Nutrient and Suspended Sediment Monitoring on the Conococheague Creek at Fairview, MD for WYs 1994 – 2004

By

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LIST OF ACRONYMS

%ΔC	Percent change in concentration
AMLE	Adjusted Maximum Likelihood Estimator
CBPO	Chesapeake Bay Program Office
cfs	Cubic feet per second
CI	Confidence Interval
CWA	Clean Water Act
DMR	Discharge Monitoring Report
dNH_4	Dissolved Ammonia
dNO_{23}	Dissolved Nitrite-Plus-Nitrate
dPO_4	Dissolved Orthophosphate
FAC	Flow-Adjusted Concentrations
FWC	Flow-Weighted Concentrations
ICPRB	Interstate Commission on The Potomac River Basin
MD DNR	Maryland Department of Natural Resources
mg/L	Milligram per liter
mgd	Million gallons per day
MRLC	Multi-Resolution Land Characteristics
MVUE	Minimum Variance Unbiased Estimator
NPDES	National Pollution Discharge Elimination System
NWIS	National Water Information System
NWQL	National Water Quality Laboratory
PA DEP	Pennsylvania Department Of Environmental Protection
QAPP	Quality Assurance Project Plan
SAV	Submerged Aquatic Vegetation
sq mi	Square mile
SSC	Suspended Sediment Concentration
t/day	Ton per day
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TON	Total Organic Nitrogen
TP	Total Phosphate
TSS	Total Suspended Solids
US EPA	United States Environmental Protection Agency
uS/cm	Microsiemens per centimeter
USGS	United States Geological Survey
WQS	Water Quality Standards
WY	Water Year

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EXECUTIVE SUMMARY

As a signatory of the Chesapeake Bay Agreement, the Commonwealth of Pennsylvania is committed to the restoration of the Chesapeake Bay by implementing nutrient and sediment reduction programs within the Pennsylvania portion of the Bay watershed. To evaluate the success of these programs in the Pennsylvania portion of the Conococheague Creek watershed, a sub-basin of the Potomac River basin, the State's Department of Environmental Protection joint with the Interstate Commission on the Potomac River Basin, and the United States Geological Survey to operate a water quality monitoring site near Fairview, Maryland. This report presents a summary of the nutrient and suspended sediment data collected during water years (WYs) 1994 - 2004 (i.e., October 1, 1993 through September 30, 2004) and the results of analyses estimating nutrient and sediment loads and trends in water quality over the eleven-year study period.

Water quality samples were taken under both nonstorm and storm flow conditions. Data were analyzed to estimate concentrations, loads, and trends for dissolved ammonia (dNH_4), dissolved nitrite-plus-nitrate (dNO_{23}), total organic nitrogen (TON), total nitrogen (TN), dissolved orthophosphate (dPO_4), total phosphate (TP), and suspended sediment (SSC). Seasonal and annual loads were estimated using the United States Geological Survey (USGS) ESTIMATOR program, a 7–parameter, log-linear regression model. The relative contributions of wastewater treatment facilities to total nitrogen and total phosphorus loads were estimated based on discharge monitoring report data.

The concentrations of many water quality constituents are related to streamflow, but the relationships differ depending on the constituent and input sources. Instream concentrations of constituents that reach a stream via overland flow often increase when streamflow increases. In contrast, point source inputs to a waterbody are usually relative constant and therefore, an increase in flow may result in a decrease in concentration due to a dilution effect. To facilitate an assessment of changes in water quality due to human activities within a watershed, flow-induced variability must be removed. Trend analyses of flow-adjusted concentrations (FAC) are therefore the best indicators of whether management practices are successful. Trends in streamflow and loads were tested by use of regression analyses on the monthly output from ESTIMATOR, whereas trends in flow-adjusted concentrations were obtained by examining the regression coefficients of the ESTIMATOR program.

Unusual weather conditions occurred during the period of study, including a regional period of drought from 1999 through 2002 followed by very wet conditions in 2003 and 2004. Overall, however, a significant trend in mean-monthly flow was not observed during the period of study.

The loads of all modeled nitrogen and phosphorus species as well as of suspended sediment increased considerably in WY 2003 over the previous four years. These increases in load were likely linked to several severe precipitation events that occurred during the fall of 2002 and the winter and spring of 2003. Similar high loads were also estimated for other years with above average precipitation. Overall, with the exception of dPO_4 whose load decreased slightly over the study period, no significant trends in constituent loads were observed. An analysis of the discharge monitoring data from the three significant wastewater treatment facilities located within the watershed revealed that they might contribute significantly to the instream load of TP

under low flow conditions. Altogether, however, the facilities' TP and TN loads decreased during the eleven years of study.

ESTIMATOR results indicated that the flow-adjusted concentration of TON and SSC increased significantly and of dPO_4 decreased significantly during the study period. No significant trends in the FAC of the other nutrients were observed. ESTIMATOR results also showed that the concentrations of the nutrients and suspended sediment varied seasonally; and except for dNH4, the highest concentrations generally occurring during the summer months. The concentrations of dNH_4, TON, TN, TP, and SSC were also positively correlated to streamflow, which indicates that nonpoint sources likely were the major inputs. On the other hand, dNO_{23} and dPO_4 were negatively correlated to streamflow, which might be indicative of point source inputs.

INTRODUCTION

The Chesapeake Bay, the nation's largest and most biologically diverse estuary, has been adversely affected by excessive nutrients and sedimentation and is listed as an impaired water body under the Clean Water Act. The ever-increasing population growth and related development, intensive agricultural practices, and reduction in forest cover within the watershed are major factors contributing to nutrient enrichment, low dissolved oxygen, and siltation.

Priorities for achieving improved water quality in the Bay include a reduction of nutrients, in particular nitrogen and phosphorus, and suspended sediment. Although nitrogen and phosphorus are essential for plant life, excessive levels can stimulate rapid growth of algae and noxious aquatic weeds. As the algae and weeds die off, the subsequent processes of biological decay may lower dissolved oxygen levels, which impacts fish and other aquatic species. Dense populations and blooms of algae can also affect submerged aquatic vegetation (SAV) by blocking light from reaching the plants, which in turn affects the aquatic species that depend on the SAV for food, shelter, and nursery areas. Suspended sediment is one of the most widespread pollutants impacting the nation's water resources. It reduces light penetration of the water column and may adversely impact filter-feeding fish and other aquatic animals. When sediment settles, it alters streambed characteristics and thereby changes the species composition of benthic communities and reduces the availability of spawning grounds for fish. In addition, a variety of pollutants may adhere to and be transported by sediment.

Both point and nonpoint sources contribute to the nutrient and sediment pollution of the Bay. In contrast to point source pollution, which originates from a specific locale, nonpoint source pollution does not arise from one particular identifiable source. Nonpoint source pollution can enter a waterbody with overland flow, air pollution, and groundwater. Examples of nonpoint sources for nitrogen include agricultural application of commercial fertilizers, runoff from feedlots and urban areas, leachate from failing septic systems, and atmospheric deposition. Wastewater and stormwater discharges and sanitary and combined sewer overflows are examples of point sources for nitrogen. Common sources of phosphorus include weathering of soils and rocks, runoff from agricultural land, and municipal wastewater discharges. Sediment erosion is a natural process caused by the actions of wind and water and can be greatly accelerated by both natural disturbances, such as floods and fires, and by human activities, such as reduction in plant cover, agriculture, and construction. Furthermore, sediment transported to streams may alter stream morphology by accelerating bank and bed erosion, which exasperates the siltation problem.

Background

In 1983, the states of Maryland, Pennsylvania, and Virginia, the District of Columbia, the Chesapeake Bay Commission, and the United States Environmental Protection Agency entered into the first Chesapeake Bay Agreement designed to protect and restore water quality and living resources (Chesapeake Bay Program, 1987). As a signatory of the Chesapeake Bay Agreement**,** the Commonwealth of Pennsylvania is committed to achieve and maintain a 40 percent reduction in controllable nutrient loads as agreed to in 1987. In 2000 the Chesapeake Bay Agreement was amended to include, among other items, the goal of correcting the nutrient and sediment related

problems in the Chesapeake Bay and its tidal tributaries sufficiently to remove the Bay and the tidal portions of its tributaries from the list of impaired waters by 2010 (Chesapeake Bay Program, 2000). Toward this objective, numerical load-reduction targets have been established for the Potomac River watershed, of which the Conococheague Creek is a tributary.

Objective of the Monitoring Program

The Potomac River is the second largest tributary to the Chesapeake Bay, and like other tributaries is impacted by nutrient and sediment pollution. Due to differences in land use and geology, the tributaries to the Potomac River contribute varying amounts of these pollutants, which make it necessary to develop and implement tributary-specific nutrient reduction strategies and sediment control programs. To track the success of these programs, water quality data must be collected and analyzed so that annual loads and trends over time can be determined. Towards this objective, water quality samples were taken on the Conococheague Creek near Fairview, Maryland from October 1, 1993 through September 30, 2004. The location of the sampling site is shown in (Figure 1).

As stated in the Conococheague Creek Quality Assurance Project Plan (QAPP), the objective of the monitoring program is "… to provide nutrient and suspended sediment loading data for the Conococheague basin in sufficient detail to: establish a sound data base for government, agriculture, industry, and the public to most effectively plan, implement, and evaluate immediate and long range nutrient reduction efforts, and provide nutrient loading data for the Chesapeake Bay watershed model" (ICPRB, 2003).

This report presents the results of the monitoring effort for water years 1994 – 2004. Seasonal and annual concentrations and loads as well as trends are reported for dissolved ammonia, dissolved nitrite-plus-nitrate, total organic nitrogen, total nitrogen, dissolved orthophosphate, total phosphate, and suspended sediment. The Conococheague Creek water quality study was supported through an inter-agency cooperative agreement between the Interstate Commission on the Potomac River Basin (ICPRB), the Pennsylvania Department of Environmental Protection (PA DEP), and the United States Geological Survey (USGS).

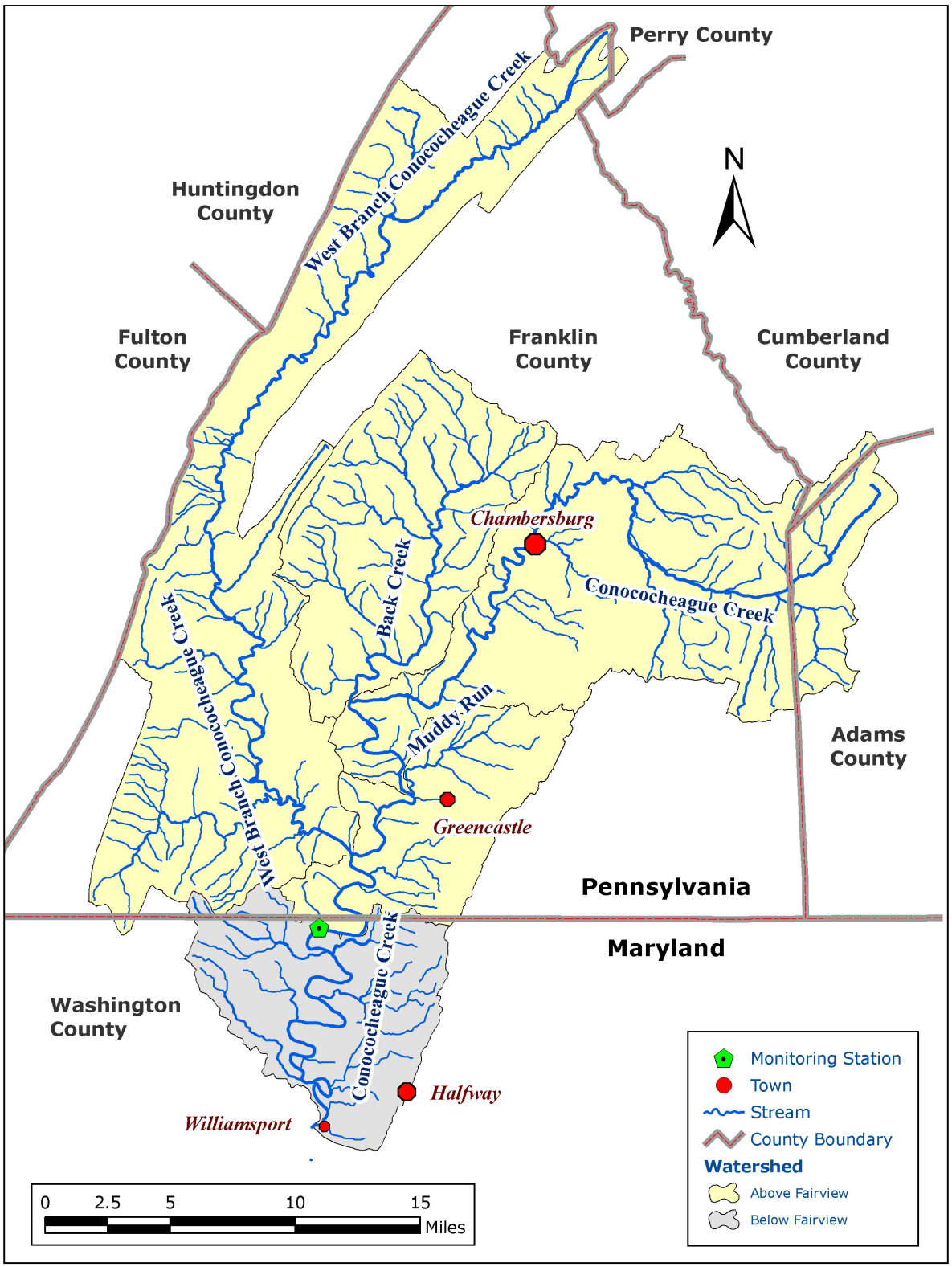


Figure 1. Conococheague Creek Watershed

BASIN CHARACTERISTICS

General Setting

The Conococheague Creek watershed (USGS hydrologic unit code 02070004) is part of the Upper Potomac River basin and encompasses approximately 560 square miles (sq mi) of which 494 sq mi drain the area above the USGS stream gage station (01614500) at Fairview, MD (Figure 1).

The Conococheague Creek basin has a mean elevation of 1054 feet above the National Geodetic Vertical Datum, a channel slope of 11.2 feet/mile, and a stream length of 61.1 miles (Slack et al., 1993). The monitored drainage area, that is the portion of the Conococheague Creek watershed above Fairview, includes the West Branch Conococheague Creek, Back Creek, Muddy Branch, and mainstem Conococheague Creek watersheds. The West Branch, Back Creek, and Muddy Branch receive drainage from Franklin County, PA and the mainstem from Adams and Franklin Counties, PA. The portion of the watershed below Fairview is located within Washington County, MD. The watershed is bound to the east by the Antietam Creek and Monocacy River watersheds and to the west by the Licking Creek and Little Conococheague watersheds.

Land Use / Land Cover

Based on the 1997 Multi-Resolution Land Characteristics (MRLC) Landsat-derived land use / land cover grid, the predominant land use in the monitored drainage area is mixed agricultural land (57.5 %), consisting of cropland, pasture, and hay land, followed by forest (37.6 %) as shown in Table 1 and Figure 1. Less than three percent of the area is developed, with Chambersburg and Greencastle being the major urban centers.

Table 1. Land Use / Land Cover in the Conococheague Creek Drainage Area Above Fairview, MD

Land Use	Area (sq mi)	Area (percent)
Mixed Agriculture	287.1	57.5
Forest	187.5	37.6
Urban	14.7	2.9
Barren	2.4	0.5
Wetlands	5.2	1.0
Open water	2.2	0.4

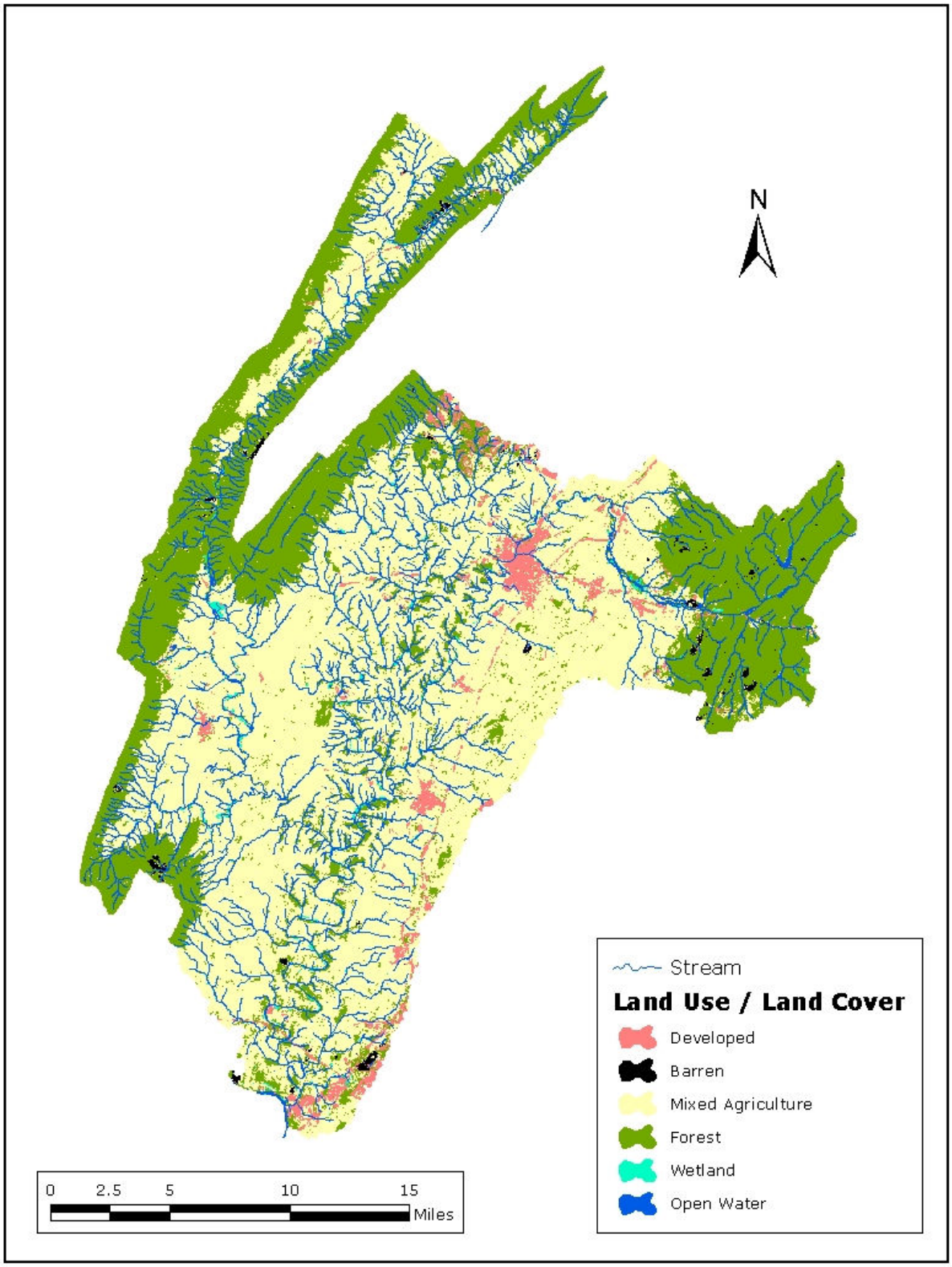


Figure 2. Land Use / Land Cover in the Conococheague Creek Watershed above Fairview

Stream Impairments

Under the federal Clean Water Act (CWA), States are mandated to develop water quality standards (WQS) that are consistent with the statutory goals of the CWA. WQS set the goals for a body of water by designating uses (e.g., human health, recreation, water supply, aquatic life, agriculture), establishing criteria to protect these uses (e.g., numeric pollutant concentrations, narrative requirements), and establishing provisions to achieve and protect water quality.

When monitoring shows that a segment or a body of water does not meet WQS even when pollution controls required by law are in place, it is considered impaired and must be listed in Section 303(d). States or the United Sates Environmental Protection Agency (US EPA) use the 303(d) list to determine the condition(s) that would have to be met for a waterbody to return to a condition that would meet WQS and to identify waterbodies for which Total Maximum Daily Load (TMDL) allocations must be developed. A TMDL specifies the maximum allowable pollutant load that a waterbody can receive while still meeting WQS. Waters impaired by other causes, such as altered flow or channel modification, do not require a TMDL but should be identified in Section 305(b).

For 2004, PA DEP developed a format that combines Section 303(d) and Section 305(b), the "2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report" (PA DEP, 2004). The stream segments within the study area identified as not attaining WQS are depicted in Figure 3, and the corresponding list can be found in Appendix A. The sources of pollution have been attributed to grazing and crop related agriculture, urban runoff, storm sewers, land development, and habitat modifications. The causes of impairment are listed as nutrients, organic enrichment, low dissolved oxygen, siltation, and habitat alterations.

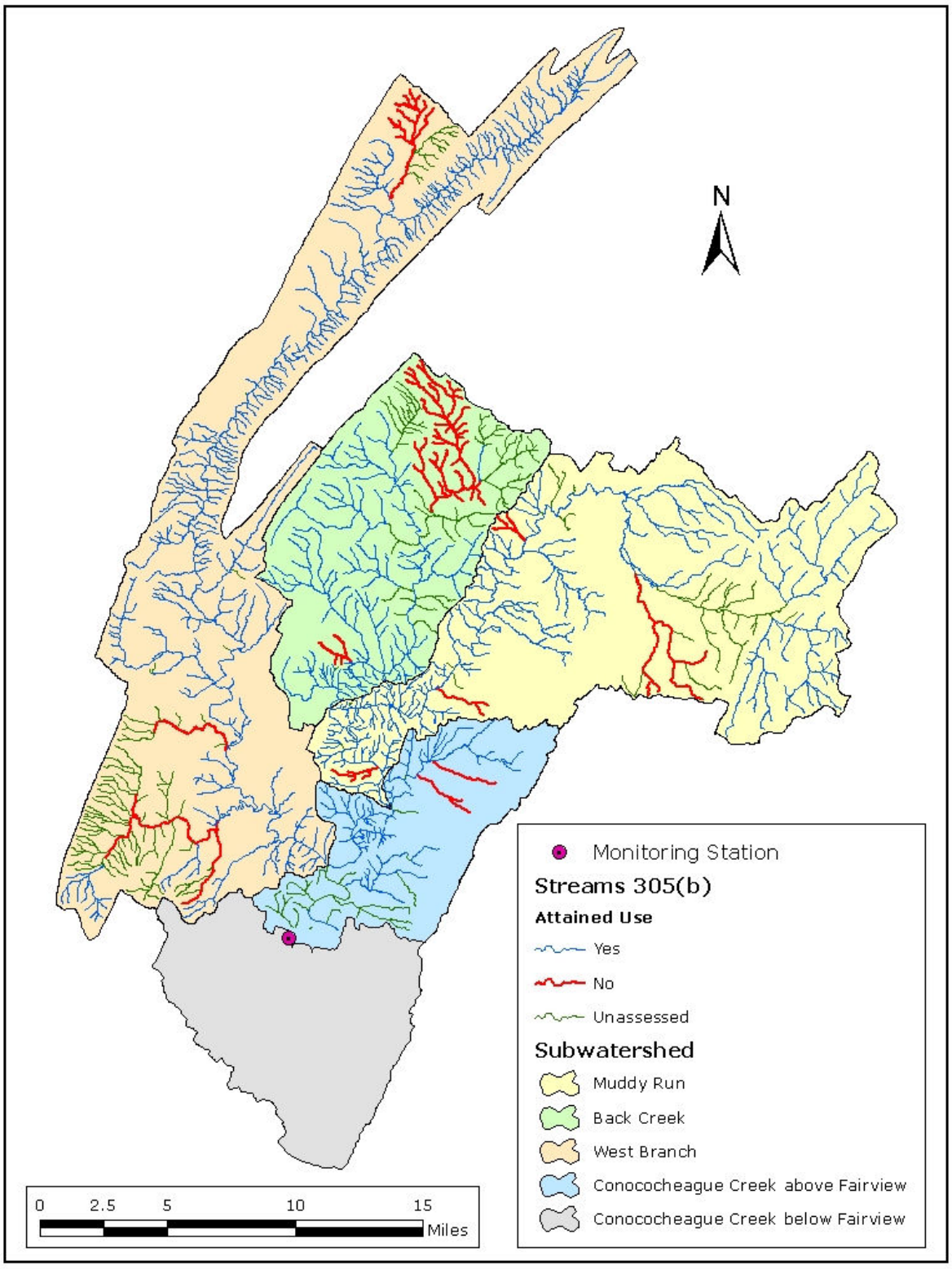
Point Sources

In the development of Pennsylvania's Tributary Strategies, the PA DEP classified facilities with annual average flows of 0.4 mgd or greater as significant (CBPO, 1998). Three such facilities are located within the monitored area: the Antrim Township Waste Water Treatment Facility, Chambersburg Borough Water System, and Greencastle Waste Water Treatment Plant. The PA DEP issues National Pollution Discharge Elimination System (NPDES) permits to point source facilities that require them to submit discharge monitoring reports (DMRs) on a regular, usually monthly, basis. DMRs may include discharge rates, nutrient and total suspended solids measurements, and other parameters. Facility information related to the National Pollution Discharge Elimination System (NPDES) is given in Table 2 and the locations are shown in Figure 4.

Table 2. Significant Point Source Facilities

Facility Name	NPDES ID	Size	SIC Description	Average Design Flow (mgd)
Antrim Township WWTF	PA0080519	Minor	Sewerage System	1.2
Chambersburg Borough WS	PA0026051	Major	Sewerage System	6.8
Greencastle WWTP	PA0020834	Minor	Sewerage System	0.8

Source: Chesapeake Bay Program Office (CBPO) Nutrient Point Source Database



Source for impaired stream segments: ERRI, 2002

Figure 3. Impaired Stream Segments in the Conococheague Creek Drainage Area Above Fairview, MD

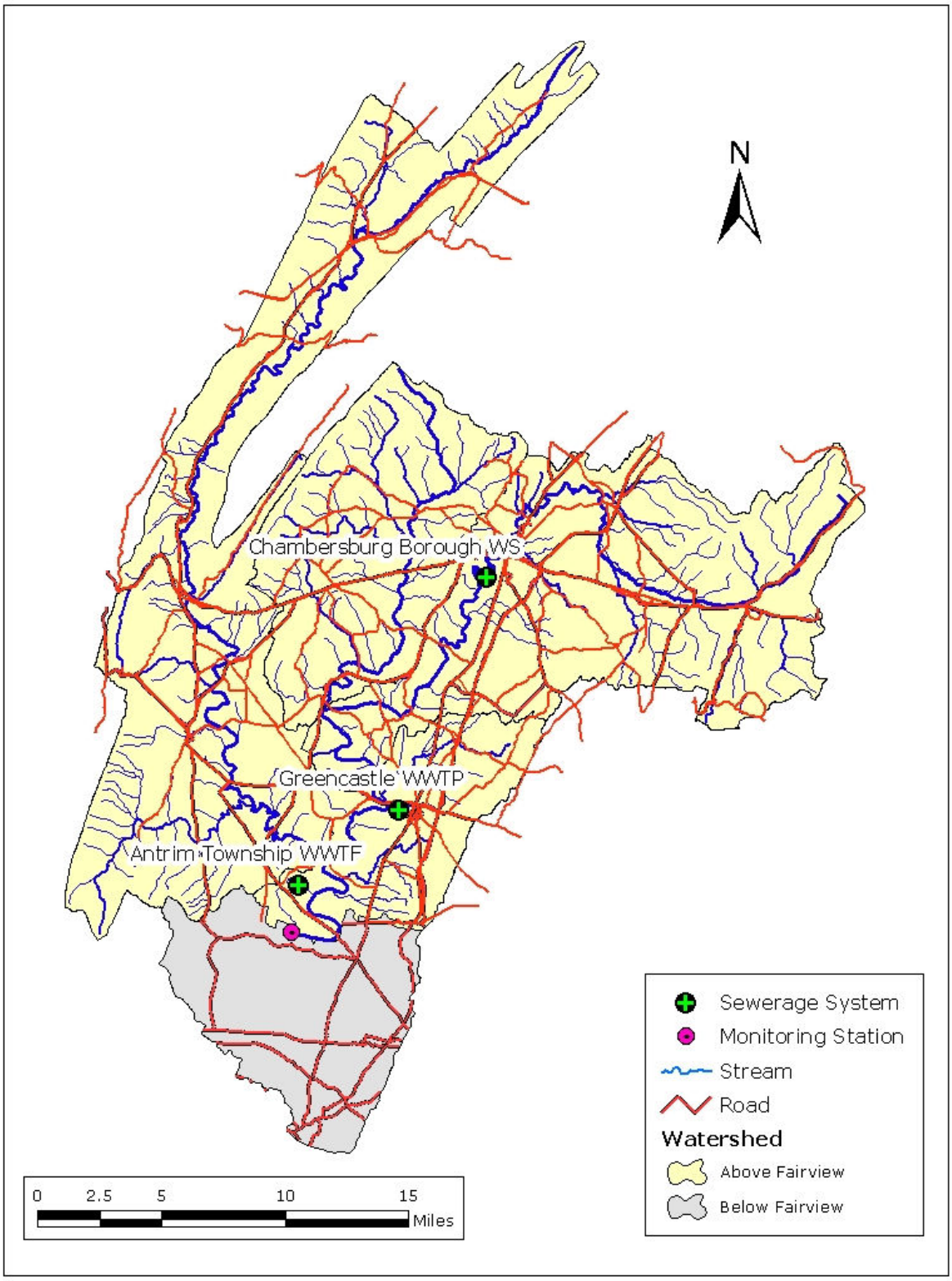


Figure 4. Location of Point Source Dischargers with Design Flows of at Least 0.1 mgd in the Conococheague Creek Drainage Basin Above Fairview, MD

METHODS OF DATA COLLECTION AND ANALYSIS

Descriptions of the methods used to measure streamflow and to collect and analyze water quality samples are given in the following sections.

Monitoring Station Location

The water quality monitoring station was established on the Conococheague Creek just downstream of the Pennsylvania state line near Fairview, MD. The station is located at the USGS stream gage station 01614500, which has been in operation since 1928. The gage station is situated on the right bank, 0.7 miles upstream from the highway bridge in Fairview, MD, 2.0 miles upstream from Rockdale Run, and 19.1 miles upstream from the mouth (James et al., 2001).

The site is ideally located because it receives drainage from the entire Pennsylvania portion of the Conococheague Creek watershed with very little drainage originating in Maryland. Furthermore, the city of Chambersburg, the largest urbanized area in the Pennsylvania portion of the Potomac River basin, is located in the Conococheague Creek watershed upstream of the monitoring station.

Measurement of Streamflow

Accurate measurements of streamflow are important because concentrations of water quality constituents are often linked to streamflow. In addition, flow data is needed to convert concentrations to loads. The USGS equipped the Conococheague Creek gage station with a Sutron 8400 digital data recorder (with a 15 minute scan interval) and a Stevens A-35 graphic recorder referenced to an integral float-tape gage. The National Weather Service also installed a Handar 550 Hydrologger telephone telemeter, which relays real-time automated gage-height records.

Sample Collection

USGS personnel began collecting water quality parameters for this project starting with WY 1994. Data were also available from the Maryland Department of Natural Resources (MD DNR) who started sampling at the Fairview site (MD DNR station number CON0180) in January 1986 as part of the Chesapeake Bay Program Tributary Strategies data collection effort. The collection and analysis of the streamflow measurements and water quality samples were conducted in accordance with the respective ICPRB or MD DNR Quality Assurance Project Plans (QAPPs) (ICPRB, 2003; MD DNR, 2001). USGS water quality data collection and analysis procedures are briefly described in the following paragraphs.

USGS personnel collected both nonstorm and storm flow water quality samples using a Sigma 900 MAX refrigerated automatic sampler that could be activated manually or could be set to trigger automatically at a predetermined stream gage height. The accuracy of the automatic sampling procedure was checked by collecting manual grab samples concurrently with automatic samples for several nonstorm flows and storm events per year. A comparison of the automated versus manual sampling techniques can be found in Appendix. B.

Annually, the USGS collected a minimum of twelve nonstorm flow samples at approximate monthly intervals as well as samples from five storm events, weather permitting. The storm flow sampling was designed to capture one spring storm occurring before and one after the regional application of agricultural fertilizer, one summer storm, one fall storm, and one winter storm. The storm samples were collected at equal flow volume intervals whenever the stream stage exceeded a preset level of generally five feet. At times during a prolonged dry weather period, USGS personnel reset the trigger gage height and sample volume interval to increase the likelihood of capturing a desired storm. Water quality samples were preserved in the field as described in the QAPP and transported to USGS laboratories for analyses.

Sample Analysis

Water samples were analyzed for nutrient and organic carbon concentrations at the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado, while suspended sediment concentrations were determined at the USGS Sediment Laboratory in Louisville, Kentucky. The accuracy of the laboratory procedures was assessed by evaluating equipment blanks and concurrent replicate samples taken from the automatic sampler at a frequency of one blank and one concurrent replicate for every ten samples. All laboratory methods were checked for accuracy, precision, and bias by using standard reference materials and by participating in the USGS Office of Water Quality sample-testing program. The water quality data were entered into the USGS National Water Information System (NWIS) database. Table 3 lists available water quality parameters for the Conococheague Creek station during the study period, including twelve nitrogen species, four phosphorus species, and suspended sediment.

Table 3. List of Water Quality Parameters Available from NWIS for WYs 1994 – 2004

Parameter	Unit	USGS NWIS Code
Water temperature	^{0}Celsius	00010
Instantaneous discharge	cfs	00061
Gage height	feet	00065
Specific conductance	uS/cm	00095
Oxygen, dissolved	mg/L	00300
Oxygen, dissolved	% saturation	00301
pH, whole water, field	standard units	00400
Nitrogen, total, as N	mg/L	00600
Nitrogen, dissolved, as N	mg/L	00602
Nitrogen, organic, total, as N	mg/L	00605
Nitrogen, organic, dissolved, as N	mg/L	00607
Nitrogen, ammonia, dissolved, as N	mg/L	00608
Nitrogen, nitrite, dissolved, as N	mg/L	00613
Nitrogen, nitrate, dissolved, as N	mg/L	00618
Nitrogen, ammonia + organic, dissolved as N	mg/L	00623
Nitrogen, ammonia + organic, total, as N	mg/L	00625
Nitrogen, nitrite-plus-nitrate, dissolved, as N	mg/L	00631
Nitrogen, ammonia, dissolved, as NH_4	mg/L	71846
Nitrogen, nitrate, dissolved, as NO_3	mg/L	71851
Nitrogen, nitrite, dissolved, as NO_2	mg/L	71856
Phosphate, ortho, dissolved, as PO_4	mg/L	00660
Phosphorus, total, as P	mg/L	00665
Phosphorus, dissolved, as P	mg/L	00666
Phosphorus, ortho, dissolved, as P	mg/L	00671
Carbon, organic, total, as C	mg/L	00680
Sediment, concentration, suspended	mg/L	80154
Sediment, discharge, suspended	t/day	80155

cfs, cubic feet per second; uS/cm, microsiemens per centimeter; mg/L, milligrams per liter

STREAMFLOW AND WATER QUALITY DATA

Streamflow Data

Approved flow data were obtained from the NWIS database and were used to compute streamflow statistics for the monitored period (i.e., WY 1994 – WY 2004) and for the entire period of record. These statistics are presented in Table 4. A summary of extreme data is given in Table 5. Figure 5 shows mean-daily discharge, Figure 6 seasonal mean-daily discharge, and Figure 7 annual mean-daily discharge. All discharges are expressed in cubic feet per second (cfs).

