# Cumberland Gap National Historical Park Stream Monitoring Program

## Assessment of Chemical and Biological Conditions
## January through December 1993

Prepared by:

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and

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The University of Tennessee
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## 1. Introduction - purpose and scope

In the early 1980s, in Cumberland Gap National Historical Park (CUGA), preliminary construction was begun on a highway tunnel through Cumberland Mountain for the relocation of U. S. Hwy. 25E which at present follows the route of the old Wilderness Road through the Cumberland Gap. Tunnel excavation was completed by March 1993. A water monitoring program was initiated in 1990 by the National Park Service to monitor the effects, if any, of the construction on the waters, bed sediments, and biota of several streams in the park. The program was later joined by the University of Tennessee's Cooperative Park Studies Unit. Both the National Park Service and the Cooperative Park Studies Unit have generated several reports summarizing the analyses of water, sediment and benthos samples collected during the program (Nodvin and Rhodes, 1993a and b; 1994). In the immediate precursor to the present study, Moore and Smoot (1993) summarized the results of laboratory analyses performed on water and sediment samples collected from July 1991, through December 1992. The present report summarizes analytical results obtained from similar samples collected from January through December 1993; it also includes a summary of the results of benthic macroinvertebrate sampling from June 1990, to May 1993. In the report, trends in water and sediment quality and in benthic macroinvertebrate abundance are examined in relation to current and historical influences on park watersheds.

## 2. Sampling Program

A number of sampling stations were established on ten streams and associated areas in the park. In addition to the stations established to monitor the direct effects of tunnel construction, stations were established on streams which would be affected by the anticipated relocation of U. S. 25E and other proposed road improvements. Additional stations were located on back country streams to serve as project controls, others on Davis Branch to monitor conditions affecting the population of the threatened blackside dace (Phoxinus cumberlandensis), and still others near points of particular interest such as stockpiles of excavated tunnel materials. It was planned to sample some stations biweekly, others quarterly, and a number of the more important stations after storm events. The only presently active station ( TC10) on Tunnel Creek, a stream which receives discharge directly from the tunnels, was sampled daily durung 1993, because tunnel construction was in progress. Sampling intervals were changed at various stations as the study progressed, and in several cases, sampling was discontinued prior to 1993. A list of the stations at which at least one water or sediment sample was collected in 1993, and their locations, is presented in Table 1. Stations, streams, and watersheds are described, and their associated maps are included in Appendix A .

## 3. In-stream Measurements and Sample Collection and Analysis

Several measurements of water properties are performed in the stream at the time of

**Table 1. Sampling stations and locations in Cumberland Gap National Historical Park[1]**

| Sampling Stations | Location |
|---|---|
| Kentucky Stations | |
| YC5, YC5A, YC12 | Little Yellow Creek |
| DB5, DB10 | Davis Branch |
| MF2, MF5 | Martins Fork |
| TC10 | Tunnel Creek |
| SH10 | Shillalah Creek |
| SR10 | Sugar Run |
| 988 | Near intersection Hwy. 988 and U.S. 25E |
| DR9 | Dark Ridge Creek |
| KY18 | Proposed staging area upstream of YC5 |
| RR1 | Near end of existing railroad tunnel |
| Tennessee Stations | |
| GC3, GC4, GC7 | Gap Creek |
| IF | Gap Creek near historical iron furnace site |
| TD1 | Hwy. tunnel discharge outlet near Gap Creek |
| STOR1 | Near intersection of U.S .58 and U.S. 25E |
| CAVE | Tunnel cavern |
| Virginia Stations | |
| ST5, ST10 | Station Creek |
| LH5 | Lewis Hollow (Unnamed stream) |
| CUDJO | Cudjo Cave |

[1] Stations at which at least one water or sediment sample was collected in 1993

sample collection. A Hydrolab is used to measure temperature, pH, Eh, dissolved oxygen, and specific conductance, and a Marsh-McBirney Flomate 210D flowmeter and an H. F. Scientific DRT-15 C turbidimeter are used to measure flowrate and turbidity, respectively. Methods used to make field measurements and to obtain water and sediment samples are described in Curtis, et al. (Undated).

Most laboratory analyses are performed at Tennessee Technological University in Cookeville, Tennessee, although oil and Grease analyses (EPA Method 413.2) are performed at the park laboratory. Concentrations of major anions and cations are determined by means of an ion chromatograph (EPA Method 300.1) , and inductively coupled plasma analysis (ICP) (EPA Method 200.7) is used to determine concentrations of dissolved metals (Nodvin and Rhodes, 1993b). A total of 37 parameters are reported for regular (biweekly) samples and 47 for quarterly and storm event samples (Moore and Smoot, 1993). When both in-stream measurements and laboratory analyses are considered, a sample data report can include more than 50 parameters ( Table 7).

## 4. Water Quality Criteria

Federal surface water quality criteria for aquatic life (Table 2) and federal drinking water standards (Table 3) serve as guidelines for use by the states in the development of their own water quality criteria (Smoot, et al., 1991). The surface water quality criteria adopted by Kentucky, Tennessee, and Virginia and approved by the U. S. Environmental Protection Agency are presented in Tables 4, 5, and 6, respectively. When these criteria are applied to an individual stream, they become the standards by which the water quality of that stream must be judged.

## 5. Water-quality results - 1993

### 5.1 Introduction

In this section, the parameter values determined at the stations on each stream are compared to the criteria of the state in which the stream is located in order to assess the stream's water quality. The comparisons are based on the 1993 water quality results contained in Appendix D. Many of the parameters reported by the CUGA water monitoring program are not found on any of the state lists of water quality criteria (Table 7); they are compared to federal criteria where possible.

Verbal comparisons of parameter values with state criteria are supplemented in several cases by graphical analyses in the form of Tukey box plots. Box plots are explained in Appendix

**Table 2 . Selected federal water-quality criteria for freshwater aquatic life[1]**

| Constituent or Property | Toxicity Criteria | |
|---|---|---|
| | acute[2] | chronic[3] |
| Alkalinity (mg/L as $CaCO_3$) | | > 20 |
| Ammonia, total (mg/L) | Criteria pH and temperature dependent | |
| Arsenic, total trivalent (μg/L as As) | 360 | 190 |
| Cadmium, total (μg/L as Cd) | 3.9* | 1.1* |
| Chromium, total (μg/L as Cr) | | |
| Chromium, hexavalent | 16 | 11 |
| Chromium, trivalent | 1,700* | 210* |
| Copper, total (μg/L as Cu) | 18* | 12* |
| Cyanide, total (μg/L as Cn) | 0.022 | 0.0052 |
| Dissolved oxygen (mg/L) | < 3.0-4.0 | < 5.5 |
| Iron, total (μg/L as Fe) | | 1,000 |
| Lead, total (μg/L as Pb) | 82* | 3.2* |
| Mercury, total (μg/L as Hg) | 2.4 | 0.012 |
| Nickel, total (μg/L as Ni) | 1,800* | 96* |
| pH (Standard units) | | 6.5-6.9 |
| Selenium, total (μg/L as Se) | 260 | 35 |
| Silver, total (μg/L as Ag) | 4.1* | 0.12 |
| Temperature (° C) | Species-dependent criteria | |
| Zinc, total (μg/L as Zn) | 320* | 47 |

[1] (Smoot, et al. 1991)

[2] Highest 1-hour average concentration that should not cause unacceptable toxic effects in aquatic organisms during short-term exposure..

[3] Highest 4-day average concentration that should not cause unacceptable toxic effects in aquatic organisms during long-term exposure.

*Hardness level of 100 mg/L used to calculate criteria.

**Table 3. Selected federal drinking-water standards[1]**

| Constituent or Property | MCL[2] | MCLG[3] | PMCL[4] | PMCLG[5] | SMCL[6] |
|---|---|---|---|---|---|
| Arsenic, total (µg/L) | 50 | | | 50 | |
| Barium, total (µg/L) | 1,000 | | | 1,500 | |
| Cadmium, total (µg/L) | 10 | | | 5 | |
| Chloride, dissolved (mg/L) | | | | | 250 |
| Chromium, total (µg/L) | 50 | | | 120 | |
| Copper, total (µg/L) | | | 1,300 | 1,300 | 1,000 |
| Dissolved solids, total (mg/L) | | | | | 500 |
| Fluoride, dissolved (mg/L) | 4 | 4 | | | 2 |
| Iron, total (µg/L) | | | | | 300 |
| Lead, total (µg/L) | 50 | | 5 | 0 | |
| Manganese, total (µg/L) | | | | | 50 |
| Mercury, total (µg/L) | 2 | | | 3 | |
| Nitrogen, total nitrate (mg/L) | 10 | | | 10 | |
| Nitrogen, total nitrite (mg/L) | | | | 1 | |
| pH (standard units) | | | | | 6.5 - 8.5 |
| Selenium, total (µg/L) | 10 | | | 45 | |
| Silver, total (µg/L) | 50 | | | | |
| Sulfate, dissolved (mg/L) | | | | | 250 |
| Zinc, total (µg/L) | | | | | 5,000 |

[1] (Smoot, et al., 1991)
[2] Maximum contaminant level
[3] Maximum contaminant level goal
[4] Proposed MCL
[5] Proposed MCLG
[6] Secondary MCL

**Table 4. Selected Kentucky surface water-quality criteria[1]**

| Constituent or Property | Domestic water supply | Warmwater aquatic habitat | Coldwater aquatic habitat[2] | Recreational waters |
|---|---|---|---|---|
| Ammonia, total un-ionized (mg/L) | | 0.05 | | |
| Arsenic, total (μg/L as As) | | 50 | | |
| Barium, total (μg/L as Ba) | 1,000 | | | |
| Beryllium, total (μg/L as Be) | | 11 (soft)<br>1,100 (hard) | | |
| Cadmium, total (μg/L as Cd) | | 4 (soft)<br>12 (hard) | | |
| Chloride, dissolved (mg/L as Cl) | 250 | 600 | | |
| Chromium, total (μg/L as Cr) | 50 | 100 | | |
| Copper, total (μg/L as Cu) | 1,000 | | | |
| Cyanide, total (μg/L as Cn) | | 5 | | |
| Dissolved oxygen (mg/L) | | < 4 | < 5 | |
| Dissolved solids, total (mg/L) | 750 | | | |
| Fecal coliform bacteria (colonies/100 mL) | 2,000 | | | 200*<br>1,000** |
| Fluoride, dissolved (mg/L as F) | 1 | | | |
| Iron, total (μg/L as Fe) | | 1,000 | | |
| Lead, total (μg/L as Pb) | 50 | | | |
| Manganese, total (μg/L as Mn) | 50 | | | |
| Mercury, total (μg/L as Hg) | | 0.2 | | |
| Nitrogen, total nitrate (mg/L as N) | 10 | | | |
| pH (standard units) | | 6.0 - 9.0 | | 6.0 - 9.0*<br>6.0 - 9.0** |
| Selenium, total (μg/L as Se) | 10 | | | |
| Silver, total (μg/L as Ag) | 50 | | | |
| Sulfate, dissolved (mg/L as $SO_4$) | 250 | | | |
| Temperature (° C) | | <31.7 | *** | |
| Zinc, total (μg/L as Zn) | | 47 | | |

[1] (Smoot et al. 1991)

[2] Warmwater aquatic habitat criteria apply where none established for coldwater habitats.

* primary contact recreation

** secondary contact recreation

*** not to exceed natural seasonal variations

(soft) water has an equivalent concentration of calcium carbonate of 0 to 75 milligrams per liter

(hard) water has an equivalent concentration of calcium carbonate of over 75 milligrams per liter

**Table 5. Selected Tennessee surface water quality criteria**[1]

| Constituent or Property | Domestic water supply | Freshwater fish and aquatic life Maximum Concentration | Freshwater fish and aquatic life Continuous Concentration | Recreation |
|---|---|---|---|---|
| Antimony ($\mu$g/L) | | | | 4310 |
| Arsenic, total ($\mu$g/L) | 50 | 360 | 190 | |
| Beryllium ($\mu$g/L) | | | | 1.3 |
| Cadmium ($\mu$g/L)** | 10 | 4* | 1* | |
| Chromium, total ($\mu$g/L) | 50 | | 100 | |
| Copper ($\mu$g/L)** | | 18* | 12* | |
| Cyanide ($\mu$g/L) | 22 | 5.2 | | |
| Dissolved oxygen (mg/L) | | | > 5 | |
| Lead ($\mu$g/L)** | 50 | 82* | 3* | |
| Mercury ($\mu$g/L) | 2 | 2.4 | 0.012 | 0.2 |
| Nickel ($\mu$g/L)** | | 1,400 | 160 | 10 |
| pH (standard units) | | | 6.5 - 8.5 | 6.0 - 9.0 |
| Selenium ($\mu$g/L) | 10 | 20 | 5 | |
| Silver ($\mu$g/L) | 50 | 4* | | |
| Temperature (° C) | | | < 30.5 | < 30.5 |
| Zinc ($\mu$g/L)** | | 117* | 106* | 1* |

[1] (Tennessee Department of Environment and Conservation, 1991)
* Dissolved
** Hardness level of 100 mg/L used to calculate criteria

**Table 6. Selected Virginia surface water quality standards for freshwater[1]**

| | Aquatic Life | | Human Health | |
|---|---|---|---|---|
| | Exposure Level | | Water Supply | |
| Constituent or Property | Acute[2] | Chronic[3] | Public | All other |
| Arsenic ($\mu$g/L) | | | 50 | |
| Arsenic III ($\mu$g/L) | 360 | 190 | | |
| Barium ($\mu$g/L) | | | 2,000 | |
| Cadmium ($\mu$g/L) | 3.9[4] | 1.1[4] | 16 | 170 |
| Chloride ($\mu$g/L) | 860,000 | 230,000 | 260,000 | |
| Chromium III ($\mu$g/L) | 1,737[4] | 207[4] | 33,000 | 670,000 |
| Chromium VI ($\mu$g/L) | 16 | 11 | 170 | 3,400 |
| Copper ($\mu$g/L) | 17.7[4] | 11.8[4] | 1,300 | |
| Cyanide ($\mu$g/L) | 22 | 5.2 | 700 | 215,000 |
| Dissolved oxygen (mg/L) | 4[5] | 5[6] | | |
| Iron, soluble ($\mu$g/L) | | | 300 | |
| Lead ($\mu$g/L) | 81.7[4] | 3.2[4] | 15 | |
| Manganese, soluble ($\mu$g/L) | | | 50 | |
| Mercury ($\mu$g/L) | 2.4 | 0.012 | 0.144 | 0.146 |
| Nickel ($\mu$g/L) | 1,418[4] | 157[4] | 607 | 4,583 |
| Nitrate, as N ($\mu$g/L) | | | 10,000 | |
| pH (standard units) | | 6.0 - 9.0 | | |
| Phosphorous, as P ($\mu$g/L) | | | 21,000 | 4,600,000 |
| Selenium ($\mu$g/L) | 20 | 5 | 172 | 11,200 |
| Silver ($\mu$g/L) | 4.1[4] | | | |
| Sulfate ($\mu$g/L) | | | 250,000 | |
| Temperature (° C) | | 31 | | |
| Total dissolved solids ($\mu$g/L) | | | 500,000 | |
| Zinc ($\mu$g/L) | 117[4] | 106[4] | 5,000 | |

[1] (Virginia Water Control Board, 1992)

[2] One-hour average concentration not to be exceeded more than once every three years

[3] Four-day average concentration not to be exceeded more than once every three years

[4] Hardness level of 100 mg/L used to calculate criteria

[5] Minimum standard

[6] Daily average

Table 7. A comparison of inorganic constituents and physical properties.

| Constituent or Property | CUGA Water [1] | CUGA Sediment[1] | Federal |  | KY[4] | TN[5] | VA[6] |
|---|---|---|---|---|---|---|---|
|  |  |  | DW[2] | AQ[3] |  |  |  |
| Aluminum | + | + |  |  |  |  |  |
| Aluminum, total | + |  |  |  |  |  |  |
| Ammonia |  |  |  | + | + |  |  |
| Antimony |  |  |  |  |  | + |  |
| Arsenic | + | + | + | + | + | + | + |
| Barium | + | + | + |  | + |  | + |
| Beryllium |  |  |  |  | + | + |  |
| Bicarbonate | + |  |  |  |  |  |  |
| Boron | + | + |  |  |  |  |  |
| Bromine | + | + |  |  |  |  |  |
| Cadmium | + | + | + | + | + | + | + |
| Calcium | + | + |  |  |  |  |  |
| Carbon, total |  | + |  |  |  |  |  |
| Carbon, total organic | + | + |  |  |  |  |  |
| Carbonate | + |  |  |  |  |  |  |
| Chloride | + | + | + |  | + |  | + |
| Chromium | + | + | + | + | + | + | + |
| Cobalt |  | + |  |  |  |  |  |
| Copper | + | + | + | + | + | + | + |
| Cyanide |  |  |  | + | + | + | + |
| Fluoride | + | + | + |  | + |  |  |
| Germanium |  | + |  |  |  |  |  |
| Iron, total | + |  | + | + | + |  |  |
| Iron | + | + |  |  |  |  | + |
| Lead | + | + | + | + | + | + | + |
| Lithium | + | + |  |  |  |  |  |
| Magnesium | + | + |  |  |  |  |  |
| Manganese, total | + |  |  |  | + |  |  |
| Manganese | + | + | + |  |  |  | + |
| Mercury | + | + | + | + | + | + | + |
| Molybdenum | + | + |  |  |  |  |  |
| Nickel | + | + |  | + |  | + | + |
| Nitrate | + | + | + |  | + |  | + |
| Nitrite | + | + | + |  |  |  |  |
| Orthophosphate | + | + |  |  |  |  |  |
| Phosphorous | + | + |  |  |  |  | + |
| Phosphorous, total |  |  |  |  |  |  | + |
| Potassium | + | + |  |  |  |  |  |
| Selenium |  |  | + | + | + | + | + |
| Silicon | + | + |  |  |  |  |  |
| Silver |  |  | + | + | + | + | + |
| Sodium | + | + |  |  |  |  |  |
| Strontium | + | + |  |  |  |  |  |
| Sulfate | + | + | + |  | + |  | + |
| Sulfur, total |  | + |  |  |  |  |  |
| Titanium | + | + |  |  |  |  |  |
| Vanadium | + | + |  |  |  |  |  |
| Zinc | + | + | + | + | + | + | + |

(Continued)

**Table 7. (Continued). A comparison of inorganic constituents and physical properties.**

| Properties, measurements and miscellaneous variables | | | | | | | |
|---|---|---|---|---|---|---|---|
| Constituent or Property | CUGA Water [1] | CUGA Sediment[1] | Federal DW[2] | Federal AQ[3] | KY[4] | TN[5] | VA[6] |
| Acidity | + | * | | | | | |
| Acid-base account, net | | + | | | | | |
| Alkalinity | + | ** | | + | | | |
| Anions | + | | | | | | |
| Anion-cation ratio | + | | | | | | |
| Cations | + | | | | | | |
| Color | + | | | | | | |
| Eh | + | | | | | | |
| Flowrate (Discharge) | + | | | | | | |
| Hardness | + | | | | | | |
| Oil & grease | + | | | | | | |
| Oxygen, dissolved | + | | | + | + | + | + |
| pH | + | *** | + | + | + | + | + |
| Temperature | + | | | + | + | + | + |
| Turbidity | + | | | | | | |
| Sediment, total suspended | + | | | | | | |
| Solids, total dissolved | + | | + | | + | | + |
| Specific conductance | + | | | | | | |

[1] Present study
[2] (Smoot, et al., 1991)
[3] (Smoot, et al., 1991)
[4] (Smoot, et al., 1991)
[5] (Tennessee Department of Environment and Conservation, 1991)
[6] (Virginia Water Control Board, 1992)
* Potential acidity
** Neutralization potential
*** Paste pH

G. The plots, depicting the distribution of measured values, were prepared for each parameter at several stations when sufficient data were available. Generally, this meant that a station was sampled biweekly and that most values were above the detection limit. Constituent concentrations reported as zero were censored by adjusting them to the detection limit.

### 5.2 Flow rate (Discharge)

The flow rate, or discharge, is a measure of the amount of water passing a given point in a stream in a given time period. In the data upon which this study is based, the flow rate measured at each station at each sampling period is reported in cubic feet per second. Although flow rate is not a water quality parameter, high flow rates, caused by storms, for instance, can significantly affect water quality by resuspending the bottom sediments which settled out of the water column during periods of lower flows , thus increasing the total concentrations of constituents by the amounts which are sorbed to the sediments. In addition, various species of aquatic organisms are adapted to the differences in flow rate which are present in riffle and pool areas of a stream.

In Kentucky waters, flow rates were generally less than 5.0 cfs in Davis Branch and Tunnel Creek and at RR1. Flow rates generally ranged from near zero to around 20 cfs in Little Yellow Creek stations YC5 and YC5A and to around 45 cfs at YC12. At all of these stations, uncharacteristically high flows occurred occasionally (Figure 1), and in several instances, flows occurred which were too high to measure. In Tennessee, flows at Gap Creek stations normally ranged from near zero to about 18 cfs except at GC4 (which is actually located on a tributary to Gap Creek) where flows were generally less than 1.0 cfs (Figure 2).

### 5.3 Temperature

Kentucky and Tennessee water quality criteria for the protection of aquatic life require water temperatures to be less than 31.7° C and 30.5° C, respectively, for warmwater streams. Virginia requires that streams in mountainous regions have water temperatures less than 31° C. In Kentucky, the temperature criterion was not found to be exceeded at any sampling station on Davis Branch or Little Yellow Creek. Seventy-five percent of the observed temperatures in those streams were less than 20° C except at YC12 (Figure 3). At both SH10 and 988 which were sampled only in the winter and spring, measured temperatures were equal to or lower than 11° C. Three quarterly samples in winter, spring, and fall found temperatures at Martins Fork stations to be lower than 11.5 ° C. In Tennessee, temperatures at Gap Creek stations were rarely found to exceed 20° C (Figure 4). In Virginia, water temperatures measured on the same dates at ST5, ST10, and LH5 were lower than 10.5 ° C.

### 5.4 Dissolved oxygen

In both Kentucky and Virginia, water quality criteria for the protection of aquatic life require that dissolved oxygen concentrations be at least 4 mg/L in warmwater streams. In Kentucky, levels below the minimum were measured at DB5 on Davis Branch. Moore and Smoot (1993) used data from Davis Branch to demonstrate the inverse relationship between temperature and dissolved oxygen concentration. All of the three low levels at DB5 were associated with periods of water temperatures from 19.3 to 22.0 ° C. At YC5 on Little Yellow Creek, dissolved

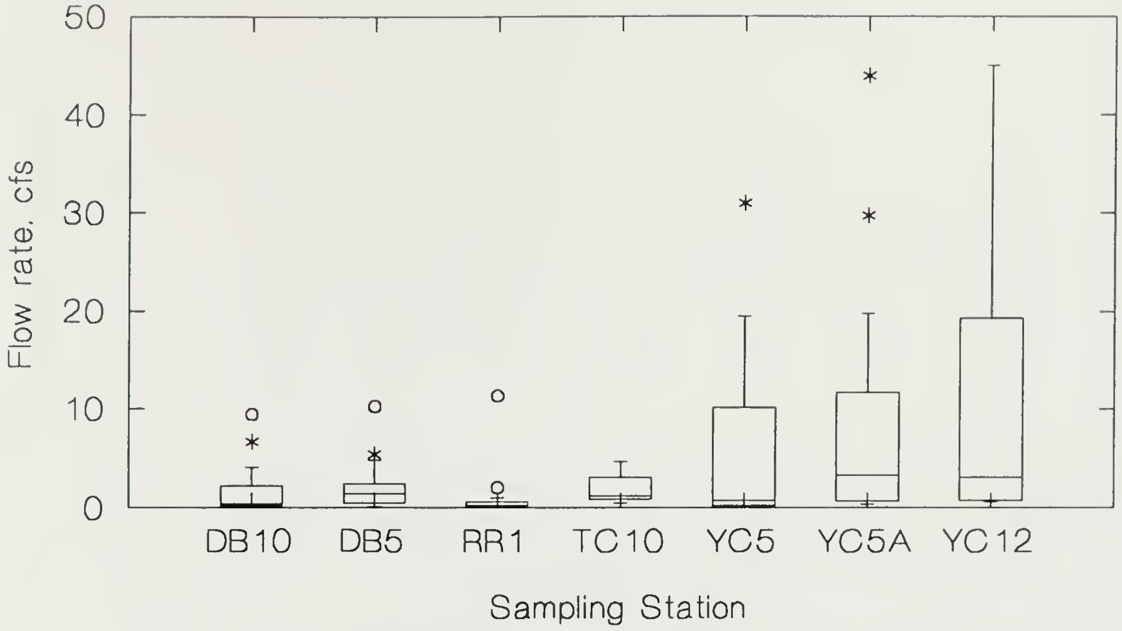

Figure 1. Flow rate distribution at Kentucky stations - 1993
(See Appendix G for explanation of boxplot)

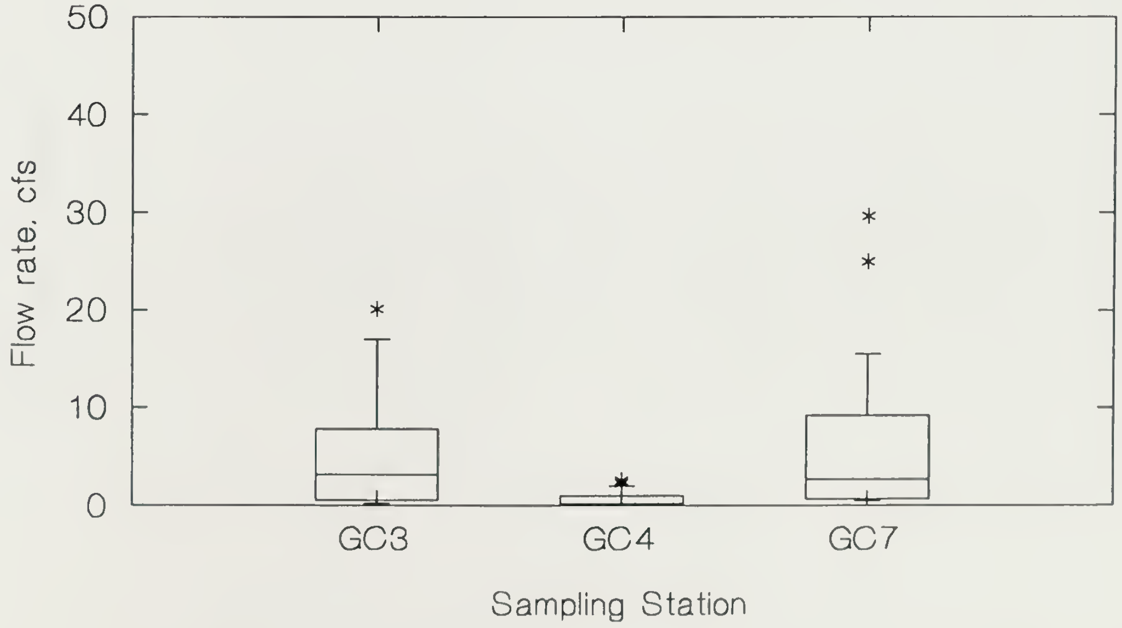

Figure 2. Flow rate distribution at Tennessee stations - 1993
(See Appendix G for explanation of boxplot)

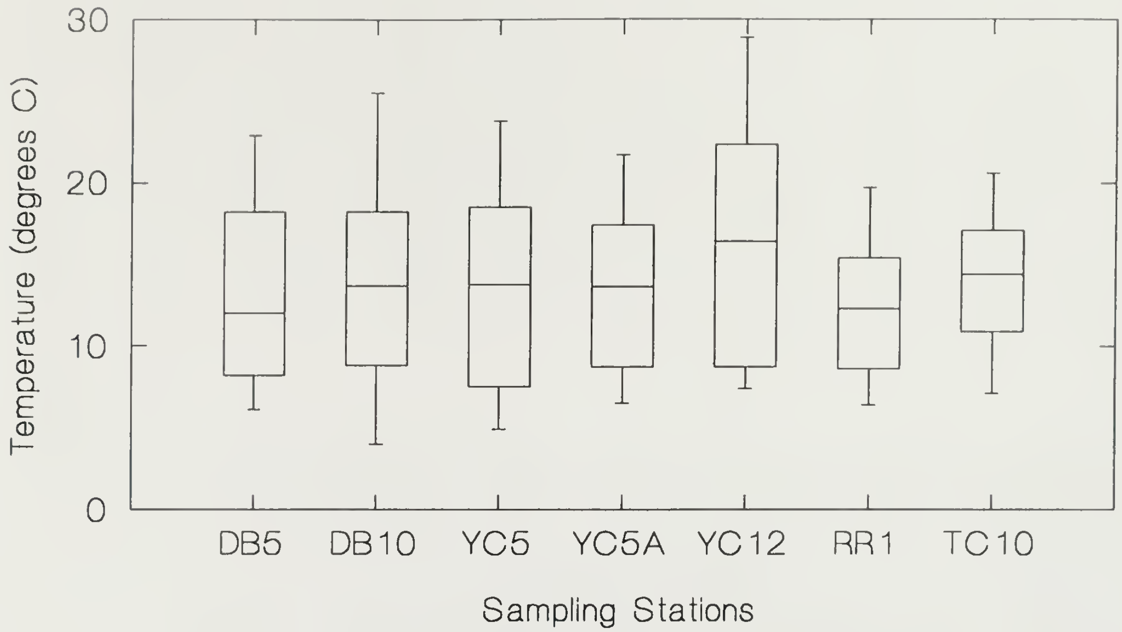

Figure 3. Temperature distribution at Kentucky stations - 1993
(See Appendix G for explanation of boxplot)

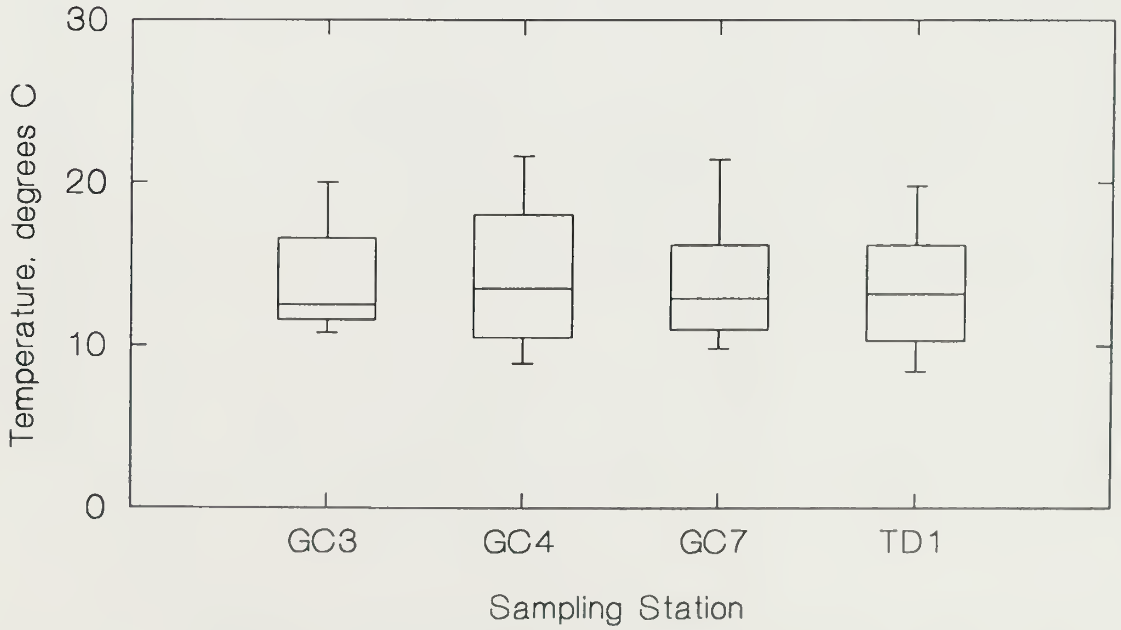

Figure 4. Temperature distribution at Tennessee stations - 1993
(See Appendix G for explanation of boxplot)

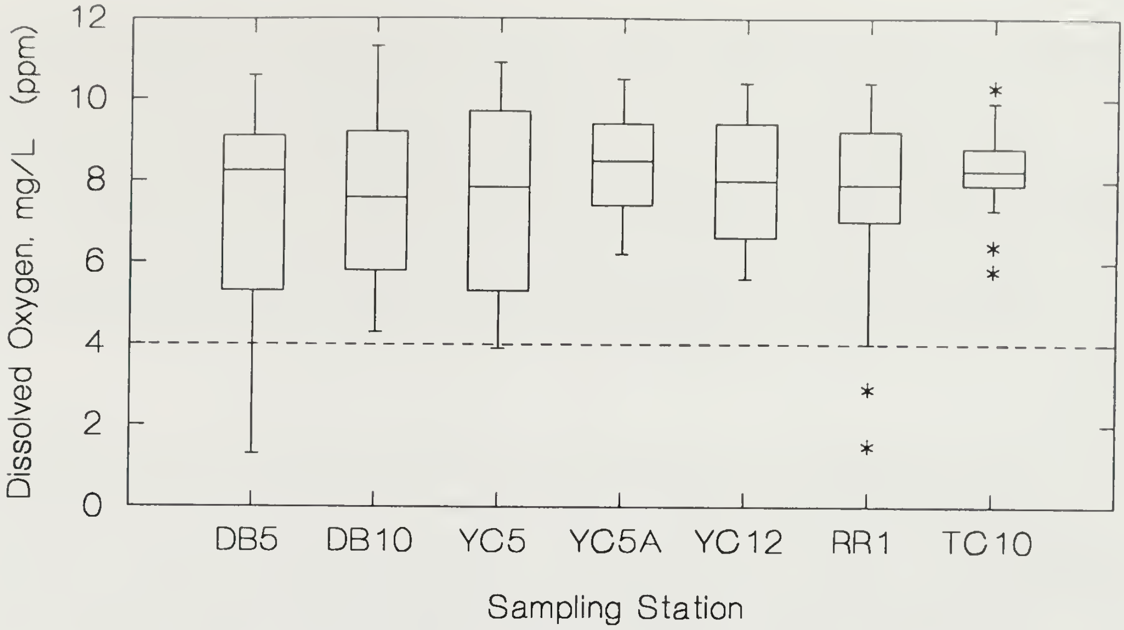

Figure 5. Dissolved oxygen distribution at Kentucky stations - 1993
(Dotted lines represent state criteria limits.
See Appendix G for explanation of boxplot.)

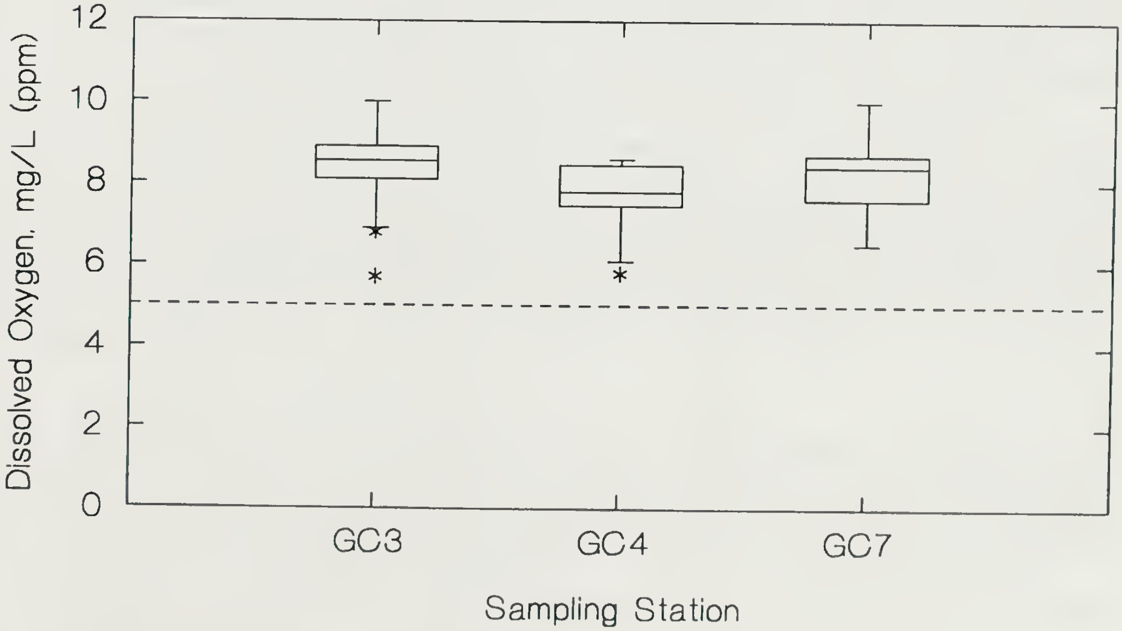

Figure 6. Dissolved oxygen distribution at Tennessee stations - 1993
(Dotted lines represent state criteria limits.
See Appendix G for explanation of boxplot.)

oxygen levels were barely below the 4 mg/L criterion on three occasions at temperatures ranging from 15.5 to 23.8° C; however, low levels were measured twice at RR1 at temperatures of only 7.2 and 13.5° C. No dissolved oxygen concentrations below 4 mg/l were measured at other stations on Little Yellow Creek or Tunnel Creek (Figure 5) or at any other sampling station in Kentucky. In Tennessee, dissolved oxygen levels were higher than the 5 mg/L criterion at all Gap Creek stations, but low concentrations occurred in the tunnel discharge on several occasions (Figure 6). All concentrations measured at other Tennessee stations were above the criterion level. In Virginia, dissolved oxygen concentrations were higher than 4 mg/L at all sampling periods.

### 5.5 pH

The pH of an aqueous solution is defined as the negative base-10 logarithm of the hydrogen ion activity and can range from 0 (very acidic) to 14 (very alkaline) (Smoot, et al., 1991). The pH in natural waters normally ranges from about 6.0 to 8.5 (Hem, 1985), because these streams have achieved equilibrium with the surrounding weathered rocks and minerals of the surface. When runoff from construction materials such as shotcrete or from unweathered subsurface materials exposed by construction reaches a stream, large pH fluctuations may result which can cause severe harm to aquatic organisms living downstream from the point of entry of the runoff. Kentucky and Virginia water quality criteria for the protection of aquatic life require that pH be in the range 6.0 to 9.0 units, whereas Tennessee criteria specify a range of 6.5 to 8.5 units.

In Kentucky, pH levels in regular samples were above the Kentucky criterion on a few occasions in Tunnel Creek and in Little Yellow Creek at YC5A (Figure 7) which is only about 50 feet downstream from the mouth of Tunnel Creek. However, a considerable amount of acid was added to Tunnel Creek in 1993 (Nodvin and Rhodes, 1993b) to neutralize basic conditions caused by shotcreteing, and daily pH levels at TC10 ranged as low as 3.7 and 3.4 on 1/30/93 and 2/13/93, respectively, and as high as 11.9 on 2/6/93 (Appendix H). At Station 988, all pH values were within the specified range, but acidic conditions appeared to be present throughout the year in Shillalah Creek and Martins Fork, which reportedly are normally acidic streams. In Tennessee, pH values in Gap Creek and the tunnel discharge were between 6.5 and 8.5 units (Figure 8) as was drainage from the stockpile at STOR1. In Virginia, pH values in Station Creek and at LH5 were within criteria limits.

### 5.6 Alkalinity

The alkalinity of a water may be defined as the capacity of the solutes it contains to react with and neutralize acid. The principal source of the carbonate and bicarbonate ions that produce alkalinity in water is the $CO_2$ gas in the atmosphere (Hem, 1985) which forms a weak solution of carbonic acid, $H_2CO_3$, when it combines with rainwater. In areas of limestone geology, the carbonic acid solution dissolves carbonate-rich material as it sinks to the water table and moves through the subsurface. When it enters a stream as base flow, the dissolved carbonates become an important source of alkalinity. Alkalinity is important to aquatic life because it acts as a buffer

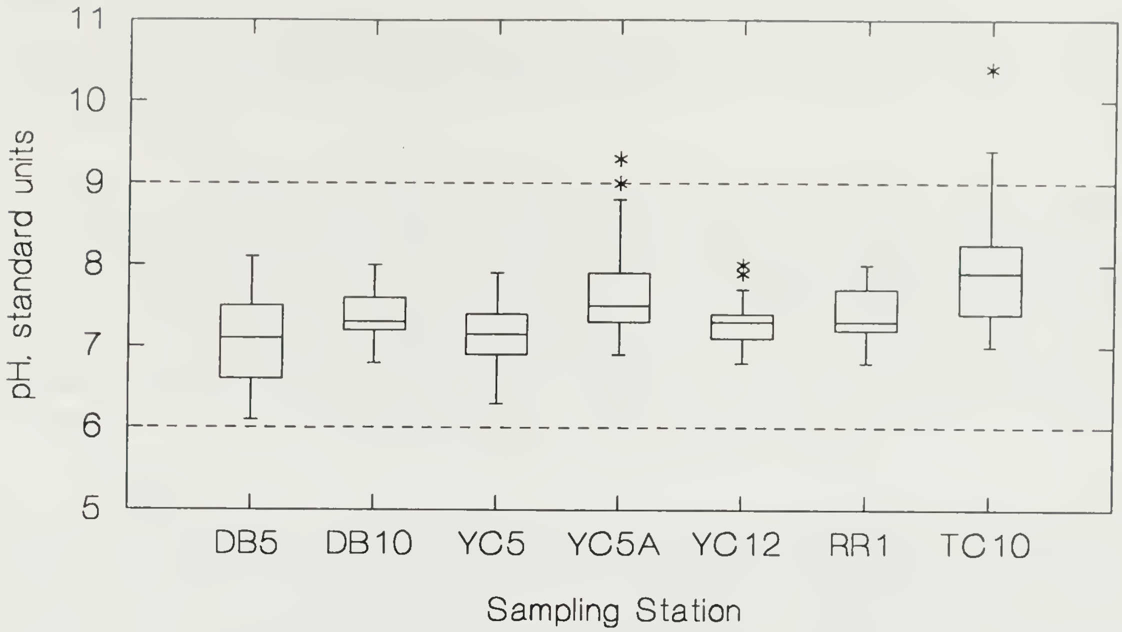

Figure 7. pH distribution at Kentucky stations - 1993
(Dotted lines represent state criteria limits)
(See Appendix G for explanation of boxplot)

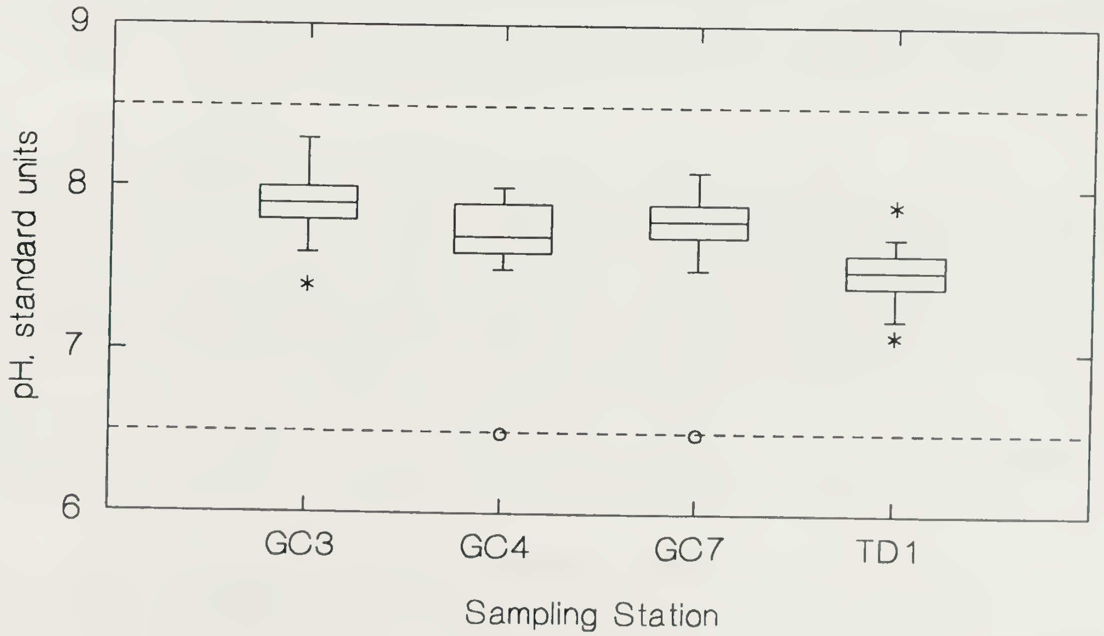

Figure 8. pH distribution at Tennessee stations - 1993
(Dotted lines represent state criteria limits)
(See Appendix G for explanation of boxplot)

to keep the pH within tolerable limits by neutralizing acidic materials entering the stream. Neither Kentucky, Tennessee, nor Virginia has established water quality criteria for alkalinity; however, federal criteria (Table 2) specify that not less than 20 mg/L as $CaCO_3$ should be present for the protection of aquatic life.

In Kentucky, alkalinity was below 20 mg/L in about 30 percent and 50 percent of samples from DB10 and DB5, respectively. At Little Yellow Creek stations, it was below that figure in about 50 percent of samples from YC5 and YC12 and about 35 percent of samples from YC5A. Alkalinity levels were greater than 20 mg/L throughout the year at TC10, RR1, and 988, but they were very low in the acidic Shillalah Creek and Martins Fork. In Tennessee, alkalinity levels were consistently above federal criteria at all stations. In Virginia, alkalinity levels ranged from 12 to 60 mg/L in Station Creek and from 8.6 to 38 mg/L at LH5 in Lewis Hollow.

### 5.7 Acidity

Acidity is a measure of the capacity of a water to neutralize a strong base. According to Hem (1985), strongly acid water may be produced by the oxidation of sulfide minerals exposed to the air by mining operations, and in some areas, natural sediments at or near the surface may contain enough reduced minerals to significantly increase the acidity of natural runoff. Mining operations are not noticeably affecting park streams at present, but runoff from naturally acidic sediments may be contributing to the acidity of Shillalah Creek and Martins Fork. Neither Kentucky, Tennessee, Virginia, nor the federal government has established water quality criteria for acidity.

In Kentucky, only Shillalah Creek and Martins Fork had measurable acidity ranging from below detection limits to 7.5 mg/L. In Tennessee, measurable acidity was not encountered at any stations. In Virginia, none of the sampled streams were found to have measurable acidity.

### 5.8 Redox potential

The redox potential is a numerical index of the intensity of oxidizing or reducing conditions within a system. Positive potentials indicate that the system is relatively oxidizing, and negative potentials indicate that it is relatively reducing. Eh values relate to ratios of solute activities and give little or no indication of the quantitative capacity of the system to oxidize or reduce material that might be introduced from outside. pH - Eh relationships are useful for predicting and defining equilibrium behavior of multi-valent elements (Hem, 1985).

Measured values of the redox potential generally ranged from 273 to 672 indicating oxidizing conditions in park waters. One value of 75 was measured at YC5A on 3/23/93.

### 5.9 Anion/cation ratio, specific conductance, and total dissolved solids

Stream water contains a number of dissolved inorganic constituents derived from dissolution of minerals in the streambed or from point or nonpoint sources external to the stream. As the minerals enter solution, they dissociate into positively charged cations or negatively charged anions.

### 5.9.1 Anion/cation ratio

Since on a macro scale, the positive and negative ionic charges must be in balance , the anion/cation ratio provides a rough indication of whether a water quality analysis was performed properly. The closer the ratio approaches a value of one, the more nearly equal the charge balance. In about 13 percent of samples for which an anion/cation ratio was reported, its value was less than 0.85 or greater than 1.15. Thus, it appears probable that some samples should be reanalyzed. Calculation of the anion-cation balance discussed by Nodvin and Rhodes (1993a) could provide a simple means of determining which samples should be returned for reanalysis if, as they suggest, the criterion of Hillman, et al. (1986) is followed and a sample is reanalyzed when the absolute value of its ion difference exceeds 15 percent.

### 5.9.2 Specific conductance and total dissolved solids

Specific conductance is the measure of the ability of water to conduct an electrical current. It is related to the quantity and types of ionized substances in water. Dissolved solids consist of inorganic salts and other dissolved materials such as organic matter. By multiplying specific conductance in microsiemens per centimeter by 0.6, an estimate of the dissolved solids concentration in milligrams per liter is obtained (Smoot, et al., 1991). When measurements of both parameters are available, they can be used to provide a check on the accuracy of the analysis. The dissolved solids value in milligrams per liter should generally be from 0.55 to 0.75 times the specific conductance in microsiemens per centimeter (Hem, 1985). Neither Kentucky, Tennessee, or Virginia has established a criterion for specific conductance or total dissolved solids for the protection of aquatic life; however, Kentucky and Virginia have established criteria of 750 and 500 mg/L, respectively, for total dissolved solids in domestic and public water supplies. The federal drinking water standard is 500 mg/L.

In Kentucky, total dissolved solids concentrations were found to be generally less than 250 mg/L at stations on Davis Branch, Little Yellow Creek, Tunnel Creek, and at RR1 (Figure 9). They were extremely low in quarterly samples from Shillalah Creek and Martins Fork with high values of 12 and 8 mg/L, respectively, but at 988, where the sampling effort was restricted to five samples in spring and winter, total dissolved solids levels ranged from 210 to 597 mg/L. These values, though higher than at other stations, are still well below the Kentucky criterion. In Virginia, total dissolved solids values in Station Creek and the Lewis Hollow drainage were well below the Virginia criterion, ranging from 24 to 76 mg/L. In Tennessee, total dissolved solids values ranged from 37 to 255 mg/L in all samples.

### 5.10 Major cations

Those ions making up the bulk of the total dissolved solids in a stream are referred to as major cations or major anions. According to Nodvin and Rhodes (1993a;b), major cations in streams within the park include calcium ($Ca^{2+}$), magnesium ($Mg^{2+}$), sodium ($Na^{+}$), potassium ($K^{+}$), ammonium ($NH_4^{+}$), and hydrogen ion ($H^{+}$). Neither Kentucky, Virginia, Tennessee, nor the federal government has established water quality criteria for any of the major cations. No

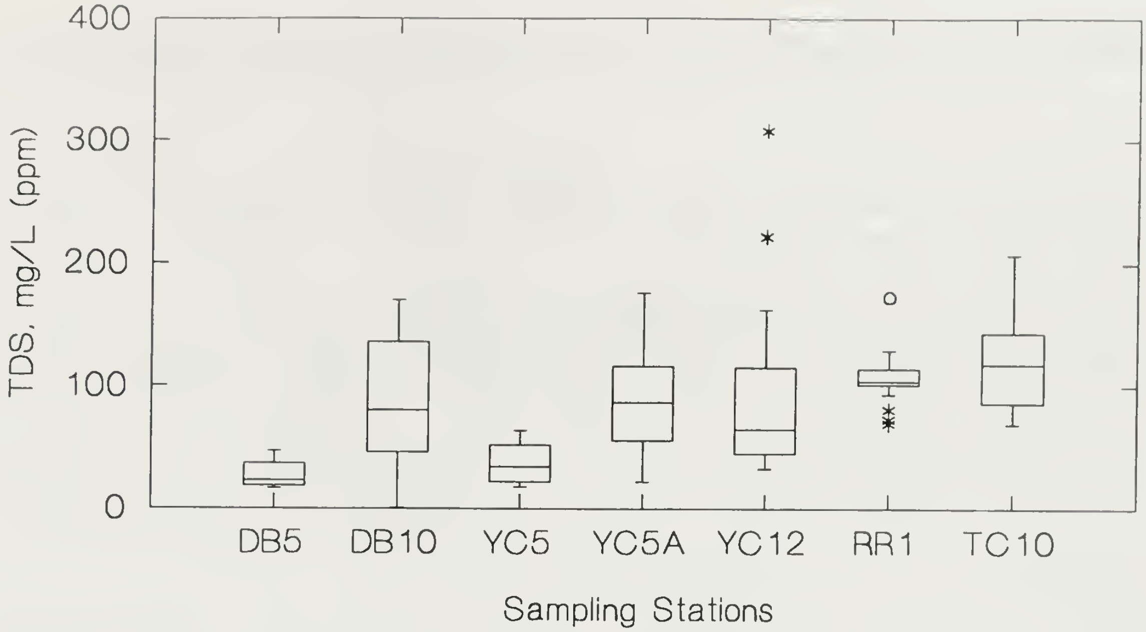

Figure 9. Total dissolved solids distribution at Kentucky stations - 1993
(See Appendix G for explanation of boxplot)

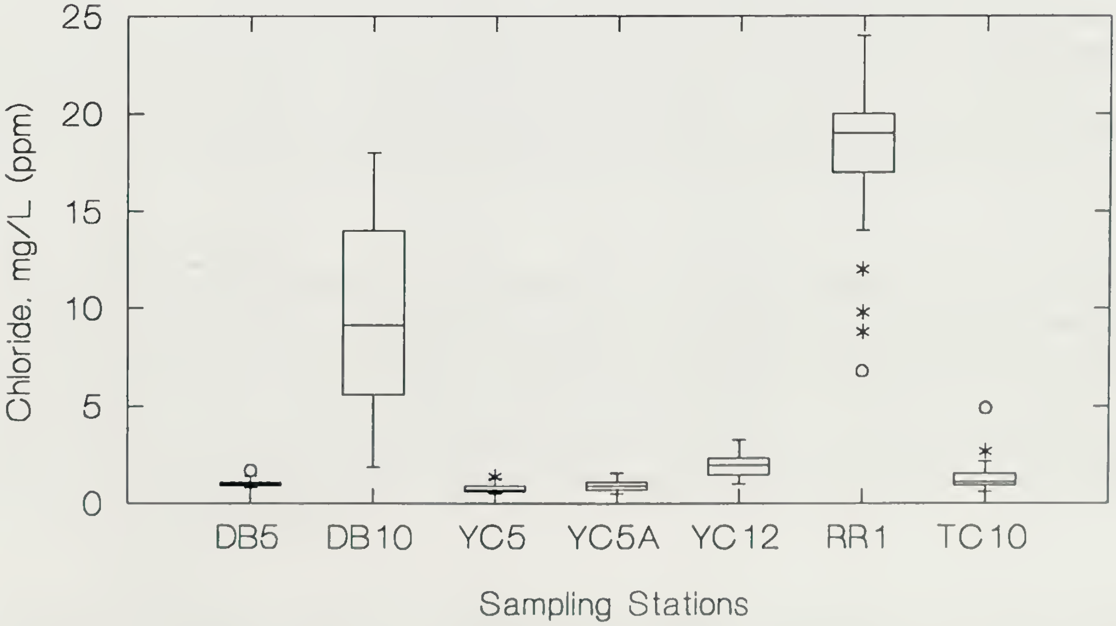

Figure 10. Chloride distribution at Kentucky stations - 1993
(See Appendix G for explanation of boxplot)

analysis is performed for ammonium in this study (Table 7), and the hydrogen ion concentration can be calculated from the formula $[H^+] = 10^{-pH}$.

### 5.10.1 Calcium , magnesium, and hardness

Calcium and magnesium are essential elements for plants and animals, and calcium is a major component of the solutes in most natural water. The sum of their concentrations (usually reported as mg/L of $CaCO_3$) is known as hardness (Nodvin and Rhodes, 1994). Hardness is a quality which is of more value in determining the suitability of a water for domestic use than in determining its suitability for aquatic life, since it primarily affects the efficiency of soap and the clogging of water lines with precipitate. Many domestic water supplies are softened to less than 100 mg/L of hardness as $CaCO_3$ (Hem, 1985). In the present study ,calcium concentrations ranged from 0.4 to 91.7 mg/L as Ca, magnesium from 0.3 to 22.0 mg/L as Mg, and hardness from 3 to 260 mg/L as $CaCO_3$ at all stations.

### 5.10.2 Sodium

Sodium occurs in virtually all surface water, although its concentration varies widely. Potential sources of sodium in the study area include de-icing salts, domestic sewage, and industrial effluents (Smoot, et al., 1991). Neither Kentucky, Tennessee, Virginia, or the federal government have established water-quality standards for sodium for the protection of aquatic life or for water supplies. Sodium concentrations in samples ranged from below detection limits to 63 mg/L.

### 5.10.3 Potassium

Potassium concentrations in most natural waters are much lower than sodium concentrations due to the tendency of potassium to combine with clay minerals. Sources of potassium include the feldspars orthoclase and microcline and leachate from dead plant material such as dead leaves (Hem, 1985). Neither Kentucky, Tennessee, Virginia, nor the federal government has established water-quality standards for potassium for the protection of aquatic life or for water supplies. Potassium concentrations in samples ranged from 0.3 to 7.8 mg/L.

### 5.11 Major anions

Major anions include chloride($Cl^-$), fluoride ($F^-$), nitrite ($NO_2^-$), nitrate ($NO_3^-$), sulfate ($SO_4^{2-}$), and bicarbonate ($HCO_3^-$). At pHs greater than 10, significant amounts of carbonate ($CO_3^{2-}$), and hydroxyl ($OH^-$) may be present. The federal drinking water standards list proposed limits for nitrate and nitrite. Kentucky and Virginia have established chloride criteria for the protection of aquatic life and nitrate and sulfate criteria for public water supplies. Kentucky alone has a fluoride criterion for public water supplies, and Tennessee has not established water-quality criteria for any of the major anions.

### 5.11.1 Chloride

Chloride is similar to sodium in its widespread occurrence and its varying concentrations in surface waters. As with sodium, potential sources of chloride in the study area include de-icing

salts, domestic sewage, and industrial effluents (Smoot, et al., 1991). The Kentucky chloride criterion is 600 mg/L as Cl for warmwater aquatic habitats, and the Virginia criterion for the protection of aquatic life is 860 mg/L for acute exposure and 230 mg/L for chronic exposure. At all sampling stations in Kentucky (Figure 10), Virginia, and Tennessee, measured chloride levels were generally less than 25 mg/L.

### 5.11.2 Fluoride

According to Hem (1985), the inclusion of fluoride among the major anions is arbitrary, since concentrations present in most natural waters are less than 1.0 mg/L. The Kentucky criterion for fluoride in water supplies is 1.0 mg/L. Sample concentrations of fluoride in this study ranged from below detection limits to 0.5 mg/L.

### 5.11.3 Nitrate and nitrite

Nitrate and nitrite are the anionic forms of nitrogen which occur in water. Point sources of nitrogen contamination include municipal and industrial wastewater and feedlot runoff. Nonpoint sources include fertilizers, leachate from dumps or landfills, and leachate from septic tank drainfields. Nitrate is an important plant nutrient and is a factor in causing nuisance phytoplankton blooms in lakes; however, this effect is rarely seen in free-flowing streams (Smoot, et al., 1991). The occurrence of nitrate and nitrite in water has been extensively studied because of the public health relationship, since concentrations of nitrate in excess of 10 mg/L as N may cause methemoglobinemia in small children (Hem, 1985). Federal drinking water standards set proposed limits of 10 mg/L as N for nitrate and 1.0 mg/L as nitrite for nitrite. Kentucky and Virginia have also established 10 mg/L as N criteria for nitrate, but they have not established criteria for nitrite. Tennessee has not established criteria for either nitrate or nitrite.

In Kentucky, nitrate concentrations ranged from below detection limits to 8.5 mg/L ( 1.9 mg/L as N) at most sampling stations; however, at 988, nitrate concentrations ranged from 13.0 to 30.0 mg/L (2.9 to 6.8 mg/L as N). Nitrite concentrations at Kentucky stations generally ranged from below detection limits to about 1.0 mg/L as nitrite; however, in two April samples at DB5, nitrite concentrations were measured at 2.0 and 2.1 mg/L as nitrite. In Virginia, nitrate concentrations ranged from below detection limits to 0.5 mg/L (0.1 mg/L as N), and all nitrite concentrations were below detection limits. In Tennessee, nitrate concentrations ranged from below detection limits to 6 mg/L (1.4 mg/L as N), and nitrite concentrations ranged from below detection limits to 1.0 mg/L as nitrite.

### 5.11.4 Sulfate

Sulfur is an essential element in the life processes of plants and animals. It is widely distributed in reduced form in igneous and sedimentary rocks as metallic sulfides. When sulfide minerals undergo weathering in contact with aerated water, the sulfate is oxidized to yield sulfate ions that go into solution in the water (Hem, 1985). In the park, an important source of sulfate anions may be the calcium sulfate ($CaSO_4$) that is used to neutralize basic conditions caused by tunnel construction. The federal government, Kentucky, and Virginia have established water

quality criteria of 250 mg/L for sulfate in water supplies. Tennessee has not established sulfate criteria. Sulfate concentrations in samples ranged from below detection limits to 190 mg/L.

### 5.11.5 Carbonate and Bicarbonate

Carbonate and bicarbonate ions are important contributors to alkalinity, which controls the pH of natural waters. In samples with pH > 10, significant amounts of hydroxyl and carbonate may be present. Samples with moderate pH levels may contain both carbonate and bicarbonate ions, but samples with pH values from 4 to 6 would contain only bicarbonate (Nodvin and Rhodes, 1993). No criteria have been established which specifically address the concentrations of carbonate and bicarbonate. No values for carbonate concentrations were reported for the study. Bicarbonate concentrations in samples ranged from below detection limits to about 140 mg/L.

### 5.12 Suspended sediment, turbidity, and color

Large amounts of suspended sediment may adversely affect the biological community of a stream. It can also transport sorbed metals, organics, and nutrients, and it is aesthetically displeasing. Turbidity is a measure of suspended sediment that is based on the amount of light which is able to pass through the suspension. The less transmitted light which is measured, the higher the apparent turbidity. Thus, there is a direct relationship between suspended sediment concentrations and turbidity. Color, which is imparted to water by dissolved materials leached from organic debris such as dead leaves (Hem, 1985), can produce artificially high turbidity readings by absorbing light, thus decreasing the amount of light which is transmitted. No water quality criteria have been established by the federal government or by Kentucky, Tennessee, or Virginia which address suspended sediment concentrations, turbidity, or color. Polymer and alum were added to the tunnel effluent to control suspended sediment and turbidity.

Total suspended sediment concentrations generally ranged from below detection limits to about 94 mg/L, but in samples collected on 3/23/93, suspended sediment concentrations ranged from 123 to 715 mg/L. Daily suspended sediment concentrations ranged from below detection limits to 302 mg/L at TC10 (Appendix H). Turbidities generally ranged from below detection limits to 57 ntu; however, turbidity levels of 200 ntu were measured at most stations on 3/23/93, and a level of 425 ntu was measured at YC5A on that date. Sample color values generally ranged from below detection limits to about 40 Pt-Co with a high of 176 Pt-Co at YC5A on 3/23/93.

### 5.13 Plant nutrients

Among the major nutrients which aquatic vascular plants and algae require for growth are the elements phosphorous, potassium, and nitrogen. The forms of nitrogen available for plant growth, ammonium, nitrate, and nitrite, of which nitrate is predominant, have already been discussed (Sections 5.10 and 5.11.3). Potassium was discussed in Section 5.10.3.

### 5.13.1 Phosphorous

Phosphorous is the major nutrient which is most frequently determined to be limiting to plant growth. Some of the more important sources include the breakdown and erosion of phosphorous-bearing minerals, decaying organic material, fertilizers, detergents, sewage effluents,

and septic tank leachates (Smoot, et al., 1991). Dissolved phosphorous is likely to be present as the orthophosphates $H_2PO_4^-$ and $HPO_4^{2-}$ at the pH levels present in park streams (Hem, 1985). Dissolved phosphorous is reported in units of mg/L as P. Orthophosphate is reported in units of mg/L as $PO_4$.

No water-quality criteria for dissolved phosphorous have been established by the federal government, Kentucky, or Tennessee. Virginia has established a criterion for dissolved phosphorous of 21 mg/L as P for public water supplies and 4,600 mg/L as P for all other water supplies. Both dissolved phosphorous and orthophosphate were generally below detection limits at all stations, but occasional higher concentrations were measured. Maximum concentrations were 2.9 mg/L as P and 8.5 mg/L as $PO_4$, respectively, for the two parameters.

### 5.14 Total organic carbon

Organic carbon present in all natural waters may comprise waste and decay products of living organisms, pesticides, polychlorinated biphenyls, or any of thousands of chemicals in general use. Amounts of organic compounds present in most waters are small compared with amounts of dissolved inorganics, but they can cause severe adverse effects to human health and to stream biota (Smoot, et al., 1991). Total organic carbon (TOC) is a gross measure of organic carbon used for assessment purposes.

Neither the federal government, Kentucky, Tennessee, nor Virginia has established water-quality criteria for total organic carbon. Concentrations of total organic carbon were measured on only three dates at most stations. On 3/23/93, when stream levels were so high that discharge could not safely be measured, total organic carbon levels ranged from 6.2 to 20 mg/L. On 12/5/93, at lower discharges, concentrations ranged from 1.5 to 5.4 mg/L, and they were below detection limits at all sampled stations on 13 December.

### 5.15 Major metals, trace elements, and inorganic compounds

Surface water contamination by metals is of concern because many metals can be toxic to aquatic organisms when present in high concentrations. Metals may enter receiving waters from such sources as runoff from rocks and soils, precipitation containing atmospheric pollutants, urban stormwater runoff, domestic and industrial wastewaters, and fertilizers. Metals are often transported in the stream by suspended sediments (Smoot, et al., 1991). Major metals, trace elements, and miscellaneous inorganic compounds which are monitored in this study include aluminum, arsenic, barium, boron, bromide, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, silicon, strontium, titanium, vanadium, and zinc.

#### 5.15.1 Aluminum

Although aluminum is the third most abundant element in the earth's crust, it usually occurs at concentrations of less than 1 mg/L in natural waters unless the pH is below 4.0. At low pH values it can be present in sufficient amounts to be deleterious to fish (Hem, 1985). One natural source of aluminum is weathering from aluminum-bearing rocks (Hem, 1985), but it seems likely that it could also occur in low-pH leachate from landfills.

Neither Kentucky, Tennessee, Virginia, nor the federal government has established water-quality criteria for aluminum. Sample concentrations ranged from below detection limits to 0.93 mg/L for dissolved aluminum and from below detection limits to 3.3 mg/L for total aluminum. Many of the highest values at various stations did not represent typical values but were isolated peaks from a single storm event.

### 5.15.2 Arsenic

Small concentrations of arsenic can be toxic to humans and other organisms; therefore, it is considered highly undesirable in surface water. Arsenic is found in pesticides and is produced by the burning of coal. These may be potential sources of stream contamination (Hem, 1985). The federal government has established standards for total arsenic of 0.05 mg/L as As in drinking water. For the protection of aquatic life, federal standards are 0.36 and 0.19 mg/L total trivalent arsenic for acute and chronic exposure, respectively. Tennessee has adopted the federal standards for drinking water and for aquatic life protection. Virginia has adopted the federal drinking water standard, but not the aquatic life standards, and Kentucky has established a total arsenic criterion of 0.05 mg/L as As for warmwater aquatic habitats.

The state and federal criteria reported above are for total arsenic, but the samples were analyzed only for dissolved arsenic. It should be borne in mind that the discussion which follows is based only on the reported dissolved arsenic values.

In Kentucky, dissolved arsenic concentrations were either not reported or were below detection limits in all samples with the exception of a sample collected at YC5 on 12/5/93 after a storm event in which the concentration was 0.39 mg/L. In Tennessee and Virginia, dissolved arsenic levels in all samples were either not reported or were below detection limits.

### 5.15.3 Barium

Barium is considered an undesirable impurity in drinking water (Hem, 1985). According to Smoot, et al. (1991), it occurs in igneous and carbonate sedimentary rocks, and is found in low concentrations in most surface water. The proposed federal drinking water standard for total barium is 1.5 mg/L. Kentucky has established a domestic water supply criterion for total barium of 1.0 mg/L as Ba and Virginia has established a criterion of 2.0 mg/L as Ba for dissolved barium. Tennessee has not established a drinking water criterion for barium. No barium criteria have been established for the protection of aquatic life.

The Kentucky and federal criteria reported above are for total barium, but the samples were analyzed only for dissolved barium. It should be borne in mind that the discussion which follows is based only on the reported dissolved barium values.

Barium appears to have been sampled only two or three times per station, and at most stations, at least two of the samples were associated with storm events. In Kentucky, dissolved barium values ranged from below detection limits to about 0.04 mg/L. In Tennessee, they ranged

from below detection limits to 0.02 mg/L, and in Virginia, dissolved barium values generally ranged from 0.01 to 0.02 mg/L with a high of 0.20 mg/L at ST10.

### 5.15.4 Boron

Boron is a minor constituent of most waters, and it is essential for plant growth. One potential source is the weathering of granitic rocks and pegmatites (Hem, 1985). Neither Kentucky, Tennessee, Virginia, nor the federal government has established boron water-quality criteria. Sample values for dissolved boron ranged from below detection limits to about 0.06 mg/L

### 5.15.5 Bromide

Bromide is not known to have any ecological significance in small quantities. Sources of bromide include ethylene dibromide, a gasoline additive, and fumigants and fire-retardant agents (Hem, 1985). Neither Kentucky, Tennessee, Virginia, nor the federal government has established a bromide water-quality standard. Sample values for bromide were generally below detection limits; however, values of 0.4 and 0.8 mg/L were measured in samples from RR1 and YC5A, respectively.

### 5.15.6 Cadmium

Cadmium rarely occurs in water in other than very small amounts (Smoot, et al., 1991). Cadmium has a tendency to bioaccumulate in plants and can cause bone deterioration if the plants are consumed. Detectable concentrations are likely to be the result of contamination from the burning of fossil fuels or from leachate from industrial landfills (Hem, 1985). The federal drinking water standard for total cadmium is 0.01 mg/L with a proposed standard of 0.005 mg/L as Cd. Federal total cadmium standards for the protection of aquatic life are 0.0039 mg/L as Cd for acute exposure and 0.0011 mg/L as Cd for chronic exposure when a hardness level of 100 mg/L is used to calculate the standard. Kentucky does not have a drinking water criterion for total cadmium; however, total cadmium criteria for warmwater aquatic habitats are 0.004 mg/L as Cd for soft water and 0.012 mg/L as Cd for hard water. Tennessee has established a total cadmium criterion of 0.01 mg/L. Tennessee total cadmium criteria for the protection of aquatic life are 0.004 mg/l for a maximum concentration and 0.001 mg/L for a continuous concentration when a hardness level of 100 mg/L is used to calculate the criteria. Virginia has established a dissolved cadmium criterion for public water supplies of 0.016 mg/L and a criterion of 0.17 mg/L for all other water supplies. Virginia dissolved cadmium criteria for the protection of aquatic life are 0.0039 mg/L for acute exposure and 0.0011 mg/L for chronic exposure when a hardness level of 100 mg/L is used to calculate the criteria.

The Kentucky, Tennessee, and federal criteria reported above are for total cadmium, but the samples were analyzed only for dissolved cadmium. It should be borne in mind that the discussion which follows is based only on the reported dissolved cadmium values.

Cadmium analyses were performed on only one to three samples per station. Dissolved cadmium was below detection limits in all samples.

