STORM RUNOFF AND ITS EFFECTS ON THE WATER QUALITY AND BOTTOM-MATERIAL QUALITY OF CEDAR CREEK, WEST-CENTRAL ILLINOIS, 1985-86

By Ward O. Freeman, Arthur R. Schmidt, and Roger D. McFarlane

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CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who may want to use metric (International System) units, the inch-pound values in this report may be converted by using the following factors:

Multiply inch-pound unit	By	To obtain metric unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
square foot (ft^2)	0.09294	square meter (m^2)
cubic foot (ft^3)	28.32	liter (L)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
	3,785	cubic meter per day (m^3/d)
pound, avoirdupois (lb)	453.6×10^3	milligram (mg)
	453.6×10^6	microgram (µg)

- -

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

$$°F = 1.8 \times °C + 32$$

- -

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.

STORM RUNOFF AND ITS EFFECTS ON THE WATER QUALITY AND BOTTOM-MATERIAL QUALITY OF CEDAR CREEK, WEST-CENTRAL ILLINOIS, 1985-86

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ABSTRACT

Storm-related constituent loads to a 26.2-mile reach of Cedar Creek, flowing through Galesburg, Illinois, were estimated from measurements made at 49 combined sewers, 7 storm sewers, a wastewater-treatment facility, 3 tributaries, and 5 stream sites along Cedar Creek. Sediment oxygen demands and bottom-material constituent concentrations were determined at 45 locations in the creek and tributaries. Data were collected from May through December 1985, and from March through October 1986.

Storm-related water-quality samples from Cedar Creek indicate that concentrations of copper, lead, cadmium, zinc, iron, manganese, and dissolved solids exceeded the State general-use water-quality standards. Combined-sewer overflow concentrations of total suspended solids, zinc, iron, and oxygen-demanding wastes exceeded the State effluent standards. Odors and the amount of floating material may indicate that the combined-sewer overflows also exceeded the State standard on offensive discharges. Storm-sewer discharge concentrations of lead, iron, and dissolved solids also exceeded the State effluent standards.

Bottom-material constituent concentrations of mercury, lead, chromium, cadmium, and zinc were extremely high compared to mean background concentrations for Illinois. Sediment oxygen demands ranged from 0.4 to 9.1 grams per square meter per day. Agricultural runoff contributes a substantial amount of suspended solids and oxygen-demanding materials, but these sources are, for the most part, downstream from the areas of bottom material having high sediment oxygen demands. Bottom-material samples and the locations of the subreaches with high sediment oxygen demands indicate that runoff from the ongoing construction of U.S. Highway 34 did not contribute substantial amounts of metals or oxygen-demanding sediments. The locations of the majority of sites with elevated sediment-oxygen-demand rates and bottom-material constituent concentrations indicate that major sources of constituents are runoff from combined sewers and storm sewers and effluent from the Galesburg wastewater-treatment facility. A sludge-application field located just upstream from the wastewater-treatment facility also is a possible source of oxygen-demanding materials. Runoff from combined sewers is a major source of cadmium, copper, lead, and zinc in streamflow and bottom materials in Cedar Creek. The wastewater-treatment-facility effluent and runoff from the storm sewers are major sources of mercury and chromium, respectively, in streamflow and bottom materials in Cedar Creek. Mercury from the wastewater-treatment facility is most likely in the dissolved phase because suspended-solids concentrations are very low compared to other sources of runoff.

INTRODUCTION

Background

Assessment of the characteristics of storm runoff and its effects on water quality in a receiving stream requires knowledge of the environmental processes in the stream as well as knowledge of the constituent loads contributed by the runoff. Several studies to characterize the effect of urban runoff on streamflow have been conducted since the Nationwide Urban Runoff Program began in 1978. Similar studies that examine runoff from rural areas have been conducted more recently under the Rural Clean Water Program (Dressing, 1987). Many of these studies have indicated that the effect of runoff on the water quality of the receiving stream is fairly localized, of short duration, and generally limited to the high-flow period caused by the storm. However, as the stream conditions return to prestorm levels, suspended solids contributed by storm runoff can settle to the streambed and form deposits having high constituent concentrations or high oyxgen demands (Athayde, 1984; Clarke, 1984). This implies that the effect of storm runoff on water quality is most evident during subsequent low-flow periods, when dilution by streamflow is reduced and dissolved-oxygen concentrations may be low.

Physical and chemical characteristics of storm runoff depend on many factors including size, topography, surface cover, and land use of the drainage basin; antecedent soil-moisture conditions; and characteristics of the storm. The most important of these factors is land use (Wanielista and others, 1977; Polls and Lanyon, 1980; Novotny and others, 1985; and Dressing, 1987). Agricultural runoff differs from urban runoff just as, within an urban area, runoff from an industrial region will differ from residential runoff. Constituent loads contributed by these different sources of runoff will have differing effects on the receiving stream.

The U.S. Geological Survey, in cooperation with the Illinois Environmental Protection Agency (IEPA), has conducted several stream-quality-assessment studies in Illinois. This study focuses on Cedar Creek, a small stream in west-central Illinois, and is the first of these studies to assess the water-quality characteristics of storm runoff.

A report by the Illinois State Water Survey (1916) indicates that very severe pollution problems existed in Cedar Creek in the early 1900's. Although the water quality of Cedar Creek appears to have improved since then, more recent studies by the IEPA, the Galesburg Sanitary District (GSD) (Ken Newman, Illinois Environmental Protection Agency, written commun., 1985), and by Clark, Dietz, and Associates (1980) indicate that water in Cedar Creek still does not meet State water-quality standards in several subreaches. These studies indicate that dissolved-oxygen concentrations, in particular, were below the minimum concentration required by the State general-use water-quality standard (Illinois Pollution Control Board, 1986).

The purpose of this study was to describe the water quality of Cedar Creek and to determine cause-and-effect relations of processes that affect the water quality in the creek. This study was approached in two phases. The first phase, described by Schmidt and others (1989), was an assessment of the low-flow water quality of Cedar Creek. The second phase, described in this report, is an assessment of storm-runoff quality and storm-related constituent loads. The first phase of this study identified sediment oxygen demand as the primary process causing low dissolved-oxygen concentrations in Cedar Creek. Because of this, a major focus on the second phase of the study is to characterize bottom materials and identify sources of sediments to the creek. The data-collection methods and summaries of the data for both phases of the project are described by McFarlane and others (1987).

Purpose and Scope

The purpose of this report is to describe the storm-related sources of chemical constituents that affect the water quality of Cedar Creek. In particular, the purpose is to describe the characteristics of combined-sewer overflows and storm-sewer discharges from the city of Galesburg and their contribution to constituent loads and bottom materials in the creek.

This report details the interpretation methods and results used to describe storm runoff and to identify the primary storm-related sources of several constituents to Cedar Creek. This report includes discussion of the duration, accumulation, and intensity of precipitation for several storms; the frequency, duration, and peak discharge of overflow from each of 49 combined sewers within the study reach; the constituent concentrations determined from samples of combined-sewer overflow, storm-sewer discharge, wastewater-treatment-facility effluent, and streamflow; the sediment oxygen demands and bottom-material constituent concentrations determined from 45 sites in Cedar Creek and its tributaries; and the storm-related discharge volumes from each of seven sources of storm runoff. The seven sources of storm runoff are flow from upstream of Galesburg, overflow from combined sewers, discharge from separate storm sewers, effluent from the wastewater-treatment facility, and discharges from three tributaries draining agricultural land. Constituent loads for these seven sources are estimated from constituent concentrations and discharge volumes from samples and measurements made primarily during five storms in 1986. The storm-related constituent loads are used to determine the percentage of the total load that is contributed by each of the seven sources of runoff. These results, in conjunction with the locations of elevated sediment oxygen demands and bottom-material constituent concentrations, indicate the effect of storm runoff on water quality of Cedar Creek.

Study Area

Cedar Creek drains 165 mi^2 (square miles) of Knox, Warren, and Henderson Counties in west-central Illinois. This study focused on a 26.2-mile reach of Cedar Creek from near its headwaters at RM (river mile) 45.2 (45.2 miles above the mouth of Cedar Creek) to the confluence of Markham Creek with Cedar Creek (RM 19.0) (fig. 1). Figure 2 shows the land-use characteristics of the 66.9-mi^2 study area. Almost 80 percent of the basin is cropland or pasture. Galesburg (population 35,305, U.S. Census Bureau, 1980) is the only urban area in the study basin. The land use in Galesburg is 56.5 percent residential; 26.0 percent commercial; 7.2 percent cropland or pasture; 5.5 percent industrial; 3.1 percent transportation, communications, and utilities (much of which is railways); and 1.7 percent other uses (U.S. Geological Survey, 1979).