Table 4. Monthly Mean-daily Discharge Statistics

Monthly Mean-daily Discharge (cfs) (WYs 1994 –2004)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1993	***	***	***	***	***	***	***	***	***	222	953	1,217
1994	561	1,060	3,725	1,378	988	279	253	746	271	165	442	794
1995	1,152	436	489	304	282	423	649	181	103	310	732	564
1996	2,404	1,324	1,500	1,181	1,137	1,843	821	536	1,886	1,104	995	1,926
1997	664	969	1,276	461	286	322	170	129	165	124	1,571	516
1998	1,870	2,473	2,172	1,275	1,678	505	301	259	129	131	108	109
1999	597	359	1,053	1,087	440	174	106	101	275	514	259	456
2000	214	683	1,222	988	556	538	263	194	232	154	171	366
2001	328	522	796	973	360	490	204	140	87	76	75	91
2002	140	115	371	436	462	193	72	67	111	139	725	894
2003	1,144	552	2,017	1,130	1,539	2,496	374	372	895	721	1,027	1,792
2004	703	916	1,136	1,482	866	630	356	602	1,567	***	***	***
Summary Statistics (WYs 1994 – 2004)												
Mean	889	855	1,432	972	781	718	324	303	520	360	642	793
Minimum	140	115	371	304	282	174	72	67	87	76	75	91
25th Percentile	445	479	924	717	400	300	187	135	120	142	215	411
75th Percentile	1,148	1,014	1,758	1,228	1,062	584	365	454	585	477	974	1,056
Maximum	2,404	2,473	3,725	1,483	1,678	2,496	821	746	1,886	1,104	1,571	1,926
Long-term Summary Statistics (WYs 1929 - 2004)												
Mean	682	835	1,196	1,054	746	512	308	232	283	335	457	633
Minimum	89	115	274	304	218	120	62	48	55	42	45	61
25th Percentile	384	471	783	588	409	254	161	126	111	119	162	222
75th Percentile	910	1,179	1,505	1,339	994	567	375	283	218	356	669	916
Maximum	2,404	2,473	3,725	2,991	1,736	3,278	1,227	921	1,886	2,177	1,571	1,926

Table 5. Discharge Summary Statistics

	WYs 1994 - 2004		WYs 1929 - 2004	
	Value (cfs)	**Date of Occurrence**	**Value (cfs)**	**Date of Occurrence**
Annual Daily Mean	715		605	
Highest Annual Daily Mean	1,387	1996	1,387	1996
Lowest Annual Daily Mean	337	2002	224	1928
Highest Daily Mean	14,600	1/20/1996	26,700	6/23/1972
Lowest Daily Mean	38	8/22/2002	25	11/28/1930

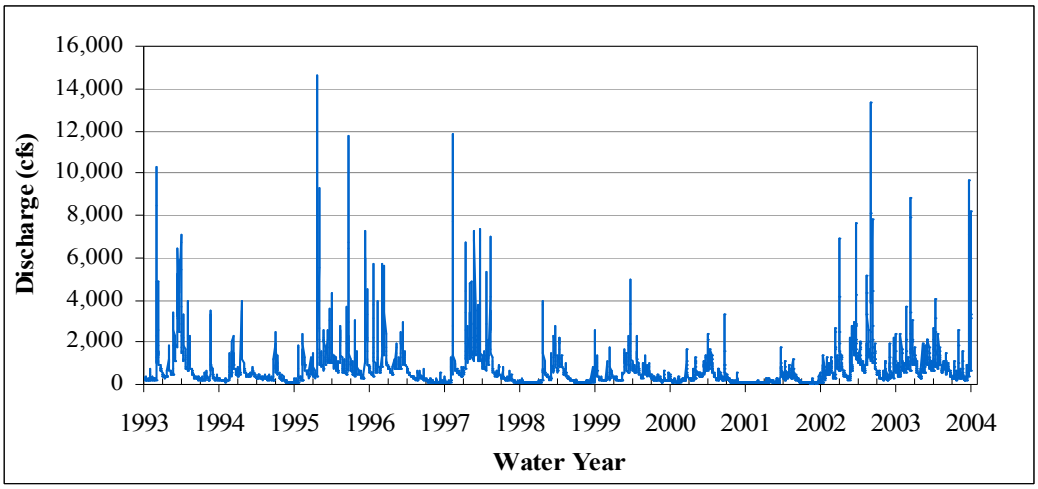


Figure 5. Mean-daily Discharge During the Monitoring Period

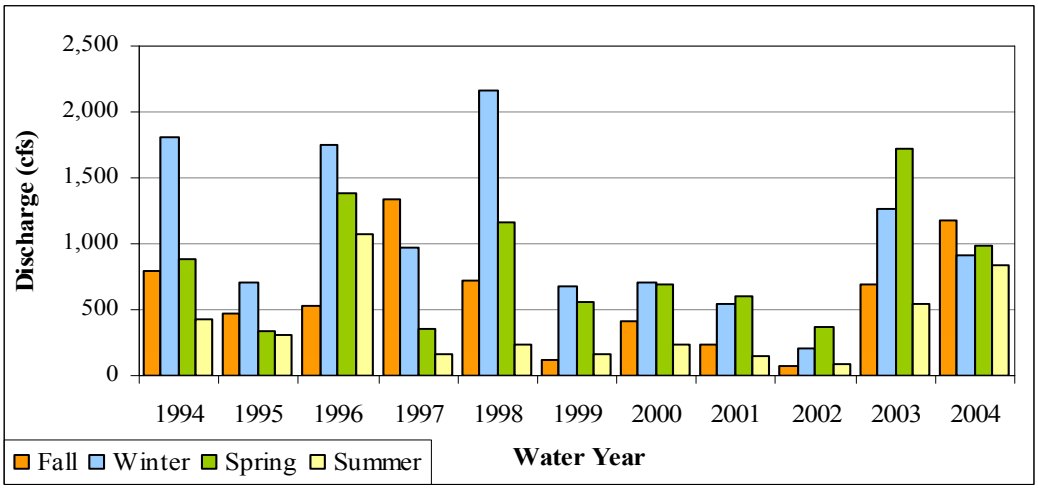


Figure 6. Seasonal Mean-daily Discharge by Water Year

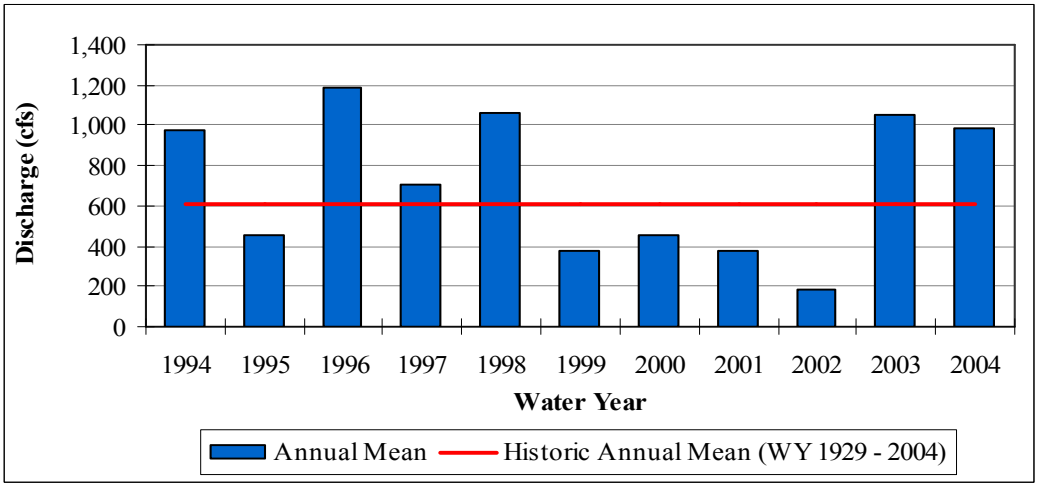


Figure 7. Annual Mean-daily Discharge by Water Year

Annual mean-daily discharges exceeded the historic (WYs 1929 – 2004) annual mean-daily discharge of 605 cfs in six of the eleven monitored years. The study period saw the wettest year on record in 1996 as well as a period of severe drought conditions from the summer of 1998 through the summer 2002. On a seasonal basis, mean-daily flows tended to be highest during the winter months (January through March) and lowest during the summer months (July through September).

Water Quality Data

Although a total of 27 physical and chemical water quality parameters were available from NWIS (see Table 3), only six nutrient species (i.e., dissolved ammonia, dissolved nitrite-plus-nitrate, total organic nitrogen, total nitrogen, dissolved orthophosphate, total phosphate) and suspended sediment were selected for estimations of seasonal and annual concentrations, loads, and trends. When the concentration of a constituent was missing in the dataset, it was calculated from the reported species of the constituent. To calculate total nitrogen concentration, for example, the concentrations of total Kjeldahl nitrogen (i.e., organic nitrogen plus total ammonia) and total nitrite-plus-nitrate were added. USGS analytical methods with corresponding US EPA methods and reporting limits are listed in Table 6 for the selected water quality parameters. Summary statistics for the USGS constituents collected during WYs 1994 - 2004 are shown in Table 7. Figure 8 depicts the constituent concentrations against instantaneous flow.

Table 6. Laboratory Methods and Detection Limits of the Water Quality Parameters Selected for Analyses

USGS NWIS Code	Parameter	USGS Method	US EPA Method	Reporting Limit
00608	Nitrogen, ammonia, dissolved, as N, (mg/L)	I-2522-90	350.1	0.041
00631	Nitrogen, nitrite-plus-nitrate, dissolved, as N, (mg/L)	I-2545-90	353.2	0.060
00605	Nitrogen, organic, total, as N, (mg/L)	NA	NA	NA
00600	Nitrogen, total, as N, (mg/L)	NA	NA	NA
00665	Phosphorus, total, as P, (mg/L)	I-4610-91	365.4	0.0037
00671	Phosphorus, ortho, dissolved, as P, (mg/L)	I-2601-90	365.1	0.018
80154	Sediment, suspended, (mg/L)	NA	NA	1

NA = not applicable

Table 7. Summary Statistics for Suspended Sediment and Selected Nutrient Data Collected by the USGS at Fairview, MD (WYs 1994 – 2004)

Statistic	dNH_4	dNO_{23}	TON	TN	dPO_4	TP	SSC
Nonstorm Samples							
Number of Observations	134	134	129	129	134	129	129
Mean Concentration	0.04	3.90	0.42	4.37	0.07	0.13	34
Storm Samples							
Number of Observations	423	423	422	422	417	422	395
Mean Concentration	0.07	3.35	1.25	4.67	0.06	0.33	188
Combined Samples							
Number of Observations	560	560	551	551	551	551	524
Minimum Concentration	0.02	1.68	0.02	2.54	0.01	0.02	1
Mean Concentration	0.07	3.48	1.06	4.60	0.06	0.28	150
Maximum Concentration	0.74	7.96	5.92	10.00	0.64	2.00	1,390

All concentrations are expressed in milligrams per liter (mg/L)

As can be seen in Table 7, the number of storm samples, which were collected during 61 distinct storm events, far outnumbers the number of the nonstorm observations. As a consequence, the mean concentrations of the combined samples are skewed toward the mean concentrations of the storm samples. With the exception of two nutrients, dissolved nitrite-plus-nitrate and orthophosphate, mean constituent concentrations were higher during storm flows. Figure 8 demonstrates that the extreme maximum concentrations were due to a few outliers.

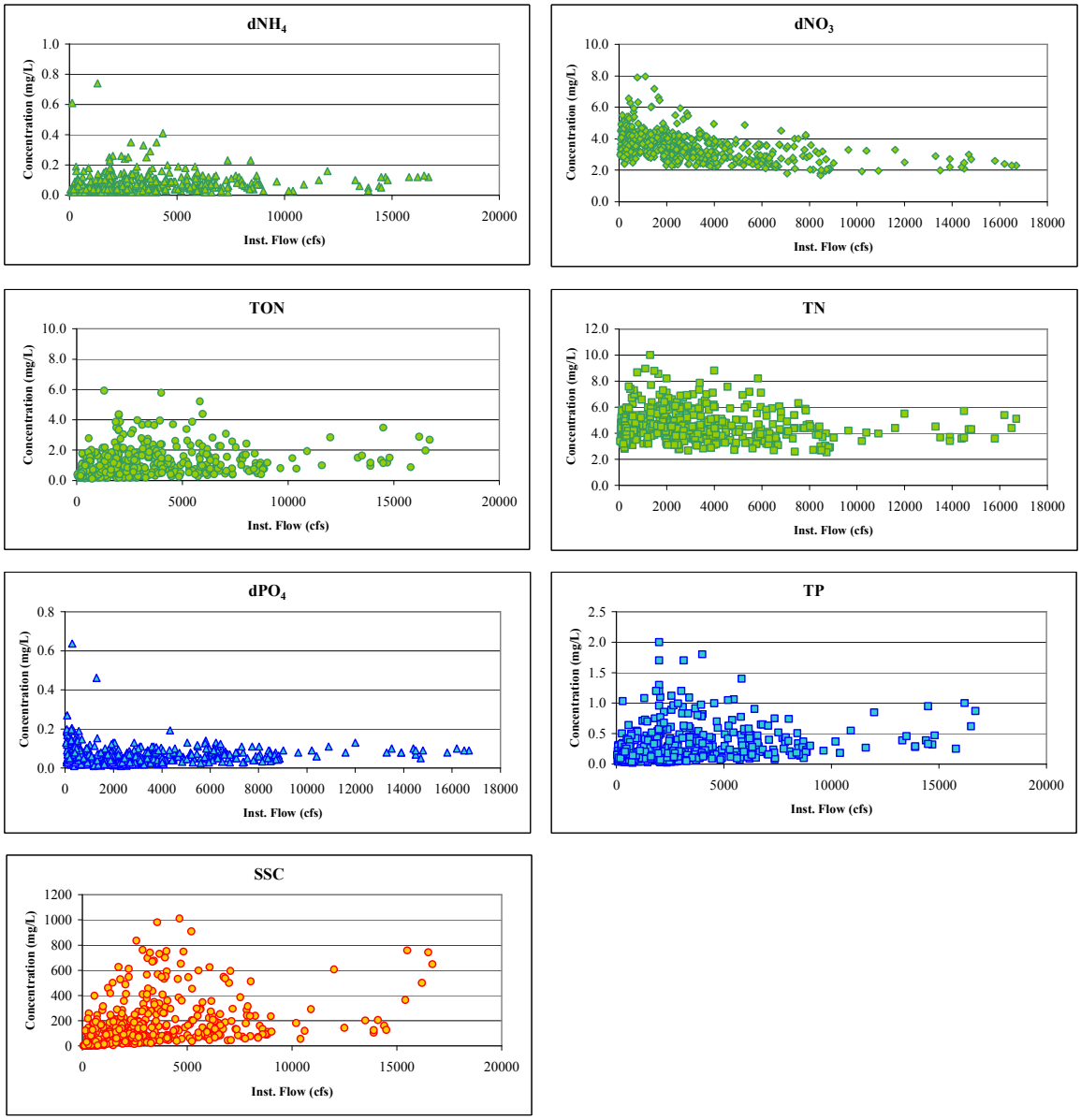


Figure 8. Concentration versus Instantaneous Flow

Summary statistics for the MD DNR data are presented in Table 8. The reader should note that MD DNR sediment data were not used in the analyses presented in this study because the MD DNR sampled total suspended sediment (TSS) whereas the USGS sampled suspended sediment concentration (SSC). Although these two types of data have been used interchangeably to quantify the concentration of suspended solids (usually given in mg/L) in a water-sediment mixture, TSS and SSC data may not be comparable because sampling and analytical methods differ (Gray et al., 2000, Glysson et al., 2000). Sample preparation for both essentially consists of filtering, drying, and weighing, but whereas the SSC analysis is performed on the entire water sample, only an aliquot of the original sample is taken for TSS analysis. This sub-sampling may introduce errors because mere agitation of the sample may not reproduce the particle-size

distribution of the original sample, particularly if the water-sediment mixture contains a significant amount of sand-sized material, which tends to settle fast. Gray et al. (2000) tentatively reported that TSS might be biased downward relative to SSC by 25 to 34 percent. Because neither paired samples of TSS and SSC were available for comparison, nor the grain-size distribution at the sampling site was known, the compatibility of the USGS SSC and MD DNR TSS data could not be assessed.

Table 8. Summary Statistics for the Nutrient Data Collected by MD DNR at Fairview, MD (WY 1994 – 2004)

Statistic	dNH_4	dNO_{23}	TON	TN	dPO_4	TP
Number of Observations	139	139	136	140	137	140
Minimum Concentration	0.01	1.82	0.09	2.18	0.01	0.02
Mean Concentration	0.04	3.81	0.50	4.34	0.08	0.11
Maximum Concentration	0.42	6.35	2.40	6.95	0.28	0.48

Note: All concentrations are in mg/L

A comparison of the combined sample data from the USGS (see Table 7) with the MD DNR data (Table 8) shows that the mean concentration of dNO_{23} and dPO_4 of the MD DNR dataset are higher and all maximum constituent concentrations of the MD DNR dataset are lower than of the USGS dataset. These results suggest that the routine MD DNR sampling did not capture extreme storm events. For the analyses presented in this report, the MD DNR and USGS nutrient datasets were combined nevertheless in the hope that the range of flow over which data were collected was increased and, as a consequence, that the representativeness of the data improved.

NUTRIENT AND SEDIMENT LOAD ESTIMATES

Water quality constituents can be quantified by several means, including concentration and load. Concentration is simply the mass of the constituent per volume of water and is often expressed in milligrams per liter (mg/L). Concentration gives information about the instream condition at the monitoring site and is influenced by many factors including amount of streamflow, land use practices, type of bedrock, and point source discharges. Load, the product of concentration and streamflow, represents the total mass of material carried by a stream and is a useful measure for assessing impact on receiving waters.

Load Estimate Methodology

Multivariate regression analyses were used to estimate nutrient and suspended sediment loads and to determine trends. This section includes a description of the dataset construction and data analyses methods.

The ESTIMATOR Model

ESTIMATOR, a 7-parameter, log-linear regression model developed by Tim Cohn and others (Cohn et. al., 1989 and 1992; Gilroy et al., 1990) was used to estimate nutrient and suspended sediment loads. The load estimation proceeds in two-step: first ESTIMATOR predicts daily instream constituent concentrations by use of the multivariate regression model as shown in equation 1, and then computes loads from the estimated constituent concentrations and daily streamflow by use of equation 2. Equation 1 takes the following form:

$$ln[C] = \beta_0 + \beta_1 * ln[Q/Q_c] + \beta_2 * (ln[Q/Q_c])^2 + \beta_3 * [T - T_c] + \beta_4 * [T - T_c]^2 + \beta_5 * sin[2 * \pi T] + \beta_6 * cos[2\pi * T] + \varepsilon$$

(Equation 1)

where

ln[]	=	natural logarithm function,
C	=	measured concentration (mg/L),
β_0 - β_6	=	coefficients of the regression model,
Q	=	mean-daily discharge on the day the sample was taken (cfs),
Q_c	=	centering variable defined such that β_1 and β_2 are statistically independent,
sin	=	sine function,
cos	=	cosine function,
T	=	decimal time (year),
T_c	=	centering variable defined such that β_3 and β_4 are statistically independent,
π	=	3.14169, and
ε	=	independent random error.

The coefficients of the regression model, β_0 through β_6, are computed from the logarithms of the observed concentration data by ordinary least squares (Draper and Smith, 1981, Gilroy et al. 1990), in the case of non-censored data, or by minimum variance, in the case of censored data (i.e., value below the analytical reporting limit). β_0 is a constant, β_1 and β_2 describe the relation between concentration and flow, β_3 and β_4 describe the relation between concentration and time regardless of flow, and β_5 and β_6 describe seasonal variation in the data (Cohn et. al., 1992). The centering variables, Q_c and T_c, are used to reduce covariance among the independent parameters and to enhance the precision of the load estimates. They are defined such that the predictor values corresponding to β_1 and β_2 and β_3 and β_4, are orthogonal (Cohn et. al., 1992). It is assumed that the model error, ε, is independent and normally distributed with zero mean and variance σ_ε^2, and that the concentrations fit the specified log-linear model. The ESTIMATOR model includes the Adjusted Maximum Likelihood Estimator (AMLE) to statistically address censored data and multiple reporting limits within the database as described by Cohn (1988) and a Minimum Variance Unbiased Estimator (MVUE) described by Bradu and Mundlak (1970) and Cohn et al. (1989, 1992) to correct the retransformation bias associated with log-linear models.

The model calculates daily loads from daily mean flow and estimated daily concentrations (Equation 2). These mean-daily loads are then summed to obtain monthly and annual mean-daily load estimates. Equation 2 takes the following form:

$$L = Q*C*k \quad \text{(Equation 2)}$$

where

L = daily mean load (kg/day),
Q = daily mean flow (cfs),
C = estimated daily concentration (mg/L), and
k = 2.447, conversion factor for unit conversion.

The model statistics can be used to evaluate the precision and accuracy of the results, although they do not account for sampling bias, lack of data, and data characteristics that do not meet model assumptions. The coefficient of determination, R^2, represents the percent of variation that can be explained by the regression equation: the higher the value, the higher the degree of accuracy. The serial correlation of residuals, SCR, gives a measure of data redundancy and model validity and ideally should be 0.4 or less (Cohn et al., 1992). The probability plot correlation coefficient, PPCC, indicates whether the residuals are normally distributed; in other words, as PPCC departs from 1, the residuals depart from normality. As a rule, the PPCC should be greater than 0.96. The degree of uncertainty of the load estimates can be obtained by evaluating the 95 percent confidence interval (CI), which describes the likelihood that the true mean of the load estimate is contained within the interval. The regression summaries (i.e., regression coefficients, t-statistic, p-value) can be used to characterize the relationship of the concentrations to flow and season and to determine trends over time as described in more detail in the trend analysis section.

Dataset Construction for Regression Analyses

ESTIMATOR requires a complete record of daily discharge that covers at least the time period over which loads are to be estimated. It is also important to obtain a sufficient number of water quality samples that thoroughly characterize the relationship between constituent concentration and flow. The more data available, the more accurate the load estimates, but a minimum of 10 observations are recommended for each regression coefficient used, and 20 percent of the observations should be above the minimum detection limit (Baier et al., 1995; Cohn, 2002). This translates into a minimum of 70 observations for a 7-parameter analysis.

Ideally, half of the samples should be obtained during high flow, and the rest should be distributed uniformly throughout the year because constituent concentrations can be greatly affected by the discharge at the time of sampling. For example, instream concentrations of constituents that are transported by storm runoff tend to increase with increasing streamflow. On the other hand, constituent concentrations originating from point sources, which usually yield a constant input, tend to decrease with increasing flow due to a dilution effect. Furthermore, the concentration-flow relationship may vary seasonally.

It is also important to obtain representative water quality samples during the rising and falling limbs and at or near the peak of a storm hydrograph because particulate constituents tend to have higher concentrations during the rising limb, whereas dissolved constituents tend to have higher concentrations during the falling limb. If this is not taken into account, the results may be biased. For example, if only storm samples taken on the rising limb are included in the

regression analysis, the estimated particulate concentrations may be positively biased, and estimated dissolved concentrations may be negatively biased.

The ESTIMATOR model considers each sample as an independent observation. Samples taken at regular intervals during a single storm event or during intensive sampling, however, may be serially dependent, that is, a given measurement may be dependent on a prior measurement. When comparing the number of nonstorm and storm samples collected by the USGS (Table 9), it becomes clear that the storm flow observations (423) far outnumber the low flow observations (134). In a given year, however, far more low flow days occur than storm flow days. Therefore if each storm flow sample was treated as a discrete data point, the regression analysis could be biased in favor of storm flow during which much of the nutrient and sediment transport may occur.

Table 9. Number of Nonstorm and Storm Flow Observations (WYs 1994 – 2004)

Water Year	Number of USGS			Number of MD DNR Samples	Comments
	Nonstorm Samples	Storm Samples	Storms Sampled		
1994	9	3	3	12	Start-up year. Limited sampling by USGS.
1995	11	1	1	12	Dry year.
1996	12	102	11	11	Very wet year.
1997	12	31	4	12	Dry spring and summer. USGS sampled storms December through March only.
1998	12	75	7	12	Wet year with a very wet spring. USGS sampled storms December through March only.
1999	13	39	6	10	Dry year. Small storms (except hurricane Floyd). USGS sampled storms during spring and fall only.
2000	13	22	6	12	Dry year.
2001	12	49	7	12	Dry year. USGS did not collect storm samples during fall.
2002	12	24	4	12	Dry year. USGS sampled storms during spring and fall only.
2003	12	69	10	12	Wet year.
2004	16	8	2	12	Wet year.
Total	134	423	61	129	

To adjust for the disproportionately large number of storm data and to reduce the potential for serial correlation, the storm data were thinned to three samples per storm. When possible, one sample each was chosen from the rising and falling limbs and one at or near the peak of the hydrograph. As an alternative, the mean of the concentrations measured on a single day could have been used, but this procedure may reduce the variance in the dataset. All of the monthly MD DNR nutrient data for water years 1994 through 2004 were included in the final dataset.

Test statistics obtained from ESTIMATOR for the complete and thinned datasets are shown in Table 10. As indicated by the SCR, the correlation between samples in the thinned dataset is reduced, which indicates that the data is less redundant and that the model validity may be improved. The model fit, as indicated by R^2, is also somewhat better for TP and SSC. The residuals of both the complete and thinned datasets approach normal distributions as indicated by the PPCC. Summary statistics of the data used to run the model are given in Table 11. Appendix C contains the complete USGS data (Table C1), the final nutrient datasets (i.e., thinned USGS plus MD DNR nutrient data) (Table C2) and final suspended sediment data (i.e., thinned USGS suspended sediment data) (Table C3).

Table 10. Test Statistics of the Concentration Models for Total Nitrogen, Total Phosphorus and Suspended Sediment of the Complete and Thinned Datasets

	Complete Dataset			Thinned Dataset		
	USGS + MD DNR Data		USGS Data	USGS + MD DNR Data		USGS Data
	TN	TP	SSC	TN	TP	SSC
N	681	681	519	426	426	280
S	0.21	0.75	0.99	0.20	0.73	1.09
R^2	25.2	23.4	55.5	20.2	27.4	59.8
PPCC	0.996	0.995	0.999	0.998	0.997	0.998
SCR	0.66	0.62	0.63	0.53	0.45	0.45

N denotes the number of observations used to fit the model, S is the standard deviation of the residuals from ordinary least squares fit, R^2, the coefficient of determination, represents the fit of the regression model to the data, PPCC, the probability plot correlation coefficient, tests the normality of the residuals, and SCR is indicative of the serial correlation of the residuals.

Table 11. Summary Statistics of the Nutrient and Suspended Sediment Concentrations (in mg/L) Used in the ESTIMATOR Model

Sample Statistics	dNH4	dNO23	TON	TN	dPO4	TP	SSC
Number of Samples	433	433	422	426	428	426	280
Minimum Concentration	0.01	1.79	0.09	2.18	0.01	0.02	1
Mean Concentration	0.06	3.63	0.84	4.52	0.07	0.22	126
Maximum Concentration	0.74	7.96	5.92	10.00	0.46	2.00	1010

Results of the Load Estimates

Model-estimated nutrient and suspended sediment loads by season and water year as well as their 95 percent confidence intervals are presented in Table 12. The generally wide confidence intervals indicate that the data is rather variable throughout a year.

Table 12. Estimated Nutrient and Suspended Sediment Loads (in 1,000 lbs) by Season and Water Year

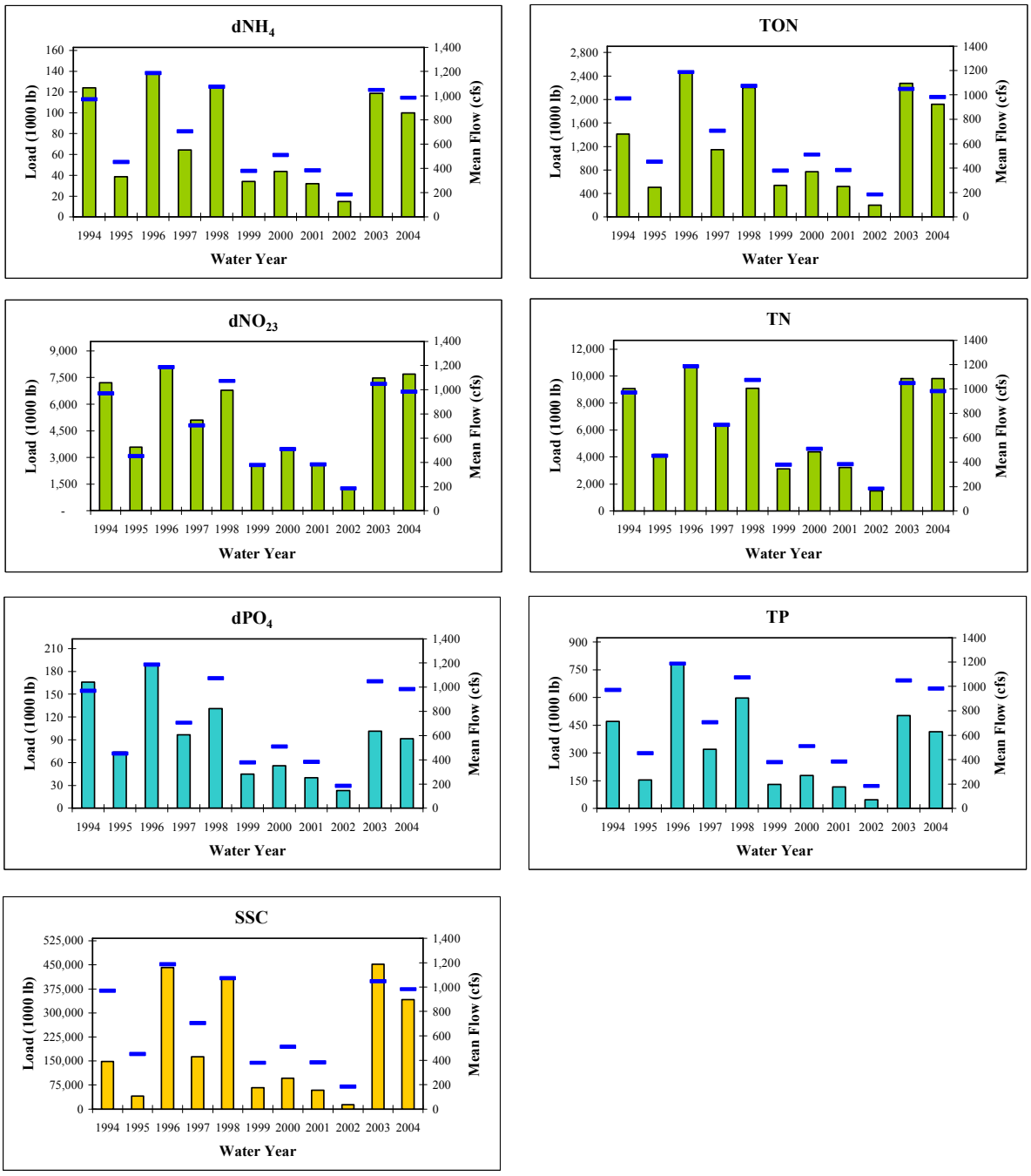
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
dNH_4											
Fall	23.6	9.0	10.0	31.8	19.1	1.8	6.9	3.8	1.3	13.1	29.4
Winter	24.2	6.9	42.9	7.1	32.9	13.1	15.4	13.8	7.5	58.1	25.8
Spring	8.3	6.0	25.0	2.4	3.7	2.7	3.6	2.3	1.4	9.8	22.5
Summer	67.9	16.7	60.1	23.0	69.3	16.6	17.7	11.9	4.4	37.7	22.2
Total WY	124.1	38.6	138.0	64.3	125.0	34.1	43.6	31.8	14.6	118.7	99.9
95 % CI for WY	91 - 166	31 - 47	106 - 178	53 - 78	98 - 157	27 - 42	36 - 53	26 - 38	12 - 18	91 - 152	76 - 129
TON											
Fall	327.2	127.8	175.7	705.9	468.1	25.0	157.8	67.1	15.4	280.8	616.8
Winter	259.0	85.3	780.0	94.5	589.6	205.7	272.5	241.9	110.4	1,164.1	389.9
Spring	166.5	113.5	726.4	44.6	80.8	64.8	81.8	44.7	22.3	266.4	630.3
Summer	657.9	176.0	780.5	298.8	1,068.0	240.6	259.5	163.4	49.0	563.8	282.5
Total WY	1,410.5	502.6	2,462.7	1,143.7	2,206.4	536.1	771.5	517.2	197.2	2,275.2	1,919.4
95 % CI for WY	1,094 - 1,791	418 - 599	1,974 - 3,041	948 - 1,367	1,787 - 2,695	443 - 643	659 - 900	437 - 607	166 - 233	1,810 - 2,824	1,481 - 2,442
dNO_{23}											
Fall	1,635	1,022	1,120	2,530	1,290	210	808	446	142	1,434	2,415
Winter	1,638	618	2,199	613	1,787	918	1,153	1,013	639	2,758	1,847
Spring	895	609	1,957	283	426	282	430	261	148	1,144	1,657
Summer	3,047	1,340	2,795	1,683	3,275	1,112	1,143	950	362	2,129	1,774
Total WY	7,215	3,590	8,072	5,109	6,778	2,522	3,534	2,670	1,290	7,465	7,692
95 % CI for WY	6,760 - 7,693	3,416 - 3,770	7,743 - 8,430	4,896 - 5,328	6,489 - 7,077	2,408 - 2,641	3,392 - 3,686	2,561 - 2,783	1,230 - 1,353	7,133 - 7,807	7,260 - 8,141
TN											
Fall	2,042.1	1,178.3	1,333.3	3,341.5	1,721.5	233.5	979.8	516.7	155.5	1,762.0	3,118.0
Winter	1,986.4	712.4	2,985.1	717.1	2,401.9	1,148.5	1,453.2	1,275.4	759.3	3,859.1	2,317.0
Spring	1,094.3	742.6	2,697.0	330.5	513.0	348.8	516.9	307.8	171.6	1,444.4	2,273.2
Summer	3,940.6	1,554.5	3,697.9	2,047.1	4,463.1	1,381.3	1,431.2	1,130.4	410.2	2,765.9	2,119.2
Total WY	9,063.5	4,187.8	10,713.3	6,436.2	9,099.5	3,112.1	4,381.1	3,230.3	1,496.6	9,831.4	9,827.4
95 % CI for WY	8,478 - 9,679	3,984 - 4,399	10,251 - 11,215	6,158 - 6,723	8,693 - 9,520	2,967 - 3,262	4,204 - 4,572	3,096 - 3,369	1,426 - 1,570	9,365 - 10,315	9,238 - 10,438

Table 12. continued

Season	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
dPO_4											
Fall	43.1	20.5	21.9	51.9	31.6	6.4	13.8	8.0	4.4	16.9	28.8
Winter	32.3	14.0	54.8	11.9	33.7	14.6	17.1	14.4	8.7	44.0	18.8
Spring	27.5	18.7	57.5	10.2	12.1	9.2	10.6	7.5	5.4	17.6	30.1
Summer	62.9	20.6	54.3	22.8	53.7	14.9	14.3	10.4	4.8	22.7	14.0
Total WY	165.9	73.8	188.5	96.8	131.1	45.0	55.7	40.2	23.3	101.1	91.6
95 % CI for WY	138 - 198	65 - 84	162 - 218	85 - 109	113 - 151	40 - 50	50 - 62	36 - 45	21 - 26	87 - 117	76 - 109
TP											
Fall	127.4	40.0	52.5	207.5	157.6	9.1	40.2	17.4	5.6	58.8	133.6
Winter	76.4	26.5	250.4	25.7	148.6	46.7	59.6	51.7	23.4	271.3	71.4
Spring	61.0	38.5	242.8	16.5	25.6	20.6	23.8	13.9	7.8	60.3	161.7
Summer	205.9	48.8	236.5	70.3	265.2	53.4	54.5	32.6	10.4	111.1	48.6
Total WY	470.7	153.7	782.2	320.0	596.9	129.9	178.1	115.7	47.3	501.5	415.4
95 % CI for WY	338 - 638	124 - 189	570 – 1,050	250 - 404	438 - 794	104 - 160	148 - 213	95 - 140	39 - 57	360 - 681	289 - 577
SSC											
Fall	36,453	9,460	17,374	124,414	102,553	504	19,203	4,781	185	37,073	107,005
Winter	21,926	6,195	151,983	5,561	109,420	24,839	35,103	35,298	8,909	277,594	51,014
Spring	19,761	11,559	163,378	1,843	5,434	9,246	5,223	2,052	850	41,194	154,228
Summer	70,393	13,890	108,962	30,921	188,643	32,581	36,988	16,633	3,554	95,445	29,505
Total WY	148,534	41,104	441,696	162,740	406,051	67,170	96,518	58,765	13,498	451,305	341,753
95 % CI for WY	74,939 - 265,321	22,856 - 68,367	230,443 - 770,095	88,790 - 274,542	218,299 - 692,531	35,907 - 115,041	59,645 - 148,413	30,463 - 102,935	7,507 - 22,448	225,453 - 811,877	152,069 - 664,346

Seasonal and the annual load patterns are shown in Figure 9 and Figure 10 respectively. As can be seen, the loads vary considerably with the seasons and among years, but overall, the load patterns tended to follow flow patterns (see Figure 6 and Figure 7). Figure 10 demonstrates that annual nutrient and sediment loads were elevated in years with above average precipitation (i.e., 1994, 1996, 1997, 1998, 2003, 2004). During dry years, most of the nutrients applied to the watershed (e.g., from agricultural fertilizer, air deposition, urban and industrial sources) tend to remain in place; sever precipitation events, however, may cause the build-up nutrients to be delivered via runoff to the stream. Heavy precipitation may also lead to significant soil and streambed erosion and thereby increase the suspended sediment load considerably.

