

**LEVEL ONE WATER-QUALITY INVENTORY AND MONITORING**  
**PETERSBURG NATIONAL BATTLEFIELD (PETE), VIRGINIA**

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U.S. Geological Survey  
1730 East Parham Road  
Richmond, Virginia 2322

## INTRODUCTION

The U.S. Geological Survey conducted a Level 1 Water-Quality Inventory and Monitoring (WAQIM) data-collection effort for Petersburg National Battlefield (PETE) from September 1998 through June 1999. The primary objective of the WAQIM program was to provide the National Park Service (NPS) and PETE with at least a nominal inventory of its natural resources and to provide those data in a data-management system consistent with park management needs. Water-quality inventory data (physical, chemical, and biological) were collected from "key" water bodies within the boundaries of PETE. The key water bodies are those waters within park boundaries that are essential to the central cultural, historical or natural resources management themes of the parks or provide habitats to threatened or endangered plants and animals. Data were collected during four different seasons (Fall, Winter, Spring, and Summer) over a range of hydrologic conditions. Because of the drought conditions that persisted during the study period, variations in flow between seasons were less pronounced than during normal hydrologic conditions.

Petersburg National Battlefield (PETE), which commemorates the final decisive campaign of the Civil War, comprises 2,460 acres primarily located on the eastern side of Petersburg, Virginia (fig. 4). The park contains three perennial streams: Harrison Creek, Poor Creek, and Hatchers Run. Harrison Creek and Poor Creek are located in the main unit of the park, although, the headwaters of both creeks are located outside of the park's south boundary. Both streams flow across the main unit of the park, flow out of the park across its north boundary, and flow into the Appomattox River less than 2 miles north of the park. Land use adjacent to the boundary of the main unit of the park ranges from forested to heavily urbanized. Hatchers Run flows along the northern boundary of the Five Forks unit of the park, which is located about 12 miles southwest of Petersburg, and drains a forested and agricultural watershed.

Threats to water-quality in the park include urban development along the boundaries of the main unit of the park and agricultural activity in the Hatchers Run watershed. The primary water-quality threats include increased nutrient loading and bacteriological contamination of the streams in the park. Parameters most sensitive to these potential water-quality threats include nutrients and bacteria. Data-collection sites and the parameters analyzed were selected based on the spatial distribution of land-use activities inside and immediately outside of the park's boundaries and the nature of the potential threats to park water-quality.

The waterbodies within PETE are classified by the Virginia Department of Environmental Quality's Water Quality Standards (1997) as Class III Nontidal Waters. The waters are designated for recreational uses, such as swimming, and the propagation and growth of a balanced, indigenous population of aquatic life, including game fish if

they can reasonably be expected to inhabit them. Numerical criteria for dissolved oxygen, temperature, pH, metals, and fecal coliform bacteria apply to these waters.

## **DESCRIPTION OF INVENTORY PROCESS**

### **Site Descriptions**

The water-quality inventory for PETE included the periodic collection of physical, chemical, and microbiological data from two sites on Harrison Creek, two sites on Poor Creek (fig. 1) and one site on Hatchers Run (fig. 2). These sites are: (1) Harrison Creek at Siege Road at Petersburg, Va (02041758), (2) Harrison Creek at Highway 36 at Petersburg, Va (02041760), (3) Poor Creek at Highway 460 at Petersburg, Va (02041748), (4) Poor Creek near Blandford Cemetery at Petersburg, Va (02041748), and (5) Hatchers Run at Route 627 near Five Forks, Va (02046265).

Harrison Creek at Siege Road at Petersburg, VA (02041758) is located approximately 50 feet downstream from Siege Road in the main unit of the park. Stream width is typically less than 8 feet. The surrounding area is moderately wooded. Access is via Siege Road, approximately 1.3 miles from Visitor Center. Harrison Creek at Highway 36 at Petersburg, Va (02041760) is located at the north boundary of the main unit of the park approximately 150 feet downstream from Highway 36. Stream width is typically less than 8 feet. The surrounding area is moderately wooded. Access is via Highway 36, approximately 0.5 miles east of the park entrance. Poor Creek at Highway 460 at Petersburg, Va (02041748) is located immediately south of the main unit's south boundary approximately 45 feet downstream from US 460. Stream width is typically less than 8 feet. The surrounding area is moderately wooded. Access is via Siege Road, approximately 2.85 miles from Visitor Center. Poor Creek near Blandford Cemetery at Petersburg, Va (02041748) is located in main unit of park near the park's northwest boundary. Stream width is typically less than 15 feet. The surrounding area is moderately wooded. Access is via Siege Road, approximately 1.55 miles inside of PETE and through Colquit's Salient. Hatchers Run at Route 627 near Five Forks, VA (02046265) is located in the Five Forks unit of the park approximately 30 feet downstream from State Route 627. Stream width is typically less than 15 feet. The surrounding area includes lightly wooded stream banks, beaver activity, light rural development, and agriculture. Access is from State Route 627, southeast of US460, approximately 20 miles southwest of Petersburg City.

