

Prepared in cooperation with
Northern Shenandoah Valley Regional Commission
and Virginia Polytechnic Institute and State University

Water-Quality Synoptic Sampling, July 1999: North Fork Shenandoah River, Virginia



Scientific Investigations Report 2004-5153

U.S. Department of the Interior
U.S. Geological Survey

Cover photograph of North Fork Shenandoah River, near Cootes Store, Virginia; view looking upstream,
by Donald C. Hayes, U.S. Geological Survey, October 22, 2002.

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Conversion Factors, Datum, and Abbreviated Water-Quality Units

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Area		
cubic foot (ft ³)	0.028317	cubic meter
square mile (mi ²)	259.0	hectare (ha)
square mile (mi ²)	2.590	square kilometer (km ²)
Volume		
gallon (gal)	3.785	liter (L)
Mass		
ounce, avoirdupois (oz)	2.835	milligram
Flow		
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

Vertical coordinate information is referenced to National Geodetic Vertical Datum of 1929 (NGVD 29)

Horizontal coordinate information is referenced to North American Datum of 1927 (NAD 27)

Abbreviated water-quality units: Chemical concentration is reported in milligrams per liter (mg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as mass (milligrams) of solute per unit volume (liter) of water. For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in parts per million. Specific electrical conductance of water is reported in microsiemens per centimeter at 25 degrees Celsius (μS/cm).

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Abstract

A study was conducted of water-quality conditions that may affect aquatic life during periods of low streamflow on the North Fork Shenandoah River, Va. Monthly mean streamflows in July 1999 at three streamflow-gaging stations were the lowest measured during the historical record on the river. Daily extremes of dissolved-oxygen concentrations were measured, along with pH, specific conductance, and water-temperature values, at 52 sites along 80 mi of the North Fork Shenandoah River from Cootes Store, Va., to its confluence with Passage Creek, near Strasburg, Va.

Dissolved-oxygen concentrations ranged from 2.1 to 16.4 milligrams per liter (mg/L). Dissolved-oxygen concentrations were equal to or less than the State water-quality minimum of 4.0 mg/L at 18 of 52 monitoring sites; all 18 sites were in the upper and middle portions of the river, where more than half of the first 34 sites had minimum dissolved-oxygen concentrations equal to or less than 4.0 mg/L. There were large variations from minimum to maximum dissolved-oxygen concentrations, with concentrations fluctuating as much as 10 mg/L per day; and typically 5 mg/L per day during the study period.

pH ranged from 7.6 to 9.6, with pH values frequently greater than 9.0 in the downstream portion of the river. Specific-conductance values ranged from 178 to 856 microsiemens per centimeter ($\mu\text{S}/\text{cm}$), with values greater than 600 $\mu\text{S}/\text{cm}$ only measured at a group of five sites in the upstream portion of the river. Air temperatures ranged from 21.0 to 37.0 degrees Celsius ($^{\circ}\text{C}$), and water temperatures ranged from 17.00 to 30.14 $^{\circ}\text{C}$. Along the length of the North Fork Shenandoah River, longitudinal variation in water-quality parameters was small. Groups of sites that differed from the general pattern define reaches where increased monitoring may help determine the factors that affect water quality at those sites.

Introduction

The demands on the water resources of the Shenandoah River Basin in Virginia are a concern to a number of local, State, and Federal agencies, as well as private citizen groups. The demand on water resources has increased as a result of population growth in the past 20 years. From 1980 to 2000, popu-

lation in the Shenandoah River Basin increased 30 percent, and water withdrawals for public supply and domestic use increased 40 percent (Solley and others, 1988, 1993, 1998; Hutson and others, 2004). Droughts in this region tax ground-water and surface-water supplies, which are used for public supply, domestic, and agricultural uses in the basin. In 1997, 1998, and 1999, drought conditions in the Shenandoah River Basin contributed to critical losses suffered by farmers, such as major damage to corn, hay, pasture, and small grain, as well as cattle weight loss. In response to these losses, Clarke County declared a state of emergency for three consecutive summers (Alison Teetor, Natural Resource Planner, Clarke County, Va., oral commun., 2004). During the 1999 low-flow period, mean monthly flows in July recorded at three streamflow-gaging stations on the North Fork Shenandoah River, a major tributary to the Shenandoah River, were the lowest observed over the 55- to 74-year periods of record (White and others, 2000). These droughts increased public awareness of the importance of a sustainable water supply and indicated a need for information on the availability and quality of water resources in the Shenandoah Basin.

There are concerns that streamflows are adequate not only for a sustainable public water supply but also to support the aquatic and terrestrial community, to support recreation, and to maintain aesthetic characteristics of rivers in the basin. The North Fork Shenandoah River Basin, which is located in Virginia and West Virginia, 75 mi west of Washington, D.C. (fig. 1), supports a diverse aquatic and terrestrial community including 10 Federal or State listed species (indicating endangered, threatened, or special concern): freshwater mussels (brook floater, green floater, yellow lampmussel), isopods (Madison cave isopod, Shenandoah Valley cave isopod), reptiles and amphibians (wood turtle, cow knob salamander), birds (peregrine falcon), and bats (Indiana bat, Virginia big-eared bat) (Roble, 2001). Ensuring adequate streamflows to support these species and the diverse fish community (at least 37 species) (Persinger, 2003) not only protects the aquatic and terrestrial community in the North Fork Shenandoah Basin, but also maintains the river as a source for recreation.

In 1998, the U.S. Geological Survey (USGS), in cooperation with the Northern Shenandoah Valley Regional Commission (NSVRC) and Virginia Polytechnic Institute and State University (VPI), began a study to collect data and information on hydrology, habitat requirements of fish, and water use as part of a comprehensive assessment of water availability in the

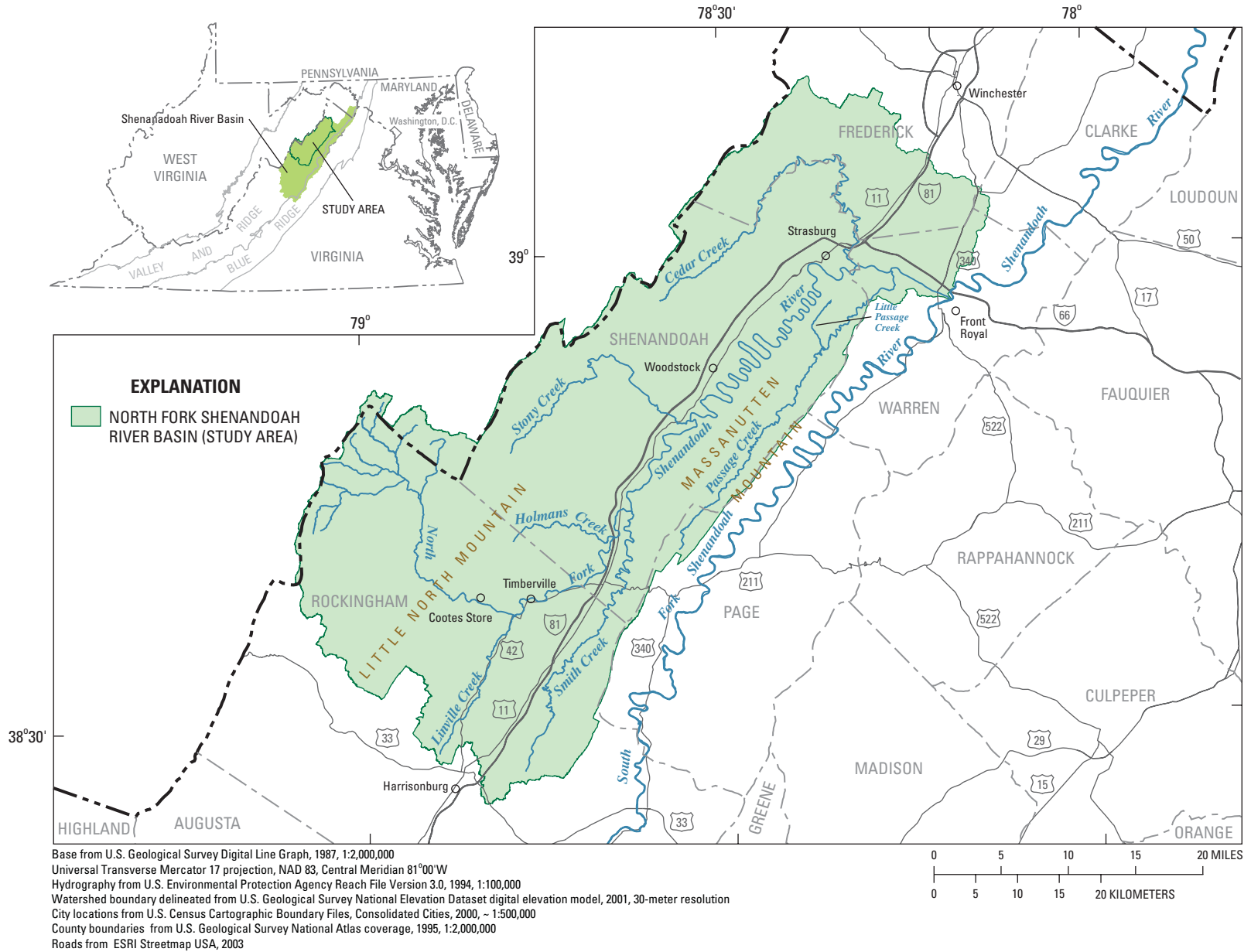


Figure 1. Location of the North Fork Shenandoah River Basin, Virginia (study area).

North Fork Shenandoah River Basin. Prior to the onset of this study, Zappia and Hayes (1998) related water availability to the physical habitat needs of fish and other water uses along the Shenandoah River using Instream Flow Incremental Methodology (IFIM) techniques. Other studies have shown the utility of the IFIM process for water-resources management during low-flow conditions (Stalnaker, 1981; Leonard, Orth, and Goudreau, 1986; Orth and Leonard, 1990; Vadas and Weigmann, 1993). Following Zappia and Hayes (1998), IFIM techniques are being used in the North Fork Shenandoah River Basin to enhance understanding of low-flow conditions, to relate water availability to physical habitat needs of fish, and to provide science-based information for water management.

As part of the North Fork Shenandoah River IFIM study, water-quality data were collected in July 1999 at 52 sites along 80 mi of the North Fork Shenandoah River from Cootes Store, Va., to the confluence with Passage Creek, near Strasburg, Va. The objective of this water-quality study was to measure daily minimum and maximum values of dissolved-oxygen concentrations, and to measure pH, specific conductance, and water temperatures during low-flow conditions. Monitoring the variability of dissolved-oxygen concentrations throughout the river is important because a wide, fluctuating range of dissolved-oxygen concentrations may affect metabolism, growth, and development of fish (Wilding, 1939; Stewart and others, 1967; Whitworth, 1968; Fry, 1971; Davis, 1975).

Purpose and Scope

This report describes the daily fluctuations of dissolved-oxygen concentrations and reports associated water temperature, pH, and specific-conductance values at 52 sites along 80 mi of the North Fork Shenandoah River from Cootes Store, Va., to its confluence with Passage Creek, near Strasburg, Va. Water-quality data were collected at 18 continuous monitoring sites and at 34 instantaneous monitoring sites from July 12-30, 1999.

This study was a short-term (less than one month) synoptic survey of water quality to measure daily minimum and maximum values of dissolved-oxygen concentrations and to contribute to the North Fork Shenandoah River IFIM study. This data-collection effort provides information about water-quality conditions that may affect aquatic life during summer low-flow periods (defined as flows less than the 90-percent exceedance flows) on the North Fork Shenandoah River, Va. The geographic distribution of water-quality values is presented in tables and on maps that show the range of values at each monitoring site relative to the site's location along the river.

Description of Study Area

The headwater streams that feed the North Fork Shenandoah River have their source in West Virginia, but the mainstem begins in Rockingham County, Va., and continues through Shenandoah and Warren Counties in Virginia. The river gener-

ally flows northeast parallel to Interstate-81 and Highway-11 from Timberville, Va., to Front Royal, Va. The study sites included in this report are on an 80-mi-long portion of the North Fork Shenandoah River between Cootes Store, Va., and its confluence with Passage Creek near Strasburg, Va. (fig. 2), integrating a drainage area of 768 mi².

The North Fork Shenandoah River lies within the Valley and Ridge Physiographic Province. The basin topography is characterized by rolling hills and valleys, and is bordered on the eastern edge by Massanutten Mountain, which separates the North Fork Shenandoah River from the South Fork Shenandoah River (Virginia Department of Conservation and Economic Development, 1968). The northeast-southwest trending ridges of the Valley and Ridge are formed by resistant quartzite, sandstone, and conglomerates; the valleys are underlain by more readily weathered limestone, shale, and dolomite (Hack, 1965; Hayes, 1991). Karst topography over the limestone and dolomite rocks results in sinkholes, springs, and concentrated ground-water discharge to the river. The river has cut down to erosion-resistant bedrock along much of its length, giving it a characteristic shallow and wide channel. In the upper reaches, the North Fork Shenandoah River crosses the valleys and ridges around Little North Mountain, and then flows through the eastern side of the valley near Massanutten Mountain, where it has wide, gradual meanders (approximately 1.3–5.0 mi. in length between meanders) until it reaches Edinburg, Va. Downstream of Edinburg, Va., the river enters the Seven Bends area (fig. 2) where it is characterized by extremely narrow meanders (approximately 0.3 mi. in length between meanders). In the Seven Bends area there are 180-degree reversals, as the river winds in and out of the ridges on the eastern side of the valley. In this area, the river follows fracture zones in the shales of the Martinsburg Formation (Hack, 1965) that helped to form the narrow meanders which are common in the Seven Bends area (fig. 2).

Geographic location and topography strongly affect climate in the North Fork Shenandoah River Basin and in the Shenandoah River Basin overall. As frontal systems pass through the Valley and Ridge and Blue Ridge Physiographic Provinces of western Virginia (fig. 1), airflow is generally from the west. With westerly airflow, the Shenandoah River Basin is in the rain shadow of the mountains on the western edge of the Valley and Ridge; with easterly airflow, the basin is in the rain shadow of the Blue Ridge Mountains. As a result, the Shenandoah River Basin is one of the driest portions of the State, with a total annual rainfall typically a sparse 33.0 in. (Hayden and Michaels, 2003). During June, July, and August, mean rainfall is 11.0 in., with an average temperature range from 21.0 to 24.0°C, and average maximum temperature range from 28.2 to 31.0°C (Southeast Regional Climate Center, 2003).

The Shenandoah River Basin has a rural character, with land use dominated by forest and wetlands (59 percent) and agriculture (38 percent) (U.S. Environmental Protection Agency, 1996). The basin population was 402,500 people in 2000, and has grown 17 percent from 345,100 people since the 1990 census (U.S. Census Bureau, 2002). Historically, the

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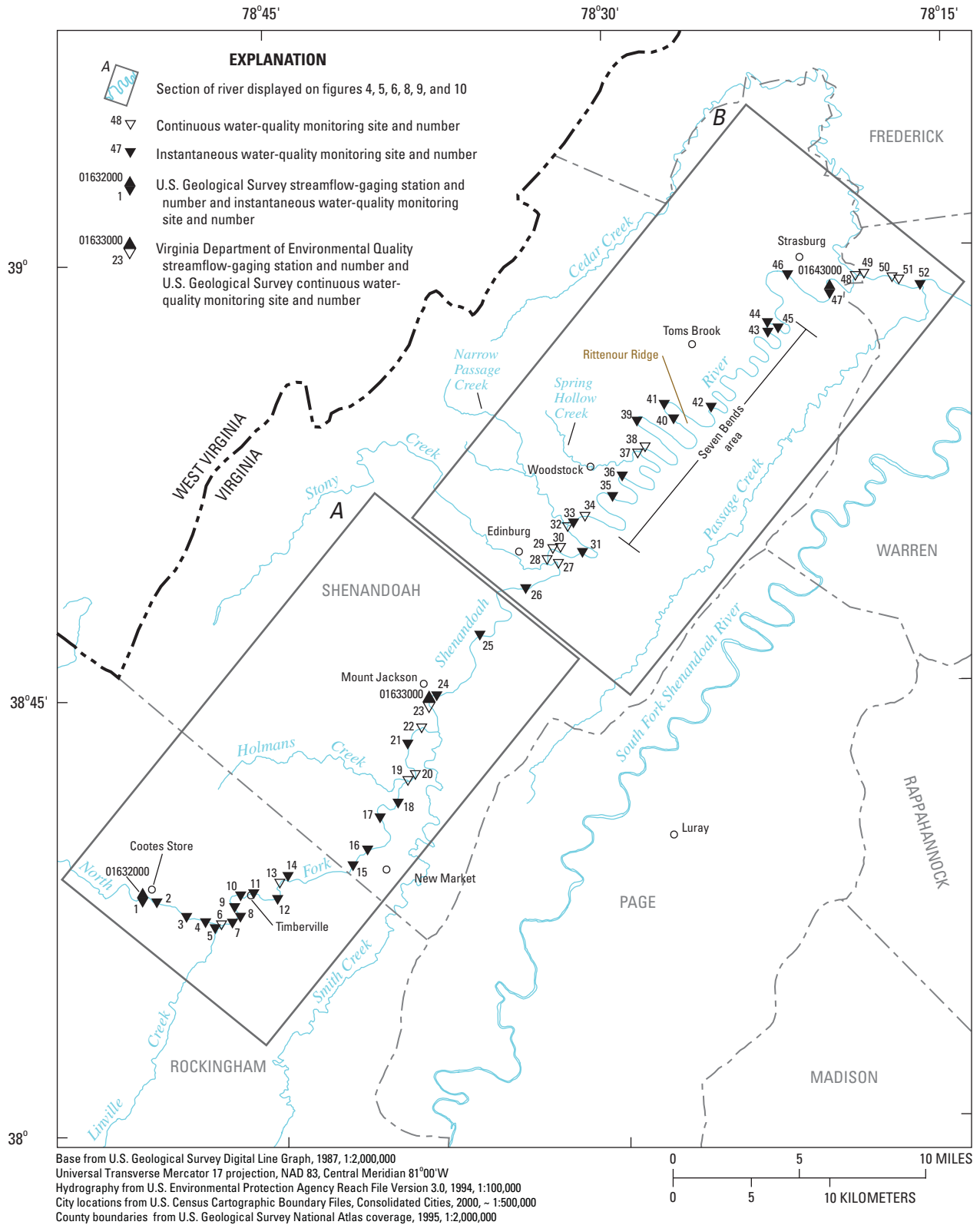


Figure 2. Locations of continuous and instantaneous water-quality monitoring sites, and streamflow-gaging stations on the North Fork Shenandoah River, Virginia. Site numbers increase downstream.

economy of the area has been closely tied to rivers for agriculture, transportation, subsistence, and recreation. Currently (2004), economic activities in the basin are largely associated with livestock production (poultry and dairy cattle), agricultural-related industries, tourism and recreation, beverage bottling, and industries catering to universities and colleges. The rivers are both a water resource as well as a source of beauty and pride throughout the basin.

Acknowledgments

The authors thank the following for their expertise, time, and other support in completing the water quality portion of the North Fork Shenandoah River IFIM study: Dr. Donald Orth, VPI; the staff of the Department of Fisheries and Wildlife Sciences, VPI; and the members of the Northern Shenandoah Valley Regional Commission. The authors thank all the members of the Minimum Instream Flow technical advisory committee of NSVRC for their time and support, as well as their genuine interest in the health of the Shenandoah River Basin. The authors also thank Pat Maier and the Friends of the North Fork Shenandoah River for their assistance in contacting private land owners and obtaining permission for access to their land. The willingness of property owners to allow access to the river greatly assisted the data-collection efforts.

Methods of Study

As a part of the IFIM study along the North Fork Shenandoah River, water-quality data were collected during July of 1999 when the monthly mean streamflows were the lowest for the 74-year period of record at both the Cootes Store and Strasburg streamflow-gaging stations, and for the 55-year period of record for the Mount Jackson streamflow-gaging station (White and others, 2000). Discharge (streamflow) measurements were not made in conjunction with the synoptic sampling; however, the three gages recorded streamflows equivalent to the 98- and 99-percent exceedance values, and were used as an indication of low streamflow conditions during the study period. Exceedance values are derived from a flow-duration curve, which is a cumulative frequency curve that shows the percent of time specified flows were equaled or exceeded during a given period (Searcy, 1959). Daily mean streamflow values ranging between the 25- and 75-percent exceedance values describe normal flow conditions.

During the study period (July 12–30, 2004), the USGS streamflow-gaging station at Cootes Store, Va., recorded daily mean streamflow values ranging from 0.55 to 1.2 ft³/s (White and others, 2000) (fig. 3). These streamflows represent approximately the 99-percent exceedance value for the Cootes Store gage data during July and August. Based on the previous 50 years of data, typical flows during July and August at the Cootes Store gage range from 4.9 ft³/s (75-percent exceedance value) to 40 ft³/s (25-percent exceedance value).

During the study period, the Virginia Department of Environmental Quality (VDEQ) streamflow-gaging station near Mount Jackson, Va., recorded daily mean streamflow values ranging from 4.5 ft³/s to 15.0 ft³/s (White and others, 2000) (fig. 3). These streamflows are within the 98- and 99-percent exceedance values for the Mount Jackson gage data during July and August. Based on the previous 50 years of data, typical flows during July and August at the Mount Jackson gage range from 55 ft³/s (75-percent exceedance value) to 159 ft³/s (25-percent exceedance value).

During the study period, the USGS streamflow-gaging station near Strasburg, Va., recorded daily mean streamflow values ranging from 50 ft³/s to 76 ft³/s (White and others, 2000) (fig. 3). These streamflows represent approximately the 99-percent exceedance value for the Strasburg gage data during July and August. Based on the previous 50 years of data, typical flows during July and August at the Strasburg gage range from 122 ft³/s (75-percent exceedance value) to 287 ft³/s (25-percent exceedance value).

Low-flow conditions in the summer of 1999 were affected by lower than normal precipitation during the previous 12 months. From July 1998 to June 1999, the total monthly precipitation was 62 percent lower than normal, and on average 1.7–2.5 in. below the historical mean for each month except for January 1999 and March 1999 (Southeast Regional Climate Center, 2003). Precipitation during the fall of 1998 (September, October, and November) was 70 percent lower than the historical mean (Southeast Regional Climate Center, 2003). The reduced precipitation during the previous 12 months likely contributed to a decrease in both ground-water storage and ground-water discharge to the river.

Some precipitation fell during the field data collection period. In the downstream section of the basin, a total of 2.5 in. of rain was recorded at the weather station in Winchester, Va., during the study period: July 13 (0.1 in.), July 22 (0.6 in.), and July 29 (1.5 in.) (Southeast Regional Climate Center, 2003). The rain would have affected primarily the Cedar Creek drainage, and would have increased streamflow to the four study sites downstream of the confluence of Cedar Creek and the North Fork Shenandoah River. In the middle of the basin, a total of 1.2 in. of rain was recorded at the weather station in Woodstock, Va., during the study period: July 13 (0.1 in.), July 22 (0.8 in.), and July 29 (0.3 in.) (Southeast Regional Climate Center, 2003).

Site Selection

Monitoring sites for continuous water-quality data collection were selected on the basis of water-use information from VDEQ on permitted withdrawals and discharges within the basin (Virginia Department of Environmental Quality, written commun., 1998). The total permitted withdrawals or discharges were determined for six tributaries to the North Fork Shenandoah River by combining values of all permits within the tributary basin. Nine locations were selected for continuous

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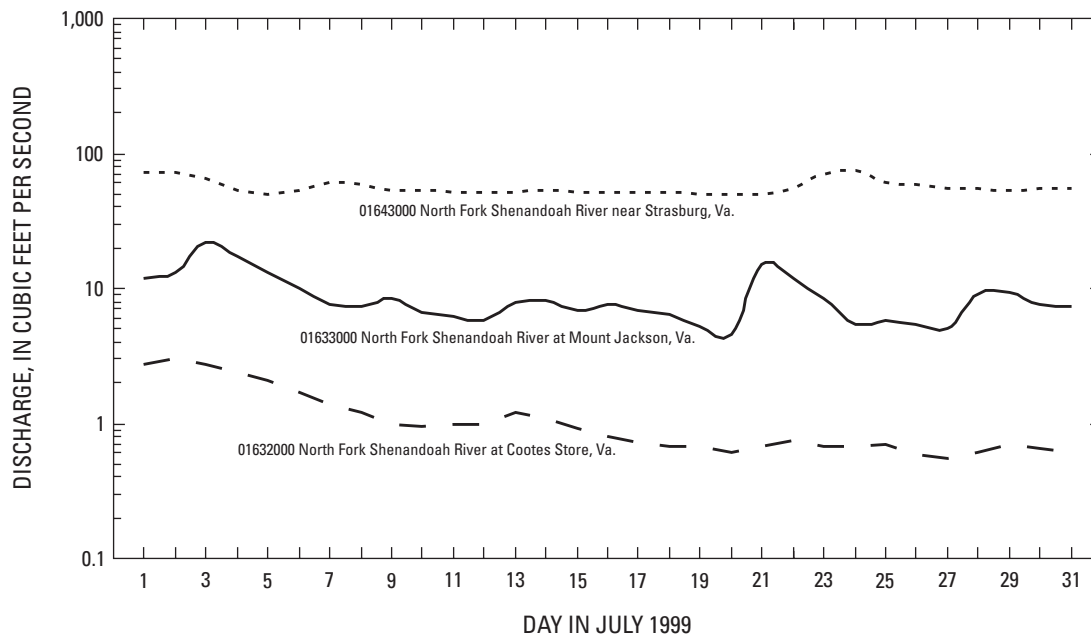


Figure 3. Streamflow in July 1999 for 3 streamflow-gaging stations on the North Fork Shenandoah River, Virginia.

water-quality data collection at the confluence of tributaries with substantial total permitted withdrawals or discharges, and along the mainstem where permitted withdrawal or discharge values were large. During the data-collection effort, monitoring instruments were placed upstream and downstream of each of the 9 locations for a total of 18 continuous water-quality monitoring sites.

In addition to the continuous water-quality monitoring sites, 34 monitoring sites were selected for instantaneous water-quality data collection. It was desirable to sample as many sites on the river as possible in order to document longitudinal variations in water quality. Geographic constraints limited the number of sites available for instantaneous water-quality measurements; however, bridges, boat ramps, local parks, and some private property served as access points for the instantaneous water-quality monitoring sites. All available access points were included in the study.

Location information for continuous and instantaneous water-quality monitoring sites is in table 1 and figure 2. Site numbers increase in the downstream direction, with site 1 being the most upstream site and site 52 the most downstream site.

Instrumentation

All instruments used for collection of water-quality field parameters were of the YSI-6 series, and contain sensors with identical specifications (table 2). Instruments used for continuous data collection were YSI 600XLM and YSI 6920 models; instruments used for instantaneous data collection were YSI 600XL models. The instruments contain sensors for measuring dissolved oxygen, pH, specific conductance, and temperature.

All instruments were checked for temperature accuracy in the office before the field data collection began, and again after field data collection was completed. Water temperature was accurate within 0.5°C of a calibrated analog thermometer at near-freezing temperature and at room temperature. Water-quality monitoring instruments used for continuous monitoring were calibrated for dissolved oxygen and pH, and compared against standards for specific conductance immediately prior to field deployment. Monitors used for instantaneous sampling were calibrated in the same manner prior to field deployment, and calibrated twice daily during field data collection.

Water-Quality Field Parameters

The water-quality parameters measured at both continuous and instantaneous monitoring sites were dissolved oxygen, pH, specific conductance, and water temperature. Additionally, air temperature and barometric pressure were measured at instantaneous monitoring sites. Study methods were designed so that the associated parameters were measured concurrently with the expected maximum and minimum dissolved-oxygen concentrations for each site; associated parameter values, therefore, do not necessarily represent maximum and minimum values. USGS protocols were followed for sampling-equipment cleaning, calibration, and data collection (U.S. Geological Survey, 1997).

Table 1. Locations of water-quality monitoring sites on the North Fork Shenandoah River, Virginia.

[Bold text indicates continuous water-quality monitoring sites; plain text indicates instantaneous monitoring sites; DMS.S, degrees minutes decimal-seconds; NAD27, North American datum of 1927]

Site number (Fig. 2)	Site name	Latitude DMS.S (NAD27)	Longitude DMS.S (NAD27)
1	At Cootes Store, Va.	N 383813.6	W 0785110.1
2	At Evans Ford near Cootes Store, Va.	N 383759.8	W 0785032.3
3	Along Route 789 near Cootes Store, Va.	N 383728.0	W 0784915.2
4	At Route 617 at Broadway, Va.	N 383715.9	W 0784807.1
5	At Route 411 at Broadway, Va.	N 383710.9	W 0784743.9
6	At Route 411 at Broadway, Va.	N 383711.0	W 0784743.9
7	Below Linville Creek at Broadway, Va.	N 383714.6	W 0784728.3
8	At dam at Timberville, Va.	N 383738.2	W 0784659.5
9	Below dam at Timberville, Va.	N 383740.5	W 0784702.5
10	At Memorial Park at Timberville, Va.	N 383810.0	W 0784651.3
11	Route 42 at Timberville, Va.	N 383815.2	W 0784625.8
12	Above Shenville farm at Timberville, Va.	N 383820.3	W 0784511.4
13	Below Shenville farm at Timberville, Va.	N 383833.0	W 0784508.4
14	Below Shenville farm at Timberville, Va.	N 383834.7	W 0784507.9
15	At Route 617 at New Market, Va.	N 383906.5	W 0784152.9
16	Along Route 617 at New Market, Va.	N 383938.3	W 0784113.6
17	Along Route 736 at Quicksburg, Va.	N 384044.1	W 0784038.4
18	Along Route 767 at Quicksburg, Va.	N 384113.5	W 0783950.2
19	Above Holmans Creek near Quicksburg, Va.	N 384159.2	W 0783923.4
20	Below Holmans Creek near Quicksburg, Va.	N 384159.9	W 0783920.8
21	At Route 720 near Mount Jackson, Va.	N 384314.9	W 0783920.5
22	At Route 11 at Mount Jackson, Va.	N 384349.0	W 0783843.2
23	At Mount Jackson, Va.	N 384444.3	W 0783821.7
24	At Mount Jackson, Va.	N 384445.2	W 0783820.6
25	At Route 707 near Mount Jackson, Va.	N 384656.3	W 0783602.9
26	At Route 698 at Edinburg, Va.	N 384830.2	W 0783358.4
27	Above Stoney Creek at Edinburg, Va.	N 384920.0	W 0783254.6
28	Below Stoney Creek at Edinburg, Va.	N 384927.4	W 0783259.9
29	Above dam at Edinburg, Va.	N 384951.4	W 0783242.9
30	Below dam at Edinburg, Va.	N 384949.8	W 0783240.5
31	Along Route 673 near Edinburg, Va.	N 384941.7	W 0783125.8
32	Above Narrow Passage Creek at Route 672	N 385041.1	W 0783155.7
33	Near boat ramp at Narrow Passage Creek	N 385043.4	W 0783147.6
34	Below Narrow Passage Creek near Edinburg Va.	N 385047.7	W 0783142.3
35	At Route 609 near Woodstock, Va.	N 385135.6	W 0783002.7
36	At Lupton Road at Woodstock, Va.	N 385217.4	W 0782935.3
37	Above Spring Hollow Creek at Woodstock, Va.	N 385306.9	W 0782848.0
38	Below Spring Hollow Creek at Woodstock, Va.	N 385312.7	W 0782845.5
39	At Route 663 at Woodstock, Va.	N 385410.2	W 0782852.5
40	Along Rittenour Ridge near Woodstock, Va.	N 385412.4	W 0782715.2
41	At Route 661 near Woodstock, Va.	N 385443.1	W 0782739.1
42	At Route 654 near Maurertown, Va.	N 385434.7	W 0782535.3
43	Along Route 648 near Fishers Hill, Va.	N 385706.3	W 0782259.5
44	Along Route 644 near Fishers Hill, Va.	N 385725.9	W 0782300.2

Table 1. Continued.

Site number (Fig. 2)	Site name	Latitude DMS.S (NAD27)	Longitude DMS.S (NAD27)
45	At Route 744 near Fishers Hill, Va.	N 385714.6	W 0782232.1
46	At Route 648 at Strasburg, Va.	N 385903.9	W 0782203.1
47	Near Strasburg, Va.	N 385837.4	W 0782011.5
48	Above Cedar Creek near Strasburg, Va.	N 385858.2	W 0781904.0
49	Below Cedar Creek near Strasburg, Va.	N 385900.8	W 0781857.1
50	Above Winchester Dam at Waterlick, Va.	N 385852.7	W 0781726.1
51	Below Winchester Dam at Waterlick, Va.	N 385849.4	W 0781723.7
52	Above Passage Creek at Waterlick, Va.	N 385835.6	W 0781613.3

Table 2. Water-quality sampling instrument specifications used in the water-quality synoptic sampling on the North Fork Shenandoah River, Virginia.

[°C, degrees Celsius; mS/cm, millisiemens per centimeter; %, percent; air sat, air saturation; mg/L, milligrams per liter]

Water-quality field parameter	Range ¹	Accuracy ¹
Temperature	-5–45 °C	± 0.15 °C
Specific conductance	0–100 mS/cm	± 0.5% reading + 0.001 mS/cm
pH	0–14 units	± 0.2 units
Dissolved oxygen, percent air saturation	0–500 % air sat	0–200 % air sat: ± 2 % reading or 2 % air sat (the greater value) 200–500 % air sat: ± 6 % of reading
Dissolved oxygen, mg/L	0–50 mg/L	0–20 mg/L: ± 2 % of reading or 0.2 mg/L (the greater value) 20–50 mg/L: ± 6 % of reading

¹From YSI Incorporated, 1998, Environmental Monitoring Systems operations manual: 6-series, Revision A, Yellow Springs, Ohio, 255 p.

Continuous Water-Quality Field Measurements

Self-contained water-quality monitors and data loggers were used to measure and record dissolved oxygen, pH, specific conductance, and water temperature at 18 continuous monitoring sites. Most continuous monitoring sites were within 500 ft of a permitted withdrawal or discharge; however, some continuous monitoring sites were located on either end of a stream reach with numerous permitted sites to assess water quality upstream and downstream of the reach. At each continuous water-quality monitoring site, a YSI 600XLM or YSI 6920 multi-parameter instrument was housed within a section of polyvinylchloride (PVC) pipe that was secured to the stream bottom. The water-quality monitor was placed in the centroid of flow, with the sensors elevated above the streambed and other obstructions to flow such as large boulders and logs. The average depth of all continuous monitoring sites was 2.3 ft, and the median depth was 1.7 ft. Because the water was shallow, elevating the sensors above the streambed and any obstructions placed them approximately in the flowing portion of the water column. At the few sites that were greater than 3 ft deep, the water-quality monitor was placed 1–3 ft below the water surface.

Water-quality data were collected semi-hourly (every 30 minutes, on the hour and half-hour) for 1–8 days during July 12–30, 1999. Maximum and minimum dissolved-oxygen concentrations were taken from the semi-hourly data for each of the 18 sites. These data represent the greatest (MAX) and least (MIN) semi-hourly dissolved-oxygen concentrations recorded during the study period, but are not necessarily values that were measured on the same day. Instead, these values are the upper and lower limits of the range of measured concentrations.

Instantaneous Water-Quality Field Measurements

Hand-held water-quality monitors were used to measure dissolved oxygen, pH, specific conductance, and water temperature at 34 sites along the river. Air temperature and barometric pressure also were measured and recorded at these sites. Water-quality data were collected once in the early morning (AM) and once in the late afternoon (PM) for each site from July 27–29, 1999. The data were collected just before sunrise and just before sunset when the daily minimum and maximum dissolved-oxygen concentrations would be expected, respectively. The study design did not allow for depth-integrated sampling along a cross section at each site, but the sampling was done in a part of the channel that was representative of stream-flow. Water-quality measurements were made at approximately 60 percent of water depth.

Results of Water-Quality Synoptic Sampling

Throughout this report, the order of the data is from site 1, near Cootes Store, Va., to site 52, the most downstream site,

near the confluence of the North Fork Shenandoah River with Passage Creek. Maximum and minimum dissolved-oxygen concentrations and associated parameter values of pH, specific conductance, and water temperature from the continuous and instantaneous water-quality monitoring sites are in tables 3 and 4. Maximum and minimum values for the associated parameters of pH, specific conductance, and water temperature not found in table 3 may be in the appendix, which contains the complete set of semi-hourly data for continuous monitoring sites. The longitudinal distribution of water-quality values is displayed on a map of the North Fork Shenandoah River Basin (figs. 4, 5, 6, 8, 9, and 10). On these figures, the 52 study sites and associated water-quality data are divided into two sections, with sites 1–25 in section A and sites 26–52 in section B. These divisions are arbitrary and were made for displaying the data.