Figure 9. Seasonal Nutrient and Sediment Loads (in 1,000 lbs) by Water Year



Annual loads are shown as columns and annual mean flows as horizontal bars

Figure 10. Annual Nutrient and Sediment Loads (in 1,000 lbs) by Water Year

Point Source Contributions to Total Nitrogen and Total Phosphorus Loads

As already mentioned, three significant point source facilities are located within the monitored area: the Antrim Township WWTF, the Chambersburg Borough WS, and the Greencastle WWTP. Data for these facilities were obtained from the Chesapeake Bay Program Office's Nutrient Point Source Database (http://www.chesapeakebay.net/data), which includes monitored or estimated flow and nutrient data approved and/or submitted by the PA DEP. A summary of annual mean-daily flow and TN and TP loads for water years 1994 to 2004 is presented in Table 13 and the complete set of records can be found in Appendix D. As can be seen in Table 13, TN and TP loads decreased during the period of study.

Table 14 shows seasonal and annual TN and TP loads of the sewerage plants and contrasts these loads with instream loads at the sampling station as determined by ESTIMATOR. For seasons dominated by low-flow conditions, nutrient loads from the three facilities can be large as compared to instream loads. Discharged TP loads can even surpass the estimated instream loads. This suggests that the entire load discharged by the facilities is not delivered to the sampling station. On an annual basis, the combined contributions of the three point source facilities to instream loads ranged from 2 to 13 percent for TN and 8 to 83 percent for TP over the eleven-year study period.

Table 13. Annual Mean-daily Flow and Nutrient Loads of Significant Point Source Facilities (WYs 1994 – 2004)

Parameter	Facility	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Flow (mgd)	Antrim Township WWTF	0.5	0.5	0.5	0.5	0.5	0.7	0.6	0.5	0.5	0.8	0.7
	Chambersburg Borough WS	6.6	6.9	6.3	5.0	5.7	4.8	4.6	4.6	4.6	6.1	6.3
	Greencastle WWTP	0.8	0.9	0.8	0.8	0.9	1.0	1.0	0.6	0.4	0.7	0.6
TN (lbs/d)	Antrim Township WWTF	88.6	91.9	90.2	89.4	92.8	142.3	93.3	28.6	32.0	50.0	35.2
	Chambersburg Borough WS	1,271.6	1,369.1	1,232.7	975.7	962.9	589.2	384.1	356.8	384.6	410.6	423.1
	Greencastle WWTP	50.1	50.1	50.1	50.1	23.1	10.3	9.1	61.7	85.6	55.1	29.3
TP (lbs/d)	Antrim Township WWTF	19.3	19.3	19.3	19.3	22.1	40.0	18.8	5.7	5.2	9.0	8.9
	Chambersburg Borough WS	309.9	317.4	202.3	154.9	140.1	103.6	100.5	97.7	47.9	89.6	115.9
	Greencastle WWTP	11.3	11.0	11.1	11.2	10.1	6.8	5.8	9.5	10.2	13.6	12.1

Table 14. Relative Contributions of Significant Point Source Facilities to the Instream Loads of TN and TP by Season and Water (WYs 2004 - 2004)

TN

	Facility Load (in 1,000 lbs per Season)											Conococheague Load (in 1,000 lbs per Season)										
Season	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Fall	123	132	141	105	97	80	61	38	40	47	48	2,042	1,178	1,333	3,341	1,722	233	980	517	156	1,762	3,118
Winter	129	138	124	103	112	66	48	43	41	42	45	1,986	712	2,985	717	2,402	1,149	1,453	1,275	759	3,859	2,317
Spring	131	140	118	96	102	67	37	42	54	49	40	1,094	743	2,697	330	513	349	517	308	172	1,444	2,273
Summer	132	141	120	103	82	58	33	40	48	50	45	3,941	1,554	3,698	2,047	4,463	1,381	1,431	1,130	410	2,766	2,119
Year	515	551	502	407	393	271	178	163	183	188	178	9,063	4,188	10,713	6,436	9,100	3,112	4,381	3,230	1,497	9,831	9,827

	Percent Contribution of Facilities to Instream Load										
Season	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Fall	6	11	11	3	6	34	6	7	26	3	2
Winter	7	19	4	14	5	6	3	3	5	1	2
Spring	12	19	4	29	20	19	7	14	31	3	2
Summer	3	9	3	5	2	4	2	4	12	2	2
Year	6	13	5	6	4	9	4	5	12	2	2

TP

	Facility Load (in 1,000 lbs per Season)											Conococheague Load (in 1,000 lbs per Season)										
Season	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Fall	31	31	32	15	14	13	14	11	7	8	14	127	40	52	208	158	9	40	17	6	59	134
Winter	31	31	17	17	18	12	9	11	8	11	13	76	27	250	26	149	47	60	52	23	271	71
Spring	31	32	19	18	17	12	12	12	4	11	14	61	38	243	17	26	21	24	14	8	60	162
Summer	31	32	16	18	14	18	11	8	4	11	10	206	49	237	70	265	53	54	33	10	111	49
Year	124	127	85	68	63	55	46	41	23	41	50	471	154	782	320	597	130	178	116	47	501	415

	Percent Contribution of Facilities to Instream Load										
Season	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Fall	24	79	61	7	9	146	35	62	119	13	10
Winter	40	119	7	65	12	26	15	21	34	4	18
Spring	51	83	8	111	65	57	49	83	52	19	8
Summer	15	66	7	26	5	33	20	25	43	10	21
Year	26	83	11	21	11	42	26	36	49	8	12

TREND ANALYSIS

One of the goals of monitoring water quality is to document trends or changes in constituent concentrations and loads over time. Water quality can be affected by management strategies designed to reduce point and nonpoint source pollution in the watershed as well as by natural processes, in particular streamflow. For example, a positive correlation may exist between streamflow and constituent concentrations originating from nonpoint sources. This type of pollution is often transported in precipitation-induced runoff, and thus heavy precipitation may result in elevated instream concentrations. In contrast, point source inputs, such as wastewater discharges, are usually fairly constant. Thus, an increase in streamflow can have a dilution effect, causing a decrease in concentration.

Constituent concentrations may not only be correlated to flow but also to season and time. Variations in concentrations may be linked to seasonal agricultural practices, increased biological activity during warmer month (i.e., assimilation of bioavailable nutrients by algae and aquatic plants), or temperature-dependent nitrification and volatilization. Seasonal variations in precipitation will also affect instream concentrations; for example, precipitation-induced discharge may dominant during fall and baseflow during summer.

Trend Analysis Methods

Water quality trends can be evaluated in terms of flow, flow-weighted concentration, flow-adjusted concentration, and load. Each approach yields different information about the processes that effect changes in water quality. By combining the analytical methods, a better understanding of the processes operating in a watershed may be obtained. Briefly, a trend in flow reflects the changes in hydrology that occurred in the watershed, and a trend in load gives information about the flux of a constituent through the system.

Flow-weighted concentrations (FWCs) approximate the average concentrations during the period of investigation and reflect the water quality conditions that affect the biological processes of a stream. The flow-adjusted concentration (FAC), an approximation of instream concentration for which the effects of flow variability have been removed, is more useful for assessing the success of nutrient and sediment reductions strategies implemented in a watershed. Therefore, trends in FACs show whether nutrient and sediment reduction strategies are successful.

FWC were obtained by dividing the monthly load estimate obtained from ESTIMATOR by the average monthly flow. ESTIMATOR uses daily flow to estimate concentrations between sampling dates, and therefore, the FWC method should yield more representative estimates of monthly stream quality conditions than monthly samples (Langland et al., 2001).

Trends in streamflow, loads, and FWC were estimated by regressing dependent variables (e.g., flow, load, concentration) as a function of the explanatory variable (i.e., time). The analyses were performed on log-transformed variables. Trends were considered significant when the p-value was equal to or less than 0.05, with a 95% confidence interval. The sign of the slope indicates whether the dependent variable is positively (+) or negatively (-) related to time.

The concentration estimates produced by ESTIMATOR are inherently flow-adjusted because the program separates variability in concentration caused by variability in flow from that caused by variability in time. Trends in time for FACs can be deduced from the time regression coefficients, β_3 and β_4. The relationship between concentration and time is defined by both linear $[T-T_c]$ and quadratic $[T-T_c]^2$) terms. A significant linear parameter shows that a temporal trend exists, and the sign indicates the direction of the trend. A significant quadratic parameter indicates that the relationship between concentration and time is non-linear. When both the linear and quadratic time terms are significant, then either an acceleration (positive β_4) or deceleration (negative β_4) in trend occurred in later years (Darrell et al., 1998).

The ESTIMATOR model output can also be used to explore effects of flow or season on constituent concentrations. ESTIMATOR defines the relationship between concentration and flow in both linear ($\ln[Q/Q_c]$) and quadratic ($\ln[Q/Q_c]^2$) terms. As Darrel et al. (1998) state, when the β_1 coefficient is significant, streamflow alone may be a good predictor of concentration. A negative β_1 value indicates that the constituent concentration becomes diluted as flow increases, which suggests contributions by point sources. On the other hand, a positive β_1 indicates that concentrations increase with increasing flow, which points to nonpoint sources as the major contributors. When the value of β_1 is near zero, the constituent concentration is not affected by flow. This may occur, for example, when the baseflow and surface runoff concentrations of dissolved constituents are almost equal (Cohn and others, 1992). When β_2 is significant, the relationship between the constituent concentration and flow is non-linear. When both β_1 and β_2 are significant, either an acceleration (+) or deceleration (-) in the rate of change in concentration occurred (Darrel et al., 1998). For example, a significant, positive β_1 combined with a significant, negative β_2, suggests that the constituent concentration is positively correlated with streamflow but that the rate of change in concentration decreases at higher flows. When either or both of the seasonal regression coefficients (β_5 and β_6) are significant, concentrations are influenced by seasonal processes that are independent of variations in flow (Darrell et al., 1998).

The magnitude of FWC and FAC trends (i.e. percent change in concentration over time) was computed by using the following equation (Darrel et al., 1998; Langland et al., 2000):

$$\%\Delta C = [e^{(b*\Delta t)} - 1]*100 \qquad \text{(Equation 3)}$$

where

$\%\Delta C$ = percent change in concentration,
b = the slope of linear regression line, and
Δt = the time in years over which the trend was estimated.

For the computation of FAC time trends appearing in Table 17, $b = \beta_3$, the coefficient of the linear time term in the regression model. FAC trends were also computed using the equation given in Langland et al. (2004), which includes the non-linear time term of the regression model. Results from this computation did not differ qualitatively from those given in Table 17.

Trend Analyses Results

Trends in Mean-Monthly Flow and Constituent Loads

The linear regression of flow over time revealed no significant trends during the study period. Of the loads analyzed, only the dPO_4 showed a slight downward trend (Table 15).

Table 15. Trends in Mean-Monthly Streamflow and Estimated Loads (WYs 1994 – 2004)

Parameter	Slope	T	P	Trend Direction Over Time
Flow	-0.0001	-1.0846	0.2801	NS
dNH_4	-0.0001	-1.1008	0.2730	NS
dNO_{23}	-0.0001	-1.2003	0.2322	NS
TON	0.0000	-0.2220	0.8247	NS
TN	-0.0001	-1.0542	0.2938	NS
dPO_4	-0.0002	-4.3595	0.0000	**DN**
TP	-0.0001	-1.6613	0.0991	NS
SSC	0.0001	0.3545	0.7236	NS

Based on linear regression on log-transformed data
DN, down; NS, not significant

Trends in Flow-weighted Concentrations

The results of the regression analysis on FWCs are show in Table 16. Downward trends were observed for dPO_4 and TP and an upward trend for TON during the period of study. The percent changes in concentrations over time, as indicated by $\%\Delta C$, however, were small. Significant trends were not observed for the other constituents.

Table 16. Trends in Flow-weighted Concentrations (WYs 1994 – 2004)

Parameter	Slope	T	P	Trend Direction Over Time	$\%\Delta C$
dNH_4	0.0000	-1.0490	0.2961	NS	---
dNO_{23}	0.0000	-0.9437	0.3471	NS	---
TON	0.0001	2.0833	0.0392	**UP**	**0.0615**
TN	0.0000	-0.2014	0.8407	NS	---
dPO_4	-0.0002	-5.4630	0.0000	**DN**	**-0.1762**
TP	-0.0001	-2.2956	0.0233	**DN**	**-0.0702**
SSC	0.0001	1.5482	0.1240	NS	---

Based on linear regression on log-transformed data
DN, down; NS, not significant

Trends in Flow-adjusted Concentrations and other ESTIMATOR Results

Table 17 shows the trend statistics from ESTIMATOR, followed by descriptions of trends in FACs as related to flow, time, and season.

Table 17. Estimated Regression Coefficients from ESTIMATOR

Constituent	Regression Parameter	Constant	Flow		Time		Season		Time Trend and
		β_0	β_1	β_2	β_3	β_4	β_5	β_6	%ΔC
dNH_4	Value	-3.5184	***0.2000***	***0.0740***	-0.0017	0.0025	***0.1713***	-0.0012	NS
	T	*****	5.8200	3.3000	-0.1300	0.5500	2.8400	-0.0200	
	P	0.0000	0.0000	0.0008	0.8889	0.5775	0.0034	0.9819	
	S.D.	0.0742	0.0343	0.0224	0.0124	0.0045	0.0602	0.0598	
dNO_{23}	Value	1.2906	***-0.0475***	***-0.0525***	-0.0011	***0.0062***	***-0.0899***	***0.0355***	NS
	T	68.5800	-5.2700	-8.9400	-0.3300	5.2600	-5.7700	2.3100	
	P	0.0000	0.0000	0.0000	0.7368	0.0000	0.0000	0.0203	
	S.D.	0.0188	0.0090	0.0059	0.0032	0.0012	0.0156	0.0154	
TON	Value	-0.4022	***0.3909***	0.0221	***0.0294***	***-0.0103***	***-0.2308***	***-0.1972***	**UP**
	T	-6.9800	14.2300	1.2400	2.9200	-2.7900	-4.8000	-4.1900	**39.1**
	P	0.0000	0.0000	0.2124	0.0034	0.0052	0.0000	0.0000	
	S.D.	0.0576	0.0275	0.0179	0.0101	0.0037	0.0481	0.0470	
TN	Value	1.5134	***0.0435***	***-0.0354***	0.0017	***0.0040***	***-0.1146***	-0.0029	NS
	T	80.9200	4.8700	-6.0700	0.5200	3.3000	-7.3600	-0.1900	
	P	0.0000	0.0000	0.0000	0.6010	0.0009	0.0000	0.8484	
	S.D.	0.0187	0.0089	0.0058	0.0033	0.0012	0.0156	0.0153	
dPO_4	Value	-3.0005	***-0.0698***	***0.1134***	***-0.0667***	0.0015	***-0.3055***	***-0.2002***	**DN**
	T	*****	-3.0200	7.5400	-8.0300	0.4900	-7.6600	-5.0600	**-52.68**
	P	0.0000	0.0024	0.0000	0.0000	0.6218	0.0000	0.0000	
	S.D.	0.0484	0.0231	0.0150	0.0083	0.0030	0.0399	0.0395	
TP	Value	-1.9202	***0.3363***	***0.0991***	-0.0184	***-0.0093***	***-0.3417***	***-0.2566***	NS
	T	*****	10.4600	4.7300	-1.5600	-2.1400	-6.1000	-4.6600	
	P	0.0000	0.0000	0.0000	0.1174	0.0314	0.0000	0.0000	
	S.D.	0.0673	0.0321	0.0210	0.0118	0.0043	0.0560	0.0550	
SSC	Value	4.1245	***1.0984***	***-0.1196***	***0.0722***	***-0.0256***	***-0.4332***	***-0.3908***	**UP**
	T	33.8500	19.2400	-3.1400	3.1500	-3.0000	-4.2600	-3.7400	**124.71**
	P	0.0000	0.0000	0.0016	0.0016	0.0026	0.0000	0.0002	
	S.D.	0.1219	0.0571	0.0381	0.0229	0.0086	0.1018	0.1045	

Regression coefficients that are significant at the 95% confidence level are displayed in ***bold***
***** = highly significant, but result not returned by ESTIMATOR
Trend directions: UP, up; DN, down; NS, not significant

Relation of Concentration to Flow

As already mentioned, the relation of concentration to streamflow is an indication of the dominant source (i.e., point versus nonpoint source) for constituent input to a stream system. The significant, positive β_1 regression coefficients for dNH_4, TON, TN, TP, and SSC (Table 17) indicate that the concentration of these constituents increased with increasing streamflow, which suggests that they originated from nonpoint sources and likely were carried in surface runoff. The negative but low magnitude β_1 coefficients for dNO_{23} and dPO_4 indicate that the concentrations of these two nutrient decreased slightly with increasing flow, which indicates a dilution effect and suggests that point sources may be contributors. With the exception of TON, the relationship between the concentrations and streamflow were non-linear as indicated by the significant β_2 coefficients.

Relation of Concentration to Time

Based on an evaluation of the linear time coefficients, β_3, the concentration of dPO_4 decreased during the study period, whereas the concentrations of TON and SSC increased (Table 17). The magnitudes of these trends were quite high as indicated by %ΔC. The remaining constituents did not show a significant trend over time.

Relation of Concentration to Season

The seasonal regression coefficients obtained from ESTIMATOR were significant for all constituents. This suggests that seasonal processes within the watershed independent of stream flow influenced instream concentrations. The season in which the peak concentration occurs can be estimated from the regression term $[\beta_5*\sin(2*\pi T) + \beta_6*\cos(2*\pi T)$. As shown in Figure 11, the instream concentration of dNH_4 tends to be slightly elevated during the spring, and the concentrations of the other constituents tend to be highest during the summer.

Comparison of Current FAC to Previous Studies

The results for the FACs of the present study differ from those obtained by Langland et al., (2004). Langland et al. (2004) report that trends in FAC of nutrients (e.g., TN, TNH_4, TNO_{23}, and TP) were improving during the time period of 1985 – 2003, while the current study (WYs 1994 – 2004) found no significant trend for these nutrients. Perhaps the most significant difference was found for the trend in FAC for suspended sediment. The result of the present analysis indicates that SSC increased significantly during the study period of 1994 – 2004, whereas Langland et al. (2004) found that TSS remained relatively unchanged over the time period of 1985 – 2003. It should be noted, however, that prior to 1994 only routine monthly water quality samples were collected at the Fairview station, which may have biased the trend analyses somewhat. Moreover, Langland et al. (2004) combined total suspended solids and total suspended sediment data for their trend analysis. Because field and analytical methods differ for the determination of the two parameters, as explained in the section on Water Quality Data, caution should be exercised when comparing the results of the trend analyses for suspended sediment between the two studies.

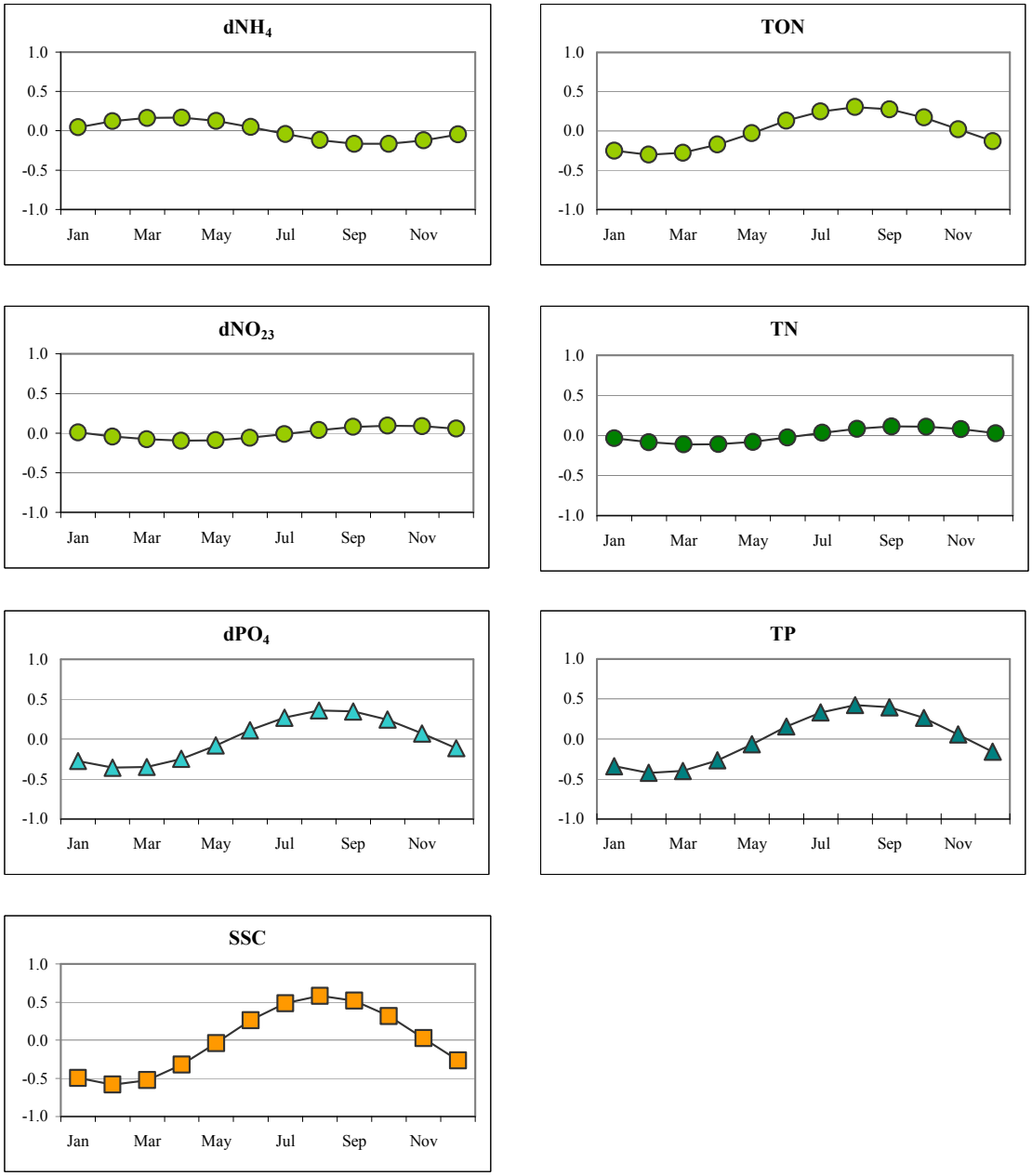


Figure 11. Seasonal Instream Concentration Patterns

SUMMARY AND CONCLUSIONS

This study was designed to estimate seasonal and annual concentrations and loads as well as trends for dissolved ammonia (dNH_4), dissolved nitrite-plus-nitrate (dNO_{23}), total organic nitrogen (TON), total nitrogen (TN) dissolved orthophosphate (dPO_4), total phosphate (TP), and suspended sediment (SSC). Water quality samples were taken under both nonstorm and storm flow conditions over the eleven-year period of study, water years 1994 through 2004.

The multivariate USGS ESTIMATOR model was used to approximate annual and seasonal loads for the constituents of interest. Trends in flow and loads were examined using regression analyses on log-transformed values. Although discharge fluctuated greatly due to extreme weather conditions that occurred during the study period, a trend in flow was not observed. Likewise, no trends were apparent in suspended sediment and nutrients loads, with the exception of the dPO_4 load, which declined somewhat. An analysis of eleven years of the discharge monitoring data from the three significant wastewater treatment facilities within monitored area revealed that these point sources might contribute significantly to the instream loads of TP under low flow conditions. Overall, however, the facilities' TN and TP loads.

Trends in the flow-adjusted concentrations (FACs) of the constituents also were analyzed. The FAC is an approximation of the instream concentration for which the effect of flow has been removed, and therefore, is useful for assessing the success of nutrient and sediment reductions strategies implemented in a watershed. FAC trends were determined from the time regression coefficients of the ESTIMATOR model results, which showed a significant decrease for dPO_4 and a significant increase for both TON and SSC. The FACs of the other nutrients remained unchanged.

ESTIMATOR model output can also shed light on how flow and season affect constituent concentrations. It was found that suspended sediment and nutrient concentrations varied seasonally, with the highest concentrations generally occurring during the summer months. The concentrations of dNH_4, TON, TN, TP, and SSC were found to be positively correlated with streamflow, which indicates that nonpoint sources were likely major contributors to the instream concentrations. On the other hand, dNO_{23} and dPO_4 were inversely related to flow, which might indicate that point sources were major inputs.

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APPENDIX A

Impaired Streams In The Pennsylvania Portion of the Conococheague Creek Watershed

Table A1: Impaired Streams Requiring TMDLs in the Conococheague Creek Drainage Area Above Fairview, MD

Category 5: Impaired Streams Requiring TMDLs

AssessmentID	Source/Cause	List Date	Tmdl Date	Down RMI	Up RMI	Total Miles	Use Assessed
State Water Plan: 13C							
	Stream Name=Back Creek Watershed=13C Code:59902						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	13.52	16.9	3.4	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Back Creek (Unt 59925) Watershed=13C Code:59925						
970925-1500-JDC	Agriculture/Siltation	1998	2011	0.11	1.68	1.6	Aquatic Life
	Agriculture/Organic Enrichment/Low D.O.	1998	2011				
	Source Unknown/Cause Unknown	1998	2011				
	Stream Name=Back Creek (Unt 59927) Watershed=13C Code:59927						
970925-1500-JDC	Agriculture/Organic Enrichment/Low D.O.	1998	2011	0	1.17	1.2	Aquatic Life
	Agriculture/Siltation	1998	2011				
	Source Unknown/Cause Unknown	1998	2011				
	Stream Name=Back Creek (Unt 59928) Watershed=13C Code:59928						
970925-1500-JDC	Agriculture/Organic Enrichment/Low D.O.	1998	2011	0	0.31	0.3	Aquatic Life
	Agriculture/Siltation	1998	2011				
	Source Unknown/Cause Unknown	1998	2011				
	Stream Name=Back Creek (Unt 59929) Watershed=13C Code:59929						
970925-1500-JDC	Agriculture/Siltation	1998	2011	0	0.37	0.4	Aquatic Life
	Agriculture/Organic Enrichment/Low D.O.	1998	2011				
	Source Unknown/Cause Unknown	1998	2011				
	Stream Name=Back Creek (Unt 60093) Watershed=13C Code:60093						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.52	0.5	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Back Creek (Unt 60094) Watershed=13C Code:60094						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.47	0.5	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Blue Spring Creek Watershed=13C Code:59458						
990723-1000-JDC	Grazing Related Agric/Siltation	2002	2015	0	1.12	1.1	Aquatic Life
	Grazing Related Agric/Nutrients	2002	2015				
	Stream Name=Conococheague Creek (Unt 59872) Watershed=13C Code:59872						
980521-1000-BJG	Grazing Related Agric/Siltation	2002	2017	0	2.02	2	Aquatic Life
	Grazing Related Agric/Nutrients	2002	2017				
	Land Development/Siltation	2002	2017				
	Stream Name=Conococheague Creek (Unt 59873) Watershed=13C Code:59873						
980521-1000-BJG	Grazing Related Agric/Nutrients	2002	2017	0	0.62	0.6	Aquatic Life
	Grazing Related Agric/Siltation	2002	2017				
	Land Development/Siltation	2002	2017				
	Stream Name=Conococheague Creek (Unt 59874) Watershed=13C Code:59874						
980521-1000-BJG	Grazing Related Agric/Nutrients	2002	2017	0	0.37	0.4	Aquatic Life
	Grazing Related Agric/Siltation	2002	2017				
	Land Development/Siltation	2002	2017				

Category 5: Impaired Streams Requiring TMDLs

AssessmentID	Source/Cause	List Date	Tmdl Date	Down RMI	Up RMI	Total Miles	Use Assessed
	Stream Name=Conococheague Creek (Unt 59875) Watershed=13C Code:59875						
980521-1000-BJG	Grazing Related Agric/Siltation	2002	2017	0	0.36	0.4	Aquatic Life
	Grazing Related Agric/Nutrients	2002	2017				
	Land Development/Siltation	2002	2017				
	Stream Name=Conococheague Creek (Unt 60142) Watershed=13C Code:60142						
971015-0945-JDC	Urban Runoff/Storm Sewers/Siltation	1998	2011	0	2.38	2.4	Aquatic Life
	Urban Runoff/Storm Sewers/Organic Enrichment/Low D.O.	1998	2011				
	Stream Name=Conococheague Creek (Unt 60143) Watershed=13C Code:60143						
971015-0945-JDC	Urban Runoff/Storm Sewers/Siltation	1998	2011	0	0.61	0.6	Aquatic Life
	Urban Runoff/Storm Sewers/Organic Enrichment/Low D.O.	1998	2011				
	Stream Name=Conococheague Creek (Unt 60194) Watershed=13C Code:60194						
980506-1130-BJG	Land Development/Oil and Grease	2002	2017	0	1.53	1.5	Aquatic Life
	Stream Name=Conococheague Creek (Unt 60195) Watershed=13C Code:60195						
980506-1130-BJG	Land Development/Oil and Grease	2002	2017	0	0.85	0.8	Aquatic Life
	Stream Name=Conococheague Creek (Unt 60196) Watershed=13C Code:60196						
980506-1130-BJG	Land Development/Oil and Grease	2002	2017	0	0.68	0.7	Aquatic Life
	Stream Name=Conococheague Creek (Unt 60221) Watershed=13C Code:60221						
980923-1500-JDC	Crop Related Agric/Nutrients	2002	2015	0	6.25	6.2	Aquatic Life
	Crop Related Agric/Siltation	2002	2015				
	Stream Name=Conococheague Creek (Unt 60222) Watershed=13C Code:60222						
980923-1500-JDC	Crop Related Agric/Nutrients	2002	2015	0	3.34	3.3	Aquatic Life
	Crop Related Agric/Siltation	2002	2015				
	Stream Name=Conococheague Creek (Unt 60224) Watershed=13C Code:60224						
980923-1500-JDC	Crop Related Agric/Siltation	2002	2015	0	0.68	0.7	Aquatic Life
	Crop Related Agric/Nutrients	2002	2015				
	Stream Name=Conococheague Creek (Unt 60226) Watershed=13C Code:60226						
980923-1500-JDC	Crop Related Agric/Nutrients	2002	2015	0	2.43	2.4	Aquatic Life
	Crop Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run Watershed=13C Code:59687						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0.83	5.54	4.7	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59713) Watershed=13C Code:59713						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	1.31	1.3	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59714) Watershed=13C Code:59714						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.51	0.5	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59715) Watershed=13C Code:59715						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.31	0.3	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				

Category 5: Impaired Streams Requiring TMDLs

AssessmentID	Source/Cause	List Date	Tmdl Date	Down RMI	Up RMI	Total Miles	Use Assessed
	Stream Name=Dry Run (Unt 59716) Watershed=13C Code:59716						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.57	0.6	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59717) Watershed=13C Code:59717						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	1.67	1.7	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59718) Watershed=13C Code:59718						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.02	0	Aquatic Life
20001107-1030-RJS	Grazing Related Agric/Siltation	2002	2015	0	0.02	0	Aquatic Life
	Stream Name=Dry Run (Unt 59719) Watershed=13C Code:59719						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.96	1	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59720) Watershed=13C Code:59720						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.07	0.1	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59721) Watershed=13C Code:59721						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	1.13	1.1	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59722) Watershed=13C Code:59722						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.9	0.9	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59723) Watershed=13C Code:59723						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.78	0.8	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Dry Run (Unt 59724) Watershed=13C Code:59724						
20001107-1030-RJS	Crop Related Agric/Siltation	2002	2015	0	0.27	0.3	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Stream Name=Johnston Run Watershed=13C Code:59515						
990730-1300-JDC	Grazing Related Agric/Nutrients	2002	2015	0	2.2	2.2	Aquatic Life
	Grazing Related Agric/Siltation	2002	2015				
	Urban Runoff/Storm Sewers/Nutrients	2002	2015				
990805-1000-JDC	Urban Runoff/Storm Sewers/Siltation	2002	2015	2.2	2.81	0.6	
	Urban Runoff/Storm Sewers/Nutrients	2002	2015				
990805-1230-JDC	Grazing Related Agric/Nutrients	2002	2017	2.81	4.49	1.7	
	Grazing Related Agric/Siltation	2002	2017				
	Stream Name=Licking Creek Watershed=13C Code:59425						
990723-1130-JDC	Grazing Related Agric/Siltation	2002	2015	3.33	7.44	4.1	Aquatic Life
990723-1130-JDC	Grazing Related Agric/Nutrients	2002	2015	3.33	7.44	4.1	Aquatic Life
990723-1000-JDC	Grazing Related Agric/Siltation	2002	2015	7.44	8.63	1.2	
	Grazing Related Agric/Nutrients	2002	2015				
20030807-1230-JDC	Grazing Related Agric/Siltation	2004	2017	8.63	11.1	2.5	
	Stream Name=Licking Creek (Unt 59431) Watershed=13C Code:59431						
20030807-0930-JDC	Grazing Related Agric/Siltation	2004	2017	0	3.8	3.8	Aquatic Life

Category 5: Impaired Streams Requiring TMDLs

AssessmentID	Source/Cause	List Date	Tmdl Date	Down RMI	Up RMI	Total Miles	Use Assessed
	Stream Name=Muddy Run (Unt 59848) Watershed=13C Code:59848						
971010-1415-JDC	Agriculture/Organic Enrichment/Low D.O.	1998	2011	0	2.67	2.7	Aquatic Life
	Agriculture/Siltation	1998	2011				
	Agriculture/Taste and Odor	1998	2011				
	Agriculture/Noxious Aquatic Plants	1998	2011				
	Stream Name=Muddy Run (Unt 59849) Watershed=13C Code:59849						
971010 1415 JDC	Agriculture/Organic Enrichment/Low D.O.	1998	2011	0	0.62	0.6	Aquatic Life
	Agriculture/Taste and Odor	1998	2011				
	Agriculture/Noxious Aquatic Plants	1998	2011				
	Agriculture/Siltation	1998	2011				
	Stream Name=Muddy Run (Unt 59856) Watershed=13C Code:59856						
971010-0930-JDC	Agriculture/Siltation	1998	2011	0	2.85	2.8	Aquatic Life
	Stream Name=Rocky Spring Branch Watershed=13C Code:60038						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	2.33	2.3	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Rocky Spring Branch (Unt 60039) Watershed=13C Code:60039						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.75	0.8	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Rocky Spring Branch (Unt 60040) Watershed=13C Code:60040						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	1.64	1.6	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Rocky Spring Branch (Unt 60041) Watershed=13C Code:60041						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.97	1	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Rocky Spring Branch (Unt 60042) Watershed=13C Code:60042						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.62	0.6	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Rocky Spring Branch (Unt 60043) Watershed=13C Code:60043						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.52	0.5	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Rocky Spring Branch (Unt 60044) Watershed=13C Code:60044						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.89	0.9	Aquatic Life
	Other/Turbidity	2002	2015				
	Stream Name=Rocky Spring Branch (Unt 60045) Watershed=13C Code:60045						
980428-1100-BJG	Other/Siltation	2002	2015	0	4.91	4.9	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60046) Watershed=13C Code:60046						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.57	0.6	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60047) Watershed=13C Code:60047						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.57	0.6	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60048) Watershed=13C Code:60048						
980428-1100-BJG	Other/Siltation	2002	2015	0	1.1	1.1	Aquatic Life

Category 5: Impaired Streams Requiring TMDLs

AssessmentID	Source/Cause	List Date	Tmdl Date	Down RMI	Up RMI	Total Miles	Use Assessed
	Stream Name=Rocky Spring Branch (Unt 60049) Watershed=13C Code:60049						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.65	0.6	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60050) Watershed=13C Code:60050						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.49	0.5	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60051) Watershed=13C Code:60051						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.26	0.3	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60052) Watershed=13C Code:60052						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.47	0.5	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60053) Watershed=13C Code:60053						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.61	0.6	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60054) Watershed=13C Code:60054						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.37	0.4	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60055) Watershed=13C Code:60055						
980428-1100-BJG	Other/Siltation	2002	2015	0	1.16	1.2	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60056) Watershed=13C Code:60056						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.7	0.7	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60057) Watershed=13C Code:60057						
980428-1100-BJG	Other/Siltation	2002	2015	0	1.57	1.6	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60058) Watershed=13C Code:60058						
980428-1100-BJG	Other/Siltation	2002	2015	0	2.42	2.4	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60059) Watershed=13C Code:60059						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.93	0.9	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60060) Watershed=13C Code:60060						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.79	0.8	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60061) Watershed=13C Code:60061						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.6	0.6	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60062) Watershed=13C Code:60062						
980428-1100-BJG	Other/Siltation	2002	2015	0	2.05	2	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60063) Watershed=13C Code:60063						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.56	0.6	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60064) Watershed=13C Code:60064						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.35	0.4	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60065) Watershed=13C Code:60065						
980428-1100-BJG	Other/Siltation	2002	2015	0	0.36	0.4	Aquatic Life
	Stream Name=Rocky Spring Branch (Unt 60066) Watershed=13C Code:60066						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.54	0.5	Aquatic Life
	Other/Turbidity	2002	2015				

Category 5: Impaired Streams Requiring TMDLs

AssessmentID	Source/Cause	List Date	Tmdl Date	Down RMI	Up RMI	Total Miles	Use Assessed
	Stream Name=Rocky Spring Branch (Unt 60067) Watershed=13C Code:60067						
980519-1130-BJG	Grazing Related Agric/Siltation	2002	2015	0	0.87	0.9	Aquatic Life
	Other/Turbidity	2002	2015				

Source: PA DEP, 2000

APPENDIX B

Comparison Between Manual and Automatic Sampling Procedures

To evaluate the accuracy of the automatic sampling, manual grab samples were collected concurrently with the automatic samples. Manual nonstorm samples were taken at five verticals across the section, composited using the equal discharge sampling procedure, and depth-integrated using standard USGS equipment and techniques.