### **Description of Data Collection**

Data-collection activities were conducted in September and December 1998 and February and June 1999 (table 1). Data-collection and analysis were conducted according to standard USGS protocols (U.S. Geological Survey, 1997, 1998, 1999; Rantz and others, 1982). Stream water-quality samples were collected as point samples or cross-sectional depth-integrated samples, depending on streamflow conditions. Discharge, water temperature, pH, specific conductivity, dissolved oxygen, and alkalinity were measured at every site on every visit. Water samples were collected and analyzed for nutrients and bacteria at every site on every visit. Samples were collected and analyzed for major ion

and trace element analysis on one visit. Also, during each data-collection trip, quality control/quality assurance (QA/QC) samples were collected and analyzed to insure data quality. Field blanks and duplicate samples were routinely employed for all analytical methods.

### **PRINCIPAL INVESTIGATORS**

The principal investigators of the WAQIM program included staff of the U.S. Geological Survey (USGS), Water Resources Division (WRD) district office in Richmond, Virginia. Michael E. Lewis, Supervisory Hydrologist, supervised all work. J. Michael Gearheart, Hydrologic Technician, implemented all fieldwork. All water-quality samples collected as part of the inventory, with the exception of bacteriological samples, were submitted for analysis to the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado. Bacteriological samples were processed by field personnel at each site and analyzed in the Richmond, Virginia office of the USGS.