### 5.15.7 Chromium

Chromium is an essential trace element which is involved in glucose tolerance. In its hexavalent form, Cr (VI), it is also a possible carcinogen (Manahan, 1991). Concentrations of chromium in natural waters that have not been affected by waste disposal are commonly less than 0.01 mg/L (Hem, 1985). The federal drinking water standard for total chromium is 0.05 mg/L with a proposed standard of 0.12 mg/L. Federal total chromium criteria for aquatic life protection are 0.016 mg/L for Cr (VI) and 1.7 mg/L for Cr (III) for acute exposure and 0.011 mg/L for Cr (VI) and 0.21 mg/L for Cr (III) for chronic exposure when a hardness level of 100 mg/L is used to calculate the Cr (III) criteria. The Kentucky and Tennessee total chromium criteria are 0.05 mg/L as Cr for domestic water supplies and 0.10 mg/L as Cr for warmwater aquatic habitats. The Virginia total chromium criteria for public water supplies are 0.17 mg/L for Cr (VI) and 33.0 mg/L for Cr (III). For all other water supplies they are 3.4 mg/L and 670.0 mg/L, respectively . Virginia dissolved chromium criteria for the protection of aquatic life are 0.016 mg/L for Cr (VI) and 1.737 mg/L for Cr (III) for acute exposure and 0.011 mg/L for Cr (VI) and 0.207 mg/L for Cr (III) for chronic exposure when a hardness level of 100 mg/L is used to calculate the criteria.

The Kentucky, Tennessee, and federal criteria reported above are for total chromium, but the samples were analyzed only for dissolved chromium. It should be borne in mind that the discussion which follows is based only on the reported dissolved chromium values. In addition, it is assumed that all of the reported values are for hexavalent chromium, Cr (VI).

In Kentucky and Tennessee, dissolved chromium values were generally below detection limits; however, in a total of fourteen samples at six stations, dissolved chromium values ranged from 0.01 mg/L to 0.04 mg/L. These values are less than the Kentucky and Tennessee water quality criteria for total chromium. In Virginia, dissolved chromium values were below detection limits.

### 5.15.8 Copper

Copper is essential for plants and animals, which use it in the synthesis of chlorophyll and hemoglobin, respectively. Although it is toxic to algae, particularly in waters of low alkalinity, copper in water is not known to have an adverse effect on humans (Smoot, et al., 1991). Potential sources of copper include dissolution from copper pipes and plumbing fixtures, agricultural pesticide sprays, and algicides (Hem, 1985). The proposed federal total copper standard for drinking water is 1.3 mg/L, and the secondary standard is 1.0 mg/L. The federal total copper criteria for the protection of aquatic life are 0.018 mg/L for acute exposure and 0.012 mg/L for chronic exposure when a hardness level of 100 mg/L is used to calculate the criteria. Virginia has adopted the federal standards; however, it has applied them to dissolved copper. Kentucky has established a total copper criterion of 1.0 mg/l for domestic water supplies but has not established criteria for the protection of aquatic life. Tennessee does not have a total copper criterion for water supplies, but criteria for the protection of aquatic life are 0.018 mg/L as a maximum concentration and 0.012 mg/L as a continuous concentration when a hardness level of 100 mg/L is used to calculate the criteria.

The Kentucky, Tennessee, and federal criteria reported above are for total copper, but the samples were analyzed only for dissolved copper. It should be borne in mind that the discussion which follows is based only on the reported dissolved copper values.

In Kentucky, dissolved copper values were generally below detection limits, but ranged up to 0.02 mg/L on several occasions. These levels were well below the state drinking water criterion. In Tennessee, dissolved copper values were generally below detection limits, but in three samples from Gap Creek stations, they reached values of 0.02 to 0.04 mg/L. These values are higher than the Tennessee maximum and continuous concentration criteria for the protection of aquatic life, but the criteria are based on a hardness level of 100 mg/l. No attempt was made to recalculate the criteria to take into account the hardness level in the samples. In Virginia, dissolved copper concentrations in all samples were below detection limits.

### 5.15.9 Iron

Iron is an essential element in the metabolisms of plants and animals. If present in excess in water, however, it forms precipitates which stain laundry and plumbing fixtures (Hem, 1985). In addition, ferric hydroxide flocs may coat fish gills, and the precipitates may smother fish eggs and bottom-dwelling organisms. Coal mining exposes iron-bearing minerals associated with the coal; thus, mine drainage is a major source of iron in surface waters (Smoot, et al., 1991). The federal drinking water standard for total iron is 0.3 mg/L, and the chronic exposure standard for the protection of aquatic life is 1.0 mg/L as Fe. Kentucky has not established a drinking water criterion for total iron, but it has adopted the federal total iron standard for the protection of aquatic life. Virginia has adopted the federal drinking water standard for total iron; however, it has applied the standard to dissolved iron. Virginia has not established iron standards for the protection of aquatic life. Tennessee has not established any water-quality criteria for iron.

In Kentucky, total iron concentrations generally were less than the 1.0 mg/L criterion for the protection of aquatic life at all stations except DB5, where the criterion was exceeded in 40 percent of samples. A few isolated exceedances ranging from 1.1 to 3.5 mg/L also occurred at other stations (Figure 11). Dissolved iron concentrations in Kentucky ranged from below detection limits to 1.1 mg/L. In Tennessee, total iron concentrations in samples ranged from below detection limits to 1.5 mg/L, and dissolved iron concentrations ranged from below detection limits to 0.41 mg/L. In Virginia, total iron concentrations ranged from 0.09 to 1.3 mg/L, and dissolved iron concentrations ranged from 0.03 to 0.26 mg/L.

### 5.15.10 Lead

Acute lead poisoning in humans causes severe dysfunction in the kidneys, reproductive system, liver, and the brain and central nervous system. Mild lead poisoning causes anemia (Manahan, 1991). Lead has been dispersed throughout the environment by the use of leaded gasoline. Large amounts of lead can also be released by the burning of coal (Smoot, 1991).The

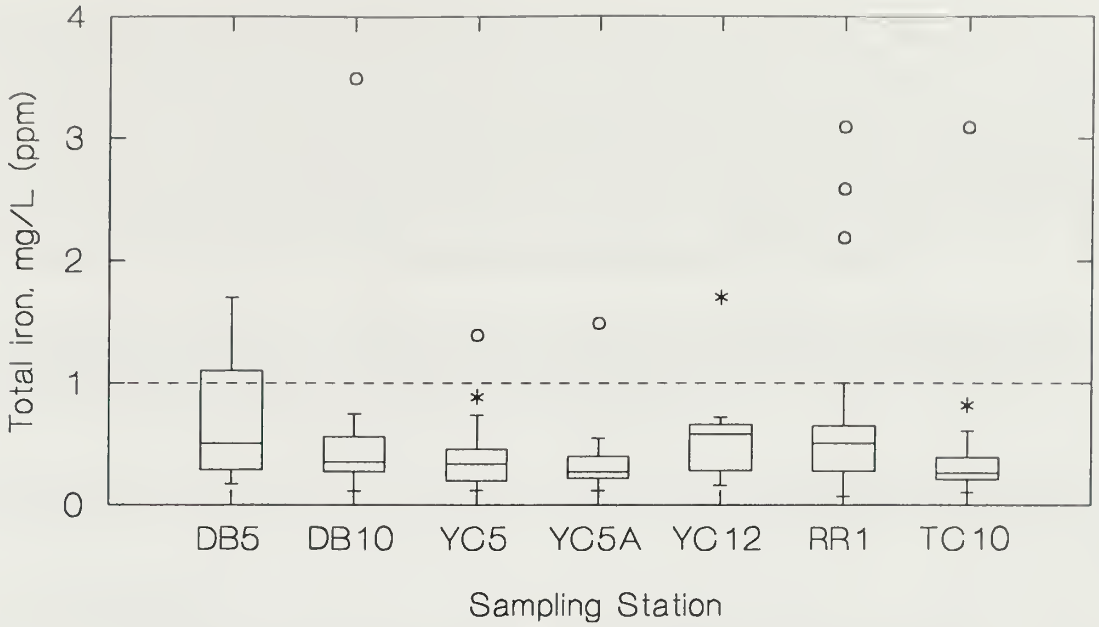

Figure 11. Total iron distribution at Kentucky stations - 1993
(Dotted line represents state criterion)
(See Appendix G for explanation of boxplot)

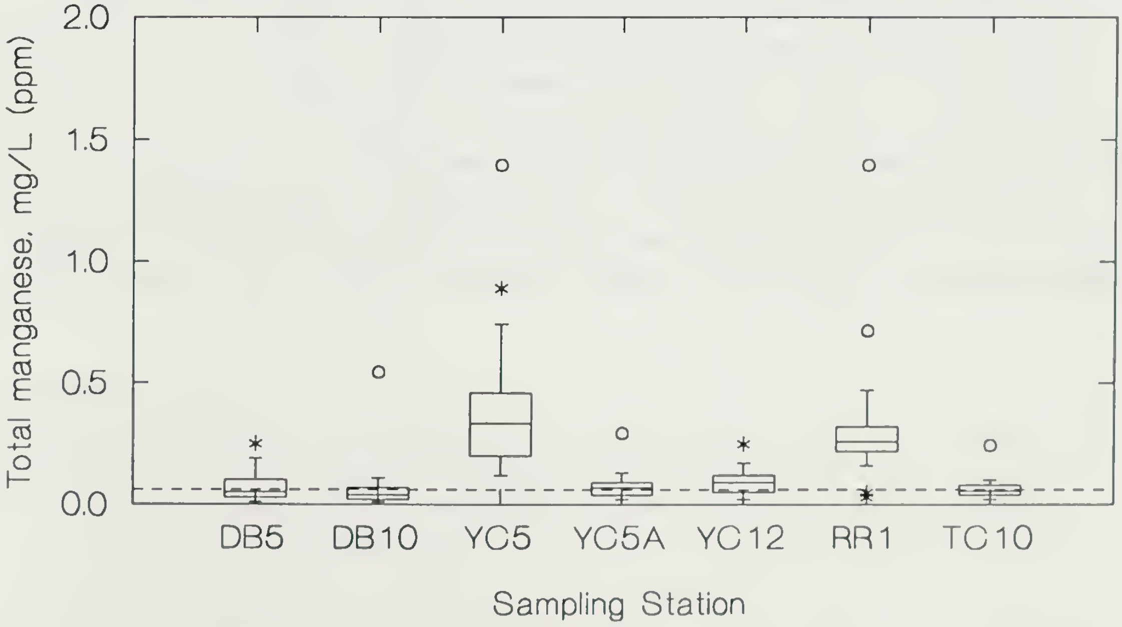

Figure 12. Total manganese distribution at Kentucky stations - 1993
(Dotted line represents state criterion)
(See Appendix G for explanation of boxplot)

federal drinking water standard for total lead is 0.05 mg/L with a proposed standard of 0.005 mg/L. The federal total lead criteria for the protection of aquatic life are 0.082 mg/L as Pb for acute exposure and 0.0032 mg/L for chronic exposure when a hardness level of 100 mg/L is used to calculate the criteria. Kentucky has adopted the federal total lead standard for drinking water but has not established total lead criteria for the protection of aquatic life. Tennessee and Virginia have adopted the federal total lead criteria for the protection of aquatic life as well as the federal total lead drinking water standard, but Virginia has applied them to dissolved lead.

The Kentucky, Tennessee, and federal criteria reported above are for total lead, but the samples were analyzed only for dissolved lead. It should be borne in mind that the discussion which follows is based only on the reported dissolved lead values.

Dissolved lead values were below detection limits in all but one sample collected after a storm event on 3/23/93 at YC5.

### 5.15.11 Manganese

Manganese is an essential element for both plants and animals; however, it is an undesirable impurity in water supplies chiefly because of its deposition of black oxide stains (Hem, 1985). Sources of manganese in water include the weathering of manganese-bearing rocks (Hem 1985), and drainage from coal mines (Smoot, et al., 1991). The federal drinking water standard for total manganese of 0.05 mg/L has been adopted by Kentucky, Tennessee, and Virginia, but Virginia has applied it to dissolved manganese. No manganese criteria for the protection of aquatic life have been established.

In Kentucky, total manganese concentrations often exceeded drinking water criteria at all stations, in particular, YC5 and RR1. Total manganese values generally ranged from below detection limits to about 0.55 mg/L, but higher values occurred in some samples (Figure 12). Dissolved manganese values ranged from below detection limits to 0.61 mg/L. In Tennessee, total manganese values generally ranged from below detection limits to about 0.09 mg/L with occasional higher values ranging up to 0.27 mg/L (TD1). Dissolved manganese values generally ranged from below detection limits to about 0.07 mg/l . In Virginia, total manganese levels generally ranged from below detection limits to 0.03 mg/l with high values of 0.27 and 0.40 mg/L at LH5 and ST10, respectively. Dissolved manganese values ranged from below detection limits to 0.03 mg/L.

### 5.15.12 Mercury

Mercury generates the most concern of any of the heavy-metal pollutants. Among the toxicological effects of mercury are neurological damage, chromosome breakage, and birth defects. Mercury enters the environment from a large number of sources such as discarded laboratory chemicals, broken thermometers, dry-cell batteries, fungicides, and pharmaceutical products. Sewage effluent sometimes contains up to ten times the amount of mercury found in typical natural waters (Manahan, 1991). The federal drinking water standard for total mercury is 0.002 mg/L, and federal total mercury criteria for the protection of aquatic life are 0.0024 mg/L

for acute exposure and 0.000012 mg/L ( 0.12 $\mu$g/L) for chronic exposure. Kentucky has established a total mercury criterion of 0.0002 mg/L for the protection of aquatic life but has not established a total mercury criterion for domestic water supplies. Tennessee has adopted federal total mercury standards for drinking water and for the protection of aquatic life. Virginia has adopted federal total mercury standards for the protection of aquatic life, but it has applied them to dissolved mercury. It has established dissolved mercury standards of 0.7 mg/L for public water supplies and 215.0 mg/L for all other water supplies.

The Kentucky, Tennessee, and federal criteria reported above are for total mercury, but the samples were analyzed only for dissolved mercury. It should be borne in mind that the discussion which follows is based only on the reported dissolved mercury values.

In Kentucky and Tennessee, only one or two samples were analyzed for dissolved mercury at each station. Samples collected in association with a storm event contained 0.83 to 1.13 mg/L of dissolved mercury, but samples which were not associated with a storm event contained concentrations below the detection limits. In Virginia, only one sample from each station was analyzed for dissolved mercury. The samples were associated with storm events and contained 0.58 to 1.1 mg/L of dissolved mercury.

### 5.15.13 Molybdenum

Molybdenum is a fairly rare element which is essential in animal and plant nutrition (Hem, 1985). The most common environmental source of molybdenum is the burning of fossil fuels (Smoot, et al, 1991). Neither Kentucky, Tennessee, Virginia, nor the federal government has established water criteria for molybdenum.

Only one or two samples from each station were analyzed for molybdenum. Dissolved molybdenum levels were below detection limits in all samples.

### 5.15.14 Nickel

Nickel, while relatively nontoxic to man, is toxic to a broad range of aquatic plants and animals. Its effects vary according to species, pH and synergistic effects. Nickel is a widely used industrial metal, and the improper disposal of industrial wastes can be a major source of nickel contamination (Hem, 1985). The federal government has not established drinking water standards for nickel. Federal total nickel water-quality criteria for the protection of aquatic life are 1.8 mg/L as Ni for acute exposure and 0.096 mg/L as Ni for chronic exposure when a hardness level of 100 mg/L is used to calculate the criteria. Kentucky has not established water-quality criteria for nickel. Tennessee has not established total nickel criteria for domestic water supplies, but its total nickel criteria for the protection of aquatic life are 1.4 mg/L as a maximum concentration and 0.16 mg/L as a continuous concentration when a hardness level of 100 mg/L is used to calculate the criteria. Virginia has established dissolved nickel criteria of 0.61 mg/L public water supplies and 4.58 mg/L for all other water supplies. The Virginia dissolved nickel criteria for the protection of aquatic life are 1.42 mg/L for acute exposure and 0.16 mg/L for chronic exposure when a hardness level of 100 mg/L is used to calculate the criteria.

The Kentucky, Tennessee, and federal criteria reported above are for total nickel, but the samples were analyzed only for dissolved nickel. It should be borne in mind that the discussion which follows is based on the reported dissolved nickel values.

In Kentucky, dissolved nickel concentrations were generally below detection limits, although several samples contained levels of 0.01 or 0.02 mg/L. Dissolved nickel levels of 0.2 and 2.6 mg/L were measured in two samples from SH10 and TC10, respectively. In Tennessee, dissolved nickel concentrations were generally below detection limits, although concentrations ranged from 0.01 to 0.02 mg/L in six samples. In Virginia, only two to three samples were collected at each station. Dissolved nickel concentrations in the samples were below detection limits.

### 5.15.15 Silicon

Silicon is the second most common element in the earth's crust after oxygen. In natural waters, it occurs as silica ($SiO_2$) (Hem, 1985). Silicosis is a common occupational disease resulting from human exposure to silica dust (Manahan, 1991), but apparently silica has no health or ecological effects in aqueous solution. Neither Kentucky, Tennessee, Virginia nor the federal government has established water-quality criteria for silica.

Sample values for dissolved silicon generally ranged from 1.3 to 5.9 mg/L. In two cases, however, dissolved silicon values were below the detection limit, and in one sample from DB10, a value of 12.0 mg/L was reported.

### 5.15.16 Strontium

Strontium chemistry is similar to that of calcium. Although it is interchangeable with calcium in bone (Manahan, 1991), it is usually not a water-quality concern unless its radioactive isotope, $^{90}Sr$, a product of atomic fission, is present (Hem, 1985). Neither Kentucky, Tennessee, Virginia, nor the federal government has established water-quality criteria for strontium.

Analyses for dissolved strontium were performed only on samples collected on 2/23/93 in association with a storm event. Dissolved strontium values ranged from below detection limits to 0.14 mg/L.

### 5.15.17 Titanium

Titanium is an abundant element in crustal rocks, but is usually present in natural waters only at very low levels (Hem, 1985). No references were encountered regarding any health or ecology-related effects of titanium in aquatic systems. Neither Kentucky, Tennessee, Virginia, nor the federal government has established water-quality criteria for titanium.

Sample values for dissolved titanium for the most part were below the detection limit. In eight samples, however, they ranged from 0.01 to 0.10 mg/L, and in 6 samples, dissolved titanium values ranged from 3.0 to 9.8 mg/L.

### 5.15.18 Vanadium

Vanadium is involved in biochemical processes in living matter. It is present in coal and petroleum and may be released to the environment when those fuels are burned (Hem, 1985). Little is known of the effects of vanadium on aquatic organisms; however, it accumulates in certain animal organs (Smoot, et al., 1991). Neither Kentucky, Tennessee, Virginia, nor the federal government has established water-quality criteria for vanadium.

Sample values for dissolved vanadium were generally below the detection limit; however, values from seven samples ranged from 0.01 to 0.07 mg/L.

### 5.15.19 Zinc

Zinc is essential in plant and animal enzyme metabolism, and it aids wound healing. It is toxic to plants at higher levels (Manahan, 1991). At concentrations greater than 5 mg/L, a significant number of people can detect zinc by taste, but no health effects are considered likely (Hem, 1985). Zinc is a major component of sewage sludge (Manahan, 1991) which if improperly disposed of could provide a potential source of zinc. Other potential sources are runoff from mining areas and industrial and urban wastes from galvanized pipes (Smoot, et al., 1991). The federal drinking water standard for total zinc is 5.0 mg/L, and the federal total zinc criteria for the protection of aquatic life are 0.32 mg/L as Zn for acute exposure and 0.047 mg/L as Zn for chronic exposure when a hardness level of 100 mg/L is used to calculate the criteria. Kentucky has not established a zinc criterion for domestic water supplies, but it has adopted the federal total zinc criterion of 0.047 mg/L for the protection of aquatic life. Tennessee has not established a zinc criterion for domestic water supplies, but it has established total zinc criteria for the protection of aquatic life of 0.117 mg/L as a maximum concentration and 0.106 mg/L as a continuous concentration when a hardness level of 100 mg/L is used to calculate the criteria. Virginia has adopted the federal total zinc drinking water standard for public water supplies, and its zinc standards for the protection of aquatic life are identical to those of Tennessee; however, Virginia standards apply to dissolved, rather than total, zinc.

The Kentucky, Tennessee, and federal criteria reported above are for total zinc, but the samples were analyzed only for dissolved zinc. It should be borne in mind that the discussion which follows is based only on the reported dissolved zinc values.

In Kentucky, dissolved zinc values generally ranged from below the detection limit to 0.04 mg/L, but at TC10, RR1, and YC5, values from 0.5 to 0.6 mg/L were measured which are above the Kentucky criteria for the protection of aquatic life if 100 mg/L of hardness is assumed. Even higher values of 4.2 and 4.5 mg/L for dissolved zinc were measured in two samples from DB5 and SH10, respectively. In Tennessee, dissolved zinc values ranged from below the detection limit to 0.05 mg/L. The values are below the Tennessee criteria for total zinc when 100 mg/L hardness is assumed. In Virginia, dissolved zinc values ranged from below the detection limit to 0.02 mg/L. These values are below the Virginia criteria for dissolved zinc when 100 mg/L of hardness is assumed. No attempt was made to recalculate criteria to take into account the hardness levels in the samples.

**Table 8. Guidelines for the Pollutional Classification of Great Lakes Harbor Sediments Established by the U. S. Environmental Protection Agency, Region V. (1977)**

| Parameter | Nonpolluted | Moderately Polluted | Heavily Polluted |
|---|---|---|---|
| Ammonia (mg/kg dry wt.) | < 75 | 75 - 200 | > 200 |
| Arsenic (mg/kg dry wt.) | < 3 | 3 - 8 | > 8 |
| Barium (mg/kg dry wt.) | < 20 | 20 - 60 | > 60 |
| Cadmium (mg/kg dry wt.) | * | * | * |
| Chromium (mg/kg dry wt.) | < 25 | 25 - 75 | > 75 |
| COD (mg/kg dry wt.) | < 40,000 | 50,000 - 80,000 | > 80,000 |
| Copper (mg/kg dry wt.) | < 25 | 25 - 50 | > 50 |
| Cyanide (mg/kg dry wt.) | < 0.10 | 0.10 - 0.25 | > 0.25 |
| Iron (mg/kg dry wt.) | < 17,000 | 17,000 - 25,000 | > 25,000 |
| Lead (mg/kg dry wt.) | < 40 | 40 - 60 | > 60 |
| Manganese (mg/kg dry wt.) | < 300 | 300 - 500 | > 500 |
| Mercury (mg/kg dry wt.) | * | 1 | > 1 |
| Nickel (mg/kg dry wt.) | < 20 | 20 - 50 | > 50 |
| Oil & Grease (Hexane solubles, mg/kg dry wt.) | < 1,000 | 1,000 - 2,000 | > 2,000 |
| Phosphorous (mg/kg dry wt.) | < 420 | 420 - 650 | > 650 |
| TKN mg/kg dry wt.) | < 1,000 | 1,000 - 2,000 | > 2,000 |
| Total PCBs (mg/kg dry wt.) | * | 10 | > 10 |
| Volatile Solids (%) | < 5 | 5 - 8 | > 8 |
| Zinc (mg/kg dry wt.) | < 90 | 90 - 200 | > 200 |

* Limits not established

### 5.16 Oil and grease

Oil and grease analyses are used to determine whether waters are being contaminated with petroleum products. Sources relevant to this study would include leaks and spills of fuels or motor oils required for construction machinery.

In Kentucky waters, oil and grease values were below the detection limit at DB5 but ranged from 0.05 to 3.0 mg/L at DB10. AT RR1, oil and grease values ranged from 0.03 to 0.6 mg/L, and at TC10 they ranged from below the detection limit to 6.0 mg/L. In Little Yellow Creek, oil and grease values were below the detection limit at YC5 and YC12, but they ranged from below the detection limit to 2.0 mg/L at YC5A, which is a short distance downstream from the mouth of Tunnel Creek. In Tennessee waters, Oil and grease values were below the detection limit at GC3, but ranged from below the detection limit to 3.4 mg/L and 1.5 mg/L at GC4 and GC7, respectively. Oil and grease values ranged from below the detection limit to 4.0 mg/L at TD1. In Virginia waters, oil and grease values were generally not reported .

## 6. Streambed-sediment chemistry - 1993

### 6.1 Sediment parameters and criteria

In the CUGA water monitoring program, a total of 40 constituents and physical properties are reported for sediment samples rather than the 55 that are reported for some water samples (Table 7). Because no federal or state criteria for streambed pollutants are known to exist (Nodvin and Rhodes, 1994), this report follows the practice established in previous reports (Nodvin and Rhodes, 1993b, 1994; Moore and Smoot, 1993) of applying the harbor pollution guidelines developed for great lakes harbor sediments (U. S. EPA, 1977) as pollution guidelines for the streambed sediment samples collected during this study (Table 8). Only 12 of the 40 sediment parameters measured in this study are included among the 19 pollutants for which guidelines are listed in Table 8.

### 6.2 Sediment sampling methods

Sediment samples are collected quarterly from selected stations by means of a stainless steel spoon and bucket. They are composited from at least three areas at a site, and bankside deposits are avoided. Samples are stored in pre-cleaned borosilicate glass freezer jars with teflon-lined lids (Nodvin and Rhodes, 1993a).

### 6.3 Analytical results - constituents

#### 6.3.1 Aluminum

Aluminum concentrations in sediment samples ranged from 0.2 to 183.0 mg/kg for Davis Branch, 2.3 to 494.0 mg/kg for Gap Creek, 11.6 to 589.0 mg/kg for Tunnel Creek, and 0.6 to 299.0 mg/kg for Little Yellow Creek. Concentrations in samples from other streams ranged from 3.1 to 512.0 mg/kg. No guidelines for aluminum are included in Table 8.

### 6.3.2 Arsenic

Arsenic concentrations were below detection limits in all samples. These sediments can be classified as nonpolluted with regard to arsenic according to the guidelines of Table 8.

### 6.3.3 Barium

With regard to barium, sediment samples from Tunnel Creek and Little Yellow Creek were nonpolluted, with barium concentrations of less than 20 mg/kg. Samples from Gap Creek , Davis Branch, Lewis Hollow, Station Creek, and Sugar Run, were nonpolluted to moderately polluted, with barium concentrations ranging from 9.4 to 55.5 mg/kg. Moderate to heavy pollution was measured in three samples from TD1, with barium concentrations ranging from 46.2 to 94.8 mg/kg although the barium concentration in a fourth sample was less than 1.0 mg/kg.

### 6.3.4 Boron

Boron concentrations in sediment samples ranged from 0.1 to 2.8 mg/kg for Davis Branch, 0.14 to 3.31 mg/kg for Gap Creek, 0.12 to 2.20 mg/kg for Tunnel Creek, and 0.02 to 3.6 mg/kg for Little Yellow Creek. Concentrations in samples from other streams ranged from below detection limits to 3.4 mg/kg. No guidelines for boron are included in Table 8.

### 6.3.5 Bromine

Bromine concentrations in sediment samples were below the detection limit in all but two samples. Concentrations of 0.5 and 7.0 mg/kg were measured in samples from TC10 and TD1, respectively. No guidelines for bromine are included in Table 8.

### 6.3.6 Cadmium

Cadmium concentrations were below the detection limit in sediment samples from Davis Branch, Little Yellow Creek, and Sugar Run. In Gap Creek, Station Creek, and Lewis Hollow samples, they ranged from below the detection limit to 0.30 mg/kg. In sediment samples from TD1, cadmium concentrations ranged from below the detection limit to 0.95 mg/kg. Although cadmium is listed as a parameter in Table 8, no guidelines are provided, since limits have not been established.

### 6.3.7 Calcium

Calcium concentrations in sediment samples ranged from 5 to 4020 mg/kg for Davis Branch, 59 to 12,600 mg/kg for Gap Creek, 71 to 19,299 mg/kg for Tunnel Creek, 3 to 4760 mg/kg for Little Yellow Creek, 9 to 15,500 for Station Creek, 130 to 17,900 at TD1, 12 to 1140 for Lewis Hollow, and a calcium concentration of 7,820 was measured in one sample from Sugar Run. No guidelines for calcium are included in Table 8.

### 6.3.8 Carbon, total

Total carbon concentrations in all sediment samples ranged from 3.2 to 37.0 mg/kg. No guidelines for total carbon are listed in Table 8.

### 6.3.9 Carbon, total organic

Total organic carbon concentrations in all sediment samples ranged from below the detection limit to 94.0 mg/kg. No guidelines for total organic carbon are listed in Table 8.

### 6.3.10 Chloride

Chloride concentrations in most sediment samples ranged from 0.6 mg/kg to 61.o mg/kg; however, a chloride concentration of 630.0 mg/kg was measured in a sample collected at YC5 on 1/23/93. No guidelines for chloride are listed in Table 8.

### 6.3.11 Chromium

Chromium values in most sediment samples ranged from below the detection limit to 0.2 mg/kg; however, values of 1.5, 6.3, and 11.0 mg/kg were measured in samples from TD1, TC10, and YC5A, respectively. All of the samples contained chromium concentrations of less than 25 mg/l; therefore, they are classified as "nonpolluted" with regard to chromium according to the guidelines of Table 8.

### 6.3.12 Cobalt

Cobalt concentrations in sediment samples ranged from below the detection limit to 3.7 mg/kg. No guidelines for cobalt are listed in Table 8.

### 6.3.13 Copper

Copper concentrations in sediment generally ranged from below the detection limit to 5.82 mg/kg; however, a concentration of 16.0 mg/kg was measured in a sample collected at TD1 on 7/6/93. All of the samples contained copper concentrations of less than 25 mg/kg; therefore, they are classified as "nonpolluted" with regard to copper according to the guidelines of Table 8.

### 6.3.14 Fluoride

Fluoride concentrations ranged from below the detection limit to 9.0 mg/kg in samples from Davis Branch and Lewis Hollow. In other samples, they ranged from below the detection limit to 90.4 mg/kg. No guidelines for fluoride are listed in Table 8.

### 6.3.15 Germanium

Germanium concentrations were below the detection limit in all sediment samples. No guidelines for germanium are listed in Table 8.

### 6.3.16 Iron

Iron concentrations in sediment samples ranged form below the detection limit to 878.0 mg/kg. All of the samples contained iron concentrations of less than 17,000 mg/kg; therefore, they are classified as "nonpolluted" with regard to iron according to the guidelines of Table 8.

### 6.3.17 Lead

Lead concentrations in sediment samples ranged from below the detection limit to 12.0 mg/kg. All of the samples contained lead concentrations of less than 40 mg/kg; therefore, they are classified as "nonpolluted" with regard to lead according to the guidelines of Table 8.

### 6.3.18 Lithium

Lithium concentrations were below the detection limit in all sediment samples. No lithium guidelines are listed in Table 8.

### 6.3.19 Magnesium

Magnesium concentrations in sediment samples generally ranged from about 0.5 to 920 mg/kg; however, a concentration of 4,900 mg/kg was measured in a sample from TD1 that was collected on 10/19/93. No magnesium guidelines are listed in Table 8.

### 6.3.20 Manganese

Manganese concentrations in sediment samples generally ranged from 2.4 to 289 mg/kg. Thus, since they contained manganese concentrations of less than 300 mg/kg, these samples would be classified as "nonpolluted" with regard to manganese according to the guidelines in Table 8. One sample collected at TD1 on 10/19/93 contained a manganese concentration of 361 mg/kg; it would therefore be classified as "moderately polluted" with regard to manganese.

### 6.3.21 Mercury

Mercury concentrations were below the detection limit in all sediment samples. No guideline has been established below which a sediment would be considered "nonpolluted" with regard to mercury (Table 8); however, all of the sample concentrations were lower than the 1 mg/kg guideline for "moderately polluted" sediments.

### 6.3.22 Molybdenum

Molybdenum concentrations were below the detection limit in all sediment samples. No molybdenum guidelines are listed in Table 8.

### 6.3.23 Nickel

Nickel concentrations in all sediment samples ranged from below the detection limit to 3.80 mg/kg. Thus, since they contained nickel concentrations of less than 20 mg/kg, they would be classified as "nonpolluted" with regard to nickel according to the guidelines in Table 8.

### 6.3.24 Nitrate

Nitrate concentrations in sediment samples ranged from below the detection limit to 55.0 mg/kg. No nitrate guidelines are listed in Table 8.

### 6.3.25 Nitrite

Nitrite concentrations in sediment samples ranged from below the detection to 16.0 mg/kg. No nitrite guidelines are listed in Table 8.

### 6.3.26 Orthophosphate

Orthophosphate concentrations in sediment samples were below the detection limit. No orthophosphate guidelines are listed in Table 8.

### 6.3.27 Phosphorous

Phosphorous concentrations in sediment samples ranged from below the detection limit to 50.0 mg/kg . All of the samples contained less than 420 mg/kg of phosphorous; therefore, they would be classified as "nonpolluted" with regard to phosphorous, according to the guidelines in Table 8.

### 6.3.28 Potassium

Potassium concentrations in sediment samples ranged from below the detection limit to 120.0 mg/kg. No potassium guidelines are listed in Table 8.

### 6.3.29 Silicon

Silicon concentrations in sediment samples ranged from below the detection limit to 830.0 mg/kg. No silicon guidelines are listed in Table 8

### 6.3.30 Sodium

Sodium concentrations in sediment samples ranged from below the detection limit to 55.0 mg/kg. No sodium guidelines are listed in Table 8.

### 6.3.31 Strontium

Strontium concentrations in sediment samples ranged from below the detection limit to 22.0 mg/kg. No strontium guidelines are listed in Table 8.

### 6.3.32 Sulfate

Sulfate concentrations in sediment samples generally ranged from below the detection limit to 310.0 mg/kg; however, a sulfate concentration of 1,100.0 mg/kg was measured in a sample from TC10 that was collected on 6/1/93. No sulfate guidelines are listed in Table 8.

### 6.3.33 Sulfur, total

Total sulfur concentrations were quite low in sediment samples collected on 1/26/93 and 6/1/93, ranging from below the detection limit to 0.34 mg/kg; however, concentrations in samples collected on 7/6/93 ranged from 154.0 to 1,930.0 mg/kg. The SR10 sample collected on 7/6/93, in which the total sulfur concentration was below the detection limit, was the exception to the pattern. No total sulfur guidelines are listed in Table 8.

### 6.3.34 Titanium

Titanium concentrations in sediment samples ranged from below the detection limit to 6.5 mg/kg. No titanium guidelines are listed in Table 8.

### 6.3.35 Vanadium

Vanadium concentrations in sediment samples were below detection limits in all but one sample. A vanadium concentration of 2.2 mg/kg was measured in a sample collected at YC5A on 10/19/93. No vanadium guidelines are listed in Table 8.

### 6.3.36 Zinc

Zinc concentrations in sediment samples ranged from below the detection limit to 39.8 mg/kg. All of the samples contained zinc concentrations of less than 90 mg/kg; therefore, they are classified as "nonpolluted" with regard to zinc according to the guidelines of Table 8.

## 6.4 Analytical results - properties

### 6.4.1 Acidity, potential

Potential acidity is a calculated quantity which is based on a sample's total sulfur content. It is calculated according to the formula: Potential acidity = % total sulfur in sample x 31.25, and it is reported in terms of calcium carbonate (Harwood, 1994. Personal communication). Potential acidity in sediment samples ranged from below the detection limit to 11.0 mg/kg. No potential acidity guidelines are listed in Table 8.

### 6.4.2 Acid-base account, net

The net acid-base account is calculated as the difference between the neutralization potential and the potential acidity (Harwood, 1994. Personal communication). Reported values ranged from 1.1 to 300.0 mg/kg although some of the values were incorrectly calculated as sums, rather than as differences. No net acid-base account guidelines are listed in Table 8.

### 6.4.3 Neutralization potential

The neutralization potential is a measure of the alkalinity of a solid sample. It is reported in terms of calcium carbonate (Harwood, 1994. Personal communication). Neutralization potential values in sediment samples ranged from 1.15 to 297.0 mg/kg. No neutralization potential guidelines are listed in Table 8.

### 6.4.4 Paste pH

Paste pH is the pH value of a slurry formed from a solid sample (Harwood, 1994. Personal communication). Paste pH values of sediment samples ranged from 4.6 to 8.6. No paste pH guidelines are listed in Table 8.

# 7.0 Recommendations

## 7.1 Introduction

Generally, a parameter (a particular constituent or property of a water or sediment) should be included in a monitoring program when its excess or deficiency could adversely affect aquatic

biota, other users of the water, or esthetics, or when knowledge of its magnitude would aid in predicting the possible effects of other parameters. If a parameter does not meet these criteria, it might be wise to consider deleting it from the monitoring program, since its inclusion might fail to advance the purposes of the program, be economically unjustified, or be a source of potential confusion and unnecessary labor when interpreting data or preparing reports.

Many of the most important water-quality parameters are listed by the federal and state governments with accompanying criteria for each for the protection of aquatic life, human health, and recreation. The criteria become enforceable standards when applied to a particular water and the parameters to which they refer should, therefore, be included in any monitoring program involving that water. Some parameters which may have been perceived by government to carry lower risk and for which no water quality criteria exist may still be included in a particular monitoring program for the sake of completeness or to avoid potential liability. Others may be included in order to monitor project-specific activities or conditions, and in some cases, it might be desirable to monitor a parameter of minor significance long enough to establish the range of concentrations over which it is normally present. The following sections suggest parameters that for the reasons described above might possibly be considered for addition to or deletion from the CUGA water monitoring program. Other possible changes are suggested relevant to the analyses performed and the way the parameters are presently reported.

### 7.2 Water quality

Consideration should be given to deleting the following from analyses performed on water samples:

| | |
|---|---|
| Boron: | no established criteria, adverse effects unlikely, poor pollution indicator, sufficient baseline data obtained |
| Bromide | no established criteria, adverse effects unlikely, limited pollution indicator, sufficient baseline data obtained |
| Carbonate: | no established criteria, adverse effects unlikely, appreciable amounts present only at pH>10 |
| Fluoride: | criteria and adverse effects only for drinking water, poor pollution indicator, sufficient baseline data obtained |
| Molybdenum: | no established criteria, adverse effects unlikely, poor pollution indicator, sufficient baseline data obtained |
| Orthophosphate: | no established criteria, adverse effects unlikely, sufficient baseline data obtained |
| Potassium: | no established criteria, adverse effects unlikely, poor pollution indicator, sufficient baseline data obtained |
| Silicon: | no established criteria, adverse effects unlikely, poor pollution indicator, sufficient baseline data obtained |
| Strontium: | no established criteria, adverse effects unlikely, poor pollution indicator, sufficient baseline data obtained |

Titanium: no established criteria, adverse effects unlikely, poor pollution indicator, sufficient baseline data obtained

Vanadium: no established criteria, adverse effects unlikely, poor pollution indicator, sufficient baseline data obtained

Recommended additions to the program are as follows:

Ammonia, total: listed in federal and Kentucky water-quality criteria

Antimony: listed in Tennessee water-quality criteria

Beryllium: listed in Kentucky and Tennessee water-quality criteria

Cyanide: listed in federal, Kentucky, Virginia, and Tennessee water-quality criteria

Phosphorous, total: listed in Virginia water-quality criteria

Selenium: listed in federal, Kentucky, Tennessee, and Virginia water-quality criteria

Silver: listed in federal, Kentucky, Tennessee, and Virginia water-quality criteria

It is also evident that for most of the metals, only dissolved values are reported, whereas federal, Kentucky, and Tennessee criteria are based upon values for the total metals. Only Virginia criteria are based upon dissolved values. It is recommended that a decision be made to report both total and dissolved values or, since most of the active areas of the project are in Kentucky and Tennessee, to report total values only.

### 7.3 Sediments

Consideration should be given to deleting the following from analyses performed on sediment samples:

Boron: recommended for deletion from water analyses

Bromide: recommended for deletion from water analyses

Cobalt: no guidelines established, adverse effects unlikely, poor pollution indicator

Fluoride: recommended for deletion from water analyses

Germanium: no guidelines established, not included in water analyses, sufficient baseline data obtained

Molybdenum: recommended for deletion from water analyses

Orthophosphate: recommended for deletion from water analysis

Potassium: recommended for deletion from water analyses

Silicon: recommended for deletion from water analyses

Strontium: recommended for deletion from water analyses

Titanium: recommended for deletion from water analyses

Vanadium: recommended for deletion from water analyses

Consideration should be given to adding the following to the analyses performed on sediment samples:

Ammonia: guidelines established, recommended for addition to water analyses

Cyanide: guidelines established, recommended for addition to water analyses

## 8.0 Trend analysis

### 8.1 Introduction

Historically, human-related sources of degradation to the water quality of the streams being monitored are likely to have included, among others, timbering, mining, road construction, urban runoff, and leachate from septic systems. Due to the scarcity of historical data, it is difficult to determine whether the changes reached an equilibrium level at some time in the past or whether they are continuing. Information that would help to answer this question could be important in interpreting the findings of the present study. If stream water quality was at equilibrium when construction began on the tunnel, then observed changes might well be attributed to construction activities. On the other hand, ongoing historical water quality trends could be erroneously perceived as resulting from recent construction activities, thus raising needless concerns about the impact of construction on park streams.

### 8.2 Evaluation of historical trends-Davis Branch and Little Yellow Creek

A search was made of the U. S. EPA's STORET database, which contains sampling sites and their associated quality data, to determine whether it contained information regarding any of the watersheds in the park. Only two entries were found. They contained water quality data that had been collected in the vicinity of Middlesboro, Kentucky, on Little Yellow Creek and Davis Branch, from 5/27/64 through 9/22/64 (Appendix E). The mean values of several parameters

represented in the 1964 data (Table 9) were compared to the distributions of measured concentrations of the same parameters from samples collected at YC5 and DB10 in 1993. These stations were chosen to represent streams or stream reaches that have not been disturbed by recent construction activities. The distributions are represented by Tukey box plots, which are explained in Appendix G.

The differences between the 1964 and 1993 data do not appear to be very great. This suggests that present water quality in areas of Little Yellow Creek upstream from TC10 and in Davis Branch is reasonably close to that of 30 years ago. Although the 1964 manganese concentrations were found to be far upper outliers to the 1993 distributions of manganese concentrations in both streams (Figure 13), 1964 levels of most other parameters are within the interquartile ranges or outer adjacent values or are outliers of 1993 distributions. The 1964 total alkalinity concentrations are within the 1993 range, although in Davis Branch, the 1964 value lies slightly outside the 1993 interquartile range (Figure 14). In Davis Branch, the 1964 chloride value is slightly less than the upper adjacent value of the 1993 distribution, but in Little Yellow Creek, it is an outlier of a very narrow chloride distribution (Figure 15). The 1964 conductivity value is just outside the upper hinge of the 1993 interquartile range in Davis Branch, and it is below the median but within the interquartile range in Little Yellow Creek (Figure 16). The 1964 concentrations of total iron lie within the lower half of the 1993 interquartile range in both the Davis Branch and the Little Yellow Creek distributions (Figure 17). The 1964 sulfate concentration is within the upper adjacent value of the 1993 Davis Branch distribution, but it appears to be positioned as an outlier to the relatively narrow 1993 sulfate distribution in Little Yellow Creek (Figure 18). The 1964 pH value is very close to the median value of the 1993 Davis Branch distribution, but it is located not far above the lower adjacent value of the Little Yellow Creek distribution (Figure 19). The 1964 concentration of $HCO_3^-$ is positioned as a far upper outlier to the 1993 Davis Branch distribution, but it lies near the median of the relatively narrow 1993 distribution of $HCO_3^-$ concentrations in Little Yellow Creek (Figure 20).

### 8.3 Evaluation of recent trends - Tunnel Creek, Davis Branch and Little Yellow Creek

The importance, as well as the occurrence, of contamination events are often not recognized until their effects upon the stream's aquatic biota become evident. It was for this reason that a program of quarterly sampling of benthic macroinvertebrates was initiated in conjunction with the CUGA water monitoring program. The results of the program through 5/93 are presented in Skelton and Eisenhour (1993). A summary of the results is contained in Appendix D

A review of data from TC10 in Tunnel Creek suggests that sedimentation and/or pH fluctuations have had a catastrophic impact on the abundance of benthos in that stream. Figure 21 shows that from 7/91 through 12/91, discharges of water with pH near 4.0 and suspended sediment loads of up to 615 mg/L were measured at TC10. The affect on benthic organisms is evident in Figure 22. The number of specimens declined from an average of 57 per sample prior to 8/91 to an average of about 2 per sample after 9/91.

**Table 9. Mean values of selected 1964 water quality parameters [1]**

| Parameter | Davis Branch | Little Yellow Creek |
|---|---|---|
| Alkalinity, total (mg/L) | 91.5 | 10.0 |
| Chloride (mg/L) | 17.5 | 1.7 |
| Conductivity ($\mu$g/L) | 270.0 | 30.7 |
| $HCO_3^-$ (mg/L) | 112.0 | 12.0 |
| Iron, total ($\mu$g/L) | 320.0 | 240.0 |
| Manganese ($\mu$g/L) | 215.0 | 583.0 |
| pH (S.U.) | 7.4 | 6.5 |
| Sulfate (mg/L) | 23.0 | 5.1 |

[1] From U, S. EPA STORET database (Appendix E)

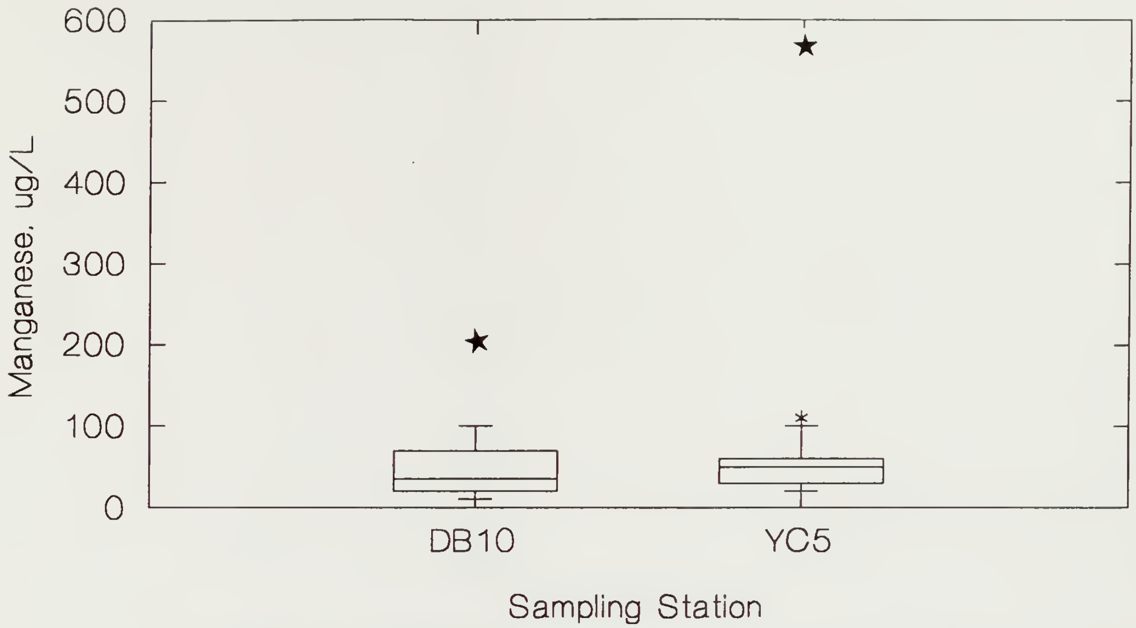

Figure 13. Dissolved manganese distribution at DB10 and YC5 - 1993
(★ = 1964 mean)
(See Appendix G for explanation of boxplot)

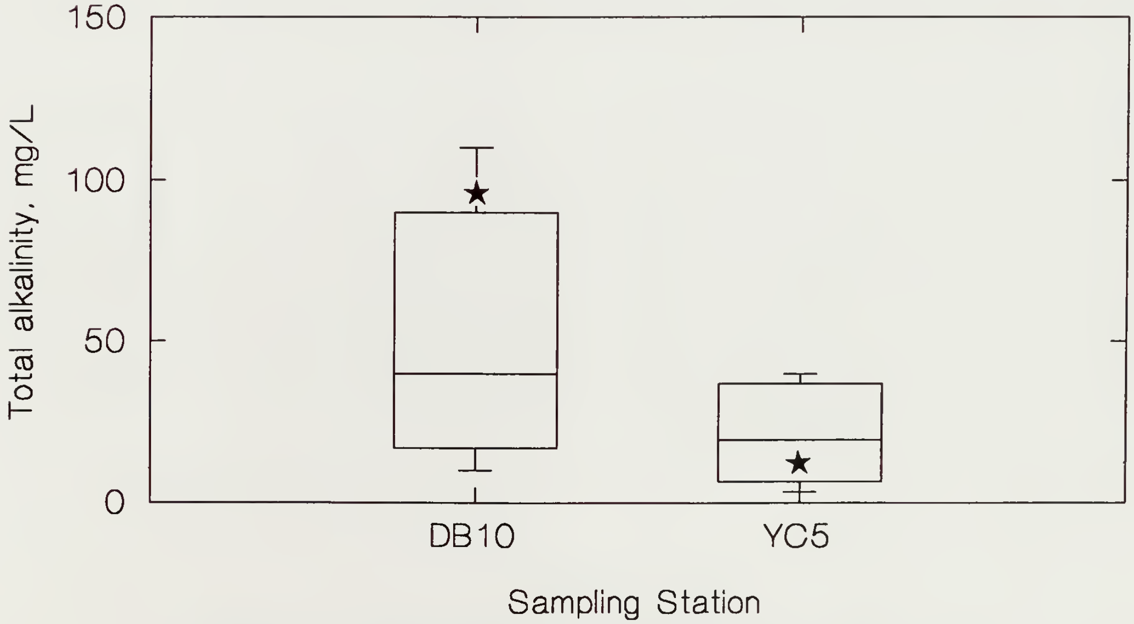

Figure 14. Total alkalinity distribution at DB10 and YC5 - 1993
(★ = 1964 mean)
(See Appendix G for explanation of boxplot)

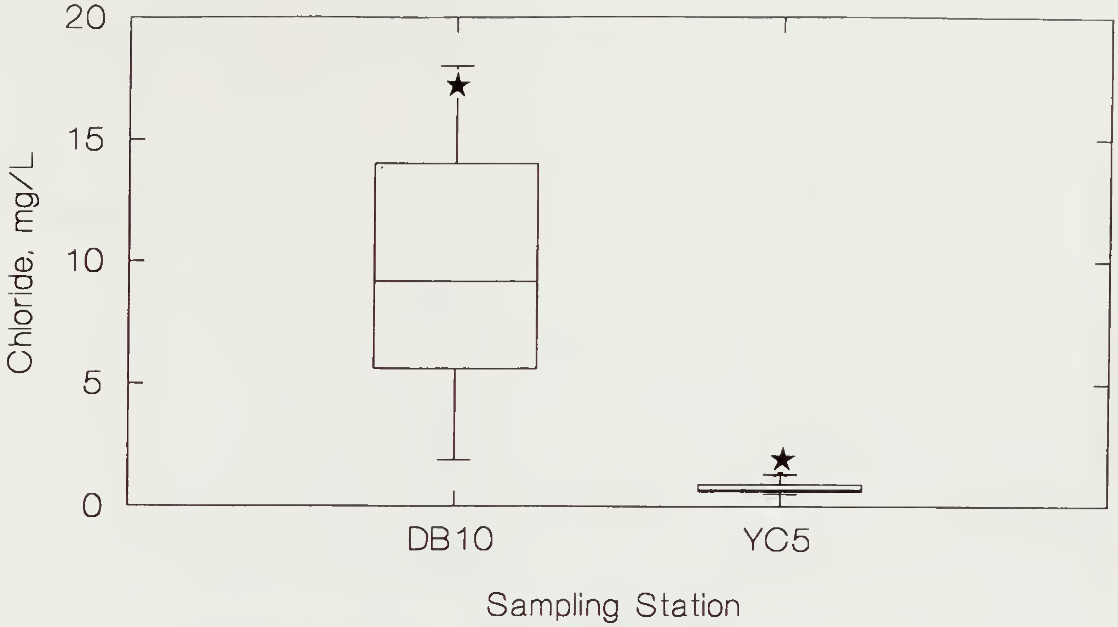

Figure 15. Chloride distribution at DB10 and YC5 - 1993
(★ = 1964 mean)
(See Appendix G for explanation of boxplot)

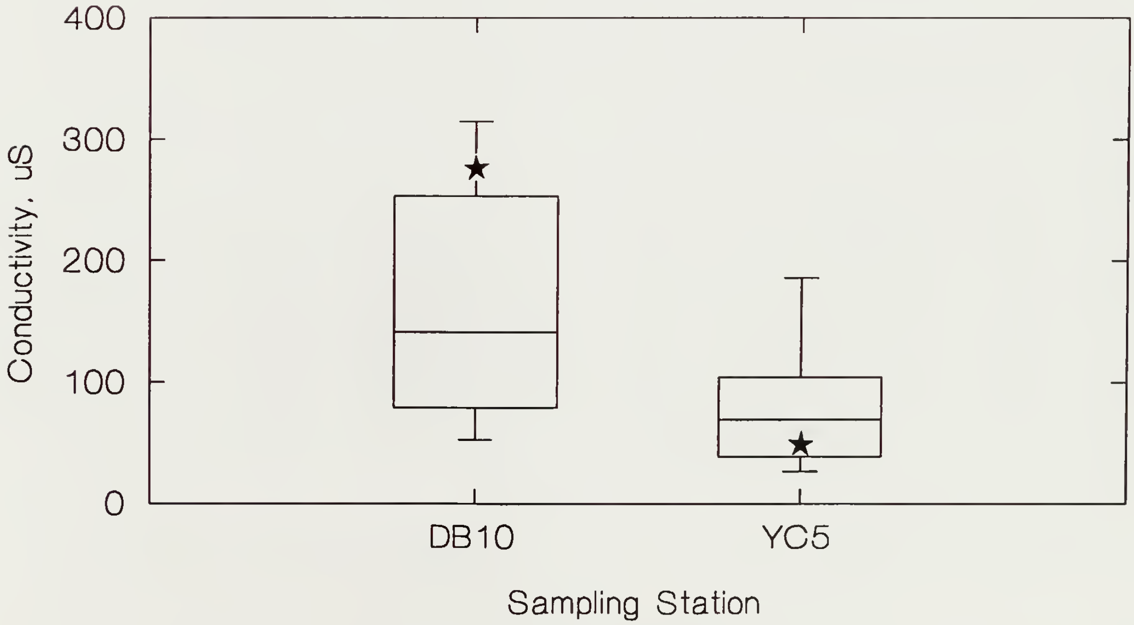

Figure 16. Conductivity distribution at DB10 and YC5 - 1993
(★ = 1964 mean)
(See Appendix G for explanation of boxplot)

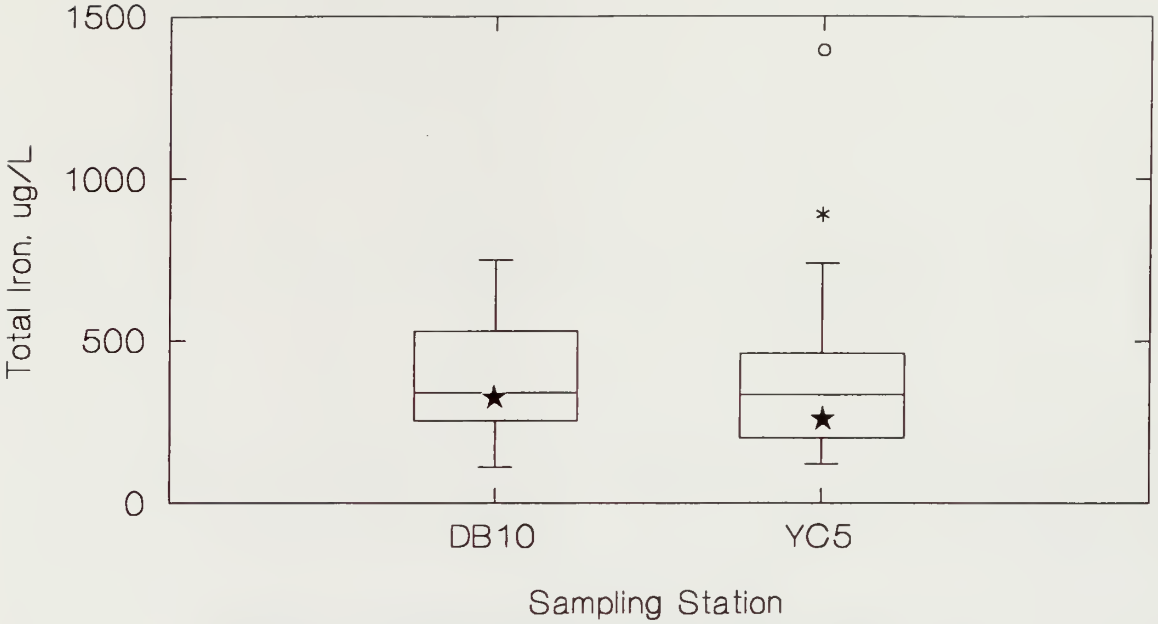

Figure 17. Total iron distribution at DB10 and YC5 - 1993
(★ = 1964 mean)
(See Appendix G for explanation of boxplot)

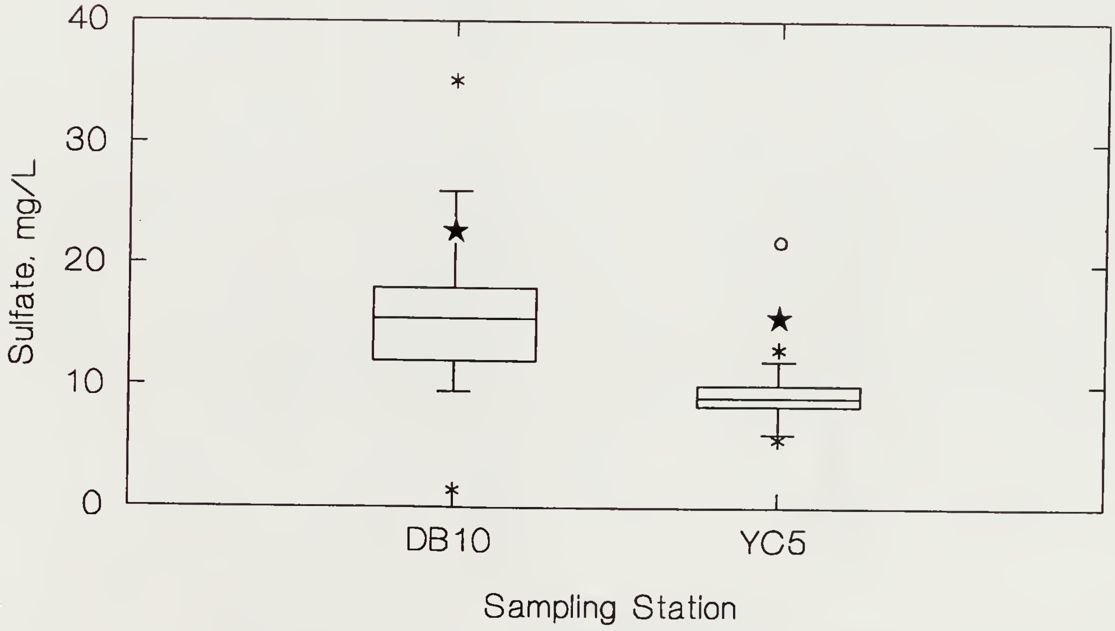

Figure 18. Total sulfate distribution at DB10 and YC5 - 1993
(★ = 1964 mean)
(See Appendix G for explanation of boxplot)

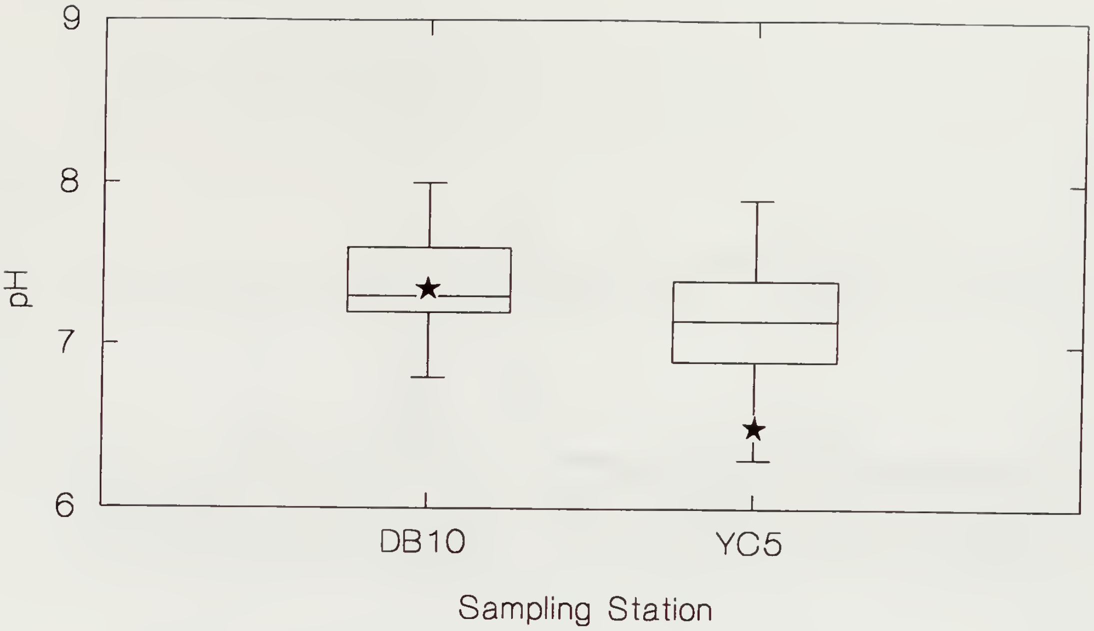

Figure 19. pH distribution at DB10 and YC5 - 1993
(★ = 1964 mean)
(See Appendix G for explanation of boxplot)

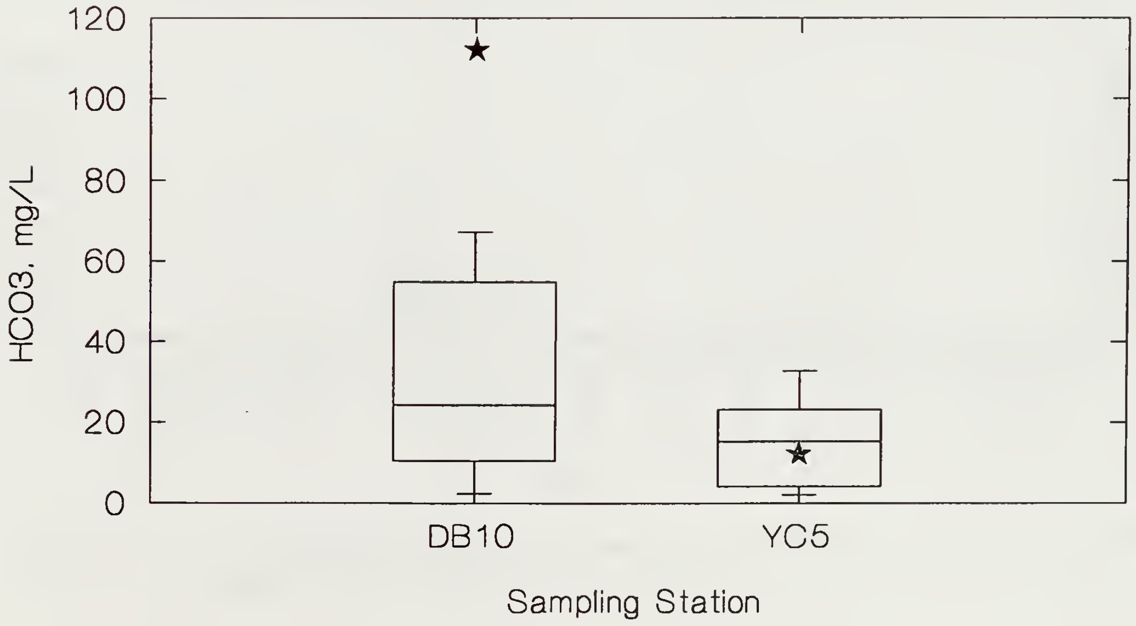

Figure 20. Bicarbonate ($HCO_3$) distribution at DB10 and YC5 - 1993
(★ = 1964 mean)
(See Appendix G for explanation of boxplot)

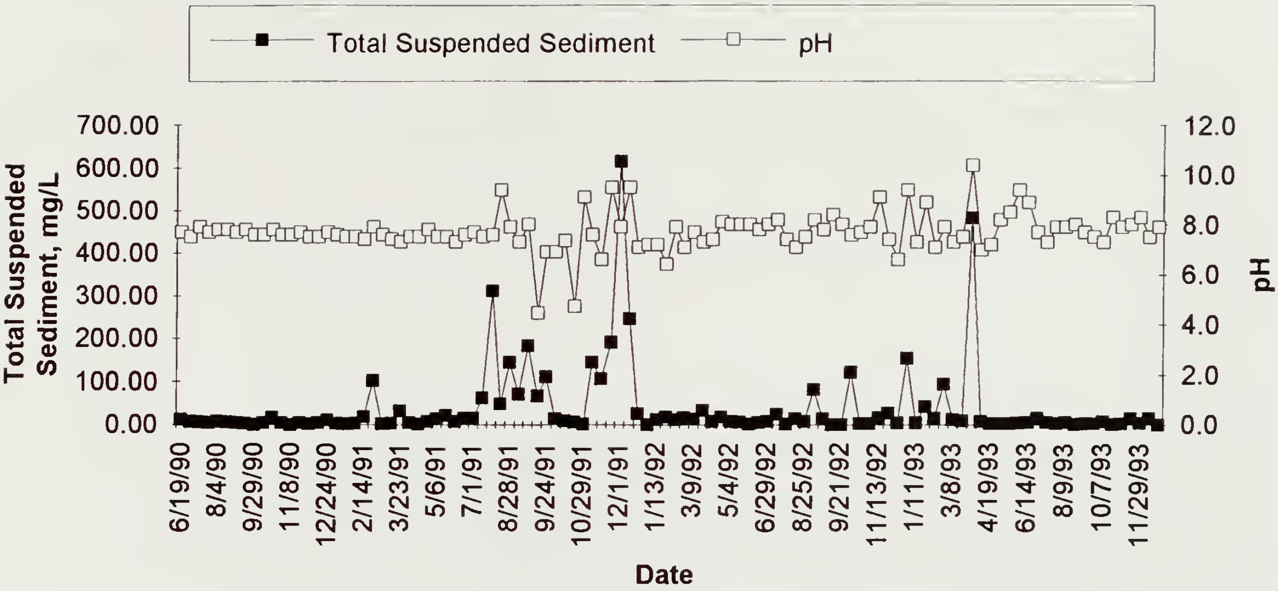

Figure 21. pH and total suspended sediment at station TC10 1990 - 1993 (Based on data in Appendices D and F)

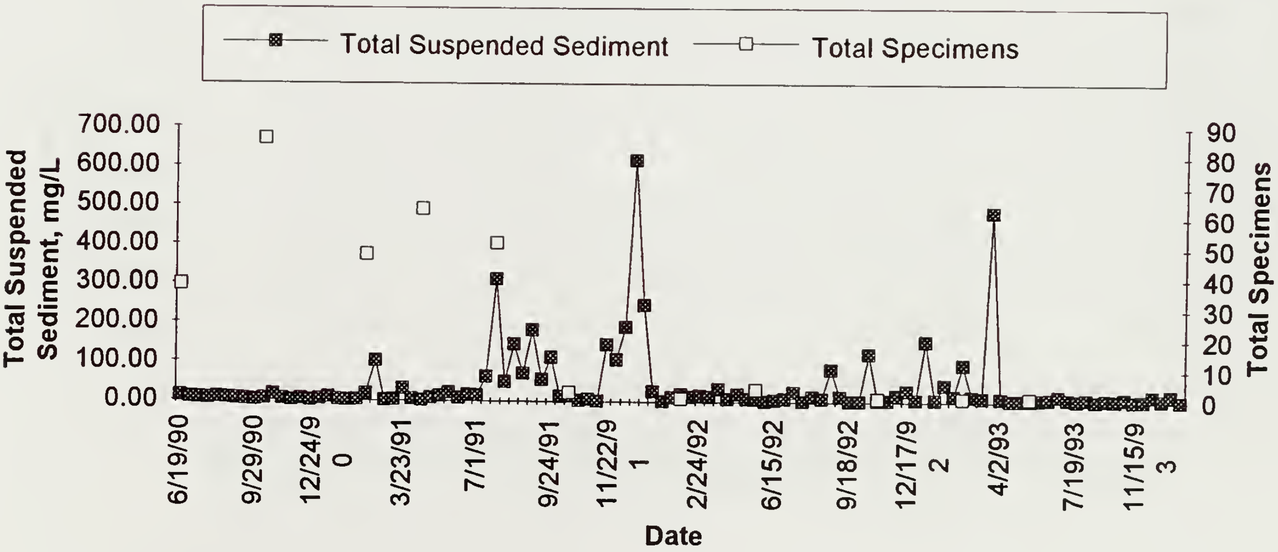

Figure 22. Total suspended sediment and total specimens at station TC10 1990 - 1993 (Based on data in Appendices D and F)

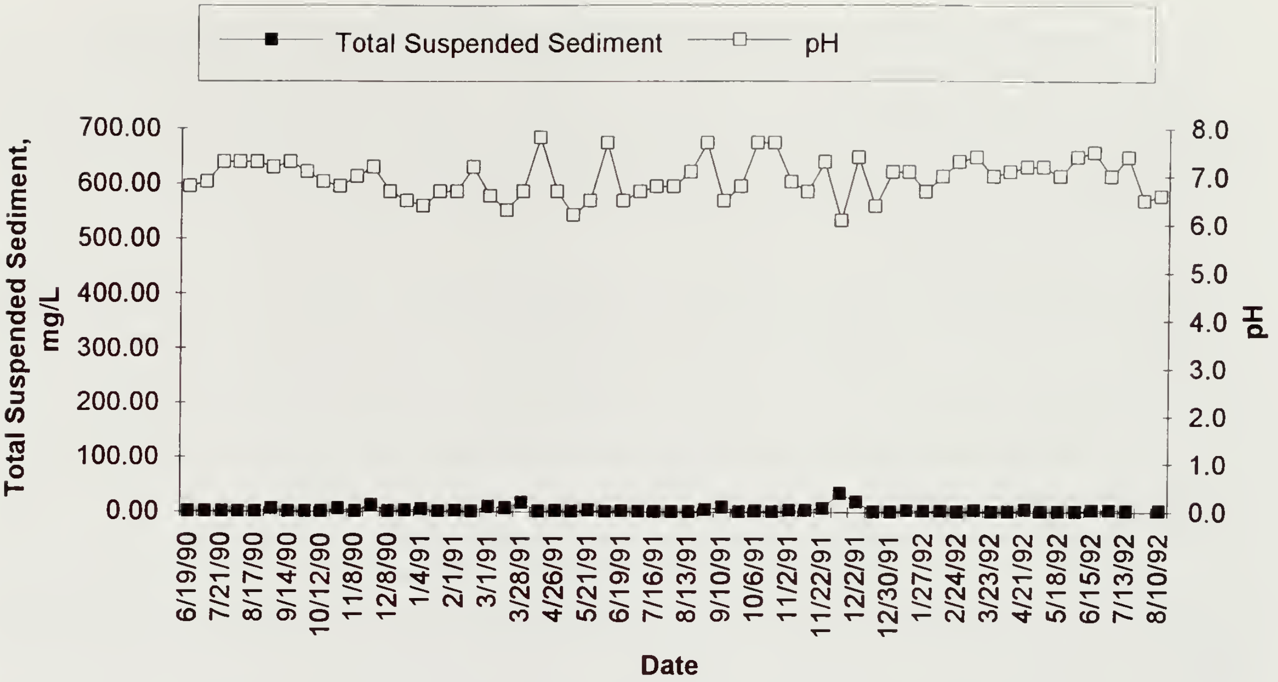

Figure 23. pH and total suspended sediment at station YC1 1990 - 1992 (Based on data in Appendices D and F)

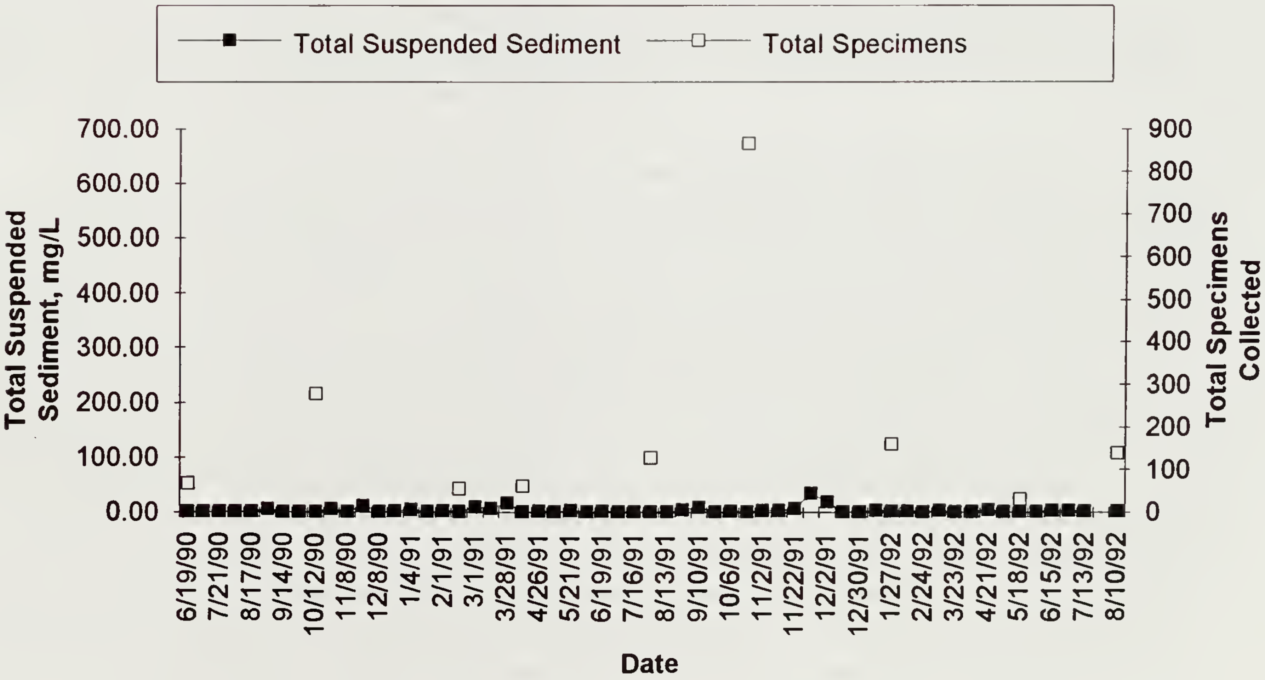

Figure 24. Total suspended sediment and total specimens at station YC1 1990 - 1992 (Based on data in Appendices D and F)

Available data suggest that the discharge from Tunnel Creek may have impacted downstream stations in Little Yellow Creek, but in the latter stream, the relationship between Tunnel Creek discharge and a decline in benthos abundance at receiving stations is not as easily demonstrated as it was at TC10. The lack of daily measurements at Little Yellow Creek stations is one factor that tends to obscure the relationship. It is also possible that the relationship is obscured by dilution of the Tunnel Creek flows. Even though in 1993 median flows at TC10 were slightly larger than at YC5, high flows at YC5 were as much as four times larger than the highest flows at TC10 (Figure 1). High sediment loads in Little Yellow Creek due to unknown causes unrelated to tunnel construction might be another obscuring factor. At YC1, The highest measured suspended sediment value was only about 34 mg/L on 12/1/91 and pH values were greater than 6.0 for the entire study period (Figure 23). As expected, benthic populations at YC1 were relatively stable with an average of about 100 specimens per sample, excluding the extremely large sample of 10/91, and they did not exhibit the abrupt decline in numbers evident at TC10. At YC5, pH values remained above 6.0, and no large fluctuations were evident (Figure 25). It appears, however, that numbers of benthic organisms in samples may have begun to decline after a suspended sediment concentration of 662 mg/L was measured at YC5 on 9/14/90. The sediment source must have been a local one, since on that date suspended sediment levels of only 1.0 and 3.0 mg/L were measured at YC1 and TC10 ,respectively. Another sediment peak of 430 mg/L was recorded at YC5 on 8/28/91 during the period when high sediment loads were occurring in Tunnel Creek. After this peak, the number of specimens in samples remained at the low levels indicated in Figure 26. It is possible that the observed decline in the number of organisms at YC5 was wholly unrelated to the Tunnel Creek discharge, but since YC5 is very close to the mouth of Tunnel Creek, although upstream, it could be speculated that some eddy effect at high flows allows Tunnel Creek to affect YC5.

