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Assessment of Sedimentation in Crowders Creek, York County, South Carolina, 1999–2000

U.S. Geological Survey
Open-File Report 00-378

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

Errata sheet for
U.S. Geological Survey Open-File Report 00-378
"Assessment of Sedimentation in Crowders Creek, York County, South Carolina, 1999-2000"

The underwater contours shown on the Lake Wylie topographic quadrangle (U.S. Geological Survey, 1973, revised 1993) were drawn from maps obtained from Duke Energy Corporation (formerly Duke Power Company). These maps (dated January 1, 1925) were produced for Duke Power Company in 1924, prior to the enlargement of Lake Wylie dam, which was completed in 1926. Therefore, changes in the volume of Crowders Creek cove available for water storage were actually determined from a comparison of 1924 topographic data with 1999 bathymetric data. Please note this on pages 1, 4, 6, and 13 of the report.

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By Douglas D. Nagle

U.S. GEOLOGICAL SURVEY

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Columbia, South Carolina
2000

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Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
yard (yd)	0.9144	meter
square mile (mi^2)	2.590	square kilometer
cubic foot (ft^3)	28.32	cubic decimeter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic yard (yd^3)	0.7646	cubic meter
ton per day (ton/d)	0.9072	metric ton per day

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Concentrations of chemical constituents in sediment are given in micrograms per gram (µg/g), micrograms per kilogram (µg/kg), or percent.

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ABSTRACT

Sedimentation in Crowders Creek cove in Lake Wylie, located in York County, South Carolina, has restricted boat navigation and made a boat ramp unusable. To provide baseline information, the U.S. Geological Survey, in cooperation with the York County Council, collected bathymetric and bed-sediment data in the cove, and streamflow and suspended-sediment data in a free-flowing reach of Crowders Creek.

Bathymetric data from a survey of the cove made in November 1999 were compared with bathymetric data derived from a 1973 U.S. Geological Survey topographic map. It was determined that at water-surface elevation of 568 feet, the volume of the cove available for water storage had decreased 90 percent, from 1.3 million cubic yards in 1973 to 135,000 cubic yards in 1999.

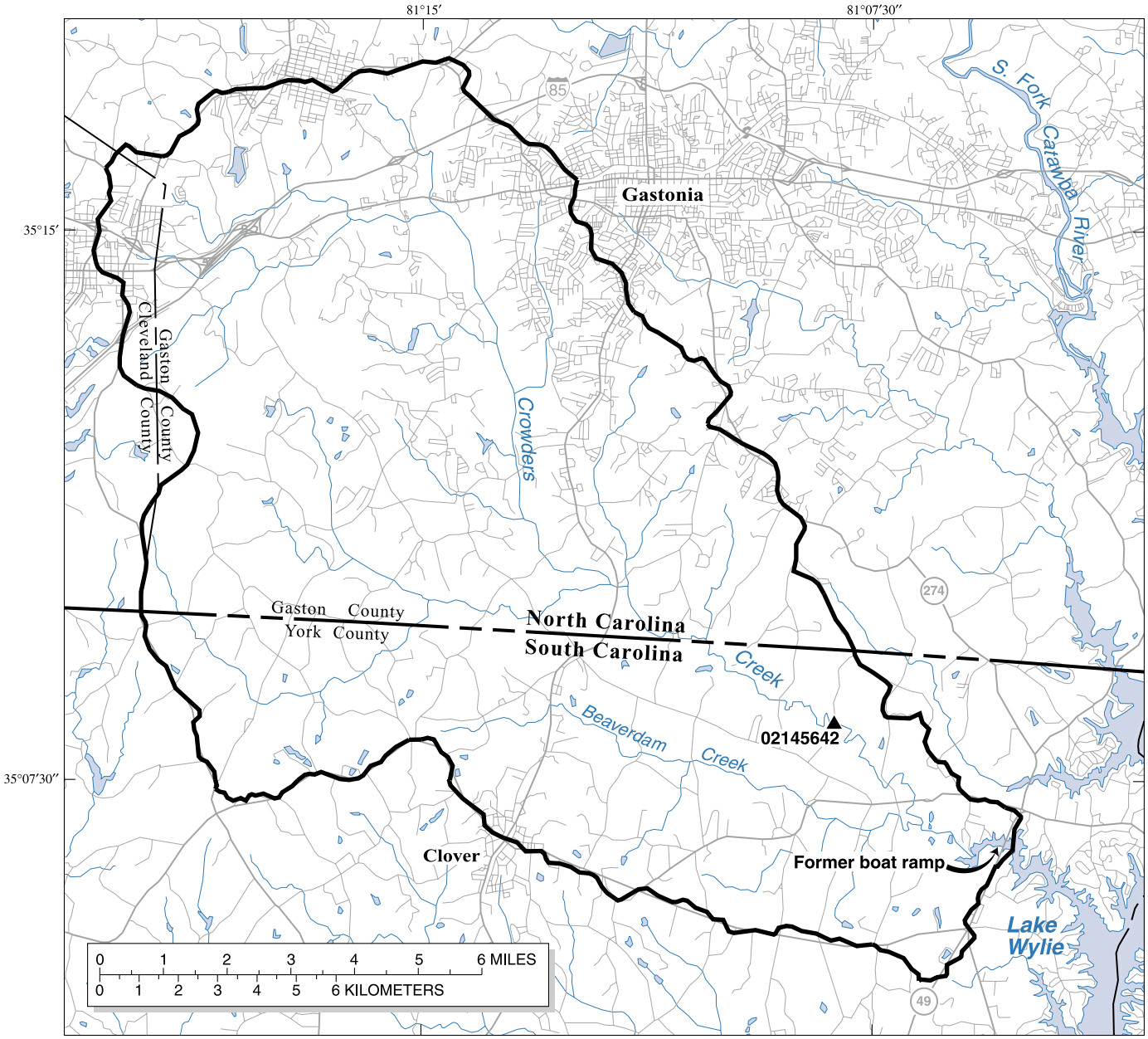
Continuous water-level and streamflow data were collected at a U.S. Geological Survey stream-gaging station on Crowders Creek near Clover, South Carolina, for the period October 1, 1999, to April 30, 2000. Suspended-sediment concentration data were collected at four sites on February 14, 2000. The maximum instantaneous streamflow recorded during this event was 864 cubic feet per second, and the largest suspended-sediment load was calculated to be 2,120 tons per day.