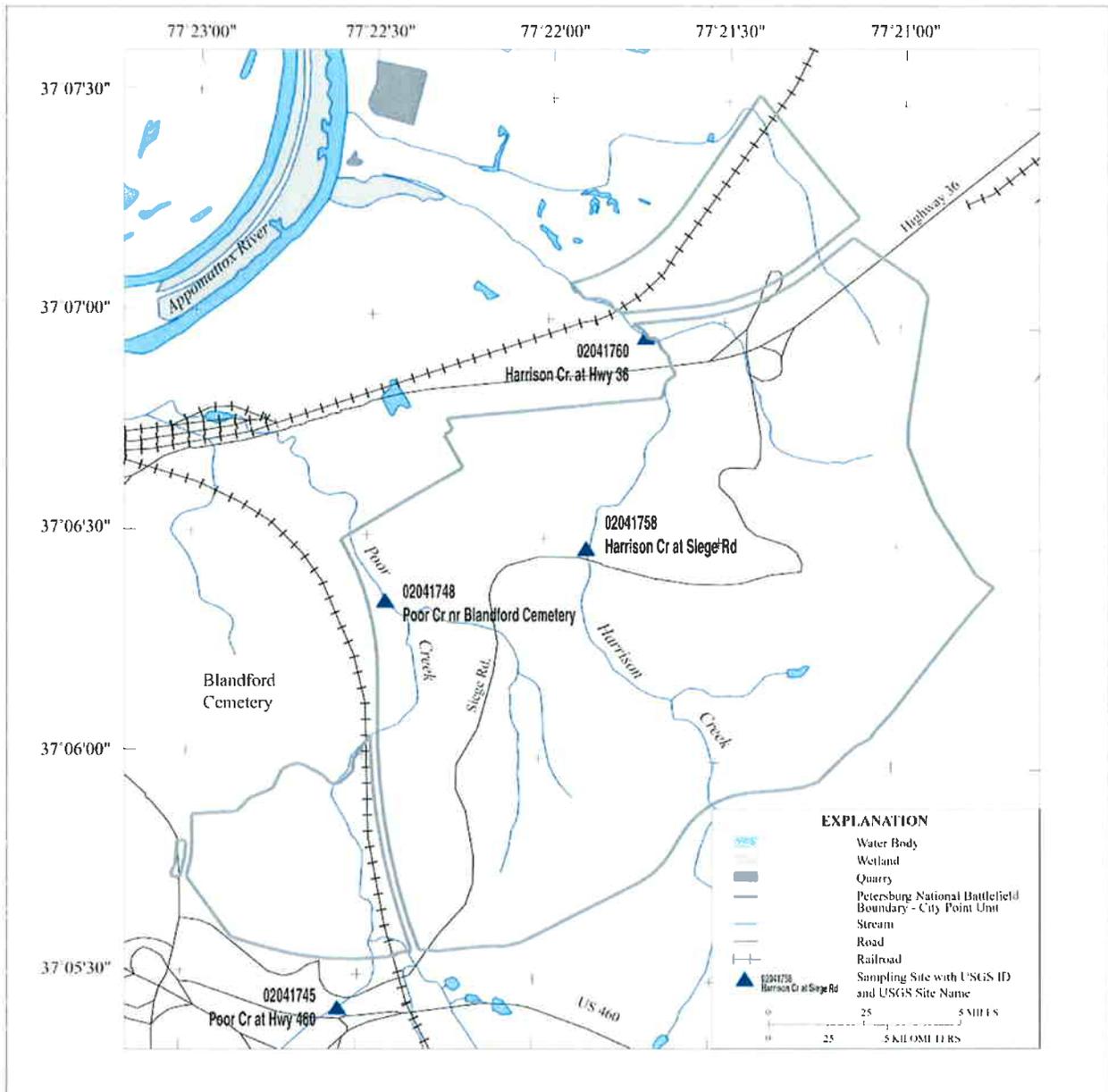


Figure 1. Map of main unit study area and data-collection sites.