Extreme sediment and pH values were not measured at YC5A, the first station downstream from the mouth of Tunnel Creek. No pH values below 6.0 were measured at YC5A, and the highest sediment load measured was 227 mg/L near the end of the period of high sediment discharge from Tunnel Creek (Figure 27). It is assumed that extremes occurred, however, and that the samples collected at two-week intervals at YC5A simply could not adequately represent the daily fluctuations in the pH and sediment load of the Tunnel Creek discharge. This assumption is supported by the fact that the pattern of benthos abundance at YC5A is similar to that at TC10, although not as pronounced (Figure 28). At YC12, apparent pH fluctuations were small, measured pH values rarely dropped below 6.5, and measured suspended sediment concentrations were generally low with the highest peak prior to 1993 being 106 mg/L on 12/2/91 (Figure 29). The abundance of benthic macroinvertebrates in YC12 samples did not appear to decline appreciably until after the 5/92 sample, when the number dropped from an average of 51 specimens per sample to an average of 11 per sample (Figure 30). The delay in the decline of macroinvertebrate abundance can possibly be attributed to the fact that YC12 is about a mile downstream from the mouth of Tunnel Creek, although the large daily pH fluctuations known to have occurred in Tunnel Creek in 1992 (Heather Rhodes, personal communication) could have been a contributing factor. At Station DB10, in Davis Branch, pH values were generally higher than 6.5, and sediment loads were generally low with the highest value measured prior to 1993

being 136 mg/L on 12/2/91 (Figure 31). As expected, no decline in benthic organisms occurred at DB10 that could be attributed to pH and suspended sediment levels in the Tunnel Creek discharge. A slight decline in abundance after the sample of 4/91 (Figure 32) appears to be of a magnitude that could be due to seasonal variation in abundance or to variation in sampling effort.

## 9. Conclusions

### 9.1 Water Quality

The results of the CUGA water monitoring program indicate that for most parameters, water quality was generally good in 1993 in the streams of interest. However, large pH fluctuations occurred in Tunnel Creek and presumably in downstream areas of Little Yellow Creek due to the basic conditions caused by tunnel construction and the addition of acid to neutralize them. At DB5, dissolved oxygen concentrations were below and dissolved iron conditions above Kentucky water quality criteria levels on several occasions. Since total manganese is significant only in public water supplies because it can cause unaesthetic staining, the fact that it frequently was found to exceed criteria levels in park streams is not considered significant. Some metals, including mercury, copper, and zinc occasionally exceeded criteria concentrations in samples, but no trends were evident, and in several cases, the samples were collected during the high flows associated with storm events.

### 9.2 Sediments

Streambed sediments tested in 1993 can generally be considered "nonpolluted" according to the guidelines for Great Lakes harbor sediments listed in Table 8. Some degree of pollution was found only for barium, manganese, and mercury. Moderate to heavy barium pollution was found in three samples from TD1, and samples from several other streams were nonpolluted to moderately polluted. One sample from TD1 was moderately polluted with regard to manganese, and, although no guideline was established below which mercury could be considered nonpolluting, mercury concentrations in all samples were lower than the 1 mg/kg guideline for moderate mercury pollution.

### 9.3 Water quality trends

After comparing sample data from the STORET database with current water quality data, it was apparent that water quality at YC5 and DB10 was not appreciably different in 1993 than it was in 1964. The data cannot be used to demonstrate the absence of adverse long-term water quality trends, because no data are available for the intervening years.

Declines in the abundance of benthic macroinvertebrates at some sampling stations in Tunnel Creek and Little Yellow Creek suggest that acidic conditions and sedimentation resulting from tunnel construction activities have degraded the biological carrying capacities of the affected areas of the streams.

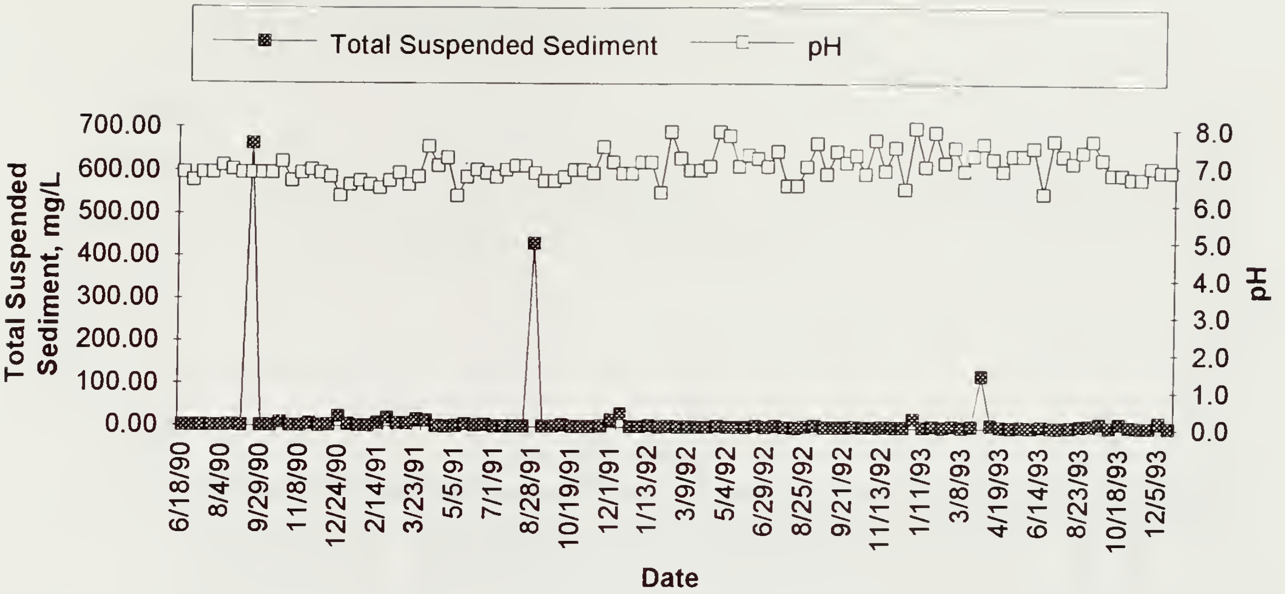

Figure 25. pH and total suspended sediment at station YC5 1990 - 1993 (Based on data in Appendices D and F)

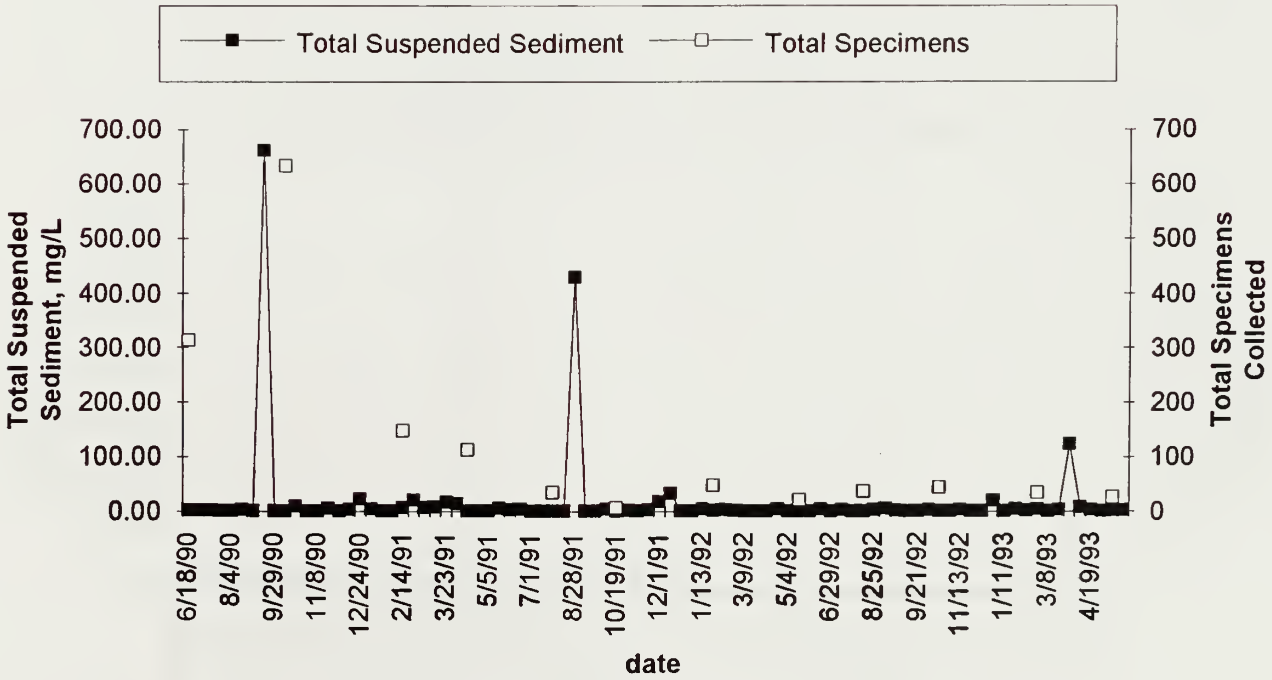

Figure 26. Total suspended sediment and total specimens at station YC5 1990 - 1993 (Based on data in Appendices D and F)

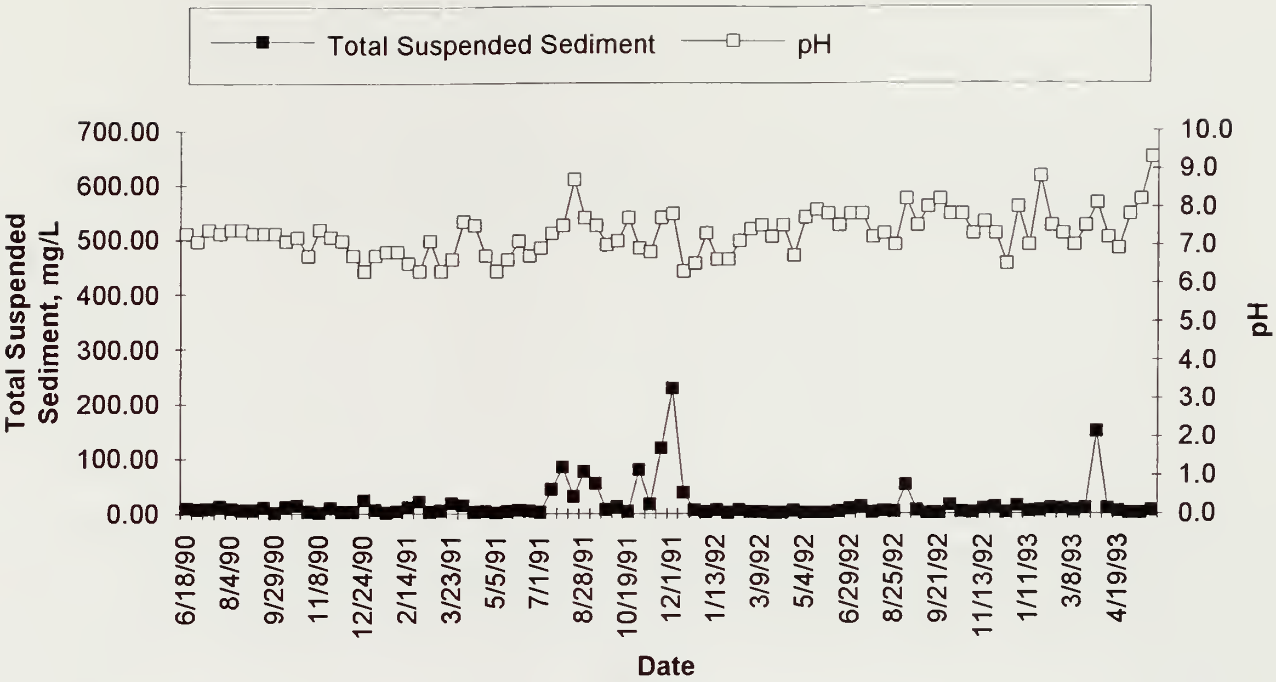

Figure 27. pH and total suspended sediment at station YC5A 1990 - 1993 (Based on data in Appendices D and F)

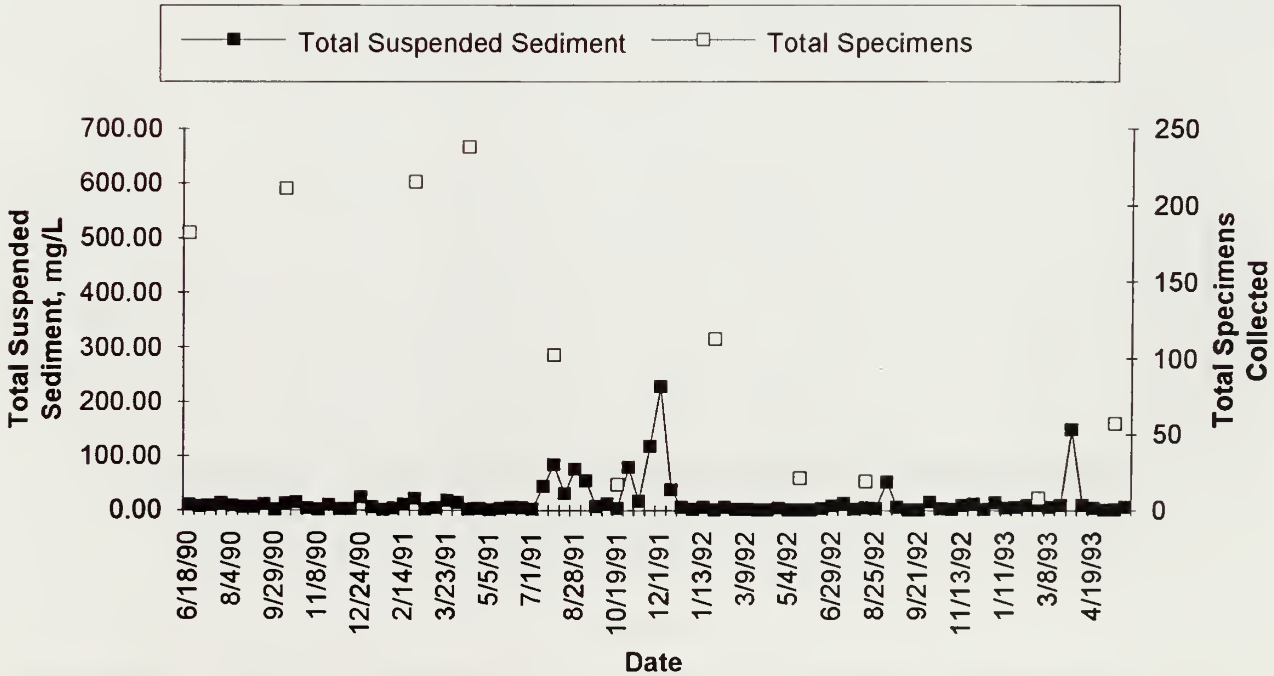

Figure 28. Total suspended sediment and total specimens at station YC5A 1990 - 1993 (Based on data in Appendices D and F)

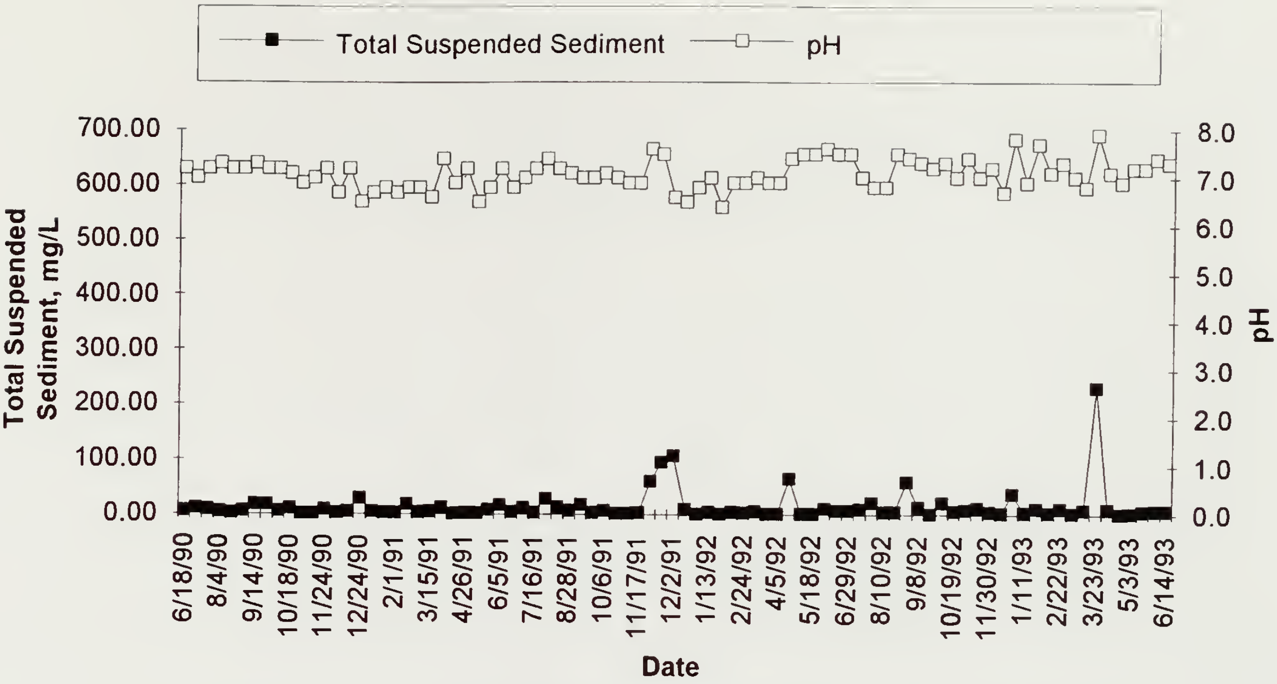

Figure 29. pH and total suspended sediment at YC12 1990 - 1993 (Based on data in Appendices D and F)

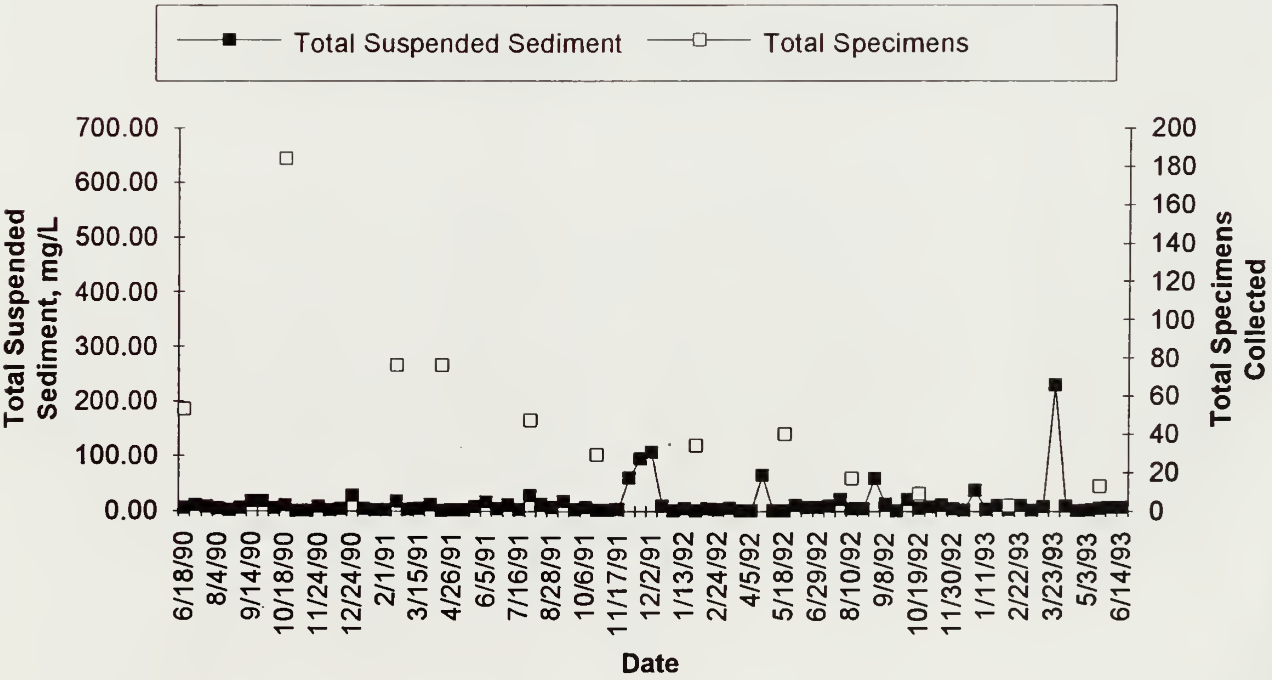

Figure 30. Total suspended sediment and total specimens at station YC12 1990 - 1993 (Based on data in Appendices D and F)

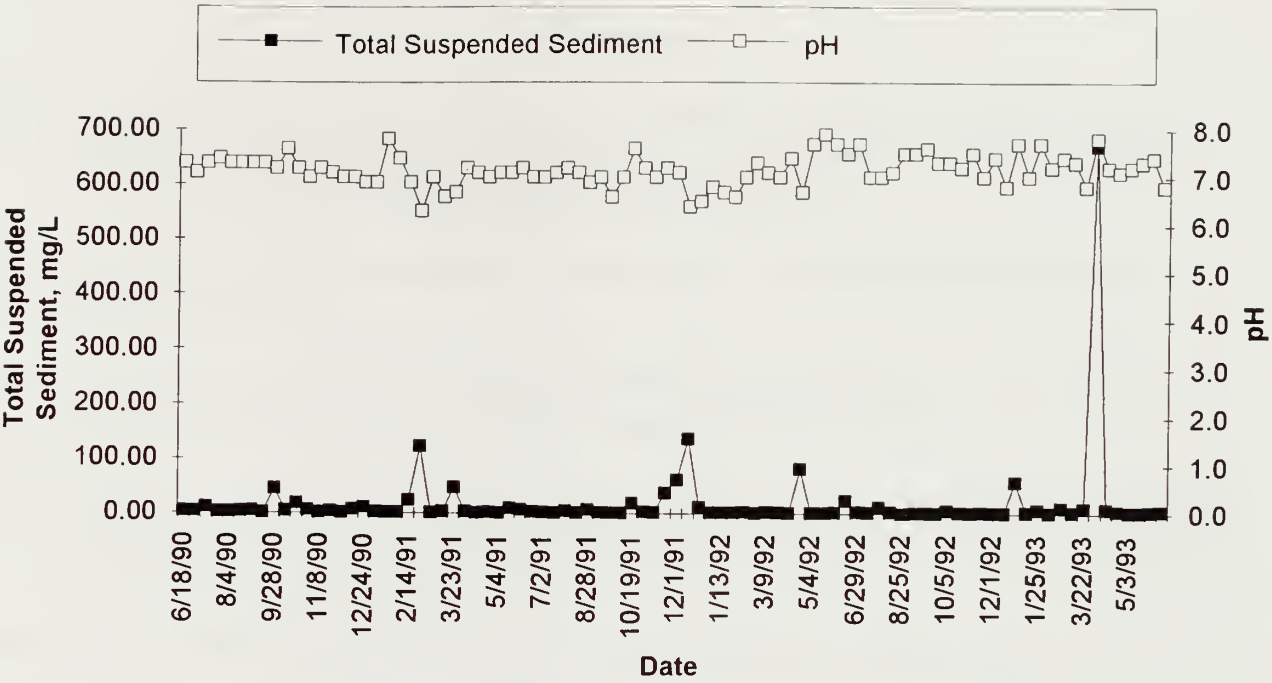

Figure 31. pH and total suspended sediment at station DB10 1990 - 1993 (Based on data in Appendices D and F)

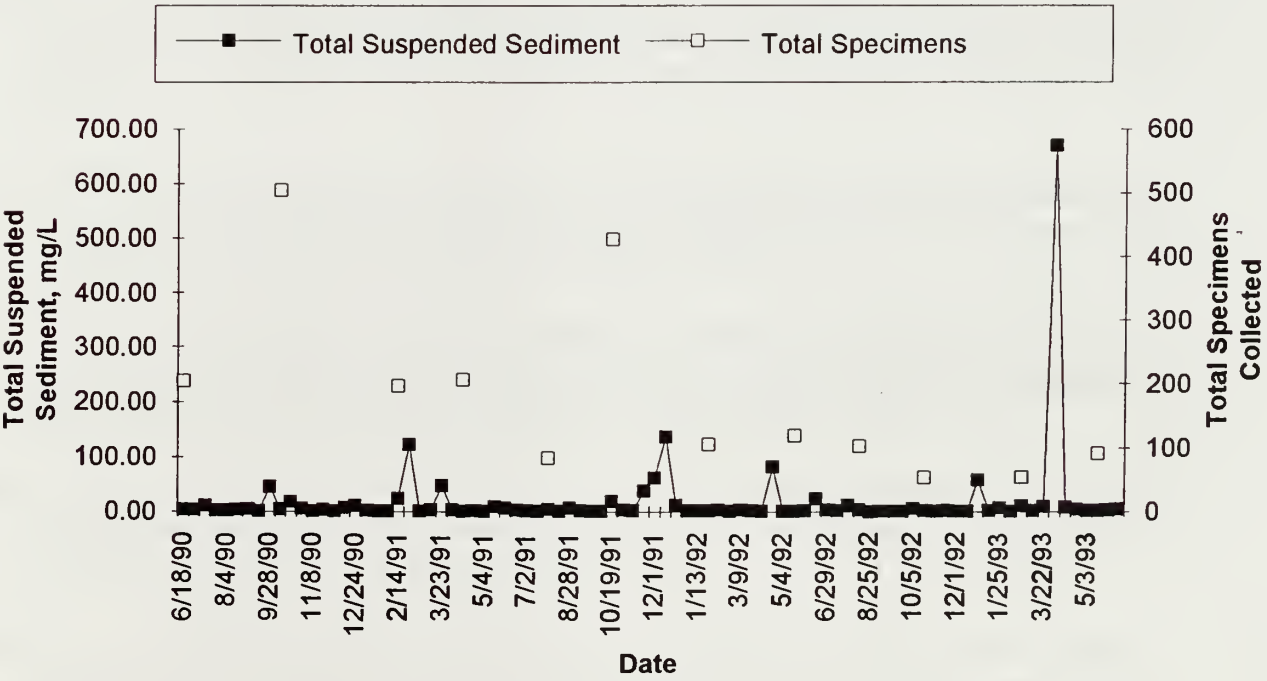

Figure 32. Total suspended sediment and total specimens at station DB10 1990 - 1993 (Based on data in Appendices D and F)

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## Appendices

## Appendix A

### Stream, Watershed, and Sampling Station Information

The descriptions in this appendix are based on information provided by Mr. Jimmy W. Johnson of the National Park Service, Mr. Shane Sturgill, a University of Tennessee employee who performs the sampling a personal tour of the sampling stations on March 18, 1994, and a review of U.S.G.S. 7.5-minute topographic quadrangle maps.

## Appendix A Index

## A.1 Introduction

This appendix contains information concerning stations at which water and\or sediment samples were collected in 1993. At the end of the Appendix, watershed maps (Figures A-2 through A-4) are provided with station locations marked , and a summary map (Figure A-1) indicates the location of each watershed within the park.

### A.2.1 Dark Ridge Creek (DR9)

| | |
|---|---|
| Stream Description: | Dark Ridge Creek is located in Kentucky in the northwest section of the park. The stream, which is too small to be depicted on the topographic map which was reviewed, reportedly originates in a hollow on the east slope of Dark Ridge and flows east for approximately 0.15 miles before entering Sugar Run near the park boundary a short distance downstream from station SR10. Dark Ridge Creek reportedly flows continuously and is about 3 to 4 feet wide near its confluence with Sugar Run. |
| Watershed Description: | The Dark Ridge Creek watershed is small, with an area of about 0.1 square miles. It is located entirely in Kentucky in the northwest section of the park between the Davis Branch and Sugar Run watersheds (Figure A-1). Past impacts include timber removal and the construction of a segment of Hwy. 988. The only current potential source of adverse impact to the water quality of Dark Ridge Creek is runoff from Hwy. 988. |
| Sampling Stations: | DR9: Located on Dark Ridge Creek near its confluence with Sugar Run ( near the point at which Sugar Run exits the park.) It replaced SR10 as a monitoring point for planned Hwy. 988 straightening which was to have been carried out by using fill materials excavated from the tunnel. The proposed roadwork was blocked by the discovery of a federally listed threatened species, the blackside dace (Phoxinus cumberlandensis), in the adjacent Davis Branch, and roadwork was limited to resurfacing. Since the anticipated construction did not occur, DR9 is now sampled only on an annual or, at most, quarterly basis. In 1993, it was sampled once on 8/23. |
| Maps Reviewed: | U. S. G. S. 7.5-minute topographic quadrangles<br>1. Middlesboro South, Ky. - Tenn. - Va. 1974 (Photorevised 1991)<br>2. Middlesboro North, Ky. 1974<br>3. Middlesboro North, Ky. 1959 |

### A.2.2 Davis Branch (DB5, 6, 7, 8, 10)

Stream Description:

Davis Branch is located in Kentucky and is entirely contained in the northwest section of the park. It is approximately 2.7 miles in length, and it flows south to enter Little Yellow Creek between YC5A and YC6 (Figure A-2). It contains a federally listed threatened minnow, the blackside dace (*Phoxinus cumberlandensis*). State Route 988 (Sugar Run Road) lies adjacent to much of the upper section of the stream, and U. S. 25E parallels the lower section.

Watershed Description:

The Davis Branch watershed has an area of about 1.2 square miles, all of which is located in the park (Figure A-1). Historically, the watershed has probably been affected by timbering. At present, potential sources of adverse impact appear to be limited to runoff from State Route 988 in the north , from U. S. 25E in the south, and from a service road and rifle range near the stream in the vicinity of Hwy. 988.

Sampling Stations

DB5: Located in the upper reaches of Davis Branch above the influence of State Route 988. It is used as a control station. There appeared to be a considerable coating of sediment on the rocks of the stream bottom when I visited the station on March 18, 1994. Perhaps the sediment was due to reported upstream beaver activity. In 1993, water samples were collected at DB5 at approximate two-week intervals and after storm events until 9/7, and one additional sample was collected on 12/5. Sediment samples were collected at quarterly intervals through 10/19, and benthic macroinvertebrate samples were collected in at least the first two quarters.

DB6, DB7, DB8: Located along the middle reaches of Davis Branch. These stations were established primarily to study the blackside dace population. Reportedly, initial dissolved oxygen measurements were made when the stations were established. No water or sediment samples were collected in 1993.

DB10: Located approximately 100 yards above Davis Branch's confluence with Little Yellow Creek. It is used to monitor the effects of all upstream impacts to Davis Branch. This station is located between abutments of a bridge which no longer exists; therefore, it has been affected historically by bridge construction and possible highway runoff. In 1993, water samples were collected at approximate two-week intervals and after storm events. Sediment samples were collected at quarterly intervals through 10/19, and benthic macroinvertebrate samples were collected in at least the first two quarters.

Maps Reviewed:

U. S. G. S. 7.5-minute topographic quadrangles

1. Middlesboro South, Ky. - Tenn. - Va. 1974 (Photorevised 1991)
2. Middlesboro North, Ky. 1974
3. Middlesboro North, Ky. 1959

### A.2.3 Gap Creek (GC3, 4, 7)

Stream Description: Gap Creek originates on Cumberland Mountain in Cudjo Cave a short distance north of the Virginia-Tennessee state line. It flows south down the mountain, passes beneath U. S. 25E, and through the town of Cumberland Gap, Tennessee (Figure A-2). Only about a mile of the stream's upper reaches lie within the park when the portion within the town's boundaries is excluded. Gap Creek is a narrow, high-gradient stream with an irregular, rocky bottom until approximately the point at which it crosses the state line and enters the town. The gradient then begins to diminish and the bottom becomes more regular. Near the south side of town, a tributary which receives runoff from U. S. 58 enters Gap Creek. In addition, outflow from the tunnel cavern emerges in an area used by the town as a dump, passes Station TD1, and enters Gap Creek near the mouth of the tributary .

Watershed Description: Only the upper portion of the Gap Creek watershed is included in the monitoring program because it is the only portion which can be affected by tunnel construction and highway construction activities. It is approximately 0.9 square miles in area and encompasses the town of Cumberland Gap as well as portions of U. S. 25E and U. S. 58 (Figure A-2). In the watershed, major potential sources of adverse impact to the water quality of Gap Creek include the sewage treatment plant discharge and surface runoff from the town, runoff from the town dump located over the tunnel discharge outflow, and proposed future construction on U. S. 58.

Sampling Stations

GC3: Located within the town of Cumberland Gap (Figure A-2). It serves as a control for the effects of tunnel discharge and highway construction runoff on Gap Creek. Water quality at GC3 could potentially be influenced by surface runoff from U. S. 25E and from nearby parts of the town. To avoid disturbing a population of stocked rainbow trout, benthic macroinvertebrate samples (which are labeled as originating from GC3) are collected upstream near the iron furnace in the high-gradient section. In 1993, water samples were collected at GC3 at approximate two-week intervals and after storm events, and three sediment samples were collected through 7/6. Benthic macroinvertebrate samples were collected in at least the first two quarters.

GC4: Located on the tributary which receives runoff from U. S. 58 (Refer to Stream Description) near its confluence with Gap Creek (about 100 feet below GC3) (Figure A-2). It will be used to monitor the effects on water quality of construction of U. S. 58. It is not presently monitored, since no construction is in progress. It potentially could reflect the effects of surface runoff from nearby parts of the town as well as from U. S. 58. In 1993, water samples were collected at GC4 at approximate two-week intervals and after storm events through 9/21.

GC7: located about 0.65 miles downstream from GC3 and about 0.28 miles upstream from the park boundary (Figure A-2). Used to monitor the persistence of adverse water quality effects from the influences mentioned. In 1993, water samples were collected at GC7 at approximate two-week intervals and after storm events, and sediment samples were collected at quarterly intervals through 10/19. Benthic macroinvertebrates were sampled in at least the first two quarters..

Maps Reviewed: U. S. G. S. 7.5-minute topographic quadrangles
1. Middlesboro South, Ky. - Tenn. - Va. 1974 (Photorevised 1991)

### A.2.4 Lewis Hollow (Unnamed stream)

| | |
|---|---|
| Stream Description: | The stream segment of interest in this study is approximately 1.0 miles long. It originates in, and is entirely contained within, Lewis Hollow on the Virginia side of Cumberland Mountain (Figure A-2). After flowing south out of Lewis Hollow, the stream crosses beneath U. S. 58 and flows east along the southern border of the park to join Station Creek outside the park boundary. The stream segment serves as a control to monitor the effects of planned future construction on U. S. 58. |
| Watershed Description: | Lewis Hollow constitutes the entire watershed for the stream segment of interest, an area of about 0.3 square miles. The watershed is located about one-third of the way along the park's southern boundary from the west end (Figure A-1). Past impacts to the watershed reportedly include selective timber removal in the 1950's prior to the establishment of the park. A map review does not indicate any potential source of adverse impact to the water quality of the stream other than a hiking trail along the ridge at the head of the hollow. |
| Sampling Stations: | LH5: Located at the mouth of Lewis Hollow about 50 feet upstream from U. S. 58 ) (Figure A-2). In 1993, only three water samples were collected at LH5, two of which were associated with storm events , and sediment samples were collected in the first three quarters. Benthic macroinvertebrates were collected in at least the first two quarters. |
| Maps Reviewed: | U. S. G. S. 7.5-minute topographic quadrangles<br>1. Middlesboro South, Ky. - Tenn. - Va. 1974 (Photorevised 1991)<br>2. Wheeler, Tenn. - Va. 1956 (Photorevised 1978)<br>3. Wheeler, Tenn. - Va. 1956 |

### A.2.5 Little Yellow Creek

Stream Description:

Little Yellow Creek flows northeast from Tennessee into Kentucky and enters the park near the middle of its west side (Figure A-3). It abruptly turns west forming the boundary between the park and the town of Middlesboro before exiting the park to the north. The dam forming Fern Lake, a 170-acre impoundment on Little Yellow Creek, is located about 0.6 stream miles outside the park boundary. Tunnel Creek and Davis Branch are important tributaries to the section of Little Yellow Creek which lies inside the park.

Watershed Description:

The Little Yellow Creek watershed has an area of about 5.8 square miles. Only about 20 percent of the watershed, generally, that which lies north of the Fern Lake Dam, is located inside the park (Figure A-3). Reportedly, the in-park watershed historically supported some mining and logging activity. This part of the watershed includes part of the town of Middlesboro, Kentucky, a segment of U. S. 25E (part of which was under construction in 1991), facilities of the Union College Environmental Education Center, various secondary roads and several other buildings. Fern Lake serves as a water supply reservoir for the town of Middlesboro. It is likely that the lake, which is fed by runoff from the watershed outside the park, acts as a settling basin for sediment and buffers acid mine drainage from the strip mines and shallow deep mines reportedly present in that section of the watershed. Reportedly, its water is of good quality and requires very little treatment. A review of the 1959 Fork Ridge, Tenn.-Ky. topographic map discovered little human habitation, no stripmines, and no industry in the watershed south of the Fern Lake dam (outside the park). It is likely that the human population and the number of stripmines in that area have increased over the past twenty-five years.

Sampling Stations:

YC1: Most upstream station in the park on Little Yellow Creek. It is located at the park boundary about 0.6 stream miles below the Fern Lake dam (Figure A-3), and it is unaffected by any construction activities in the park. Serves as a control station to monitor the effects of tunnel or highway construction activities on Little Yellow Creek. In 1993, no water or sediment samples were collected at YC1, but benthic macroinvertebrates were sampled at least in the first two quarters.

YC5: Located about 0.75 miles downstream from YC1 and a short distance upstream from the confluence of Tunnel Creek with Little Yellow Creek (Figure A-3). Since it is unaffected by the Tunnel Creek discharge and is unlikely to be affected by highway construction, it also serves as a control station to monitor the effects of tunnel or highway construction activities on Little Yellow Creek. In 1993, water samples were collected at approximate two-week intervals and after

storm events, and sediment samples were collected quarterly. Benthic macroinvertebrates were sampled in at least the first two quarters.

YC5A: Located approximately 70 yards downstream from YC5 and a short distance downstream from the confluence of Tunnel Creek with Little Yellow Creek. It is used to monitor the maximum impact of tunnel construction on Little Yellow Creek. When YC5A was visited on July 14, 1994, sediment from Little Yellow Creek was visible over about half of the stream width in the area of the station. In 1993, water samples were collected at approximate two-week intervals and after storm events, and sediment samples were collected quarterly. Benthic macroinvertebrates were sampled in at least the first two quarters.

YC6: located about 0.4 miles downstream from YC5A (Figure A-3). It is used to monitor the effects of tunnel construction on Little Yellow Creek . It is also located in an area which could be affected by runoff from construction of U. S. 25E or by surface runoff or subsurface drainage from Middlesboro. Water sampling was discontinued at YC6 after 8/92 when beavers reportedly flooded the trailer park adjacent to the creek. Benthic macroinvertebrate sampling was discontinued after 10/92. On March 18, 1994, I observed trash along the creek in the area of the station and a drain tile (apparently from a soil stockpile near U. S. 25E) which was positioned to discharge into the creek.

YC12: Located about 0.6 miles downstream from YC6 (Figure A-3). It is located at the point at which Little Yellow Creek exits the park. It is likely that the effects of tunnel construction are somewhat less at this station than at more upstream stations, but it is probably affected by runoff from the construction of U. S. 25E and by surface runoff and subsurface drainage from Middlesboro. Water samples were collected regularly at YC12 until 9/93. It is now sampled only after storm events. Benthic macroinvertebrate samples were collected in at least the first two quarters of 1993. Although fecal coliform counts are reported to be high, beaver, and a variety of fish and benthic macroinvertebrates including mussels are reported to be present.

Maps Reviewed: U. S. G. S. 7.5-minute topographic quadrangles

1. Middlesboro South, Ky.-Tenn.-Va. 1974 (Photorevised 1991)
2. Fork Ridge, Tenn.-Ky. 1959
3. Mingo Mtns., Tenn. - Ky. 1950

### A.2.6 Martins Fork ( of the Cumberland River) (MF2, 5)

| | |
|---|---|
| Stream Description: | The upper reaches of Martins Fork which are being monitored for this study flow from west to east along the top of Cumberland Mountain entirely within the Kentucky section of the park near the park's eastern end (Figure A-4 ). This section of Martins Fork is about 3.6 miles long, and is described by park personnel as "a small, acidic, backcountry stream." The entire stream segment serves as a control to monitor the effects of tunnel and highway construction and other activities on the waters and sediments of other streams in more heavily frequented areas of the park. In 1993, water samples were collected at both stations three times through 10/15, and benthic macroinvertebrates were sampled on 2/93. |
| Watershed Description: | The section of the Martins Fork watershed which is included in this study lies almost entirely within the park and has an area of about 2.1 square miles. It is situated in a remote, region of the park, and backpackers and a small picnic area are the only apparent potential sources of adverse impacts to water quality. In the past, the watershed may have been impacted by timbering. |
| Sampling Stations: | MF2: Located in the extreme upper reaches of Martins Fork (Figure A-4). It is adjacent to a small picnic area.<br>MF5: Located about 3.5 miles downstream from MF2 (Figure A-4) . Marks the downstream limit of the Martins Fork study area. |
| Maps Reviewed: | U. S. G. S. 7.5-minute topographic quadrangles<br>1. Varilla, Ky. - Va. 1974 (Photorevised 1991)<br>2. Varilla, Ky. - Va. 1954<br>3. Ewing, Ky. - Va. 1946 (Photorevised 1969) |

### A.2.7 Shillalah Creek (SH10)

| | |
|---|---|
| Stream Description: | The portion of Shillalah Creek being monitored for this study flows from east to west along the top of Cumberland Mountain entirely within the Kentucky section of the park (Figure A-7). It is located west of the Martins Fork watershed, near the center of the park's east-west extent (Figure A-1). This section of Shillalah Creek is about 3.4 miles long, and is described by park personnel as " a small, acidic, backcountry stream." The entire stream segment serves as a control to monitor the effects of tunnel and highway construction and other activities on the waters and sediments of streams in more heavily frequented areas of the park. |
| Watershed Description: | The section of the Shillalah Creek watershed that is included in this study lies almost entirely within the park and has an area of about 1.4 square miles. It is situated in a remote region of the park; therefore, backpackers and a small restored community with riding stables known as the Hensley Settlement are the only apparent sources of potential adverse impacts to water quality. In the past, the watershed may have been impacted by timbering, and activities in the original Hensley Settlement. |
| Sampling Stations: | SH10: Located at the point where Shillalah Creek exits the park (Figure A-4). It is the only sampling station on Shillalah Creek. In 1993, water samples were collected at SH10 three times through 10/15 and benthic macroinvertebrates were sampled once on 2/93. |
| Maps | U. S. G. S. 7.5-minute topographic quadrangles<br>1. Varilla, Ky. - Va. 1974 (Photorevised 1991)<br>2. Varilla, Ky. - Va. 1954 |

### A.2.8 Station Creek (ST5, 10)

| | |
|---|---|
| Stream Description: | Station Creek originates on Cumberland Mountain in the Virginia section of the park. After about 1.25 miles, it exits the park, flows west along the park's southern boundary for approximately a mile, turns south after reentering the park, and after about another mile, again exits the park's southern boundary at U. S. 58 about two miles east of the U. S. 25E-U. S. 58 intersection on the Virginia side of the Virginia-Tennessee state line (Figure A-2). |
| Watershed Description: | The portion of the Station Creek watershed which supplies the stream section described above has an area of about 1.7 square miles. It is located entirely in Virginia, and mostly within the park. Historically, it is likely that the watershed was affected by timbering. A review of topographic maps suggests that the watershed is presently entirely undeveloped with the exception of a campground near where the creek finally leaves the park. |
| Sampling Stations: | ST5: Located about 0.45 miles north of the point at which Station Creek intersects U. S. 58 as it exits the park (Figure A-2). ST5 will serve as a control to monitor the effects on Station Creek of future highway construction on U. S. 58, and of timber removal which recently occurred on nearby private property.<br>ST10: Located at the point at which Station Creek intersects U. S. 58 (at the park boundary) (Figure A-2). It is used to monitor the impacts on water quality of a 150-site campground with a septic system and future impacts of highway construction on U. S. 58. In 1993, quarterly sediment samples were collected at ST10.<br>In 1993, at both stations, water samples were collected on 1/11 and 12/5, and benthic macroinvertebrates were sampled in at least the first two quarters. |
| Maps Reviewed: | U. S. G. S. 7.5-minute topographic quadrangles<br>1. Middlesboro South, Ky. - Tenn. - Va. 1974 (Photorevised 1991)<br>2. Varilla, Ky. - Va. 1974 (Photorevised 1991)<br>3. Wheeler, Tenn. - Va. 1956 (Photorevised 1978) |

### A.2.9 Sugar Run (SR10)

| | |
|---|---|
| Stream Description: | Sugar Run originates in the park, on the Kentucky side of Cumberland Mountain. It flows north for approximately 2.0 miles to exit the park near its northwest corner (Figure A-9). It is joined by an unnamed tributary about 0.7 miles upstream from the park boundary. |
| Watershed Description: | The section of the Sugar Run watershed that is included in this study lies entirely within the Kentucky section of the park and has an area of about 1.2 square miles. It is located adjacent to the Davis Branch watershed in the northwest section of the park (Figure A-1). The Sugar Run watershed has probably been affected historically by timbering. Current potential sources of adverse impacts to Sugar Run water quality are a small section of Skyland Road in the southwest corner of the watershed ,and, in the northern tip of the watershed, a picnic area, septic system, and a short segment of Hwy. 988. |
| Sampling Stations: | SR10: Located adjacent to the picnic area and Hwy. 988 near the point where Sugar Run exits the park (Figure A-2). It was originally intended for use in monitoring planned construction on Hwy. 988; however, it was later decided that station DR9 could be better used for that purpose, and that SR10 would be used as a control. Regular water and benthic macroinvertebrate sampling at SR10 was discontinued after 1/92. In 1993, one sediment sample was collected at SR10 on 7/6. |
| Maps Reviewed | U. S. G. S. 7.5-minute topographic quadrangles<br>1. Middlesboro South, Ky. - Tenn. - Va. 1974 (Photorevised 1991)<br>2. Middlesboro North, Ky. 1974 |

### A.3.1 Tunnel Creek (TC10)

| | |
|---|---|
| Stream Description: | Tunnel Creek , in the western end of the park, is a short stream about 0.6 miles long which flows west off of Cumberland Mountain to enter Little Yellow Creek between YC5 and YC5A (Figure A-2), the sampling stations upstream and downstream, respectively, from the confluence (Figure A-10). In its upper reaches, above the openings of the highway tunnels on the Kentucky side, it remains a small, wet-weather stream. Its lower reaches now flow continuously due to groundwater contributions from the tunnels. The lower portions of the stream contain several impoundments which are used during periods of tunnel construction to treat the discharge from the tunnels. |
| Watershed Description: | The Tunnel Creek watershed, which lies between the Davis Branch watershed to the north and the Little Yellow Creek watershed to the south (Figure A-1), has an area of about 0.25 square miles, all of which is located in the park. Historically, it has probably been affected by timbering. Currently, there do not appear to be any potential sources of stream contamination in the watershed other than construction activities on the tunnels. |
| Sampling Stations | TC10: Located at the last water treatment point on Tunnel Creek before it enters Little Yellow Creek (Figure A-2). Reportedly, pH fluctuations and high sediment loads eliminated or greatly reduced benthic macroinvertebrate populations here during periods of tunnel construction. TC10 was sampled daily during construction periods. It has been sampled twice weekly for a limited number of parameters since construction was halted in December, 1993, and regular water quality sampling is conducted twice per month and after storm events. Quarterly sediment samples were collected in 1993, and benthic macroinvertebrate samples were collected in at least the first two quarters. |
| Maps Reviewed: | U. S. G. S. 7.5-minute topographic quadrangles<br>1. Middlesboro South, Ky. - Tenn. -Va. 1974 (Photorevised 1991) |

## A.3 Miscellaneous Sampling Stations

### A.3.1 KY18

Station KY18, located on a drainage ditch a short distance upstream from station YC5 (Figure A-2 ), was used to monitor an area which was once proposed for use as a staging area for construction machinery and materials. As it happened, the area was used only as a pipe storage area and as a parking area for three office trailers. The area, which in wet weather drains to Little Yellow Creek, was initially monitored for oil and grease, but monitoring was eventually discontinued. In 1993, one water sample was collected at KY18 on 3/23.

### A.3.2 RR1

Station RR1 is used to monitor the quality of outflow from the Kentucky end of the existing railroad tunnel built in the 1800s (Figure A-2 ) . Dye tracer tests have not demonstrated a hydraulic connection between the existing tunnel and the highway tunnels which are presently under construction; however, the owner of a tannery which obtains its water from the railroad tunnel discharge says that his water supply has declined over the past several years. The portion of the flow that is not diverted enters Davis Branch about 150 yards upstream from its confluence with Little Yellow Creek. In 1993, water samples only were collected at RR1 at approximate two-week intervals and after storm events.

### A.3.3 STOR1

Station STOR1, about one-half mile south of the intersection of U. S. 25E and U. S. 58 (Figure A-2 ), is located on a drainage ditch leading from a seep originating from an encapsulated spoil pile of low-pH shale. In 1993, samples of runoff from the pile were collected through 3/23 and one on 12/5. It does not appear to be located in an area which can affect any streams in the park.

### A.3.4 TD1

Station TD1 is located on a small Gap Creek tributary (Figure A-2) which was demonstrated by dye tracer tests to be formed by the discharge from a cavern penetrated during the construction of the tunnel. The discharge emerges in an area which was used as a dump by residents of the town of Cumberland Gap. In 1993, water samples were collected from TD1 at approximate two-week intervals and after storm events, and sediment samples were collected quarterly.

### A.3.5 988

Station 988 is located in Kentucky in a steep, rocky roadside drainage ditch near the junction of Hwy. 988 (Sugar Run Road) and U. S. 25E (Figure A-2). It is used to monitor runoff from a stockpile of excavated tunnel material. It is generally sampled only after storm

events. In 1993, four water samples were collected at 988 through 3/23 and one on 12/5.

### A.3.6 CAVE

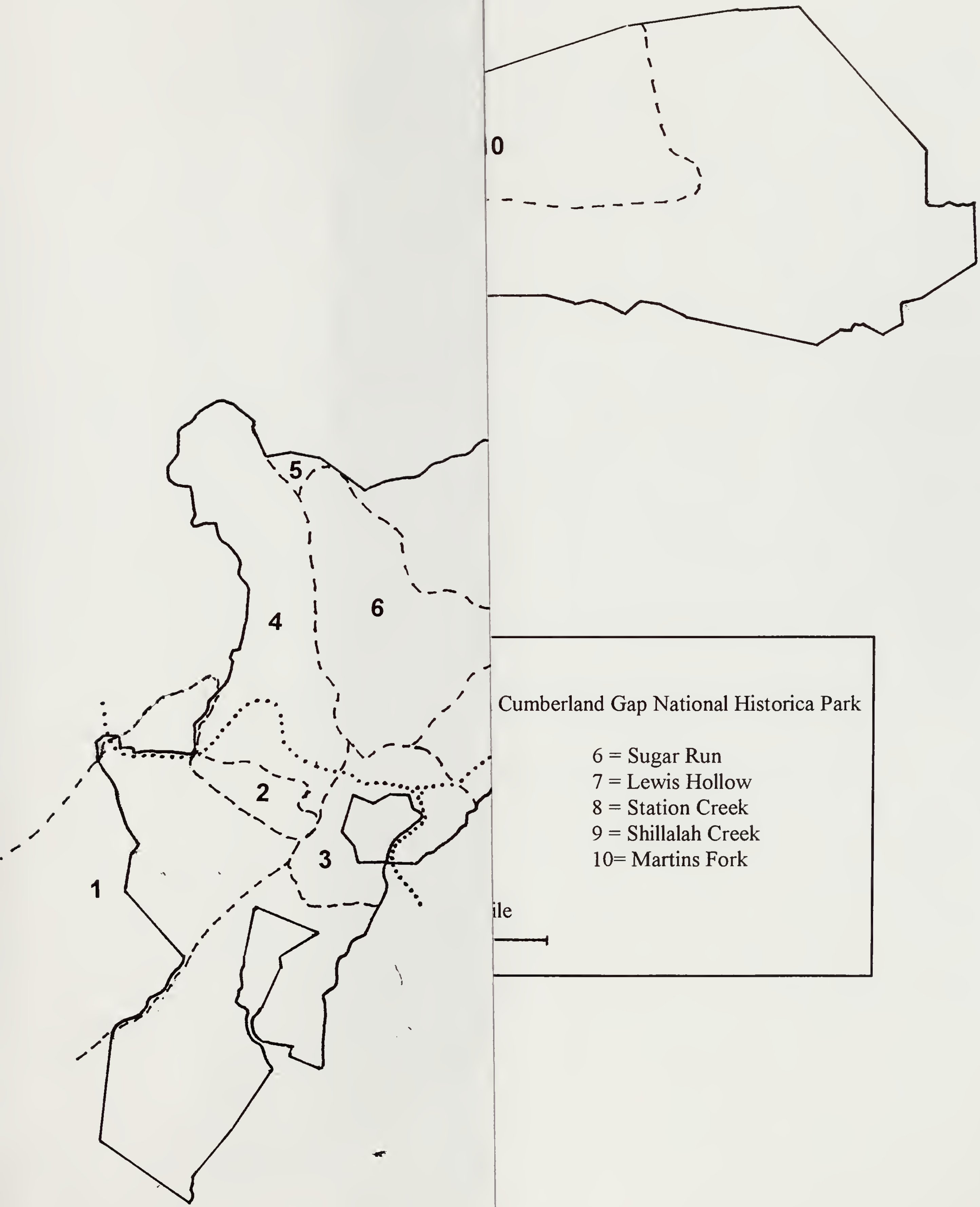
Station CAVE is located in the cavern which was penetrated during construction of the tunnels. It was sampled five times in 1993. Four of the samples were quarterly water- quality samples, and the fifth, collected on 12/5/93, was associated with a storm event.

### A.3.7 CUDJO

Station CUDJO is located in Cudjo Cave (Figure A-2) on Cumberland Mountain in Virginia, which is the source of Gap Creek. One water sample was collected at this station on 6/26/93.

### A.3.8 IF (Iron Furnace)

Station IF is located on Gap Creek above GC3 and adjacent to a historic iron furnace. One water sample was collected at this station on 3/23/93.