Dissolved Oxygen

There were large variations in MIN and MAX values of dissolved-oxygen concentrations recorded with continuous measurement techniques, as well as in AM and PM values recorded with instantaneous measurement techniques. Dissolved-oxygen concentrations from both continuous and instantaneous water-quality monitoring sites ranged from 2.1 mg/L to 16.4 mg/L; dissolved oxygen as percent air saturation ranged from 25 to 204 percent (figs. 4 and 5, tables 3 and 4). The State numerical criterion for the minimum concentration of dissolved oxygen in Piedmont and Mountainous zones is 4.0 mg/L (State Water Control Board, 2002). State water-quality criteria are designed to maintain water-quality conditions conducive to healthy aquatic communities. Dissolved-oxygen concentrations were equal to or less than the State water-quality minimum at 18 of 52 monitoring sites; all 18 sites were in the upper and middle portions of the river, where more than half of the first 34 sites had minimum dissolved-oxygen concentrations equal to or less than 4.0 mg/L (fig. 4). No dissolved-oxygen concentrations less than the State minimum were recorded downstream of site 34 near Narrow Passage Creek (fig. 4).

The results from continuous sampling (MIN and MAX values) and instantaneous sampling (AM and PM values) were compared. To compare the values that approximate the daily minimum dissolved-oxygen concentration, a Wilcoxon two-sample ranked sum test (Ott and Longnecker, 2001) of the MIN and AM datasets was completed. The mean of the MIN dataset was 4.4 mg/L, and the median was 4.7 mg/L; the mean of the AM dataset was 4.9 mg/L, and the median was 4.7 mg/L. Results from the Wilcoxon test showed no significant difference between the two datasets (p -value = 0.8099). To compare the values that approximate the daily maximum dissolved-oxygen concentration, a Wilcoxon two-sample ranked sum test of the MAX and PM datasets was completed. The mean of the PM dataset was 11.0 mg/L, and the median also was 11.0 mg/L; the mean of the MAX dataset was 12.0 mg/L, and the median was 12.9 mg/L. Results from the Wilcoxon test showed no significant difference between the two datasets (p -value = 0.4901).

Table 3. Minimum and maximum dissolved-oxygen concentrations and associated water-quality parameter values from continuous monitoring sites on the North Fork Shenandoah River, Virginia.

[MIN, minimum dissolved-oxygen concentration; MAX, maximum dissolved-oxygen concentration; °C, degrees Celsius; DOsat, dissolved oxygen as percent air saturation; DO, dissolved oxygen; mg/L, milligrams per liter; SC, specific conductance; µS/cm, microsiemens per centimeter; –, no data]

Site number (Fig. 2)	Begin date	Begin time (local)	End date	End time (local)	Water depth (ft)	Statistic	Date	Time (local)	DOsat (percent)	DO (mg/L)	DO ¹ (ratio)	pH (standard units)	SC (µS/cm)	Water temperature (°C)
6	07/29/1999	14:30	07/30/1999	10:00	1.5	MIN	07/30/1999	07:30	43.7	3.7	3.4	7.7	295	24.40
						MAX	07/29/1999	18:00	162.6	12.7	–	8.5	316	28.12
13	07/29/1999	12:00	07/30/1999	9:30	1.7	MIN	07/30/1999	03:00	32.9	2.7	6.1	–	800	24.75
						MAX	07/29/1999	14:30	203.5	16.4	–	–	713	26.21
19	07/15/1999	11:30	07/20/1999	12:00	2.0	MIN	07/20/1999	06:00	26.2	2.2	6.8	7.6	457	24.32
						MAX	07/18/1999	13:30	192.9	15.0	–	8.8	429	28.27
20	07/15/1999	12:30	07/20/1999	12:00	2.1	MIN	07/20/1999	06:00	36.8	3.1	4.9	7.7	–	24.29
						MAX	07/18/1999	13:30	198.0	15.3	–	8.9	–	28.73
22	07/28/1999	14:30	07/30/1999	8:30	2.8	MIN	07/29/1999	09:30	29.6	2.5	2.6	7.6	446	24.16
						MAX	07/28/1999	17:30	79.7	6.5	–	8.0	423	25.72
23	07/28/1999	13:00	07/30/1999	8:00	2.1	MIN	07/30/1999	06:30	50.5	4.3	2.4	7.8	432	23.88
						MAX	07/28/1999	15:00	127.8	10.3	–	8.4	442	26.48
27	07/26/1999	16:30	07/28/1999	7:30	1.4	MIN	07/27/1999	08:00	57.7	5.0	3.2	7.7	390	22.68
						MAX	07/27/1999	17:30	198.5	15.9	–	8.6	366	26.83
28	07/26/1999	16:00	07/28/1999	7:30	1.5	MIN	07/27/1999	07:30	53.9	4.7	3.1	7.8	419	22.20
						MAX	07/27/1999	17:30	178.6	14.4	–	8.7	391	25.29
29	07/26/1999	15:00	07/28/1999	8:00	10.0	MIN	07/27/1999	17:00	68.1	5.7	2.3	7.9	449	23.93
						MAX	07/27/1999	22:00	157.5	13.1	–	8.5	436	24.68
30	07/26/1999	14:30	07/28/1999	8:00	2.2	MIN	07/27/1999	07:30	83.3	7.1	1.3	8.0	438	23.23
						MAX	07/27/1999	15:00	105.4	9.0	–	8.1	438	23.17
32	07/12/1999	19:00	07/20/1999	16:00	0.6	MIN	07/14/1999	07:30	36.7	3.2	4.5	8.3	471	22.14
						MAX	07/19/1999	17:30	181.6	14.4	–	8.8	451	27.11
34	07/12/1999	18:30	07/20/1999	15:00	0.5	MIN	07/20/1999	08:00	57.6	4.8	2.8	8.2	470	25.09
						MAX	07/16/1999	17:30	168.0	13.4	–	8.8	455	26.72
37	07/21/1999	11:00	07/27/1999	9:00	2.0	MIN	07/26/1999	07:00	59.4	4.7	2.1	8.4	438	26.91
						MAX	07/26/1999	18:30	132.9	10.0	–	8.8	425	30.12
38	07/21/1999	11:30	07/27/1999	9:30	1.6	MIN	07/24/1999	04:00	62.4	4.9	1.9	8.4	431	27.51
						MAX	07/26/1999	18:00	124.0	9.4	–	8.7	433	29.66

Table 3. Continued.

Site number (Fig. 2)	Begin date	Begin time (local)	End date	End time (local)	Water depth (ft)	Statistic	Date	Time (local)	DOsat (percent)	DO (mg/L)	DO ¹ (ratio)	pH (standard units)	SC (μS/cm)	Water temperature (°C)
48	07/27/1999	15:00	07/29/1999	8:30	-	MIN	07/29/1999	07:30	69.6	5.7	1.5	9.2	406	25.46
						MAX	07/28/1999	13:00	111.4	8.6		9.3	410	28.93
49	07/27/1999	15:30	07/29/1999	8:30	1.6	MIN	07/29/1999	07:30	71.9	5.9	1.5	9.1	395	24.96
						MAX	07/28/1999	13:00	113.1	8.8		9.2	397	28.38
50	07/28/1999	14:00	07/30/1999	8:30	4.4	MIN	07/29/1999	10:00	66.8	5.5	1.8	8.9	403	25.39
						MAX	07/29/1999	21:30	123.0	9.7		9.1	390	27.81
51	07/29/1999	9:30	07/30/1999	9:00	1.5	MIN	07/29/1999	10:00	77.9	6.4	1.4	8.9	402	25.46
						MAX	07/29/1999	22:30	113.5	8.9		9.1	392	27.73

¹Calculated by dividing the maximum dissolved-oxygen concentration by the minimum dissolved-oxygen concentration

Table 4. Early morning and late afternoon dissolved-oxygen concentrations and associated water-quality parameter values from instantaneous monitoring sites on the North Fork Shenandoah River, Virginia.

[AM, early morning dissolved-oxygen concentration; PM, late afternoon dissolved-oxygen concentration; °C, degrees Celsius; DOsat, dissolved oxygen as percent air saturation; DO, dissolved oxygen; mg/L, milligrams per liter; mm Hg, millimeters of mercury; SC, specific conductance; µS/cm, microsiemens per centimeter; –, no data]

Site number (Fig. 2)	Statistic	Date	Time (local)	DOsat (percent)	DO (mg/L)	DO ¹ (ratio)	pH (standard units)	SC (µS/cm)	Water temperature (°C)	Air temperature (°C)	Barometric pressure (mm Hg)
1	AM	07/27/1999	04:20	62.8	5.1		7.7	185	25.84	22.0	730
	PM	07/27/1999	14:49	126.9	9.9	1.9	8.2	178	28.46	33.0	–
2	AM	07/27/1999	04:26	71.9	6.0	1.6	7.7	278	24.14	22.0	730
	PM	07/27/1999	14:55	129.5	9.9		8.2	307	29.13	–	730
3	AM	07/27/1999	04:59	54.1	4.4	1.1	7.6	301	25.77	22.0	730
	PM	07/27/1999	15:08	61.7	5.0		7.8	255	26.54	33.0	730
4	AM	07/27/1999	05:15	70.5	5.7	1.6	7.9	274	25.24	22.0	730
	PM	07/27/1999	15:17	122.0	9.3		8.8	244	29.42	33.0	730
5	AM	07/27/1999	05:25	44.3	3.6	2.4	7.8	284	25.01	21.0	731
	PM	07/27/1999	15:23	111.0	8.7		8.3	281	28.06	33.0	730
7	AM	07/27/1999	05:46	41.8	3.5	3.4	7.8	365	24.62	21.5	730
	PM	07/27/1999	15:28	149.6	11.8		8.4	360	27.79	33.0	730
8	AM	07/27/1999	06:07	82.0	6.7	1.8	7.9	308	25.66	22.0	–
	PM	07/27/1999	15:52	150.7	11.8		8.5	343	27.78	33.0	730
9	AM	07/27/1999	06:15	72.3	5.9	–	7.9	426	25.74	22.0	–
	PM	–	–	–	–	–	–	–	–	–	–
10	AM	07/27/1999	06:32	43.0	3.6	3.9	7.8	778	25.21	21.0	732
	PM	07/27/1999	16:13	184.5	14.0		8.5	856	29.84	32.0	730
11	AM	07/28/1999	04:12	97.1	7.8	1.3	8.2	663	26.49	23.0	732
	PM	07/27/1999	16:26	132.7	10.3		8.5	648	28.36	32.0	–
12	AM	07/27/1999	07:05	30.9	2.6	3.8	7.8	780	24.11	–	732
	PM	07/27/1999	16:40	126.8	9.8		8.5	780	29.38	–	732
14	AM	07/27/1999	07:17	25.1	2.1	3.0	7.7	756	23.78	22.0	732
	PM	07/27/1999	16:46	80.8	6.3		8.2	730	28.06	32.0	732
15	AM	07/28/1999	04:21	49.2	4.3	2.9	7.8	544	22.67	23.0	732
	PM	07/27/1999	17:04	150.8	12.3		8.4	510	25.62	33.5	732
16	AM	07/28/1999	04:30	47.7	4.0	2.8	7.7	462	24.27	33.0	732
	PM	07/27/1999	17:14	139.0	11.0		8.4	510	27.32	33.5	732

Table 4. Continued.

Site number (Fig. 2)	Statistic	Date	Time (local)	DOsat (percent)	DO (mg/L)	DO ¹ (ratio)	pH (standard units)	SC (µS/cm)	Water temperature (°C)	Air temperature (°C)	Barometric pressure (mm Hg)
17	AM	07/28/1999	04:40	65.0	5.3	2.0	7.9	514	25.47	23.0	732
	PM	07/27/1999	17:32	137.6	10.8		8.4	516	27.93	33.0	732
18	AM	07/28/1999	04:50	47.1	3.9	2.5	7.8	482	25.58	23.0	732
	PM	07/29/1999	14:30	120.8	9.8		8.3	496	24.31	31.5	730
21	AM	07/28/1999	05:08	33.3	2.7	3.3	7.7	458	25.41	23.0	732
	PM	07/29/1999	14:42	112.1	9.0		8.3	432	26.62	31.5	730
24	AM	07/28/1999	05:28	41.0	3.4	3.5	7.8	447	24.56	22.0	736
	PM	07/29/1999	14:55	150.9	12.1		8.4	430	26.39	32.5	730
25	AM	07/28/1999	05:46	27.7	2.3	3.4	7.8	444	25.30	22.0	236
	PM	07/29/1999	15:10	98.3	7.9		8.3	422	26.82	32.5	730
26	AM	07/28/1999	05:50	39.7	3.8	3.5	7.7	464	17.00	22.0	736
	PM	07/29/1999	15:26	149.9	13.3		8.3	232	21.13	32.5	732
31	AM	07/28/1999	06:18	64.4	5.5	2.2	7.8	456	22.87	22.0	739
	PM	07/29/1999	15:38	152.0	12.1		8.6	448	27.02	32.5	732
33	AM	07/28/1999	06:29	45.5	3.7	3.3	8.1	452	25.38	22.0	740
	PM	07/29/1999	16:02	154.9	12.3		8.6	440	27.06	33.0	733
35	AM	07/28/1999	05:50	51.4	4.2	3.0	7.9	427	25.83	26.0	736
	PM	07/29/1999	16:20	166.4	12.6		8.9	413	29.79	33.5	732
36	AM	07/28/1999	05:40	73.6	5.9	2.0	8.5	419	26.88	25.5	–
	PM	07/29/1999	16:35	151.6	11.9		8.8	409	28.04	33.0	733
39	AM	07/28/1999	05:10	95.2	7.5	1.3	8.9	437	27.59	25.0	737
	PM	07/29/1999	16:00	124.1	9.7		8.8	434	27.85	34.0	733
40	AM	07/28/1999	04:40	60.5	4.9	3.0	8.9	440	26.35	25.5	738
	PM	07/29/1999	15:45	189.1	14.5		9.1	426	29.19	32.5	734
41	AM	07/28/1999	04:15	58.0	4.7	3.3	8.6	455	26.23	24.5	738
	PM	07/29/1999	15:35	202.2	15.3		9.3	416	29.74	33.0	734
42	AM	07/27/1999	06:40	76.0	6.1	1.7	9.3	412	26.92	24.5	738
	PM	07/27/1999	17:40	132.4	10.3		9.0	445	28.21	35.0	735
43	AM	07/27/1999	05:50	68.8	5.6	2.0	8.9	425	25.95	23.5	740
	PM	07/27/1999	17:10	149.5	11.4		9.6	390	29.52	35.0	736

Table 4. Continued.

Site number (Fig. 2)	Statistic	Date	Time (local)	DO _{sat} (percent)	DO (mg/L)	DO ¹ (ratio)	pH (standard units)	SC (μS/cm)	Water temperature (°C)	Air temperature (°C)	Barometric pressure (mm Hg)
44	AM	07/27/1999	05:58	56.4	4.5	2.8	9.0	417	26.47	23.5	–
	PM	07/27/1999	17:15	163.2	12.5		9.5	392	29.48	34.5	–
45	AM	07/27/1999	05:30	55.1	4.4	3.3	9.0	415	26.78	23.0	–
	PM	07/27/1999	17:00	193.2	14.6		9.5	392	30.14	37.0	736
46	AM	07/27/1999	05:05	87.9	7.0	1.5	9.3	397	27.41	22.5	738
	PM	07/27/1999	16:40	132.2	10.3		9.3	400	28.45	33.0	737
47	AM	07/27/1999	04:40	58.7	4.7	3.0	9.1	413	26.39	22.0	–
	PM	07/27/1999	16:21	184.2	14.0		9.5	405	29.58	34.5	737
52	AM	07/27/1999	04:20	73.6	5.8	1.5	8.9	403	27.15	21.5	739
	PM	07/27/1999	16:05	111.2	8.6		9.0	414	28.82	33.5	738

¹Calculated by dividing the late afternoon dissolved-oxygen concentration by the early morning dissolved-oxygen concentration

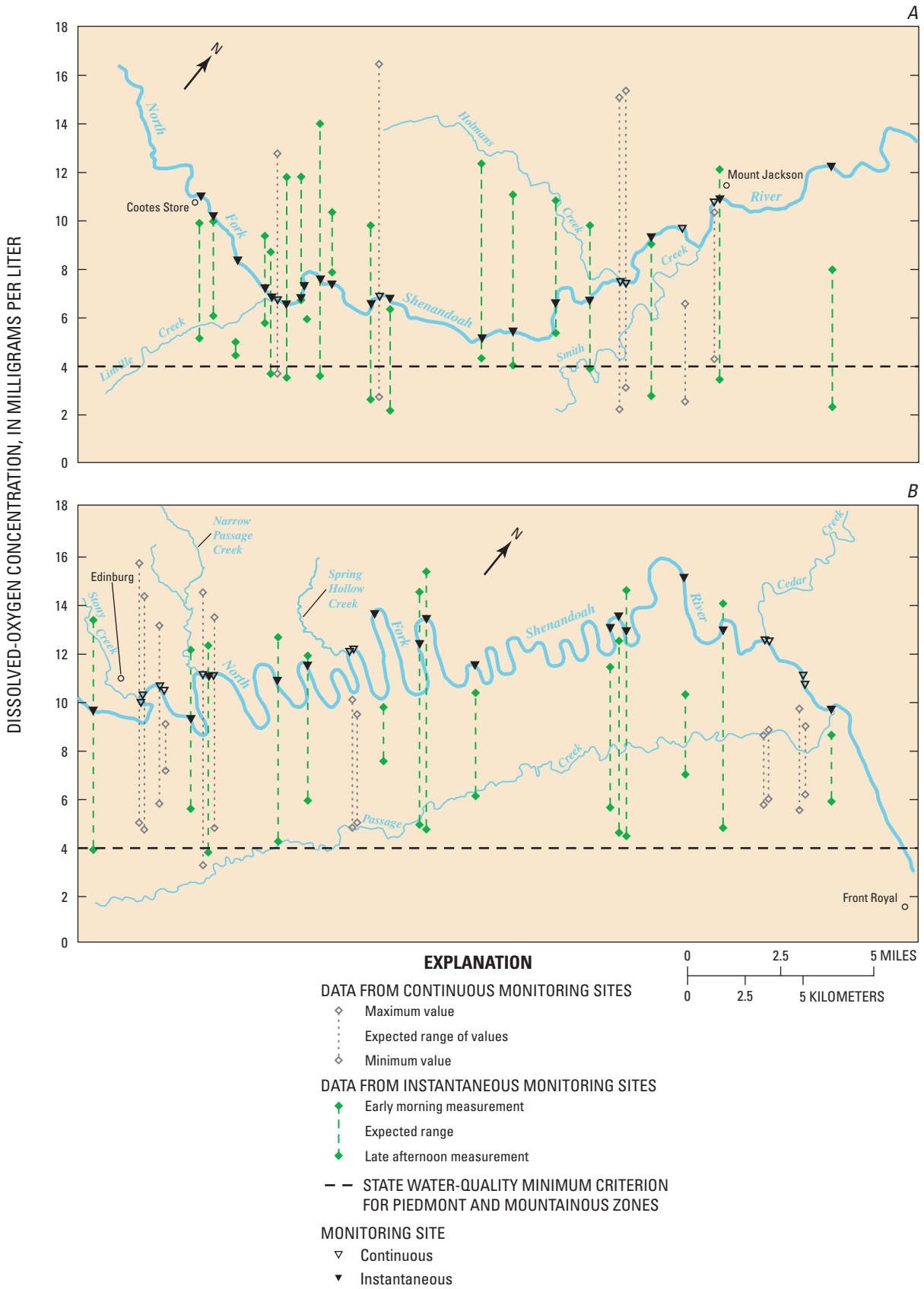


Figure 4. Dissolved-oxygen concentrations at water-quality monitoring sites in sections A and B of the North Fork Shenandoah River, Virginia.

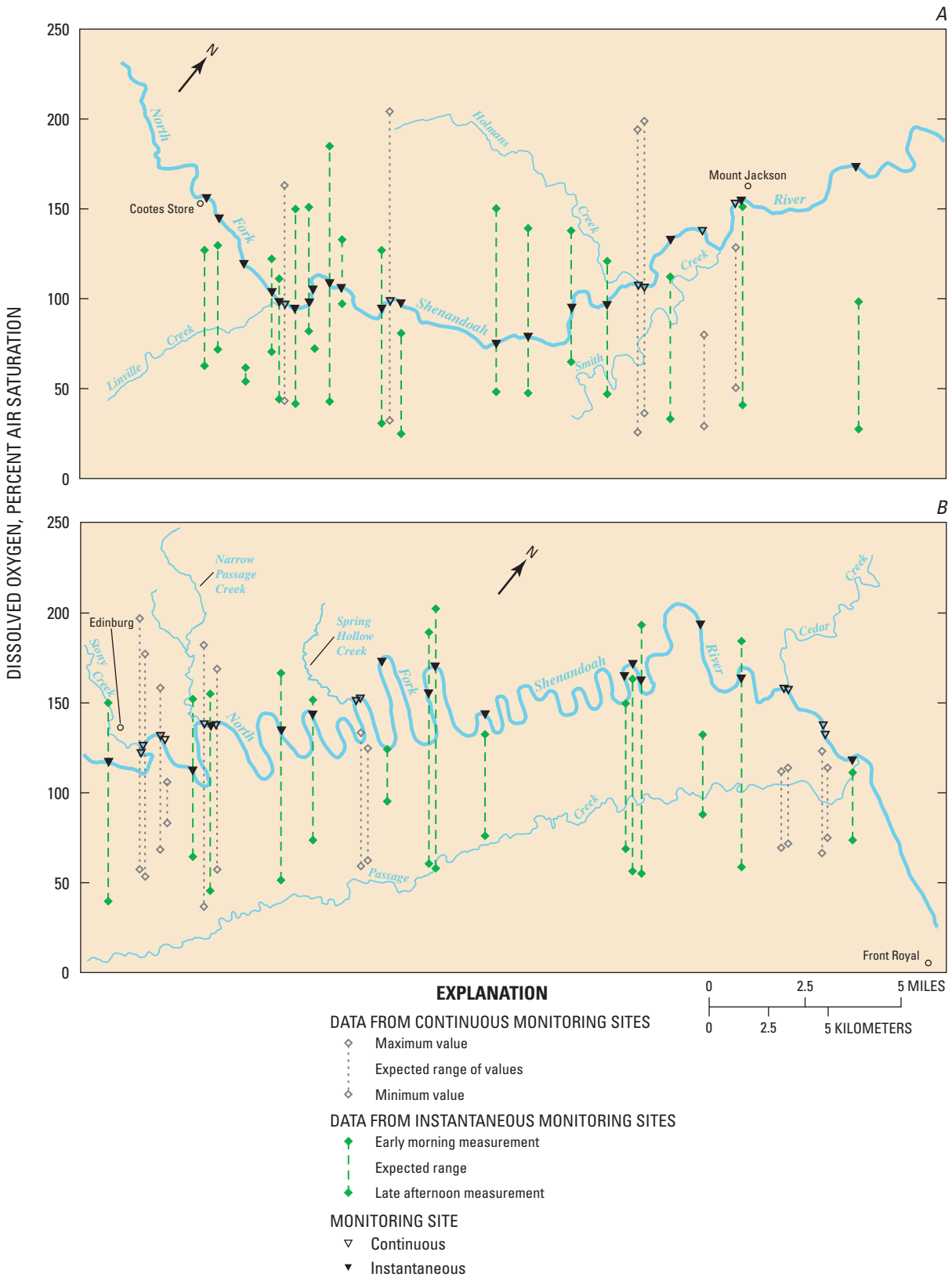


Figure 5. Dissolved-oxygen as percent air saturation at water-quality monitoring sites in sections A and B of the North Fork Shenandoah River, Virginia.

Although there were no significant differences between datasets, the range of values recorded during the continuous sampling (2.2–16.4 mg/L) was greater than the range of values from the instantaneous sampling (2.1–15.3 mg/L). The dissolved-oxygen ratios (fig. 6) represent the maximum dissolved-oxygen concentration divided by the minimum dissolved-oxygen concentration at each monitoring site. The larger the ratio, the greater the difference between the maximum and minimum dissolved-oxygen concentrations. Ratios can be used to compare daily fluctuations of dissolved-oxygen concentrations.

At continuous water-quality monitoring sites, dissolved-oxygen concentrations fluctuated as much as 10 mg/L per day, and typically fluctuated at least 5 mg/L per day during the study period. The daily fluctuations of dissolved-oxygen concentrations for selected pairs of continuous water-quality monitoring sites (sites 19 and 20, 32 and 34, and 37 and 38) are illustrated (fig. 7 and app.). At instantaneous water-quality monitoring sites, the mean daily fluctuation of dissolved-oxygen concentrations was approximately 6 mg/L. Daily fluctuations of dissolved-oxygen concentrations have been recently documented on the Colorado River below Glen Canyon Dam, Ariz. (Flynn and others, 2001), on the White River near Sumner, Wash. (Ebbert, 2003), and on six rivers within south-central Texas (Ging and Otero, 2003). The previously mentioned studies report daily fluctuations in the range of 5 mg/L. Photosynthesis and respiration of the benthic organisms affect the daily fluctuation of dissolved-oxygen concentration and pH in rivers (Hem, 1989; Marzolf and others, 1999; Flynn and others, 2001). Summer low flows and high water temperatures on the North Fork Shenandoah River may have contributed to excessive algal growth, which may affect the wide range of daily fluctuation of dissolved-oxygen concentrations.

pH

At all sites, pH was slightly alkaline, with values ranging from 7.6 to 9.6 (fig. 8, tables 3 and 4). The greatest pH values were found between sites 40 and 52 in the Seven Bends area of the river (fig. 2). The State numerical criteria for the minimum and maximum values of pH in Piedmont and Mountainous zones are 6.0 and 9.0, respectively (State Water Control Board, 2002). Upstream of site 40, at Rittenour Ridge (fig. 2), all measured pH values were less than 9.0, but from Rittenour Ridge downstream to site 52, pH values greater than 9.0 were measured at all sites (fig. 8). Most semi-hourly values from continuous water-quality monitoring sites were less than 9.0, but at sites 48, 49, 50, and 51, pH values greater than 9.0 were measured on multiple days (app.). River water generally has a pH in the range of 6.5–8.5 (Hem, 1989). When photosynthesis by aquatic organisms takes up dissolved carbon dioxide during the day, and the organisms release carbon dioxide at night through respiration, pH fluctuation may occur, and the maximum pH value can reach as high as 9.0 (Stumm and Morgan, 1981; Hem, 1989). On the White River near Sumner, Wash., the minimum

and the maximum pH values ranged from approximately 7.5 to 8.5 daily in September and October 2002 (Ebbert, 2003). As turbidity increased in the White River, the daily fluctuation of pH decreased, demonstrating the effect photosynthesis has on daily fluctuation of pH in streams (Ebbert, 2003). On the North Fork Shenandoah River, the karst topography over the limestone and dolomite rocks may contribute to the greater pH of river water in this area, but the maximum pH values measured were likely affected by photosynthesis and respiration as well.

Specific Conductance

Specific-conductance values from both continuous and instantaneous water-quality monitoring sites ranged from 178 to 856 $\mu\text{S}/\text{cm}$ (fig. 9). No State numerical criteria have been established for specific-conductance values. Most specific-conductance values were less than 550 $\mu\text{S}/\text{cm}$. From sites 10 to 14, specific-conductance values were greater than 600 $\mu\text{S}/\text{cm}$, and ranged from 648 to 856 $\mu\text{S}/\text{cm}$. Daily fluctuations of specific conductance of 10 to 30 $\mu\text{S}/\text{cm}$ were typical at continuous and instantaneous water-quality monitoring sites.

Temperature

Air and water temperature serve as a reference to climactic conditions during the study period. Air temperature data were collected only from the 34 instantaneous water-quality monitoring sites. Air temperatures ranged from 21.0 to 37.0°C (table 4). These air temperatures are typical for summer months in this region. Water temperatures from both continuous and instantaneous water-quality monitoring sites ranged from 17.00 to 30.14°C (fig. 10, tables 3 and 4). As would be expected during a summer low-flow period, water temperature was above 25°C at least once at 50 sites. The State numerical criterion for the maximum water temperature in Piedmont and Mountainous zones is 31.0°C (State Water Control Board, 2002). All measured water temperatures were below 31.0°C (fig. 10), except for some of the semi-hourly values collected at continuous water-quality monitoring site 37, where a maximum water temperature of 31.10°C was measured on July 23, 1999 (app.). The complete range of values from the semi-hourly temperature dataset is reported in the appendix. A water temperature of 17.00°C was measured at site 26, an instantaneous monitoring site (section B, fig. 10). This value is less than all other measured water temperatures; however, during field data collection it was noted that a spring discharged to the river at this site. Because ground-water temperatures are typically colder than surface-water temperatures in the summer, it is likely that the water temperature measured at site 26 was affected by ground-water discharge from the spring.

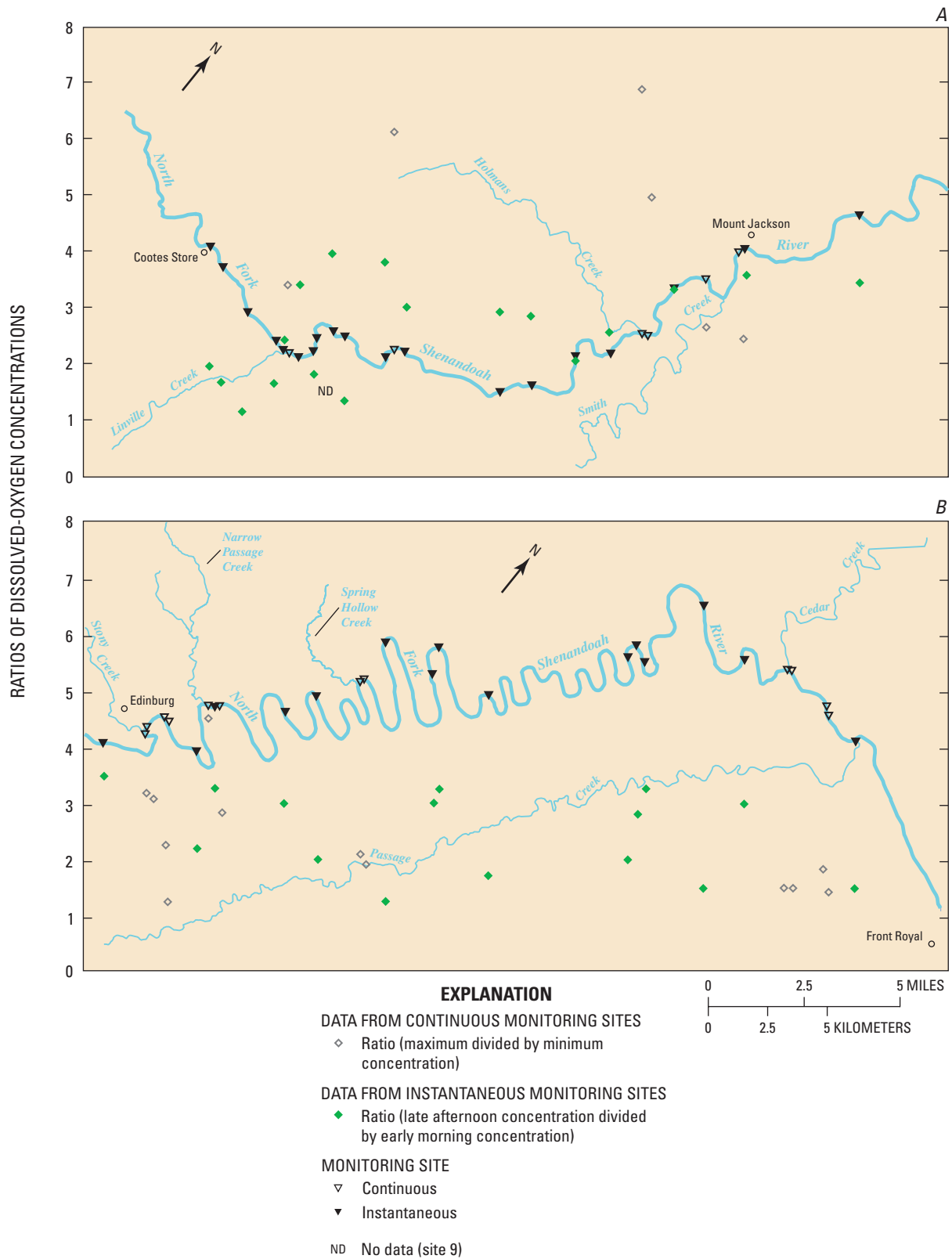


Figure 6. Ratios of dissolved-oxygen concentrations at water-quality monitoring sites in sections A and B of the North Fork Shenandoah River, Virginia.

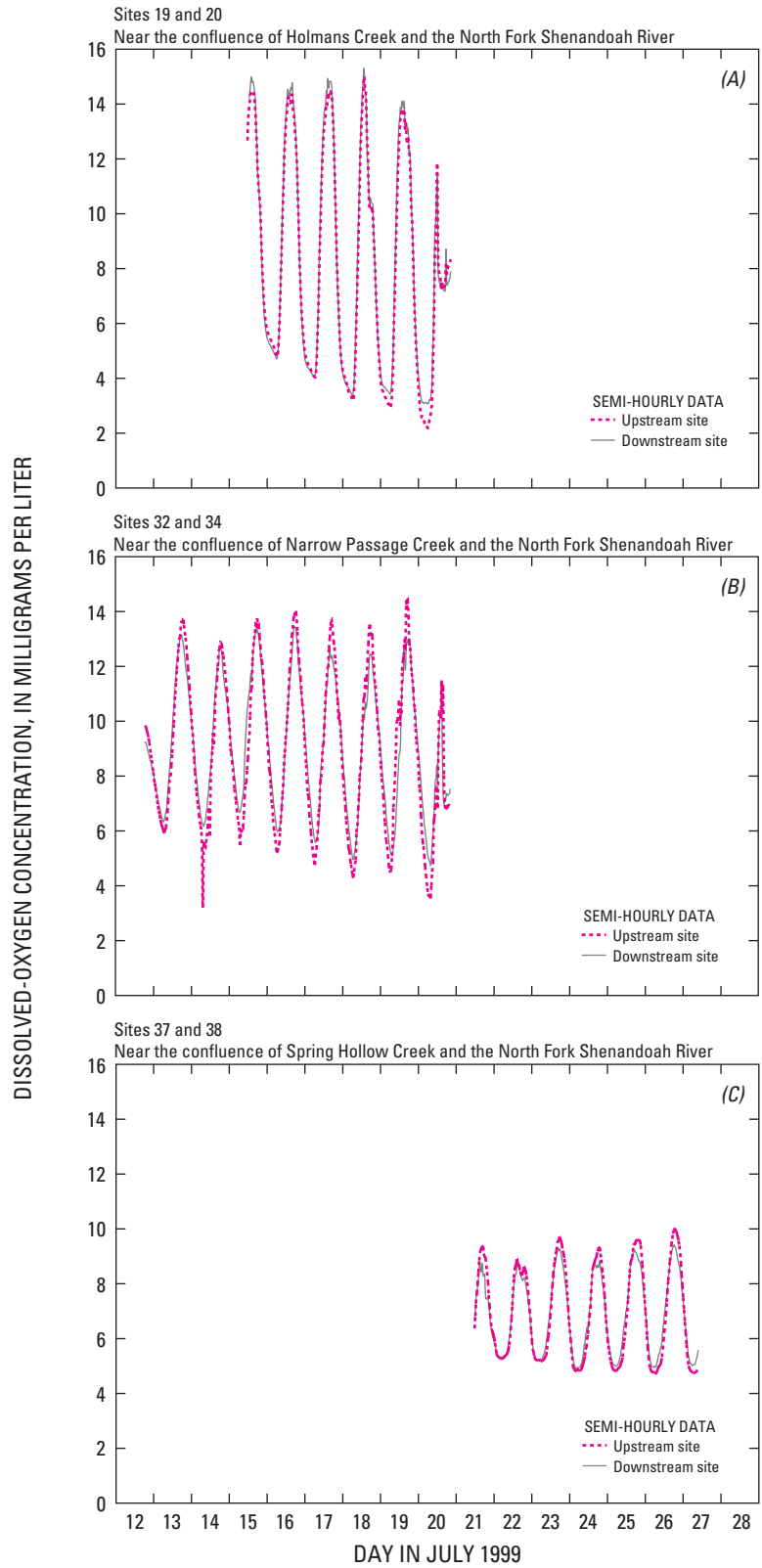


Figure 7. Dissolved-oxygen concentrations at three pairs of upstream and downstream continuous water-quality monitoring sites along the North Fork Shenandoah River, Virginia, during July 15-20 (A), July 12-20 (B), and July 21-27 (C), 1999.