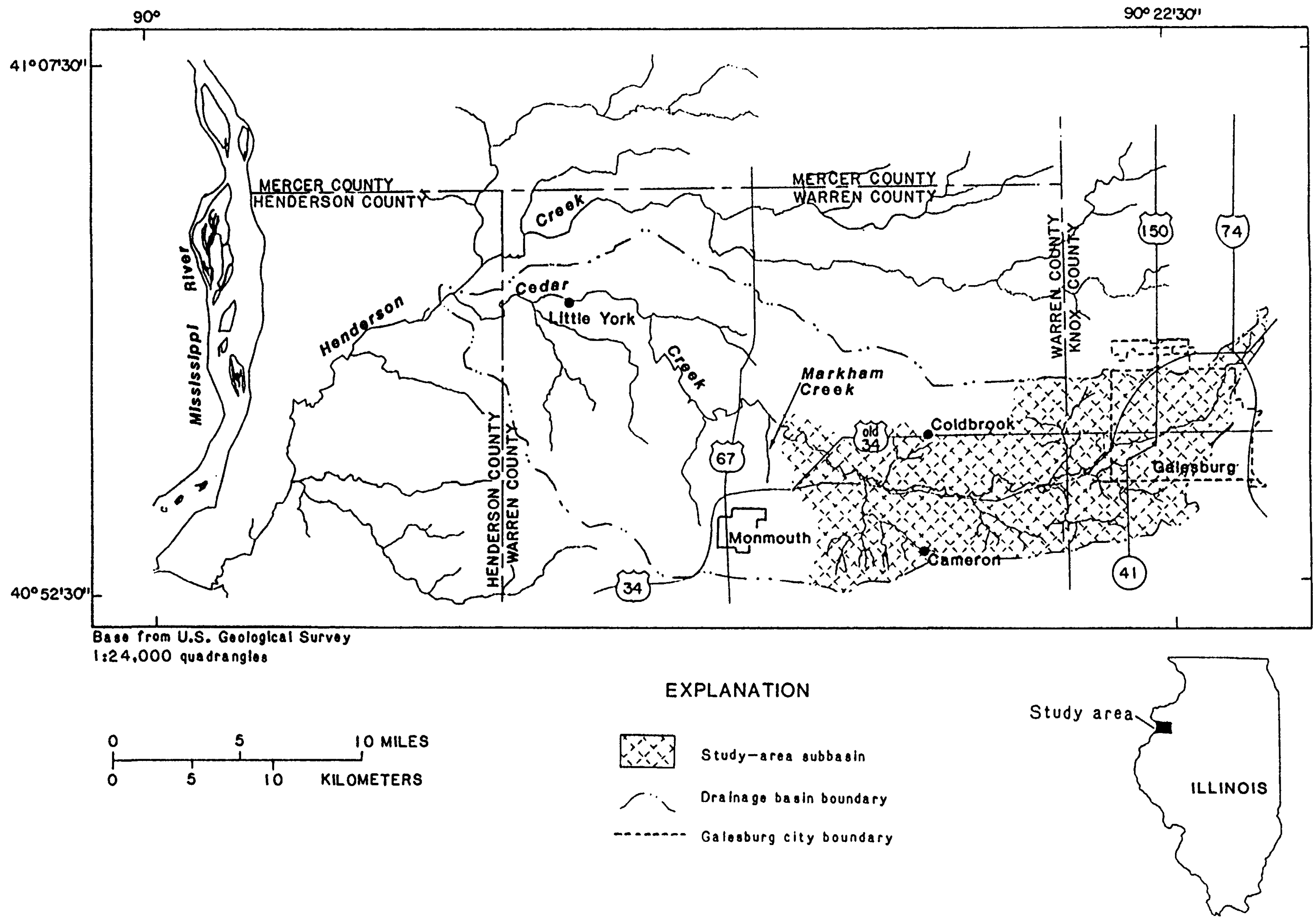

Figure 1.--Location of the Cedar Creek basin in west-central Illinois.

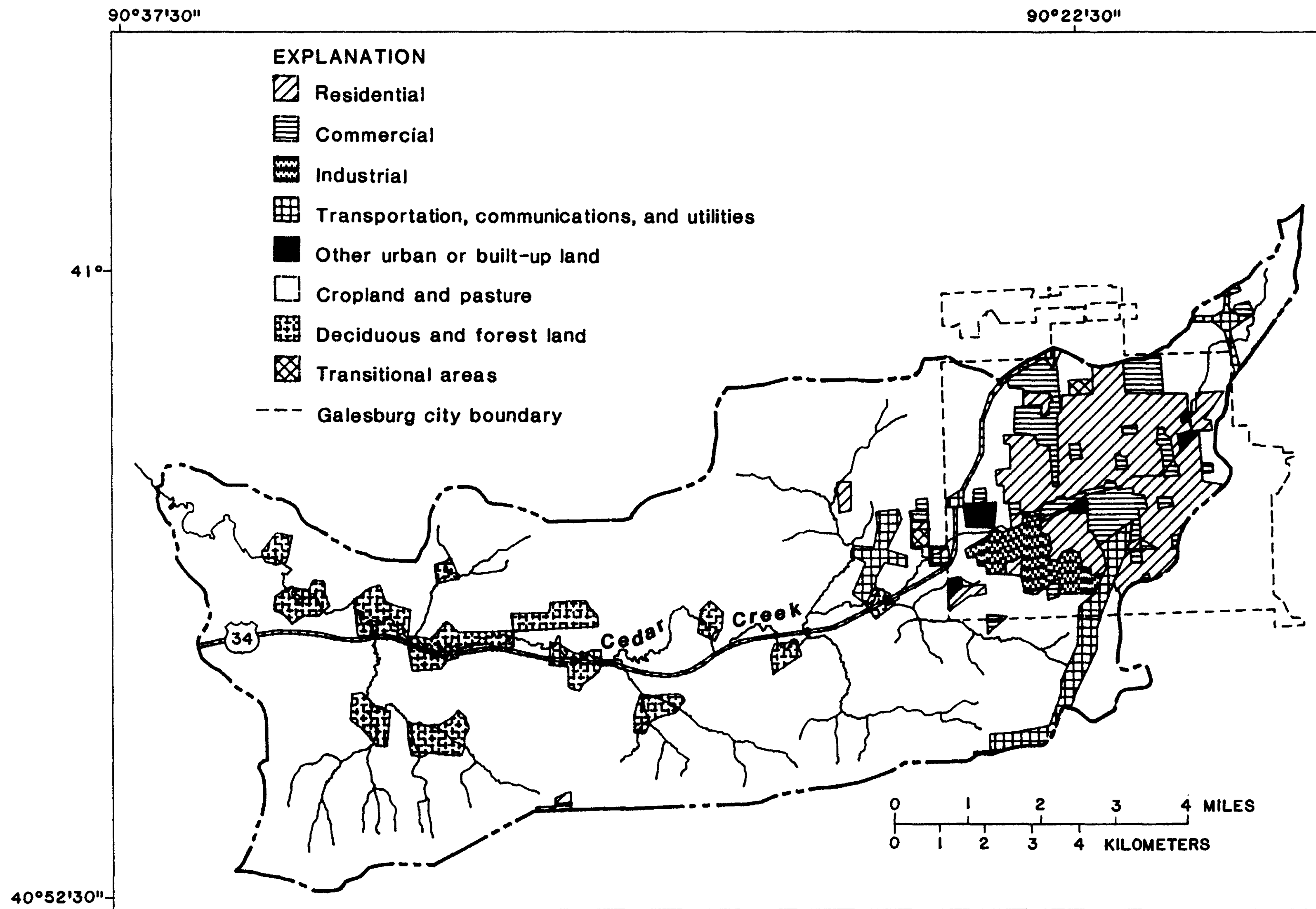

Figure 2.--Land use in the Cedar Creek study basin (land-use categories and areas digitized from U.S. Geological Survey, 1979).

The upstream part of the creek is highly channelized and includes a concrete-lined subreach in Galesburg. Several other subreaches of Cedar Creek also have been channelized by the Illinois Department of Transportation (IDOT) as a part of the construction of U.S. Highway 34. This construction was taking place during the study.

Downstream from its headwaters, the first 4.5 miles of the creek (headwaters to site 3) flow intermittently in a natural channel containing several pools and riffles (fig. 3). The streambed is composed of silt and clay and contains some organic material washed from the farm fields at the creek's headwaters. Trees lining a part of this subreach contribute leaf litter to the organic material in the stream. Part of the subreach without trees--that is open to sunlight--supports macrophytic growth during the summer. Streamflow velocities are low through this entire subreach, and, although the streamflow is intermittent, there is usually some flow, and the pools almost always contain water. Site 1 (fig. 3) was located in this subreach at RM 45.2 to provide information on the quality and quantity of flow from upstream of Galesburg. Table 1 describes the data-collection sites shown in figure 3.

The next 1.8 miles of Cedar Creek (site 3 to site 5) are concrete lined and contain about 120 combined-sewer and storm-sewer outfall pipes that discharge to the creek. There is little bottom material in this subreach because velocities are fast enough to transport the material farther downstream. This subreach flows intermittently, but ground-water inflow through cracks in the concrete-lined channel and from infiltration to storm sewers generally maintains some flow in the channel. During the summer, abundant growths of periphyton cover the channel bottom.

From the end of the concrete channel downstream 2.0 miles to the wastewater-treatment-facility outfall (site 5 to site WWTF), the streambed is composed of clay, sand, and silt. Velocities in this subreach are very low, and suspended materials tend to settle out. There are extensive deposits of silt and sludge-like material. Site 8 was located in this subreach at RM 40.8 to provide information on the quality and quantity of flow leaving Galesburg.

The remaining 21.2 miles of the study reach (site WWTF to site 20) are a natural meandering channel with a regular pattern of pools and riffles. The streambed is composed primarily of silt and clay material. Sites 11, 14, and 18 (RM 38.1, 31.9, and 24.7) were located in this subreach to characterize the quality and quantity of flow in Cedar Creek. Five sections of this subreach were channelized as a part of the construction of U.S. Highway 34. The longest of these is the 0.36-mile section downstream from RM 37.4 (downstream from site 11) (fig. 4).

There are several sections in each subreach with large deposits of organic sludge-like material. The largest of these deposits is upstream from the channel modification at RM 39.5 (fig. 4). This channel modification is a high-flow diversion where low and medium flows follow the natural channel and high flows follow a straight section bypassing the natural channel. A bend in the creek and a rubble dam that routes low flows to the natural channel cause an eddy where velocities are low, and suspended materials settle to the streambed. Because velocities in the natural channel are seldom fast enough to resuspend bottom materials, the entire section of natural channel around the high-flow diversion contains large deposits of sludge and silt.

