. QC Check Sample Results for the Fourth Quarter of 1988

	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
	µM	µM	µM	µM	µM	µM	µM	µM	µM		µM	µS
STANDARD	217	127	25.0	41.0	41.7	15.9	29.9	30.0	15.5	4.32	47.9	19
GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
473 OCT/88	212	146	27.1	40.8	39.8	15.0	28.8	29.7	15.9	4.31	49.0	22
473 OCT/88	219	146	25.0	41.2	41.1	16.5	28.1	27.3	14.7	4.31	49.0	27
473 OCT/88					41.1		28.9	30.9	10.7	4.28	52.5	25
473 OCT/88					39.8		31.3	29.7	19.0	4.29	51.3	26
474 OCT/88	214	128	24.9	40.7	37.1	16.5	28.5	28.3	15.4	4.28	52.5	25
474 OCT/88	217	147	24.9	41.2	37.1	18.0	29.1	30.7	15.9	4.29	51.3	26
474 OCT/88					42.4		28.5	29.5	18.1	4.29	51.3	
474 OCT/88					41.1		30.5	32.4	16.4	4.31	49.0	
475 OCT/88	219	117	25.2	40.6	39.8	16.5	28.5	30.2	15.5	4.30	50.1	26
475 OCT/88	210	118	24.9	40.6	39.8	15.0	29.0	32.5	21.8	4.29	51.3	27
475 OCT/88	214	141	24.9	40.4	39.8		29.4	29.6	18.0	4.30	50.1	26
475 OCT/88					39.8		29.1	31.3	16.8	4.30	50.1	25
476 OCT/88 *	212	102	24.8	40.5	42.4	15.0	30.0	30.6	16.9	4.20	63.1	26
476 OCT/88 *	213	104	24.9	40.9	42.4	16.5	30.4	32.7	17.9	4.24	57.5	26
476 OCT/88 *							28.5	30.3	16.6	4.24	57.5	28
476 OCT/88 *							27.3	30.0	17.0	4.22	60.3	25
477 NOV/88 *	248	119	24.8	40.8	42.4	15.8	29.6	29.6	15.5	4.25	56.2	22
477 NOV/88 *	217	132	25.0	40.7	40.7	16.5	30.0	30.6	15.5	4.18	66.1	33
477 NOV/88 *							29.1	30.5	14.7	4.20	63.1	25
477 NOV/88 *							29.9	28.6	16.0	4.21	61.7	25
478 NOV/88 *	218	98	26.5	41.5	40.7	18.1	29.4	30.8	16.3	4.18	66.1	24
478 NOV/88 *	218	167	25.9	42.5	40.7	15.1	29.5	29.3	16.3	4.20	63.1	23
478 NOV/88 *					38.0		30.8	30.9	15.4	4.20	63.1	24
478 NOV/88 *							29.2	26.8	18.7	4.18	66.1	24
479 NOV/88 *	214	122	25.6	41	40.7	16.6	28.3	31.8	13.9	4.19	64.6	23
479 NOV/88 *	213	117	25.4	40.9	39.3	15.1	29.9	21.3	11.5	4.19	64.6	22
479 NOV/88 *					38.0		29.3	30.0	17.9	4.19	64.6	22
479 NOV/88 *							27.3	26.4	15.4	4.18	66.1	21
480 JAN/89 *	215	126	26.6	44.1	40.7	14.3	29.3	28.0	15.3	4.18	66.1	24
480 JAN/89 *	218	136	25.2	41.8	35.4	15.1	29.3	31.7	16.2	4.17	67.6	22
480 JAN/89 *					40.9	15.1	29.8	34.1	16.0	4.20	63.1	22
480 JAN/89 *							28.7	28.2	16.3	4.18	66.1	22
481 JAN/89 *	215	111	25.6	42.1	38.2	16.8	30.0	29.7	11.1	4.18	66.1	24
481 JAN/89 *	219	130	25.4	42.1	41.0	15.9	30.0	32.8	19.5	4.19	64.6	22
481 JAN/89 *	221	105	29.0	43.8	41.0	15.9	25.9	32.3	15.0	4.19	64.6	22
481 JAN/89 *							29.3	30.0	16.3	4.17	67.6	22
482 JAN/89 *	242	125	25.1	41.5	40.9	15.1	29.3	26.5	14.4	4.18	66.1	24
482 JAN/89 *	215	111	26.0	43.7	41.7	15.9	29.8	30.4	15.9	4.18	66.1	22
482 JAN/89	214	140	24.0	40.1	41.0		28.3	31.1	15.9	4.35	44.7	22
482 JAN/89							29.3	24.2	17.3	4.34	45.7	23
483 JAN/89			28.2	43.2	37.6	14.1	30.4	30.6	15.5	4.33	46.8	23
483 JAN/89			23.7	39.2	39.3	15.9	29.8	30.8	15.9	4.35	44.7	22
483 JAN/89					39.3		31.6	34.7	18.0	4.34	45.7	21
483 JAN/89							28.9	30.6	17.9	4.35	44.7	22
484 FEB/89			24.0	39.8	42.5	14.1	29.3	29.8	17.0	4.36	43.7	22
484 FEB/89			24.3	39.8	39.9	15.6	29.0	33.3	16.6	4.34	45.7	22
484 FEB/89					43.0		29.6	30.9	17.9	4.32	47.9	23
484 FEB/89							32.6	32.5	18.3	4.35	44.7	24

TABLE B.2. (Continued)

GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
485 FEB/89	225	125	24.9	41.7	39.9	15.6	30.8	31.7	15.7	4.32	47.9	22
485 FEB/89	215	111	24.8	41.7	39.9	15.6	30.1	32.2	18.5	4.31	49.8	23
485 FEB/89					39.9	14.7	30.9	31.5		4.32	47.9	22
485 FEB/89							30.8	31.7				
AVG VALUE (μM)	202.64	120.41	24.57	40.80	39.22	15.26	28.83	29.59	16.89	4.17	55.15	23.24
STD DEV (μM)	42.80	18.40	1.15	1.19	1.64	9.97	1.09	2.32	1.79	0.07	8.33	2.21
COUNT	25	25	29	29	40	29	52	52	50	51	51	49

* Lab was very cold during these pH analyses.

TABLE B.3. QC Check Sample Results for the First Quarter of 1989

	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
	µM	µM	µM	µM	µM	µM	µM	µM	µM		µM	µS
STANDARD	130	76.0	15.0	24.6	41.7	15.9	19.9 31.8	20.4	10.3	4.32	47.9	22
GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
490 FEB/89	112	70.5	14.4	24.2	43.0	15.1	20.1	23.7	9.5	4.30	50.1	23
490 FEB/89	118	69.1	13.9	23.4	41.6	15.9	19.9	24.5	11.4	4.31	49.0	22
490 FEB/89					39.0		19.8	24.7	12.0	4.32	47.9	22
490 FEB/89							22.1	19.1	8.7	4.31	49.0	22
491 FEB/89	119	71.5	14.3	23.4	36.3	14.3	21.0	21.1	8.6	4.29	51.3	23
491 FEB/89	113	67.3	15.6	26.2	41.0	14.3	19.4	18.9	6.9	4.29	51.3	22
491 FEB/89					41.6		21.1	20.4	16.0	4.30	50.1	22
491 FEB/89							19.6	19.0	9.0	4.29	51.3	22
492 FEB/89	118	71.0	14.7	24.6	41.6	15.0	19.3	20.5	8.5	4.29	51.3	22
492 FEB/89	117	55.5	17.1	25.5	41.6	15.6	18.2	25.1	9.3	4.31	49.0	22
492 FEB/89					40.4		20.9	20.5	6.8	4.32	47.9	24
492 FEB/89							19.5	19.3	6.5	4.30	50.1	22
493 FEB/89	113	66.3	14.7	24.5	41.7	16.9	19.6	20.1	7.1	4.31	49.0	22
493 FEB/89	113	80.4	17.4	26.7	39.1		20.0	20.1	8.8	4.30	50.1	22
493 FEB/89					40.4		19.7	22.6	7.0	4.31	49.0	22
493 FEB/89										4.29	51.3	22
494 MAR/89	119	70.0	14.1	24.3	41.7	31.4	19.3	22.6	10.0	4.30	50.1	24
494 MAR/89	122	97.0	14.2	23.9	43.0		21.1	23.8	10.4	4.31	49.0	21
494 MAR/89					36.5		21.1	23.3	12.0	4.29	51.3	22
494 MAR/89							21.1			4.30	50.1	21
495 MAR/89	118	45.0	14.4	23.7	42.4	31.9	20.3	22.4	11.4	4.32	47.9	23
495 MAR/89	119	56.0	13.9	23.6	41.0		21.3	22.5	11.4	4.31	49.0	22
495 MAR/89					32.2		20.3	23.0	13.6	4.32	47.9	24
495 MAR/89					41.0		19.6	19.9	9.9	4.30	50.1	22
496 MAR/89	118	84.8	14.8	24.1	44.0	30.2	19.4	19.9	10.4	4.30	50.1	23
496 MAR/89	121	55.1	15.1	24.1	40.3	30.8	19.5	22.3	13.8	4.30	50.1	22
496 MAR/89					42.5		19.6	21.8	13.6	4.31	49.0	23
496 MAR/89					43.2		19.6	21.7	13.5	4.31	49.0	22
497 MAR/89	115	78.0	14.7	24.1	44.0	31.2	19.4	21.5	13.4	4.30	50.1	24
497 MAR/89	111	55.1	14.1	24.0	42.3	26.6	19.4	22.0	13.5	4.31	49.0	23
497 MAR/89					44.6	30.1	19.3	21.9	13.3	4.31	49.0	22
497 MAR/89					40.1		19.1	20.8	12.8	4.30	50.1	23
498 MAR/89	116	68.7	14.1	23.3	40.4	15.5	21.1	21.8	13.9	4.32	47.9	24
498 MAR/89	120	85.0	15.0	24.0	40.4	13.1	19.8	22.9	13.6	4.32	47.9	22
498 APR/89					42.8		20.8	22.4	13.9	4.31	49.0	23
498 APR/89					40.4		19.6	23.4	14.3	4.32	47.9	23
499 APR/89	123	87.9	14.1	24.4	42.0	14.7	17.9	18.8	12.0	4.34	45.7	23
499 APR/89	115	59.0	14.5	23.6	42.0	14.7	21.4	21.2	13.2	4.33	46.8	22
499 APR/89							19.2	20.9	13.0	4.31	49.0	25
499 APR/89							19.0	20.5	10.2	4.31	49.0	23
500 APR/89	124	93.0	14.4	24.2	46.8	14.7	19.9	21.1	10.8	4.33	46.8	22
500 APR/89	124	68.9	14.5	23.5		13.9	19.0	20.5	11.1	4.32	47.9	23
500 APR/89	125	68.7	14.4	23.9			20.1	23.7	13.4	4.33	46.8	22
500 APR/89							19.8	22.9	13.0	4.32	47.9	23
501 APR/89	132	63.7	14.6	24.0	40.9	15.5	19.5	21.0	10.7	4.27	53.7	24
501 APR/89	117	74.4	14.1	24.0	40.9		19.3	19.4	11.0	4.29	51.3	22
501 APR/89					41.6		19.8	20.7	12.0	4.31	49.0	24
501 APR/89							19.7	21.1	12.7	4.31	49.0	22
502 APR/89	124	68.6	14.2	23.5	41.6	32.5	19.3	21.1	12.9	4.31	49.0	23
502 APR/89	122	83.8	14.9	25.6	46.2	33.2	19.4	19.7	12.1	4.33	46.8	23
502 MAY/89					42.2		21.7	22.8	8.6	4.31	49.0	22
502 MAY/89							19.2	19.8	10.7	4.31	49.0	22
503 MAY/89	118	67.8	20.0	32.7	43.6	36.0	19.2	20.1	11.2	4.31	49.0	22
503 MAY/89	117	92.5	14.4	23.4	41.2		19.2	20.2	12.9	4.33	46.8	21
503 MAY/89					34.8		19.4	19.8	12.4	4.33	46.8	19

TABLE B.3. (Continued)

GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
583 MAY/89							19.7	20.7	12.7	4.31	49.0	22
584 MAY/89	111	84.9	14.2	23.7	42.5		18.6	19.9	10.6	4.32	47.9	22
584 MAY/89	107	80.1	14.3	23.6	38.6		19.0	19.5	9.4	4.31	49.0	21
584 MAY/89					42.5		18.7	19.4	9.3	4.33	46.8	21
584 MAY/89							19.1	19.7	10.3			21
585 MAY/89	115	83.0	16.4	24.3	46.4		18.6	19.9	10.6			
585 MAY/89	114	78.4	14.4	23.6	43.8		19.0	19.5	9.4			
585 MAY/89					42.5		18.7	19.4	9.3			
585 MAY/89							19.1	19.7	10.3			
586 MAY/89	112	74.0	14.2	23.8	42.5	31.2						
586 MAY/89	118	86.4	14.3	23.6	40.2							
586 MAY/89					44.8							
AVG VALUE (μM)	117.66	71.47	14.40	23.69	41.49	14.94	19.75	20.83	10.96	4.31	49.04	22.38
STD DEV (μM)	4.90	11.92	2.70	4.31	.59	0.90	0.88	3.08	2.55	0.01	1.49	0.98
COUNT	35	35	36	36	52	14	63	63	63	59	59	60
AVG VALUE (μM)						31.37						
STD DEV (μM)						2.18						
COUNT						11						

TABLE B.4. QC Check Sample Results for the Second Quarter of 1989

	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
	µM	µM	µM	µM	µM	µM	µM	µM	µM		µM	µS
STANDARD	17.4	10.2	7.5	12.4	41.7	15.9	23.9	24.5	12.3	4.32	47.9	22
GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
507 APR/89	13.2	10.6	7.1	11.0	39.9		23.9	25.0	13.5	4.27	53.7	21
507 APR/89	11.9	3.9	7.1	11.0	41.3		23.0	24.9	12.8	4.31	49.0	21
507 APR/89	12.6	27.8					23.6	25.1	12.7			
507 APR/89	12.0	7.4					23.3	23.9	13.0			
508 APR/89	12.1	4.9	7.1	11.9	41.3	14.3	24.6	23.7	13.4	4.32	47.9	22
508 APR/89	11.9	3.6			39.8		24.2	24.6	13.4	4.31	49.0	22
508 APR/89							24.1	24.9	12.5			
508 APR/89						16.1	23.2	24.1	13.0			
509 MAY/89	12.6	6.4	6.8	11.3	42.0		23.0	23.8	12.6	4.31	49.0	22
509 MAY/89	12.2	10.0	5.5	11.7			23.3	23.8	12.9			
509 MAY/89						16.1	23.5	24.6	13.2			
509 MAY/89							23.1	24.7	13.1			
510 MAY/89	12.8	<	5.9	12.4	42.0		23.9	22.9	12.8	4.32	47.9	25
510 MAY/89	12.9	<	5.1	11.2	42.1	14.3	23.4	23.7	12.5	4.3	50.1	22
510 MAY/89					42.0		23.1	23.5	12.4			
510 MAY/89							23.2	23.5	12.7			
511 MAY/89	13.0	11.2	7.0	11.7	39.8	14.3	24.7	24.1	12.8	4.28	52.5	22
511 MAY/89	14.5	6.5	7.1	11.4	42.0		22.7	23.0	12.6	4.3	50.1	21
511 MAY/89					44.3		23.4	23.2	12.7			
511 MAY/89						16.1	22.7	24.5	15.1			
512 MAY/89	14.2	21.9	7.1	11.7	42.0		23.3	23.9	14.0	4.33	46.8	22
512 MAY/89	12.5	24.1	6.9	11.6	38.6		23.4	23.7	14.6	4.33	46.8	22
512 MAY/89						16.1	23.5	24.4	15.0	4.35	44.7	22
512 MAY/89										4.32	47.9	
513 JUN/89	14.6	9.6	7.3	11.7	38.6		23.3	24.3	15.0	4.32	47.9	23
513 JUN/89	12.6	4.2	7.0	11.6	41.5	17.9	23.1	23.9	14.2	4.33	46.8	21
513 JUN/89					41.5		23.3	24.0	14.3	4.32	47.9	
513 JUN/89					42.2		23.1	23.4				
514 JUN/89	12.9	10.8	7.3	11.0	41.2	13.2	22.9	23.4	13.3	4.31	49.0	21
514 JUN/89			7.2	11.8	41.2		22.6	23.1	13.7	4.3	50.1	20
514 JUN/89					40.4		23.1	22.6	13.5	4.3	50.1	19
514 JUN/89						14.9	22.9	23.5	13.7			
515 JUN/89	13.4	10.3	7.3	11.5	40.4		24.6	25.6	18.1	4.31	49.0	20
515 JUN/89	12.7	21.8	7.1	11.8	41.9		24.6	25.4	18.1	4.32	47.9	22
515 JUN/89					41.2	14.9	24.6	25.8	18.3			
515 JUN/89							24.6	26.1	18.8			
516 JUN/89	13.1	14.8	7.1	12.0	41.0	14.9	24.6	25.6	18.4	4.3	50.1	24
516 JUN/89	12.5	18.9	7.3	11.9	45.6		24.8	25.7	17.3			
516 JUN/89					41.0		24.7	26.2	17.3			
516 JUN/89						14.9			18.6			
517 JUN/89	12.8	20.1	7.0	12.2	40.3		24.8	26.2	12.2	4.32	47.9	22
517 JUN/89	13.3	9.0	7.0	11.4	41.0		25.0	26.6	13.3	4.3	50.1	23
517 JUN/89	14.0	9.3	7.0	11.7	39.5	13.2	22.9	29.1				
517 JUN/89							22.8	23.5				
518 JUL/89	13.5	12.7	8.0	12.0	42.6		23.2	23.9	13.5	4.3	50.1	23
518 JUL/89	13.6	<	7.4	11.1	42.6		23.1	23.6	13.0	4.31	49.0	23
518 JUL/89					42.4	16.5	23.1	23.7	13.4			
518 JUL/89							23.0	23.3	13.6			
519 JUL/89	14.1	19.5	6.7	11.5	44.0		23.3	23.5	13.8	4.32	47.9	22
519 JUL/89	13.9	7.4	6.8	11.4	42.4	16.5	23.1	23.7	14.4	4.32	47.9	22
519 JUL/89	14.4	12.7		10.7	44.0		23.2	23.7	14.2			
519 JUL/89			7.6				23.2	23.8	14.2			
520 JUL/89	13.8	1.6	7.1	13.1	40.8	15.6	22.9	23.5	12.4	4.34	45.7	22
520 JUL/89	13.3	<	7.2	11.9	40.8		23.1	23.7	12.5	4.31	49.0	21
520 JUL/89					40.8		23.0	23.6	12.6	4.33	46.8	23
520 JUL/89							23.4	23.9	13.4			

TABLE B.4. (Continued)

GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
521 JUL/89	15.7	19.9	7.2	11.6	40.8	12.5	23.6	24.3	14.1	4.32	47.9	22
521 JUL/89	14.7	5.0	7.2	11.9	42.4		23.2	24.2	13.9	4.33	46.8	23
521 JUL/89							23.7	23.7	13.7	4.32	47.9	23
521 JUL/89							23.1	23.2	13.3			
522 JUL/89	15.3	<	7.0	12.7	43.2	15.6	23.9	23.9	13.6	4.33	46.8	22
522 JUL/89	18.2	4.2	7.0	13.0	43.2		23.4	24.1	14.1	4.3	50.1	22
522 JUL/89	13.9	12.6	7.3	13.5			22.8	23.6	13.7	4.32	47.9	22
522 JUL/89							23.1	23.8	13.8			
523 JUL/89	13.4	8.0	7.0	11.6	40.0	17.2	22.9	23.7	12.6	4.32	47.9	22
523 JUL/89	13.8	<	7.3	11.9	40.8		23.1	24.5	13.0	4.31	49.0	21
523 JUL/89					40.8		23.6	24.0	13.4	4.32	47.9	21
523 JUL/89					41.6		23.9	24.5	13.2			
524 JUL/89	12.7	<	8.1	13.7	42.4		23.8	23.8	13.7	4.32	47.9	22
524 JUL/89	13.0	20.6	8.3	11.7	42.1	16.4	23.4	23.8	14.0	4.32	47.9	21
524 JUL/89					42.8		23.4	24.5	14.2	4.33	46.8	21
524 JUL/89							23.1	23.7	14.0			
525 JUL/89	15.1	<	7.1	11.5	41.2	14.0	23.3	24.7	15.4	4.31	49.0	22
525 JUL/89	17.0	28.0	7.3	11.5	41.2		23.7	26.2	15.9	4.32	47.9	21
525 JUL/89					39.5	15.6	23.7	24.4	14.5	4.32	47.9	22
525 JUL/89							23.2	26.5	17.2			
526 JUL/89	17.8	27.2	7.0	11.3	41.2	14.8	23.8	23.3	13.4	4.32	47.9	22
526 JUL/89	29.0	40.0	7.0	11.8	41.2		22.3	24.7	13.3	4.32	47.9	22
526 JUL/89					41.2	18.3	23.6	23.1	13.6	4.33	46.8	22
526 JUL/89							23.2	23.2	13.0			
527 JUL/89	15.2	5.6	7.1	11.6	42.7	16.9	23.0	23.6	11.7	4.33	46.8	22
527 JUL/89	18.5	15.4	7.3	11.9	42.7		23.3	24.6	12.8	4.33	46.8	22
527 JUL/89					39.5	15.6	22.6	24.2	14.7	4.32	47.9	22
527 JUL/89							23.5	23.3	14.8			
528 JUL/89	10.9	0.6	7.4	11.8	41.1	16.9	23.4	25.0	14.8	4.32	47.9	22
528 JUL/89	23.4	<	7.0	11.4	39.5	16.6	23.2	24.7	14.8	4.32	47.9	22
AVG VALUE (μM)	14.26	13.69	7.10	11.83	41.52	15.52	23.46	24.26	14.01	4.32	48.28	21.88
STD DEV (μM)	3.01	8.73	0.54	0.57	1.38	1.36	0.59	1.10	1.55	0.01	1.52	0.95
COUNT	48	39	46	46	60	29	84	84	82	54	54	52

< = less than minimum detectable level, not included in average.