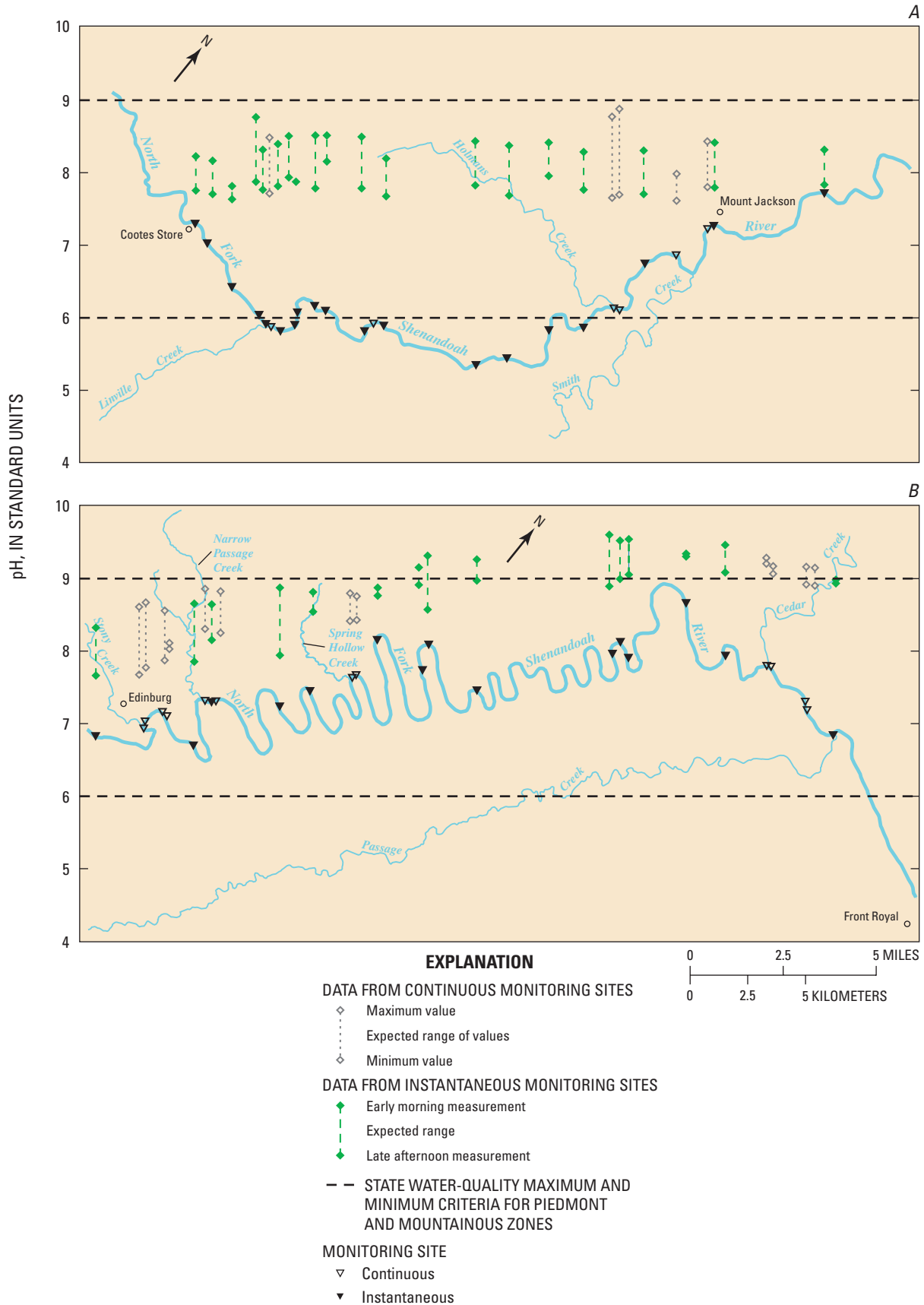


Figure 8. pH at water-quality monitoring sites in sections A and B of the North Fork Shenandoah River, Virginia.

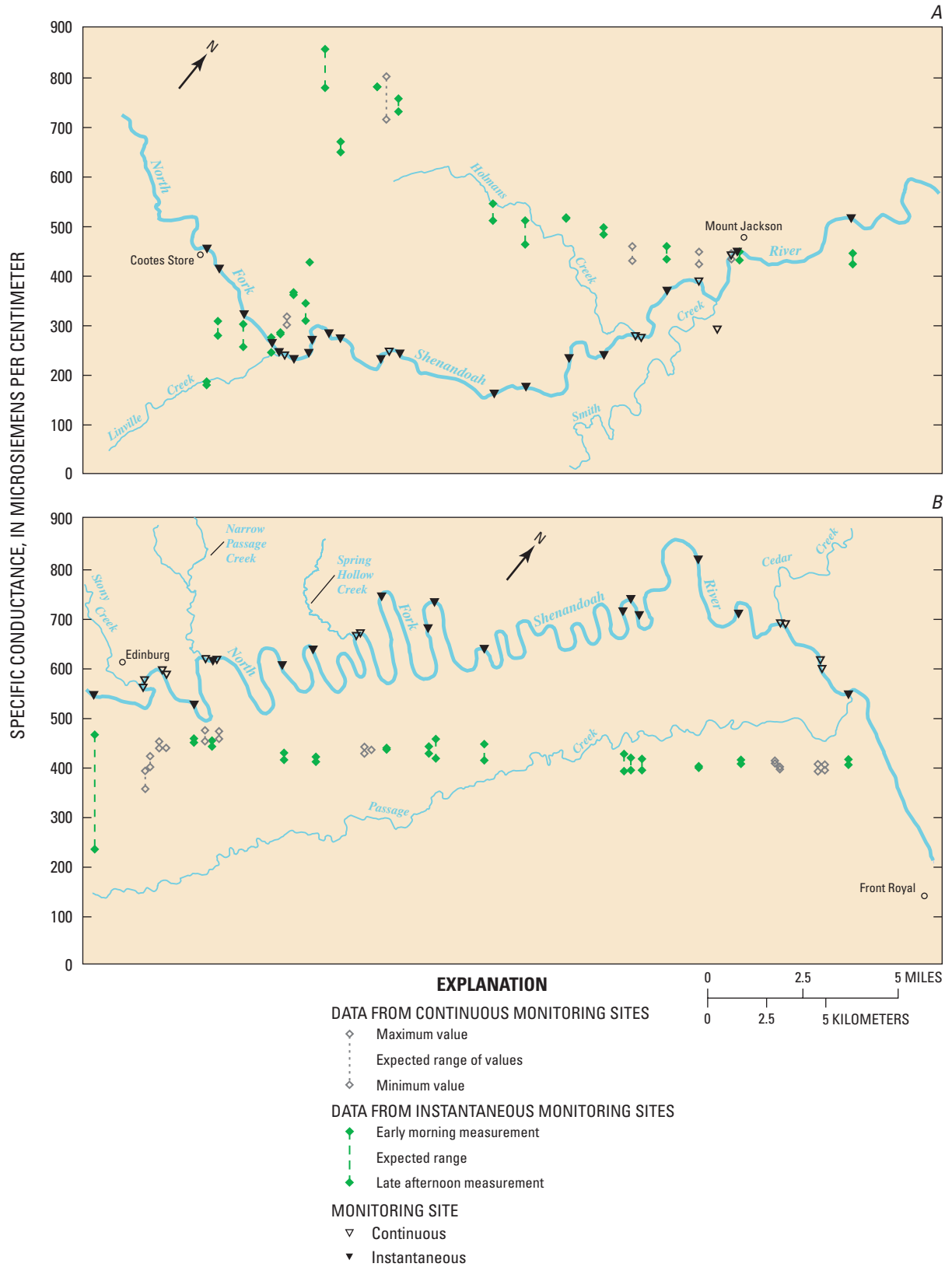


Figure 9. Specific conductance at water-quality monitoring sites in sections A and B of the North Fork Shenandoah River, Virginia.

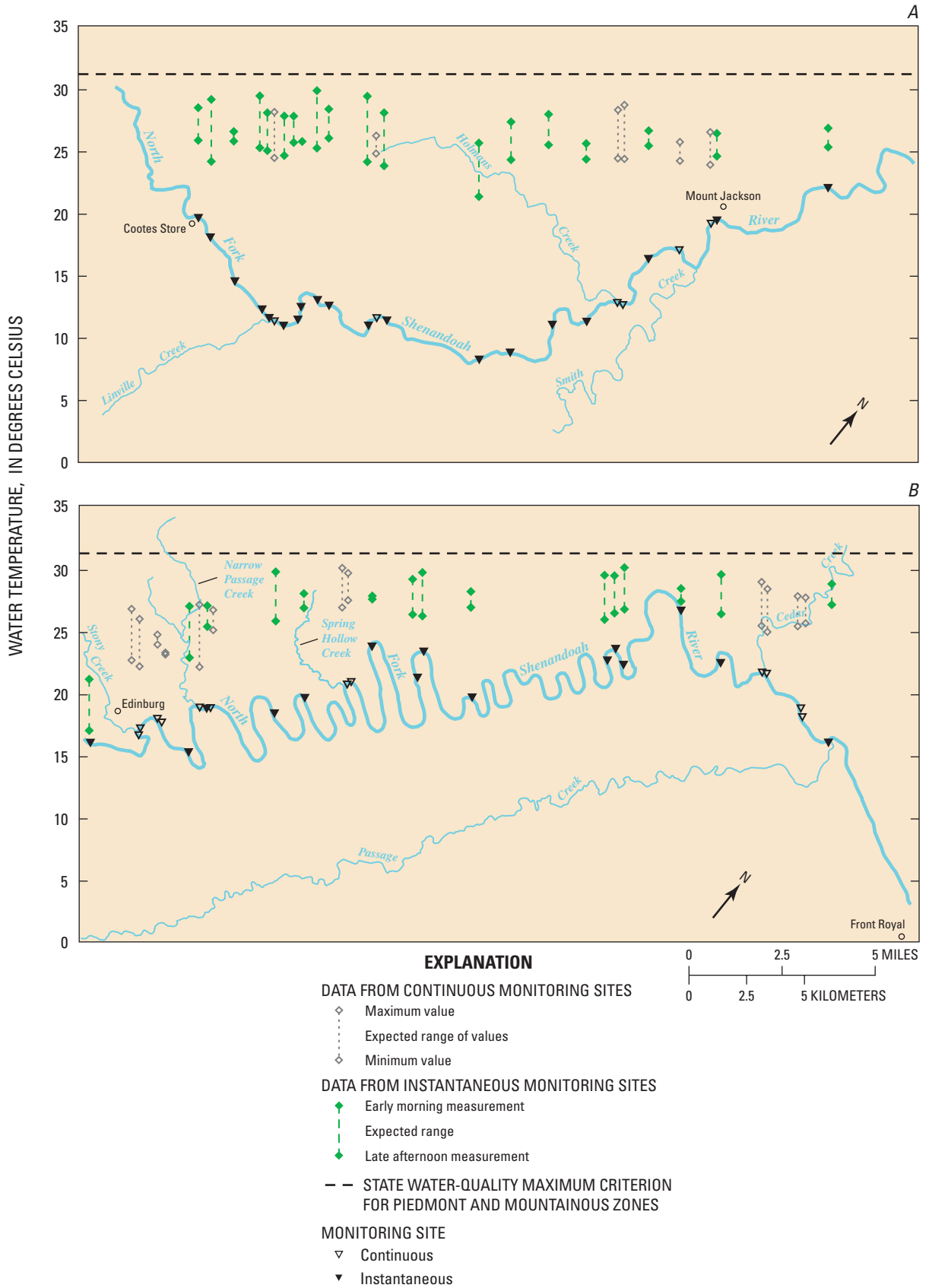


Figure 10. Water temperature at water-quality monitoring sites in sections A and B of the North Fork Shenandoah River, Virginia.

Summary and Conclusions

Increased demand for water resources, in conjunction with population growth, has brought about widespread concern about water availability within the North Fork Shenandoah River Basin, Virginia. In a rural basin with the potential for urban and industrial growth, the availability of a clean, abundant water supply is a primary concern. There is also concern for maintaining streamflows that are adequate to support the aquatic community, to support recreation, and to maintain aesthetic characteristics of the river. Mean monthly flows in July 1999 recorded at three streamflow-gaging stations on the river were the lowest recorded in the past 55- to 74-year periods of record. Recent droughts have increased public awareness of the importance of a sustainable water supply and have increased demand for water-availability and water-quality information to assist with water-resources management in the basin.

In 1998, an Instream Flow Incremental Methodology (IFIM) study was initiated by the USGS, in cooperation with the Northern Shenandoah Valley Regional Commission and Virginia Polytechnic Institute and State University, to incorporate hydrologic information, habitat requirements of fish, and water-use information into a comprehensive assessment of the water resources of the North Fork Shenandoah River Basin. As a part of the IFIM study, water-quality data were collected in July of 1999 to provide information about water-quality conditions to which aquatic life are exposed during summer low-flow periods (defined as flows less than the 90-percent exceedance flow). The study focused on dissolved-oxygen concentrations because the variability of dissolved-oxygen concentrations can affect fish health.

Dissolved-oxygen concentration, pH, specific conductance, and water temperature were measured at 52 sites along 80 mi of the North Fork Shenandoah River from Cootes Store, Va., to its confluence with Passage Creek, near Strasburg, Va. Maximum and minimum dissolved-oxygen concentrations were determined for 18 sites with continuous water-quality monitors. These data represent the greatest (MAX) and least (MIN) semi-hourly concentrations of dissolved oxygen recorded during the study period and are the upper and lower limits of the range of values measured. Dissolved-oxygen concentrations also were measured at 34 sites in the early morning (AM) and late afternoon (PM) with hand-held water-quality monitors to best approximate the daily minimum and daily maximum dissolved-oxygen concentrations, respectively.

Dissolved-oxygen concentrations ranged from 2.1 to 16.4 mg/L. Dissolved oxygen as percent air saturation ranged from 25 to 204 percent. Daily fluctuations of dissolved-oxygen concentrations were at least 5 mg/L at each site. Dissolved-oxygen concentrations were equal to or less than the State water-quality minimum of 4.0 mg/L at 18 of 52 monitoring sites; all 18 sites were in the upper and middle portions of the river, where more than half of the first 34 sites had minimum dissolved-oxygen concentrations equal to or less than 4.0 mg/L.

The pH was slightly alkaline at all sites, and ranged from 7.6 to 9.6, with pH values greater than 9.0 measured at the 13 sites farthest downstream. The State numerical criteria for the minimum and maximum values of pH in Piedmont and Mountainous zones are 6.0 and 9.0, respectively. One-hundred percent of pH values measured were greater than the State minimum, and 75 percent of pH values measured were less than the State maximum during the study period. More information is needed about the combined effects of geology, ground-water discharge to the river, primary production, and human impacts to the river, to determine the cause of the maximum pH values on the North Fork Shenandoah River. Specific-conductance values ranged from 178 to 856 $\mu\text{S}/\text{cm}$, with values greater than 600 $\mu\text{S}/\text{cm}$ measured at a group of 5 sites in the upper portion of the river. Air temperatures ranged from 21.0 to 37.0°C, and water temperatures ranged from 17.00 to 30.14°C. The State numerical criterion for the maximum water temperature in Piedmont and Mountainous zones is 31.0°C. At 51 sites, measured water temperatures were below 31.0°C.

Water-quality data in this report serve as baseline information on summer, extreme low-flow conditions on the North Fork Shenandoah River. The flows observed are not within the normal range of flows for summer months, and are in part the result of reduced precipitation over the previous 12 months. However, water-quality conditions vary seasonally and annually, depending on the hydrologic condition, and periodically, extremely low-flow conditions result. The dissolved-oxygen concentrations measured during this study showed great daily fluctuations, and were less than the State minimum criteria at 18 sites. pH values exceeded State numerical criteria for maximum value of pH at 13 sites. To understand the degree to which the water-quality conditions observed in this study are representative, and to understand how the water-quality conditions recorded in this study can affect the aquatic community, it would be best to have a comparable dataset from a summer period within a normal range of flows. Further study would be required to assess the duration of conditions similar to those reported in this study, and any changes in water-quality conditions that result from increased water withdrawals from the North Fork Shenandoah River.

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Appendix

Appendix Continuous water-quality monitoring data for the North Fork Shenandoah River, Virginia

[See table 1 for site names and descriptions; see figure 2 for site locations; °C, degrees Celsius; SC, specific conductance; $\mu\text{S}/\text{cm}$, microsiemens per centimeter; DOsat, dissolved oxygen as percent air saturation; DO, dissolved oxygen; mg/L, milligrams per liter; –, no data]

Date	Time	Water temperature (°C)	SC ($\mu\text{S}/\text{cm}$)	DOsat (percent)	DO (mg/L)	pH (standard units)
Site 6						
7/29/1999	14:30:40	26.77	302	101.7	8.1	8.0
7/29/1999	15:00:40	26.93	302	100.6	8.0	8.0
7/29/1999	15:30:40	27.43	300	109.2	8.6	8.1
7/29/1999	16:00:40	27.41	301	115.6	9.1	8.2
7/29/1999	16:30:40	27.59	302	130.4	10.3	8.2
7/29/1999	17:00:40	27.72	304	132.4	10.4	8.3
7/29/1999	17:30:40	28.06	309	149.4	11.7	8.4
7/29/1999	18:00:40	28.12	316	162.6	12.7 ^a	8.5
7/29/1999	18:30:40	28.41	316	158.1	12.3	8.5
7/29/1999	19:00:40	28.35	315	159.1	12.4	8.5
7/29/1999	19:30:40	28.41	310	161.0	12.5	8.6
7/29/1999	20:00:40	28.74	300	149.5	11.5	8.6
7/29/1999	20:30:40	29.29	269	113.5	8.7	8.6
7/29/1999	21:00:40	29.3	267	102.1	7.8	8.4
7/29/1999	21:30:40	29.16	265	93.7	7.2	8.3
7/29/1999	22:00:40	28.92	264	85.2	6.6	8.3
7/29/1999	22:30:40	28.62	265	81.9	6.3	8.3
7/29/1999	23:00:40	28.28	266	76.4	6.0	8.2
7/29/1999	23:30:40	27.91	268	70.4	5.5	8.1
7/30/1999	0:00:40	27.55	271	65.3	5.2	8.0
7/30/1999	0:30:40	27.19	273	61.2	4.9	7.9
7/30/1999	1:00:40	26.85	276	57.5	4.6	7.9
7/30/1999	1:30:40	26.54	279	54.4	4.4	7.8
7/30/1999	2:00:40	26.26	281	52.0	4.2	7.8
7/30/1999	2:30:40	26	283	49.8	4.0	7.8
7/30/1999	3:00:40	25.77	285	48.3	3.9	7.8
7/30/1999	3:30:40	25.55	286	47.4	3.9	7.8
7/30/1999	4:00:40	25.34	287	47.0	3.9	7.7
7/30/1999	4:30:40	25.15	289	46.8	3.9	7.7
7/30/1999	5:00:40	24.97	290	46.7	3.9	7.7
7/30/1999	5:30:40	24.82	291	46.3	3.8	7.7
7/30/1999	6:00:40	24.69	292	45.4	3.8	7.7
7/30/1999	6:30:40	24.58	293	44.5	3.7	7.7
7/30/1999	7:00:40	24.48	294	44.0	3.7	7.7
7/30/1999	7:30:40	24.4	295	43.7	3.7 ^b	7.7
7/30/1999	8:00:40	24.38	296	44.9	3.8	7.7
7/30/1999	8:30:40	24.42	296	48.1	4.0	7.7
7/30/1999	9:00:40	24.41	297	50.9	4.3	7.7
7/30/1999	9:30:40	24.42	297	53.3	4.5	7.8
7/30/1999	10:00:40	24.71	297	60.7	5.0	7.8
Site 13						
7/29/1999	12:00:40	24.11	761	136.3	11.4	–
7/29/1999	12:30:40	24.54	758	157.2	13.1	–

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/29/1999	13:00:40	24.76	750	167.7	13.9	–
7/29/1999	13:30:40	25.1	743	181.0	14.9	–
7/29/1999	14:00:40	25.45	730	197.9	16.2	–
7/29/1999	14:30:40	26.21	713	203.5	16.4 ^a	–
7/29/1999	15:00:40	27.26	703	205.0	16.2	–
7/29/1999	15:30:40	28.41	727	194.2	15.1	–
7/29/1999	16:00:40	28.68	729	188.1	14.5	–
7/29/1999	16:30:40	28.61	729	182.6	14.1	–
7/29/1999	17:00:40	28.6	726	181.5	14.0	–
7/29/1999	17:30:40	28.6	726	177.6	13.7	–
7/29/1999	18:00:40	28.52	725	171.8	13.3	–
7/29/1999	18:30:40	28.41	726	163.9	12.7	–
7/29/1999	19:00:40	27.97	733	150.3	11.8	–
7/29/1999	19:30:40	27.71	739	136.7	10.7	–
7/29/1999	20:00:40	27.52	746	121.1	9.5	–
7/29/1999	20:30:40	27.38	752	104.6	8.3	–
7/29/1999	21:00:40	27.26	760	88.6	7.0	–
7/29/1999	21:30:40	27.01	765	76.7	6.1	–
7/29/1999	22:00:40	26.72	772	68.3	5.5	–
7/29/1999	22:30:40	26.46	776	61.4	4.9	–
7/29/1999	23:00:40	26.27	782	55.5	4.5	–
7/29/1999	23:30:40	26.07	787	50.2	4.1	–
7/30/1999	0:00:40	25.82	791	46.2	3.8	–
7/30/1999	0:30:40	25.61	793	43.7	3.6	–
7/30/1999	1:00:40	25.59	798	40.5	3.3	–
7/30/1999	1:30:40	25.43	802	38.2	3.1	–
7/30/1999	2:00:40	25.2	801	35.9	3.0	–
7/30/1999	2:30:40	24.98	800	33.9	2.8	–
7/30/1999	3:00:40	24.75	800	32.9	2.7 ^b	–
7/30/1999	3:30:40	24.55	799	34.9	2.9	–
7/30/1999	4:00:40	24.35	797	34.7	2.9	–
7/30/1999	4:30:40	24.19	795	35.3	3.0	–
7/30/1999	5:00:40	24.06	794	35.2	3.0	–
7/30/1999	5:30:40	23.95	792	35.2	3.0	–
7/30/1999	6:00:40	23.81	791	37.7	3.2	–
7/30/1999	6:30:40	23.73	790	37.6	3.2	–
7/30/1999	7:00:40	23.69	788	40.4	3.4	–
7/30/1999	7:30:40	23.64	787	44.4	3.8	–
7/30/1999	8:00:40	23.63	786	48.4	4.1	–
7/30/1999	8:30:40	23.67	784	57.2	4.8	–
7/30/1999	9:00:40	23.75	782	62.3	5.3	–
7/30/1999	9:30:40	23.79	782	63.6	5.4	–
Site 19						
7/15/1999	11:30:00	23.92	477	150.4	12.7	8.5
7/15/1999	12:00:40	24.37	460	161.9	13.5	8.6
7/15/1999	12:30:40	24.81	457	167.3	13.9	8.6
7/15/1999	13:00:40	25.24	453	172.0	14.1	8.7
7/15/1999	13:30:40	25.57	450	175.8	14.4	8.7
7/15/1999	14:00:40	25.86	447	178.2	14.5	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (μS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/15/1999	14:30:40	26.04	444	178.5	14.5	8.7
7/15/1999	15:00:40	26.22	441	178.3	14.4	8.7
7/15/1999	15:30:40	26.31	439	178.6	14.4	8.7
7/15/1999	16:00:40	26.27	437	175.1	14.1	8.7
7/15/1999	16:30:40	26.19	436	169.7	13.7	8.7
7/15/1999	17:00:40	25.96	437	159.9	13.0	8.6
7/15/1999	17:30:40	25.78	437	153.4	12.5	8.6
7/15/1999	18:00:40	25.51	440	141.7	11.6	8.6
7/15/1999	18:30:40	25.36	442	134.6	11.0	8.5
7/15/1999	19:00:40	25.24	444	130.1	10.7	8.5
7/15/1999	19:30:40	25.04	446	125.8	10.4	8.5
7/15/1999	20:00:40	24.75	449	115.0	9.5	8.4
7/15/1999	20:30:40	24.45	453	103.2	8.6	8.3
7/15/1999	21:00:40	24.22	457	93.8	7.9	8.2
7/15/1999	21:30:40	24.04	460	86.3	7.3	8.1
7/15/1999	22:00:40	23.91	462	80.6	6.8	8.1
7/15/1999	22:30:40	23.82	465	75.9	6.4	8.0
7/15/1999	23:00:40	23.75	466	72.2	6.1	8.0
7/15/1999	23:30:40	23.68	467	69.7	5.9	8.0
7/16/1999	0:00:40	23.63	468	68.1	5.8	8.0
7/16/1999	0:30:40	23.58	468	66.7	5.7	7.9
7/16/1999	1:00:40	23.53	469	65.7	5.6	7.9
7/16/1999	1:30:40	23.48	469	64.9	5.5	7.9
7/16/1999	2:00:40	23.44	470	63.9	5.4	7.9
7/16/1999	2:30:40	23.41	470	63.5	5.4	7.9
7/16/1999	3:00:40	23.36	471	62.4	5.3	7.9
7/16/1999	3:30:40	23.33	471	61.5	5.2	7.9
7/16/1999	4:00:40	23.27	472	60.6	5.2	7.9
7/16/1999	4:30:40	23.24	472	59.8	5.1	7.9
7/16/1999	5:00:40	23.18	472	58.5	5.0	7.9
7/16/1999	5:30:40	23.13	472	57.3	4.9	7.9
7/16/1999	6:00:40	23.08	473	56.1	4.8	7.9
7/16/1999	6:30:40	23.03	473	56.0	4.8	7.9
7/16/1999	7:00:40	23.02	473	58.4	5.0	7.9
7/16/1999	7:30:40	23.06	473	64.6	5.5	7.9
7/16/1999	8:00:40	23.13	472	73.6	6.3	8.0
7/16/1999	8:30:40	23.28	471	84.8	7.2	8.1
7/16/1999	9:00:40	23.50	470	97.8	8.3	8.2
7/16/1999	9:30:40	23.77	467	111.1	9.4	8.3
7/16/1999	10:00:40	24.08	465	123.7	10.4	8.3
7/16/1999	10:30:40	24.44	463	136.2	11.4	8.4
7/16/1999	11:00:40	24.84	460	147.4	12.2	8.5
7/16/1999	11:30:40	25.25	458	155.8	12.8	8.5
7/16/1999	12:00:40	25.66	455	163.7	13.4	8.6
7/16/1999	12:30:40	26.00	454	168.6	13.7	8.6
7/16/1999	13:00:40	26.47	451	175.5	14.1	8.7
7/16/1999	13:30:40	26.71	450	178.0	14.2	8.7
7/16/1999	14:00:40	26.82	449	176.3	14.1	8.7
7/16/1999	14:30:40	27.04	448	176.6	14.0	8.7
7/16/1999	15:00:40	27.21	447	179.2	14.2	8.7
7/16/1999	15:30:40	27.35	445	181.3	14.3	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/16/1999	16:00:40	27.47	445	181.7	14.3	8.7
7/16/1999	16:30:40	27.32	445	173.2	13.7	8.7
7/16/1999	17:00:40	27.34	445	172.1	13.6	8.7
7/16/1999	17:30:40	27.20	445	165.6	13.1	8.7
7/16/1999	18:00:40	27.07	445	160.9	12.8	8.6
7/16/1999	18:30:40	26.87	447	153.3	12.2	8.6
7/16/1999	19:00:40	26.69	449	144.3	11.6	8.6
7/16/1999	19:30:40	26.44	451	132.9	10.7	8.5
7/16/1999	20:00:40	26.14	455	119.9	9.7	8.4
7/16/1999	20:30:40	25.84	458	106.0	8.6	8.4
7/16/1999	21:00:40	25.58	461	93.9	7.7	8.3
7/16/1999	21:30:40	25.37	464	84.2	6.9	8.2
7/16/1999	22:00:40	25.22	466	76.9	6.3	8.1
7/16/1999	22:30:40	25.09	467	71.3	5.9	8.0
7/16/1999	23:00:40	24.98	468	66.3	5.5	8.0
7/16/1999	23:30:40	24.87	468	62.5	5.2	7.9
7/17/1999	0:00:40	24.77	469	59.5	4.9	7.9
7/17/1999	0:30:40	24.67	469	57.9	4.8	7.9
7/17/1999	1:00:40	24.61	469	56.8	4.7	7.9
7/17/1999	1:30:40	24.53	469	55.7	4.6	7.9
7/17/1999	2:00:40	24.46	469	54.2	4.5	7.9
7/17/1999	2:30:40	24.39	468	53.0	4.4	7.8
7/17/1999	3:00:40	24.32	468	52.6	4.4	7.8
7/17/1999	3:30:40	24.26	468	51.8	4.3	7.8
7/17/1999	4:00:40	24.19	468	50.4	4.2	7.8
7/17/1999	4:30:40	24.12	468	49.5	4.2	7.8
7/17/1999	5:00:40	24.06	468	48.9	4.1	7.8
7/17/1999	5:30:40	23.98	467	48.5	4.1	7.8
7/17/1999	6:00:40	23.93	467	48.2	4.1	7.8
7/17/1999	6:30:40	23.87	467	47.9	4.0	7.8
7/17/1999	7:00:40	23.84	466	50.7	4.3	7.8
7/17/1999	7:30:40	23.88	465	57.4	4.8	7.9
7/17/1999	8:00:40	23.97	464	67.2	5.7	7.9
7/17/1999	8:30:40	24.13	463	78.3	6.6	8.0
7/17/1999	9:00:40	24.35	461	91.1	7.6	8.1
7/17/1999	9:30:40	24.65	459	106.0	8.8	8.2
7/17/1999	10:00:40	25.00	456	120.4	9.9	8.3
7/17/1999	10:30:40	25.39	454	133.3	10.9	8.3
7/17/1999	11:00:40	25.80	451	145.4	11.8	8.4
7/17/1999	11:30:40	26.21	449	154.7	12.5	8.5
7/17/1999	12:00:40	26.62	447	163.0	13.1	8.5
7/17/1999	12:30:40	26.93	445	167.3	13.3	8.6
7/17/1999	13:00:40	27.20	443	169.8	13.5	8.6
7/17/1999	13:30:40	27.56	441	177.0	14.0	8.7
7/17/1999	14:00:40	27.76	440	177.1	13.9	8.7
7/17/1999	14:30:40	28.16	438	184.0	14.4	8.7
7/17/1999	15:00:40	28.29	438	183.0	14.2	8.7
7/17/1999	15:30:40	28.57	436	186.7	14.5	8.8
7/17/1999	16:00:40	28.67	436	186.1	14.4	8.8
7/17/1999	16:30:40	28.83	435	187.1	14.4	8.8

Appendix Continued

Date	Time	Water temperature (°C)	SC (μS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/17/1999	17:00:40	28.94	434	185.7	14.3	8.8
7/17/1999	17:30:40	28.84	434	179.4	13.8	8.8
7/17/1999	18:00:40	28.69	435	171.2	13.2	8.7
7/17/1999	18:30:40	28.36	437	158.5	12.3	8.7
7/17/1999	19:00:40	28.04	440	143.7	11.2	8.6
7/17/1999	19:30:40	27.71	443	128.4	10.1	8.6
7/17/1999	20:00:40	27.41	448	110.8	8.8	8.5
7/17/1999	20:30:40	27.10	451	97.6	7.8	8.4
7/17/1999	21:00:40	26.82	454	87.6	7.0	8.3
7/17/1999	21:30:40	26.55	456	78.4	6.3	8.2
7/17/1999	22:00:40	26.30	457	70.4	5.7	8.1
7/17/1999	22:30:40	26.10	459	62.6	5.1	8.0
7/17/1999	23:00:40	25.95	460	58.1	4.7	7.9
7/17/1999	23:30:40	25.82	460	55.1	4.5	7.9
7/18/1999	0:00:40	25.71	461	52.6	4.3	7.9
7/18/1999	0:30:40	25.62	461	50.7	4.1	7.8
7/18/1999	1:00:40	25.54	462	49.8	4.1	7.8
7/18/1999	1:30:40	25.46	461	48.4	4.0	7.8
7/18/1999	2:00:40	25.38	460	47.1	3.9	7.8
7/18/1999	2:30:40	25.29	460	46.7	3.8	7.8
7/18/1999	3:00:40	25.19	460	45.1	3.7	7.8
7/18/1999	3:30:40	25.10	460	43.1	3.6	7.8
7/18/1999	4:00:40	25.03	460	42.2	3.5	7.8
7/18/1999	4:30:40	24.96	460	41.8	3.5	7.8
7/18/1999	5:00:40	24.88	459	40.9	3.4	7.8
7/18/1999	5:30:40	24.82	459	40.2	3.3	7.8
7/18/1999	6:00:40	24.74	459	38.7	3.2	7.7
7/18/1999	6:30:40	24.67	459	38.4	3.2	7.7
7/18/1999	7:00:40	24.64	458	40.0	3.3	7.7
7/18/1999	7:30:40	24.64	457	46.9	3.9	7.8
7/18/1999	8:00:40	24.71	457	57.4	4.8	7.8
7/18/1999	8:30:40	24.86	456	70.2	5.8	7.9
7/18/1999	9:00:40	25.05	454	83.0	6.9	8.0
7/18/1999	9:30:40	25.26	452	98.7	8.1	8.1
7/18/1999	10:00:40	25.53	450	112.8	9.2	8.2
7/18/1999	10:30:40	25.84	447	129.8	10.6	8.3
7/18/1999	11:00:40	26.20	444	145.0	11.7	8.4
7/18/1999	11:30:40	26.60	441	158.1	12.7	8.5
7/18/1999	12:00:40	27.03	438	168.4	13.4	8.6
7/18/1999	12:30:40	27.46	435	177.7	14.0	8.7
7/18/1999	13:00:40	27.84	433	185.6	14.6	8.7
7/18/1999	13:30:40	28.27	429	192.9	15.0 ^a	8.8
7/18/1999	14:00:40	28.37	428	188.5	14.6	8.8
7/18/1999	14:30:40	28.49	428	186.9	14.5	8.8
7/18/1999	15:00:40	28.45	429	176.6	13.7	8.7
7/18/1999	15:30:40	28.21	431	162.4	12.7	8.7
7/18/1999	16:00:40	28.03	432	153.9	12.0	8.7
7/18/1999	16:30:40	27.74	436	137.1	10.8	8.6
7/18/1999	17:00:40	27.52	439	128.6	10.1	8.5
7/18/1999	17:30:40	27.40	439	128.2	10.1	8.5
7/18/1999	18:00:40	27.32	439	128.0	10.1	8.5