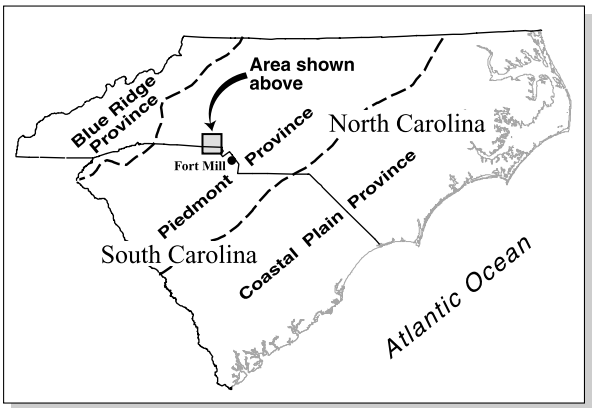
Bed-sediment samples were collected at four locations in the study area: one in the lower reach of Crowders Creek and three in the cove. These samples were analyzed for a total of 44 trace elements, 29 organochlorine pesticides, degradation products and polychlorinated biphenyls, and for particle-size distribution. None of the trace element concentrations exceeded guidelines for the concentrations above which adverse effects on stream biota are expected to occur. Two of 29 organochlorine pesticides were detected—p,p'-DDT at 11 micrograms per kilogram was detected at one site, and p,p'-DDE at 3.2 micrograms per kilogram was detected at another site. Particle-size analyses at these four sampling sites indicated that at least 60 percent of the sediments are smaller than 0.063 millimeter, which indicates the sediment is composed mostly of silts and clays.

INTRODUCTION

Anecdotal accounts indicate that sedimentation has increased in Crowders Creek cove in Lake Wylie, S.C., over the past 10 to 15 years. This sedimentation has restricted boat navigation and rendered a boat ramp unusable upstream from the State highway 49–274 bridge (fig. 1).

In addition to limiting recreational opportunities in the cove, increased suspended sediment can have detrimental effects on the aquatic community. Sediment that accumulates on the substrate will block sunlight from reaching photosynthetic organisms. As a result, these organisms will cease producing oxygen causing them to die. In turn, organisms that depend on photosynthetic organisms for food will then begin to die. In addition, sedimentation can cover habitat areas that are used for shelter and foraging by macroinvertebrates, causing their death by suffocation. These macroinvertebrates are the major source of food for





EXPLANATION

- Lake or pond
- Crowders Creek Basin boundary
- State boundary
- County boundary
- Stream
- Primary highway
- Secondary highway
- ▲02145642 USGS stream-gaging station

Figure 1. Crowders Creek Basin in North and South Carolina.

larger macroinvertebrates and small fish. Sedimentation also decreases the area available for fish to lay eggs and reduces the percentage of successful egg hatching. Finally, transported sediment may include adsorbed metals and organic compounds that can have toxic effects on biota.

In 1999, the U.S. Geological Survey (USGS), in cooperation with York County Council, initiated a study to make a preliminary environmental investigation of sediment quantity and quality in Crowders Creek cove. Data collected from this study can be used by York County as a baseline for future investigations and to assist in determining remedial activities.

Purpose and Scope

The purpose of this report is to document the extent and progression of sedimentation in Crowders Creek cove in Lake Wylie, S.C. The report also provides streamflow and suspended-sediment data for Crowders Creek upstream from the backwater effects of Lake Wylie, and bed-sediment data from four sites in Crowders Creek cove.

The scope of this study includes the free-flowing reach of Crowders Creek upstream from Lake Wylie and the cove formed where Crowders Creek flows into Lake Wylie. Suspended-sediment loads entering the cove from Crowders Creek were estimated for a high-flow event. Bed-sediment samples from four locations were analyzed for selected trace elements, organochlorine pesticides, and for particle-size distribution. Identification of possible sources of sediment, metals, or pesticides was beyond the scope of this study.

Previous Studies

The USGS, in cooperation with the York County Council, presented water-quality data for Crowders Creek during two low-flow events and two high-flow events (Gissendanner, 1994). These data showed that fecal coliform concentrations exceeded South Carolina Department of Health and Environmental Control (SCDHEC) 1992 standards for freshwater. Additional analyses indicated that 19 selected physical and chemical constituents met SCDHEC standards. Samples of suspended sediment indicated relatively high sediment concentrations in Crowders Creek during high-flow events. From data collected at USGS gaging station 02145642, Crowders Creek near Clover, S.C. (fig. 1), Gissendanner (1994) calculated sediment loads for low streamflows of 30 cubic feet per second (ft^3/s) and 33 ft^3/s at 1.1 tons per day (tons/d) and 0.09 ton/d, respectively. Sediment loads for high streamflows of 520 ft^3/s and 500 ft^3/s were calculated at 1,680 tons/d and 652 tons/d, respectively. For these four events, particle-size distribution analysis indicated that from 86 to 100 percent of the suspended sediment was silt- and clay-size particles less than 0.063 millimeter (mm) in diameter.

In addition, the SCDHEC presented water- and bed-sediment quality data collected during the period 1989–93 (South Carolina Department of Health and Environmental Control, 1996). In Crowders Creek, the SCDHEC measured high concentrations of zinc in both the sediment and in the water. In Crowders Creek cove, the pesticides, p,p'-DDT, p,p'-DDD, aldrin, eldrin, and parathion, and the fungicide, hexachlorobenzene, were detected in sediment. Lead, copper, and zinc also were detected at high concentrations in sediment samples.

In 1999, the SCDHEC presented water- and bed-sediment quality data for the period 1994–98 and compared these data to data collected during the period 1989–93. In Crowders Creek, the SCDHEC did not detect metals or pesticides in water or sediment, but did list the sites as impaired for recreational uses due to fecal coliform bacteria excursions (South Carolina Department of Health and Environmental Control, 1999).