TABLE B.5. QC Check Sample Results for the Third Quarter of 1989

	Na μM	K μM	Ca μM	Mg μM	NH ₄ μM	SO ₂ μM	SO ₄ μM	NO ₃ μM	Cl μM	pH	H μM	COND μS
STANDARD	17.4 217.0 43.5	10.2 256.0 23.6	7.5 25.0	12.4 41.0	69.5	15.9	28.0 19.9 28.0	28.5 20.4 28.5	12.3 10.3 14.3	4.32	47.9	22 21
GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
530 AUG/89	14.0	<	7.0	11.7	66.1	17.5	28.3	27.5	15.0	4.32	47.9	21
530 AUG/89	19.6	7.2	7.8	11.1	67.8	17.5	28.3	27.6	15.2	4.33	46.8	25
530 AUG/89							27.5	28.5	15.9			
531 AUG/89	13.9	20.4	7.3	11.7	69.7	16.0	27.0	27.7	14.1	4.32	47.9	22
531 AUG/89	21.8	10.0	7.1	11.9	70.6	16.0	27.1	28.3	15.3	4.33	46.8	21
531 AUG/89							27.7	29.0	15.5			
531 AUG/89							27.3	28.2	15.1			
532 AUG/89	15.6	<	7.2	11.6	68.7	16.0	27.2	28.1	15.2	4.3	50.1	23
532 AUG/89					63.7	14.6	27.2	28.1	15.3	4.33	46.8	22
532 AUG/89							27.0	28.1	14.5			
532 AUG/89							27.1	28.0	14.6			
533 AUG/89	15.1	13.3	7.3	11.8	71.6	16.0	26.9	26.1	14.5	4.33	46.8	22
533 AUG/89	17.0	41.0		11.5	71.6	14.6	27.3	28.2	14.9	4.32	47.9	24
533 AUG/89							26.8	28.1	14.6			
533 AUG/89							26.9	27.9	15.4			
534 SEP/89	204.0	198.0	7.3	11.9	72.6	16.0	18.9	19.0	11.5	4.32	47.9	22
534 SEP/89	204.0	252.0	7.6	12.0	75.6	16.7	19.3	20.0	12.8	4.32	47.9	22
534 SEP/89												
535 SEP/89	209.0	243.0	7.3	12.2	67.3	16.0	19.1	19.6	13.5	4.29	51.3	23
535 SEP/89	208.0	212.0	7.4	11.9	72.9	16.7	19.3	20.0	12.4	4.29	51.3	23
535 SEP/89							19.4	19.8	12.0			21
535 SEP/89							19.3	19.8	12.9			
536 SEP/89	206.0	263.0	7.1	11.3	67.3	16.0	18.5	18.9	11.1	4.32	47.9	22
536 SEP/89	184.0	289.0	7.2	11.7	68.3	16.7	19.2	19.8	12.6	4.32	47.9	22
536 SEP/89							19.3	20.0	12.3			
536 SEP/89							19.3	20.0	12.4			
537 SEP/89	223.0	235.0	7.4	12.7	69.2	16.0	19.5	20.3	13.1	4.32	47.9	22
537 SEP/89	207.0	167.0	6.9	11.4		16.0	19.2	19.8	13.2	4.31	49.0	22
537 SEP/89							19.7	19.3	11.0	4.31	49.0	
537 SEP/89							20.6	20.3	14.5			
538 SEP/89	35.2	16.4	7.1	11.9	69.2	16.0	19.3	19.8	10.1	4.34	45.7	23
538 SEP/89	34.3	9.1	9.6	12.9	71.1	16.0	17.0	19.1	10.7	4.32	47.9	22
538 SEP/89							18.5	19.3	10.2	4.3	50.1	23
538 SEP/89							26.4		13.4			
539 SEP/89	35.7	3.4	8.2	13.2	72.1	16.2	27.8	27.7	15.2	4.3	50.1	24
539 SEP/89	34.5	<	6.7	11.2		17.6	27.1	29.0	17.4	4.32	47.9	22
539 SEP/89							27.1	29.0	17.3	4.32	47.9	22
539 SEP/89							27.1	29.0	17.4			
540 SEP/89	34.3	24.8	7.9	12.7	69.9	16.2	26.9	27.1	9.7	4.31	49.0	19
540 SEP/89	35.9	3.6	6.8	10.6	67.6	15.4	26.1	25.9	14.4	4.31	49.0	19
540 SEP/89	35.0	19.2	6.9	11.9			27.0	27.2	15.2	4.31	49.0	20
540 OCT/89							26.8	28.3	15.5			
541 OCT/89	34.2	31.6	24.5	40.0	72.1	16.2	27.0	27.9	14.0	4.31	49.0	20
541 OCT/89	32.5	18.6	23.4	40.4		16.2	26.6	27.6	14.7	4.29	51.3	18
541 OCT/89							26.6	27.5	14.8	4.29	51.3	
541 OCT/89							27.3	28.5	15.2			
542 OCT/89	36.1	14.8	24.0	40.2	72.1	16.2	27.3	28.4	15.8	4.31	49.0	21
542 OCT/89	36.2	4.5	23.2	39.8		16.2	38.2	27.8	15.3	4.32	47.9	18
542 OCT/89							25.5	30.1	16.2			
542 OCT/89							26.6	28.7	15.8			

TABLE B.5. (Continued)

GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
543 OCT/89			27.4	40.2	63.1	16.0	20.1	30.5	15.5	4.32	47.9	20
543 OCT/89			23.8	40.1	63.1	17.4	27.1	26.6	13.7	4.28	52.5	20
543 OCT/89							27.9	28.9	15.5			
543 OCT/89							28.9	29.4	15.8			
544 OCT/89	30.2	39.9	25.4	41.6	67.6	16.0	27.4	27.3	15.3	4.33	46.8	20
544 OCT/89						16.0			14.7	4.32	47.9	20
544 OCT/89										4.31	49.0	21
AVG VALUE (μM)	16.71	18.38	7.38	11.65	69.48	16.20	27.04	27.96	15.07	4.31	48.60	20.86
STD DEV (μM)	2.76	12.14	0.60	0.60	3.40	0.60	0.37	0.61	0.53	0.01	1.53	3.81
COUNT	7	5	21	22	25	30	15	15	15	36	36	35
AVG VALUE (μM)	205.6	232.4	24.5	40.3			19.1	19.7	12.2			
STD DEV (μM)	10.0	36.3	1.4	0.5			0.7	0.4	1.2			
COUNT	8	8	7	7			17	17	17			
AVG VALUE (μM)	35.0	16.9					27.6	28.2	15.1			
STD DEV (μM)	1.1	11.3					2.4	1.1	1.6			
COUNT	12	11					22	21	22			

< = less than minimum detectable level, not included in averages.

TABLE B.6. QC Check Sample Results for the Fourth Quarter of 1989

	Na µM	K µM	Ca µM	Mg µM	NH ₄ µM	SO ₂ µM	SO ₄ µM	NO ₃ µM	Cl µM	pH	H µM	COND µS
STANDARD	43.5	25.6	12.5	20.6	69.5	15.9	29.9	30.6	15.4	4.32	47.86	22
GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
545 NOV/89	33.0	30.0	12.5	21.1	70.6	16.0	28.0	29.0	17.3	4.31	49.0	20
545 NOV/89	31.0	42.0	12.7	21.1	66.2	15.5	27.0	28.5	15.8	4.30	50.1	21
545 NOV/89	34.3	18.5	12.7	20.6								
546 NOV/89	31.6	10.2	12.5	20.7	69.7	15.5	28.8	30.7	14.9	4.36	43.7	20
546 NOV/89	38.0	0.3	12.6	21.0	68.0	15.5	28.2	29.5	14.2	4.30	50.1	21
546 NOV/89	35.0	31.2	12.8	21.4			27.3	28.4	13.5	4.32	47.9	20
546 NOV/89							29.8	31.7	15.9			
547 NOV/89	35.0	29.8	12.0	21.7	69.7	16.2	29.4	29.8	12.8	4.31	49.0	20
547 NOV/89					69.4	17.0	29.2	30.6	13.8	4.31	49.0	19
547 NOV/89					69.4		29.4	30.7	14.1	4.30	50.1	20
547 NOV/89							29.3	31.8	15.3			
548 NOV/89	36.8	29.8	12.4	20.7	67.3	17.0	29.8	31.9	15.2	4.31	49.0	20
548 NOV/89	34.0	42.0	13.1	21.6		17.0	29.4	30.8	14.6	4.32	47.9	19
548 NOV/89							29.3	30.2	15.6	4.33	46.8	20
548 NOV/89							29.8	31.2	16.3			
549 NOV/89	35.0	6.0	12.0	20.8	67.3	17.0	29.2	30.4	16.9	4.32	47.9	21
549 NOV/89	35.7	31.8	12.4	21.1		16.4	29.6	31.3	18.1	4.33	46.8	19
549 NOV/89							22.8	27.0	15.6	4.33	46.8	20
549 NOV/89							31.6	26.8	13.7			
550 NOV/89	38.5	34.8	12.4	21.1	67.3	15.3	35.1	27.3	14.3	4.31	49.0	21
550 NOV/89	36.2	21.8	12.4	21.2	66.9	16.4	30.7	26.6	16.1	4.30	50.1	21
550 NOV/89							30.6	27.7	16.5			
550 NOV/89							39.4	30.2	15.1			
551 NOV/89	36.1	6.7	12.3	20.8	66.9	15.3	29.0	30.3	15.7	4.29	51.3	21
551 NOV/89	33.8	28.7	12.3	20.5		16.4	29.2	30.2	16.3	4.33	46.8	21
551 NOV/89	37.5	41.5	12.3	20.5			29.5	30.0	17.0			
551 NOV/89							29.1	30.4	17.7			
552 NOV/89	33.0	24.6	12.5	21.2	65.1	16.4	29.3	30.4	16.0	4.32	47.9	23
552 NOV/89					68.6	16.4	29.1	29.4	15.7	4.32	47.9	20
552 NOV/89							29.6	30.4	17.0			
553 NOV/89	32.0	14.3	12.5	21.5	70.4	15.5	29.3	29.9	16.8	4.31	49.0	22
553 NOV/89					66.9	16.8	29.4	31.0	17.0	4.32	47.9	20
553 NOV/89							29.7	31.6	17.7			
553 NOV/89							29.3	30.4	16.9			
554 NOV/89	36.2	24.0	12.3	20.0	68.6	15.5	32.1	29.9	15.3	4.32	47.9	22
554 NOV/89	35.2	24.0	12.3	19.9	64.2	15.5	29.2	29.4	15.9	4.32	47.9	21
554 NOV/89	36.3	20.1	12.5	20.8			29.0	29.6	16.0	4.32	47.9	22
554 NOV/89							30.0	30.4	16.7			
555 NOV/89	34.3	17.0	12.2	21.8	64.2	16.4	29.1	30.4	16.3	4.32	47.9	22
555 NOV/89	36.8	33.4			70.1	17.0	30.0	30.9	15.1	4.32	47.9	21
555 NOV/89							30.6	30.3	16.4			
555 NOV/89							35.1	30.1	16.2			
556 NOV/89	34.7	33.4			68.5	15.7	31.2	31.1	16.7	4.32	47.9	21
556 NOV/89	35.0	31.1			66.9	17.0	31.0	31.7	18.3	4.32	47.9	21
556 NOV/89							31.3	33.2	17.3			
556 NOV/89							32.7	31.5	18.2			
557 NOV/89	33.3	39.3			71.2	15.7	30.3	31.5	16.9	4.17	67.6	21
557 NOV/89					68.5		31.2	32.3	17.6	4.17	67.6	21
557 NOV/89							31.4	32.7	18.3			
557 NOV/89	35.7	24.1					30.7	31.7	17.7			
558 DEC/89					67.7	15.7	31.2	32.3	17.4	4.19	64.6	19
558 DEC/89					64.2		32.0	32.6	18.1	4.19	64.6	20
558 DEC/89	37.5	38.5					31.2	33.6	17.6			
558 DEC/89	30.6	53.3					29.9	30.7	15.2			

TABLE B.6. (Continued)

GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
559 DEC/89					67.7	15.7	32.9	35.1	19.8	4.19	64.6	20
559 DEC/89	34.6	25.8	12.1	20.6	67.7		30.2	31.2	16.6	4.23	58.9	20
559 DEC/89	37.2		13.2	20.2			32.0	32.7	17.5			
AVG VALUE (μM)	34.96	27.40	12.46	20.91	67.86	16.14	30.19	30.56	16.26	4.32	48.23	20.66
STD DEV (μM)	1.99	11.46	0.29	0.49	1.89	0.61	2.19	1.62	1.39	0.01	1.42	0.96
COUNT	31	30	24	24	28	27	56	56	56	35	35	35

TABLE B.7. QC Check Sample Results for the First Quarter of 1990

	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
	µM	µM	µM	µM	µM	µM	µM	µM	µM		µM	µS
STANDARD	43.5	25.6	12.5	20.6	76.5	15.9	31.9	32.6	16.4	4.22	60.3	22
GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
560 JAN/90	35.0	61.0	12.1	20.5	73.4	12.2	31.1	34.1	16.8	4.22	60.3	19
560 JAN/90	33.8	<	12.3	19.6	73.4	15.0	31.7	34.1	17.4	4.21	61.7	19
560 JAN/90					83.9		31.5	32.3	17.5	4.15	70.8	21
560 JAN/90					71.7		31.5	30.7	17.4	4.17	67.6	20
561 JAN/90	37.5	22.1	12.1	20.5	78.1	15.0	30.4	31.6	16.9	4.17	67.6	19
561 JAN/90	37.0	40.5	12.0	20.2	75.4	15.9	30.3	31.0	16.8	4.14	72.4	19
561 JAN/90					72.7		30.3	31.0	16.8	4.17	67.6	21
561 JAN/90					76.8		31.9	33.4	19.1	4.14	72.4	20
562 JAN/90	40.8	24.4	11.7	20.1	75.4	15.9	30.8	33.2	17.9	4.17	67.6	19
562 JAN/90	39.8	10.2	12.7	19.1	75.4	15.0	32.1	33.3	18.3	4.20	63.1	20
562 JAN/90					78.1		31.0	33.7	17.3	4.18	66.1	20
562 JAN/90					80.8					4.15	70.8	20
563 JAN/90	38.0	24.1	12.8	18.8	77.2	13.1	31.3	36.2	18.1	4.21	61.7	21
563 JAN/90	40.9	12.7	12.1	20.1	75.5	15.0	31.4	32.7	17.1	4.14	72.4	21
563 JAN/90					69.3		31.4	32.7	17.1	4.18	66.1	19
563 JAN/90					73.2		30.5	32.0	18.1	4.18	66.1	20
564 JAN/90	38.0	31.5	11.9	19.8	78.6	14.0	31.2	34.0	16.9	4.17	67.6	19
564 JAN/90			12.0	19.9	75.9	15.6	31.3	34.2	17.0	4.16	69.2	20
564 JAN/90					74.6		30.6	32.2	17.2	4.21	61.7	20
564 JAN/90					78.6		30.9	31.4	17.0	4.17	67.6	19
565 JAN/90	38.7	23.3	12.4	20.4	81.3	15.6	30.4	31.1	16.7	4.24	57.5	19
565 JAN/90	39.8	18.2	12.5	20.7	77.3	15.6	30.7	31.6	17.5	4.20	63.1	19
565 JAN/90					75.8	17.2	31.4	31.8	17.3	4.21	61.7	20
565 JAN/90					77.1	17.2	31.4	33.9	15.8	4.18	66.1	20
566 JAN/90	37.8	25.1	12.4	21.7	73.0	15.6	31.7	32.8	17.1	4.18	66.1	22
566 JAN/90	37.6	14.1	12.3	20.9		15.6	31.6	33.1	16.6	4.20	63.1	22
566 JAN/90						15.6	31.5	34.5	16.7	4.20	63.1	20
566 JAN/90						15.6	33.0	31.9	17.6	4.21	61.7	21
567 JAN/90	37.3	23.3	12.2	20.2	73.1	14.5	31.4	31.6	16.4	4.20	63.1	21
567 JAN/90	37.1	28.0	12.8	23.1	73.1	16.9	31.3	31.5	16.0	4.22	60.3	20
567 JAN/90					73.1	16.9	31.7	32.5	17.1	4.20	63.1	21
567 JAN/90					74.4		31.7	32.5	17.8	4.22	60.3	21
568 FEB/90	38.3	17.6	12.3	20.8	75.6	16.9	31.0	31.3	16.0	4.16	69.2	18
568 FEB/90	39.1	5.7	12.5	21.5	72.3	16.9	30.7	29.2	16.1	4.15	70.8	18
568 FEB/90							31.3	32.1	17.2	4.19	64.6	
568 FEB/90							31.6	32.2	18.3	4.17	67.6	
569 MAR/90					74.7	16.9	30.7	29.6	17.4	4.17	67.6	19
569 MAR/90	37.9	30.4	12.3	20.4	73.6	14.6	31.0	31.1	17.2	4.16	69.2	20
569 MAR/90	38.4	31.1	12.0	20.2		14.6	29.8	30.2	16.6	4.19	64.6	20
569 MAR/90							30.2	34.3	17.2	4.21	61.7	20
570 MAR/90	37.1	24.6	14.5	22.1	73.5	14.6	30.7	29.6	15.5	4.23	58.9	17
570 MAR/90	39.4	33.9	12.5	20.8	72.3	14.6	30.4	32.1	16.6	4.24	57.5	18
570 MAR/90	39.7	31.5	12.5	20.6			30.7	31.0	16.9	4.20	63.1	19
570 MAR/90							30.7	29.7	16.4	4.21	61.7	19
571 MAR/90	37.3	24.1	11.6	21.2	73.5	14.6	31.0	32.1	16.9	4.22	60.3	20
571 MAR/90	38.5	29.4	13.0	21.2	72.3	17.1	31.0	32.3	16.3	4.21	61.7	19
571 MAR/90			11.5	21.2	72.3	17.1	32.1	34.9	17.2	4.18	66.1	19
571 MAR/90					71.0		32.1	30.8	16.4	4.19	64.6	20
572 MAR/90	40.8	34.1	12.1	21.2	71.0	17.1	33.1	37.0	17.9	4.17	67.6	21
572 MAR/90	38.0	69.0	12.6	21.3	69.7	17.1	32.5	33.6	18.3	4.19	64.6	19
572 MAR/90							31.6	31.6	17.0	4.17	67.6	18
572 MAR/90							30.2	29.1	15.9	4.19	64.6	20
573 MAR/90	35.2	12.1	12.7	20.5	72.4	16.8	30.5	31.3	16.4	4.19	64.6	20
573 MAR/90			12.6	21.2	76.2	14.5	30.2	28.5	16.5	4.20	63.1	19
573 MAR/90					66.9		30.6	31.6	16.9	4.17	67.6	19
573 MAR/90										4.17	67.6	18

TABLE B.7. (Continued)

GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
574 MAR/98	38.0	38.0	12.7	20.6	71.2	14.5	33.0	28.0	18.0			
574 MAR/98					73.7	16.8	32.0	31.3	17.1			
574 MAR/98							32.3	32.6	16.9			
574 MAR/98							32.5	34.2	17.2			
AVG VALUE (μM)	37.96	27.41	12.38	20.66	74.53	15.61	31.25	32.27	17.10	4.19	65.10	19.67
STD DEV (μM)	1.70	13.57	0.53	0.83	3.18	1.23	0.75	1.94	0.68	0.02	3.70	1.04
COUNT	28	27	31	31	46	37	58	58	58	58	58	54

< = Below minimum detectable level, not included in average.

TABLE B.8. QC Check Sample Results for the Second Quarter of 1990

	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
	µM	µM	µM	µM	µM	µM	µM	µM	µM		µM	µS
STANDARD	13.0	12.8	7.5	12.2	69.5	21.2	19.9	20.4	10.3	4.28	52.5	18
GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
575 APR/90	12.1	2.8	7.2	12.3	73.8	22.6	17.2	22.4	13.4	4.30	50.1	19
575 APR/90	8.6	23.4	7.7	11.8	72.4	22.6	22.6	25.3	9.8	4.28	52.5	19
575 APR/90					73.8		19.4	22.5	12.0			
575 APR/90					72.4		18.7	19.0	9.2			
576 APR/90	14.0	0.1	7.3	13.0	67.4	20.4	18.7	19.6	10.5	4.30	50.1	18
576 APR/90	16.1	16.8	7.2	11.8	65.8	22.6	18.7	20.1	11.0	4.28	52.5	19
576 APR/90							20.2	19.5	11.5			
576 APR/90							18.8	19.6	11.7			
577 APR/90	13.9	39.2	7.1	12.0	66.6	22.7	19.2	18.7	10.4	4.28	52.5	18
577 APR/90	11.1	23.3	7.3	11.8	64.9	22.7	18.7	19.5	11.3	4.30	50.1	19
577 APR/90							19.0	19.7	11.2	4.29	51.3	
577 APR/90							19.0	19.3	11.3			
578 APR/90	15.0	0.1	7.3	11.8	65.7	22.7	19.1	19.7	11.2	4.27	53.7	18
578 APR/90	6.6	74.5	7.3	11.9	65.7	22.7	18.7	20.0	11.4	4.29	51.3	19
578 APR/90	8.2	0.1	7.7	11.9			18.7	20.1	11.0	4.29	51.3	
578 APR/90							19.2	20.6	10.2			
579 APR/90	7.3	0.1	7.3	11.9	67.2	22.7	18.7	19.6	11.0	4.24	57.5	18
579 APR/90	10.0	1.0	7.4	12.0	66.4	22.7	19.1	20.2	11.6	4.27	53.7	17
579 APR/90							18.9	19.2	11.5	4.25	56.2	18
579 APR/90							18.8	20.2	10.5			
580 MAY/90	9.7	0.1	7.5	12.0	67.3	22.7	18.6	19.0	10.6	4.27	53.7	19
580 MAY/90	10.3	0.1	7.1	11.9	67.3	22.7	20.1	19.3	10.6	4.29	51.3	17
580 MAY/90		0.1	7.0	11.9			18.3	18.6	14.2			
580 MAY/90							18.4	19.3	8.2			
581 MAY/90	10.4	0.1	6.8	11.8	67.3	21.2	16.0	18.7	9.0	4.31	49.0	19
581 MAY/90	14.4	10.9	6.9	12.0	66.4	21.2	19.0	19.2	10.5	4.27	53.7	17
581 MAY/90	11.0						18.3	18.8	10.7	4.20	51.3	18
581 MAY/90							18.4	18.9	11.1			
582 MAY/90	10.5	0.1	7.2	12.2	70.3	21.2	20.1	19.1	112.1	4.31	49.0	18
582 MAY/90	10.0	81.5	7.0	11.5	66.9	21.2	18.8	19.3	11.4	4.32	47.9	19
582 MAY/90							18.5	19.5	10.0			
582 MAY/90							18.7	18.9	10.6			
583 MAY/90	10.5	15.7	7.4	11.7	66.9	22.5	18.3	22.1	12.8	4.29	51.3	19
583 MAY/90	11.0	0.1	7.0	11.6	65.2	20.9	18.9	21.7	10.6	4.28	52.5	18
583 MAY/90							19.1	20.0	11.9	4.28	52.5	18
583 MAY/90							19.1	21.4	12.5			
584 MAY/90	10.8	54.0	7.2	12.0	68.6	20.9	18.4	19.9	10.3	4.31	49.0	
584 MAY/90	11.1		8.0	12.1	68.6	20.9	18.4	19.1	11.1	4.29	51.3	20
584 MAY/90							19.0	20.2	11.4	4.28	52.5	18
584 MAY/90							18.5	19.5	11.1			18
585 JUN/90	13.9	10.0	8.1	12.7	69.2	20.9	18.6	19.3	10.0	4.28	52.5	19
585 JUN/90	10.0				67.6	22.1	18.8	19.7	10.2	4.29	51.3	17
585 JUN/90							18.7	19.6	10.5			
585 JUN/90							18.7	19.4	10.8			
586 JUN/90	8.6	8.5	7.3	11.5	61.1	20.9	18.2	19.0	10.6	4.28	52.5	18
586 JUN/90	9.5	8.9	7.3	11.6	69.2	22.1	18.7	20.5	11.4	4.28	52.5	18
586 JUN/90							18.5	20.6	11.4	4.28	52.5	18
586 JUN/90							18.9	20.2	11.6			
587 JUN/90	11.6	0.1	7.6	11.7	70.8	22.1	20.0	22.6	10.5	4.32	47.9	18
587 JUN/90	10.2	4.4	7.3	11.6	70.8	22.7	19.7	21.4	14.2	4.32	47.9	17
587 JUN/90							19.8	22.4	13.1	4.31	49.0	18
587 JUN/90							20.0	19.6	13.5			
588 JUN/90	11.2	0.1	7.2	11.7	70.8	19.7	18.4	18.9	11.8	4.31	49.0	19
588 JUN/90	11.8	45.2	7.0	11.7	67.6	20.7	19.4	21.9	12.7	4.32	47.9	18
588 JUN/90					70.7		19.4	20.2	12.4	4.31	49.0	18
588 JUN/90							18.7	19.4	12.1			

TABLE B.8. (Continued)

GROUP DATE	Na	K	Ca	Mg	NH ₄	SO ₂	SO ₄	NO ₃	Cl	pH	H	COND
589 JUN/98	11.1	8.8	7.8	11.5	73.8	28.7	19.5	28.9	12.3	4.28	52.5	28
589 JUN/98	11.1	3.3	7.1	11.3	66.8	23.7	19.8		12.4			
589 JUN/98					72.3	22.7						
AVG VALUE (µM)	11.17	14.42	7.29	11.88	68.46	21.87	18.93	28.85	13.82	4.29	51.38	18.28
STD DEV (µM)	2.38	22.15	8.28	8.34	2.89	8.96	8.78	1.28	13.17	8.82	2.11	8.77
COUNT	32	38	31	31	34	31	58	57	58	38	38	38