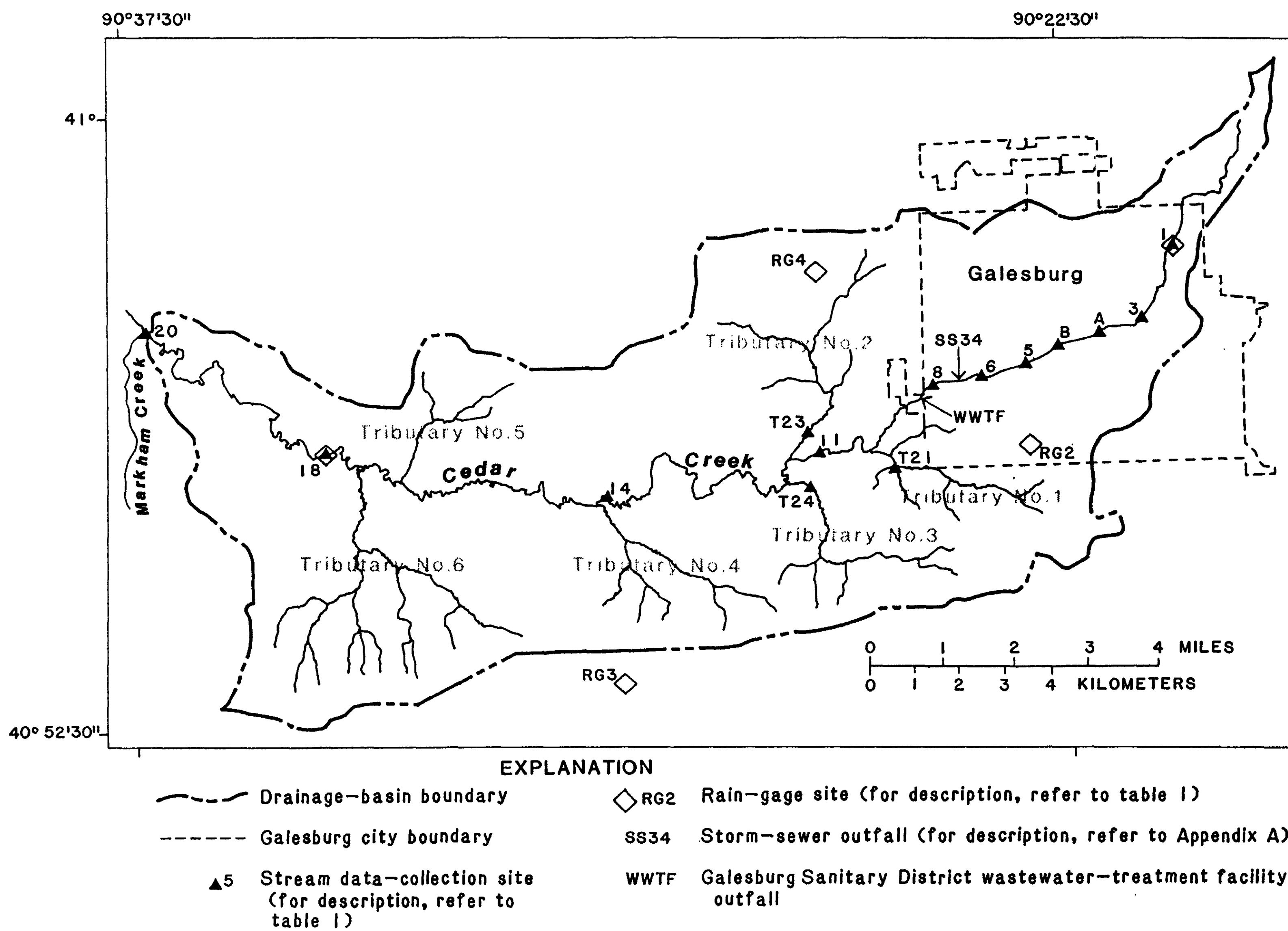

Figure 3.--Location of the stream, wastewater-treatment-facility outfall, and rain-gage data-collection sites in the Cedar Creek study basin (modified from McFarlane and others, 1987, fig. 3).

Table 1.--Stream and precipitation data-collection site descriptions

[Site codes correspond to those in figures 1 and 5-8 of this report; dashes indicate no data]

Site code	Station number[1]	River mile above mouth	Drainage area (square miles)	Site name and location
			Stream sites	
1	05468200	45.2	2.08	Cedar Creek at Farnham Street at Galesburg Lat: 40°58'07" Long: 90°20'42"
3	05468210	44.0	2.80	Cedar Creek at Losey Street at Galesburg Lat: 40°57'17" Long: 90°21'12"
A	--	43.2	--	Cedar Creek at Kellogg Street at Galesburg Lat: 40°57'04" Long: 90°21'58"
B	--	42.7	--	Cedar Creek at Academy Street at Galesburg Lat: 40°56'57" Long: 90°22'33"
5	05468220	42.2	8.01	Cedar Creek at Henderson Street at Galesburg Lat: 40°56'46" Long: 90°23'01"
C	--	--	--	Railroad Creek at Depot Street at Galesburg Lat: 40°56'45" Long: 90°22'52"
6	05468225	41.6	8.45	Cedar Creek at McClure Street at Galesburg Lat: 40°56'35" Long: 90°23'44"
8	05468240	40.8	11.6	Cedar Creek at Highway 34 at Galesburg Lat: 40°56'31" Long: 90°24'34"
WWTF	405617090250101	40.2	--	Galesburg Sanitary District wastewater-treatment-facility outfall at Galesburg Lat: 40°56'17" Long: 90°25'01"

Table 1.--Stream and precipitation data-collection site descriptions--Continued

Site code	Station number[1]	River mile above mouth	Drainage area (square miles)	Site name and location
				Stream sites--Continued
11	05468265	38.1	20.2	Cedar Creek at County Line Road near Galesburg Lat: 40°55'43" Long: 90°26'28"
14	05468308	31.9	36.9	Cedar Creek at Road 1500 E near Coldbrook Lat: 40°55'16" Long: 90°29'53"
18	05468367	24.7	60.8	Cedar Creek at Road 1100 E near Monmouth Lat: 40°55'50" Long: 90°34'23"
20	05468400	19.0	66.9	Cedar Creek above mouth of Markham Creek near Monmouth Lat: 40°57'27" Long: 90°37'14" (not a data-collection site for this phase of the project)
T21	05468253	[2]39.3	3.82	Cedar Creek Tributary No. 1 at Road 1450 N at Galesburg Lat: 40°55'29" Long: 90°25'17"
T23	05468280	[2]37.7	6.98	Cedar Creek Tributary No. 2 at Road 2100 N near Galesburg Lat: 40°55'58" Long: 90°26'39"
T24	05468293	[2]37.0	4.52	Cedar Creek Tributary No. 3 at Atchison, Topeka, and Santa Fe Railroad near Galesburg Lat: 40°55'18" Long: 90°26'39"
				Precipitation sites
1	05468200	45.2	--	Cedar Creek at Farnham Street at Galesburg Lat: 40°58'07" Long 90°20'42"
RG2	405544090230501	--	--	Henderson Street at Galesburg Lat: 40°55'44" Long 90°23'05"

Table 1.--Stream and precipitation data-collection site descriptions--Continued

Site code	Station number[1]	River mile above mouth	Drainage area (square miles)	Site name and location
				Precipitation sites--Continued
RG3	405256090294201	--	--	Road 1750 N at Cameron Lat: 40°52'56" Long: 90°29'42"
RG4	405756090262701	--	--	County Line Road near Galesburg Lat: 40°57'56" Long: 90°26'27"
18	05468367	24.7	--	Cedar Creek at Roade 1100 E near Monmouth Lat: 40°55'50" Long: 90°34'23"

[1] Station numbers refer to the site identifications used in the U.S. Geological Survey's National Water Information System computerized data base.

[2] River miles indicates the location of the mouth of the tributary above the mouth of Cedar Creek.

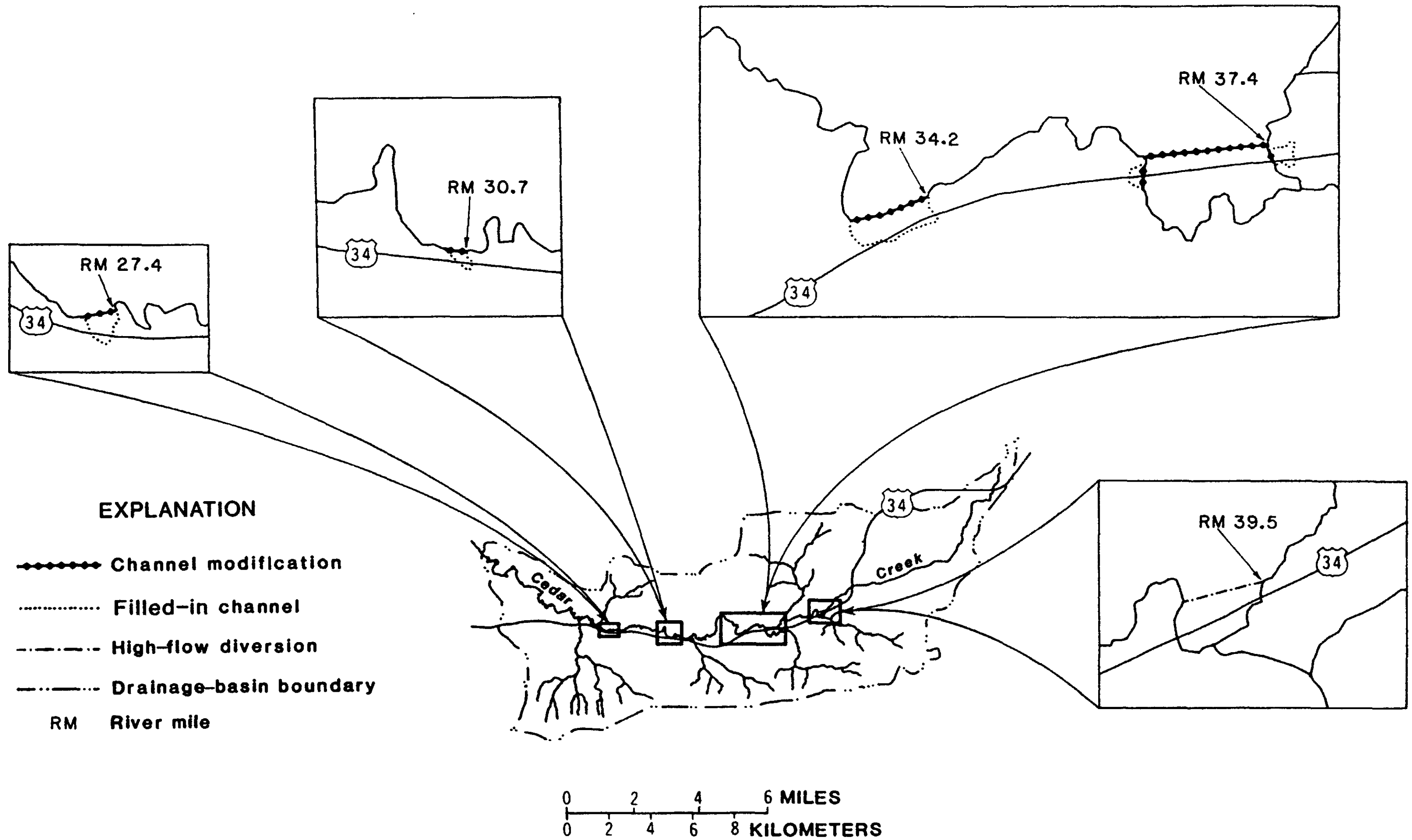

Figure 4.--Location of channel modifications to Cedar Creek (modified from McFarlane and others, 1987, fig. 4).