In Crowders Creek cove, the SCDHEC measured high concentrations of zinc in the water, and high concentrations of zinc and copper in the sediment. In addition, the pesticides, PCB-1248 and p,p'-DDT, were detected in sediment samples. The cove also is listed as impaired for recreational uses due to fecal coliform bacteria excursions (South Carolina Department of Health and Environmental Control, 1999).

Description of Study Area

The Crowders Creek Basin is located in the Piedmont Physiographic Province of North Carolina and South Carolina (fig. 1). The Piedmont Province is primarily composed of fractured crystalline rock and metamorphosed volcanic rock (Miller, 1990). Alluvial deposits of sand, silt, and clay are present along the valley floors. Streamflows are more variable in the Piedmont Province than in other physiographic areas of the State. Land cover in the watershed includes forested (62.3 percent), agricultural (12.3 percent), water (11.0 percent), shrub (9.2 percent), urban (3.8 percent), and barren (1.3 percent) (South Carolina Department of Health and Environmental Control, 1996).

Crowders Creek drains an area of 115 square miles at its confluence with Lake Wylie, which is the oldest lake on the Catawba River. The lake was created in 1904 by constructing a dam on the Catawba River near Fort Mill, S.C. Although the lake is used primarily to generate hydroelectric power (Gissendanner, 1994), it also serves as a water-supply reservoir for the cities of Rock Hill, Tega Cay, and Fort Mill, S.C., and for York County, S.C.

DATA COLLECTION AND ANALYTICAL METHODS

Data collected for this study include (1) current (1999) bathymetric data for Crowders Creek cove, (2) water-level (stage), streamflow, and suspended-sediment data for Crowders Creek, and (3) bed sediment quality and particle-size data for Crowders Creek and the cove (fig. 2). All bed-sediment quality data-collection methods followed standard USGS National Water-Quality Assessment Program (NAWQA) protocols (Arbogast, 1996). Bed-sediment samples were composited into representative samples and sent to the USGS National Water Quality Laboratory in Denver, Colorado, for analysis of trace elements and organic compounds (Foreman and others, 1995). Suspended-sediment samples were sent to the USGS Iowa District Sediment Laboratory in Iowa City, Iowa, for a suspended sediment sand/fine break analysis. Particle-size distribution samples were sent to the USGS Sediment Analysis Laboratory in Vancouver, Washington, for dry sieve and sedigraph analysis. Results of analyses are presented in the following sections.