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/18/1999	18:30:40	27.27	440	129.6	10.3	8.5
7/18/1999	19:00:40	27.12	441	125.3	10.0	8.5
7/18/1999	19:30:40	26.95	442	117.1	9.3	8.4
7/18/1999	20:00:40	26.77	443	109.2	8.7	8.4
7/18/1999	20:30:40	26.60	445	100.1	8.0	8.3
7/18/1999	21:00:40	26.45	447	89.3	7.2	8.2
7/18/1999	21:30:40	26.29	448	79.9	6.4	8.2
7/18/1999	22:00:40	26.15	450	72.1	5.8	8.1
7/18/1999	22:30:40	26.00	451	64.7	5.2	8.0
7/18/1999	23:00:40	25.84	452	58.4	4.8	8.0
7/18/1999	23:30:40	25.66	453	52.6	4.3	7.9
7/19/1999	0:00:40	25.49	454	48.2	3.9	7.8
7/19/1999	0:30:40	25.34	455	45.4	3.7	7.8
7/19/1999	1:00:40	25.21	455	43.7	3.6	7.8
7/19/1999	1:30:40	25.10	455	42.9	3.5	7.8
7/19/1999	2:00:40	25.00	455	41.3	3.4	7.8
7/19/1999	2:30:40	24.91	455	40.5	3.4	7.8
7/19/1999	3:00:40	24.82	455	40.0	3.3	7.7
7/19/1999	3:30:40	24.74	455	38.8	3.2	7.7
7/19/1999	4:00:40	24.66	455	38.1	3.2	7.7
7/19/1999	4:30:40	24.59	455	37.1	3.1	7.7
7/19/1999	5:00:40	24.55	455	37.0	3.1	7.7
7/19/1999	5:30:40	24.49	455	36.2	3.0	7.7
7/19/1999	6:00:40	24.42	455	35.0	2.9	7.7
7/19/1999	6:30:40	24.37	455	35.9	3.0	7.7
7/19/1999	7:00:40	24.30	455	38.9	3.3	7.7
7/19/1999	7:30:40	24.35	454	46.2	3.9	7.8
7/19/1999	8:00:40	24.42	454	57.5	4.8	7.8
7/19/1999	8:30:40	24.56	453	70.4	5.9	7.9
7/19/1999	9:00:40	24.76	451	84.0	7.0	8.0
7/19/1999	9:30:40	25.02	450	99.6	8.2	8.1
7/19/1999	10:00:40	25.35	447	114.2	9.4	8.2
7/19/1999	10:30:40	25.71	445	128.2	10.4	8.3
7/19/1999	11:00:40	26.11	442	141.8	11.5	8.4
7/19/1999	11:30:40	26.52	440	153.3	12.3	8.5
7/19/1999	12:00:40	26.90	437	162.1	12.9	8.6
7/19/1999	12:30:40	27.30	435	169.7	13.4	8.6
7/19/1999	13:00:40	27.49	434	171.0	13.5	8.6
7/19/1999	13:30:40	27.77	433	176.0	13.8	8.7
7/19/1999	14:00:40	27.80	433	174.8	13.7	8.7
7/19/1999	14:30:40	27.77	432	172.8	13.6	8.7
7/19/1999	15:00:40	27.87	432	174.6	13.7	8.7
7/19/1999	15:30:40	27.72	429	166.8	13.1	8.7
7/19/1999	16:00:40	27.71	430	169.0	13.3	8.7
7/19/1999	16:30:40	27.63	433	160.6	12.6	8.7
7/19/1999	17:00:40	27.63	432	159.4	12.6	8.7
7/19/1999	17:30:40	27.70	429	163.0	12.8	8.7
7/19/1999	18:00:40	27.60	432	156.4	12.3	8.7
7/19/1999	18:30:40	27.55	435	153.1	12.1	8.7
7/19/1999	19:00:40	27.34	436	140.3	11.1	8.6
7/19/1999	19:30:40	27.15	438	128.6	10.2	8.5

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/19/1999	20:00:40	27.05	439	121.8	9.7	8.5
7/19/1999	20:30:40	26.91	441	109.2	8.7	8.4
7/19/1999	21:00:40	26.74	444	93.0	7.4	8.3
7/19/1999	21:30:40	26.58	447	83.8	6.7	8.2
7/19/1999	22:00:40	26.42	449	74.2	6.0	8.2
7/19/1999	22:30:40	26.26	451	64.6	5.2	8.1
7/19/1999	23:00:40	26.10	452	57.8	4.7	8.0
7/19/1999	23:30:40	25.93	453	51.2	4.2	7.9
7/20/1999	0:00:40	25.74	454	45.4	3.7	7.9
7/20/1999	0:30:40	25.56	455	40.2	3.3	7.8
7/20/1999	1:00:40	25.39	455	35.8	2.9	7.8
7/20/1999	1:30:40	25.23	456	33.0	2.7	7.7
7/20/1999	2:00:40	25.10	456	31.4	2.6	7.7
7/20/1999	2:30:40	24.97	457	31.5	2.6	7.7
7/20/1999	3:00:40	24.85	457	31.4	2.6	7.7
7/20/1999	3:30:40	24.74	457	30.2	2.5	7.7
7/20/1999	4:00:40	24.61	457	28.1	2.3	7.7
7/20/1999	4:30:40	24.53	457	28.1	2.3	7.7
7/20/1999	5:00:40	24.44	457	27.6	2.3	7.6
7/20/1999	5:30:40	24.37	457	26.6	2.2	7.6
7/20/1999	6:00:40	24.32	457	26.2	2.2 ^b	7.6
7/20/1999	6:30:40	24.30	457	27.4	2.3	7.6
7/20/1999	7:00:40	24.29	457	29.3	2.5	7.6
7/20/1999	7:30:40	24.32	457	30.5	2.6	7.7
7/20/1999	8:00:40	24.34	457	33.5	2.8	7.7
7/20/1999	8:30:40	24.37	457	36.7	3.1	7.7
7/20/1999	9:00:40	24.46	457	48.2	4.0	7.7
7/20/1999	9:30:40	24.62	456	62.9	5.2	7.8
7/20/1999	10:00:40	24.87	454	84.0	7.0	7.9
7/20/1999	10:30:40	25.20	452	102.5	8.4	8.1
7/20/1999	11:00:40	25.37	449	112.1	9.2	8.2
7/20/1999	11:30:40	25.60	448	124.4	10.2	8.3
7/20/1999	12:00:40	25.98	444	145.8	11.8	8.4

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7/15/1999	12:30:40	25.23	–	172.6	14.2	8.7
7/15/1999	13:00:40	25.68	–	177.6	14.5	8.7
7/15/1999	13:30:40	26.11	–	181.8	14.7	8.8
7/15/1999	14:00:40	26.47	–	186.4	15.0	8.8
7/15/1999	14:30:40	26.54	–	184.2	14.8	8.8
7/15/1999	15:00:40	26.78	–	185.3	14.8	8.8
7/15/1999	15:30:40	26.86	–	184.1	14.7	8.8
7/15/1999	16:00:40	26.81	–	181	14.5	8.8
7/15/1999	16:30:40	26.71	–	176.2	14.1	8.8
7/15/1999	17:00:40	26.34	–	162.5	13.1	8.7
7/15/1999	17:30:40	26.11	–	155.3	12.6	8.7
7/15/1999	18:00:40	25.79	–	140.5	11.5	8.6
7/15/1999	18:30:40	25.65	–	137.5	11.2	8.6
7/15/1999	19:00:40	25.46	–	129.3	10.6	8.5
7/15/1999	19:30:40	25.29	–	123.3	10.1	8.5
7/15/1999	20:00:40	25	–	113.5	9.4	8.4

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/15/1999	20:30:40	24.68	–	101.4	8.4	8.3
7/15/1999	21:00:40	24.39	–	90.2	7.5	8.2
7/15/1999	21:30:40	24.14	–	82.8	7.0	8.1
7/15/1999	22:00:40	23.96	–	76.9	6.5	8.1
7/15/1999	22:30:40	23.82	–	72.3	6.1	8.0
7/15/1999	23:00:40	23.71	–	68.9	5.8	8.0
7/15/1999	23:30:40	23.62	–	66.1	5.6	8.0
7/16/1999	0:00:40	23.56	–	64.4	5.5	7.9
7/16/1999	0:30:40	23.49	–	63.2	5.4	7.9
7/16/1999	1:00:40	23.43	–	62.4	5.3	7.9
7/16/1999	1:30:40	23.37	–	61.5	5.2	7.9
7/16/1999	2:00:40	23.34	–	61	5.2	7.9
7/16/1999	2:30:40	23.29	–	60.3	5.1	7.9
7/16/1999	3:00:40	23.24	–	59.6	5.1	7.9
7/16/1999	3:30:40	23.21	–	58.9	5.0	7.9
7/16/1999	4:00:40	23.15	–	58.3	5.0	7.9
7/16/1999	4:30:40	23.09	–	57.2	4.9	7.9
7/16/1999	5:00:40	23.06	–	56.6	4.9	7.9
7/16/1999	5:30:40	23	–	55.5	4.8	7.9
7/16/1999	6:00:40	22.96	–	54.9	4.7	7.9
7/16/1999	6:30:40	22.91	–	55.2	4.7	7.9
7/16/1999	7:00:40	22.91	–	58.3	5.0	7.9
7/16/1999	7:30:40	22.95	–	64.9	5.6	7.9
7/16/1999	8:00:40	23.06	–	75	6.4	8.0
7/16/1999	8:30:40	23.24	–	86.9	7.4	8.1
7/16/1999	9:00:40	23.51	–	100.3	8.5	8.2
7/16/1999	9:30:40	23.83	–	114	9.6	8.3
7/16/1999	10:00:40	24.2	–	127.4	10.7	8.4
7/16/1999	10:30:40	24.63	–	140	11.6	8.5
7/16/1999	11:00:40	25.1	–	151.4	12.5	8.6
7/16/1999	11:30:40	25.54	–	160.5	13.1	8.6
7/16/1999	12:00:40	26	–	168.6	13.7	8.7
7/16/1999	12:30:40	26.38	–	173.6	14.0	8.7
7/16/1999	13:00:40	26.91	–	182	14.5	8.8
7/16/1999	13:30:40	27.11	–	181.6	14.4	8.8
7/16/1999	14:00:40	27.21	–	179	14.2	8.8
7/16/1999	14:30:40	27.53	–	182.9	14.4	8.8
7/16/1999	15:00:40	27.78	–	185.9	14.6	8.8
7/16/1999	15:30:40	27.84	–	185.3	14.5	8.8
7/16/1999	16:00:40	28.09	–	189	14.8	8.8
7/16/1999	16:30:40	27.87	–	179.9	14.1	8.8
7/16/1999	17:00:40	27.8	–	177.1	13.9	8.8
7/16/1999	17:30:40	27.63	–	170.3	13.4	8.8
7/16/1999	18:00:40	27.49	–	165.5	13.1	8.7
7/16/1999	18:30:40	27.24	–	155.9	12.4	8.7
7/16/1999	19:00:40	26.97	–	144.9	11.6	8.6
7/16/1999	19:30:40	26.7	–	132.5	10.6	8.6
7/16/1999	20:00:40	26.42	–	119.9	9.7	8.5
7/16/1999	20:30:40	26.07	–	104.8	8.5	8.4
7/16/1999	21:00:40	25.76	–	92.4	7.5	8.3

Appendix Continued

Date	Time	Water temperature (°C)	SC (μS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/16/1999	21:30:40	25.5	–	82.4	6.7	8.2
7/16/1999	22:00:40	25.29	–	74.4	6.1	8.1
7/16/1999	22:30:40	25.13	–	68.6	5.7	8.0
7/16/1999	23:00:40	24.99	–	63.7	5.3	8.0
7/16/1999	23:30:40	24.86	–	59.9	5.0	7.9
7/17/1999	0:00:40	24.74	–	56.8	4.7	7.9
7/17/1999	0:30:40	24.62	–	55.2	4.6	7.9
7/17/1999	1:00:40	24.53	–	53.9	4.5	7.9
7/17/1999	1:30:40	24.43	–	52.9	4.4	7.9
7/17/1999	2:00:40	24.35	–	52.4	4.4	7.8
7/17/1999	2:30:40	24.27	–	52	4.4	7.8
7/17/1999	3:00:40	24.22	–	51.5	4.3	7.8
7/17/1999	3:30:40	24.13	–	50.9	4.3	7.8
7/17/1999	4:00:40	24.08	–	50.4	4.2	7.8
7/17/1999	4:30:40	24.01	–	49.5	4.2	7.8
7/17/1999	5:00:40	23.94	–	48.9	4.1	7.8
7/17/1999	5:30:40	23.86	–	48.6	4.1	7.8
7/17/1999	6:00:40	23.8	–	48	4.1	7.8
7/17/1999	6:30:40	23.73	–	48.6	4.1	7.8
7/17/1999	7:00:40	23.71	–	52.3	4.4	7.8
7/17/1999	7:30:40	23.76	–	59.8	5.1	7.9
7/17/1999	8:00:40	23.89	–	70.5	5.9	8.0
7/17/1999	8:30:40	24.09	–	82.9	7.0	8.1
7/17/1999	9:00:40	24.35	–	96.8	8.1	8.2
7/17/1999	9:30:40	24.71	–	111.7	9.3	8.3
7/17/1999	10:00:40	25.13	–	126.1	10.4	8.4
7/17/1999	10:30:40	25.6	–	140.6	11.5	8.5
7/17/1999	11:00:40	26.05	–	152.1	12.3	8.6
7/17/1999	11:30:40	26.47	–	160.9	12.9	8.6
7/17/1999	12:00:40	26.91	–	169.7	13.5	8.7
7/17/1999	12:30:40	27.32	–	175	13.9	8.7
7/17/1999	13:00:40	27.55	–	176	13.9	8.7
7/17/1999	13:30:40	28.09	–	185.2	14.5	8.8
7/17/1999	14:00:40	28.27	–	184.8	14.4	8.8
7/17/1999	14:30:40	28.78	–	193.3	14.9	8.9
7/17/1999	15:00:40	28.86	–	189.3	14.6	8.9
7/17/1999	15:30:40	29.06	–	192.6	14.8	8.9
7/17/1999	16:00:40	29.23	–	193.9	14.8	8.9
7/17/1999	16:30:40	29.38	–	193.9	14.8	8.9
7/17/1999	17:00:40	29.45	–	191.3	14.6	8.9
7/17/1999	17:30:40	29.29	–	183.1	14.0	8.9
7/17/1999	18:00:40	29.15	–	175.1	13.4	8.8
7/17/1999	18:30:40	28.72	–	160.2	12.4	8.8
7/17/1999	19:00:40	28.32	–	143.9	11.2	8.7
7/17/1999	19:30:40	27.94	–	126.3	9.9	8.6
7/17/1999	20:00:40	27.62	–	110.5	8.7	8.5
7/17/1999	20:30:40	27.3	–	96.3	7.6	8.4
7/17/1999	21:00:40	27	–	84.8	6.8	8.3
7/17/1999	21:30:40	26.71	–	76.5	6.1	8.2
7/17/1999	22:00:40	26.44	–	69	5.6	8.1

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/17/1999	22:30:40	26.19	–	62.5	5.1	8.0
7/17/1999	23:00:40	26	–	57.5	4.7	7.9
7/17/1999	23:30:40	25.84	–	53.8	4.4	7.9
7/18/1999	0:00:40	25.7	–	51.1	4.2	7.9
7/18/1999	0:30:40	25.58	–	49.4	4.0	7.8
7/18/1999	1:00:40	25.48	–	48.3	4.0	7.8
7/18/1999	1:30:40	25.38	–	47	3.9	7.8
7/18/1999	2:00:40	25.28	–	46.3	3.8	7.8
7/18/1999	2:30:40	25.18	–	45.5	3.7	7.8
7/18/1999	3:00:40	25.1	–	44.9	3.7	7.8
7/18/1999	3:30:40	25.02	–	44.4	3.7	7.8
7/18/1999	4:00:40	24.95	–	43.7	3.6	7.8
7/18/1999	4:30:40	24.87	–	42.9	3.6	7.8
7/18/1999	5:00:40	24.79	–	42.1	3.5	7.8
7/18/1999	5:30:40	24.72	–	41.5	3.4	7.8
7/18/1999	6:00:40	24.65	–	40.7	3.4	7.8
7/18/1999	6:30:40	24.58	–	41	3.4	7.8
7/18/1999	7:00:40	24.56	–	44.3	3.7	7.8
7/18/1999	7:30:40	24.59	–	51.4	4.3	7.8
7/18/1999	8:00:40	24.68	–	62.3	5.2	7.9
7/18/1999	8:30:40	24.83	–	75.3	6.2	8.0
7/18/1999	9:00:40	25.03	–	90	7.4	8.1
7/18/1999	9:30:40	25.31	–	106.2	8.7	8.2
7/18/1999	10:00:40	25.64	–	122	10.0	8.3
7/18/1999	10:30:40	26.02	–	137.3	11.1	8.4
7/18/1999	11:00:40	26.42	–	151.1	12.2	8.5
7/18/1999	11:30:40	26.88	–	164.6	13.1	8.6
7/18/1999	12:00:40	27.33	–	174	13.8	8.7
7/18/1999	12:30:40	27.81	–	184.1	14.5	8.8
7/18/1999	13:00:40	28.26	–	191.2	14.9	8.8
7/18/1999	13:30:40	28.73	–	198	15.3 ^a	8.9
7/18/1999	14:00:40	28.7	–	188.5	14.6	8.8
7/18/1999	14:30:40	28.8	–	185.4	14.3	8.8
7/18/1999	15:00:40	28.8	–	181.9	14.0	8.8
7/18/1999	15:30:40	28.36	–	157.6	12.3	8.7
7/18/1999	16:00:40	28.17	–	150.5	11.7	8.7
7/18/1999	16:30:40	27.92	–	139.4	10.9	8.7
7/18/1999	17:00:40	27.67	–	131.7	10.4	8.6
7/18/1999	17:30:40	27.62	–	134.1	10.6	8.6
7/18/1999	18:00:40	27.55	–	132.6	10.5	8.6
7/18/1999	18:30:40	27.47	–	131.6	10.4	8.6
7/18/1999	19:00:40	27.4	–	130.9	10.4	8.6
7/18/1999	19:30:40	27.22	–	121.6	9.6	8.5
7/18/1999	20:00:40	26.98	–	111.5	8.9	8.4
7/18/1999	20:30:40	26.77	–	100.7	8.1	8.3
7/18/1999	21:00:40	26.55	–	89.3	7.2	8.3
7/18/1999	21:30:40	26.35	–	79.7	6.4	8.2
7/18/1999	22:00:40	26.16	–	71.2	5.8	8.1
7/18/1999	22:30:40	25.99	–	64.4	5.2	8.0
7/18/1999	23:00:40	25.82	–	59.6	4.9	8.0

Appendix Continued

Date	Time	Water temperature (°C)	SC (μS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/18/1999	23:30:40	25.64	–	54.9	4.5	7.9
7/19/1999	0:00:40	25.47	–	51	4.2	7.9
7/19/1999	0:30:40	25.29	–	48	3.9	7.8
7/19/1999	1:00:40	25.15	–	46.3	3.8	7.8
7/19/1999	1:30:40	25.02	–	45.3	3.7	7.8
7/19/1999	2:00:40	24.91	–	44.6	3.7	7.8
7/19/1999	2:30:40	24.83	–	44.4	3.7	7.8
7/19/1999	3:00:40	24.75	–	43.9	3.6	7.8
7/19/1999	3:30:40	24.66	–	43.3	3.6	7.7
7/19/1999	4:00:40	24.6	–	43	3.6	7.7
7/19/1999	4:30:40	24.53	–	42.5	3.5	7.7
7/19/1999	5:00:40	24.47	–	42.1	3.5	7.7
7/19/1999	5:30:40	24.4	–	41.5	3.5	7.7
7/19/1999	6:00:40	24.33	–	41	3.4	7.7
7/19/1999	6:30:40	24.27	–	41.7	3.5	7.7
7/19/1999	7:00:40	24.25	–	45.6	3.8	7.8
7/19/1999	7:30:40	24.27	–	52.5	4.4	7.8
7/19/1999	8:00:40	24.36	–	63.4	5.3	7.9
7/19/1999	8:30:40	24.52	–	76.7	6.4	8.0
7/19/1999	9:00:40	24.76	–	91.6	7.6	8.1
7/19/1999	9:30:40	25.08	–	107.3	8.9	8.2
7/19/1999	10:00:40	25.47	–	123.4	10.1	8.3
7/19/1999	10:30:40	25.9	–	138.5	11.2	8.4
7/19/1999	11:00:40	26.35	–	152	12.3	8.5
7/19/1999	11:30:40	26.83	–	164.4	13.1	8.6
7/19/1999	12:00:40	27.13	–	169.2	13.4	8.7
7/19/1999	12:30:40	27.54	–	175.8	13.9	8.7
7/19/1999	13:00:40	27.77	–	175.6	13.8	8.7
7/19/1999	13:30:40	28.06	–	180.3	14.1	8.8
7/19/1999	14:00:40	28.17	–	179.8	14.0	8.8
7/19/1999	14:30:40	28.14	–	177.7	13.9	8.8
7/19/1999	15:00:40	28.24	–	180.6	14.1	8.8
7/19/1999	15:30:40	27.97	–	168.9	13.2	8.8
7/19/1999	16:00:40	27.97	–	169.8	13.3	8.8
7/19/1999	16:30:40	28.02	–	169.6	13.3	8.8
7/19/1999	17:00:40	28	–	167.1	13.1	8.8
7/19/1999	17:30:40	28.04	–	167.8	13.1	8.8
7/19/1999	18:00:40	27.83	–	156.5	12.3	8.7
7/19/1999	18:30:40	27.83	–	157	12.3	8.7
7/19/1999	19:00:40	27.66	–	149.2	11.7	8.7
7/19/1999	19:30:40	27.39	–	132.6	10.5	8.6
7/19/1999	20:00:40	27.21	–	122	9.7	8.6
7/19/1999	20:30:40	27.05	–	112.5	9.0	8.5
7/19/1999	21:00:40	26.85	–	98.6	7.9	8.4
7/19/1999	21:30:40	26.65	–	86.3	6.9	8.3
7/19/1999	22:00:40	26.46	–	76.1	6.1	8.2
7/19/1999	22:30:40	26.27	–	67.4	5.4	8.1
7/19/1999	23:00:40	26.09	–	60.5	4.9	8.0
7/19/1999	23:30:40	25.92	–	55.1	4.5	7.9
7/20/1999	0:00:40	25.74	–	50.3	4.1	7.9

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/20/1999	0:30:40	25.57	–	46	3.8	7.8
7/20/1999	1:00:40	25.39	–	42.8	3.5	7.8
7/20/1999	1:30:40	25.22	–	40.4	3.3	7.8
7/20/1999	2:00:40	25.07	–	38.9	3.2	7.7
7/20/1999	2:30:40	24.93	–	37.9	3.1	7.7
7/20/1999	3:00:40	24.79	–	37.8	3.1	7.7
7/20/1999	3:30:40	24.69	–	37.2	3.1	7.7
7/20/1999	4:00:40	24.58	–	37.4	3.1	7.7
7/20/1999	4:30:40	24.49	–	37.3	3.1	7.7
7/20/1999	5:00:40	24.41	–	37.3	3.1	7.7
7/20/1999	5:30:40	24.34	–	36.8	3.1	7.7
7/20/1999	6:00:40	24.29	–	36.8	3.1 ^b	7.7
7/20/1999	6:30:40	24.28	–	36.9	3.1	7.7
7/20/1999	7:00:40	24.27	–	38.3	3.2	7.7
7/20/1999	7:30:40	24.26	–	38.4	3.2	7.7
7/20/1999	8:00:40	24.28	–	40	3.4	7.7
7/20/1999	8:30:40	24.3	–	44.4	3.7	7.7
7/20/1999	9:00:40	24.43	–	58.3	4.9	7.8
7/20/1999	9:30:40	24.61	–	71.3	5.9	7.9
7/20/1999	10:00:40	24.89	–	91.3	7.6	8.0
7/20/1999	10:30:40	25.31	–	112.9	9.3	8.2
7/20/1999	11:00:40	25.48	–	119.1	9.7	8.3
7/20/1999	11:30:40	25.74	–	131.2	10.7	8.4

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7/28/1999	14:30:40	25.69	453	62.2	5.1	7.8
7/28/1999	15:00:40	25.64	453	53.9	4.4	7.8
7/28/1999	15:30:40	26.14	453	62.7	5.1	7.9
7/28/1999	16:00:40	26.39	455	78.4	6.3	8.0
7/28/1999	16:30:40	26.43	455	79.6	6.4	8.0
7/28/1999	17:00:40	25.71	454	53.7	4.4	7.8
7/28/1999	17:30:40	25.72	423	79.7	6.5 ^a	8.0
7/28/1999	18:00:40	25.41	409	75.5	6.2	7.9
7/28/1999	18:30:40	25.49	416	71.7	5.9	7.9
7/28/1999	19:00:40	25.6	426	67	5.5	7.9
7/28/1999	19:30:40	25.67	434	67.5	5.5	7.9
7/28/1999	20:00:40	25.42	430	48.7	4.0	7.8
7/28/1999	20:30:40	25.32	428	41	3.4	7.7
7/28/1999	21:00:40	25.29	430	44.2	3.6	7.7
7/28/1999	21:30:40	25.29	432	46.8	3.8	7.7
7/28/1999	22:00:40	25.24	427	44.4	3.7	7.7
7/28/1999	22:30:40	25.16	427	44.6	3.7	7.7
7/28/1999	23:00:40	25.12	431	43.6	3.6	7.7
7/28/1999	23:30:40	25.08	436	43.3	3.6	7.7
7/29/1999	0:00:40	25.03	440	39.2	3.2	7.7
7/29/1999	0:30:40	24.98	441	41.5	3.4	7.7
7/29/1999	1:00:40	24.92	443	42.6	3.5	7.7
7/29/1999	1:30:40	24.84	444	44.2	3.7	7.7
7/29/1999	2:00:40	24.73	444	44	3.7	7.7
7/29/1999	2:30:40	24.65	444	41.4	3.4	7.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (μS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/29/1999	3:00:40	24.58	444	42.3	3.5	7.7
7/29/1999	3:30:40	24.5	445	41.4	3.5	7.7
7/29/1999	4:00:40	24.44	444	40.4	3.4	7.7
7/29/1999	4:30:40	24.37	445	40.6	3.4	7.7
7/29/1999	5:00:40	24.31	445	38.1	3.2	7.7
7/29/1999	5:30:40	24.26	446	39.4	3.3	7.7
7/29/1999	6:00:40	24.23	445	38.9	3.3	7.7
7/29/1999	6:30:40	24.18	446	36.6	3.1	7.7
7/29/1999	7:00:40	24.16	445	37.1	3.1	7.7
7/29/1999	7:30:40	24.15	445	35.7	3.0	7.7
7/29/1999	8:00:40	24.14	445	36	3.0	7.7
7/29/1999	8:30:40	24.14	445	37.6	3.2	7.6
7/29/1999	9:00:40	24.15	445	37.2	3.1	7.6
7/29/1999	9:30:40	24.16	446	29.6	2.5 ^b	7.6
7/29/1999	10:00:40	24.22	445	36.4	3.1	7.6
7/29/1999	10:30:40	24.23	445	33.9	2.8	7.6
7/29/1999	11:00:40	24.27	445	35.2	2.9	7.6
7/29/1999	11:30:40	24.33	445	38.6	3.2	7.7
7/29/1999	12:00:40	24.37	444	36.9	3.1	7.7
7/29/1999	12:30:40	24.44	443	37.7	3.2	7.6
7/29/1999	13:00:40	24.53	443	40.4	3.4	7.7
7/29/1999	13:30:40	24.55	442	40.3	3.4	7.7
7/29/1999	14:00:40	24.62	441	46.9	3.9	7.7
7/29/1999	14:30:40	24.6	440	46.6	3.9	7.7
7/29/1999	15:00:40	24.74	440	43.6	3.6	7.7
7/29/1999	15:30:40	24.69	439	50	4.2	7.7
7/29/1999	16:00:40	24.8	439	51.1	4.2	7.7
7/29/1999	16:30:40	24.79	438	53.3	4.4	7.7
7/29/1999	17:00:40	24.82	439	56.2	4.7	7.7
7/29/1999	17:30:40	24.84	438	55.4	4.6	7.7
7/29/1999	18:00:40	24.88	438	55.4	4.6	7.7
7/29/1999	18:30:40	24.9	439	52	4.3	7.7
7/29/1999	19:00:40	26.07	442	56	4.5	8.0
7/29/1999	19:30:40	26.24	444	66.1	5.3	8.0
7/29/1999	20:00:40	26.17	444	62.2	5.0	8.0
7/29/1999	20:30:40	26.22	444	64.9	5.2	7.9
7/29/1999	21:00:40	26.15	444	59	4.8	7.9
7/29/1999	21:30:40	26.08	444	58.2	4.7	7.9
7/29/1999	22:00:40	26	444	56.9	4.6	7.8
7/29/1999	22:30:40	25.92	445	51.7	4.2	7.8
7/29/1999	23:00:40	25.8	445	47.7	3.9	7.8
7/29/1999	23:30:40	25.72	445	52.1	4.2	7.8
7/30/1999	0:00:40	25.63	445	50.9	4.2	7.8
7/30/1999	0:30:40	25.53	445	52.4	4.3	7.8
7/30/1999	1:00:40	25.43	446	51.1	4.2	7.8
7/30/1999	1:30:40	25.35	446	51.3	4.2	7.8
7/30/1999	2:00:40	25.26	445	64.4	5.3	7.8
7/30/1999	2:30:40	25.17	445	61.9	5.1	7.7
7/30/1999	3:00:40	25.09	445	63.9	5.3	7.7
7/30/1999	3:30:40	25.02	445	67.6	5.6	7.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/30/1999	4:00:40	24.95	445	66.2	5.5	7.7
7/30/1999	4:30:40	24.9	445	64.7	5.4	7.7
7/30/1999	5:00:40	24.84	445	65.5	5.4	7.7
7/30/1999	5:30:40	24.79	445	49.1	4.1	7.7
7/30/1999	6:00:40	24.74	445	70.8	5.9	7.7
7/30/1999	6:30:40	24.69	445	65.9	5.5	7.7
7/30/1999	7:00:40	24.66	445	66.9	5.6	7.7
7/30/1999	7:30:40	24.65	444	68.1	5.7	7.7
7/30/1999	8:00:40	24.64	445	69.9	5.8	7.7
7/30/1999	8:30:40	24.67	444	69.3	5.8	7.7
7/30/1999	9:00:40	23.82	3	93.7	7.9	8.0

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7/28/1999	13:00:40	25.84	447	108.2	8.8	8.2
7/28/1999	13:30:40	25.96	445	115.3	9.4	8.3
7/28/1999	14:00:40	26.15	444	121.1	9.8	8.3
7/28/1999	14:30:40	26.36	443	126.3	10.2	8.4
7/28/1999	15:00:40	26.48	442	127.8	10.3 ^a	8.4
7/28/1999	15:30:40	26.53	442	126.8	10.2	8.4
7/28/1999	16:00:40	26.6	442	126	10.1	8.4
7/28/1999	16:30:40	26.64	441	124.9	10.0	8.4
7/28/1999	17:00:40	26.35	431	118.6	9.6	8.4
7/28/1999	17:30:40	25.74	387	108.5	8.8	8.4
7/28/1999	18:00:40	25.91	409	105.3	8.6	8.4
7/28/1999	18:30:40	25.81	411	98.1	8.0	8.4
7/28/1999	19:00:40	25.66	409	92	7.5	8.3
7/28/1999	19:30:40	25.53	415	87.2	7.1	8.2
7/28/1999	20:00:40	25.38	420	83.5	6.8	8.2
7/28/1999	20:30:40	25.21	425	80.2	6.6	8.1
7/28/1999	21:00:40	25.02	430	76.5	6.3	8.1
7/28/1999	21:30:40	24.84	435	73.3	6.1	8.0
7/28/1999	22:00:40	24.71	438	71.1	5.9	8.0
7/28/1999	22:30:40	24.61	440	69.5	5.8	8.0
7/28/1999	23:00:40	24.54	440	67.7	5.6	8.0
7/28/1999	23:30:40	24.44	437	66.2	5.5	8.0
7/29/1999	0:00:40	24.37	435	64.5	5.4	8.0
7/29/1999	0:30:40	24.3	432	63	5.3	8.0
7/29/1999	1:00:40	24.23	429	61.5	5.2	7.9
7/29/1999	1:30:40	24.17	426	59.9	5.0	7.9
7/29/1999	2:00:40	24.09	424	58.9	4.9	7.9
7/29/1999	2:30:40	24.03	422	57.6	4.9	7.9
7/29/1999	3:00:40	23.96	422	57.2	4.8	7.9
7/29/1999	3:30:40	23.9	422	56.3	4.8	7.9
7/29/1999	4:00:40	23.84	422	55.6	4.7	7.9
7/29/1999	4:30:40	23.78	424	55.2	4.7	7.9
7/29/1999	5:00:40	23.73	425	54.5	4.6	7.9
7/29/1999	5:30:40	23.69	427	53.7	4.5	7.9
7/29/1999	6:00:40	23.64	429	53.2	4.5	7.9
7/29/1999	6:30:40	23.59	431	52.8	4.5	7.9
7/29/1999	7:00:40	23.57	433	51.8	4.4	7.8

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/29/1999	7:30:40	23.51	433	52.6	4.5	7.8
7/29/1999	8:00:40	23.52	435	52.9	4.5	7.8
7/29/1999	8:30:40	23.56	437	53.5	4.5	7.8
7/29/1999	9:00:40	23.68	438	56.9	4.8	7.9
7/29/1999	9:30:40	23.8	439	58.4	4.9	7.9
7/29/1999	10:00:40	24.02	439	63.9	5.4	7.9
7/29/1999	10:30:40	24.19	440	70	5.9	7.9
7/29/1999	11:00:40	24.39	439	76.4	6.4	8.0
7/29/1999	11:30:40	24.58	439	83.8	7.0	8.0
7/29/1999	12:00:40	24.79	438	91.3	7.6	8.1
7/29/1999	12:30:40	25.03	437	100.5	8.3	8.2
7/29/1999	13:00:40	25.28	436	109.1	9.0	8.2
7/29/1999	13:30:40	25.51	435	114.9	9.4	8.3
7/29/1999	14:00:40	25.82	434	120.8	9.8	8.3
7/29/1999	14:30:40	26.03	434	122.1	9.9	8.3
7/29/1999	15:00:40	26.26	433	124.3	10.0	8.4
7/29/1999	15:30:40	26.4	433	125	10.1	8.4
7/29/1999	16:00:40	26.48	433	124.3	10.0	8.4
7/29/1999	16:30:40	26.51	433	122.3	9.8	8.4
7/29/1999	17:00:40	26.46	434	118.9	9.6	8.4
7/29/1999	17:30:40	26.4	434	114.4	9.2	8.3
7/29/1999	18:00:40	26.31	435	109.8	8.9	8.3
7/29/1999	18:30:40	26.23	436	105.8	8.5	8.3
7/29/1999	19:00:40	26.15	437	102.8	8.3	8.2
7/29/1999	19:30:40	26.06	437	100.2	8.1	8.2
7/29/1999	20:00:40	25.95	437	97.2	7.9	8.2
7/29/1999	20:30:40	25.83	437	94.3	7.7	8.2
7/29/1999	21:00:40	25.69	437	90.9	7.4	8.2
7/29/1999	21:30:40	25.53	437	87.1	7.1	8.1
7/29/1999	22:00:40	25.36	436	83	6.8	8.1
7/29/1999	22:30:40	25.18	436	78.4	6.5	8.0
7/29/1999	23:00:40	24.99	436	74	6.1	8.0
7/29/1999	23:30:40	24.82	436	70.1	5.8	8.0
7/30/1999	0:00:40	24.66	435	66.1	5.5	7.9
7/30/1999	0:30:40	24.5	435	62.8	5.2	7.9
7/30/1999	1:00:40	24.4	435	59.9	5.0	7.9
7/30/1999	1:30:40	24.3	434	58.1	4.9	7.9
7/30/1999	2:00:40	24.23	434	56.5	4.7	7.9
7/30/1999	2:30:40	24.18	434	55.3	4.6	7.8
7/30/1999	3:00:40	24.14	433	54.1	4.5	7.8
7/30/1999	3:30:40	24.1	433	53.6	4.5	7.8
7/30/1999	4:00:40	24.06	433	52.7	4.4	7.8
7/30/1999	4:30:40	24.02	432	52.5	4.4	7.8
7/30/1999	5:00:40	23.99	432	51.9	4.4	7.8
7/30/1999	5:30:40	23.95	433	51.6	4.3	7.8
7/30/1999	6:00:40	23.91	432	51.3	4.3	7.8
7/30/1999	6:30:40	23.88	432	50.5	4.3 ^b	7.8
7/30/1999	7:00:40	23.87	432	50.5	4.3	7.8
7/30/1999	7:30:40	23.87	432	51	4.3	7.8
7/30/1999	8:00:40	23.84	431	51.1	4.3	7.8