Other areas of deposition generally are associated with reduced stream velocities because of deep pools or bends in the channel. One of these areas is upstream from the wastewater-treatment facility. Velocities are low enough that suspended materials settle and sludge-like bottom materials accumulate and raise sediment oxygen demands. Velocities in this subreach, however, are fast enough during periods of high flow to resuspend much of the bottom material and transport it farther downstream.

Surface runoff at Galesburg is drained primarily by combined sewers, although a large part of the city also is drained by separate storm sewers. In many cases, the combined- and storm-sewered areas coincide. Most of the combined-sewer systems consist of vitrified clay pipe. Inspection of the condition of the combined-sewer system has shown many cracks and joint separations, which make infiltration of ground water a possible problem (Huff and others, 1981). The GSD has been actively reducing the number of storm-drainage connections to the combined-sewer system. However, infiltration to the system and storm-drainage connections that still (1986) exist overload the system during storms and cause overflows to Cedar Creek.

Combined sewage can overflow either directly to the creek or to storm sewers that discharge to the creek at 49 points in the system. Combined sewers overflow when captured storm runoff exceeds their capacity or when flow to the interceptor sewer is obstructed. Figure 5 shows a diagram of a typical overflow drainage structure in Galesburg. The location of these combined-sewer overflow structures, as well as the location of several of the major storm sewers, are shown in figures 6 through 9 and are described in appendix A at the end of this report.

Acknowledgments

The authors wish to acknowledge the assistance provided by the Illinois Environmental Protection Agency in providing equipment and manpower for this study and especially in meeting the laboratory needs (at all hours of the day and night) of the storm-related water-quality analyses. Acknowledgment also is given to the Galesburg Sanitary District for providing information about, and access to, their facilities. We also wish to thank the city of Galesburg, local residents, and the Atchison, Topeka, and Santa Fe Railway Company for granting permission to access sites and install equipment for sampling.

METHODS OF DATA COLLECTION AND INTERPRETATION

Data-collection methods and data summaries are described in detail by McFarlane and others (1987). The following is a brief description of the data-collection methods for the second phase of the study as well as a somewhat more detailed description of some of the calculations used to interpret these data.

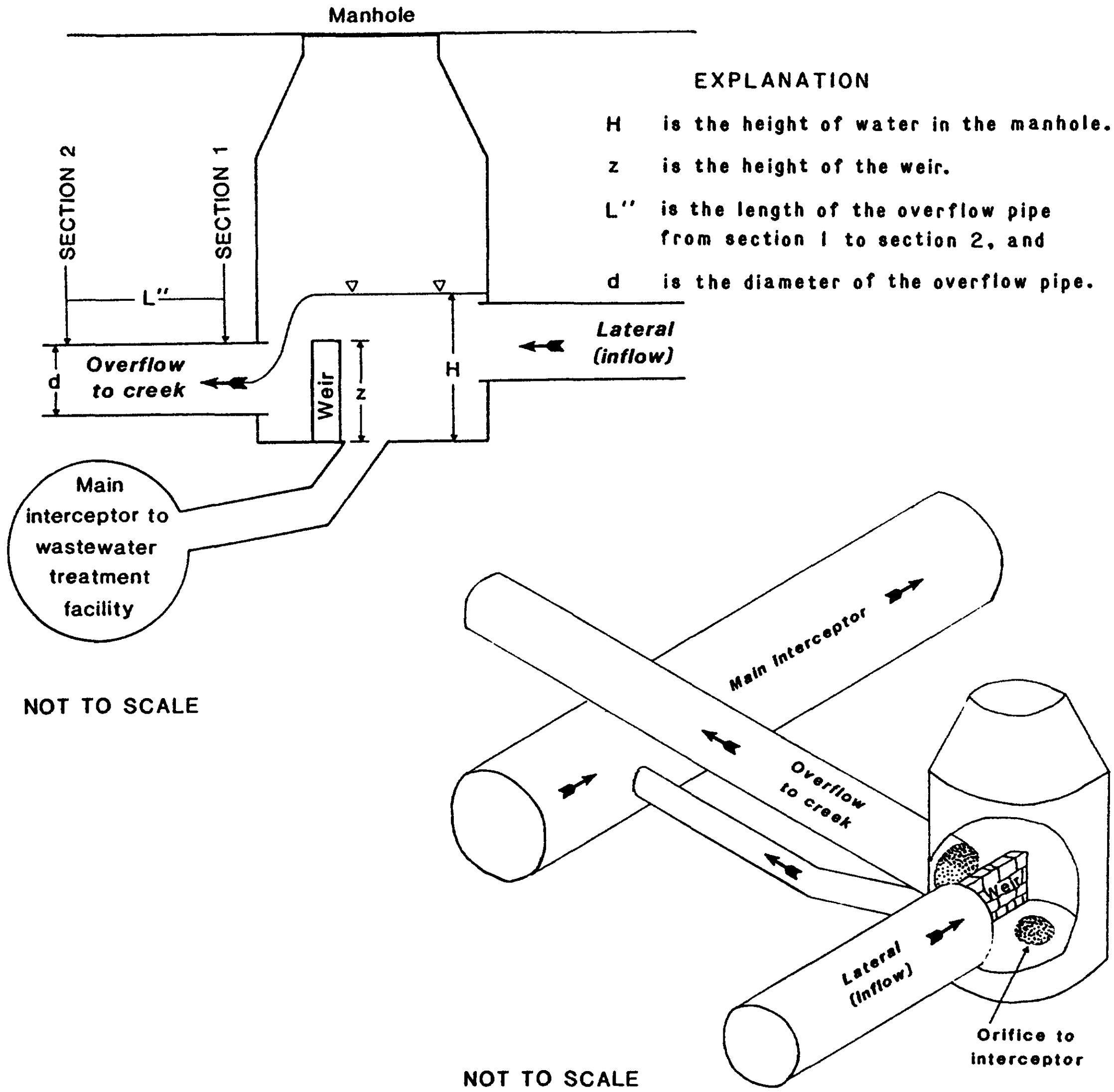

Figure 5.--Typical combined-sewer overflow structure in Galesburg (modified from McFarlane and others, 1987, fig. 2). Symbols refer to equations 3 through 6 of this report.

Precipitation

Rain gages were installed at five locations in (or near) the study area (fig. 3). Tipping-bucket rain gages were used to measure precipitation in 1/100-inch increments. Precipitation quantities were totaled using 5-minute time intervals.

Seventy-one storms were monitored between August and November 1985 and between May and October 1986. For this project, a storm was considered to be a period of precipitation with a 2-hour period of no precipitation both preceding and following it. Samples of runoff and streamflow were collected during five storms in 1986--May 16-20, July 7-10, July 31 to August 1, August 26-27, and September 11-12.