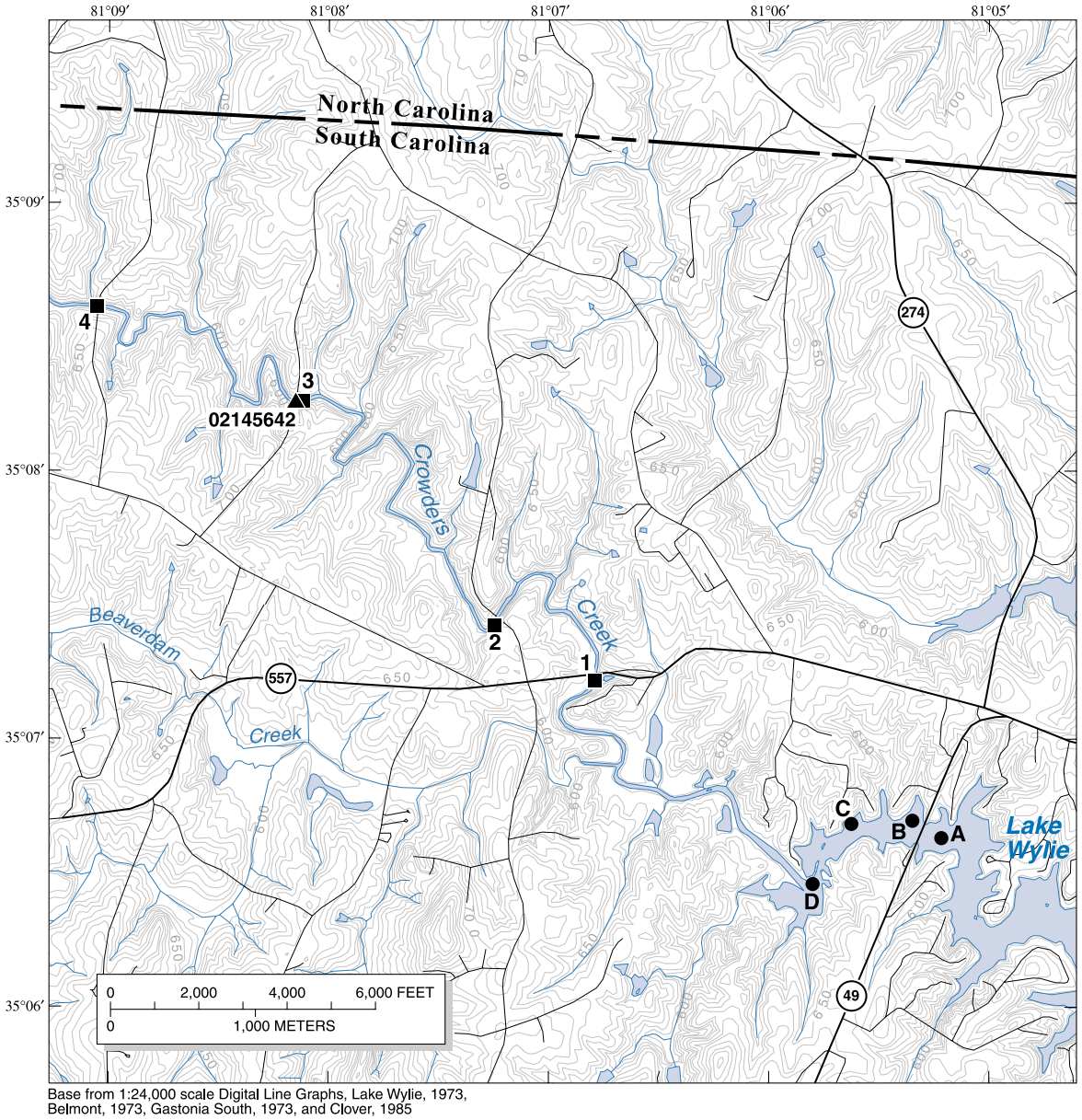
Bathymetric Data

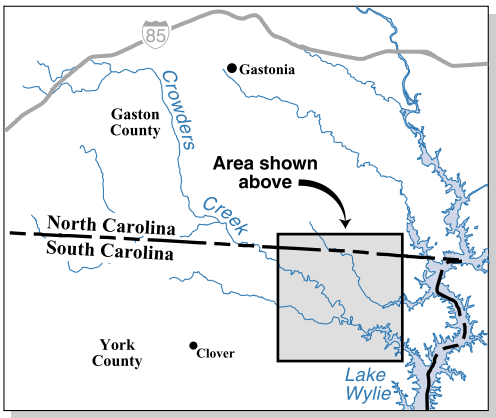
Bathymetric data obtained from a USGS topographic map (U.S. Geological Survey, 1973) were used to produce the contour map shown in figure 3. Bathymetric data were collected in November 1999 by using a Global Positioning System (GPS) receiver and data-logger interfaced with a boat-mounted sonic fathometer. The horizontal coordinates obtained by the GPS receiver were matched to the depths obtained with the fathometer by time-tagging the two measurements. Contours were then created from the data by using contouring and three-dimensional surface-mapping software (Golden Software, Inc., 1996). The bathymetric contours created from data collected in November 1999 are shown in figure 4.

Estimates of the volume of the cove were computed from the 1973 and 1999 data by using contouring and three-dimensional surface-mapping software (Golden Software, Inc., 1996). Based on these estimates, the volume of water storage available in the cove changed from 1.3 million cubic yards (yd^3) in 1973 to 135,000 yd^3 in 1999, a decrease of 90 percent. The 1973 and 1999 volumes also were computed by using Geographical Information Systems (GIS) software (Environmental Systems Research Institute, Inc., 1998). The volumes computed by using these two software programs agreed within 6.0 and 0.7 percent for 1973 and 1999 data, respectively.

Streamflow and Suspended-Sediment Data

The USGS streamgaging station 02145642 on Crowders Creek near Clover, S.C., (figs. 1,2) was established in March 1991, and continuous stage data were collected until September 1992. Twenty-one streamflow measurements made during this period were used to develop a stage-streamflow relation. For the current study period, two streamflow measurements were made to verify the stage-streamflow relation.





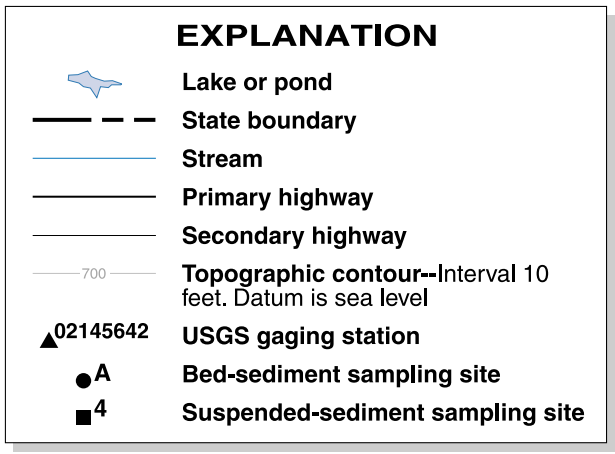


Figure 2. Locations of suspended- and bed-sediment sampling sites in the Crowders Creek Basin.