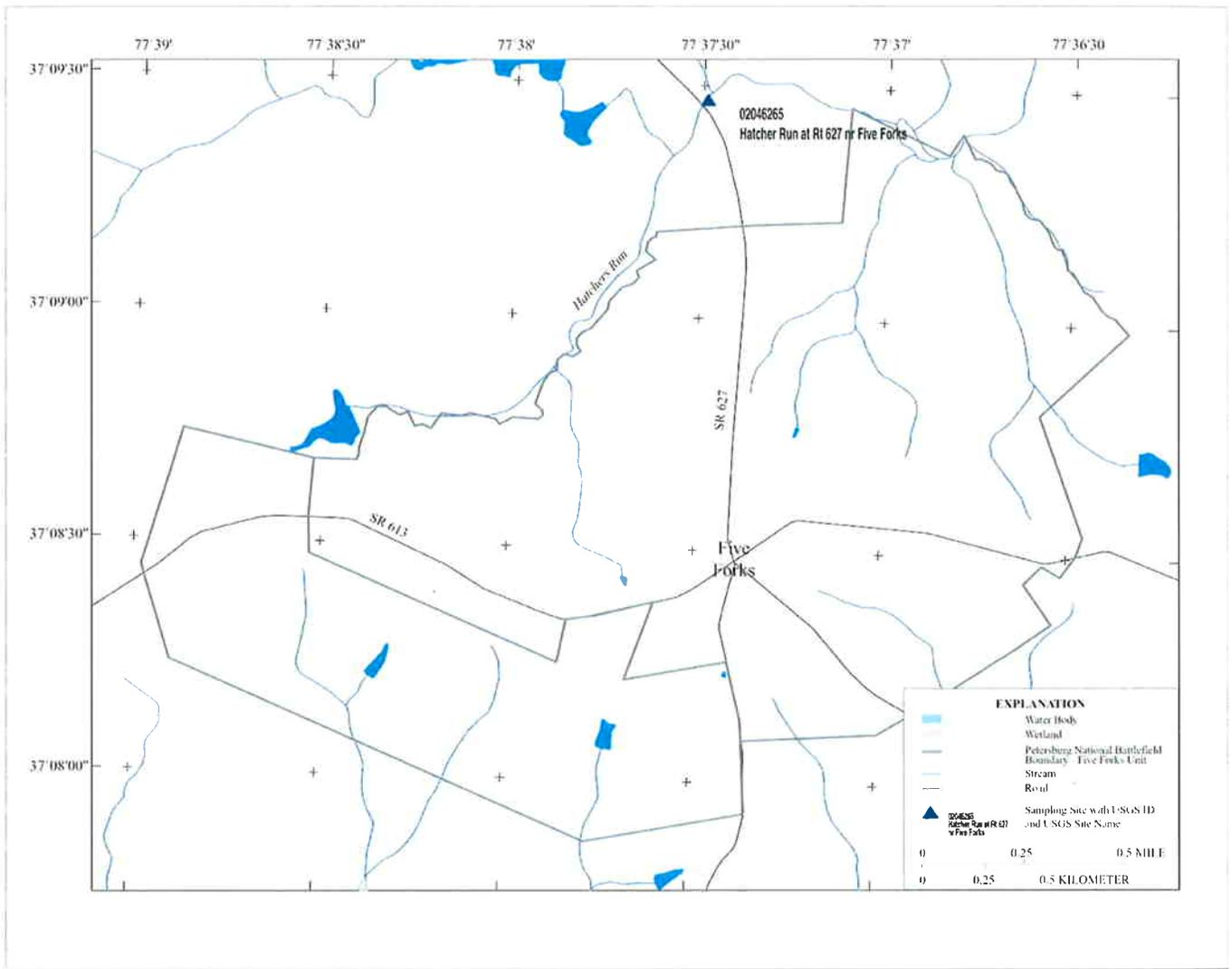


Figure 2. Map of Five Forks unit study area and data-collection sites.

Table 1. Data-collection schedule

Parameter	Data collection period			
	September 1998	December 1998	February 1999	June 1999
Field parameters	X	X	X	X
Fecal bacteria	X	X	X	X
Nutrients	X	X	X	X
Major Ions	X			
Trace elements				X

## WATER-QUALITY RESULTS

Tables 2-6 provide all physical, microbiological, and chemical data collected as part of the APCO WAQIM project. All data are also provided in a Microsoft Excel spreadsheet (WQDATA.XLS). In addition to the water-quality data spreadsheet, three additional supporting documents are included on the attached 3.5-inch diskette: (1) PARAMETER.DOC; (2) STATION.XLS; AND (3) README.DOC.

“PARAMETER.DOC” is a Microsoft Word file that explicitly defines each water-quality parameter included in the following tables and in the water-quality data spreadsheet.

“STATION.XLS” is a Microsoft Excel file that contains specific location data for each site where water-quality data was collected. “README.DOC” is a Microsoft Word file that contains basic information related to the project such as contact information for those who conducted the work and analyzed the samples.

Applicable State of Virginia water quality criteria are provided in Table xx. No samples for cadmium, lead, copper, mercury, nickel, selenium, silver, zinc or ammonia exceeded their respective acute or chronic criteria for the protection of freshwater life. The field parameters of temperature and pH were also within their respective criteria.

Criteria exceedences were observed for fecal coliform bacteria and dissolved oxygen. The one-time fecal coliform bacteria body contact recreation criteria of 1000 colonies per 100 ml of water was exceeded at least once at three of the five inventory locations, with the highest bacterial concentration of 20,000 colonies per 100 ml of water recorded in a sample collected Poor Creek at Hiway 460 on 12/09/98. One dissolved oxygen measurement of 3.6 mg per liter collected on Hatchers Run at Rt. 627 on 06/22/99 fell below the 4.0 mg per liter minimum criteria for this parameter.

Table 2. Field parameter data

[ft<sup>3</sup>/s, cubic feet per second; °C, degrees Celsius;  $\mu$  S/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter; mg/L as CaCO<sub>3</sub>, milligrams per liter as calcium carbonate]

Date	Time	Discharge (ft <sup>3</sup> /s)	Water temperature (°C) Criterion = 32 maximum	pH (units) Criterion = 6.0-9.0	Specific conductance ( $\mu$ S/cm)	Dissolved oxygen (mg/L) Criterion = 4.0 minimum	Alkalinity (mg/L as CaCO <sub>3</sub> )
<b>Harrison Creek at Siege Rd at Petersburg, VA (02041758)</b>							
Sept 9, 1998	12:30	0.001	18.0	7.5	143	8.2	46
Dec 8, 1998	11:15	0.02	15.7	7.5	180	7.7	53
Feb 9, 1999	11:35	0.33	6.3	7.8	184	12.4	38
June 22, 1999	9:35	0.120	17.8	6.8	149	8.2	50.2
<b>Harrison Creek at Hwy 36 at Petersburg, VA (02041760)</b>							
Sept 9, 1998	9:30	0.10	17.3	6.8	81	7.5	30
Dec 8, 1998	8:45	0.14	16.1	6.7	81	6.7	20
Feb 9, 1999	13:50	0.58	9.5	7.3	138	10.6	29
June 22, 1999	12:00	0.179	18.2	6.8	103	6.6	30.5
<b>Poor Creek at Hwy 460 at Petersburg, VA (02041745)</b>							
Sept 10, 1998	10:00	0.09	19.2	7.4	185	7.5	39
Dec 9, 1998	10:00	1.2	13.0	6.9	84	9.3	12
Feb 10, 1999	9:30	0.14	7.5	7.6	305	11.3	44
June 23, 1999	10:30	0.026	17.9	7.2	217	6.9	51.0
<b>Poor Creek near Blandford Cemetery at Petersburg, VA (02041748)</b>							
Sept 9, 1998	15:30	0.10	18.6	7.3	163	8.0	40
Dec 8, 1998	13:30	0.07	16.1	7.5	240	7.8	62
Feb 10, 1999	12:25	0.65	9.1	7.5	241	11.8	27
June 23, 1999	13:00	0.133	19.4	7.6	183	7.0	44.0
<b>Hatchers Run at Rt 627 nr Five Forks, VA (02046265)</b>							
Sept 10, 1998	13:10	0.03	22.3	6.6	79	5.1	11
Dec 9, 1998	13:20	0.54	13.4	6.2	117	5.4	10
Feb 9, 1999	9:00	3.5	5.9	6.3	51	8.3	6
June 22, 1999	14:45	3.68	21.0	6.2	53	3.6	13.2