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
Site 27						
7/26/1999	16:30:40	26.77	366	188.2	15.0	8.6
7/26/1999	17:00:40	26.89	362	189.4	15.1	8.6
7/26/1999	17:30:40	26.86	358	190.1	15.2	8.6
7/26/1999	18:00:40	26.78	354	196.1	15.7	8.6
7/26/1999	18:30:40	26.59	352	190.3	15.3	8.6
7/26/1999	19:00:40	26.39	352	183.1	14.7	8.5
7/26/1999	19:30:40	26.15	351	173.2	14.0	8.5
7/26/1999	20:00:40	25.87	351	161.1	13.1	8.4
7/26/1999	20:30:40	25.6	354	148.7	12.1	8.4
7/26/1999	21:00:40	25.37	357	138.3	11.3	8.3
7/26/1999	21:30:40	25.13	359	128	10.6	8.3
7/26/1999	22:00:40	24.92	363	120.8	10.0	8.2
7/26/1999	22:30:40	24.74	366	114.9	9.5	8.2
7/26/1999	23:00:40	24.55	368	110.1	9.2	8.1
7/26/1999	23:30:40	24.39	370	105.8	8.8	8.1
7/27/1999	0:00:40	24.23	373	102.1	8.6	8.1
7/27/1999	0:30:40	24.05	376	99	8.3	8.0
7/27/1999	1:00:40	23.89	379	95.3	8.0	8.0
7/27/1999	1:30:40	23.74	382	91.6	7.7	8.0
7/27/1999	2:00:40	23.59	385	88.2	7.5	7.9
7/27/1999	2:30:40	23.45	387	84.2	7.2	7.9
7/27/1999	3:00:40	23.31	390	80.3	6.8	7.9
7/27/1999	3:30:40	23.18	392	76.7	6.6	7.8
7/27/1999	4:00:40	23.05	393	73.6	6.3	7.8
7/27/1999	4:30:40	22.94	394	70.5	6.1	7.8
7/27/1999	5:00:40	22.84	394	67.4	5.8	7.7
7/27/1999	5:30:40	22.76	394	64.9	5.6	7.7
7/27/1999	6:00:40	22.71	394	62.3	5.4	7.7
7/27/1999	6:30:40	22.68	393	59.9	5.2	7.7
7/27/1999	7:00:40	22.66	392	58.4	5.0	7.7
7/27/1999	7:30:40	22.66	391	58.2	5.0	7.7
7/27/1999	8:00:40	22.68	390	57.7	5.0 ^b	7.7
7/27/1999	8:30:40	22.73	389	60.2	5.2	7.7
7/27/1999	9:00:40	22.8	388	65.3	5.6	7.7
7/27/1999	9:30:40	22.9	386	71.9	6.2	7.7
7/27/1999	10:00:40	23.04	385	79.1	6.8	7.8
7/27/1999	10:30:40	23.2	382	88.1	7.5	7.8
7/27/1999	11:00:40	23.42	383	97.3	8.3	7.9
7/27/1999	11:30:40	23.61	380	105.9	9.0	8.0
7/27/1999	12:00:40	23.99	380	116.9	9.8	8.0
7/27/1999	12:30:40	24.44	377	129	10.8	8.1
7/27/1999	13:00:40	24.95	377	140.8	11.6	8.2
7/27/1999	13:30:40	25.28	378	149	12.2	8.3
7/27/1999	14:00:40	25.59	376	156.7	12.8	8.3
7/27/1999	14:30:40	25.95	373	166.2	13.5	8.4
7/27/1999	15:00:40	26.2	373	176.4	14.3	8.4
7/27/1999	15:30:40	26.31	372	181.4	14.6	8.5
7/27/1999	16:00:40	26.47	368	186.5	15.0	8.5

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/27/1999	16:30:40	26.61	370	191	15.3	8.5
7/27/1999	17:00:40	26.71	368	195.3	15.6	8.5
7/27/1999	17:30:40	26.83	366	198.5	15.9 ^a	8.6
7/27/1999	18:00:40	26.68	366	192.3	15.4	8.5
7/27/1999	18:30:40	26.59	366	186	14.9	8.5
7/27/1999	19:00:40	26.42	367	179.6	14.5	8.5
7/27/1999	19:30:40	26.23	367	172.6	13.9	8.5
7/27/1999	20:00:40	26.03	368	163.5	13.2	8.4
7/27/1999	20:30:40	25.83	370	152.5	12.4	8.4
7/27/1999	21:00:40	25.62	373	140.9	11.5	8.3
7/27/1999	21:30:40	25.4	375	130.1	10.7	8.2
7/27/1999	22:00:40	25.21	377	122.3	10.1	8.2
7/27/1999	22:30:40	25.03	380	115.7	9.6	8.1
7/27/1999	23:00:40	24.87	381	111.3	9.2	8.1
7/27/1999	23:30:40	24.71	383	106.9	8.9	8.1
7/28/1999	0:00:40	24.56	384	103	8.6	8.0
7/28/1999	0:30:40	24.42	386	99.1	8.3	8.0
7/28/1999	1:00:40	24.28	387	95.4	8.0	8.0
7/28/1999	1:30:40	24.12	389	92.3	7.7	7.9
7/28/1999	2:00:40	23.99	390	88.2	7.4	7.9
7/28/1999	2:30:40	23.85	391	84.4	7.1	7.9
7/28/1999	3:00:40	23.7	393	81	6.9	7.8
7/28/1999	3:30:40	23.59	394	74.9	6.3	7.8
7/28/1999	4:00:40	23.46	394	73.7	6.3	7.8
7/28/1999	4:30:40	23.34	395	70.7	6.0	7.7
7/28/1999	5:00:40	23.24	395	67.7	5.8	7.7
7/28/1999	5:30:40	23.15	395	64.9	5.5	7.7
7/28/1999	6:00:40	23.07	394	62.1	5.3	7.7
7/28/1999	6:30:40	23.01	394	59.8	5.1	7.7
7/28/1999	7:00:40	22.97	393	58.8	5.0	7.6
7/28/1999	7:30:40	22.97	392	61.1	5.2	7.7

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7/26/1999	16:00:40	25.84	405	171.6	14.0	8.6
7/26/1999	16:30:40	25.97	403	167.9	13.6	8.6
7/26/1999	17:00:40	26	400	165.9	13.4	8.7
7/26/1999	17:30:40	25.96	396	163.3	13.2	8.6
7/26/1999	18:00:40	25.83	392	159.2	13.0	8.6
7/26/1999	18:30:40	25.69	389	156.1	12.7	8.6
7/26/1999	19:00:40	25.53	386	151.7	12.4	8.6
7/26/1999	19:30:40	25.42	384	145.2	11.9	8.5
7/26/1999	20:00:40	25.31	382	138.3	11.4	8.5
7/26/1999	20:30:40	25.14	382	129.4	10.7	8.4
7/26/1999	21:00:40	24.95	383	120.1	9.9	8.3
7/26/1999	21:30:40	24.75	386	111.4	9.2	8.3
7/26/1999	22:00:40	24.53	389	104.2	8.7	8.2
7/26/1999	22:30:40	24.35	392	97.8	8.2	8.2
7/26/1999	23:00:40	24.15	396	92.4	7.8	8.1
7/26/1999	23:30:40	23.98	400	87.8	7.4	8.1
7/27/1999	0:00:40	23.81	404	84	7.1	8.0

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/27/1999	0:30:40	23.65	407	80.7	6.8	8.0
7/27/1999	1:00:40	23.51	410	78	6.6	8.0
7/27/1999	1:30:40	23.4	411	75.5	6.4	8.0
7/27/1999	2:00:40	23.26	414	73.5	6.3	7.9
7/27/1999	2:30:40	23.14	415	71.3	6.1	7.9
7/27/1999	3:00:40	23.01	417	69.1	5.9	7.9
7/27/1999	3:30:40	22.88	418	67	5.8	7.9
7/27/1999	4:00:40	22.77	418	64.7	5.6	7.9
7/27/1999	4:30:40	22.65	419	62.6	5.4	7.8
7/27/1999	5:00:40	22.54	419	60.4	5.2	7.8
7/27/1999	5:30:40	22.44	420	58.7	5.1	7.8
7/27/1999	6:00:40	22.37	420	56.9	4.9	7.8
7/27/1999	6:30:40	22.3	419	55.4	4.8	7.8
7/27/1999	7:00:40	22.25	419	54.4	4.7	7.8
7/27/1999	7:30:40	22.2	419	53.9	4.7 ^b	7.8
7/27/1999	8:00:40	22.18	418	54.2	4.7	7.7
7/27/1999	8:30:40	22.19	418	58	5.1	7.8
7/27/1999	9:00:40	22.23	403	63.8	5.6	7.8
7/27/1999	9:30:40	22.31	421	70.3	6.1	7.9
7/27/1999	10:00:40	22.46	410	79	6.8	7.9
7/27/1999	10:30:40	22.61	405	88.6	7.7	8.0
7/27/1999	11:00:40	22.86	407	99.2	8.5	8.1
7/27/1999	11:30:40	23.08	411	109.9	9.4	8.2
7/27/1999	12:00:40	23.45	411	121.8	10.4	8.3
7/27/1999	12:30:40	23.93	406	133.9	11.3	8.4
7/27/1999	13:00:40	24.4	407	145.4	12.1	8.5
7/27/1999	13:30:40	24.78	402	153.9	12.8	8.6
7/27/1999	14:00:40	25.04	404	160.1	13.2	8.6
7/27/1999	14:30:40	25.51	402	167.1	13.7	8.7
7/27/1999	15:00:40	25.88	400	174	14.1	8.7
7/27/1999	15:30:40	25.98	398	176.3	14.3	8.7
7/27/1999	16:00:40	26.05	397	174.5	14.1	8.7
7/27/1999	16:30:40	26.15	395	175.6	14.2	8.7
7/27/1999	17:00:40	26.29	393	175.6	14.2	8.7
7/27/1999	17:30:40	26.29	391	178.6	14.4 ^a	8.7
7/27/1999	18:00:40	26.19	390	173.2	14.0	8.6
7/27/1999	18:30:40	26.06	390	166.5	13.5	8.6
7/27/1999	19:00:40	25.92	389	159.1	12.9	8.6
7/27/1999	19:30:40	25.77	396	153.1	12.5	8.5
7/27/1999	20:00:40	25.61	397	145.7	11.9	8.5
7/27/1999	20:30:40	25.43	398	136.6	11.2	8.4
7/27/1999	21:00:40	25.25	399	124.5	10.2	8.3
7/27/1999	21:30:40	25.05	400	115.2	9.5	8.3
7/27/1999	22:00:40	24.86	402	106.9	8.8	8.2
7/27/1999	22:30:40	24.66	404	100	8.3	8.1
7/27/1999	23:00:40	24.47	406	94.2	7.9	8.1
7/27/1999	23:30:40	24.3	407	89.3	7.5	8.0
7/28/1999	0:00:40	24.15	408	85.2	7.2	8.0
7/28/1999	0:30:40	24.01	410	82	6.9	8.0
7/28/1999	1:00:40	23.89	411	78.9	6.7	8.0

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/28/1999	1:30:40	23.76	412	76.2	6.4	7.9
7/28/1999	2:00:40	23.65	413	73.9	6.3	7.9
7/28/1999	2:30:40	23.53	415	71.6	6.1	7.9
7/28/1999	3:00:40	23.41	416	69.3	5.9	7.9
7/28/1999	3:30:40	23.29	416	67.1	5.7	7.8
7/28/1999	4:00:40	23.17	418	64.9	5.6	7.8
7/28/1999	4:30:40	23.06	419	62.7	5.4	7.8
7/28/1999	5:00:40	22.96	419	60.4	5.2	7.8
7/28/1999	5:30:40	22.85	419	58.3	5.0	7.8
7/28/1999	6:00:40	22.74	420	56.6	4.9	7.8
7/28/1999	6:30:40	22.65	420	55.1	4.8	7.8
7/28/1999	7:00:40	22.57	420	55.1	4.8	7.7
7/28/1999	7:30:40	22.54	420	57.1	4.9	7.8

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7/26/1999	15:00:40	24.48	446	85.6	7.1	8.0
7/26/1999	15:30:40	24.73	447	88.6	7.4	8.0
7/26/1999	16:00:40	24.27	452	74.7	6.3	7.9
7/26/1999	16:30:40	24.52	449	92.4	7.7	8.0
7/26/1999	17:00:40	24.63	449	101.9	8.5	8.0
7/26/1999	17:30:40	23.77	445	88.1	7.4	8.0
7/26/1999	18:00:40	23.92	444	90.4	7.6	8.0
7/26/1999	18:30:40	23.79	443	105.1	8.9	8.2
7/26/1999	19:00:40	23.96	442	124	10.4	8.3
7/26/1999	19:30:40	24.06	441	131.6	11.1	8.4
7/26/1999	20:00:40	24.15	439	140.2	11.8	8.4
7/26/1999	20:30:40	24.25	438	144.3	12.1	8.5
7/26/1999	21:00:40	24.26	439	150.1	12.6	8.5
7/26/1999	21:30:40	24.57	431	151.9	12.6	8.5
7/26/1999	22:00:40	24.73	431	151.2	12.5	8.5
7/26/1999	22:30:40	24.84	431	146.6	12.1	8.5
7/26/1999	23:00:40	24.58	436	146.3	12.2	8.5
7/26/1999	23:30:40	24.61	438	144.6	12.0	8.5
7/27/1999	0:00:40	24.67	437	145.3	12.1	8.5
7/27/1999	0:30:40	24.65	437	143.7	11.9	8.5
7/27/1999	1:00:40	24.66	437	139.5	11.6	8.5
7/27/1999	1:30:40	24.63	438	137	11.4	8.5
7/27/1999	2:00:40	24.65	438	131.9	11.0	8.4
7/27/1999	2:30:40	24.63	437	129.4	10.8	8.4
7/27/1999	3:00:40	24.59	437	129.2	10.7	8.4
7/27/1999	3:30:40	24.48	438	125.3	10.5	8.4
7/27/1999	4:00:40	24.39	439	116.5	9.7	8.4
7/27/1999	4:30:40	24.27	439	111.7	9.4	8.3
7/27/1999	5:00:40	24.09	440	101.1	8.5	8.2
7/27/1999	5:30:40	23.97	439	92.4	7.8	8.2
7/27/1999	6:00:40	23.87	439	90.3	7.6	8.1
7/27/1999	6:30:40	23.8	441	87.4	7.4	8.1
7/27/1999	7:00:40	23.62	442	80.1	6.8	8.0
7/27/1999	7:30:40	23.52	444	74.9	6.4	8.0
7/27/1999	8:00:40	24.08	440	107	9.0	8.3

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/27/1999	8:30:40	24.01	441	105.6	8.9	8.2
7/27/1999	9:00:40	23.64	445	83.8	7.1	8.1
7/27/1999	9:30:40	23.69	445	84	7.1	8.0
7/27/1999	10:00:40	23.87	443	90.5	7.6	8.1
7/27/1999	10:30:40	23.69	444	85.4	7.2	8.1
7/27/1999	11:00:40	23.92	443	93.4	7.9	8.1
7/27/1999	11:30:40	23.71	446	86.2	7.3	8.0
7/27/1999	12:00:40	23.51	447	75.8	6.4	8.0
7/27/1999	12:30:40	23.43	447	74	6.3	7.9
7/27/1999	13:00:40	24.03	446	88.1	7.4	8.0
7/27/1999	13:30:40	23.95	446	82.6	7.0	8.0
7/27/1999	14:00:40	23.96	447	80.3	6.8	8.0
7/27/1999	14:30:40	23.85	448	81.2	6.9	8.0
7/27/1999	15:00:40	23.59	449	75.1	6.4	7.9
7/27/1999	15:30:40	23.99	449	78.3	6.6	7.9
7/27/1999	16:00:40	23.7	450	74.2	6.3	7.9
7/27/1999	16:30:40	23.53	450	85.7	7.3	7.9
7/27/1999	17:00:40	23.93	449	68.1	5.7 ^b	7.9
7/27/1999	17:30:40	23.55	448	69.1	5.9	7.9
7/27/1999	18:00:40	23.54	441	89.8	7.6	8.0
7/27/1999	18:30:40	23.62	441	89.2	7.6	8.1
7/27/1999	19:00:40	23.7	440	106.1	9.0	8.2
7/27/1999	19:30:40	24.02	441	102.7	8.6	8.2
7/27/1999	20:00:40	24.12	435	112.9	9.5	8.2
7/27/1999	20:30:40	24.45	433	122.2	10.2	8.3
7/27/1999	21:00:40	24.39	435	147.7	12.3	8.5
7/27/1999	21:30:40	24.5	435	153.5	12.8	8.5
7/27/1999	22:00:40	24.68	436	157.5	13.1 ^a	8.5
7/27/1999	22:30:40	24.81	434	157.6	13.1	8.6
7/27/1999	23:00:40	24.97	432	157.6	13.0	8.6
7/27/1999	23:30:40	24.98	434	154.9	12.8	8.6
7/28/1999	0:00:40	25.02	433	152.3	12.6	8.6
7/28/1999	0:30:40	25	433	150.4	12.4	8.5
7/28/1999	1:00:40	24.98	434	147.3	12.2	8.5
7/28/1999	1:30:40	25.02	434	142.3	11.7	8.5
7/28/1999	2:00:40	25	435	137.5	11.4	8.5
7/28/1999	2:30:40	24.94	435	134.8	11.1	8.5
7/28/1999	3:00:40	24.93	435	131.4	10.9	8.5
7/28/1999	3:30:40	24.89	435	129.7	10.7	8.4
7/28/1999	4:00:40	24.84	435	128.4	10.6	8.4
7/28/1999	4:30:40	24.75	435	124.8	10.4	8.4
7/28/1999	5:00:40	24.61	436	122.1	10.2	8.4
7/28/1999	5:30:40	24.56	437	111	9.2	8.3
7/28/1999	6:00:40	24.25	441	94.5	7.9	8.1
7/28/1999	6:30:40	24.04	441	80.2	6.7	8.0
7/28/1999	7:00:40	23.98	442	79.3	6.7	8.0
7/28/1999	7:30:40	23.79	442	74	6.3	8.0
7/28/1999	8:00:40	23.7	445	73	6.2	8.0

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/26/1999	14:30:40	23.43	445	102.2	8.7	8.1
7/26/1999	15:00:40	23.46	445	101.8	8.6	8.1
7/26/1999	15:30:40	23.41	445	102.3	8.7	8.1
7/26/1999	16:00:40	23.41	444	102.8	8.7	8.1
7/26/1999	16:30:40	23.42	444	101.1	8.6	8.1
7/26/1999	17:00:40	23.32	444	100.2	8.5	8.1
7/26/1999	17:30:40	23.33	443	100.7	8.6	8.1
7/26/1999	18:00:40	23.27	443	98.9	8.4	8.1
7/26/1999	18:30:40	23.21	443	96	8.2	8.1
7/26/1999	19:00:40	23.19	443	94.9	8.1	8.1
7/26/1999	19:30:40	23.2	443	92.4	7.9	8.1
7/26/1999	20:00:40	23.29	443	90.3	7.7	8.1
7/26/1999	20:30:40	23.24	443	89.2	7.6	8.1
7/26/1999	21:00:40	23.27	443	88.1	7.5	8.1
7/26/1999	21:30:40	23.24	443	88.7	7.6	8.1
7/26/1999	22:00:40	23.26	442	88.8	7.6	8.1
7/26/1999	22:30:40	23.28	442	88	7.5	8.1
7/26/1999	23:00:40	23.36	442	87.7	7.5	8.1
7/26/1999	23:30:40	23.36	442	88	7.5	8.1
7/27/1999	0:00:40	23.39	441	88.1	7.5	8.1
7/27/1999	0:30:40	23.39	442	88.4	7.5	8.1
7/27/1999	1:00:40	23.4	442	89	7.6	8.2
7/27/1999	1:30:40	23.45	441	89.3	7.6	8.2
7/27/1999	2:00:40	23.49	441	89.3	7.6	8.2
7/27/1999	2:30:40	23.44	441	88.5	7.5	8.2
7/27/1999	3:00:40	23.39	441	88.3	7.5	8.1
7/27/1999	3:30:40	23.44	441	88.2	7.5	8.2
7/27/1999	4:00:40	23.4	441	87.9	7.5	8.1
7/27/1999	4:30:40	23.41	441	87.9	7.5	8.1
7/27/1999	5:00:40	23.4	441	87	7.4	8.1
7/27/1999	5:30:40	23.38	440	85.9	7.3	8.1
7/27/1999	6:00:40	23.39	439	84.7	7.2	8.1
7/27/1999	6:30:40	23.31	439	83.9	7.2	8.0
7/27/1999	7:00:40	23.28	439	83.8	7.1	8.0
7/27/1999	7:30:40	23.23	438	83.3	7.1 ^b	8.0
7/27/1999	8:00:40	23.16	438	83.9	7.2	8.0
7/27/1999	8:30:40	23.16	438	87.4	7.5	8.0
7/27/1999	9:00:40	23.11	439	89	7.6	8.0
7/27/1999	9:30:40	23.08	439	91.2	7.8	8.0
7/27/1999	10:00:40	23.08	439	95.2	8.1	8.0
7/27/1999	10:30:40	23.07	439	95.6	8.2	8.0
7/27/1999	11:00:40	23.2	440	100.4	8.6	8.1
7/27/1999	11:30:40	23.14	439	101	8.6	8.1
7/27/1999	12:00:40	23.29	439	104.4	8.9	8.1
7/27/1999	12:30:40	23.31	438	105.4	9.0	8.1
7/27/1999	13:00:40	23.29	439	105.2	9.0	8.1
7/27/1999	13:30:40	23.21	438	104.5	8.9	8.1
7/27/1999	14:00:40	22.98	439	99.7	8.6	8.1
7/27/1999	14:30:40	23.09	439	103.6	8.9	8.1
7/27/1999	15:00:40	23.17	438	105.4	9.0 ^a	8.1

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/27/1999	15:30:40	22.97	438	100.1	8.6	8.1
7/27/1999	16:00:40	22.9	438	99.1	8.5	8.1
7/27/1999	16:30:40	23.05	438	103.2	8.8	8.1
7/27/1999	17:00:40	23.09	437	103.6	8.9	8.1
7/27/1999	17:30:40	22.96	438	98.5	8.5	8.1
7/27/1999	18:00:40	22.94	438	98.1	8.4	8.1
7/27/1999	18:30:40	22.97	437	99.4	8.5	8.1
7/27/1999	19:00:40	23.01	437	97.6	8.4	8.1
7/27/1999	19:30:40	22.97	437	93.8	8.0	8.1
7/27/1999	20:00:40	22.99	438	88.8	7.6	8.1
7/27/1999	20:30:40	22.99	437	86	7.4	8.0
7/27/1999	21:00:40	22.96	438	84.8	7.3	8.0
7/27/1999	21:30:40	23.07	437	86.7	7.4	8.1
7/27/1999	22:00:40	23.07	438	86	7.4	8.1
7/27/1999	22:30:40	23.09	437	86.5	7.4	8.1
7/27/1999	23:00:40	23.18	437	87.4	7.5	8.1
7/27/1999	23:30:40	23.21	437	88.4	7.5	8.1
7/28/1999	0:00:40	23.27	437	88.8	7.6	8.1
7/28/1999	0:30:40	23.24	437	87.8	7.5	8.1
7/28/1999	1:00:40	23.25	437	88.3	7.5	8.1
7/28/1999	1:30:40	23.33	436	88.8	7.6	8.1
7/28/1999	2:00:40	23.29	437	88.4	7.5	8.1
7/28/1999	2:30:40	23.31	437	88.1	7.5	8.1
7/28/1999	3:00:40	23.39	437	88.1	7.5	8.1
7/28/1999	3:30:40	23.33	437	87.8	7.5	8.1
7/28/1999	4:00:40	23.41	436	88.4	7.5	8.1
7/28/1999	4:30:40	23.42	436	88.6	7.5	8.1
7/28/1999	5:00:40	23.42	436	88.2	7.5	8.1
7/28/1999	5:30:40	23.37	436	87.8	7.5	8.1
7/28/1999	6:00:40	23.38	436	87.3	7.4	8.1
7/28/1999	6:30:40	23.37	436	86	7.3	8.0
7/28/1999	7:00:40	23.32	436	85.3	7.3	8.0
7/28/1999	7:30:40	23.3	436	87	7.4	8.0
7/28/1999	8:00:40	23.29	436	88.7	7.6	8.0

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7/12/1999	19:00:40	21.35	469	111.4	9.9	8.3
7/12/1999	19:30:40	21.28	470	110	9.7	8.3
7/12/1999	20:00:40	21.21	470	108.6	9.6	8.3
7/12/1999	20:30:40	21.14	470	107.5	9.6	8.3
7/12/1999	21:00:40	21.06	471	105.4	9.4	8.3
7/12/1999	21:30:40	21	471	103.8	9.2	8.3
7/12/1999	22:00:40	20.93	471	100.9	9.0	8.3
7/12/1999	22:30:40	20.86	472	98.4	8.8	8.3
7/12/1999	23:00:40	20.8	472	96.1	8.6	8.3
7/12/1999	23:30:40	20.75	472	93	8.3	8.3
7/13/1999	0:00:40	20.7	473	91	8.2	8.3
7/13/1999	0:30:40	20.66	473	88.1	7.9	8.2
7/13/1999	1:00:40	20.61	474	86.3	7.7	8.2
7/13/1999	1:30:40	20.54	474	84.4	7.6	8.2

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/13/1999	2:00:40	20.49	475	81.3	7.3	8.2
7/13/1999	2:30:40	20.45	475	79	7.1	8.2
7/13/1999	3:00:40	20.38	477	76.7	6.9	8.1
7/13/1999	3:30:40	20.33	478	74.8	6.7	8.1
7/13/1999	4:00:40	20.29	478	72.9	6.6	8.1
7/13/1999	4:30:40	20.25	478	70.9	6.4	8.1
7/13/1999	5:00:40	20.21	478	69.7	6.3	8.1
7/13/1999	5:30:40	20.18	478	68.2	6.2	8.0
7/13/1999	6:00:40	20.11	478	67.6	6.1	8.0
7/13/1999	6:30:40	20.08	479	66.1	6.0	8.0
7/13/1999	7:00:40	20.07	479	65.5	5.9	8.0
7/13/1999	7:30:40	20.05	479	66.7	6.1	8.0
7/13/1999	8:00:40	20.05	479	67.5	6.1	8.0
7/13/1999	8:30:40	20.05	478	70.2	6.4	8.0
7/13/1999	9:00:40	20.1	479	73.9	6.7	8.0
7/13/1999	9:30:40	20.14	478	78.2	7.1	8.0
7/13/1999	10:00:40	20.3	478	82.8	7.5	8.1
7/13/1999	10:30:40	20.51	478	89	8.0	8.1
7/13/1999	11:00:40	20.53	478	89.1	8.0	8.1
7/13/1999	11:30:40	20.81	477	93.7	8.4	8.2
7/13/1999	12:00:40	21	476	99.3	8.8	8.2
7/13/1999	12:30:40	21.21	476	106.9	9.5	8.2
7/13/1999	13:00:40	21.43	475	112.3	9.9	8.3
7/13/1999	13:30:40	21.77	474	119.7	10.5	8.3
7/13/1999	14:00:40	21.99	473	125.8	11.0	8.4
7/13/1999	14:30:40	22.21	472	131.6	11.4	8.4
7/13/1999	15:00:40	22.57	471	137.6	11.9	8.5
7/13/1999	15:30:40	22.76	470	142	12.2	8.5
7/13/1999	16:00:40	23	468	148.2	12.7	8.6
7/13/1999	16:30:40	23.04	467	152.1	13.0	8.6
7/13/1999	17:00:40	23.24	466	152.9	13.0	8.6
7/13/1999	17:30:40	23.39	465	159.9	13.6	8.7
7/13/1999	18:00:40	23.46	464	160.7	13.6	8.7
7/13/1999	18:30:40	23.53	464	160.5	13.6	8.7
7/13/1999	19:00:40	23.64	462	161.5	13.7	8.7
7/13/1999	19:30:40	23.69	462	159.7	13.5	8.7
7/13/1999	20:00:40	23.72	461	156.9	13.3	8.8
7/13/1999	20:30:40	23.73	460	154.4	13.1	8.8
7/13/1999	21:00:40	23.73	460	150.8	12.7	8.8
7/13/1999	21:30:40	23.72	459	146.1	12.4	8.8
7/13/1999	22:00:40	23.67	459	141.1	11.9	8.8
7/13/1999	22:30:40	23.62	459	137.6	11.7	8.8
7/13/1999	23:00:40	23.55	459	132.5	11.2	8.8
7/13/1999	23:30:40	23.47	459	126.5	10.7	8.8
7/14/1999	0:00:40	23.38	459	121.7	10.4	8.8
7/14/1999	0:30:40	23.27	460	115.4	9.8	8.7
7/14/1999	1:00:40	23.23	460	112.2	9.6	8.7
7/14/1999	1:30:40	23.12	461	105.3	9.0	8.7
7/14/1999	2:00:40	23.04	462	100.1	8.6	8.7
7/14/1999	2:30:40	22.94	463	95.1	8.2	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/14/1999	3:00:40	22.85	463	91.5	7.9	8.6
7/14/1999	3:30:40	22.75	456	85.9	7.4	8.6
7/14/1999	4:00:40	22.66	462	82.5	7.1	8.5
7/14/1999	4:30:40	22.6	458	80.3	6.9	8.5
7/14/1999	5:00:40	22.51	455	76.3	6.6	8.5
7/14/1999	5:30:40	22.41	469	73.2	6.4	8.4
7/14/1999	6:00:40	22.34	469	71.3	6.2	8.4
7/14/1999	6:30:40	22.24	470	68.6	6.0	8.4
7/14/1999	7:00:40	22.18	471	61.8	5.4	8.3
7/14/1999	7:30:40	22.14	471	36.7	3.2 ^b	8.3
7/14/1999	8:00:40	22.08	467	63	5.5	8.3
7/14/1999	8:30:40	22.05	467	64	5.6	8.3
7/14/1999	9:00:40	22.03	464	61.2	5.3	8.2
7/14/1999	9:30:40	21.99	461	63.8	5.6	8.2
7/14/1999	10:00:40	21.99	472	66.4	5.8	8.2
7/14/1999	10:30:40	22	472	70.2	6.1	8.2
7/14/1999	11:00:40	22	472	76.8	6.7	8.2
7/14/1999	11:30:40	22.03	472	77.6	6.8	8.3
7/14/1999	12:00:40	22.05	472	67	5.9	8.3
7/14/1999	12:30:40	22.04	463	91.7	8.0	8.3
7/14/1999	13:00:40	22.09	471	97.4	8.5	8.3
7/14/1999	13:30:40	22.18	471	103	9.0	8.4
7/14/1999	14:00:40	22.37	470	110.4	9.6	8.4
7/14/1999	14:30:40	22.49	470	105.9	9.2	8.4
7/14/1999	15:00:40	22.75	470	119.6	10.3	8.5
7/14/1999	15:30:40	22.82	469	126.4	10.9	8.5
7/14/1999	16:00:40	22.97	468	130.1	11.2	8.5
7/14/1999	16:30:40	23.05	467	134.8	11.5	8.6
7/14/1999	17:00:40	23.17	466	140.5	12.0	8.6
7/14/1999	17:30:40	23.27	465	147.2	12.6	8.6
7/14/1999	18:00:40	23.33	465	148.2	12.6	8.7
7/14/1999	18:30:40	23.36	464	151.4	12.9	8.7
7/14/1999	19:00:40	23.34	463	150.9	12.8	8.7
7/14/1999	19:30:40	23.28	463	150	12.8	8.7
7/14/1999	20:00:40	23.25	463	147.2	12.6	8.7
7/14/1999	20:30:40	23.23	462	145.2	12.4	8.7
7/14/1999	21:00:40	23.21	462	142.3	12.1	8.8
7/14/1999	21:30:40	23.17	462	138.8	11.9	8.8
7/14/1999	22:00:40	23.12	462	135	11.5	8.8
7/14/1999	22:30:40	23.03	462	130.6	11.2	8.8
7/14/1999	23:00:40	22.96	462	126.2	10.8	8.7
7/14/1999	23:30:40	22.89	463	121.5	10.4	8.7
7/15/1999	0:00:40	22.79	464	116.4	10.0	8.7
7/15/1999	0:30:40	22.72	464	113.3	9.8	8.7
7/15/1999	1:00:40	22.65	464	104.4	9.0	8.7
7/15/1999	1:30:40	22.56	465	102.5	8.9	8.7
7/15/1999	2:00:40	22.47	466	98.9	8.6	8.7
7/15/1999	2:30:40	22.39	467	95.7	8.3	8.6
7/15/1999	3:00:40	22.31	468	91.7	8.0	8.6
7/15/1999	3:30:40	22.23	469	86.7	7.5	8.6

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/15/1999	4:00:40	22.12	470	83.4	7.3	8.5
7/15/1999	4:30:40	22.06	470	81.4	7.1	8.5
7/15/1999	5:00:40	21.97	471	77.9	6.8	8.5
7/15/1999	5:30:40	21.86	472	74.8	6.6	8.4
7/15/1999	6:00:40	21.77	473	72.2	6.3	8.4
7/15/1999	6:30:40	21.65	473	69.7	6.1	8.4
7/15/1999	7:00:40	21.59	474	62.3	5.5	8.4
7/15/1999	7:30:40	21.51	474	68	6.0	8.3
7/15/1999	8:00:40	21.51	474	67.5	6.0	8.4
7/15/1999	8:30:40	21.49	473	69.8	6.2	8.4
7/15/1999	9:00:40	21.53	473	69.6	6.1	8.4
7/15/1999	9:30:40	21.59	473	75	6.6	8.4
7/15/1999	10:00:40	21.76	472	82.3	7.2	8.4
7/15/1999	10:30:40	21.92	472	87.8	7.7	8.4
7/15/1999	11:00:40	22.04	471	89.3	7.8	8.4
7/15/1999	11:30:40	22.21	471	94.6	8.2	8.4
7/15/1999	12:00:40	22.41	470	99.8	8.6	8.5
7/15/1999	12:30:40	22.61	470	106.9	9.2	8.5
7/15/1999	13:00:40	22.83	469	110.5	9.5	8.5
7/15/1999	13:30:40	23.06	469	119.3	10.2	8.6
7/15/1999	14:00:40	23.37	263	130.6	11.1	8.6
7/15/1999	14:30:40	23.53	262	131.8	11.2	8.6
7/15/1999	15:00:40	23.92	262	144.7	12.2	8.7
7/15/1999	15:30:40	24.17	262	152	12.7	8.7
7/15/1999	16:00:40	24.35	261	155.3	13.0	8.7
7/15/1999	16:30:40	24.57	261	158.8	13.2	8.7
7/15/1999	17:00:40	24.71	260	162.9	13.5	8.8
7/15/1999	17:30:40	24.83	260	162.4	13.5	8.8
7/15/1999	18:00:40	25	260	166.5	13.8	8.8
7/15/1999	18:30:40	25.06	260	163	13.4	8.8
7/15/1999	19:00:40	25.15	259	163.9	13.5	8.8
7/15/1999	19:30:40	25.2	259	159.1	13.1	8.8
7/15/1999	20:00:40	25.24	259	154.9	12.7	8.8
7/15/1999	20:30:40	25.3	259	149.6	12.3	8.9
7/15/1999	21:00:40	25.31	258	148.3	12.2	8.9
7/15/1999	21:30:40	25.29	257	144.2	11.8	8.9
7/15/1999	22:00:40	25.25	257	139.1	11.4	8.9
7/15/1999	22:30:40	25.2	256	133	10.9	8.9
7/15/1999	23:00:40	25.12	257	129.4	10.7	8.8
7/15/1999	23:30:40	25.05	257	124.3	10.3	8.8
7/16/1999	0:00:40	24.99	257	118.6	9.8	8.8
7/16/1999	0:30:40	24.92	257	111.5	9.2	8.8
7/16/1999	1:00:40	24.84	257	107.4	8.9	8.8
7/16/1999	1:30:40	24.77	258	99.3	8.2	8.8
7/16/1999	2:00:40	24.69	258	98	8.1	8.7
7/16/1999	2:30:40	24.62	258	92.5	7.7	8.7
7/16/1999	3:00:40	24.52	259	85.8	7.2	8.7
7/16/1999	3:30:40	24.41	381	83.2	7.0	8.7
7/16/1999	4:00:40	24.31	416	77.2	6.5	8.6
7/16/1999	4:30:40	24.18	426	73.2	6.1	8.6