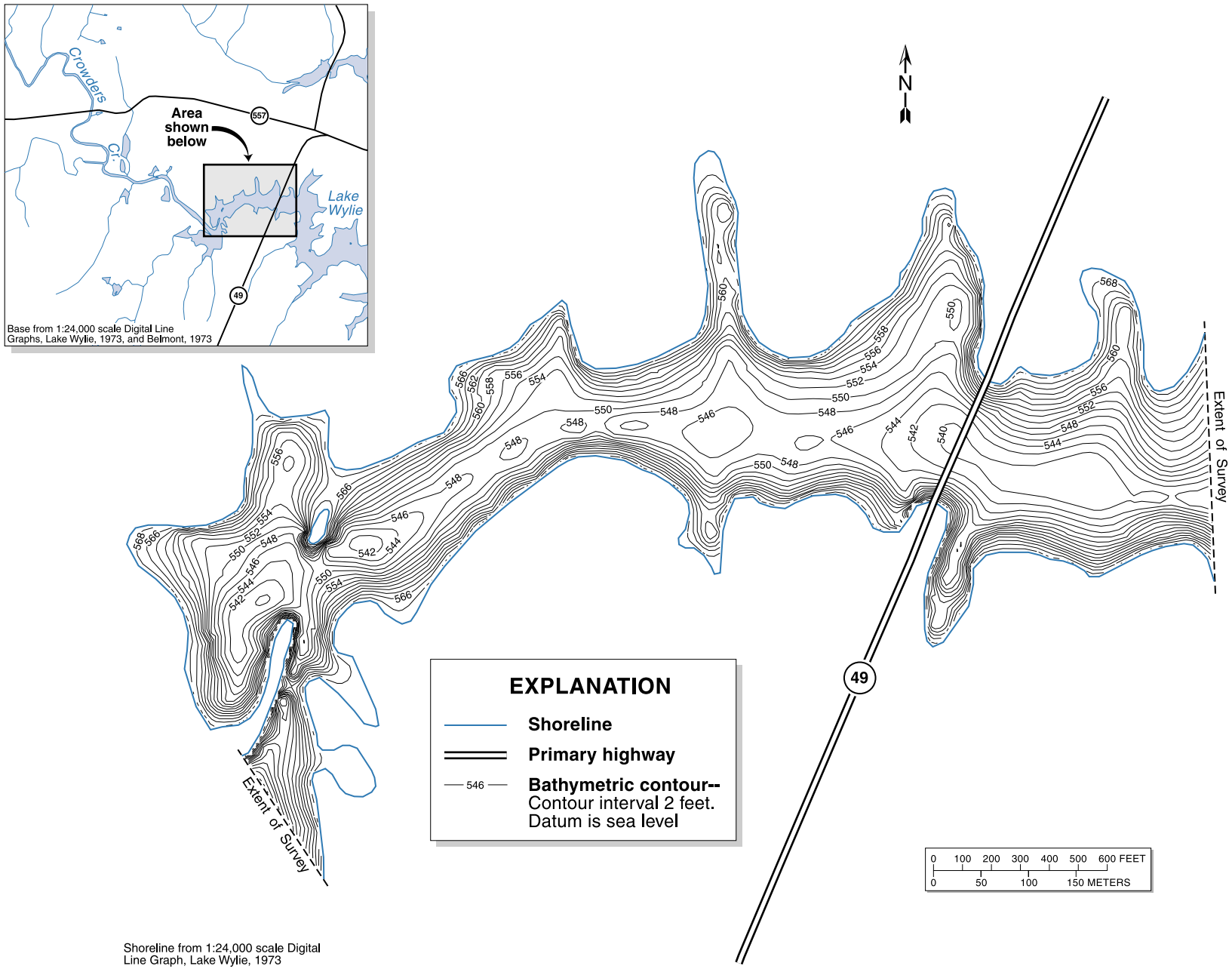


Figure 3. Bathymetric contours of Crowders Creek cove developed from a 1973 topographic map of Lake Wylie (U.S. Geological Survey, 1973).

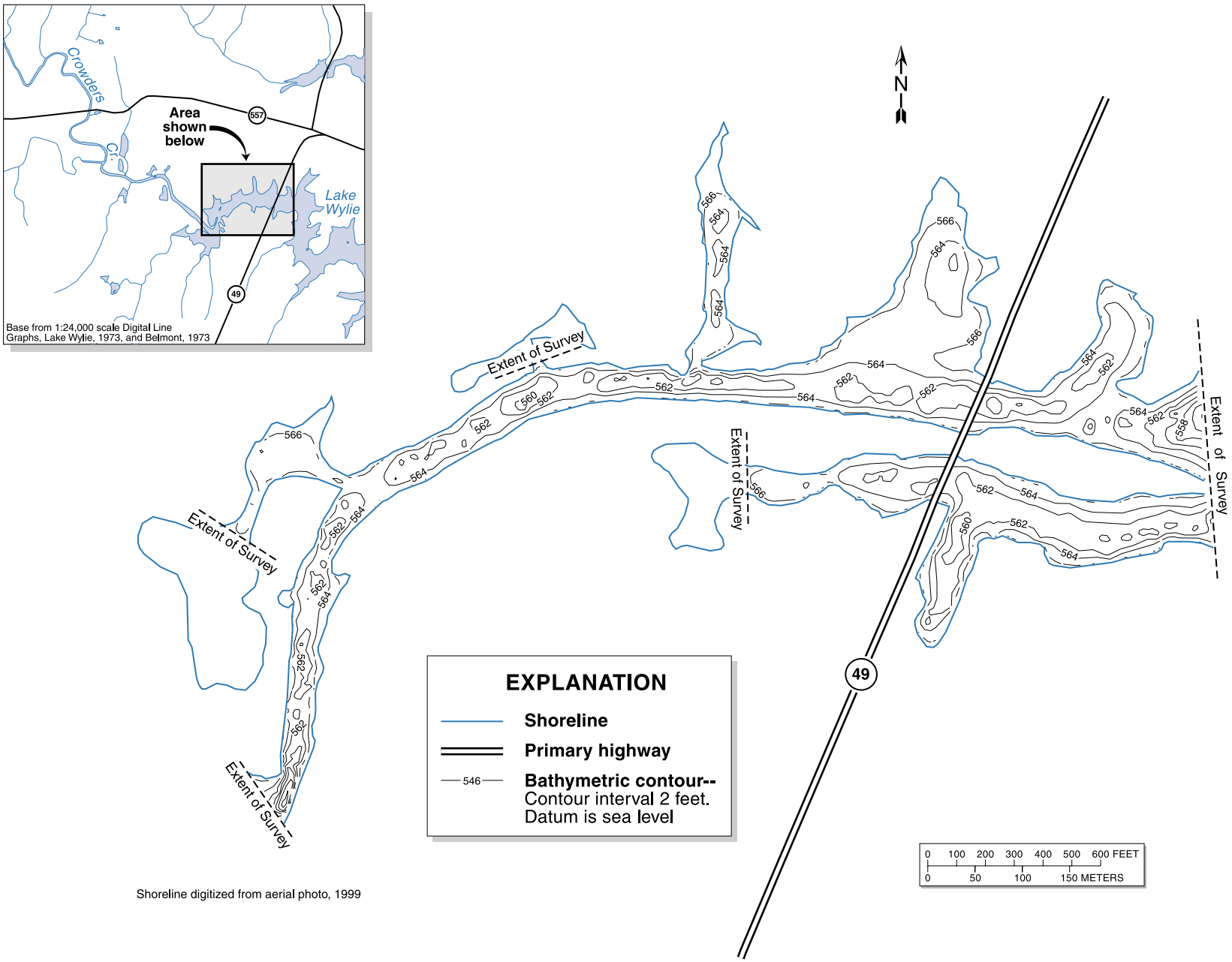


Figure 4. Bathymetric contours of Crowders Creek cove developed from data collected in November 1999.

For this study, gaging station 02145642 was reactivated on October 1, 1999, and stage data were collected at 15-minute intervals. Daily mean streamflows for the period October 1, 1999, to April 30, 2000, are listed in table 1. For this period, the maximum instantaneous stage was 8.18 feet (ft), and the maximum instantaneous streamflow was 1,670 ft^3/s. The maximum daily mean streamflow of 923 ft^3/s was recorded on March 20, 2000. The minimum daily mean streamflow of 23 ft^3/s was recorded on October 3, 1999. The mean streamflow from October 1999 to April 2000 was 70.6 ft^3/s.