TABLE B.9. Duplicate Aliquot Analyses for 1989

GROUP DATE	pH		COND		SO ₄		NO ₃		Cl		NH ₄		Na		K		Ca		Mg	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
490 JAN/89	4.23	4.21	27	28	23.3	24.0	9.5	7.9	6.0	6.9	5.4	4.0	2.8	2.8	<	<	1.1	1.1	<	<
491 JAN/89	4.33	4.32	22	24	11.0	10.0	24.0	24.0	14.0	16.0	15.0	16.0	1.0	1.2	<	<	0.9	1.1	0.7	<
492 JAN/89	4.17	4.17	36	36	6.1	6.7	36.0	38.0	21.0	19.0	6.5	5.9	0.8	1.1	6.6	9.8	1.1	1.1	0.5	0.6
493 JAN/89	4.25	4.23	27	27	29.0	26.0	8.7	10.0	13.0	14.0	6.5	7.2	7.7	8.4	<	<	1.3	1.3	0.9	0.8
494 JAN/89	4.30	4.29	26	27	24.0	24.0	21.0	20.0	2.0	2.0	8.5	9.8	1.1	1.4	<	<	5.6	5.4	0.7	1.6
495 JAN/89	3.86	3.87	65	62	14.0	14.0	110.0	110.0	15.0	14.0	17.0	19.0	1.9	1.7	<	<	2.0	1.8	0.7	0.7
496 MAR/89	3.93	3.94	59	55	28.0	29.0	97.0	99.0	16.0	15.0	39.0	40.0	4.0	4.6	<	<	4.9	4.8	1.4	1.4
497 MAR/89					26.0	25.3	9.9	10.0	9.1	8.9	8.1	9.4	2.6	2.7	2.3	6.3	1.4	1.4	<	<
498 MAR/89	4.66	4.67	39	38	22.0	22.0	17.0	18.0	20.0	20.0	9.5	8.8	<	<	<	<	0.6	0.6	<	<
499 MAR/89	4.64	4.65	16	14	11.0	12.0	10.0	10.0	23.0	24.0	12.0	12.0	21.0	20.0	6.0	9.0	19.0	21.0	8.8	8.0
500 APR/89	4.00	3.98	47	48	26.0	26.0	56.0	56.0	6.7	7.2	15.0	14.0	0.7	1.1	<	<	3.5	3.6	0.8	0.7
501 APR/89	4.46	4.46	18	18	14.0	14.0	21.0	21.0	9.9	9.7	18.0	18.0	1.3	<	16.0	2.9	1.0	0.9	<	<
502 APR/89	4.03	4.04			36.0	36.0	25.0	25.0	43.0	41.0	36.0	36.0	4.0	3.9	<	<	3.3	3.3	1.2	1.1
503 APR/89	4.33	4.36	22	21	17.0	18.0	13.0	14.0	16.0	16.0	6.5	7.7	7.1	6.7	17.0	3.7	0.7	1.0	1.2	1.1
504 APR/89	4.99	5.00	5	5	4.2	4.0	3.1	3.1	9.0	8.7	1.9	1.3	2.1	2.0	6.0	21.0	<	<	<	<
505 APR/89	4.24	4.24	29	27	27.0	28.0	19.0	20.0	0.9	0.9	7.7	7.7	1.2	2.2	<	<	3.1	3.2	0.9	0.9
506 APR/89					8.2	9.4	11.0	10.0	2.0	1.5	3.9	4.6								
507 MAY/89	4.23	4.22	32	32	28.0	28.0	30.0	29.0	2.3	2.8	21.0	21.0	3.1	2.8	<	<	2.6	2.5	0.9	0.9
508 MAY/89	3.98	3.99	50	49	26.0	27.0	54.0	52.0	30.0	30.0	21.0	21.0	1.8	2.0	<	<	5.0	5.0	1.2	1.1
509 MAY/89	3.84	3.84	73	75	63.0	63.0	110.0	110.0	11.0	11.0	69.0	69.0	4.0	4.0	20.0	<	11.0	9.3	1.6	1.9
510 JUN/89	3.78	3.80	70	71	46.0	44.0	120.0	120.0	6.0	6.3	28.0	28.0	2.6	2.7	<	<	13.0	13.0	2.4	2.4
511 JUN/89	4.48	4.52	17	19	19.0	19.0	6.3	7.8	15.0	14.0	11.0	11.0	6.9	8.1	4.4	19.0	0.6	0.6	1.2	1.3
512 JUN/89	4.17	4.17	54	54	35.0	35.0	50.0	49.0	130.0	130.0	20.0	19.0	110.0	120.0	3.6	9.6	8.5	8.7	17.0	16.0
513 JUN/89	4.20	4.20	31	32	33.0	33.0	25.0	25.0	9.3	8.5	28.0	28.0	2.0	1.0	11.0	12.0	1.5	1.6	0.6	0.6
514 JUN/89	3.90	3.92	52	52	51.0	51.0	56.0	56.0	9.4	9.0	46.0	44.0	1.3	0.6	9.7	1.5	3.8	3.8	0.7	0.6
515 JUN/89	4.26	4.27	29	28	35.0	36.0	36.0	36.0	11.0	11.0	48.0	47.0	1.5	0.6	5.1	<	4.2	4.2	1.0	1.1
516 JUN/89	4.45	4.43	17	19	11.0	11.0	24.0	21.0	7.7	9.6	5.3	5.3	<	<	1.0	<	1.7	1.8	0.5	0.5
517 JUN/89	4.41	4.40	21	20	14.0	11.0	14.0	11.0	8.6	6.7	8.4	9.1	0.7	1.5	<	<	4.7	4.6	1.3	1.3
518 JUN/89	4.07	4.07	49	48	56.0	56.0	39.0	3.4	19.0	19.0			6.6	6.4	17.0	5.8	11.0	11.0	2.6	2.5
519 JUN/89	4.26	4.26	36	37	32.0	32.0	24.0	24.0	49.0	49.0	24.0	24.0	39.0	42.0	14.0	21.0	4.6	4.6	0.4	5.7
520 JUL/89	4.32	4.31	27	27	24.0	24.0	14.0	14.0	12.0	12.0	14.0	14.0	5.4	5.1	5.9	<	6.7	6.7	0.9	0.9
521 JUL/89	4.95	4.90	7	8	5.2	5.3	5.2	4.6	6.6	6.2	4.7	4.7	1.1	<	<	<	<	<	<	<
522 JUL/89	4.08	4.09	36	40	33.0	33.0	26.0	29.0	11.0	11.0	13.0	13.0	0.9	<	<	<	2.7	2.9	0.7	0.7
523 JUL/89	4.42	4.41	20	22	23.0	23.0	21.0	20.0	7.1	6.3	24.0	20.0	1.1	2.0	0.6	7.7	2.7	2.6	0.9	0.9
524 JUL/89	4.84	4.85	7	8	6.3	6.4	5.2	5.0	6.0	6.5	4.1	4.1	1.5	<	<	<	<	<	<	<
525 JUL/89	4.38	4.39	21	19	14.0	14.0	21.0	22.0	6.6	6.9	6.6	5.6	1.6	0.8	27.0	24.0	1.3	1.4	<	<
526 JUL/89	4.84	4.84	8	8	5.2	5.2	7.9	8.5	6.2	5.6	5.0	5.0	0.8	0.6	2.2	<	0.8	0.8	0.5	0.5
527 JUL/89	4.00	3.99	48	47	44.0	43.0	41.0	41.0	7.8	8.6	24.0	24.0	<	<	3.7	<	1.8	1.8	0.6	0.6
528 JUL/89	4.53	4.55	20	20					7.6	7.6	16.0	15.0	2.7	3.7	15.0	9.0	7.2	7.0	7.6	7.4
529 JUL/89	4.80	4.81	11	11	12.0	12.0	14.0	14.0	9.0	8.6	11.0	11.0	1.3	0.9	22.0	6.3	7.9	7.5	1.2	1.3
530 JUL/89	4.35	4.34	24	24	25.0	24.0	17.0	17.0	21.0	21.0	4.0	4.0	<	<	<	<	8.7	8.8	0.8	0.8
531 JUL/89	6.46	6.20	10	9	6.2	6.2	8.5	8.6	21.0	21.0	23.0	19.0	23.0	23.0	40.0	<	19.0	19.0	2.2	2.1
532 JUL/89	4.33	4.36	26	24	25.0	25.0	13.0	14.0	5.6	6.1	23.0	19.0	1.5	0.9	<	<	1.6	1.6	0.7	<

TABLE B.9. (Continued)

GROUP DATE	pH		COND		SO ₄		NO ₃		Cl		NH ₄		Na		K		Ca		Mg	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
533 JUL/89	3.75	3.76	86	89	100.0	100.0	90.0	90.0	53.0	57.0	32.0	42.0	7.1	7.7	5.2	20.0	5.7	5.8	1.8	1.6
534 AUG/89	4.53	4.55	18	15	15.0	15.0	13.0	13.0	3.9	3.3	13.0	15.0	1.4	<	43.0	<	1.7	1.6	<	0.5
535 AUG/89	5.22	5.19	4	4	1.9	1.9	3.1	2.7	10.0	9.5			3.4	4.9	21.0	65.0	<	<	0.5	0.5
536 SEP/89	6.35	6.24	8	8	6.7	6.6	9.7	9.6	21.0	21.0			23.0	24.0	<	<	21.0	21.0	2.4	2.5
537 SEP/89	3.59	3.59	120	110	170.0	170.0	80.0	70.0	2.8	2.9			1.0	0.8	<	5.3	9.6	9.7	1.9	1.5
538 SEP/89	4.45	4.48	20	18	21.0	21.0	17.0	16.0	3.7	3.4			1.3	1.0	15.0	19.0	1.1	1.1	1.0	1.7
539 SEP/89	3.89	3.99	49	49	48.0	48.0	36.0	34.0	17.0	17.0			1.2	2.2	13.0	12.0	2.8	2.9	<	1.0
540 OCT/89	4.35	4.38	27	26	24.0	25.0	27.0	21.0	84.0	54.0			37.0	40.0	<	5.4	3.3	3.4	7.7	6.3
541 OCT/89	4.66	4.67	13	12	11.0	11.0	7.4	8.1	31.0	31.0			19.0	19.0	<	23.0	2.0	1.9	2.8	2.7
542 OCT/89	4.22	4.28	25	23	21.0	21.0	20.0	20.0	18.0	7.8			1.1	1.3	<	<	2.8	2.8	0.5	0.5
543 OCT/89	4.78	4.79	10	10	9.3	10.0	9.2	8.5	4.9	4.4			2.4	2.9	<	9.8	5.1	5.1	1.8	2.1
545 OCT/89	5.98	5.89	13	13	18.0	18.0	12.0	12.0	19.0	19.0			9.5	12.0	17.0	15.0	2.7	2.7	3.0	3.1
546 OCT/89	4.07	4.06	37	37	18.0	19.6	21.0	20.0	9.8	11.0			<	<	3.5	8.4	4.8	4.9	0.6	0.6
547 OCT/89	4.61	4.64	11	11	9.2	9.3	8.2	8.2	8.3	8.1			1.1	0.8	<	7.7	1.4	1.4	0.8	<
548 OCT/89	4.86	4.84	20	20	35.0	35.0	43.0	42.0	11.0	10.0			1.3	1.5	18.0	<	23.0	24.0	4.0	4.2
549 OCT/89	4.29	4.28	32	33	36.0	32.0	19.0	20.0	62.0	62.0			38.0	37.0	<	<	3.5	3.7	0.7	0.1
550 NOV/89	3.87	3.94	43	44	30.0	31.0	63.0	64.0	13.0	13.0			2.8	2.5	9.1	3.5	7.4	7.4	1.3	1.3
551 NOV/89	4.39	4.41	14	14	14.0	14.0	10.0	10.0	12.0	12.0			2.3	2.6	<	<	1.2	1.2	0.6	1.0
552 NOV/89	3.87	3.99	53	50	11.9	11.0	9.7	9.5	9.9	10.0			<	1.4	<	1.3	3.7	3.7	0.6	1.0
553 NOV/89	3.98	3.94	39	39	34.0	34.0	42.0	43.0	19.0	19.0			4.9	4.8	<	<	1.9	1.8	1.5	0.9
554 NOV/89	4.64	4.64	11	11	11.0	11.0	12.0	16.0	8.9	9.8			0.8	<	0.9	<	1.0	1.1	<	1.1
555 NOV/89	4.65	4.69	10	10	7.6	10.0	16.0	15.0	8.9	8.7			1.2	1.4	20.0	2.2	<	0.6	0.9	1.2
556 NOV/89	4.36	4.05	22	32	17.0	17.0	34.0	34.0	22.0	20.0			4.4	3.2	8.3	6.2	1.7	1.7	0.2	1.0
557 DEC/89	4.37	4.31	15	15	14.0	14.0	13.0	13.0	9.1	9.2			1.7	1.7	4.3	<	1.2	1.1	<	<
558 DEC/89	4.26	4.26	26	26	29.0	29.0	42.0	42.0	15.0	15.0			0.0	5.6	<	<	14.0	14.0	2.8	2.8
559 DEC/89	4.24	4.27	20	21	11.0	10.0	34.0	33.0	12.0	13.0			3.4	3.0	70.0	85.0	1.9	1.9	<	<

TABLE B.10. Fraction of Duplicate Analyses with Equal
or Smaller Absolute Relative Difference

Absolute Relative Difference	Ion								
	H ⁺	SO ₄	NO ₃	Cl	NH ₄	Na	K	Ca	Mg
1.0%	0.179	0.647	0.485	0.382	0.465	0.089	0.000	0.508	0.365
1.5%	0.552	0.676	0.574	0.426	0.512	0.143	0.000	0.619	0.385
2.0%	0.552	0.750	0.632	0.456	0.512	0.196	0.000	0.698	0.442
2.5%	0.701	0.824	0.691	0.544	0.535	0.250	0.000	0.714	0.500
5.0%	0.881	0.926	0.882	0.824	0.721	0.375	0.077	0.905	0.673
10.0%	0.940	0.971	0.956	0.926	0.930	0.607	0.192	0.984	0.827
15.0%	0.970	0.985	1.000	0.971	0.977	0.714	0.269	0.984	0.885
20.0%	0.970	0.985	1.000	0.971	1.000	0.821	0.346	1.000	0.885
25.0%	0.970	0.985	1.000	0.985	1.000	0.857	0.385	1.000	0.942
30.0%	0.985	0.985	1.000	0.985	1.000	0.911	0.385	1.000	0.962
35.0%	1.000	0.985	1.000	0.985	1.000	0.946	0.385	1.000	0.962
40.0%	1.000	1.000	1.000	1.000	1.000	0.982	0.385	1.000	0.981
50.0%	1.000	1.000	1.000	1.000	1.000	1.000	0.577	1.000	0.981
60.0%	1.000	1.000	1.000	1.000	1.000	1.000	0.731	1.000	0.981
80.0%	1.000	1.000	1.000	1.000	1.000	1.000	0.923	1.000	1.000
100.0%	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

FIGURE B.1. The Analytical Bias for Ion Concentrations, pH, and Conductivity Calculated from Quality Control Check Samples Analyzed During Each Quarter of the Year During the Period of ERP Operation. The vertical bar shows the 95% confidence interval about the mean bias.

APPENDIX C

DATA LISTING BY SAMPLE

APPENDIX C

DATA LISTING BY SAMPLE

This appendix provides a listing of ion concentrations and other pertinent information for all samples obtained from the ERP sites, including the MAP3S site at Pennsylvania State University, during the period August 1988 through May 1990. Table C.1 defines the column headings used in the data listings presented in Tables C.2 through C.5. The Acid Deposition System (ADS) codes found in the tables are defined in Table C.6.

TABLE C.1. Data Column Headings for Sample Data Listings

<u>Column Heading</u>	<u>Description</u>
YYMMDDHHHHSS	Sample identification code: YYMMDD = Year, month and day sample is collected HHHH = GMT hour and minute sample is collected SS = site identification number
LID	Number of lid openings during sample collection period
ADATE	Arrival date of sample in the laboratory (MM.DD)
SVOL	Sample volume (mL) in collection bucket
PVOL	Predicted volume (mL) based on rainfall during sample collection period and a bucket area of 682 cm ²
LAB pH	pH of sample as measured in the laboratory
(H+)	Hydrogen ion concentration (μMol/L) based on pH
CONDOC	Conductivity (μSiemens)
(SO4=)	Sulfate ion concentration (μMol/L)
(NO3-)	Nitrate ion concentration (μMol/L)
(Cl-)	Chloride ion concentration (μMol/L)
ANION	Sum of all anion concentrations (μEq/L)
(NH4+)	Ammonium ion concentration (μMol/L)
(Na+)	Sodium ion concentration (μMol/L)
(K+)	Potassium ion concentration (μMol/L)
(Ca++)	Calcium ion concentration (μMol/L)
(Mg++)	Magnesium ion concentration (μMol/L)
CATION	Sum of all cation concentrations (μEq/L)
CALC CO	Calculated conductivity based on ion concentrations (μSiemens)
ADS	First, second, and third ADS code flags
ADS	
ADS	
DEP	Type of deposition W = wet only B = bulk
PRE	Type of precipitation R = rain M = mixed rain and snow S = snow

TABLE C.2. Data Listing for Precipitation Samples Collected at the Moss Lake Site

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB	pH	(H+)	CONDUC	(SD4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	PRE
8801218130015	16	1.10	710	660	4.27	53.70	33.0	15.0	61.0	9.0	100.00	33.0	2.7	0.4	3.9	1.2	100.00	29.17	B38				S
8801219180015	6	1.10	10	35	200.00	-200.00	-200.0	0.3	98.0	39.0	152.20	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				S
8801221141515	8	1.10	120	86	3.94	114.82	70.0	67.0	130.0	33.0	277.60	67.0	22.0	2.4	30.0	7.2	270.62	69.63	B38				S
8801223155515	3	1.10	140	70	4.60	25.12	18.0	12.0	13.0	10.0	47.60	15.0	4.5	0.7	1.5	0.9	58.12	14.32					S
8801227130015	24	1.10	1200	1400	4.52	30.20	17.0	6.9	17.0	9.9	41.30	11.0	0.5	0.4	1.0	0.4	44.90	14.57					S
8801229124515	8	1.10	1100	1100	4.36	43.65	24.0	14.0	20.0	9.5	58.10	9.2	1.5	0.4	1.4	0.4	58.35	20.46					S
8801230124015	22	1.10	48	160	3.97	107.15	57.0	4.9	120.0	28.0	158.40	5.4	3.3	1.9	4.1	1.3	128.55	50.12					S
890103130015	10	2.07	550	450	4.93	93.33	40.0	24.0	63.0	11.0	122.60	42.0	0.9	0.4	2.1	0.6	142.03	45.00					S
890108163515	16	2.07	490	430	4.20	63.10	31.0	20.0	18.0	13.0	71.60	8.7	0.5	0.4	1.3	0.4	78.10	28.18					S
890109170015	18	2.07	460	170	4.74	18.20	13.0	6.2	26.0	7.1	43.10	6.7	0.5	0.4	0.6	2.0	43.00	10.89					S
890110130015	13	2.07	110	230	4.44	36.31	20.0	3.9	30.0	9.5	47.90	5.4	3.4	0.4	6.4	1.4	61.11	17.53					S
890111133515	4	2.07	16	-200	5.37	4.27	65.0	45.0	250.0	110.0	450.00	60.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					S
890113124515	9	2.07	87	160	4.19	64.57	20.0	14.0	12.0	45.0	85.60	5.4	3.7	0.4	0.7	0.4	76.27	29.66					S
890115184515	2	2.07	540	520	4.39	40.74	20.0	11.0	26.0	13.0	61.60	9.4	1.5	0.4	0.9	0.4	54.64	19.66					S
890117143015	19	2.07	120	210	4.02	95.50	44.0	16.0	59.0	49.0	140.00	20.0	3.7	23.0	3.6	0.7	150.80	47.91					S
890118124515	5	2.07	270	310	4.50	31.62	21.0	9.0	36.0	17.0	71.60	19.0	4.0	0.4	9.3	2.0	77.62	19.05					S
890119123515	12	2.07	190	170	4.06	87.10	43.0	17.0	67.0	22.0	123.60	34.0	2.9	0.4	6.2	1.2	139.20	42.89					S
890120140015	3	2.07	490	500	4.21	61.60	30.0	10.0	44.0	10.0	80.60	24.0	0.7	24.0	1.4	0.4	113.96	31.13					S
890121174015	4	2.07	300	300	4.33	46.77	23.0	11.0	24.0	15.0	61.60	10.0	1.0	0.4	1.0	0.4	68.97	22.25					S
890127200015	20	2.07	1200	1400	4.18	66.07	41.0	22.0	37.0	0.7	90.30	25.0	1.0	11.0	1.8	0.6	108.67	32.65					S
890128190015	1	2.07	33	50	4.34	45.71	40.0	19.0	22.0	32.0	92.60	34.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					S
890131143015	5	2.07	410	450	3.97	107.15	51.0	32.0	51.0	19.0	134.60	32.0	2.7	13.0	2.1	0.5	160.65	51.01					S
890201130015	1	3.07	15	-200	-200.00	-200.00	-200.0	6.5	29.0	98.0	140.00	-200.0	2.7	0.4	10.0	1.7	-200.00	-200.00					S
890203131015	15	3.07	330	300	3.66	218.78	94.0	67.0	110.0	10.0	200.00	58.0	1.8	16.0	6.6	1.5	310.78	101.09	B38				S
890206154515	8	3.07	230	280	4.30	50.12	27.0	3.0	30.0	19.0	56.20	-200.0	1.4	5.4	1.7	0.4	-200.00	-200.00					S
890207131015	3	3.07	330	330	3.87	134.90	64.0	14.0	110.0	15.0	153.60	10.0	1.8	0.4	1.9	0.7	160.30	59.95					S
890208145015	10	3.07	25	69	-200.00	-200.00	-200.0	8.6	120.0	43.0	180.80	5.7	6.2	0.4	7.0	2.9	-200.00	-200.00					S
890209133015	7	3.07	210	180	5.89	1.29	13.0	7.7	35.0	12.0	63.00	12.0	5.5	31.0	32.0	11.0	135.79	12.91	B41				S
890213134515	20	3.07	440	630	4.12	75.86	34.0	6.3	59.0	16.0	86.20	5.7	1.4	0.4	3.6	0.8	92.10	7.71					S
890214130015	7	3.07	420	480	4.32	47.86	22.0	13.0	23.0	3.3	52.90	65.0	0.6	45.0	1.8	0.4	162.85	28.90					S
890216120015	7	3.07	230	280	4.44	36.31	17.0	7.4	13.0	10.0	44.40	1.6	0.5	17.0	1.9	0.5	60.21	17.50					S
890220154015	5	3.07	13	100	-200.00	-200.00	-200.0	100.0	130.0	200.0	650.00	61.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					S
890222131015	6	3.07	980	1100	4.43	37.15	18.0	12.0	16.0	8.9	49.50	5.7	0.7	23.0	0.8	0.4	68.95	18.83					S
890227140015	7	3.07	20	35	-200.00	-200.00	-200.0	12.0	110.0	200.0	334.00	9.7	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					S
890228124515	9	3.07	45	86	3.92	120.23	56.0	10.0	110.0	27.0	157.60	11.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					S
890301145015	4	4.11	20	-200	-200.00	-200.00	-200.0	13.0	150.0	56.0	231.00	18.0	17.0	5.4	17.0	3.9	-200.00	-200.00					S
890302122015	14	4.11	130	190	4.52	30.20	17.0	6.6	32.0	20.0	65.80	65.0	9.1	1.4	5.4	1.8	120.10	21.46	A90				S
890303140015	8	4.11	21	69	-200.00	-200.00	-200.0	1.9	67.0	41.0	102.40	1.9	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					S
890306153015	25	4.11	790	860	4.00	100.00	44.0	34.0	38.0	17.0	123.60	13.0	3.0	9.1	1.7	0.7	129.90	46.03					S
890313150015	20	4.11	220	200	4.09	81.28	38.0	14.0	49.0	31.0	108.60	13.0	6.2	1.1	6.9	1.3	110.98	38.49					S
890315131515	3	4.11	67	51	4.03	93.33	58.0	59.0	90.0	20.0	234.60	60.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					S
890316130015	5	4.11	120	86	4.85	14.13	43.0	96.0	97.0	26.0	314.60	110.0	9.0	15.0	74.0	9.9	315.93	46.27	D22				S
890317131515	1	4.11	160	190	4.11	77.62	45.0	24.0	95.0	14.0	157.60	55.0	1.7	0.5	4.9	1.1	146.82	43.36	D22				S
890318190015	7	4.11	1300	1300	4.26	54.95	28.0	20.0	39.0	11.0	90.60	15.0	2.0	2.3	7.6	1.4	93.05	28.14	D22				S
890321173015	5	4.11	390	430	4.20	63.10	28.0	6.6	53.0	12.0	78.80	7.1	1.1	10.0	1.4	0.4	84.90	29.22	D22				S
890325170015	11	4.11	330	300	4.63	23.44	11.0	6.2	4.6	15.6	32.90	0.6	1.2	4.4	2.6	0.7	36.24	11.35	D22				S
890327180015	2	4.11	130	140	3.87	134.90	64.0	34.0	82.0	41.0	191.60	30.0	0.5	2.6	6.4	1.8	184.40	64.45	D22				S