Table 3. Bacteria data.

[col/100 ml; colonies per 100 milliliters; e, estimated value; >, greater than; K, non-ideal colony count]

Date	Time	Total coliform (col/100 ml)	Fecal coliform (col/100 ml) Criterion <sup>1</sup> 200/1000	Fecal streptococcus (col/100 ml)
<b>Harrison Creek at Siege Rd at Petersburg, VA (02041758)</b>				
Sept 9, 1998	12:30	650	520	500
Dec 8, 1998	11:15	770	430	1,000
Feb 9, 1999	11:35	190	23K	85K
June 22, 1999	9:35	620	620	2,500
<b>Harrison Creek at Hwy 36 at Petersburg, VA (02041760)</b>				
Sept 9, 1998	9:30	>270	1,100	540
Dec 8, 1998	8:45	140K	65K	630
Feb 9, 1999	13:50	1,200	40K	48K
June 22, 1999	12:00	1,600	400	940
<b>Poor Creek at Hwy 460 at Petersburg, VA (02041745)</b>				
Sept 10, 1998	10:00	2,700K	2,000K	650
Dec 9, 1998	10:00	20,000K	20,000K	10,000
Feb 10, 1999	9:30	1,300	>180	690
June 23, 1999	10:30	4,300	1,475K	1,120
<b>Poor Creek near Blandford Cemetery at Petersburg, VA (02041748)</b>				
Sept 9, 1998	15:30	1,900K	>210	1,200
Dec 8, 1998	13:30	3,000	110K	300
Feb 10, 1999	12:25	450	39K	35K
June 23, 1999	13:00	3,100	260	350
<b>Hatchers Run at Rt 627 nr Five Forks, VA (02046265)</b>				
Sept 10, 1998	13:10	450	450	8K
Dec 9, 1998	13:20	7,500	5,800	2,500
Feb 9, 1999	9:00	940	30K	36K
June 22, 1999	14:45	6,100	177	1,060

<sup>1</sup> Except for shellfish waters, fecal coliform concentrations shall not exceed a geometric mean of 200 colonies per 100 ml of water for two or more samples over a 30-day period, or a fecal coliform level of 1,000 per 100 ml at any one time.

Table 4. Nutrient data

[mg/L, milligrams per liter; N, nitrogen; P, phosphorous; &lt; less than; e, estimated value]