A total of 12 single-stage suspended-sediment samplers**,** US U-59, type A**,** were installed at four locations along the upper reach of Crowders Creek (fig. 2). Site 3 is located at gaging station 02145642. The samplers at these sites are used for automatic collection of suspended sediment in flashy, intermittent streams when it is not possible to sample manually. Three sediment samplers were placed at different

Table 1. Daily mean streamflow data for U.S. Geological Survey streamgaging station 02145642, Crowders Creek near Clover, S.C., for the period October 1, 1999, to April 30, 2000

[e, estimated; —, no data. Units in cubic feet per second]

Day	October	November	December	January	February	March	April
1	27e	26	30	33	88	49	64
2	24	52	30	32	76	48	67
3	23	41	30	33	66	47	83
4	29e	30	30	38	62	47	81
5	41	29	29	44	56	46	79
6	28	28	55	36	52	45	75
7	26	28	42	35	50	45	73
8	25	28	34	34	49	44	77
9	25	29	32	36	48	44	83
10	135	29	37	304	47	44	70
11	601	29	41	122	46	43	69
12	86	29	33	66	182	50	69
13	56	28	33	54	140	43	114
14	51	28	91	47	438	42	100
15	42	28	33	44	147	42	451
16	37	28	41	42	91	105	298
17	36	28	37	41	73	496	136e
18	35	28	35	44	77	109	102e
19	34	28	34	44	69	76	89
20	36	26	36	51	60	923	79
21	48	27	72	44	56	394	73
22	38	28	87	40	54	152	67
23	34	29	48	54	52	110	62
24	32	30	41	64	51	95	62
25	32	29	39	71	50	87	100
26	33	67	36	68	49	80	73
27	32e	43	35	53	51	77	68
28	27	32	35	49	65	85	112
29	27	31	34	47	50	71	97
30	26	31	33	102	—	68	79
31	25	—	33	128	—	68	—
Mean	56.7	31.6	41.2	61.3	82.6	119	102
Maximum	601	67	91	304	438	923	451
Minimum	23	26	29	32	46	42	62

elevations at each site to take advantage of low-, medium-, and high-flow events at the four sites.

In general, the sampler consists of a glass bottle fitted with a rubber stopper and two copper tubes—one serves as an intake tube and the other as an exhaust (fig. 5). As the water surface rises in the stream, the water level also rises in the intake tube of the sampler. When the water level reaches the crown of the intake, water flows over the crown, which begins a siphoning effect that fills the bottle. Sampling ceases when the water level in the bottle reaches the inner end of an air exhaust. An air lock in the air exhaust then prevents circulation through the sampler. An air lock also forms in the intake and prevents the sample from being enriched by water surging back and forth in the intake and transporting sediment into the sample container (Guy and Norman, 1973). It should be noted that these samplers have the following limitations: (1) samples are taken at or near the surface of the stream, (2) samples usually are obtained near the edge of the stream, (3) intake velocities rarely equal stream velocities, (4) no samples are taken on the falling stage of the stream, and (5) the original sample may be altered by subsequent submergence (Federal Inter-Agency Sedimentation Project, 1986).

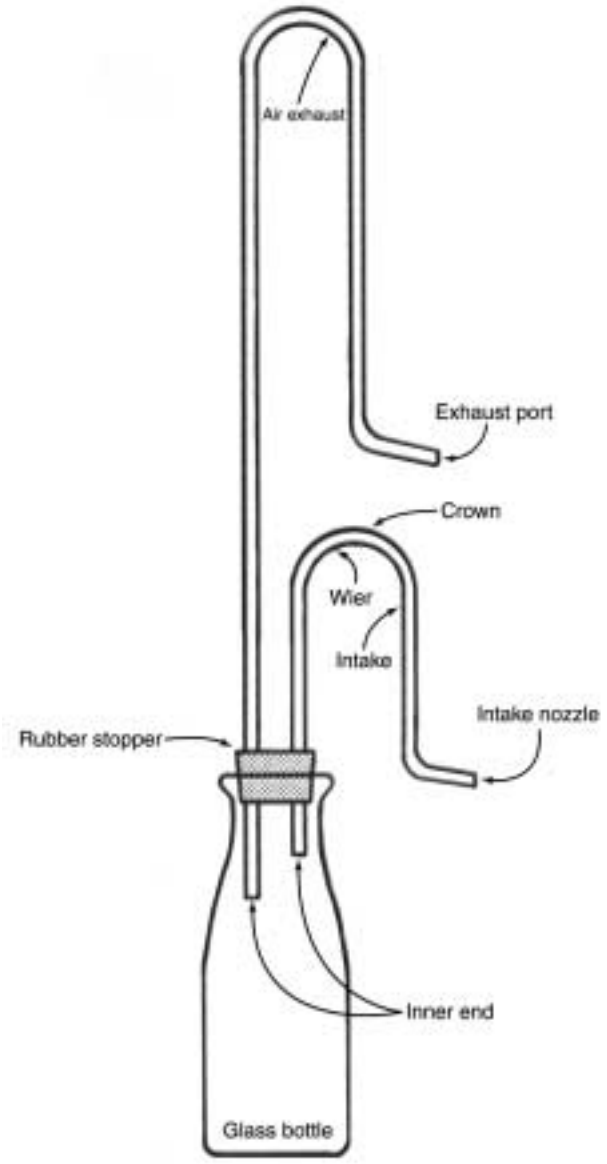


Figure 5. Single-stage suspended-sediment sampler (modified from Guy and Norman, 1973).

On February 14, 2000, rainfall resulted in a maximum gage height of 5.70 ft and an instantaneous peak flow of 864 ft^3/s. The sediment samplers were recovered on February 15, 2000. Two samplers at site 3 and one at site 2 were found to have been destroyed or were missing, resulting in retrieval of 9 of the 12 samplers. Streamflows were estimated at sites 1, 2, and 4 by multiplying the flow measured at USGS gaging station 02145642 (site 3) by the ratio of the drainage areas of the selected site and the gaging station. Suspended-sediment loads were calculated for three stages of the rising limb of the hydrograph and are listed in table 2. The maximum suspended-sediment load calculated was 2,120 tons/d during a flow of 795 ft^3/s at site 4, (table 2). At station 02145642 (site 3), a suspended-sediment load of 402 tons/d was calculated for a flow of 151 ft^3/s. These suspended-sediment load calculations are an instantaneous single day estimation and are not meant to infer yearly estimates. As previously stated, Gissendanner (1994) calculated suspended-sediment loads at gaging station 02145642 to be 1,680 and 652 tons/d, for flows of 520 and 500 ft^3/s, respectively. The distribution of sediment-particle size ranged from 65.9 to 92.5 percent finer than 0.063 mm during this study (table 2). Bed-sediment loads were not calculated for this study.