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/16/1999	5:00:40	24.08	431	70.6	5.9	8.5
7/16/1999	5:30:40	23.98	428	67.4	5.7	8.5
7/16/1999	6:00:40	23.87	461	63.3	5.3	8.5
7/16/1999	6:30:40	23.79	460	62	5.2	8.4
7/16/1999	7:00:40	23.7	461	62	5.2	8.4
7/16/1999	7:30:40	23.61	458	64.6	5.5	8.4
7/16/1999	8:00:40	23.56	459	65.2	5.5	8.4
7/16/1999	8:30:40	23.6	466	70.6	6.0	8.4
7/16/1999	9:00:40	23.63	466	76.2	6.5	8.4
7/16/1999	9:30:40	23.73	466	81.2	6.9	8.5
7/16/1999	10:00:40	23.84	466	87	7.3	8.5
7/16/1999	10:30:40	23.97	465	93.5	7.9	8.5
7/16/1999	11:00:40	24.05	465	99.8	8.4	8.5
7/16/1999	11:30:40	24.22	465	105.8	8.9	8.6
7/16/1999	12:00:40	24.39	464	111.9	9.3	8.6
7/16/1999	12:30:40	24.54	463	115.5	9.6	8.6
7/16/1999	13:00:40	24.74	463	121.8	10.1	8.6
7/16/1999	13:30:40	24.93	462	128	10.6	8.6
7/16/1999	14:00:40	25.16	462	136	11.2	8.7
7/16/1999	14:30:40	25.42	460	144.7	11.9	8.7
7/16/1999	15:00:40	25.55	460	149.3	12.2	8.7
7/16/1999	15:30:40	25.74	459	153.4	12.5	8.7
7/16/1999	16:00:40	26.03	457	162	13.1	8.8
7/16/1999	16:30:40	26.19	456	165.6	13.4	8.8
7/16/1999	17:00:40	26.35	455	170.2	13.7	8.8
7/16/1999	17:30:40	26.48	454	172.5	13.9	8.8
7/16/1999	18:00:40	26.58	453	174	14.0	8.9
7/16/1999	18:30:40	26.65	452	174.4	14.0	8.9
7/16/1999	19:00:40	26.67	451	171.2	13.7	8.9
7/16/1999	19:30:40	26.63	451	165.5	13.3	8.9
7/16/1999	20:00:40	26.57	451	157.1	12.6	8.9
7/16/1999	20:30:40	26.51	450	151.9	12.2	8.9
7/16/1999	21:00:40	26.45	450	148.7	12.0	8.9
7/16/1999	21:30:40	26.37	450	143.7	11.6	8.9
7/16/1999	22:00:40	26.29	450	137.8	11.1	8.9
7/16/1999	22:30:40	26.19	451	132.3	10.7	8.9
7/16/1999	23:00:40	26.09	451	128.3	10.4	8.9
7/16/1999	23:30:40	26	451	121.9	9.9	8.9
7/17/1999	0:00:40	25.91	452	116.2	9.4	8.8
7/17/1999	0:30:40	25.82	453	109.2	8.9	8.8
7/17/1999	1:00:40	25.74	453	103.4	8.4	8.8
7/17/1999	1:30:40	25.64	455	96.3	7.9	8.8
7/17/1999	2:00:40	25.55	456	90.2	7.4	8.7
7/17/1999	2:30:40	25.46	456	88.5	7.3	8.7
7/17/1999	3:00:40	25.33	458	80.7	6.6	8.7
7/17/1999	3:30:40	25.24	459	77.4	6.4	8.6
7/17/1999	4:00:40	25.12	460	72.3	6.0	8.6
7/17/1999	4:30:40	25	461	68.9	5.7	8.6
7/17/1999	5:00:40	24.88	462	65.8	5.4	8.5
7/17/1999	5:30:40	24.77	463	62.4	5.2	8.5

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/17/1999	6:00:40	24.67	464	59.4	4.9	8.5
7/17/1999	6:30:40	24.58	464	57.2	4.8	8.4
7/17/1999	7:00:40	24.49	465	60.5	5.0	8.4
7/17/1999	7:30:40	24.42	454	64.1	5.4	8.4
7/17/1999	8:00:40	24.38	464	67.4	5.6	8.4
7/17/1999	8:30:40	24.39	467	74.6	6.2	8.5
7/17/1999	9:00:40	24.45	465	80.2	6.7	8.5
7/17/1999	9:30:40	24.52	464	82.4	6.9	8.5
7/17/1999	10:00:40	24.66	464	93.7	7.8	8.6
7/17/1999	10:30:40	24.8	464	96	8.0	8.6
7/17/1999	11:00:40	24.89	463	99.5	8.2	8.6
7/17/1999	11:30:40	25.02	463	110.1	9.1	8.7
7/17/1999	12:00:40	25.12	463	111.2	9.2	8.7
7/17/1999	12:30:40	25.35	462	119.4	9.8	8.8
7/17/1999	13:00:40	25.6	461	126.7	10.4	8.8
7/17/1999	13:30:40	25.75	461	135.1	11.0	8.7
7/17/1999	14:00:40	26.02	459	140	11.3	8.8
7/17/1999	14:30:40	26.28	457	147.8	11.9	8.8
7/17/1999	15:00:40	26.5	457	148.9	12.0	8.7
7/17/1999	15:30:40	26.72	456	158.1	12.7	8.8
7/17/1999	16:00:40	26.96	455	163.6	13.0	8.8
7/17/1999	16:30:40	27.13	453	169.7	13.5	8.8
7/17/1999	17:00:40	27.28	452	173.5	13.7	8.9
7/17/1999	17:30:40	27.33	451	171.2	13.6	8.8
7/17/1999	18:00:40	27.36	451	167.7	13.3	8.8
7/17/1999	18:30:40	27.35	451	163.4	12.9	8.9
7/17/1999	19:00:40	27.38	450	160.6	12.7	8.9
7/17/1999	19:30:40	27.35	450	154.4	12.2	8.9
7/17/1999	20:00:40	27.28	449	147.9	11.7	8.9
7/17/1999	20:30:40	27.2	449	140.5	11.2	8.8
7/17/1999	21:00:40	27.1	449	134.9	10.7	8.8
7/17/1999	21:30:40	27.02	448	127.1	10.1	8.8
7/17/1999	22:00:40	26.91	450	129.5	10.3	8.8
7/17/1999	22:30:40	26.79	449	125	10.0	8.8
7/17/1999	23:00:40	26.69	450	119	9.5	8.8
7/17/1999	23:30:40	26.6	451	111.9	9.0	8.8
7/18/1999	0:00:40	26.5	452	104.4	8.4	8.7
7/18/1999	0:30:40	26.42	452	99.3	8.0	8.7
7/18/1999	1:00:40	26.35	454	92.6	7.5	8.7
7/18/1999	1:30:40	26.29	454	89.7	7.2	8.7
7/18/1999	2:00:40	26.19	456	84.5	6.8	8.6
7/18/1999	2:30:40	26.1	457	78.8	6.4	8.6
7/18/1999	3:00:40	26	457	74.3	6.0	8.5
7/18/1999	3:30:40	25.91	458	71.3	5.8	8.5
7/18/1999	4:00:40	25.8	459	66.1	5.4	8.5
7/18/1999	4:30:40	25.68	460	64.7	5.3	8.5
7/18/1999	5:00:40	25.57	461	60.5	4.9	8.3
7/18/1999	5:30:40	25.47	462	58.4	4.8	8.4
7/18/1999	6:00:40	25.39	462	55.6	4.6	8.4
7/18/1999	6:30:40	25.27	463	53.6	4.4	8.3

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/18/1999	7:00:40	25.19	463	52.4	4.3	8.3
7/18/1999	7:30:40	25.14	463	54.9	4.5	8.4
7/18/1999	8:00:40	25.06	463	58.1	4.8	8.4
7/18/1999	8:30:40	25.04	463	59.9	4.9	8.4
7/18/1999	9:00:40	25.05	463	72.2	6.0	8.4
7/18/1999	9:30:40	25.11	463	75	6.2	8.5
7/18/1999	10:00:40	25.2	463	82.7	6.8	8.5
7/18/1999	10:30:40	25.29	461	88.3	7.3	8.6
7/18/1999	11:00:40	25.46	460	97.4	8.0	8.7
7/18/1999	11:30:40	25.57	460	100.8	8.2	8.7
7/18/1999	12:00:40	25.69	460	105.2	8.6	8.5
7/18/1999	12:30:40	25.79	461	115.6	9.4	8.7
7/18/1999	13:00:40	25.99	460	124.9	10.1	8.7
7/18/1999	13:30:40	26.24	458	133.9	10.8	8.8
7/18/1999	14:00:40	26.25	457	135.3	10.9	8.7
7/18/1999	14:30:40	26.49	457	144.3	11.6	8.8
7/18/1999	15:00:40	26.55	457	139.2	11.2	8.7
7/18/1999	15:30:40	26.65	456	144.5	11.6	8.7
7/18/1999	16:00:40	26.75	455	152.4	12.2	8.8
7/18/1999	16:30:40	26.85	453	160.6	12.8	8.8
7/18/1999	17:00:40	26.95	452	167.9	13.4	8.9
7/18/1999	17:30:40	27.02	451	169.9	13.5	8.9
7/18/1999	18:00:40	27.04	451	165.6	13.2	8.9
7/18/1999	18:30:40	27.05	450	166	13.2	8.9
7/18/1999	19:00:40	27.04	449	164.8	13.1	8.9
7/18/1999	19:30:40	27.01	449	155.3	12.4	8.8
7/18/1999	20:00:40	26.97	449	151.7	12.1	8.9
7/18/1999	20:30:40	26.92	449	144.5	11.5	8.9
7/18/1999	21:00:40	26.87	449	141.7	11.3	8.9
7/18/1999	21:30:40	26.81	449	135.5	10.8	8.8
7/18/1999	22:00:40	26.75	449	130	10.4	8.8
7/18/1999	22:30:40	26.66	449	122.5	9.8	8.8
7/18/1999	23:00:40	26.58	449	119.5	9.6	8.8
7/18/1999	23:30:40	26.49	450	115.9	9.3	8.8
7/19/1999	0:00:40	26.39	451	109.9	8.8	8.8
7/19/1999	0:30:40	26.31	452	104	8.4	8.8
7/19/1999	1:00:40	26.21	453	98	7.9	8.7
7/19/1999	1:30:40	26.11	453	94.7	7.7	8.7
7/19/1999	2:00:40	26.01	454	89.7	7.3	8.7
7/19/1999	2:30:40	25.91	455	83.1	6.7	8.7
7/19/1999	3:00:40	25.8	457	77.5	6.3	8.6
7/19/1999	3:30:40	25.69	458	70.7	5.8	8.6
7/19/1999	4:00:40	25.62	459	69.4	5.7	8.6
7/19/1999	4:30:40	25.47	459	66.3	5.4	8.5
7/19/1999	5:00:40	25.35	461	62.5	5.1	8.5
7/19/1999	5:30:40	25.27	462	58.1	4.8	8.4
7/19/1999	6:00:40	25.14	463	55.4	4.6	8.4
7/19/1999	6:30:40	25.05	464	54.7	4.5	8.3
7/19/1999	7:00:40	24.97	464	55.7	4.6	8.3
7/19/1999	7:30:40	24.93	464	61.6	5.1	8.4

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/19/1999	8:00:40	24.88	464	71	5.9	8.4
7/19/1999	8:30:40	24.87	464	82.9	6.9	8.5
7/19/1999	9:00:40	24.92	464	89.7	7.4	8.6
7/19/1999	9:30:40	24.99	463	97.4	8.0	8.6
7/19/1999	10:00:40	25.1	463	107	8.8	8.7
7/19/1999	10:30:40	25.23	462	121.6	10.0	8.7
7/19/1999	11:00:40	25.36	461	122.2	10.0	8.7
7/19/1999	11:30:40	25.51	461	126.1	10.3	8.8
7/19/1999	12:00:40	25.67	460	131.3	10.7	8.9
7/19/1999	12:30:40	25.7	460	120.8	9.8	8.7
7/19/1999	13:00:40	25.83	460	128.8	10.5	8.9
7/19/1999	13:30:40	26.04	459	126.8	10.3	8.7
7/19/1999	14:00:40	26.16	457	146.5	11.8	8.8
7/19/1999	14:30:40	26.29	457	151.8	12.2	8.8
7/19/1999	15:00:40	26.52	456	154.3	12.4	8.8
7/19/1999	15:30:40	26.66	455	162.1	13.0	8.8
7/19/1999	16:00:40	26.76	455	158.7	12.7	8.7
7/19/1999	16:30:40	26.95	453	180	14.3	8.9
7/19/1999	17:00:40	27.04	452	177.3	14.1	8.8
7/19/1999	17:30:40	27.11	451	181.6	14.4 ^a	8.8
7/19/1999	18:00:40	27.14	451	174.2	13.8	8.9
7/19/1999	18:30:40	27.18	451	162.6	12.9	8.9
7/19/1999	19:00:40	27.2	450	159.9	12.7	8.9
7/19/1999	19:30:40	27.19	450	154.2	12.2	8.8
7/19/1999	20:00:40	27.15	450	148.2	11.8	8.8
7/19/1999	20:30:40	27.12	449	145.1	11.5	8.8
7/19/1999	21:00:40	27.07	450	140.5	11.2	8.8
7/19/1999	21:30:40	27.01	450	133.7	10.6	8.8
7/19/1999	22:00:40	26.95	450	131.4	10.5	8.8
7/19/1999	22:30:40	26.89	451	122.1	9.7	8.8
7/19/1999	23:00:40	26.81	451	116.3	9.3	8.8
7/19/1999	23:30:40	26.73	452	112.5	9.0	8.8
7/20/1999	0:00:40	26.64	452	108.8	8.7	8.7
7/20/1999	0:30:40	26.57	455	99.4	8.0	8.7
7/20/1999	1:00:40	26.49	455	93.7	7.5	8.7
7/20/1999	1:30:40	26.4	456	90.1	7.3	8.7
7/20/1999	2:00:40	26.32	457	81.6	6.6	8.7
7/20/1999	2:30:40	26.22	457	74.4	6.0	8.6
7/20/1999	3:00:40	26.12	459	69.7	5.6	8.6
7/20/1999	3:30:40	26.03	461	67.3	5.5	8.5
7/20/1999	4:00:40	25.94	461	63	5.1	8.5
7/20/1999	4:30:40	25.83	461	58	4.7	8.5
7/20/1999	5:00:40	25.71	461	54	4.4	8.4
7/20/1999	5:30:40	25.63	462	50.6	4.1	8.4
7/20/1999	6:00:40	25.52	463	47.8	3.9	8.3
7/20/1999	6:30:40	25.42	464	45.3	3.7	8.3
7/20/1999	7:00:40	25.34	464	44.2	3.6	8.3
7/20/1999	7:30:40	25.29	465	44.5	3.7	8.3
7/20/1999	8:00:40	25.22	465	43.6	3.6	8.3
7/20/1999	8:30:40	25.16	465	48.7	4.0	8.3

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/20/1999	9:00:40	25.15	465	54.9	4.5	8.3
7/20/1999	9:30:40	25.13	465	59.1	4.9	8.4
7/20/1999	10:00:40	25.21	465	77.5	6.4	8.6
7/20/1999	10:30:40	25.26	464	79	6.5	8.5
7/20/1999	11:00:40	25.39	463	83.8	6.9	8.6
7/20/1999	11:30:40	25.43	463	92.6	7.6	8.6
7/20/1999	12:00:40	25.56	463	92.8	7.6	8.6
7/20/1999	12:30:40	25.58	463	83.9	6.9	8.5
7/20/1999	13:00:40	25.71	463	111.6	9.1	8.7
7/20/1999	13:30:40	25.79	462	127.1	10.3	8.7
7/20/1999	14:00:40	25.88	460	125.8	10.2	8.7
7/20/1999	14:30:40	25.97	460	125.2	10.2	8.7
7/20/1999	15:00:40	26.1	459	142	11.5	8.8
7/20/1999	15:30:40	26.14	458	127.9	10.3	8.7
7/20/1999	16:00:40	26.24	457	139	11.2	8.7

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7/12/1999	18:30:40	21.4	–	104.4	9.2	8.3
7/12/1999	19:00:40	21.36	–	104.4	9.2	8.3
7/12/1999	19:30:40	21.24	–	103.3	9.2	8.3
7/12/1999	20:00:40	21.1	–	101.7	9.1	8.3
7/12/1999	20:30:40	21.01	–	100.4	9.0	8.3
7/12/1999	21:00:40	20.93	–	99.2	8.9	8.3
7/12/1999	21:30:40	20.86	–	97.5	8.7	8.3
7/12/1999	22:00:40	20.8	–	95.8	8.6	8.3
7/12/1999	22:30:40	20.77	–	95.1	8.5	8.3
7/12/1999	23:00:40	20.73	–	93.1	8.3	8.3
7/12/1999	23:30:40	20.68	–	92.1	8.3	8.3
7/13/1999	0:00:40	20.58	–	90.2	8.1	8.3
7/13/1999	0:30:40	20.5	–	88.3	8.0	8.2
7/13/1999	1:00:40	20.43	–	85.8	7.7	8.2
7/13/1999	1:30:40	20.38	–	84.5	7.6	8.2
7/13/1999	2:00:40	20.32	–	82.1	7.4	8.2
7/13/1999	2:30:40	20.31	–	80.9	7.3	8.2
7/13/1999	3:00:40	20.28	–	78.9	7.1	8.2
7/13/1999	3:30:40	20.22	–	76.9	7.0	8.1
7/13/1999	4:00:40	20.14	–	75.7	6.9	8.1
7/13/1999	4:30:40	20.07	–	73.9	6.7	8.1
7/13/1999	5:00:40	20.02	–	72.5	6.6	8.1
7/13/1999	5:30:40	19.97	–	71.2	6.5	8.1
7/13/1999	6:00:40	19.95	–	70.2	6.4	8.0
7/13/1999	6:30:40	19.94	–	69.5	6.3	8.0
7/13/1999	7:00:40	19.96	–	70.3	6.4	8.0
7/13/1999	7:30:40	19.95	–	71.7	6.5	8.0
7/13/1999	8:00:40	19.85	–	73.8	6.7	8.0
7/13/1999	8:30:40	19.84	–	75.2	6.9	8.0
7/13/1999	9:00:40	19.88	–	79.3	7.2	8.1
7/13/1999	9:30:40	19.97	–	83.2	7.6	8.1
7/13/1999	10:00:40	20.17	–	87.5	7.9	8.1

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/13/1999	10:30:40	20.49	–	93	8.4	8.1
7/13/1999	11:00:40	20.67	–	97.3	8.7	8.2
7/13/1999	11:30:40	21.06	–	103.2	9.2	8.2
7/13/1999	12:00:40	21.37	–	108.6	9.6	8.3
7/13/1999	12:30:40	21.58	480	115.6	10.2	8.3
7/13/1999	13:00:40	21.71	480	119	10.5	8.3
7/13/1999	13:30:40	22.17	479	126.3	11.0	8.4
7/13/1999	14:00:40	22.37	477	130.6	11.3	8.4
7/13/1999	14:30:40	22.72	476	136	11.7	8.5
7/13/1999	15:00:40	22.95	474	141.5	12.1	8.5
7/13/1999	15:30:40	23.02	473	144.8	12.4	8.5
7/13/1999	16:00:40	23.26	472	148.7	12.7	8.6
7/13/1999	16:30:40	23.32	469	150.8	12.8	8.6
7/13/1999	17:00:40	23.46	467	153.6	13.1	8.6
7/13/1999	17:30:40	23.6	465	154.7	13.1	8.7
7/13/1999	18:00:40	23.67	462	155.2	13.1	8.7
7/13/1999	18:30:40	23.63	460	153.3	13.0	8.7
7/13/1999	19:00:40	23.59	459	151.8	12.9	8.7
7/13/1999	19:30:40	23.52	458	148.9	12.6	8.7
7/13/1999	20:00:40	23.47	457	145.4	12.4	8.7
7/13/1999	20:30:40	23.41	455	141.2	12.0	8.7
7/13/1999	21:00:40	23.42	455	138.8	11.8	8.7
7/13/1999	21:30:40	23.44	454	136.8	11.6	8.7
7/13/1999	22:00:40	23.44	453	133.2	11.3	8.7
7/13/1999	22:30:40	23.42	453	130.3	11.1	8.7
7/13/1999	23:00:40	23.34	453	126.6	10.8	8.7
7/13/1999	23:30:40	23.24	454	122	10.4	8.7
7/14/1999	0:00:40	23.15	455	118.7	10.1	8.7
7/14/1999	0:30:40	23.1	456	115.3	9.9	8.7
7/14/1999	1:00:40	23.05	457	111.5	9.5	8.7
7/14/1999	1:30:40	22.99	458	107.5	9.2	8.6
7/14/1999	2:00:40	22.92	460	104.1	8.9	8.6
7/14/1999	2:30:40	22.79	462	99.7	8.6	8.6
7/14/1999	3:00:40	22.68	464	95	8.2	8.6
7/14/1999	3:30:40	22.59	465	91.6	7.9	8.6
7/14/1999	4:00:40	22.53	466	88.1	7.6	8.5
7/14/1999	4:30:40	22.48	467	84.6	7.3	8.5
7/14/1999	5:00:40	22.43	469	82	7.1	8.5
7/14/1999	5:30:40	22.35	471	78.6	6.8	8.4
7/14/1999	6:00:40	22.26	472	75.7	6.6	8.4
7/14/1999	6:30:40	22.15	475	73.6	6.4	8.4
7/14/1999	7:00:40	22.06	476	72.3	6.3	8.3
7/14/1999	7:30:40	22.02	477	71.4	6.2	8.3
7/14/1999	8:00:40	22.02	476	70.8	6.2	8.3
7/14/1999	8:30:40	22	477	71.8	6.3	8.3
7/14/1999	9:00:40	21.98	477	72.9	6.4	8.3
7/14/1999	9:30:40	21.94	477	75.3	6.6	8.3
7/14/1999	10:00:40	21.92	477	78.3	6.8	8.3
7/14/1999	10:30:40	21.94	477	82.2	7.2	8.3
7/14/1999	11:00:40	21.96	477	84.8	7.4	8.3

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/14/1999	11:30:40	22.03	477	89	7.8	8.3
7/14/1999	12:00:40	22.05	476	91.5	8.0	8.3
7/14/1999	12:30:40	22.06	476	95	8.3	8.3
7/14/1999	13:00:40	22.11	477	100	8.7	8.4
7/14/1999	13:30:40	22.35	476	107.9	9.4	8.4
7/14/1999	14:00:40	22.61	476	113.9	9.8	8.4
7/14/1999	14:30:40	22.7	475	120	10.3	8.5
7/14/1999	15:00:40	22.99	473	126.2	10.8	8.5
7/14/1999	15:30:40	23.2	473	131	11.2	8.5
7/14/1999	16:00:40	23.35	473	134.6	11.5	8.5
7/14/1999	16:30:40	23.45	472	139.6	11.9	8.6
7/14/1999	17:00:40	23.48	469	142.8	12.1	8.6
7/14/1999	17:30:40	23.51	470	142.7	12.1	8.6
7/14/1999	18:00:40	23.52	298	150.1	12.7	8.6
7/14/1999	18:30:40	23.5	291	149	12.7	8.6
7/14/1999	19:00:40	23.45	284	148.6	12.6	8.7
7/14/1999	19:30:40	23.32	279	145.7	12.4	8.7
7/14/1999	20:00:40	23.19	274	141.4	12.1	8.7
7/14/1999	20:30:40	23.06	271	136.8	11.7	8.6
7/14/1999	21:00:40	22.97	269	133.3	11.4	8.6
7/14/1999	21:30:40	22.92	267	130.8	11.2	8.7
7/14/1999	22:00:40	22.87	266	128.3	11.0	8.7
7/14/1999	22:30:40	22.84	266	126.4	10.9	8.7
7/14/1999	23:00:40	22.79	267	123.5	10.6	8.7
7/14/1999	23:30:40	22.7	269	120.1	10.4	8.7
7/15/1999	0:00:40	22.57	272	115.8	10.0	8.6
7/15/1999	0:30:40	22.46	276	112.1	9.7	8.6
7/15/1999	1:00:40	22.38	280	108.5	9.4	8.6
7/15/1999	1:30:40	22.32	285	105.4	9.2	8.6
7/15/1999	2:00:40	22.27	290	101.8	8.9	8.6
7/15/1999	2:30:40	22.21	294	97.9	8.5	8.6
7/15/1999	3:00:40	22.15	299	95.4	8.3	8.6
7/15/1999	3:30:40	22.01	304	91.4	8.0	8.5
7/15/1999	4:00:40	21.91	308	88.7	7.8	8.5
7/15/1999	4:30:40	21.83	314	85.8	7.5	8.5
7/15/1999	5:00:40	21.75	318	82.7	7.3	8.5
7/15/1999	5:30:40	21.69	323	80.2	7.1	8.4
7/15/1999	6:00:40	21.63	328	77.4	6.8	8.4
7/15/1999	6:30:40	21.57	333	76.1	6.7	8.4
7/15/1999	7:00:40	21.47	338	75.7	6.7	8.4
7/15/1999	7:30:40	21.37	341	76.5	6.8	8.3
7/15/1999	8:00:40	21.34	344	79	7.0	8.3
7/15/1999	8:30:40	21.36	347	81	7.2	8.3
7/15/1999	9:00:40	21.4	349	83	7.3	8.3
7/15/1999	9:30:40	21.43	351	86.4	7.6	8.3
7/15/1999	10:00:40	21.63	353	98	8.6	8.4
7/15/1999	10:30:40	21.78	354	105.9	9.3	8.4
7/15/1999	11:00:40	22.08	353	112.8	9.8	8.4
7/15/1999	11:30:40	22.37	353	118.9	10.3	8.5
7/15/1999	12:00:40	22.7	351	123.3	10.6	8.5
7/15/1999	12:30:40	23	350	127.4	10.9	8.5

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/15/1999	13:00:40	23.31	348	130.4	11.1	8.6
7/15/1999	13:30:40	23.62	344	135.1	11.4	8.6
7/15/1999	14:00:40	23.92	468	139.3	11.7	8.6
7/15/1999	14:30:40	23.94	467	136.1	11.5	8.6
7/15/1999	15:00:40	24.23	466	145.7	12.2	8.6
7/15/1999	15:30:40	24.42	465	150.5	12.6	8.6
7/15/1999	16:00:40	24.67	462	154.9	12.9	8.7
7/15/1999	16:30:40	24.9	460	158.7	13.1	8.7
7/15/1999	17:00:40	25.01	457	161.9	13.4	8.7
7/15/1999	17:30:40	25.01	454	160.3	13.2	8.7
7/15/1999	18:00:40	25.1	451	161.8	13.3	8.8
7/15/1999	18:30:40	25.13	449	160.7	13.2	8.8
7/15/1999	19:00:40	25.09	447	158.3	13.1	8.8
7/15/1999	19:30:40	25.06	444	155.4	12.8	8.8
7/15/1999	20:00:40	25.03	442	151.4	12.5	8.8
7/15/1999	20:30:40	25.01	442	146.5	12.1	8.8
7/15/1999	21:00:40	25.03	460	143	11.8	8.8
7/15/1999	21:30:40	25.03	460	139.3	11.5	8.8
7/15/1999	22:00:40	25	460	135.6	11.2	8.8
7/15/1999	22:30:40	24.96	460	132.3	10.9	8.8
7/15/1999	23:00:40	24.86	461	127.5	10.6	8.8
7/15/1999	23:30:40	24.77	461	122.7	10.2	8.7
7/16/1999	0:00:40	24.73	461	119.6	9.9	8.7
7/16/1999	0:30:40	24.69	460	113.7	9.4	8.7
7/16/1999	1:00:40	24.64	461	110.7	9.2	8.7
7/16/1999	1:30:40	24.58	461	107.2	8.9	8.7
7/16/1999	2:00:40	24.45	462	102.2	8.5	8.7
7/16/1999	2:30:40	24.35	463	98.3	8.2	8.7
7/16/1999	3:00:40	24.26	464	94.3	7.9	8.6
7/16/1999	3:30:40	24.17	464	90.5	7.6	8.6
7/16/1999	4:00:40	24.06	465	86.2	7.2	8.6
7/16/1999	4:30:40	23.99	466	82.9	7.0	8.6
7/16/1999	5:00:40	23.93	468	79.7	6.7	8.5
7/16/1999	5:30:40	23.85	467	76.1	6.4	8.5
7/16/1999	6:00:40	23.75	467	73.1	6.2	8.5
7/16/1999	6:30:40	23.61	469	71	6.0	8.4
7/16/1999	7:00:40	23.5	469	70.3	6.0	8.4
7/16/1999	7:30:40	23.46	469	71	6.0	8.4
7/16/1999	8:00:40	23.4	470	71.8	6.1	8.4
7/16/1999	8:30:40	23.38	470	73.1	6.2	8.4
7/16/1999	9:00:40	23.42	469	75.4	6.4	8.4
7/16/1999	9:30:40	23.6	469	81	6.9	8.4
7/16/1999	10:00:40	23.79	469	86.5	7.3	8.4
7/16/1999	10:30:40	23.95	468	90.6	7.6	8.4
7/16/1999	11:00:40	24.2	467	96.8	8.1	8.5
7/16/1999	11:30:40	24.64	466	105	8.7	8.5
7/16/1999	12:00:40	24.78	465	109.7	9.1	8.5
7/16/1999	12:30:40	25.04	465	116.4	9.6	8.6
7/16/1999	13:00:40	25.35	464	123.8	10.2	8.6
7/16/1999	13:30:40	25.51	464	129.4	10.6	8.6

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/16/1999	14:00:40	25.76	462	135	11.0	8.6
7/16/1999	14:30:40	25.98	461	141.2	11.5	8.7
7/16/1999	15:00:40	26.04	461	143.7	11.6	8.7
7/16/1999	15:30:40	26.08	459	148	12.0	8.8
7/16/1999	16:00:40	26.34	457	153.9	12.4	8.8
7/16/1999	16:30:40	26.53	457	160.4	12.9	8.8
7/16/1999	17:00:40	26.64	456	165.1	13.2	8.8
7/16/1999	17:30:40	26.72	455	168	13.4 ^a	8.8
7/16/1999	18:00:40	26.77	453	167.8	13.4	8.8
7/16/1999	18:30:40	26.76	451	167.8	13.4	8.8
7/16/1999	19:00:40	26.72	450	163.1	13.1	8.8
7/16/1999	19:30:40	26.65	448	160.6	12.9	8.8
7/16/1999	20:00:40	26.54	447	154.1	12.4	8.8
7/16/1999	20:30:40	26.41	447	148.1	11.9	8.8
7/16/1999	21:00:40	26.28	447	143.8	11.6	8.8
7/16/1999	21:30:40	26.17	447	139.3	11.3	8.8
7/16/1999	22:00:40	26.09	447	136	11.0	8.8
7/16/1999	22:30:40	26.01	447	132.1	10.7	8.8
7/16/1999	23:00:40	25.94	448	128.4	10.4	8.8
7/16/1999	23:30:40	25.87	448	124	10.1	8.8
7/17/1999	0:00:40	25.78	449	119.9	9.8	8.8
7/17/1999	0:30:40	25.64	450	114.6	9.4	8.7
7/17/1999	1:00:40	25.51	452	109.9	9.0	8.7
7/17/1999	1:30:40	25.4	453	104.5	8.6	8.7
7/17/1999	2:00:40	25.3	454	99.7	8.2	8.7
7/17/1999	2:30:40	25.21	455	95.6	7.9	8.7
7/17/1999	3:00:40	25.12	456	91.8	7.6	8.6
7/17/1999	3:30:40	25.04	457	87.5	7.2	8.6
7/17/1999	4:00:40	24.97	459	83.1	6.9	8.6
7/17/1999	4:30:40	24.87	460	79.6	6.6	8.5
7/17/1999	5:00:40	24.71	462	75.4	6.3	8.5
7/17/1999	5:30:40	24.57	464	72.5	6.0	8.5
7/17/1999	6:00:40	24.45	464	69.6	5.8	8.4
7/17/1999	6:30:40	24.35	465	67.7	5.7	8.4
7/17/1999	7:00:40	24.31	466	66.8	5.6	8.4
7/17/1999	7:30:40	24.27	467	68	5.7	8.4
7/17/1999	8:00:40	24.24	466	69.2	5.8	8.4
7/17/1999	8:30:40	24.23	466	71.3	6.0	8.4
7/17/1999	9:00:40	24.22	467	74	6.2	8.4
7/17/1999	9:30:40	24.31	467	79.8	6.7	8.5
7/17/1999	10:00:40	24.46	466	92.7	7.7	8.6
7/17/1999	10:30:40	24.84	464	101	8.4	8.6
7/17/1999	11:00:40	24.99	464	104.4	8.6	8.6
7/17/1999	11:30:40	25.23	463	109.2	9.0	8.6
7/17/1999	12:00:40	25.49	462	112.5	9.2	8.6
7/17/1999	12:30:40	25.68	462	120	9.8	8.6
7/17/1999	13:00:40	25.94	461	126.5	10.3	8.6
7/17/1999	13:30:40	26.11	460	131.7	10.7	8.6
7/17/1999	14:00:40	26.55	458	141.3	11.3	8.7
7/17/1999	14:30:40	26.75	458	143.6	11.5	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (μS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/17/1999	15:00:40	26.98	457	150.1	12.0	8.7
7/17/1999	15:30:40	27.22	456	155.2	12.3	8.7
7/17/1999	16:00:40	27.32	454	160.1	12.7	8.7
7/17/1999	16:30:40	27.4	438	156.3	12.4	8.7
7/17/1999	17:00:40	27.53	435	155.9	12.3	8.7
7/17/1999	17:30:40	27.58	431	157.3	12.4	8.8
7/17/1999	18:00:40	27.5	429	154.3	12.2	8.8
7/17/1999	18:30:40	27.4	427	152	12.0	8.8
7/17/1999	19:00:40	27.32	426	149.7	11.9	8.8
7/17/1999	19:30:40	27.19	424	146.8	11.7	8.8
7/17/1999	20:00:40	27.08	425	143.2	11.4	8.8
7/17/1999	20:30:40	27.01	424	138.6	11.0	8.8
7/17/1999	21:00:40	26.96	423	136.2	10.9	8.8
7/17/1999	21:30:40	26.91	424	133.2	10.6	8.8
7/17/1999	22:00:40	26.84	423	129.5	10.3	8.7
7/17/1999	22:30:40	26.74	424	125.6	10.1	8.7
7/17/1999	23:00:40	26.58	426	121.4	9.7	8.7
7/17/1999	23:30:40	26.46	428	115.9	9.3	8.7
7/18/1999	0:00:40	26.34	429	109.8	8.8	8.7
7/18/1999	0:30:40	26.23	431	104.6	8.4	8.7
7/18/1999	1:00:40	26.18	432	99.8	8.1	8.7
7/18/1999	1:30:40	26.12	434	95.5	7.7	8.6
7/18/1999	2:00:40	26.04	436	91.3	7.4	8.6
7/18/1999	2:30:40	25.9	438	86.4	7.0	8.6
7/18/1999	3:00:40	25.76	441	82.5	6.7	8.6
7/18/1999	3:30:40	25.67	443	79.3	6.5	8.5
7/18/1999	4:00:40	25.56	445	75.1	6.1	8.5
7/18/1999	4:30:40	25.48	445	71.9	5.9	8.5
7/18/1999	5:00:40	25.41	447	68.9	5.7	8.4
7/18/1999	5:30:40	25.33	448	65.6	5.4	8.4
7/18/1999	6:00:40	25.22	448	63.2	5.2	8.4
7/18/1999	6:30:40	25.07	449	60.9	5.0	8.3
7/18/1999	7:00:40	24.98	449	60.1	5.0	8.3
7/18/1999	7:30:40	24.9	453	61.4	5.1	8.3
7/18/1999	8:00:40	24.87	452	63.9	5.3	8.3
7/18/1999	8:30:40	24.89	451	66.2	5.5	8.3
7/18/1999	9:00:40	24.94	453	69.3	5.7	8.3
7/18/1999	9:30:40	24.99	452	73.3	6.1	8.3
7/18/1999	10:00:40	25.04	454	79.2	6.5	8.3
7/18/1999	10:30:40	25.22	454	87.1	7.2	8.4
7/18/1999	11:00:40	25.37	452	94.1	7.7	8.4
7/18/1999	11:30:40	25.6	458	100.5	8.2	8.4
7/18/1999	12:00:40	25.91	456	107.5	8.7	8.5
7/18/1999	12:30:40	26.07	455	113.4	9.2	8.5
7/18/1999	13:00:40	26.41	456	120.8	9.7	8.6
7/18/1999	13:30:40	26.59	455	126.7	10.2	8.6
7/18/1999	14:00:40	26.52	456	125.8	10.1	8.6
7/18/1999	14:30:40	26.61	451	133.1	10.7	8.6
7/18/1999	15:00:40	26.49	454	130.2	10.5	8.6
7/18/1999	15:30:40	26.55	453	132.1	10.6	8.6