Date	Time	Nitrogen, nitrite, dissolved (mg/L as N)	Nitrogen, nitrate + nitrite, dissolved (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrogen, ammonia + organic, total (mg/L as N) Criterion <sup>2</sup> 12.25 (Acute) 2.13 (Chronic)	Nitrogen, ammonia + organic, dissolved (mg/L as N)
<b>Harrison Creek at Siege Rd at Petersburg, VA (02041758)</b>						
Sept 9, 1998	12:30	<0.010	<0.050	<0.020	0.24	0.17
Dec 8, 1998	11:15	<0.01	<0.05	<0.02	0.2	0.2
Feb 9, 1999	11:35	<0.01	<0.05	<0.02	0.2	0.1
June 22, 1999	9:35	<0.01	0.08	0.03	0.3	0.2
<b>Harrison Creek at Hwy 36 at Petersburg, VA (02041760)</b>						
Sept 9, 1998	9:30	<0.010	0.081	0.085	0.15	0.13
Dec 8, 1998	8:45	<0.01	0.06	0.03	0.2	0.1
Feb 9, 1999	13:50	<0.01	<0.05	0.04	0.2	0.1
June 22, 1999	12:00	<0.01	0.08	0.06	0.3	0.2
<b>Poor Creek at Hwy 460 at Petersburg, VA (02041745)</b>						
Sept 10, 1998	10:00	0.031	0.316	0.410	0.65	0.63
Dec 9, 1998	10:00	0.01	0.27	0.07	0.5	0.5
Feb 10, 1999	9:30	<0.01	0.2	0.04	0.3	0.2
June 23, 1999	10:30	0.01	0.22	0.04	0.4	0.3
<b>Poor Creek near Blandford Cemetery at Petersburg, VA (02041748)</b>						
Sept 9, 1998	15:30	0.01	0.185	0.205	0.35	0.33
Dec 8, 1998	13:30	<0.01	<0.05	<0.02	0.2	0.2
Feb 10, 1999	12:25	<0.01	0.11	0.03	0.2	0.1
June 23, 1999	13:00	<0.01	0.12	0.03	0.3	0.2
<b>Hatchers Run at Rt 627 nr Five Forks, VA (02046265)</b>						
Sept 10, 1998	13:10	<0.010	<0.050	0.04	0.83	0.53
Dec 9, 1998	13:20	<0.01	0.09	<0.02	0.4	0.4
Feb 9, 1999	9:00	<0.01	<0.05	<0.02	0.3	0.3
June 22, 1999	14:45	<0.01	<0.05	<0.02	0.7	0.5

<sup>2</sup> Converted to mg/l ammonia as N, and derived for representative temperature and pH of 15 degrees C and 7.5 S.U., respectively

Table 4. Nutrient data--Continued.

[mg/L, milligrams per liter; N, nitrogen; P, phosphorous; &lt; less than; e, estimated value]

Date	Time	Phosphorus, total (mg/L as P)	Phosphorus, dissolved (mg/L as P)	Orthophosphate, dissolved (mg/L as P)
<b>Harrison Creek at Siege Rd at Petersburg, VA (02041758)</b>				
Sept 9, 1998	12:30	0.046	<0.010	0.019
Dec 8, 1998	11:15	0.05e	0.03e	0.03
Feb 9, 1999	11:35	0.0132	0.0052	<0.01
June 22, 1999	9:35	0.037	0.02	0.02
<b>Harrison Creek at Hwy 36 at Petersburg, VA (02041760)</b>				
Sept 9, 1998	9:30	0.036	0.029	0.029
Dec 8, 1998	8:45	0.08	<0.05	0.02
Feb 9, 1999	13:50	0.024	0.0151	0.02
June 22, 1999	12:00	0.053	0.022	0.03
<b>Poor Creek at Hwy 460 at Petersburg, VA (02041745)</b>				
Sept 10, 1998	10:00	0.085	0.058	0.061
Dec 9, 1998	10:00	0.08	0.07	0.08
Feb 10, 1999	9:30	0.0219	0.0054	<0.01
June 23, 1999	10:30	0.064	0.015	0.02
<b>Poor Creek near Blandford Cemetery at Petersburg, VA (02041748)</b>				
Sept 9, 1998	15:30	0.05	0.048	0.028
Dec 8, 1998	13:30	0.05e	<0.05	0.02
Feb 10, 1999	12:25	0.018	<0.004	<0.01
June 23, 1999	13:00	0.04	0.015	0.02
<b>Hatchers Run at Rt 627 nr Five Forks, VA (02046265)</b>				
Sept 10, 1998	13:10	0.034	<0.010	<0.010
Dec 9, 1998	13:20	0.03e	<0.05	0.01
Feb 9, 1999	9:00	0.015	0.006	<0.01
June 22, 1999	14:45	0.063	0.009	<0.01

Table 5. Major-element data.  
[mg/l, milligrams per liter; --, no data]