TABLE C.2. Continued

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDUC	(SO4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	PRE
890329123015	14	4.11	380	400	4.25	56.23	32.0	31.0	36.0	11.0	109.60	40.0	3.3	0.4	4.5	1.2	111.33	31.41				W
890401193015	14	5.02	2600	-200	4.29	51.29	23.0	17.0	18.0	0.9	63.50	9.0	0.5	2.5	0.7	0.4	57.09	22.17				W
890403193015	7	5.02	160	-200	4.11	77.62	37.0	38.0	32.0	3.0	111.60	35.0	0.5	0.4	1.5	0.4	117.32	38.14				W
890404140015	7	5.02	70	-200	4.01	97.72	51.0	36.0	47.0	3.9	123.50	16.0	1.5	7.0	1.9	0.4	126.82	45.16				W
890405143015	11	5.02	1000	-200	4.23	58.88	32.0	28.0	29.0	2.5	88.10	21.0	3.0	0.4	2.5	0.9	90.00	29.00				W
890406135015	4	5.02	16	-200	-200.00	-200.00	-200.00	44.0	82.0	3.6	174.20	21.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W
890407182015	13	5.02	1500	-200	4.29	51.29	24.0	12.0	35.0	1.6	61.20	12.0	0.5	0.4	0.6	0.4	66.19	23.38	R			W
890408183015	3	5.02	8	-200	-200.00	-200.00	-200.00	41.0	17.0	3.2	102.80	24.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W
890410203015	7	5.02	110	-200	4.32	47.86	26.0	13.0	41.0	1.8	69.40	18.0	1.0	0.4	3.6	1.1	76.66	23.62				W
890416174015	13	5.02	210	-200	3.93	117.49	54.0	18.0	94.0	10.0	140.00	15.0	1.2	0.4	2.6	0.6	148.49	52.75				W
890416184715	6	5.02	41	-200	3.85	141.25	69.0	83.0	59.0	3.6	229.20	63.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W
890418133015	1	5.02	140	-200	4.18	66.07	34.0	22.0	44.0	2.3	91.80	18.0	1.5	0.4	4.9	1.1	97.97	31.73				W
890420213015	3	5.02	29	-200	-200.00	-200.00	-200.00	24.0	150.0	13.0	211.00	55.0	2.4	0.4	24.0	5.3	-200.00	-200.00				W
890430163015	12	5.02	115	-200	3.97	107.15	51.0	32.0	60.0	7.2	131.80	14.0	1.1	0.4	4.8	1.1	134.45	48.77				W
890504142015	40	6.06	2500	-200	4.05	22.39	12.0	9.2	9.1	7.5	35.00	4.1	0.5	3.7	0.6	0.4	32.69	11.12				W
890506150015	1	6.06	1500	1500	4.77	16.98	8.8	3.7	9.8	5.1	22.90	0.9	0.5	3.2	0.5	0.4	23.38	8.00				W
890507171015	10	6.06	180	170	4.20	63.10	29.0	24.0	31.0	10.0	89.60	4.7	0.5	0.4	2.5	0.7	76.10	29.32				W
890508283015	18	6.06	200	190	4.58	27.54	14.0	8.8	16.0	9.0	43.20	6.1	0.5	0.4	0.6	0.4	36.54	13.38				W
890509150015	3	6.06	33	-200	4.34	45.71	24.0	18.0	23.0	11.0	70.60	11.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W
890511220015	4	6.06	1600	1200	5.06	8.71	6.4	3.4	5.5	11.0	23.90	1.5	0.6	0.4	1.4	0.4	14.81	5.15				W
890512160015	3	6.06	470	410	4.41	38.90	21.0	16.0	13.0	8.6	54.20	8.8	1.0	0.4	4.7	1.3	61.10	18.91				W
890513201015	1	6.06	520	450	4.10	79.43	35.0	20.0	44.0	12.0	96.60	2.3	0.5	0.4	1.3	0.4	86.03	35.19				W
890521192015	6	6.06	560	69	4.13	74.13	37.0	39.0	28.0	10.0	116.60	34.0	0.5	0.4	1.8	0.5	113.63	37.28				W
890524192015	4	6.06	1200	1200	4.04	22.91	12.0	8.2	12.0	8.5	37.50	4.5	0.5	0.4	1.5	0.4	32.11	11.32				W
890528151415	19	6.06	950	780	4.07	85.11	42.0	44.0	47.0	12.0	147.60	28.0	0.5	0.1	8.1	2.5	149.91	44.17				W
890531201015	18	6.06	530	520	3.81	154.88	75.0	82.0	55.0	14.0	233.60	45.0	2.5	13.0	3.8	1.3	225.58	76.22				W
890601161015	4	7.12	630	610	-200.00	-200.00	-200.00	130.0	140.0	19.0	419.60	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W
890602223015	5	7.12	480	430	4.29	51.29	26.0	25.0	23.0	7.1	80.70	21.0	0.5	10.0	2.0	0.7	88.19	26.40				W
890604213015	6	7.12	420	350	4.24	57.54	20.0	25.0	28.0	6.8	85.40	13.0	1.7	22.0	2.5	0.8	100.84	29.31	B38			W
890606170015	8	7.12	220	220	4.06	83.18	30.0	22.0	52.0	6.7	103.30	4.7	1.7	11.0	4.0	1.5	111.58	36.35	B38			W
890611180015	10	7.12	1600	1500	4.67	21.38	11.0	9.7	8.5	5.4	33.90	4.7	0.5	0.4	0.8	0.4	29.38	10.46	B38			W
890613192015	10	7.12	200	210	4.36	43.65	22.0	22.0	20.0	7.9	72.50	6.3	0.5	0.4	6.7	1.7	67.65	21.93	B38			W
890615144515	10	7.12	240	350	4.48	33.11	16.0	7.0	26.0	6.5	47.10	4.0	2.8	0.4	2.1	0.6	45.71	15.71				W
890616152015	20	7.12	240	250	4.41	38.90	19.0	12.0	21.0	6.1	51.70	0.8	1.2	0.4	1.8	0.7	46.30	17.75				W
890617152015	6	7.12	490	470	4.06	87.10	40.0	38.0	35.0	7.5	115.10	13.0	2.7	0.4	2.6	0.6	110.00	40.34				W
890619132015	7	7.12	97	86	-200.00	-200.00	-200.00	59.0	58.0	11.0	187.60	20.0	1.0	0.4	9.1	3.3	-200.00	-200.00				W
890624200015	1	7.12	1400	1300	4.47	33.88	18.0	15.0	14.0	7.7	52.30	13.0	0.9	0.4	1.1	0.4	51.18	16.85	B38			W
890628151515	10	7.12	510	450	4.03	93.33	51.0	53.0	58.0	10.0	174.60	34.0	2.0	0.4	16.0	2.7	165.13	49.85				W
890705170015	3	8.08	250	280	4.17	67.61	42.0	49.0	32.0	9.3	139.90	34.0	3.8	9.2	11.0	1.9	140.41	38.59				W
890708154015	3	8.08	200	230	4.84	14.45	25.0	45.0	44.0	8.4	143.00	58.0	2.0	11.0	32.0	5.4	162.25	24.62	B38			W
890709101015	1	8.08	490	480	4.34	45.71	29.0	31.0	28.0	8.1	98.70	27.0	0.6	1.7	9.9	2.4	99.61	26.06				W
890710162015	6	8.08	930	930	4.28	54.95	37.0	45.0	45.0	8.2	143.80	55.0	0.5	0.4	13.0	2.6	142.05	35.45				W
890711134015	2	8.08	410	380	4.54	28.84	41.0	92.0	83.0	9.3	236.90	120.0	0.8	15.0	36.0	6.7	248.04	41.78				W
89071717015	1	8.08	62	69	4.01	97.72	63.0	78.0	87.0	10.6	261.60	60.0	2.0	0.4	37.0	7.9	249.92	62.46				W
890718154515	2	8.08	150	140	4.51	30.90	28.0	35.0	30.0	8.2	168.80	31.0	0.5	0.4	22.0	1.8	110.40	23.57				W
890720171515	5	8.08	190	210	3.84	144.54	78.0	83.0	99.0	14.0	279.60	48.0	0.7	0.4	24.0	3.6	248.84	77.42				W
890721142515	1	0.00	0	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W

TABLE C.2. Continued

YTMDDHHSS	LID	ADATE	SVOL	PVOL	LAB	PH	(H+)	CONDUC	(SD4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC	CO	ADS	ADS	DEP	PRE
898723214015	4	8.08	64	69	3.65	223.87	120.0	120.0	140.0	140.0	18.0	398.53	37.0	1.1	0.4	30.0	4.0	342.37	114.35					V R
898729175015	5	8.08	3200	3600	4.35	44.67	25.0	25.0	14.0	14.0	5.9	70.13	21.0	1.2	0.4	1.6	0.4	71.27	22.63	C21				V R
898731171515	1	8.08	120	100	5.24	5.75	7.7	8.1	9.0	16.0	41.80	15.0	1.4	4.7	9.7	1.1	48.45	7.74					V R	
89883182015	10	9.21	62	60	4.07	85.11	54.0	100.0	80.0	9.7	298.30	69.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0			V R	
89885153015	10	9.21	4500	4000	4.56	27.54	17.0	21.6	14.0	4.1	60.73	11.0	0.9	0.4	2.1	0.7	45.44	15.23					V R	
89887174515	2	9.21	400	330	4.38	41.69	25.0	28.0	28.5	5.0	90.20	22.0	1.0	0.4	5.2	0.4	76.29	23.40					V R	
898814170515	22	9.21	310	120	5.29	5.13	7.2	9.4	18.0	3.9	41.60	7.5	0.5	0.4	14.0	0.4	42.33	6.91	C22 B41				V R	
898816130015	2	9.21	110	280	3.81	154.88	73.0	96.0	66.0	7.0	265.60	22.0	0.5	0.4	13.0	2.0	207.78	76.85					V R	
898821161015	9	9.21	1600	1100	4.45	35.48	20.0	19.0	18.0	4.6	61.20	8.4	0.5	0.4	2.4	0.4	50.38	17.83					V R	
898823163015	2	9.21	220	190	4.31	48.98	26.0	29.0	25.0	3.6	87.20	15.0	0.5	0.4	5.1	0.7	76.48	25.25					V R	
898826152015	1	10.00	2	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0			V R	
898830230715	4	9.21	830	860	4.26	54.95	29.0	35.0	33.0	4.9	108.50	31.0	0.5	0.4	3.3	0.4	94.26	29.87					V R	
898831182015	1	9.21	62	0	6.32	0.48	8.9	11.0	17.0	6.2	45.80	24.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0			V R	
898902181515	7	10.03	2300	2000	4.19	64.57	26.0	26.0	19.0	7.2	78.80	17.0	0.7	11.0	1.2	0.6	90.87	30.61					V R	
898915170015	11	10.03	3200	3600	4.19	64.57	26.0	23.0	26.0	7.7	80.30	11.0	0.5	0.4	1.3	0.9	80.87	29.52					V R	
898918174015	12	10.03	700	790	4.54	28.84	12.0	8.7	12.0	6.3	36.30	3.4	0.5	0.5	20.0	0.7	54.94	14.55					V R	
898920194015	6	10.03	4100	3200	5.29	5.13	2.7	0.7	3.9	5.6	11.50	0.6	0.9	13.5	0.5	-200.0	-200.0	-200.0	-200.0			V R		
898924152515	20	10.03	2200	2100	4.63	23.44	13.0	11.0	9.0	9.4	41.60	17.0	2.4	20.0	1.2	0.6	72.44	14.63					V R	
898927154515	300	10.03	420	480	4.61	24.55	16.0	27.0	19.0	8.8	84.50	32.0	0.5	34.0	9.1	1.2	111.65	20.52					V R	
891004140015	4	11.07	690	620	4.71	19.50	11.0	7.7	10.0	7.3	33.30	3.5	0.5	0.4	3.1	0.4	30.90	9.91					V R	
891009163015	15	11.07	310	310	4.12	75.86	38.0	36.0	72.0	9.8	154.40	40.0	1.2	1.6	18.0	2.7	160.00	43.01					V R	
891011175515	5	11.07	300	330	4.37	42.66	21.0	9.0	30.0	7.0	62.40	8.7	1.0	19.0	4.1	0.4	80.36	21.94					V R	
891013182515	2	11.07	68	86	4.72	19.05	38.0	71.0	110.0	15.0	207.60	73.0	20.0	2.4	82.0	10.0	200.45	42.17					V R	
891015155515	5	11.07	600	590	4.30	50.12	24.0	18.0	21.0	7.9	65.50	12.0	0.7	4.6	3.6	0.9	76.42	24.01					V R	
891021201315	2	11.07	210	190	4.01	97.72	53.0	59.0	100.0	13.0	231.00	70.0	2.5	17.0	33.0	4.9	271.02	62.06					V R	
891023234015	8	11.07	950	1000	4.56	27.54	15.0	12.0	9.3	7.0	40.90	7.8	0.5	20.0	2.1	0.4	60.84	14.91					V R	
891018184515	7	12.05	1000	-200	4.08	9.32	5.2	1.6	4.5	6.6	14.90	0.6	0.5	0.4	0.5	0.4	11.62	4.18					V M	
891101184515	13	11.07	220	210	4.61	24.55	15.0	12.0	33.0	8.4	65.60	17.0	2.1	3.9	12.0	1.4	74.35	16.38					V M	
891105170015	7	12.05	500	400	4.11	77.62	25.0	16.0	58.0	8.8	97.40	14.0	1.3	9.3	5.5	1.2	115.82	36.64	B39				V R	
891106183015	8	12.05	740	470	4.15	70.79	36.0	44.0	46.0	14.0	148.60	42.0	2.1	10.0	4.7	1.4	137.09	40.18	B38				V R	
891109120015	12	12.05	550	700	4.00	100.00	45.0	36.0	72.0	14.0	158.60	24.0	1.2	13.0	1.9	0.4	142.00	49.52					V R	
891109115515	7	12.05	250	240	4.16	69.18	28.0	17.0	43.0	8.3	85.90	6.8	0.6	4.4	0.5	0.9	83.78	31.40	B39				V R	
891101014515	6	12.05	820	810	4.45	35.48	16.0	18.0	18.0	8.5	59.10	8.5	1.4	4.8	0.7	0.4	52.38	17.87					V R	
891113100015	23	12.05	500	600	4.32	47.86	23.0	19.0	43.0	14.0	95.00	10.0	0.9	3.5	3.2	0.7	76.06	25.57	B38				V M	
891115100515	7	12.05	150	160	3.92	120.23	49.0	38.0	61.0	15.0	152.00	10.0	2.9	0.4	3.9	1.1	149.53	55.04					V R	
891116180015	5	12.05	2700	2000	4.99	10.23	5.1	7.1	5.1	8.4	28.30	0.9	2.2	7.5	0.5	0.5	22.83	6.47	B39				V R	
891117134015	5	12.05	60	80	4.52	30.20	9.4	8.0	31.0	22.0	69.60	4.2	0.7	1.3	24.0	3.1	90.60	19.25	B39				V S	
891121151515	15	12.05	3600	3500	4.58	26.30	13.0	10.0	28.0	9.4	56.60	13.0	0.5	17.0	2.6	0.5	63.00	15.79					V M	
891127201515	17	12.05	360	400	4.04	91.20	49.0	27.0	110.0	30.0	194.60	35.0	0.5	13.0	16.0	2.8	177.30	51.49					V M	
891128203515	4	12.05	520	540	4.04	91.20	52.0	51.0	76.0	19.0	197.60	48.0	0.5	9.6	15.0	3.4	186.10	52.47	B39				V M	
891201191515	18	1.03	730	-200	4.29	51.29	15.0	5.1	28.0	5.2	44.00	5.2	1.2	0.4	0.9	0.4	60.80	21.70					V S	
891204201515	15	1.03	82	260	4.95	89.13	40.0	20.0	97.0	31.0	168.60	35.0	5.8	0.4	25.0	2.8	185.93	49.17					V S	
891207120515	4	1.03	500	550	4.32	47.86	17.0	8.0	25.0	5.7	47.30	12.0	0.9	0.4	2.9	0.4	67.76	21.45					V S	
891211133015	9	1.03	35	35	-200.00	-200.00	-200.0	22.0	99.0	34.0	177.60	36.0	0.5	0.4	8.6	0.7	-200.00	-200.00					V S	
891216151515	5	1.03	530	570	6.47	0.34	17.0	3.7	58.0	6.3	70.30	0.6	0.6	6.2	0.5	0.4	9.54	6.39					V S	
891216154515	4	1.03	6	69	-200.00	-200.00	-200.0	8.6	100.0	120.0	237.00	5.2	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0			V S	

TABLE C.2. Continued

YYMMDDHHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDUC	[SO4=]	[NO3-]	[Cl-]	ANION	[NH4+]	[Na+]	(K+)	[Ca++]	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	PRE
891221114515	7	1.03	89	210	4.06	87.10	27.0	9.1	54.0	29.0	101.80	8.7	1.7	6.2	11.0	2.1	129.90	46.38				V S
891227160015	20	1.03	91	170	3.83	147.91	47.0	9.3	83.0	33.0	135.20	5.2	2.0	15.0	0.5	0.4	172.51	63.23				V S
900101203015	40	2.08	1400	-200	4.20	83.10	19.0	14.0	21.0	17.0	66.60	2.7	0.5	0.4	0.8	0.4	69.10	27.31		E21		V M
900105125515	7	2.08	530	500	4.11	77.62	27.0	19.0	33.0	23.0	94.60	13.0	2.5	6.7	4.5	0.6	110.02	36.17				V M
900108165015	16	2.08	110	100	3.88	131.83	50.0	29.0	120.0	55.0	233.60	72.0	4.0	19.0	13.0	2.5	257.83	71.63				V S
900112114015	40	2.08	850	900	4.16	69.16	25.0	12.0	48.0	16.0	88.60	8.7	0.6	18.0	4.4	0.7	166.68	33.11				V S
900113144015	40	2.08	240	360	5.07	8.51	7.7	8.5	15.0	14.0	46.60	6.7	0.9	33.0	1.0	0.4	51.91	9.45				V S
900117112515	10	2.08	180	220	3.63	234.42	86.0	63.0	100.0	61.0	347.60	82.0	18.0	13.0	12.0	2.5	376.42	116.76				V M
900118202515	16	2.08	1400	1500	4.01	97.72	37.0	31.0	47.0	18.0	127.60	2.3	3.5	1.8	0.9	1.3	109.72	44.18				V R
90012201515	45	2.08	700	730	4.08	83.18	29.0	18.0	47.0	23.0	166.60	19.0	2.1	5.6	1.0	0.4	112.68	38.92				V M
900123202515	8	2.08	96	160	4.27	53.70	23.0	9.7	62.0	20.0	102.60	20.0	0.2	0.4	1.2	0.7	86.10	28.20				V S
90012611015	16	2.08	1300	1100	4.18	68.07	21.0	14.0	37.0	16.0	81.60	2.3	1.1	1.5	2.3	1.2	83.97	30.17				V M
900129174015	12	2.08	400	410	4.26	54.95	20.0	9.1	26.0	19.0	63.80	6.9	1.3	0.4	0.9	0.4	60.15	24.61				V S
900130150015	1	2.08	1900	2000	4.77	16.98	5.7	3.1	9.9	9.0	25.70	0.6	0.5	4.8	0.5	0.4	24.68	6.31				V S
900205170015	40	3.07	1600	1700	4.23	58.88	18.0	10.0	28.0	12.0	60.60	7.6	0.5	0.4	0.9	0.5	70.18	25.75				V M
900210114515	8	3.07	1600	1700	4.08	83.18	28.0	27.0	38.0	6.8	97.40	20.0	3.0	2.8	1.5	0.6	113.18	38.23				V M
900213193015	4	3.07	73	52	3.79	162.16	53.0	15.0	65.0	74.0	169.60	28.0	10.0	2.6	7.6	2.0	222.18	72.97				V S
900216204015	12	3.07	2800	2800	4.28	52.48	19.0	13.0	28.0	14.0	68.60	5.0	2.2	0.4	0.6	0.6	62.48	23.97				V M
900220161015	20	3.07	400	380	3.94	114.82	40.0	31.0	72.0	22.0	155.60	26.0	1.9	0.4	7.5	1.0	160.12	54.48				V M
900223154015	6	3.07	990	1100	4.26	54.95	20.0	20.0	26.0	8.3	74.90	15.0	4.5	5.8	1.0	0.5	83.25	26.58				V R
900224212515	12	3.07	90	120	3.86	138.04	45.0	34.0	55.0	30.0	153.60	23.0	0.6	0.4	1.3	0.4	165.44	61.47				V M
900226201015	1	3.07	330	430	4.40	30.81	12.0	3.8	24.0	10.0	42.20	0.6	1.5	2.5	0.7	0.4	46.61	17.37				V S
900228125015	18	3.07	170	300	4.06	87.10	31.0	21.0	82.0	16.0	120.60	20.0	2.2	6.4	3.1	0.6	129.10	42.09				V S
900230164515	3	0.00	3	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				V S
900305193015	3	4.03	36	70	3.84	144.54	47.0	15.0	28.0	100.0	218.60	6.4	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				V S
900311203515	2	4.03	200	220	3.62	239.88	81.0	84.0	148.0	35.0	343.60	90.0	0.7	7.3	2.3	0.7	349.88	110.83				V R
900312193015	5	4.03	900	950	4.53	29.51	9.0	12.0	8.9	8.9	42.40	0.6	0.5	8.2	0.5	0.4	40.61	14.17				V R
900313161515	2	4.03	300	310	4.16	69.16	26.0	16.0	16.0	2.8	51.40	2.3	5.0	6.4	2.4	1.8	85.88	28.82				V R
900318175015	15	4.03	930	920	4.15	70.79	23.0	29.0	28.0	21.0	107.60	18.0	-300.0	-300.0	1.1	1.0	-300.00	-300.00				V R
900320122515	10	4.03	530	520	4.66	87.16	26.0	12.0	61.0	8.6	94.20	7.6	0.7	4.3	0.5	0.4	101.50	38.24				V M
900321213515	2	4.03	1100	1200	4.58	27.54	7.7	5.5	13.0	8.6	33.20	0.6	0.5	7.5	0.5	0.4	37.94	12.73				V S
900326223515	10	4.03	340	450	4.20	63.16	23.0	17.0	41.0	24.0	99.60	27.0	0.7	1.1	6.2	1.7	107.70	32.26				V M
900402154015	13	5.08	1200	-200	4.16	69.16	23.0	24.0	17.0	14.0	79.60	5.0	0.5	10.0	1.4	0.4	88.28	31.33		E21		V M
900404124015	15	5.08	2200	2200	4.69	20.42	7.2	12.0	8.6	9.8	43.20	0.8	0.5	10.0	0.5	0.4	33.52	11.19		E21		V M
900405163015	9	5.08	240	200	4.66	21.88	9.0	11.0	9.8	19.0	51.40	2.5	0.6	10.0	0.5	0.4	36.78	12.46		E21		V M
900406120515	6	5.08	520	520	4.54	28.84	12.0	11.0	25.0	9.9	57.50	3.3	1.7	10.0	1.3	0.8	48.04	15.51				V S
900411123515	5	0.00	2100	-200	4.42	38.02	14.0	15.0	20.0	11.0	61.60	10.0	1.1	10.0	2.1	0.5	64.32	19.67		E21		V S
900416200015	25	5.08	520	590	4.15	70.79	28.0	23.0	41.0	11.0	98.60	27.0	3.4	10.0	3.6	0.9	120.19	35.28				V M
900417190015	6	5.08	390	380	4.01	97.72	38.0	29.0	60.0	12.0	130.60	35.0	0.9	10.0	3.6	1.1	153.02	47.51		E21		V M
900423144515	30	5.08	810	740	4.01	97.72	38.0	30.0	46.0	14.0	120.60	17.0	1.5	10.0	3.7	1.0	135.62	45.51	C22 B30	E21		V M
90043024515	10	5.08	350	350	3.97	107.15	41.0	49.0	58.0	14.0	170.60	48.0	3.0	10.0	7.6	2.3	189.15	55.44		E21		V R
900506170015	11	6.05	1200	1200	4.40	39.61	14.0	11.0	19.0	1.2	42.80	3.4	0.7	10.0	0.7	0.6	56.51	18.14		E21		V R
900507181015	4	6.05	300	280	4.27	53.70	22.0	27.0	20.0	3.7	70.30	20.0	0.8	10.0	3.2	0.7	100.30	27.73				V R
900511123015	36	6.05	1500	1500	4.59	26.70	13.0	12.0	13.0	2.6	40.20	7.6	0.6	10.0	1.6	0.5	48.10	13.43				V R
900514191015	7	6.50	2100	2100	4.38	41.69	15.0	15.0	14.0	3.2	47.80	6.8	0.6	10.0	0.5	0.4	60.89	19.39				V R
900517180015	6	6.05	1800	1600	4.67	86.11	32.0	29.0	35.0	4.6	98.20	14.0	1.3	15.0	1.6	0.8	120.21	39.34		E21		V R
900519112515	30	6.05	2100	2400	4.26	54.95	18.0	18.0	18.0	4.0	58.60	8.5	0.5	10.0	0.8	0.4	76.35	24.98	B38	E21		V R