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/18/1999	16:00:40	26.59	452	135.9	10.9	8.6
7/18/1999	16:30:40	26.66	450	142.5	11.4	8.7
7/18/1999	17:00:40	26.89	447	152.9	12.2	8.7
7/18/1999	17:30:40	26.96	447	156.2	12.4	8.7
7/18/1999	18:00:40	26.98	445	156.2	12.4	8.8
7/18/1999	18:30:40	26.96	441	155.5	12.4	8.8
7/18/1999	19:00:40	26.91	443	152.5	12.2	8.8
7/18/1999	19:30:40	26.87	445	148.1	11.8	8.8
7/18/1999	20:00:40	26.83	444	145	11.6	8.8
7/18/1999	20:30:40	26.75	445	141.6	11.3	8.8
7/18/1999	21:00:40	26.63	444	136.6	11.0	8.7
7/18/1999	21:30:40	26.53	451	132.2	10.6	8.7
7/18/1999	22:00:40	26.44	446	128.5	10.3	8.7
7/18/1999	22:30:40	26.37	445	125.1	10.1	8.7
7/18/1999	23:00:40	26.29	444	121.5	9.8	8.7
7/18/1999	23:30:40	26.25	445	117.8	9.5	8.7
7/19/1999	0:00:40	26.19	446	113.8	9.2	8.7
7/19/1999	0:30:40	26.08	448	108.6	8.8	8.7
7/19/1999	1:00:40	25.94	451	104.1	8.5	8.7
7/19/1999	1:30:40	25.82	453	99	8.1	8.6
7/19/1999	2:00:40	25.73	453	95.3	7.8	8.6
7/19/1999	2:30:40	25.61	454	91.5	7.5	8.6
7/19/1999	3:00:40	25.54	453	87.8	7.2	8.6
7/19/1999	3:30:40	25.48	454	83.7	6.9	8.6
7/19/1999	4:00:40	25.42	454	79	6.5	8.5
7/19/1999	4:30:40	25.34	454	76	6.2	8.5
7/19/1999	5:00:40	25.24	458	72	5.9	8.5
7/19/1999	5:30:40	25.07	457	68.7	5.7	8.4
7/19/1999	6:00:40	24.95	459	65.9	5.4	8.4
7/19/1999	6:30:40	24.85	460	63.6	5.3	8.3
7/19/1999	7:00:40	24.8	461	62.2	5.2	8.3
7/19/1999	7:30:40	24.77	458	62.5	5.2	8.3
7/19/1999	8:00:40	24.73	458	63.3	5.3	8.3
7/19/1999	8:30:40	24.72	459	65.8	5.5	8.3
7/19/1999	9:00:40	24.65	459	68	5.7	8.3
7/19/1999	9:30:40	24.68	459	71.6	5.9	8.3
7/19/1999	10:00:40	24.8	458	77.7	6.4	8.3
7/19/1999	10:30:40	25.03	457	85.3	7.0	8.4
7/19/1999	11:00:40	25.31	455	93.2	7.7	8.4
7/19/1999	11:30:40	25.65	454	101	8.2	8.5
7/19/1999	12:00:40	25.9	453	108.3	8.8	8.5
7/19/1999	12:30:40	25.91	454	109.1	8.9	8.5
7/19/1999	13:00:40	26.04	452	114.7	9.3	8.5
7/19/1999	13:30:40	26.24	463	132	10.7	8.6
7/19/1999	14:00:40	26.41	463	141.9	11.4	8.7
7/19/1999	14:30:40	26.46	462	142.1	11.4	8.7
7/19/1999	15:00:40	26.81	460	159.5	12.7	8.8
7/19/1999	15:30:40	26.79	460	152.1	12.2	8.7
7/19/1999	16:00:40	26.78	460	148.8	11.9	8.7
7/19/1999	16:30:40	27.01	457	159.8	12.7	8.8

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/19/1999	17:00:40	27.11	456	162.9	12.9	8.8
7/19/1999	17:30:40	27.09	456	162.9	12.9	8.8
7/19/1999	18:00:40	27.05	454	160.6	12.8	8.8
7/19/1999	18:30:40	27.1	453	163.2	13.0	8.8
7/19/1999	19:00:40	27.13	452	161.6	12.8	8.8
7/19/1999	19:30:40	27.05	452	154.3	12.3	8.8
7/19/1999	20:00:40	27.01	452	148.9	11.9	8.8
7/19/1999	20:30:40	26.94	453	144.3	11.5	8.7
7/19/1999	21:00:40	26.83	454	137.6	11.0	8.7
7/19/1999	21:30:40	26.76	453	134.3	10.7	8.7
7/19/1999	22:00:40	26.68	453	129.3	10.4	8.7
7/19/1999	22:30:40	26.61	453	127	10.2	8.7
7/19/1999	23:00:40	26.57	454	122	9.8	8.7
7/19/1999	23:30:40	26.53	454	117.6	9.4	8.7
7/20/1999	0:00:40	26.46	455	113.2	9.1	8.7
7/20/1999	0:30:40	26.34	456	108.5	8.7	8.7
7/20/1999	1:00:40	26.22	458	104.1	8.4	8.6
7/20/1999	1:30:40	26.12	459	99	8.0	8.6
7/20/1999	2:00:40	26.03	460	94.8	7.7	8.6
7/20/1999	2:30:40	25.95	461	90.4	7.3	8.6
7/20/1999	3:00:40	25.89	461	85.2	6.9	8.5
7/20/1999	3:30:40	25.82	462	81.6	6.6	8.5
7/20/1999	4:00:40	25.74	463	77.1	6.3	8.5
7/20/1999	4:30:40	25.63	465	73.9	6.0	8.4
7/20/1999	5:00:40	25.49	466	70.3	5.8	8.4
7/20/1999	5:30:40	25.39	467	67	5.5	8.4
7/20/1999	6:00:40	25.34	468	63.7	5.2	8.3
7/20/1999	6:30:40	25.28	468	61.3	5.0	8.3
7/20/1999	7:00:40	25.23	468	60.4	5.0	8.3
7/20/1999	7:30:40	25.18	468	59.4	4.9	8.3
7/20/1999	8:00:40	25.09	470	57.6	4.8 ^b	8.2
7/20/1999	8:30:40	25.01	470	60.5	5.0	8.2
7/20/1999	9:00:40	25.01	470	67.1	5.5	8.3
7/20/1999	9:30:40	25.03	470	71.5	5.9	8.3
7/20/1999	10:00:40	25.12	468	78.3	6.5	8.4
7/20/1999	10:30:40	25.32	468	85	7.0	8.4
7/20/1999	11:00:40	25.56	467	95.4	7.8	8.5
7/20/1999	11:30:40	25.56	467	96.6	7.9	8.4
7/20/1999	12:00:40	25.68	467	102.8	8.4	8.5
7/20/1999	12:30:40	25.54	467	95.9	7.8	8.5
7/20/1999	13:00:40	25.75	466	112	9.1	8.6
7/20/1999	13:30:40	25.85	465	119.9	9.7	8.6
7/20/1999	14:00:40	25.96	465	125.7	10.2	8.6
7/20/1999	14:30:40	25.97	464	127.8	10.4	8.6
7/20/1999	15:00:40	26.16	463	138.9	11.2	8.7
Site 37						
7/21/1999	10:42:03	26.8	430	72.9	5.8	8.6
7/21/1999	11:00:40	26.93	431	76.1	6.1	8.6
7/21/1999	11:30:40	27.14	431	80.2	6.4	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/21/1999	12:00:40	27.43	430	86.5	6.8	8.7
7/21/1999	12:30:40	27.72	429	92.7	7.3	8.7
7/21/1999	13:00:40	27.93	428	97.6	7.6	8.7
7/21/1999	13:30:40	28.09	427	102.3	8.0	8.7
7/21/1999	14:00:40	28.3	426	108.1	8.4	8.8
7/21/1999	14:30:40	28.54	425	114.3	8.9	8.8
7/21/1999	15:00:40	28.73	424	118.4	9.1	8.8
7/21/1999	15:30:40	28.8	424	119.8	9.2	8.8
7/21/1999	16:00:40	28.81	422	120.8	9.3	8.8
7/21/1999	16:30:40	28.85	422	121.7	9.4	8.8
7/21/1999	17:00:40	28.81	420	121.1	9.3	8.8
7/21/1999	17:30:40	28.7	413	117.8	9.1	8.9
7/21/1999	18:00:40	28.64	411	116.3	9.0	8.9
7/21/1999	18:30:40	28.64	413	115.7	8.9	8.9
7/21/1999	19:00:40	28.59	413	112.1	8.7	8.8
7/21/1999	19:30:40	28.52	413	108.7	8.4	8.8
7/21/1999	20:00:40	28.34	409	103.6	8.1	8.8
7/21/1999	20:30:40	28.1	408	97.3	7.6	8.8
7/21/1999	21:00:40	27.85	407	91.9	7.2	8.8
7/21/1999	21:30:40	27.6	406	87.1	6.9	8.8
7/21/1999	22:00:40	27.36	405	83.1	6.6	8.7
7/21/1999	22:30:40	27.24	409	80.3	6.4	8.7
7/21/1999	23:00:40	27.2	414	78.8	6.3	8.7
7/21/1999	23:30:40	27.15	417	77.6	6.2	8.7
7/22/1999	0:00:40	27.07	420	75.8	6.0	8.7
7/22/1999	0:30:40	26.97	422	73.3	5.8	8.7
7/22/1999	1:00:40	26.87	424	70.3	5.6	8.7
7/22/1999	1:30:40	26.79	425	68.4	5.5	8.7
7/22/1999	2:00:40	26.73	425	67.3	5.4	8.6
7/22/1999	2:30:40	26.68	426	66.8	5.4	8.6
7/22/1999	3:00:40	26.64	426	66.4	5.3	8.6
7/22/1999	3:30:40	26.61	426	66.3	5.3	8.6
7/22/1999	4:00:40	26.58	427	66.2	5.3	8.6
7/22/1999	4:30:40	26.56	427	65.8	5.3	8.6
7/22/1999	5:00:40	26.53	428	65.9	5.3	8.6
7/22/1999	5:30:40	26.5	428	66.1	5.3	8.6
7/22/1999	6:00:40	26.48	428	66	5.3	8.6
7/22/1999	6:30:40	26.46	428	66.5	5.4	8.6
7/22/1999	7:00:40	26.45	429	66.6	5.4	8.6
7/22/1999	7:30:40	26.45	429	66.9	5.4	8.6
7/22/1999	8:00:40	26.46	429	67.5	5.4	8.6
7/22/1999	8:30:40	26.48	429	68.1	5.5	8.6
7/22/1999	9:00:40	26.53	429	69.6	5.6	8.6
7/22/1999	9:30:40	26.66	429	72	5.8	8.6
7/22/1999	10:00:40	26.91	429	75.7	6.0	8.6
7/22/1999	10:30:40	27.18	428	79.8	6.3	8.6
7/22/1999	11:00:40	27.45	427	85.5	6.8	8.6
7/22/1999	11:30:40	27.73	427	91.8	7.2	8.7
7/22/1999	12:00:40	28.17	425	99.6	7.8	8.7
7/22/1999	12:30:40	28.54	424	106.1	8.2	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/22/1999	13:00:40	28.65	423	110	8.5	8.8
7/22/1999	13:30:40	28.74	423	112	8.6	8.8
7/22/1999	14:00:40	28.84	423	113.5	8.8	8.8
7/22/1999	14:30:40	29.03	421	116	8.9	8.8
7/22/1999	15:00:40	29.13	422	114.4	8.8	8.8
7/22/1999	15:30:40	29.28	422	113.7	8.7	8.8
7/22/1999	16:00:40	29.21	422	112.9	8.6	8.8
7/22/1999	16:30:40	29.18	422	110.1	8.4	8.8
7/22/1999	17:00:40	29.2	422	109.5	8.4	8.8
7/22/1999	17:30:40	29.22	422	108.7	8.3	8.8
7/22/1999	18:00:40	29.25	422	109.6	8.4	8.8
7/22/1999	18:30:40	29.27	422	111.6	8.5	8.8
7/22/1999	19:00:40	29.23	422	112.5	8.6	8.8
7/22/1999	19:30:40	29.1	422	111.6	8.6	8.8
7/22/1999	20:00:40	28.95	422	110	8.5	8.8
7/22/1999	20:30:40	28.7	422	107.3	8.3	8.8
7/22/1999	21:00:40	28.43	422	103.7	8.1	8.8
7/22/1999	21:30:40	28.15	423	99	7.7	8.8
7/22/1999	22:00:40	27.94	425	94.2	7.4	8.8
7/22/1999	22:30:40	27.75	425	89.8	7.1	8.7
7/22/1999	23:00:40	27.59	426	85.3	6.7	8.7
7/22/1999	23:30:40	27.45	427	79.7	6.3	8.7
7/23/1999	0:00:40	27.38	428	74.7	5.9	8.6
7/23/1999	0:30:40	27.39	429	71	5.6	8.6
7/23/1999	1:00:40	27.43	429	69.8	5.5	8.6
7/23/1999	1:30:40	27.48	429	67.9	5.4	8.6
7/23/1999	2:00:40	27.51	430	66.7	5.3	8.6
7/23/1999	2:30:40	27.5	431	66.2	5.2	8.6
7/23/1999	3:00:40	27.46	431	65.9	5.2	8.6
7/23/1999	3:30:40	27.4	432	65.9	5.2	8.5
7/23/1999	4:00:40	27.35	432	65.8	5.2	8.5
7/23/1999	4:30:40	27.29	432	65.8	5.2	8.5
7/23/1999	5:00:40	27.22	432	65.7	5.2	8.5
7/23/1999	5:30:40	27.15	433	65.3	5.2	8.5
7/23/1999	6:00:40	27.08	433	65.3	5.2	8.5
7/23/1999	6:30:40	27.01	433	65.2	5.2	8.5
7/23/1999	7:00:40	26.96	433	65.5	5.2	8.5
7/23/1999	7:30:40	26.94	434	65.8	5.2	8.5
7/23/1999	8:00:40	26.93	434	66.1	5.3	8.5
7/23/1999	8:30:40	26.96	434	67.3	5.4	8.5
7/23/1999	9:00:40	27.03	434	67.7	5.4	8.5
7/23/1999	9:30:40	27.18	433	70.5	5.6	8.5
7/23/1999	10:00:40	27.39	433	75.5	6.0	8.5
7/23/1999	10:30:40	27.59	433	77.5	6.1	8.5
7/23/1999	11:00:40	27.83	432	82	6.4	8.5
7/23/1999	11:30:40	28.17	432	87.3	6.8	8.5
7/23/1999	12:00:40	28.49	431	91.7	7.1	8.6
7/23/1999	12:30:40	28.94	431	98.1	7.6	8.6
7/23/1999	13:00:40	29.33	430	103.8	7.9	8.6
7/23/1999	13:30:40	29.72	429	109.9	8.3	8.6

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/23/1999	14:00:40	30.08	429	115	8.7	8.7
7/23/1999	14:30:40	30.22	428	117.4	8.8	8.7
7/23/1999	15:00:40	30.48	428	121.1	9.1	8.7
7/23/1999	15:30:40	30.58	427	123.2	9.2	8.7
7/23/1999	16:00:40	30.92	427	127.6	9.5	8.7
7/23/1999	16:30:40	31.03	427	129	9.6	8.7
7/23/1999	17:00:40	31.07	426	129.1	9.6	8.8
7/23/1999	17:30:40	31.12	426	130.9	9.7	8.8
7/23/1999	18:00:40	31.07	426	130.2	9.7	8.8
7/23/1999	18:30:40	30.95	426	128.2	9.5	8.8
7/23/1999	19:00:40	30.84	426	126.5	9.4	8.8
7/23/1999	19:30:40	30.72	426	123.5	9.2	8.8
7/23/1999	20:00:40	30.55	426	121.4	9.1	8.8
7/23/1999	20:30:40	30.33	426	118.7	8.9	8.8
7/23/1999	21:00:40	30.04	426	115.5	8.7	8.8
7/23/1999	21:30:40	29.82	426	111.3	8.4	8.7
7/23/1999	22:00:40	29.64	427	105.2	8.0	8.7
7/23/1999	22:30:40	29.44	427	98.4	7.5	8.7
7/23/1999	23:00:40	29.26	428	92.9	7.1	8.7
7/23/1999	23:30:40	29.08	429	85.8	6.6	8.7
7/24/1999	0:00:40	28.91	430	82.2	6.3	8.6
7/24/1999	0:30:40	28.73	431	77.3	6.0	8.6
7/24/1999	1:00:40	28.56	432	72.3	5.6	8.6
7/24/1999	1:30:40	28.38	432	68.9	5.4	8.6
7/24/1999	2:00:40	28.22	433	64.2	5.0	8.5
7/24/1999	2:30:40	28.05	434	63.2	4.9	8.5
7/24/1999	3:00:40	27.88	434	62.1	4.9	8.5
7/24/1999	3:30:40	27.7	435	61.3	4.8	8.5
7/24/1999	4:00:40	27.54	435	61.2	4.8	8.4
7/24/1999	4:30:40	27.4	435	61.6	4.9	8.4
7/24/1999	5:00:40	27.29	435	61.5	4.9	8.4
7/24/1999	5:30:40	27.2	435	61.3	4.9	8.4
7/24/1999	6:00:40	27.12	435	61.2	4.9	8.4
7/24/1999	6:30:40	27.07	434	60.7	4.8	8.4
7/24/1999	7:00:40	27.01	435	61.1	4.9	8.4
7/24/1999	7:30:40	26.99	435	61.6	4.9	8.4
7/24/1999	8:00:40	26.99	434	62.6	5.0	8.4
7/24/1999	8:30:40	27.01	435	63.8	5.1	8.4
7/24/1999	9:00:40	27.08	434	65.7	5.2	8.4
7/24/1999	9:30:40	27.21	434	67.7	5.4	8.4
7/24/1999	10:00:40	27.37	434	70.9	5.6	8.4
7/24/1999	10:30:40	27.52	434	72	5.7	8.4
7/24/1999	11:00:40	27.73	433	76.2	6.0	8.4
7/24/1999	11:30:40	27.85	433	78.7	6.2	8.4
7/24/1999	12:00:40	27.97	432	82.9	6.5	8.5
7/24/1999	12:30:40	28.08	432	87.2	6.8	8.5
7/24/1999	13:00:40	28.19	431	91.2	7.1	8.5
7/24/1999	13:30:40	28.48	430	98.9	7.7	8.5
7/24/1999	14:00:40	28.96	428	106.8	8.2	8.6
7/24/1999	14:30:40	29.19	427	111.1	8.5	8.6

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/24/1999	15:00:40	29.35	427	113.3	8.7	8.6
7/24/1999	15:30:40	29.48	427	114.8	8.8	8.7
7/24/1999	16:00:40	29.61	426	116.5	8.9	8.7
7/24/1999	16:30:40	29.7	426	117.7	8.9	8.7
7/24/1999	17:00:40	29.76	426	118.8	9.0	8.7
7/24/1999	17:30:40	29.78	425	121.1	9.2	8.7
7/24/1999	18:00:40	29.83	425	122.5	9.3	8.7
7/24/1999	18:30:40	29.86	425	123.1	9.3	8.7
7/24/1999	19:00:40	29.85	424	122.9	9.3	8.7
7/24/1999	19:30:40	29.76	425	120.1	9.1	8.7
7/24/1999	20:00:40	29.65	425	116.9	8.9	8.7
7/24/1999	20:30:40	29.52	425	112.2	8.5	8.7
7/24/1999	21:00:40	29.37	425	109	8.3	8.7
7/24/1999	21:30:40	29.21	425	104.4	8.0	8.7
7/24/1999	22:00:40	28.97	426	98.6	7.6	8.7
7/24/1999	22:30:40	28.71	427	92.7	7.2	8.7
7/24/1999	23:00:40	28.43	428	86.2	6.7	8.6
7/24/1999	23:30:40	28.21	429	81.3	6.3	8.6
7/25/1999	0:00:40	28.02	430	76.4	6.0	8.6
7/25/1999	0:30:40	27.9	431	73.2	5.7	8.5
7/25/1999	1:00:40	27.79	431	70.8	5.6	8.5
7/25/1999	1:30:40	27.7	432	67.8	5.3	8.5
7/25/1999	2:00:40	27.61	432	65.5	5.2	8.5
7/25/1999	2:30:40	27.55	432	63.7	5.0	8.5
7/25/1999	3:00:40	27.48	433	62.5	4.9	8.4
7/25/1999	3:30:40	27.41	433	61.9	4.9	8.4
7/25/1999	4:00:40	27.36	434	61.3	4.9	8.4
7/25/1999	4:30:40	27.3	434	61	4.8	8.4
7/25/1999	5:00:40	27.24	434	61.2	4.9	8.4
7/25/1999	5:30:40	27.18	434	61.1	4.9	8.4
7/25/1999	6:00:40	27.12	434	61.1	4.9	8.4
7/25/1999	6:30:40	27.06	434	61.7	4.9	8.4
7/25/1999	7:00:40	27	434	62	4.9	8.4
7/25/1999	7:30:40	26.96	434	62.4	5.0	8.4
7/25/1999	8:00:40	26.95	434	62.5	5.0	8.4
7/25/1999	8:30:40	26.99	434	64.4	5.1	8.4
7/25/1999	9:00:40	27.03	434	65	5.2	8.4
7/25/1999	9:30:40	27.18	434	67.2	5.3	8.4
7/25/1999	10:00:40	27.41	434	72.5	5.7	8.4
7/25/1999	10:30:40	27.57	434	74.9	5.9	8.4
7/25/1999	11:00:40	27.77	434	78	6.1	8.4
7/25/1999	11:30:40	28.08	434	82.9	6.5	8.5
7/25/1999	12:00:40	28.38	433	86.8	6.8	8.5
7/25/1999	12:30:40	28.56	433	90.3	7.0	8.5
7/25/1999	13:00:40	28.85	432	96.4	7.4	8.5
7/25/1999	13:30:40	29.11	430	103.5	7.9	8.6
7/25/1999	14:00:40	29.52	430	110.4	8.4	8.6
7/25/1999	14:30:40	29.8	429	115.8	8.8	8.6
7/25/1999	15:00:40	29.77	428	116.7	8.9	8.7
7/25/1999	15:30:40	29.9	428	118.5	9.0	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/25/1999	16:00:40	30	428	121.4	9.2	8.7
7/25/1999	16:30:40	30.12	427	124.9	9.4	8.7
7/25/1999	17:00:40	30.16	427	125.6	9.5	8.7
7/25/1999	17:30:40	30.14	426	125.5	9.5	8.7
7/25/1999	18:00:40	30.14	426	127.2	9.6	8.7
7/25/1999	18:30:40	30.11	426	127.1	9.6	8.7
7/25/1999	19:00:40	30.12	426	127.1	9.6	8.8
7/25/1999	19:30:40	30.11	425	127	9.6	8.8
7/25/1999	20:00:40	30.12	425	127.4	9.6	8.8
7/25/1999	20:30:40	30.07	425	126.7	9.6	8.8
7/25/1999	21:00:40	29.91	425	124.3	9.4	8.8
7/25/1999	21:30:40	29.68	426	120.1	9.1	8.8
7/25/1999	22:00:40	29.45	426	114.2	8.7	8.8
7/25/1999	22:30:40	29.23	427	108.7	8.3	8.7
7/25/1999	23:00:40	28.99	428	102.7	7.9	8.7
7/25/1999	23:30:40	28.77	429	96.1	7.4	8.7
7/26/1999	0:00:40	28.57	430	90.1	7.0	8.7
7/26/1999	0:30:40	28.38	431	84.2	6.5	8.6
7/26/1999	1:00:40	28.21	433	78.1	6.1	8.6
7/26/1999	1:30:40	28.07	434	72.7	5.7	8.6
7/26/1999	2:00:40	27.94	435	68.2	5.3	8.5
7/26/1999	2:30:40	27.84	436	64.6	5.1	8.5
7/26/1999	3:00:40	27.73	437	62.8	4.9	8.5
7/26/1999	3:30:40	27.61	437	61.6	4.9	8.5
7/26/1999	4:00:40	27.5	438	60.7	4.8	8.5
7/26/1999	4:30:40	27.38	438	60.5	4.8	8.4
7/26/1999	5:00:40	27.27	440	60.3	4.8	8.4
7/26/1999	5:30:40	27.17	438	60.1	4.8	8.4
7/26/1999	6:00:40	27.07	438	60	4.8	8.4
7/26/1999	6:30:40	26.98	438	59.7	4.8	8.4
7/26/1999	7:00:40	26.91	438	59.4	4.7 ^b	8.4
7/26/1999	7:30:40	26.84	438	60.7	4.8	8.4
7/26/1999	8:00:40	26.79	437	61.5	4.9	8.4
7/26/1999	8:30:40	26.79	437	62.4	5.0	8.4
7/26/1999	9:00:40	26.79	437	62.8	5.0	8.4
7/26/1999	9:30:40	26.83	437	63.4	5.1	8.4
7/26/1999	10:00:40	26.85	437	64.5	5.2	8.4
7/26/1999	10:30:40	26.88	437	66.8	5.3	8.4
7/26/1999	11:00:40	27.07	437	70.5	5.6	8.4
7/26/1999	11:30:40	27.29	437	74.8	5.9	8.4
7/26/1999	12:00:40	27.57	436	79.1	6.2	8.4
7/26/1999	12:30:40	27.81	436	83.2	6.5	8.5
7/26/1999	13:00:40	28.07	435	88.1	6.9	8.5
7/26/1999	13:30:40	28.35	434	94.4	7.3	8.5
7/26/1999	14:00:40	28.52	433	99.3	7.7	8.6
7/26/1999	14:30:40	28.73	432	105.1	8.1	8.6
7/26/1999	15:00:40	29	431	109.3	8.4	8.6
7/26/1999	15:30:40	29.24	430	115.3	8.8	8.6
7/26/1999	16:00:40	29.5	429	119.1	9.1	8.7
7/26/1999	16:30:40	29.74	428	124	9.4	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/26/1999	17:00:40	29.92	427	127.5	9.6	8.7
7/26/1999	17:30:40	30.04	426	130.2	9.8	8.8
7/26/1999	18:00:40	30.14	426	132.4	10.0	8.8
7/26/1999	18:30:40	30.12	425	132.9	10.0 ^a	8.8
7/26/1999	19:00:40	30.09	425	132.5	10.0	8.8
7/26/1999	19:30:40	30.02	424	131.5	9.9	8.8
7/26/1999	20:00:40	29.9	424	129.9	9.8	8.8
7/26/1999	20:30:40	29.72	424	128	9.7	8.8
7/26/1999	21:00:40	29.51	423	125.6	9.6	8.8
7/26/1999	21:30:40	29.34	423	123	9.4	8.8
7/26/1999	22:00:40	29.13	424	118.8	9.1	8.8
7/26/1999	22:30:40	28.9	425	113.7	8.8	8.8
7/26/1999	23:00:40	28.63	425	107.8	8.3	8.8
7/26/1999	23:30:40	28.37	426	102.1	7.9	8.8
7/27/1999	0:00:40	28.11	427	96.2	7.5	8.8
7/27/1999	0:30:40	27.88	428	90.2	7.1	8.7
7/27/1999	1:00:40	27.65	429	84.1	6.6	8.7
7/27/1999	1:30:40	27.46	429	78.8	6.2	8.7
7/27/1999	2:00:40	27.27	430	73.1	5.8	8.7
7/27/1999	2:30:40	27.1	432	68.4	5.4	8.6
7/27/1999	3:00:40	26.97	433	65.2	5.2	8.6
7/27/1999	3:30:40	26.85	433	62.7	5.0	8.6
7/27/1999	4:00:40	26.77	434	61.3	4.9	8.5
7/27/1999	4:30:40	26.69	434	60.5	4.9	8.5
7/27/1999	5:00:40	26.61	434	60	4.8	8.5
7/27/1999	5:30:40	26.56	434	59.6	4.8	8.5
7/27/1999	6:00:40	26.5	434	59.4	4.8	8.5
7/27/1999	6:30:40	26.45	434	59	4.8	8.5
7/27/1999	7:00:40	26.43	434	59.2	4.8	8.5
7/27/1999	7:30:40	26.4	434	59.2	4.8	8.5
7/27/1999	8:00:40	26.38	435	59.4	4.8	8.5
7/27/1999	8:30:40	26.37	435	59.7	4.8	8.5
7/27/1999	9:00:40	26.39	435	60.4	4.9	8.5
Site 38						
7/21/1999	11:30:40	27.11	441	83.4	6.6	8.6
7/21/1999	12:00:40	27.5	439	89.5	7.1	8.7
7/21/1999	12:30:40	27.75	438	94.2	7.4	8.7
7/21/1999	13:00:40	27.95	438	98.4	7.7	8.7
7/21/1999	13:30:40	28	437	100.9	7.9	8.7
7/21/1999	14:00:40	28.17	438	104.8	8.2	8.7
7/21/1999	14:30:40	28.44	434	111.2	8.6	8.8
7/21/1999	15:00:40	28.55	434	113.5	8.8	8.8
7/21/1999	15:30:40	28.51	434	109.2	8.5	8.8
7/21/1999	16:00:40	28.5	435	110.3	8.6	8.8
7/21/1999	16:30:40	28.6	431	112.8	8.7	8.8
7/21/1999	17:00:40	28.31	431	106.7	8.3	8.8
7/21/1999	17:30:40	28.18	428	106.2	8.3	8.8
7/21/1999	18:00:40	28.19	428	107	8.3	8.8
7/21/1999	18:30:40	26.75	502	94.3	7.5	8.5

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/21/1999	19:00:40	26.96	389	93.4	7.4	8.6
7/21/1999	19:30:40	27.15	349	94.4	7.5	8.7
7/21/1999	20:00:40	27.33	373	94.4	7.5	8.7
7/21/1999	20:30:40	27.43	386	91.8	7.3	8.7
7/21/1999	21:00:40	27.39	389	88	7.0	8.7
7/21/1999	21:30:40	27.3	391	84.1	6.7	8.7
7/21/1999	22:00:40	27.14	392	80.6	6.4	8.7
7/21/1999	22:30:40	27.01	396	78.3	6.2	8.7
7/21/1999	23:00:40	26.95	399	76	6.1	8.7
7/21/1999	23:30:40	26.93	404	75.1	6.0	8.7
7/22/1999	0:00:40	26.86	407	73.8	5.9	8.7
7/22/1999	0:30:40	26.8	410	72.1	5.8	8.7
7/22/1999	1:00:40	26.73	412	70.2	5.6	8.6
7/22/1999	1:30:40	26.66	413	68.3	5.5	8.6
7/22/1999	2:00:40	26.6	413	67	5.4	8.6
7/22/1999	2:30:40	26.55	414	66.3	5.3	8.6
7/22/1999	3:00:40	26.51	415	65.9	5.3	8.6
7/22/1999	3:30:40	26.48	415	65.5	5.3	8.6
7/22/1999	4:00:40	26.44	415	65.4	5.3	8.6
7/22/1999	4:30:40	26.41	416	65.2	5.3	8.6
7/22/1999	5:00:40	26.38	416	65.2	5.2	8.6
7/22/1999	5:30:40	26.36	416	65.3	5.3	8.6
7/22/1999	6:00:40	26.32	420	65.3	5.3	8.6
7/22/1999	6:30:40	26.3	417	65.8	5.3	8.6
7/22/1999	7:00:40	26.31	418	66.5	5.4	8.6
7/22/1999	7:30:40	26.29	428	67.2	5.4	8.5
7/22/1999	8:00:40	26.32	424	68.3	5.5	8.6
7/22/1999	8:30:40	26.37	423	69.7	5.6	8.6
7/22/1999	9:00:40	26.46	423	72	5.8	8.6
7/22/1999	9:30:40	26.66	424	74.9	6.0	8.6
7/22/1999	10:00:40	26.95	422	77.8	6.2	8.6
7/22/1999	10:30:40	27.26	420	81.2	6.4	8.6
7/22/1999	11:00:40	27.6	416	86.1	6.8	8.6
7/22/1999	11:30:40	27.86	421	91.6	7.2	8.6
7/22/1999	12:00:40	28.2	420	97.3	7.6	8.7
7/22/1999	12:30:40	28.49	418	102.2	7.9	8.7
7/22/1999	13:00:40	28.64	419	105.8	8.2	8.7
7/22/1999	13:30:40	28.7	417	108	8.3	8.7
7/22/1999	14:00:40	28.78	418	108.9	8.4	8.8
7/22/1999	14:30:40	29.02	415	112.6	8.7	8.8
7/22/1999	15:00:40	29.12	415	112.6	8.6	8.8
7/22/1999	15:30:40	29.24	415	112.4	8.6	8.8
7/22/1999	16:00:40	29.24	415	112	8.6	8.8
7/22/1999	16:30:40	29.17	415	109.4	8.4	8.8
7/22/1999	17:00:40	29.14	415	107.9	8.3	8.8
7/22/1999	17:30:40	29.13	415	106.8	8.2	8.8
7/22/1999	18:00:40	29.14	415	106	8.1	8.8
7/22/1999	18:30:40	29.14	415	106.6	8.2	8.8
7/22/1999	19:00:40	29.12	415	107.2	8.2	8.8
7/22/1999	19:30:40	29.06	416	106.6	8.2	8.8
7/22/1999	20:00:40	28.9	417	103.6	8.0	8.8