Date	Time	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity (mg/L as CaCO <sub>3</sub> )	Sulfate, dissolved (mg/L as SO <sub>4</sub> )
<b>Harrison Creek at Siege Rd at Petersburg, VA (02041758)</b>							
Sept 9, 1998	12:30	18	2.0	5.9	2.8	49	8.5
Dec 8, 1998	11:15	--	--	--	--	--	--
Feb 9, 1999	11:35	--	--	--	--	--	--
June 22, 1999	9:35	--	--	--	--	--	--
<b>Harrison Creek at Hwy 36 at Petersburg, VA (02041760)</b>							
Sept 9, 1998	9:30	6.9	1.2	4.5	2.1	30	2.7
Dec 8, 1998	8:45	--	--	--	--	--	--
Feb 9, 1999	13:50	--	--	--	--	--	--
June 22, 1999	12:00	--	--	--	--	--	--
<b>Poor Creek at Hwy 460 at Petersburg, VA (02041745)</b>							
Sept 10, 1998	10:00	20	2.7	8.4	3.0	42	16
Dec 9, 1998	10:00	--	--	--	--	--	--
Feb 10, 1999	9:30	--	--	--	--	--	--
June 23, 1999	10:30	--	--	--	--	--	--
<b>Poor Creek near Blandford Cemetery at Petersburg, VA (02041748)</b>							
Sept 9, 1998	15:30	17	3.0	7.2	3.0	39	18
Dec 8, 1998	13:30	--	--	--	--	--	--
Feb 10, 1999	12:25	--	--	--	--	--	--
June 23, 1999	13:00	--	--	--	--	--	--
<b>Hatchers Run at Rt 627 nr Five Forks, VA (02046265)</b>							
Sept 10, 1998	13:10	4.5	1.5	5.1	2.3	12	13
Dec 9, 1998	13:20	--	--	--	--	--	--
Feb 9, 1999	9:00	--	--	--	--	--	--
June 22, 1999	14:45	--	--	--	--	--	--

Table 5. Major-element data—Continued.  
 [mg/l, milligrams per liter, <, less than; --no data]

Date	Time	Chloride, dissolved (mg/l as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO <sub>2</sub> )
<b>Harrison Creek at Siege Rd at Petersburg, VA (02041758)</b>				
Sept 9, 1998	12:30	7.3	0.15	16
Dec 8, 1998	11:15	--	--	--
Feb 9, 1999	11:35	--	--	--
June 22, 1999	9:35	--	--	--
<b>Harrison Creek at Hwy 36 at Petersburg, VA (02041760)</b>				
Sept 9, 1998	9:30	6.8	<0.10	18
Dec 8, 1998	8:45	--	--	--
Feb 9, 1999	13:50	--	--	--
June 22, 1999	12:00	--	--	--
<b>Poor Creek at Hwy 460 at Petersburg, VA (02041745)</b>				
Sept 10, 1998	10:00	14	0.69	17
Dec 9, 1998	10:00	--	--	--
Feb 10, 1999	9:30	--	--	--
June 23, 1999	10:30	--	--	--
<b>Poor Creek near Blandford Cemetery at Petersburg, VA (02041748)</b>				
Sept 9, 1998	15:30	10	0.48	19
Dec 8, 1998	13:30	--	--	--
Feb 10, 1999	12:25	--	--	--
June 23, 1999	13:00	--	--	--
<b>Hatchers Run at Rt 627 nr Five Forks, VA (02046265)</b>				
Sept 10, 1998	13:10	4.3	0.12	10
Dec 9, 1998	13:20	--	--	--
Feb 9, 1999	9:00	--	--	--
June 22, 1999	14:45	--	--	--

Table 6. Trace-element data.

[ $\mu$  g/L, micrograms per liter; <, less than; --, no data]

Date	Time	Aluminum, total ( $\mu$ g/L as Al)	Arsenic, total ( $\mu$ g/L as As)	Barium, total ( $\mu$ g/L as Ba)	Beryllium, total ( $\mu$ g/L as Ba)	Cadmium, total ( $\mu$ g/L as Cd) Criterion* 3.9 (Acute) 1.1 (Chronic)	Chromium, total ( $\mu$ g/L as Cr)	Cobalt, total ( $\mu$ g/ L as Co)	Copper, total ( $\mu$ g/L as Cu) Criterion* 18 (Acute) 12 (Chronic)	Iron, total ( $\mu$ g/ L as Fe)
<b>Harrison Creek at Siege Rd at Petersburg, VA (02041758)</b>										
Sept 9, 1998	12:30	--	--	--	--	--	--	--	--	--
Dec 8, 1998	11:15	--	--	--	--	--	--	--	--	--
Feb 9, 1999	11:35	--	--	--	--	--	--	--	--	--
June 22, 1999	9:35	84.3	1	46.0	<4	<1	<1.0	<1	1	783
<b>Harrison Creek at Hwy 36 at Petersburg, VA (02041760)</b>										
Sept 9, 1998	9:30	--	--	--	--	--	--	--	--	--
Dec 8, 1998	8:45	--	--	--	--	--	--	--	--	--
Feb 9, 1999	13:50	--	--	--	--	--	--	--	--	--
June 22, 1999	12:00	47.9	1	38.3	<4	<1	<1.0	1	2	975
<b>Poor Creek at Hwy 460 at Petersburg, VA (02041745)</b>										
Sept 10, 1998	10:00	--	--	--	--	--	--	--	--	--
Dec 9, 1998	10:00	--	--	--	--	--	--	--	--	--
Feb 10, 1999	9:30	--	--	--	--	--	--	--	--	--
June 23, 1999	10:30	69.8	<1	39.5	<4	<1	<1.0	1	1	926
<b>Poor Creek near Blandford Cemetery at Petersburg, VA (02041748)</b>										
Sept 9, 1998	15:30	--	--	--	--	--	--	--	--	--
Dec 8, 1998	13:30	--	--	--	--	--	--	--	--	--
Feb 10, 1999	12:25	--	--	--	--	--	--	--	--	--
June 23, 1999	13:00	67.2	1	39.4	<4	<1	<1.0	<1	1	739
<b>Hatchers Run at Rt 627 nr Five Forks, VA (02046265)</b>										
Sept 10, 1998	13:10	--	--	--	--	--	--	--	--	--
Dec 9, 1998	13:20	--	--	--	--	--	--	--	--	--
Feb 9, 1999	9:00	--	--	--	--	--	--	--	--	--
June 22, 1999	14:45	137	2	44.0	<4	1	1.5	2	3	6,690