TABLE C.2. Continued

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDC	(SO4=)	(NO3-)	(Cl-)	ANION (NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	PRE
900521185515	13	6.05	2000	1800	4.07	85.11	31.0	32.0	24.0	5.0	93.00	15.0	0.5	10.0	0.7	0.4	112.01	30.50		E21	W R
900530230015	6	6.05	920	550	4.23	58.98	23.0	26.0	28.0	5.0	86.20	29.0	0.5	10.0	1.3	0.7	102.30	29.97	830	E22	W R
900604190015	4	7.03	1300	1300	4.40	39.81	15.0	22.0	12.0	6.3	82.90	13.0	1.4	10.0	1.4	0.4	87.01	20.40		E21	W R
900605191515	2	7.03	22	17	-200.00	-200.00	-200.0	11.0	8.0	5.0	37.00	18.0	1.6	10.0	5.5	0.9	-200.00	-200.00		W R	
900608183015	7	7.03	150	120	4.02	95.50	35.0	40.0	37.0	15.0	132.00	13.0	5.1	10.0	4.8	1.7	130.00	45.70		E21	W R
90061113015	17	7.03	670	710	4.07	85.11	35.0	32.0	54.0	1.0	119.00	25.0	4.0	10.0	2.1	0.7	130.31	41.52		W R	
900615130015	3	7.03	270	280	4.08	83.18	30.0	40.0	42.0	10.0	132.00	30.0	3.7	10.0	3.2	1.0	136.20	42.33		W R	

TABLE C.3. Data Listing for Precipitation Samples Collected at the Biscuit Brook Site

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB	pH	(H+)	CONDUC	(SD4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC	CO	ADS	ADS	DEF	PRE	
880825120025	3	-200	630	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	R
880825120025	12	11.14	2200	1800	4.58	26.30	14.0	13.0	9.3	7.7	43.60	8.0	2.8	0.4	1.5	0.6	0.4	41.70	13.35					V	R
880830120025	6	11.14	2500	2400	5.03	9.33	8.1	7.7	6.7	8.6	31.50	4.0	3.0	1.5	3.1	0.9	0.5	25.83	6.52					V	R
880905120025-300	11.14	1800	-300	-300	4.63	23.44	10.0	6.4	9.5	6.3	29.20	2.7	0.7	16.0	0.5	0.4	0.4	44.64	11.79					V	R
880906120025-300	11.14	51	-300	-300	4.25	56.23	30.0	39.0	23.0	7.6	109.40	34.0	6.0	0.4	1.4	0.4	0.4	101.03	30.75					V	R
880913120025	7	11.14	210	130	4.14	72.44	33.0	28.0	39.0	7.5	103.10	19.0	3.7	0.4	2.2	0.5	0.5	100.94	34.74					V	R
880916120025	10	-200	390	280	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	R
880921120025	13	11.14	890	630	4.04	91.20	45.0	44.0	44.0	13.0	145.60	27.0	0.7	0.4	2.5	1.7	133.70	45.32					V	R	
880922120025	7	-200	25	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	R
880923120025	2	11.14	370	280	4.06	87.10	42.0	40.0	44.0	12.0	136.60	21.0	7.2	0.4	6.1	1.1	131.30	43.17					V	R	
880924120025	2	11.14	50	65	3.70	199.53	83.0	94.0	86.0	11.0	285.60	69.0	11.0	0.4	5.1	4.5	293.13	97.85					V	R	
881003120025	12	11.14	470	350	4.24	57.54	34.0	47.0	28.0	9.3	131.90	57.0	5.7	0.4	1.5	0.8	125.24	34.57					V	R	
881008120025	3	12.20	110	-200	4.09	81.28	47.0	16.0	35.0	8.2	75.80	11.0	4.8	0.4	1.2	0.4	100.68	35.17					V	M	
881009122425	30	12.20	110	-200	4.45	35.48	16.0	6.2	18.0	8.4	39.44	5.5	5.4	0.4	0.5	0.4	48.58	16.05	836				V	M	
881011120025	10	12.20	170	-200	3.84	144.54	91.0	63.0	140.0	11.0	277.60	61.0	3.6	4.8	31.0	7.3	290.54	79.65					V	R	
881012113025	10	12.20	110	-200	4.70	19.95	13.0	11.0	15.0	1.2	38.80	7.9	7.3	0.4	2.3	0.8	41.35	11.85					V	M	
881013120025	3	12.20	49	-200	4.49	32.36	20.0	23.0	22.0	2.7	71.30	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	V	M
881019120025	10	12.20	620	-200	4.01	97.72	52.0	48.0	46.0	4.0	146.60	38.0	4.2	0.4	3.3	1.2	149.32	48.39					V	M	
881022123025	3	12.20	1400	-200	4.68	20.89	8.5	5.4	8.7	4.1	24.20	3.5	3.1	0.4	0.5	0.6	30.69	9.60					V	M	
881023133025	10	12.20	760	-200	4.63	23.44	8.9	8.4	8.2	1.4	27.60	2.7	1.9	0.4	0.5	0.4	30.24	10.56					V	M	
881024160025	4	12.20	980	-200	4.26	54.95	22.0	20.0	38.0	2.8	81.40	27.0	2.9	4.7	1.0	0.4	92.35	27.74					V	R	
881025120025	2	12.20	42	-200	4.18	66.07	57.0	110.0	110.0	11.0	341.60	74.0	63.0	11.0	36.0	11.0	308.07	62.19					V	S	
881027120025	7	12.20	24	-200	3.94	114.82	72.0	54.0	160.0	18.0	288.60	74.0	8.1	0.4	30.0	8.5	274.32	70.74					V	M	
881029130025	1	12.20	630	-200	4.12	75.86	29.0	30.0	37.0	4.8	102.40	24.0	2.4	0.4	2.4	0.7	108.86	36.23					V	M	
881031130025-200	-200	1	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	R
881102140025	10	12.20	1000	-200	5.04	9.12	4.0	2.0	4.9	1.4	10.90	1.4	0.5	0.4	0.5	0.4	13.22	4.21					V	M	
881103120025	12	12.20	370	-200	4.42	38.02	15.2	14.0	22.0	5.5	58.10	11.0	2.0	0.4	1.2	0.4	54.62	18.47					V	M	
881106133025	6	12.20	3100	-200	4.86	13.80	9.7	4.7	4.6	8.2	22.80	2.7	2.4	0.4	0.5	0.4	21.10	6.93					V	R	
881107143725	6	12.20	110	-200	4.10	79.43	43.0	31.0	52.0	9.9	124.50	26.0	8.5	0.4	1.2	0.4	117.53	39.37					V	R	
881109141025	6	12.20	160	-200	3.71	194.98	100.0	76.0	140.0	26.0	318.60	85.0	2.1	13.0	16.0	4.0	335.68	106.80					V	R	
881111131725	5	12.20	2100	-200	3.79	132.18	94.0	73.0	120.0	20.0	288.60	82.0	7.8	0.4	8.4	3.0	275.18	85.26					V	R	
881114133025	4	12.20	1300	-200	4.73	18.62	11.0	7.8	5.3	12.0	33.50	2.7	5.6	16.0	0.5	0.9	45.72	16.73					V	R	
881117131025	14	12.20	1100	-200	4.22	60.26	26.0	24.0	32.0	13.0	93.60	22.0	6.4	1.6	0.8	1.1	93.06	30.10					V	R	
881118081525	4	12.20	150	-200	4.71	19.50	10.0	12.0	7.0	5.4	37.00	2.7	0.6	14.0	3.3	0.6	44.60	11.15					V	R	
881121132525	7	12.20	3500	-200	4.74	18.20	8.0	5.6	7.9	5.3	24.80	2.7	0.5	9.8	0.5	0.4	33.00	9.18					V	M	
881127164525	6	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	R
881128143025	16	12.20	740	-200	4.54	28.84	13.0	11.0	19.0	7.4	49.00	11.0	1.0	0.4	1.3	0.4	44.64	14.71					V	R	
881129130025	5	12.20	39	-200	4.29	51.29	32.0	29.0	31.0	8.9	98.50	48.0	0.5	0.4	4.0	1.3	102.79	28.69					V	S	
881202131025	9	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	S
881204151025	5	12.20	38	-200	5.05	8.91	12.0	11.0	17.0	10.0	49.00	15.0	4.7	7.1	9.4	2.5	59.51	9.81					V	S	
881206140025	5	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	S
881212142025	10	12.20	65	-200	4.07	85.11	41.0	5.9	91.0	7.5	110.90	19.0	1.3	0.4	8.9	2.5	128.61	49.36					V	S	
881216153525	4	1.11	180	-200	4.46	34.67	23.0	9.7	43.0	9.3	72.30	18.0	1.5	1.7	7.7	2.0	75.27	19.86					V	S	
881220150025	3	-200	16	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	M
881226212025	11	1.11	2000	-200	4.36	43.65	24.0	16.0	13.0	11.0	56.60	4.6	4.3	3.9	1.2	0.9	60.65	20.45					V	M	
881229144025	4	1.11	750	-200	4.26	54.95	31.0	24.0	22.0	17.0	87.60	29.0	7.7	0.4	1.5	1.5	98.05	28.59					V	M	

TABLE C.3. Continued

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB	pH	(H+)	CONDUC	(SD4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	PRE
890102152325-300	1	1.11	-200	-200	-200.00	-200.00	-200.00	-200.0	48.0	35.0	15.0	146.00	21.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00		W	R
890103143625-300	1	1.11	-200	-200	3.94	114.82	67.0	46.0	88.0	11.0	191.60	47.0	0.5	7.6	3.3	9.9	178.32	58.57			W	R	
890108160025-300	-200	2	418	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00	A28	W	R
890113132525	5	3.22	1100	-200	4.45	35.48	17.0	12.0	11.0	5.9	41.50	3.7	4.4	0.4	0.7	0.7	48.78	16.08			W	M	
890115143025	3	3.22	700	-200	4.53	29.51	17.0	11.0	14.0	5.7	42.30	9.5	2.4	25.0	0.7	0.4	68.61	16.12			W	M	
890117134525	3	3.22	29	-200	-200.00	-200.00	-200.0	26.0	55.0	6.6	114.20	36.0	2.2	0.4	5.3	1.1	-200.00	-200.00	-200.00		W	S	
890119133025	3	-200	13	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00		W	S
890121140525-300	3	3.22	250	-200	4.23	58.88	34.0	16.0	56.0	8.6	97.20	25.0	1.6	0.4	7.5	1.1	103.00	30.46			W	S	
890127135025	8	3.22	1100	-200	3.91	123.03	60.0	44.0	51.0	17.0	158.60	27.0	12.0	0.4	2.4	1.8	170.83	57.52			W	M	
890128144525	1	3.22	190	-200	4.38	41.69	27.0	14.0	42.0	5.4	78.00	29.0	1.2	5.8	5.4	1.7	91.89	23.41			W	M	
890130132025	3	3.22	75	-200	4.08	63.18	37.0	19.0	43.0	6.3	87.90	6.7	0.5	0.4	2.8	0.8	97.98	36.37			W	M	
890203181525	5	3.22	320	-200	4.00	100.00	48.0	26.0	56.0	7.0	115.60	15.0	0.9	0.4	3.6	0.8	125.10	44.99			W	R	
890204153025-300	-200	1	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00		W	M
890205160525-300	3	3.22	100	-200	4.44	36.31	17.0	3.4	31.0	6.4	44.80	3.7	2.9	20.0	2.6	0.5	69.11	18.08			W	S	
890207142525-300	3	3.22	68	-200	3.83	147.91	67.0	35.0	110.0	18.0	198.60	22.0	3.7	0.0	3.1	0.9	187.61	68.78			W	S	
890210135525	2	4.12	47	-200	-200.00	-200.00	-200.0	8.9	86.0	26.0	130.40	5.2	14.0	9.3	17.0	4.1	-200.00	-200.00	-200.00		W	S	
890212160025-300	-200	15	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00		W	S
890213132025	3	3.22	820	820	4.11	77.62	39.0	27.0	39.0	19.0	112.60	25.0	6.3	0.4	1.6	0.8	114.12	37.81			W	S	
890214144525	6	3.22	50	-200	-200.00	-200.00	-200.0	12.0	59.0	37.0	120.60	11.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00		W	S	
890216132025	8	3.22	850	-200	4.10	79.43	38.0	27.0	23.0	11.0	95.60	11.0	2.1	1.4	0.6	0.4	95.93	35.88			W	R	
890219190025-300	-200	13	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00		W	S
890221210025-300	3	3.22	2700	-200	4.64	22.91	12.0	8.2	8.7	10.0	35.70	3.0	1.1	0.4	0.5	0.4	29.21	11.01			W	R	
890223160025	10	4.12	180	-200	4.07	85.11	38.0	11.0	69.0	9.8	101.40	4.5	0.6	0.4	1.6	0.4	94.61	37.66			W	S	
890227132025	10	4.12	58	-200	3.92	120.23	52.0	15.0	130.0	19.0	179.60	24.0	4.7	0.4	7.7	1.7	168.13	57.98			W	S	
890228141525-200	-200	10	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00		W	R
890305150025	2	4.12	590	-200	4.14	72.44	33.0	25.0	28.0	13.0	89.60	6.5	3.2	5.3	2.0	1.0	93.44	33.21			W	M	
890313154025-300	4	4.12	210	-200	3.70	199.53	88.0	34.0	190.0	21.0	270.60	37.0	7.3	17.0	9.8	2.0	284.43	95.49			W	S	
890318204525-300	4	4.12	680	-200	4.24	57.54	29.0	33.0	27.0	12.0	105.60	31.0	5.5	0.4	4.7	1.1	106.04	31.05			W	R	
890321142025-300	4	4.12	790	-200	4.31	48.98	21.0	6.2	42.0	7.1	62.10	7.7	0.5	0.4	0.8	0.4	59.98	22.33			W	S	
890325154525	1	4.12	2200	-200	5.13	7.41	3.6	2.1	1.8	1.0	7.00	1.9	1.3	11.0	0.5	0.4	23.41	4.23			W	R	
890329142225-300	4	4.12	430	-200	4.29	51.29	28.0	24.0	28.0	19.0	95.60	25.0	2.2	9.0	4.7	1.1	99.69	28.18	B38		W	R	
890331141025-300	4	4.12	1200	-200	4.06	87.10	39.0	36.0	39.0	15.0	120.60	22.0	4.5	1.1	1.9	0.8	120.10	41.92			W	R	
890401200025-300	4	4.12	290	-200	3.98	104.71	41.0	39.0	38.0	3.5	120.10	18.0	0.7	15.0	1.2	0.4	141.61	48.00			W	R	
890404152225	10	4.12	1000	-200	3.89	128.82	56.0	62.0	58.0	13.0	195.60	60.0	4.8	3.3	2.8	1.2	204.92	64.70			W	R	
890407152525-300	4	4.12	1100	-200	4.19	64.57	26.0	17.0	32.0	1.2	67.80	8.5	0.6	0.4	1.8	0.4	78.47	28.39			W	M	
890410140025-200	6	6.06	180	-200	3.86	138.04	64.0	31.0	110.0	8.3	180.90	24.0	0.8	11.0	1.7	0.4	178.04	64.17			W	M	
890411124525-200	6	6.06	69	-200	4.26	54.95	33.0	28.0	58.0	8.5	121.10	44.0	1.8	0.4	6.6	1.8	117.95	32.25			W	M	
890414143025	4	6.06	380	-200	3.99	102.33	58.0	28.0	140.0	17.0	213.60	29.0	6.0	0.4	20.0	6.2	190.13	56.33	B38		W	S	
890418183725	7	6.06	1100	-200	4.29	51.29	29.0	25.0	23.0	6.2	79.80	14.0	1.0	7.2	1.4	0.4	77.09	25.55			W	R	
890426132525	1	6.06	260	-200	6.20	0.63	9.3	8.5	15.0	15.0	0.2	47.60	6.8	65.0	0.4	3.1	0.8	70.63	7.66	B38		W	R
890430144525	1	6.06	480	-200	3.85	141.25	68.0	69.0	63.0	9.2	210.80	28.0	3.3	22.0	6.3	2.0	211.15	69.48	B38		W	R	
89050710025-300	3	6.06	5200	-200	4.33	46.77	24.0	17.0	22.0	6.7	63.30	13.0	0.5	0.4	0.6	0.4	63.07	22.10			W	R	
890508130025	3	6.06	5200	-200	4.57	26.92	14.0	11.0	11.0	5.7	39.30	8.4	1.1	10.0	0.5	0.4	54.22	14.19			W	R	
890507184525	4	6.06	180	-200	4.31	48.98	27.0	22.0	29.0	6.2	79.80	11.0	0.8	3.2	4.0	1.3	74.58	24.55			W	R	
890509132025	10	6.06	200	-200	4.28	52.48	29.0	24.0	31.0	6.3	85.90	20.0	0.5	7.6	1.9	0.6	85.58	26.91			W	R	
890511163025-300	3	6.06	2400	-200	4.47	33.88	17.0	14.0	15.0	6.0	49.60	7.9	0.6	2.5	0.6	0.4	46.78	16.35			W	R	
890512182025	3	6.06	160	-200	3.80	158.49	73.0	51.0	95.0	11.0	208.60	12.0	1.5	20.0	3.7	0.9	201.19	73.47			W	R	

TABLE C.3. Continued

YYMMDDHHHSS	LID	ADATE	SVOL	PVOL	LAB	pH	(H+)	CONDUC	(SO4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC	CD	ADS	ADS	ADS	DEP	PRE	
890515130025	7	6.06	210	-200	3.72	190.55	100.0	100.0	94.0	130.0	14.0	332.00	83.0	4.0	13.0	7.0	2.3	209.15	97.65						W	R
890517123025	7	6.06	3000	-200	4.79	16.22	10.0	10.0	7.0	5.6	7.9	28.10	3.1	1.1	0.4	0.8	0.4	23.22	8.16						W	R
890521183025	300	6.06	320	-200	3.88	131.83	64.0	69.0	69.0	55.0	10.0	203.60	41.0	1.1	28.0	3.7	1.4	212.13	66.64	B38					W	R
890525133525	7	6.06	1000	-200	4.47	33.88	15.0	11.0	11.0	17.0	6.6	46.20	3.1	1.3	12.0	1.8	0.6	55.08	16.60						W	R
890527200025	300	6.06	290	-200	4.22	60.26	41.0	49.0	68.0	68.0	12.0	178.60	41.0	4.6	14.0	23.9	6.3	178.46	41.34	B38					W	R
890531220025	6	6.06	140	-200	3.87	134.90	68.0	68.0	66.0	54.0	16.0	282.00	28.0	4.4	24.0	7.1	1.8	201.10	66.36						W	R
890602130025	300	6.06	180	-200	4.23	50.88	36.0	34.0	32.0	32.0	11.0	111.00	20.0	1.0	8.2	6.2	1.4	104.88	31.73						W	R
890602210025	1	7.13	520	670	3.92	120.23	60.0	76.0	42.0	9.7	204.30	47.0	0.9	0.4	4.1	1.8	1.4	179.53	61.16	B38					W	R
890606192025	300	7.13	1400	1300	4.00	100.00	48.0	43.0	41.0	6.2	135.00	24.0	0.5	0.5	2.0	1.8	0.6	131.30	47.09						W	R
890608155425	13	7.13	180	170	4.46	34.67	17.0	7.8	26.0	7.3	49.50	4.0	0.5	0.4	2.4	1.0	1.0	46.37	16.39						W	R
890610143025	20	7.13	880	900	4.38	41.69	20.0	11.0	20.0	20.0	7.6	58.20	4.7	1.5	0.4	3.6	0.4	56.29	19.65						W	R
890614151525	7	7.13	1300	1200	4.10	79.43	38.0	35.0	36.0	36.0	8.4	114.00	19.0	1.9	0.4	4.9	0.6	111.73	38.20						W	R
890616190025	16	7.13	2100	2200	4.14	72.44	33.0	28.0	25.0	7.4	89.00	10.0	0.5	0.4	1.4	0.4	0.4	86.94	32.81						W	R
890617183525	10	7.13	370	310	4.45	35.48	21.0	19.0	22.0	7.9	68.50	8.7	2.9	5.1	9.1	1.2	1.2	72.78	19.61						W	R
890622130025	300	7.13	210	200	4.16	69.18	35.0	27.0	64.0	15.0	133.60	14.0	5.5	0.4	16.0	3.3	127.68	37.20						W	R	
890624125525	6	7.13	1300	1000	4.51	30.90	20.0	11.0	23.0	7.7	53.30	13.0	2.2	0.4	3.6	0.5	54.70	18.19						W	R	
890627141525	12	7.13	320	210	4.42	38.02	28.0	33.0	29.0	10.0	105.60	45.0	1.3	0.4	11.0	1.8	110.32	25.76						W	R	
890628163025	2	7.13	200	190	4.62	23.99	16.0	15.0	16.0	6.9	53.50	6.3	2.3	0.4	9.6	0.8	53.79	13.97						W	R	
890706124025	5	7.13	2000	-200	4.45	35.48	19.0	12.0	18.0	8.8	49.40	7.0	0.9	15.0	0.7	0.5	60.78	17.77						W	R	
890707155025	1	7.13	660	-200	4.88	13.18	7.9	3.5	9.0	7.0	23.00	4.4	0.5	8.0	1.0	0.4	29.68	7.45						W	R	
890708152025	1	7.13	310	-200	4.44	36.31	22.0	24.0	25.0	9.4	83.00	31.0	1.1	0.4	5.3	1.5	82.41	21.83						W	R	
890711140025	3	8.23	740	-200	4.19	64.57	38.0	57.0	22.0	7.0	143.00	57.0	2.5	60.0	7.7	1.9	203.27	42.79						W	R	
890717160025	300	8.23	180	-200	4.17	67.31	33.0	18.0	51.0	11.0	98.00	0.6	0.6	43.0	6.7	1.7	128.61	34.81						W	R	
890721135025	9	8.23	1100	-200	4.28	52.48	26.0	17.0	31.0	5.1	70.70	8.2	0.5	52.0	0.6	0.4	115.18	27.95						W	R	
890727001525	5	8.23	85	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	26.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00					W	R
890728190025	4	8.23	1100	-200	4.54	28.84	17.0	15.0	13.0	3.7	47.30	14.0	0.7	20.0	1.7	0.4	67.74	16.25						W	R	
890803153025	2	10.04	930	-300	4.33	46.77	26.0	26.0	23.0	9.2	84.00	25.0	1.0	0.4	5.7	2.1	88.77	25.28						W	R	
890807135025	5	10.04	570	520	4.16	69.18	35.0	41.0	25.0	11.0	118.60	37.0	1.6	21.0	3.5	0.4	136.78	37.64	B05					W	R	
890814130025	30	10.04	3200	3000	4.69	20.42	9.5	4.4	11.0	6.9	27.30	0.6	1.0	0.4	0.5	0.4	24.22	9.32						W	R	
890819190025	1	10.04	220	-200	4.13	74.13	28.0	19.0	23.0	18.0	79.00	2.3	3.6	8.8	2.6	0.4	94.83	33.64	B05					W	R	
890821180525	9	10.04	430	-300	4.06	87.10	36.0	28.0	37.0	14.0	187.60	12.0	7.0	0.4	2.1	1.5	113.70	39.94						W	R	
890822141525	2	10.04	6	-300	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	83.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00					W	R
890830210025	4	10.04	870	850	3.75	177.83	67.0	69.0	36.0	13.0	187.60	18.0	0.5	0.4	2.6	0.4	202.73	77.68						W	R	
890902142325	3	10.04	560	520	3.89	128.82	60.0	56.0	58.0	12.0	182.00	28.0	0.8	0.8	4.2	11.0	3.3	188.42	62.13						W	R
890915132025	7	10.04	1400	1400	4.16	69.18	30.0	29.0	25.0	11.0	94.00	16.0	1.7	0.4	2.5	0.4	93.08	32.71						W	R	
890917182325	15	10.04	1200	1200	4.70	19.95	8.9	5.0	12.0	7.8	30.40	0.6	1.0	1.0	0.5	0.4	24.35	9.43						W	R	
890920160025	4	10.04	6700	6000	4.91	12.30	5.8	4.3	5.2	12.0	26.40	0.6	3.7	16.0	0.5	0.4	34.40	7.71						W	R	
890921150025	6	10.04	190	170	4.26	54.95	24.0	18.0	29.0	11.0	76.00	7.9	2.6	0.4	0.9	0.4	88.45	25.87						W	R	
890923200025	7	10.04	980	-300	4.37	42.66	27.0	25.0	27.0	54.0	131.60	10.0	39.0	2.5	3.4	7.0	114.96	28.48	A22					W	R	
890925272525	300	10.04	110	-300	4.27	53.70	27.0	40.0	20.0	7.8	106.20	6.8	1.8	6.9	14.0	1.8	100.00	29.42	A22					W	R	
891003142025	1	11.07	1600	1600	5.93	1.17	13.0	18.0	12.0	19.0	78.10	71.0	10.0	10.0	16.0	2.7	3.1	109.77	13.06	B05				W	R	
891006173025	4	11.07	190	210	3.99	102.33	45.0	47.0	46.0	9.5	156.10	19.0	0.5	8.8	10.0	1.8	154.23	50.03						W	R	
891009180025	3	-200	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00	-200.00					W	M
891011210025	1	11.07	620	1500	4.08	83.18	34.0	21.0	56.0	13.0	111.60	18.0	0.9	2.4	2.7	1.1	112.08	39.12						W	R	
891015141025	4	11.07	1000	970	3.82	151.36	64.0	49.0	110.0	14.0	222.00	55.0	0.5	0.4	10.0	2.2	231.66	74.49	B05					W	R	
891018133025	8	11.07	1200	1300	4.31	48.98	22.0	14.0	18.0	9.1	55.70	3.5	0.5	3.5	1.2	0.4	59.68	21.88	B05					W	R	
891021124525	15	11.07	6300	5100	4.88	13.18	6.8	3.5	5.9	9.2	22.70	0.6	0.5	3.6	0.5	0.4	19.68	6.68	B05					W	R	