Bed-Sediment Data

Bed-sediment samples were collected on December 3, 1999, from four locations in the study area: one in the lower reach of Crowders Creek and three in the cove (fig. 2). These samples were analyzed for 44 trace elements, 29 organochlorine pesticides, pesticide degradates and polychlorinated biphenyls (PCBs), and for particle-size distribution. Trace elements and organochlorine pesticides were selected for analysis because of their hydrophobic nature or

Table 2. Suspended-sediment data collected at four sites on Crowders Creek, York County, S.C., during three stages of flow on February 14, 2000

[Site locations are shown in figure 2; mi^2, square mile; ft^3/s, cubic foot per second; mg/L, milligram per liter; ton/d, ton per day; mm, millimeter; —, no data; USGS, U.S. Geological Survey]

Suspended-sediment data	Low stage	Rising stage	High stage
Site 1, drainage area 91.6 mi^2			
Flow, in ft^3/s	155	426	814
Suspended sediment, in mg/L	417	709	639
Sediment load, in ton/d	175	815	1,404
Sediment grain size, percent finer than 0.063 mm	76.1	88.7	86.8
Site 2, drainage area 90.7 mi^2			
Flow, in ft^3/s	154	—	831
Suspended sediment, in mg/L	512	—	714
Sediment load, in ton/d	213	—	1,602
Sediment grain size, percent finer than 0.063 mm	92.5	—	89.3
Site 3, (USGS streamgaging station 02145642), drainage area 89.0 mi^2			
Flow, in ft^3/s	151	—	—
Suspended sediment, in mg/L	986	—	—
Sediment load, in ton/d	402	—	—
Sediment grain size, percent finer than 0.063 mm	76.1	—	—
Site 4, drainage area 86.9 mi^2			
Flow, in ft^3/s	147	404	795
Suspended sediment, in mg/L	510	912	988
Sediment load, in ton/d	202	995	2,120
Sediment grain size, percent finer than 0.063 mm	85.2	66.1	65.9

tendency to adhere to sediment particles. The large volume of sediment transported into Crowders Creek cove provides a means for these compounds to enter the cove if they are present in the watershed. A Teflon bailer was used to obtain a representative sample of the depositional zones. The sample was wet-sieved with a 0.063-mm nylon cloth to provide a less than 0.063-mm fraction for analyses of trace elements and organochlorine pesticides. The bailer was hand-driven into the bed sediment to obtain a representative sample from the top of the sediment to a depth of 2.5 to 3.0 ft.

A coring device was used in an attempt to obtain cores of the bed sediment for particle-size distribution. Because the sediment was composed of very fine silt, however, obtaining an intact core proved difficult. Alternatively, the samples obtained with the bailer were used for the particle-size distribution analyses.

Federal and State guidelines currently (2000) do not exist for the protection of aquatic life based on bed-sediment trace-element and organochlorine pesticide concentrations. The bed-sediment samples were compared to Canadian sediment-quality guidelines (SQG) (Canadian Council of Ministers of the Environment, 1995). The Canadian SQGs designate probable effect levels (PELs) as concentrations above which there is a greater probability of adverse effects on aquatic life.

Nine trace elements (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc) have been classified by the Environmental Protection Agency as priority pollutants (Office of the Federal Register National Archives and Records Administration, 1996) because in low concentrations these elements are toxic to aquatic organisms. Of these nine priority pollutants, none exceeded the PELs in the samples collected during this study (table 3). Arsenic concentrations ranged from 4.3 to 5.7 micrograms per gram (µg/g), well below the 17 µg/g PEL. Cadmium concentrations ranged from 0.16 to 0.33 µg/g, chromium concentrations ranged from 53 µg/g to 61 µg/g, copper concentrations ranged from 53 to 59 µg/g, lead concentrations ranged from 41 to 45 µg/g, mercury concentrations ranged from 0.05 to 0.07 µg/g, and zinc concentrations ranged from 110 to 140 µg/g; all concentrations were below their respective PELs (table 3). No PELs have been established for nickel or selenium. A complete list of the trace-element

Table 3. Trace-element concentrations in bed-sediment samples at four sites on Crowders Creek and Crowders Creek cove, York County, S.C., December 3, 1999

[Sites shown in figure 2. µg/g, microgram per gram; —, no probable effect level has been established]

Element	Unit of measure	Site A	Site B	Site C	Site D	Canadian probable effect level (µg/g)
Aluminum	percent	11	9.4	11	10	—
Antimony	µg/g	2.2	1.6	2.4	1.3	—
Arsenic	µg/g	5.7	4.3	5.6	5.1	17
Barium	µg/g	630	620	610	600	—
Beryllium	µg/g	2.7	2.2	2.3	2.3	—
Bismuth	µg/g	1	1	1	1	—
Cadmium	µg/g	.25	.33	.24	.16	3.5
Calcium	percent	.39	.42	.4	.35	—
Cerium	µg/g	130	100	120	120	—
Chromium	µg/g	53	54	54	61	90
Cobalt	µg/g	26	19	24	18	—
Copper	µg/g	58	54	59	53	197
Europium	µg/g	2.6	2	2.4	2.2	—
Gallium	µg/g	25	22	26	24	—
Gold	µg/g	1	1	1	1	—
Holmium	µg/g	1.4	1.1	1.3	1.2	—
Iron	percent	4.3	4	4.4	4.2	—
Lanthanum	µg/g	67	53	64	58	—
Lead	µg/g	45	42	44	41	91
Lithium	µg/g	70	72	78	68	—
Magnesium	percent	.38	.34	.39	.34	—
Manganese	µg/g	1,000	900	1,100	820	—
Mercury	µg/g	.07	.05	.06	.06	.49
Molybdenum	µg/g	1.6	1.3	1.6	1.7	—
Neodymium	µg/g	66	50	62	57	—
Nickel	µg/g	22	19	23	19	—
Niobium	µg/g	14	14	14	13	—
Phosphorus	percent	.11	.09	.11	.099	—
Potassium	percent	1.5	1.5	1.5	1.5	—
Scandium	µg/g	15	14	16	15	—
Selenium	µg/g	.70	.56	.64	1.1	—
Silver	µg/g	.38	.59	.49	.34	—
Sodium	percent	.28	.32	.27	.27	—
Strontium	µg/g	140	150	140	160	—
Tantalum	µg/g	1.9	1.6	1.8	1.5	—
Thallium	µg/g	1	1	1	1	—
Thorium	µg/g	19	16	19	17	—
Titanium	percent	.62	.62	.63	.6	—
Tin	µg/g	4.6	3.6	4.6	5.4	—
Uranium	µg/g	4.8	4.2	5	4.6	—
Vanadium	µg/g	120	110	120	110	—
Ytterbium	µg/g	3.1	2.5	2.8	2.6	—
Yttrium	µg/g	33	26	30	28	—
Zinc	µg/g	140	120	140	110	315