0
5
6
4
2
3
1
Cumberland Gap National Historica Park
6 = Sugar Run
7 = Lewis Hollow
8 = Station Creek
9 = Shillalah Creek
10= Martins Fork
ile

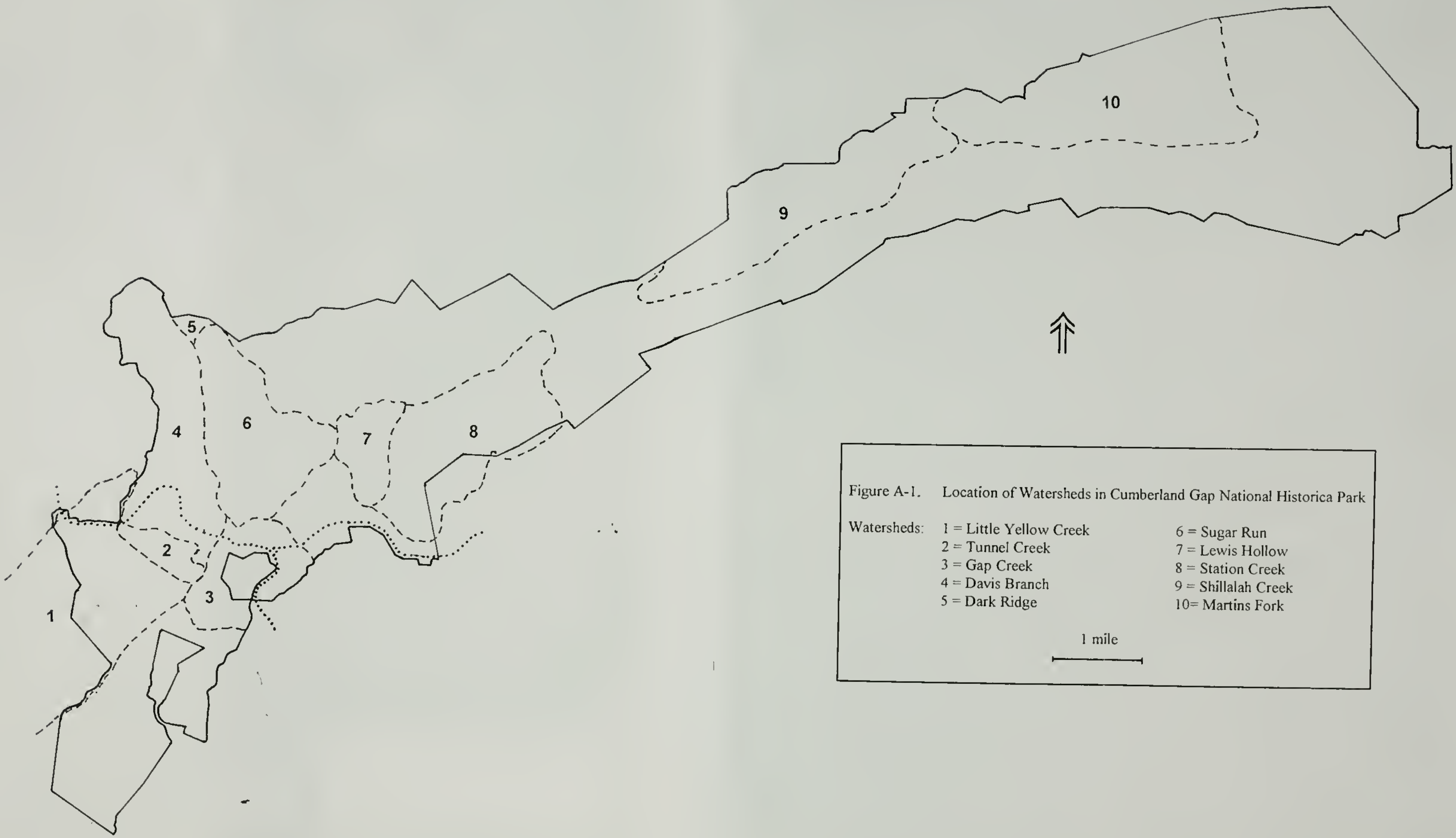
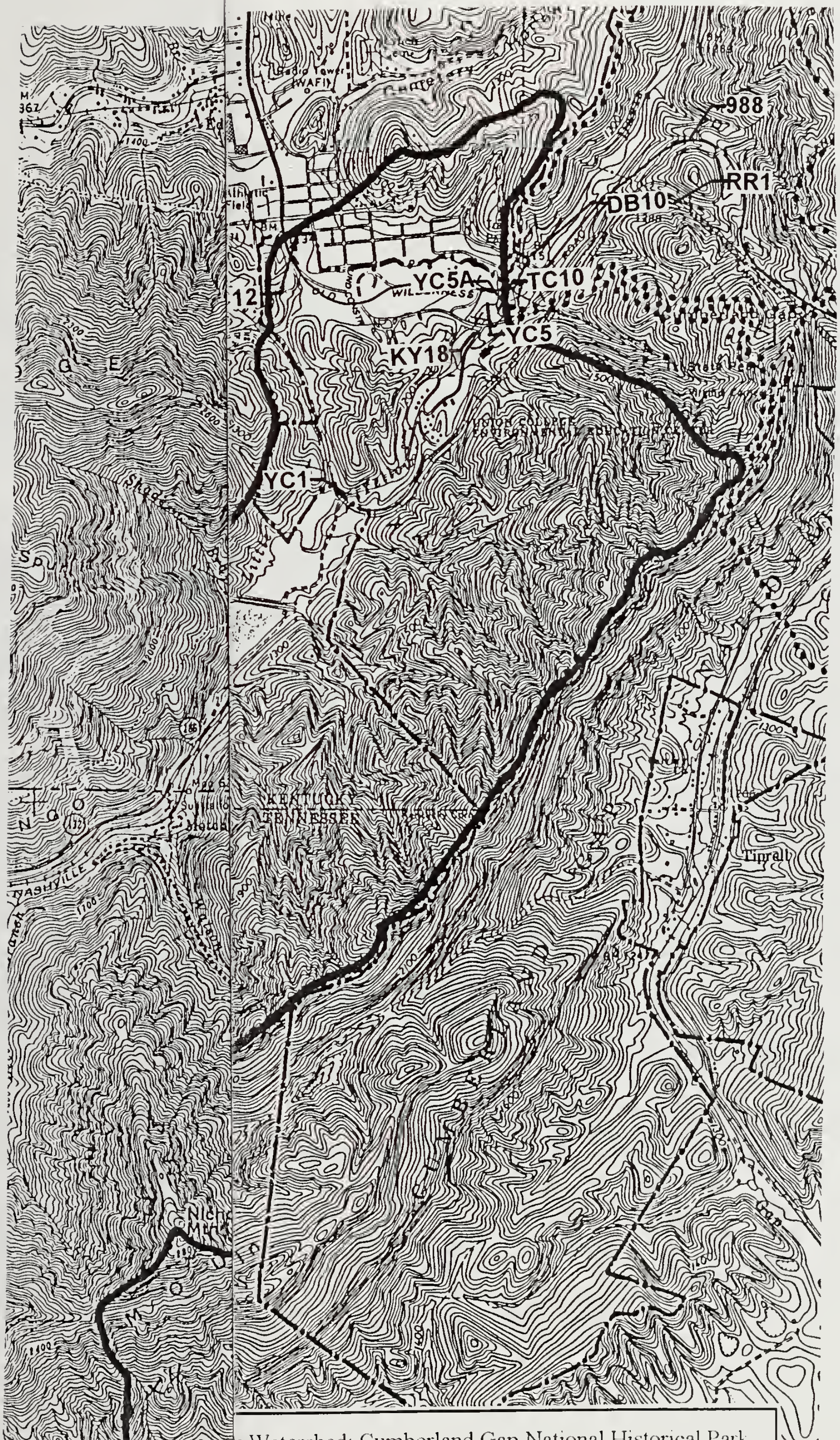


Figure A-1. Location of Watersheds in Cumberland Gap National Historica Park

Watersheds:
1 = Little Yellow Creek
2 = Tunnel Creek
3 = Gap Creek
4 = Davis Branch
5 = Dark Ridge
6 = Sugar Run
7 = Lewis Hollow
8 = Station Creek
9 = Shillalah Creek
10= Martins Fork



k Watershed: Cumberland Gap National Historical Park

oro South, Ky.-Tenn.-Va. 1974, Rev. 1991
e, Tenn.-Ky. 1959

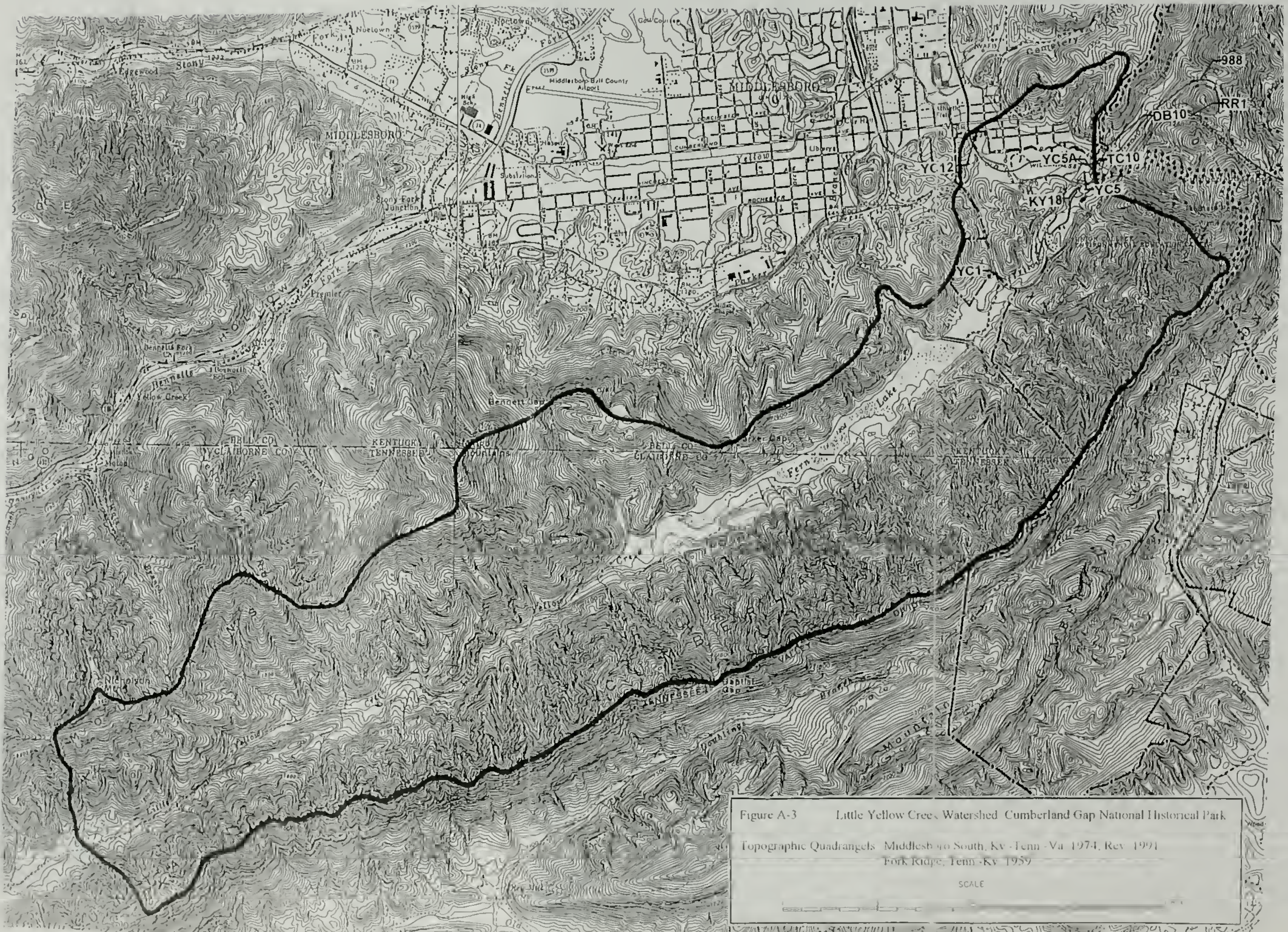
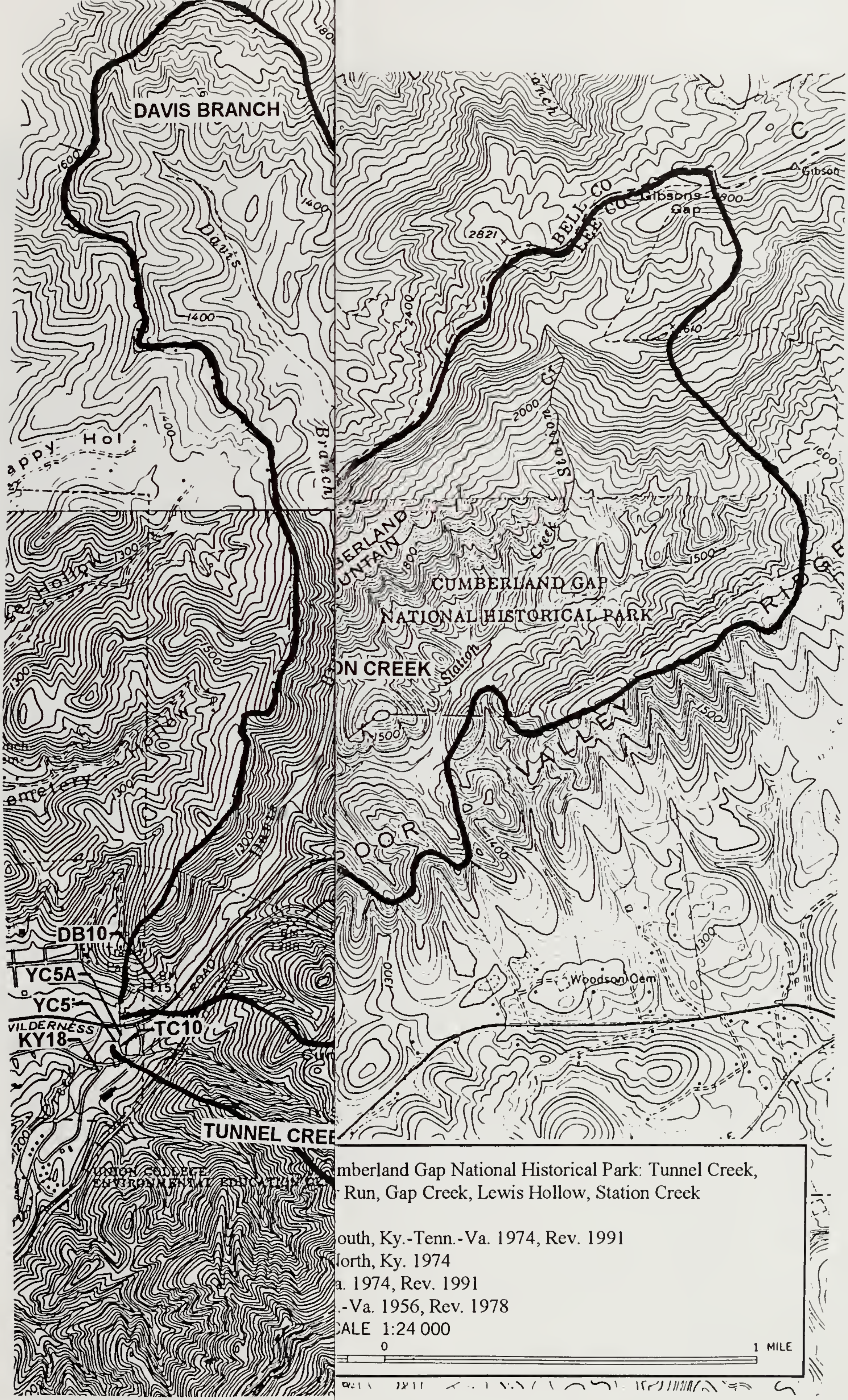


Figure A-3 Little Yellow Creek Watershed Cumberland Gap National Historical Park

Topographic Quadrangels Middlesboro South, Ky.-Tenn.-Va. 1974, Rev. 1991
Fork Ridge, Tenn.-Ky. 1959



mberland Gap National Historical Park: Tunnel Creek,
r Run, Gap Creek, Lewis Hollow, Station Creek

outh, Ky.-Tenn.-Va. 1974, Rev. 1991
Jorth, Ky. 1974
a. 1974, Rev. 1991
.-Va. 1956, Rev. 1978
CALE 1:24 000

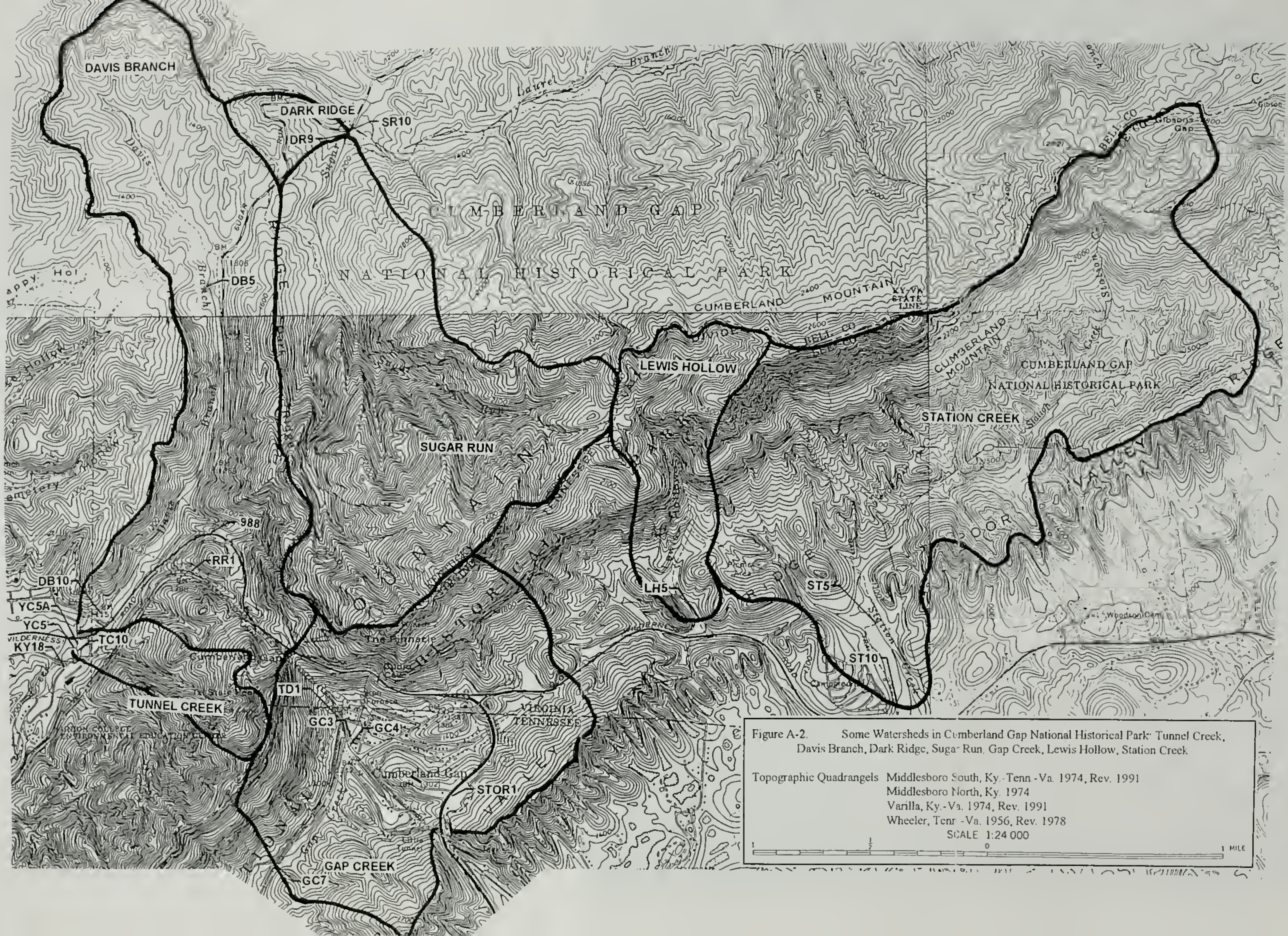
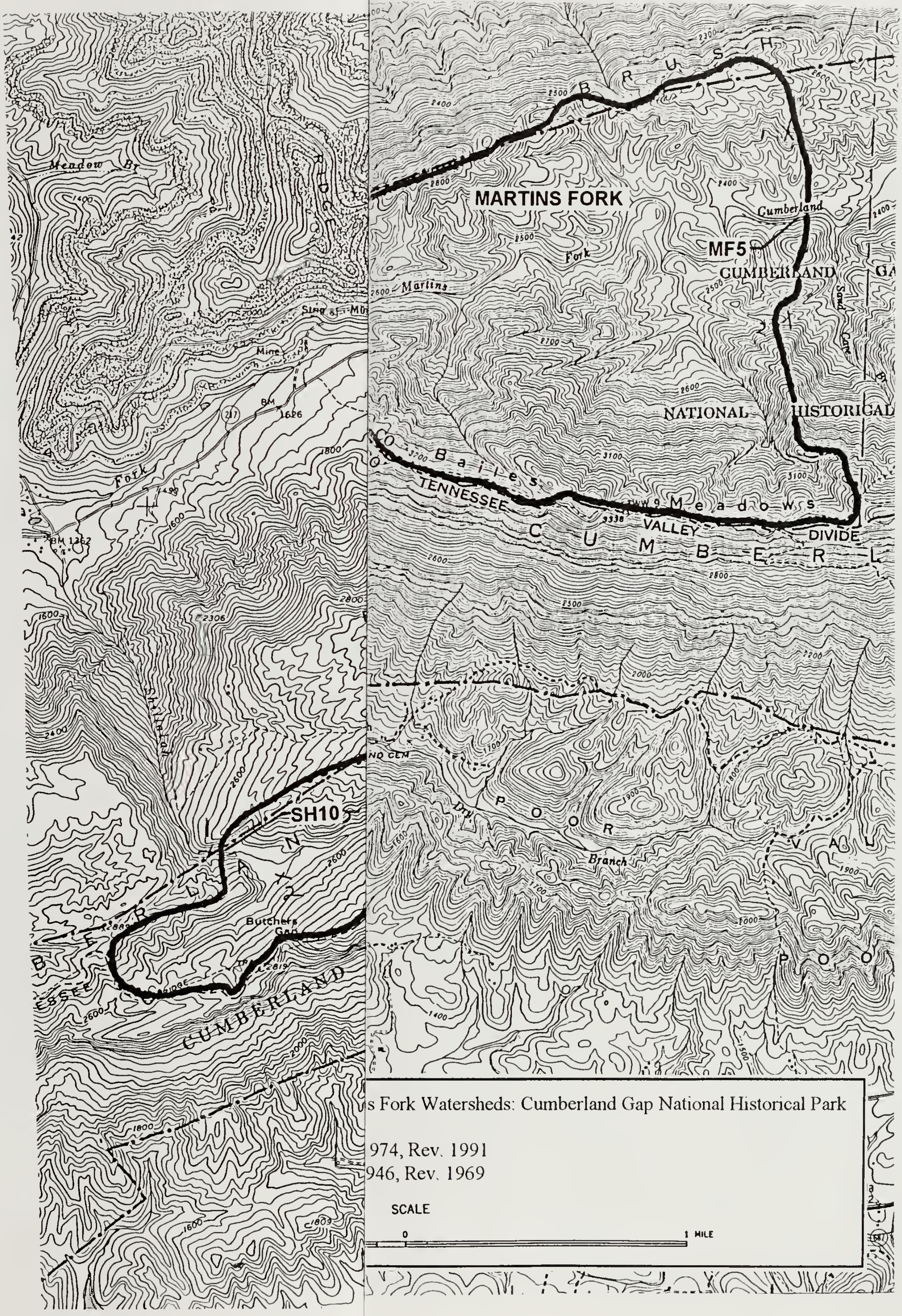


Figure A-2. Some Watersheds in Cumberland Gap National Historical Park: Tunnel Creek, Davis Branch, Dark Ridge, Sugar Run, Gap Creek, Lewis Hollow, Station Creek

| | |
|---|---|
| Topographic Quadrangels | Middlesboro South, Ky.-Tenn.-Va. 1974, Rev. 1991 |
| | Middlesboro North, Ky. 1974 |
| | Varilla, Ky.-Va. 1974, Rev. 1991 |
| | Wheeler, Tenn.-Va. 1956, Rev. 1978 |

SCALE 1:24 000



s Fork Watersheds: Cumberland Gap National Historical Park

974, Rev. 1991
946, Rev. 1969

SCALE

0 1 MILE

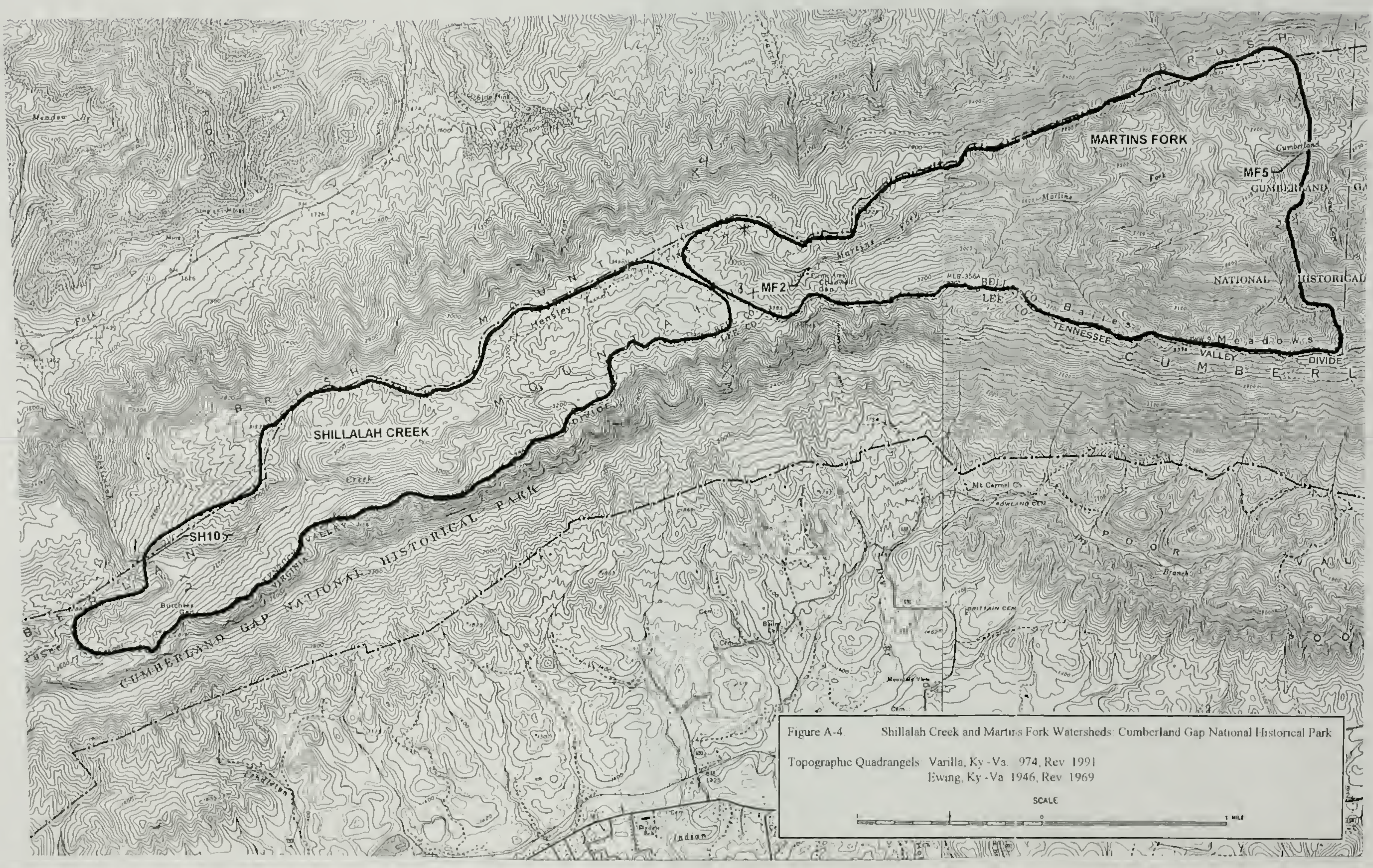


Figure A-4. Shillalah Creek and Martins Fork Watersheds: Cumberland Gap National Historical Park

Topographic Quadrangels: Varilla, Ky.-Va. 974, Rev. 1991
Ewing, Ky.-Va. 1946, Rev. 1969

# Appendix B

## 1993 Water Quality Data

## Appendix B Index

* In the tabulated data, a lower case "s" after a station designates a sample that was collected in association with a storm event (e.g. YC5s).

# Station CAVE Water Quality Data 1993

| Site | Date | TIME | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| CAVE | 2/22/93 | 1310 | 12.5 | 7.7 | 7.1 | 67 | | 229 | 464 | 120.00 | 130 | 130 | 10 | | 11.0 | <0.1 | |
| CAVE | 7/6/93 | 1415 | 15.0 | 7.8 | 7.3 | bdl | 0.80 | 122 | 437 | 25.00 | 60 | 70 | 10 | | 56.0 | bdl | |
| CAVE | 11/28/93 | 1155 | 13.4 | 7.8 | 9.2 | bdl | 0.45 | 307 | 496 | 47.60 | 160 | 160 | 10 | | 140.0 | bdl | |
| CAVEs | 12/5/93 | 0808 | 13.7 | 7.7 | 8.6 | bdl | 3.20 | 254 | 547 | 22.00 | 140 | 134 | 40 | | 110.0 | bdl | 5.20 |
| CAVE | 12/12/93 | 1340 | 13.4 | 7.7 | 9.0 | bdl | 0.61 | 247 | 513 | 7.60 | 130 | 131 | 10 | bdl | 110.0 | bdl | bdl |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | BR | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| CAVE | 2/22/93 | 46.37 | 3.20 | 0.80 | 1.00 | 2.63 | 9.10 | 1.07 | <0.02 | 1.60 | 6.71 | | 2.47 | 0.94 | <0.1 | <0.1 | <0.3 | |
| CAVE | 7/6/93 | 21.40 | 1.60 | 0.80 | 1.00 | 1.28 | 4.40 | 0.39 | bdl | 6.40 | 34.16 | | 1.40 | 1.09 | bdl | bdl | bdl | |
| CAVE | 11/28/93 | 55.90 | 5.00 | 1.10 | 1.00 | 3.26 | 10.00 | 1.00 | bdl | 1.50 | 85.40 | | 3.08 | 0.94 | 0.30 | bdl | bdl | |
| CAVEs | 12/5/93 | 50.00 | 2.70 | 0.42 | 0.80 | 2.76 | 11.00 | 1.10 | bdl | 1.30 | 67.10 | | 2.49 | | 0.10 | bdl | bdl | bdl |
| CAVE | 12/12/93 | 47.00 | 2.70 | 0.40 | 0.90 | 2.62 | 11.00 | 1.10 | bdl | 1.30 | 67.10 | | 2.48 | 0.95 | 0.20 | bdl | bdl | bdl |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| CAVE | 2/22/93 | 0.04 | <0.01 | | | <0.01 | <0.01 | <0.01 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.6 | | <0.01 | | 0.01 | 2.4 | 0.06 | 1.8 |
| CAVE | 7/6/93 | 0.18 | bdl | | | bdl | 0.01 | 0.11 | | bdl | | bdl | bdl | bdl | 3.8 | | bdl | | bdl | 0.11 | 0.02 | 0.89 |
| CAVE | 11/28/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | | | bdl | | 0.07 | 0.07 | 0.01 | 0.12 |
| CAVEs | 12/5/93 | 0.12 | bdl | 0.02 | bdl | bdl | bdl | 0.09 | 0.9 | bdl | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.27 | 0.01 | 0.52 |
| CAVE | 12/12/93 | 0.15 | bdl | bdl | bdl | bdl | bdl | 0.09 | bdl | bdl | bdl | bdl | bdl | bdl | | | bdl | bdl | bdl | 0.09 | bdl | 0.16 |

# Station DB5 Water Quality Data 1993 Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| DB5 | 1/11/93 | 1530 | 9.1 | 7.6 | 8.7 | 18 | 2.20 | 61 | 504 | 5.80 | 14 | 22 | 25 | | 8.5 | <0.1 | |
| DB5 | 1/25/93 | 1405 | 7.3 | 7.5 | 9.3 | 10 | 2.40 | 39 | 389 | 8.80 | 13 | 19 | 15 | | 7.8 | <0.1 | |
| DB5 | 2/8/93 | 1350 | 6.1 | 7.1 | 10.6 | 4 | 0.49 | 47 | 436 | <0.01 | 17 | 21 | 15 | <0.01 | 11.0 | <0.1 | |
| DB5 | 2/22/93 | 1130 | 7.0 | 7.8 | 9.0 | 17 | 5.40 | 30 | 371 | 12.70 | 12 | 17 | 20 | | 4.3 | <0.1 | |
| DB5 | 3/8/93 | 1300 | 8.8 | 7.4 | 9.1 | 8 | 1.40 | 34 | 497 | 3.30 | 13 | 22 | 15 | | 9.0 | | |
| DB5 | 3/22/93 | 1355 | 10.0 | 6.3 | 8.7 | 8 | 4.80 | 35 | 499 | 11.00 | 12 | 18 | 15 | | 3.9 | bdl | |
| DB5s | 3/23/93 | 1410 | 8.2 | 7.3 | 9.0 | 200 | | 29 | 464 | 221.00 | 9 | 17 | 40 | | 2.2 | bdl | 11.00 |
| DB5 | 4/2/93 | 1320 | 6.9 | 7.1 | 9.4 | 9 | 1.40 | 40 | 422 | 10.20 | 13 | 23 | 10 | | 6.3 | bdl | |
| DB5 | 4/19/93 | 1304 | 14.1 | 6.8 | 7.8 | 7 | 0.80 | 36 | 486 | 4.20 | 14 | 23 | 15 | | 8.5 | bdl | |
| DB5 | 5/3/93 | 1110 | 13.9 | 7.6 | 6.5 | 6 | 0.54 | 6 | 436 | 3.30 | 16 | 24 | 15 | | 10.0 | bdl | |
| DB5 | 5/17/93 | 1305 | 16.5 | 7.0 | 6.7 | 7 | 0.13 | 48 | 525 | 5.70 | 21 | 31 | 30 | | 20.0 | bdl | |
| DB5 | 5/31/93 | 1320 | 17.4 | 7.1 | 6.7 | 10 | 0.07 | 86 | 448 | 8.70 | 25 | 35 | 40 | | 21.0 | | |
| DB5 | 6/14/93 | 1105 | 18.2 | 6.5 | 5.0 | 12 | 0.07 | 81 | 434 | 7.00 | 29 | 37 | 40 | | 24.0 | bdl | |
| DB5 | 7/6/93 | 1520 | 22.0 | 8.1 | 1.3 | 9 | | 90 | 464 | 6.60 | 28 | 47 | 30 | | 33.0 | bdl | |
| DB5 | 7/19/93 | 1455 | 22.9 | 6.6 | 5.3 | 17 | | 85 | 449 | 11.10 | 35 | 41 | 35 | | 29.0 | bdl | |
| DB5 | 8/23/93 | 1515 | 21.8 | 7.3 | 3.5 | 6 | | 93 | 488 | 3.50 | 39 | 46 | 40 | bdl | 32.0 | bdl | |
| DB5 | 9/7/93 | 1502 | 19.3 | 6.3 | 1.7 | 7 | | 114 | 520 | 5.20 | 38 | 45 | 60 | | 31.0 | bdl | |
| DB5s | 12/5/93 | 0957 | 10.1 | 6.1 | 9.4 | bdl | 10.40 | 40 | 520 | 32.90 | 13 | 18 | 30 | bdl | 4.7 | bdl | 2.20 |

# Station DB5 Water Quality Data 1993 Page 2 of 3

| | | | | | | Major | | | | | | | Major | Anions/ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Date | Ca | Mg | Na | K | Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Anions | Cations | F | BR | PO4 | As |
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| DB5 | 1/11/93 | 2.55 | 1.90 | 1.30 | 0.90 | 0.37 | 7.80 | 0.55 | <0.02 | 1.80 | 5.19 | | 0.39 | 1.06 | <0.1 | <0.1 | <0.3 | |
| DB5 | 1/25/93 | 2.24 | 1.70 | 1.10 | 0.80 | | 6.80 | 0.36 | <0.02 | 0.90 | 4.76 | | | 1.05 | <0.1 | <0.1 | <0.3 | |
| DB5 | 2/8/93 | 3.20 | 2.30 | 1.20 | 0.90 | | 5.80 | <0.05 | <0.02 | 1.00 | 6.71 | | | 0.85 | <0.1 | <0.1 | <0.3 | |
| DB5 | 2/22/93 | 1.98 | 1.60 | 1.00 | 0.90 | 0.31 | 7.30 | 0.34 | <0.02 | 1.10 | 2.62 | | 0.27 | 0.90 | <0.1 | <0.1 | <0.3 | |
| DB5 | 3/8/93 | 2.40 | 1.70 | 1.30 | 0.70 | 0.34 | 7.80 | 1.90 | | 0.80 | 5.49 | | 0.40 | 1.15 | | | | |
| DB5 | 3/22/93 | 2.24 | 1.60 | 1.10 | 0.80 | 0.32 | 8.90 | bdl | bdl | 1.30 | 17.69 | | 0.30 | 0.94 | bdl | bdl | bdl | |
| DB5s | 3/23/93 | 1.70 | 1.10 | 0.49 | 1.00 | 0.26 | 10.00 | bdl | bdl | 0.80 | 1.34 | | 0.27 | 1.06 | bdl | bdl | bdl | |
| DB5 | 4/2/93 | 2.37 | 1.80 | 1.10 | 0.80 | 0.34 | 10.00 | 0.34 | 2.10 | 0.90 | 3.84 | | 0.41 | 1.20 | bdl | bdl | bdl | |
| DB5 | 4/19/93 | 2.43 | 1.80 | 1.20 | 0.90 | 0.35 | 9.90 | 0.33 | 2.00 | 1.00 | 5.19 | | 0.41 | 1.18 | bdl | bdl | bdl | |
| DB5 | 5/3/93 | 3.09 | 2.10 | 1.20 | 0.80 | 0.40 | 9.00 | bdl | 0.91 | 0.80 | 6.10 | | 0.43 | 1.07 | bdl | bdl | bdl | |
| DB5 | 5/17/93 | 4.46 | 2.50 | 1.40 | 1.10 | 0.53 | 7.50 | 0.38 | 0.56 | 0.90 | 12.20 | | 0.60 | 1.13 | bdl | bdl | bdl | |
| DB5 | 5/31/93 | 5.40 | 2.80 | 1.50 | 1.20 | 0.61 | 6.60 | 2.70 | 0.68 | 1.20 | 12.81 | | 0.65 | 1.06 | bdl | | bdl | |
| DB5 | 6/14/93 | 6.08 | 3.30 | 1.60 | 1.40 | 0.70 | 7.00 | 1.20 | 0.33 | 1.10 | 14.64 | | 0.68 | 0.97 | bdl | bdl | bdl | |
| DB5 | 7/6/93 | 8.00 | 4.10 | 1.70 | 1.70 | 0.89 | 7.20 | 1.20 | 1.40 | 1.00 | 20.13 | | 0.89 | 1.00 | bdl | bdl | bdl | |
| DB5 | 7/19/93 | 8.07 | 3.60 | 1.60 | 1.70 | 0.84 | 5.30 | 1.30 | bdl | 0.90 | 17.69 | | 0.74 | 0.88 | bdl | bdl | bdl | |
| DB5 | 8/23/93 | 8.81 | 4.00 | 1.70 | 2.20 | 0.92 | 7.60 | 0.55 | bdl | 1.00 | 19.52 | | 0.84 | 0.92 | 0.10 | bdl | bdl | |
| DB5 | 9/7/93 | 8.90 | 3.80 | 1.50 | 2.60 | 0.92 | 6.60 | 0.40 | bdl | 1.40 | 18.91 | | 0.81 | 0.88 | 0.10 | bdl | bdl | |
| DB5s | 12/5/93 | 2.50 | 1.60 | 0.80 | 1.10 | 0.35 | 7.70 | 0.21 | bdl | 1.00 | 2.87 | | 0.29 | | bdl | bdl | bdl | bdl |

# Station DB5 Water Quality Data 1993    Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| DB5 | 1/11/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.15 | | 0.04 | | <0.01 | 0.10 | <0.1 | 3.60 | | <0.01 | | <0.01 | 0.42 | 0.05 | 0.03 |
| DB5 | 1/25/93 | 0.02 | <0.01 | | | <0.01 | <0.01 | 0.15 | | 0.03 | | <0.01 | <0.1 | <0.1 | 3.50 | | <0.01 | | <0.01 | 0.32 | 0.03 | 0.19 |
| DB5 | 2/8/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.20 | | 0.06 | | <0.01 | <0.1 | <0.1 | 3.40 | | 3.00 | | 4.20 | 0.56 | 0.06 | 0.05 |
| DB5 | 2/22/93 | 0.04 | <0.01 | | | <0.01 | <0.01 | 0.13 | | 0.01 | | <0.01 | <0.1 | <0.1 | 3.30 | | 0.02 | | <0.01 | 0.29 | 0.01 | 0.54 |
| DB5 | 3/8/93 | 0.03 | | | | | | 0.18 | | 0.03 | | 0.01 | | | 3.30 | | bdl | | | 0.31 | 0.03 | 0.03 |
| DB5 | 3/22/93 | 0.04 | bdl | | | bdl | bdl | 0.09 | | 0.02 | | bdl | bdl | bdl | 3.50 | | bdl | | bdl | 0.21 | 0.02 | 0.04 |
| DB5s | 3/23/93 | 0.26 | bdl | 0.01 | | bdl | 0.01 | 0.20 | | 0.06 | | 0.01 | bdl | bdl | 1.90 | bdl | 0.06 | bdl | 0.02 | 1.10 | 0.19 | 0.52 |
| DB5 | 4/2/93 | 0.02 | bdl | | | bdl | bdl | 0.15 | | 0.03 | | bdl | bdl | bdl | 3.30 | | 0.01 | | bdl | 0.17 | 0.03 | 0.02 |
| DB5 | 4/19/93 | 0.03 | bdl | | | bdl | bdl | 0.04 | | 0.03 | | bdl | bdl | bdl | 3.30 | | bdl | | bdl | 0.29 | 0.03 | 0.09 |
| DB5 | 5/3/93 | bdl | bdl | | | bdl | bdl | 0.08 | | 0.04 | | bdl | bdl | bdl | 3.50 | | bdl | | 0.02 | 0.28 | 0.05 | 0.05 |
| DB5 | 5/17/93 | 0.03 | bdl | | | bdl | bdl | 0.32 | | 0.07 | | bdl | bdl | bdl | 3.70 | | bdl | | 0.02 | 0.69 | 0.07 | 0.06 |
| DB5 | 5/31/93 | 0.01 | | | | 0.01 | bdl | 0.41 | | 0.10 | | bdl | bdl | bdl | 3.70 | | bdl | | 0.04 | 1.10 | bdl | 0.16 |
| DB5 | 6/14/93 | 0.02 | bdl | | | bdl | bdl | 0.54 | | 0.07 | | bdl | bdl | bdl | 4.10 | | bdl | | 0.03 | 1.00 | 0.08 | 0.05 |
| DB5 | 7/6/93 | 0.03 | bdl | | | bdl | 0.02 | 0.73 | | 0.24 | | bdl | bdl | bdl | 3.90 | | bdl | | bdl | 1.70 | 0.25 | 0.07 |
| DB5 | 7/19/93 | 0.02 | 0.02 | | | bdl | 0.01 | 0.73 | | 0.09 | | bdl | bdl | bdl | 3.60 | | bdl | | bdl | 1.10 | 0.10 | 0.07 |
| DB5 | 8/23/93 | 0.02 | bdl | | | bdl | bdl | 0.43 | | 0.13 | | bdl | bdl | bdl | 3.70 | | bdl | | bdl | 1.00 | 0.13 | 0.12 |
| DB5 | 9/7/93 | 0.01 | bdl | | | bdl | bdl | 0.66 | | 0.16 | | bdl | bdl | bdl | 2.90 | | bdl | | bdl | 1.50 | 0.17 | 0.08 |
| DB5s | 12/5/93 | 0.17 | bdl | 0.02 | bdl | bdl | bdl | 0.18 | 0.83 | 0.04 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.46 | 0.05 | 0.41 |

# Station DB10 Water Quality Data 1993    Page 1 of 3

| Site | Date | TIME | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| DB10 | 1/11/93 | 1105 | 8.8 | 7.0 | 9.2 | 4 | 2.20 | 77 | 501 | 1.50 | 27 | 39 | 10 | 0.60 | 17.0 | <0.1 | |
| DB10 | 1/25/93 | 1315 | 6.3 | 7.7 | 10.4 | 8 | 4.10 | 68 | 396 | 6.60 | 23 | 36 | 15 | | 14.0 | <0.1 | |
| DB10 | 2/8/93 | 1415 | 7.0 | 7.2 | 9.7 | 1 | 0.49 | 104 | 449 | 0.80 | 34 | 50 | 15 | 3.00 | 24.0 | <0.1 | |
| DB10 | 2/22/93 | 1215 | 7.5 | 7.4 | 9.0 | 11 | 9.60 | 57 | 451 | 10.40 | 22 | bdl | 15 | | 12.0 | <0.1 | |
| DB10 | 3/8/93 | 1440 | 9.0 | 7.3 | 8.9 | 6 | 2.90 | 79 | 469 | 1.80 | 29 | 52 | 10 | bdl | 19.0 | | |
| DB10 | 3/22/93 | 1330 | 9.2 | 6.8 | 8.7 | 7 | 6.70 | 78 | 494 | 8.80 | 24 | 41 | 15 | | 10.0 | bdl | |
| DB10s | 3/23/93 | 1350 | 8.8 | 7.8 | 7.6 | 200 | | 53 | 457 | 670.00 | 18 | 30 | 40 | bdl | 13.0 | bdl | 12.00 |
| DB10 | 4/2/93 | 1115 | 7.4 | 7.2 | 9.3 | 6 | 2.60 | 94 | 409 | 8.30 | 30 | 50 | 5 | | 17.0 | bdl | |
| DB10 | 4/19/93 | 1221 | 13.8 | 7.1 | 7.7 | 5 | 1.40 | 73 | 506 | 4.70 | 28 | 46 | 15 | bdl | 17.0 | bdl | |
| DB10 | 5/3/93 | 1450 | 14.6 | 7.2 | 7.6 | 5 | 1.00 | 82 | 488 | 2.40 | 34 | 49 | 5 | | 23.0 | bdl | |
| DB10 | 5/17/93 | 1110 | 15.9 | 7.3 | 6.5 | 3 | 0.28 | 116 | 480 | 2.50 | 52 | 75 | 20 | | 43.0 | bdl | |
| DB10 | 5/31/93 | 1035 | 17.3 | 7.4 | 5.1 | 3 | 0.10 | 188 | 380 | 3.00 | 65 | 90 | 20 | | 53.0 | bdl | |
| DB10 | 6/14/93 | 1045 | 18.7 | 6.8 | 5.8 | 5 | 0.20 | 214 | 398 | 4.10 | 85 | 103 | 20 | | 69.0 | bdl | |
| DB10 | 7/6/93 | 1450 | 25.5 | 8.0 | 4.3 | 9 | 0.06 | 252 | 438 | 4.70 | 110 | 136 | 5 | | 90.0 | bdl | |
| DB10 | 7/19/93 | 1110 | 22.2 | 7.6 | 5.8 | 5 | 0.10 | 247 | 377 | 2.80 | 96 | 127 | 20 | | 78.0 | bdl | |
| DB10 | 8/9/93 | 1438 | 21.9 | 7.7 | 6.8 | 4 | 0.01 | 307 | 360 | 4.00 | 130 | 163 | 15 | bdl | 110.0 | bdl | |
| DB10 | 8/23/93 | 1535 | 25.1 | 7.9 | 5.4 | 4 | 0.10 | 271 | 461 | 2.10 | 110 | 152 | 10 | bdl | 91.0 | bdl | |
| DB10 | 9/7/93 | 1434 | 22.3 | 7.3 | 6.0 | 3 | | 303 | 488 | 3.30 | 120 | 153 | 20 | | 100.0 | bdl | |
| DB10 | 9/21/93 | 1010 | 18.2 | 7.6 | 4.9 | 5 | 0.25 | 299 | 425 | 3.20 | 140 | 160 | 20 | | 100.0 | bdl | |
| DB10 | 10/7/93 | 1017 | 13.6 | 7.4 | 5.4 | 3 | 0.23 | 315 | 422 | 2.00 | 130 | 161 | 15 | | 100.0 | bdl | |
| DB10 | 10/18/93 | 1110 | 15.4 | 7.3 | 4.4 | 1 | 0.43 | 289 | 493 | 1.70 | 120 | 170 | 25 | bdl | 110.0 | bdl | |
| DB10 | 11/4/93 | 1201 | 9.6 | 7.4 | 8.1 | 2 | | 226 | 449 | 3.20 | 85 | 112 | 25 | | 62.0 | bdl | |
| DB10 | 11/15/93 | 1042 | 14.3 | 7.2 | 6.8 | bdl | 0.25 | 253 | 447 | 2.00 | 97 | 133 | 20 | | 66.0 | bdl | |
| DB10 | 11/29/93 | 1522 | 7.2 | 7.3 | 10.3 | bdl | | 166 | 409 | 1.40 | 61 | 86 | 15 | | 37.0 | bdl | |
| DB10s | 12/5/93 | 0939 | 10.2 | 7.0 | 9.6 | bdl | | 79 | 494 | 20.50 | 29 | 40 | 20 | | 13.0 | bdl | 2.30 |
| DB10 | 12/13/93 | 1103 | 4.0 | 7.1 | 11.3 | bdl | 0.87 | 116 | 380 | 0.50 | 42 | 59 | 10 | 0.05 | 24.0 | bdl | bdl |

# Station DB10 Water Quality Data 1993    Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | BR | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| DB10 | 1/11/93 | 7.25 | 2.20 | 2.80 | 1.00 | 0.69 | 11.00 | 0.64 | <0.02 | 3.30 | 10.37 |  | 0.67 | 0.97 | <0.1 | <0.1 | <0.3 |  |
| DB10 | 1/25/93 | 6.23 | 1.90 | 2.40 | 1.00 |  | 9.70 | 3.52 | <0.02 | 2.10 | 8.54 |  |  | 1.02 | <0.1 | <0.1 | <0.3 |  |
| DB10 | 2/8/93 | 9.85 | 2.40 | 3.30 | 1.00 |  | 12.00 | 3.11 | <0.02 | 3.50 | 14.64 |  |  | 1.02 | <0.1 | <0.1 | <0.3 |  |
| DB10 | 2/22/93 | 5.89 | 1.90 | <0.01 | 0.80 | 0.58 | 35.10 | <0.1 | 0.98 | 3.80 | 7.32 |  | 0.61 | 1.06 | <0.1 | <0.1 | <0.1 |  |
| DB10 | 3/8/93 | 8.31 | 2.00 | 5.20 | 0.90 | 0.83 | 13.00 | 2.50 |  | 8.40 | 11.59 |  | 0.93 | 1.11 |  |  |  |  |
| DB10 | 3/22/93 | 6.72 | 1.80 | 4.00 | 0.80 | 0.68 | 13.00 | 0.55 | bdl | 7.80 | 2.38 |  | 0.70 | 1.03 | bdl | bdl | bdl |  |
| DB10s | 3/23/93 | 4.90 | 1.30 | 1.40 | 1.40 | 0.49 | 9.50 | 1.10 | bdl | 1.90 | 7.93 |  | 0.53 | 1.08 | bdl | bdl | bdl |  |
| DB10 | 4/2/93 | 8.35 | 2.10 | 4.60 | 1.40 | 0.83 | 14.00 | 0.67 | 0.83 | 7.20 | 10.37 |  | 0.86 | 1.04 | bdl | bdl | bdl |  |
| DB10 | 4/19/93 | 8.05 | 2.00 | 3.60 | 0.90 | 0.75 | 14.00 | 0.97 | 0.86 | 5.60 | 10.37 |  | 0.82 | 1.20 | bdl | bdl | bdl |  |
| DB10 | 5/3/93 | 9.92 | 2.00 | 3.90 | 0.50 | 0.88 | 12.00 | 0.37 | 0.42 | 5.60 | 14.03 |  | 0.88 | 1.00 | bdl | bdl | bdl |  |
| DB10 | 5/17/93 | 15.90 | 2.90 | 4.80 | 1.20 | 1.28 | 14.00 | 0.88 | 1.10 | 8.00 | 26.23 |  | 1.42 | 1.11 | bdl | bdl | bdl |  |
| DB10 | 5/31/93 | 20.90 | 3.20 | 6.50 | 1.40 | 1.63 | 14.00 | 1.00 | 1.00 | 10.00 | 32.33 |  | 1.67 | 1.02 | bdl | bdl | bdl |  |
| DB10 | 6/14/93 | 27.70 | 3.90 | 6.50 | 1.60 | 2.04 | 12.00 | bdl | bdl | 9.90 | 42.09 |  | 1.91 | 0.94 | bdl | bdl | bdl |  |
| DB10 | 7/6/93 | 35.20 | 4.70 | 8.00 | 2.10 | 2.55 | 17.00 | 1.70 | bdl | 13.00 | 54.90 |  | 2.55 | 1.00 | bdl | bdl | bdl |  |
| DB10 | 7/19/93 | 32.30 | 3.80 | 8.80 | 1.80 | 2.37 | 19.00 | 1.30 | bdl | 13.00 | 47.58 |  | 2.34 | 0.99 | bdl | bdl | bdl |  |
| DB10 | 8/9/93 | 43.40 | 5.20 | 12.00 | 2.00 | 3.17 | 17.00 | 0.59 | bdl | 17.00 | 67.10 |  | 3.04 | 0.96 | bdl | bdl | bdl |  |
| DB10 | 8/23/93 | 37.10 | 4.40 | 21.00 | 2.30 | 3.19 | 18.00 | 0.48 | bdl | 14.00 | 55.51 |  | 2.61 | 0.82 | 0.20 | bdl | bdl |  |
| DB10 | 9/7/93 | 41.30 | 5.00 | 12.00 | 1.90 | 3.05 | 17.00 | 0.38 | bdl | 15.00 | 61.00 |  | 2.79 | 0.92 | 0.20 | bdl | bdl |  |
| DB10 | 9/21/93 | 46.30 | 5.10 | 11.00 | 2.30 | 3.27 | 18.00 | 0.34 | bdl | 16.00 | 61.00 |  | 2.84 | 0.87 | 0.20 | bdl | bdl |  |
| DB10 | 10/7/93 | 42.60 | 5.20 | 12.00 | 2.30 | 3.15 | 20.00 | bdl | bdl | 18.00 | 61.00 |  | 2.93 | 0.93 | 0.20 | bdl | bdl |  |
| DB10 | 10/18/93 | 40.30 | 5.00 | 18.00 | 2.90 | 3.28 | 20.00 | bdl | bdl | 18.00 | 67.10 |  | 3.12 | 0.95 | bdl | bdl | bdl |  |
| DB10 | 11/4/93 | 27.60 | 3.90 | 9.40 | 2.60 | 2.18 | 17.00 | 0.50 | bdl | 13.00 | 37.82 |  | 1.98 | 0.91 | 0.20 | bdl | bdl |  |
| DB10 | 11/15/93 | 31.60 | 4.40 | 12.00 | 3.20 | 2.55 | 26.00 | 0.16 | bdl | 16.00 | 40.26 |  | 2.33 | 0.91 | 0.20 | bdl | bdl |  |
| DB10 | 11/29/93 | 18.60 | 3.50 | 7.60 | 1.60 | 1.59 | 21.00 | 0.54 | bdl | 10.00 | 22.57 |  | 1.48 | 0.93 | 0.20 | bdl | bdl |  |
| DB10s | 12/5/93 | 8.40 | 1.90 | 2.30 | 0.97 | 0.72 | 1.40 | 0.89 | bdl | 3.10 | 7.93 |  | 0.66 |  | 0.10 | bdl | bdl | bdl |
| DB10 | 12/13/93 | 12.60 | 2.60 | 4.50 | 1.20 | 1.08 | 17.00 | 0.49 | bdl | 6.00 | 14.64 |  | 1.02 | 0.95 | 0.10 | bdl | bdl | bdl |

# Station DB10 Water Quality Data 1993 Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| DB10 | 1/11/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.11 | | 0.03 | | <0.01 | <0.1 | <0.1 | 3.30 | | <0.01 | | <0.01 | 0.37 | 0.03 | <0.01 |
| DB10 | 1/25/93 | 0.01 | <0.01 | | | <0.01 | 0.02 | 0.10 | | 0.02 | | <0.01 | <0.1 | <0.1 | 3.10 | | <0.01 | | <0.01 | 0.24 | 0.03 | 0.11 |
| DB10 | 2/8/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.18 | | 0.04 | | <0.01 | <0.1 | <0.1 | 2.80 | | <0.01 | | <0.01 | 0.29 | 0.04 | <0.01 |
| DB10 | 2/22/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.06 | | 0.01 | | <0.02 | 2.90 | <0.3 | 12.00 | | 0.10 | | <0.01 | 0.27 | 0.01 | <0.28 |
| DB10 | 3/8/93 | 0.03 | | | | | | 0.12 | | 0.02 | | | | | 2.80 | | | | | 0.21 | 0.02 | 0.07 |
| DB10 | 3/22/93 | 0.02 | bdl | | | bdl | bdl | 0.06 | | 0.01 | | bdl | bdl | bdl | 3.00 | | bdl | | bdl | 0.17 | 0.02 | 0.11 |
| DB10s | 3/23/93 | 0.25 | bdl | 0.02 | | bdl | bdl | 0.31 | | 0.08 | | bdl | bdl | bdl | 2.10 | 0.01 | bdl | bdl | 0.02 | 3.50 | 0.55 | 1.60 |
| DB10 | 4/2/93 | 0.01 | bdl | | | bdl | bdl | 0.08 | | 0.02 | | bdl | bdl | bdl | 2.90 | | bdl | | 0.01 | 0.11 | 0.02 | 0.01 |
| DB10 | 4/19/93 | bdl | bdl | | | bdl | bdl | 0.10 | | 0.02 | | bdl | bdl | bdl | 2.80 | | bdl | | bdl | 0.24 | 0.02 | 0.11 |
| DB10 | 5/3/93 | 0.02 | bdl | | | bdl | 0.01 | 0.08 | | bdl | | bdl | bdl | bdl | 2.90 | | bdl | | 0.01 | 0.21 | bdl | 0.03 |
| DB10 | 5/17/93 | bdl | bdl | | | bdl | bdl | 0.23 | | 0.05 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.01 | 0.36 | 0.05 | 0.05 |
| DB10 | 5/31/93 | bdl | bdl | | | bdl | bdl | 0.31 | | 0.07 | | bdl | bdl | bdl | 2.90 | | bdl | | 0.04 | 0.51 | 0.08 | 0.89 |
| DB10 | 6/14/93 | bdl | bdl | | | bdl | bdl | 0.33 | | 0.07 | | bdl | bdl | bdl | 3.40 | | bdl | | 0.04 | 0.58 | 0.07 | 0.02 |
| DB10 | 7/6/93 | 0.01 | bdl | | | bdl | 0.01 | 0.30 | | 0.10 | | bdl | bdl | bdl | 3.80 | | bdl | | 0.01 | 0.56 | 0.11 | 0.03 |
| DB10 | 7/19/93 | 0.02 | bdl | | | bdl | bdl | 0.40 | | 0.07 | | 0.01 | bdl | bdl | 3.10 | | bdl | | bdl | 0.55 | 0.07 | 0.03 |
| DB10 | 8/9/93 | bdl | 0.02 | | | bdl | bdl | 0.16 | | 0.09 | | bdl | bdl | bdl | 3.20 | | bdl | | bdl | 0.75 | 0.10 | 0.02 |
| DB10 | 8/23/93 | bdl | 0.02 | | | bdl | bdl | 0.32 | | 0.05 | | bdl | bdl | bdl | 3.40 | | bdl | | bdl | 0.48 | 0.05 | 0.01 |
| DB10 | 9/7/93 | bdl | 0.02 | | | bdl | bdl | 0.29 | | 0.08 | | bdl | bdl | bdl | 3.30 | | bdl | | bdl | 0.59 | 0.08 | 0.02 |
| DB10 | 9/21/93 | bdl | 0.01 | | | bdl | 0.02 | 0.20 | | 0.06 | | bdl | bdl | bdl | 3.10 | | bdl | | 0.01 | | | bdl |
| DB10 | 10/7/93 | bdl | bdl | | | bdl | bdl | 0.24 | | 0.03 | | bdl | bdl | bdl | 2.90 | | bdl | | 0.02 | 0.73 | 0.04 | bdl |
| DB10 | 10/18/93 | bdl | 0.01 | | | bdl | bdl | 0.24 | | 0.02 | | bdl | bdl | bdl | 3.10 | | bdl | | 0.01 | 0.34 | 0.02 | bdl |
| DB10 | 11/4/93 | bdl | 0.02 | | | bdl | bdl | 0.29 | | 0.01 | | bdl | 0.10 | bdl | 3.00 | | bdl | | 0.02 | 0.39 | 0.02 | 0.02 |
| DB10 | 11/15/93 | bdl | bdl | | | bdl | bdl | 0.22 | | 0.02 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.03 | 0.34 | 0.03 | 0.02 |
| DB10 | 11/29/93 | 0.01 | bdl | | | bdl | bdl | 0.19 | | 0.04 | | bdl | bdl | bdl | | | bdl | | bdl | 0.30 | 0.04 | 0.04 |
| DB10s | 12/5/93 | 0.14 | bdl | 0.02 | bdl | bdl | 0.02 | 0.12 | 0.92 | 0.03 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.32 | 0.04 | 0.24 |
| DB10 | 12/13/93 | bdl | bdl | bdl | bdl | bdl | bdl | 0.19 | bdl | 0.04 | bdl | bdl | bdl | | | | bdl | bdl | 0.01 | 0.27 | 0.05 | bdl |

# Station GC3 Water Quality Data 1993 Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| GC3 | 1/11/93 | 1425 | 11.6 | 7.4 | 8.6 | 6 | 7.30 | 124 | 520 | 0.80 | 59 | 63 | 5 | | 49.0 | <0.1 | |
| GC3 | 1/25/93 | 1440 | 11.4 | 7.9 | 8.9 | 2 | 9.90 | 128 | 425 | 3.00 | 62 | 67 | <5 | | 52.0 | <0.1 | |
| GC3 | 2/8/93 | 1310 | 12.1 | 8.0 | 8.5 | 2 | 2.60 | 140 | 467 | 5.20 | 64 | 69 | 10 | | 57.0 | <0.1 | |
| GC3 | 2/22/93 | 0955 | 11.5 | | 8.5 | 7 | 20.10 | 126 | 485 | 9.10 | 68 | 71 | 15 | | 53.0 | <0.1 | |
| GC3 | 3/8/93 | 1045 | 11.6 | 7.8 | 8.7 | 3 | 7.80 | 114 | 482 | 2.00 | 55 | 66 | 10 | | 54.0 | | |
| GC3 | 3/22/93 | 1430 | 0.2 | 7.7 | 8.7 | 5 | 17.00 | 120 | 425 | 4.40 | 58 | 63 | 15 | | 48.0 | bdl | |
| GC3s | 3/23/93 | 1450 | 11.9 | 7.6 | 8.7 | 200 | | 134 | 434 | 138.00 | 63 | 79 | 30 | | 58.0 | bdl | 8.00 |
| GC3 | 4/2/93 | 1350 | 10.8 | 7.4 | 8.9 | 4 | 8.70 | 127 | 402 | 6.80 | 59 | 64 | 5 | | 51.0 | bdl | |
| GC3 | 4/19/93 | 1344 | 13.2 | 7.9 | 8.2 | 2 | 4.60 | 104 | 439 | 2.80 | 60 | 67 | 10 | | 54.0 | bdl | |
| GC3 | 5/3/93 | 1020 | 12.5 | 8.0 | 8.0 | 2 | 3.70 | 110 | 492 | 1.80 | 64 | 69 | 5 | | 56.0 | bdl | |
| GC3 | 5/17/93 | 1400 | 13.8 | 8.1 | 7.3 | 1 | 2.30 | 125 | 448 | 0.80 | 68 | 77 | 5 | | 64.0 | bdl | |
| GC3 | 5/31/93 | 1400 | 13.3 | 7.9 | 9.2 | 1 | 0.60 | 161 | 331 | 2.20 | 72 | 79 | 10 | | 67.0 | bdl | |
| GC3 | 6/14/93 | 1320 | 15.0 | 8.0 | 8.1 | 3 | 1.60 | 155 | 378 | 2.00 | 79 | 82 | 5 | | 71.0 | bdl | |
| GC3 | 7/6/93 | 1050 | 16.6 | 8.0 | 5.7 | 3 | 0.40 | 181 | 366 | 3.60 | 93 | 96 | 5 | | 84.0 | bdl | |
| GC3 | 7/19/93 | 1535 | 17.7 | 8.0 | 8.4 | 7 | 0.30 | 202 | 392 | 11.90 | 98 | 102 | 10 | | 89.0 | bdl | |
| GC3 | 8/9/93 | 1133 | 16.6 | 8.2 | 10.0 | 2 | 0.53 | 193 | 343 | 3.80 | 100 | 105 | 10 | bdl | 91.0 | bdl | |
| GC3 | 8/23/93 | 1415 | 20.0 | 8.3 | 8.3 | 2 | 0.45 | 172 | 411 | 1.80 | 100 | 105 | 10 | bdl | 91.0 | bdl | |
| GC3 | 9/7/93 | 1540 | 19.3 | 7.8 | 6.8 | 2 | | 199 | 433 | 3.70 | 100 | 92 | 10 | | 70.0 | bdl | |
| GC3 | 9/21/93 | 1103 | 16.8 | 8.1 | 6.9 | 2 | 0.23 | 209 | 415 | 2.20 | 120 | 112 | bdl | | 92.0 | bdl | |
| GC3 | 11/29/93 | 0833 | 11.0 | 7.8 | 9.8 | bdl | | 95 | 506 | 1.80 | 44 | 37 | 10 | | 30.0 | bdl | |
| GC3s | 12/5/93 | 1017 | 12.0 | 7.9 | 9.6 | bdl | | 118 | 466 | 38.30 | 60 | 62 | 5 | bdl | 41.0 | bdl | 1.60 |
| GC3 | 12/13/93 | 1300 | 11.7 | 7.8 | 9.5 | bdl | 4.80 | 103 | 455 | 4.80 | 49 | 51 | 10 | bdl | 35.0 | bdl | bdl |

# Station GC3 Water Quality Data 1993 Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | BR | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| GC3 | 1/11/93 | 20.26 | 2.10 | 1.20 | 0.70 | 1.25 | 7.50 | 1.00 | <0.02 | 1.20 | 29.89 | | 1.19 | 0.95 | <0.1 | <0.1 | <0.3 | |
| GC3 | 1/25/93 | 21.18 | 2.20 | 0.70 | 0.60 | | 8.10 | 1.08 | <0.02 | 1.00 | 31.72 | | | 1.00 | <0.1 | <0.1 | <0.3 | |
| GC3 | 2/8/93 | 21.75 | 2.30 | 0.70 | 0.90 | | 6.70 | 1.04 | <0.02 | 1.10 | 34.77 | | | 1.00 | <0.1 | <0.1 | <0.3 | |
| GC3 | 2/22/93 | 23.27 | 2.30 | 1.00 | 0.80 | 1.41 | 8.00 | 1.90 | <0.02 | 1.40 | 32.23 | | 1.30 | | <0.1 | <0.1 | <0.3 | |
| GC3 | 3/8/93 | 19.10 | 1.90 | 0.80 | 0.80 | 1.16 | 7.70 | 1.50 | | 1.70 | 32.94 | | 1.31 | 1.13 | | | | |
| GC3 | 3/22/93 | 20.10 | 1.90 | 0.70 | 0.60 | 1.20 | 8.50 | 1.40 | bdl | 1.20 | 6.10 | | 1.19 | 0.99 | bdl | bdl | bdl | |
| GC3s | 3/23/93 | 22.00 | 1.90 | 0.79 | 1.60 | 1.36 | 13.00 | 2.70 | bdl | 2.00 | 35.38 | | 1.53 | 1.13 | bdl | bdl | bdl | |
| GC3 | 4/2/93 | 20.10 | 2.00 | 0.60 | 0.70 | 1.21 | 7.50 | 1.10 | bdl | 1.10 | 31.11 | | 1.22 | 1.01 | bdl | bdl | bdl | |
| GC3 | 4/19/93 | 20.50 | 2.00 | 0.80 | 5.00 | 1.23 | 8.80 | 0.93 | 0.85 | 1.20 | 32.94 | | 1.31 | 1.06 | bdl | bdl | bdl | |
| GC3 | 5/3/93 | 22.40 | 2.00 | 0.80 | 0.50 | 1.31 | 7.70 | 0.83 | 0.45 | 0.90 | 34.16 | | 1.33 | 1.01 | bdl | bdl | bdl | |
| GC3 | 5/17/93 | 23.40 | 2.30 | 0.90 | 0.60 | 1.41 | 7.90 | 1.60 | 0.95 | 0.90 | 39.04 | | 1.52 | 1.08 | bdl | bdl | bdl | |
| GC3 | 5/31/93 | 25.00 | 2.40 | 1.00 | 0.60 | 1.50 | 7.20 | 0.85 | 0.99 | 1.10 | 40.87 | | 1.56 | 1.04 | bdl | bdl | bdl | |
| GC3 | 6/14/93 | 27.30 | 2.80 | 0.90 | 0.70 | 1.65 | 6.70 | bdl | bdl | 0.90 | 43.31 | | 1.59 | 0.96 | bdl | bdl | bdl | |
| GC3 | 7/6/93 | 31.10 | 3.60 | 1.30 | 0.70 | 1.92 | 7.10 | 0.76 | bdl | 1.20 | 51.24 | | 1.87 | 0.98 | bdl | bdl | bdl | |
| GC3 | 7/19/93 | 33.50 | 3.50 | 1.60 | 0.70 | 2.04 | 7.50 | 0.75 | bdl | 1.30 | 54.29 | | 1.99 | 0.97 | bdl | bdl | bdl | |
| GC3 | 8/9/93 | 35.00 | 4.20 | 1.50 | 0.70 | 2.17 | 6.20 | 0.95 | bdl | 1.40 | 55.51 | | 2.00 | 0.92 | bdl | bdl | bdl | |
| GC3 | 8/23/93 | 35.40 | 3.90 | 1.50 | 0.80 | 2.17 | 6.30 | 0.71 | bdl | 1.40 | 55.51 | | 2.01 | 0.93 | 0.10 | bdl | bdl | |
| GC3 | 9/7/93 | 35.00 | 3.80 | 1.60 | 0.70 | 2.14 | 6.50 | 0.66 | bdl | 1.40 | 42.70 | | 1.59 | 0.74 | 0.10 | bdl | bdl | |
| GC3 | 9/21/93 | 40.40 | 4.10 | 1.80 | 1.10 | 2.45 | 7.00 | 0.71 | bdl | 1.40 | 56.12 | | 2.04 | 0.83 | 0.10 | bdl | bdl | |
| GC3 | 11/29/93 | 14.70 | 1.70 | 0.60 | 0.70 | 0.92 | 0.70 | 0.21 | bdl | 0.40 | 18.30 | | 0.63 | 0.69 | bdl | bdl | bdl | |
| GC3s | 12/5/93 | 21.00 | 2.00 | 1.00 | 0.77 | 1.29 | 9.50 | 1.40 | bdl | 1.10 | 25.01 | | 1.07 | | bdl | bdl | bdl | bdl |
| GC3 | 12/13/93 | 16.70 | 1.90 | 0.60 | 0.90 | 1.04 | 8.20 | 1.00 | bdl | 1.00 | 21.35 | | 0.92 | 0.88 | bdl | bdl | bdl | bdl |

# Station GC3 Water Quality Data 1993     Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| GC3 | 1/11/93 | <0.01 | <0.01 | | bdl | <0.01 | <0.01 | 0.02 | | <0.01 | | <0.01 | <0.1 | <0.01 | 2.50 | | 4.01 | | <0.01 | 0.04 | <0.01 | <0.01 |
| GC3 | 1/25/93 | <0.01 | <0.01 | | | <0.01 | 0.04 | 0.01 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.60 | | <0.01 | | <0.01 | 0.06 | <0.01 | 0.07 |
| GC3 | 2/8/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | <0.01 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.60 | | <0.01 | | <0.01 | 0.05 | <0.01 | <0.01 |
| GC3 | 2/22/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.03 | | <0.01 | | <0.01 | <0.1 | bdl | 2.50 | | <0.01 | | <0.01 | 0.13 | <0.01 | 0.21 |
| GC3 | 3/8/93 | 0.01 | | | | 0.01 | | 0.01 | | | | | | | 2.40 | | bdl | | | 0.03 | | 0.01 |
| GC3 | 3/22/93 | 0.02 | bdl | | | bdl | bdl | 0.03 | | bdl | | 0.01 | bdl | bdl | 2.70 | | bdl | | bdl | 0.03 | bdl | 0.06 |
| GC3s | 3/23/93 | 0.23 | bdl | 0.01 | | 0.02 | bdl | 0.16 | | bdl | | bdl | bdl | bdl | 2.70 | 0.06 | bdl | 0.04 | 0.01 | 0.35 | 0.08 | 0.44 |
| GC3 | 4/2/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | 2.40 | | bdl | | bdl | bdl | bdl | bdl |
| GC3 | 4/19/93 | 0.02 | bdl | | | bdl | bdl | 0.01 | | bdl | | bdl | bdl | bdl | 2.40 | | bdl | | bdl | 0.04 | bdl | 0.03 |
| GC3 | 5/3/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | 2.50 | | bdl | | 0.01 | 0.02 | bdl | bdl |
| GC3 | 5/17/93 | bdl | bdl | | | bdl | bdl | 0.03 | | bdl | | bdl | bdl | bdl | 2.60 | | bdl | | 0.01 | 0.03 | bdl | 0.03 |
| GC3 | 5/31/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | 2.60 | | bdl | | 0.03 | 0.04 | bdl | 0.09 |
| GC3 | 6/14/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | 2.70 | | bdl | | 0.02 | 0.03 | bdl | bdl |
| GC3 | 7/6/93 | 0.05 | bdl | | | bdl | bdl | 0.01 | | bdl | | bdl | bdl | bdl | 3.10 | | bdl | | 0.03 | 0.01 | bdl | 0.02 |
| GC3 | 7/19/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | 3.00 | | bdl | | bdl | 0.07 | bdl | 0.01 |
| GC3 | 8/9/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | 3.10 | | bdl | | bdl | 0.03 | bdl | 0.03 |
| GC3 | 8/23/93 | bdl | bdl | | | bdl | bdl | 0.01 | | bdl | | bdl | bdl | bdl | 3.10 | | bdl | | bdl | 0.03 | bdl | 0.02 |
| GC3 | 9/7/93 | bdl | bdl | | | bdl | 0.01 | 0.01 | | bdl | | bdl | bdl | bdl | 3.10 | | bdl | | bdl | 0.03 | bdl | 0.04 |
| GC3 | 9/21/93 | bdl | bdl | | | | bdl | bdl | | bdl | | bdl | bdl | bdl | 3.20 | | bdl | | bdl | 0.04 | bdl | bdl |
| GC3 | 11/29/93 | 0.01 | bdl | | | bdl | bdl | 0.02 | | bdl | | bdl | bdl | bdl | | | bdl | | bdl | 0.02 | bdl | 0.02 |
| GC3s | 12/5/93 | 0.13 | bdl | 0.01 | bdl | bdl | bdl | 0.09 | 0.83 | bdl | bdl | 0.01 | bdl | bdl | | | bdl | bdl | bdl | 0.20 | 0.03 | 0.22 |
| GC3 | 12/13/93 | 0.02 | bdl | bdl | bdl | bdl | bdl | 0.02 | bdl | bdl | bdl | bdl | bdl | bdl | | | bdl | bdl | bdl | 0.03 | bdl | 0.03 |

# Station GC4 Water Quality Data 1993 Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| GC4 | 1/11/93 | 1435 | 9.9 | 7.5 | 8.5 | 77 | 2.60 | 299 | 518 | 72.90 | 130 | 149 | 30 | 3.40 | 98.0 | <0.1 | |
| GC4 | 1/25/93 | 1450 | 9.9 | 7.7 | 7.9 | 6 | 1.30 | 264 | 440 | 5.80 | 150 | 175 | 15 | | 120.0 | <0.1 | |
| GC4 | 2/8/93 | 1320 | 12.0 | 8.0 | 8.5 | 3 | 0.17 | 160 | 465 | 5.40 | 120 | 131 | 5 | | 100.0 | <0.1 | |
| GC4 | 2/22/93 | 1005 | 9.4 | 7.9 | 8.6 | 13 | 2.30 | 237 | 487 | 9.30 | 150 | 172 | 15 | | 110.0 | <0.1 | |
| GC4 | 3/8/93 | 1050 | 10.7 | 7.8 | 7.9 | 11 | 1.00 | 215 | 485 | 6.10 | 140 | 188 | 10 | | 130.0 | | |
| GC4 | 3/22/93 | 1440 | 11.2 | 7.6 | 8.1 | 8 | 2.00 | 226 | 422 | 7.40 | 140 | 171 | 15 | | 99.0 | bdl | |
| GC4s | 3/23/93 | 1455 | 10.3 | 7.5 | 8.6 | 200 | | 129 | 445 | 302.00 | 53 | 78 | 35 | | 40.0 | bdl | 11.00 |
| GC4 | 4/2/93 | 1400 | 8.9 | 7.6 | 8.6 | 5 | 0.98 | 352 | 401 | 8.80 | 170 | 213 | 5 | | 130.0 | bdl | |
| GC4 | 4/19/93 | 1356 | 13.5 | 7.9 | 7.8 | 4 | 0.50 | 132 | 433 | 4.60 | 150 | 187 | 10 | | 120.0 | bdl | |
| GC4 | 5/3/93 | 1030 | 12.6 | 8.0 | 7.6 | 3 | 0.49 | 132 | 485 | 2.40 | 220 | 246 | 10 | | 170.0 | bdl | |
| GC4 | 5/17/93 | 1405 | 16.4 | 7.8 | 6.1 | 5 | 0.18 | 293 | 447 | 9.80 | 160 | 185 | 10 | 3.00 | 140.0 | bdl | |
| GC4 | 5/31/93 | 1405 | 14.5 | 7.7 | 8.4 | 4 | 0.19 | 235 | 335 | 6.80 | 140 | 134 | 10 | | 120.0 | bdl | |
| GC4 | 6/14/93 | 1325 | 18.2 | 7.6 | 6.5 | 5 | 0.15 | 467 | 388 | 3.90 | 200 | 173 | 5 | bdl | 150.0 | bdl | |
| GC4 | 7/6/93 | 1100 | 19.0 | 6.5 | 5.8 | 3 | 0.05 | 466 | 382 | 1.10 | 240 | 219 | 10 | | 190.0 | bdl | |
| GC4 | 7/19/93 | 1540 | 21.6 | 7.7 | 7.0 | 3 | 0.10 | 550 | 391 | 2.50 | 250 | 291 | 10 | | 190.0 | bdl | |
| GC4 | 8/9/93 | 1132 | 17.9 | 7.9 | 7.6 | 3 | 0.09 | 479 | 364 | 5.20 | 260 | 268 | bdl | bdl | 190.0 | bdl | |
| GC4 | 8/23/93 | 1410 | 19.9 | 7.9 | 7.3 | 3 | 0.20 | 475 | 460 | 2.50 | 230 | 255 | 15 | | 180.0 | bdl | |
| GC4 | 9/7/93 | 1544 | 18.9 | 7.7 | 7.8 | 3 | | 512 | 441 | 3.90 | 260 | 277 | 10 | | 190.0 | bdl | |
| GC4 | 9/21/93 | 1105 | 17.5 | 7.9 | 7.6 | 3 | 0.10 | 523 | 427 | 2.20 | 270 | 302 | 10 | | 150.0 | bdl | |