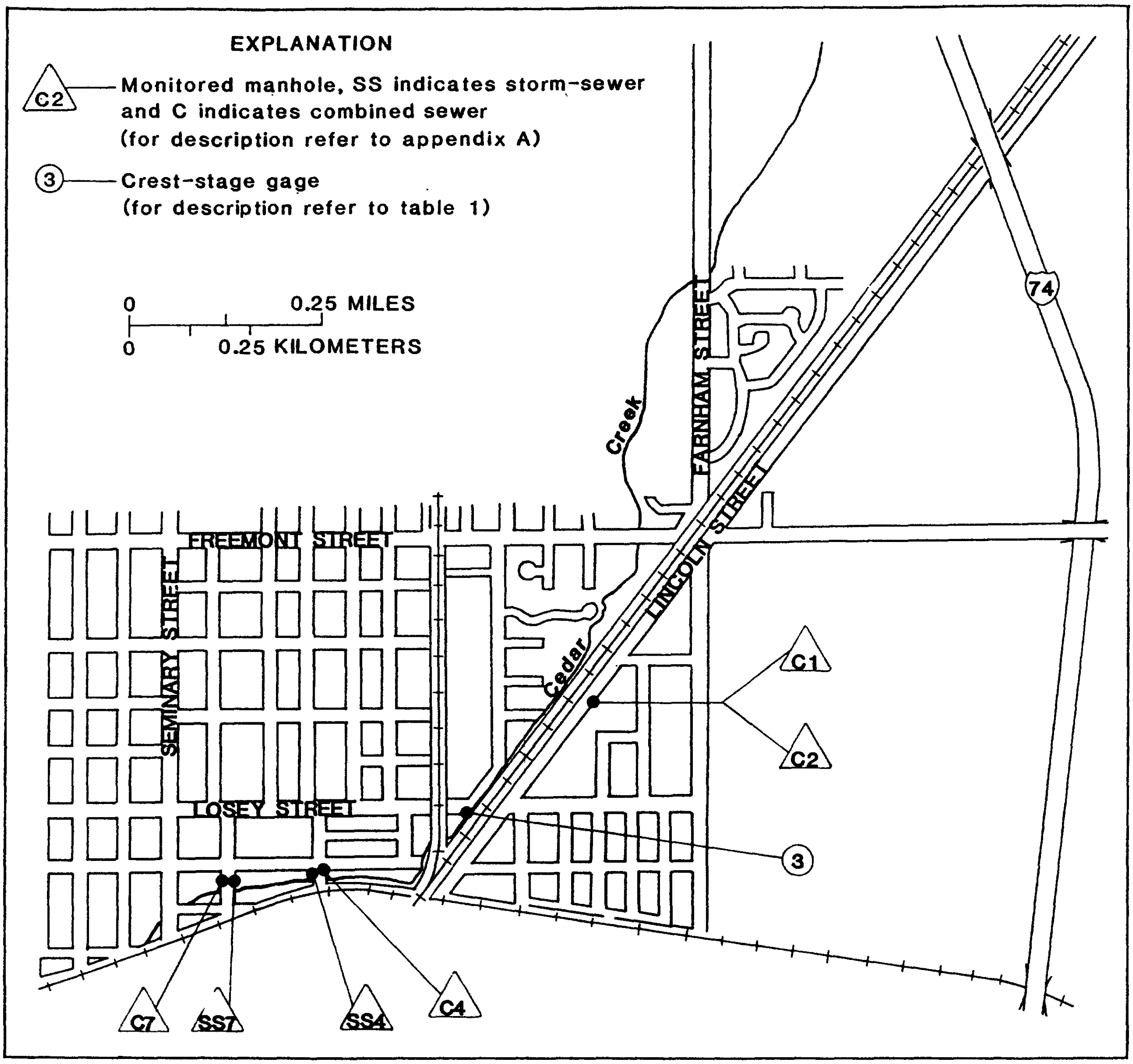

Figure 6.--Location of selected storm sewers, combined sewers, and crest-stage gages in the northeastern quarter of Galesburg (from McFarlane and others, 1987, fig. 5).

Precipitation characteristics calculated from two rain gages (sites 1 and RG2) were related to characteristics of combined-sewer overflow, storm-sewer discharges, and percent runoff from Galesburg. Descriptive characteristics for the storms were developed from area-weighted averages determined using the Theissen method (Linsley and Franzini, 1964, p. 13-14).

Combined sewers were examined after every storm, when possible, to determine if an overflow had occurred. Storms often occurred too frequently, however, to allow time for examination of the combined sewers. Methods for monitoring the combined sewers are described in a later section of this report.

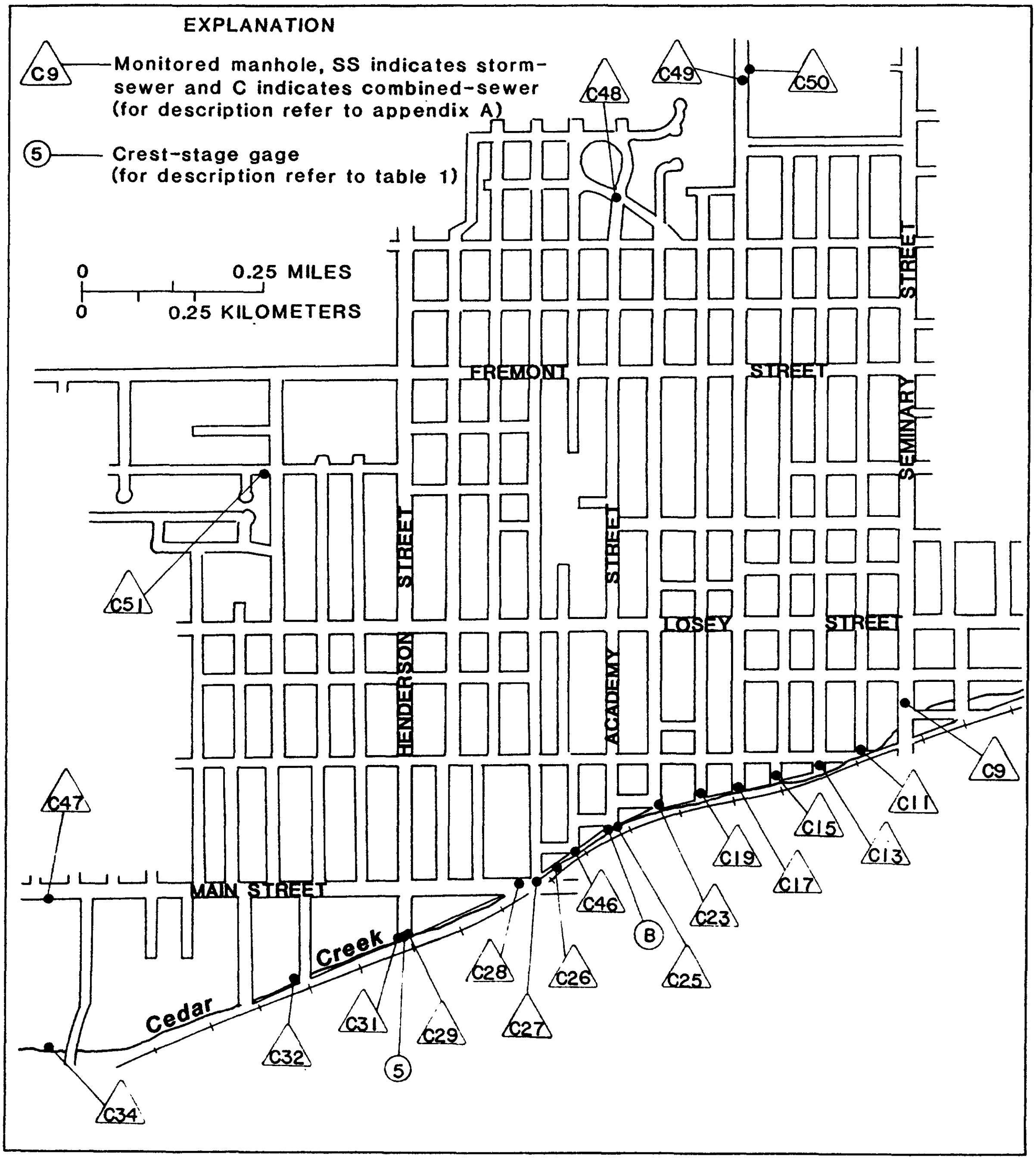

Figure 7.--Location of selected storm sewers, combined sewers, and crest-stage gages in the northwestern quarter of Galesburg (modified from McFarlane and others, 1987, fig. 6).

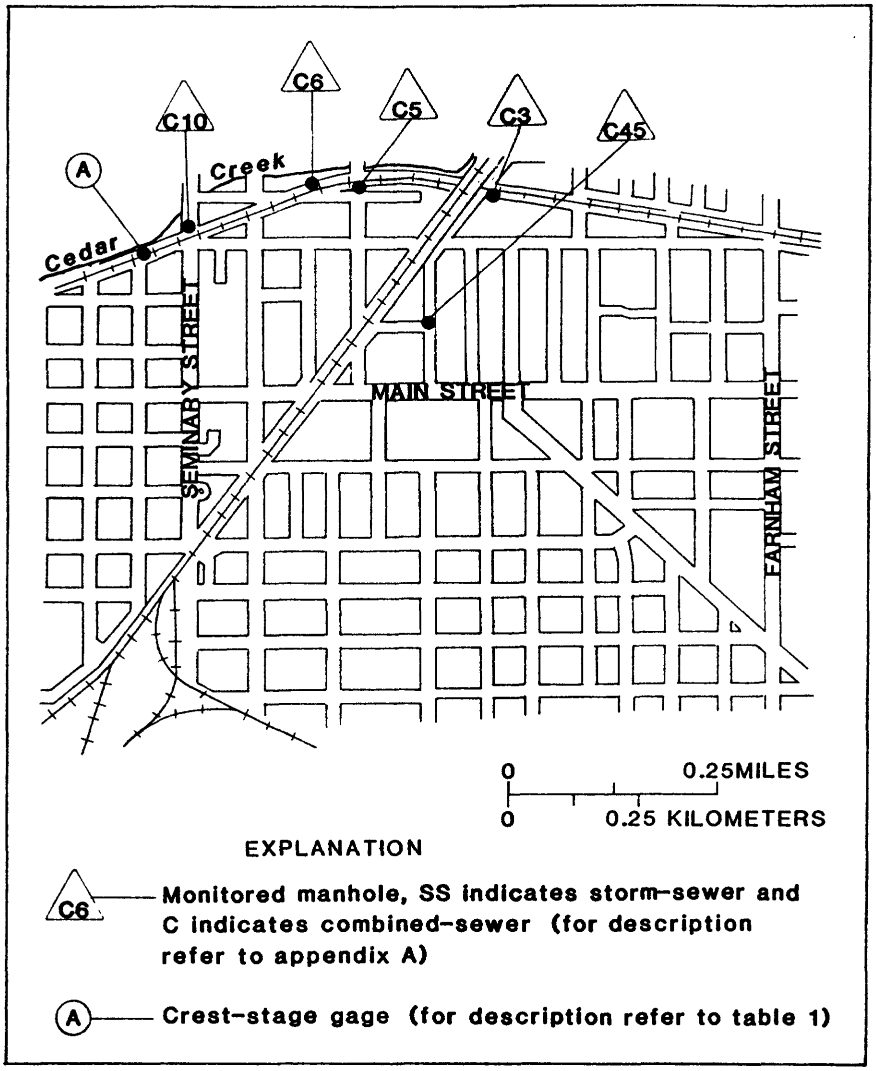

Figure 8.--Location of selected storm sewers, combined sewers, and crest-stage gages in the south-eastern quarter of Galesburg (from McFarlane and others, 1987, fig. 7).

The period between each time the combined sewers were examined will be referred to as a monitoring period. Combined sewers were monitored for 33 periods in 1985 and 1986. Each of these monitoring periods included one or more storms.