TABLE C.3. Continued

YYMMDDHHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDUC	(SD4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	FRE	
89010231900025	10	11.07	130	240	4.12	75.86	37.0	32.0	61.0	14.0	139.60	42.0	0.5	17.0	7.9	1.6	164.36	42.02			W	R	
8911011600025	8	11.07	2000	-200	4.53	29.51	15.0	11.0	11.0	10.0	51.60	6.1	6.0	0.9	0.8	1.5	47.11	15.15			W	R	
891104133025	5	11.07	130	-200	3.94	114.82	47.0	27.0	86.0	15.0	155.60	38.0	0.5	19.0	2.8	0.7	177.32	55.85			W	M	
891106191525	2	12.05	250	240	3.80	158.49	58.0	63.0	68.0	19.0	213.60	52.0	4.1	0.4	5.4	1.7	229.19	75.88	B05		W	R	
891108143025	4	12.05	76	52	-200.00	-200.00	-200.00	53.0	110.0	18.0	234.60	30.0	3.4	3.2	21.0	4.2	-200.00	-200.00			W	R	
891109204525	9	12.05	1000	950	4.03	93.33	30.0	21.0	38.0	12.0	92.60	10.0	0.5	0.4	2.3	0.4	109.63	40.45	B41		W	R	
891111195025	3	12.05	220	240	4.31	48.98	23.0	21.0	54.0	15.0	111.60	31.0	0.5	0.4	14.0	2.9	114.68	29.31	B05		W	M	
891112142025	2	12.05	37	35	3.92	120.23	60.0	41.0	120.0	10.0	220.60	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W	R	
891115193025	5	12.05	220	190	4.22	60.28	22.0	33.0	55.0	10.0	137.60	21.0	4.4	9.6	3.8	1.4	105.66	34.99			W	R	
891117155525	3	12.05	2600	2500	4.44	36.31	15.0	14.0	12.0	24.0	64.60	9.6	13.0	7.5	0.9	2.1	72.41	19.64	B41		W	M	
891119140025	1	12.05	56	52	-200.00	-200.00	-200.00	12.0	49.0	13.0	86.60	17.0	0.5	0.4	3.8	0.8	-200.00	-200.00			W	S	
891121140025	6	12.05	640	640	4.18	66.07	25.0	21.0	54.0	14.0	110.60	26.0	0.5	0.4	9.8	1.4	115.37	34.27	B41		W	M	
891123154025	300	12.05	290	240	4.47	33.88	8.8	3.1	11.0	14.0	31.80	0.6	0.5	0.4	0.9	0.4	37.98	14.40			W	S	
891126211325	1	12.05	100	120	3.82	151.36	53.0	37.0	60.0	38.0	170.60	30.0	0.5	0.4	2.4	0.6	188.26	68.03			W	R	
891128135225	1	12.05	860	790	3.98	104.71	39.0	34.0	42.0	19.0	129.60	24.0	4.9	0.4	1.9	1.0	139.81	48.45			W	R	
891201184525	1	12.05	60	100	-200.00	-200.00	-200.00	26.0	71.0	18.0	141.60	35.0	3.7	0.4	11.0	2.5	-200.00	-200.00			W	S	
891204106025	1	12.05	48	48	-200.00	-200.00	-200.00	17.0	42.0	11.0	87.60	20.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W	S	
891207135625	1	1.05	330	-200	4.20	63.10	25.0	16.0	43.0	12.0	87.60	28.0	2.3	15.0	2.8	1.2	114.40	31.95			W	M	
891216283525	3	1.05	610	670	4.12	75.86	26.0	5.8	51.0	12.0	75.20	6.9	1.8	10.0	1.0	0.4	97.36	33.41			W	S	
891227132025	12	1.05	160	190	4.14	72.44	24.0	4.7	46.0	5.0	61.00	2.6	4.2	0.4	1.1	0.9	83.64	30.32			W	S	
891228174525	2	1.05	41	120	4.01	97.72	37.0	5.2	76.0	22.0	169.60	2.6	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W	S	
900102143025	13	1.05	2300	-200	4.07	85.11	33.0	21.0	37.0	9.8	90.30	8.7	1.4	0.4	0.5	0.4	97.41	37.10			W	M	
900111183525	300	2.06	250	260	4.17	67.61	27.0	18.0	67.0	23.0	126.60	22.0	14.0	4.6	3.2	1.3	117.21	35.94			W	M	
900113182025	6	2.06	330	360	4.43	37.15	20.0	16.0	57.0	13.0	102.60	31.0	4.1	0.4	12.0	3.4	103.45	24.51			W	S	
900116135225	2	2.06	180	160	4.05	89.13	29.0	20.0	48.0	12.0	100.60	22.0	1.3	0.4	1.6	0.4	118.83	40.41			W	M	
900118131025	3	2.06	120	52	3.63	234.42	81.0	66.0	130.0	24.0	286.60	46.0	12.0	7.6	4.7	2.2	313.82	100.11			W	R	
900123141725	8	2.06	1800	2000	4.35	44.67	17.0	10.0	19.0	8.3	47.90	5.4	0.5	0.4	1.3	0.6	54.77	19.74			W	S	
900124144725	3	2.06	550	520	4.09	81.28	26.0	21.0	68.0	13.0	123.60	28.0	3.3	0.9	6.0	1.9	129.28	40.48			W	S	
900127141025	7	2.06	2500	2500	4.83	93.33	15.0	11.0	16.0	8.1	46.70	0.6	0.5	0.4	1.1	0.4	98.83	36.34			W	M	
900130202425	3	2.06	3200	3100	4.53	29.51	9.3	7.2	12.0	11.0	38.00	2.7	2.3	12.0	0.9	0.6	49.91	14.43			W	M	
900203141825	2	2.06	650	-200	4.13	74.13	22.0	22.0	20.0	3.0	67.60	4.0	0.5	0.4	0.5	0.4	80.83	31.29			W	M	
900206143025	1	3.07	1300	-300	4.31	48.98	14.0	14.0	16.0	11.0	55.60	0.6	2.0	1.1	1.8	0.4	57.08	21.63			W	M	
900210141025	5	3.07	1000	1100	4.17	67.61	23.0	21.0	38.0	11.0	91.60	10.0	1.2	0.4	2.6	0.4	91.21	31.89			W	R	
900217195025	11	3.07	2200	2100	4.06	87.10	30.0	28.0	45.0	16.0	117.60	18.0	7.7	7.9	3.4	1.3	130.10	41.80			W	M	
900223143025	6	3.07	1200	1100	4.33	46.77	18.0	17.0	27.0	19.0	80.60	11.0	8.8	17.0	3.0	1.8	93.17	25.20			W	R	
900224200025	5	3.07	790	710	4.17	7.61	22.0	16.0	40.0	12.0	84.60	8.8	1.2	2.6	1.2	0.6	83.81	30.86			W	M	
900226182025	300	3.07	430	480	4.05	89.13	25.0	3.2	72.0	9.5	88.50	2.5	0.5	0.4	0.5	0.4	94.33	37.83			W	S	
900306213225	5	4.03	450	-300	4.06	87.10	32.0	8.7	89.0	7.6	114.60	7.6	13.0	9.3	1.3	0.4	120.40	40.71			W	S	
900312183825	9	4.03	920	830	3.84	229.09	82.0	76.0	140.0	30.0	322.60	74.0	16.0	0.4	2.5	2.4	331.29	110.54			W	R	
900314145225	1	4.03	89	70	4.20	63.10	28.0	34.0	41.0	14.0	123.60	22.0	13.0	4.9	8.4	2.4	120.60	34.60			W	R	
900316170025	15	-200	1200	1800	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	A26		W	M
900319102225	3	4.03	17	0	-200.00	-200.00	-200.00	36.0	35.0	8.1	115.70	38.0	2.0	0.4	4.7	2.2	-200.00	-200.00			W	R	
900320141525	3	4.03	1100	970	4.14	72.44	23.0	22.0	26.0	9.8	80.40	11.0	3.7	0.4	1.0	0.8	91.14	32.41			W	M	
900321141225	2	4.03	1300	1200	4.50	31.62	9.3	9.1	12.0	2.1	32.90	3.2	0.5	3.4	0.5	0.4	40.52	14.03			W	S	
900330213925	9	4.03	720	640	4.49	32.36	9.5	6.2	20.0	9.0	42.00	2.5	1.8	0.4	1.1	0.4	48.06	14.81			W	M	
900401134225	300	4.03	-200	-200	4.17	67.61	20.0	21.0	27.0	11.0	80.60	4.5	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W	R

TABLE C.3. Continued

YYMMDDHHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDC	(S04=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	ADS	DEP	PRE
900404132025	5	5.08	1400	-200	4.24	57.54	21.0	20.0	23.0	9.8	73.48	7.5	1.9	10.0	0.7	0.4	79.14	26.98					W R
900405143025	8	5.08	55	51	4.20	63.10	23.0	19.0	26.0	11.0	75.80	6.6	0.5	10.0	0.6	0.5	82.40	28.92					W M
900406134525	5	5.08	35	-200	4.22	60.26	14.0	13.0	81.0	13.0	120.60	13.0	1.6	10.0	5.6	1.2	98.46	32.21					E21 W S
900407131025	5	5.08	33	35	6.15	0.71	14.0	9.3	82.0	14.0	115.20	5.6	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					W S
900411143525	7	5.08	3200	3100	4.11	77.62	30.0	37.0	38.0	22.0	134.60	28.0	4.8	19.0	3.1	1.0	137.62	41.11	B38				E21 W R
900412153025	1	5.08	23	17	4.68	21.88	20.0	30.0	57.0	12.0	129.60	48.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					W S
900416170725	2	5.08	820	73	4.22	60.26	21.0	22.0	21.0	5.3	70.90	15.0	0.8	10.0	3.0	0.6	93.26	28.48					E21 W R
900418132425	4	5.08	310	290	3.93	117.49	48.0	41.0	64.0	7.3	153.90	32.0	1.9	10.0	0.7	1.5	181.79	56.52					W M
900421142025	5	5.08	620	590	4.01	97.72	48.0	32.0	68.0	6.5	139.10	40.0	0.5	10.0	0.5	0.4	150.02	46.07					E21 W R
900425192025	5	5.08	310	310	4.04	91.20	37.0	32.0	42.0	6.2	112.80	22.0	2.0	10.0	3.5	1.4	135.00	43.06					W R
900429130925	300	5.08	-200	-200	3.25	562.34	230.0	200.0	240.0	49.0	689.60	140.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00					W R
900430164525	300	5.08	-200	-200	4.46	34.67	21.0	14.0	12.0	19.0	59.60	12.0	5.2	10.0	0.7	0.8	84.87	18.52					W R
900505132925	300	5.08	-200	-200	4.19	64.67	24.0	20.0	31.0	16.0	86.60	8.5	1.1	10.0	2.2	0.7	89.97	30.60					W R
900506154925	300	5.08	-200	-200	4.09	81.28	27.0	23.0	31.0	16.0	93.60	5.9	0.5	10.0	0.7	0.4	99.88	36.56					E22 W R
900508125225	6	8.05	310	-200	4.88	13.18	24.0	47.0	80.0	8.2	182.80	100.0	3.4	10.0	0.7	0.5	128.98	26.34					W R
900511145125	5	6.05	4400	4400	4.55	28.18	11.0	12.0	11.0	6.2	41.80	10.0	2.5	10.0	0.7	0.5	53.08	14.60					E21 W R
900514130025	9	6.05	3000	3000	4.22	60.26	25.0	20.0	26.0	7.1	85.70	22.0	1.7	10.0	1.1	0.4	98.96	29.91					W R
900516135425	4	6.05	80	70	4.86	87.10	30.0	28.0	30.0	5.7	92.30	9.3	2.0	10.0	1.9	1.0	114.20	38.99					E21 W R
900517132425	9	6.05	1000	1000	4.31	48.98	20.0	19.0	18.0	5.2	61.80	8.5	1.2	10.0	0.7	0.4	70.88	23.15					W R
900518162525	2	6.05	460	430	4.12	75.86	27.0	25.0	32.0	7.1	89.70	14.0	2.6	10.0	1.8	0.7	107.46	35.20					E21 W R
900519130825	7	6.05	480	550	4.38	41.69	16.0	17.0	16.0	4.9	55.50	12.0	0.5	24.0	0.9	0.5	80.99	21.40					E21 W R
900522132225	8	6.05	1000	1000	4.24	57.54	22.0	23.0	18.0	6.8	71.40	10.0	0.7	10.0	1.0	0.4	81.04	26.98					W R
900524132525	4	6.05	81	86	5.62	2.40	7.8	11.0	18.0	7.7	48.30	30.0	0.8	14.0	15.0	1.7	80.60	9.42					W R
900530130125	18	6.05	3000	2900	4.30	50.12	19.0	22.0	16.0	6.3	80.90	20.0	0.5	10.0	1.2	0.5	84.02	24.82	C21				W R

TABLE C.4. Data Listing for Precipitation Samples Collected at the Penn State MAP3S Site

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDUC	(SD4=)	(ND3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	PRE
890104130030-300	1.11	310	310	310	4.45	35.48	17.0	2.9	40.0	12.0	58.48	4.0	4.6	0.4	4.7	1.2	56.28	17.76				W S
890105131530-300	-200	12	0	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890106130030-300	1.11	100	100	100	4.08	83.18	38.0	24.0	44.0	21.0	113.60	11.0	8.7	1.7	5.3	1.1	117.38	39.48				W S
890107131530-300	1.11	270	240	240	4.26	54.95	24.0	4.7	37.0	14.0	61.00	4.7	7.9	0.4	0.6	0.4	70.03	24.49				W M
890108131530-300	1.11	850	790	790	4.23	58.98	26.0	29.0	13.0	9.2	80.80	10.0	3.8	0.4	1.0	0.5	76.08	27.63				W R
890112140030-300	2.08	360	190	190	4.26	54.95	26.0	22.0	33.0	5.5	83.10	18.0	1.3	0.4	1.9	0.7	79.85	26.95				W M
890113130030-300	2.08	470	470	470	4.51	30.90	15.0	12.0	8.5	4.9	41.30	3.9	1.4	21.0	0.5	0.4	59.00	15.53				W M
890114125530-300	-200	200	16	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890115132030-300	2.08	670	450	450	4.52	30.20	16.0	12.0	11.0	9.1	44.70	4.6	2.4	34.0	1.9	0.4	75.00	16.97				W M
890117140030-300	-200	0	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890119130030-300	-200	2	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W M
890120131530-300	-200	1	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W R
890121131030-300	2.08	20	-200	-200.00	-200.00	-200.00	-200.00	32.0	85.0	21.0	170.60	56.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890126125530-300	2.08	130	86	86	3.63	234.42	110.0	70.0	150.0	24.0	328.60	44.0	18.0	0.4	20.0	4.7	346.22	112.46				W R
890127131030-300	2.08	31	69	-200.00	-200.00	-200.00	-200.00	32.0	37.0	160.0	261.60	12.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W R
890130131530-300	2.08	37	1	-200.00	-200.00	-200.00	-200.00	23.0	34.0	21.0	181.60	10.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W R
890202130030-300	-200	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W R
890203130030-300	2.08	360	310	310	4.17	67.61	32.0	14.0	22.0	2.6	53.20	10.0	1.1	0.4	0.7	0.4	81.31	28.43				W R
890204133530-300	2.08	410	350	350	4.54	28.84	14.0	8.5	7.1	1.8	28.50	2.6	1.6	0.4	1.1	0.4	36.44	12.45				W M
890205134030-300	-200	2	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890206133030-300	-200	1	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890207130030-300	-200	1	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890214130030-300	3.09	220	240	240	4.17	67.61	32.0	24.0	27.0	9.2	84.80	15.0	1.9	0.4	0.8	0.4	87.31	31.19				W M
890215130030-300	3.09	790	730	730	4.20	63.14	30.0	24.0	26.0	2.9	69.50	8.1	0.5	1.4	1.4	0.4	76.70	28.02				W R
890216130030-300	3.09	430	400	400	4.18	66.1	32.0	22.0	18.0	7.2	69.80	9.5	0.5	1.2	0.6	0.4	79.27	29.12				W R
890221131530-300	3.09	1100	1000	1000	4.31	48.98	25.0	19.0	19.0	5.2	62.80	12.0	1.0	0.4	0.9	0.4	64.98	22.80				W R
890222125030-300	3.09	400	400	400	4.37	42.66	20.0	17.0	14.0	5.5	54.10	8.8	1.2	0.4	1.3	0.4	56.46	19.78				W R
890222132530-300	-200	2	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890226132030-300	-200	4	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890227131530-300	3.09	89	89	89	4.25	56.23	26.0	14.0	30.0	8.9	67.50	8.8	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W S
890304131030-300	3.09	47	35	35	3.97	107.15	53.0	31.0	67.0	18.0	147.60	16.0	1.3	0.4	2.4	0.4	40.81	14.30	839			W R
890305130530-300	4.05	49	0	-200.00	-200.00	-200.00	-200.00	42.0	90.0	20.0	194.60	36.0	21.0	0.6	7.3	3.8	-200.00	-200.00	-200.00			W R
890306130030-300	4.05	1500	1200	1200	4.53	29.51	13.0	12.0	15.0	5.9	45.50	4.0	1.3	0.4	2.4	0.4	40.81	14.30	839			W R
890307133030-300	4.05	650	470	470	5.44	3.63	8.0	8.1	16.0	13.0	45.80	4.0	7.2	0.4	9.9	0.9	36.83	6.44	839			W R
890308131030-300	4.05	98	17	5.05	8.91	8.3	4.6	22.0	22.0	9.4	41.20	2.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W R
890315130030-300	4.05	53	0	-200.00	-200.00	-200.00	-200.00	36.0	66.0	16.0	154.60	32.0	7.9	0.4	12.0	3.2	-200.00	-200.00	-200.00			W R
890318130030-300	4.05	51	0	-200.00	-200.00	-200.00	-200.00	55.0	55.0	45.0	210.60	54.0	14.0	0.4	25.0	7.6	-200.00	-200.00	-200.00			W R
890321132030-300	4.05	360	330	330	4.03	93.33	47.0	36.0	25.0	42.0	139.60	36.0	4.0	0.4	3.3	1.2	142.73	46.31	839			W M
890324130030-300	4.05	640	600	600	4.39	40.74	18.0	10.0	26.0	9.7	56.30	9.2	0.5	0.4	0.6	0.4	52.84	19.16				W S
890329125030-300	4.05	820	540	540	4.62	23.99	11.0	5.7	11.0	8.9	46.30	4.6	0.5	11.0	0.7	0.4	42.29	11.97	A22			W M
890325131530-300	4.05	1100	1000	1000	4.56	27.54	13.0	12.0	6.4	8.8	39.80	4.6	0.5	0.4	2.1	0.4	38.04	13.20				W M
890328130030-300	-200	8	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00			W R
890329125030-300	4.05	480	350	350	4.11	77.62	39.0	40.0	32.0	13.0	125.60	26.0	3.7	0.4	4.8	1.4	120.12	39.12				W R
890330131030-300	4.05	1000	850	850	3.89	128.82	65.0	57.0	85.0	16.0	215.60	61.0	3.0	0.4	4.0	1.3	203.82	66.02				W R
890331124530-300	4.05	610	430	430	4.05	89.13	41.0	27.0	52.0	11.0	117.60	20.0	1.0	0.4	0.9	0.4	113.13	41.41				W R

TABLE C.4. Continued

YYMMDDHHSS	LTD	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDUC	(SD4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	PRE
890401131030-300	4.05	190	190	190	3.85	141.25	55.0	43.0	48.0	30.0	164.60	23.0	0.6	0.4	4.7	1.4	177.45	63.87				W R
890403121530-300	5.04	240	220	220	4.13	74.13	36.0	23.0	48.0	1.8	96.40	20.0	1.4	20.0	3.5	0.8	124.13	30.33				W R
890404122030-300	5.04	160	69	69	4.16	69.18	38.0	38.0	36.0	12.0	124.60	26.0	7.0	29.0	6.3	2.2	148.18	38.53				W R
890405121530-300	5.04	75	1	1	-200.00	-200.00	-200.0	56.0	118.0	10.0	232.60	84.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890406115030-300	5.04	64	1	1	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890407114530-300	5.04	200	-200	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890409123030-300	5.04	90	62	62	3.95	112.20	54.0	30.0	65.0	29.0	154.60	48.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890410120030-300	5.04	50	1	1	3.64	229.09	110.0	75.0	160.0	23.0	333.60	71.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W M
890411123030-300	5.04	26	1	1	-200.00	-200.00	-200.0	30.0	158.0	16.0	228.60	57.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
89041122030-200	-200	2	-200	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890411512030-300	5.04	25	1	1	-200.00	-200.00	-200.0	74.0	98.0	15.0	281.60	89.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890416121530-300	5.04	67	69	69	3.75	177.83	87.0	75.0	71.0	36.0	257.60	52.0	1.6	6.4	8.4	1.8	252.43	86.13				W R
890418115030-300	5.04	84	35	35	3.93	117.49	64.0	59.0	99.0	17.0	216.60	28.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890419122530-300	5.04	48	1	1	-200.00	-200.00	-200.0	59.0	38.0	8.8	165.40	42.0	2.5	24.0	12.0	1.9	-200.00	-200.00				W R
890422123030-200	-200	4	-200	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890430122530-200	-200	4	-200	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890501120030-300	5.04	81	20	20	3.53	295.12	160.0	180.0	160.0	22.0	542.60	95.0	6.6	21.0	37.0	6.5	504.72	156.29				W R
890502123530-300	5.06	1900	1800	1800	3.96	109.65	54.0	54.0	62.0	11.0	181.60	44.0	0.7	0.6	3.7	0.6	163.55	55.39				W R
890504121530-300	5.06	130	100	100	4.14	72.44	37.0	38.0	54.0	28.0	158.60	34.0	18.0	0.4	8.4	2.3	146.24	41.46	B36			W R
890505120030-300	5.06	250	170	170	4.27	53.70	29.0	36.0	36.0	11.0	119.60	48.0	1.0	2.0	4.2	1.0	115.10	31.81				W R
890506123030-300	5.06	570	520	520	4.28	52.48	24.0	25.0	38.0	8.6	89.20	21.0	0.5	0.4	3.3	0.8	82.58	26.89				W R
890507123030-300	5.06	530	470	470	4.31	48.98	22.0	24.0	28.0	7.4	82.00	14.0	0.9	1.2	3.5	1.0	74.98	24.73				W R
890508120030-300	5.06	210	220	220	4.33	46.77	25.0	16.0	42.0	9.0	83.60	17.0	0.6	12.0	4.8	1.2	88.37	25.18				W R
890509124530-200	-200	-200	-200	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890510120530-300	5.06	1200	1200	1200	4.27	53.70	29.0	24.0	35.0	8.8	92.40	26.0	0.6	10.0	2.0	0.4	95.10	28.43				W R
890511120530-300	5.06	620	690	690	4.28	52.48	26.0	24.0	24.0	7.6	80.20	11.0	0.5	2.0	3.1	0.4	73.58	25.59				W R
890512120030-300	5.06	620	570	570	5.07	8.51	4.5	3.1	3.8	7.9	18.50	0.6	0.5	0.9	0.8	0.4	12.91	4.59				W R
890514121530-300	5.06	63	35	35	-200.00	-200.00	-200.0	50.0	92.0	13.0	205.60	28.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890515120030-300	5.06	83	35	35	4.08	83.18	53.0	70.0	59.0	14.0	213.60	84.0	1.5	4.8	9.7	2.5	197.88	52.63				W R
890516120030-300	5.06	850	760	760	4.11	77.62	36.0	40.0	33.0	11.0	124.60	29.0	0.5	16.0	3.5	0.7	130.52	39.96				W R
890517115030-300	5.06	710	620	620	4.19	64.57	32.0	28.0	34.0	9.9	100.50	18.0	0.6	10.0	3.0	0.6	100.37	32.36				W R
890521115530-300	5.06	95	120	120	3.98	104.71	65.0	85.0	120.0	22.0	312.60	91.0	8.0	14.0	31.0	8.3	296.31	71.58	B36			W R
890523120030-300	-200	4	-200	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890524120030-300	5.06	420	350	350	3.79	162.18	81.0	78.0	86.0	14.0	256.60	40.0	2.2	5.5	12.0	6.7	247.28	80.82				W R
890526120530-300	5.06	1600	1500	1500	4.22	60.26	32.0	30.0	28.0	12.0	98.60	17.0	3.7	6.4	4.4	1.3	92.76	30.34	B41			W R
890527122030-300	5.06	130	52	52	-200.00	-200.00	-200.0	9.8	11.0	9.3	40.50	3.8	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890528122530-300	-200	13	17	17	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890530120030-300	5.06	180	60	60	6.09	0.81	9.7	6.9	8.1	22.0	44.50	3.1	21.0	0.4	20.0	2.2	69.71	7.40				W R
890531121530-300	5.06	400	260	260	3.78	165.96	81.0	93.0	68.0	18.0	262.60	43.0	4.4	6.9	11.0	3.0	248.26	82.86				W R
890601120530-300	5.06	41	17	17	3.98	125.89	57.0	51.0	48.0	21.0	169.60	5.3	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890602120530-300	7.06	110	69	69	3.78	165.98	94.0	120.0	110.0	21.0	371.60	65.0	8.4	4.8	26.0	7.5	301.16	93.48				W R
890604122030-300	7.06	590	470	470	4.03	93.33	48.0	49.0	28.0	6.8	133.40	31.0	0.5	0.4	3.4	0.8	133.63	45.20				W R
890606120630-300	7.06	490	400	400	3.92	120.23	59.0	57.0	47.0	8.0	169.60	29.0	0.9	0.4	2.7	0.7	157.33	57.03	B05			W R
890609120030-200	-200	3	-200	-200	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890610122030-300	7.06	280	230	230	3.95	112.20	55.0	52.0	51.0	7.5	163.10	33.0	0.9	0.4	3.4	0.6	154.50	54.09				W R
890613120030-300	7.06	1200	1100	1100	4.19	64.57	34.0	36.0	28.0	6.5	99.10	30.0	0.5	0.4	1.6	0.4	99.47	32.33				W R
890614115030-300	7.06	470	350	350	4.23	58.88	28.0	20.0	22.0	4.6	67.20	6.5	0.6	0.4	0.6	0.4	68.58	26.13				W R