The manual and automatic samples were taken within 15 to 30 minutes of each other and had similar instantaneous flow rates. Two-sample student's t-tests, which assumed means of the automated and manual datasets were equal, were performed on the concentrations of the nutrient and suspended sediment samples and showed no significant differences between the two sampling techniques for WYs 1998 – 2004 at a confidence level of 0.05 (Table B1). The percent error between the two sampling methods (Table B2) was calculated as follows:

$$\text{Percent Error} = [(C_A - C_M) / C_M] * 100$$

where

C_A = concentration of the automatic sample and

C_M = concentration of the manual sample.

Figure A1 presents graphs of automatic versus manual sample concentrations (in mg/L) against a 45-degree line, and Figure A2 shows concentrations versus instantaneous flow.

Table B1. Comparison of Manual Versus Automated Sampling (WYs 1998 - 2004)

Statistic	Inst. Flow		SSC		dNH_4		dNO_23		TN		dPO_4		TP	
	A	M	A	M	A	M	A	M	A	M	A	M	A	M
Mean	855	885	31	36	0.04	0.04	3.68	3.64	4.08	4.04	0.06	0.06	0.12	0.13
Variance	2.3E+06	2.5E+06	4,787	4,841	0.00	0.00	0.67	0.65	0.61	0.62	0.00	0.00	0.01	0.01
Observations	41	41	49	50	48	48	50	50	44	45	37	37	49	50
Pooled Variance	2.4E+06		4,814		0.00		0.66		0.62		0.00		0.01	
Hypothesized Mean Difference	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
df	80		97		94		98		87		72		97	
t Stat	-0.09		-0.34		-0.43		0.27		0.28		0.08		-0.06	
P(T<=t) one-tail	0.47		0.37		0.33		0.39		0.39		0.47		0.48	
t Critical one-tail	1.66		1.66		1.66		1.66		1.66		1.67		1.66	
P(T<=t) two-tail	0.93		0.74		0.67		0.78		0.78		0.94		0.95	
t Critical two-tail	1.99		1.98		1.99		1.98		1.99		1.99		1.98	

t-Test: Two-sample assuming equal variances with alpha = 0.05; A = automatic, M = manual, d = dissolved, T = Total

Table B2. Percent Error Between Automatic and Manual Samples

Date	dNH_4			dNO_{23}			TN			$o\text{-}PO_4$			TP			SSC		
	A	M	% Error	A	M	% Error	A	M	% Error	A	M	% Error	A	M	% Error	A	M	% Error
10/16/97	0.02	0.02	0.00	4.14	4.09	1.22	4.47	4.44	0.68	0.17	0.17	1.18	0.21	0.20	1.98	3	3	0.00
11/18/97	0.02	0.02	0.00	4.98	4.89	1.84	5.17	5.06	2.17	0.02	0.03	-26.67	0.05	0.05	2.13	9	9	0.00
12/18/97	0.02	0.02	0.00	4.05	3.93	3.05	4.20	4.08	2.94	0.05	0.05	8.00	0.05	0.05	-2.04	7	5	40.00
01/06/98	0.02	0.02	0.00	3.56	3.53	0.85	3.80	3.74	1.60	0.03	0.03	24.00	0.06	0.04	62.86	10	8	25.00
01/10/98	0.02	0.02	0.00	2.97	3.01	-1.33	3.55	3.58	-0.84	0.04	0.04	8.11	0.11	0.11	0.00	53	58	-8.62
02/07/98	0.02	0.03	-11.11	3.36	3.36	0.00	3.65	3.63	0.55	0.04	0.03	6.06	0.06	0.04	31.82	28	31	-9.68
02/24/98	0.06	0.06	-3.39	1.79	1.79	0.00	2.99	2.89	3.46	0.09	0.09	-4.30	0.34	0.31	11.73	161	139	15.83
03/11/98	0.02	0.02	15.00	2.86	2.59	10.42	3.09	2.74	12.77	0.03	0.02	47.37	0.05	0.03	75.00	16	18	-11.11
03/23/98	0.05	0.05	-2.04	2.83	2.88	-1.74	3.07	3.14	-2.23	0.02	0.02	-5.00	0.05	0.05	-1.92	25	29	-13.79
04/08/98	0.03	0.03	8.00	3.59	3.49	2.87	3.80	3.67	3.54	0.02	0.02	11.76	0.03	0.03	20.00	5	5	0.00
05/11/98	0.07	0.08	-5.13	2.48	2.38	4.20	2.77	2.69	2.97	0.02	0.02	20.00	0.06	0.06	-7.81	35	40	-12.50
06/17/98	0.05	0.06	-13.56	4.11	4.00	2.75	4.46	4.39	1.59	0.08	0.06	32.79	0.11	0.09	19.10	14	16	-12.50
07/14/98	0.06	0.05	9.62	4.84	4.75	1.89	5.12	4.98	2.81	0.07	0.07	4.48	0.08	0.08	5.13	9	12	-25.00
08/10/98	0.05	0.11	-56.60	4.77	4.59	3.92	5.19	5.37	-3.35	0.12	0.17	-27.22	0.16	0.25	-35.60	10	18	-44.44
09/09/98	0.03	0.03	-10.00	5.50	5.43	1.29	5.80	5.74	1.05	0.15	0.14	13.33	0.17	0.16	6.21	6	7	-14.29
10/13/98	0.02	0.03	-14.81	4.49	4.46	0.67	4.84	4.92	-1.63				0.16	0.16	2.55	5	6	-16.67

Date	dNH_4			dNO_{23}			TN			$o\text{-}PO_4$			TP			SSC		
	A	M	% Error	A	M	% Error	A	M	% Error	A	M	% Error	A	M	% Error	A	M	% Error
11/09/98	0.02	0.02	0.00	4.58	4.53	1.10	4.82	4.81	0.21				0.08	0.08	5.06	5	4	25.00
12/08/98	0.05	0.05	-4.08	3.92	3.84	2.08	4.21	4.10	2.68				0.17	0.16	8.18	3	9	-66.67
02/10/99	0.09	0.08	16.88	4.30	4.13	4.12	4.76	4.41	7.94				0.06	0.06	8.47	6	8	-25.00
03/17/99	0.02	0.02	0.00	3.48	3.39	2.65	4.13	4.15	-0.48				0.10	0.12	-15.70	30	43	-30.23
04/15/99	0.03	0.02	30.00	2.90	2.88	0.69	3.26	3.26	0.00				0.06	0.06	-3.28	22	25	-12.00
05/13/99	0.04	0.05	-14.89	2.69	2.60	3.46	3.08	3.08	0.00				0.08	0.09	-3.53	11	17	-35.29
06/09/99	0.02	0.02	-16.67	2.86	2.77	3.25	3.15	3.15	0.00				0.12	0.12	0.82	4	6	-33.33
07/08/99	0.02	0.03	-20.00	2.98	2.86	4.20	3.42	3.37	1.48				0.04	0.23	-81.50	5	10	-50.00
08/10/99	0.03	0.03	0.00	3.04	3.04	0.00	3.46	3.46	0.00				0.22	0.22	0.00	2	3	-33.33
08/31/99	0.03	0.02	25.00	2.89	2.82	2.48	3.33	3.26	2.15				0.20	0.18	12.09	10	7	42.86
09/15/99	0.02	0.03	-25.00	3.48	3.42	1.75	3.86	3.80	1.58				0.20	0.16	25.32	8	13	-38.46
09/29/99	0.08	0.08	5.19	3.61	3.40	6.18	4.81	4.50	6.89				0.26	0.29	-10.54	96	103	-6.80
10/14/99	0.02	0.02	0.00	4.39	4.32	1.62	4.83	4.68	3.21	0.07	0.06	17.54	0.09	0.09	6.90	17	24	-29.17
01/27/00	0.06	0.06	5.45	3.66	3.61	1.39	3.94	3.88	1.55	0.08	0.08	3.95	0.09	0.09	-6.52	1	12	-91.67
05/15/00	0.02	0.02	0.00	3.10	3.11	-0.32	3.41	3.49	-2.29	0.03	0.03	3.45	0.06	0.07	-14.86	8	6	33.33
09/05/00	0.02	0.02	0.00	3.98	3.92	1.53	4.45	4.38	1.60	0.13	0.12	11.76	0.15	0.14	7.09	11	11	0.00
10/05/00	0.02	0.02	0.00	3.70	3.61	2.49	4.10	3.90	5.13	0.10	0.09	15.12	0.13	0.13	5.51	2	5	-60.00
02/27/01	0.04	0.04	0.00	3.17	3.11	1.93	3.50	3.40	2.94	0.01	0.02	-22.22	0.04	0.04	-4.65	3	6	-50.00
05/16/01	0.04	0.04	0.00	3.81	3.65	4.38	4.20	4.00	5.00	0.02	0.02	12.50	0.04	0.04	5.00	8	10	-20.00
08/23/01	0.03	0.02	12.50	4.33	4.29	0.93	4.80	4.80	0.00	0.10	0.09	21.18	0.16	0.15	3.33	122	144	-15.28
10/10/01	0.04	0.04	0.00	3.98	4.06	-1.97	4.33	4.52	-4.20	0.04	0.04	0.00	0.06	0.07	-5.97	2	2	-5.88
01/22/02	0.02	0.04	-50.00	3.38	3.43	-1.46	3.66	3.73	-1.88	0.03	0.03	0.00	0.04	0.04	0.00	3	7	-63.51
04/11/02	0.04	0.04	0.00	2.47	2.53	-2.37	2.85	2.88	-1.04	0.04	0.04	0.00	0.07	0.06	3.13	5	5	-7.41
07/16/02	0.04	0.04	0.00	2.90	2.97	-2.36	3.39	3.39	0.00	0.20	0.21	-4.76	0.22	0.22	0.00	9	4	161.11
08/24/02	0.04	0.04	0.00	2.48	2.64	-6.06	5.28	5.44	-2.94	0.06	0.10	-40.00	0.64	0.60	6.67	399	400	-0.25
10/07/02	0.04	0.04	0.00	4.08	4.25	-4.00				0.07	0.07	0.00	0.10	0.10	7.29	2	4	-50.00
02/06/03	0.04	0.04	0.00	5.22	5.14	1.56				0.01	0.01	0.00	0.04	0.03	6.06	3	5	-40.00
03/21/03				2.91	2.92	-0.34				0.06	0.06	0.00	0.38	0.34	11.76	238	238	0.00
05/05/03				4.13	4.10	0.73				0.02	0.02	0.00	0.06	0.06	-9.52	10	14	-28.57
08/18/03	0.04	0.03	33.33	4.03	3.88	3.87				0.09	0.09	0.00	0.17	0.27	-38.52	31	127	-75.59
12/04/03	0.040	0.040	0.00	4.22	4.29	-1.63	4.40	4.50	-2.22	0.02	0.03	-33.33	0.04	0.04	-9.76	5	5	0.00
05/17/04	0.030	0.030	0.00	3.45	3.46	-0.29		3.90		0.02	0.01	100.00		0.06			24	
08/11/04	0.040	0.040	0.00	5.00	4.97	0.60	5.30	5.30	0.00	0.05	0.05	0.00	0.09	0.09	-2.22	12	19	-36.84
09/08/04	0.040	0.040	0.00	4.66	4.77	-2.31	4.90	5.00	-2.00	0.04	0.04	0.00	0.06	0.06	3.33	31	62	-50.00

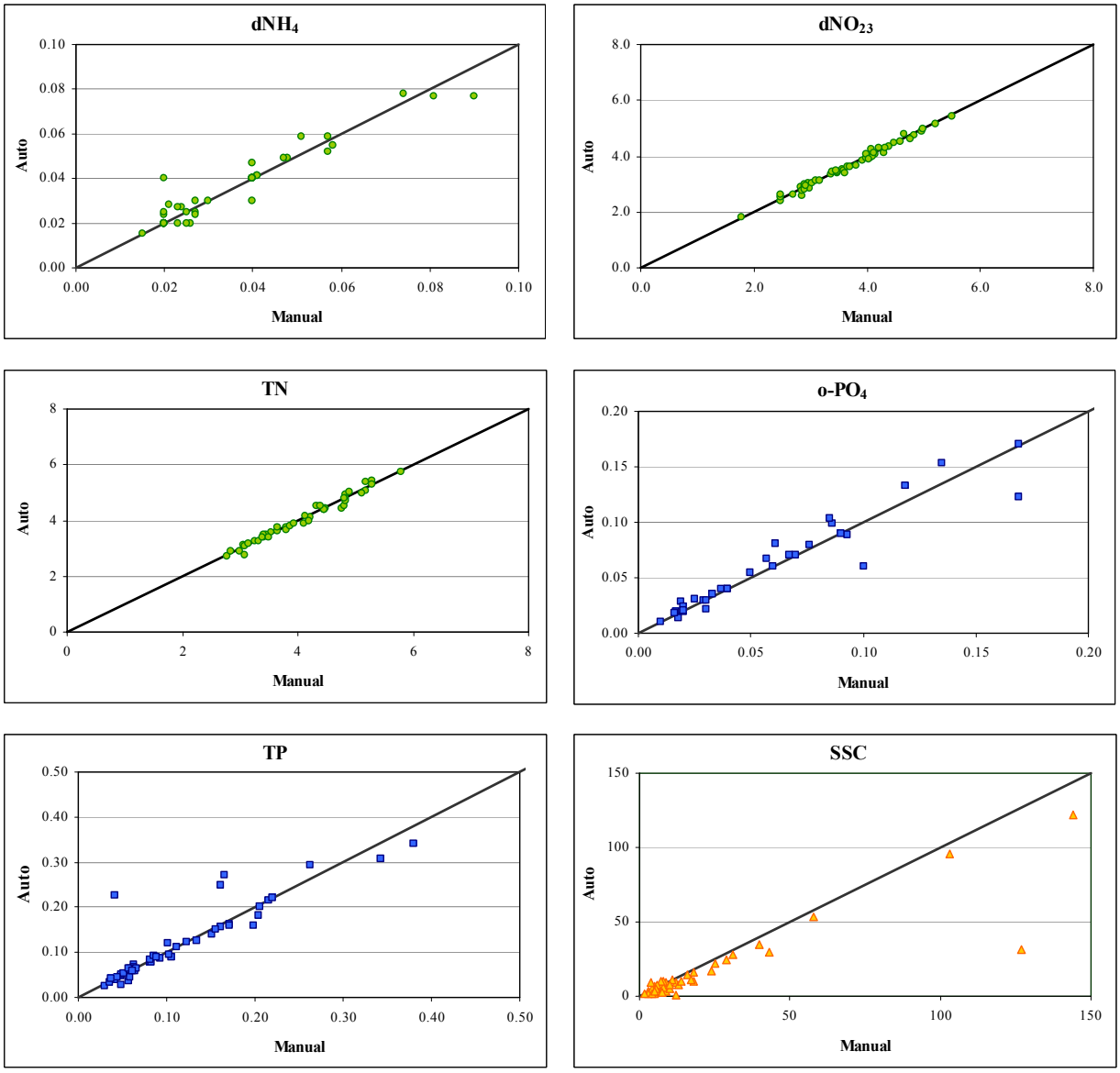

Figure B1. Automatic Versus Manual Sample Concentrations (in mg/L)

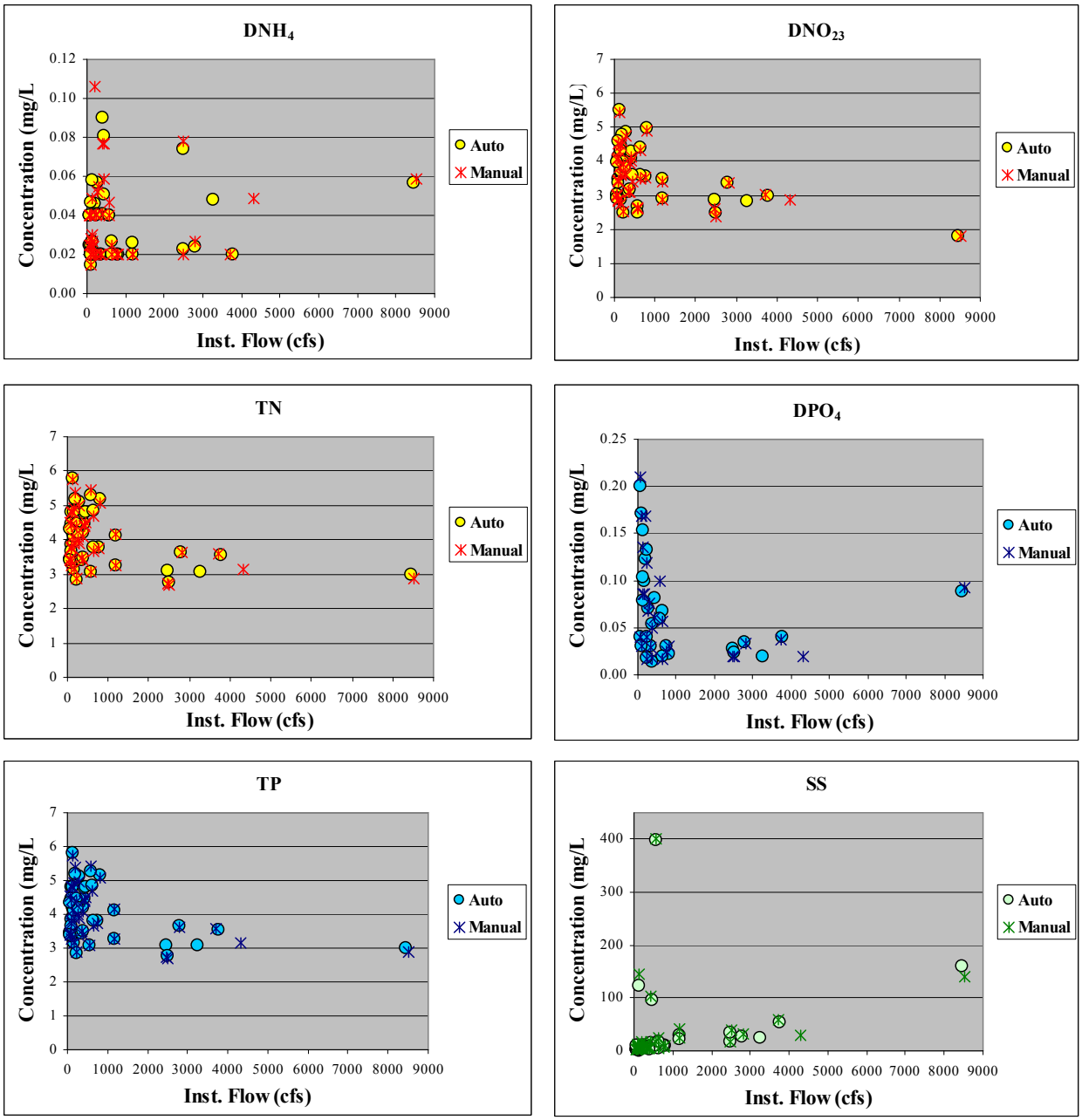

Figure B2. Automatic and Manual Sample Concentrations versus Instantaneous Flow

APPENDIX C

Water Quality Parameter Tables

Table C1. Complete USGS Data for WYs 1994 –2004 for Selected Nutrients, Suspended Sediment, and Ancillary Parameters.

		Gage Height	Inst Q.	DO, water	DO, water	pH, water	Cond.	Temp, water	NH3-N + Org N (D)	NH3-N + Org N (T)	NH3-N (D)	NO23-N (D)	NO2-N (D)	o- PO4 (D)	P (D)	TP	TOC	Sus Sed
		ft	cfs	mg/L	% Sat.	whole	msiem	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date	Time	P00065	P00061	P00300	P00301	P00400	P00095	P00010	P00623	P00625	P00608	P00631	P00613	P00671	P00666	P00665	P00680	P80154
10/05/1993	1145	1.87	214	9.5		7.9	449	13.5	0.2	0.3	0.02	5.3	< .010	0.15	0.13	0.14		7
11/02/1993	1000	2.75	567	10.6		7.7	335	6.5	0.3	0.6	0.03	4	0.02	0.09	0.11	0.16		21
11/30/1993	1215	5.35	2260	11.2		7.6	251	7	< .20	0.4	0.06	3.7	0.01	0.04	< .01	0.1		44
12/08/1993	1115	4.78	1830	11.2		7.6	289	7.5	< .20	0.3	0.03	4.1	< .010	0.04	0.03	0.07		27
02/02/1994	1115	3.19	804	13.8		7.6	338	1	< .20	0.3	0.05	4.5	0.05	0.04	0.02	0.04		
03/08/1994	1300	5.68	2540	11.3		7.5	277	5.5	0.4	0.9	0.15	4.2	0.03	0.06	0.07	0.18		
04/14/1994	0915	6.86	3630	9.9		7.3	262	11	0.3	1.1	0.11	2.5	0.03	0.05	0.06	0.26		155
05/05/1994	1100	3.83	1200	10.4		7.6	316	13	0.3	0.4	0.04	3.5	0.02	0.05	0.07	0.09		20
06/07/1994	1630	2.24	342	10.1		8.3	437	24.5	0.3	0.6	0.05	5.4	0.05	0.1	0.12	0.14		
06/21/1994	1045	1.94		7.1		7.7	452	27.5										
07/07/1994	1100	2.08	284	9.3		8.1	453	25.5	0.3	0.5	0.04	4.9	0.02	0.13	0.13	0.18		
08/01/1994	1545	2.42	415	7.9		7.4	363	24	0.4	0.9	0.1	4.2	0.04	0.15	0.14	0.29		102
09/22/1994	1145	1.76	201	8.5		8	470	16.5	0.2	0.3	0.02	5.1	0.02	0.1	0.11	0.13		3
11/14/1994	1515	1.68	182	15.8		8.6	409	10	< .20	0.3	< .01	3.3	< .010	0.1	0.11	0.11		1
12/20/1994	1215	2.75	539	11.8		8	355	6	< .20	0.3	0.1	4.1	0.04	0.05	0.04	0.05		
01/11/1995	1130	2.53	463	12.9		8	355	2	0.2	0.3	0.07	3.9	0.04	0.04	0.05	0.08		8
01/20/1995	1445	6.9	3670			7.5	224	6.5	0.3	1.9	0.12	2.4	0.02	0.11	0.09	0.43		
01/20/1995	1500	6.95	3720			7.5	224	6.5	0.5	1.5	0.13	2.3	0.02	0.11	0.1	0.43		
02/22/1995	1300	2.48	440	14.9		8.4	352	4	< .20	0.2	0.03	3.8	0.03	0.04	0.04	0.07		4
02/22/1995	1330	2.48	440	14.9		8.4	352	4	< .20	0.3	0.02	3.7	0.03	0.04	0.04	0.08		14
03/16/1995	1300	2.87	629	17.3		8.9	305	12										4
04/10/1995	1145	2.33	377	8.4		7.8	371	12	0.4	0.4	0.04	3.1	0.06	0.09	0.08	0.11		7
04/10/1995	1200	2.34	381	8.4		7.8	371	12	0.3	0.4	0.05	3	0.06	0.08	0.08	0.1		10
05/08/1995	1400	1.97	258	8.8		7.6	345	18	0.2	0.4	0.05	2.9	0.04	0.16	0.16	0.19		14
05/08/1995	1500	1.97	248	8.8		7.6	345	18	0.3	0.4	0.06	2.8	0.04	0.15	0.15	0.19		29
06/05/1995	1100	2.12	298	8.2		7.6	318	20.5	0.2	0.3	0.05	2.9	0.04	0.14	0.13	0.15	3.9	15
06/05/1995	1115	2.11	294	8.2		7.6	318	20.5	0.2	0.4	0.04	2.8	0.04	0.13	0.13	0.14		23
06/20/1995	1145	1.71	175	9.1		8.1	397	24.1										
06/27/1995	1130	6.31	3100	6.5		7.2	250	20.5	0.9	3.8	0.14	3.2	0.05	0.11	0.13	0.94		698

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
07/13/1995	1230	2.86	624	8		7.5	388	21.5	0.3	0.4	0.03	4.3	0.02	0.07	0.06	0.09	4	35
08/14/1995	1345	1.72	178	10.4		8.3	461	27.5	< .20	0.4	< .01	4.1	0.02	0.13	0.12	0.16	2.8	3
09/13/1995	1330	1.35	91	10.5		8.4	503	20.5	0.2	0.3	< .01	4.9	0.01	0.27	0.3	0.31	3.5	3
09/19/1995	1100	1.5	120	9.5		8.1	506	17.5	0.3	0.4	< .01	5.1	0.03	0.31	0.33	0.34		
09/19/1995	1200	1.5	120	10.1		8.2	506	18	0.2	0.3	< .01	5.1	0.03	0.31	0.32	0.33		
09/19/1995	1300	1.49	118	10.3		8.3	505	19	0.3	0.4	< .01	5.1	0.03	0.32	0.33	0.34		
09/19/1995	1400	1.48	116	10.7		8.3	502	20	0.3	0.4	< .01	5.1	0.02	0.32	0.34	0.32		
09/19/1995	1415	1.48	116	10.7		8.3	502	20										
09/19/1995	1500	1.47	114	10.8		8.4	497	20	0.3	0.4	0.03	5.1	0.02	0.32	0.34	0.35		
09/19/1995	1600	1.47	114	10.7		8.4	497	20.5	0.3	0.4	< .01	5.1	0.02	0.31	0.32	0.33		
09/19/1995	1700	1.46	112	10.4		8.5	492	20	0.3	0.4	0.02	4.9	0.02	0.29	0.33	0.33		
09/19/1995	1800	1.46	112	9.7		8.4	489	19.5	0.3	0.4	0.02	5.1	0.02	0.3	0.32	0.33		
09/19/1995	1900	1.46	112	9.2		8.4	487	19	0.3	0.3	< .01	5.1	0.02	0.3	0.32	0.31		
09/19/1995	2000	1.45	111	8.8		8.4	488	18.5	0.3	0.3	< .01	5.1	0.02	0.29	0.3	0.3		
09/19/1995	2100	1.45	111	8.5		8.3	488	18.5	0.2	0.4	0.02	5	0.02	0.29	0.29	0.31		
09/19/1995	2200	1.45	111	8.3		8.3	488	18	0.2	0.3	< .01	5	0.02	0.28	0.32	0.3		
09/19/1995	2300	1.45	111	8.1		8.2	480	18	0.2	0.3	< .01	4.9	0.02	0.27	0.27	0.32		
09/20/1995	0000	1.44	109	7.8		8.2	475	18	0.2	0.3	< .01	4.8	0.02	0.27	0.27	0.29		
09/20/1995	0100	1.44	109	7.7		8.2	477	18	0.3	0.4	< .01	4.8	0.02	0.27	0.27	0.27		
09/20/1995	0200	1.43	107	7.4		8.2	477	18	0.3	0.6	< .01	4.8	0.02	0.27	0.26	0.29		
09/20/1995	0300	1.43	107	7.3		8.1	475	18	0.3	0.3	0.02	4.7	0.03	0.27	0.25	0.28		
09/20/1995	0400	1.42	105	7.1		8.1	471	18	0.2	0.3	< .01	4.7	0.02	0.26	0.28	0.28		
09/20/1995	0500	1.42	105	7		8.1	474	18	0.3	0.3	< .01	4.6	0.02	0.26	0.25	0.28		
09/20/1995	0600	1.42	105	6.8		8	476	17.5	0.2	0.3	< .01	4.7	0.02	0.26	0.28	0.27		
09/20/1995	0700	1.41	103	6.8		8	475	17.5	0.2	0.3	< .01	4.7	0.02	0.26	0.27	0.28		
09/20/1995	0800	1.41	103	7		8	474	17.5	< .20	0.3	< .01	4.7	0.02	0.26	0.27	0.27		
09/20/1995	0900	1.41	103	7.5		8	474	18	0.2	0.3	0.02	4.7	0.02	0.26	0.25	0.27		
09/20/1995	1000	1.4	103	7.7		8	475	18	0.2	0.3	< .01	4.7	0.02	0.26	0.25	0.27		
09/20/1995	1100	1.41	103	8		8	476	18	0.2	0.3	0.02	4.7	0.02	0.26	0.26	0.26		
09/20/1995	1200	1.41	103	8.3		8.1	476	18	0.3	0.3	0.02	4.7	0.02	0.27	0.27	0.27		
09/20/1995	1300	1.41	103	8.8		8.1	477	18.5	0.3	0.3	0.02	4.8	0.02	0.27	0.27	0.27		

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
09/20/1995	1400	1.41	103	9.3		8.2	478	18.5	0.3	0.3	0.02	4.8	0.02	0.27	0.28	0.26		
09/20/1995	1500	1.41	102	9.5		8.2	477	19	0.3	0.3	0.02	4.8	0.02	0.27	0.28	0.27		
09/20/1995	1600	1.4	102	9.5		8.3	482	19	0.3	0.3	0.02	4.9	0.02	0.27	0.29	0.27		
09/20/1995	1700	1.4	102	9.6		8.3	479	19	0.3	0.3	0.02	4.8	0.02	0.27	0.27	0.29		
09/20/1995	1800	1.4	102	9.2		8.3	481	19	0.3	0.3	0.02	4.9	0.02	0.27	0.27	0.27		
09/20/1995	1900	1.39	100	8.9		8.3	482	19	0.3	0.3	0.02	4.9	0.02	0.26	0.28	0.26		
09/20/1995	2000	1.39	100	8.4		8.3	484	19	0.2	0.3	0.02	4.9	0.02	0.26	0.27	0.28		
09/20/1995	2100	1.39	100	8.2		8.3	483	18.5	0.2	0.3	< .01	4.8	0.02	0.25	0.26	0.26		
09/20/1995	2200	1.39	100	7.9		8.2	485	18.5	0.3	0.3	0.02	4.9	0.02	0.23	0.25	0.27		
09/20/1995	2300	1.39	100	7.5		8.1	487	18.5	0.3	0.3	0.03	4.8	0.02	0.27	0.26	0.26		
09/21/1995	0000	1.39	100	7.4		8.1	490	18.5	< .20	0.3	0.02	4.8	0.01	0.25	0.25	0.26		
09/21/1995	0100	1.39	100	7.2		8.1	490	18.5	0.2	0.3	0.02	4.9	0.02	0.24	0.24	0.27		
09/21/1995	0200	1.39	100	7		8	493	18.5	0.2	0.3	0.07	4.8	0.01	0.25	0.26	0.27		
09/21/1995	0300	1.39	100	7		8	495	18.5	0.2	0.3	< .01	4.8	0.02	0.25	0.26	0.28		
09/21/1995	0400	1.39	100	6.8		8	496	18.5	0.2	0.3	0.02	4.8	0.02	0.26	0.26	0.28		
09/21/1995	0500	1.39	100	6.7		8	497	18.5	0.2	0.3	0.02	4.8	0.02	0.25	0.27	0.27		
09/21/1995	0600	1.39	100	6.6		7.9	497	18.5	0.2	0.3	0.02	4.8	0.02	0.25	0.26	0.27		
09/21/1995	0700	1.39	100	6.6		7.9	498	18.5	0.3	0.3	0.02	4.8	0.02	0.25	0.26	0.28		
09/21/1995	0800	1.38	98	6.8		7.9	497	18.5	0.2	0.3	0.02	4.8	0.02	0.25	0.26	0.27		
09/21/1995	0900	1.38	98	7.3		7.9	495	18.5	0.2	0.3	0.02	4.7	0.02	0.25	0.24	0.25		
09/21/1995	1000	1.38	98	8		8	495	19	0.2	0.3	< .01	4.7	0.02	0.24	0.25	0.26		
09/21/1995	1100	1.38	98	8.8		8.1	491	19.5	0.2	0.4	< .01	4.7	0.02	0.25	0.25	0.27		
10/03/1995	1400	1.34	87	12.8		8.5	485	19	0.3	0.3	< .01	4.5	< .010	0.27	0.29	0.29	4.1	2
10/21/1995	1041	5	1990						0.5	3.3	< .01	2.7	0.05	0.08	0.07	2		
10/21/1995	1452	6.35	3140			7.5	289		0.7	2.7	0.04	3.2	0.03	0.11	0.11	1.7		
10/21/1995	1823	6.23	3020			7.5	250		0.6	1.9	0.03	3.6	0.04	0.1	0.1	1.2		
10/21/1995	2227	5.71	2560			7.6	245		0.6	2.1	0.03	4	0.04	0.08	0.09	0.89		
10/22/1995	0249	5.68	2540			7.5	267		0.5	1.5	0.04	3.9	0.04	0.06	0.05	0.61		
10/22/1995	0717	5.5	2380			7.5	249		0.5	1.3	0.04	4.2	0.04	0.05	0.03	0.57		
11/06/1995	1430	1.75	194	12.9		8.1	428	7.5	0.2	0.3	< .01	4.4	< .010	0.12	0.11	0.12	3.4	1
11/12/1995	0807	5	1990			7.5	313		0.6	3.9	0.07	2.6	0.02	0.13	0.17	1.7		

		Gage Height	Inst Q.	DO, water	DO, water	pH, water	Cond.	Temp, water	NH3-N + Org N (D)	NH3-N + Org N (T)	NH3-N (D)	NO23-N (D)	NO2-N (D)	o- PO4 (D)	P (D)	TP	TOC	Sus Sed
		ft	cfs	mg/L	% Sat.	whole	msiem	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date	Time	P00065	P00061	P00300	P00301	P00400	P00095	P00010	P00623	P00625	P00608	P00631	P00613	P00671	P00666	P00665	P00680	P80154
11/12/1995	1332	5.08	2050			7.4	253		0.6	3.9	0.03	2.7	0.02	0.13	0.17	1.1		
11/12/1995	1847	5.25	2180			7.4	246		0.6	2.1	0.04	2.8	0.02	0.09	0.12	0.56		
11/12/1995	2354	5.12	2080			7.4	232		0.5	2.1	0.03	2.9	0.02	0.06	0.1	0.5		
12/12/1995	1430	2.41	452	15.7		8.2	375	0.2	< .20	0.3	< .01	4.4	0.01	0.04	0.03	0.07	2.1	14
01/16/1996	1545	2.46	432	15.7		8.1	377	0.5	0.3	0.6	0.04	4.6	0.03	0.06	0.06	0.08	3.8	8
01/19/1996	1144	4.84	1880						0.5	3.6	0.11	2.7	0.03	0.06	0.07	1.2		
01/19/1996	1437	8.8	5830						0.5	5.4	0.19	2.8	0.02	0.07	0.07	1.4		
01/19/1996	1616	9.91	7360						0.5	2.8	0.23	2.6	0.01	0.08	0.08	0.75		
01/19/1996	1741	10.62	8420						0.6	2	0.23	2.5	0.02	0.09	0.11	0.51		
01/20/1996	1346	14.2	14700						0.4	1.3	0.12	3	0.02	0.05	0.06	0.32		
01/21/1996	0747	10.52	8270				198		0.3	0.7	0.05	3.2	0.01	0.05	0.05	0.18		
01/21/1996	0911	10.1	7640				202											72
01/21/1996	1042	9.68	7030				206		0.3	0.5	0.05	3.4	0.01	0.05	0.04	0.16		
01/21/1996	1222	9.24	6420				210											77
01/21/1996	1410	8.84	5890				216		0.3	0.5	0.04	3.5	0.01	0.05	0.05	0.15		
01/21/1996	1609	8.45	5390				222											69
01/21/1996	1819	8.03	4890				229		0.3	0.4	0.04	3.7	0.01	0.05	0.05	0.11		
01/21/1996	2043	7.58	4380				233											65
01/21/1996	2323	7.2	3980				244		0.2	0.5	0.04	4	0.01	0.05	0.04	0.13		
01/22/1996	0220	6.83	3600				249											81
01/22/1996	0533	6.55	3330				255		0.3	0.5	0.04	4.1	0.01	0.04	0.04	0.12		
01/22/1996	0902	6.28	3070				260											81
01/22/1996	1248	6.04	2850				266		0.2	0.5	0.03	4.2	0.01	0.04	0.05	0.11		
01/22/1996	1651	5.81	2650				267											74
01/22/1996	2111	5.63	2490				276		0.2	0.5	0.06	4.3	0.01	0.03	0.02	0.11		
01/23/1996	0144	5.5	2380				280											71
01/23/1996	0632	5.33	2240				285		0.2	< .20	0.04	4.4	0.01	0.04	0.03	0.05		
01/23/1996	1137	5.18	2130				293											57
01/23/1996	1659	5.03	2010				298		0.5	0.6	0.26	4.5	0.01	0.07	0.07	0.11		
01/23/1996	2237	4.95	1960				303											51
01/24/1996	0430	4.81	1850				305		0.4	0.6	0.25	4.5	0.01	0.06	0.07	0.11		