Total accumulated precipitation was calculated from the Theissen-averaged data for each of these 33 periods, and the total precipitation from the largest storm occurring during a monitoring period also was calculated. Maximum 1-hour intensity was calculated from Theissen-averaged data summed over 1-hour periods.

Antecedent-precipitation indices were developed using a method described by Viessman and others (1977, p. 99-101). For the calculations used in this report, precipitation for 10 days prior to a storm was assumed to have an effect on the moisture content of the soil and, thus, the amount of water that

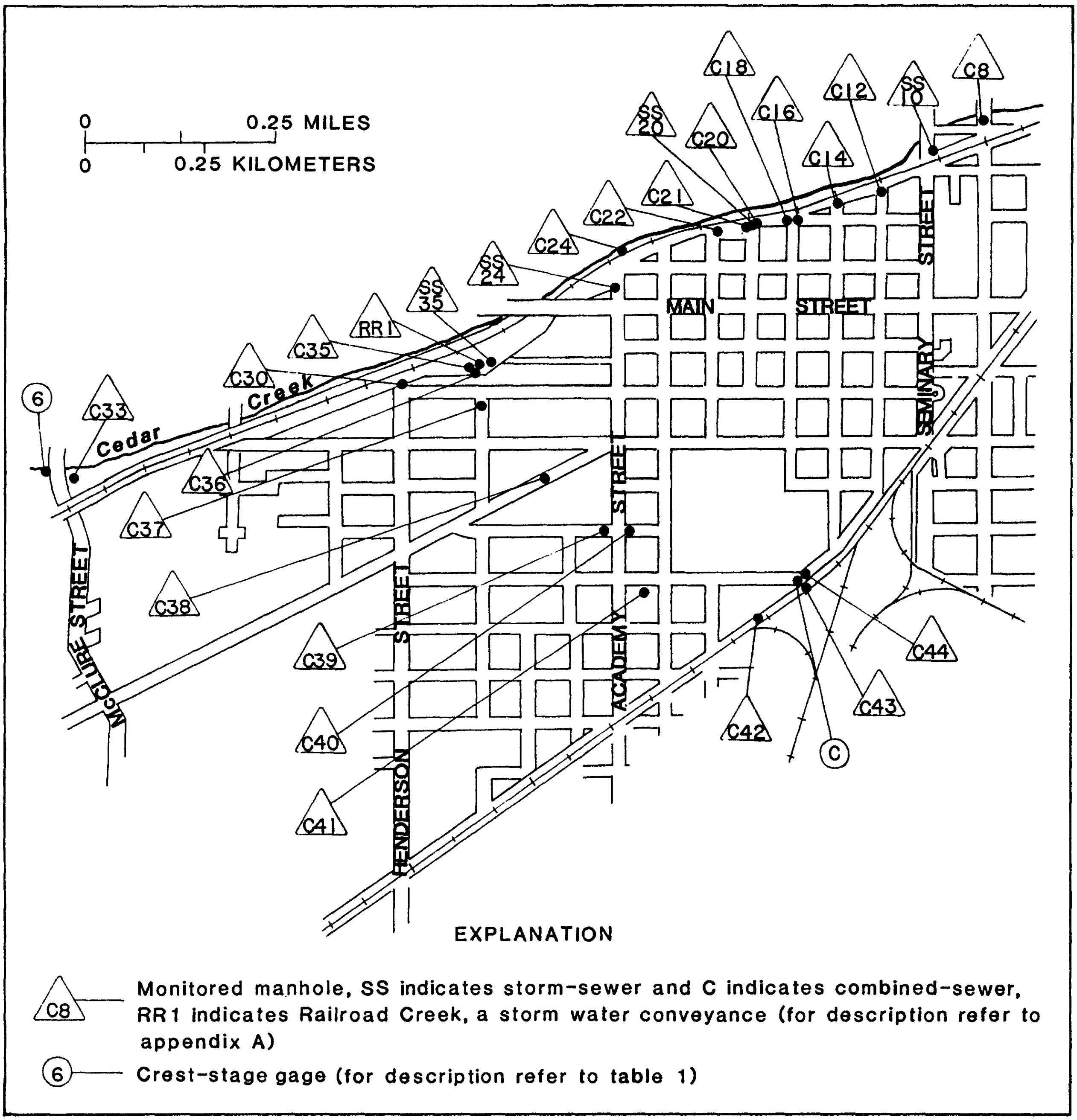

Figure 9.--Location of selected storm sewers, combined sewers, and crest-stage gages in the southwestern quarter of Galesburg (from McFarlane and others, 1987, fig. 8).

could be absorbed. In calculating the antecedent-precipitation index, total 5-minute precipitation values were weighted exponentially so that precipitation 10 days prior to the storm would have the least weight and precipitation 5 minutes prior to the storm would have the most weight. The equation used is as follows:

$$p_a = b_{2880}\, p_{2880} + b_{2879}\, p_{2879} + \ldots\ldots + b_1\, p_1, \qquad (1)$$

where p_a is the antecedent-precipitation index;

b is the coefficient ranging exponentially from 0.04 (for 2,880 5-minute periods prior to current storm) to 0.99 (for one 5-minute period prior to current storm); and

p is the total 5-minute precipitation [the subscripts indicate the length of time prior to the storm from 10 days (2,880) to 5 minutes (1)].

The method described above generally is not used for a single storm; calculations usually are based on daily totals instead of 5-minute totals. It was necessary for this study, however, to develop indices for individual storms because short-term antecedent conditions were expected to have some effect on the quantity and quality of runoff from Galesburg.

Discharge Rates and Volumes

Cedar Creek and Its Tributaries

Continuous-stage recorders were installed at five sites on Cedar Creek (sites 1, 8, 11, 14, and 18) and at sites on three tributaries (sites T21, T23, and T24) (fig. 3 and table 1). Discharge was measured several times at each site, under differing conditions, to develop stage-discharge relations by use of methods described by Rantz and others (1982). Discharge was estimated from stage measurements by use of these relations.

These eight sites were automated, but equipment malfunctions did occur. The most reliable site was site 14, which was used as an index gage of stream discharge for the project. Most problems occurred at site 8, the only site where stage was monitored using pressure transducers. The pressure transducers were difficult to calibrate; did not hold a calibration; and, because of sensing methods, stage readings would fluctuate enough to require time averaging. Sites T21 and T23 were subject to flooding, which also caused equipment malfunctions.

The total volume of discharge for each storm was defined as the amount of water that passed a site within a certain period. The period was based on the shape of the flow hydrograph and the traveltime of the peak of the hydrograph. The period for the five creek sites began when the discharge rose to 1.5 times the mean base discharge, as determined from the stage record immediately preceding the storm. The period ended when discharge had receded to near the mean base discharge. The traveltime from site to site was reviewed to verify that the duration, starting time, and ending time were reasonable from one site to the next.

The period over which discharge was summed to determine volume for the three tributary sites was based on the traveltime from the mouth of the tributary to the next site on Cedar Creek downstream from the mouth. The time period at the tributary site was equal to the period at the creek site but was offset by the traveltime. This period was chosen to account for the flow from the tributary that contributed to the volume of flow at the next creek site downstream. This method can slightly overestimate the contribution from the tributaries.

Some stage records for sites were lost because of equipment malfunctions. When records were lost, volumes at a site for a storm event were estimated on the basis of drainage area and records from surrounding sites. This was accomplished by use of the following equation:

$$V_u = V_k - V_i - (C_k \times D_x), \qquad (2)$$

where V_u is the unknown volume for the upstream site,

V_k is the known volume from the downstream site,

V_i is the volume of any inflows between the upstream and downstream sites,

C_k is the runoff coefficient for the known site (calculated by dividing the volume of runoff by the drainage area for the site), and

D_x is the intervening drainage area minus the drainage areas for the known inflows.

The volume at site 8 was used to calculate the discharge from Galesburg. This calculation was important in determining the amount of storm-sewer discharge. Site 8 also was the site with the most missing record. Stage record for four of the five storms sampled in 1986 (May 16-20, July 7-10, July 31 to August 1, and August 26-27) were missing at site 8. Comparisons between volumes calculated from stage records at site 8 and volumes calculated using equation 2 indicate that the results from equation 2 may be in error by as much as plus or minus 20 percent. Equation 2 also was used to estimate the discharge volume at site 11 for three of the five storms (May 16-20, July 31 to August 1, and August 26-27). Comparisons with volumes from stage records at site 11 also indicate that the results from equation 2 may be in error by as much as plus or minus 20 percent.

Discharge volumes at Tributary No. 1 and Tributary No. 2 (sites T21 and T23) were estimated for the second of the five sampled storms (July 7-10) by multiplying the drainage area of each tributary by the runoff coefficient for Tributary No. 3. Comparisons with measured values indicate that this method is fairly accurate for Tributary No. 2 (plus or minus 5 percent), but it may substantially underestimate the volume from Tributary No. 1. The discharge volume at Tributary No. 3 (site T24) for the first of the five sampled storms (May 16-20) was estimated by multiplying the drainage area by the runoff coefficient for Tributary No. 2. Comparisons with measured results indicate that for volumes in this range (5 to 10 million cubic feet) the estimated results may be in error by as much as plus or minus 40 percent.

Many of the discharge volumes for this phase of the study were estimated. The comparisons between estimated and measured discharge volumes, as described above, indicate that there may be a significant amount of error in the estimates. There are not enough measured values, however, to develop improved methods of estimating volume; so these estimates, along with measured values, when available, are used for calculations in the remainder of this report.

The volume of streamflow contributed by runoff from Galesburg was calculated by subtracting the discharge volume at site 1 from the discharge volume at site 8 (fig. 3). The percent runoff for Galesburg (percentage of total precipitation to reach the creek) was determined by dividing the volume of runoff from Galesburg by the product of the total precipitation and the intervening drainage area.