concentrations detected at the four sites is presented in table 3.

Organochlorine pesticides, pesticide degradates, and PCBs also were analyzed in bed-sediment samples from the four sites; 2 of the 29 compounds analyzed were detected (table 4). At site A, the pesticide, p,p'-DDT, was detected at 11 micrograms per kilogram (µg/kg), which exceeded the PEL of 4.77 µg/kg. At site D, the pesticide, p,p'-DDE, was detected at 3.2 µg/kg, which did not exceed the PEL of 6.75 µg/kg. No PCBs or pesticide degradates were detected at any of the four sites. A list of the organochlorine compounds analyzed during this study is presented in table 4.

The bed-sediment samples that were analyzed for sediment quality also were analyzed for distribution of particle size. All samples were composed of sediments that were at least 60 percent smaller than 0.063 mm. This indicates that the sediment is composed mostly of silt and clay. The particle-size distribution of the bed sediment is listed in table 5.

Table 4. Organochlorine pesticide, pesticide degradates, and polychlorinated biphenyl concentrations measured in bed-sediment samples at four sites on Crowders Creek and Crowders Creek cove, York County, S.C., December 3, 1999

[Sites shown in figure 2. Concentrations are in micrograms per kilogram. nd, not detected]

Compound	Site A	Site B	Site C	Site D
Cis-nonachlor	nd	nd	nd	nd
Trans-nonachlor	nd	nd	nd	nd
Oxychlordane	nd	nd	nd	nd
Aldrin	nd	nd	nd	nd
Cis-chlordane	nd	nd	nd	nd
Trans-chlordane	nd	nd	nd	nd
Chlorneb	nd	nd	nd	nd
DCPA	nd	nd	nd	nd
o, p'-DDD	nd	nd	nd	nd
p, p'-DDD	nd	nd	nd	nd
o, p'-DDE	nd	nd	nd	nd
p, p'-DDE	nd	nd	nd	3.2
o, p'-DDT	nd	nd	nd	nd
p, p'-DDT	11	nd	nd	nd
Dieldrin	nd	nd	nd	nd
Endosulfan	nd	nd	nd	nd
Heptachlor	nd	nd	nd	nd
Heptachlor epoxide	nd	nd	nd	nd
Hexaclorabenzene	nd	nd	nd	nd
Isodrin	nd	nd	nd	nd
Lindane	nd	nd	nd	nd
p, p'-Methoxychlor	nd	nd	nd	nd
o, p-Methoxychlor	nd	nd	nd	nd
Mirex	nd	nd	nd	nd
Cis-permethrin	nd	nd	nd	nd
Trans-permethrin	nd	nd	nd	nd
Toxaphene	nd	nd	nd	nd
PCB	nd	nd	nd	nd
Pentachloroanisole	nd	nd	nd	nd

Table 5. Particle-size distribution in bed-sediment samples at four sites on Crowders Creek and Crowders Creek cove, York County, S.C., December 3, 1999

[mm, millimeter]

Site (fig. 2)	Percent finer than		
	0.250 mm	0.125 mm	0.063 mm
A	99.3	90.0	64.2
B	98.6	91.2	63.8
C	99.3	93.0	66.7
D	99.5	93.5	60.7

SUMMARY

Crowders Creek flows into Lake Wylie, the oldest lake on the Catawba River. Lake Wylie was created in 1904 by the construction of a dam on the Catawba River near Fort Mill, S.C. Based on residents' observations, the rates of sedimentation in the Crowders Creek cove have increased in the past 10 to 15 years.

Bathymetric data were collected in November 1999 and used to develop contours of the Crowders Creek cove. These data were compared to U.S. Geological Survey topographic data from 1973. Since 1973, the volume of the cove available for water storage has changed from 1.3 million cubic yards to 135,000 cubic yards, a decrease of 90 percent.

Water-level and streamflow data were collected at U.S. Geological Survey streamgaging station 02145642 Crowders Creek near Clover, S.C., from October 1, 1999, to April 30, 2000. Streamflow data were used to estimate suspended-sediment loads in Crowders Creek. Single-stage sediment samplers were installed at four selected sites (including gaging station 02145642) in Crowders Creek. Sediment loads were calculated for three stages of the rising limb of the hydrograph for a storm event that occurred on February 14, 2000. The maximum instantaneous flow for this event was 864 cubic feet per second at station 02145642 (site 3), and the maximum sediment load was calculated to be 2,120 tons per day at site 4.

Bed-sediment samples were collected at four locations in the study area and analyzed for a total of 44 trace elements, 29 organochlorine pesticides, pesticide degradates and polychlorinated biphenyls, and for particle-size distribution. None of the priority pollutants (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc) exceeded Canadian sediment-quality guidelines probable effect levels. Two of 29 compounds analyzed for organochlorine pesticides were detected. At one site, p,p'-DDT concentration was measured to be 11 micrograms per kilogram. At another site, p,p'-DDE concentration was measured to be 3.2 micrograms per kilogram. Particle-size analyses at the four sites indicated that at least 60 percent of the sediments are smaller than 0.063 millimeter, which indicates the sediment is composed mostly of silts and clays.

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