TABLE C.4. Continued

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDUC	(S04=)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEP	PRE
890615120030-300	7.06	590	520	3.83	147.91	72.0	78.0	54.0	12.0	222.60	40.0	2.3	0.4	8.0	1.5	209.61	72.14				W R
890616120030-300	7.06	1300	1100	4.92	95.50	49.0	44.0	42.0	8.0	138.60	36.0	0.5	0.4	3.0	0.5	139.40	46.61				W R
890617120030-300	7.06	1400	1300	4.55	28.18	14.0	12.0	11.0	5.2	40.80	4.9	0.7	2.7	1.5	0.4	40.28	13.61				W R
890620120030-300	7.06	1700	1600	3.94	114.82	54.0	56.0	42.0	11.0	165.60	28.0	0.9	0.4	4.9	0.7	163.32	55.59	B39			W R
890621120030-300	7.06	2000	2500	4.41	38.90	22.0	23.0	20.0	6.1	72.70	20.0	1.9	9.3	2.4	0.6	76.16	21.46	B41			W R
890622120030-300	7.06	180	160	5.04	9.12	7.9	6.2	16.0	7.8	36.80	14.0	1.8	1.2	4.6	1.2	37.72	7.67	B41			W R
890623120030-300	7.06	39	300	-200.00	-200.00	-200.00	13.0	70.0	11.0	107.60	24.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890624120030-300	7.06	140	300	4.24	57.54	28.0	30.0	34.0	9.0	103.60	20.0	0.7	0.4	9.6	1.7	101.24	30.39				W R
890625120030-200	-200	19	300	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890626121530-200	-200	8	300	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890628120030-300	7.06	1100	1200	3.79	162.18	79.0	100.0	45.0	11.0	256.60	46.0	0.5	0.9	5.0	2.1	223.78	79.81				W R
890629121530-300	7.06	86	52	4.66	21.88	20.0	36.0	24.0	7.0	91.60	16.0	0.5	0.4	23.0	3.1	90.98	18.26				W R
890704133030-200	7.06	22	26	-200.00	-200.00	-200.00	24.0	54.0	19.0	121.60	14.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890705120030-300	8.03	3000	2900	4.08	13.18	11.0	6.3	6.4	8.6	28.20	4.8	1.0	0.4	1.0	0.4	22.18	7.25	B38			W R
890706125030-300	8.03	370	300	4.43	37.15	21.0	16.0	24.0	15.0	71.60	9.7	3.9	0.4	6.0	1.2	65.55	19.90	B38			W R
890708123030-200	-200	2	200	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890710122530-200	-200	2	200	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890713121030-300	8.03	1800	1700	4.18	62.07	34.0	26.0	27.0	9.5	89.10	8.1	0.5	0.4	3.2	0.7	82.87	30.66				W R
890714120030-300	8.03	730	490	4.35	44.67	24.0	25.0	17.0	8.9	76.50	11.0	0.5	0.4	6.8	0.8	71.77	22.87				W R
890716123030-300	8.03	32	1	-200.00	-200.00	-200.00	130.0	100.0	100.0	490.60	45.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890717120030-300	8.03	170	140	4.16	69.18	34.0	28.0	41.0	10.0	103.60	16.0	0.5	0.4	7.0	1.2	98.00	33.45	B38			W R
890720115030-300	8.03	1900	1800	4.17	67.61	34.0	35.0	28.0	7.5	106.10	29.0	1.6	27.0	2.7	0.8	132.21	35.93	B38			W R
890721115530-300	8.03	2100	1900	4.40	39.81	21.0	21.0	16.0	6.3	64.90	19.0	0.5	0.4	2.7	0.8	66.71	20.48				W R
890723123030-300	8.03	510	1000	4.17	67.61	32.0	30.0	16.0	7.6	84.20	8.1	1.0	0.4	3.4	0.5	84.91	30.89				W R
890727123030-300	8.03	27	1	-200.00	-200.00	-200.00	170.0	180.0	29.0	549.60	40.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890728121030-200	-200	-200	-200	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890731122030-300	8.03	160	89	3.66	218.78	100.0	120.0	79.0	74.0	393.60	50.0	1.7	0.4	18.0	2.6	312.08	111.49				W R
890801120030-300	-200	17	35	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890805123030-300	9.06	320	300	3.99	102.33	47.0	62.0	56.0	12.0	192.60	26.0	5.3	3.2	15.0	3.7	174.23	54.20				W R
890806123030	2	-200	6	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890807120530	1	9.06	190	150	4.03	93.33	45.0	45.0	49.0	152.60	20.0	0.5	0.4	6.4	1.6	130.23	46.14	B41			W R
890819120030	11	9.06	36	1	-200.00	-200.00	-200.0	38.0	20.0	113.60	9.0	1.9	13.0	17.0	3.6	-200.00	-200.00				W R
890828134530	8	-200	8	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890821121530	4	9.06	110	36	3.66	218.78	100.0	120.0	27.0	16.0	283.60	53.0	5.3	12.0	9.8	2.9	314.48	103.00	B41		W R
890823123030	1	-200	1	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890824123030	2	-200	14	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890830120530	4	9.06	230	200	3.74	181.97	82.0	100.0	58.0	14.0	270.60	22.0	5.1	34.0	3.9	1.0	252.87	88.34	B41		W R
890902123030	2	9.06	1500	1500	4.11	77.62	32.0	37.0	32.0	116.60	13.0	0.8	5.4	1.3	0.4	100.22	37.24				W R
890908120030	1	-200	5	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890911115030	10	10.11	210	160	3.79	162.18	65.0	84.0	62.0	15.0	245.60	9.4	3.4	3.8	1.3	185.58	76.13				W R
890912120030	1	10.11	43	35	-200.00	-200.00	-200.0	65.0	27.0	13.0	170.60	13.0	1.2	0.4	2.2	0.6	-200.00	-200.00			W R
890914120030	1	10.11	44	0	-200.00	-200.00	-200.0	190.0	240.0	644.60	110.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890915115030	4	10.11	1800	1700	4.07	85.11	39.0	45.0	30.0	12.0	133.60	46.0	1.9	0.4	2.2	1.3	140.31	43.38	B57		W R
890916123530	6	10.11	590	560	3.88	131.83	53.0	39.0	58.0	11.0	145.60	22.0	1.2	0.4	1.0	0.4	158.23	58.58	B05		W R
890917123030	5	10.11	770	660	4.38	41.69	18.0	57.0	18.0	12.0	144.60	6.7	3.5	0.4	0.5	0.6	54.49	26.02			W R
890918121530	2	-200	4	-200.00	-200.00	-200.00	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R
890919115530	1	10.11	41	17	-200.00	-200.00	-200.0	76.0	56.0	14.0	222.60	13.0	-200.0	-200.0	-200.0	-200.00	-200.00				W R

TABLE C.4. Continued

LID	ADATE	SVOL	PVOL	LAB	pH	(H+)	CONDUC	(SD4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC	CO	ADS	ADS	DEP	PRE
2	-260	5	-260	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
15	10.11	970	830	4.30	50.12	26.0	52.0	23.0	21.0	148.00	15.0	10.0	5.2	2.6	2.1	89.72	30.91	B05					
7	10.11	530	490	4.30	50.12	27.0	30.0	14.0	20.0	112.00	23.0	3.9	14.0	4.6	1.1	102.42	27.99	B57					
13	10.11	570	540	4.57	26.92	13.0	12.0	14.0	2.7	41.30	7.0	0.5	2.6	3.0	0.6	44.22	13.50						
2	11.08	39	0	-260.00	-260.00	-260.00	60.0	91.0	17.0	228.00	55.0	1.7	5.1	40.0	8.6	-260.00	-260.00						
2	-200	17	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
6	11.08	38	0	-260.00	-260.00	-260.00	59.0	100.0	21.0	239.00	84.0	1.9	4.2	31.0	6.8	-260.00	-260.00						
9	11.08	320	280	4.16	69.18	32.0	18.0	62.0	12.0	110.00	22.0	1.1	8.1	0.7	1.9	121.58	35.55						
8	11.08	220	170	6.65	0.22	40.0	40.0	70.0	14.0	224.00	310.0	0.5	30.0	19.0	7.7	402.12	41.57	B57					
4	11.08	790	690	4.27	63.70	18.0	16.0	21.0	8.0	61.00	4.3	0.5	0.4	2.3	0.7	84.90	23.94						
6	11.08	490	450	4.19	64.57	24.0	19.0	23.0	8.1	69.70	4.2	0.8	11.0	1.3	0.6	84.37	28.99						
4	11.08	1900	1800	4.79	16.22	9.1	5.0	6.0	6.0	6.00	3.2	0.5	1.1	0.5	0.4	22.82	7.74						
11	11.08	1200	1200	4.45	35.48	15.0	13.0	11.0	6.5	44.10	4.2	0.5	3.3	0.5	0.4	45.28	16.28						
0	11.08	85	0	4.40	39.81	16.0	15.0	7.6	7.2	45.40	2.2	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
15	-200	19	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
6	11.08	100	160	4.26	54.95	27.0	17.0	42.0	30.0	166.00	13.0	23.0	7.3	5.3	4.2	117.25	30.57						
8	11.08	1300	1400	4.62	23.99	11.0	9.2	8.2	8.2	35.40	0.6	1.0	10.0	1.4	0.4	39.19	11.97						
4	12.05	36	0	-260.00	-260.00	-260.00	40.0	200.0	35.0	375.00	50.0	3.0	15.0	20.0	3.8	-260.00	-260.00	B38					
2	-200	18	0	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
4	12.05	170	100	3.81	154.88	59.0	58.0	59.0	27.0	292.00	44.0	9.6	9.2	10.0	2.5	242.68	74.70						
8	12.05	140	69	3.96	109.05	73.0	50.0	173.0	20.0	240.00	35.0	3.3	0.4	13.0	2.4	179.15	60.18						
13	12.05	650	610	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
2	12.05	71	0	-260.00	-260.00	-260.00	17.0	22.0	0.9	63.50	8.7	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
4	12.05	100	87	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
5	-200	8	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
9	12.05	69	52	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
5	12.05	2100	2000	4.41	38.90	14.0	10.0	8.4	5.9	34.90	6.1	1.0	0.4	0.5	0.4	48.20	16.77						
6	12.05	110	100	5.82	1.51	7.2	12.0	9.8	8.3	42.70	6.1	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	B39			
2	-200	12	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
5	12.05	140	170	4.74	18.20	21.0	25.0	57.0	18.0	123.00	54.0	5.1	3.6	23.0	5.5	137.90	22.77	B38					
16	12.05	130	120	4.26	54.95	17.0	6.2	34.0	9.0	56.00	5.2	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
1	-200	2	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
10	12.05	60	17	-260.00	-260.00	-260.00	11.0	20.0	10.0	60.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
4	12.05	35	0	-260.00	-260.00	-260.00	37.0	34.0	14.0	122.00	5.2	3.9	4.3	1.4	0.4	-260.00	-260.00	-260.00	-260.00				
5	12.05	300	280	3.95	112.20	30.0	40.0	45.0	18.0	143.00	26.0	3.6	0.4	4.8	1.7	155.20	52.55	E21					
7	-200	7	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
3	-200	3	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
12	05	15	0	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
3	-200	3	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
1	-200	12	-200	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
7	-200	13	35	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
14	1.16	79	120	4.15	70.79	33.0	30.0	63.0	19.0	142.00	21.0	4.1	10.0	24.0	6.0	105.89	40.67	E21					
5	-200	10	0	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
4	-200	15	17	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
6	-200	6	0	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
10	1.16	25	17	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
4	1.16	43	35	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00	-260.00				
9	1.16	440	450	4.04	91.20	32.0	5.0	67.0	17.0	96.20	3.5	2.7	6.0	3.9	0.7	113.40	40.18	E21					

TABLE C.4. Continued

YMWDDHHHSS	LJ?	ADATE	SVOL	PVOL	LAB pH	(H-)	CONDUC	(SO4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K-)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEF	PRE
891220130530	14	-200	15	18	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
891221131030	0	-200	3	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
891226130030	2	-200	2	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
891227133530	0	-200	0	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
891229131530	7	-200	7	35	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
891230132530	6	1.16	590	490	4.23	58.88	21.0	10.0	32.0	12.0	64.50	10.0	3.8	0.4	2.1	0.6	78.48	28.51				W S
891231132530	6	1.16	130	35	-200.00	-200.00	-200.00	47.0	98.0	25.0	217.60	66.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W M
900101135530	5	1.17	650	620	4.20	63.10	22.0	26.0	15.0	8.7	76.30	7.0	0.6	1.8	0.5	0.4	74.30	28.42				W M
900111134030	1	-200	0	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W M
900112130030	1	2.07	21	0	-200.00	-200.00	-200.00	15.0	39.0	26.0	95.60	19.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W M
900113133530	3	2.07	36	35	-200.00	-200.00	-200.00	9.8	27.0	13.0	60.26	11.0	2.4	0.4	3.9	1.2	-200.00	-200.00	-200.00	-200.00	-200.00	W S
900115130530	3	2.07	130	35	4.18	66.07	22.0	17.0	40.0	14.0	88.60	13.0	2.4	0.4	6.1	1.1	96.27	31.39				W S
900118130030	1	2.07	260	170	3.95	112.20	43.0	33.0	50.0	19.0	135.60	13.0	5.0	0.4	0.9	0.6	134.60	50.55				W R
900120133030	6	2.07	330	210	4.39	40.74	13.0	5.4	27.0	11.0	49.40	2.7	0.5	0.4	0.5	0.7	46.74	18.19				W M
900121133030	5	2.07	900	1200	4.07	85.11	28.0	35.0	27.0	13.0	110.60	11.0	0.5	13.0	0.5	0.4	111.41	39.74	D21			W M
900123133030	5	2.07	35	67	-200.00	-200.00	-200.00	22.0	84.0	30.0	104.60	24.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W M
900124131030	3	-200	16	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W M
900125131030	0	-200	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W R
900126130030	7	2.07	310	200	4.26	52.48	19.0	15.0	30.0	14.0	74.60	11.0	2.7	1.7	2.8	0.6	74.68	25.20	E21			W M
900127133030	2	-200	17	17	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
900129131530	2	2.07	840	680	4.10	79.43	24.0	8.3	57.0	16.0	90.20	8.1	4.0	0.4	1.5	0.8	96.53	35.35				W S
900130131530	6	2.07	1600	1800	4.28	52.48	17.0	15.0	19.0	13.0	62.60	5.4	2.5	1.3	0.5	0.4	63.48	23.63				W M
900202130030	1	2.07	40	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W R
900203133030	6	3.06	290	300	3.83	147.91	46.0	46.0	46.0	18.0	156.60	9.5	2.2	0.4	1.4	0.8	164.41	64.27				W R
900204133030	7	3.06	330	300	4.04	91.20	29.0	24.0	49.0	5.4	103.00	11.0	1.1	3.6	0.8	0.4	109.30	40.61				W R
900205130030	3	3.06	61	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W R
900210133030	15	3.06	830	830	4.21	61.66	21.0	22.0	23.0	4.9	72.50	10.0	6.6	0.4	0.8	0.4	75.06	27.76	E21			W R
900212135530	8	3.06	150	120	3.79	162.18	53.0	44.0	97.0	20.0	213.60	30.0	3.6	0.4	9.4	3.0	228.98	76.57	E21			W S
900214130030	1	-200	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W R
900215130030	10	3.06	650	520	3.80	158.49	54.0	57.0	71.0	25.0	210.60	25.0	15.0	6.4	8.1	3.2	227.49	75.03				W R
900216131530	12	-200	3	700	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W R
900217132530	1	3.06	90	70	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W R
900221132530	5	3.06	170	100	4.67	21.38	13.0	9.2	12.0	29.0	60.00	6.3	18.0	2.3	3.4	3.2	61.18	14.97				W R
900224133030	3	3.06	61	17	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W M
900225134530	7	3.06	280	240	6.58	0.26	92.0	22.0	64.0	12.0	127.80	630.0	5.6	211.0	200.0	43.0	1332.86	96.86	B41			W M
900226131530	1	-200	18	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
900228130530	3	3.06	63	0	4.15	70.79	12.0	10.0	51.0	15.0	86.60	14.0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
900305132030	5	-200	4	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
900306131530	9	4.04	59	35	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W S
900309130030	3	4.04	110	35	3.96	104.71	32.0	22.0	57.0	12.0	113.60	6.4	1.7	8.5	4.5	0.9	132.11	46.58				W R
900310133030	5	4.04	240	190	3.91	123.03	44.0	42.0	62.0	13.0	169.60	30.0	0.7	5.4	1.8	0.9	164.53	57.59				W R
900311133030	2	4.04	200	140	3.85	138.04	48.0	44.0	59.0	16.0	164.60	18.0	3.2	1.2	2.8	0.6	167.24	62.22				W R
900317134030	10	4.04	480	310	4.39	40.74	15.0	17.0	23.0	17.0	74.50	17.0	12.0	16.0	2.1	1.6	87.14	22.64				W R
900318133030	4	4.04	160	140	4.34	45.71	13.0	13.0	13.0	12.0	51.66	0.6	0.7	0.4	0.5	0.4	49.21	19.96				W R
900320131030	3	4.04	870	640	4.16	69.18	23.0	12.0	47.0	3.3	74.90	5.7	1.3	0.4	1.1	0.4	79.58	30.25				W M
900321130030	2	-200	1	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W R
900323130030	3	-200	30	0	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	W R

TABLE C.4. Continued

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB	pH	(H+)	CONDUC	[SO4=]	[NO3-]	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC	CO	ADS	ADS	PRE
980325134530	-200	-200	-200	-200	-200	3.77	169.82	52.0	49.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	V
980330130030	8	4.04	260	230	3.77	169.82	52.0	49.0	89.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	V
980331133530	3	4.04	300	230	4.23	58.88	20.0	16.0	34.0	3.1	69.70	8.3	0.5	1.9	1.0	0.4	0.4	72.38	26.55			V	
980401123030	3	4.04	87	52	3.81	154.88	51.0	90.0	10.0	200.0	19.0	-4.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	-200.0	V	
980402120030	3	5.09	460	400	4.05	89.13	29.0	28.0	36.0	19.0	111.60	9.1	0.6	10.0	0.7	0.5	120.43	41.33			E21	V	
980403120030	2	5.09	490	380	4.09	81.28	32.0	35.0	35.0	18.0	123.60	25.9	4.0	11.0	0.9	0.4	124.68	40.50			E21	V	
980404120030	10	5.09	33	52	-200.00	-200.00	-200.00	-200.00	12.0	63.0	23.0	110.60	3.6	0.5	10.0	1.2	0.6	-200.00	-200.00	-200.00	-200.00	V	
980405115030	7	5.09	310	310	4.45	35.48	13.0	13.0	14.0	17.0	57.60	0.6	0.5	10.0	1.0	0.4	52.38	17.78			E21	V	
980406121030	5	5.09	170	170	4.06	87.10	32.0	22.0	77.0	24.0	145.60	31.0	0.5	10.0	4.9	1.5	141.40	44.73	839		E21	V	
980407123030	6	5.09	190	120	3.98	109.65	37.0	14.0	99.0	25.0	152.60	6.4	2.6	10.0	3.4	0.7	136.85	51.12			E21	V	
980408121030	2	-200	6	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980411120030	7	5.09	850	800	4.26	54.95	24.0	29.0	28.0	20.0	106.60	22.0	4.1	10.0	3.2	1.9	101.25	30.10			V		
980412115530	5	-200	12	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980413120030	1	-200	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980415122030	21	5.09	210	140	3.76	173.78	68.0	82.0	130.0	16.0	310.60	91.0	13.0	10.0	1.1	0.5	290.98	91.88	839		E21	V	
980418121030	3	-200	1	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980421123530	4	5.09	840	750	3.92	120.23	43.0	40.0	43.0	21.0	144.60	10.0	3.6	10.0	1.1	0.5	153.03	54.89			E21	V	
980426121530	-200	-200	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980430115030	7	5.09	850	110	4.01	97.72	36.0	40.0	42.0	17.0	139.60	38.0	0.5	10.0	1.3	1.3	151.42	48.22			E21	V	
980504120530	-300	-200	-200	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980505124530	8	6.07	1600	1600	4.34	45.71	20.0	20.0	25.0	6.3	71.90	17.0	1.7	10.0	1.5	0.7	77.81	23.45			V		
980506123030	0	-200	1	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980507123030	1	6.07	44	0	-200.00	-200.00	-200.00	-200.00	75.0	97.0	15.0	262.60	46.0	10.0	10.0	8.5	2.7	-200.00	-200.00	-200.00	-200.00	V	
980508120030	3	6.07	250	220	6.13	0.74	7.0	8.0	10.0	2.0	30.20	0.6	26.0	10.0	19.0	2.2	79.74	6.94			V		
980510115030	5	6.07	420	310	4.03	23.44	9.3	9.4	11.0	5.7	36.10	4.3	0.7	10.0	0.6	0.4	40.24	11.98			V		
980511122030	7	6.07	1400	1200	4.71	19.50	7.9	9.0	7.7	5.9	32.20	3.4	0.5	10.0	0.6	0.4	35.40	10.26			V		
980513120030	14	6.07	210	160	3.87	134.90	55.0	53.0	89.0	14.0	299.60	24.0	8.0	10.0	14.0	3.7	212.30	67.13			E21	V	
980514115530	5	6.07	330	240	4.15	70.79	28.0	30.0	25.0	9.7	95.30	14.0	3.1	10.0	1.8	0.7	102.89	33.89			V		
980515113530	1	-200	15	-200	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980516115030	8	6.07	750	690	3.82	151.36	56.0	61.0	73.0	13.0	298.60	33.0	4.8	10.0	7.8	2.3	219.36	72.60	839		E21	V	
980517120030	7	6.07	1500	1400	4.14	72.44	29.0	33.0	22.0	9.4	98.60	15.0	4.2	10.0	1.8	0.7	106.64	34.81	838		V		
980518113030	3	-200	24	17	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980520122030	4	-200	20	17	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	V	
980521124030	12	6.07	520	470	3.94	114.82	43.0	43.0	48.0	11.0	145.60	23.0	2.2	10.0	3.0	1.1	158.22	53.74	838		E22	V	
980526123030	6	6.07	800	730	4.59	25.70	10.0	12.0	7.9	7.0	39.50	0.6	0.5	10.0	0.5	0.4	38.60	12.75	838		V		
980527123030	4	6.07	34	17	-200.00	-200.00	-200.00	-200.00	44.0	33.0	11.0	132.60	35.0	0.5	10.0	2.9	0.6	-200.00	-200.00	-200.00	-200.00	V	
980529120030	14	6.07	300	240	4.29	51.29	20.0	17.0	25.0	9.3	68.90	5.1	0.5	10.0	1.7	0.4	71.09	24.29			V		
980530113030	7	6.07	2200	2100	4.09	12.88	5.9	5.1	5.0	6.6	22.40	1.7	0.5	10.0	0.5	0.6	27.28	7.11			V		