Table 6. Trace-element data—Continued.

[ $\mu$  g/L, micrograms per liter; <, less than; --, no data]

Date	Time	Lead, total ( $\mu$ g/L as Pb) Criterion * 120 (Acute) 14 (Chronic)	Lithium, total ( $\mu$ g/L as Li)	Manganese total ( $\mu$ g/L as Mn)	Mercury, total ( $\mu$ g/L as Hg) Criterion 2.4 (Acute) 0.12 (Chronic)	Molyb- denum, total ( $\mu$ g/ L as Mo)	Nickel, total ( $\mu$ g/L as Ni) Criterion* 180 (Acute) 20 (Chronic)	Selenium, total ( $\mu$ g/L as Se) Criterion* 20(Acute) 5.0 (Chronic)	Silver, total ( $\mu$ g/L as Ag) Criterion* 4.1 (Acute)	Zinc, total ( $\mu$ g/L as Zn) Criterion 120 (Acute) 110 (Chronic)
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**Harrison Creek at Siege Rd at Petersburg, VA (02041758)**

Sept 9, 1998	12:30	--	--	--	--	--	--	--	--	--
Dec 8, 1998	11:15	--	--	--	--	--	--	--	--	--
Feb 9, 1999	11:35	--	--	--	--	--	--	--	--	--
June 22, 1999	9:35	<1	<12	37.9	<0.1	1.2	<1	<1	<1	<40

**Harrison Creek at Hwy 36 at Petersburg, VA (02041760)**

Sept 9, 1998	9:30	--	--	--	--	--	--	--	--	--
Dec 8, 1998	8:45	--	--	--	--	--	--	--	--	--
Feb 9, 1999	13:50	--	--	--	--	--	--	--	--	--
June 22, 1999	12:00	<1	<12	105	<0.1	<1.0	1	1	<1	<40

**Poor Creek at Hwy 460 at Petersburg, VA (02041745)**

Sept 10, 1998	10:00	--	--	--	--	--	--	--	--	--
Dec 9, 1998	10:00	--	--	--	--	--	--	--	--	--
Feb 10, 1999	9:30	--	--	--	--	--	--	--	--	--
June 23, 1999	10:30	<1	<12	64.9	<0.1	<1.0	2	<1	<1	<40

**Poor Creek near Blandford Cemetery at Petersburg, VA (02041748)**

Sept 9, 1998	15:30	--	--	--	--	--	--	--	--	--
Dec 8, 1998	13:30	--	--	--	--	--	--	--	--	--
Feb 10, 1999	12:25	--	--	--	--	--	--	--	--	--
June 23, 1999	13:00	<1	<12	39.7	<0.1	1	2	<1	<1	<40

**Hatchers Run at Rt 627 nr Five Forks, VA (02046265)**

Sept 10, 1998	13:10	--	--	--	--	--	--	--	--	--
Dec 9, 1998	13:20	--	--	--	--	--	--	--	--	--
Feb 9, 1999	9:00	--	--	--	--	--	--	--	--	--
June 22, 1999	14:45	<1	<12	421	<0.1	<1.0	<1	<1	<1	<40

\* Criteria based on hardness equal to 100 mg/l CaCO<sub>3</sub> and Water Effect Ratio of 1

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