# Station GC4 Water Quality Data 1993 Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | BR | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GC4 | 1/11/93 | 38.59 | 7.80 | 5.70 | 2.00 | 2.86 | 26.00 | 1.64 | <0.02 | 7.90 | 59.78 |  | 2.75 | 0.96 | <0.1 | <0.1 | <0.3 |  |
| GC4 | 1/25/93 | 44.40 | 9.50 | 6.50 | 2.10 |  | 30.00 | 1.33 | <0.02 | 8.30 | 73.20 |  |  | 0.99 | <0.1 | <0.1 | <0.3 |  |
| GC4 | 2/8/93 | 37.89 | 6.70 | 2.80 | 1.20 |  | 18.00 | 0.87 | <0.02 | 4.00 | 61.00 |  |  | 0.97 | <0.1 | <0.1 | <0.3 |  |
| GC4 | 2/22/93 | 44.54 | 9.40 | 8.50 | 2.30 | 3.42 | 27.00 | 1.76 | <0.02 | 12.00 | 67.10 |  | 3.13 | 0.92 | <0.1 | <0.1 | <0.3 |  |
| GC4 | 3/8/93 | 43.20 | 8.40 | 10.00 | 2.90 | 3.35 | 32.00 | 1.30 |  | 12.00 | 79.30 |  | 3.63 | 1.08 |  |  |  |  |
| GC4 | 3/22/93 | 39.90 | 8.70 | 13.00 | 2.00 | 3.32 | 27.00 | 1.40 | bdl | 19.00 | 60.39 |  | 3.11 | 0.94 | bdl | bdl | bdl |  |
| GC4s | 3/23/93 | 17.00 | 2.40 | 2.70 | 2.20 | 1.26 | 20.00 | 2.70 | bdl | 6.30 | 24.40 |  | 1.44 | 1.00 | bdl | bdl | bdl |  |
| GC4 | 4/2/93 | 49.60 | 11.00 | 11.00 | 2.70 | 3.92 | 39.00 | 1.20 | bdl | 20.00 | 79.30 |  | 4.00 | 1.02 | bdl | bdl | bdl |  |
| GC4 | 4/19/93 | 44.30 | 9.90 | 7.50 | 1.80 | 3.39 | 35.00 | 0.39 |  | 14.00 | 73.20 |  | 3.61 | 1.07 |  |  |  |  |
| GC4 | 5/3/93 | 64.70 | 14.00 | 8.40 | 2.00 | 4.78 | 40.00 | 0.49 | bdl | 14.00 | 103.70 |  | 4.64 | 0.97 | bdl | bdl | bdl |  |
| GC4 | 5/17/93 | 45.90 | 10.00 | 4.70 | 1.40 | 3.34 | 31.00 | 0.44 | bdl | 7.60 | 85.40 |  | 3.67 | 1.10 | bdl | bdl | 8.00 |  |
| GC4 | 5/31/93 | 43.00 | 8.80 | 5.10 | 1.50 | 3.12 | 25.00 | 0.86 | bdl | 7.80 | 73.20 |  | 3.15 | 1.01 | bdl | bdl | bdl |  |
| GC4 | 6/14/93 | 54.10 | 15.00 | 4.70 | 1.60 | 4.17 | 0.10 | bdl | bdl | 7.10 | 91.50 |  | 3.20 | 0.77 | bdl | bdl | bdl |  |
| GC4 | 7/6/93 | 63.50 | 20.00 | 7.30 | 2.20 | 5.18 | bdl | 0.25 | bdl | 12.00 | 115.90 |  | 4.14 | 0.80 | bdl | bdl | bdl |  |
| GC4 | 7/19/93 | 69.00 | 19.00 | 9.70 | 2.60 | 5.48 | 61.00 | 0.38 | bdl | 15.00 | 115.90 |  | 5.50 | 1.00 | bdl | bdl | bdl |  |
| GC4 | 8/9/93 | 66.20 | 22.00 | 6.90 | 1.80 | 5.44 | 46.00 | 0.42 | bdl | 10.00 | 115.90 |  | 5.06 | 0.93 | 0.20 | bdl | bdl |  |
| GC4 | 8/23/93 | 62.80 | 18.00 | 7.30 | 2.20 | 4.98 | 45.00 | 0.33 | bdl | 11.00 | 109.80 |  | 4.87 | 0.98 | 0.30 | bdl | bdl |  |
| GC4 | 9/7/93 | 68.10 | 21.00 | 8.30 | 2.00 | 5.52 | 51.00 | 0.23 | bdl | 12.00 | 115.90 |  | 5.22 | 0.95 | 0.30 | bdl | bdl |  |
| GC4 | 9/21/93 | 71.10 | 22.00 | 7.40 | 2.00 | 5.71 | 98.00 | 0.35 | bdl | 11.00 | 91.50 |  | 5.37 | 0.94 | 0.30 | bdl | bdl |  |

# Station GC4 Water Quality Data 1993 Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| GC4 | 1/11/93 | 0.02 | <0.01 | | bdl | <0.01 | <0.01 | 0.09 | | 0.02 | | bdl | <0.1 | <0.1 | 2.30 | | <0.01 | | <0.01 | 0.84 | 0.09 | 0.23 |
| GC4 | 1/25/93 | <0.01 | <0.01 | | | <0.01 | 0.03 | 0.04 | | 0.02 | | <0.01 | <0.1 | <0.1 | 2.90 | | <0.01 | | <0.01 | 0.16 | 0.02 | 0.11 |
| GC4 | 2/8/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | <0.01 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.80 | | <0.01 | | <0.01 | 0.07 | <0.01 | <0.01 |
| GC4 | 2/22/93 | <0.01 | 0.01 | | | <0.01 | <0.01 | 0.10 | | 0.01 | | <0.01 | <0.1 | <0.1 | 2.90 | | 0.02 | | <0.01 | 0.14 | 0.01 | 0.24 |
| GC4 | 3/8/93 | 0.02 | 0.01 | | | | | 0.04 | | 0.02 | | | | | 2.60 | | | | | 0.23 | 0.02 | 0.22 |
| GC4 | 3/22/93 | bdl | bdl | | | bdl | bdl | 0.05 | | 0.01 | | 0.01 | bdl | bdl | 2.70 | | bdl | | bdl | 0.10 | 0.02 | bdl |
| GC4s | 3/23/93 | 0.29 | bdl | 0.02 | | bdl | bdl | 0.27 | | 0.02 | | bdl | bdl | bdl | 2.20 | 0.05 | bdl | 0.01 | 0.01 | 1.20 | 0.27 | 0.81 |
| GC4 | 4/2/93 | bdl | bdl | | | bdl | bdl | 0.03 | | 0.02 | | bdl | bdl | bdl | 2.80 | | bdl | | bdl | 0.07 | 0.02 | bdl |
| GC4 | 4/19/93 | | 0.01 | | | | | 0.02 | | 0.02 | | | | | 2.60 | | | | | 0.09 | 0.02 | |
| GC4 | 5/3/93 | bdl | bdl | | | bdl | bdl | bdl | | 0.02 | | bdl | bdl | bdl | 3.20 | | bdl | | bdl | 0.08 | 0.02 | 0.02 |
| GC4 | 5/17/93 | bdl | 0.01 | | | bdl | bdl | 0.02 | | 0.02 | | bdl | bdl | bdl | 3.20 | | bdl | | 0.01 | 0.07 | 0.02 | 0.04 |
| GC4 | 5/31/93 | bdl | bdl | | | bdl | 0.01 | 0.03 | | 0.01 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.03 | 0.12 | 0.02 | 0.18 |
| GC4 | 6/14/93 | bdl | bdl | | | bdl | bdl | 0.02 | | bdl | | bdl | bdl | bdl | 3.60 | | bdl | | 0.02 | 0.08 | 0.01 | 0.02 |
| GC4 | 7/6/93 | 0.02 | 0.01 | | | bdl | bdl | 0.02 | | 0.01 | | bdl | bdl | bdl | 4.30 | | 0.01 | | bdl | 0.08 | 0.02 | bdl |
| GC4 | 7/19/93 | bdl | 0.02 | | | bdl | bdl | 0.02 | | 0.02 | | 0.01 | bdl | bdl | 3.70 | | bdl | | bdl | 0.08 | 0.02 | 0.01 |
| GC4 | 8/9/93 | bdl | 0.02 | | | bdl | bdl | 0.02 | | bdl | | bdl | bdl | bdl | 4.00 | | bdl | | bdl | 0.08 | 0.01 | 0.03 |
| GC4 | 8/23/93 | 0.01 | 0.02 | | | bdl | bdl | 0.02 | | bdl | | bdl | bdl | bdl | 3.80 | | bdl | | 0.01 | 0.07 | bdl | 0.03 |
| GC4 | 9/7/93 | bdl | 0.03 | | | bdl | 0.01 | 0.02 | | bdl | | bdl | bdl | bdl | 4.00 | | bdl | | bdl | 0.06 | bdl | 0.10 |
| GC4 | 9/21/93 | bdl | 0.02 | | | bdl | bdl | 0.02 | | bdl | | bdl | bdl | bdl | 3.90 | | bdl | | 0.01 | 0.05 | bdl | bdl |

# Station GC7 Water Quality Data 1993 Page 1 of 3

| Site | Date | | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| GC7 | 1/11/93 | 1450 | 11.0 | 7.6 | 8.4 | 53 | 10.20 | 190 | 515 | 43.80 | 95 | 106 | 35 | 1.50 | 73.0 | <0.1 | |
| GC7 | 1/25/93 | 1510 | 10.6 | 7.8 | 8.6 | 7 | 15.50 | 180 | 447 | 6.20 | 83 | 93 | 15 | | 63.0 | <0.1 | |
| GC7 | 2/8/93 | 1330 | 11.6 | 8.1 | 9.8 | 4 | 3.20 | 99 | 475 | 4.80 | 86 | 97 | 5 | | 74.0 | <0.1 | |
| GC7 | 2/22/93 | 1030 | 10.7 | 8.0 | 8.4 | 16 | 29.70 | 154 | 481 | 24.90 | 82 | 90 | 20 | | 64.0 | <0.1 | |
| GC7 | 3/8/93 | 1110 | 11.2 | 7.7 | 8.8 | 12 | 13.50 | 170 | 464 | 6.50 | 77 | 98 | 10 | | 72.0 | | |
| GC7 | 3/22/93 | 1500 | 11.8 | 7.7 | 8.4 | 9 | 25.00 | 155 | 408 | 11.10 | 71 | 85 | 15 | | 55.0 | bdl | |
| GC7s | 3/23/93 | 1505 | 10.2 | 7.5 | 8.6 | 200 | | 147 | 452 | 381.00 | 62 | 89 | 40 | | 50.0 | bdl | 11.00 |
| GC7 | 4/2/93 | 1415 | 10.0 | 7.5 | 8.2 | 5 | 8.30 | 177 | 408 | 10.70 | 78 | 93 | 5 | | 65.0 | bdl | |
| GC7 | 4/19/93 | 1409 | 15.5 | 7.9 | 8.3 | 4 | 6.10 | 153 | 435 | 3.70 | 80 | 99 | 5 | | 72.0 | | |
| GC7 | 5/3/93 | 1005 | 12.9 | 7.9 | 8.5 | 5 | 5.30 | 18 | 504 | 3.60 | 81 | 88 | 10 | | 67.0 | bdl | |
| GC7 | 5/17/93 | 1420 | 16.2 | 8.0 | 7.5 | 6 | 1.60 | 175 | 405 | 6.00 | 95 | 113 | 10 | | 85.0 | bdl | |
| GC7 | 5/31/93 | 1415 | 15.0 | 7.8 | 8.6 | 3 | 1.40 | 236 | 359 | 4.40 | 100 | 79 | 10 | | 23.0 | bdl | |
| GC7 | 7/6/93 | 1110 | 17.4 | 6.5 | 6.5 | 5 | 0.76 | 263 | 403 | 3.50 | 130 | 142 | 10 | bdl | 110.0 | bdl | |
| GC7 | 7/19/93 | 1545 | 21.4 | 7.9 | 7.1 | 7 | 0.60 | 382 | 383 | 6.30 | 170 | 209 | 10 | | 130.0 | bdl | |
| GC7 | 8/9/93 | 1045 | 17.3 | 7.9 | 7.9 | 5 | 0.84 | 314 | 373 | 7.10 | 150 | 174 | 10 | bdl | 130.0 | bdl | |
| GC7 | 8/23/93 | 1350 | 19.4 | 8.0 | 8.0 | 4 | 0.65 | 296 | 476 | 5.50 | 150 | 175 | 10 | | 130.0 | bdl | |
| GC7 | 9/7/93 | 1554 | 19.6 | 7.7 | 75.0 | 5 | | 325 | 445 | 7.50 | 160 | 175 | 10 | | 120.0 | bdl | |
| GC7 | 9/21/93 | 1118 | 17.6 | 7.9 | 7.7 | 6 | 0.45 | 361 | 434 | 11.80 | 220 | 208 | 15 | | 120.0 | bdl | |
| GC7 | 10/7/93 | 0932 | 13.8 | 7.8 | 7.4 | 5 | 0.55 | 362 | 502 | 2.50 | 160 | 189 | 10 | | 120.0 | bdl | |
| GC7 | 10/18/93 | 1030 | 15.0 | 7.7 | 7.0 | 6 | 0.52 | 403 | 527 | 4.60 | 200 | 223 | 15 | | 140.0 | bdl | |
| GC7 | 11/4/93 | 1451 | 10.3 | 7.8 | 9.2 | 3 | | 405 | 485 | 3.20 | 200 | 221 | 10 | | 130.0 | bdl | |
| GC7 | 11/15/93 | 0950 | 13.7 | 7.6 | 7.2 | bdl | 2.20 | 453 | 467 | 16.30 | 210 | 255 | 20 | | 130.0 | bdl | |
| GC7 | 11/29/93 | 1013 | 9.8 | 7.8 | 10.0 | bdl | | 176 | 486 | 6.30 | 80 | 89 | 10 | | 51.0 | bdl | |
| GC7s | 12/5/93 | 1059 | 11.8 | 7.7 | 9.2 | bdl | | 168 | 481 | 50.10 | 81 | 87 | 25 | | 53.0 | bdl | 1.50 |
| GC7 | 12/13/93 | 1222 | 11.2 | 7.7 | 9.2 | bdl | 4.70 | 175 | 410 | 5.00 | 82 | 90 | 10 | | 57.0 | bdl | bdl |

# Station GC7 Water Quality Data 1993 Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | BR | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| GC7 | 1/11/93 | 30.15 | 4.80 | 2.70 | 1.50 | 2.05 | 17.00 | 2.43 | <0.02 | 3.30 | 44.53 | | 1.95 | 0.95 | <0.1 | <0.1 | <0.3 | |
| GC7 | 1/25/93 | 26.55 | 4.10 | 1.90 | 1.20 | | 15.00 | 3.09 | <0.02 | 2.70 | 38.43 | | | 0.97 | <0.1 | <0.1 | <0.3 | |
| GC7 | 2/8/93 | 27.92 | 4.00 | 2.50 | 1.20 | | 12.00 | 2.12 | <0.02 | 2.70 | 45.14 | | | 0.99 | <0.1 | <0.1 | <0.3 | |
| GC7 | 2/22/93 | 27.05 | 3.40 | 1.80 | 1.20 | 1.74 | 13.00 | 2.28 | <0.02 | 2.90 | 39.04 | | 1.67 | 0.96 | <0.1 | <0.1 | <0.3 | |
| GC7 | 3/8/93 | 25.10 | 3.60 | 2.80 | 1.00 | 1.70 | 15.00 | 2.20 | | 4.50 | 43.92 | | 1.93 | 1.14 | 0.30 | | | |
| GC7 | 3/22/93 | 23.50 | 3.10 | 2.40 | 0.80 | 1.55 | 15.00 | 2.00 | bdl | 5.10 | 33.50 | | 1.59 | 1.02 | bdl | bdl | bdl | |
| GC7s | 3/23/93 | 20.00 | 2.90 | 2.50 | 2.70 | 1.45 | 27.00 | 3.40 | bdl | bdl | 30.50 | | 1.63 | 1.12 | 0.20 | bdl | bdl | |
| GC7 | 4/2/93 | 25.10 | 3.60 | 2.70 | 1.20 | 1.69 | 15.00 | 1.80 | 0.65 | 4.00 | 39.65 | | 1.77 | 1.05 | bdl | bdl | bdl | |
| GC7 | 4/19/93 | 25.80 | 3.80 | 2.40 | 0.90 | 1.72 | 16.00 | 1.90 | 1.00 | 3.60 | 43.92 | | 1.93 | 1.12 | | | | |
| GC7 | 5/3/93 | 27.00 | 3.30 | 2.00 | 0.90 | 1.72 | 11.00 | 1.20 | bdl | 2.30 | 40.87 | | 1.65 | 0.96 | bdl | bdl | bdl | |
| GC7 | 5/17/93 | 30.80 | 4.40 | 3.10 | 1.00 | 2.06 | 15.00 | 3.70 | 0.46 | 3.90 | 51.85 | | 2.19 | 1.07 | bdl | bdl | bdl | |
| GC7 | 5/31/93 | 32.10 | 4.90 | 3.70 | 1.20 | 2.19 | 16.00 | 2.00 | 0.64 | 4.60 | 14.03 | | 0.97 | 0.44 | bdl | bdl | bdl | |
| GC7 | 7/6/93 | 39.00 | 7.40 | 4.10 | 1.50 | 2.76 | 19.00 | 1.60 | bdl | 3.30 | 67.10 | | 2.72 | 0.98 | bdl | bdl | bdl | |
| GC7 | 7/19/93 | 52.70 | 9.90 | 8.40 | 2.90 | 3.87 | 44.00 | 4.40 | bdl | 8.50 | 79.30 | | 3.83 | 0.99 | bdl | bdl | bdl | |
| GC7 | 8/9/93 | 46.60 | 8.50 | 6.40 | 1.90 | 3.35 | 23.00 | 3.50 | bdl | 5.90 | 79.30 | | 3.31 | 0.99 | 0.20 | bdl | bdl | |
| GC7 | 8/23/93 | 46.30 | 7.90 | 7.10 | 2.10 | 3.32 | 24.00 | 1.80 | bdl | 7.20 | 79.30 | | 3.34 | 1.01 | 0.20 | bdl | bdl | |
| GC7 | 9/7/93 | 48.80 | 8.80 | 7.60 | 2.00 | 3.53 | 27.00 | 1.70 | bdl | 6.60 | 73.20 | | 3.19 | 0.90 | 0.20 | bdl | bdl | |
| GC7 | 9/21/93 | 57.80 | 6.60 | 2.90 | 1.00 | 4.13 | 16.00 | 0.24 | bdl | 8.50 | 103.70 | | 3.40 | 0.85 | 0.30 | bdl | bdl | |
| GC7 | 10/7/93 | 49.80 | 9.40 | 9.90 | 2.60 | 3.45 | 29.00 | 6.00 | bdl | 9.60 | 73.20 | | 3.39 | 0.90 | 0.30 | bdl | bdl | |
| GC7 | 10/18/93 | 59.00 | 12.00 | 9.20 | 3.30 | 4.41 | 44.00 | 1.80 | bdl | 9.40 | 85.40 | | 4.03 | 0.91 | 0.30 | bdl | bdl | |
| GC7 | 11/4/93 | 58.60 | 12.00 | 8.10 | 2.70 | 4.32 | 47.00 | 4.30 | bdl | 10.00 | 79.30 | | 3.95 | 0.91 | 0.30 | bdl | bdl | |
| GC7 | 11/15/93 | 63.00 | 13.00 | 10.00 | 5.00 | 4.78 | 68.00 | 4.70 | bdl | 13.00 | 79.30 | | 4.47 | 0.94 | 0.30 | bdl | bdl | |
| GC7 | 11/29/93 | 25.30 | 4.10 | 2.40 | 1.50 | 1.74 | 20.00 | 1.90 | bdl | 2.90 | 31.11 | | 1.55 | 0.89 | 0.10 | bdl | | |
| GC7s | 12/5/93 | 27.00 | 3.50 | 1.40 | 1.10 | 1.74 | 18.00 | 1.60 | bdl | 2.00 | 32.33 | | 1.52 | bdl | 0.10 | bdl | bdl | |
| GC7 | 12/13/93 | 26.20 | 4.00 | 2.40 | 1.00 | 1.76 | 18.00 | 1.20 | bdl | 2.90 | 34.77 | | 1.63 | 0.92 | 0.20 | bdl | bdl | bdl |

# Station GC7 Water Quality Data 1993 Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| GC7 | 1/11/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.05 | | 0.01 | bdl | <0.01 | 0.10 | <0.1 | 2.70 | | <0.01 | | <0.01 | 0.58 | 0.04 | 0.16 |
| GC7 | 1/25/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.03 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.60 | | <0.01 | | <0.01 | 0.12 | 0.01 | 0.12 |
| GC7 | 2/8/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | <0.01 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.70 | | <0.01 | | <0.01 | 0.06 | <0.01 | <0.01 |
| GC7 | 2/22/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.05 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.60 | | <0.01 | | <0.01 | 0.24 | 0.01 | 0.34 |
| GC7 | 3/8/93 | 0.04 | | | | | | 0.02 | | 0.07 | | | | | 2.50 | | 8.00 | | | 0.14 | 0.01 | 0.13 |
| GC7 | 3/22/93 | 0.02 | bdl | | | bdl | bdl | 0.03 | | bdl | | 0.01 | bdl | bdl | 2.80 | | bdl | | bdl | 0.09 | 0.01 | 0.07 |
| GC7s | 3/23/93 | 0.28 | bdl | 0.02 | | bdl | bdl | 0.17 | | 0.02 | | bdl | bdl | bdl | 2.40 | 0.07 | 0.01 | 0.01 | 0.02 | 1.50 | 0.27 | 1.10 |
| GC7 | 4/2/93 | bdl | bdl | | | bdl | bdl | 0.02 | | bdl | | bdl | bdl | bdl | 2.50 | | bdl | | bdl | 0.04 | bdl | 0.04 |
| GC7 | 4/19/93 | | | | | | | 0.02 | | | | | | | 2.50 | | | | | 0.11 | 0.01 | 0.07 |
| GC7 | 5/3/93 | bdl | 0.01 | | | bdl | bdl | 0.01 | | bdl | | bdl | bdl | bdl | 2.60 | | bdl | | 0.02 | 0.07 | bdl | 0.04 |
| GC7 | 5/17/93 | 0.01 | 0.01 | | | bdl | bdl | 0.03 | | bdl | | bdl | bdl | bdl | 2.80 | | bdl | | 0.01 | 0.07 | 0.01 | 0.09 |
| GC7 | 5/31/93 | 0.02 | bdl | | | bdl | bdl | 0.03 | | bdl | | bdl | bdl | bdl | 2.80 | | bdl | | 0.04 | 0.13 | 0.01 | 0.15 |
| GC7 | 7/6/93 | bdl | bdl | | | bdl | bdl | 0.02 | | bdl | | bdl | 0.10 | bdl | 3.50 | | bdl | | bdl | 0.10 | 0.01 | 0.12 |
| GC7 | 7/19/93 | bdl | 0.02 | | | bdl | bdl | 0.03 | | 0.01 | | bdl | 0.20 | bdl | 3.60 | | bdl | | bdl | 0.02 | 0.02 | 0.07 |
| GC7 | 8/9/93 | 0.03 | 0.03 | | | bdl | bdl | 0.02 | | bdl | | bdl | 0.20 | bdl | 3.50 | | bdl | | bdl | 0.15 | 0.02 | 0.10 |
| GC7 | 8/23/93 | bdl | 0.02 | | | bdl | bdl | 0.03 | | 0.01 | | bdl | 0.20 | bdl | 3.60 | | bdl | | 0.02 | 0.12 | 0.02 | 0.10 |
| GC7 | 9/7/93 | bdl | 0.03 | | | bdl | 0.01 | 0.03 | | 0.01 | | bdl | 0.20 | bdl | 3.60 | | bdl | | bdl | 0.12 | 0.02 | 0.08 |
| GC7 | 9/21/93 | 0.01 | 0.03 | | | | 0.02 | 0.07 | | 0.06 | | bdl | bdl | bdl | 3.50 | | bdl | | bdl | 0.32 | 0.07 | 0.03 |
| GC7 | 10/7/93 | bdl | 0.01 | | | bdl | bdl | 0.02 | | bdl | | bdl | 0.30 | bdl | 3.70 | | bdl | | 0.02 | 0.16 | 0.01 | 0.04 |
| GC7 | 10/18/93 | 0.01 | 0.03 | | | bdl | bdl | 0.05 | | 0.01 | | bdl | 0.20 | bdl | 3.70 | | bdl | | 0.02 | 0.19 | 0.02 | 0.12 |
| GC7 | 11/4/93 | bdl | 0.03 | | | bdl | bdl | 0.04 | | bdl | | bdl | bdl | bdl | 3.50 | | bdl | | 0.05 | 0.12 | 0.01 | 0.03 |
| GC7 | 11/15/93 | 0.09 | 0.03 | | | bdl | bdl | 0.11 | | 0.03 | | bdl | 0.10 | bdl | 3.00 | | bdl | | 0.04 | 0.32 | 0.05 | 0.41 |
| GC7 | 11/29/93 | 0.02 | bdl | | | bdl | bdl | 0.03 | | 0.01 | | bdl | bdl | bdl | | | bdl | | 0.04 | 0.08 | 0.02 | 0.09 |
| GC7s | 12/5/93 | 0.16 | 0.01 | 0.02 | bdl | bdl | bdl | 0.10 | 0.88 | bdl | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.25 | 0.04 | 0.23 |
| GC7 | 12/13/93 | 0.01 | bdl | bdl | bdl | bdl | bdl | 0.03 | bdl | 0.01 | bdl | bdl | bdl | bdl | | | bdl | | 0.01 | 0.07 | 0.01 | 0.12 |

# Station LH5 Water Quality Data 1993

| Site | Date | TIME | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| LH5 | 1/11/93 | 1400 | 8.9 | 7.2 | 9.3 | 11 | 0.88 | 104 | 540 | 7.50 | 49 | 52 | 10 | | 38.0 | <0.1 | |
| LH5s | 3/23/93 | 1535 | 8.1 | 6.7 | 8.7 | 200 | | 50 | 508 | 344.00 | 15 | 24 | 30 | | 8.6 | bdl | 11.00 |
| LH5s | 12/5/93 | 1306 | 9.9 | 7.0 | 9.7 | bdl | 7.10 | 62 | 517 | 13.10 | 26 | 28 | 15 | | 16.0 | bdl | 3.00 |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | BR | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| LH5 | 1/11/93 | 15.73 | 2.40 | 0.70 | 0.90 | 1.03 | 8.40 | <0.05 | <0.02 | 1.00 | 23.18 | | 0.96 | 0.93 | <0.1 | <0.1 | 7.50 | |
| LH5s | 3/23/93 | 4.20 | 0.99 | 0.32 | 0.83 | 0.36 | 11.00 | 0.50 | bdl | 0.80 | 5.25 | | 0.43 | 1.20 | bdl | bdl | bdl | |
| LH5s | 12/5/93 | 8.00 | 1.40 | 0.39 | 0.74 | 0.57 | 7.00 | 0.16 | bdl | 0.60 | 9.76 | | 0.49 | | bdl | bdl | bdl | bdl |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| LH5 | 1/11/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.04 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.60 | | <0.01 | | <0.01 | 0.15 | <0.01 | 0.07 |
| LH5s | 3/23/93 | 0.23 | bdl | 0.01 | | bdl | bdl | 0.26 | | 0.01 | | bdl | bdl | bdl | 2.00 | 0.01 | bdl | bdl | 0.02 | 0.74 | 0.27 | 1.10 |
| LH5s | 12/5/93 | 0.16 | bdl | 0.02 | bdl | bdl | bdl | 0.09 | 0.85 | bdl | bdl | bdl | bdl | bdl | | | bdl | bdl | bdl | 0.17 | 0.01 | 0.63 |

# Station MF2 Water Quality Data 1993

| Site | Date | TIME | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| MF2 | 1/29/93 | 1420 | 5.7 | 4.9 | 10.1 | 1 | 0.96 | 18 | 672 | 8.70 | 4 | 8 | 5 | | 0.2 | 6.8 | |
| MF2 | 4/17/93 | 1515 | 7.3 | 4.1 | 8.3 | bdl | | 16 | 636 | 8.00 | 4 | 7 | 10 | bdl | bdl | bdl | |
| MF2 | 10/15/93 | 1339 | 11.4 | 5.0 | 7.9 | bdl | 0.22 | 17 | 589 | 5.40 | 4 | 7 | 10 | | 0.3 | 2.7 | |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | BR | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| MF2 | 1/29/93 | 0.81 | 0.43 | 0.20 | 0.30 | | 3.60 | 2.16 | <0.02 | 0.60 | 0.12 | | | 1.41 | <0.1 | <0.1 | <0.3 | |
| MF2 | 4/17/93 | 0.95 | 0.43 | 0.60 | 0.30 | 0.12 | 3.70 | 1.00 | bdl | 0.20 | | | 0.10 | 0.81 | bdl | bdl | bdl | |
| MF2 | 10/15/93 | 0.88 | 0.44 | 0.30 | 0.40 | 0.11 | 3.60 | 0.16 | bdl | 0.80 | 0.18 | | 1.06 | 0.97 | bdl | bdl | bdl | |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| MF2 | 1/29/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | <0.01 | | 0.02 | | <0.01 | <0.1 | <0.1 | 1.40 | | <0.01 | | <0.01 | 0.04 | 0.02 | 0.06 |
| MF2 | 4/17/93 | 0.04 | bdl | | | bdl | bdl | bdl | | 0.02 | | bdl | bdl | bdl | 1.30 | | bdl | | 0.02 | 0.05 | 0.02 | 0.08 |
| MF2 | 10/15/93 | 0.03 | 0.01 | | | bdl | bdl | 0.02 | | 0.05 | | bdl | bdl | bdl | 1.60 | | bdl | | 0.03 | 0.03 | 0.06 | 0.08 |

# Station MF5 Water Quality Data 1993

| Site | Date | TIME | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| MF5 | 1/29/93 | 1500 | 5.3 | 4.7 | 9.8 | 2 | 4.10 | 18 | 651 | 3.20 | 3 | 7 | 10 | | <0.1 | 7.5 | |
| MF5 | 4/15/93 | 1445 | 11.4 | 4.6 | 7.6 | bdl | 4.20 | 19 | 662 | 1.60 | 4 | 7 | 5 | | bdl | bdl | |
| MF5 | 10/15/93 | 1429 | 11.0 | 4.5 | 7.7 | bdl | 0.55 | 23 | 616 | 3.50 | 4 | 8 | 20 | | bdl | 3.7 | |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| MF5 | 1/29/93 | 0.43 | 0.41 | 0.20 | 0.30 | | 4.10 | 0.82 | <0.02 | 0.60 | | | | 1.40 | <0.1 | <0.1 | <0.3 | |
| MF5 | 4/15/93 | 0.78 | 0.30 | 0.30 | 0.98 | 0.10 | 4.30 | 0.37 | bdl | 0.20 | | | 0.10 | | bdl | bdl | bdl | |
| MF5 | 10/15/93 | 0.90 | 0.44 | 0.20 | 0.30 | 0.12 | 4.60 | bdl | bdl | 0.80 | | | 0.12 | 0.97 | bdl | bdl | bdl | |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| MF5 | 1/29/93 | 0.08 | <0.01 | | | <0.01 | <0.01 | 0.01 | | 0.02 | | <0.01 | <0.1 | <0.1 | 1.50 | | <0.01 | | <0.01 | 0.04 | 0.02 | 0.10 |
| MF5 | 4/15/93 | 0.09 | bdl | | | bdl | bdl | 0.03 | | 0.39 | | bdl | bdl | bdl | 1.30 | | bdl | | 0.02 | 0.07 | 0.02 | 0.09 |
| MF5 | 10/15/93 | 0.17 | bdl | | | bdl | bdl | 0.06 | | 0.10 | | bdl | bdl | bdl | 1.80 | | bdl | | 0.03 | 0.09 | 0.10 | 0.18 |

# Station RR1 Water Quality Data 1993 Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | deg C |  | ppm | ntu | cfs | uS |  | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| RR1 | 1/11/93 | 1030 | 9.0 | 6.8 | 9.0 | 15 | 0.23 | 187 | 515 | 12.00 | 70 | 103 | 5 | 0.60 | 43.0 | <0.1 |  |
| RR1 | 1/25/93 | 1250 | 6.4 | 7.8 | 10.2 | 15 | 0.42 | 163 | 436 | 12.50 | 62 | 93 | 10 |  | 34.0 | <0.1 |  |
| RR1 | 2/8/93 | 1030 | 5.2 | 7.2 | 10.4 | 13 | 0.16 | 186 | 418 | 14.00 | 65 | 102 | 10 |  | 32.0 | <0.1 |  |
| RR1 | 2/22/93 | 1250 | 6.9 | 7.5 | 9.7 | 6 | 0.95 | 135 | 474 | 9.30 | 56 | 81 | 5 |  | 36.0 | <0.1 |  |
| RR1 | 3/8/93 | 1405 | 7.9 | 7.2 | 9.2 | 7 | 0.41 | 196 | 457 | 6.80 | 65 | 114 | 10 |  | 41.0 |  |  |
| RR1 | 3/22/93 | 1305 | 8.8 | 7.0 | 9.6 | 7 | 1.00 | 196 | 496 | 6.60 | 54 | 98 | 10 |  | 29.0 | bdl |  |
| RR1s | 3/23/93 | 1335 | 8.6 | 7.7 | 7.3 | 200 | 11.50 | 105 | 451 | 715.00 | 38 | 70 | 40 |  | 34.0 | bdl | 13.00 |
| RR1 | 4/2/93 | 1030 | 7.4 | 7.1 | 9.4 | 11 | 0.60 | 207 | 379 | 6.40 | 64 | 174 | 5 |  | 130.0 | bdl |  |
| RR1 | 4/19/93 | 1030 | 11.7 | 7.5 | 8.2 | 17 | 0.70 | 179 | 423 | 19.20 | 67 | 118 | 15 |  | 41.0 | bdl |  |
| RR1 | 5/3/93 | 1320 | 12.3 | 7.4 | 7.8 | 34 | 0.20 | 172 | 392 | 27.10 | 67 | 108 | 35 |  | 36.0 | bdl |  |
| RR1 | 5/17/93 | 1040 | 13.9 | 7.3 | 6.8 | 4 | 0.23 | 175 | 415 | 11.50 | 64 | 113 | 10 |  | 34.0 | bdl |  |
| RR1 | 5/31/93 | 1015 | 13.5 | 7.2 | 1.5 | 4 | 0.18 | 221 | 417 | 3.40 | 60 | 99 | 10 |  | 27.0 |  |  |
| RR1 | 6/14/93 | 1030 | 15.4 | 6.8 | 7.1 | 6 | 0.19 | 213 | 308 | 12.40 | 64 | 103 | bdl | bdl | 30.0 | bdl |  |
| RR1 | 7/6/93 | 1425 | 19.7 | 8.0 | 5.8 | 5 | 0.34 | 203 | 424 | 4.20 | 56 | 111 | 5 | 0.03 | 34.0 | bdl |  |
| RR1 | 7/19/93 | 1025 | 17.7 | 7.7 | 7.1 | 9 | 0.10 | 219 | 273 | 9.50 | 72 | 114 | 5 |  | 34.0 | bdl |  |
| RR1 | 8/9/93 | 1409 | 18.2 | 7.7 | 7.9 | 19 | 0.09 | 197 | 385 | 13.50 | 69 | 102 | 10 | bdl | 35.0 | bdl |  |
| RR1 | 8/23/93 | 1140 | 19.5 | 7.8 | 8.0 | 12 | 0.54 | 240 | 440 | 15.50 | 70 | 102 | 15 | bdl | 36.0 | bdl |  |
| RR1 | 9/7/93 | 1411 | 18.2 | 6.9 | 7.0 | 4 |  | 272 | 529 | 5.50 | 68 | 101 | 10 |  | 33.0 | bdl |  |
| RR1 | 9/21/93 | 0948 | 16.0 | 7.7 | 6.6 | 5 | 0.10 | 208 | 414 | 5.40 | 75 | 107 | 10 |  | 34.0 | bdl |  |
| RR1 | 10/7/93 | 1124 | 13.2 | 7.3 | 8.4 | 5 | 0.09 | 205 | 411 | 5.70 | 71 | 101 | 10 |  | 33.0 | bdl |  |
| RR1 | 10/18/93 | 1201 | 14.4 | 7.2 | 4.0 | 51 | 0.21 | 205 | 470 | 38.20 | 73 | 104 | 10 |  | 30.0 | bdl |  |
| RR1 | 11/4/93 | 1141 | 9.7 | 7.2 | 8.2 | 57 |  | 214 | 382 | 51.00 | 72 | 109 | 25 |  | 37.0 | bdl |  |
| RR1 | 11/15/93 | 1302 | 12.8 | 7.2 | 7.4 | bdl | 0.14 | 229 | 413 | 9.30 | 82 | 129 | bdl |  | 43.0 | bdl |  |
| RR1 | 11/29/93 | 1509 | 7.2 | 7.3 | 2.9 | bdl |  | 234 | 341 | 11.90 | 82 | 125 | 10 |  | 37.0 | bdl |  |
| RR1s | 12/5/93 | 0925 | 9.9 | 7.5 | 9.8 | bdl | 2.20 | 153 | 482 | 8.00 | 56 | 73 | 15 | bdl | 35.0 | bdl | 2.40 |
| RR1 | 12/13/93 | 1151 | 7.2 | 7.3 | 10.4 | bdl | 0.19 | 219 | 402 | 20.80 | 80 | 119 | 10 | bdl | 44.0 | bdl | bdl |

# Station RR1 Water Quality Data 1993 Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| RR1 | 1/11/93 | 20.67 | 4.40 | 8.80 | 1.20 | 1.82 | 27.00 | 0.50 | <0.02 | 14.00 | 26.23 | | 1.82 | 1.00 | <0.1 | <0.1 | <0.3 | |
| RR1 | 1/25/93 | 19.21 | 3.50 | 7.00 | 1.10 | | 24.00 | 7.53 | <0.02 | 9.80 | 20.74 | | | 1.00 | <0.1 | <0.1 | <0.3 | |
| RR1 | 2/8/93 | 17.69 | 5.00 | 8.90 | 1.50 | | 32.00 | 1.14 | <0.02 | 16.00 | 19.52 | | | 1.03 | <0.1 | <0.1 | <0.3 | |
| RR1 | 2/22/93 | 18.30 | 2.60 | 7.80 | 1.00 | 1.49 | 17.00 | 0.65 | <0.02 | 12.00 | 21.96 | | 1.42 | 0.95 | <0.1 | <0.1 | <0.3 | |
| RR1 | 3/8/93 | 20.30 | 3.50 | 17.00 | 1.30 | 2.08 | 26.00 | 0.92 | | 20.00 | 25.01 | | 1.94 | 0.93 | | | | |
| RR1 | 3/22/93 | 17.70 | 2.50 | 16.00 | 0.90 | 1.81 | 17.00 | 1.90 | bdl | 24.00 | 41.48 | | 1.65 | 0.91 | bdl | bdl | bdl | |
| RR1s | 3/23/93 | 13.00 | 1.50 | 4.10 | 1.50 | 1.11 | 18.00 | 1.70 | bdl | 8.80 | 70.74 | | 1.33 | 1.20 | bdl | bdl | bdl | |
| RR1 | 4/2/93 | 20.10 | 3.40 | 14.00 | 1.30 | 1.93 | 32.00 | 0.54 | bdl | 24.00 | 79.30 | | 3.95 | 2.05 | bdl | bdl | bdl | |
| RR1 | 4/19/93 | 19.80 | 4.20 | 12.00 | 1.10 | 1.89 | 34.00 | 1.20 | 1.00 | 20.00 | 25.01 | | 2.13 | 1.13 | bdl | bdl | bdl | |
| RR1 | 5/3/93 | 19.20 | 4.60 | 11.00 | 1.20 | 1.86 | 31.00 | 0.48 | bdl | 19.00 | 21.96 | | 1.91 | 1.00 | bdl | bdl | bdl | |
| RR1 | 5/17/93 | 16.90 | 5.20 | 11.00 | 1.40 | 1.80 | 35.00 | 0.88 | bdl | 22.00 | 20.74 | | 2.04 | 1.14 | bdl | bdl | bdl | |
| RR1 | 5/31/93 | 16.30 | 4.80 | 10.00 | 1.70 | 1.71 | 29.00 | 0.92 | bdl | 20.00 | 16.47 | | 1.72 | 1.01 | | | bdl | |
| RR1 | 6/14/93 | 17.00 | 5.00 | 9.90 | 1.60 | 1.76 | 26.00 | 3.40 | bdl | 21.00 | 18.30 | | 1.79 | 1.02 | bdl | bdl | bdl | |
| RR1 | 7/6/93 | 18.40 | 5.40 | 10.00 | 1.80 | 1.86 | 34.00 | 1.50 | bdl | 19.00 | 20.74 | | 1.95 | 1.05 | bdl | bdl | bdl | |
| RR1 | 7/19/93 | 19.40 | 5.70 | 9.80 | 2.00 | 1.93 | 35.00 | 1.60 | bdl | 20.00 | 20.74 | | 2.00 | 1.03 | bdl | 0.4 | bdl | |
| RR1 | 8/9/93 | 18.60 | 5.50 | 9.60 | 1.90 | 1.86 | 27.00 | 1.00 | bdl | 17.00 | 21.35 | | 1.77 | 0.95 | 0.20 | bdl | bdl | |
| RR1 | 8/23/93 | 19.50 | 5.30 | 9.70 | 2.10 | 1.90 | 25.00 | 0.96 | bdl | 17.00 | 21.96 | | 1.75 | 0.92 | 0.20 | bdl | bdl | |
| RR1 | 9/7/93 | 18.40 | 5.40 | 9.30 | 1.70 | 1.82 | 29.00 | 0.96 | bdl | 16.00 | 20.13 | | 1.74 | 0.96 | 0.20 | bdl | bdl | |
| RR1 | 9/21/93 | 20.50 | 5.80 | 9.20 | 1.90 | 1.96 | 30.00 | 0.81 | bdl | 18.00 | 20.74 | | 1.84 | 0.94 | 0.20 | bdl | bdl | |
| RR1 | 10/7/93 | 18.90 | 5.70 | 9.00 | 1.80 | 1.87 | 27.00 | 0.86 | bdl | 17.00 | 20.13 | | 1.73 | 0.92 | 0.20 | bdl | bdl | |
| RR1 | 10/18/93 | 20.00 | 5.60 | 9.70 | 1.70 | 1.95 | 28.00 | 0.67 | bdl | 20.00 | 18.30 | | 1.77 | 0.91 | 0.20 | bdl | bdl | |
| RR1 | 11/4/93 | 19.20 | 5.90 | 9.20 | 1.80 | 1.91 | 29.00 | 0.98 | bdl | 20.00 | 22.57 | | 1.93 | 1.01 | 0.20 | bdl | bdl | |
| RR1 | 11/15/93 | 20.70 | 7.30 | 9.60 | 1.90 | 2.14 | 42.00 | 0.87 | bdl | 20.00 | 26.23 | | 2.33 | 1.09 | 0.30 | bdl | bdl | |
| RR1 | 11/29/93 | 21.90 | 6.60 | 11.00 | 1.70 | 2.17 | 38.00 | 2.40 | bdl | 21.00 | 22.57 | | 2.17 | 1.00 | 0.20 | bdl | bdl | |
| RR1s | 12/5/93 | 19.00 | 2.20 | 4.90 | 0.93 | 1.38 | 17.00 | 0.67 | bdl | 6.90 | 21.35 | | 1.27 | | 0.20 | bdl | bdl | bdl |
| RR1 | 12/13/93 | 23.90 | 4.90 | 10.00 | 1.20 | 2.08 | 33.00 | 0.65 | bdl | 18.00 | 26.84 | | 2.09 | 1.01 | 0.10 | bdl | bdl | bdl |

# Station RR1 Water Quality Data 1993    Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| RR1 | 1/11/93 | 0.09 | <0.01 | | | <0.01 | <0.01 | 0.09 | | 0.19 | | <0.01 | <0.1 | <0.1 | 2.80 | | <0.01 | | 0.02 | 0.38 | 0.28 | 0.70 |
| RR1 | 1/25/93 | 0.06 | <0.01 | | | <0.01 | <0.01 | 0.08 | | 0.15 | | <0.01 | <0.1 | <0.1 | 2.60 | | <0.01 | | 0.04 | 0.36 | 0.18 | 0.53 |
| RR1 | 2/8/93 | <0.01 | 0.02 | | | <0.01 | <0.01 | 0.13 | | 0.28 | | <0.01 | <0.1 | <0.1 | 3.00 | | <0.01 | | 0.02 | 0.70 | 0.30 | 1.40 |
| RR1 | 2/22/93 | 0.02 | <0.01 | | | <0.01 | <0.01 | 0.03 | | 0.05 | | <0.01 | <0.1 | <0.1 | 2.20 | | <0.01 | | <0.01 | 0.10 | 0.05 | 0.23 |
| RR1 | 3/8/93 | 0.04 | | | | | | 0.06 | | 0.15 | | 0.01 | | | 2.50 | | | | 0.01 | 0.22 | 0.16 | 0.33 |
| RR1 | 3/22/93 | 0.02 | bdl | | | bdl | bdl | 0.02 | | 0.04 | | 0.01 | bdl | bdl | 2.40 | | bdl | | 0.01 | 0.07 | 0.05 | 0.06 |
| RR1s | 3/23/93 | 0.93 | 0.01 | 0.03 | | bdl | bdl | 0.38 | | 0.05 | | 0.07 | bdl | bdl | 1.80 | bdl | 0.05 | 0.01 | 0.02 | 2.60 | 0.72 | 2.20 |
| RR1 | 4/2/93 | bdl | bdl | | | bdl | bdl | 0.03 | | 0.13 | | bdl | bdl | bdl | 2.30 | | bdl | | 0.03 | 0.08 | 1.40 | 0.25 |
| RR1 | 4/19/93 | 0.01 | bdl | | | bdl | bdl | 0.03 | | 0.16 | | bdl | bdl | bdl | 2.50 | | bdl | | 0.01 | 0.56 | 0.23 | 0.57 |
| RR1 | 5/3/93 | 0.06 | bdl | | | bdl | bdl | 0.09 | | 0.21 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.02 | 1.00 | 0.25 | 0.97 |
| RR1 | 5/17/93 | 0.03 | bdl | | | bdl | bdl | 0.13 | | 0.28 | | bdl | bdl | bdl | 3.30 | | bdl | | 0.02 | 0.28 | 0.28 | 0.67 |
| RR1 | 5/31/93 | 0.08 | | | | | 0.01 | 0.14 | | 0.26 | | bdl | bdl | bdl | 3.40 | | bdl | | 0.05 | 0.27 | 0.27 | 0.58 |
| RR1 | 6/14/93 | 0.07 | bdl | | | bdl | bdl | 0.12 | | 0.22 | | bdl | bdl | bdl | 3.70 | | bdl | | 0.03 | 0.51 | 0.23 | 0.57 |
| RR1 | 7/6/93 | 0.08 | bdl | | | bdl | bdl | 0.05 | | 0.21 | | bdl | bdl | bdl | 3.90 | | bdl | | bdl | 0.29 | 0.21 | 0.25 |
| RR1 | 7/19/93 | 0.08 | bdl | | | bdl | bdl | 0.11 | | 0.29 | | 0.01 | bdl | bdl | 3.80 | | bdl | | bdl | 0.54 | 0.35 | 0.63 |
| RR1 | 8/9/93 | 0.07 | bdl | | | bdl | bdl | 0.01 | | 0.23 | | bdl | bdl | bdl | 3.70 | | bdl | | bdl | 0.65 | 0.26 | 0.50 |
| RR1 | 8/23/93 | 0.07 | bdl | | | bdl | bdl | bdl | | 0.20 | | bdl | bdl | bdl | 3.80 | | bdl | | bdl | 0.76 | 0.22 | 0.47 |
| RR1 | 9/7/93 | 0.07 | bdl | | | bdl | bdl | 0.03 | | 0.23 | | bdl | bdl | bdl | 3.70 | | bdl | | 0.01 | 0.34 | 0.24 | 0.25 |
| RR1 | 9/21/93 | 0.06 | bdl | | | bdl | bdl | 0.09 | | 0.23 | | bdl | bdl | bdl | 3.70 | | bdl | | 0.02 | 0.43 | 0.25 | 0.31 |
| RR1 | 10/7/93 | 0.04 | bdl | | | bdl | bdl | 0.25 | | 0.25 | | bdl | bdl | bdl | 3.70 | | bdl | | 0.02 | 0.58 | 0.28 | 0.54 |
| RR1 | 10/18/93 | 0.08 | bdl | | | bdl | bdl | 0.14 | | 0.32 | | bdl | bdl | bdl | 3.70 | | bdl | | 0.02 | 2.20 | 0.36 | 0.53 |
| RR1 | 11/4/93 | 0.04 | 0.01 | | | bdl | bdl | 0.31 | | 0.30 | | bdl | bdl | bdl | 3.60 | | bdl | | 0.03 | 3.10 | 0.32 | 1.10 |
| RR1 | 11/15/93 | 0.11 | bdl | | | bdl | bdl | 0.34 | | 0.45 | | 0.02 | bdl | bdl | 3.80 | | bdl | | 0.04 | 0.55 | 0.47 | 0.61 |
| RR1 | 11/29/93 | 0.03 | bdl | | | bdl | bdl | 0.29 | | bdl | | 0.03 | bdl | bdl | | | bdl | | 0.01 | 0.60 | 0.37 | 0.63 |
| RR1s | 12/5/93 | 0.13 | bdl | 0.02 | bdl | bdl | bdl | 0.07 | 0.92 | 0.03 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.09 | 0.03 | 0.15 |
| RR1 | 12/13/93 | 0.07 | bdl | bdl | bdl | bdl | bdl | 0.10 | bdl | 0.22 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.02 | 0.74 | 0.26 | 0.65 |

# Station SH10 Water Quality Data 1993

| Site | Date | TIME | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| SH10 | 1/29/93 | 1330 | 4.3 | 5.5 | 10.2 | 6 | 3.60 | 19 | 614 | 4.40 | 5 | 12 | 5 | | <0.1 | 6.9 | |
| SH10 | 4/15/93 | 1335 | 11.0 | 4.3 | 10.5 | bdl | 4.00 | 17 | 666 | 3.50 | 4 | 8 | 10 | | bdl | bdl | |
| SH10 | 10/15/93 | 1246 | 10.5 | 5.8 | 8.9 | bdl | 0.96 | 22 | 562 | bdl | 5 | 5 | 10 | | 2.0 | 2.5 | |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| SH10 | 1/29/93 | 1.24 | 0.54 | 0.30 | 0.40 | | 6.30 | 2.23 | <0.02 | 0.80 | | | | 1.37 | <0.1 | <0.1 | <0.3 | |
| SH10 | 4/15/93 | 0.92 | 0.48 | 0.30 | 0.30 | 0.12 | 5.00 | bdl | bdl | 0.50 | | | 0.12 | 1.01 | bdl | bdl | bdl | |
| SH10 | 10/15/93 | 0.90 | 0.60 | 0.04 | 1.41 | 0.12 | 1.70 | bdl | bdl | 0.80 | 1.22 | | 0.18 | 8.00 | bdl | bdl | bdl | |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| SH10 | 1/29/93 | 0.07 | <0.01 | | | <0.01 | <0.01 | 0.01 | | 0.03 | | <0.01 | <0.1 | <0.1 | 1.50 | | <0.01 | | 0.02 | 0.04 | 0.03 | 0.08 |
| SH10 | 4/15/93 | 0.09 | bdl | | | bdl | bdl | bdl | | 0.03 | | bdl | bdl | bdl | 1.40 | | bdl | | 0.02 | 0.02 | 0.03 | 0.09 |
| SH10 | 10/15/93 | 0.04 | bdl | | | bdl | bdl | bdl | | 0.61 | | 0.20 | bdl | bdl | bdl | | 9.78 | | 4.50 | bdl | 0.03 | 0.04 |

# Station ST5 Water Quality Data 1993

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| ST5 | 1/11/93 | 1340 | 8.7 | 7.2 | 7.7 | 6 | 2.60 | 92 | 537 | 3.50 | 38 | 43 | 40 | | 29.0 | <0.1 | |
| ST5s | 12/5/93 | 1255 | 9.7 | 7.0 | 9.8 | bdl | 11.60 | 49 | 512 | 13.40 | 19 | 26 | 20 | | 15.0 | bdl | 3.30 |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| ST5 | 1/11/93 | 11.18 | 2.50 | 0.80 | 1.00 | 0.83 | 8.50 | <0.05 | <0.02 | 0.90 | 17.69 | | 0.78 | 0.95 | <0.1 | <0.1 | <0.3 | |
| ST5s | 12/5/93 | 5.50 | 1.30 | 0.48 | 0.96 | 0.44 | 7.70 | 0.20 | bdl | 0.80 | 9.15 | | 0.49 | | bdl | bdl | bdl | bdl |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| ST5 | 1/11/93 | 0.03 | <0.01 | | | <0.01 | <0.01 | 0.03 | | <0.01 | | <0.01 | <0.1 | <0.1 | 3.20 | | <0.01 | | <0.01 | 0.09 | <0.01 | 0.08 |
| ST5s | 12/5/93 | 0.11 | bdl | 0.02 | bdl | bdl | bdl | 0.08 | 1.10 | bdl | bdl | bdl | bdl | bdl | | | bdl | bdl | bdl | 0.22 | 0.02 | 0.26 |

# Station ST10 Water Quality Data 1993

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| ST10 | 1/11/93 | 1320 | 9.2 | 7.2 | 9.0 | 3 | 2.30 | 142 | 536 | 2.60 | 73 | 76 | 10 | | 60.0 | <0.1 | |
| ST10 | 3/23/93 | 1530 | 8.7 | 7.3 | 7.4 | 200 | | 51 | 473 | 335.00 | 20 | 29 | 30 | | 12.0 | bdl | 12.00 |
| ST10s | 12/5/93 | 1246 | 10.2 | 7.2 | 9.6 | bdl | 20.60 | 105 | 510 | 16.50 | 50 | 43 | 25 | | 20.0 | bdl | 3.40 |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| ST10 | 1/11/93 | 24.61 | 2.90 | 1.20 | 0.80 | 1.54 | 8.60 | 0.49 | <0.02 | 1.30 | 36.60 | | 1.42 | 0.93 | <0.1 | <0.1 | <0.3 | |
| ST10 | 3/23/93 | 6.50 | 0.99 | 0.32 | 0.88 | 0.47 | 11.00 | 0.38 | bdl | 0.90 | 7.32 | | 0.50 | 1.07 | bdl | bdl | bdl | |
| ST10s | 12/5/93 | 17.00 | 1.70 | 0.66 | 1.00 | 1.07 | 8.50 | 0.50 | bdl | 1.10 | 12.20 | | 0.62 | | 0.10 | bdl | bdl | bdl |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| ST10 | 1/11/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.03 | | <0.01 | | <0.01 | <0.1 | <0.1 | 3.20 | | <0.01 | | <0.01 | 0.09 | <0.01 | 0.04 |
| ST10 | 3/23/93 | 0.18 | bdl | 0.02 | | bdl | bdl | 0.19 | | 0.03 | | bdl | bdl | bdl | 1.90 | 0.01 | 0.01 | bdl | 0.02 | 1.30 | 0.40 | 1.20 |
| ST10s | 12/5/93 | 0.22 | bdl | 0.20 | bdl | bdl | bdl | 0.15 | 0.58 | bdl | bdl | bdl | bdl | bdl | | | bdl | bdl | bdl | 0.21 | 0.03 | 0.28 |

# Station ST10 Water Quality Data 1993

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | deg C |  | ppm | ntu | cfs | uS |  | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ST10 | 1/11/93 | 1320 | 9.2 | 7.2 | 9.0 | 3 | 2.30 | 142 | 536 | 2.60 | 73 | 76 | 10 |  | 60.0 | <0.1 |  |
| ST10 | 3/23/93 | 1530 | 8.7 | 7.3 | 7.4 | 200 |  | 51 | 473 | 335.00 | 20 | 29 | 30 |  | 12.0 | bdl | 12.00 |
| ST10s | 12/5/93 | 1246 | 10.2 | 7.2 | 9.6 | bdl | 20.60 | 105 | 510 | 16.50 | 50 | 43 | 25 |  | 20.0 | bdl | 3.40 |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| ST10 | 1/11/93 | 24.61 | 2.90 | 1.20 | 0.80 | 1.54 | 8.60 | 0.49 | <0.02 | 1.30 | 36.60 |  | 1.42 | 0.93 | <0.1 | <0.1 | <0.3 |  |
| ST10 | 3/23/93 | 6.50 | 0.99 | 0.32 | 0.88 | 0.47 | 11.00 | 0.38 | bdl | 0.90 | 7.32 |  | 0.50 | 1.07 | bdl | bdl | bdl |  |
| ST10s | 12/5/93 | 17.00 | 1.70 | 0.66 | 1.00 | 1.07 | 8.50 | 0.50 | bdl | 1.10 | 12.20 |  | 0.62 |  | 0.10 | bdl | bdl | bdl |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ST10 | 1/11/93 | <0.01 | <0.01 |  |  | <0.01 | <0.01 | 0.03 |  | <0.01 |  | <0.01 | <0.1 | <0.1 | 3.20 |  | <0.01 |  | <0.01 | 0.09 | <0.01 | 0.04 |
| ST10 | 3/23/93 | 0.18 | bdl | 0.02 |  | bdl | bdl | 0.19 |  | 0.03 |  | bdl | bdl | bdl | 1.90 | 0.01 | 0.01 | bdl | 0.02 | 1.30 | 0.40 | 1.20 |
| ST10s | 12/5/93 | 0.22 | bdl | 0.20 | bdl | bdl | bdl | 0.15 | 0.58 | bdl | bdl | bdl | bdl | bdl |  |  | bdl | bdl | bdl | 0.21 | 0.03 | 0.28 |

# Station STOR1 Water Quality Data 1993

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| STOR1 | 1/11/93 | 1515 | 9.5 | 7.4 | 8.0 | 200 | 0.80 | 220 | 524 | 195.00 | 96 | 122 | 10 | | 87.0 | <0.1 | |
| STOR1 | 2/22/93 | 1110 | 9.7 | 7.4 | 7.6 | 12 | 0.46 | 150 | 495 | 4.70 | 82 | 90 | 10 | | 64.0 | <0.1 | |
| STOR1 | 3/22/93 | 1515 | 9.8 | 6.8 | 7.7 | 6 | 0.49 | 200 | 463 | 7.30 | 88 | 107 | 15 | | 76.0 | bdl | |
| STOR1s | 3/23/93 | 1520 | 9.0 | 7.3 | 8.4 | 200 | 5.50 | 113 | 463 | 195.00 | 45 | 69 | 35 | | 35.0 | bdl | 12.00 |
| STOR1s | 12/5/93 | 1114 | 12.0 | 7.4 | 7.9 | bdl | 0.20 | 268 | 478 | 5.90 | 130 | 139 | 15 | | 86.0 | bdl | 5.40 |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| STOR1 | 1/11/93 | 31.46 | 4.40 | 3.40 | 3.80 | 2.25 | 16.00 | 3.32 | <0.02 | 6.10 | 53.07 | | 2.31 | 1.03 | 0.30 | <0.1 | <0.3 | |
| STOR1 | 2/22/93 | 26.99 | 3.50 | 1.60 | 2.10 | 1.76 | 13.00 | 1.67 | <0.02 | 2.30 | 39.04 | | 1.64 | 0.94 | <0.1 | <0.1 | <0.3 | |
| STOR1 | 3/22/93 | 30.50 | 3.00 | 4.30 | 1.60 | 1.99 | 12.00 | 1.60 | bdl | 7.90 | 46.36 | | 2.02 | 1.01 | bdl | bdl | bdl | |
| STOR1s | 3/23/93 | 14.00 | 2.20 | 2.20 | 2.20 | 1.06 | 17.00 | 4.60 | bdl | 1.40 | 21.35 | | 1.25 | 1.18 | 0.20 | bdl | bdl | |
| STOR1s | 12/5/93 | 41.00 | 6.10 | 2.50 | 2.80 | 2.73 | 30.00 | 3.00 | bdl | 2.00 | 52.46 | | 2.45 | | bdl | bdl | bdl | bdl |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr. | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| STOR1 | 1/11/93 | 0.61 | 0.01 | | | <0.01 | <0.01 | 0.41 | | 0.02 | | <0.01 | 0.10 | <0.1 | 2.60 | | 0.01 | | 0.02 | 0.13 | 0.09 | 0.78 |
| STOR1 | 2/22/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.07 | | 0.01 | | <0.01 | <0.1 | <0.1 | 2.30 | | <0.01 | | 0.01 | 0.16 | 0.01 | 0.22 |
| STOR1 | 3/22/93 | bdl | bdl | | | bdl | bdl | 0.04 | | 0.02 | | bdl | bdl | bdl | 2.50 | | bdl | | 0.01 | 0.08 | 0.02 | bdl |
| STOR1s | 3/23/93 | 0.21 | 0.01 | bdl | | bdl | bdl | 0.16 | | 0.03 | | 0.02 | bdl | bdl | 1.50 | 0.08 | bdl | bdl | 0.02 | 0.83 | 0.09 | 0.64 |
| STOR1s | 12/5/93 | 0.08 | 0.02 | 0.02 | bdl | bdl | bdl | 0.08 | 0.90 | 0.01 | bdl | bdl | bdl | bdl | | | bdl | 0.01 | 0.02 | 0.18 | 0.01 | 0.25 |

# Station TC10 Water Quality Data 1993 Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| TC10 | 1/11/93 | 0940 | 11.1 | 7.3 | 9.2 | 5 | 2.50 | 130 | 567 | 4.20 | 67 | 79 | <5 | 0.80 | 59.0 | <0.1 | |
| TC10 | 1/25/93 | 1145 | 8.9 | 8.9 | 9.9 | 67 | 4.10 | 258 | 475 | 42.50 | 120 | 160 | 15 | 3.30 | 47.0 | <0.1 | |
| TC10 | 2/8/93 | 0825 | 7.1 | 7.1 | 10.3 | 15 | 1.80 | 222 | 382 | 14.90 | 120 | 193 | 5 | 0.45 | 23.0 | <0.1 | |
| TC10 | 2/22/93 | 1345 | 11.6 | 7.9 | 8.7 | 25 | 4.30 | 489 | 460 | 94.60 | 92 | 118 | 10 | 0.90 | 75.0 | <0.1 | |
| TC10 | 3/8/93 | 1330 | 12.0 | 7.3 | 8.6 | 14 | 3.40 | 297 | 358 | 12.50 | 130 | 207 | 10 | | 40.0 | | |
| TC10 | 3/22/93 | 1050 | 12.0 | 7.5 | 9.2 | 7 | 4.70 | 174 | 506 | 8.70 | 79 | 93 | 15 | | 68.0 | bdl | |
| TC10s | 3/23/93 | 1255 | 10.6 | 10.4 | 8.8 | 200 | | 216 | 371 | 483.00 | 88 | 173 | 25 | | 51.0 | bdl | 7.10 |
| TC10 | 4/2/93 | 0920 | 10.3 | 7.0 | 8.8 | 6 | 3.20 | 309 | 280 | 7.20 | 130 | 197 | 5 | 1.40 | 28.0 | bdl | |
| TC10 | 4/19/93 | 0917 | 11.8 | 7.2 | 8.2 | 2 | 3.00 | 162 | 509 | 2.70 | 60 | 78 | 5 | 0.60 | 57.0 | bdl | |
| TC10 | 5/3/93 | 1420 | 14.4 | 8.2 | 7.7 | 4 | 2.50 | 169 | 419 | 2.80 | 82 | 118 | 5 | | 48.0 | bdl | |
| TC10 | 5/17/93 | 0945 | 15.5 | 8.5 | 7.7 | 2 | 0.78 | 121 | 471 | 3.70 | 46 | 70 | 10 | | 44.0 | bdl | |
| TC10 | 5/31/93 | 0915 | 16.9 | 9.4 | 8.5 | 6 | 0.81 | 142 | 396 | 3.90 | 44 | 70 | 10 | | 32.0 | | |
| TC10 | 6/14/93 | 0920 | 17.3 | 8.9 | 7.3 | 4 | 1.10 | 132 | 342 | 5.50 | 42 | 69 | 10 | bdl | 39.0 | bdl | |
| TC10 | 6/28/93 | 0850 | 16.3 | 7.7 | | 3 | 1.20 | 308 | | 15.00 | 65 | 70 | 15 | 6.00 | 47.0 | bdl | |
| TC10 | 7/6/93 | 1330 | 20.5 | 7.3 | 6.4 | 12 | 2.00 | 229 | 393 | 6.60 | 96 | 138 | 10 | 2.00 | 48.0 | bdl | |
| TC10 | 7/19/93 | 0945 | 20.6 | 7.9 | 7.3 | 8 | 0.50 | 211 | 357 | 2.90 | 67 | 114 | 5 | bdl | 33.0 | bdl | |
| TC10 | 8/9/93 | 1317 | 19.7 | 7.9 | 8.4 | 3 | 0.91 | 225 | 380 | 5.30 | 90 | 135 | 10 | bdl | 44.0 | bdl | |
| TC10 | 8/23/93 | 1030 | 20.0 | 8.0 | 7.9 | 2 | 1.20 | 203 | 450 | 1.60 | 76 | 110 | 10 | | 47.0 | bdl | |
| TC10 | 9/7/93 | 1219 | 19.0 | 7.7 | 8.1 | 2 | | 186 | 509 | 3.80 | 75 | 100 | 10 | bdl | 64.0 | bdl | |
| TC10 | 9/21/93 | 0856 | 17.3 | 7.5 | 8.2 | 3 | 0.60 | 291 | 423 | 2.60 | 120 | 178 | 10 | | 20.0 | bdl | |
| TC10 | 10/7/93 | 1045 | 14.6 | 7.3 | 9.1 | 11 | 0.67 | 238 | 408 | 8.20 | 84 | 130 | 10 | | 33.0 | bdl | |
| TC10 | 10/18/93 | 1238 | 15.7 | 8.3 | 8.7 | 5 | 0.89 | 212 | 440 | 2.00 | 70 | 123 | 10 | 0.30 | 55.0 | bdl | |
| TC10 | 11/4/93 | 1236 | 11.6 | 7.9 | 8.1 | 4 | | 244 | 444 | 3.40 | 110 | 135 | 10 | | 58.0 | bdl | |
| TC10 | 11/15/93 | 1109 | 14.9 | 8.0 | 5.8 | bdl | 0.58 | 271 | 431 | 15.10 | 120 | 149 | 10 | | 76.0 | bdl | |
| TC10 | 11/29/93 | 1443 | 8.9 | 8.3 | 8.3 | bdl | 1.00 | 235 | 438 | 4.10 | bdl | 126 | 10 | | 82.0 | bdl | |
| TC10s | 12/5/93 | 0903 | 10.7 | 7.5 | 8.2 | bdl | 4.30 | 140 | 556 | 15.60 | 55 | 76 | 15 | | 32.0 | bdl | 1.60 |
| TC10 | 12/13/93 | 1017 | 7.9 | 7.9 | 7.9 | bdl | 0.87 | 204 | 480 | bdl | 93 | 109 | 10 | | 74.0 | bdl | bdl |

# Station TC10 Water Quality Data 1993    Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| TC10 | 1/11/93 | 22.51 | 2.50 | 2.00 | 2.80 | 1.49 | 12.00 | 0.42 | <0.02 | 1.00 | 35.99 |  | 1.46 | 0.99 | <0.1 | <0.1 | <0.3 |  |
| TC10 | 1/25/93 | 44.23 | 1.30 | 4.40 | 4.10 |  | 75.00 | 0.81 | 0.42 | 1.20 | 28.67 |  |  | 0.99 | <0.1 | <0.1 | <0.3 |  |
| TC10 | 2/8/93 | 46.19 | 1.20 | 3.80 | 5.11 |  | 120.00 | 0.92 | 0.37 | 1.20 | 14.03 |  |  | 1.11 | <0.1 | <0.1 | <0.3 |  |
| TC10 | 2/22/93 | 32.43 | 2.60 | 2.60 | 3.60 | 2.04 | 22.00 | 8.46 | <0.02 | 1.50 | 45.75 |  | 2.14 | 1.05 | <0.1 | <0.1 | <0.3 |  |
| TC10 | 3/8/93 | 49.00 | 1.80 | 4.40 | 5.70 | 2.94 | 119.00 | 1.50 |  | 0.80 | 24.40 |  | 3.34 | 1.14 | 0.30 |  |  |  |
| TC10 | 3/22/93 | 28.10 | 2.30 | 1.20 | 1.60 | 1.68 | 16.00 | 0.65 | bdl | 2.20 | 4.76 |  | 1.77 | 1.05 | bdl | bdl | bdl |  |
| TC10s | 3/23/93 | 34.00 | 0.92 | bdl | 2.30 | 1.98 | 96.00 | 1.00 | bdl | 5.00 | 31.11 |  | 3.19 | 1.61 | 0.20 | bdl | bdl |  |
| TC10 | 4/2/93 | 47.60 | 1.50 | 2.70 | 5.90 | 2.77 | 120.00 | 1.30 | bdl | 1.00 | 17.08 |  | 3.12 | 1.13 | 0.30 | bdl | bdl |  |
| TC10 | 4/19/93 | 20.80 | 1.90 | 1.90 | 3.00 | 1.36 | 13.00 | 1.20 | 0.33 | 1.10 | 34.77 |  | 1.48 | 1.09 | 0.20 | bdl | bdl |  |
| TC10 | 5/3/93 | 29.70 | 1.90 | 2.50 | 3.80 | 1.85 | 51.00 | bdl | bdl | 0.60 | 29.28 |  | 2.04 | 1.10 | bdl | bdl | bdl |  |
| TC10 | 5/17/93 | 16.10 | 1.50 | 2.70 | 5.10 | 1.19 | 17.00 | 0.52 | bdl | 0.70 | 26.84 |  | 1.26 | 1.06 | bdl | bdl | bdl |  |
| TC10 | 5/31/93 | 13.50 | 2.40 | 4.10 | 6.90 | 1.27 | 21.00 | 0.58 | 0.37 | 0.90 | 19.52 |  | 1.12 | 0.88 |  |  |  |  |
| TC10 | 6/14/93 | 14.80 | 1.30 | 4.20 | 5.90 | 1.21 | 17.00 | 1.10 | bdl | 1.00 | 23.79 |  | 1.18 | 0.98 | bdl | bdl | bdl |  |
| TC10 | 6/28/93 | 23.00 | 1.70 | 4.00 | 5.50 | 1.62 | bdl | 6.43 | bdl | 0.77 | 28.67 |  | 1.08 | 0.67 | 0.35 | bdl | bdl |  |
| TC10 | 7/6/93 | 34.00 | 2.60 | 3.20 | 4.20 | 2.16 | 62.00 | 0.60 | bdl | 2.20 | 29.28 |  | 2.32 | 1.07 | bdl | bdl | bdl |  |
| TC10 | 7/19/93 | 23.40 | 2.20 | 4.90 | 6.90 | 1.74 | 54.00 | 1.20 | 0.18 | 1.10 | 20.13 |  | 1.86 | 1.06 | 0.30 | bdl | bdl |  |
| TC10 | 8/9/93 | 32.30 | 2.30 | 7.90 | 4.70 | 2.28 | 58.00 | 1.40 | 0.27 | 1.40 | 26.84 |  | 2.17 | 0.95 | 0.20 | bdl | bdl |  |
| TC10 | 8/23/93 | 26.50 | 2.50 | 6.00 | 5.70 | 1.94 | 39.00 | 1.00 | bdl | 0.90 | 28.67 |  | 1.81 | 0.93 | 0.20 | bdl | bdl |  |
| TC10 | 9/7/93 | 25.00 | 3.10 | 5.20 | 5.00 | 1.87 | 21.00 | 1.20 | bdl | 0.80 | 39.04 |  | 1.77 | 0.95 | 0.20 | bdl | bdl |  |
| TC10 | 9/21/93 | 44.40 | 3.40 | 4.70 | 5.80 | 2.86 | 100.00 | 4.50 | bdl | 2.70 | 12.20 |  | 2.65 | 0.93 | 0.40 | bdl | bdl |  |
| TC10 | 10/7/93 | 28.10 | 3.30 | 6.30 | 6.70 | 2.15 | 59.00 | 4.10 | bdl | 1.70 | 20.13 |  | 2.02 | 0.97 | 0.30 | bdl | bdl |  |
| TC10 | 10/18/93 | 23.20 | 3.00 | 17.00 | 7.80 | 2.35 | 35.00 | 1.60 | bdl | 1.60 | 33.55 |  | 1.92 | 0.82 | 0.40 | bdl | bdl |  |
| TC10 | 11/4/93 | 34.70 | 5.10 | 3.00 | 5.80 | 2.43 | 49.00 | 0.99 | bdl | 1.00 | 35.38 |  | 2.24 | 0.92 | 0.20 | bdl | bdl |  |
| TC10 | 11/15/93 | 39.30 | 5.30 | 4.10 | 6.10 | 2.73 | 45.00 | 1.40 | bdl | 1.90 | 46.36 |  | 2.55 | 0.93 | 0.30 | bdl | bdl |  |
| TC10 | 11/29/93 | 33.00 | 4.70 | 4.20 | 5.60 | 2.36 | 22.00 | 5.10 | bdl | 1.20 | 50.02 |  | 2.24 | 0.95 | 0.40 | bdl | bdl |  |
| TC10s | 12/5/93 | 17.00 | 2.80 | 3.40 | 3.20 | 1.32 | 27.00 | 1.70 | bdl | 1.10 | 19.50 |  | 1.27 |  | 0.20 | bdl | bdl | bdl |
| TC10 | 12/13/93 | 30.70 | 4.00 | 3.80 | 4.40 | 2.14 | 19.00 | 0.81 | bdl | 1.20 | 45.14 |  | 1.94 | 0.91 | 0.30 | bdl | bdl | bdl |