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/22/1999	20:30:40	28.71	418	101.3	7.8	8.8
7/22/1999	21:00:40	28.47	418	98.8	7.7	8.8
7/22/1999	21:30:40	28.22	418	95.2	7.4	8.8
7/22/1999	22:00:40	27.98	420	91.5	7.2	8.7
7/22/1999	22:30:40	27.78	421	87.8	6.9	8.7
7/22/1999	23:00:40	27.6	422	83.7	6.6	8.7
7/22/1999	23:30:40	27.46	423	80	6.3	8.7
7/23/1999	0:00:40	27.34	424	76.1	6.0	8.6
7/23/1999	0:30:40	27.28	424	72.2	5.7	8.6
7/23/1999	1:00:40	27.29	424	70.1	5.6	8.6
7/23/1999	1:30:40	27.31	427	68.4	5.4	8.6
7/23/1999	2:00:40	27.34	424	67	5.3	8.6
7/23/1999	2:30:40	27.33	425	66.4	5.3	8.6
7/23/1999	3:00:40	27.3	425	66.4	5.3	8.5
7/23/1999	3:30:40	27.25	427	66.1	5.2	8.5
7/23/1999	4:00:40	27.2	426	65.9	5.2	8.5
7/23/1999	4:30:40	27.14	427	66	5.2	8.5
7/23/1999	5:00:40	27.07	427	65.9	5.2	8.5
7/23/1999	5:30:40	26.99	428	66.1	5.3	8.5
7/23/1999	6:00:40	26.93	428	65.9	5.3	8.5
7/23/1999	6:30:40	26.87	428	66	5.3	8.5
7/23/1999	7:00:40	26.82	429	67	5.4	8.5
7/23/1999	7:30:40	26.8	430	68	5.4	8.5
7/23/1999	8:00:40	26.8	432	69.1	5.5	8.5
7/23/1999	8:30:40	26.87	432	70.7	5.6	8.5
7/23/1999	9:00:40	26.98	436	73	5.8	8.5
7/23/1999	9:30:40	27.2	435	75.9	6.0	8.5
7/23/1999	10:00:40	27.48	435	79.9	6.3	8.5
7/23/1999	10:30:40	27.74	435	83.3	6.5	8.5
7/23/1999	11:00:40	28.01	435	86.8	6.8	8.5
7/23/1999	11:30:40	28.33	435	91	7.1	8.6
7/23/1999	12:00:40	28.62	436	95	7.4	8.6
7/23/1999	12:30:40	28.99	434	99.8	7.7	8.6
7/23/1999	13:00:40	29.32	434	104.4	8.0	8.6
7/23/1999	13:30:40	29.59	433	107.8	8.2	8.6
7/23/1999	14:00:40	29.87	434	112.1	8.5	8.7
7/23/1999	14:30:40	30.04	434	114.8	8.7	8.7
7/23/1999	15:00:40	30.26	432	117.8	8.9	8.7
7/23/1999	15:30:40	30.46	429	120.4	9.0	8.7
7/23/1999	16:00:40	30.57	431	122.4	9.2	8.7
7/23/1999	16:30:40	30.78	428	124.6	9.3	8.7
7/23/1999	17:00:40	30.8	428	123.8	9.2	8.7
7/23/1999	17:30:40	30.91	426	124.7	9.3	8.8
7/23/1999	18:00:40	30.83	425	123.4	9.2	8.8
7/23/1999	18:30:40	30.76	423	121.6	9.1	8.8
7/23/1999	19:00:40	30.65	422	119.2	8.9	8.7
7/23/1999	19:30:40	30.54	422	116.7	8.7	8.7
7/23/1999	20:00:40	30.39	422	113.8	8.5	8.7
7/23/1999	20:30:40	30.22	422	110.3	8.3	8.7
7/23/1999	21:00:40	30	420	107.8	8.1	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/23/1999	21:30:40	29.77	420	104	7.9	8.7
7/23/1999	22:00:40	29.55	420	100.4	7.6	8.7
7/23/1999	22:30:40	29.36	422	96	7.3	8.7
7/23/1999	23:00:40	29.18	424	91.4	7.0	8.7
7/23/1999	23:30:40	28.99	426	85.7	6.6	8.6
7/24/1999	0:00:40	28.83	427	81.2	6.3	8.6
7/24/1999	0:30:40	28.66	428	78	6.0	8.6
7/24/1999	1:00:40	28.5	428	74.2	5.8	8.6
7/24/1999	1:30:40	28.33	429	70.8	5.5	8.5
7/24/1999	2:00:40	28.18	429	67.9	5.3	8.5
7/24/1999	2:30:40	28.01	430	65.7	5.1	8.5
7/24/1999	3:00:40	27.85	431	64.1	5.0	8.5
7/24/1999	3:30:40	27.69	430	62.9	5.0	8.4
7/24/1999	4:00:40	27.51	431	62.4	4.9 ^b	8.4
7/24/1999	4:30:40	27.34	431	62.4	4.9	8.4
7/24/1999	5:00:40	27.2	432	62.3	4.9	8.4
7/24/1999	5:30:40	27.09	432	62.3	5.0	8.4
7/24/1999	6:00:40	27	432	62.2	5.0	8.4
7/24/1999	6:30:40	26.92	432	62.3	5.0	8.4
7/24/1999	7:00:40	26.88	431	63.3	5.1	8.4
7/24/1999	7:30:40	26.84	432	63.6	5.1	8.3
7/24/1999	8:00:40	26.85	434	65.8	5.3	8.4
7/24/1999	8:30:40	26.88	434	68.1	5.4	8.4
7/24/1999	9:00:40	27.04	436	71.8	5.7	8.4
7/24/1999	9:30:40	27.15	437	73.7	5.9	8.4
7/24/1999	10:00:40	27.36	437	77.1	6.1	8.4
7/24/1999	10:30:40	27.5	438	79.2	6.3	8.4
7/24/1999	11:00:40	27.72	438	81.7	6.4	8.4
7/24/1999	11:30:40	27.74	440	80.3	6.3	8.4
7/24/1999	12:00:40	27.79	439	83.8	6.6	8.4
7/24/1999	12:30:40	28.03	437	91.4	7.1	8.5
7/24/1999	13:00:40	28.03	436	91.5	7.2	8.5
7/24/1999	13:30:40	28.31	438	98.9	7.7	8.5
7/24/1999	14:00:40	28.79	433	106.4	8.2	8.6
7/24/1999	14:30:40	29.11	433	110.9	8.5	8.6
7/24/1999	15:00:40	29.27	433	113.7	8.7	8.6
7/24/1999	15:30:40	29.39	432	115	8.8	8.7
7/24/1999	16:00:40	29.41	431	113.7	8.7	8.7
7/24/1999	16:30:40	29.49	430	113.2	8.6	8.7
7/24/1999	17:00:40	29.5	430	112.7	8.6	8.7
7/24/1999	17:30:40	29.5	431	114.1	8.7	8.7
7/24/1999	18:00:40	29.5	431	112.9	8.6	8.7
7/24/1999	18:30:40	29.54	431	114.1	8.7	8.7
7/24/1999	19:00:40	29.54	430	116.1	8.8	8.7
7/24/1999	19:30:40	29.42	432	112.4	8.6	8.7
7/24/1999	20:00:40	29.33	431	110	8.4	8.7
7/24/1999	20:30:40	29.21	431	106.1	8.1	8.7
7/24/1999	21:00:40	29.09	430	103.1	7.9	8.7
7/24/1999	21:30:40	28.97	431	100.3	7.7	8.7
7/24/1999	22:00:40	28.8	433	96.1	7.4	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/24/1999	22:30:40	28.59	433	91.5	7.1	8.6
7/24/1999	23:00:40	28.35	434	86.6	6.7	8.6
7/24/1999	23:30:40	28.13	433	82	6.4	8.6
7/25/1999	0:00:40	27.94	433	78.1	6.1	8.5
7/25/1999	0:30:40	27.77	434	74.9	5.9	8.5
7/25/1999	1:00:40	27.63	435	72.3	5.7	8.5
7/25/1999	1:30:40	27.54	433	70.1	5.5	8.5
7/25/1999	2:00:40	27.43	433	67.9	5.4	8.5
7/25/1999	2:30:40	27.35	432	66	5.2	8.5
7/25/1999	3:00:40	27.27	433	64.9	5.1	8.4
7/25/1999	3:30:40	27.21	432	63.9	5.1	8.4
7/25/1999	4:00:40	27.13	432	63.4	5.0	8.4
7/25/1999	4:30:40	27.08	430	63	5.0	8.4
7/25/1999	5:00:40	27.02	431	62.8	5.0	8.4
7/25/1999	5:30:40	26.95	432	62.8	5.0	8.4
7/25/1999	6:00:40	26.89	432	63	5.0	8.4
7/25/1999	6:30:40	26.84	431	63.4	5.1	8.4
7/25/1999	7:00:40	26.79	432	64.4	5.2	8.4
7/25/1999	7:30:40	26.75	432	65.3	5.2	8.4
7/25/1999	8:00:40	26.75	432	66.6	5.3	8.4
7/25/1999	8:30:40	26.82	435	68.9	5.5	8.4
7/25/1999	9:00:40	26.93	437	71.6	5.7	8.4
7/25/1999	9:30:40	27.12	437	74.9	6.0	8.4
7/25/1999	10:00:40	27.42	439	79.5	6.3	8.4
7/25/1999	10:30:40	27.65	440	82.5	6.5	8.4
7/25/1999	11:00:40	27.86	438	85.4	6.7	8.5
7/25/1999	11:30:40	28.18	440	89.5	7.0	8.5
7/25/1999	12:00:40	28.31	439	90.9	7.1	8.5
7/25/1999	12:30:40	28.45	439	93.8	7.3	8.5
7/25/1999	13:00:40	28.7	438	98.1	7.6	8.5
7/25/1999	13:30:40	28.97	436	103	7.9	8.6
7/25/1999	14:00:40	29.29	434	109.2	8.4	8.6
7/25/1999	14:30:40	29.53	438	113.9	8.7	8.6
7/25/1999	15:00:40	29.57	434	115.7	8.8	8.6
7/25/1999	15:30:40	29.71	433	118.1	9.0	8.7
7/25/1999	16:00:40	29.81	433	119.5	9.1	8.7
7/25/1999	16:30:40	29.86	431	120.6	9.1	8.7
7/25/1999	17:00:40	29.89	429	121.6	9.2	8.7
7/25/1999	17:30:40	29.81	429	121.1	9.2	8.7
7/25/1999	18:00:40	29.77	424	120.4	9.1	8.7
7/25/1999	18:30:40	29.73	431	119.5	9.1	8.7
7/25/1999	19:00:40	29.73	431	118.4	9.0	8.7
7/25/1999	19:30:40	29.71	430	117	8.9	8.7
7/25/1999	20:00:40	29.72	431	116.3	8.8	8.7
7/25/1999	20:30:40	29.68	431	115.5	8.8	8.7
7/25/1999	21:00:40	29.57	434	114	8.7	8.7
7/25/1999	21:30:40	29.43	431	111.5	8.5	8.7
7/25/1999	22:00:40	29.26	430	107.8	8.2	8.7
7/25/1999	22:30:40	29.02	432	103.2	7.9	8.7
7/25/1999	23:00:40	28.83	431	99.1	7.6	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/25/1999	23:30:40	28.57	434	94.4	7.3	8.7
7/26/1999	0:00:40	28.41	431	89.3	6.9	8.6
7/26/1999	0:30:40	28.21	433	85.1	6.6	8.6
7/26/1999	1:00:40	28.05	432	80.7	6.3	8.6
7/26/1999	1:30:40	27.9	431	76	6.0	8.6
7/26/1999	2:00:40	27.75	432	72.4	5.7	8.5
7/26/1999	2:30:40	27.62	433	68.5	5.4	8.5
7/26/1999	3:00:40	27.49	433	66.1	5.2	8.5
7/26/1999	3:30:40	27.37	434	64.3	5.1	8.4
7/26/1999	4:00:40	27.27	433	63	5.0	8.4
7/26/1999	4:30:40	27.15	434	62.5	5.0	8.4
7/26/1999	5:00:40	27.02	434	62.3	5.0	8.4
7/26/1999	5:30:40	26.92	435	62.3	5.0	8.4
7/26/1999	6:00:40	26.81	435	62.4	5.0	8.4
7/26/1999	6:30:40	26.73	436	62.1	5.0	8.4
7/26/1999	7:00:40	26.65	436	62.9	5.0	8.4
7/26/1999	7:30:40	26.58	437	64.4	5.2	8.4
7/26/1999	8:00:40	26.55	439	66.2	5.3	8.4
7/26/1999	8:30:40	26.54	440	67.7	5.4	8.4
7/26/1999	9:00:40	26.56	442	68.5	5.5	8.4
7/26/1999	9:30:40	26.65	440	70.7	5.7	8.4
7/26/1999	10:00:40	26.67	442	71.3	5.7	8.4
7/26/1999	10:30:40	26.74	442	73.7	5.9	8.4
7/26/1999	11:00:40	27.04	443	79.1	6.3	8.4
7/26/1999	11:30:40	27.33	441	82.7	6.5	8.5
7/26/1999	12:00:40	27.69	440	87.5	6.9	8.5
7/26/1999	12:30:40	27.87	439	90.6	7.1	8.5
7/26/1999	13:00:40	28.09	441	94.6	7.4	8.5
7/26/1999	13:30:40	28.31	440	98.1	7.6	8.5
7/26/1999	14:00:40	28.29	441	100.7	7.8	8.5
7/26/1999	14:30:40	28.57	440	105.9	8.2	8.6
7/26/1999	15:00:40	28.69	438	108.8	8.4	8.6
7/26/1999	15:30:40	28.95	438	113.6	8.7	8.6
7/26/1999	16:00:40	29.05	438	115.3	8.9	8.6
7/26/1999	16:30:40	29.32	433	119.6	9.1	8.7
7/26/1999	17:00:40	29.4	436	121.1	9.2	8.7
7/26/1999	17:30:40	29.57	434	122.8	9.3	8.7
7/26/1999	18:00:40	29.66	433	124	9.4 ^a	8.7
7/26/1999	18:30:40	29.68	432	123.4	9.4	8.8
7/26/1999	19:00:40	29.64	432	122.9	9.3	8.8
7/26/1999	19:30:40	29.62	431	121.4	9.2	8.8
7/26/1999	20:00:40	29.56	431	119.2	9.1	8.8
7/26/1999	20:30:40	29.39	433	116.6	8.9	8.8
7/26/1999	21:00:40	29.22	432	114.2	8.7	8.8
7/26/1999	21:30:40	29.04	431	112.6	8.6	8.8
7/26/1999	22:00:40	28.86	432	109.9	8.5	8.8
7/26/1999	22:30:40	28.66	431	106.4	8.2	8.7
7/26/1999	23:00:40	28.47	429	102.3	7.9	8.7
7/26/1999	23:30:40	28.21	433	98.1	7.6	8.7
7/27/1999	0:00:40	27.97	433	93.7	7.3	8.7
7/27/1999	0:30:40	27.74	432	89.4	7.0	8.7

Appendix Continued

Date	Time	Water temperature (°C)	SC (μS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/27/1999	1:00:40	27.53	431	85	6.7	8.7
7/27/1999	1:30:40	27.33	431	80.8	6.4	8.6
7/27/1999	2:00:40	27.16	430	76.6	6.1	8.6
7/27/1999	2:30:40	26.99	430	72.4	5.8	8.6
7/27/1999	3:00:40	26.84	430	69.2	5.5	8.6
7/27/1999	3:30:40	26.69	430	66.6	5.3	8.5
7/27/1999	4:00:40	26.57	430	64.6	5.2	8.5
7/27/1999	4:30:40	26.46	430	63.6	5.1	8.5
7/27/1999	5:00:40	26.37	430	62.9	5.1	8.5
7/27/1999	5:30:40	26.31	430	62.4	5.0	8.5
7/27/1999	6:00:40	26.24	432	62.2	5.0	8.5
7/27/1999	6:30:40	26.2	431	62.6	5.1	8.5
7/27/1999	7:00:40	26.17	432	62.6	5.1	8.4
7/27/1999	7:30:40	26.14	434	62.6	5.1	8.4
7/27/1999	8:00:40	26.12	438	64	5.2	8.4
7/27/1999	8:30:40	26.12	439	65.3	5.3	8.4
7/27/1999	9:00:40	26.13	440	66.8	5.4	8.4
7/27/1999	9:30:40	26.19	440	69.2	5.6	8.4

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7/27/1999	15:00:40	28.55	422	99.5	7.7	9.1
7/27/1999	15:30:40	28.52	424	100.7	7.8	9.1
7/27/1999	16:00:40	28.48	426	101.4	7.9	9.1
7/27/1999	16:30:40	28.46	428	103.8	8.1	9.1
7/27/1999	17:00:40	28.41	429	104.9	8.1	9.0
7/27/1999	17:30:40	28.37	431	103	8.0	9.0
7/27/1999	18:00:40	28.37	433	103	8.0	9.0
7/27/1999	18:30:40	28.4	433	104.7	8.1	9.0
7/27/1999	19:00:40	28.45	433	105.6	8.2	9.0
7/27/1999	19:30:40	28.5	433	106.8	8.3	9.0
7/27/1999	20:00:40	28.53	432	106.7	8.3	9.0
7/27/1999	20:30:40	28.54	432	105.6	8.2	9.0
7/27/1999	21:00:40	28.51	432	104.7	8.1	9.0
7/27/1999	21:30:40	28.46	431	104.3	8.1	9.0
7/27/1999	22:00:40	28.42	430	104.6	8.1	9.0
7/27/1999	22:30:40	28.37	429	104.7	8.1	9.1
7/27/1999	23:00:40	28.29	428	104.2	8.1	9.1
7/27/1999	23:30:40	28.26	426	104.9	8.2	9.1
7/28/1999	0:00:40	28.19	424	104.5	8.2	9.1
7/28/1999	0:30:40	28.13	422	104.4	8.2	9.1
7/28/1999	1:00:40	28.05	421	103.5	8.1	9.2
7/28/1999	1:30:40	27.97	420	102.4	8.0	9.2
7/28/1999	2:00:40	27.89	419	100.9	7.9	9.2
7/28/1999	2:30:40	27.8	418	99.3	7.8	9.2
7/28/1999	3:00:40	27.71	417	96.9	7.6	9.2
7/28/1999	3:30:40	27.61	416	94.5	7.4	9.2
7/28/1999	4:00:40	27.51	415	92	7.3	9.2
7/28/1999	4:30:40	27.42	415	89.6	7.1	9.2
7/28/1999	5:00:40	27.3	414	86.8	6.9	9.3
7/28/1999	5:30:40	27.19	413	84.1	6.7	9.3

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/28/1999	6:00:40	27.06	413	81.2	6.5	9.3
7/28/1999	6:30:40	26.94	413	78.9	6.3	9.3
7/28/1999	7:00:40	26.83	412	77.1	6.2	9.3
7/28/1999	7:30:40	26.74	412	76.3	6.1	9.3
7/28/1999	8:00:40	26.7	412	76.6	6.1	9.3
7/28/1999	8:30:40	26.74	411	78.5	6.3	9.3
7/28/1999	9:00:40	26.83	411	81.3	6.5	9.3
7/28/1999	9:30:40	26.96	410	84.5	6.7	9.3
7/28/1999	10:00:40	27.15	409	88	7.0	9.3
7/28/1999	10:30:40	27.43	409	92.9	7.3	9.3
7/28/1999	11:00:40	27.75	409	98.2	7.7	9.3
7/28/1999	11:30:40	28.11	408	103.1	8.0	9.3
7/28/1999	12:00:40	28.44	409	107.1	8.3	9.3
7/28/1999	12:30:40	28.76	409	110.3	8.5	9.3
7/28/1999	13:00:40	28.93	410	111.4	8.6 ^a	9.3
7/28/1999	13:30:40	28.96	411	108.8	8.4	9.2
7/28/1999	14:00:40	28.83	413	105.5	8.1	9.2
7/28/1999	14:30:40	28.62	415	102.1	7.9	9.2
7/28/1999	15:00:40	28.38	417	96.1	7.5	9.1
7/28/1999	15:30:40	28.16	418	92	7.2	9.1
7/28/1999	16:00:40	27.95	419	88.8	7.0	9.1
7/28/1999	16:30:40	27.73	421	85.7	6.7	9.1
7/28/1999	17:00:40	27.55	419	84.5	6.7	9.0
7/28/1999	17:30:40	27.46	419	86.2	6.8	9.0
7/28/1999	18:00:40	27.48	418	91	7.2	9.0
7/28/1999	18:30:40	27.48	417	93.5	7.4	9.0
7/28/1999	19:00:40	27.51	417	95.5	7.5	9.1
7/28/1999	19:30:40	27.57	416	98.4	7.8	9.1
7/28/1999	20:00:40	27.59	416	99.7	7.9	9.1
7/28/1999	20:30:40	27.55	416	98.8	7.8	9.1
7/28/1999	21:00:40	27.46	415	97.8	7.7	9.1
7/28/1999	21:30:40	27.38	415	96.5	7.6	9.1
7/28/1999	22:00:40	27.31	414	95.4	7.6	9.1
7/28/1999	22:30:40	27.25	414	94.6	7.5	9.1
7/28/1999	23:00:40	27.15	413	93.3	7.4	9.1
7/28/1999	23:30:40	27.09	412	92.1	7.3	9.1
7/29/1999	0:00:40	27.01	411	91.3	7.3	9.1
7/29/1999	0:30:40	26.92	410	90.2	7.2	9.2
7/29/1999	1:00:40	26.83	409	89.1	7.1	9.2
7/29/1999	1:30:40	26.74	408	88.2	7.1	9.2
7/29/1999	2:00:40	26.63	407	86.7	7.0	9.2
7/29/1999	2:30:40	26.52	407	85.3	6.9	9.2
7/29/1999	3:00:40	26.4	406	83.6	6.7	9.2
7/29/1999	3:30:40	26.28	406	81.9	6.6	9.2
7/29/1999	4:00:40	26.18	406	80.1	6.5	9.2
7/29/1999	4:30:40	26.07	406	78.3	6.3	9.2
7/29/1999	5:00:40	25.97	406	76.5	6.2	9.2
7/29/1999	5:30:40	25.87	406	74.6	6.1	9.2
7/29/1999	6:00:40	25.77	406	73	5.9	9.2
7/29/1999	6:30:40	25.68	406	71.5	5.8	9.2
7/29/1999	7:00:40	25.56	406	70.4	5.8	9.2

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/29/1999	7:30:40	25.46	406	69.6	5.7 ^b	9.2
7/29/1999	8:00:40	25.38	406	70.5	5.8	9.2
7/29/1999	8:30:40	25.29	406	70.7	5.8	9.2
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7/27/1999	15:30:40	28.25	406	107.5	8.4	9.0
7/27/1999	16:00:40	28.32	407	108.6	8.5	9.0
7/27/1999	16:30:40	28.35	407	110.3	8.6	9.0
7/27/1999	17:00:40	28.34	411	110.5	8.6	9.0
7/27/1999	17:30:40	28.18	411	108.7	8.5	9.0
7/27/1999	18:00:40	28.23	415	107.7	8.4	9.0
7/27/1999	18:30:40	28.22	414	107.3	8.4	9.0
7/27/1999	19:00:40	28.28	416	107.5	8.4	9.0
7/27/1999	19:30:40	28.22	410	107.5	8.4	8.9
7/27/1999	20:00:40	28.3	414	107.5	8.4	9.0
7/27/1999	20:30:40	28.28	412	106.5	8.3	9.0
7/27/1999	21:00:40	28.27	412	105	8.2	9.0
7/27/1999	21:30:40	28.2	410	103.4	8.1	9.0
7/27/1999	22:00:40	28.13	409	102.2	8.0	9.0
7/27/1999	22:30:40	28.05	408	101.7	8.0	9.0
7/27/1999	23:00:40	27.98	408	101.3	7.9	9.0
7/27/1999	23:30:40	27.9	407	100.9	7.9	9.0
7/28/1999	0:00:40	27.8	406	100.3	7.9	9.0
7/28/1999	0:30:40	27.7	405	99.9	7.9	9.0
7/28/1999	1:00:40	27.63	404	99.7	7.9	9.1
7/28/1999	1:30:40	27.52	403	98.5	7.8	9.1
7/28/1999	2:00:40	27.41	402	97.2	7.7	9.1
7/28/1999	2:30:40	27.32	402	96	7.6	9.1
7/28/1999	3:00:40	27.23	402	94.5	7.5	9.1
7/28/1999	3:30:40	27.11	401	92.4	7.3	9.1
7/28/1999	4:00:40	27.01	401	90.4	7.2	9.1
7/28/1999	4:30:40	26.91	401	88.5	7.1	9.1
7/28/1999	5:00:40	26.79	401	86.3	6.9	9.1
7/28/1999	5:30:40	26.66	400	84.1	6.7	9.1
7/28/1999	6:00:40	26.55	400	81.9	6.6	9.1
7/28/1999	6:30:40	26.43	400	79.6	6.4	9.1
7/28/1999	7:00:40	26.29	400	78.1	6.3	9.1
7/28/1999	7:30:40	26.19	400	77	6.2	9.1
7/28/1999	8:00:40	26.18	401	77.4	6.3	9.1
7/28/1999	8:30:40	26.16	400	78.8	6.4	9.1
7/28/1999	9:00:40	26.22	400	80.9	6.5	9.1
7/28/1999	9:30:40	26.34	399	84.1	6.8	9.1
7/28/1999	10:00:40	26.5	399	87.4	7.0	9.1
7/28/1999	10:30:40	26.74	399	91.3	7.3	9.1
7/28/1999	11:00:40	27.05	398	96.1	7.6	9.2
7/28/1999	11:30:40	27.35	398	101.2	8.0	9.2
7/28/1999	12:00:40	27.74	398	106.1	8.3	9.2
7/28/1999	12:30:40	28.13	397	110.6	8.6	9.2
7/28/1999	13:00:40	28.38	397	113.1	8.8 ^a	9.2
7/28/1999	13:30:40	28.45	398	113	8.8	9.1

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/28/1999	14:00:40	28.49	399	112.1	8.7	9.1
7/28/1999	14:30:40	28.32	398	109.9	8.5	9.1
7/28/1999	15:00:40	28.08	399	106.5	8.3	9.1
7/28/1999	15:30:40	27.92	401	101	7.9	9.0
7/28/1999	16:00:40	27.72	402	97.2	7.6	9.0
7/28/1999	16:30:40	27.56	403	93.2	7.4	9.0
7/28/1999	17:00:40	27.36	404	90	7.1	9.0
7/28/1999	17:30:40	27.25	403	89.4	7.1	9.0
7/28/1999	18:00:40	27.16	401	90.6	7.2	8.9
7/28/1999	18:30:40	27.18	403	92.1	7.3	9.0
7/28/1999	19:00:40	27.14	400	93.9	7.5	9.0
7/28/1999	19:30:40	27.19	401	96.8	7.7	9.0
7/28/1999	20:00:40	27.18	400	98.1	7.8	9.0
7/28/1999	20:30:40	27.14	400	97.8	7.8	9.0
7/28/1999	21:00:40	27.06	399	96.9	7.7	9.0
7/28/1999	21:30:40	26.97	399	95.7	7.6	9.0
7/28/1999	22:00:40	26.86	399	94.4	7.5	9.0
7/28/1999	22:30:40	26.78	399	93	7.4	9.0
7/28/1999	23:00:40	26.71	399	92	7.4	9.0
7/28/1999	23:30:40	26.59	398	90.6	7.3	9.0
7/29/1999	0:00:40	26.52	398	89.7	7.2	9.0
7/29/1999	0:30:40	26.41	396	88.6	7.1	9.0
7/29/1999	1:00:40	26.32	396	87.6	7.1	9.0
7/29/1999	1:30:40	26.24	395	86.7	7.0	9.1
7/29/1999	2:00:40	26.12	394	85.5	6.9	9.1
7/29/1999	2:30:40	26.03	394	84.4	6.8	9.1
7/29/1999	3:00:40	25.9	394	83.2	6.8	9.1
7/29/1999	3:30:40	25.79	394	81.7	6.7	9.1
7/29/1999	4:00:40	25.69	394	80.4	6.6	9.1
7/29/1999	4:30:40	25.6	395	79	6.5	9.1
7/29/1999	5:00:40	25.47	394	77.4	6.3	9.1
7/29/1999	5:30:40	25.36	394	76	6.2	9.1
7/29/1999	6:00:40	25.3	395	74.7	6.1	9.1
7/29/1999	6:30:40	25.2	396	73.5	6.1	9.1
7/29/1999	7:00:40	25.07	395	72.7	6.0	9.1
7/29/1999	7:30:40	24.96	395	71.9	5.9 ^b	9.1
7/29/1999	8:00:40	24.93	396	71.9	5.9	9.1
7/29/1999	8:30:40	24.84	396	72.2	6.0	9.1
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7/28/1999	14:00:40	27.37	405	85.9	6.8	9.0
7/28/1999	14:30:40	27.38	404	83.3	6.6	9.0
7/28/1999	15:00:40	27.37	403	83.6	6.6	9.0
7/28/1999	15:30:40	27.36	403	84	6.6	9.0
7/28/1999	16:00:40	27.35	403	85.2	6.7	9.1
7/28/1999	16:30:40	27.37	402	88.4	7.0	9.1
7/28/1999	17:00:40	27.4	400	92.5	7.3	9.1
7/28/1999	17:30:40	27.5	398	97.8	7.7	9.1
7/28/1999	18:00:40	27.6	397	102.3	8.1	9.1
7/28/1999	18:30:40	27.63	398	102.5	8.1	9.1

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/28/1999	19:00:40	27.69	397	104.6	8.2	9.1
7/28/1999	19:30:40	27.76	396	107.8	8.5	9.2
7/28/1999	20:00:40	27.84	394	111.1	8.7	9.2
7/28/1999	20:30:40	27.89	394	112.6	8.8	9.2
7/28/1999	21:00:40	27.94	393	114.7	9.0	9.2
7/28/1999	21:30:40	27.94	391	116.1	9.1	9.2
7/28/1999	22:00:40	27.87	391	115.4	9.1	9.2
7/28/1999	22:30:40	27.77	392	112.3	8.8	9.2
7/28/1999	23:00:40	27.67	392	109.4	8.6	9.2
7/28/1999	23:30:40	27.5	393	104.8	8.3	9.2
7/29/1999	0:00:40	27.34	394	100.4	8.0	9.1
7/29/1999	0:30:40	27.22	395	97.7	7.8	9.1
7/29/1999	1:00:40	27.07	395	95.3	7.6	9.1
7/29/1999	1:30:40	26.93	396	91.5	7.3	9.1
7/29/1999	2:00:40	26.77	397	87.7	7.0	9.1
7/29/1999	2:30:40	26.59	398	84.2	6.8	9.0
7/29/1999	3:00:40	26.46	399	82.1	6.6	9.0
7/29/1999	3:30:40	26.28	400	79.1	6.4	9.0
7/29/1999	4:00:40	26.18	401	77	6.2	9.0
7/29/1999	4:30:40	26.04	402	74.9	6.1	9.0
7/29/1999	5:00:40	25.9	403	72.7	5.9	8.9
7/29/1999	5:30:40	25.78	402	71.5	5.8	8.9
7/29/1999	6:00:40	25.63	402	70	5.7	8.9
7/29/1999	6:30:40	25.54	402	68.9	5.6	8.9
7/29/1999	7:00:40	25.41	402	68.5	5.6	8.9
7/29/1999	7:30:40	25.31	401	67.4	5.5	8.9
7/29/1999	8:00:40	25.24	401	67.2	5.5	8.9
7/29/1999	8:30:40	25.15	400	66.9	5.5	8.9
7/29/1999	9:00:40	25.16	400	66.7	5.5	8.9
7/29/1999	9:30:40	25.23	402	66.8	5.5	8.9
7/29/1999	10:00:40	25.39	403	66.8	5.5 ^b	8.9
7/29/1999	10:30:40	25.4	402	68.5	5.6	8.9
7/29/1999	11:00:40	25.58	401	70.4	5.8	8.9
7/29/1999	11:30:40	25.7	400	71.8	5.9	8.9
7/29/1999	12:00:40	25.93	398	72.6	5.9	9.0
7/29/1999	12:30:40	26.27	398	74.1	6.0	9.0
7/29/1999	13:00:40	26.3	397	74.5	6.0	9.0
7/29/1999	13:30:40	26.52	397	76.2	6.1	9.0
7/29/1999	14:00:40	26.62	396	77	6.2	9.0
7/29/1999	14:30:40	26.74	396	78.1	6.3	9.0
7/29/1999	15:00:40	26.89	396	80.6	6.4	9.0
7/29/1999	15:30:40	26.95	395	83.3	6.6	9.0
7/29/1999	16:00:40	27.06	394	87	6.9	9.0
7/29/1999	16:30:40	27.09	394	91.1	7.2	9.0
7/29/1999	17:00:40	27.2	393	94.9	7.5	9.1
7/29/1999	17:30:40	27.37	393	100.2	7.9	9.1
7/29/1999	18:00:40	27.47	392	105.2	8.3	9.1
7/29/1999	18:30:40	27.55	391	109.5	8.6	9.1
7/29/1999	19:00:40	27.63	391	113	8.9	9.1
7/29/1999	19:30:40	27.66	391	114.1	9.0	9.1

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/29/1999	20:00:40	27.71	391	115.7	9.1	9.1
7/29/1999	20:30:40	27.74	391	117.2	9.2	9.1
7/29/1999	21:00:40	27.8	390	119.7	9.4	9.1
7/29/1999	21:30:40	27.81	390	123	9.7 ^a	9.1
7/29/1999	22:00:40	27.76	390	122.8	9.6	9.1
7/29/1999	22:30:40	27.71	391	122	9.6	9.1
7/29/1999	23:00:40	27.64	392	121	9.5	9.1
7/29/1999	23:30:40	27.57	393	119.6	9.4	9.1
7/30/1999	0:00:40	27.51	394	118.3	9.3	9.1
7/30/1999	0:30:40	27.44	395	117.1	9.3	9.1
7/30/1999	1:00:40	27.32	396	115.8	9.2	9.1
7/30/1999	1:30:40	27.18	397	113.3	9.0	9.0
7/30/1999	2:00:40	27.07	399	110.4	8.8	9.0
7/30/1999	2:30:40	26.97	399	107.8	8.6	9.0
7/30/1999	3:00:40	26.85	400	104.5	8.3	9.0
7/30/1999	3:30:40	26.77	401	101.5	8.1	9.0
7/30/1999	4:00:40	26.63	402	97.9	7.9	9.0
7/30/1999	4:30:40	26.49	402	93.6	7.5	9.0
7/30/1999	5:00:40	26.33	403	89.1	7.2	8.9
7/30/1999	5:30:40	26.19	403	85.3	6.9	8.9
7/30/1999	6:00:40	26.02	404	80.7	6.5	8.9
7/30/1999	6:30:40	25.93	403	78	6.3	8.9
7/30/1999	7:00:40	25.74	403	74	6.0	8.8
7/30/1999	7:30:40	25.71	402	73	6.0	8.8
7/30/1999	8:00:40	25.7	401	72.4	5.9	8.8
7/30/1999	8:30:40	25.64	401	71.4	5.8	8.8

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7/29/1999	9:30:40	25.39	402	78.3	6.4	8.9
7/29/1999	10:00:40	25.46	402	77.9	6.4 ^b	8.9
7/29/1999	10:30:40	25.65	402	79.9	6.5	8.9
7/29/1999	11:00:40	25.85	402	82.2	6.7	8.9
7/29/1999	11:30:40	26.04	401	84.1	6.8	8.9
7/29/1999	12:00:40	26.29	401	86.5	7.0	8.9
7/29/1999	12:30:40	26.3	400	85.3	6.9	8.9
7/29/1999	13:00:40	26.55	399	89.1	7.2	9.0
7/29/1999	13:30:40	26.75	398	89.8	7.2	9.0
7/29/1999	14:00:40	26.87	397	92.4	7.4	9.0
7/29/1999	14:30:40	26.89	397	91.3	7.3	9.0
7/29/1999	15:00:40	27.04	397	94.4	7.5	9.0
7/29/1999	15:30:40	27.07	396	94.9	7.6	9.0
7/29/1999	16:00:40	27.08	396	95.5	7.6	9.0
7/29/1999	16:30:40	27.08	395	97.1	7.7	9.0
7/29/1999	17:00:40	27.25	395	102.5	8.1	9.0
7/29/1999	17:30:40	27.33	394	104.9	8.3	9.1
7/29/1999	18:00:40	27.41	394	106.3	8.4	9.1
7/29/1999	18:30:40	27.44	393	107	8.5	9.1
7/29/1999	19:00:40	27.52	393	108.6	8.6	9.1
7/29/1999	19:30:40	27.61	392	110.4	8.7	9.1
7/29/1999	20:00:40	27.67	392	110.8	8.7	9.1

Appendix Continued

Date	Time	Water temperature (°C)	SC (µS/cm)	DOsat (percent)	DO (mg/L)	pH (standard units)
7/29/1999	20:30:40	27.7	392	111.2	8.8	9.1
7/29/1999	21:00:40	27.7	392	111.7	8.8	9.1
7/29/1999	21:30:40	27.72	392	112.4	8.8	9.1
7/29/1999	22:00:40	27.74	392	113.3	8.9	9.1
7/29/1999	22:30:40	27.73	392	113.5	8.9 ^a	9.1
7/29/1999	23:00:40	27.7	392	113.3	8.9	9.1
7/29/1999	23:30:40	27.65	393	112.8	8.9	9.1
7/30/1999	0:00:40	27.59	394	112.1	8.8	9.1
7/30/1999	0:30:40	27.52	395	111.3	8.8	9.1
7/30/1999	1:00:40	27.45	396	110.4	8.7	9.1
7/30/1999	1:30:40	27.35	397	108.8	8.6	9.1
7/30/1999	2:00:40	27.26	398	107.1	8.5	9.1
7/30/1999	2:30:40	27.15	399	105.2	8.4	9.0
7/30/1999	3:00:40	27.03	399	103	8.2	9.0
7/30/1999	3:30:40	26.9	401	100.4	8.0	9.0
7/30/1999	4:00:40	26.76	402	97.4	7.8	9.0
7/30/1999	4:30:40	26.61	403	94.1	7.5	8.9
7/30/1999	5:00:40	26.46	403	90.8	7.3	8.9
7/30/1999	5:30:40	26.31	404	87.6	7.1	8.9
7/30/1999	6:00:40	26.18	404	84.9	6.9	8.9
7/30/1999	6:30:40	26.06	404	82.5	6.7	8.8
7/30/1999	7:00:40	25.97	404	81.2	6.6	8.8
7/30/1999	7:30:40	25.92	404	81.1	6.6	8.8
7/30/1999	8:00:40	25.89	403	80.2	6.5	8.8
7/30/1999	8:30:40	25.84	403	79.5	6.5	8.8
7/30/1999	9:00:40	25.85	402	80.4	6.5	8.8

^aMaximum dissolved-oxygen concentration^bMinimum dissolved-oxygen concentration