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
01/24/1996	1025	4.96	1960															
01/24/1996	1510	6.08	2890															115
01/24/1996	1806	6.95	3720				271		0.5	1	0.16	3.9	0.01	0.07	0.07	0.23		
01/24/1996	2053	7.49	4290				253		0.5	1.5	0.16	3.6	0.01	0.07	0.08	0.34		
01/24/1996	2324	7.72	4540				240											136
01/25/1996	0149	7.81	4640						0.4	1	0.15	3.5	0.01	0.07	0.07	0.22		
01/25/1996	0414	7.77	4600				236											122
01/25/1996	0640	7.67	4480						0.4	0.8	0.11	3.6	0.01	0.05	0.06	0.17		
01/25/1996	0911	7.55	4350				243											112
01/25/1996	1146	7.41	4200				250		0.3	0.8	0.07	3.8	0.01	0.04	0.05	0.18		
01/25/1996	1429	7.22	4000				245											85
01/25/1996	1721	6.95	3720				249		0.3	0.5	0.06	3.7	< .010	0.04	0.04	0.11		
01/25/1996	2028	6.65	3420				245											67
01/25/1996	2351	6.34	3130				256		0.2	0.5	0.04	3.9	0.01	0.03	0.03	0.1		
01/26/1996	0333	6.06	2870															52
01/26/1996	0735	5.8	2640				268		0.2	0.4	0.03	4.1	< .010	0.03	0.05	0.1		
01/26/1996	1207	5.56	2430															42
01/26/1996	1654	5.37	2280						< .20	0.4	< .01	4.3	0.02	0.02	0.03	0.08		
01/26/1996	2153	5.26	2190				280											38
01/27/1996	0256	5.34	2250						< .20	0.4	0.02	4.4	0.02	0.03	0.03	0.08		
01/27/1996	0719	6.26	3050				250											284
01/27/1996	1016	7.68	4490						0.3	1.2	0.1	3.6	0.02	0.08	0.07	0.29		
01/27/1996	1227	8.64	5630				221											293
01/27/1996	1416	9.27	6460						0.4	1.5	0.12	3.2	0.02	0.1	0.1	0.4		
01/27/1996	1554	9.78	7170				199											295
01/27/1996	1723	10.16	7730						0.3	1.5	0.13	2.9	0.02	0.11	0.12	0.43		
01/27/1996	1846	10.5	8240				187											240
01/27/1996	2004	10.8	8700						0.3	1.3	0.13	2.7	0.02	0.08	0.12	0.37		
01/28/1996	1747	10.98	8990				187											235
01/28/1996	1903	10.7	8550						0.2	0.5	0.04	3.2	0.02	0.04	0.03	0.14		
01/28/1996	2024	10.35	8010				196											78

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
01/28/1996	2151	9.92	7370						< .20	0.4	0.02	4	0.01	0.03	0.03	0.08		
01/28/1996	2327	9.36	6580				211											86
01/29/1996	0115	8.73	5740						< .20	0.3	0.03	3.5	0.01	0.03	0.04	0.07		
01/29/1996	0320	8.14	5010				228											85
01/29/1996	0541	7.68	4490						< .20	0.3	0.03	3.8	0.01	0.04	0.04	0.1		
01/29/1996	0816	7.36	4150				235											59
01/29/1996	1103	7.1	3870						< .20	0.5	0.02	3.9	0.01	0.04	0.04	0.1		
01/29/1996	1402	6.83	3600															53
01/29/1996	1713	6.6	3370						0.2	0.5	0.05	3.3	0.02	0.04	0.04	0.11		
01/29/1996	2049	6.41	3190															41
01/30/1996	0024	6.25	3040						0.3	0.3	< .01	4	< .010	0.03	0.03	0.07		
01/30/1996	0408	6.09	2900															41
01/30/1996	0805	5.93	2750						0.2	0.3	0.02	4.1	0.01	0.03	0.03	0.07		
01/30/1996	1214	5.76	2600															36
01/30/1996	1637	5.6	2470						0.4	0.3	0.02	4.1	0.01	0.03	0.03	0.06		
01/30/1996	2113	5.49	2380															40
01/31/1996	0159	5.39	2290						0.2	0.3	0.02	4.2	0.01	0.03	0.03	0.07		
01/31/1996	0656	5.27	2200															28
01/31/1996	1206	5.15	2100						0.5	0.3	0.03	4.2	0.01	0.03	0.02	0.05		
01/31/1996	1732	5.01	2000															46
01/31/1996	2314	4.88	1900						0.2	0.2	0.02	4.3	< .010	0.03	0.02	0.07		
02/13/1996	1400	3.56	1030	12.7		7.5	317	2.5	0.3	0.3	< .01	4.7	0.02	0.03	0.04	0.06		11
02/21/1996	0224	5	1990						0.4	2.3	0.07	3.8	0.04	0.04	0.05	0.48		
02/21/1996	0645	6.1	2900				278											334
02/21/1996	1038	6.04	2850						1.3	2.2	0.35	3.2	0.04	0.13	0.17	0.37		
02/21/1996	1441	5.8	2640				247											273
02/21/1996	1858	5.72	2570						0.5	1.3	0.12	3.3	0.03	0.05	0.06	0.28		
02/21/1996	2322	5.61	2480				263											139
02/22/1996	0357	5.49	2380						0.3	0.9	0.05	3.3	0.03	0.03	0.04	0.17		
02/22/1996	0844	5.34	2250				250											110
02/22/1996	1345	5.26	2190						< .20	0.7	0.05	3.1	0.03	0.03	0.04	0.12		

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
02/22/1996	1856	5.14	2100				249											128
02/23/1996	0014	5.16	2110						< .20	0.8	0.03	3.3	0.02	0.03	0.03	0.11		
02/23/1996	0528	5.16	2110				251											78
02/23/1996	1049	5.07	2040						0.2	0.9	0.02	3.3	0.02	0.03	0.03	0.15		
02/23/1996	1619	5.01	2000				250											70
02/23/1996	2155	4.99	1990						< .20	0.4	0.03	3	0.02	0.03	0.06	0.08		
02/24/1996	0329	5.17	2120						< .20	0.6	0.02	3.2	0.02	0.03	0.03	0.11		
02/24/1996	0859	5.05	2030				251											69
02/24/1996	1422	5.15	2100						0.2	0.6	0.03	3.3	0.02	0.03	0.03	0.13		
02/24/1996	1934	5.2	2140				245											90
02/25/1996	0044	5.22	2160						< .20	0.9	0.03	3.1	0.02	0.03	0.02	0.19		
02/25/1996	0552	5.21	2150				238											80
02/25/1996	1110	5.07	2040						< .20	0.3	0.02	3	0.02	0.02	0.03	0.03		
02/25/1996	1643	4.96	1960				239											78
02/25/1996	2232	4.83	1870						< .20	0.3	0.02	3	0.02	0.02	0.02	0.04		
03/07/1996	1436	5	1990						0.4	4.4	0.1	2.7	0.05	0.03	0.05	1.2		
03/07/1996	1912	6.06	2870				255											410
03/07/1996	2247	6.43	3210						0.5	2.6	0.12	3.2	0.02	0.05	0.05	0.59		
03/08/1996	0219	6.28	3070				236											378
03/08/1996	0604	6.03	2840						0.4	1.5	0.06	3.4	0.01	0.04	0.04	0.35		
03/08/1996	1008	5.78	2620				244											194
03/08/1996	1434	5.51	2390						< .20	0.8	0.05	3.8	0.01	0.03	0.04	0.19		
03/08/1996	1925	5.27	2200				253											136
03/09/1996	0041	5.05	2030						< .20	0.6	0.03	3.8	< .010	0.03	0.03	0.13		
03/19/1996	1215	3.43	946	11.3		7.9	317	8	0.3	0.5	0.13	3.8	0.02	0.04	0.05	0.09		15
03/20/1996	0109	5	1990						0.4	0.8	0.07	3.3	0.06	0.06	0.06	0.15		
03/20/1996	0506	6.8	3570				247											982
03/20/1996	0759	7.21	3990						0.6	1.6	0.1	2.6	0.03	0.07	0.07	0.45		
03/20/1996	1048	7.11	3890				215											533
03/20/1996	1341	7.07	3840						0.7	0.9	0.05	2.8	0.02	0.05	0.08	0.14		
03/20/1996	1632	7.17	3950				223											308

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
03/20/1996	1919	7.23	4010						0.6	1	< .01	2.9	0.02	0.04	0.05	0.22		
03/20/1996	2207	7.12	3900				218											260
03/21/1996	0103	6.91	3680						0.4	0.8	0.05	2.9	0.02	0.04	0.05	0.16		
03/21/1996	0410	6.67	3440				215											183
03/21/1996	0731	6.43	3210						0.4	0.6	0.05	3	0.02	0.04	0.04	0.11		
03/21/1996	1106	6.21	3010				223											208
03/21/1996	1454	6.02	2830						0.3	0.5	0.07	3.2	0.02	0.05	0.05	0.1		
03/21/1996	1856	5.84	2670				231											199
03/21/1996	2314	5.66	2520						0.3	0.6	0.04	3.3	0.02	0.04	0.06	0.13		
03/22/1996	0347	5.48	2370				239											126
03/22/1996	0838	5.3	2220						0.3	0.5	0.04	3.4	0.02	0.02	0.02	0.09		
03/22/1996	1346	5.15	2110				248											101
04/01/1996	1907	5	1990						0.3	3.4	0.05	3.1	0.05	0.04	0.05	1.3		
04/01/1996	2305	6.94	3710						0.4	0.6	0.11	3	0.05	0.04	0.04	0.09		
04/02/1996	0142	7.8	4630				228											1010
04/02/1996	0401	8.02	4880															
04/02/1996	0618	7.97	4820				214											749
04/02/1996	0839	7.84	4670						0.4	2.7	0.09	3.2	0.02	0.06	0.05	0.7		
04/02/1996	1103	7.73	4550				221											531
04/02/1996	1331	7.63	4440						0.4	1.4	0.05	3.4	0.02	0.04	0.04	0.43		
04/02/1996	1606	7.41	4200				231											295
04/02/1996	1858	7.06	3830						0.3	1.2	0.04	3.7	0.02	0.02	0.03	0.33		
04/02/1996	2200	6.74	3510				238											199
04/03/1996	0120	6.41	3190						0.3	0.9	0.03	3.6	0.02	0.02	0.02	0.21		
04/03/1996	0459	6.11	2910				243											175
04/03/1996	0857	5.88	2710						0.3	1	0.02	3.7	0.02	0.02	0.02	0.22		
04/03/1996	1311	5.7	2550				253											99
04/03/1996	1739	5.54	2420						0.2	0.9	< .01	3.8	0.02	0.02	0.02	0.19		
04/03/1996	2223	5.38	2290				264											148
04/04/1996	0322	5.23	2170						< .20	0.4	< .01	3.9	0.02	0.02	0.02	0.08		
04/04/1996	0837	5.11	2070				272											97

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
04/04/1996	1406	4.98	1980						< .20	0.7	0.02	3.8	0.02	0.02	0.01	0.14		
04/24/1996	1400	3.04	712	15.5		8.7	320	15.5	0.2	0.3	0.02	3.4	0.02	0.03	0.04	0.05	3.7	4
05/21/1996	1330	3.18	799	8.2		7.7	334	21.5	0.2	0.6	< .01	3.8	0.04	0.04	0.06	0.12	4.2	25
06/12/1996	1130	7.24	4000						0.7	5.8	< .01	3	0.05	0.05	0.11	1.8		752
06/19/1996	1045	12.71	12000	6.5		7	147	20	0.6	3	0.16	2.5	0.04	0.13	0.12	0.85	20	607
06/19/1996	1238	14.08	14500	6.5		7	147	20	0.6	3.6	0.12	2.1	0.04	0.07	0.08	0.95		
06/19/1996	1323	14.6	15500															758
06/19/1996	1405	14.98	16200						3.2	3	0.12	2.4	0.04	0.1	1	1		
06/19/1996	1445	15.13	16500															744
06/19/1996	1524	15.22	16700						2.9	2.8	0.12	2.3	0.04	0.09	0.9	0.87		
06/19/1996	1602	15.21	16700															649
06/19/1996	1642	15.13	16500						0.5	2.1	0.13	2.3	0.04	0.09	0.08	0.62		
06/19/1996	1721	14.98	16200															500
06/19/1996	1802	14.77	15800						0.6	1	0.12	2.6	0.04	0.08	0.08	0.25		
06/19/1996	1845	14.54	15400															365
06/19/1996	1931	14.22	14800						1.7	1.6	0.1	2.7	0.04	0.09	0.42	0.47		
06/19/1996	2019	13.84	14100															205
06/19/1996	2111	13.43	13300						0.5	1.6	0.1	2.9	0.04	0.08	0.08	0.39		
06/19/1996	2208	12.99	12500															144
06/19/1996	2313	12.48	11600						0.5	1.1	0.1	3.3	0.04	0.08	0.07	0.27		
06/20/1996	0027	11.92	10600															120
06/20/1996	0154	11.38	9640						1.1	0.9	0.09	3.3	0.04	0.08	0.23	0.22		
06/20/1996	0336	10.84	8770															102
06/20/1996	0537	10.38	8060						0.9	0.8	0.07	3.6	0.04	0.07	0.21	0.21		
06/20/1996	0757	9.95	7420															85
06/20/1996	1042	9.48	6750						0.8	0.7	0.07	3.6	0.04	0.05	0.21	0.21		
06/20/1996	1412	8.78	5810															80
06/20/1996	1556	8.41	5340						0.8	0.8	0.05	3.7	0.03	0.05	0.18	0.17		
06/21/1996	1100	9.87	7300	6.4		7	204	20	0.4	0.8	0.1	2.8	0.04	0.11	0.12	0.24		136
07/16/1996	1430	2.54	481	11.9		8.4	410	23	< .20	0.2	0.03	4.3	0.02	0.06	0.05	0.05	2.6	5
08/20/1996	1030	2.36	405	9.3		7.9	413	20	< .20	0.4	0.03	4.8	0.02	0.07	0.05	0.08	2.7	3

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
09/12/1996	1245	3.57	1030	8.6		7.5	314	19.5	0.2	0.3	0.02	3.2	0.02	0.06	0.07	0.06	3.6	11
10/09/1996	1245	2.81	567	10.7		7.8	400	13	< .20	< .20	< .01	4.6	0.01	0.05	0.05	0.05	2.8	4
11/13/1996	1530	3.56	1030	12.2		7.7	330	6	< .20	< .20	0.03	4.1	0.03	0.04	0.03	0.04	1.9	5
12/01/1996	1638	4.79	1840						0.3	0.8	0.06	3.2	0.02	0.04	0.04	0.14		
12/01/1996	2057	5.97	2790				270											96
12/01/1996	2355	6.82	3590						0.5	1.6	0.12	2.6	0.02	0.11	0.11	0.41		
12/02/1996	0212	7.62	4430				216											213
12/02/1996	0404	8.17	5050						0.5	1.8	0.19	2.5	0.03	0.13	0.15	0.49		
12/02/1996	0543	8.53	5490				201											240
12/02/1996	0713	8.78	5810						0.5	1.7	0.12	2.4	0.02	0.14	0.14	0.48		
12/02/1996	0838	8.95	6030				193											222
12/02/1996	0959	9.11	6240						0.4	1.7	0.09	2.4	0.02	0.13	0.13	0.48		
12/02/1996	1118	9.16	6310				188											171
12/02/1996	1236	9.17	6320						0.4	1.5	0.07	2.4	0.01	0.11	0.11	0.41		
12/02/1996	1353	9.07	6190				186											134
12/02/1996	1512	9.05	6160						0.4	1.1	0.07	2.5	0.03	0.1	0.09	0.3		
12/02/1996	1633	8.96	6040				189											105
12/02/1996	1754	8.93	6000						0.3	0.9	0.05	2.6	0.02	0.08	0.08	0.24		
12/02/1996	1916	8.91	5980				192											86
12/02/1996	2039	8.91	5980						0.3	0.8	0.05	2.7	0.01	0.06	0.05	0.17		
12/02/1996	2201	8.9	5960				189											91
12/02/1996	2324	8.85	5900						0.3	0.8	0.04	2.7	0.02	0.05	0.06	0.2		
12/03/1996	0048	8.79	5820				188											95
12/03/1996	0214	8.62	5600						0.3	0.8	0.04	2.6	0.02	0.05	0.05	0.2		
12/13/1996	0626	5.05	2030						0.2	0.3	< .01	3.3	0.02	0.06	0.05	0.07		
12/13/1996	1025	6.68	3450				262											114
12/13/1996	1250	7.72	4540						0.4	0.6	0.06	2.8	0.02	0.1	0.11	0.14		
12/13/1996	1446	8.24	5130				222											172
12/13/1996	1630	8.53	5490						0.4	0.7	0.07	2.7	0.02	0.11	0.11	0.14		
12/13/1996	1808	8.72	5730				208											148
12/13/1996	1942	8.83	5870						0.2	1.1	0.03	2.9	0.02	0.05	0.05	0.26		

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
12/13/1996	2115	8.9	5960				204											121
12/13/1996	2247	8.9	5960						0.4	4.5	0.11	2.6	0.02	0.1	0.1	0.13		
12/14/1996	0018	8.93	6000				207											89
12/14/1996	0149	8.97	6060						0.3	0.7	0.06	2.7	0.02	0.08	0.09	0.17		
12/14/1996	0318	9.02	6120				210											84
12/14/1996	0447	9.07	6190						0.3	0.4	0.05	2.8	0.02	0.07	0.09	0.09		
12/14/1996	0615	9.07	6190				212											82
12/14/1996	0742	9.08	6200						0.3	0.6	0.04	2.9	0.02	0.05	0.06	0.13		
12/14/1996	0910	9.05	6160				212											78
12/14/1996	1039	9.01	6110						0.2	0.5	0.03	2.9	0.02	0.04	0.04	0.12		
12/14/1996	1209	8.9	5960				213											67
12/16/1996	1500	5.46	2350	10.8		7.7	273	7	< .20	0.22	< .01	3.55	0.015	0.02	0.02	0.03	2.4	22
01/23/1997	1600	2.53	443	15.4		8.3	380	3	0.2	< .20	< .01	4.8	0.03	0.04	0.04	0.03	2.2	2
02/13/1997	1500	3.1	754			8.5	338	3.5	0.4	< .20	< .01	3.8	0.02	0.02	< .01	0.02	2.2	2
03/05/1997	2240	4.59	1700						0.2	1.6	< .01	3.6	0.01	0.02	< .01	0.26		
03/06/1997	0319	5.44	2330				287											129
03/06/1997	0656	5.74	2590						0.4	1.6	0.11	3.4	0.02	0.05	0.03	0.28		
03/06/1997	1023	5.77	2610				269											179
03/06/1997	1349	5.75	2600						0.3	1.3	0.07	3.4	0.02	0.04	0.03	0.22		
03/06/1997	1720	5.66	2520				263											106
03/06/1997	2102	5.49	2380						0.2	0.9	0.03	3.5	0.01	0.03	0.01	0.17		
03/07/1997	0100	5.33	2240				271											67
03/07/1997	0513	5.16	2110						< .20	0.5	0.03	3.6	0.01	0.02	0.01	0.07		
03/07/1997	0949	4.96	1960				272											52
03/14/1997	1542	4.92	1930						< .20	1.2	< .01	3.2	< .010	0.02	< .01	0.18		
03/14/1997	1930	6.52	3300				267											280
03/14/1997	2217	6.81	3580						0.6	2.3	0.25	2.7	0.02	0.07	0.05	0.48		
03/15/1997	0100	6.76	3530				229											251
03/15/1997	0347	6.66	3430						0.4	1.6	0.09	2.8	0.02	0.05	0.03	0.31		
03/15/1997	0642	6.53	3310				231											147
03/15/1997	0944	6.37	3150						0.3	0.9	0.07	3.1	0.02	0.03	0.02	0.15		

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
03/15/1997	1300	6.15	2950				240											92
03/15/1997	1635	5.88	2710						0.3	0.7	0.05	3.2	0.01	0.03	0.02	0.1		
03/15/1997	2036	5.56	2430				250											62
03/16/1997	0111	5.25	2180						0.2	0.5	< .01	3.3	0.01	0.02	0.01	0.06		
03/16/1997	0626	4.99	1990				275											46
03/17/1997	1615	4.24	1460	13.5		7.8	287	5.5	< .20	< .20	< .01	3.7	< .010	0.02	< .01	0.03	6.9	6
04/16/1997	1415	2.44	413	13.3		8.3	354	14.5	< .20	0.34	0.02	3.68	0.023	0.04	0.03	0.07	2.2	2
05/15/1997	1400	1.98	252	11.6		8.2	400	18.5	< .20	0.23	0.03	4.21	0.041	0.09	0.09	0.13	5.8	3
06/20/1997	1230	2.33	377	8.4		7.8	340	23	0.42	0.56	0.06	4.04	0.067	0.11	0.12	0.18	6.4	22
07/08/1997	1515	1.65	164	9.7		8.3	417	27	0.26	0.38	0.02	3.65	0.019	0.12	0.13	0.15	4.6	5
08/21/1997	1115	2.31	347	7.6		7.7	451	20	0.42	0.94	0.09	4.03	0.033	0.19	0.22	0.29	3.7	38
09/09/1997	1600	1.34	86	7.3		7.9	491	20	0.35	0.29	0.03	4.46	0.02	0.18	0.18	0.19	2.7	7
10/16/1997	1500	1.45	109	14		8.6	474	15	0.31	0.33	< .01	4.14	0.012	0.17	0.19	0.21	3.6	3
11/07/1997	1631	5	1990						0.46	1.8	0.12	3.27	0.023	0.1	0.09	0.49		
11/07/1997	2001	7.86	4690															653
11/07/1997	2105	8.52	5470						0.56	4	0.13	3.18	0.026	0.12	0.11	1.06		
11/07/1997	2109	8.57	5540															599
11/07/1997	2134	8.77	5790						0.6	2.5	0.06	3.01	0.025	0.13	0.11	0.78		
11/07/1997	2200	8.98	6070															625
11/07/1997	2202	9.25	6430						0.51	2.9	0.07	3.02	0.028	0.12	0.1	0.9		
11/07/1997	2331	9.65	6990															500
11/10/1997	1730	5.5	2380						0.24	0.59	0.14	4.04	0.022	0.05	0.04	0.1		42
11/18/1997	1500	3.19	804	12		7.6	342	5	0.11	0.19	< .02	4.98	< .010	0.02	0.02	0.05	2.4	9
12/18/1997	1245	2.35	386	13.9		8.4	359	3	0.22	0.15	< .02	4.05	< .010	0.05	0.03	0.05	2.3	7
01/06/1998	1345	3.11	759	13.6		8.3	312	8	0.23	0.24	< .02	3.56	< .010	0.03	0.05	0.06	2.9	10
01/08/1998	0758	4.92	1930						0.38	1	< .02	2.77	0.036	0.04	0.04	0.29		
01/08/1998	0833	5.04	2020				277											162
01/08/1998	1250	6.65	3420						0.5	2.2	< .02	2.45	0.034	0.09	0.09	0.59		
01/08/1998	1529	7.77	4590				220											385
01/08/1998	1742	8.29	5190						0.53	1.3	0.03	2.42	0.029	0.08	0.08	0.42		
01/08/1998	1943	8.63	5610				215											288

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
01/08/1998	2136	8.9	5960						0.54	1.9	0.04	2.41	0.028	0.1	0.1	0.54		
01/08/1998	2324	9.08	6200				208											242
01/09/1998	0109	9.16	6310						0.49	1.4	< .02	2.44	0.029	0.09	0.08	0.37		
01/09/1998	0251	9.27	6460				202											185
01/09/1998	0431	9.38	6610						0.38	1	< .02	2.39	0.031	0.08	0.07	0.29		
01/10/1998	1224	7.43	4220				219											62
01/10/1998	1509	7.11	3890						0.3	0.57	< .02	2.99	0.022	0.04	0.03	0.12		
01/10/1998	1600	7	3770	11.3		7.6	225	8	0.2	0.58	< .02	2.97	0.023	0.04	0.03	0.11		53
01/10/1998	1808	6.78	3550				223		0.25	0.56	< .02	3.02	0.02	0.03	0.03	0.1		
01/10/1998	2124	6.52	3300				226											48
01/11/1998	0055	6.29	3080				230		0.24	0.48	< .02	3.08	0.019	0.03	0.03	0.09		
01/11/1998	0440	6.08	2890				235											41
01/11/1998	0842	5.88	2710				237		0.25	0.43	< .02	3.18	0.019	0.03	0.03	0.08		
01/11/1998	1303	5.7	2550				241											35
01/11/1998	1737	5.51	2390				245		0.24	0.38	< .02	3.28	0.019	0.03	0.02	0.06		
01/11/1998	2231	5.34	2250				249											28
01/12/1998	0343	5.17	2120				251		0.18	0.35	< .02	3.33	0.018	0.03	0.03	0.07		
01/12/1998	0913	5	1990				256											26
01/23/1998	1828	5	1990						0.21	0.64	< .02	3.23	0.013	0.04	0.03	0.12		
01/23/1998	2145	5.91	2740				274											88
01/24/1998	0130	6.26	3050						0.29	0.96	0.04	2.88	0.017	0.06	0.04	0.18		
01/24/1998	0511	6.16	2960				270											80
01/24/1998	0900	6.04	2850						0.3	0.66	0.02	3.02	0.015	0.09	0.07	0.17		
01/24/1998	1257	5.93	2750				253											48
01/24/1998	1705	5.8	2640						0.21	0.46	< .02	3.2	0.013	0.05	0.06	0.09		
01/24/1998	2119	5.79	2630				256											41
01/25/1998	0136	5.73	2580						0.19	0.46	< .02	3.3	0.011	0.04	0.04	0.1		
01/25/1998	0608	5.54	2420				270											34
01/25/1998	1057	5.34	2250						0.2	0.42	< .02	3.43	0.012	0.04	0.02	0.07		
01/25/1998	1604	5.15	2110				274											27
01/25/1998	2134	4.98	1980						0.2	0.32	< .02	3.61	< .010	0.04	0.03	0.07		

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
01/26/1998	0321	4.85	1880				282											20
01/28/1998	0914	4.98	1980						0.22	0.61	0.06	3.22	0.019	0.04	0.04	0.11		
01/28/1998	1102	5.4	2300				262											86
01/28/1998	1500	6.62	3390						0.29	0.43	0.1	3.09	0.018	0.06	0.06	0.1		
01/28/1998	1749	7.63	4440				242											130
01/28/1998	2010	8.02	4880						0.34	0.44	0.09	2.72	0.014	0.06	0.05	0.09		
01/28/1998	2226	8.04	4900				223											148
01/29/1998	0045	7.84	4670						0.3	0.65	0.08	2.84	0.013	0.06	0.07	0.16		
01/29/1998	0313	7.5	4300				235											92
01/29/1998	0555	7.16	3940						0.28	0.6	0.08	3.19	0.015	0.04	0.04	0.13		
01/29/1998	0854	6.79	3560				255											66
01/29/1998	1208	6.53	3310						0.24	0.45	0.06	3.49	0.016	0.03	0.03	0.09		
01/29/1998	1536	6.27	3060				261											46
01/29/1998	1922	6.02	2830						0.16	0.2	0.04	3.61	0.015	0.02	0.02	0.05		
01/29/1998	2330	5.83	2660				273											38
01/30/1998	0354	5.68	2540						0.17	0.27	0.03	3.74	0.013	0.01	0.03	0.05		
01/30/1998	0831	5.53	2410				283											32
01/30/1998	1320	5.4	2300						0.35	0.25	0.04	3.78	0.016	< .01	0.02	0.06		
01/30/1998	1512	5.37	2280				292											30
02/05/1998	0334	5	1990						0.26	0.59	0.02	3.21	< .010	0.06	0.04	0.12		
02/05/1998	0555	6.06	2870				266											97
02/05/1998	0859	7.52	4320						0.35	1.2	0.07	2.6	< .010	0.09	0.07	0.28		
02/05/1998	1118	8.31	5210				213											204
02/05/1998	1318	8.8	5830						0.42	1.5	0.09	2.26	< .010	0.1	0.08	0.37		
02/05/1998	1508	9.16	6310				202											199
02/05/1998	1650	9.39	6620						0.34	1.1	0.06	2.19	< .010	0.09	0.06	0.28		
02/05/1998	1829	9.45	6710				189											136
02/05/1998	2008	9.43	6680						0.33	0.85	0.05	2.25	< .010	0.07	0.06	0.2		
02/05/1998	2148	9.31	6510				191											92
02/05/1998	2332	9.14	6280						0.28	0.72	0.05	2.42	< .010	0.06	0.05	0.15		
02/06/1998	0121	8.93	6000				203											81

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
02/06/1998	0314	8.75	5770						0.25	0.62	0.06	2.55	< .010	0.06	0.04	0.11		
02/06/1998	0512	8.58	5550				211											71
02/06/1998	0715	8.39	5310						0.26	0.58	0.05	2.66	< .010	0.05	0.04	0.12		
02/06/1998	0923	8.23	5120				224											62
02/06/1998	1135	8.06	4920						0.2	0.53	0.04	2.74	< .010	0.04	0.03	0.1		
02/06/1998	1353	7.89	4730				226											56
02/06/1998	1617	7.64	4450						0.21	0.44	0.04	2.83	< .010	0.04	0.03	0.09		
02/06/1998	1853	7.31	4090				230											48
02/06/1998	2143	6.95	3720						0.2	0.34	0.03	2.96	< .010	0.04	0.02	0.06		
02/07/1998	0051	6.64	3410				238											42
02/07/1998	0413	6.41	3190						0.19	0.34	0.05	3.13	< .010	0.03	0.02	0.07		
02/07/1998	0748	6.22	3010				247											35
02/07/1998	1400	5.98	2800	12		7.6	253	6	0.13	0.29	0.02	3.35	< .010	0.04	0.04	0.06	3.5	28
02/07/1998	1532	5.92	2740						< .10	0.26	< .02	3.11	< .010	0.03	0.02	0.04		
02/07/1998	1947	5.74	2590				262											26
02/08/1998	0019	5.57	2440						0.11	0.29	< .02	3.23	< .010	0.04	0.03	0.04		
02/08/1998	0506	5.42	2320				266											24
02/08/1998	1006	5.29	2210						0.12	0.23	< .02	2.98	< .010	0.04	0.04	0.07		
02/08/1998	1516	5.15	2100				272											22
02/08/1998	2042	5.03	2010						< .10	0.22	< .02	2.94	< .010	0.03	0.04	0.04		
02/09/1998	0228	4.9	1920				277											18
02/24/1998	1400	10.64	8460	11.5		7.4	164	4	0.38	1.2	0.06	1.79	< .010	0.09	0.09	0.34	8.4	161
03/08/1998	2114	5.01	2000						0.21	0.44	< .02	2.85	< .010	0.01	< .01	0.04		
03/08/1998	2322	5.39	2300				268											40
03/09/1998	0402	5.57	2440						0.29	0.77	< .02	2.47	0.011	0.03	0.03	0.16		
03/09/1998	0837	5.73	2580				234											54
03/09/1998	1228	6.52	3300						0.25	0.59	0.03	2.48	< .010	0.03	0.04	0.15		
03/09/1998	1534	7.03	3800				220											82
03/09/1998	1823	7.21	3990						0.35	0.9	0.04	2.23	< .010	0.05	0.05	0.18		
03/09/1998	2107	7.32	4100				212											86
03/09/1998	2348	7.35	4140						0.36	0.97	0.05	2.29	0.01	0.04	0.04	0.23		

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
03/10/1998	0229	7.34	4120				211											72
03/10/1998	0512	7.29	4070						0.23	0.68	0.03	2.49	< .010	0.03	0.03	0.14		
03/10/1998	0757	7.2	3980				212											54
03/10/1998	1046	7.09	3860						0.26	0.48	< .02	2.39	< .010	0.03	0.02	0.1		
03/10/1998	1343	6.92	3690				214											39
03/10/1998	1647	6.76	3530						0.21	0.4	< .02	2.42	< .010	0.03	0.04	0.1		
03/10/1998	2000	6.6	3370				212											36
03/10/1998	2322	6.45	3230						0.19	0.84	0.02	2.29	< .010	0.02	0.01	0.07		
03/11/1998	0254	6.29	3080				213											29
03/11/1998	0637	6.09	2900						0.18	0.29	0.02	2.38	0.081	0.02	< .01	0.06		
03/11/1998	1036	5.87	2700				218											24
03/11/1998	1453	5.69	2540						0.13	0.2	0.02	2.6	< .010	0.02	< .01	0.04		
03/11/1998	1700	5.61	2480	12.4		7.7	230	5	0.13	0.23	0.02	2.86	< .010	0.03	0.01	0.05	2.3	16
03/21/1998	1615	10.65	8470						0.41	1	0.08	1.68	0.014	0.07	0.1	0.27		
03/21/1998	1733	10.73	8590				171											134
03/21/1998	1850	10.78	8670						0.38	1.1	0.09	1.94	0.014	0.07	0.09	0.27		
03/21/1998	2007	10.85	8780				174											90
03/21/1998	2123	10.88	8830						0.36	0.9	0.08	2.02	0.012	0.06	0.06	0.23		
03/21/1998	2239	10.89	8850				180											112
03/21/1998	2355	10.9	8860						0.32	0.82	0.07	2.11	0.012	0.05	0.06	0.2		
03/22/1998	0112	10.88	8830				178											94
03/22/1998	0228	10.87	8810						0.32	0.8	0.07	2.1	0.012	0.04	0.04	0.2		
03/22/1998	0344	10.82	8740				176											94
03/22/1998	0501	10.81	8720						0.34	0.48	0.07	2.06	0.012	0.04	0.04	0.1		
03/22/1998	0618	10.73	8590				173											94
03/22/1998	0736	10.67	8500						0.28	0.69	0.05	2.01	0.011	0.04	0.03	0.16		
03/22/1998	0855	10.59	8380				172											71
03/22/1998	1015	10.45	8160						0.27	0.67	0.06	2.05	0.011	0.03	0.03	0.15		
03/22/1998	1138	10.18	7760				176											59
03/22/1998	1306	9.93	7390						0.24	0.49	0.06	2.1	0.01	0.03	0.03	0.1		
03/22/1998	1438	9.62	6940				181											45