# Station TC10 Water Quality Data 1993    Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| TC10 | 1/11/93 | 0.02 | <0.01 | | | <0.01 | <0.01 | 0.01 | | 0.04 | | <0.01 | <0.1 | <0.1 | 3.90 | | <0.01 | | 0.02 | 0.13 | 0.04 | 0.04 |
| TC10 | 1/25/93 | 0.19 | 0.02 | | | 0.01 | <0.01 | 0.09 | | <0.01 | | <0.01 | 0.10 | <0.1 | 5.70 | | <0.01 | | 0.01 | 0.49 | 0.04 | 0.75 |
| TC10 | 2/8/93 | 0.12 | 0.01 | | | <0.01 | <0.01 | 0.21 | | 0.05 | | <0.01 | <0.1 | <0.1 | 5.00 | | <0.01 | | 0.02 | 0.82 | 0.05 | 0.51 |
| TC10 | 2/22/93 | 0.05 | <0.01 | | | <0.01 | <0.01 | 0.03 | | 0.01 | | <0.01 | <0.1 | <0.1 | 3.50 | | <0.01 | | <0.01 | 0.61 | 0.04 | 1.60 |
| TC10 | 3/8/93 | 0.05 | | | | 0.01 | | 0.21 | | 0.05 | | 0.02 | | | 3.80 | | | | | 0.52 | 0.06 | 0.29 |
| TC10 | 3/22/93 | bdl | bdl | | | bdl | bdl | bdl | | 0.02 | | bdl | bdl | bdl | 3.20 | | bdl | | 0.01 | 0.10 | 0.02 | 0.05 |
| TC10s | 3/23/93 | 0.39 | bdl | 0.02 | | bdl | bdl | 0.03 | | bdl | | 2.60 | bdl | bdl | 4.40 | 0.09 | bdl | bdl | 0.01 | 3.10 | 0.25 | 3.30 |
| TC10 | 4/2/93 | 0.05 | bdl | | | bdl | bdl | 0.21 | | 0.04 | | bdl | bdl | bdl | 5.40 | | bdl | | 0.01 | 0.36 | 0.04 | 0.14 |
| TC10 | 4/19/93 | 0.06 | bdl | | | bdl | bdl | 0.02 | | 0.02 | | bdl | bdl | bdl | 3.90 | | bdl | | 0.02 | 0.16 | 0.02 | 0.08 |
| TC10 | 5/3/93 | 0.06 | bdl | | | bdl | bdl | 0.04 | | 0.05 | | bdl | bdl | bdl | 4.30 | | bdl | | 0.01 | 0.27 | 0.05 | 0.16 |
| TC10 | 5/17/93 | 0.19 | bdl | | | bdl | bdl | 0.04 | | 0.01 | | bdl | bdl | bdl | 4.50 | | bdl | | 0.02 | 0.16 | 0.02 | 0.21 |
| TC10 | 5/31/93 | 0.33 | | | | | 0.02 | 0.39 | | | | | | | 4.90 | | | | 0.05 | 0.24 | 0.02 | 0.44 |
| TC10 | 6/14/93 | 0.26 | bdl | | | 0.01 | bdl | 0.01 | | bdl | | bdl | bdl | bdl | 4.90 | | bdl | | bdl | 0.22 | 0.03 | 0.32 |
| TC10 | 6/28/93 | 0.14 | bdl | | | bdl | 0.01 | 0.05 | | 0.04 | | bdl | bdl | bdl | 4.60 | | bdl | | 0.06 | 0.37 | 0.04 | 0.31 |
| TC10 | 7/6/93 | 0.07 | bdl | | | bdl | 0.01 | 0.08 | | 0.07 | | bdl | bdl | bdl | 4.50 | | bdl | | bdl | 0.51 | 0.07 | 0.20 |
| TC10 | 7/19/93 | 0.06 | bdl | | | bdl | bdl | bdl | | 0.09 | | bdl | bdl | bdl | 4.60 | | bdl | | 0.01 | 0.35 | 0.10 | 0.19 |
| TC10 | 8/9/93 | 0.10 | 0.02 | | | bdl | bdl | 0.12 | | 0.09 | | bdl | bdl | bdl | 4.60 | | bdl | | 0.03 | 0.39 | 0.09 | 0.19 |
| TC10 | 8/23/93 | 0.09 | 0.02 | | | bdl | bdl | 0.03 | | 0.08 | | bdl | bdl | bdl | 4.80 | | bdl | | 0.01 | 0.26 | 0.08 | 0.15 |
| TC10 | 9/7/93 | 0.09 | 0.02 | | | bdl | bdl | 0.04 | | 0.09 | | bdl | bdl | bdl | 4.50 | | bdl | | bdl | 0.22 | 0.09 | 0.10 |
| TC10 | 9/21/93 | 0.07 | 0.02 | | | | bdl | 0.08 | | 0.12 | | bdl | bdl | bdl | 5.60 | | bdl | | 0.03 | | | |
| TC10 | 10/7/93 | 0.04 | 0.03 | | | bdl | bdl | 0.08 | | 0.03 | | bdl | bdl | bdl | 6.70 | | bdl | | 0.02 | 0.26 | 0.04 | 0.23 |
| TC10 | 10/18/93 | 0.07 | 0.06 | | | bdl | bdl | 0.03 | | 0.07 | | bdl | bdl | bdl | 5.70 | | bdl | | 0.01 | 0.22 | 0.07 | 0.18 |
| TC10 | 11/4/93 | 0.03 | 0.04 | | | bdl | 0.02 | 0.02 | | 0.08 | | bdl | bdl | bdl | 4.60 | | bdl | | 0.02 | 0.15 | 0.09 | 0.17 |
| TC10 | 11/15/93 | 0.03 | 0.02 | | | bdl | bdl | 0.02 | | 0.08 | | 0.01 | bdl | bdl | 4.20 | | bdl | | 0.03 | 0.35 | 0.09 | 0.25 |
| TC10 | 11/29/93 | 0.04 | 0.02 | | | bdl | 0.02 | 0.03 | | 0.07 | | bdl | bdl | bdl | | | bdl | | 0.02 | 0.21 | 0.07 | 0.04 |
| TC10s | 12/5/93 | 0.09 | 0.02 | 0.02 | bdl | bdl | bdl | 0.05 | 0.96 | 0.06 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.26 | 0.07 | 0.25 |
| TC10 | 12/13/93 | 0.03 | 0.02 | bdl | bdl | bdl | bdl | 0.04 | bdl | 0.07 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.02 | 0.17 | 0.07 | 0.05 |

# Station TD1 Water Quality Data 1993 Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| TD1 | 1/11/93 | 1415 | 10.2 | 7.3 | 5.5 | 7 | 0.04 | 285 | 530 | 5.10 | 150 | 159 | 30 | 0.80 | 130.0 | <0.1 | |
| TD1 | 1/25/93 | 1430 | 8.4 | 7.6 | 5.3 | 3 | 0.06 | 287 | 422 | 5.40 | 150 | 160 | <5 | | 130.0 | <0.1 | |
| TD1 | 2/8/93 | 1300 | 9.9 | 7.7 | 6.7 | 2 | 0.01 | 267 | 469 | 6.10 | 140 | 151 | 10 | 0.30 | 130.0 | <0.1 | |
| TD1 | 2/22/93 | 0945 | 9.2 | 7.9 | 6.5 | 6 | 0.06 | 242 | 491 | 4.60 | 140 | 152 | 15 | | 230.0 | <0.1 | |
| TD1 | 3/8/93 | 1030 | 10.3 | 7.6 | 6.6 | 2 | 0.06 | 248 | 510 | 1.90 | 140 | 163 | 10 | | 140.0 | | |
| TD1 | 3/22/93 | 1420 | 11.5 | 7.1 | 6.3 | 10 | 0.18 | 241 | 456 | 24.70 | 140 | 148 | 10 | | 110.0 | bdl | |
| TD1s | 3/23/93 | 1445 | 12.7 | 7.6 | 8.4 | 200 | 6.60 | 223 | 432 | 287.00 | 110 | 127 | 35 | | 96.0 | bdl | 8.70 |
| TD1 | 4/2/93 | 1340 | 9.8 | 7.2 | 6.3 | 12 | 0.02 | 275 | 397 | 12.90 | 140 | 146 | 5 | | 110.0 | bdl | |
| TD1 | 4/19/93 | 1329 | 14.6 | 7.4 | 4.5 | 14 | 0.80 | 250 | 433 | 27.70 | 140 | 150 | 25 | 2.30 | 120.0 | | |
| TD1 | 5/3/93 | 1040 | 13.6 | 7.7 | 4.8 | 2 | bdl | 252 | 459 | 2.00 | 160 | 166 | 10 | | 140.0 | bdl | |
| TD1 | 5/17/93 | 1340 | 16.2 | 7.5 | 4.0 | 3 | 0.01 | 254 | 441 | 5.20 | 150 | 165 | 10 | | 150.0 | bdl | |
| TD1 | 5/31/93 | 1340 | 15.2 | 7.2 | 2.5 | 7 | 0.02 | 321 | 418 | 16.20 | 150 | 166 | 10 | | 150.0 | bdl | |
| TD1 | 6/14/93 | 1310 | 17.5 | 7.4 | 4.2 | 4 | 0.04 | 332 | 410 | 2.70 | 170 | 179 | 10 | | 160.0 | bdl | |
| TD1 | 7/6/93 | 1030 | 18.3 | 7.3 | 3.7 | 4 | bdl | 331 | 355 | 3.80 | 180 | 189 | 10 | | 170.0 | bdl | |
| TD1 | 7/19/93 | 1515 | 19.8 | 7.5 | 4.8 | 7 | 0.01 | 365 | 379 | 5.00 | 180 | 177 | 5 | 4.00 | 170.0 | bdl | |
| TD1 | 8/9/93 | 1143 | 18.4 | 7.5 | 5.0 | 4 | bdl | 350 | 282 | 6.10 | 180 | 164 | 10 | bdl | 130.0 | bdl | |
| TD1 | 8/23/93 | 1425 | 19.5 | 7.7 | 4.3 | 4 | 0.01 | 366 | 421 | 4.00 | 190 | 195 | 10 | bdl | 170.0 | bdl | |
| TD1 | 9/7/93 | 1518 | 19.1 | 7.3 | 3.9 | 7 | | 376 | 423 | 31.50 | 140 | 172 | 10 | | 170.0 | bdl | |
| TD1 | 10/7/93 | 0952 | 14.2 | 7.4 | 5.0 | 10 | bdl | 373 | 385 | 17.60 | 190 | 193 | 10 | | 160.0 | bdl | |
| TD1 | 10/18/93 | 1047 | 14.9 | 7.5 | 5.6 | 5 | 0.01 | 379 | 422 | 8.80 | 200 | 202 | 10 | | 160.0 | bdl | |
| TD1 | 11/4/93 | 1507 | 11.6 | 7.4 | 6.1 | 5 | | 395 | 353 | 9.70 | 200 | 205 | 15 | | 160.0 | bdl | |
| TD1 | 11/15/93 | 1013 | 12.0 | 7.5 | 6.7 | bdl | 0.04 | 382 | 401 | 12.90 | 190 | 199 | 10 | | 140.0 | bdl | |
| TD1 | 11/29/93 | 0841 | 8.8 | 7.7 | 7.4 | bdl | | 346 | 425 | 21.70 | 180 | 170 | 10 | | 120.0 | bdl | |
| TD1s | 12/5/93 | 1039 | 13.2 | 7.9 | 8.9 | bdl | 3.00 | 258 | 464 | 27.30 | 140 | 135 | 75 | | 110.0 | bdl | 4.60 |
| TD1 | 12/13/93 | 1320 | 10.5 | 7.6 | 8.2 | bdl | 0.08 | 283 | 439 | 10.90 | 150 | 147 | 10 | | 120.0 | bdl | bdl |

# Station TD1 Water Quality Data 1993 Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| TD1 | 1/11/93 | 53.36 | 5.00 | 1.70 | 1.00 | 3.17 | 17.00 | 0.77 | <0.02 | 1.60 | 79.30 | | 3.03 | 0.96 | 0.30 | <0.1 | <0.3 | |
| TD1 | 1/25/93 | 52.31 | 4.80 | 1.70 | 0.90 | | 19.00 | 0.96 | <0.02 | 1.50 | 79.30 | | | 0.99 | <0.1 | <0.1 | <0.3 | |
| TD1 | 2/8/93 | 49.24 | 4.60 | 1.70 | 1.00 | | 14.00 | 0.83 | <0.02 | 1.40 | 79.30 | | | 1.00 | 0.30 | <0.1 | <0.3 | |
| TD1 | 2/22/93 | 50.32 | 4.60 | 1.30 | 0.90 | 2.96 | 21.00 | 1.05 | <0.02 | 1.80 | 140.30 | | 2.89 | 0.97 | <0.1 | <0.1 | <0.3 | |
| TD1 | 3/8/93 | 48.50 | 4.20 | 1.40 | 0.70 | 2.84 | 20.00 | 1.40 | | 1.90 | 85.40 | | 3.31 | 1.17 | 0.40 | | | |
| TD1 | 3/22/93 | 47.60 | 4.20 | 2.90 | 0.80 | 2.86 | 22.00 | 2.20 | bdl | 2.60 | 67.10 | | 2.76 | 0.97 | 0.20 | bdl | bdl | |
| TD1s | 3/23/93 | 39.00 | 2.60 | 0.90 | 2.30 | 2.29 | 21.00 | 3.10 | bdl | bdl | 58.56 | | 2.42 | 1.06 | 0.20 | bdl | bdl | |
| TD1 | 4/2/93 | 48.40 | 4.20 | 1.30 | 0.90 | 2.83 | 22.00 | 1.10 | 0.35 | 1.50 | 67.10 | | 2.74 | 0.97 | 0.20 | bdl | bdl | |
| TD1 | 4/19/93 | 49.20 | 4.10 | 1.40 | 0.50 | 2.86 | 20.00 | 0.57 | 0.70 | 1.40 | 12.20 | | 2.87 | 1.00 | 0.20 | | bdl | |
| TD1 | 5/3/93 | 56.40 | 4.50 | 1.60 | 0.40 | 3.26 | 17.00 | 0.31 | 0.52 | 1.20 | 85.40 | | 3.20 | 0.98 | bdl | bdl | bdl | |
| TD1 | 5/17/93 | 52.90 | 4.30 | 1.70 | 0.50 | 3.07 | 13.00 | 0.51 | 0.54 | 1.40 | 91.50 | | 3.34 | 1.09 | 0.10 | bdl | bdl | |
| TD1 | 5/31/93 | 53.60 | 4.40 | 1.90 | 0.80 | 3.13 | 13.00 | 0.65 | 0.52 | 1.50 | 91.50 | | 3.33 | 1.06 | bdl | bdl | bdl | |
| TD1 | 6/14/93 | 61.00 | 5.10 | 2.10 | 0.70 | 3.57 | 11.00 | 0.69 | 0.54 | 1.60 | 97.60 | | 3.51 | 0.98 | 0.20 | bdl | bdl | |
| TD1 | 7/6/93 | 62.30 | 5.80 | 2.90 | 1.00 | 3.74 | 13.00 | 0.20 | bdl | 1.60 | 103.70 | | 3.73 | 1.00 | 0.20 | bdl | bdl | |
| TD1 | 7/19/93 | 64.30 | 5.50 | 2.80 | 0.90 | 3.80 | 1.30 | bdl | bdl | bdl | 103.70 | | 3.43 | 0.90 | bdl | bdl | bdl | |
| TD1 | 8/9/93 | 64.10 | 5.70 | 2.80 | 0.70 | 3.80 | 9.50 | 0.36 | bdl | 2.10 | 79.30 | | 2.87 | 0.76 | 0.20 | bdl | bdl | |
| TD1 | 8/23/93 | 65.10 | 5.70 | 2.70 | 1.00 | 3.85 | 16.00 | 0.19 | bdl | 2.00 | 103.70 | | 3.81 | 0.99 | 0.30 | bdl | bdl | |
| TD1 | 9/7/93 | 45.00 | 6.00 | 2.90 | 0.70 | 2.88 | 13.00 | 0.27 | bdl | 2.20 | 103.70 | | 3.75 | 1.30 | 0.20 | bdl | bdl | |
| TD1 | 10/7/93 | 66.60 | 6.30 | 2.90 | 1.00 | 3.99 | 17.00 | 0.15 | bdl | 2.20 | 97.60 | | 3.63 | 0.91 | 0.30 | bdl | bdl | |
| TD1 | 10/18/93 | 70.80 | 6.50 | 2.90 | 0.90 | 4.21 | 22.00 | 0.16 | bdl | 2.40 | 97.60 | | 3.74 | 0.89 | 0.20 | bdl | bdl | |
| TD1 | 11/4/93 | 69.50 | 6.40 | 2.90 | 1.00 | 4.14 | 25.00 | 1.20 | bdl | 2.40 | 97.60 | | 3.82 | 0.92 | 0.30 | bdl | bdl | |
| TD1 | 11/15/93 | 66.50 | 6.50 | 2.70 | 1.20 | 4.00 | 32.00 | 2.30 | bdl | 3.20 | 85.40 | | 3.61 | 0.90 | 0.30 | bdl | bdl | |
| TD1 | 11/29/93 | 61.10 | 5.80 | 2.20 | 1.00 | 3.64 | 24.00 | 1.30 | bdl | 2.00 | 73.20 | | 2.99 | 0.82 | 0.30 | bdl | | |
| TD1s | 12/5/93 | 50.00 | 3.00 | 0.49 | 0.91 | 2.81 | 12.00 | 0.79 | bdl | 1.30 | 67.10 | | 2.51 | | 0.20 | bdl | bdl | bdl |
| TD1 | 12/13/93 | 51.90 | 4.00 | 0.80 | 0.90 | 2.98 | 15.00 | 0.59 | | 1.50 | 73.20 | | 2.78 | 0.93 | 0.20 | bdl | bdl | bdl |

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| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| TD1 | 1/11/93 | <0.01 | <0.01 | | bdl | <0.01 | <0.01 | 0.05 | | 0.01 | bdl | <0.01 | <0.1 | <0.1 | 2.70 | | <0.01 | | <0.01 | 0.20 | 0.02 | <0.01 |
| TD1 | 1/25/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.07 | | 0.02 | | <0.01 | <0.1 | <0.1 | 2.70 | | <0.01 | | <0.01 | 0.14 | 0.03 | <0.01 |
| TD1 | 2/8/93 | <0.01 | <0.01 | | | 0.02 | <0.01 | 0.04 | | 0.01 | | <0.01 | <0.1 | <0.1 | 2.80 | | <0.01 | | <0.01 | 0.10 | 0.01 | <0.01 |
| TD1 | 2/22/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.02 | | <0.01 | | <0.01 | <0.1 | <0.1 | 2.80 | | <0.01 | | <0.01 | 0.12 | <0.01 | 0.02 |
| TD1 | 3/8/93 | | | | | | | 0.23 | | | | | | | 2.80 | | | | | 0.08 | 0.01 | |
| TD1 | 3/22/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | 3.10 | | bdl | | bdl | 0.26 | 0.03 | 0.13 |
| TD1s | 3/23/93 | 0.23 | 0.01 | 0.02 | | bdl | bdl | 0.23 | | bdl | | bdl | bdl | bdl | 2.40 | 0.08 | 0.03 | bdl | bdl | 0.39 | 0.22 | 0.77 |
| TD1 | 4/2/93 | bdl | bdl | | | bdl | bdl | 0.03 | | 0.01 | | bdl | bdl | bdl | 2.80 | | bdl | | 0.01 | 0.11 | 0.03 | 0.02 |
| TD1 | 4/19/93 | | | | | | | 0.05 | | 0.02 | | bdl | bdl | bdl | 2.80 | | bdl | | bdl | 0.40 | 0.04 | 0.04 |
| TD1 | 5/3/93 | bdl | bdl | | | bdl | bdl | 0.05 | | 0.02 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.01 | 0.11 | 0.02 | 0.04 |
| TD1 | 5/17/93 | bdl | bdl | | | bdl | bdl | 0.05 | | 0.02 | | bdl | bdl | bdl | 2.90 | | bdl | | 0.02 | 0.13 | 0.02 | 0.02 |
| TD1 | 5/31/93 | bdl | bdl | | | bdl | bdl | 0.09 | | 0.03 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.04 | 0.23 | 0.03 | 0.13 |
| TD1 | 6/14/93 | 0.01 | bdl | | | bdl | bdl | 0.13 | | 0.04 | | bdl | bdl | bdl | 3.50 | | bdl | | 0.03 | 0.15 | 0.04 | 0.06 |
| TD1 | 7/6/93 | bdl | bdl | | | bdl | bdl | 0.17 | | 0.06 | | bdl | bdl | bdl | 3.60 | | bdl | | 0.01 | 0.22 | 0.06 | 0.06 |
| TD1 | 7/19/93 | bdl | bdl | | | bdl | 0.01 | 0.07 | | 0.05 | | bdl | bdl | bdl | 3.50 | | bdl | | bdl | 0.25 | 0.05 | bdl |
| TD1 | 8/9/93 | bdl | 0.01 | | | bdl | bdl | 0.02 | | 0.04 | | bdl | bdl | bdl | 3.50 | | bdl | | bdl | 0.17 | 0.05 | 0.01 |
| TD1 | 8/23/93 | bdl | bdl | | | bdl | bdl | 0.05 | | 0.05 | | bdl | bdl | bdl | 3.60 | | bdl | | bdl | 0.14 | 0.05 | 0.01 |
| TD1 | 9/7/93 | bdl | 0.02 | | | bdl | bdl | 0.06 | | 0.07 | | bdl | bdl | bdl | 3.60 | | bdl | | bdl | 0.58 | 0.10 | 0.10 |
| TD1 | 10/7/93 | bdl | bdl | | | bdl | bdl | 0.09 | | 0.06 | | bdl | bdl | bdl | 3.40 | | bdl | | 0.02 | 0.89 | 0.89 | 0.02 |
| TD1 | 10/18/93 | bdl | 0.01 | | | bdl | bdl | 0.10 | | 0.05 | | bdl | bdl | bdl | 3.40 | | bdl | | 0.02 | 0.40 | 0.07 | bdl |
| TD1 | 11/4/93 | bdl | 0.01 | | | bdl | bdl | 0.10 | | 0.04 | | bdl | bdl | bdl | 3.20 | | bdl | | 0.02 | 0.70 | 0.08 | bdl |
| TD1 | 11/15/93 | bdl | bdl | | | bdl | bdl | 0.12 | | 0.03 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.03 | 0.45 | 0.05 | 0.07 |
| TD1 | 11/29/93 | bdl | bdl | | | bdl | bdl | 0.14 | | 0.03 | | 0.01 | | bdl | | | bdl | | bdl | 0.56 | 0.06 | 0.05 |
| TD1s | 12/5/93 | 0.24 | bdl | 0.02 | bdl | bdl | bdl | 0.16 | 0.89 | bdl | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.37 | 0.02 | 0.49 |
| TD1 | 12/13/93 | 0.05 | bdl | bdl | bdl | bdl | bdl | 0.06 | bdl | 0.01 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.19 | 0.02 | 0.05 |

# Station YC5 Water Quality Data 1993    Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| YC5 | 1/11/93 | 1020 | 7.7 | 7.0 | 9.4 | 3 | 11.30 | 41 | 495 | 1.30 | 15 | 21 | 10 | | 6.5 | <0.1 | |
| YC5 | 1/25/93 | 1230 | 7.0 | 7.9 | 9.9 | 2 | 19.50 | 38 | 426 | 4.20 | 14 | 21 | 15 | | 5.2 | <0.1 | |
| YC5 | 2/8/93 | 1150 | 4.9 | 7.1 | 10.9 | 1 | 2.10 | 46 | 460 | 1.80 | 17 | 24 | 10 | | 8.3 | <0.1 | |
| YC5 | 2/22/93 | 1425 | 7.3 | 7.5 | 10.3 | 2 | | 27 | 444 | 4.10 | 13 | 18 | 5 | | 4.7 | <0.1 | |
| YC5 | 3/8/93 | 1350 | 8.1 | 6.9 | 9.5 | 2 | 11.50 | 35 | 452 | 0.90 | 14 | 21 | 5 | | 7.3 | | |
| YC5 | 3/22/93 | 1115 | 7.5 | 7.3 | 9.9 | 2 | 31.00 | 37 | 498 | 3.90 | 14 | 22 | 10 | | 3.9 | | |
| YC5s | 3/23/93 | 1300 | 7.3 | 7.6 | 9.7 | 200 | | 33 | 488 | 123.00 | 15 | 22 | 25 | | 3.4 | bdl | 6.20 |
| YC5 | 4/2/93 | 1100 | 10.0 | 7.2 | 9.0 | 13 | 11.00 | 40 | 415 | 7.70 | 14 | 22 | 10 | bdl | 4.5 | | |
| YC5 | 4/19/93 | 0938 | 13.2 | 6.9 | 7.9 | 5 | 5.20 | 37 | 500 | 3.70 | 15 | 26 | 5 | | 6.7 | bdl | |
| YC5 | 5/3/93 | 1430 | 16.7 | 7.3 | 7.8 | 2 | 4.30 | 39 | 454 | bdl | 16 | 23 | 15 | | 7.0 | bdl | |
| YC5 | 5/17/93 | 1010 | 17.0 | 7.3 | 5.5 | 3 | 0.83 | 57 | 525 | 2.30 | 27 | 34 | 20 | bdl | 18.0 | | |
| YC5 | 5/31/93 | 0945 | 18.5 | 7.5 | 7.0 | 4 | 0.64 | 98 | 425 | 1.70 | 28 | 35 | 25 | | 21.0 | | |
| YC5 | 6/14/93 | 0935 | 19.4 | 6.3 | 5.3 | 2 | 0.09 | 86 | 465 | 4.10 | 37 | 49 | 20 | | 36.0 | | |
| YC5 | 7/6/93 | 1400 | 23.8 | 7.7 | 3.9 | 2 | 0.18 | 97 | 437 | 0.90 | 45 | 49 | 10 | | 38.0 | | |
| YC5 | 7/19/93 | 1135 | 23.2 | 7.3 | 6.8 | 5 | 0.20 | 106 | 372 | 1.10 | 48 | 52 | 20 | bdl | 37.0 | bdl | |
| YC5 | 8/9/93 | 1344 | 22.4 | 7.1 | 4.5 | 2 | 0.05 | 82 | 362 | 3.30 | 38 | 42 | 10 | bdl | 31.0 | bdl | |
| YC5 | 8/23/93 | 1055 | 21.6 | 7.4 | 4.6 | 1 | 0.50 | 100 | 452 | 6.20 | 47 | 51 | 20 | | 36.0 | | |
| YC5 | 9/7/93 | 1219 | 19.0 | 7.7 | 8.1 | 2 | | 186 | 509 | 6.70 | 39 | 43 | 30 | | 32.0 | | |
| YC5 | 9/21/93 | 0904 | 18.0 | 7.2 | 3.9 | 2 | 0.23 | 103 | 439 | 12.30 | 51 | 54 | 15 | | 38.0 | bdl | |
| YC5 | 10/7/93 | 1105 | 14.3 | 6.8 | 5.5 | 5 | 0.12 | 104 | 428 | 3.30 | 48 | 52 | 20 | bdl | 38.0 | bdl | |
| YC5 | 10/18/93 | 1252 | 15.5 | 6.8 | 3.9 | 1 | 0.21 | 119 | 434 | 12.60 | 57 | 58 | 30 | | 40.0 | bdl | |
| YC5 | 11/4/93 | 1251 | 8.6 | 6.7 | 7.1 | 1 | | 114 | 422 | 4.40 | 54 | 58 | 30 | | 39.0 | bdl | |
| YC5 | 11/15/93 | 1129 | 14.4 | 6.7 | 5.3 | bdl | 0.60 | 121 | 411 | 3.20 | 54 | 58 | 30 | | 38.0 | bdl | |
| YC5 | 11/29/93 | 1457 | 6.2 | 7.0 | 7.9 | bdl | | 128 | 428 | 2.60 | 55 | 64 | 15 | | 29.0 | bdl | |
| YC5s | 12/5/93 | 0914 | 9.6 | 6.9 | 10.1 | bdl | | 40 | 534 | 15.00 | 15 | 19 | 20 | | 6.1 | bdl | 1.80 |
| YC5 | 12/13/93 | 1038 | 6.7 | 6.9 | 10.2 | bdl | 9.30 | 44 | 423 | 2.30 | 17 | 21 | 10 | | 7.0 | bdl | bdl |

# Station YC5 Water Quality Data 1993 Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| YC5 | 1/11/93 | 2.91 | 1.9 | 0.7 | 1 | 0.37 | 8.4 | 0.91 | <0.02 | 1 | 3.97 | | 0.35 | 0.94 | <0.1 | <0.1 | 0.3 | |
| YC5 | 1/25/93 | 2.48 | 1.9 | 0.7 | 0.9 | | 8.5 | 1.77 | <0.02 | 0.7 | 3.17 | | | 1.01 | <0.1 | <0.1 | <0.3 | |
| YC5 | 2/8/93 | 3.52 | 2 | 0.8 | 1 | | 9.5 | 1 | <0.02 | 0.8 | 5.06 | | | 1 | <0.1 | <0.1 | <0.3 | |
| YC5 | 2/22/93 | 2.3 | 1.9 | 0.6 | 0.9 | 0.32 | 8.4 | <0.05 | <0.02 | 0.9 | 2.87 | | 0.29 | 0.91 | <0.1 | <0.1 | <0.3 | |
| YC5 | 3/8/93 | 2.6 | 1.9 | 0.7 | 0.7 | 0.34 | 9.9 | | | 0.5 | 4.45 | | 0.37 | 1.09 | | | | |
| YC5 | 3/22/93 | 2.52 | 1.9 | 0.8 | 0.7 | 0.34 | 12 | 1.2 | | 0.7 | 32.94 | | 0.37 | 1.08 | | | bdl | |
| YC5s | 3/23/93 | 3.20 | 1.60 | 0.70 | 1.50 | 0.37 | 12.00 | bdl | bdl | 0.80 | 2.07 | | 0.34 | 0.93 | bdl | bdl | bdl | |
| YC5 | 4/2/93 | 2.51 | 1.9 | 0.5 | 0.9 | 0.34 | 11 | 0.6 | 0.95 | 0.5 | 2.75 | | 0.36 | 1.08 | bdl | | bdl | |
| YC5 | 4/19/93 | 2.97 | 1.9 | 0.6 | 0.7 | 0.35 | 13 | 1.6 | bdl | 0.6 | 4.09 | | 0.45 | 1.26 | bdl | bdl | bdl | |
| YC5 | 5/3/93 | 3.19 | 2 | 0.7 | 0.9 | 0.38 | 10 | 0.22 | 0.46 | 0.9 | 4.27 | | 0.39 | 1.01 | bdl | | bdl | |
| YC5 | 5/17/93 | 6.55 | 2.6 | 0.8 | 1.1 | 0.61 | 11 | 0.55 | bdl | 0.6 | 10.98 | | 0.61 | 1.01 | bdl | bdl | bdl | |
| YC5 | 5/31/93 | 7.12 | 2.5 | 0.7 | 1.2 | 0.63 | 8.7 | 0.68 | 0.89 | 0.7 | 12.81 | | 0.65 | 1.04 | | | | |
| YC5 | 6/14/93 | 10 | 2.9 | 0.8 | 1.2 | 0.83 | 7.5 | 3.9 | bdl | 0.7 | 21.96 | | 0.96 | 1.16 | bdl | | bdl | |
| YC5 | 7/6/93 | 12.4 | 3.3 | 0.8 | 1.5 | 0.97 | 6.9 | 0.54 | bdl | 0.7 | 23.18 | | 0.93 | 0.96 | bdl | bdl | bdl | |
| YC5 | 7/19/93 | 13.4 | 3.4 | 0.9 | 1.4 | 1.03 | 9.3 | 0.5 | bdl | 0.6 | 22.57 | | 0.96 | 0.93 | bdl | bdl | bdl | |
| YC5 | 8/9/93 | 10.8 | 2.6 | 1.1 | 1.4 | 0.85 | 5.6 | 0.19 | bdl | 0.7 | 18.91 | | 0.77 | 0.9 | 0.1 | bdl | bdl | |
| YC5 | 8/23/93 | 13.5 | 3.1 | 1 | 1.7 | 1.03 | 9.2 | bdl | bdl | 0.7 | 21.96 | | 0.94 | 0.91 | 0.1 | | bdl | |
| YC5 | 9/7/93 | 11 | 2.8 | 0.9 | 1.4 | 0.87 | 6 | 0.46 | bdl | 0.6 | 19.52 | | 0.82 | 0.94 | 0.5 | bdl | bdl | |
| YC5 | 9/21/93 | 14.7 | 3.4 | 0.9 | 1.9 | 1.11 | 8.3 | 0.14 | bdl | 0.9 | 23.18 | | 0.97 | 0.88 | 0.2 | bdl | bdl | |
| YC5 | 10/7/93 | 14.1 | 3.2 | 1.1 | 1.9 | 1.07 | 6.7 | 0.65 | bdl | 0.9 | 23.18 | | 0.94 | 0.88 | 0.1 | bdl | bdl | |
| YC5 | 10/18/93 | 16.5 | 3.7 | 1 | 2.4 | 1.24 | 8.8 | bdl | bdl | 1.1 | 24.4 | | 1.03 | 0.82 | 0.2 | bdl | bdl | |
| YC5 | 11/4/93 | 15.7 | 3.5 | 1.1 | 2.1 | 1.18 | 10 | 0.14 | bdl | 1.3 | 23.79 | | 1.04 | 0.88 | 0.2 | bdl | bdl | |
| YC5 | 11/15/93 | 16.2 | 3.2 | 1 | 2.6 | 1.19 | 9.9 | 0.17 | bdl | 1.4 | 23.18 | | 1.02 | 0.86 | 0.2 | bdl | bdl | |
| YC5 | 11/29/93 | 15.1 | 4.1 | 1.3 | 1.6 | 1.2 | 22 | 0.3 | bdl | 1.2 | 17.69 | | 1.08 | 0.9 | 0.1 | bdl | bdl | |
| YC5s | 12/5/93 | 2.80 | 2.00 | 0.60 | 0.86 | 0.36 | 7.70 | 0.16 | bdl | 0.60 | 3.72 | | 0.30 | | bdl | bdl | bdl | 0.39 |
| YC5 | 12/13/93 | 3.55 | 2 | 0.6 | 1.1 | 0.41 | 8.5 | 0.18 | bdl | 0.7 | 4.27 | | 0.34 | 0.83 | bdl | bdl | bdl | bdl |

# Station YC5 Water Quality Data 1993 Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| YC5 | 1/11/93 | 0.04 | 0.01 | | | <0.01 | <0.01 | 0.15 | | 0.03 | | <0.01 | <0.1 | <0.1 | 2.50 | | <0.01 | | <0.01 | 0.19 | 0.03 | 0.04 |
| YC5 | 1/25/93 | <0.01 | 0.01 | | | <0.01 | <0.01 | 0.11 | | 0.03 | | <0.01 | <0.1 | <0.1 | 2.40 | | <0.01 | | <0.01 | 0.20 | 0.03 | 0.05 |
| YC5 | 2/8/93 | <0.01 | 0.01 | | | <0.01 | <0.01 | 0.12 | | 0.04 | | <0.01 | <0.1 | <0.1 | 2.40 | | <0.01 | | 0.01 | 0.18 | 0.04 | 0.06 |
| YC5 | 2/22/93 | <0.01 | <0.01 | | | 0.03 | <0.01 | 0.08 | | 0.02 | | <0.01 | <0.1 | <0.1 | 2.30 | | <0.01 | | <0.01 | 0.20 | 0.02 | 0.06 |
| YC5 | 3/8/93 | | | | | | | 0.09 | | 0.02 | | 0.01 | | | 2.30 | | 8.00 | | 0.01 | 0.16 | 0.02 | 0.05 |
| YC5 | 3/22/93 | 0.02 | | | | | | 0.06 | | 0.02 | | 0.02 | | | 2.30 | | bdl | | 0.01 | 0.14 | 0.03 | 0.06 |
| YC5s | 3/23/93 | 0.03 | 0.01 | 0.02 | | 0.02 | bdl | 0.09 | | 0.04 | | bdl | bdl | 0.02 | 2.10 | 0.01 | bdl | 0.05 | 0.02 | 1.40 | 0.32 | 0.54 |
| YC5 | 4/2/93 | 0.06 | | | | bdl | bdl | 0.09 | | 0.03 | | bdl | bdl | bdl | 2.10 | | bdl | | 0.05 | 0.12 | 0.04 | 0.07 |
| YC5 | 4/19/93 | 0.02 | 0.01 | | | bdl | bdl | 0.11 | | 0.03 | | bdl | bdl | bdl | 2.00 | | bdl | | 0.01 | 0.25 | 0.03 | 0.14 |
| YC5 | 5/3/93 | 0.02 | bdl | | | 0.02 | bdl | 0.09 | | 0.02 | | bdl | bdl | bdl | 1.80 | | bdl | | 0.01 | 0.15 | 0.03 | 0.05 |
| YC5 | 5/17/93 | 0.02 | bdl | | | bdl | bdl | 0.16 | | 0.05 | | bdl | bdl | bdl | 2.10 | | bdl | | 0.02 | 0.28 | 0.05 | 0.02 |
| YC5 | 5/31/93 | | 0.03 | | | | | 0.19 | | 0.06 | | | | | 2.50 | | bdl | | 0.04 | 0.32 | 0.06 | 0.07 |
| YC5 | 6/14/93 | 0.05 | | | | bdl | bdl | 0.28 | | 0.11 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.03 | 0.74 | 0.29 | 0.13 |
| YC5 | 7/6/93 | bdl | bdl | | | bdl | bdl | 0.25 | | 0.10 | | bdl | bdl | bdl | 3.10 | | bdl | | bdl | 0.89 | 0.53 | 0.08 |
| YC5 | 7/19/93 | bdl | 0.02 | | | bdl | bdl | 0.26 | | 0.05 | | bdl | bdl | bdl | 2.90 | | bdl | | bdl | 0.34 | 0.05 | 0.02 |
| YC5 | 8/9/93 | bdl | 0.01 | | | bdl | bdl | 0.30 | | 0.06 | | bdl | bdl | bdl | 2.90 | | bdl | | 0.02 | 0.42 | 0.09 | 0.03 |
| YC5 | 8/23/93 | | 0.01 | | | bdl | bdl | 0.29 | | 0.10 | | bdl | bdl | bdl | 3.20 | | bdl | | bdl | 0.46 | 0.10 | 0.02 |
| YC5 | 9/7/93 | bdl | 0.01 | | | bdl | 0.01 | 0.34 | | 0.08 | | bdl | bdl | bdl | 3.20 | | bdl | | bdl | 0.46 | 0.09 | bdl |
| YC5 | 9/21/93 | bdl | bdl | | | bdl | 0.01 | 0.20 | | 0.05 | | bdl | bdl | bdl | 3.20 | | bdl | | 0.02 | 0.32 | 0.05 | bdl |
| YC5 | 10/7/93 | bdl | 0.01 | | | bdl | bdl | 0.21 | | 0.05 | | bdl | bdl | bdl | 3.20 | | bdl | | 0.02 | 0.33 | 0.05 | bdl |
| YC5 | 10/18/93 | bdl | 0.02 | | | bdl | bdl | 0.30 | | 0.10 | | bdl | bdl | bdl | 3.50 | | bdl | | 0.02 | 0.48 | 0.10 | bdl |
| YC5 | 11/4/93 | bdl | 0.02 | | | bdl | bdl | 0.33 | | 0.05 | | bdl | bdl | bdl | 3.50 | | bdl | | 0.03 | 0.47 | 0.05 | bdl |
| YC5 | 11/15/93 | 0.04 | bdl | | | bdl | bdl | 0.24 | | 0.03 | | bdl | bdl | bdl | 3.10 | | bdl | | 0.03 | 0.38 | 0.03 | 0.10 |
| YC5 | 11/29/93 | 0.02 | 0.01 | | | bdl | bdl | 0.36 | | 0.05 | | bdl | bdl | bdl | bdl | | bdl | | bdl | 0.46 | 0.05 | 0.07 |
| YC5s | 12/5/93 | 0.02 | 0.02 | 0.02 | bdl | bdl | bdl | 0.18 | 0.83 | 0.09 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.41 | 0.11 | 0.15 |
| YC5 | 12/13/93 | 0.04 | bdl | bdl | bdl | bdl | bdl | 0.19 | bdl | 0.06 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.01 | 0.35 | 0.07 | 0.16 |

# Station YC5A Water Quality Data 1993 Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| YC5A | 1/11/93 | 1000 | 8.7 | 7.0 | 9.1 | 6 | 11.70 | 78 | 540 | 4.80 | 25 | 32 | 10 | 0.40 | 14.0 | <0.1 | |
| YC5A | 1/25/93 | 1215 | 7.5 | 8.8 | 9.4 | 18 | 29.70 | 121 | 449 | 5.10 | 48 | 65 | 20 | 2.00 | 19.0 | <0.1 | |
| YC5A | 2/8/93 | 1145 | 6.5 | 7.5 | 10.5 | 6 | 4.10 | 183 | 413 | 9.00 | 70 | 100 | 10 | 1.30 | 15.0 | <0.1 | |
| YC5A | 2/22/93 | 1420 | 8.5 | 7.3 | 9.7 | 7 | 44.00 | 193 | 454 | 9.80 | 63 | 78 | 5 | 0.30 | 10.0 | <0.1 | |
| YC5A | 3/8/93 | 1340 | 9.2 | 7.0 | 9.4 | 4 | 14.70 | 114 | 416 | 5.10 | 65 | 100 | 5 | 0.50 | 16.0 | | |
| YC5A | 3/22/93 | 1100 | 9.3 | 7.5 | 9.5 | 5 | 44.00 | 96 | 497 | 9.20 | 42 | 55 | 15 | 0.30 | 22.0 | | |
| YC5As | 3/23/93 | 1310 | 8.0 | 8.1 | | 425 | | 9 | 75 | 150.00 | 21 | 33 | 30 | | 12.0 | bdl | 8.60 |
| YC5A | 4/2/93 | 0940 | 10.4 | 7.2 | 8.6 | 12 | 19.80 | 41 | 375 | 8.90 | 16 | 22 | 10 | 1.00 | 4.9 | bdl | |
| YC5A | 4/19/93 | 0929 | 12.6 | 6.9 | 8.3 | 3 | 8.00 | 95 | 503 | 4.10 | 46 | 67 | 5 | 0.60 | 20.0 | bdl | |
| YC5A | 5/3/93 | 1425 | 15.6 | 7.8 | 7.8 | 2 | 6.20 | 105 | 430 | 1.10 | 52 | 72 | 10 | | 26.0 | bdl | |
| YC5A | 5/17/93 | 1000 | 15.8 | 8.2 | 7.1 | 3 | 2.20 | 122 | 486 | 1.00 | 40 | 56 | 10 | | 28.0 | bdl | |
| YC5A | 5/31/93 | 0930 | 17.1 | 9.3 | 7.5 | 7 | 3.30 | 134 | 369 | 5.20 | 38 | 59 | 10 | | 36.0 | | |
| YC5A | 6/14/93 | 0930 | 17.5 | 9.0 | 7.4 | 3 | 1.10 | 128 | 353 | 2.80 | 46 | 70 | 10 | | 40.0 | bdl | |
| YC5A | 7/6/93 | 1350 | 20.7 | 7.6 | 6.2 | 5 | 0.50 | 235 | 399 | 5.30 | 91 | 128 | 10 | 1.00 | 49.0 | bdl | |
| YC5A | 7/19/93 | 1040 | 21.7 | 7.5 | 7.1 | 4 | 0.30 | 179 | 241 | 2.30 | 65 | 100 | 10 | bdl | 36.0 | bdl | |
| YC5A | 8/9/93 | 1340 | 19.9 | 7.8 | 6.9 | 3 | 0.61 | 228 | 347 | 4.40 | 86 | 125 | 10 | bdl | 42.0 | bdl | |
| YC5A | 8/23/93 | 1050 | 20.2 | 7.8 | 7.7 | 3 | 0.93 | 188 | 432 | 2.20 | 74 | 116 | 10 | bdl | 63.0 | bdl | |
| YC5A | 9/7/93 | 1233 | 19.2 | 7.5 | 7.1 | 3 | | 185 | 511 | 503.00 | 73 | 96 | 10 | bdl | 62.0 | bdl | |
| YC5A | 9/21/93 | 0859 | 17.4 | 7.4 | 8.3 | 3 | 0.69 | 286 | 419 | 2.20 | 120 | 176 | 10 | | 20.0 | bdl | |
| YC5A | 10/7/93 | 1058 | 14.7 | 7.3 | 8.7 | 8 | 0.60 | 236 | 406 | 5.30 | 82 | 126 | 10 | | 18.0 | | |
| YC5A | 10/18/93 | 1247 | 15.7 | 7.9 | 8.4 | 3 | 0.70 | 209 | 443 | 3.70 | 68 | 108 | 15 | bdl | 51.0 | bdl | |
| YC5A | 11/4/93 | 1245 | 11.2 | 7.5 | 9.2 | 2 | | 225 | 432 | 3.00 | 110 | 131 | 10 | | 57.0 | bdl | |
| YC5A | 11/15/93 | 1120 | 14.8 | 7.6 | 7.4 | bdl | 1.20 | 235 | 407 | 8.80 | 90 | 109 | 15 | | 62.0 | bdl | |
| YC5A | 11/29/93 | 1446 | 8.4 | 8.1 | 10.2 | bdl | | 227 | 434 | 4.00 | 98 | 118 | bdl | | 78.0 | bdl | |
| YC5As | 12/5/93 | 0910 | 9.9 | 7.1 | 9.6 | bdl | | 65 | 544 | 17.20 | 23 | 30 | 15 | | 11.0 | | 2.20 |
| YC5A | 12/13/93 | 1028 | 7.0 | 7.4 | 10.5 | bdl | 9.00 | 104 | 417 | 1.70 | 17 | 27 | 10 | | 16.0 | bdl | bdl |

# Station YC5A Water Quality Data 1993 Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| YC5A | 1/11/93 | 6.69 | 2.00 | 0.90 | 1.20 | 0.58 | 11.00 | 0.26 | <0.02 | 1.20 | 8.54 | | 0.55 | 0.94 | <0.1 | <0.1 | <0.3 | |
| YC5A | 1/25/93 | 16.36 | 1.60 | 1.70 | 2.00 | | 30.00 | 0.45 | <0.02 | 0.90 | 11.59 | | | 0.97 | <0.1 | <0.1 | <0.3 | |
| YC5A | 2/8/93 | 25.68 | 1.50 | 2.30 | 3.30 | | 54.00 | 2.91 | <0.02 | 0.90 | 9.15 | | | 0.94 | <0.1 | <0.1 | <0.3 | |
| YC5A | 2/22/93 | 21.75 | 2.00 | 1.40 | 1.90 | 1.36 | 43.00 | 0.53 | <0.02 | 0.90 | 6.10 | | 1.13 | 0.83 | <0.1 | <0.1 | <0.3 | |
| YC5A | 3/8/93 | 23.00 | 1.80 | 2.50 | 2.90 | 1.48 | 59.00 | 0.53 | | 0.60 | 9.76 | | 1.57 | 1.06 | 0.30 | | | |
| YC5A | 3/22/93 | 13.30 | 2.00 | | 1.20 | 0.90 | 22.00 | 0.75 | bdl | 1.00 | 2.38 | | 0.94 | 1.04 | | | | |
| YC5As | 3/23/93 | 5.50 | 1.70 | 0.79 | 1.60 | 0.52 | 15.00 | 0.40 | bdl | 0.80 | 7.32 | | 0.58 | 1.12 | bdl | bdl | bdl | |
| YC5A | 4/2/93 | 3.31 | 1.90 | 0.60 | 1.00 | 0.38 | 11.00 | bdl | bdl | 1.10 | 2.99 | | 0.36 | 0.94 | bdl | 0.8 | bdl | |
| YC5A | 4/19/93 | 15.00 | 2.00 | 1.20 | 1.80 | 1.01 | 34.00 | 0.49 | bdl | 0.70 | 12.20 | | 1.13 | 1.12 | bdl | bdl | bdl | |
| YC5A | 5/3/93 | 17.60 | 1.90 | 1.60 | 2.30 | 1.17 | 32.00 | bdl | bdl | 0.50 | 15.86 | | 1.20 | 1.03 | bdl | bdl | bdl | |
| YC5A | 5/17/93 | 12.40 | 2.10 | 1.70 | 2.80 | 0.94 | 19.00 | 0.44 | bdl | 0.60 | 17.08 | | 0.98 | 1.04 | bdl | bdl | bdl | |
| YC5A | 5/31/93 | 12.40 | 1.60 | 3.00 | 4.80 | 1.02 | 14.00 | 0.43 | | 0.90 | 21.96 | | 1.04 | 1.02 | | | | |
| YC5A | 6/14/93 | 15.70 | 1.60 | 4.40 | 5.90 | 1.28 | 17.00 | 0.43 | bdl | 1.00 | 24.40 | | 1.19 | 0.93 | bdl | bdl | bdl | |
| YC5A | 7/6/93 | 32.00 | 2.80 | 2.80 | 3.70 | 2.07 | 55.00 | 0.38 | bdl | 1.00 | 29.89 | | 2.16 | 1.04 | bdl | bdl | bdl | |
| YC5A | 7/19/93 | 22.00 | 2.40 | 4.00 | 5.50 | 1.62 | 43.00 | 0.32 | bdl | 0.80 | 21.96 | | 1.64 | 1.02 | bdl | bdl | bdl | |
| YC5A | 8/9/93 | 30.50 | 2.30 | 7.00 | 4.30 | 2.14 | 53.00 | 1.10 | bdl | 1.10 | 25.62 | | 2.00 | 0.93 | 0.10 | bdl | bdl | |
| YC5A | 8/23/93 | 25.40 | 2.60 | 5.40 | 5.20 | 1.86 | 38.00 | 0.61 | bdl | 0.60 | 38.43 | | 2.09 | 1.12 | 0.20 | bdl | bdl | |
| YC5A | 9/7/93 | 24.00 | 3.10 | 4.90 | 4.90 | 1.80 | 20.00 | 0.85 | bdl | 0.80 | 37.82 | | 1.70 | 0.94 | 0.20 | bdl | bdl | |
| YC5A | 9/21/93 | 43.80 | 3.30 | 5.50 | 5.90 | 2.85 | 100.00 | 3.30 | bdl | 1.50 | 12.20 | | 2.60 | 0.91 | 0.40 | bdl | bdl | |
| YC5A | 10/7/93 | 27.50 | 3.30 | 5.00 | 5.80 | 2.06 | 69.00 | 0.98 | bdl | 1.30 | 10.98 | | 1.87 | 0.91 | 0.30 | bdl | bdl | |
| YC5A | 10/18/93 | 22.30 | 3.10 | 9.80 | 7.00 | 1.98 | 32.00 | 1.30 | bdl | 1.60 | 31.11 | | 1.77 | 0.90 | 0.40 | bdl | bdl | |
| YC5A | 11/4/93 | 33.90 | 5.00 | 2.80 | 5.70 | 2.37 | 47.00 | 0.67 | bdl | 1.00 | 34.77 | | 2.17 | 0.92 | 0.30 | bdl | bdl | |
| YC5A | 11/15/93 | 28.80 | 4.40 | 2.80 | 4.80 | 2.05 | 29.00 | 0.50 | bdl | 1.60 | 37.82 | | 1.91 | 0.93 | 0.20 | bdl | bdl | |
| YC5A | 11/29/93 | 31.70 | 4.70 | 4.00 | 5.10 | 2.27 | 23.00 | 1.50 | bdl | 1.10 | 47.58 | | 2.11 | 0.93 | 0.30 | bdl | bdl | |
| YC5As | 12/5/93 | 5.50 | 2.10 | 1.20 | 1.30 | 0.54 | 12.00 | 0.64 | bdl | 0.70 | 6.71 | | 0.51 | | 0.10 | bdl | bdl | bdl |
| YC5A | 12/13/93 | 3.75 | 1.90 | 0.70 | 1.00 | 0.41 | 8.90 | 0.16 | bdl | 0.70 | 9.76 | | 0.53 | 1.29 | 0.10 | bdl | bdl | bdl |

# Station YC5A Water Quality Data 1993 Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| YC5A | 1/11/93 | 0.01 | <0.01 | | | <0.01 | <0.01 | 0.09 | | 0.04 | | <0.01 | <0.1 | <0.1 | 2.80 | | <0.01 | | <0.01 | 0.22 | 0.04 | 0.04 |
| YC5A | 1/25/93 | 0.06 | <0.01 | | | <0.01 | <0.01 | 0.04 | | 0.02 | | <0.01 | <0.1 | <0.1 | 3.40 | | <0.01 | | <0.01 | 0.32 | 0.03 | 0.38 |
| YC5A | 2/8/93 | 0.02 | <0.01 | | | 0.01 | <0.01 | 0.11 | | 0.04 | | <0.01 | <0.1 | <0.1 | 3.70 | | <0.01 | | 0.01 | 0.55 | 0.04 | 0.28 |
| YC5A | 2/22/93 | <0.01 | <0.01 | | | 0.03 | <0.01 | 0.06 | | 0.02 | | <0.01 | <0.1 | <0.1 | 3.10 | | <0.01 | | <0.01 | 0.28 | 0.02 | 0.14 |
| YC5A | 3/8/93 | 0.02 | 0.01 | | | 0.01 | | 0.11 | | 0.03 | | | | | 2.80 | | | | 0.01 | 0.30 | 0.04 | 0.17 |
| YC5A | 3/22/93 | | | | | 0.04 | | 0.03 | | 0.02 | | | | | 2.80 | | 5.00 | | 0.01 | 0.18 | 0.03 | 0.07 |
| YC5As | 3/23/93 | 0.20 | bdl | 0.02 | | bdl | 0.02 | 0.15 | | 0.04 | | bdl | bdl | bdl | 2.40 | 0.02 | bdl | bdl | 0.01 | 1.50 | 0.30 | 0.70 |
| YC5A | 4/2/93 | 0.05 | bdl | | | bdl | bdl | 0.03 | | 0.04 | | bdl | bdl | bdl | 2.10 | | bdl | | 0.02 | 0.12 | 0.04 | 0.05 |
| YC5A | 4/19/93 | 0.01 | 0.02 | | | bdl | 0.01 | 0.10 | | 0.05 | | bdl | bdl | bdl | 2.80 | | bdl | | 0.01 | 0.47 | 0.06 | 0.14 |
| YC5A | 5/3/93 | 0.04 | bdl | | | bdl | bdl | 0.06 | | 0.04 | | bdl | bdl | bdl | 3.00 | | bdl | | 0.02 | 0.22 | 0.04 | 0.11 |
| YC5A | 5/17/93 | 0.04 | bdl | | | bdl | bdl | 0.06 | | 0.05 | | bdl | bdl | bdl | 3.20 | | bdl | | 0.02 | 0.27 | 0.05 | 0.08 |
| YC5A | 5/31/93 | 0.18 | | | | | | 0.05 | | 0.03 | | | | | 4.10 | | | | 0.04 | 0.25 | 0.04 | 0.24 |
| YC5A | 6/14/93 | 0.18 | bdl | | | 0.01 | bdl | 0.03 | | 0.03 | | bdl | bdl | bdl | 4.70 | | bdl | | 0.03 | 0.23 | 0.04 | 0.20 |
| YC5A | 7/6/93 | 0.16 | bdl | | | bdl | bdl | 0.26 | | 0.09 | | bdl | bdl | bdl | 4.30 | | bdl | | bdl | 0.47 | 0.07 | 0.24 |
| YC5A | 7/19/93 | 0.06 | 0.01 | | | bdl | bdl | 0.09 | | 0.09 | | bdl | bdl | bdl | 4.20 | | bdl | | bdl | 0.25 | 0.09 | 0.08 |
| YC5A | 8/9/93 | 0.10 | 0.02 | | | bdl | bdl | 0.12 | | 0.08 | | bdl | bdl | bdl | 4.40 | | bdl | | 0.03 | 0.40 | 0.09 | 0.19 |
| YC5A | 8/23/93 | 0.09 | 0.02 | | | bdl | bdl | 0.03 | | 0.08 | | bdl | bdl | bdl | 4.60 | | bdl | | bdl | 0.31 | 0.09 | 0.15 |
| YC5A | 9/7/93 | 0.08 | 0.02 | | | bdl | bdl | 0.06 | | 0.08 | | bdl | bdl | bdl | 4.40 | | bdl | | bdl | 0.24 | 0.08 | 0.12 |
| YC5A | 9/21/93 | 0.06 | 0.03 | | | bdl | 0.02 | 0.09 | | 0.12 | | bdl | bdl | bdl | 5.50 | | bdl | | 0.03 | 0.27 | 0.13 | 0.20 |
| YC5A | 10/7/93 | 0.02 | 0.03 | | | bdl | bdl | 0.08 | | 0.07 | | bdl | bdl | bdl | 5.90 | | bdl | | 0.02 | 0.16 | 0.09 | 0.25 |
| YC5A | 10/18/93 | 0.04 | 0.05 | | | bdl | bdl | 0.06 | | 0.07 | | bdl | bdl | bdl | 5.40 | | bdl | | 0.01 | 0.23 | 0.07 | 0.17 |
| YC5A | 11/4/93 | 0.03 | 0.03 | | | bdl | bdl | 0.02 | | 0.08 | | bdl | bdl | bdl | 4.50 | | bdl | | 0.03 | 0.15 | 0.08 | 0.14 |
| YC5A | 11/15/93 | 0.02 | 0.02 | | | bdl | bdl | 0.08 | | 0.06 | | bdl | bdl | bdl | 3.70 | | bdl | | 0.03 | 0.40 | 0.07 | 0.31 |
| YC5A | 11/29/93 | 0.01 | 0.02 | | | bdl | 0.01 | 0.03 | | 0.06 | | bdl | bdl | bdl | | | bdl | | bdl | 0.20 | 0.07 | 0.04 |
| YC5As | 12/5/93 | 0.03 | bdl | 0.02 | bdl | bdl | bdl | 0.11 | 0.93 | 0.08 | bdl | bdl | bdl | bdl | | | bdl | 0.01 | bdl | 0.41 | 0.11 | 0.33 |
| YC5A | 12/13/93 | 0.05 | bdl | bdl | bdl | bdl | bdl | 0.17 | bdl | 0.06 | bdl | bdl | bdl | bdl | | | bdl | bdl | 0.02 | 0.37 | 0.07 | 0.15 |

# Station YC12 Water Quality Data 1993 Page 1 of 3

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| YC12 | 1/11/93 | 1140 | 8.3 | 6.9 | 9.1 | 6 | 15.00 | 76 | 490 | 3.20 | 26 | 35 | 15 | | 17.0 | <0.1 | |
| YC12 | 1/25/93 | 1330 | 7.4 | 7.7 | 9.8 | 9 | 33.80 | 68 | 417 | 10.40 | 25 | 33 | 15 | | 10.0 | <0.1 | |
| YC12 | 2/8/93 | 1430 | 8.2 | 7.1 | 10.4 | 3 | 3.10 | 116 | 433 | 3.20 | 46 | 65 | 15 | | 21.0 | <0.1 | |
| YC12 | 2/22/93 | 1230 | 7.4 | 7.3 | 9.8 | 7 | 45.00 | 69 | 471 | 10.20 | 32 | 44 | 10 | | 11.0 | <0.1 | |
| YC12 | 3/8/93 | 1450 | 9.1 | 7.0 | 93.0 | 4 | 19.30 | 79 | 460 | 2.70 | 32 | 47 | 10 | | 14.0 | | |
| YC12 | 3/22/93 | 1335 | 9.1 | 6.8 | 9.6 | 8 | 39.00 | 57 | 487 | 8.60 | 21 | 38 | 15 | | 7.8 | | |
| YC12s | 3/23/93 | 1400 | 7.9 | 7.9 | 9.2 | 200 | | 53 | 449 | 230.00 | 19 | 33 | 35 | | 13.0 | bdl | 7.70 |
| YC12 | 4/2/93 | 1135 | 9.4 | 7.1 | 8.7 | 9 | 21.70 | 92 | 357 | 9.80 | 32 | 48 | 10 | | 12.0 | bdl | |
| YC12 | 4/19/93 | 1245 | 15.7 | 6.9 | 7.7 | 6 | 9.00 | 77 | 463 | 0.40 | 32 | 52 | 5 | | 13.0 | bdl | |
| YC12 | 5/3/93 | 1501 | 16.4 | 7.2 | 7.5 | 2 | 7.80 | 78 | 436 | 1.50 | 35 | 46 | 10 | | 19.0 | bdl | |
| YC12 | 5/17/93 | 1130 | 17.8 | 7.2 | 6.7 | 5 | 2.30 | 115 | 463 | 5.60 | 52 | 71 | 25 | | 46.0 | bdl | |
| YC12 | 5/31/93 | 1050 | 19.1 | 7.4 | 6.3 | 7 | 2.00 | 169 | 372 | 7.10 | 56 | 78 | 15 | | 48.0 | | |
| YC12 | 6/14/93 | 1055 | 20.4 | 7.3 | 6.2 | 7 | 1.00 | 173 | 389 | 6.90 | 65 | 90 | 15 | bdl | 51.0 | bdl | |
| YC12 | 7/6/93 | 1505 | 28.9 | 8.0 | 5.6 | 6 | 0.58 | 7 | 431 | 5.30 | 76 | 109 | 10 | | 54.0 | bdl | |
| YC12 | 7/19/93 | 1130 | 24.6 | 7.5 | 6.5 | 14 | 0.60 | 279 | 350 | 13.90 | 110 | 162 | 15 | | 57.0 | bdl | |
| YC12 | 8/9/93 | 1450 | 24.6 | 7.3 | 8.0 | 6 | 0.71 | 470 | 387 | 8.40 | 200 | 308 | 10 | bdl | 28.0 | bdl | |
| YC12 | 8/23/93 | 1550 | 26.3 | 7.4 | 8.1 | 4 | 0.64 | 369 | 467 | 3.50 | 160 | 222 | 25 | | 38.0 | bdl | |
| YC12 | 9/7/93 | 1445 | 24.3 | 7.4 | 7.9 | 5 | | 232 | 468 | 29.20 | 92 | 121 | 20 | | 58.0 | bdl | |
| YC12 | 9/21/93 | 1018 | 18.7 | 7.4 | 6.4 | 6 | 0.65 | 216 | 428 | 4.80 | 100 | 122 | 20 | | 60.0 | bdl | |

# Station YC12 Water Quality Data 1993 Page 2 of 3

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| YC12 | 1/11/93 | 6.75 | 2.30 | 1.30 | 1.00 | 0.62 | 11.00 | 0.39 | <0.02 | 1.70 | 10.37 | | 0.62 | 1.01 | <0.1 | <0.1 | <0.3 | |
| YC12 | 1/25/93 | 6.78 | 1.90 | 1.30 | 1.00 | | 14.00 | 1.54 | <0.02 | 1.10 | 6.10 | | | 0.94 | <0.1 | <0.1 | <0.3 | |
| YC12 | 2/8/93 | 14.29 | 2.40 | 1.90 | 1.70 | | 29.00 | 1.21 | <0.02 | 1.60 | 12.81 | | | 1.04 | <0.1 | <0.1 | <0.3 | |
| YC12 | 2/22/93 | 9.27 | 2.10 | 1.20 | 1.10 | 0.72 | 22.00 | 0.38 | <0.02 | 1.30 | 6.71 | | 0.72 | 1.01 | <0.1 | <0.1 | <0.3 | |
| YC12 | 3/8/93 | 9.32 | 2.10 | 2.00 | 1.30 | 0.76 | 21.00 | 0.56 | | 2.30 | 8.54 | | 0.79 | 1.04 | | | | |
| YC12 | 3/22/93 | 5.33 | 1.90 | 0.01 | 0.90 | 0.50 | 22.00 | bdl | 0.75 | 1.00 | 13.42 | | 0.65 | 1.30 | bdl | bdl | bdl | |
| YC12s | 3/23/93 | 5.20 | 1.50 | 1.00 | 1.30 | 0.48 | 14.00 | 0.53 | bdl | 1.40 | 7.93 | | 0.60 | 1.24 | bdl | bdl | bdl | |
| YC12 | 4/2/93 | 9.56 | 2.10 | 1.60 | 1.60 | 0.77 | 23.00 | 0.59 | bdl | 2.00 | 7.32 | | 0.79 | 1.03 | bdl | bdl | bdl | |
| YC12 | 4/19/93 | 9.35 | 2.20 | 1.40 | 1.20 | 0.75 | 28.00 | 0.50 | bdl | 1.70 | 7.93 | | 0.89 | 1.20 | bdl | bdl | bdl | |
| YC12 | 5/3/93 | 10.20 | 2.30 | 1.50 | 1.30 | 0.80 | 18.00 | bdl | bdl | 1.20 | 11.59 | | 0.79 | 0.99 | bdl | bdl | bdl | |
| YC12 | 5/17/93 | 16.80 | 2.50 | 2.80 | 3.20 | 1.26 | 15.00 | 0.56 | bdl | 2.00 | 28.06 | | 1.30 | 1.03 | bdl | bdl | bdl | |
| YC12 | 5/31/93 | 18.50 | 2.40 | 3.70 | 4.20 | 1.41 | 17.00 | 0.58 | | 2.60 | 29.28 | | 1.40 | 0.99 | | | | |
| YC12 | 6/14/93 | 22.10 | 2.30 | 4.10 | 4.80 | 1.61 | 22.00 | 0.97 | bdl | 2.40 | 31.11 | | 1.56 | 0.97 | bdl | bdl | bdl | |
| YC12 | 7/6/93 | 25.90 | 2.80 | 4.40 | 5.20 | 1.87 | 36.00 | 0.21 | bdl | 2.10 | 32.94 | | 1.89 | 1.02 | bdl | bdl | bdl | |
| YC12 | 7/19/93 | 39.70 | 3.00 | 5.20 | 5.50 | 2.60 | 70.00 | 0.85 | bdl | 3.30 | 34.77 | | 2.71 | 1.04 | bdl | bdl | bdl | |
| YC12 | 8/9/93 | 76.00 | 2.70 | 12.00 | 7.10 | 4.72 | 190.00 | 0.77 | bdl | 2.50 | 17.08 | | 4.61 | 0.98 | 0.20 | bdl | bdl | |
| YC12 | 8/23/93 | 57.90 | 3.10 | 7.20 | 7.20 | 3.65 | 120.00 | 0.53 | bdl | 2.90 | 23.18 | | 3.37 | 0.92 | 0.30 | bdl | bdl | |
| YC12 | 9/7/93 | 31.50 | 3.20 | 6.50 | 5.90 | 2.28 | 36.00 | 0.89 | bdl | 1.70 | 35.38 | | 1.98 | 0.87 | 0.20 | bdl | bdl | |
| YC12 | 9/21/93 | 34.70 | 3.30 | 4.10 | 4.50 | 2.30 | 36.00 | 0.44 | bdl | 2.10 | 36.60 | | 2.03 | 0.88 | 0.30 | bdl | bdl | |