Runoff From Galesburg

All flow data from the wastewater-treatment facility are based on stage above a sharp-crested weir located at the entrance to the discharge pipe to the stream. Stage was measured by personnel of the Galesburg Sanitary District nine times daily, and discharge was estimated from a stage-discharge rating for the weir. Volume was determined by summing discharge over a certain period. The period was based on the traveltime from the effluent discharge pipe to the next site on Cedar Creek downstream from the discharge pipe. The period was set equal to the period at the creek site but was offset by the traveltime. This period was chosen to account for the flow from the wastewater-treatment facility that contributed to the volume of flow at the next creek site downstream. This method can slightly overestimate the contribution from the wastewater-treatment facility.

All 49 combined sewers were monitored to determine if they overflowed with each storm event. The outfall pipes and the crests of the weirs were coated with a chalk-water mixture between storms to identify if flow in the pipe had occurred. Crest-stage gages and flow-duration timers were used in 24 of the combined-sewer manholes to identify the peak-flow stage and the flow duration. Flow-duration timers also were installed by the GSD. These timers gave reliable results that were used for most overflow-volume calculations. Two of the 49 combined-sewer overflows were instrumented with dye-injection equipment, automatic samplers, and ultrasonic stage sensors. A complete description of the sampling and monitoring methods is provided by McFarlane and others (1987, p. 23-28).

Appendix B, at the end of this report, describes the physical characteristics and locations of the combined sewers in Galesburg. Included in this appendix is a ranking of the combined sewers on the basis of the frequency of overflows monitored during this study. A rank of 1 indicates that the pipe overflowed more frequently and a rank of 49 indicates that the pipe overflowed less frequently. This ranking is just an approximation and includes some less-reliable data from 1985. Ties were broken by comparing the number of times overflow results were uncertain (sewers with greater uncertainty were assumed to overflow less frequently).

Overflow characteristics were determined for use in estimating constituent loads to the receiving stream. If no overflow-duration data were available for a given combined-sewer overflow structure, then both the maximum duration and the mean duration of overflows measured from all the combined sewers for that storm event were used to give a possible range. Durations greater than 20 hours were considered to be outliers and were not used to calculate the maximum or mean duration results. The U.S. Geological Survey flow-duration timer results were used if the value was lower than the GSD duration value or lower than the maximum duration when GSD duration data were not available because some of the U.S. Geological Survey timers would not always stop timing after the overflow had stopped.

Peak discharge rates from the combined sewers were calculated using one or more of four theoretical discharge equations. If the peak elevation of the water above the weir (fig. 5) were known, this information and the diameter of the outfall pipe were used to determine which of the theoretical equations to use. If the height of the water in the manhole (H) divided by the diameter of the outfall pipe (d) was less than 1.2, the following sharp-crested-weir formula described by Chow (1959, p. 360-362, was used:

$$Q = CLh^{1.5}, \qquad (3)$$

where $C = 3.27 + 0.40(h/z)$, in $ft^{0.5}/s$;

$L = L' - 0.02h$, in feet;

Q is the discharge, in cubic feet per second;

h is the height of water above the weir, in feet;

z is the height of the weir, in feet; and

L' is the length of the weir, in feet.

If the value of the height of water in the manhole (H) divided by the diameter of the outfall pipe (d) were equal to or greater than 1.2, the following orifice flow formula described by Chow (1959, p. 467-469) was used:

$$Q = 0.81A\sqrt{2gH}, \qquad (4)$$

where $A = \pi(d/2)^2$, area, in square feet;

g is the acceleration due to gravity, in feet per second squared;

H is the height of water in the manhole, in feet;

d is the diameter of the outfall pipe, in feet; and

all other variables are as described above.

Several combined-sewer overflow structures did not have stage-monitoring equipment, so that peak stage above the weir was not measured. Maximum discharge for these overflow pipes was calculated from the maximum elevation of flow as determined by the chalk washed from sections 1 and 2 in the overflow pipes (fig. 5). These calculations used one or both of the following methods --a variation on the slope area method described by Chow (1959, p. 3-16)

$$Q = a_2 \sqrt{\frac{2g(\Delta y - h_f)}{1-(a_2/a_1)^2}}, \tag{5}$$

where $h_f = f(L''/d)(v^2/(2g))$,

$f = 116n^2/R^{0.33}$, for inch-pound units;

a is the cross-sectional area of flow (1 and 2 indicate upstream and downstream sections, respectively), in square feet;

Δy is the difference in water-surface elevation between sections 1 and 2, in feet;

h_f is the loss due to friction in the pipe, in feet;

f is the dimensionless Darcy friction coefficient;

L'' is the distance between sections 1 and 2, in feet;

v is the velocity, in feet per second;

n is the dimensionless Manning's roughness coefficient (Chow, 1959, p. 110);

R is the hydraulic radius, in feet; and

all other variables are as described above;

or the following California pipe equation for free overfall described by Henderson (1966, p. 197):

$$Q = 1.55(h'/d)^{1.88} (d^2 \sqrt{gd}), \tag{6}$$

where h' is the peak stage measured just inside the outfall pipe (section 2), in feet; and

all other variables are as described above.

For those pipes where peak discharge could not be determined, the mean of the peak-discharge rates determined from all of the other pipes for that storm was used.

Two methods were used to calculate the volume of overflow from each pipe for each storm. These methods gave a range in overflow volume by indicating the high and low boundaries. The first assumed a Gaussian-type distribution of discharge over time (fig. 10A) and that the overflow durations for pipes without duration data were equal to the maximum measured duration (excluding outliers) for that storm. For these assumptions, volume of overflow was calculated by multiplying 50 percent (coefficient representing flow distribution = 0.50) of the peak discharge rate (to account for Gaussian-type distribution) by the duration. The Gaussian-type distribution was chosen as a first approximation of the shape of the overflow hydrograph. The shape of the hydrograph was measured for only 2 of the 49 pipes and only for a few of the storms.

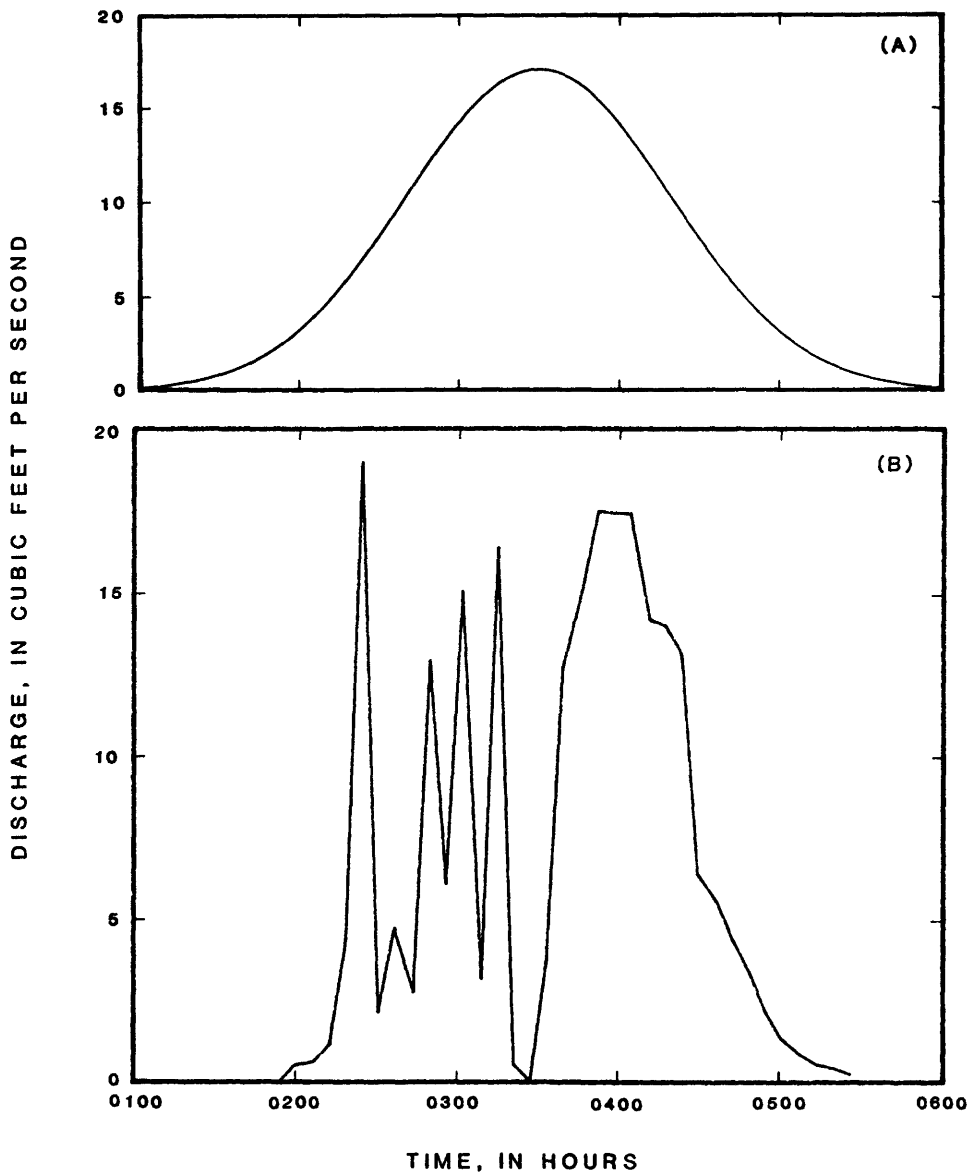

Figure 10.--An example of (A) theoretical Gaussian-type distribution of overflow discharge and (B) the distribution of overflow discharge for a site equipped with an ultrasonic stage sensor (site C22) (modified from McFarlane and others, 1987, fig. 13).

These measured results indicate that the Gaussian approximation may overestimate the volume. Thus, by using this approximation and the maximum duration for those pipes without known duration values, a maximum boundary for the range in overflow volume was obtained.