TABLE C.4. Continued

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDUC	(SO4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC CO	ADS	ADS	DEF	PRE
900603130030	9	6.07	600	520	4.33	46.77	20.0	19.0	15.0	11.0	64.60	15.0	3.9	10.0	3.9	1.2	85.87	23.63				V R
900604122030-300	6.07	-200	-200		4.6	97.72	37.0	24.0	41.0	12.0	101.60	16.0	0.5	10.0	2.9	0.7	131.42	43.88				V R
900607122030	4	7.05	870	820	3.97	107.15	40.0	49.0	33.0	8.1	139.70	17.0	0.8	10.0	4.0	1.5	145.95	50.29		E21		V R
900609120030	9	7.05	1600	1500	4.09	81.28	30.0	32.0	28.0	9.7	102.30	11.0	0.5	10.0	2.1	0.6	108.18	37.74		E21		V R
900610131530	12	7.05	290	260	4.18	59.18	25.0	30.0	21.0	7.1	88.70	11.0	0.5	10.0	1.1	0.4	93.68	32.40				V R
900615120030	4	7.05	1200	1100	3.93	117.49	46.0	64.0	43.0	9.0	100.60	51.0	0.5	10.0	5.1	1.3	191.79	59.51		E21		V R
900619121530	4	7.05	250	160	4.15	70.79	38.0	58.0	53.0	11.0	104.10	82.0	3.1	10.0	16.0	7.0	211.89	46.95		E21		V R
900620120030	2	-200	22	0	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				V R
900621120030	3	-200	11	0	-200.00	-200.00	-200.0	-200.0	-200.0	-200.0	-200.00	-200.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				V R
900623122030	5	7.05	550	500	4.31	48.98	19.0	12.0	11.0	2.1	37.70	17.0	0.5	10.0	1.9	0.6	81.48	22.13				V R
900624120030	1	7.05	73	17	3.77	169.82	56.0	69.0	50.0	12.0	200.60	29.0	-200.0	-200.0	-200.0	-200.0	-200.00	-200.00				V R
900625120030	7	7.05	160	240	4.54	28.84	11.0	11.0	10.0	5.7	38.30	4.7	0.5	10.0	0.5	0.4	45.84	14.05	A26			V R
900630124530	2	7.05	1200	1100	3.60	251.19	64.0	110.0	56.0	14.0	200.60	43.0	5.3	12.0	5.5	2.4	327.29	114.34		E21		V R

TABLE C.5. Data Listing for Precipitation Samples Collected at the Linn Run Site

YYMMDDHHHSS	LID	ADATE	SVOL	PVOL	LAB pH	(H+)	CONDUC	(S04=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC	CO	ADS	ADS	ADS	DEP	PRE
890223142035	45	3.07	2300	2200	4.27	53.70	25.0	21.0	14.0	11.0	67.00	13.0	0.6	0.4	0.8	0.4	70.10	24.88	B41	C22				
890227182035	73	3.07	1100	-200	4.21	61.66	29.0	13.0	32.0	10.0	74.00	11.0	1.7	0.4	2.3	0.4	80.16	28.20	B41	C22				
890307164535	6	4.06	4000	1700	4.49	32.36	16.0	11.0	12.0	12.0	46.00	4.2	0.8	0.4	1.9	0.4	42.36	15.34	C22					
890315153035	4	4.06	89	100	3.95	112.20	65.0	55.0	66.0	52.0	228.00	53.0	20.0	9.7	18.0	4.3	239.50	63.93	B41	C21				
890318114535	23	4.06	550	-200	4.14	72.44	43.0	37.0	25.0	20.0	119.00	33.0	4.9	1.3	5.0	1.5	124.64	37.57						
890319171535	4	4.06	23	500	-200.00	-200.00	-200.00	39.0	26.0	23.0	127.00	33.0	4.6	7.3	5.1	1.5	-200.00	-200.00						
890322150035	8	4.06	2100	2500	4.28	54.95	28.0	16.0	20.0	13.0	65.00	9.5	0.5	5.4	0.8	0.4	72.75	25.25	C21					
890324193035	6	4.06	1400	200	4.72	19.65	10.0	5.4	10.0	9.5	30.00	5.3	0.5	1.4	0.5	0.4	28.05	9.52						
890329170035	3	4.06	1600	240	4.16	69.18	37.0	30.0	21.0	13.0	108.00	34.0	3.1	0.4	2.3	0.7	112.88	35.03						
890330160035	2	4.06	1600	400	3.92	120.23	61.0	53.0	64.0	16.0	106.00	41.0	3.7	0.4	4.9	1.7	178.53	59.61						
890401180035	4	4.06	1300	940	4.11	77.62	30.0	24.0	29.0	7.2	84.00	15.0	0.5	0.4	1.0	0.4	90.32	34.64	C21					
890403181535	3	5.04	520	470	4.16	69.18	30.0	21.0	24.0	15.0	81.00	13.0	1.9	0.4	2.3	0.4	89.88	31.53						
890405161535	2	5.04	180	-200	3.86	130.04	58.0	41.0	53.0	30.0	105.00	18.0	6.2	1.4	4.4	1.3	175.04	62.74						
890410164535-300	5.04	690	210		3.99	102.33	50.0	31.0	58.0	20.0	138.00	37.0	2.8	6.1	5.1	1.1	160.63	49.86						
890413163035-300	5.04	560	210		4.17	67.61	36.0	26.0	75.0	6.4	131.00	58.0	0.9	17.0	5.4	1.5	167.31	39.39	C22					
890415160135-300	5.04	120	940		3.90	125.89	53.0	34.0	49.0	29.0	146.00	24.0	0.5	7.9	5.9	1.4	172.89	57.89						
890419220035-300	5.04	1530	-200		4.00	100.00	46.0	37.0	51.0	7.3	132.00	37.0	2.0	0.4	5.3	1.1	152.20	48.10						
890426223935-300	5.04	390	210		3.78	173.78	65.0	54.0	42.0	32.0	182.00	0.6	0.5	11.0	9.0	2.1	200.08	76.21						
890429180035	1	5.04	970	570	4.33	46.77	22.0	15.0	20.0	13.0	63.00	10.0	1.0	6.5	3.6	0.8	73.07	22.71						
890430014535	1	5.04	390	170	3.71	194.98	82.0	80.0	68.0	27.0	255.00	47.0	2.7	6.9	7.3	1.6	269.30	91.99						
890502164535	2	5.04	1500	1500	3.85	141.25	38.0	52.0	53.0	11.0	168.00	30.0	1.1	0.4	3.4	0.6	180.75	64.45						
890504232035-300	6.06	1000	1100		4.05	89.13	48.0	38.0	63.0	0.6	148.20	52.0	0.5	21.0	2.0	0.7	169.23	47.68	B41	C21				
890505173135-300	6.06	890	-200		4.34	45.71	28.0	22.0	16.0	5.3	65.90	17.0	0.8	15.0	1.6	0.4	82.51	23.38	B41					
890506160035-300	6.06	1100	900		4.17	67.61	31.0	27.0	19.0	7.0	80.00	7.6	0.5	0.4	1.6	0.4	80.11	30.36						
890508131635-300	6.06	1200	830		4.13	74.13	37.0	32.0	41.0	8.4	114.00	27.0	0.5	11.0	3.8	1.1	122.43	37.55	B41	C21				
890512153035-300	6.06	2100	4300		4.23	58.88	26.0	21.0	17.0	9.6	69.20	7.6	0.5	0.4	0.6	0.4	69.38	26.37	C22					
890514164935	4	6.06	520	350	3.88	131.83	58.0	39.0	59.0	20.0	157.00	14.0	0.5	13.0	6.0	1.5	174.33	60.38	C21					
890515232435	1	6.06	1400	300	4.16	69.18	35.0	30.0	22.0	9.3	103.90	26.0	0.5	0.4	2.9	0.7	103.28	34.10						
890516220035	1	6.06	550	300	3.67	213.80	100.0	86.0	110.0	20.0	300.00	43.0	0.6	0.4	3.9	1.0	267.00	100.48						
890521141935	1	6.06	480	200	3.77	169.82	87.0	85.0	69.0	23.0	262.00	43.0	1.2	3.6	3.8	2.4	253.22	84.26	C22					
890523223035	3	6.06	1000	-200	4.01	97.72	53.0	47.0	39.0	9.6	143.20	36.0	0.5	17.0	8.6	1.1	149.32	48.15						
890526150035	3	6.06	1200	900	4.02	95.50	53.0	53.0	42.0	20.0	108.00	31.0	11.0	15.0	11.0	3.1	180.70	51.12	C21					
890527171535	1	6.06	91	87	4.29	51.29	44.0	110.0	11.0	30.0	261.00	13.0	21.0	0.4	48.0	9.1	199.89	45.13						
890530221035	2	6.06	320	200	4.07	85.11	49.0	56.0	39.0	19.0	170.00	38.0	6.5	11.0	11.0	2.6	167.81	47.61						
890539221035	4	7.06	480	550	4.39	40.74	26.0	33.0	17.0	18.0	101.00	25.0	8.0	17.0	4.9	1.2	103.74	25.86						
890604141235	4	7.06	480	550	4.09	81.28	30.0	33.0	29.0	11.0	106.00	13.0	0.9	0.9	2.8	0.7	103.08	37.66						
890610174535	4	7.06	720	710	4.18	66.07	30.0	30.0	16.0	5.1	81.70	9.8	0.5	0.4	1.0	0.4	79.57	30.01						
890613194735	5	7.06	650	690	3.92	120.23	58.0	61.0	41.0	8.8	179.20	29.0	0.5	6.8	4.2	1.0	168.93	57.88						
890614205735	3	7.06	460	160	4.10	79.43	37.0	37.0	28.0	6.6	109.20	13.0	0.7	14.0	7.0	1.1	123.33	38.60						
890616132135-300	7.06	840	830		4.22	60.26	27.0	28.0	20.0	5.2	81.00	8.2	0.7	12.0	3.1	0.7	88.76	28.94	C21					
890617171735-300	7.06	1300	540		4.56	27.54	14.0	13.0	7.3	0.7	34.60	4.1	0.5	29.0	1.6	0.4	65.14	14.76						
890621192735-300	7.06	5500	4300		4.29	51.29	26.0	26.0	17.0	6.3	75.90	16.0	0.7	9.8	1.7	0.4	81.99	25.63	C21					
890623144635-300	7.06	400	400		4.39	40.74	21.0	20.0	19.0	5.7	65.30	11.0	0.5	14.0	5.7	0.8	79.24	21.52	C21					
890628191235-300	7.06	2900	2700		3.82	151.36	66.0	78.0	27.0	6.6	190.20	23.0	2.1	3.0	2.0	0.4	184.26	39.20	C21					
890707173035	8	8.09	1100	880	4.02	95.50	45.0	44.0	25.0	8.9	122.50	6.5	1.2	6.2	2.2	0.7	115.20	43.66	B05					
890714192935-300	8.09	690	710		3.81	154.88	71.0	74.0	52.0	16.0	216.00	24.0	0.5	18.0	5.6	1.9	212.38	73.92						
890717155135	2	8.09	220	200	3.98	104.71	55.0	44.0	40.0	23.0	151.00	13.0	0.5	7.3	6.0	1.4	149.31	50.01						

TABLE C.5. Continued

YYMMDDHHSS	LID	ADATE	SVOL	PVOL	LAB	pH	(H+)	CONDUC	(SO4=)	(NO3-)	(Cl-)	ANION	(NH4+)	(Na+)	(K+)	(Ca++)	(Mg++)	CATION	CALC	C3	ADS	A33	ADS	DEP	PRE	
890720185935	-300	8.09	1500	129	4.05	89.13	45.0	45.0	48.0	24.0	18.0	138.60	30.0	0.5	27.0	2.6	0.4	152.63	45.87					W	R	
890726222035	2	8.09	2300	3700	3.90	125.89	65.0	65.0	66.0	44.0	10.0	186.60	35.0	1.5	2.7	4.1	1.0	175.29	61.10	B05				W	R	
890728222035	3	8.09	300	380	3.82	151.36	75.0	73.0	73.0	65.0	19.0	230.60	39.0	0.5	0.4	8.7	2.4	213.46	73.91					W	R	
890731181535	3	8.09	1100	1200	3.88	131.83	68.0	68.0	68.0	33.0	21.0	174.60	19.0	1.3	0.4	3.2	0.5	159.93	60.83	B05				W	R	
890808225035	-300	8.07	910	350	3.99	102.33	44.0	48.0	48.0	43.0	18.0	157.60	25.0	0.0	13.0	5.7	1.5	155.33	50.89	B05				W	R	
890820191035	6	9.07	1600	1200	4.21	61.66	31.0	35.0	35.0	24.0	9.9	104.50	18.0	0.5	8.2	2.7	0.4	94.58	31.49	B39				W	R	
890821171535	2	9.07	770	830	4.13	74.13	38.0	48.0	48.0	25.0	8.9	130.50	20.0	0.5	7.4	3.3	0.6	109.83	37.94					W	R	
890824192035	3	9.07	1700	1700	4.20	63.10	33.0	41.0	30.0	30.0	7.9	120.50	24.0	0.5	0.4	3.8	0.8	97.20	33.19					W	R	
890830183035	4	9.07	1200	1100	4.22	60.26	28.0	33.0	33.0	27.0	8.6	102.20	19.0	0.5	3.3	2.5	0.5	89.66	30.52					W	R	
890903190035	-300	10.03	840	350	3.90	125.89	49.0	48.0	48.0	36.0	17.0	149.60	19.0	2.0	13.0	2.9	0.5	166.69	57.80					W	R	
890908223535	4	10.03	1600	1500	3.73	186.21	80.0	83.0	83.0	61.0	11.0	238.60	39.0	1.1	10.6	6.8	1.5	252.91	87.13	B05				W	R	
890911224535	1	10.03	900	1100	3.86	138.04	61.0	59.0	59.0	37.0	10.0	165.60	16.0	0.8	15.0	6.2	1.1	184.44	63.48	B05				W	R	
890915191535	1	10.03	620	480	3.96	109.65	45.0	43.0	43.0	39.0	7.6	133.20	19.0	0.5	0.4	9.3	0.6	149.35	50.57	B05				W	R	
890917204935	5	10.03	1000	1300	4.12	75.86	35.0	30.0	30.0	37.9	8.9	104.50	20.0	0.5	0.4	5.4	0.4	108.36	36.28	B05				W	R	
890924214235	4	10.03	2600	2100	4.12	75.86	31.0	28.0	28.0	24.0	9.0	89.60	18.0	2.0	0.4	1.5	0.4	100.06	34.74	B05				W	R	
891002214535	-300	11.07	1200	1500	4.37	42.66	18.0	15.0	10.0	10.0	11.0	51.60	8.7	0.5	0.4	2.2	0.6	57.86	19.68	B05				W	R	
891003204535	-300	11.07	180	240	4.27	53.70	40.0	67.0	67.0	95.0	16.0	245.60	80.0	1.4	0.4	29.0	5.6	204.70	46.26	A99				W	R	
891007174035	-300	11.07	990	1000	4.07	85.11	37.0	41.0	34.0	12.0	128.60	29.0	0.5	0.5	2.1	6.3	1.3	131.91	42.29	B41	C21			W	R	
891008214535	1	11.07	330	360	4.46	34.67	20.0	19.0	19.0	21.0	10.0	69.60	24.0	0.5	5.0	4.9	0.6	75.17	19.94					W	R	
891011204535	2	11.07	1200	730	4.92	12.02	10.0	13.0	13.0	15.0	7.3	48.90	13.0	0.7	21.0	12.0	2.5	75.72	11.76					W	R	
891019143035	-300	11.09	4120	4700	4.40	39.81	19.0	13.0	13.0	14.0	5.9	48.50	6.3	1.7	0.4	1.1	0.5	51.41	18.04	C22				W	R	
891020184035	-300	12.05	500	620	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	-200.00	A30			W	R	
891022194035	-300	11.07	130	1500	4.58	26.30	27.0	38.0	38.0	58.0	15.0	149.60	35.0	1.9	0.4	40.0	8.1	159.80	27.73					W	R	
891101155835	1	12.05	1500	-200	4.66	21.88	12.0	14.0	14.0	6.7	11.0	46.30	4.2	0.5	5.8	1.9	0.4	36.98	12.04	B41				W	R	
891104173035	4	12.05	280	69	3.94	114.82	57.0	40.0	40.0	78.0	31.0	189.60	47.0	0.5	4.4	8.4	1.2	185.92	58.82					W	S	
891109193035	4	12.05	1300	1300	4.31	48.98	23.0	20.0	20.0	23.0	12.0	75.60	8.5	0.7	0.4	2.4	1.3	65.98	23.71	C21				W	R	
891112173035	-300	12.05	180	160	4.21	61.66	37.0	32.0	32.0	80.0	17.0	161.60	51.0	0.9	0.9	12.0	2.7	143.86	38.69	B41	C22			W	R	
891115170035	-300	12.05	74	100	4.22	60.26	30.0	25.0	25.0	31.0	17.0	98.60	11.0	11.0	0.4	4.3	1.6	94.46	30.26					W	R	
891117190035	9	12.05	1700	1500	4.64	22.91	11.0	11.0	11.0	14.0	9.0	45.60	3.4	0.5	0.4	1.0	0.6	30.41	11.80	C21				W	M	
891120180035	1	12.05	130	260	4.34	45.71	26.0	16.0	16.0	58.0	15.0	105.60	20.0	0.7	7.6	13.0	2.3	104.61	27.26	B41				W	M	
891124213035	1	12.05	400	87	4.68	20.89	22.0	22.0	22.0	58.0	29.0	129.60	22.0	8.0	2.3	27.0	0.9	120.99	22.49	B41	B37	D24		W	S	
891126193035	2	12.05	700	740	4.18	66.97	30.0	29.0	29.0	25.0	9.0	92.60	15.0	0.5	0.4	1.9	0.9	87.57	31.32	B41				W	R	
891128173035	2	12.05	220	210	4.21	61.66	34.0	34.0	34.0	27.0	13.0	108.60	18.0	2.5	0.4	4.7	1.2	94.36	31.61	B41				W	R	
891209164035	27	1.03	990	950	3.73	186.21	68.0	48.0	48.0	98.0	26.0	228.60	47.0	5.6	2.5	11.0	3.0	269.31	86.58	B41	B37	C21		W	S	
891216183035	-300	1.03	400	-400	4.15	70.79	25.0	10.0	10.0	38.0	14.0	72.60	8.7	2.4	7.2	3.9	0.5	97.89	31.76	B41				W	S	
891222161535	-300	1.03	210	-400	3.92	120.23	45.0	13.0	13.0	83.0	34.0	143.60	6.9	11.0	8.4	13.0	1.9	176.33	55.66	B41				W	S	
891229170035	-300	1.03	400	-400	4.05	89.13	32.0	17.0	17.0	34.0	21.0	89.60	14.0	4.0	7.0	1.7	0.6	118.73	39.69	B41				W	S	
900102190035	-300	2.06	2500	-200	4.14	72.44	23.0	19.0	27.0	27.0	11.0	76.60	13.0	0.5	0.4	0.7	0.4	88.54	32.05	B41				E21	W	R
900105194535	-300	2.06	335	-200	4.03	93.33	34.0	37.0	39.0	39.0	15.0	128.60	30.0	4.9	2.7	7.7	1.5	149.33	45.65	B41				E21	W	R
900111173035	-300	2.06	500	-200	4.07	85.11	30.0	23.0	49.0	49.0	15.0	110.60	40.0	0.5	8.2	1.4	0.9	138.41	41.63	B41				E21	W	R
900114160035	-300	2.06	300	-200	4.73	18.62	15.0	20.0	34.0	20.0	20.0	94.60	30.0	4.1	13.0	16.0	3.7	105.12	18.80	B41				E21	W	S
900119184535	-300	2.06	770	-200	4.01	97.72	31.0	28.0	35.0	35.0	19.0	110.60	13.0	5.0	0.4	2.6	1.0	123.32	43.88					E21	W	R
900122190035	-300	2.06	2300	-200	4.20	63.10	20.0	19.0	19.0	21.0	13.0	72.60	13.0	1.9	0.4	0.9	0.4	80.40	28.58					E21	W	R
900126163035	-300	2.06	320	-200	4.19	64.57	21.0	16.0	16.0	24.0	14.0	70.60	12.0	0.5	0.4	3.0	0.4	84.27	29.03					E21	W	R
900127191535	-300	2.06	550	-200	4.30	50.12	17.0	15.0	15.0	23.0	12.0	65.60	11.0	2.0	0.4	2.4	0.4	69.12	23.54	B41				E21	W	M
900131203035	-300	2.06	2000	-200	4.32	47.66	15.0	14.0	14.0	20.0	13.0	61.60	9.0	2.0	0.4	0.8	0.4	61.86	22.15	B41				E21	W	M

TABLE C.6 ADS Note Codes

A NOTES: These notes explain why one or more component results are not reported.

<u>ADS Code</u>	<u>Note Description</u>
A21	equipment failure - all of event missed
A22	equipment failure - some data loss
A23	contaminated and discarded in field
A24	sample too aged for SO ₂ analysis
A25	sample leaked in shipment
A26	sample inadvertently discarded in field
A27	sample not shipped
A28	sample spoiled before analysis
A29	vandalism - some data loss
A30	no explanation from operator
A39	malfunction or operator error
A62	bias in measurement of pH likely, true pH probably lower
A99	parameter(s) not entered at this time

B NOTES: These notes relate to the quality of the sample, field conditions during the sample, etc. Presumably all components have a valid measurement if no notes more severe than A type notes are associated with the sample.

<u>ADS Code</u>	<u>Note Description</u>
B05	insects in sample
B31	alternate rain gage used
B32	alternate collector used
B33	wind problems
B34	snowbridge or ice problems
B35	overflow
B36	sample frozen
B37	late collection
B38	organic debris in sample
B39	unidentified debris in sample

TABLE C.6 (Continued)

B NOTES (Continued)

<u>ADS Code</u>	<u>Note Description</u>
B40	flyash in sample
B41	dust/dirt in sample
B42	bird droppings in funnel
B57	bird droppings in sample
B58	wet side open until sample collected

C NOTES: These notes relate to the quantity of the sample.

<u>ADS Code</u>	<u>Note Description</u>
C21	two events combined
C22	more than two events combined
C23	weekly sample
C24	sample leaked before volume measurement

D NOTES: These notes explain why one or more measurements is suspect.

<u>ADS Code</u>	<u>Note Description</u>
D21	equipment failure - part of event missed
D22	possible operator contamination
D23	field pH suspect due to procedure
D24	predicted volume suspect due to rain gauge problems

E NOTES: These notes explain what was done when ion or conductivity balance was not achieved.

<u>ADS Code</u>	<u>Note Description</u>
E21	Re-evaluation criteria met, re-evaluation pending
E22	Re-evaluation criteria met, re-evaluation completed

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