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
03/22/1998	1616	9.3	6500						0.24	0.46	0.06	2.23	0.01	0.03	0.04	0.1		
03/22/1998	1801	8.97	6060				191											47
03/22/1998	1955	8.63	5610						0.21	0.45	0.05	2.38	0.011	0.03	0.03	0.1		
03/22/1998	2157	8.32	5220				200											38
03/23/1998	0009	7.99	4840						0.19	0.34	0.09	2.38	< .010	0.03	0.01	0.08		
03/23/1998	0231	7.68	4490				207											39
03/23/1998	1600	6.48	3260	11.9		7.5	227	6.5	0.14	0.24	0.05	2.83	0.011	0.02	0.03	0.05	2.9	24
04/08/1998	1345	2.99	647	13.1		8.5	343	13.5	< .10	0.21	0.03	3.59	0.012	0.02	0.02	0.03	2.3	5
04/19/1998	1558						207		0.55	1.7	0.07	1.95	0.024	0.05	0.07	0.37		205
04/20/1998	0442						182		0.39	0.97	0.06	1.82	0.023	0.05	0.04	0.23		137
04/20/1998	1447						204		0.29	0.4	0.05	2.17	< .010	0.03	0.04	0.08		55
05/11/1998	1300	5.64	2500	9.5		7.7	237	13.5	0.19	0.29	0.07	2.48	< .010	0.02	0.03	0.06	3.4	35
06/17/1998	1530	2.46	432	8.9		8	385	21	0.22	0.35	0.05	4.11	< .010	0.08	0.09	0.11	2.6	< 14
07/14/1998	1315	2.08	284	10.7		8.2	444	24	0.2	0.28	0.06	4.84	0.02	0.07	0.07	0.08	2.1	9
08/10/1998	1530	1.82	197	7.2		7.9	459	24	0.23	0.42	0.05	4.77	0.023	0.12	0.11	0.16	3	10
09/09/1998	1100	1.56	132	9.7		8	513	17.5	0.26	0.3	0.03	5.5	0.012	0.15	0.17	0.17	2.6	6
10/13/1998	1630	1.59	151	13.6		8.4	448	16	0.28	0.35	0.02	4.49	0.011	0.14	0.14	0.16	2.9	5
11/09/1998	1615	1.4	100	16.2		8.7	482	8.5	0.37	0.24	< .02	4.58	0.085	0.08	0.09	0.08	3.6	5
12/08/1998	1415	1.48	116	7.5		7.7	479	12	0.26	0.29	0.05	3.92	0.015	0.14	0.16	0.17	3.5	3
01/06/1999	1100	1.98	126	12.8		7.8	565	0	0.94	1.1	0.6	4.62	0.018	0.1	0.128	0.144	3.6	8
01/24/1999	0126	5	1990				320		0.71	4.5	0.138	3.69			0.097	0.96		
01/24/1999	0531	6.82	3590				293											570
01/24/1999	0816	7.74	4560				258		0.83	3.9	0.198	3.66			0.16	1		
01/24/1999	1038	8.17	5050				243											545
01/24/1999	1249	8.45	5390				238		0.78	2.5	0.184	3.71			0.16	0.72		
01/24/1999	1453	8.72	5730				230											347
01/24/1999	1650	8.89	5950				228		0.77	2.4	0.152	3.62			0.141	0.58		
01/24/1999	1843	9.02	6120				223											274
01/24/1999	2035	9.06	6180				218		0.68	2.2	0.133	3.6			0.136	0.49		
01/24/1999	2225	9.09	6220				215											208
01/25/1999	0015	9.08	6200				209		0.59	1.8	0.128	3.55			0.123	0.42		

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
01/25/1999	0207	9	6100				207											158
01/25/1999	0401	8.83	5870				208		0.68	1	0.107	3.67			0.114	0.3		
01/25/1999	0601	8.56	5530				212											106
01/25/1999	0812	8.05	4910				222		0.59	1.1	0.086	3.94			0.099	0.24		
01/25/1999	1100	6.6	3370				232											90
01/25/1999	1500	5.67	2530				245		0.56	1	0.074	4.21			0.072	0.201		
01/25/1999	1959	5.13	2090				258											59
02/10/1999	1445	2.42	410	13.1		7.9	386	6	0.25	0.46	0.09	4.3	0.024	0.04	0.053	0.064	2.1	6
03/17/1999	1530	3.8	1180	13.9		7.8	305	8	0.34	0.65	< .02	3.48	0.03	0.03	0.039	0.102	5.6	30
03/17/1999	2222	5	1990						0.37	1.1	0.03	3.39	0.018	0.01	0.026	0.195		107
03/18/1999	0324	5.51	2390						0.37	1.4	0.03	3.4	0.019	0.03	0.045	0.29		148
03/18/1999	0807	5.44	2330						0.37	1.3	0.03	3.53	0.016	0.03	0.045	0.26		129
03/18/1999	1258	5.42	2320						0.34	1.4	0.03	3.53	0.017	0.02	0.033	0.199		95
03/18/1999	1755	5.31	2230				263		0.32	0.81	0.02	3.54	0.015	0.02	0.029	0.127		
03/18/1999	2259	5.27	2200				265											63
03/19/1999	0413	5.12	2080				255		0.24	0.64	0.02	3.43	0.012	0.02	0.024	0.114		
03/19/1999	0948	4.93	1940				250											53
04/15/1999	1500	3.81	1180			7.8	283	11	0.22	0.36	0.03	2.9	0.016	0.03	0.03	0.059	6.2	22
05/13/1999	1145	2.74	562	8		7.8	321	17.5	0.18	0.39	0.04	2.69	0.025	0.04	0.055	0.082	3.4	11
06/09/1999	1400	1.69	173	12.4		8.6	407	28.5	0.31	0.29	< .02	2.86	0.023	0.09	0.112	0.123	2.6	4
07/08/1999	1215	1.4	104	9.3		8.2	481	27	0.14	0.44	< .02	2.98	0.03	0.19	< .05	0.042	3.2	5
08/10/1999	1330	1.22	68	11.7		8.5	498	23.5	0.3	0.42	0.03	3.04	0.016	0.19	0.211	0.216	2.5	2
08/31/1999	1130	1.38	98	8.8		8	452	20	0.24	0.44	0.03	2.89	0.012	0.17	0.194	0.204	4.5	10
09/07/1999	1452	2	251						0.31	1	< .02	2.93	0.029	0.13	0.144	0.29		81
09/07/1999	1841	2.14	298						0.36	1.2	0.05	3.17	0.041	0.14	0.158	0.35		122
09/07/1999	2232	2.07	274						0.39	1.1	0.06	3.26	0.042	0.13	0.177	0.33		102
09/08/1999	0220	2.14	298						0.62	1.9	0.18	3.28	0.064	0.64	0.52	1.03		258
09/08/1999	0608	2.09	281						0.53	1.2	0.09	3.48	0.047	0.2	0.21	0.071		120
09/08/1999	1012	2.01	254						0.43	0.95	0.07	3.57	0.049	0.19	0.17	0.29		70
09/08/1999	1440	2	251						0.4	0.79	0.05	3.17	0.044	0.14	0.183	0.26		54
09/08/1999	1857	1.97	242						0.39	0.85	0.04	2.87	0.038	0.14	0.17	0.26		63

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
09/15/1999	1145	1.38	99	7.2		7.7	482	19.5	0.37	0.38	0.02	3.48	0.016	0.19	0.21	0.2	3.3	8
09/16/1999	1350	2.03	260						0.44	1.8	< .02	3.14	0.012	0.2	0.22	0.5		217
09/17/1999	0750	3.44	952						0.58	1.9	0.06	4.68	0.022	0.1	0.126	0.55		283
09/18/1999	0012	2.83	608						0.54	1.4	0.04	5.71	0.027	0.08	0.106	0.31		148
09/19/1999	0438	2.15	302						0.38	1.1	0.02	4.85	0.022	0.07	0.085	0.172		74
09/29/1999	0021	2	251						0.29	1.1	< .02	3.51	0.011	0.14	0.14	0.33		130
09/29/1999	0324	2.58	485						0.27	1.5	0.02	3.63	0.023	0.14	0.14	0.42		177
09/29/1999	0539	2.69	538						0.3	1.3	0.02	3.75	0.018	0.15	0.14	0.4		163
09/29/1999	0751	2.66	523						0.25	1.1	0.02	3.69	0.017	0.14	0.14	0.35		143
09/30/1999	0300	2.98	689						0.54	1.5	0.02	3.14	0.021	0.15	0.175	0.38		
09/30/1999	0645	4.62	1720				309											626
09/30/1999	0838	5.83	2660						0.6	3.4	0.07	3.46	0.022	0.09	0.115	0.96		
09/30/1999	1002	6.44	3220				285											740
09/30/1999	1117	6.62	3390						0.76	3.8	0.08	4.07	0.028	0.07	0.112	1.09		
09/30/1999	1230	6.64	3410				268											676
09/30/1999	1343	6.61	3380						0.72	1.6	0.08	4.37	0.03	0.07	0.105	0.45		
09/30/1999	1458	6.57	3340				254											436
09/30/1999	1612	6.6	3370						0.66	2.8	0.07	4.54	0.029	0.08	0.109	0.62		
09/30/1999	1725	6.65	3420				241											349
09/30/1999	1838	6.71	3480						0.58	2	0.05	4.36	0.024	0.07	0.087	0.42		
09/30/1999	1949	6.76	3530				228											304
09/30/1999	2058	6.84	3610						0.54	2.4	0.04	4.12	0.021	0.05	0.075	0.45		
09/30/1999	2207	6.89	3660				238											337
09/30/1999	2315	6.9	3670						0.54	2.1	0.04	4.18	0.02	0.05	0.066	0.42		
10/01/1999	0023	6.83	3600				248											296
10/01/1999	0134	6.63	3400						0.44	1.6	0.03	4.3	0.021	0.05	0.072	0.34		
10/01/1999	0251	6.34	3130				238											255
10/01/1999	0416	5.92	2740						0.53	1.9	0.03	4.13	0.021	0.04	0.061	0.32		
10/01/1999	0555	5.42	2320				233											208
10/01/1999	0754	4.95	1960						0.49	1.4	0.02	4.21	0.018	0.04	0.058	0.24		
10/01/1999	1010	4.6	267				241											143

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
10/01/1999	1145	4.46	1610						0.48	1.6	0.02	4.4	0.017	0.04	0.059	0.23		
10/14/1999	1530	2.87	629	9.1		7.7	354	14	0.25	0.44	< .02	4.39	< .010	0.05	0.067	0.093	4	17
11/09/1999	1530	1.77	190	12.1		8.2	405	9.5	0.26	0.37	0.04	2.91	< .010	0.06	0.08	0.094		2
12/09/1999	1130	4.59	181	13.8		8.4	328	4	0.19	0.18	< .02	2.9	< .010	0.04	0.066	0.071		1
12/15/1999	0038	4.98	1980						0.58	1.4	0.09	2.62	0.014	0.08	0.103	0.48		226
12/15/1999	0608	4.9	1920						0.77	2.2	0.17	3.1	0.023	0.12	0.158	0.54		167
01/27/2000	1530	2.08	148	14.5		8.1	368	0	0.2	0.28	0.06	3.66	0.023	0.06	0.079	0.086	1.9	M
02/07/2000	1430	2.35	142	15.1		8.1	361	0	0.18	0.22	0.04	3.47	0.017	0.06	0.074	0.081		M
02/15/2000	0247	4.15	1400						0.39	1	0.06	3.51	0.041	0.06	0.082	0.25		110
02/15/2000	1824	4.09	1370						0.34	0.72	0.03	3.65	0.05	0.04	0.057	0.146		46
03/07/2000	1645	2.83	608	13		8.2	313	10.5	0.14	0.26	< .02	3.32	< .010	0.02	0.031	0.047		8
03/12/2000	0824	5.63	2490						1.5	1.6	0.09	2.45	0.026	0.04	0.062	0.42		250
03/12/2000	1221	6.14	2940						2.3	1.8	0.12	2.42	0.024	0.05	0.085	0.49		292
03/13/2000	0058	5.51	2390						0.46	1.1	0.04	2.73	0.014	0.02	0.043	0.192		103
03/21/2000	2309	7.05	3820						0.53	1.8	0.09	2.25	0.014	0.04	0.09	0.54		408
03/22/2000	0142	7.89	4730						0.56	2.3	0.09	2.28	0.015	0.08	0.096	0.59		360
03/22/2000	0803	8.5	5450						0.53	1.9	0.1	2.54	0.013	0.07	0.09	0.52		297
03/22/2000	1624	8.16	5040						0.41	1.2	0.04	2.9	< .010	0.05	0.056	0.3		164
03/22/2000	2106	7.54	4340						0.8	1.9	0.41	3.04	0.01	0.19	0.21	0.45		120
03/24/2000	0402	5.2	2140						0.21	0.52	0.03	3.5	< .010	0.02	0.032	0.111		45
04/22/2000	1443	4.99	1980				247		0.36	0.97	0.06	2.31	0.013	0.04	0.046	0.197		74
04/22/2000	2330	5.44	2330				230		0.4	0.77	0.08	2.35	0.015	0.04	0.053	0.205		82
04/23/2000	0743	5.59	2460				218		0.39	0.7	0.05	2.36	0.015	0.03	0.044	0.173		82
04/23/2000	1555	5.42	2320				221		0.34	0.64	0.04	2.5	0.012	0.03	0.037	0.135		62
04/24/2000	0055	5.08	2050				222		0.29	0.59	0.03	2.53	0.01	0.03	0.033	0.118		48
04/26/2000	1430	3.88	1230	10.2		7.6	257	12.5	0.17	0.34	< .02	2.85	< .010	0.03	0.032	0.069		22
05/15/2000	1145	2.25	346	16.6		8.8	364	18	0.22	0.38	< .02	3.11	0.016	0.03	0.029	0.074	2.9	6
06/19/2000	1400	2.76	572	8.2		7.7	360	21	0.35	0.87	0.05	4.2	0.03	0.06	0.076	0.16		55
07/14/2000	1215	1.88	221	9.9		8.1	440	22.5	0.24	0.38	0.02	3.93	0.013	0.07	0.089	0.108		10
08/08/2000	1600	2.06	277	10.2		8	405	25.5	0.51	0.54	0.02	3.37	0.018	0.09	0.119	0.141		16
09/02/2000	1430	3.49	984			7.4	454		0.43	1.7	0.03	3.71	0.017	0.08	0.115	0.53		315

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
09/05/2000	1415	1.9	228	9.3		8	413	23	0.35	0.47	0.02	3.98	0.016	0.09	0.133	0.151	3.9	11
10/05/2000	1330	1.64	159	10.1		8.2	466	17.2	0.21	0.38	< .02	3.7	< .010	0.1	0.113	0.134	2.3	2
11/14/2000	1600	1.72	180	11.8		8.4	407	9.5	0.23	0.24	< .04	2.81	0.006	0.06	0.073	0.089		M
12/12/2000	1500	1.57	146	17.7	131	8.7	408	2.5	0.15	0.23	< .04	3.48	E .005	0.05	0.059	0.066		2
12/17/2000	1006	3.5	990			7.2	366		0.5	1.7	0.09	3.67	0.017	0.07	0.091	0.42		149
12/17/2000	1411	4.16	1410			7.3	343		0.6	2	0.12	3.74	0.018	0.07	0.099	0.47		223
12/17/2000	1725	4.44	1600			7.2	322		0.74	1.8	0.15	4.02	0.02	0.08	0.111	0.46		210
12/17/2000	2022	4.6	1700			7.3	309		0.8	1.8	0.16	4.34	0.022	0.09	0.122	0.46		213
12/17/2000	2309	4.75	1810			7.3	302		0.77	2.1	0.16	4.52	0.025	0.1	0.126	0.45		203
12/18/2000	0147	4.86	1890			7.3	293		0.68	1.6	0.12	4.55	0.022	0.09	0.12	0.41		194
12/18/2000	0419	4.95	1960			7.3	292		0.64	1.6	0.12	4.7	0.022	0.08	0.111	0.38		183
12/18/2000	0651	4.87	1900			7.4	288		0.59	1.3	0.1	4.58	0.02	0.08	0.105	0.32		152
12/18/2000	0930	4.71	1780			7.4	281		0.56	1.5	0.11	4.59	0.02	0.07	0.092	0.27		123
12/18/2000	1223	4.48	1620			7.4	276		0.48	1.1	0.08	4.41	0.021	0.06	0.077	0.23		101
12/18/2000	1533	4.25	1470			7.4	281		0.44	1	0.06	4.43	0.02	0.05	0.068	0.2		72
12/18/2000	1906	4	1310			7.5	285		0.39	0.87	0.05	4.41	0.016	0.04	0.058	0.173		54
01/24/2001	1600	2.44	423	14.9		8	384	0.7	0.28	0.42	< .04	4.22	0.033	0.03	0.047	0.073		10
01/30/2001	2201	4	1310			7.3	350		0.46	1.3	0.1	3.43	0.028	0.04	0.062	0.27		124
01/31/2001	0822	3.98	1300			7.2	302		3.7	7	0.74	3.34	0.097	0.46	0.56	1.08		105
02/27/2001	1500	2.37	388	16.7		8.8	337	7.5	0.25	0.29	< .04	3.17	0.044	E .01	0.021	0.041	2.3	3
03/19/2001	1330	3.02	711	13.5		8	306	7.5	0.22	0.3	< .04	3.22	0.013	0.02	0.027	0.074		8
03/22/2001	0801	3.98	1300				280		0.37	1.2	0.08	2.88	0.022	0.03	0.037	0.21		110
03/22/2001	1826	4.27	1480				266		0.29	1	0.06	2.85	0.028	0.02	0.03	0.196		96
03/23/2001	0444	4.05	1340				267		0.24	0.99	0.06	2.8	0.02	0.02	0.026	0.153		79
03/23/2001	1624	3.83	1200				264		0.21	0.73	E .03	2.96	0.017	E .01	0.021	0.099		44
03/30/2001	0458	3.97	1290				286		0.45	1.3	0.06	3.1	0.02	0.04	0.053	0.29		185
03/30/2001	1136	6.28	3070				251		0.73	2.9	0.17	2.84	0.031	0.05	0.063	0.83		566
03/30/2001	1612	6.34	3130				241		0.78	2.3	0.19	3.12	0.029	0.06	0.074	0.63		457
03/30/2001	2110	6.04	2850				241		0.6	1.7	0.14	3.47	0.026	0.04	0.056	0.4		275
03/31/2001	0222	5.91	2740				246		0.45	1.1	0.09	3.48	0.023	0.03	0.04	0.29		183
03/31/2001	0817	5.33	2240				251		0.38	0.97	0.07	3.6	0.021	0.02	0.031	0.21		97

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
03/31/2001	1530	4.85	1880				261		0.39	0.93	0.06	3.68	0.019	E .02	0.028	0.157		110
03/31/2001	2353	4.52	1650				269		0.39	0.74	0.05	3.82	0.017	0.02	0.027	0.12		64
04/01/2001	0917	4.28	1490				277		0.29	0.6	E .04	3.86	0.014	E .01	0.025	0.101		46
04/01/2001	1937	4.09	1370				288		0.29	0.58	0.05	3.91	0.02	E .02	0.024	0.087		41
04/02/2001	0648	3.93	1260				290		0.21	0.44	E .03	3.88	0.014	E .01	0.023	0.077		34
05/16/2001	1330	1.92	245	17.1		7.9	394	18.2	0.23	0.35	< .04	3.81	0.019	< .02	0.018	0.042	2.9	8
05/21/2001	1144	2	257			7.2	425		0.28	0.89	0.09	3.75	0.036	0.05	0.063	0.171		38
05/22/2001	0359	2.17	316			7.2	412		0.39	0.8	0.16	3.65	0.044	0.06	0.079	0.142		29
05/22/2001	1120	2.34	381			7.3	403		0.34	0.71	0.11	3.54	0.039	0.05	0.076	0.147		30
05/23/2001	0043	2.39	402			7.2	371		0.4	0.76	0.1	3.1	0.044	0.06	0.089	0.176		42
05/23/2001	0946	3.31	874			7.3	354		0.54	2	0.18	3.08	0.046	0.1	0.108	0.39		166
05/23/2001	1456	3.35	898			7.4	338		0.65	2	0.18	3.16	0.047	0.1	0.135	0.42		173
05/23/2001	2128	2.92	656			7.5	306		0.66	1.4	0.15	2.98	0.052	0.09	0.115	0.28		105
05/24/2001	0534	2.84	613			7.5	310		0.61	1.1	0.12	3.1	0.054	0.06	0.092	0.22		70
05/24/2001	1442	2.57	481			7.6	323		0.44	0.77	0.07	3.18	0.045	0.06	0.083	0.17		42
06/14/2001	1200	1.73	182	9.7		8.1	438	24.5	0.27	0.41	< .04	3.21	0.018	0.05	0.082	0.113		13
06/22/2001	1028	2.99	694			5.8	390		0.5	1.9	0.05	3.54	0.042	0.09	0.11	0.5		243
06/22/2001	1544	3.87	1220			6.6	329		0.63	2.3	0.1	3.76	0.051	0.11	0.134	0.71		460
06/22/2001	1943	4.03	1330			6.8	316		0.83	2.4	0.14	3.58	0.063	0.15	0.185	0.73		419
06/22/2001	2227	5.29	2210			7	266		0.74	3.1	0.07	3.49	0.045	0.09	0.121	0.85		612
06/23/2001	0029	5.72	2570			7	246		0.64	3.2	0.08	2.73	0.037	0.05	0.067	1.12		835
06/23/2001	0218	6.06	2870			7.1	257		0.71	4	0.1	2.83	0.04	0.05	0.079	1		762
06/23/2001	0353	6.57	3340			7.1	249		0.77	2.7	0.12	3.21	0.04	0.08	0.101	0.83		670
06/23/2001	0516	6.9	3670			7.2	232		0.8	3.7	0.13	3.23	0.039	0.07	0.096	0.92		732
06/23/2001	0633	7.16	3940			7.2	224		0.82	4.1	0.11	3.04	0.043	0.07	0.097	0.97		701
06/23/2001	0747	7.24	4020			7.2	228		0.77	2.4	0.11	3.51	0.038	0.09	0.112	0.82		592
06/23/2001	0901	7.19	3970			7.2	230		0.82	2.5	0.11	3.71	0.04	0.1	0.129	0.78		552
06/23/2001	1017	7	3770			7.3	231		0.79	2	0.1	3.74	0.041	0.11	0.131	0.8		547
07/12/2001	1315	1.84	210	11.2		8.2	430	23.5	0.17	0.57	< .04	3.84	0.012	< .02	0.014	0.089		105
08/23/2001	1200	1.56	145	7.6		7.8	468	22	0.39	0.45	E .03	4.33	0.014	0.1	0.125	0.155	4.1	122
09/10/2001	1300	1.25	78	9.9		8	506	24	0.29	0.34	< .04	3.66	0.017	0.09	0.108	0.12		4

		Gage Height	Inst Q.	DO, water	DO, water	pH, water	Cond.	Temp, water	NH3-N + Org N (D)	NH3-N + Org N (T)	NH3-N (D)	NO23-N (D)	NO2-N (D)	o- PO4 (D)	P (D)	TP	TOC	Sus Sed
		ft	cfs	mg/L	% Sat.	whole	msiem	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date	Time	P00065	P00061	P00300	P00301	P00400	P00095	P00010	P00623	P00625	P00608	P00631	P00613	P00671	P00666	P00665	P00680	P80154
10/10/2001	1430	1.19	64	16.1		8.7	527	10.8	0.26	0.46	< .04	4.06	0.009	0.04	0.059	0.067	3.8	2
11/13/2001	1415	1.21	67	13.4		7.3	522	6	0.31	0.35	< .04	3.33	E .007	0.03	0.048	0.053		3
12/04/2001	1349	1.27	76	13.7		7.8	494	6.3	0.29	0.34	< .04	3.14	0.016	0.14	0.164	0.174		2
01/22/2002	1415	1.36	105	16		7.7	438	2.9	0.24	0.3	< .04	3.43	0.011	0.03	0.039	0.044	2.3	7
02/14/2002	1245	1.39	105	15.3		7.3	447	2.7	0.24	0.32	< .04	3.31	0.019	0.05	0.066	0.076		3
03/03/2002	1900	2	257			8.1	448		0.34	0.61	E .02	3.15	0.019	0.12	0.136	0.192		22
03/04/2002	0308	2.15	309			7.9	438		0.32	0.62	< .04	3.31	0.024	0.1	0.126	0.187		22
03/04/2002	1128	2.17	316			7.9	390		0.42	0.66	E .04	2.98	0.031	0.1	0.116	0.18		20
03/04/2002	1908	2.13	303			7.9	361		0.37	0.67	< .04	2.67	0.029	0.07	0.088	0.15		20
03/05/2002	1443	1.88	221			7.9	326		0.3	0.51	E .02	2.41	0.018	0.05	0.064	0.118		12
03/06/2002	1345	1.76	189	14.2		7.7	373	5.3	0.25	0.36	< .04	2.85	0.011	0.05	0.062	0.096		4
03/20/2002	1424	2.99	692			6.9	326		0.45	2	0.06	2.73	0.023	0.07	0.088	0.47		210
03/20/2002	1905	4.21	1440			7	317		0.51	1.7	0.1	3.05	0.026	0.06	0.077	0.7		501
03/20/2002	2206	4.73	1800			7.1	297		0.64	2.6	0.1	3.19	0.029	0.06	0.08	0.75		529
03/21/2002	0039	5.08	2050			6.8	285		0.75	2.3	0.13	3.49	0.027	0.06	0.08	0.77		488
03/21/2002	0301	5.1	2070			6.9	280		0.77	2.8	0.13	3.84	0.029	0.06	0.08	0.65		413
03/21/2002	0526	4.99	1980			7.3	278		0.8	1.8	0.13	4.14	0.028	0.06	0.077	0.57		358
03/21/2002	0758	4.88	1900			6.8	266		0.95	2.3	0.1	4.13	0.022	0.05	0.069	0.43		285
03/21/2002	1036	4.75	1810			6.5	258		0.61	1.9	0.08	4.04	0.02	0.04	0.06	0.34		220
03/21/2002	1323	4.62	1720				260		0.51	1.7	0.07	3.99	0.019	0.04	0.051	0.34		183
03/21/2002	1656	4.43	1590				269		0.46	1.5	0.05	4.05	E .004	0.04	0.049	0.26		145
03/21/2002	2340	4.04	1330				262		0.41	1.3	0.05	4.29	0.024	0.04	0.05	0.2		97
03/22/2002	1307	3.39	922				275		0.38	0.83	0.05	4.33	< .008	0.03	0.039	0.144		54
04/11/2002	1400	1.92	233	12.8		8.5	357	17	0.23	0.35	< .04	2.53	0.012	0.04	0.05	0.064		5
05/07/2002	1015	2.19	323	9.5		7.7	354	16.7	0.21	0.29	< .04	2.87	0.01	0.02	0.035	0.054		10
06/10/2002	1230	1.78	194	8.5	100	8	389	23.5	0.37	0.37	E .02	3.03	0.015	0.06	0.077	0.105		14
07/16/2002	1200	1.26	75	10.2		8.4	498	25.4	0.3	0.42	< .04	2.97	0.021	0.21	0.23	0.22		4
08/24/2002	2004	2.76	572			7.9	426		0.46	2.8	< .04	2.48	0.016	0.06	0.091	0.64		399
08/29/2002	1230	1.31	83	8.2		8.1	464	19.9	0.34	0.49	E .03	2.99	0.018	0.12	0.149	0.165		7
09/12/2002	1230	1.04	43	13		8.6	561	22.3	0.37	0.4	< .04	2.97	0.015	0.13	0.14	0.15		3
09/27/2002	1328	2.41	409			5.6	398		0.61	1.2	0.07	4.79	0.019	0.11	0.132	0.28		121

		Gage Height	Inst Q.	DO, water	DO, water	pH, water	Cond.	Temp, water	NH3-N + Org N (D)	NH3-N + Org N (T)	NH3-N (D)	NO23-N (D)	NO2-N (D)	o- PO4 (D)	P (D)	TP	TOC	Sus Sed
		ft	cfs	mg/L	% Sat.	whole	msiem	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date	Time	P00065	P00061	P00300	P00301	P00400	P00095	P00010	P00623	P00625	P00608	P00631	P00613	P00671	P00666	P00665	P00680	P80154
09/27/2002	2255	2.7	540			6.2	398		0.65	1.9	0.07	4.78	0.025	0.1	0.131	0.4		182
09/28/2002	0559	2.88	634			6.3	396		0.7	1.6	0.07	5.4	0.032	0.1	0.124	0.36		192
09/28/2002	1305	2.85	618			6.8	413		0.69	1.3	0.07	5.94	0.036	0.09	0.117	0.29		137
09/28/2002	2120	2.55	472			7	440		0.79	1.1	0.09	6.29	0.046	0.1	0.128	0.25		93
09/29/2002	0721	2.39	402			7.3	434		0.66	1.1	0.06	6.56	0.039	0.08	0.104	0.2		83
10/07/2002	1030	1.44	105	11	117	8.1	514	17.8	0.27	0.31	< 0.04	4.08	0.008	0.07	0.092	0.103		2
10/07/2002	1100								0.25	0.30	< 0.04	4.25	0.01	0.07	0.084	0.096		4
10/16/2002	1932	4.06	1340			6.1	417		0.49	1.70	< 0.04	6.01	0.012	0.07	0.086	0.410		246
10/17/2002	0135	4.52	1650			6.7	390		0.69	1.90	0.05	6.65	0.022	0.10	0.118	0.520		290
10/17/2002	0717	4.27	1480			7.0	376		0.66	1.60	0.02	7.18	0.023	0.08	0.109	0.390		193
10/17/2002	2047	3.77	1100			7.1	390		0.45	1.00	0.04	7.96	0.021	0.06	0.077	0.220		98
10/18/2002	1547	3.12	765			7.2	415		0.37	0.76	0.04	7.9	0.019	0.05	0.064	0.142		53
11/07/2002	1100	3.17	793	11.6	101	6.5	381	8.7	0.35	0.56	0.04	6.33	0.012	0.04	0.074	0.108		13
12/12/2002	1120	4.45	1600	14.4	107	7.4	343	2.5	0.56	1.30	0.09	4.65	0.011	0.04	0.075	0.220		111
12/13/2002	2139	4.8	1850			6.9	325		0.34	0.79	0.07	4.99	0.014	0.04	0.044	0.143		77
12/14/2002	0354	5.56	2430			7.0	310		0.46	1.40	0.08	4.98	0.013	0.04	0.059	0.280		158
12/14/2002	0910	5.87	2700			7.2	304		0.46	1.50	0.08	5.24	0.011	0.05	0.060	0.300		192
12/14/2002	1851	6.03	2850			7.2	308		0.46	1.30	0.06	5.63	0.017	0.05	0.066	0.290		176
12/15/2002	0924	5.72	2570			7.2	307		0.34	0.92	0.03	5.95	0.012	0.04	0.049	0.182		92
12/16/2002	1345	4.57	1700	13.5	111	7.5	339	6.2	0.34	0.51	0.04	6.45	0.008	0.03	0.032	0.086		34
01/01/2003	1928	4.78	1850			6.5	259		0.41	3.90	< 0.04	3.39	0.008	0.05	0.091	1.200		1390
01/02/2003	0023	8.29	5200			6.9	252		0.51	3.50	0.12	3.44	0.01	0.07	0.099	1.050		909
01/02/2003	0904	9.47	6730			6.7	221		0.52	2.40	0.12	3.64	0.012	0.07	0.089	0.650		549
01/02/2003	1626	10.03	7530			6.6	228		0.44	2.30	0.11	4.01	0.012	0.05	0.071	0.520		387
01/02/2003	1849	10.22	7830			6.5	235		0.42	1.70	0.09	4.17	0.013	0.04	0.060	0.420		286
01/02/2003	2105	10.23	7850			6.6	234		0.42	1.50	0.09	4.24	0.013	0.04	0.054	0.360		242
01/03/2003	0148	9.53	6810			6.6	243		0.37	1.10	0.07	4.52	0.013	0.03	0.045	0.240		188
01/03/2003	0441	8.42	5280			7.0	260		0.37	1.10	0.06	4.88	0.012	0.03	0.048	0.240		202
01/03/2003	0843	7.2	3980			7.1	273		0.31	1.10	E 0.04	4.95	0.012	0.03	0.044	0.189		155
01/04/2003	0112	6.08	2890			7.2	297		0.25	0.66	E 0.02	5.45	0.011	0.03	0.036	0.122		82
01/04/2003	1502	5.47	2360			7.3	317		0.30	0.59	E 0.03	5.51	0.011	0.03	0.035	0.110		67

		Gage Height	Inst Q.	DO, water	DO, water	pH, water	Cond.	Temp, water	NH3-N + Org N (D)	NH3-N + Org N (T)	NH3-N (D)	NO23-N (D)	NO2-N (D)	o- PO4 (D)	P (D)	TP	TOC	Sus Sed
		ft	cfs	mg/L	% Sat.	whole	msiem	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date	Time	P00065	P00061	P00300	P00301	P00400	P00095	P00010	P00623	P00625	P00608	P00631	P00613	P00671	P00666	P00665	P00680	P80154
01/07/2003	1225								< 0.10	< 0.10	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	< 0.004		0
01/07/2003	1330	4.09	1370	15.1	116	7.7	375	4	0.22	0.32	< 0.04	6.05	0.008	0.02	0.027	0.055		24
02/06/2003	1110								< 0.10	< 0.10	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	< 0.004		1
02/06/2003	1115								< 0.10	E 0.06	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	< 0.004		1
02/06/2003	1147								< 0.10	1.00	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	0.080		1
02/06/2003	1148								< 0.10	E 0.06	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	0.007		1
02/06/2003	1205								< 0.10	< 0.10	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	< 0.004		
02/06/2003	1214								< 0.10	< 0.10	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	< 0.004		
02/06/2003	1245	2.33	377	15.9	115	8.3	402	1.8	0.23	0.30	< 0.04	5.22	0.012	E 0.01	0.018	0.035	2.6	3
02/06/2003	1300								0.21	0.32	< 0.04	5.14	0.009	E 0.01	0.018	0.033		5
02/23/2003	1048	4.84	1870			7.2	300		0.69	1.60	0.23	3.37	0.014	0.06	0.076	0.260		120
02/23/2003	1919	5.73	2580			7.1	270		0.68	1.70	0.24	3.31	0.022	0.07	0.080	0.300		61
02/24/2003	0159	5.91	2730			7.2	254		0.76	1.60	0.25	3.08	0.014	0.07	0.100	0.300		163
02/24/2003	1805	4.85	1880			7.2	290		0.61	0.96	0.18	3.44	0.015	0.06	0.079	0.193		170
03/04/2003	1315	3.21	816	17.4	135	8.0	368	4	0.34	0.44	E 0.03	4.3	0.017	0.03	0.042	0.068		8
03/06/2003	0951	4.8	1840			6.2	308		0.58	1.40	0.13	3.46	0.022	0.05	0.074	0.290		231
03/06/2003	1659	6.66	3430			6.6	274		0.92	2.20	0.33	3.11	0.029	0.08	0.114	0.440		329
03/06/2003	2148	7.27	4050			6.8	250		0.92	2.20	0.35	2.94	0.028	0.09	0.118	0.480		360
03/07/2003	0223	6.98	3750			6.9	248		0.81	1.90	0.29	2.96	0.032	0.08	0.109	0.380		273
03/07/2003	1428	5.53	2410			7.2	274		0.71	1.10	0.26	3.31	0.022	0.05	0.075	0.180		84
03/08/2003	0940	4.5	1640			7.2	310		0.44	0.63	0.1	3.97	0.021	0.04	0.051	0.118		42
03/08/2003	2132	4.45	1600			7.3	320		0.39	0.50	0.06	4.08	0.027	0.03	0.050	0.096		28
03/09/2003	1738	5.82	2660			7.3	282		0.60	0.98	0.11	3.6	0.024	0.07	0.088	0.220		140
03/09/2003	2306	7.1	3860			7.4	251		0.70	1.90	0.18	3.19	0.022	0.09	0.114	0.380		262
03/10/2003	1100	6.12	2920			7.4	271		0.53	0.96	0.14	3.47	0.02	0.06	0.081	0.210		142
03/20/2003	1707	6.3	3080			6.7	235		0.38	1.70	0.06	2.81	0.016	0.05	0.065	0.430		410
03/21/2003	0008	9.52	6810			6.7	211		0.63	2.40	0.13	2.74	0.022	0.07	0.086	0.650		537
03/21/2003	0457	10.27	7890			7.3	198		0.55	1.80	0.12	2.82	0.019	0.06	0.079	0.440		314
03/21/2003	0715	10.34	8000			7.4	198		0.52	1.80	0.1	2.91	0.018	0.06	0.072	0.380		238
03/21/2003	0716								0.52	1.50	0.1	2.92	0.019	0.06	0.072	0.340		238
03/21/2003	1408	10.2	7790			7.6	201		0.43	1.10	0.08	3.3	0.017	0.04	0.059	0.250		179