## Station YC12 Water Quality Data 1993 Page 3 of 3

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| YC12 | 1/11/93 | 0.02 | <0.01 | | | <0.01 | <0.01 | 0.17 | | 0.05 | | <0.01 | <0.1 | <0.1 | 2.80 | | <0.01 | | <0.01 | 0.32 | 0.06 | 0.04 |
| YC12 | 1/25/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.06 | | 0.03 | | <0.01 | <0.1 | <0.1 | 2.70 | | <0.01 | | <0.01 | 0.26 | 0.04 | 0.14 |
| YC12 | 2/8/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.19 | | 0.08 | | <0.01 | <0.1 | <0.1 | 3.10 | | <0.01 | | <0.01 | 0.45 | 0.08 | 0.08 |
| YC12 | 2/22/93 | <0.01 | <0.01 | | | <0.01 | <0.01 | 0.06 | | 0.02 | | <0.01 | <0.1 | <0.1 | 2.60 | | <0.01 | | <0.01 | 0.29 | 0.02 | 0.13 |
| YC12 | 3/8/93 | 0.01 | | | | | | 0.12 | | 0.04 | | 0.02 | | | 2.50 | | bdl | | | 0.25 | 0.04 | 0.05 |
| YC12 | 3/22/93 | | bdl | | | bdl | bdl | 0.03 | | 0.02 | | bdl | bdl | bdl | 2.50 | | bdl | | 0.01 | 0.16 | 0.02 | 0.01 |
| YC12s | 3/23/93 | 0.16 | bdl | 0.01 | | bdl | bdl | 0.14 | | 0.05 | | bdl | bdl | bdl | 2.30 | 0.01 | bdl | bdl | 0.01 | 1.70 | 0.25 | 0.78 |
| YC12 | 4/2/93 | 0.02 | bdl | | | bdl | bdl | 0.11 | | 0.05 | | bdl | bdl | bdl | 2.60 | | bdl | | 0.01 | 0.17 | 0.05 | 0.05 |
| YC12 | 4/19/93 | 0.02 | bdl | | | bdl | bdl | 0.12 | | 0.05 | | bdl | bdl | bdl | 2.50 | | bdl | | 0.01 | 0.37 | 0.05 | 1.00 |
| YC12 | 5/3/93 | bdl | bdl | | | bdl | bdl | 0.12 | | 0.05 | | bdl | bdl | bdl | 2.50 | | bdl | | 0.01 | 0.28 | 0.05 | 0.08 |
| YC12 | 5/17/93 | 0.04 | bdl | | | bdl | bdl | 0.18 | | 0.11 | | bdl | bdl | bdl | 3.50 | | bdl | | 0.02 | 0.62 | 0.11 | 0.04 |
| YC12 | 5/31/93 | 0.10 | 0.01 | | | | | 0.23 | | 0.10 | | | | | 3.70 | | bdl | | 0.04 | 0.72 | 0.11 | 0.28 |
| YC12 | 6/14/93 | 0.07 | 0.01 | | | bdl | bdl | 0.18 | | 0.08 | | bdl | bdl | bdl | 4.10 | | bdl | | bdl | 0.67 | 0.09 | 0.17 |
| YC12 | 7/6/93 | 0.09 | bdl | | | bdl | bdl | 0.25 | | 0.10 | | bdl | bdl | bdl | 4.30 | | bdl | | bdl | 0.58 | 0.10 | 0.15 |
| YC12 | 7/19/93 | 0.02 | 0.01 | | | bdl | bdl | 0.20 | | 0.14 | | bdl | bdl | bdl | 4.10 | | bdl | | 0.02 | 0.62 | 0.14 | 0.20 |
| YC12 | 8/9/93 | 0.02 | 0.02 | | | bdl | bdl | 0.15 | | 0.17 | | bdl | bdl | bdl | 5.40 | | bdl | | 0.03 | 0.67 | 0.17 | 0.18 |
| YC12 | 8/23/93 | 0.01 | 0.02 | | | bdl | bdl | 0.18 | | 0.16 | | 0.02 | bdl | bdl | 5.40 | | bdl | | 0.01 | 0.65 | 0.16 | 0.10 |
| YC12 | 9/7/93 | 0.03 | 0.02 | | | bdl | 0.01 | 0.35 | | 0.11 | | bdl | bdl | bdl | 4.50 | | bdl | | bdl | 0.66 | 0.12 | 0.12 |
| YC12 | 9/21/93 | bdl | 0.02 | | | bdl | bdl | 0.24 | | 0.11 | | bdl | bdl | bdl | 4.50 | | bdl | | 0.01 | 0.67 | 0.12 | 0.06 |

# Station 988 Water Quality Data 1993

| Site | Date | TIME | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| | | | | | | | | | | | | | | | | | |
| 988 | 1/11/93 | 1525 | 10.0 | 7.5 | 8.5 | 47 | 0.30 | 643 | 524 | 33.30 | 210 | 382 | 30 | | 140.0 | <0.1 | |
| 988 | 2/22/93 | 1150 | 8.4 | 7.5 | 8.2 | 4 | 0.13 | 625 | 428 | 6.40 | 230 | 396 | 10 | | 120.0 | <0.1 | |
| 988 | 3/22/93 | 1405 | 10.7 | 7.0 | 7.9 | 3 | 9.00 | 101 | 451 | 5.70 | 260 | 597 | 15 | | 140.0 | bdl | |
| 988s | 3/23/93 | 1420 | 9.2 | 7.4 | 9.1 | 200 | 10.25 | 285 | 422 | 215.00 | 87 | 210 | 30 | | 53.0 | bdl | 20.00 |
| 988s | 12/5/93 | 1006 | 10.9 | 7.4 | 9.3 | bdl | 0.92 | 551 | 495 | 10.50 | 210 | 296 | 20 | | 93.0 | bdl | 3.80 |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | BR | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | |
| 988 | 1/11/93 | 76.71 | 5.5 | 54 | 4.6 | 6.75 | 85 | 29.96 | <0.02 | 42 | 85.4 | | 6.24 | 0.93 | <0.1 | <0.1 | <0.3 | |
| 988 | 2/22/93 | 80.72 | 6 | 63 | 4.6 | 7.37 | 88 | 28.01 | <0.02 | 54 | 73.2 | | 6.21 | 0.84 | <0.1 | <0.1 | <0.3 | |
| 988 | 3/22/93 | 91.7 | 6.5 | 10 | 4.6 | 9.56 | 120 | 55 | bdl | 14 | 85.4 | | 1 | 1.05 | bdl | bdl | bdl | |
| 988s | 3/23/93 | 30 | 3 | 19 | 3 | 2.68 | 68 | 21 | bdl | 34 | 32.33 | | 3.77 | 1.41 | bdl | bdl | bdl | |
| 988s | 12/5/93 | 76 | 6.1 | 3 | 4.6 | 4.54 | 110 | 13 | bdl | 27 | 56.73 | | 5.14 | | 0.4 | bdl | bdl | bdl |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | |
| 988 | 1/11/93 | 0.08 | 0.02 | | | <0.01 | <0.01 | 0.09 | | 0.02 | | <0.01 | <0.1 | <0.1 | 2.40 | | <0.01 | | <0.01 | 0.76 | 0.06 | 0.21 |
| 988 | 2/22/93 | <0.01 | 0.02 | | | <0.01 | <0.01 | 0.03 | | 0.03 | | <0.01 | <0.1 | <0.1 | 2.30 | | <0.01 | | <0.01 | 0.13 | 0.03 | 0.07 |
| 988 | 3/22/93 | bdl | 0.01 | | | bdl | bdl | bdl | | 0.02 | | 0.02 | bdl | bdl | 2.50 | | bdl | | 0.01 | 0.06 | 0.03 | 0.01 |
| 988s | 3/23/93 | 0.26 | 0.01 | 0.02 | | bdl | 0.02 | 0.17 | | 0.02 | | bdl | bdl | bdl | 2.10 | 0.14 | bdl | bdl | 0.02 | 1.10 | 0.11 | 0.81 |
| 988s | 12/5/93 | 0.06 | 0.02 | 0.04 | bdl | bdl | bdl | 0.07 | 1.13 | 0.02 | bdl | bdl | bdl | bdl | | | bdl | 0.01 | bdl | 0.15 | 0.02 | 0.16 |

# Miscellaneous Stations Water Quality Data 1993

| Site | Date | Time | Temperature | pH | Dissolved Oxygen | Turbidity | Flow Rate | Specific Conductance | EH | Total Suspended Sediment | Hardness | Total Dissolved Solids | Color | Oil & Grease | Alkalinity | Acidity | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | deg C | | ppm | ntu | cfs | uS | | ppm | ppm | ppm | Pt-Co | ppm | ppm CaCO3 | ppm CaCO3 | ppm |
| IFs | 3/23/93 | 1430 | 11.9 | 7.7 | 6.4 | 200 | | 132 | 418 | 151 | 62 | 79 | 35 | | 54 | bdl | 8.3 |
| KY18s | 3/23/93 | 1235 | 10.1 | 7.6 | 8.3 | 200 | 4.7 | 118 | 468 | 527 | 56 | bdl | 40 | | 140 | bdl | 16 |
| CUDJO | 6/26/93 | 1135 | 12.6 | 6.6 | 5.9 | bdl | | 167 | 466 | bdl | 82 | 86 | 10 | | 74 | bdl | |
| DR9 | 8/23/93 | 1500 | 22.2 | 7.7 | 5.4 | 3 | 0.01 | 127 | 459 | 7.8 | 58 | 64 | 25 | | 51 | bdl | |

| Site | Date | Ca | Mg | Na | K | Major Cations | SO4 | NO3 | NO2 | Cl | HCO3 | CO3 | Major Anions | Anions/ Cations | F | Br | PO4 | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | meq | ppm | ppm | ppm | ppm | ppm | ppm | meq | ratio | ppm | ppm | ppm | ppm |
| IFs | 3/23/93 | 22.00 | 1.90 | 0.93 | 1.70 | 1.39 | 14.00 | 2.90 | bdl | 2.10 | 32.94 | | 1.00 | 1.06 | bdl | bdl | bdl | |
| KY18s | 3/23/93 | 20.00 | 1.40 | 0.46 | 1.60 | 1.23 | 9.00 | 0.88 | bdl | 0.90 | 85.40 | | 3.03 | | bdl | bdl | bdl | |
| CUDJO | 6/26/93 | 27.20 | 3.50 | 1.00 | 0.80 | 1.70 | 7.10 | 0.83 | 0.43 | 0.90 | 45.14 | | 1.68 | 0.98 | bdl | bdl | bdl | |
| DR9 | 8/23/93 | 18.40 | 2.90 | 2.20 | 1.70 | 1.30 | 4.40 | 0.67 | bdl | 2.90 | 31.11 | | 1.22 | 0.93 | 0.20 | bdl | bdl | |

| Site | Date | Al | B | Ba | Cd | Cr | Cu | Fe | Hg | Mn | Mo | Ni | P | Pb | Si | Sr | Ti | V | Zn | Total Fe | Total Mn | Total Al |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| IFs | 3/23/93 | 0.45 | bdl | 0.01 | | bdl | bdl | 0.12 | | bdl | | bdl | bdl | bdl | 2.60 | 0.06 | bdl | bdl | 0.02 | 0.40 | 0.11 | 0.53 |
| KY18s | 3/23/93 | 0.46 | bdl | 0.02 | | bdl | bdl | 0.27 | | 0.02 | | bdl | bdl | bdl | 2.00 | 0.04 | bdl | bdl | 0.02 | 2.10 | 0.17 | 0.93 |
| CUDJO | 6/26/93 | bdl | bdl | | | bdl | bdl | bdl | | bdl | | bdl | bdl | bdl | 3.20 | | bdl | | bdl | bdl | bdl | bdl |
| DR9 | 8/23/93 | 0.02 | bdl | | | bdl | bdl | 0.18 | | 0.02 | | bdl | bdl | bdl | 3.50 | | bdl | | bdl | 0.31 | 0.03 | 0.08 |

# Appendix C

## 1993 Sediment Chemistry Data

## Appendix C Index

# Station DB5 Sediment ChemistryData 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| DB5 | 1/26/93 | 4.60 | 0.015 | 5.50 | bdl | bdl | bdl | bdl | bdl | bdl | | bdl | bdl | 0.10 | 1.0 | 0.21 | bdl | 12.0 | 0.02 | 12.0 | 0.83 | 7.8 | bdl |
| DB5 | 6/1/93 | 5.30 | bdl | 27.00 | bdl | bdl | bdl | bdl | bdl | bdl | 12.2 | 1.0 | bdl | 3.00 | 61.0 | bdl | 4.0 | bdl | 1.85 | 49.5 | 37.00 | 25.0 | 0.74 |
| DB5 | 10/19/93 | 5.30 | | 27.00 | | | bdl | | | | 24.2 | 0.2 | | 1.28 | 42.0 | 4.17 | 4.4 | 290.0 | 2.57 | 102.0 | 110.00 | 13.0 | 0.57 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| | | | | | | | | | | | | | | | | | | | | |
| DB5 | 1/26/93 | 0.20 | 0.41 | 5 | 2.50 | bdl | 0.10 | bdl | 38.0 | bdl | 20.0 | bdl | bdl | 71.0 | 11.10 | bdl | 11.50 | 0.50 | 14.0 | 12.0 |
| DB5 | 6/1/93 | 183.00 | 2.20 | 139 | 19.00 | bdl | bdl | 1.6 | 26.0 | 3.4 | 2.7 | bdl | bdl | 97.0 | 52.00 | bdl | 4.40 | 0.40 | bdl | 4.0 |
| DB5 | 10/19/93 | 14.00 | 0.61 | 503 | 52.00 | 0.8 | | 1.4 | 3.7 | bdl | 0.2 | bdl | | 4.6 | 4.30 | | 5.60 | 2.00 | 2.7 | 3.6 |

# Station DB10 Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| DB10 | 1/26/93 | 6.50 | 0.023 | 3.20 | bdl | bdl | bdl | bdl | bdl | bdl | | bdl | bdl | bdl | 1.3 | 0.13 | bdl | 7.2 | 0.17 | 7.3 | 1.80 | 8.1 | bdl |
| DB10 | 6/1/93 | 7.60 | bdl | 7.80 | bdl | bdl | bdl | bdl | bdl | bdl | 17.7 | 5.5 | bdl | 2.83 | 190.0 | 9.60 | 6.9 | bdl | 2.17 | 137.0 | 280.0 | 27.0 | 1.60 |
| DB10 | 10/19/93 | 7.50 | | 15.00 | | | bdl | | | | 12.0 | 0.6 | | 0.91 | 77.0 | 5.31 | 6.4 | 199.0 | 1.49 | 88.6 | 290.0 | 27.0 | 0.58 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| | | | | | | | | | | | | | | | | | | | | |
| DB10 | 1/26/93 | 7.00 | 0.34 | 12 | 2.70 | bdl | bdl | bdl | 32.0 | bdl | 18.0 | bdl | bdl | 73.0 | 94.00 | bdl | 25.30 | 0.70 | 8.0 | 26.0 |
| DB10 | 6/1/93 | 296.00 | 2.20 | 4020 | 32.00 | 0.6 | bdl | 12.0 | 26.0 | 3.6 | 2.7 | bdl | bdl | 49.0 | 47.00 | bdl | 19.00 | bdl | 86.1 | 19.0 |
| DB10 | 10/19/93 | 10.70 | 0.82 | 5400 | 32.00 | 0.6 | | 11.0 | 3.7 | bdl | 0.2 | bdl | | 6.3 | 2.80 | | 59.00 | 1.30 | 1.3 | 57.7 |

# Station GC3 Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GC3 | 1/26/93 | 7.40 | 0.096 | 3.70 | bdl | bdl | bdl | bdl | bdl | bdl |  | 0.6 | bdl | 0.14 | 2.9 | 0.29 | bdl | 7.3 | 0.16 | 7.3 | 8.20 | 7.4 | bdl |
| GC3 | 6/1/93 | 7.70 | bdl | 16.00 | bdl | 0.30 | bdl | bdl | bdl | bdl | 29.8 | 18.0 | bdl | 2.13 | 570.0 | 19.90 | 22.0 | bdl | 2.76 | 195.0 | 850.00 | 30.0 | 2.00 |
| GC3 | 7/6/93 | 7.90 | 522.000 | 3.40 | bdl | 0.14 | bdl | bdl | bdl | bdl | 9.4 | 9.0 | bdl | 0.27 | 150.0 | 10.20 | 26.0 | 544.0 | bdl | 165.0 | 46.00 | 35.0 | 0.30 |

| Site | Date | Al | NI | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GC3 | 1/26/93 | 2.30 | 0.29 | 460 | 2.30 | bdl | bdl | bdl | 37.0 | bdl | 20.0 | bdl | bdl | 190.0 | 11.00 | bdl | 297.00 | 3.00 | 6.0 | 300.0 |
| GC3 | 6/1/93 | 494.00 | 3.20 | 12600 | 100.00 | bdl | bdl | 8.9 | 23.0 | 3.1 | 2.9 | bdl | bdl | 59.0 | 48.00 | bdl | 170.00 | 5.90 | 87.2 | 164.0 |
| GC3 | 7/6/93 | 9.20 | 0.99 | 19400 | 51.00 | bdl | bdl | 4.7 | 35.0 | bdl | bdl | bdl | bdl | 83.0 | 1.70 | bdl | 37.00 | 1.60 | bdl | 35.4 |

# Station GC7 Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| GC7 | 1/26/93 | 6.90 | 0.050 | 4.20 | bdl | bdl | bdl | bdl | bdl | bdl | | 0.1 | bdl | 0.19 | 3.9 | 0.24 | 1.1 | 24.0 | 0.20 | 24.0 | 9.30 | 6.5 | bdl |
| GC7 | 6/1/93 | 7.60 | bdl | 20.00 | bdl | 0.20 | bdl | bdl | bdl | bdl | 18.5 | 6.6 | bdl | 3.31 | 230.0 | 15.00 | 30.0 | 0.9 | 3.09 | 160.0 | 440.00 | 29.0 | 2.00 |
| GC7 | 7/6/93 | 7.10 | 885.000 | 8.10 | bdl | 0.14 | bdl | bdl | bdl | bdl | 21.2 | 18.0 | bdl | 0.94 | 170.0 | 12.80 | 14.0 | bdl | 1.99 | 90.1 | 46.00 | 51.0 | 0.95 |
| GC7 | 10/19/93 | 7.00 | | 11.00 | | | bdl | | | | 20.5 | 1.0 | | 1.88 | 89.0 | 18.20 | 50.0 | 373.0 | 3.07 | 232.0 | 430.00 | 34.0 | 0.97 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| | | | | | | | | | | | | | | | | | | | | |
| GC7 | 1/26/93 | 4.60 | 0.14 | 59 | 1.50 | bdl | bdl | bdl | 36.0 | bdl | 55.0 | bdl | bdl | 130.0 | 67.00 | bdl | 178.00 | 1.60 | 17.0 | 180.0 |
| GC7 | 6/1/93 | 325.00 | 3.00 | 3170 | 41.00 | bdl | bdl | 10.0 | 41.0 | 3.8 | 2.3 | bdl | bdl | 42.0 | 58.00 | bdl | 26.00 | 0.60 | 47.9 | 25.0 |
| GC7 | 7/6/93 | 142.00 | 1.30 | 8900 | 120.00 | 0.8 | bdl | 5.2 | 8.0 | bdl | bdl | bdl | bdl | bdl | 1.70 | bdl | 14.00 | 2.80 | 11.5 | 11.2 |
| GC7 | 10/19/93 | 14.20 | 1.20 | 6900 | 59.00 | 0.4 | 0.09 | 7.3 | 3.3 | bdl | 0.2 | bdl | | 13.0 | 3.20 | | 110.00 | 1.80 | 1.8 | 108.0 |

# Station LH5 Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LH5 | 1/26/93 | 6.20 | 0.012 | 5.80 | bdl | bdl | bdl | bdl | bdl | bdl | 0.1 | bdl | bdl | bdl | 2.2 | bdl | bdl | 6.2 | 0.11 | 6.2 | 1.50 | 6.6 | bdl |
| LH5 | 6/1/93 | 7.20 | bdl | 24.00 | bdl | 0.19 | bdl | bdl | bdl | bdl | 55.5 | bdl | bdl | 2.60 | 300.0 | 9.99 | 5.8 | bdl | 2.04 | 281.0 | 150.00 | 22.0 | 3.70 |
| LH5 | 7/6/93 | 7.50 | 160.000 | 11.00 | bdl | 0.14 | bdl | bdl | bdl | bdl | 37.7 | 2.8 | bdl | 0.71 | 120.0 | 3.90 | 37.0 | 364.0 | 1.19 | 128.0 | 70.00 | 36.0 | 1.60 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LH5 | 1/26/93 | 4.10 | 0.10 | 12 | 1.00 | bdl | bdl | bdl | 44.0 | bdl | 21.0 | bdl | bdl | 58.0 | 57.00 | bdl | 10.60 | 0.40 | 14.0 | 11.0 |
| LH5 | 6/1/93 | 512.00 | 3.80 | 1140 | 81.00 | bdl | bdl | 3.7 | 17.0 | 3.3 | 2.0 | bdl | bdl | 30.0 | 52.00 | bdl | 1.40 | 0.50 | 57.3 | 0.9 |
| LH5 | 7/6/93 | 159.00 | 1.00 | 1010 | 30.00 | 1.2 | bdl | 2.8 | 7.2 | bdl | bdl | bdl | bdl | 84.0 | bdl | bdl | 8.30 | 0.50 | bdl | 7.8 |

# Station ST10 Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | LI | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| ST10 | 1/26/93 | 6.4 | 0.0 | 9.9 | bdl | bdl | bdl | bdl | bdl | bdl | | bdl | bdl | bdl | 2.0 | 0.1 | bdl | 7.0 | 0.2 | 6.7 | 0.8 | 6.2 | bdl |
| ST10 | 6/1/93 | 7.0 | bdl | 24.0 | bdl | 0.1 | bdl | bdl | bdl | bdl | 28.8 | 2.5 | bdl | 3.4 | 250.0 | 8.5 | 32.0 | bdl | 1.9 | 289.0 | 84.0 | 30.0 | 3.0 |
| ST10 | 7/6/93 | 7.4 | 272.0 | 15.0 | bdl | bdl | bdl | bdl | bdl | bdl | 16.4 | 0.9 | bdl | 0.7 | 110.0 | 4.6 | 5.0 | 111.0 | 0.8 | 124.0 | 460.0 | 55.0 | 0.9 |
| ST10 | 10/19/93 | 7.2 | | 23.0 | | | bdl | | | | 25.7 | 0.4 | | 0.9 | 80.0 | 5.3 | 48.0 | 200.0 | 1.1 | 188.0 | 85.0 | 14.0 | 0.9 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| | | | | | | | | | | | | | | | | | | | | |
| ST10 | 1/26/93 | 3.1 | bdl | 9.0 | bdl | bdl | bdl | bdl | 35.0 | bdl | 20.0 | bdl | bdl | 57.0 | 75.0 | bdl | 9.7 | 0.3 | 9.0 | 10.0 |
| ST10 | 6/1/93 | 480.0 | 3.4 | 970.0 | 43.0 | bdl | 0.2 | 4.4 | 23.0 | bdl | 3.9 | bdl | bdl | 24.0 | 56.0 | bdl | 5.1 | 0.3 | 71.8 | 4.8 |
| ST10 | 7/6/93 | 173.0 | 1.0 | 15500.0 | 38.0 | 2.2 | bdl | 5.6 | 20.0 | bdl | bdl | bdl | bdl | 80.0 | bdl | bdl | 26.0 | 0.9 | bdl | 25.1 |
| ST10 | 10/19/93 | 19.8 | 2.3 | 1640.0 | 38.0 | 0.1 | 0.1 | bdl | 3.2 | bdl | 0.2 | bdl | | 12.0 | 3.3 | | 100.0 | 1.2 | 2.0 | 98.8 |

# Station TC10 Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| TC10 | 1/26/93 | 7.90 | 0.04 | 4.90 | bdl | bdl | bdl | bdl | bdl | bdl | | 0.1 | bdl | 0.12 | 12.0 | 0.16 | bdl | 14.0 | 0.23 | 14.0 | 6.50 | 6.4 | bdl |
| TC10 | 6/1/93 | 8.60 | 0.34 | 4.60 | bdl | bdl | bdl | bdl | bdl | bdl | 5.2 | 22.0 | bdl | 2.18 | 300.0 | bdl | bdl | 7.0 | bdl | 3.8 | 440.0 | 26.0 | bdl |
| TC10 | 7/6/93 | 8.00 | 1930.00 | 11.00 | bdl | bdl | bdl | bdl | bdl | bdl | 17.4 | 21.0 | bdl | 1.84 | 57.0 | 17.70 | bdl | 398.0 | 2.45 | 42.0 | 320.0 | 32.0 | 0.72 |
| TC10 | 10/19/93 | 7.00 | | 37.00 | | | bdl | | | | 13.6 | 0.7 | 1.40 | 2.20 | 200.0 | 8.06 | 21.0 | 525.0 | 2.71 | 58.3 | 170.0 | 51.0 | 0.51 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| TC10 | 1/26/93 | 11.60 | 0.61 | 71 | 3.30 | bdl | bdl | bdl | 61.0 | bdl | 30.0 | bdl | bdl | 130.0 | 72.00 | bdl | 149.00 | 1.30 | 9.0 | 150.0 | | | |
| TC10 | 6/1/93 | 66.20 | 0.40 | 19200 | 110.00 | bdl | 0.13 | bdl | 26.0 | 4.6 | bdl | bdl | bdl | 1100.0 | 50.00 | bdl | 90.00 | 11.00 | 55.2 | 79.0 | | | |
| TC10 | 7/6/93 | 589.00 | 0.34 | 9820 | 34.00 | 4.0 | 6.31 | bdl | 23.0 | bdl | bdl | bdl | bdl | 170.0 | 1.80 | bdl | 140.00 | 6.00 | bdl | 134.0 | | | |
| TC10 | 10/19/93 | 38.20 | 0.43 | 3080 | 110.00 | 2.0 | 3.65 | | 0.6 | bdl | 0.4 | 0.5 | | 3.2 | 3.60 | | 32.00 | 1.50 | 0.2 | 30.5 | | | |

# Station TD1 Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| TD1 | 1/26/93 | 6.80 | 0.140 | 11.00 | bdl | bdl | bdl | bdl | bdl | bdl | 0.1 | 0.2 | bdl | 0.25 | 7.2 | 0.47 | 2.0 | 63.0 | 0.26 | 63.0 | 8.60 | 7.7 | bdl |
| TD1 | 6/1/93 | 7.30 | bdl | 2.10 | bdl | 0.81 | bdl | bdl | bdl | bdl | 46.2 | 22.0 | bdl | 2.16 | 150.0 | 27.30 | 2.3 | bdl | 2.25 | 222.0 | 920.00 | 30.0 | 2.20 |
| TD1 | 7/6/93 | 4.80 | 154.000 | 2.90 | bdl | 0.95 | bdl | bdl | bdl | bdl | 94.8 | 1.4 | bdl | 1.53 | 41.0 | 23.30 | 4.1 | 220.0 | 16.00 | 47.6 | 160.00 | 29.0 | 1.00 |
| TD1 | 10/19/93 | 6.90 | 0.140 | 5.00 | | 0.71 | bdl | | | | 48.5 | 2.8 | | 2.43 | 120.0 | 32.30 | 3.3 | 483.0 | 6.00 | 361.0 | 4900.00 | 42.0 | 1.40 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| | | | | | | | | | | | | | | | | | | | | |
| TD1 | 1/26/93 | 9.10 | 0.26 | 130 | 2.40 | bdl | bdl | bdl | 36.0 | bdl | 20.0 | 7.0 | bdl | 310.0 | 14.00 | bdl | 26.60 | 4.40 | 64.0 | 31.0 |
| TD1 | 6/1/93 | 167.00 | 3.10 | 16800 | 66.00 | 0.5 | bdl | bdl | 30.0 | 5.0 | 3.6 | bdl | bdl | 230.0 | 80.00 | bdl | 24.00 | 2.90 | 90.4 | 21.0 |
| TD1 | 7/6/93 | 405.00 | 0.73 | 13600 | 29.00 | 0.2 | 1.50 | 1.4 | 18.0 | bdl | bdl | bdl | bdl | 120.0 | 1.80 | bdl | 4.60 | 0.50 | bdl | 4.1 |
| TD1 | 10/19/93 | 18.70 | 3.00 | 17900 | 83.00 | | 0.13 | | 4.1 | bdl | 0.2 | bdl | | 23.0 | 6.20 | | 74.00 | 4.30 | 6.2 | 69.8 |

# Station YC5 Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| YC5 | 1/26/93 | 6.00 | 0.008 | 24.00 | bdl | bdl | bdl | bdl | bdl | bdl | bdl | bdl | bdl | 0.11 | bdl | 0.14 | bdl | 2.3 | 0.11 | 2.4 | 0.59 | 5.8 | bdl |
| YC5 | 6/1/93 | 6.40 | bdl | 9.20 | bdl | bdl | bdl | bdl | bdl | bdl | 4.4 | 0.9 | bdl | 1.97 | 130.0 | 2.99 | 9.8 | 12.0 | 1.31 | 83.3 | 20.00 | 22.0 | 0.24 |
| YC5 | 7/6/93 | 8.00 | 232.000 | 24.00 | bdl | bdl | bdl | bdl | bdl | bdl | 9.9 | 3.1 | bdl | 0.52 | 340.0 | 2.12 | 8.3 | 1.3 | 1.32 | 48.3 | 64.00 | 29.0 | 0.20 |
| YC5 | 10/19/93 | 5.70 | | 11.00 | | | bdl | | | | 9.4 | 0.2 | | 1.01 | 430.0 | 2.16 | 9.1 | 176.0 | 1.06 | 22.2 | 60.00 | 14.0 | 0.16 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| | | | | | | | | | | | | | | | | | | | | |
| YC5 | 1/26/93 | 0.60 | bdl | 3 | 2.80 | bdl | bdl | bdl | 630.0 | bdl | 20.0 | bdl | bdl | 51.0 | 40.00 | bdl | 1.15 | 0.30 | 4.0 | 1.4 |
| YC5 | 6/1/93 | 166.00 | 0.50 | 230 | 18.00 | 1.6 | bdl | 4.3 | 24.0 | 7.3 | 1.7 | bdl | bdl | 29.0 | 51.00 | bdl | 4.20 | 0.20 | 1.7 | 4.0 |
| YC5 | 7/6/93 | 160.00 | 0.67 | 321 | 25.00 | 2.8 | 0.10 | 10.0 | 20.0 | bdl | bdl | bdl | bdl | 94.0 | 3.70 | bdl | 12.00 | 0.70 | bdl | 11.3 |
| YC5 | 10/19/93 | 25.60 | 0.18 | 946 | 55.00 | 5.6 | 0.05 | 1.0 | 2.7 | bdl | 0.1 | bdl | | 3.1 | 2.10 | | 3.70 | 2.60 | 1.0 | 1.1 |

# Station YC5A Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| YC5A | 1/26/93 | 7.80 | 0.039 | 7.50 | bdl | bdl | bdl | bdl | bdl | bdl | | bdl | bdl | 0.02 | bdl | 0.20 | bdl | 11.0 | 0.41 | 12.0 | 4.00 | 6.5 | bdl |
| YC5A | 6/1/93 | 8.00 | bdl | 5.60 | bdl | bdl | bdl | bdl | bdl | bdl | 8.9 | 1.5 | bdl | 2.00 | 150.0 | 6.80 | 14.0 | 3.0 | 1.91 | 16.4 | 60.00 | 13.0 | 0.96 |
| YC5A | 7/6/93 | 8.20 | 400.000 | 14.00 | bdl | bdl | bdl | bdl | bdl | bdl | 8.2 | 10.0 | bdl | 1.40 | 580.0 | 8.60 | 11.0 | 123.0 | 1.88 | 119.0 | 270.00 | 39.0 | 0.51 |
| YC5A | 10/19/93 | 7.50 | | 18.00 | | | bdl | | | | 11.2 | 0.8 | 2.20 | 3.60 | 830.0 | 39.80 | 23.0 | 878.0 | 5.82 | 104.0 | 210.00 | bdl | 1.30 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| | | | | | | | | | | | | | | | | | | | | |
| YC5A | 1/26/93 | 7.80 | bdl | 37 | 2.90 | bdl | bdl | bdl | 51.0 | bdl | 19.0 | bdl | bdl | 70.0 | 75.00 | bdl | 29.00 | 1.20 | 9.0 | 29.0 |
| YC5A | 6/1/93 | 247.00 | 1.80 | 659 | 26.00 | 0.6 | 0.80 | 5.2 | 38.0 | 16.0 | 3.1 | bdl | bdl | 40.0 | 45.00 | bdl | 8.40 | 0.10 | 1.9 | 8.3 |
| YC5A | 7/6/93 | 299.00 | 0.85 | 2670 | 54.00 | 3.4 | 5.20 | 2.8 | 10.0 | bdl | bdl | bdl | bdl | 130.0 | 1.50 | bdl | 4.70 | 1.30 | bdl | 3.4 |
| YC5A | 10/19/93 | 86.20 | 1.20 | 4760 | 110.00 | 6.5 | 11.00 | 2.7 | 2.0 | bdl | 0.2 | bdl | | 32.0 | 5.30 | | 23.00 | 2.60 | 1.6 | 20.4 |

# Miscellaneous Stations Sediment Chemistry Data 1993

| Site | Date | Paste pH | Total S | Total C | Ge | Cd | As | Hg | Mo | Li | Ba | Sr | V | B | Si | Zn | P | Fe | Cu | Mn | Mg | Na | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | | | | | | | | | | | | | | | | | | | | | |
| DG3 | 7/6/93 | 6.50 | 172.000 | 14.00 | bdl | bdl | bdl | bdl | bdl | bdl | 17.0 | 2.5 | bdl | 1.22 | 73.0 | 1.98 | 6.0 | 341.0 | 1.52 | 160.0 | 91.00 | 31.0 | 0.57 |
| SR10 | 7/6/93 | 5.90 | bdl | 17.00 | bdl | bdl | bdl | bdl | bdl | bdl | 21.2 | 1.0 | bdl | 0.94 | 130.0 | 6.37 | bdl | 172.0 | 1.28 | 23.6 | 32.00 | 27.0 | 0.85 |

| Site | Date | Al | Ni | Ca | K | Ti | Cr | Pb | Cl | NO2 | NO3 | Br | PO4 | SO4 | TOC | Oil & Grease | NEU_POT | POT_ACID | F | ACIDBASE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| | | | | | | | | | | | | | | | | | | | | |
| DG3 | 7/6/93 | 122.00 | 1.30 | 225 | 53.00 | 1.3 | bdl | 1.8 | 11.0 | bdl | bdl | bdl | bdl | 77.0 | 1.50 | bdl | 16.00 | 0.50 | bdl | 14.2 |
| SR10 | 7/6/93 | 152.00 | 0.49 | 7820 | 32.00 | 0.6 | bdl | 1.3 | 7.5 | bdl | bdl | bdl | bdl | 73.0 | bdl | bdl | 2.00 | 0.30 | bdl | 1.7 |

# Appendix D

Summary of Benthic Macroinvertebrate Samples
June 1990 to May 1993

All data in this appendix are from Skelton and Eisenhour (1993)

## Appendix D Index

## Davis Branch - Summary of Benthic Macroinvertebrate Data 1990 - 1993
## (Skelton and Eisenhour, 1993)

| Station | | Jun-90 | Oct-90 | Feb-91 | Apr-91 | Jul-Aug/91 | Oct-91 | Jan-Feb/92 | May-92 | Aug-92 | Oct-92 | Feb-93 | May-93 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DB5 | Total specimens | 105 | 257 | 83 | 394 | 82 | 29 | 53 | 70 | 84 | 46 | 48 | 110 |
| | Taxa richness | 19 | 26 | 26 | 29 | 21 | 12 | 20 | 18 | 12 | 5 | 15 | 25 |
| | % EPT taxa | 43 | 46 | 54 | 55 | 24 | 26 | 35 | 50 | 25 | 40 | 60 | 52 |
| | Diversity index | 1.12 | 1.17 | 1.2 | 1.15 | 1.14 | 0.91 | 1.17 | 1.08 | 0.82 | 0.4 | 1.01 | 0.95 |
| | | | | | | | | | | | | | |
| DB6 | Total specimens | 70 | 335 | 123 | 161 | 57 | 85 | | | | | | |
| | Taxa richness | 23 | 26 | 18 | 22 | 17 | 21 | | | | | | |
| | % EPT taxa | 39 | 38 | 56 | 59 | 41 | 38 | | | | | | |
| | Diversity index | 1.19 | 0.99 | 1.01 | 1.14 | 1.06 | 1.21 | | | | | | |
| | | | | | | | | | | | | | |
| DB7 | Total specimens | 74 | 204 | 119 | 247 | 24 | 65 | | | | | | |
| | Taxa richness | 21 | 25 | 19 | 31 | 12 | 16 | | | | | | |
| | % EPT taxa | 57 | 48 | 68 | 48 | 33 | 50 | | | | | | |
| | Diversity index | 1.04 | 1.04 | 1.08 | 1.04 | 0.99 | 1.02 | | | | | | |
| | | | | | | | | | | | | | |
| DB8 | Total specimens | 96 | 324 | 106 | 343 | 79 | 122 | | | | | | |
| | Taxa richness | 25 | 29 | 17 | 31 | 21 | 22 | | | | | | |
| | % EPT taxa | 44 | 52 | 59 | 52 | 33 | 59 | | | | | | |
| | Diversity index | 1.23 | 1.04 | 1.18 | 1.12 | 1.17 | 0.94 | | | | | | |
| | | | | | | | | | | | | | |
| DB10 | Total specimens | 203 | 504 | 196 | 207 | 84 | 428 | 106 | 119 | 103 | 54 | 54 | 91 |
| | Taxa richness | 29 | 20 | 25 | 28 | 14 | 26 | 23 | 15 | 19 | 2 | 12 | 25 |
| | % EPT taxa | 59 | 40 | 56 | 61 | 29 | 42 | 57 | 47 | 21 | 33 | 50 | 60 |
| | Diversity index | 1.12 | 0.79 | 1.09 | 1.22 | 0.9 | 0.73 | 1.07 | 0.87 | 0.99 | 0.58 | 0.89 | 1.22 |

# Gap Creek - Summary of Benthic Macroinvertebrate Data 1990 - 1993
## (Skelton and Eisenhour, 1993)

| Station | | Jun-90 | Oct-90 | Feb-91 | Apr-91 | Jul-Aug/91 | Oct-91 | Jan-Feb/92 | May-92 | Aug-92 | Oct-92 | Feb-93 | May-93 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GC3 | Total specimens | 264 | 425 | 625 | 722 | 322 | 263 | 814 | 180 | 312 | 193 | 246 | 245 |
| | Taxa richness | 14 | 21 | 13 | 15 | 19 | 16 | 27 | 10 | 14 | 9 | 19 | 17 |
| | % EPT taxa | 50 | 43 | 54 | 40 | 37 | 63 | 59 | 30 | 50 | 11 | 42 | 65 |
| | Diversity index | 0.64 | 0.84 | 0.57 | 0.39 | 0.71 | 0.76 | 0.77 | 0.77 | 0.81 | 0.83 | 0.9 | 0.82 |
| | | | | | | | | | | | | | |
| GC7 | Total specimens | 1053 | 1431 | 495 | 688 | 6655 | 1071 | 818 | 411 | 303 | 121 | 192 | 175 |
| | Taxa richness | 15 | 22 | 21 | 23 | 23 | 21 | 29 | 13 | 15 | 6 | 15 | 19 |
| | % EPT taxa | 40 | 45 | 52 | 61 | 30 | 38 | 45 | 38 | 33 | 0 | 60 | 63 |
| | Diversity index | 0.74 | 0.69 | 0.64 | 0.62 | 1.01 | 0.92 | 0.92 | 0.78 | 0.83 | 0.66 | 0.73 | 0.84 |

## Lewis Hollow - Summary of Benthic Macroinvertebrate Data 1990 - 1993
(Skelton and Eisenhour, 1993)

| Station | | Jun-90 | Oct-90 | Feb-91 | Apr-91 | Jul-Aug/91 | Oct-91 | Jan-Feb/92 | May-92 | Aug-92 | Oct-92 | Feb-93 | May-93 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH5 | Total specimens | | | | | | | | | 154 | 86 | 182 | 125 |
| | Taxa richness | | | | | | | | | 8 | 2 | 10 | 9 |
| | % EPT taxa | | | | | | | | | 38 | 50 | 60 | 0.89 |
| | Diversity index | | | | | | | | | 0.44 | 0.093 | 0.61 | 0.73 |
| | | | | | | | | | | | | | |
| LH10 | Total specimens | | | | | | | 452 | 58 | | | | |
| | Taxa richness | | | | | | | 17 | 5 | | | | |
| | % EPT taxa | | | | | | | 65 | 60 | | | | |
| | Diversity index | | | | | | | 0.29 | 0.32 | | | | |

## Martins Fork - Summary of Benthic Macroinvertebrate Data 1990 - 1993
## (Skelton and Eisenhour, 1993)

| Station | | Jun-90 | Oct-90 | Feb-91 | Apr-91 | Jul-Aug/91 | Oct-91 | Jan-Feb/92 | May-92 | Aug-92 | Oct-92 | Feb-93 | May-93 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MF2 | Total specimens | | | | | 134 | | | | 84 | | 90 | |
| | Taxa richness | | | | | 15 | | | | 15 | | 17 | |
| | % EPT taxa | | | | | 67 | | | | 53 | | 71 | |
| | Diversity index | | | | | 0.78 | | | | 0.67 | | 0.98 | |
| | | | | | | | | | | | | | |
| MF5 | Total specimens | | | | | 92 | | | | 53 | | 97 | |
| | Taxa richness | | | | | 16 | | | | 10 | | 15 | |
| | % EPT taxa | | | | | 50 | | | | 40 | | 73 | |
| | Diversity index | | | | | 0.86 | | | | 0.8 | | 0.93 | |

## Station Creek - Summary of Benthic Macroinvertebrate Data 1990 - 1993
## (Skelton and Eisenhour, 1993)

| Station | | Jun-90 | Oct-90 | Feb-91 | Apr-91 | Jul-Aug/91 | Oct-91 | Jan-Feb/92 | May-92 | Aug-92 | Oct-92 | Feb-93 | May-93 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ST5 | Total specimens | | | | | | | 664 | 70 | 118 | 102 | 104 | 169 |
| | Taxa richness | | | | | | | 32 | 8 | 23 | 9 | 18 | 27 |
| | % EPT taxa | | | | | | | 66 | 38 | 48 | 33 | 61 | 37 |
| | Diversity index | | | | | | | 0.78 | 0.74 | 1.08 | 0.79 | 0.85 | 1.09 |
| | | | | | | | | | | | | | |
| ST10 | Total specimens | | | | | | | 559 | 65 | 122 | 103 | 83 | 72 |
| | Taxa richness | | | | | | | 28 | 9 | 19 | 9 | 21 | 17 |
| | % EPT taxa | | | | | | | 68 | 56 | 37 | 11 | 66 | 71 |
| | Diversity index | | | | | | | 0.98 | 0.84 | 0.93 | 0.77 | 1.09 | 0.96 |

## Tunnel Creek - Summary of Benthic Macroinvertebrate Data 1990 - 1993
## (Skelton and Eisenhour, 1993)

| Station | | Jun-90 | Oct-90 | Feb-91 | Apr-91 | Jul-Aug/91 | Oct-91 | Jan-Feb/92 | May-92 | Aug-92 | Oct-92 | Feb-93 | May-93 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TC7 | Total specimens | 95 | 115 | 108 | | | | | | | | | |
| | Taxa richness | 4 | 8 | 9 | | | | | | | | | |
| | % EPT taxa | 50 | 38 | 67 | | | | | | | | | |
| | Diversity index | 0.32 | 0.52 | 0.48 | | | | | | | | | |
| | | | | | | | | | | | | | |
| TC10 | Total specimens | 38 | 86 | 48 | 63 | 52 | 3 | 1 | 4 | | 1 | 1 | 1 |
| | Taxa richness | 4 | 11 | 8 | 10 | 8 | 1 | 1 | 3 | | 1 | 1 | 1 |
| | % EPT taxa | 50 | 45 | 50 | 70 | 63 | 0 | 0 | 33 | | 0 | 0 | 0 |
| | Diversity index | 0.4 | 0.88 | 0.66 | 0.68 | 0.64 | 0 | 0 | 0.45 | | 0 | 0 | 0 |

# Little Yellow Creek-Summary of Benthic Macroinvertebrate Data 1990-1993
## (Skelton and Eisenhour, 1993)

| Station | | Jun-90 | Oct-90 | Feb-91 | Apr-91 | Jul-Aug/91 | Oct-91 | Jan-Feb/92 | May-92 | Aug-92 | Oct-92 | Feb-93 | May-93 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YC1 | Total specimens | 67 | 278 | 54 | 60 | 128 | 866 | 160 | 30 | 138 | 95 | 24 | 76 |
| | Taxa richness | 13 | 16 | 13 | 19 | 21 | 20 | 21 | 5 | 21 | 11 | 13 | 17 |
| | % EPT taxa | 38 | 56 | 69 | 63 | 29 | 40 | 52 | 20 | 38 | 36 | 62 | 65 |
| | Diversity index | 1.08 | 0.62 | 0.85 | 1.14 | 1 | 1 | 0.57 | 1.06 | 0.57 | 0.98 | 0.83 | 1.06 |
| | | | | | | | | | | | | | |
| YC5 | Total specimens | 313 | 633 | 147 | 112 | 34 | 7 | 47 | 21 | 36 | 44 | 34 | 26 |
| | Taxa richness | 15 | 14 | 20 | 16 | 9 | 4 | 10 | 8 | 17 | 7 | 9 | 9 |
| | % EPT taxa | 47 | 57 | 65 | 56 | 33 | 50 | 70 | 38 | 12 | 14 | 33 | 89 |
| | Diversity index | 0.74 | 0.61 | 0.92 | 0.97 | 0.45 | 0.56 | 0.73 | 0.69 | 1.15 | 0.73 | 0.83 | 0.82 |
| | | | | | | | | | | | | | |
| YC5A | Total specimens | 182 | 211 | 215 | 238 | 102 | 17 | 113 | 21 | 19 | | 8 | 57 |
| | Taxa richness | 19 | 16 | 15 | 22 | 16 | 3 | 13 | 6 | 6 | | 4 | 13 |
| | % EPT taxa | 47 | 50 | 73 | 59 | 44 | 67 | 62 | 50 | 0 | | 25 | 85 |
| | Diversity index | 0.84 | 0.84 | 0.84 | 0.93 | 0.93 | 0.35 | 0.79 | 0.68 | 0.64 | | 0.53 | 0.81 |
| | | | | | | | | | | | | | |
| YC6 | Total specimens | 74 | 66 | 32 | 93 | 68 | 16 | 9 | 11 | | 5 | | |
| | Taxa richness | 12 | 13 | 11 | 17 | 12 | 7 | 6 | 4 | | 2 | | |
| | % EPT taxa | 42 | 54 | 73 | 65 | 58 | 43 | 83 | 50 | | 0 | | |
| | Diversity index | 0.69 | 0.73 | 1 | 0.97 | 0.93 | 0.68 | 0.73 | 0.51 | | 0.29 | | |
| | | | | | | | | | | | | | |
| YC12 | Total specimens | 53 | 184 | 76 | 76 | 47 | 29 | 34 | 40 | 17 | 9 | 3 | 13 |
| | Taxa richness | 8 | 19 | 14 | 22 | 16 | 10 | 10 | 6 | 7 | 4 | 2 | 5 |
| | % EPT taxa | 38 | 37 | 71 | 55 | 31 | 30 | 30 | 0 | 0 | 0 | 0 | 20 |
| | Diversity index | 0.69 | 0.87 | 0.96 | 1.13 | 1.05 | 0.82 | 0.75 | 0.44 | 0.66 | 0.55 | 0.28 | 0.58 |

## Miscellaneous Stations
## Summary of Benthic Macroinvertebrate Data 1990 - 1993
## (Skelton and Eisenhour, 1993)

| Station | | Jun-90 | Oct-90 | Feb-91 | Apr-91 | Jul-Aug/91 | Oct-91 | Jan-Feb/92 | May-92 | Aug-92 | Oct-92 | Feb-93 | May-93 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DR9 | Total specimens | | | 163 | 230 | 27 | 103 | 175 | 42 | 33 | 25 | 51 | 70 |
| | Taxa richness | | | 25 | 28 | 17 | 22 | 32 | 10 | 15 | 10 | 16 | 14 |
| | % EPT taxa | | | 52 | 61 | 35 | 41 | 59 | 40 | 13 | 40 | 69 | 64 |
| | Diversity index | | | 1.09 | 1.18 | 1.15 | 1.13 | 1.19 | 0.9 | 1.03 | 0.78 | 1.1 | 0.91 |
| | | | | | | | | | | | | | |
| SH10 | Total specimens | | | | | 150 | | | | 36 | | 72 | |
| | Taxa richness | | | | | 20 | | | | 12 | | 11 | |
| | % EPT taxa | | | | | 60 | | | | 42 | | 82 | |
| | Diversity index | | | | | 0.97 | | | | 0.97 | | 0.69 | |
| | | | | | | | | | | | | | |
| SR10 | Total specimens | 214 | 267 | 122 | 189 | | 73 | 143 | | | | | |
| | Taxa richness | 32 | 24 | 19 | 19 | | 20 | 21 | | | | | |
| | % EPT taxa | 69 | 50 | 74 | 63 | | 50 | 67 | | | | | |
| | Diversity index | 1.29 | 1.05 | 1.09 | 1.01 | | 1.05 | 1.09 | | | | | |

# Appendix E

STORET Database Data

## Appendix E

STORET Database Data

```
                              ****  STORET SUMMARY SECTION  ****

   FOLLOWING  IS A RETRIEVAL OF DATA FROM THE ENVIRONMENTAL PROTECTION AGENCY'S  STORET SYSTEM,
   A DATABASE  OF  SAMPLING  SITES  AND THEIR ASSOCIATED  QUALITY  DATA.  THE  INFORMATION  WAS
   RETRIEVED  USING  SPECIFIC  STORET INSTRUCTION SETS  IN COMBINATION TO SELECT  ONLY THE DATA
   REQUESTED FOR THIS RETRIEVAL. BRIEF EXPLANATIONS OF THE INSTRUCTION SETS ARE INCLUDED BELOW.
                 QUESTIONS MAY BE DIRECTED TO THE STORET USER ASSISTANCE SECTION AT
                                      (800) 424-9067.

                                        ************

              FOLLOWING IS THE FORMAT FOR THE STATION HEADER INFORMATION WHICH APPEARS
               ON EACH PAGE OF THE RETRIEVAL UNLESS STATION AGGREGATION WAS PERFORMED
      ******************************************************************************
      *                                                                            *
      *                                   STATION NUMBER(S)                        *
      *                                   LATITUDE/LONGITUDE PRECISION CODE        *
      *                                   STATION LOCATION                         *
      *                                   STATE/COUNTY CODE STATE NAME COUNTY NAME *
      *                                   MAJOR BASIN NAME MAJ/MIN/SUB BASIN CODE  *
      *                                   MINOR BASIN NAME                         *
      *STATION TYPE                       AGENCY CODE  STORED DATE  HYDROLOGIC UNIT*
      *                                   STATION DEPTH      ELEVATION             *
      *                                   ECOREGION                                *
      *                                   WATER BODY                               *
      *                                   AQUIFERS                                 *
      *                                   LOCKED DATE                              *
      *                                                                            *
      *RIVER MILE INDEX                                                            *
      *                                                                            *
      ******************************************************************************

                                CONTINUED ON NEXT PAGE(S)
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```

```
                                                                03401390
                                                               36 36 22.0 083 41 22.0 2
                                                               DAVIS B AT MIDDLESBORO
                                                               21013   KENTUCKY         BELL
                                                                                        052091
YPA/AMBNT/STREAM
                                                               112WRD                       05130101
                                                               0000 FEET DEPTH


         PARAMETER                  MEDIUM        RMK   NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM  MINIMUM   BEG DATE END DATE
00075   TURB      HLGE   PPM SIO2 WATER                     2 6.000000 32.00000 5.656900    10.0      2.0   64/05/27 64/09/22
00080  COLOR     PT-CO    UNITS   WATER                     2 5.000000 .0000000 .0000000       5        5   64/05/27 64/09/22
00095 CNDUCTVY   AT 25C  MICROMHO WATER                     2 270.0000 6050.100 77.78200     325      215   64/05/27 64/09/22
00400    PH                SU     WATER                     2 7.350000 .2450000 .4949700    7.70     7.00   64/05/27 64/09/22
00410  T ALK     CACO3    MG/L    WATER                     2 91.50000 1740.500 41.71900     121       62   64/05/27 64/09/22
00440 HCO3 ION    HCO3    MG/L    WATER                     2 112.0000 2592.000 50.91200     148       76   64/05/27 64/09/22
00900 TOT HARD   CACO3    MG/L    WATER                     2 117.5000 2964.500 54.44700     156       79   64/05/27 64/09/22
00902 NC HARD    CACO3    MG/L    WATER                     2 26.00000 162.0000 12.72800      35       17   64/05/27 64/09/22
00940 CHLORIDE    TOTAL   MG/L    WATER                     2 17.50000 40.50000 6.364000      22       13   64/05/27 64/09/22
00945 SULFATE   SO4-TOT   MG/L    WATER                     2 23.00000 98.00000 9.899500      30       16   64/05/27 64/09/22
01045   IRON     FE,TOT   UG/L    WATER                     2 320.0000 3199.900 56.56800     360      280   64/05/27 64/09/22
01055 MANGNESE     MN     UG/L    WATER                     2 215.0000 42050.00 205.0600   360.0     70.0   64/05/27 64/09/22
38260   MBAS              MG/L    WATER                     1 .0000000                       .00      .00   64/09/22 64/09/22
```

```
                                                             03401380
                                                             36 35 30.0 083 42 15.0 2
                                                             L YELLOW C NR MIDDLESBORO
                                                             21013   KENTUCKY          BELL
                                                                                       052091
YPA/AMBNT/STREAM
                                                             112WRD                          05130101
                                                             0000 FEET DEPTH