		Gage Height	Inst Q.	DO, water	DO, water	pH, water	Cond.	Temp, water	NH3-N + Org N (D)	NH3-N + Org N (T)	NH3-N (D)	NO23-N (D)	NO2-N (D)	o- PO4 (D)	P (D)	TP	TOC	Sus Sed
		ft	cfs	mg/L	% Sat.	whole	msiem	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date	Time	P00065	P00061	P00300	P00301	P00400	P00095	P00010	P00623	P00625	P00608	P00631	P00613	P00671	P00666	P00665	P00680	P80154
03/21/2003	2111	9.9	7350			7.4	214		0.38	0.85	0.05	3.51	0.015	0.03	0.045	0.191		133
03/24/2003	1200								< 0.10	< 0.10	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	< 0.004		0
03/24/2003	1230								< 0.10	< 0.10	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	0.004		0
03/24/2003	1245	5.07	2040			7.6	268		0.26	0.46	< 0.04	4.04	0.015	0.02	0.026	0.071		34
04/03/2003	0915	3.74	1140	16.7	156	7.7	322	11.4	0.17	0.24	< 0.04	4.18	0.009	0.02	0.020	0.038		15
05/05/2003	1030	2.76	572	10.8	106	7.8	355	14.1	0.20	0.36	< 0.04	4.13	0.014	0.02	0.032	0.057	4.2	10
05/05/2003	1045								0.23	0.39	< 0.04	4.1	0.014	E 0.01	0.032	0.063		14
05/10/2003	1505	4.81	1870			7.8	315		0.50	1.20	E 0.04	2.85	0.018	0.03	0.048	0.290		139
05/11/2003	0020	5.59	2460			7.8	259		0.53	1.80	0.06	2.57	0.022	0.05	0.078	0.380		187
05/11/2003	1057	4.96	1960			7.6	277		0.39	1.10	E 0.04	3.07	0.03	0.03	0.048	0.179		91
05/11/2003	2351	4.48	1620			7.6	283		0.33	0.75	< 0.04	3.25	0.015	0.02	0.038	0.126		60
05/16/2003	0649	4.85	1880			7.1	268		0.41	1.50	< 0.04	2.91	0.015	0.04	0.068	0.340		258
05/16/2003	1151	8.32	5230			7.2	231		0.55	2.70	0.07	2.31	0.021	0.07	0.110	0.630		454
05/16/2003	1458	9.04	6150			7.2	206		0.62	1.80	0.07	2.12	0.02	0.09	0.129	0.580		356
05/16/2003	1748	9.35	6570			7.2	199		0.59	1.60	0.08	2.19	0.022	0.08	0.109	0.470		252
05/16/2003	2032	9.36	6580			7.2	203		0.59	1.30	0.07	2.36	0.02	0.07	0.099	0.350		165
05/16/2003	2318	9.17	6320			7.3	215		0.49	1.40	0.07	2.58	0.019	0.06	0.086	0.280		136
05/17/2003	0802	8.88	5940			7.2	230		0.43	1.00	E 0.03	2.95	0.018	0.03	0.059	0.200		110
05/17/2003	1904	7.29	4070			7.2	237		0.40	0.83	E 0.03	3.12	0.013	0.02	0.044	0.150		76
05/19/2003	0900	5.85	2680			7.3	266		0.29	0.69	< 0.04	3.3	0.011	0.02	0.037	0.110		82
06/03/2003	1215	3.52	1010	8.9	89	7.1	348	14.4	0.26	0.40	< 0.04	4.18	0.011	0.03	0.044	0.090		28
06/03/2003	1716	5.3	2210			7.2	225		0.52	2.20	< 0.04	2.3	0.026	0.07	0.126	0.680		547
06/03/2003	2226	10.35	8030			7.3	178		0.70	2.50	0.07	2.04	0.02	0.11	0.161	0.740		512
06/04/2003	0112	12.12	10900			7.1	172		0.76	2.00	0.07	1.97	0.02	0.11	0.162	0.550		292
06/04/2003	0534	13.53	13500			6.2	167		0.74	1.70	0.06	1.99	0.022	0.10	0.153	0.460		203
06/04/2003	0926	14.01	14400			6.7	170		0.68	1.40	0.06	2.2	0.02	0.10	0.141	0.390		161
06/04/2003	1118	14.05	14500			7.1	172		0.65	1.20	0.05	2.47	0.022	0.09	0.134	0.330		127
06/04/2003	1616	13.76	13900			7.1	192		0.55	1.00	0.05	2.71	0.02	0.08	0.111	0.280		105
06/05/2003	0308	11.84	10400			6.5	222		0.47	0.81	E 0.03	3.24	0.019	0.06	0.081	0.181		57
06/05/2003	1526	9.72	7080			6.5	222		0.42	0.64	E 0.02	3.52	0.019	0.05	0.074	0.159		48
06/06/2003	0930	7.26	4040			7.7	277		0.38	0.53	E 0.03	3.84	0.018	0.04	0.052	0.123		63

Date	Time	Gage Height ft P00065	Inst Q. cfs P00061	DO, water mg/L P00300	DO, water % Sat. P00301	pH, water whole P00400	Cond. msiem P00095	Temp, water C P00010	NH3-N + Org N (D) mg/L P00623	NH3-N + Org N (T) mg/L P00625	NH3-N (D) mg/L P00608	NO23-N (D) mg/L P00631	NO2-N (D) mg/L P00613	o- PO4 (D) mg/L P00671	P (D) mg/L P00666	TP mg/L P00665	TOC mg/L P00680	Sus Sed mg/L P80154
06/07/2003	1641	9.73	7110			7.0	215		0.50	1.60	0.05	2.55	0.019	0.08	0.106	0.400		198
06/07/2003	2313	11	9020			6.9	211		0.51	1.20	E 0.03	2.46	0.021	0.09	0.126	0.300		113
06/08/2003	1155	10.59	8380			6.7	250		0.43	0.80	< 0.04	3.07	0.021	0.05	0.076	0.185		64
07/09/2003	1300								< 0.10	< 0.10	< 0.04	< 0.06	< 0.008	< 0.02	E 0.003	0.005		2
07/09/2003	1400								< 0.1	< 0.10	< 0.04	< 0.06	< 0.008	< 0.02	< 0.004	< 0.004		
07/09/2003	1430	2.43	419	11.3	135	8.2	414	23.3	0.24	0.33	< 0.04	5.3	0.011	0.03	0.047	0.068		8
08/18/2003	1000								0.49	0.70	E 0.03	4.03	0.018	0.09	0.114	0.166		31
08/18/2003	1015	2.57	481	7.6	85	7.3	380	21.3	0.50	1.20	0.04	3.88	0.018	0.09	0.114	0.270		127
09/03/2003	0915	2.87	629		73	7.8	376	19.7	0.52	0.79	0.04	3.96	0.019	0.10	0.123	0.191		36
10/02/2003	1145	3.28	856	9.7	92	8.1	372	12.8	0.24	0.27	<.04	4.33	E.006	0.03	0.046	0.065		11
11/13/2003	1030	3.56	1030	14.5	130	7.6	321	9.5	0.3	0.42	<.04	3.62	0.009	0.03	0.044	0.08		16
11/19/2003	2106	4.67	1760			7.6	317		0.41	1.2	<.04	3.31	0.011	0.07	0.091	0.33		130
11/20/2003	1141	7.23	4010			7.7	241		0.47	1.5	E.03	2.95	0.013	0.05	0.068	0.34		167
11/21/2003	0110	5.89	2720			7.8	243		0.36	0.86	<.04	3.3	0.01	0.03	0.043	0.177		76
12/04/2003	1100	3.05	727	16.5	124	7.7	350	3.5	0.12	0.15	<.04	4.22	<.008	E.02	0.028	0.037	1.6	5
01/08/2004	1215	3.73	1130	13.8	100	7.7	323	1.7	0.22	0.58	<.04	4.49	E.006	0.03	0.037	0.103		89
02/10/2004	1230	3.33	886	14.4	109	7.4	368	3.6	0.29		E.03	4	0.018	0.02	0.036			
03/04/2004	1400	4.86	1890	9.2	78	7.1	265	8	0.2		E.02	3.38	0.02	0.02	0.025			
04/06/2004	1130	3.82	1190	14.5	122	8.3	288	7.6	0.22		<.04	3.49	0.008	E.01	0.019			
04/13/2004	1156	6.32	3110			7.7	237		0.51		0.07	2.81	0.022	0.04	0.069			
04/13/2004	2205	7.15	4020			7.7	234		0.41		0.09	2.77	0.019	0.03	0.051			
04/14/2004	0814	7.6	4420			7.8	230		0.44		0.09	2.82	0.023	0.04	0.056			
04/15/2004	0431	5.97	2790			7.7	254		0.27		0.04	3.42	0.011	0.02	0.032			
05/17/2004	1000	2.94	667	8.3	90	7.8	335	19.2	0.29		E.03	3.45	0.022	E.02	0.027		3.4	
06/03/2004	1115	2.7	542	10.6	114	7.9	379	18.2	0.21		<.04	4.2	0.014	0.04	0.058			
07/13/2004	1230	3.75	1140	6.7	77	7.5	272	21.3	0.55	1.4	0.06	3.17	0.023	0.05	0.078	0.26		167
08/11/2004	0745	2.09	287	6.6	75	7.9	463	20.7	0.37	0.27	<.04	5	E.006	0.05	0.083	0.088	4.7	12
09/08/2004	1215	1.8	199	9.6	108	8.1	483	20	0.23	0.28	<.04	4.66	0.012	0.04	0.053	0.062		31
09/18/2004	1015	9.7	7060			7.8	179		0.6	3.1	E.03	1.8	0.015	0.08	0.112	0.63		595
09/18/2004	1815	11.7	10200			7.8	154		0.54	1.5	E.03	1.93	0.014	0.09	0.122	0.37		181

Table C2. Nutrient Data Used in the Regression Analyses.

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
09/28/93	11:00	0.090	4.100	0.910	5.100	0.120	0.200
10/05/93	11:45	0.020	5.300	0.280	5.600	0.150	0.140
10/20/93	11:55	0.035	4.732	0.685	5.452	0.226	0.259
11/02/93	10:00	0.030	4.000	0.570	4.600	0.090	0.160
11/22/93	12:55	0.422	3.400	0.297	4.119	0.198	0.219
11/30/93	12:15	0.060	3.700	0.340	4.100	0.040	0.100
12/08/93	11:15	0.030	4.100	0.270	4.400	0.040	0.070
12/15/93	12:15	0.015	4.700	0.188	4.903	0.045	0.067
01/10/94	12:15	0.013	5.500	0.300	5.813	0.143	0.151
02/02/94	11:15	0.050	4.500	0.250	4.800	0.040	0.040
02/16/94	11:55	0.037	4.700	0.221	4.958	0.070	0.084
03/08/94	13:00	0.150	4.200	0.750	5.100	0.060	0.180
03/29/94	11:00	0.125	3.200	0.484	3.809	0.158	0.175
04/12/94	11:45	0.024	3.689	0.272	3.985	0.046	0.053
04/14/94	09:15	0.110	2.500	0.990	3.600	0.050	0.260
05/05/94	11:00	0.040	3.500	0.360	3.900	0.050	0.090
05/17/94	11:50	0.015	4.431	0.270	4.716	0.061	0.052
06/07/94	16:30	0.050	5.400	0.550	6.000	0.100	0.140
06/20/94	11:45	0.038	4.344	0.502	4.884	0.163	0.193
07/07/94	11:00	0.040	4.900	0.460	5.400	0.130	0.180
07/19/94	11:40	0.033	4.500	0.307	4.840	0.179	0.210
08/01/94	15:45	0.100	4.200	0.800	5.100	0.150	0.290
08/09/94	12:10	0.032	4.765	0.488	5.285	0.125	0.160
09/20/94	12:05	0.008	4.562	0.534	5.104	0.124	0.145
09/22/94	11:45	0.020	5.100	0.280	5.400	0.100	0.130
10/19/94	11:10	0.009	5.273	0.403	5.685	0.175	0.196
11/02/94	12:25	0.019	4.360	0.755	5.134	0.252	0.307
11/14/94	15:15	< 0.020	3.300	0.280	3.600	0.100	0.110
12/06/94	11:55	0.061	2.987	0.825	3.873	0.090	0.221
12/20/94	12:15	0.100	4.100	0.200	4.400	0.050	0.050
01/11/95	11:30	0.070	3.900	0.230	4.200	0.040	0.080
01/18/95	11:20	0.045	3.340	0.275	3.660	0.062	0.098
01/20/95	14:45	0.120	2.400	1.780	4.300	0.110	0.430
02/14/95	11:50	0.093	4.911	0.248	5.252	0.064	0.066
02/22/95	13:30	0.020	3.700	0.280	4.000	0.040	0.080
03/14/95	12:15	0.011	2.989	0.243	3.243	0.041	0.040
04/04/95	11:55	0.014	3.320	0.314	3.648	0.082	0.096
04/10/95	12:00	0.050	3.000	0.350	3.400	0.080	0.100
05/08/95	15:00	0.060	2.800	0.340	3.200	0.150	0.190
05/30/95	11:45	0.044	2.670	0.508	3.222	0.151	0.208
06/05/95	11:15	< 0.040	2.800	0.360	3.200	0.130	0.140
06/12/95	11:35	0.097	2.900	0.560	3.557	0.198	0.271
06/27/95	11:30	< 0.140	3.200	3.660	7.000	0.110	0.940
07/13/95	12:30	< 0.030	4.300	0.370	4.700	0.070	0.090

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
07/18/95	11:41	0.037	3.787	0.723	4.547	0.089	0.176
08/14/95	13:45	< 0.020	4.100	0.380	4.500	0.130	0.160
08/15/95	10:53	0.027	4.472	0.419	4.918	0.194	0.209
09/13/95	13:30	< 0.020	4.900	0.280	5.200	0.270	0.310
09/25/95	11:45	0.012	4.994	0.754	5.760	0.282	0.340
10/03/95	14:00	0.020	4.500	0.280	4.800	0.270	0.290
10/21/95	10:41	0.020	2.700	3.280	6.000	0.080	2.000
10/21/95	14:52	0.040	3.200	2.660	5.900	0.110	1.700
10/22/95	02:49	0.040	3.900	1.460	5.400	0.060	0.610
10/24/95	11:50	0.036	5.495	0.723	6.254		0.095
11/06/95	12:10	0.008	4.216	0.484	4.708	0.139	0.160
11/06/95	14:30	0.020	4.400	0.280	4.700	0.120	0.120
11/12/95	13:32	0.030	2.700	3.870	6.600	0.130	1.100
11/12/95	18:47	< 0.040	2.800	2.060	4.900	0.090	0.560
11/12/95	23:54	0.030	2.900	2.070	5.000	0.060	0.500
12/04/95	12:10	0.034	3.729	0.546	4.309	0.037	0.060
12/12/95	14:30	0.020	4.400	0.280	4.700	0.040	0.070
01/16/96	15:45	0.040	4.600	0.560	5.200	0.060	0.080
01/19/96	16:16	0.230	2.600	2.570	5.400	0.080	0.750
01/20/96	13:46	0.120	3.000	1.180	4.300	0.050	0.320
01/22/96	5:33	0.040	4.100	0.460	4.600	0.040	0.120
01/24/96	20:53	0.160	3.600	1.340	5.100	0.070	0.340
01/25/96	01:49	0.150	3.500	0.850	4.500	0.070	0.220
01/25/96	17:21	0.060	3.700	0.440	4.200	0.040	0.110
01/27/96	14:16	0.120	3.200	1.380	4.700	0.100	0.400
01/27/96	20:04	0.130	2.700	1.170	4.000	0.080	0.370
01/30/96	00:24	< 0.020	4.000	0.280	4.300	0.030	0.070
01/30/96	11:50	0.047	4.220	0.311	4.578	0.060	0.084
02/06/96	11:50	0.052	5.823	0.427	6.302	0.045	0.062
02/13/96	14:00	0.020	4.700	0.280	5.000	0.030	0.060
02/21/96	02:24	0.070	3.800	2.230	6.100	0.040	0.480
02/21/96	10:38	0.350	3.200	1.850	5.400	0.130	0.370
02/23/96	00:14	0.030	3.300	0.770	4.100	0.030	0.110
02/24/96	03:29	0.020	3.200	0.580	3.800	0.030	0.110
02/25/96	00:44	< 0.030	3.100	0.870	4.000	0.030	0.190
02/25/96	11:10	< 0.020	3.000	0.280	3.300	0.020	0.030
03/05/96	11:45	0.020	3.784	0.225	4.029	0.037	0.033
03/07/96	14:36	0.100	2.700	4.300	7.100	0.030	1.200
03/07/96	22:47	0.120	3.200	2.480	5.800	0.050	0.590
03/08/96	06:04	0.060	3.400	1.440	4.900	0.040	0.350
03/19/96	12:15	0.130	3.800	0.370	4.300	0.040	0.090
03/20/96	07:59	0.100	2.600	1.500	4.200	0.070	0.450
03/20/96	19:19	0.020	2.900	0.980	3.900	0.040	0.220
03/21/96	14:54	0.070	3.200	0.430	3.700	0.050	0.100
04/01/96	19:07	0.050	3.100	3.350	6.500	0.040	1.300

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
04/02/96	08:39	< 0.090	3.200	2.610	5.900	0.060	0.700
04/03/96	08:57	0.020	3.700	0.980	4.700	0.020	0.220
04/24/96	14:00	0.020	3.400	0.280	3.700	0.030	0.050
05/01/96	11:10	0.047	3.317	0.577	3.941	0.055	0.100
05/21/96	13:30	0.020	3.800	0.580	4.400	0.040	0.120
06/12/96	11:30	0.020	3.000	5.780	8.800	0.050	1.800
06/17/96	11:00	0.031	4.607	0.636	5.274		0.116
06/19/96	12:38	0.120	2.100	3.480	5.700	0.070	0.950
06/19/96	15:24	0.120	2.300	2.680	5.100	0.090	0.870
06/19/96	23:13	0.100	3.300	1.000	4.400	0.080	0.270
07/16/96	14:30	< 0.030	4.300	0.170	4.500	0.060	0.050
07/29/96	10:05	0.016	5.374	0.427	5.817	0.069	0.091
08/12/96	10:05	0.015	4.824	0.418	5.257	0.016	0.078
08/20/96	10:30	0.030	4.800	0.370	5.200	0.070	0.080
09/12/96	12:45	0.020	3.200		3.200	0.060	0.060
09/16/96	10:55	0.027	2.383	0.514	2.924	0.035	0.094
10/09/96	12:45	0.020	4.600	0.180	4.800	0.050	0.050
10/28/96	09:55	0.010	3.790	0.270	4.070	0.042	0.047
11/12/96	10:05	0.008	3.883	0.358	4.249	0.045	0.128
11/13/96	15:30	0.030	4.100	0.170	4.300	0.040	0.040
12/02/96	04:04	0.190	2.500	1.610	4.300	0.130	0.490
12/02/96	12:36	< 0.070	2.400	1.430	3.900	0.110	0.410
12/02/96	20:39	0.050	2.700	0.750	3.500	0.060	0.170
12/03/96	10:30	0.049	2.906	0.714	3.669	0.095	0.130
12/13/96	19:42	0.030	2.900	1.070	4.000	0.050	0.260
12/14/96	07:42	0.040	2.900	0.560	3.500	0.050	0.130
12/14/96	10:39	< 0.030	2.900	0.470	3.400	0.040	0.120
12/16/96	15:00	< 0.020	3.550	0.230	3.800	0.023	0.026
01/06/97	09:45	0.011	4.283	0.192	4.486	0.053	0.087
01/23/97	16:00	< 0.020	4.800	0.180	5.000	0.040	0.030
02/03/97	10:12	0.008	3.678	0.314	4.000	0.019	0.038
02/13/97	15:00	< 0.020	3.800	0.180	4.000	0.020	0.020
03/06/97	06:56	0.110	3.400	1.490	5.000	0.050	0.280
03/06/97	13:49	0.070	3.400	1.230	4.700	0.040	0.220
03/06/97	21:02	< 0.030	3.500	0.870	4.400	0.030	0.170
03/14/97	15:42	< 0.020	3.200	1.180	4.400	0.020	0.180
03/14/97	22:17	< 0.250	2.700	2.050	5.000	0.070	0.480
03/15/97	09:44	< 0.070	3.100	0.830	4.000	0.030	0.150
03/17/97	16:15	< 0.020	3.700	0.180	3.900	0.020	0.030
03/24/97	11:05	0.008	4.093	0.092	4.193	0.030	0.048
04/16/97	14:15	< 0.020	3.680	0.300	4.000	0.045	0.069
04/28/97	10:55	0.072	4.163		4.163	0.052	0.122
05/15/97	14:00	0.030	4.210	0.160	4.400	0.085	0.134
05/19/97	09:50	0.031	4.419		4.419	0.084	0.116
06/16/97	10:45	0.029	3.313	0.355	3.697	0.100	0.136

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
06/20/97	12:30	0.060	4.040	0.500	4.600	0.108	0.176
07/08/97	15:15	< 0.020	3.650	0.330	4.000	0.115	0.146
07/21/97	10:25	0.050	3.977	0.430	4.457	0.178	0.199
08/18/97	11:19	0.028	3.821	0.542	4.391	0.181	0.201
08/21/97	11:15	< 0.090	4.030	0.880	5.000	0.190	0.288
09/09/97	16:00	< 0.030	4.460	0.310	4.800	0.183	0.187
09/15/97	10:42	0.023	3.680	0.527	4.230	0.151	0.186
10/07/97	09:45	0.008	3.500	0.592	4.100	0.186	0.220
10/16/97	15:00	< 0.020	4.140	0.310	4.470	0.171	0.206
11/03/97	10:18	0.086	2.300	1.364	3.750	0.080	0.338
11/07/97	16:31	0.120	3.270	1.680	5.070	0.103	0.487
11/07/97	21:34	0.060	3.010	2.440	5.510	0.127	0.775
11/07/97	22:02	0.080	3.020	2.820	5.920	0.124	0.902
11/10/97	17:30	0.140	4.040	0.450	4.630	0.053	0.097
11/18/97	15:00	0.020	4.980	0.170	5.170	0.022	0.048
12/15/97	11:15	0.008	4.078	0.312	4.398	0.047	0.048
12/18/97	12:45	0.020	4.050	0.130	4.200	0.054	0.048
01/06/98	13:45	0.020	3.560	0.220	3.800	0.031	0.057
01/08/98	17:42	0.030	2.420	1.270	3.720	0.079	0.421
01/09/98	04:31	0.020	2.390	0.980	3.390	0.080	0.295
01/11/98	00:55	0.020	3.080	0.460	3.560	0.030	0.094
01/12/98	10:08	0.035	3.542	0.335	3.912	0.051	0.064
01/23/98	18:28	0.020	3.230	0.610	3.860	0.037	0.118
01/24/98	01:30	< 0.040	2.880	0.920	3.840	0.062	0.185
01/25/98	01:36	< 0.020	3.300	0.440	3.760	0.045	0.096
01/28/98	15:00	0.100	3.090	0.340	3.530	0.058	0.097
01/28/98	20:10	0.090	2.720	0.350	3.160	0.058	0.092
01/29/98	19:22	< 0.040	3.610	0.160	3.810	0.023	0.046
02/02/98	10:05	0.016	4.151	0.234	4.401	0.040	0.052
02/05/98	13:18	0.090	2.260	1.410	3.760	0.099	0.371
02/05/98	20:08	0.050	2.250	0.790	3.090	0.073	0.199
02/06/98	21:43	0.030	2.960	0.310	3.300	0.036	0.062
02/24/98	14:00	0.060	1.790	1.140	2.990	0.089	0.343
03/09/98	12:28	0.030	2.480	0.560	3.070	0.033	0.149
03/09/98	23:48	< 0.050	2.290	0.920	3.260	0.042	0.229
03/10/98	23:22	0.020	2.290	0.820	3.130	0.021	0.066
03/16/98	10:20	0.011	3.554	0.189	3.754	0.025	0.036
03/21/98	18:50	0.090	1.940	1.010	3.040	0.067	0.274
03/21/98	23:55	0.070	2.110	0.750	2.930	0.049	0.202
03/22/98	13:06	0.060	2.100	0.430	2.590	0.032	0.102
04/08/98	13:45	0.030	3.590	0.180	3.800	0.019	0.030
04/27/98	10:25	0.026	2.855	0.594	3.475	0.079	0.067
05/11/98	11:23	0.037	2.725	0.463	3.225	0.041	0.092
05/11/98	13:00	< 0.070	2.480	0.220	2.770	0.024	0.059
06/17/98	15:30	< 0.050	4.110	0.300	4.460	0.081	0.106

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
06/22/98	10:15	0.057	4.155	0.643	4.855	0.042	0.110
07/14/98	13:15	0.060	4.840	0.220	5.120	0.070	0.082
07/27/98	10:02	0.021	4.878	0.339	5.238	0.094	0.100
08/10/98	10:45	0.032	4.700	0.478	5.210	0.124	0.157
08/10/98	15:30	0.050	4.770	0.370	5.190	0.123	0.161
09/09/98	11:00	< 0.030	5.500	0.270	5.800	0.153	0.171
09/28/98	10:53	0.039	2.016	0.461	2.516	0.086	0.185
10/13/98	16:30	0.020	4.490	0.330	4.840	0.137	0.161
10/19/98	10:00	0.050	4.120	0.470	4.640	0.083	0.113
11/04/98	09:33	0.008	4.533	0.372	4.913	0.108	0.117
11/09/98	16:15	0.020	4.580	0.220	4.820	0.081	0.083
12/07/98	10:10	0.011	4.040	0.349	4.400	0.068	0.152
12/08/98	14:15	0.050	3.920	0.240	4.210	0.145	0.172
01/06/99	11:00	0.610	4.620	0.490	5.720	0.104	0.144
01/24/99	12:49	0.180	3.710	2.320	6.210		0.723
01/25/99	00:15	0.130	3.550	1.670	5.350		0.425
01/25/99	08:12	0.090	3.940	1.010	5.040		0.238
02/10/99	14:45	0.090	4.300	0.370	4.760	0.045	0.064
03/17/99	15:30	0.020	3.480	0.630	4.130	0.025	0.102
03/17/99	22:22	0.030	3.390	1.070	4.490	0.015	0.195
03/18/99	03:24	0.030	3.400	1.370	4.800	0.033	0.292
03/18/99	17:55	0.020	3.540	0.800	4.360	0.020	0.127
03/22/99	10:10	0.122	3.154	0.838	4.114	0.092	0.165
04/15/99	15:00	0.030	2.900	0.330	3.260	0.026	0.059
04/19/99	10:15	0.020	2.920	0.280	3.220	0.027	0.035
05/13/99	11:45	0.040	2.690	0.350	3.080	0.040	0.082
05/17/99	10:13	0.022	2.580	0.528	3.130	0.031	0.071
06/09/99	14:00	0.020	2.860	0.270	3.150	0.089	0.123
06/14/99	10:00	0.037	3.176	0.473	3.686	0.081	0.131
07/08/99	12:15	0.020	2.980	0.420	3.420	0.186	0.042
07/26/99	10:25	0.033	2.320	0.587	2.940	0.162	0.225
08/10/99	13:30	0.030	3.040	0.390	3.460	0.190	0.216
08/23/99	10:10	0.038	2.702	0.652	3.392	0.084	0.197
08/31/99	11:30	0.030	2.890	0.410	3.330	0.168	0.204
09/07/99	14:52	0.020	2.930	0.980	3.930	0.126	0.286
09/07/99	18:41	< 0.050	3.170	1.150	4.370	0.139	0.346
09/08/99	10:12	0.070	3.570	0.880	4.520	0.189	0.289
09/15/99	11:45	0.020	3.480	0.360	3.860	0.188	0.198
09/16/99	13:50	0.020	3.140	1.780	4.940	0.198	0.503
09/17/99	07:50	< 0.060	4.680	1.840	6.580	0.100	0.549
09/19/99	04:38	0.020	4.850	1.080	5.950	0.068	0.172
09/28/99	09:05	0.113	3.530	0.787	4.430	0.103	0.262
09/29/99	03:24	0.020	3.630	1.480	5.130	0.143	0.422
09/29/99	05:39	0.020	3.750	1.280	5.050	0.155	0.397
09/29/99	07:51	0.020	3.690	1.080	4.790	0.140	0.349

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
09/30/99	13:43	0.080	4.370	1.510	5.960	0.069	0.450
09/30/99	23:15	0.040	4.180	2.060	6.280	0.046	0.417
10/01/99	07:54	0.020	4.210	1.370	5.600	0.043	0.242
10/14/99	15:30	0.020	4.390	0.390	4.800	0.048	0.093
10/25/99	10:00	0.009	1.905	0.291	2.205	0.036	0.067
11/09/99	15:30	0.040	2.910	0.350	3.300	0.062	0.094
11/15/99	09:25	0.008	1.821	0.352	2.181	0.068	0.082
12/09/99	11:30	0.020	2.900	0.180	3.100	0.043	0.071
12/13/99	10:09	0.025	3.059	0.265	3.349	0.013	0.070
12/15/99	00:38	< 0.090	2.620	1.390	4.100	0.077	0.477
12/15/99	06:08	< 0.180	3.100	2.020	5.300	0.122	0.540
01/24/00	09:42	0.027	3.774	0.383	4.184	0.050	0.110
01/27/00	15:30	< 0.060	3.660	0.180	3.900	0.061	0.086
02/07/00	14:30	0.040	3.470	0.190	3.700	0.062	0.081
02/15/00	02:47	0.060	3.510	0.930	4.500	0.061	0.250
02/15/00	18:24	0.030	3.650	0.720	4.400	0.044	0.146
02/22/00	09:45	0.021	2.029	0.479	2.529	0.034	0.069
03/07/00	16:45	0.020	3.320	0.260	3.600	0.021	0.047
03/12/00	08:24	0.090	2.450	1.560	4.100	0.040	0.421
03/12/00	12:21	0.130	2.420	1.650	4.200	0.047	0.487
03/13/00	00:58	0.040	2.730	1.030	3.800	0.018	0.192
03/20/00	10:55	0.009	3.239	0.351	3.599	0.031	0.033
03/22/00	01:42	0.090	2.280	2.230	4.600	0.078	0.592
03/22/00	08:03	0.100	2.540	1.860	4.500	0.073	0.520
03/22/00	21:06	0.410	3.040	1.450	4.900	0.193	0.445
03/24/00	04:02	< 0.030	3.500	0.470	4.000	0.016	0.111
04/17/00	08:43	0.034	2.529	0.526	3.089	0.031	0.059
04/22/00	14:43	0.060	2.310	0.930	3.300	0.035	0.197
04/23/00	07:43	< 0.050	2.360	0.690	3.100	0.033	0.173
04/24/00	00:55	0.030	2.530	0.540	3.100	0.025	0.118
04/26/00	14:30	0.020	2.850	0.330	3.200	0.025	0.069
05/15/00	09:37	0.015	3.326	0.585	3.926	0.026	0.065
05/15/00	11:45	0.020	3.110	0.370	3.500	0.033	0.074
06/19/00	14:00	E 0.050	4.200	0.850	5.100	E 0.057	0.160
06/26/00	10:40	0.041	2.458	0.599	3.098	0.069	0.132
07/14/00	12:15	0.020	3.930	0.350	4.300	0.074	0.108
07/25/00	10:07	0.076	4.339	0.344	4.759	0.160	0.164
08/08/00	16:00	0.020	3.370	0.510	3.900	0.089	0.141
08/28/00	10:19	0.080	4.016	0.610	4.706	0.115	0.132
09/02/00	14:30	0.030	3.710	1.660	5.400	0.082	0.530
09/05/00	14:15	0.020	3.980	0.400	4.400	0.092	0.151
09/25/00	09:56	0.014	3.422	0.356	3.792	0.098	0.105
10/05/00	13:30	0.020	3.700	0.380	4.100	0.099	0.134
10/23/00	10:58	0.008	3.043	0.542	3.593	0.092	0.109
11/14/00	16:00	0.040	2.810	0.250	3.100	0.063	0.089

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
11/27/00	10:38	0.008	3.499	0.752	4.259	0.064	0.079
12/12/00	15:00	0.040	3.480	0.190	3.710	E 0.046	0.066
12/17/00	20:22	E 0.160	4.340	1.600	6.100	E 0.089	0.458
12/18/00	04:19	0.120	4.700	1.480	6.300	0.083	0.377
12/18/00	10:28	0.094	4.601	1.886	6.581	0.111	0.276
12/18/00	12:23	0.080	4.410	1.010	5.500	0.059	0.232
01/22/01	11:00	0.043	3.887	0.577	4.507	0.049	0.074
01/24/01	16:00	0.040	4.220	0.340	4.600	0.030	0.073
01/30/01	22:01	0.100	3.430	1.170	4.700	0.036	0.274
01/31/01	08:22	< 0.740	3.340	5.920	10.000	0.462	1.080
02/05/01	10:30	0.012	4.529	0.328	4.869	0.037	0.057
02/27/01	15:00	0.040	3.170	0.290	3.500	0.014	0.041
03/19/01	13:30	0.040	3.220	0.240	3.500	0.022	0.074
03/22/01	8:01	0.080	2.880	1.140	4.100	0.025	0.208
03/22/01	18:26	0.060	2.850	0.990	3.900	0.023	0.196
03/23/01	16:24	0.030	2.960	0.710	3.700	0.014	0.099
03/26/01	10:23	0.016	3.317	0.264	3.597	0.030	0.041
03/30/01	04:58	0.060	3.100	1.240	4.400	0.041	0.288
03/30/01	16:12	0.190	3.120	2.090	5.400	0.057	0.631
03/31/01	15:30	< 0.060	3.680	0.860	4.600	< 0.018	0.157
04/02/01	06:48	< 0.030	3.880	0.390	4.300	0.015	0.077
04/09/01	09:45	0.062	3.154	0.818	4.034	0.089	0.113
05/14/01	11:19	0.021	3.649	0.419	4.089	0.022	0.057
05/16/01	13:30	< 0.040	3.810	0.350	4.200	0.018	0.042
05/21/01	11:44	E 0.090	3.750	0.760	4.600	0.048	0.171
05/22/01	03:59	< 0.160	3.650	0.590	4.400	0.062	0.142
05/22/01	11:20	E 0.110	3.540	0.550	4.200	0.053	0.147
05/23/01	00:43	< 0.100	3.100	0.700	3.900	0.064	0.176
05/23/01	14:56	< 0.180	3.160	1.860	5.200	0.102	0.425
05/24/01	05:34	< 0.120	3.100	0.980	4.200	0.061	0.224
06/14/01	12:00	0.040	3.210	0.350	3.600	0.053	0.113
06/23/01	00:29	0.080	2.730	3.090	5.900	0.046	1.120
06/23/01	07:47	0.110	3.510	2.380	6.000	0.089	0.819
06/23/01	10:17	< 0.110	3.740	1.950	5.800	0.106	0.802
06/25/01	10:45	0.060	5.110	1.040	6.210	0.043	0.161
07/12/01	13:15	E 0.040	3.840	0.520	4.400	0.020	0.089
07/24/01	10:10	0.023	4.550	0.437	5.010	0.074	0.096
08/06/01	10:45	0.030	3.760	0.460	4.250	0.110	0.130
08/23/01	12:00	< 0.030	4.330	0.440	4.800	0.103	0.155
09/10/01	13:00	< 0.040	3.660	0.300	4.000	0.090	0.120
09/24/01	10:10	0.025	3.500	0.405	3.930	0.029	0.079
10/10/01	14:45	0.040	3.980	0.280	4.300	0.040	0.063
10/22/01	10:14	0.018	3.280	0.502	3.800	0.095	0.066
11/05/01	10:10	0.012	2.490	0.538	3.040	0.026	0.052
11/13/01	14:15	< 0.040	3.330	0.330	3.700	0.030	0.053