        PARAMETER                 MEDIUM          RMK   NUMBER    MEAN   VARIANCE STAN DEV MAXIMUM  MINIMUM   BEG DATE END DATE
00075   TURB     HLGE   PPM SIO2 WATER                       3 2.666700 8.333300 2.886800      6.0      1.0   64/05/27 64/09/18
00080  COLOR     PT-CO   UNITS   WATER                       3 3.666700 1.333300 1.154700        5        3   64/05/27 64/09/18
00095 CNDUCTVY   AT 25C MICROMHO WATER                       3 30.66700 2.334200 1.527800       32       29   64/05/27 64/09/18
00300    DO               MG/L   WATER                       1 8.000000                        8.0      8.0   64/09/22 64/09/22
00301    DO      SATUR  PERCENT  WATER                       1 91.00000                       91.0     91.0   64/09/22 64/09/22
00400    PH                SU    WATER                       3 6.533300 .0634230 .2518400     6.80     6.30   64/05/27 64/09/18
00410  T ALK     CACO3    MG/L   WATER                       3 10.00000 19.00000 4.358900       15        7   64/05/27 64/09/18
00440 HCO3 ION    HCO3    MG/L   WATER                       3 12.00000 28.00000 5.291500       18        8   64/05/27 64/09/18
00900 TOT HARD   CACO3    MG/L   WATER                       3 9.666700 .3336200 .5776000       10        9   64/05/27 64/09/18
00902 NC HARD    CACO3    MG/L   WATER                       3 1.333300 1.333300 1.154700        2        0   64/05/27 64/09/18
00940 CHLORIDE   TOTAL    MG/L   WATER                       3 1.666700 .3333400 .5773500        2        1   64/05/27 64/09/18
00945 SULFATE  SO4-TOT    MG/L   WATER                       3 5.133300 2.093300 1.446800        7        4   64/05/27 64/09/18
01045   IRON    FE,TOT    UG/L   WATER                       3 240.0000 3100.000 55.67800      290      180   64/05/27 64/09/18
01055 MANGNESE    MN      UG/L   WATER                       3 583.3300 775830.0 880.8100   1600.0     50.0   64/05/27 64/09/18
38260   MBAS              MG/L   WATER                       2 .0000000 .0000000 .0000000      .00      .00   64/08/26 64/09/18
```

# Appendix F

Data for Figures 21 through 32

DB10 Sediment, pH, and Specimen Data

| Date | Sediment | pH | Specimens |
|---|---|---|---|
| 6/18/90 | 3.00 | 7.3 | 203 |
| 7/6/90 | 3.00 | 7.1 | |
| 7/11/90 | 10.00 | 7.3 | |
| 7/20/90 | 2.00 | 7.4 | |
| 8/4/90 | 2.00 | 7.3 | |
| 8/18/90 | 3.00 | 7.3 | |
| 9/2/90 | 4.00 | 7.3 | |
| 9/14/90 | 0.00 | 7.3 | |
| 9/28/90 | 45.00 | 7.2 | |
| 10/11/90 | 4.00 | 7.6 | |
| 10/18/90 | 17.00 | 7.2 | 504 |
| 10/25/90 | 5.00 | 7.0 | |
| 11/8/90 | 1.00 | 7.2 | |
| 11/23/90 | 3.00 | 7.1 | |
| 12/9/90 | 1.00 | 7.0 | |
| 12/21/90 | 7.00 | 7.0 | |
| 12/24/90 | 10.00 | 6.9 | |
| 1/3/91 | 2.00 | 6.9 | |
| 1/17/91 | 1.00 | 7.8 | |
| 2/3/91 | 1.00 | 7.4 | |
| 2/14/91 | 24.00 | 6.9 | 196 |
| 2/18/91 | 122.00 | 6.3 | |
| 3/1/91 | 1.00 | 7.0 | |
| 3/15/91 | 3.60 | 6.6 | |
| 3/23/91 | 47.75 | 6.7 | |
| 3/28/91 | 3.57 | 7.2 | |
| 4/11/91 | 1.00 | 7.1 | 207 |
| 4/25/91 | 2.46 | 7.0 | |
| 5/4/91 | 1.19 | 7.1 | |
| 5/22/91 | 9.35 | 7.1 | |
| 6/4/91 | 6.58 | 7.2 | |
| 6/19/91 | 3.60 | 7.0 | |
| 7/2/91 | 1.75 | 7.0 | |
| 7/16/91 | 1.00 | 7.1 | |
| 7/30/91 | 4.40 | 7.2 | 84 |
| 8/12/91 | 1.00 | 7.1 | |
| 8/28/91 | 6.67 | 6.9 | |
| 9/10/91 | 1.66 | 7.0 | |
| 9/22/91 | 1.00 | 6.6 | |
| 10/6/91 | 1.00 | 7.0 | |
| 10/19/91 | 18.45 | 7.6 | 426 |
| 11/2/91 | 2.93 | 7.2 | |
| 11/17/91 | 2.46 | 7.0 | |
| 11/22/91 | 37.97 | 7.2 | |
| 12/1/91 | 61.46 | 7.1 | |
| 12/2/91 | 136.16 | 6.4 | |
| 12/17/91 | 11.40 | 6.5 | |
| 12/30/91 | 2.43 | 6.8 | |
| 1/13/92 | 2.39 | 6.7 | |
| 1/27/92 | 1.63 | 6.6 | |
| 2/10/92 | 3.94 | 7.0 | 106 |
| 2/24/92 | 1.00 | 7.3 | |
| 3/9/92 | 2.84 | 7.1 | |
| 3/23/92 | 2.01 | 7.0 | |
| 4/5/92 | 1.00 | 7.4 | |
| 4/21/92 | 82.00 | 6.7 | |
| 5/4/92 | 1.00 | 7.7 | |
| 5/18/92 | 1.00 | 7.9 | 119 |
| 6/1/92 | 2.00 | 7.7 | |
| 6/15/92 | 24.00 | 7.5 | |
| 6/29/92 | 2.78 | 7.7 | |
| 7/13/92 | 2.10 | 7.0 | |
| 7/27/92 | 11.30 | 7.0 | |
| 8/10/92 | 2.80 | 7.1 | 103 |
| 8/25/92 | 0.10 | 7.5 | |
| 9/8/92 | 1.00 | 7.5 | |
| 9/18/92 | 1.00 | 7.6 | |
| 9/21/92 | 1.00 | 7.3 | |
| 10/5/92 | 5.90 | 7.3 | |
| 10/19/92 | 2.10 | 7.2 | 54 |
| 11/3/92 | 0.70 | 7.5 | |
| 11/13/92 | 1.70 | 7.0 | |
| 12/1/92 | 0.50 | 7.4 | |
| 12/14/92 | 0.60 | 6.8 | |
| 12/17/92 | 58.00 | 7.7 | |
| 1/11/93 | 1.50 | 7.0 | |
| 1/25/93 | 6.60 | 7.7 | |
| 2/8/93 | 0.80 | 7.2 | |
| 2/22/93 | 10.40 | 7.4 | 54 |
| 3/8/93 | 1.80 | 7.3 | |
| 3/22/93 | 8.80 | 6.8 | |
| 3/23/93 | 670.00 | 7.8 | |
| 4/2/93 | 8.30 | 7.2 | |
| 4/19/93 | 4.70 | 7.1 | |
| 5/3/93 | 2.40 | 7.2 | |
| 5/17/93 | 2.50 | 7.3 | 91 |
| 5/31/93 | 3.00 | 7.4 | |
| 6/14/93 | 4.10 | 6.8 | |
| 7/6/93 | 4.70 | 8.0 | |
| 7/19/93 | 2.80 | 7.6 | |
| 8/9/93 | 4.00 | 7.7 | |
| 8/23/93 | 2.10 | 7.9 | |
| 9/7/93 | 3.30 | 7.3 | |
| 9/21/93 | 3.20 | 7.6 | |
| 10/7/93 | 2.00 | 7.4 | |
| 10/18/93 | 1.70 | 7.3 | |
| 11/4/93 | 3.20 | 7.4 | |
| 11/15/93 | 2.00 | 7.2 | |
| 11/29/93 | 1.40 | 7.3 | |
| 12/5/93 | 20.50 | 7.0 | |
| 12/13/93 | 0.50 | 7.1 | |

Sediment values reported as zero or "less than" were set to 1.0.

## TC10 Sediment, pH, and Specimen Data

| Date | Sediment | pH | Specimens |
|---|---|---|---|
| 6/19/90 | 12.00 | 7.7 | 38 |
| 7/7/90 | 7.00 | 7.5 | |
| 7/11/90 | 6.00 | 7.9 | |
| 7/21/90 | 5.00 | 7.7 | |
| 8/4/90 | 7.00 | 7.8 | |
| 8/17/90 | 6.00 | 7.8 | |
| 9/1/90 | 5.00 | 7.7 | |
| 9/14/90 | 3.00 | 7.8 | |
| 9/29/90 | 1.00 | 7.6 | |
| 10/12/90 | 5.00 | 7.6 | 86 |
| 10/18/90 | 16.00 | 7.8 | |
| 10/24/90 | 4.00 | 7.6 | |
| 11/8/90 | 1.00 | 7.6 | |
| 11/24/90 | 5.00 | 7.7 | |
| 12/8/90 | 2.00 | 7.5 | |
| 12/20/90 | 5.00 | 7.5 | |
| 12/24/90 | 10.00 | 7.7 | |
| 1/4/91 | 3.00 | 7.6 | |
| 1/20/91 | 2.00 | 7.5 | |
| 1/31/91 | 3.00 | 7.5 | |
| 2/14/91 | 18.00 | 7.4 | 48 |
| 2/18/91 | 103.00 | 7.9 | |
| 2/28/91 | 0.80 | 7.6 | |
| 3/15/91 | 3.20 | 7.4 | |
| 3/23/91 | 31.32 | 7.3 | |
| 3/28/91 | 3.99 | 7.5 | |
| 4/11/91 | 0.97 | 7.5 | 63 |
| 4/24/91 | 8.11 | 7.8 | |
| 5/6/91 | 13.08 | 7.5 | |
| 5/21/91 | 20.97 | 7.5 | |
| 6/5/91 | 8.20 | 7.3 | |
| 6/19/91 | 15.68 | 7.6 | |
| 7/1/91 | 14.78 | 7.7 | |
| 7/16/91 | 62.91 | 7.5 | |
| 7/31/91 | 310.78 | 7.6 | 52 |
| 8/13/91 | 48.79 | 9.4 | |
| 8/28/91 | 145.57 | 7.9 | |
| 9/3/91 | 71.44 | 7.3 | |
| 9/10/91 | 182.51 | 8.0 | |
| 9/18/91 | 56.22 | 4.5 | |
| 9/24/91 | 111.86 | 6.9 | |
| 10/8/91 | 13.10 | 6.9 | |
| 10/16/91 | 15.26 | 6.4 | 3 |
| 10/20/91 | 3.65 | 8.3 | |
| 10/24/91 | 5.50 | 4.7 | |
| 10/29/91 | 2.00 | 9.1 | |
| 11/2/91 | 145.09 | 7.6 | |
| 11/17/91 | 106.41 | 6.6 | |
| 11/22/91 | 190.86 | 9.5 | |
| 12/1/91 | 615.77 | 7.9 | |
| 12/2/91 | 246.32 | 9.5 | |
| 12/16/91 | 25.42 | 7.1 | |
| 12/30/91 | 1.00 | 7.2 | |
| 1/13/92 | 11.51 | 7.2 | |
| 1/27/92 | 18.87 | 6.4 | 1 |
| 2/10/92 | 12.16 | 7.9 | |
| 2/24/92 | 16.26 | 7.1 | |
| 3/9/92 | 13.32 | 7.7 | |
| 3/23/92 | 33.44 | 7.3 | |
| 4/5/92 | 8.00 | 7.4 | |
| 4/21/92 | 19.00 | 8.1 | |
| 5/4/92 | 8.00 | 8.0 | |
| 5/18/92 | 6.00 | 8.0 | 4 |
| 6/1/92 | 2.00 | 8.0 | |
| 6/15/92 | 4.00 | 7.8 | |
| 6/29/92 | 7.75 | 8.0 | |
| 7/13/92 | 24.10 | 8.2 | |
| 7/27/92 | 1.50 | 7.4 | |
| 8/10/92 | 12.80 | 7.1 | |
| 8/25/92 | 7.50 | 7.5 | |
| 8/28/92 | 82.40 | 8.2 | |
| 9/8/92 | 12.90 | 7.8 | |
| 9/18/92 | 1.00 | 8.4 | |
| 9/21/92 | 1.00 | 8.0 | |
| 10/5/92 | 122.00 | 7.6 | |
| 10/19/92 | 3.70 | 7.7 | 1 |
| 11/3/92 | 3.30 | 7.9 | |
| 11/13/92 | 16.00 | 9.1 | |
| 12/1/92 | 27.30 | 7.4 | |
| 12/14/92 | 4.90 | 6.6 | |
| 12/17/92 | 154.00 | 9.4 | |
| 1/11/93 | 4.20 | 7.3 | |
| 1/25/93 | 42.50 | 8.9 | |
| 2/8/93 | 14.90 | 7.1 | |
| 2/22/93 | 94.60 | 7.9 | 1 |
| 3/8/93 | 12.50 | 7.3 | |
| 3/22/93 | 8.70 | 7.5 | |
| 3/23/93 | 483.00 | 10.4 | |
| 4/2/93 | 7.20 | 7.0 | |
| 4/19/93 | 2.70 | 7.2 | |
| 5/3/93 | 2.80 | 8.2 | |
| 5/17/93 | 3.70 | 8.5 | 1 |
| 5/31/93 | 3.90 | 9.4 | |
| 6/14/93 | 5.50 | 8.9 | |
| 6/28/93 | 15.00 | 7.7 | |
| 7/6/93 | 6.60 | 7.3 | |
| 7/19/93 | 2.90 | 7.9 | |
| 8/9/93 | 5.30 | 7.9 | |
| 8/23/93 | 1.60 | 8.0 | |
| 9/7/93 | 3.80 | 7.7 | |
| 9/21/93 | 2.60 | 7.5 | |
| 10/7/93 | 8.20 | 7.3 | |
| 10/18/93 | 2.00 | 8.3 | |
| 11/4/93 | 3.40 | 7.9 | |
| 11/15/93 | 15.10 | 8.0 | |
| 11/29/93 | 4.10 | 8.3 | |
| 12/5/93 | 15.60 | 7.5 | |
| 12/13/93 | 1.00 | 7.9 | |

Sediment values reported as zero or "less than" were set to 1.0

Six observations on 9/18/91 were averaged and single values for sediment and pH were reported

The observatios of 9/23/91 and 9/24/91 were averaged and reported for 9/24/91

## YC1 Sediment, pH and Specimen Data

| Date | Sediment | pH | Specimens |
|---|---|---|---|
| 6/19/90 | 1.00 | 6.8 | 67 |
| 7/7/90 | 1.00 | 6.9 | |
| 7/21/90 | 1.00 | 7.3 | |
| 8/4/90 | 1.00 | 7.3 | |
| 8/17/90 | 1.00 | 7.3 | |
| 9/1/90 | 5.00 | 7.2 | |
| 9/14/90 | 1.00 | 7.3 | |
| 9/29/90 | 1.00 | 7.1 | |
| 10/12/90 | 1.00 | 6.9 | 278 |
| 10/25/90 | 6.00 | 6.8 | |
| 11/8/90 | 1.00 | 7.0 | |
| 11/24/90 | 12.00 | 7.2 | |
| 12/8/90 | 1.00 | 6.7 | |
| 12/21/90 | 2.00 | 6.5 | |
| 1/4/91 | 4.00 | 6.4 | |
| 1/20/91 | 1.00 | 6.7 | |
| 2/1/91 | 2.00 | 6.7 | |
| 2/14/91 | 1.00 | 7.2 | 54 |
| 3/1/91 | 8.75 | 6.6 | |
| 3/15/91 | 6.74 | 6.3 | |
| 3/28/91 | 16.04 | 6.7 | |
| 4/11/91 | 0.97 | 7.8 | 60 |
| 4/26/91 | 2.40 | 6.7 | |
| 5/5/91 | 0.80 | 6.2 | |
| 5/21/91 | 3.53 | 6.5 | |
| 6/5/91 | 1.27 | 7.7 | |
| 6/19/91 | 2.42 | 6.5 | |
| 7/1/91 | 1.00 | 6.7 | |
| 7/16/91 | 0.46 | 6.8 | |
| 7/29/91 | 1.00 | 6.8 | 128 |
| 8/13/91 | 1.00 | 7.1 | |
| 8/28/91 | 4.19 | 7.7 | |
| 9/10/91 | 8.80 | 6.5 | |
| 9/22/91 | 1.00 | 6.8 | |
| 10/6/91 | 2.55 | 7.7 | |
| 10/19/91 | 1.00 | 7.7 | 866 |
| 11/2/91 | 2.81 | 6.9 | |
| 11/17/91 | 3.63 | 6.7 | |
| 11/22/91 | 6.51 | 7.3 | |
| 12/1/91 | 33.98 | 6.1 | |
| 12/2/91 | 18.67 | 7.4 | |
| 12/17/91 | 1.00 | 6.4 | |
| 12/30/91 | 1.00 | 7.1 | |
| 1/13/92 | 3.20 | 7.1 | |
| 1/27/92 | 2.40 | 6.7 | 160 |
| 2/10/92 | 2.00 | 7.0 | |
| 2/24/92 | 0.90 | 7.3 | |
| 3/9/92 | 3.26 | 7.4 | |
| 3/23/92 | 1.00 | 7.0 | |
| 4/5/92 | 1.00 | 7.1 | |
| 4/21/92 | 4.00 | 7.2 | |
| 5/4/92 | 1.00 | 7.2 | |
| 5/18/92 | 1.00 | 7.0 | 30 |
| 6/1/92 | 1.00 | 7.4 | |
| 6/15/92 | 3.00 | 7.5 | |
| 6/29/92 | 3.90 | 7.0 | |
| 7/13/92 | 2.20 | 7.4 | |
| 7/27/92 | | 6.5 | |
| 8/10/92 | 2.50 | 6.6 | 138 |

Sediment values reported as zero or "less than" were set to 1.0

### YC5 Sediment, pH, and Specimen Data

| Date | Sediment | pH | Specimens |
|---|---|---|---|
| 6/18/90 | 2.00 | 6.8 | 313 |
| 7/7/90 | 2.00 | 6.6 | |
| 7/11/90 | 2.00 | 6.8 | |
| 7/21/90 | 1.00 | 6.8 | |
| 8/4/90 | 1.00 | 7.0 | |
| 8/17/90 | 3.00 | 6.9 | |
| 9/1/90 | 1.00 | 6.8 | |
| 9/14/90 | 662.00 | 6.8 | |
| 9/29/90 | 1.00 | 6.8 | |
| 10/12/90 | 1.00 | 6.8 | 633 |
| 10/18/90 | 9.00 | 7.1 | |
| 10/25/90 | 1.00 | 6.6 | |
| 11/8/90 | 1.00 | 6.8 | |
| 11/24/90 | 6.00 | 6.9 | |
| 12/8/90 | 1.00 | 6.8 | |
| 12/20/90 | 3.00 | 6.7 | |
| 12/24/90 | 22.00 | 6.2 | |
| 1/4/91 | 4.00 | 6.5 | |
| 1/20/91 | 1.00 | 6.6 | |
| 2/1/91 | 1.00 | 6.5 | |
| 2/14/91 | 7.00 | 6.4 | 147 |
| 2/18/91 | 20.00 | 6.6 | |
| 3/1/91 | 7.24 | 6.8 | |
| 3/15/91 | 7.61 | 6.5 | |
| 3/23/91 | 16.80 | 6.7 | |
| 3/28/91 | 13.88 | 7.5 | |
| 4/11/91 | 1.00 | 7.0 | 112 |
| 4/26/91 | 0.40 | 7.2 | |
| 5/5/91 | 1.20 | 6.2 | |
| 5/21/91 | 5.13 | 6.7 | |
| 6/5/91 | 3.25 | 6.9 | |
| 6/19/91 | 4.81 | 6.8 | |
| 7/1/91 | 1.42 | 6.7 | |
| 7/16/91 | 0.88 | 6.9 | |
| 7/31/91 | 1.00 | 7.0 | 34 |
| 8/13/91 | 1.00 | 7.0 | |
| 8/28/91 | 430.00 | 6.8 | |
| 9/10/91 | 1.00 | 6.6 | |
| 9/22/91 | 1.00 | 6.6 | |
| 10/6/91 | 4.10 | 6.7 | |
| 10/19/91 | 1.00 | 6.9 | 7 |
| 11/2/91 | 1.62 | 6.9 | |
| 11/17/91 | 1.00 | 6.8 | |
| 11/22/91 | 3.65 | 7.5 | |
| 12/1/91 | 17.21 | 7.1 | |
| 12/2/91 | 32.48 | 6.8 | |
| 12/17/91 | 0.80 | 6.8 | |
| 12/30/91 | 1.00 | 7.1 | |
| 1/13/92 | 4.43 | 7.1 | |
| 1/27/92 | 1.62 | 6.3 | 47 |
| 2/10/92 | 3.64 | 7.9 | |
| 2/24/92 | 1.83 | 7.2 | |
| 3/9/92 | 1.22 | 6.9 | |
| 3/23/92 | 1.00 | 6.9 | |
| 4/5/92 | 1.00 | 7.0 | |
| 4/21/92 | 4.00 | 7.9 | |
| 5/4/92 | 1.00 | 7.8 | |
| 5/18/92 | 1.00 | 7.0 | 21 |
| 6/1/92 | 1.00 | 7.3 | |
| 6/15/92 | 4.00 | 7.2 | |
| 6/29/92 | 1.41 | 7.0 | |
| 7/13/92 | 3.90 | 7.4 | |
| 7/27/92 | 1.00 | 6.5 | |
| 8/10/92 | 0.60 | 6.5 | 36 |
| 8/25/92 | 3.10 | 7.0 | |
| 8/28/92 | 5.90 | 7.6 | |
| 9/8/92 | 1.60 | 6.8 | |
| 9/18/92 | 1.00 | 7.4 | |
| 9/21/92 | 1.00 | 7.1 | |
| 10/5/92 | 3.00 | 7.3 | |
| 10/19/92 | 1.20 | 6.8 | 44 |
| 11/3/92 | 0.80 | 7.7 | |
| 11/13/92 | 3.35 | 6.9 | |
| 11/30/92 | 0.90 | 7.5 | |
| 12/14/92 | 1.20 | 6.4 | |
| 12/17/92 | 20.50 | 8.0 | |
| 1/11/93 | 1.30 | 7.0 | |
| 1/25/93 | 4.20 | 7.9 | |
| 2/8/93 | 1.80 | 7.1 | |
| 2/22/93 | 4.10 | 7.5 | 34 |
| 3/8/93 | 0.90 | 6.9 | |
| 3/22/93 | 3.90 | 7.3 | |
| 3/23/93 | 123.00 | 7.6 | |
| 4/2/93 | 7.70 | 7.2 | |
| 4/19/93 | 3.70 | 6.9 | |
| 5/3/93 | 1.00 | 7.3 | |
| 5/17/93 | 2.30 | 7.3 | 26 |
| 5/31/93 | 1.70 | 7.5 | |
| 6/14/93 | 4.10 | 6.3 | |
| 7/6/93 | 0.90 | 7.7 | |
| 7/19/93 | 1.10 | 7.3 | |
| 8/9/93 | 3.30 | 7.1 | |
| 8/23/93 | 6.20 | 7.4 | |
| 9/7/93 | 6.70 | 7.7 | |
| 9/21/93 | 12.30 | 7.2 | |
| 10/7/93 | 3.30 | 6.8 | |
| 10/18/93 | 12.60 | 6.8 | |
| 11/4/93 | 4.40 | 6.7 | |
| 11/15/93 | 3.20 | 6.7 | |
| 11/29/93 | 2.60 | 7.0 | |
| 12/5/93 | 15.00 | 6.9 | |
| 12/13/93 | 2.30 | 6.9 | |

Sediment values which were reported as zero or "less than" were set to 1.0
A pH value of zero on 6/19/91 was set to 6.8, the average of the two adjacent values.

YC5A pH, Sediment, and Specimen Data

| Date | Sediment | pH | Specimens |
|---|---|---|---|
| 6/18/90 | 9.00 | 7.3 | 182 |
| 7/7/90 | 7.00 | 7.1 | |
| 7/11/90 | 8.00 | 7.4 | |
| 7/21/90 | 13.00 | 7.3 | |
| 8/4/90 | 8.00 | 7.4 | |
| 8/17/90 | 6.00 | 7.4 | |
| 9/1/90 | 5.00 | 7.3 | |
| 9/14/90 | 10.00 | 7.3 | |
| 9/29/90 | 1.00 | 7.3 | |
| 10/12/90 | 11.00 | 7.1 | 211 |
| 10/18/90 | 14.00 | 7.2 | |
| 10/25/90 | 3.00 | 6.7 | |
| 11/8/90 | 1.00 | 7.4 | |
| 11/24/90 | 9.00 | 7.2 | |
| 12/8/90 | 2.00 | 7.1 | |
| 12/20/90 | 2.00 | 6.7 | |
| 12/24/90 | 24.00 | 6.3 | |
| 1/4/91 | 5.00 | 6.7 | |
| 1/20/91 | 1.00 | 6.8 | |
| 2/1/91 | 3.00 | 6.8 | |
| 2/14/91 | 10.00 | 6.5 | |
| 2/18/91 | 21.00 | 6.3 | 215 |
| 3/1/91 | 2.41 | 7.1 | |
| 3/15/91 | 4.43 | 6.3 | |
| 3/23/91 | 17.20 | 6.6 | |
| 3/28/91 | 13.60 | 7.6 | |
| 4/11/91 | 2.41 | 7.5 | 238 |
| 4/26/91 | 3.20 | 6.7 | |
| 5/5/91 | 1.21 | 6.3 | |
| 5/21/91 | 3.54 | 6.6 | |
| 6/5/91 | 4.99 | 7.1 | |
| 6/19/91 | 4.79 | 6.7 | |
| 7/1/91 | 2.59 | 6.9 | |
| 7/16/91 | 43.47 | 7.3 | |
| 7/31/91 | 84.66 | 7.5 | 102 |
| 8/13/91 | 30.88 | 8.7 | |
| 8/28/91 | 75.43 | 7.7 | |
| 9/10/91 | 54.51 | 7.5 | |
| 9/22/91 | 6.39 | 7.0 | |
| 10/6/91 | 11.14 | 7.1 | |
| 10/19/91 | 3.64 | 7.7 | 17 |
| 11/2/91 | 78.87 | 6.9 | |
| 11/17/91 | 16.22 | 6.8 | |
| 11/22/91 | 118.27 | 7.7 | |
| 12/1/91 | 227.94 | 7.8 | |
| 12/2/91 | 37.45 | 6.3 | |
| 12/17/91 | 5.87 | 6.5 | |
| 12/30/91 | 1.60 | 7.3 | |
| 1/13/92 | 5.60 | 6.6 | |
| 1/27/92 | 0.80 | 6.6 | 113 |
| 2/10/92 | 6.11 | 7.1 | |
| 2/24/92 | 2.26 | 7.4 | |
| 3/9/92 | 1.62 | 7.5 | |
| 3/23/92 | 0.40 | 7.2 | |
| 4/5/92 | 1.00 | 7.5 | |
| 4/21/92 | 4.00 | 6.7 | |
| 5/4/92 | 1.00 | 7.7 | |
| 5/18/92 | 1.00 | 7.9 | 21 |
| 6/1/92 | 1.00 | 7.8 | |
| 6/15/92 | 3.00 | 7.5 | |
| 6/29/92 | 7.70 | 7.8 | |
| 7/13/92 | 12.60 | 7.8 | |
| 7/27/92 | 1.50 | 7.2 | |
| 8/10/92 | 4.00 | 7.3 | 19 |
| 8/25/92 | 3.60 | 7.0 | |
| 8/28/92 | 51.70 | 8.2 | |
| 9/8/92 | 5.80 | 7.5 | |
| 9/18/92 | 1.00 | 8.0 | |
| 9/21/92 | 1.00 | 8.2 | |
| 10/5/92 | 15.20 | 7.8 | |
| 10/19/92 | 3.40 | 7.8 | |
| 11/3/92 | 2.30 | 7.3 | |
| 11/13/92 | 8.75 | 7.6 | |
| 11/30/92 | 11.10 | 7.3 | |
| 12/14/92 | 2.40 | 6.5 | |
| 12/17/92 | 14.40 | 8.0 | |
| 1/11/93 | 4.80 | 7.0 | |
| 1/25/93 | 5.10 | 8.8 | |
| 2/8/93 | 9.00 | 7.5 | |
| 2/22/93 | 9.80 | 7.3 | 8 |
| 3/8/93 | 5.10 | 7.0 | |
| 3/22/93 | 9.20 | 7.5 | |
| 3/23/93 | 150.00 | 8.1 | |
| 4/2/93 | 8.90 | 7.2 | |
| 4/19/93 | 4.10 | 6.9 | |
| 5/3/93 | 1.10 | 7.8 | |
| 5/17/93 | 1.00 | 8.2 | 57 |
| 5/31/93 | 5.20 | 9.3 | |
| 6/14/93 | 2.80 | 9.0 | |
| 7/6/93 | 5.30 | 7.6 | |
| 7/19/93 | 2.30 | 7.5 | |
| 8/9/93 | 4.40 | 7.8 | |
| 8/23/93 | 2.20 | 7.8 | |
| 9/7/93 | 503.00 | 7.5 | |
| 9/21/93 | 2.20 | 7.4 | |
| 10/7/93 | 5.30 | 7.3 | |
| 10/18/93 | 3.70 | 7.9 | |
| 11/4/93 | 3.00 | 7.5 | |
| 11/15/93 | 8.80 | 7.6 | |
| 11/29/93 | 4.00 | 8.1 | |
| 12/5/93 | 17.20 | 7.1 | |
| 12/13/93 | 1.70 | 7.4 | |

Sediment values reported as zero or "less than" were set to 1.0.

## YC12 Sediment, pH, and Specimen Data

| Date | Sediment | pH | Specimens |
|---|---|---|---|
| 6/18/90 | 6.00 | 7.2 | 53 |
| 7/7/90 | 10.00 | 7.0 | |
| 7/21/90 | 8.00 | 7.2 | |
| 8/4/90 | 4.00 | 7.3 | |
| 8/17/90 | 2.00 | 7.2 | |
| 9/1/90 | 6.00 | 7.2 | |
| 9/14/90 | 17.00 | 7.3 | |
| 9/29/90 | 18.00 | 7.2 | |
| 10/12/90 | 5.00 | 7.2 | |
| 10/18/90 | 10.00 | 7.1 | 184 |
| 10/25/90 | 1.00 | 6.9 | |
| 11/8/90 | 1.00 | 7.0 | |
| 11/24/90 | 8.00 | 7.2 | |
| 12/8/90 | 2.00 | 6.7 | |
| 12/21/90 | 4.00 | 7.2 | |
| 12/24/90 | 28.00 | 6.5 | |
| 1/4/91 | 4.00 | 6.7 | |
| 1/20/91 | 2.00 | 6.8 | |
| 2/1/91 | 2.00 | 6.7 | |
| 2/14/91 | 17.00 | 6.8 | 76 |
| 3/1/91 | 2.77 | 6.8 | |
| 3/15/91 | 4.02 | 6.6 | |
| 3/28/91 | 11.64 | 7.4 | |
| 4/11/91 | 0.48 | 6.9 | 76 |
| 4/26/91 | 2.40 | 7.2 | |
| 5/5/91 | 2.39 | 6.5 | |
| 5/21/91 | 8.39 | 6.8 | |
| 6/5/91 | 16.16 | 7.2 | |
| 6/19/91 | 4.36 | 6.8 | |
| 7/1/91 | 11.92 | 7.0 | |
| 7/16/91 | 3.81 | 7.2 | |
| 7/30/91 | 28.46 | 7.4 | 47 |
| 8/13/91 | 12.90 | 7.2 | |
| 8/28/91 | 6.85 | 7.1 | |
| 9/10/91 | 18.04 | 7.0 | |
| 9/22/91 | 3.19 | 7.0 | |
| 10/6/91 | 7.18 | 7.1 | |
| 10/19/91 | 2.02 | 7.0 | 29 |
| 11/2/91 | 2.07 | 6.9 | |
| 11/17/91 | 2.80 | 6.9 | |
| 11/22/91 | 60.67 | 7.6 | |
| 12/1/91 | 94.29 | 7.5 | |
| 12/2/91 | 106.08 | 6.6 | |
| 12/17/91 | 9.27 | 6.5 | |
| 12/30/91 | 1.00 | 6.8 | |
| 1/13/92 | 4.46 | 7.0 | |
| 1/27/92 | 0.40 | 6.4 | 34 |
| 2/10/92 | 4.44 | 6.9 | |
| 2/24/92 | 2.74 | 6.9 | |
| 3/9/92 | 5.63 | 7.0 | |
| 3/23/92 | 1.00 | 6.9 | |
| 4/5/92 | 1.00 | 6.9 | |
| 4/21/92 | 65.00 | 7.4 | |
| 5/4/92 | 1.00 | 7.5 | |
| 5/18/92 | 1.00 | 7.5 | 40 |
| 6/1/92 | 10.00 | 7.6 | |
| 6/15/92 | 7.00 | 7.5 | |
| 6/29/92 | 6.64 | 7.5 | |
| 7/13/92 | 9.30 | 7.0 | |
| 7/27/92 | 20.60 | 6.8 | |
| 8/10/92 | 4.60 | 6.8 | 17 |
| 8/25/92 | 4.30 | 7.5 | |
| 8/28/92 | 59.20 | 7.4 | |
| 9/8/92 | 12.30 | 7.3 | |
| 9/21/92 | 1.00 | 7.2 | |
| 10/5/92 | 20.90 | 7.3 | |
| 10/19/92 | 6.10 | 7.0 | 9 |
| 11/3/92 | 7.80 | 7.4 | |
| 11/13/92 | 11.50 | 7.0 | |
| 11/30/92 | 4.60 | 7.2 | |
| 12/14/92 | 2.60 | 6.7 | |
| 12/17/92 | 37.20 | 7.8 | |
| 1/11/93 | 3.20 | 6.9 | |
| 1/25/93 | 10.40 | 7.7 | |
| 2/8/93 | 3.20 | 7.1 | |
| 2/22/93 | 10.20 | 7.3 | 3 |
| 3/8/93 | 2.70 | 7.0 | |
| 3/22/93 | 8.60 | 6.8 | |
| 3/23/93 | 230.00 | 7.9 | |
| 4/2/93 | 9.80 | 7.1 | |
| 4/19/93 | 0.40 | 6.9 | |
| 5/3/93 | 1.50 | 7.2 | |
| 5/17/93 | 5.60 | 7.2 | 13 |
| 5/31/93 | 7.10 | 7.4 | |
| 6/14/93 | 6.90 | 7.3 | |
| 7/6/93 | 5.30 | 8.0 | |
| 7/19/93 | 13.90 | 7.5 | |
| 8/9/93 | 8.40 | 7.3 | |
| 8/23/93 | 3.50 | 7.4 | |
| 9/7/93 | 29.20 | 7.4 | |
| 9/21/93 | 4.80 | 7.4 | |

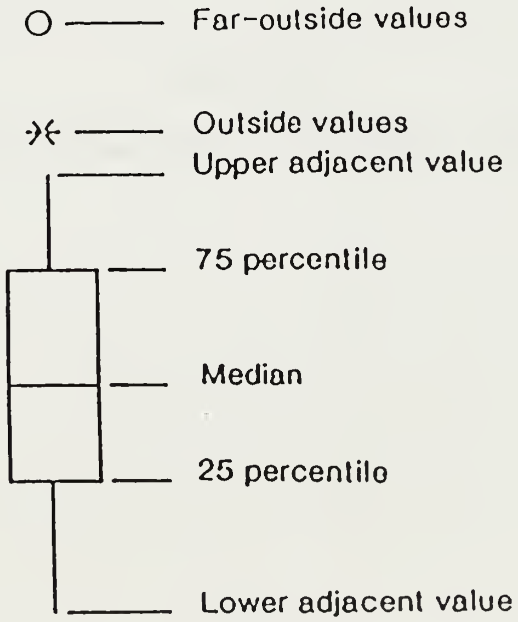
Sediment values reported as zero or "less than" were set to 1.0.

## Appendix G

Tukey Boxplots

## Tukey Boxplots

A boxplot (sometimes known as a box-and-whisker plot) is a concise, graphical display for summarizing the distribution of a data set. It consists of a center line (the median) that splits a rectangle defined by the "upper and lower hinges" located at the 75th and 25th percentiles, respectively. The box denotes the "interquartile range." The "whiskers" are lines drawn from the ends of the box to to the last observations within 1.5 times theinterquartile range beyond either end of the box. These observations are the "upper and lower adjacent values." "Outside values" are defined as values lying between 1.5 and 3.0 times the interquartile range beyond the ends of the box, and are denoted with asterisks. "Far outside values" are defined as values which are greater than 3.0 times the interquartile range, and are denoted with circles.



# Appendix H

Daily sampling data from Station TC10 - 1993

26/93

TUNNEL PROJECT
NPS DAILY WATER QUALITY MONITORING DATA
CUMBERLAND GAP NATIONAL HISTORICAL PARK

| E | SITE | pH s.u. | TURB ntu | FLOW cfs | TSS ppm | TOT.Fe mg/l | OIL/G ppm | TYPE SAMPLE | PREC inch |
|---|---|---|---|---|---|---|---|---|---|
| /01/93 | TC10 | 8.2 | 6 | 0.00 | 0.00 | 0.2 | 0.00 | 24HR | 0.02 |
| /02/93 | TC10 | 8.2 | 5 | 0.00 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 03/93 | TC10 | 8.0 | 3 | 2.70 | 7.90 | 0.3 | 0.00 | GRAB | 0.00 |
| /04/93 | TC10 | 7.9 | 4 | 0.66 | 7.90 | 0.2 | 0.00 | 24HR | 0.00 |
| /05/93 | TC10 | 7.7 | 24 | 2.50 | 28.60 | 0.3 | 0.00 | 24HR | 0.68 |
| 06/93 | TC10 | 6.5 | 16 | 3.40 | 12.00 | 0.3 | 7.75 | 24HR | 0.00 |
| 07/93 | TC10 | 6.6 | 8 | 2.80 | 23.80 | 0.3 | 0.00 | 24HR | 0.00 |
| /08/93 | TC10 | 7.2 | 18 | 3.10 | 21.55 | 0.5 | 0.60 | 24HR | 0.00 |
| 09/93 | TC10 | 7.1 | 30 | 1.67 | 62.81 | 0.4 | 3.75 | 24HR | 0.54 |
| 10/93 | TC10 | 7.3 | 9 | 2.30 | 6.48 | 0.2 | 0.00 | 24HR | 0.01 |
| /11/93 | TC10 | 7.3 | 5 | 2.50 | 3.90 | 0.2 | 0.00 | 24HR | 0.43 |
| /12/93 | TC10 | 7.6 | 60 | 2.80 | 56.00 | 0.5 | 0.00 | 24HR | 0.18 |
| 13/93 | TC10 | 7.2 | 42 | 3.00 | 32.60 | 0.3 | 0.00 | 24HR | 0.02 |
| /14/93 | TC10 | 7.6 | 40 | 2.60 | 44.00 | 0.2 | 0.75 | 24HR | 0.00 |
| /15/93 | TC10 | 7.5 | 52 | 2.80 | 40.50 | 0.5 | 4.75 | GRAB | 0.00 |
| /16/93 | TC10 | 8.2 | 21 | 1.40 | 52.02 | 0.5 | 0.00 | 24HR | 0.00 |
| /17/93 | TC10 | 7.8 | 25 | 3.30 | 33.94 | 0.3 | 0.00 | 24HR | 0.00 |
| /18/93 | TC10 | 7.7 | 10 | 2.50 | 13.66 | 0.2 | 0.00 | 24HR | 0.00 |
| /19/93 | TC10 | 7.6 | 9 | 2.20 | 4.00 | 0.2 | 0.80 | 24HR | 0.01 |
| /20/93 | TC10 | 7.0 | 32 | 2.10 | 19.90 | 0.3 | 6.10 | 24HR | 0.00 |
| /21/93 | TC10 | 7.3 | 15 | 2.50 | 11.90 | 0.3 | 0.00 | 24HR | 0.42 |
| /22/93 | TC10 | 7.1 | 65 | 1.60 | 79.50 | 0.6 | 0.00 | 24HR | 0.00 |
| /23/93 | TC10 | 6.8 | 5 | 2.60 | 32.25 | 0.3 | 0.00 | 24HR | 0.00 |
| /24/93 | TC10 | 8.5 | 17 | 4.08 | 60.98 | 0.4 | 1.30 | 24HR | 0.93 |
| /25/93 | TC10 | 8.9 | 67 | 4.10 | 131.00 | 0.8 | 3.35 | 24HR | 0.00 |
| /26/93 | TC10 | 7.6 | 35 | 3.10 | 35.97 | 0.7 | 0.08 | 24HR | 0.00 |
| /27/93 | TC10 | 9.1 | 6 | 3.20 | 19.80 | 0.4 | 3.85 | 24HR | 0.00 |
| /28/93 | TC10 | 4.6 | 12 | 2.60 | 15.80 | 0.4 | 2.40 | 24HR | 0.00 |
| /29/93 | TC10 | 4.2 | 3 | 1.90 | 19.80 | 0.4 | 1.50 | 24HR | 0.00 |
| /30/93 | TC10 | 3.7 | 5 | 2.20 | 9.90 | 0.6 | 0.40 | GRAB | 0.00 |
| /31/93 | TC10 | 8.3 | 35 | 2.20 | 71.73 | 0.5 | 0.00 | 24HR | 0.00 |
| . |  | 9.1 |  |  | 131.00 | 0.8 | 7.75 |  | 0.93 |
| n. |  | 3.7 |  |  | 0.00 | 0.2 | 0.00 |  |  |
| erage |  | 7.3 |  |  | 30.97 | 0.4 | 1.21 |  |  |
| TAL |  |  |  |  |  |  |  |  | ** 3.24** |

04/26/93

# TUNNEL PROJECT
# NPS DAILY WATER QUALITY MONITORING DATA
# CUMBERLAND GAP NATIONAL HISTORICAL PARK

| ATE | SITE | pH<br>s.u. | TURB<br>ntu | FLOW<br>cfs | TSS<br>ppm | TOT.Fe<br>mg/l | OIL/G<br>ppm | TYPE<br>SAMPLE | PREC<br>inch |
|---|---|---|---|---|---|---|---|---|---|
| 02/01/93 | TC10 | 8.3 | 14 | 1.30 | 20.10 | 0.2 | 0.00 | 24HR | 0.00 |
| 02/02/93 | TC10 | 7.4 | 25 | 2.20 | 99.30 | 0.7 | 1.05 | 24HR | 0.00 |
| 02/03/93 | TC10 | 5.0 | 6 | 1.10 | 39.60 | 0.7 | 5.15 | 24HR | 0.00 |
| 02/04/93 | TC10 | 8.2 | 5 | 2.80 | 16.00 | 0.5 | 2.50 | 24HR | 0.00 |
| 02/05/93 | TC10 | 9.7 | 8 | 1.80 | 24.00 | 0.8 | 0.00 | 24HR | 0.00 |
| 02/06/93 | TC10 | 11.9 | 30 | 1.49 | 302.16 | 1.0 | 0.00 | 24HR | 0.00 |
| 02/07/93 | TC10 | 9.5 | 40 | 1.48 | 162.98 | 0.8 | 0.00 | 24HR | 0.00 |
| 02/08/93 | TC10 | 7.1 | 15 | 1.80 | 31.90 | 0.5 | 0.45 | 24HR | 0.00 |
| 02/09/93 | TC10 | 4.9 | 10 | 1.60 | 16.00 | 1.2 | 2.60 | 24HR | 0.00 |
| 02/10/93 | TC10 | 3.5 | 36 | 2.00 | 31.80 | 1.6 | 3.35 | 24HR | 0.00 |
| 02/11/93 | TC10 | 6.9 | 30 | 1.30 | 76.20 | 1.0 | 2.30 | 24HR | 0.14 |
| 02/12/93 | TC10 | 3.5 | 9 | 0.80 | 116.60 | 0.9 | 3.20 | 24HR | 0.49 |
| 02/13/93 | TC10 | 3.4 | 40 | 1.90 | 153.28 | 1.8 | 2.00 | 24HR | 0.05 |
| 02/14/93 | TC10 | 8.9 | 14 | 1.79 | 59.19 | 0.6 | 0.00 | 24HR | 0.04 |
| 02/15/93 | TC10 | 9.0 | 22 | 1.90 | 36.20 | 0.4 | 0.00 | 24HR | 0.02 |
| 02/16/93 | TC10 | 10.5 | 53 | 3.70 | 112.30 | 1.0 | 5.35 | 24HR | 0.81 |
| 02/17/93 | TC10 | 9.8 | 80 | 2.10 | 259.38 | 0.8 | 3.75 | 24HR | 0.01 |
| 02/18/93 | TC10 | 11.2 | 35 | 1.90 | 48.00 | 1.7 | 0.00 | GRAB | 0.00 |
| 02/19/93 | TC10 | 8.0 | 25 | 4.90 | 20.40 | 0.6 | 3.30 | GRAB | 0.00 |
| 02/20/93 | TC10 | 4.9 | 6 | 1.70 | 37.19 | 1.0 | 0.20 | GRAB | 0.00 |
| 02/21/93 | TC10 | 9.3 | 17 | 3.60 | 92.18 | 1.0 | 0.30 | 24HR | 1.07 |
| 02/22/93 | TC10 | 7.9 | 25 | 4.30 | 103.84 | 0.6 | 0.90 | 24HR | 0.00 |
| 02/23/93 | TC10 | 7.4 | 15 | 2.50 | 71.60 | 0.6 | 1.75 | 24HR | 0.00 |
| 02/24/93 | TC10 | 7.9 | 20 | 2.60 | 64.00 | 0.6 | 0.90 | 24HR | 0.00 |
| 02/25/93 | TC10 | 5.1 | 39 | 4.10 | 86.58 | 0.6 | 0.30 | 24HR | 0.22 |
| 02/26/93 | TC10 | 8.5 | 28 | 2.40 | 37.40 | 0.7 | 2.00 | 24HR | 0.39 |
| 02/27/93 | TC10 | 7.0 | 25 | 2.70 | 40.31 | 0.5 | 0.00 | GRAB | 0.00 |
| 02/28/93 | TC10 | 8.3 | 33 | 2.70 | 52.14 | 0.5 | 0.00 | 24HR | 0.00 |
| ax. |  | 11.9 |  |  | 302.16 | 1.8 | 5.35 |  | 1.07 |
| in. |  | 3.4 |  |  | 16.00 | 0.2 | 0.00 |  |  |
| verage |  | 7.6 |  |  | 78.95 | 0.8 | 1.48 |  |  |
| OTAL |  |  |  |  |  |  |  |  | ** 3.24* |

/26/93

# TUNNEL PROJECT
## NPS DAILY WATER QUALITY MONITORING DATA
## CUMBERLAND GAP NATIONAL HISTORICAL PARK

| TE | SITE | pH s.u. | TURB ntu | FLOW cfs | TSS ppm | TOT.Fe mg/l | OIL/G ppm | TYPE SAMPLE | PREC inch |
|---|---|---|---|---|---|---|---|---|---|
| 3/01/93 | TC10 | 7.1 | 5 | 2.30 | 4.00 | 0.2 | 0.63 | GRAB | 0.00 |
| /02/93 | TC10 | 9.3 | 17 | 2.50 | 24.00 | 0.4 | 0.50 | 24HR | 0.08 |
| /03/93 | TC10 | 7.3 | 21 | 1.80 | 24.10 | 0.4 | 0.00 | 24HR | 0.13 |
| 3/04/93 | TC10 | 7.7 | 27 | 3.90 | 31.90 | 0.4 | 0.00 | 24HR | 0.80 |
| 3/05/93 | TC10 | 7.3 | 12 | 3.50 | 12.00 | 0.2 | 0.50 | 24HR | 0.11 |
| /06/93 | TC10 | 7.4 | 0 | 0.00 | 15.90 | 0.4 | 0.00 | 24HR | 0.00 |
| 3/07/93 | TC10 | 8.4 | 0 | 3.40 | 8.00 | 0.3 | 0.00 | GRAB | 0.05 |
| 3/08/93 | TC10 | 7.8 | 10 | 3.40 | 8.00 | 0.3 | 0.00 | 24HR | 0.17 |
| 3/09/93 | TC10 | 7.2 | 0 | 3.25 | 3.90 | 0.5 | 0.00 | 24HR | 0.00 |
| 3/10/93 | TC10 | 7.4 | 4 | 2.50 | 0.00 | 0.3 | 0.00 | 24HR | 0.03 |
| 3/11/93 | TC10 | 7.0 | 4 | 1.80 | 4.00 | 0.3 | 0.00 | 24HR | 0.00 |
| 3/12/93 | TC10 | 7.2 | 7 | 1.30 | 7.90 | 0.4 | 0.00 | 24HR | 0.05 |
| 3/16/93 | TC10 | 7.5 | 2 | 2.60 | 4.00 | 0.4 | 0.00 | 24HR | 0.00 |
| 3/17/93 | TC10 | 7.3 | 7 | 4.40 | 11.90 | 0.3 | 1.30 | 24HR | 0.13 |
| 3/18/93 | TC10 | 7.3 | 8 | 4.30 | 0.00 | 0.3 | 0.00 | 24HR | 0.01 |
| 3/19/93 | TC10 | 7.3 | 8 | 4.10 | 15.90 | 0.3 | 3.00 | 24HR | 0.00 |
| 3/20/93 | TC10 | 7.2 | 12 | 4.40 | 22.00 | 0.4 | 0.00 | 24HR | 0.07 |
| 3/21/93 | TC10 | 8.0 | 9 | 4.80 | 10.79 | 0.3 | 0.00 | 24HR | 0.10 |
| 3/22/93 | TC10 | 7.5 | 7 | 4.70 | 3.90 | 0.1 | 0.00 | 24HR | 0.03 |
| 3/23/93 | TC10 | 10.4 | 200 | 0.00 | 171.00 | 2.3 | 0.00 | GRAB | 3.06 |
| 3/24/93 | TC10 | 9.5 | 200 | 7.90 | 16.40 | 0.3 | 0.00 | 24HR | 0.12 |
| 3/25/93 | TC10 | 7.7 | 21 | 3.80 | 119.10 | 0.4 | 0.00 | 24HR | 0.00 |
| 3/26/93 | TC10 | 7.5 | 9 | 5.80 | 12.10 | 0.4 | 3.50 | 24HR | 0.00 |
| 3/27/93 | TC10 | 7.5 | 11 | 6.20 | 55.23 | 0.7 | 0.00 | 24HR | 0.80 |
| 3/28/93 | TC10 | 7.9 | 8 | 4.60 | 13.10 | 0.2 | 0.00 | 24HR | 0.01 |
| 3/29/93 | TC10 | 7.8 | 10 | 3.10 | 8.00 | 0.3 | 0.60 | 24HR | 0.00 |
| 3/30/93 | TC10 | 7.3 | 6 | 3.50 | 8.00 | 0.2 | 1.90 | 24HR | 0.00 |
| 3/31/93 | TC10 | 7.4 | 9 | 3.80 | 12.20 | 0.3 | 0.50 | 24HR | 0.32 |
| ax. |  | 10.4 |  |  | 171.00 | 2.3 | 3.50 |  | 3.06 |
| in. |  | 7.0 |  |  | 0.00 | 0.1 | 0.00 |  |  |
| verage |  | 7.7 |  |  | 22.40 | 0.4 | 0.44 |  |  |
| OTAL |  |  |  |  |  |  |  |  | ** 6.07** |

/18/93

# TUNNEL PROJECT
# NPS DAILY WATER QUALITY MONITORING DATA
# CUMBERLAND GAP NATIONAL HISTORICAL PARK

| | SITE | pH<br>s.u. | TURB<br>ntu | FLOW<br>cfs | TSS<br>ppm | TOT.Fe<br>mg/l | OIL/G<br>ppm | TYPE<br>SAMPLE | PREC<br>inch |
|---|---|---|---|---|---|---|---|---|---|
| ==== | ===== | ==== | ==== | ====== | ======= | ====== | ===== | ==== | ==== |
| /01/93 | TC10 | 7.8 | 5 | 3.00 | 4.00 | 0.2 | 3.80 | 24HR | 0.11 |
| /02/93 | TC10 | 7.0 | 6 | 3.20 | 12.00 | 0.4 | 1.40 | 24HR | 0.21 |
| /03/93 | TC10 | 10.1 | 16 | 2.70 | 4.80 | 0.3 | 0.00 | 24HR | 0.00 |
| /04/93 | TC10 | 7.9 | 8 | 2.70 | 19.70 | 0.2 | 0.00 | 24HR | 0.00 |
| /05/93 | TC10 | 7.1 | 4 | 3.00 | 1.10 | 0.4 | 0.00 | 24HR | 0.49 |
| /06/93 | TC10 | 7.7 | 4 | 2.80 | 1.10 | 0.3 | 0.00 | 24HR | 0.03 |
| /07/93 | TC10 | 7.6 | 6 | 2.30 | 3.10 | 0.2 | 0.00 | GRAB | 0.00 |
| /08/93 | TC10 | 7.6 | 6 | 2.40 | 7.90 | 0.2 | 0.00 | 24HR | 0.00 |
| /10/93 | TC10 | 7.6 | 4 | 3.20 | 6.10 | 0.5 | 0.30 | GRAB | 0.06 |
| /11/93 | TC10 | 8.8 | 3 | 2.50 | 3.50 | 0.3 | 0.00 | 24HR | 0.00 |
| /12/93 | TC10 | 7.2 | 1 | 3.40 | 4.00 | 0.2 | 0.00 | 24HR | 0.00 |
| /13/93 | TC10 | 7.2 | 2 | 3.20 | 2.30 | 0.2 | 0.00 | 24HR | 0.00 |
| /14/93 | TC10 | 7.4 | 4 | 2.40 | 3.90 | 0.3 | 0.00 | 24HR | 0.00 |
| /15/93 | TC10 | 7.4 | 2 | 2.50 | 7.90 | 0.3 | 2.10 | 24HR | 0.17 |
| /16/93 | TC10 | 7.1 | 2 | 2.70 | 12.00 | 0.4 | 0.00 | 24HR | 0.63 |
| /17/93 | TC10 | 7.7 | 2 | 2.90 | 6.10 | 0.5 | 1.30 | GRAB | 0.01 |
| /18/93 | TC10 | 8.5 | 2 | 3.00 | 3.10 | 0.3 | 0.00 | 24HR | 0.00 |
| /19/93 | TC10 | 7.2 | 2 | 3.00 | 4.00 | 0.2 | 0.60 | 24HR | 0.00 |
| /20/93 | TC10 | 7.5 | 2 | 2.60 | 4.00 | 0.4 | 0.85 | 24HR | 0.40 |
| /21/93 | TC10 | 7.5 | 3 | 2.50 | 8.00 | 0.4 | 0.00 | 24HR | 0.43 |
| /22/93 | TC10 | 7.5 | 1 | 2.30 | 8.00 | 0.3 | 0.00 | 24HR | 0.05 |
| /23/93 | TC10 | 7.5 | 1 | 3.00 | 4.00 | 0.4 | 0.00 | 24HR | 0.00 |
| /24/93 | TC10 | 7.2 | 3 | 1.70 | 7.60 | 0.5 | 0.30 | 24HR | 0.00 |
| /25/93 | TC10 | 8.6 | 3 | 2.40 | 6.40 | 0.2 | 0.00 | 24HR | 0.00 |
| 5/93 | TC10 | 7.1 | 10 | 4.70 | 24.00 | 0.3 | 18.00 | 24HR | 0.90 |
| /27/93 | TC10 | 6.8 | 8 | 2.60 | 8.00 | 0.3 | 0.00 | 24HR | 0.00 |
| /28/93 | TC10 | 7.2 | 3 | 2.50 | 4.00 | 0.4 | 0.00 | 24HR | 0.00 |
| /29/93 | TC10 | 7.4 | 4 | 2.70 | 4.00 | 0.4 | 0.00 | 24HR | 0.00 |
| /30/93 | TC10 | 7.4 | 2 | 25.00 | 4.00 | 0.4 | 0.00 | 24HR | 0.00 |
| ******** | ******** | ******** | ******** | ******** | ******** | ******** | ******** | ******** | ******** |
| . | | 10.1 | | | 24.00 | 0.5 | 18.00 | | 0.90 |
| n. | | 6.8 | | | 1.10 | 0.2 | 0.00 | | |
| erage | | 7.6 | | | 6.50 | 0.3 | 0.99 | | |
| AL | | | | | | | | | ** 3.49** |

18/93

# TUNNEL PROJECT
# NPS DAILY WATER QUALITY MONITORING DATA
# CUMBERLAND GAP NATIONAL HISTORICAL PARK

| | SITE | pH s.u. | TURB ntu | FLOW cfs | TSS ppm | TOT.Fe mg/l | OIL/G ppm | TYPE SAMPLE | PREC inch |
|---|---|---|---|---|---|---|---|---|---|
| ===== | ===== | ==== | ==== | ====== | ======= | ====== | ===== | ==== | ==== |
| 01/93 | TC10 | 7.5 | 1 | 2.67 | 3.10 | 0.3 | 0.00 | 24HR | 0.00 |
| 02/93 | TC10 | 9.2 | 3 | 2.81 | 6.20 | 0.1 | 0.00 | GRAB | 0.00 |
| 03/93 | TC10 | 8.2 | 4 | 2.50 | 4.00 | 0.3 | 0.00 | GRAB | 0.00 |
| 04/93 | TC10 | 7.4 | 4 | 2.50 | 8.00 | 0.6 | 0.00 | 24HR | 0.36 |
| 05/93 | TC10 | 7.3 | 4 | 2.10 | 4.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 06/93 | TC10 | 7.2 | 1 | 2.30 | 0.00 | 0.6 | 0.00 | 24HR | 0.00 |
| 07/93 | TC10 | 7.2 | 1 | 2.20 | 4.00 | 0.4 | 1.50 | 24HR | 0.00 |
| 08/93 | TC10 | 8.2 | 3 | 1.80 | 10.60 | 0.6 | 0.00 | 24HR | 0.00 |
| 09/93 | TC10 | 9.1 | 2 | 2.40 | 4.00 | 0.4 | 0.00 | 24HR | 0.00 |
| 10/93 | TC10 | 7.8 | 4 | 2.20 | 28.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 11/93 | TC10 | 7.4 | 2 | 1.50 | 8.00 | 0.5 | 0.00 | 24HR | 0.00 |
| 12/93 | TC10 | 8.5 | 2 | 1.60 | 4.00 | 0.4 | 0.00 | 24HR | 0.00 |
| 13/93 | TC10 | 7.2 | 3 | 1.50 | 4.00 | 0.5 | 0.00 | 24HR | 0.34 |
| 14/93 | TC10 | 7.9 | 2 | 1.60 | 4.00 | 0.5 | 0.00 | 24HR | 0.01 |
| 15/93 | TC10 | 6.3 | 3 | 1.90 | 6.70 | 0.6 | 0.00 | 24HR | 0.00 |
| 16/93 | TC10 | 9.5 | 5 | 1.70 | 12.40 | 0.4 | 0.00 | 24HR | 0.00 |
| 17/93 | TC10 | 8.5 | 2 | 0.78 | 8.00 | 0.2 | 0.00 | 24HR | 0.05 |
| 18/93 | TC10 | 7.0 | 3 | 2.20 | 12.00 | 0.4 | 0.00 | 24HR | 0.23 |
| 19/93 | TC10 | 9.0 | 2 | 1.60 | 8.00 | 0.4 | 0.00 | GRAB | 0.72 |
| 20/93 | TC10 | 8.1 | 3 | 1.10 | 8.00 | 0.3 | 0.00 | GRAB | 0.04 |
| 21/93 | TC10 | 8.5 | 2 | 1.80 | 4.00 | 0.3 | 0.00 | 24HR | 0.26 |
| 22/93 | TC10 | 7.3 | 2 | 1.60 | 8.80 | 0.4 | 0.00 | 24HR | 0.00 |
| 23/93 | TC10 | 10.4 | 2 | 1.90 | 7.30 | 0.3 | 0.00 | 24HR | 0.00 |
| 24/93 | TC10 | 8.8 | 1 | 0.71 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 5/93 | TC10 | 7.1 | 5 | 1.20 | 4.00 | 0.3 | 0.00 | 24HR | 0.37 |
| 26/93 | TC10 | 7.1 | 2 | 1.30 | 123.50 | 0.3 | 0.00 | 24HR | 0.51 |
| 27/93 | TC10 | 10.1 | 1 | 1.06 | 4.00 | 0.5 | 0.00 | 24HR | 0.00 |
| 28/93 | TC10 | 5.9 | 2 | 0.68 | 8.00 | 0.5 | 0.00 | 24HR | 0.00 |
| 29/93 | TC10 | 8.7 | 1 | 0.00 | 6.00 | 0.5 | 0.00 | 24HR | 0.15 |
| 30/93 | TC10 | 10.4 | 1 | 2.05 | 2.00 | 0.5 | 0.00 | 24HR | 0.05 |
| 31/93 | TC10 | 9.4 | 6 | 0.81 | 3.00 | 0.2 | 0.00 | 24HR | 0.25 |
| ********** | ********** | ********** | ********** | ********** | ********** | ********** | ********** | ********** | ********** |
| | | 10.4 | | | 123.50 | 0.6 | 1.50 | | 0.72 |
| | | 5.9 | | | 0.00 | 0.1 | 0.00 | | |
| rage | | 8.1 | | | 10.25 | 0.4 | 0.05 | | |
| AL | | | | | | | | | ** 3.34** |

# TUNNEL PROJECT
# NPS DAILY WATER QUALITY MONITORING DATA
# CUMBERLAND GAP NATIONAL HISTORICAL PARK

| E | SITE | pH s.u. | TURB ntu | FLOW cfs | TSS ppm | TOT.Fe mg/l | OIL/G ppm | TYPE SAMPLE | PREC inch |
|---|---|---|---|---|---|---|---|---|---|
| 6/01/93 | TC10 | 9.1 | 2 | 1.00 | 1.00 | 0.4 | 0.00 | 24HR | 0.02 |
| 6/02/93 | TC10 | 7.1 | 1 | 1.00 | 1.00 | 0.4 | 0.00 | 24HR | 0.00 |
| /03/93 | TC10 | 6.9 | 1 | 1.20 | 12.00 | 0.6 | 0.00 | GRAB | 0.00 |
| /04/93 | TC10 | 7.2 | 1 | 0.57 | 28.00 | 0.9 | 0.00 | 24HR | 0.07 |
| 6/05/93 | TC10 | 6.7 | 2 | 1.00 | 4.60 | 0.5 | 0.00 | GRAB | 0.00 |
| /06/93 | TC10 | 10.3 | 4 | 1.50 | 12.30 | 0.6 | 0.00 | 24HR | 0.00 |
| /07/93 | TC10 | 8.7 | 1 | 1.20 | 4.00 | 0.2 | 0.00 | 24HR | 0.04 |
| 6/08/93 | TC10 | 7.3 | 3 | 1.40 | 8.00 | 3.3 | 0.00 | 24HR | 0.00 |
| 6/09/93 | TC10 | 7.2 | 3 | 1.20 | 11.80 | 0.7 | 0.00 | 24HR | 0.00 |
| /10/93 | TC10 | 7.1 | 2 | 1.60 | 4.00 | 1.3 | 0.00 | 24HR | 0.00 |
| /11/93 | TC10 | 6.7 | 3 | 1.30 | 4.00 | 0.6 | 0.00 | 24HR | 0.11 |
| 6/12/93 | TC10 | 7.8 | 4 | 0.48 | 18.60 | 0.7 | 0.00 | 24HR | 0.54 |
| /13/93 | TC10 | 10.0 | 0 | 0.00 | 0.00 | 0.2 | 0.00 | GRAB | 0.20 |
| /14/93 | TC10 | 8.9 | 4 | 1.10 | 8.00 | 0.3 | 0.00 | 24HR | 0.01 |
| 6/15/93 | TC10 | 6.5 | 4 | 1.00 | 4.00 | 3.3 | 0.00 | 24HR | 0.25 |
| /16/93 | TC10 | 7.4 | 3 | 0.92 | 8.00 | 0.8 | 0.00 | 24HR | 0.00 |
| /17/93 | TC10 | 6.2 | 1 | 1.00 | 4.00 | 0.7 | 0.00 | 24HR | 0.00 |
| 6/18/93 | TC10 | 8.8 | 1 | 1.10 | 4.00 | 0.7 | 0.00 | 24HR | 0.00 |
| /19/93 | TC10 | 8.8 | 3 | 0.00 | 0.00 | 0.6 | 1.25 | 24HR | 0.00 |
| /20/93 | TC10 | 9.9 | 7 | 0.00 | 0.02 | 0.8 | 0.00 | 24HR | 0.15 |
| /21/93 | TC10 | 8.7 | 1 | 1.20 | 4.00 | 0.3 | 0.00 | 24HR | 0.11 |
| 6/22/93 | TC10 | 7.4 | 2 | 1.10 | 12.00 | 0.5 | 0.00 | 24HR | 0.36 |
| /23/93 | TC10 | 8.6 | 1 | 1.30 | 8.00 | 0.6 | 0.90 | 24HR | 0.00 |
| 24/93 | TC10 | 8.0 | 2 | 1.30 | 12.00 | 0.6 | 2.00 | 24HR | 0.00 |
| 25/93 | TC10 | 10.2 | 3 | 0.81 | 16.00 | 0.4 | 8.30 | 24HR | 0.00 |
| /26/93 | TC10 | 7.3 | 4 | 1.40 | 6.80 | 0.3 | 0.00 | 24HR | 0.47 |
| ~~/27/93~~ | ~~TC10~~ | ~~0.0~~ | ~~0~~ | ~~0.00~~ | ~~0.00~~ | ~~0.0~~ | ~~0.00~~ |  | ~~0.00~~ |
| /27/93 | TC10 | 10.0 | 1 | 1.50 | 0.00 | 0.5 | 0.00 | 24HR | 0.00 |
| /28/93 | TC10 | 7.7 | 3 | 1.20 | 4.00 | 0.4 | 6.00 | 24HR | 0.30 |
| /29/93 | TC10 | 6.4 | 3 | 1.40 | 4.00 | 0.5 | 0.00 | 24HR | 0.01 |
| /30/93 | TC10 | 9.0 | 5 | 0.00 | 4.00 | 0.2 | 6.30 | 24HR | 0.00 |
| . |  | 10.3 |  |  | 28.00 | 3.3 | 8.30 |  | 0.54 |
| . |  | 0.0 |  |  | 0.00 | 0.0 | 0.00 |  |  |
| verage |  | 7.8 |  |  | 6.72 | 0.7 | 0.80 |  |  |
| TAL |  |  |  |  |  |  |  |  | ** 2.64** |

## NPS DAILY WATER QUALITY MONITORING DATA
## CUMBERLAND GAP NATIONAL HISTORICAL PARK

| ATE | SITE | pH s.u. | TURB ntu | FLOW cfs | TSS ppm | TOT.Fe mg/l | OIL/G ppm | TYPE SAMPLE | PREC inch |
|---|---|---|---|---|---|---|---|---|---|
| 7/01/93 | TC10 | 7.5 | 8 | 0.96 | 4.00 | 0.3 | 3.70 | GRAB | 0.72 |
| 7/02/93 | TC10 | 5.6 | 3 | 1.10 | 20.00 | 0.5 | 0.60 | 24HR | 0.00 |
| 7/03/93 | TC10 | 7.1 | 4 | 1.90 | 4.60 | 0.8 | 0.00 | GRAB | 0.00 |
| 7/04/93 | TC10 | 10.2 | 1 | 1.50 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 7/05/93 | TC10 | 8.7 | 1 | 1.40 | 0.00 | 0.1 | 0.00 | 24HR | 0.00 |
| 7/06/93 | TC10 | 7.3 | 12 | 2.00 | 4.00 | 0.2 | 2.00 | 24HR | 0.00 |
| 7/07/93 | TC10 | 7.9 | 2 | 1.00 | 4.00 | 0.4 | 0.05 | 24HR | 0.00 |
| 7/08/93 | TC10 | 7.9 | 3 | 1.30 | 4.00 | 0.6 | 1.30 | 24HR | 0.00 |
| 7/09/93 | TC10 | 7.0 | 4 | 0.98 | 4.00 | 0.4 | 0.00 | 24HR | 0.09 |
| 7/10/93 | TC10 | 6.5 | 5 | 1.27 | 12.30 | 0.6 | 0.60 | 24HR | 0.02 |
| 7/11/93 | TC10 | 8.9 | 3 | 1.10 | 12.00 | 0.6 | 0.00 | 24HR | 0.25 |
| 7/12/93 | TC10 | 7.3 | 5 | 1.20 | 16.00 | 0.6 | 0.00 | 24HR | 0.00 |
| 7/13/93 | TC10 | 6.5 | 3 | 1.10 | 4.00 | 0.4 | 0.00 | 24HR | 0.12 |
| 7/14/93 | TC10 | 6.8 | 3 | 1.10 | 4.00 | 0.5 | 0.00 | 24HR | 0.20 |
| 7/15/93 | TC10 | 7.4 | 1 | 0.72 | 4.00 | 0.9 | 0.00 | 24HR | 0.78 |
| 7/16/93 | TC10 | 7.5 | 2 | 0.00 | 4.00 | 1.2 | 0.00 | 24HR | 0.00 |
| 7/17/93 | TC10 | 7.0 | 1 | 2.20 | 5.60 | 0.4 | 0.00 | 24HR | 0.00 |
| 7/18/93 | TC10 | 10.3 | 15 | 2.00 | 8.00 | 0.4 | 0.00 | 24HR | 0.90 |
| 7/19/93 | TC10 | 7.9 | 8 | 0.50 | 8.00 | 0.3 | 0.00 | 24HR | 0.00 |
| 7/20/93 | TC10 | 7.2 | 2 | 1.00 | 3.00 | 0.4 | 0.00 | 24HR | 0.39 |
| 7/21/93 | TC10 | 7.2 | 3 | 0.50 | 6.00 | 0.5 | 0.00 | 24HR | 0.00 |
| 7/22/93 | TC10 | 6.9 | 3 | 0.90 | 8.00 | 0.4 | 0.00 | 24HR | 0.00 |
| 7/23/93 | TC10 | 7.0 | 2 | 0.40 | 2.00 | 0.4 | 0.00 | 24HR | 0.00 |
| 7/24/93 | TC10 | 7.1 | 0 | 0.00 | 7.70 | 0.3 | 0.00 | 24HR | 0.00 |
| 7/25/93 | TC10 | 10.6 | 1 | 1.90 | 4.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 7/26/93 | TC10 | 7.9 | 1 | 1.60 | 1.00 | 0.4 | 0.00 | 24HR | 0.00 |
| 7/27/93 | TC10 | 6.7 | 4 | 2.05 | 4.80 | 0.5 | 0.00 | 24HR | 0.00 |
| 7/28/93 | TC10 | 7.1 | 2 | 1.80 | 7.60 | 0.0 | 0.00 | 24HR | 0.00 |
| 7/29/93 | TC10 | 7.1 | 3 | 1.70 | 5.98 | 0.3 | 0.00 | 24HR | 0.00 |
| 7/30/93 | TC10 | 7.4 | 2 | 1.40 | 4.40 | 0.0 | 0.00 | 24HR | 0.00 |
| 7/31/93 | TC10 | 7.1 | 2 | 1.70 | 5.20 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/01/93 | TC10 | 9.8 | 2 | 1.50 | 4.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/02/93 | TC10 | 7.7 | 12 | 3.10 | 19.50 | 0.0 | 0.00 | 24HR | 0.57 |
| 8/03/93 | TC10 | 7.6 | 3 | 1.10 | 4.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/04/93 | TC10 | 7.4 | 3 | 1.00 | 4.00 | 0.0 | 0.00 | 24HR | 0.10 |
| 8/05/93 | TC10 | 7.4 | 2 | 0.90 | 4.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/06/93 | TC10 | 7.2 | 1 | 2.20 | 2.00 | 0.0 | 0.00 | 24HR | 0.48 |
| 8/07/93 | TC10 | 6.7 | 4 | 1.30 | 13.70 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/08/93 | TC10 | 7.6 | 0 | 1.60 | 4.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/09/93 | TC10 | 7.9 | 3 | 0.91 | 0.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/10/93 | TC10 | 7.8 | 3 | 0.90 | 4.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/11/93 | TC10 | 7.6 | 2 | 1.00 | 4.00 | 0.0 | 0.00 | 24HR | 1.03 |
| 8/12/93 | TC10 | 7.5 | 2 | 1.80 | 0.00 | 0.0 | 0.00 | 24HR | 1.28 |
| 8/13/93 | TC10 | 7.5 | 0 | 1.50 | 12.00 | 0.0 | 0.00 | 24HR | 1.09 |
| 8/14/93 | TC10 | 7.5 | 8 | 1.90 | 14.20 | 0.0 | 0.00 | 24HR | 0.02 |
| 8/15/93 | TC10 | 7.6 | 2 | 2.20 | 7.20 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/16/93 | TC10 | 7.8 | 2 | 1.00 | 4.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/17/93 | TC10 | 6.7 | 3 | 0.70 | 0.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/18/93 | TC10 | 7.1 | 4 | 0.30 | 8.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/19/93 | TC10 | 7.2 | 2 | 0.50 | 4.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/20/93 | TC10 | 7.0 | 2 | 1.00 | 0.00 | 0.0 | 0.00 | 24HR | 0.32 |
| 8/21/93 | TC10 | 7.0 | 3 | 1.10 | 3.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/22/93 | TC10 | 7.2 | 4 | 1.30 | 3.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/23/93 | TC10 | 8.0 | 2 | 1.00 | 2.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/24/93 | TC10 | 7.5 | 1 | 1.10 | 4.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 8/25/93 | TC10 | 7.5 | 2 | 1.00 | 3.00 | [illegible] | 0.00 | 24HR | 0.01 |

NO DATA

## NPS DAILY WATER QUALITY MONITORING DATA
## CUMBERLAND GAP NATIONAL HISTORICAL PARK

| ATE | SITE | pH<br>s.u. | TURB<br>ntu | FLOW<br>cfs | TSS<br>ppm | TOT.Fe<br>mg/l | OIL/G<br>ppm | TYPE<br>SAMPLE | PREC<br>inch |
|---|---|---|---|---|---|---|---|---|---|
| /26/93 | TC10 | 7.3 | 2 | 1.00 | 3.00 | 0.0 | 0.00 | 24HR | 0.03 |
| /27/93 | TC10 | 7.2 | 2 | 0.90 | 3.00 | 0.0 | 0.00 | 24HR | 0.00 |
| /28/93 | TC10 | 7.4 | 0 | 0.00 | 7.30 | 0.0 | 0.00 | 24HR | 0.00 |
| /29/93 | TC10 | 7.8 | 2 | 1.40 | 11.90 | 0.0 | 0.00 | 24HR | 0.00 |
| /30/93 | TC10 | 7.9 | 0 | 1.20 | 8.00 | 0.0 | 0.00 | 24HR | 0.00 |
| /31/93 | TC10 | 7.5 | 0 | 0.90 | 4.00 | 0.2 | 0.00 | 24HR | 0.00 |
| /01/93 | tc10 | 7.3 | 3 | 0.90 | 7.90 | 0.2 | 0.00 | 24hr | 0.00 |
| /02/93 | TC10 | 7.5 | 4 | 1.00 | 4.10 | 0.2 | 0.00 | 24HR | 0.08 |
| /03/93 | TC10 | 7.4 | 3 | 1.10 | 4.00 | 0.0 | 0.00 | 24HR | 0.05 |
| /04/93 | TC10 | 7.9 | 7 | 1.60 | 10.80 | 0.4 | 0.00 | 24HR | 0.42 |
| /05/93 | TC10 | 8.7 | 3 | 1.50 | 4.80 | 0.3 | 0.00 | 24HR | 0.00 |
| /06/93 | TC10 | 8.4 | 0 | 1.70 | 1.60 | 0.3 | 0.00 | GRAB | 0.00 |
| /07/93 | TC10 | 7.7 | 2 | 1.50 | 16.00 | 0.2 | 0.00 | 24HR | 0.00 |
| /08/93 | TC10 | 7.6 | 3 | 1.20 | 12.00 | 0.3 | 0.00 | 24HR | 0.78 |
| /09/93 | TC10 | 7.4 | 8 | 0.95 | 4.00 | 0.4 | 0.00 | 24HR | 0.00 |
| /10/93 | TC10 | 7.5 | 0 | 0.92 | 4.90 | 0.4 | 0.00 | 24HR | 0.00 |
| /11/93 | TC10 | 7.4 | 6 | 1.40 | 9.01 | 0.4 | 0.00 | 24HR | 0.00 |
| /12/93 | TC10 | 7.8 | 5 | 1.20 | 4.10 | 0.3 | 0.00 | 24HR | 0.00 |
| /13/93 | TC10 | 8.3 | 2 | 1.20 | 4.10 | 0.3 | 0.00 | 24HR | 0.00 |
| /14/93 | TC10 | 7.1 | 0 | 0.00 | 4.00 | 0.5 | 0.00 | 24HR | 0.00 |
| /15/93 | TC10 | 7.1 | 0 | 0.00 | 0.00 | 0.5 | 0.00 | 24HR | 0.35 |
| /16/93 | TC10 | 7.3 | 0 | 0.90 | 4.10 | 0.5 | 0.00 | 24HR | 0.64 |
| /17/93 | TC10 | 7.2 | 0 | 0.00 | 0.00 | 0.5 | 0.00 | 24HR | 0.00 |
| /18/93 | TC10 | 7.5 | 0 | 1.60 | 8.30 | 0.4 | 0.00 | 24HR | 0.00 |
| /19/93 | TC10 | 7.7 | 0 | 1.40 | 12.00 | 0.3 | 0.00 | 24HR | 0.00 |
| /20/93 | TC10 | 7.9 | 2 | 0.84 | 8.10 | 0.2 | 0.00 | 24HR | 0.00 |
| /21/93 | TC10 | 7.5 | 3 | 0.63 | 0.00 | 0.3 | 0.00 | 24HR | 0.00 |
| /22/93 | TC10 | 7.8 | 3 | 0.82 | 8.70 | 0.3 | 0.00 | 24HR | 0.00 |
| /23/93 | TC10 | 7.6 | 2 | 0.90 | 4.00 | 0.4 | 0.00 | 24HR | 0.02 |
| /24/93 | TC10 | 7.6 | 9 | 1.00 | 4.00 | 0.5 | 3.90 | 24HR | 0.00 |
| /25/93 | TC10 | 7.6 | 0 | 1.40 | 2.40 | 0.3 | 3.00 | 24HR | 0.30 |
| /26/93 | TC10 | 8.0 | 14 | 1.60 | 7.90 | 0.3 | 0.30 | 24HR | 0.60 |
| /27/93 | TC10 | 8.0 | 7 | 1.50 | 3.90 | 0.2 | 0.00 | 24HR | 0.43 |
| /28/93 | TC10 | 7.6 | 9 | 0.80 | 4.00 | 0.3 | 3.50 | 24HR | 0.00 |
| /29/93 | TC10 | 7.6 | 0 | 0.69 | 0.00 | 0.2 | 2.60 | 24HR | 0.00 |
| /30/93 | TC10 | 7.5 | 0 | 0.75 | 4.00 | 0.3 | 2.00 | 24HR | 0.00 |
| x. |  | 10.6 |  |  | 20.00 | ~~1.2~~ | 3.90 |  | 1.28 |
| n. |  | 5.6 |  |  | 0.00 | ~~0.0~~ | 0.00 |  |  |
| erage |  | 7.6 |  |  | 5.54 | ~~0.2~~ | 0.26 |  |  |
| TAL |  |  |  |  |  |  |  |  | **12.06** |

NPS DAILY WATER QUALITY MONITORING DATA
CUMBERLAND GAP NATIONAL HISTORICAL PARK

| TE<br>====== | SITE<br>===== | pH<br>s.u.<br>==== | TURB<br>ntu<br>==== | FLOW<br>cfs<br>====== | TSS<br>ppm<br>======= | TOT.Fe<br>mg/l<br>====== | OIL/G<br>ppm<br>===== | TYPE<br>SAMPLE<br>==== | PREC<br>inch<br>==== |
|---|---|---|---|---|---|---|---|---|---|
| /01/93 | TC10 | 7.6 | 0 | 0.72 | 4.00 | 0.3 | 0.00 | 24HR | 0.00 |
| /03/93 | TC10 | 7.9 | 3 | 1.20 | 0.00 | 0.2 | 0.00 | 24HR | 0.35 |
| /04/93 | TC10 | 8.0 | 3 | 1.30 | 4.00 | 0.2 | 0.00 | 24HR | 0.00 |
| /05/93 | TC10 | 7.7 | 4 | 1.10 | 4.00 | 0.2 | 0.00 | 24HR | 0.00 |
| /06/93 | TC10 | 7.4 | 10 | 1.50 | 7.90 | 0.3 | 0.00 | 24HR | 0.00 |
| /07/93 | TC10 | 7.3 | 1 | 0.67 | 8.00 | 0.2 | 0.00 | 24HR | 0.00 |
| /08/93 | TC10 | 7.5 | 0 | 0.80 | 7.30 | 0.2 | 2.00 | 24HR | 0.00 |
| /09/93 | TC10 | 7.5 | 4 | 0.80 | 3.70 | 0.1 | 3.00 | 24HR | 0.78 |
| /10/93 | TC10 | 8.1 | 30 | 1.10 | 4.00 | 0.4 | 0.30 | 24HR | 1.07 |
| /11/93 | TC10 | 8.0 | 11 | 0.98 | 23.90 | 0.3 | 0.00 | 24HR | 0.00 |
| /12/93 | TC10 | 8.1 | 7 | 1.10 | 4.00 | 0.2 | 0.00 | 24HR | 0.36 |
| /13/93 | TC10 | 7.7 | 6 | 1.00 | 0.00 | 0.2 | 0.60 | 24HR | 0.00 |
| /14/93 | TC10 | 7.5 | 6 | 0.90 | 4.00 | 0.3 | 0.30 | 24HR | 0.00 |
| /15/93 | TC10 | 7.5 | 0 | 0.89 | 4.00 | 0.3 | 0.00 | 24HR | 0.00 |
| /16/93 | TC10 | 7.1 | 7 | 1.60 | 5.70 | 0.2 | 0.30 | GRAB | 0.05 |
| 17/93 | TC10 | 7.6 | 0 | 1.20 | 4.00 | 0.3 | 0.00 | 24HR | 0.09 |
| 18/93 | TC10 | 8.3 | 5 | 0.89 | 7.90 | 0.2 | 0.30 | 24HR | 0.10 |
| 19/93 | TC10 | 7.8 | 0 | 1.20 | 4.00 | 0.3 | 0.00 | 24HR | 0.08 |
| 20/93 | TC10 | 7.8 | 0 | 1.10 | 12.10 | 0.2 | 0.00 | 24HR | 0.00 |
| 21/93 | TC10 | 8.0 | 0 | 1.80 | 12.90 | 0.4 | 2.50 | 24HR | 0.34 |
| 22/93 | TC10 | 8.1 | 10 | 0.00 | 14.50 | 0.4 | 2.00 | 24HR | 0.00 |
| 23/93 | TC10 | 8.1 | 10 | 0.00 | 9.90 | 0.4 | 4.00 | 24HR | 0.00 |
| 24/93 | TC10 | 8.1 | 0 | 0.00 | 7.60 | 0.2 | 0.00 | GRAB | 0.00 |
| 25/93 | TC10 | 8.3 | 1 | 0.00 | 8.20 | 0.3 | 2.00 | 24HR | 0.00 |
| 26/93 | TC10 | 8.0 | 4 | 1.20 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 27/93 | TC10 | 7.8 | 10 | 0.00 | 8.00 | 0.3 | 3.30 | 24HR | 0.00 |
| 28/93 | TC10 | 7.9 | 6 | 0.00 | 4.00 | 0.3 | 0.00 | 24HR | 0.00 |
| 29/93 | TC10 | 7.7 | 9 | 0.65 | 8.00 | 0.3 | 4.50 | 24HR | 0.00 |
| 01/93 | TC10 | 8.1 | 0 | 1.10 | 0.00 | 0.3 | 0.00 | 24HR | 0.09 |
| 02/93 | TC10 | 7.8 | 0 | 1.10 | 3.90 | 0.6 | 0.00 | GRAB | 0.00 |
| 03/93 | TC10 | 7.8 | 0 | 1.00 | 8.20 | 0.2 | 0.00 | GRAB | 0.00 |
| 04/93 | TC10 | 7.9 | 4 | 0.00 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| 05/93 | TC10 | 7.8 | 0 | 0.00 | 4.00 | 0.2 | 0.00 | 24HR | 0.30 |
| 06/93 | TC10 | 7.9 | 0 | 0.84 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 07/93 | TC10 | 8.0 | 0 | 0.80 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 08/93 | TC10 | 7.5 | 0 | 0.00 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 09/93 | TC10 | 7.7 | 0 | 0.85 | 0.00 | 0.2 | 0.00 | 24HR | 0.02 |
| 10/93 | TC10 | 7.8 | 0 | 0.76 | 4.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 11/93 | TC10 | 6.9 | 5 | 1.30 | 4.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 12/93 | TC10 | 7.0 | 4 | 0.70 | 0.00 | 0.3 | 0.00 | 24HR | 0.00 |
| 13/93 | TC10 | 8.2 | 0 | 1.70 | 9.30 | 0.2 | 0.00 | 24HR | 0.01 |
| 14/93 | TC10 | 8.1 | 0 | 0.00 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 15/93 | TC10 | 8.0 | 0 | 0.58 | 7.90 | 0.3 | 0.00 | 24HR | 0.90 |
| 16/93 | TC10 | 8.0 | 3 | 0.70 | 0.00 | 0.2 | 0.00 | 24HR | 0.08 |
| 17/93 | TC10 | 7.6 | 3 | 1.00 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 18/93 | TC10 | 8.1 | 0 | 0.90 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 22/93 | TC10 | 7.8 | 0 | 1.00 | 0.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 23/93 | TC10 | 8.1 | 4 | 0.90 | 0.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 24/93 | TC10 | 8.2 | 3 | 0.80 | 0.00 | 0.0 | 0.00 | 24HR | 0.00 |
| 28/93 | TC10 | 8.2 | 0 | 1.10 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 29/93 | TC10 | 8.3 | 0 | 0.00 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 30/93 | TC10 | 8.2 | 0 | 0.00 | 0.00 | 0.2 | 0.00 | 24HR | 0.00 |
| 01/93 | TC10 | 8.3 | 0 | 0.00 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| 02/93 | TC10 | 7.9 | 0 | 1.10 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| 05/93 | TC10 | 7.5 | 0 | 4.30 | 0.00 | 0.0 | 0.00 | GRAB | 0.82 |
| 06/93 | TC10 | 7.9 | 0 | [illegible] | 4.00 | 0.2 | 0.00 | GRAB | [illegible] |

NPS DAILY WATER QUALITY MONITORING DATA
CUMBERLAND GAP NATIONAL HISTORICAL PARK

|  | SITE | pH<br>s.u. | TURB<br>ntu | FLOW<br>cfs | TSS<br>ppm | TOT.Fe<br>mg/l | OIL/G<br>ppm | TYPE<br>SAMPLE | PREC<br>inch |
|---|---|---|---|---|---|---|---|---|---|
| === | ===== | ==== | ==== | ====== | ======= | ====== | ===== | ==== | ==== |
| /93 | TC10 | 7.7 | 0 | 1.20 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| /93 | TC10 | 8.0 | 0 | 0.83 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| /93 | TC10 | 7.9 | 0 | 0.90 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| /93 | TC10 | 7.7 | 0 | 1.20 | 8.00 | 0.2 | 0.00 | GRAB | 0.81 |
| /93 | TC10 | 8.0 | 1 | 131.40 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| /93 | TC10 | 7.9 | 0 | 0.87 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| /93 | .TC10 | 8.0 | 0 | 1.00 | 0.00 | 0.2 | 0.00 | GRAB | 0.08 |
| /93 | TC10 | 8.1 | 0 | 1.10 | 0.00 | 0.2 | 0.00 | GRAB | 0.20 |
| /93 | TC10 | 7.6 | 0 | 0.82 | 4.00 | 0.2 | 0.00 | GRAB | 0.00 |
| /93 | TC10 | 7.5 | 0 | 0.73 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| /93 | TC10 | 7.5 | 0 | 0.80 | 0.00 | 0.2 | 0.00 | GRAB | 0.88 |
| /93 | TC10 | 7.6 | 0 | 0.72 | 0.00 | 0.2 | 0.00 | GRAB | 0.00 |
| /93 | TC10 | 7.6 | 1 | 1.10 | 0.00 | 0.0 | 0.00 | GRAB | 0.00 |
| /93 | TC10 | 7.9 | 4 | 1.00 | 2.00 | 0.0 | 0.00 | 24HR | 0.00 |
| /93 | TC10 | 8.1 | 20 | 1.10 | 20.00 | 0.0 | 0.00 | 24HR | 0.48 |

***********************************************************************

|  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|
|  |  | 8.3 |  |  | 23.90 | 0.6 | 4.50 |  | 1.07 |
|  |  | 6.9 |  |  | 0.00 | 0.0 | 0.00 |  |  |
| ge |  | 7.8 |  |  | 3.73 | 0.2 | 0.35 |  |  |

** 7.91**