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
12/03/01	10:15	0.021	3.290	0.309	3.620	0.130	0.185
12/04/01	13:49	0.040	3.140	0.320	3.500	0.140	0.174
01/14/02	09:40	0.034	3.190	0.426	3.650	0.055	0.084
01/22/02	14:30	0.020	3.380	0.300	3.700	0.030	0.044
02/04/02	09:47	0.020	3.420	0.490	3.930	0.056	0.064
02/14/02	12:45	0.040	3.310	0.250	3.600	0.050	0.076
03/03/02	19:00	0.020	3.150	0.630	3.800	0.120	0.192
03/04/02	10:11	0.046	2.870	0.904	3.820	0.123	0.164
03/04/02	03:08	0.040	3.310	0.550	3.900	0.100	0.187
03/04/02	11:28	0.040	2.980	0.580	3.600	0.100	0.180
03/05/02	14:43	< 0.020	2.410	0.470	2.900	0.050	0.118
03/20/02	22:06	< 0.100	3.190	2.510	5.800	0.060	0.750
03/21/02	03:01	0.130	3.840	2.730	6.700	0.060	0.650
03/21/02	13:23	0.070	3.990	1.640	5.700	0.040	0.340
04/11/02	14:45	0.040	2.470	0.290	2.800	0.040	0.066
04/15/02	11:30	0.147	2.400	2.403	4.950	0.123	0.481
05/07/02	10:15	0.040	2.870	0.290	3.200	0.020	0.054
05/20/02	09:55	0.066	3.280	0.694	4.040	0.055	0.092
06/03/02	10:02	0.043	2.870	0.387	3.300	0.067	0.089
06/10/02	12:30	0.020	3.030	0.350	3.400	0.060	0.105
07/08/02	11:10	0.042	2.890	0.608	3.540	0.096	0.152
07/16/02	12:15	0.040	2.900	0.460	3.400	0.200	0.220
08/05/02	10:35	0.036	2.130	0.764	2.930	0.134	0.157
08/24/02	20:04	0.040	2.480	2.780	5.300	0.060	0.640
08/29/02	12:30	0.030	2.990	0.480	3.500	0.120	0.165
09/09/02	09:46	0.021	2.920	0.659	3.600	0.244	0.252
09/12/02	12:30	0.040	2.970	0.390	3.400	0.130	0.150
09/27/02	13:28	E 0.070	4.790	1.040	5.900	0.110	0.280
09/28/02	05:59	E 0.070	5.400	1.530	7.000	0.100	0.360
09/28/02	21:20	< 0.090	6.290	1.020	7.400	E 0.100	0.250
10/07/02	10:30	< 0.040	4.080	E 0.270	4.390	0.070	0.103
10/16/02	19:32	< 0.040	6.010	E 1.660	7.710	0.070	0.410
10/17/02	01:35	0.050	6.650	1.850	8.550	0.100	0.520
10/17/02	20:47	< 0.040	7.960	E 0.960	8.960	0.060	0.220
10/28/02	10:05	0.016	6.350	0.584	6.950	0.062	0.078
11/07/02	11:00	< 0.040	6.330	E 0.520	6.890	0.040	0.108
11/18/02	10:00	0.044	5.073	0.846	5.963	0.017	0.117
12/02/02	10:25	0.008	6.252	0.232	6.492	0.018	0.031
12/12/02	11:20	0.090	4.650	1.210	5.950	0.040	0.220
12/14/02	03:54	0.080	4.980	1.320	6.380	0.040	0.280
12/14/02	18:51	0.060	5.630	1.240	6.930	0.050	0.290
12/15/02	09:24	E 0.030	5.950	E 0.890	6.870	0.040	0.182
01/02/03	09:04	0.120	3.640	2.280	6.040	0.070	0.650
01/02/03	21:05	0.090	4.240	1.410	5.740	0.040	0.360
01/03/03	08:43	E 0.040	4.950	E 1.060	6.050	0.030	0.189

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
01/06/03	10:20	0.027	6.282	0.553	6.862	0.009	0.037
01/07/03	13:30	< 0.040	6.050	E 0.280	6.370	0.020	0.055
02/03/03	09:55	0.014	6.092	0.246	6.352	0.014	0.025
02/06/03	12:45	< 0.040	5.220	E 0.260	5.520	E 0.010	0.035
02/23/03	10:48	0.230	3.370	1.370	4.970	0.060	0.260
02/24/03	01:59	0.250	3.080	1.350	4.680	0.070	0.300
02/24/03	18:05	0.180	3.440	0.780	4.400	0.060	0.193
03/03/03	10:10	0.085	5.030	0.515	5.630	0.021	0.075
03/04/03	13:15	E 0.030	4.300	E 0.410	4.740	0.030	0.068
03/06/03	16:59	0.330	3.110	1.870	5.310	0.080	0.440
03/06/03	21:48	0.350	2.940	1.850	5.140	0.090	0.480
03/09/03	17:38	0.110	3.600	0.870	4.580	0.070	0.220
03/21/03	00:08	0.130	2.740	2.270	5.140	0.070	0.650
03/21/03	07:15	0.100	2.910	1.700	4.710	0.060	0.380
03/21/03	21:11	0.050	3.510	0.800	4.360	0.030	0.191
04/03/03	09:15	< 0.040	4.180	E 0.200	4.420	0.020	0.038
04/14/03	10:07	0.012	3.820	0.638	4.470	0.017	0.036
05/05/03	10:30	< 0.040	4.130	E 0.320	4.490	0.020	0.057
05/10/03	15:05	E 0.040	2.850	E 1.160	4.050	0.030	0.290
05/11/03	00:20	0.060	2.570	1.740	4.370	0.050	0.380
05/11/03	10:57	E 0.040	3.070	E 1.060	4.170	0.030	0.179
05/16/03	11:51	0.070	2.310	2.630	5.010	0.070	0.630
05/16/03	20:32	0.070	2.360	1.230	3.660	0.070	0.350
05/17/03	19:04	E 0.030	3.120	E 0.800	3.950	0.020	0.150
05/19/03	09:53	0.055	3.260	0.595	3.910	0.044	0.104
06/02/03	09:55	0.034	3.480	0.776	4.290	0.044	0.084
06/03/03	12:15	< 0.040	4.180	E 0.360	4.580	0.030	0.090
06/04/03	01:12	0.070	1.970	1.930	3.970	0.110	0.550
06/04/03	11:18	0.050	2.470	1.150	3.670	0.090	0.330
06/05/03	15:26	E 0.020	3.520	E 0.620	4.160	0.050	0.159
06/07/03	16:41	0.050	2.550	1.550	4.150	0.080	0.400
06/07/03	23:13	E 0.030	2.460	E 1.170	3.660	0.090	0.300
06/08/03	11:55	< 0.040	3.070	E 0.760	3.870	0.050	0.185
07/09/03	14:30	< 0.040	5.300	E 0.290	5.630	0.030	0.068
07/14/03	10:20	0.031	5.660	0.459	6.150	0.050	0.087
08/18/03	10:15	0.040	3.880	1.160	5.080	0.090	0.270
08/25/03	09:35	0.016	5.508	0.474	5.998	0.050	0.068
09/03/03	09:15	0.040	3.960	0.750	4.750	0.100	0.191
09/08/03	10:10	0.017	4.614	0.693	5.324	0.035	0.088
10/02/03	11:45	< 0.040	4.330	0.230	4.600	0.030	0.065
10/20/03	10:35	0.010	4.295	0.220	4.525	0.016	0.044
11/03/03	10:32	0.011	3.488	0.329	3.828	0.032	0.053
11/13/03	10:30	< 0.040	3.620	0.380	4.000	0.030	0.080
11/19/03	21:06	< 0.040	3.310	1.160	4.500	0.070	0.330
11/20/03	11:41	0.030	2.950	1.470	4.400	0.050	0.340

Date	Time	dNH_4 (mg/L)	dNO_{23} (mg/L)	TON (mg/L)	TN (mg/L)	dPO_4 (mg/L)	TP (mg/L)
11/21/03	01:10	< 0.040	3.300	0.820	4.200	0.030	0.177
12/04/03	11:00	< 0.040	4.220	0.110	4.400	E 0.020	0.037
12/08/03	10:40	0.014	4.012	0.376	4.402	0.021	0.030
01/06/04	10:18	0.069	3.357	0.561	3.987	0.068	0.093
01/08/04	12:15	< 0.040	4.490	0.540	5.100	0.030	0.103
02/09/04	09:55	0.113	3.605	0.541	4.259	0.060	0.098
02/10/04	12:30	E 0.030	4.000			0.020	
03/04/04	14:00	E 0.030	3.380			0.020	
03/08/04	10:05	0.014	3.478	0.510	4.002	0.032	0.056
04/06/04	11:30	< 0.040	3.490			E 0.010	
04/13/04	11:56	0.070	2.810			0.040	
04/14/04	08:14	0.090	2.820			0.040	
04/15/04	04:31	0.040	3.420			0.020	
04/19/04	10:34	0.016	3.578	0.525	4.119	0.028	0.048
05/17/04	10:00	0.030	3.253	0.515	3.798	0.041	0.068
05/17/04	10:00	E 0.030	3.450			E 0.020	
06/03/04	11:15	< 0.040	4.200			0.040	
06/14/04	10:10	0.022	4.353	0.578	4.953	0.041	0.078
07/12/04	10:10	0.061	4.304	0.800	5.165	0.066	0.112
07/13/04	12:30	0.060	3.170	1.340	4.600	0.050	0.260
08/11/04	07:45	< 0.040	5.000	0.230	5.300	0.050	0.088
08/16/04	10:01	0.029	2.933	0.408	3.370	0.055	0.070
09/08/04	12:15	< 0.040	4.660	0.240	4.900	0.040	0.062
09/13/04	10:46	0.020	3.259	0.294	3.573	0.053	0.101
09/18/04	10:15	E 0.030	1.800	3.070	4.900	0.080	0.630
09/19/04	02:15	E 0.030	2.200	1.170	3.400	0.080	0.290
09/20/04	06:15	< 0.040	3.160	0.560	3.800	0.030	0.118

Table C3. Suspended Sediment Data Used in the Regression Analysis

Date	Time	SSC (mg/L)	Date	Time	SSC (mg/L)	Date	Time	SSC (mg/L)
04/15/1993	11:00	16	02/25/1996	16:43	78	11/10/1997	17:30	42
05/04/1993	09:00	14	03/07/1996	19:12	410	11/18/1997	15:00	9
06/01/1993	10:30	19	03/08/1996	02:19	378	12/18/1997	12:45	7
06/09/1993	12:30	51	03/08/1996	19:25	136	01/06/1998	13:45	10
07/06/1993	12:15	21	03/20/1996	10:48	533	01/08/1998	15:29	385
08/18/1993	13:30	5	03/20/1996	16:32	308	01/09/1998	02:51	185
08/30/1993	10:00	3	03/21/1996	18:56	199	01/11/1998	04:40	41
09/28/1993	11:00	125	04/02/1996	01:42	1010	01/23/1998	21:45	88
10/05/1993	11:45	7	04/02/1996	06:18	749	01/24/1998	05:11	80
11/02/1993	10:00	21	04/03/1996	04:59	175	01/25/1998	06:08	34
11/30/1993	12:15	44	04/24/1996	14:00	4	01/28/1998	11:02	86
12/08/1993	11:15	27	05/21/1996	13:30	25	01/28/1998	22:26	148
04/14/1994	09:15	155	06/12/1996	11:30	752	01/29/1998	23:30	38
05/05/1994	11:00	20	06/19/1996	13:23	758	02/05/1998	11:18	204
08/01/1994	15:45	102	06/19/1996	16:02	649	02/05/1998	18:29	136
09/22/1994	11:45	3	06/20/1996	00:27	120	02/07/1998	00:51	42
11/14/1994	15:15	1	07/16/1996	14:30	5	02/24/1998	14:00	161
01/11/1995	11:30	8	08/20/1996	10:30	3	03/09/1998	08:37	54
02/22/1995	13:00	4	09/12/1996	12:45	11	03/10/1998	02:29	72
03/16/1995	13:00	4	10/09/1996	12:45	4	03/11/1998	02:54	29
03/16/1995	13:00	4	11/13/1996	15:30	5	03/21/1998	17:33	134
04/10/1995	11:45	7	12/02/1996	02:12	213	03/21/1998	22:39	112
05/08/1995	14:00	14	12/02/1996	11:18	171	03/22/1998	14:38	45
06/05/1995	11:00	15	12/02/1996	19:16	86	04/08/1998	13:45	5
06/27/1995	11:30	698	12/13/1996	18:08	148	05/11/1998	13:00	35
07/13/1995	12:30	35	12/14/1996	06:15	82	06/17/1998	15:30	14
08/14/1995	13:45	3	12/14/1996	12:09	67	07/14/1998	13:15	9
09/13/1995	13:30	3	12/16/1996	15:00	22	08/10/1998	15:30	10
10/03/1995	14:00	2	01/23/1997	16:00	2	09/09/1998	11:00	6
11/06/1995	14:30	1	02/13/1997	15:00	2	10/13/1998	16:30	5
12/12/1995	14:30	14	03/06/1997	03:19	129	11/09/1998	16:15	5
01/16/1996	15:45	8	03/06/1997	10:23	179	12/08/1998	14:15	3
01/21/1996	09:11	72	03/07/1997	01:00	67	01/06/1999	11:00	8
01/21/1996	20:43	65	03/14/1997	19:30	280	01/24/1999	10:38	545
01/23/1996	11:37	57	03/15/1997	01:00	251	01/24/1999	22:25	208
01/25/1996	04:14	122	03/15/1997	20:36	62	01/25/1999	11:00	90
01/25/1996	14:29	85	03/17/1997	16:15	6	02/10/1999	14:45	6
01/26/1996	03:33	52	04/16/1997	14:15	2	03/17/1999	15:30	30
01/27/1996	15:54	295	05/15/1997	14:00	3	03/17/1999	22:22	107
01/28/1996	17:47	235	06/20/1997	12:30	22	03/18/1999	08:07	129
01/29/1996	20:49	41	07/08/1997	15:15	5	03/18/1999	22:59	63
02/13/1996	14:00	11	08/21/1997	11:15	38	04/15/1999	15:00	22
02/21/1996	06:45	334	09/09/1997	16:00	7	05/13/1999	11:45	11
02/21/1996	23:22	139	10/16/1997	15:00	3	06/09/1999	14:00	4
02/22/1996	18:56	128	11/07/1997	20:01	653	07/08/1999	12:15	5
02/24/1996	08:59	69	11/07/1997	22:00	625	08/10/1999	13:30	2
02/25/1996	05:52	80	11/07/1997	23:31	500	08/31/1999	11:30	10

Date	Time	SSC (mg/L)	Date	Time	SSC (mg/L)	Date	Time	SSC (mg/L)
09/07/1999	18:41	122	03/22/2001	08:01	110	11/07/2002	1100	13
09/08/1999	02:20	258	03/22/2001	18:26	96	12/12/2002	1120	111
09/08/1999	14:40	54	03/23/2001	16:24	44	12/14/2002	0354	158
09/15/1999	11:45	8	03/30/2001	04:58	185	12/14/2002	1851	176
09/16/1999	13:50	217	03/30/2001	16:12	457	12/16/2002	1345	34
09/17/1999	07:50	283	03/31/2001	15:30	110	01/02/2003	0904	549
09/19/1999	04:38	74	04/02/2001	06:48	34	01/02/2003	2105	242
09/29/1999	00:21	130	05/16/2001	13:30	8	01/03/2003	0843	155
09/29/1999	05:39	163	05/21/2001	11:44	38	01/07/2003	1330	24
09/29/1999	07:51	143	05/22/2001	03:59	29	02/06/2003	1245	3
09/30/1999	12:30	676	05/22/2001	11:20	30	02/23/2003	1048	120
09/30/1999	22:07	337	05/23/2001	00:43	42	02/24/2003	0159	163
10/01/1999	05:55	208	05/23/2001	14:56	173	02/24/2003	1805	170
10/14/1999	15:30	17	05/24/2001	05:34	70	03/04/2003	1315	8
11/09/1999	15:30	2	06/14/2001	12:00	13	03/06/2003	0951	231
12/09/1999	11:30	1	06/23/2001	00:29	835	03/06/2003	2148	360
12/15/1999	00:38	226	06/23/2001	07:47	592	03/08/2003	2132	28
12/15/1999	06:08	167	06/23/2001	10:17	547	03/21/2003	0008	537
02/15/2000	02:47	110	07/12/2001	13:15	105	03/21/2003	0715	238
02/15/2000	18:24	46	08/23/2001	12:00	122	03/21/2003	2111	133
03/07/2000	16:45	8	09/10/2001	13:00	4	04/03/2003	0915	15
03/12/2000	08:24	250	10/10/2001	14:30	2	05/05/2003	1030	10
03/12/2000	12:21	292	11/13/2001	14:15	3	05/11/2003	2351	60
03/13/2000	00:58	103	12/04/2001	13:49	2	05/16/2003	2032	165
03/21/2000	23:09	408	01/22/2002	14:15	7	05/17/2003	1904	76
03/22/2000	08:03	297	02/14/2002	12:45	3	06/03/2003	1215	28
03/22/2000	21:06	120	03/03/2002	19:00	22	06/04/2003	0112	292
03/24/2000	04:02	45	03/04/2002	03:08	22	06/04/2003	1118	127
04/22/2000	14:43	74	03/04/2002	11:28	20	06/05/2003	1526	48
04/23/2000	07:43	82	03/05/2002	14:43	12	06/07/2003	1641	198
04/24/2000	00:55	48	03/06/2002	13:45	4	06/07/2003	2313	113
04/26/2000	14:30	22	03/20/2002	19:05	501	06/08/2003	1155	64
05/15/2000	11:45	6	03/21/2002	03:01	413	07/09/2003	1430	8
06/19/2000	14:00	55	03/21/2002	13:23	183	08/18/2003	1015	127
07/14/2000	12:15	10	04/11/2002	14:00	5	09/03/2003	0915	36
08/08/2000	16:00	16	05/07/2002	10:15	10	10/02/2003	1145	11
09/02/2000	14:30	315	06/10/2002	12:30	14	11/13/2003	1030	16
09/05/2000	14:15	11	07/16/2002	12:00	4	11/19/2003	2106	130
10/05/2000	13:30	2	08/24/2002	20:04	399	11/20/2003	1141	167
12/12/2000	15:00	2	08/29/2002	12:30	7	11/21/2003	0110	76
12/17/2000	20:22	213	09/12/2002	12:30	3	12/04/2003	1100	5
12/18/2000	06:51	152	09/27/2002	13:28	121	01/08/2004	1215	89
12/18/2000	15:33	72	09/28/2002	05:59	192	07/13/2004	1230	167
01/24/2001	16:00	10	09/28/2002	21:20	93	08/11/2004	0745	12
01/30/2001	22:01	124	10/07/2002	1030	2	09/08/2004	1215	31
01/31/2001	08:22	105	10/16/2002	1932	246	09/18/2004	1015	595
02/27/2001	15:00	3	10/17/2002	0135	290	09/19/2004	0215	125
03/19/2001	13:30	8	10/17/2002	2047	98	09/20/2004	0615	71

APPENDIX D

Point Source Monitoring Data

Table D1. Average Monthly Flow and Nutrient Load Data for Significant Point Sources (WYs 1994 – 2004)

Antrim Township WWTF				PA0080519							
DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)	DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)	DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)
10/31/93	0.44	86.18	19.27	05/31/96	0.47	89.42	19.29	12/31/98	0.49	93.87	23.06
11/30/93	0.44	86.18	19.27	06/30/96	0.47	89.42	19.29	01/31/99	0.83	158.40	45.65
12/31/93	0.44	86.18	19.27	07/31/96	0.47	89.42	19.29	02/28/99	0.83	158.40	45.65
01/31/94	0.47	89.42	19.29	08/31/96	0.47	89.42	19.29	03/31/99	0.83	158.40	45.65
02/28/94	0.47	89.42	19.29	09/30/96	0.47	89.42	19.29	04/30/99	0.83	158.40	45.65
03/31/94	0.47	89.42	19.29	10/31/96	0.47	89.42	19.29	05/31/99	0.83	158.40	45.65
04/30/94	0.47	89.42	19.29	11/30/96	0.47	89.42	19.29	06/30/99	0.83	158.40	45.65
05/31/94	0.47	89.42	19.29	12/31/96	0.47	89.42	19.29	07/31/99	0.83	158.40	45.65
06/30/94	0.47	89.42	19.29	01/31/97	0.47	89.42	19.29	08/31/99	0.83	158.40	45.65
07/31/94	0.47	89.42	19.29	02/28/97	0.47	89.42	19.29	09/30/99	0.83	158.40	45.65
08/31/94	0.47	89.42	19.29	03/31/97	0.47	89.42	19.29	10/31/99	0.83	158.40	45.65
09/30/94	0.47	89.42	19.29	04/30/97	0.47	89.42	19.29	11/30/99	0.83	158.40	45.65
10/31/94	0.47	89.42	19.29	05/31/97	0.47	89.42	19.29	12/31/99	0.83	158.40	45.65
11/30/94	0.47	89.42	19.29	06/30/97	0.47	89.42	19.29	01/31/00	0.27	47.84	3.26
12/31/94	0.47	89.42	19.29	07/31/97	0.47	89.42	19.29	02/29/00	0.41	62.03	6.79
01/31/95	0.50	92.66	19.32	08/31/97	0.47	89.42	19.29	03/31/00	0.61	112.16	10.55
02/28/95	0.50	92.66	19.32	09/30/97	0.47	89.42	19.29	04/30/00	0.55	114.31	9.10
03/31/95	0.50	92.66	19.32	10/31/97	0.47	89.42	19.29	05/31/00	0.55	77.59	8.54
04/30/95	0.50	92.66	19.32	11/30/97	0.47	89.42	19.29	06/30/00	0.62	61.98	8.83
05/31/95	0.50	92.66	19.32	12/31/97	0.47	89.42	19.29	07/31/00	0.54	49.75	25.33
06/30/95	0.50	92.66	19.32	01/31/98	0.49	93.87	23.06	08/31/00	0.54	77.02	8.02
07/31/95	0.50	92.66	19.32	02/28/98	0.49	93.87	23.06	09/30/00	0.49	41.14	8.19
08/31/95	0.50	92.66	19.32	03/31/98	0.49	93.87	23.06	10/31/00	0.43	25.23	6.13
09/30/95	0.50	92.66	19.32	04/30/98	0.49	93.87	23.06	11/30/00	0.37	21.85	3.12
10/31/95	0.50	92.66	19.32	05/31/98	0.49	93.87	23.06	12/31/00	0.33	21.83	4.37
11/30/95	0.50	92.66	19.32	06/30/98	0.49	93.87	23.06	01/31/01	0.35	47.88	5.58
12/31/95	0.50	92.66	19.32	07/31/98	0.49	93.87	23.06	02/28/01	0.38	36.27	5.68
01/31/96	0.47	89.42	19.29	08/31/98	0.49	93.87	23.06	03/31/01	0.44	43.05	7.36
02/29/96	0.47	89.42	19.29	09/30/98	0.49	93.87	23.06	04/30/01	0.67	58.70	11.18
03/31/96	0.47	89.42	19.29	10/31/98	0.49	93.87	23.06	05/31/01	0.50	21.41	8.39
04/30/96	0.47	89.42	19.29	11/30/98	0.49	93.87	23.06	06/30/01	0.56	18.69	4.67

Antrim Township WWTF						
DMR Date	**Flow (mgd)**	**TN (lbs/d)**	**TP (lbs/d)**	**DMR Date**	**Flow (mgd)**	**TN (lbs/d)**
07/31/01	0.49	15.38	4.05	04/30/04	0.87	42.06
08/31/01	0.53	13.58	4.38	05/31/04	0.76	39.85
09/30/01	0.48	19.14	3.99	06/30/04	0.66	34.09
10/31/01	0.44	49.16	6.65	07/31/04	0.52	26.90
11/30/01	0.40	31.69	3.37	08/31/04	0.54	27.83
12/31/01	0.37	34.86	3.74	09/30/04	0.63	32.44
01/31/02	0.40	43.15	1.69			
02/28/02	0.46	60.88	4.95			
03/31/02	0.47	30.85	4.35			
04/30/02	0.49	27.75	5.30			
05/31/02	0.50	17.98	6.27			
06/30/02	0.52	22.82	7.32			
07/31/02	0.51	18.96	6.32			
08/31/02	0.50	27.54	7.09			
09/30/02	0.50	18.25	5.81			
10/31/02	0.56	31.83	7.49			
11/30/02	0.65	34.87	8.17			
12/31/02	0.79	63.04	5.91			
01/31/03	0.96	89.34	10.37			
02/28/03	0.56	33.24	8.89			
03/31/03	1.22	71.32	15.28			
04/30/03	0.81	45.00	6.72			
05/31/03	0.91	50.59	9.06			
06/30/03	1.50	82.55	11.26			
07/31/03	0.54	29.57	8.96			
08/31/03	0.50	26.81	7.96			
09/30/03	0.79	41.69	7.94			
10/31/03	0.66	33.04	7.16			
11/30/03	0.69	33.49	3.46			
12/31/03	1.01	47.01	6.72			
01/31/04	0.64	25.71	7.50			
02/29/04	0.80	47.51	12.05			
03/31/04	0.73	32.28	12.18			

Chambersburg Borough WS				PA0026051							
DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)	DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)	DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)
10/31/93	6.34	1198.62	304.29	07/31/96	6.49	1267.17	167.87	04/30/99	6.32	701.36	102.30
11/30/93	6.34	1198.62	304.29	08/31/96	5.27	1028.97	140.71	05/31/99	4.68	519.36	75.76
12/31/93	6.34	1198.62	304.29	09/30/96	6.07	1185.17	130.67	06/30/99	4.36	483.85	53.12
01/31/94	6.64	1295.97	311.81	10/31/96	4.92	960.63	125.62	07/31/99	3.92	435.02	176.63
02/28/94	6.64	1295.97	311.81	11/30/96	4.94	964.53	132.31	08/31/99	4.02	446.12	132.16
03/31/94	6.64	1295.97	311.81	12/31/96	5.52	1077.78	124.36	09/30/99	4.50	499.39	114.15
04/30/94	6.64	1295.97	311.81	01/31/97	4.88	953.21	159.68	10/31/99	4.67	518.25	101.31
05/31/94	6.64	1295.97	311.81	02/28/97	4.88	953.21	155.57	11/30/99	4.21	467.21	99.76
06/30/94	6.64	1295.97	311.81	03/31/97	5.64	1101.21	150.12	12/31/99	4.42	490.51	105.11
07/31/94	6.64	1295.97	311.81	04/30/97	4.60	898.15	163.51	01/31/00	4.15	500.02	98.34
08/31/94	6.64	1295.97	311.81	05/31/97	4.56	890.34	173.88	02/29/00	5.17	418.01	91.02
09/30/94	6.64	1295.97	311.81	06/30/97	4.96	968.44	176.72	03/31/00	5.89	422.17	70.28
10/31/94	6.64	1295.97	311.81	07/31/97	5.04	984.06	171.58	04/30/00	5.87	318.37	124.41
11/30/94	6.64	1295.97	311.81	08/31/97	5.02	980.15	170.06	05/31/00	5.27	287.14	112.13
12/31/94	6.64	1295.97	311.81	09/30/97	5.00	976.25	155.62	06/30/00	3.85	319.32	101.83
01/31/95	6.93	1393.48	319.26	10/31/97	4.54	886.43	118.19	07/31/00	3.03	206.30	75.34
02/28/95	6.93	1393.48	319.26	11/30/97	5.43	1060.21	128.67	08/31/00	3.75	317.28	95.44
03/31/95	6.93	1393.48	319.26	12/31/97	4.03	786.86	133.50	09/30/00	4.74	344.09	130.52
04/30/95	6.93	1393.48	319.26	01/31/98	6.39	1047.17	154.49	10/31/00	4.41	422.43	107.82
05/31/95	6.93	1393.48	319.26	02/28/98	7.26	1189.74	175.52	11/30/00	4.32	369.47	112.82
06/30/95	6.93	1393.48	319.26	03/31/98	7.26	1189.74	175.52	12/31/00	4.73	365.86	102.22
07/31/95	6.93	1393.48	319.26	04/30/98	6.21	1017.67	150.14	01/31/01	4.62	283.72	111.79
08/31/95	6.93	1393.48	319.26	05/31/98	6.67	1093.05	161.26	02/28/01	4.94	372.21	109.23
09/30/95	6.93	1393.48	319.26	06/30/98	5.63	922.62	136.12	03/31/01	5.37	409.09	83.79
10/31/95	6.93	1393.48	319.26	07/31/98	4.98	816.10	120.40	04/30/01	5.55	404.74	88.45
11/30/95	6.93	1393.48	319.26	08/31/98	4.81	788.24	116.29	05/31/01	4.31	270.44	107.53
12/31/95	6.93	1393.48	319.26	09/30/98	4.62	757.11	111.70	06/30/01	4.31	362.86	127.67
01/31/96	5.52	1077.78	142.78	10/31/98	4.10	671.89	99.13	07/31/01	3.74	314.87	78.64
02/29/96	6.65	1298.41	166.46	11/30/98	5.65	925.90	136.60	08/31/01	4.20	404.42	94.62
03/31/96	6.58	1284.74	174.04	12/31/98	4.22	691.56	102.03	09/30/01	4.42	301.68	47.58
04/30/96	5.86	1144.16	175.05	01/31/99	5.15	571.52	107.43	10/31/01	4.55	358.77	7.97
05/31/96	5.92	1155.88	194.13	02/28/99	4.61	511.60	64.24	11/30/01	4.51	288.26	54.19
06/30/96	5.99	1169.55	177.93	03/31/99	5.52	612.58	79.68	12/31/01	4.48	297.93	110.27

Chambersburg Borough WS			
DMR Date	**Flow (mgd)**	**TN (lbs/d)**	**TP (lbs/d)**
01/31/02	4.40	356.12	71.59
02/28/02	4.20	323.46	75.35
03/31/02	4.57	300.48	73.98
04/30/02	4.90	534.38	45.79
05/31/02	4.97	379.86	16.59
06/30/02	5.17	523.70	22.00
07/31/02	4.32	409.12	64.52
08/31/02	4.52	441.26	11.31
09/30/02	4.61	401.58	21.16
10/31/02	5.52	403.02	67.25
11/30/02	5.98	393.19	89.82
12/31/02	5.81	345.17	43.15
01/31/03	6.49	382.86	56.32
02/28/03	4.83	351.83	95.92
03/31/03	7.16	347.11	119.49
04/30/03	5.82	372.47	97.12
05/31/03	6.68	435.31	94.20
06/30/03	7.97	480.14	117.04
07/31/03	5.08	333.17	67.82
08/31/03	5.19	532.22	105.67
09/30/03	6.29	550.56	121.24
10/31/03	5.68	421.33	104.27
11/30/03	6.01	430.77	157.46
12/31/03	6.90	468.07	122.63
01/31/04	5.64	399.07	119.06
02/29/04	6.28	465.32	127.33
03/31/04	6.63	443.67	121.15
04/30/04	7.51	406.06	118.43
05/31/04	6.21	383.44	129.54
06/30/04	6.25	367.66	128.29
07/31/04	5.50	335.93	45.89
08/31/04	6.17	436.06	112.23
09/30/04	6.31	519.66	104.78

Greencastle WWTP				PA0020834							
DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)	DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)	DMR Date	Flow (mgd)	TN (lbs/d)	TP (lbs/d)
10/31/93	0.75	50.02	11.63	07/31/96	0.81	50.08	11.23	04/30/99	1.04	9.07	5.77
11/30/93	0.75	50.02	11.63	08/31/96	0.81	50.08	11.23	05/31/99	1.04	9.07	5.77
12/31/93	0.75	50.02	11.63	09/30/96	0.81	50.08	11.23	06/30/99	1.04	9.07	5.77
01/31/94	0.81	50.08	11.23	10/31/96	0.81	50.08	11.23	07/31/99	1.04	9.07	5.77
02/28/94	0.81	50.08	11.23	11/30/96	0.81	50.08	11.23	08/31/99	1.04	9.07	5.77
03/31/94	0.81	50.08	11.23	12/31/96	0.81	50.08	11.23	09/30/99	1.04	9.07	5.77
04/30/94	0.81	50.08	11.23	01/31/97	0.81	50.08	11.23	10/31/99	1.04	9.07	5.77
05/31/94	0.81	50.08	11.23	02/28/97	0.81	50.08	11.23	11/30/99	1.04	9.07	5.77
06/30/94	0.81	50.08	11.23	03/31/97	0.81	50.08	11.23	12/31/99	1.04	9.07	5.77
07/31/94	0.81	50.08	11.23	04/30/97	0.81	50.08	11.23	01/31/00	1.04	9.07	5.77
08/31/94	0.81	50.08	11.23	05/31/97	0.81	50.08	11.23	02/29/00	1.04	9.07	5.77
09/30/94	0.81	50.08	11.23	06/30/97	0.81	50.08	11.23	03/31/00	1.04	9.07	5.77
10/31/94	0.81	50.08	11.23	07/31/97	0.81	50.08	11.23	04/30/00	1.04	9.07	5.77
11/30/94	0.81	50.08	11.23	08/31/97	0.81	50.08	11.23	05/31/00	1.04	9.07	5.77
12/31/94	0.81	50.08	11.23	09/30/97	0.81	50.08	11.23	06/30/00	1.04	9.07	5.77
01/31/95	0.87	50.12	10.87	10/31/97	0.81	50.08	11.23	07/31/00	1.04	9.07	5.77
02/28/95	0.87	50.12	10.87	11/30/97	0.81	50.08	11.23	08/31/00	1.04	9.07	5.77
03/31/95	0.87	50.12	10.87	12/31/97	0.81	50.08	11.23	09/30/00	1.04	9.07	5.77
04/30/95	0.87	50.12	10.87	01/31/98	0.87	14.07	9.74	10/31/00	1.04	9.07	5.77
05/31/95	0.87	50.12	10.87	02/28/98	0.87	14.07	9.74	11/30/00	1.04	9.07	5.77
06/30/95	0.87	50.12	10.87	03/31/98	0.87	14.07	9.74	12/31/00	1.04	9.07	5.77
07/31/95	0.87	50.12	10.87	04/30/98	0.87	14.07	9.74	01/31/01	0.39	79.27	10.74
08/31/95	0.87	50.12	10.87	05/31/98	0.87	14.07	9.74	02/28/01	0.39	79.27	10.74
09/30/95	0.87	50.12	10.87	06/30/98	0.87	14.07	9.74	03/31/01	0.39	79.27	10.74
10/31/95	0.87	50.12	10.87	07/31/98	0.87	14.07	9.74	04/30/01	0.39	79.27	10.74
11/30/95	0.87	50.12	10.87	08/31/98	0.87	14.07	9.74	05/31/01	0.39	79.27	10.74
12/31/95	0.87	50.12	10.87	09/30/98	0.87	14.07	9.74	06/30/01	0.39	79.27	10.74
01/31/96	0.81	50.08	11.23	10/31/98	0.87	14.07	9.74	07/31/01	0.39	79.27	10.74
02/29/96	0.81	50.08	11.23	11/30/98	0.87	14.07	9.74	08/31/01	0.39	79.27	10.74
03/31/96	0.81	50.08	11.23	12/31/98	0.87	14.07	9.74	09/30/01	0.39	79.27	10.74
04/30/96	0.81	50.08	11.23	01/31/99	1.04	9.07	5.77	10/31/01	0.39	79.27	10.74
05/31/96	0.81	50.08	11.23	02/28/99	1.04	9.07	5.77	11/30/01	0.39	79.27	10.74
06/30/96	0.81	50.08	11.23	03/31/99	1.04	9.07	5.77	12/31/01	0.39	79.27	10.74

Greencastle WWTP							
DMR Date	**Flow (mgd)**	**TN (lbs/d)**	**TP (lbs/d)**	**DMR Date**	**Flow (mgd)**	**TN (lbs/d)**	**TP (lbs/d**
01/31/02	0.43	87.70	9.96	08/31/04	0.55	36.87	11.05
02/28/02	0.43	87.70	9.96	09/30/04	0.59	25.10	14.45
03/31/02	0.43	87.70	9.96				
04/30/02	0.43	87.70	9.96				
05/31/02	0.43	87.70	9.96				
06/30/02	0.43	87.70	9.96				
07/31/02	0.43	87.70	9.96				
08/31/02	0.43	87.70	9.96				
09/30/02	0.43	87.70	9.96				
10/31/02	0.43	87.70	9.96				
11/30/02	0.43	87.70	9.96				
12/31/02	0.43	87.70	9.96				
01/31/03	0.73	43.20	15.48				
02/28/03	0.50	29.39	18.70				
03/31/03	0.89	52.87	24.21				
04/30/03	0.59	34.77	15.58				
05/31/03	0.90	53.24	8.30				
06/30/03	1.19	70.70	11.52				
07/31/03	0.57	33.71	11.65				
08/31/03	0.59	34.75	12.64				
09/30/03	0.77	45.87	15.78				
10/31/03	0.58	34.22	12.35				
11/30/03	0.64	37.95	15.19				
12/31/03	0.80	47.78	12.75				
01/31/04	0.53	31.46	10.04				
02/29/04	0.55	36.87	11.05				
03/31/04	0.59	21.06	9.53				
04/30/04	0.69	24.71	12.57				
05/31/04	0.59	21.14	10.90				
06/30/04	0.56	13.24	14.55				
07/31/04	0.45	21.42	11.24				

Source: Chesapeake Bay Program Office's Nutrient Point Source Database (http://www.chesapeakebay.net/data),