Two of the combined sewers (C6 and C22) used ultrasonic stage recorders. Figure 10B shows an example of the discharge determined from site C22. Volumes were calculated from the stage data with the sharp-crested weir or orifice flow formulas (equations 3 or 4). Because of equipment malfunctions, however, results were only obtained for four overflow events. One event was significantly different from the rest and was not considered. The remaining three were used with the measured duration to solve for the coefficient representing flow distribution. These results indicate that volume calculations using a coefficient of 0.50 will overestimate the overflow volumes. The coefficients determined from sites C6 and C22 ranged from 0.34 to 0.42. The mean value of 0.37 was used to calculate volumes.

The second method used to calculate overflow volumes assumed a distribution similar to that measured at sites C6 and C22 and that the overflow durations for pipes without duration data were equal to the mean of the measured durations (excluding outliers). Volume of overflow for these assumptions was calculated by multiplying 37 percent (coefficient representing flow distribution = 0.37) of the peak-discharge rate (to account for the distribution similar to sites C6 and C22) by the duration. Calculations based on the mean duration yielded the low boundary for the range in overflow volume. Values from both calculation methods will be used throughout this report. Appendix B, at the end of this report, summarizes the combined-sewer overflow duration, peak discharge, and overflow volume for 11 of the 18 periods monitored in 1986. Volumes for the remaining seven periods were insignificant. Comparisons between U.S. Geological Survey and GSD overflow frequency results indicate that there are some combined sewers that are listed as having no data or no flow in table 14 of the report by McFarlane and others (1987, p. 137-147) that are in error. These discrepancies are noted in Appendix B of this report.

The total volume discharged from all the combined-sewer overflows during a storm was determined by summing the volumes from the individual pipes. Because there were two values calculated for each pipe (maximum durations and Gaussian-type distribution, and average durations and a distribution similar to that measured for sites C6 and C22), two total volumes also were calculated for all of the pipes. These two total combined-sewer overflow volumes are referred to as the maximum and average overflow volumes for the remainder of this report. Regression techniques were used to relate combined-sewer overflow characteristics such as the number, duration, and volume of overflow with precipitation characteristics.

Volume of storm-sewer discharge was calculated by subtracting the total volume of combined-sewer overflow from the total runoff contributed by Galesburg. Because two values were estimated for overflow volume, two values also were determined for storm-sewer discharge volume. As previously discussed, this gave a probable range in the volume of discharge for both the storm sewers and combined sewers. The storm-sewer discharge volume determined from maximum overflow volume is smaller than the volume determined from average overflow volume. These two values of storm-sewer discharge, however, also are referred to as maximum and average, even though the values may make these labels seem incongruous.

Two of the storm sewers (sites SS24 and SS35) were equipped with automatic stage-activated samplers and dye-injection systems. Results from dye-dilution discharge calculations were not reliable (dye-mixing lengths were insufficient to mix the dye and discharge was too unsteady) and are not reported.

Water Quality and Constituent Loads

Cedar Creek and Its Tributaries

Automatic stage-activated samplers were used at five sites on Cedar Creek (sites 1, 8, 11, 14, and 18) and at three tributary sites (sites T21, T23, and T24) (fig. 3, table 1). A rise in the stage triggered a series of timed sample collections. Each sampler could collect as many as six samples without being serviced. Equipment failure reduced the number or volume of samples collected on several occasions. Complete coverage of a storm hydrograph was not always obtained because of the limits on the number of samples that could be collected by the samplers and the difficulty in setting sampling frequencies to cover rising and falling limbs of hydrographs with differing durations. A detailed description of sampling methods, problems, and results is presented by McFarlane and others (1987, p. 23-28).

Concentrations of as many as 39 constituents were determined from the samples collected by the automatic samplers. Each water sample was analyzed in the IEPA laboratory to determine specific conductance and concentrations of total ammonia nitrogen, total nitrite plus nitrate nitrogen, total organic plus ammonia nitrogen (total Kjeldahl nitrogen), total phosphorus, total suspended solids, volatile suspended solids, and total organic carbon. Approximately 50 percent of the samples were analyzed for chemical oxygen demand; ultimate carbonaceous BOD (biochemical oxygen demand); total arsenic and fluoride, and 21 metals--total calcium, magnesium, sodium, potassium, barium, boron, beryllium, cadmium, chromium, copper, cobalt, iron, lead, manganese, nickel, silver, strontium, vanadium, zinc, aluminum, and mercury. If sample volumes were insufficient to analyze for the entire group of constituents, analyses for chemical oxygen demand and ultimate carbonaceous BOD were given priority. Finally, one sample from each site was analyzed for hardness, chloride, sulfate, phenols, total BOD, and dissolved solids. Samples were analyzed using IEPA laboratory methods (Illinois Environmental Protection Agency, 1986). Results of all analyses are listed by McFarlane and others (1987, p. 147-177).

Descriptive statistics of the constituent concentrations were determined using a computerized statistical program. These statistics include low, high, mean, standard deviation, and median concentrations for each constituent. Constituent concentrations that were less than the detection limit of the analytical method were considered missing values and were not used to determine most of the descriptive statistics. Median concentrations, however, were calculated using two methods. The first method assumes that less-than-detection values are missing, and the second method assumes that all less-than-detection values are equal to the detection limit. Appendix C, at the end of this report, lists the descriptive statistics for each of the eight creek and tributary sites, the wastewater-treatment facility, the combined sewers (together), the storm sewers (together), and Railroad Creek (Site RR1, fig. 9), which is a storm-runoff conveyance for a large part of Galesburg. Descriptive statistics are listed for results from samples collected during each of the five sampled storms in 1986 and for the results from all five storms combined for each site.

Loads were calculated as the product of the median concentration (determined by setting the less-than-detection values equal to the analytical detection limit) and the flow volume. This method was chosen because, in most instances, data were insufficient to show changes in concentration over time to improve the accuracy of calculated total loads. If the median concentration was determined from only one sample, it was not considered to be representative of the storm. For these cases, the median concentration determined from the samples collected for all of the storms at that site was used to calculate the loads using the following equation:

$$Ld = M \times c \times V, \tag{7}$$

where Ld is the contaminant load, in pounds;

M is the median concentration, in milligrams per liter;

c is a constant (0.000062426) to convert milligrams per liter to pounds per cubic foot; and

V is the volume, in cubic feet.

Runoff From Galesburg

Eight of the 49 combined-sewer overflow structures were equipped with single-stage samplers. These samplers were installed so that when the stage inside the manhole reached an elevation where it would overflow the weir, siphon action caused a sample to be collected of the first overflow from these combined sewers. In addition to these single-stage samplers, 2 of the 49 combined-sewer overflow structures (C6 and C22), two major storm sewers (SS24 and SS35), Railroad Creek (RR1), and the wastewater-treatment facility outfall (WWTF) were equipped with automatic stage-activated samplers (figs. 3, 6-9). These samplers collected six samples on a time basis similar to the samplers at the creek and tributary sites. The samplers were activated by a rise in stage above a specified level in the manhole or, in the case of the wastewater-treatment facility, a rise in stage in the creek. Additional samples were collected manually from some of the other combined-sewer and storm-sewer discharges.

Samples were analyzed for the same constituents as described for the creek and tributary samples. Sample volume was sometimes insufficient to determine the concentrations of all constituents. Analyses were prioritized with the same scheme used for the creek and tributary samples. Descriptive statistics for combined-sewer overflows were determined using the results from all of the combined sewers where samples were collected. Similarly, all of the storm sewers were used to develop the descriptive statistics for storm-sewer discharge. Railroad Creek, a large storm-runoff conveyance that receives overflow from up to nine combined sewers, was not considered to be representative of either storm-sewer discharge or combined-sewer overflow quality. Descriptive statistics are listed in appendix C at the end of this report.

Median concentrations, determined for each of the five sampled storms, were used with discharge volume to calculate constituent loads from combined sewers and storm sewers. As previously discussed, constituent concentrations that were less than the analytical detection limit were set equal to the detection limit to determine medians. If the median concentration was determined from only one sample, it was not considered to be representative. For these cases, loads were calculated with the median concentration determined from all of the samples collected during the five storms.

Bottom-Material Quality

Sediment oxygen demands were measured at 45 locations (figs. 11, 12). Table 2 describes the bottom-material sampling sites and lists the sediment oxygen demands for Cedar Creek and its tributaries. Measurements were made in the stream using the methods described by McFarlane and others (1987, p. 15-19). These methods were based on the techniques described by Butts (1974, p. 3-10) and resulted in a rate of oxygen consumption for the point (approximately 0.6 square foot of streambed) where the measurement was made. Sediment oxygen demand for each subreach of the creek (as opposed to points in the creek) was estimated by using the results of these measurements and model-simulation techniques. These simulation results are described by Schmidt and others (1989).

The Illinois State Water Survey (Butts, 1986, p. 16) describes general bottom-material quality in terms of sediment oxygen demand, as shown in table 3. This classification is used to describe bottom-material quality in Cedar Creek. Some measurements made by the Illinois State Water Survey in Cedar Creek also are included in these interpretations (Butts, 1986).

Ninety-seven bottom-material samples were collected at 45 sites in the creek and tributaries (table 2 and figs. 11, 12). Samples were analyzed for the following 12 constituents: percent volatiles, total organic plus ammonia nitrogen, chemical oxygen demand, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, and zinc. Bottom-material samples were collected primarily by scooping up the material with a sample bottle. Samples were not sieved or prepared in any other way. In a few cases, where the stream was too deep, samples were collected by using a length of PVC (polyvinylchloride) pipe as a core sampler and saving only the top 1 to 2 inches of material for analysis. Samples were analyzed by the IEPA using IEPA (1986) laboratory methods.

Kelly and Hite (1984, p. 5), in a report summarizing bottom-material data collected during 1974-80 for Illinois streams, classify bottom-material quality for all 12 constituents measured in this study (table 4). Samples used by Kelly and Hite (1984) were not sieved. They classify all of the constituents, except cadmium, in the following manner: They describe 'elevated' concentrations as being greater than or equal to two standard deviations higher than the background mean concentration, 'highly elevated' concentrations as being greater than or equal to four standard deviations higher than the background mean concentration, and 'extreme' concentrations as being greater than or equal to eight standard deviations higher than the background mean concentration.

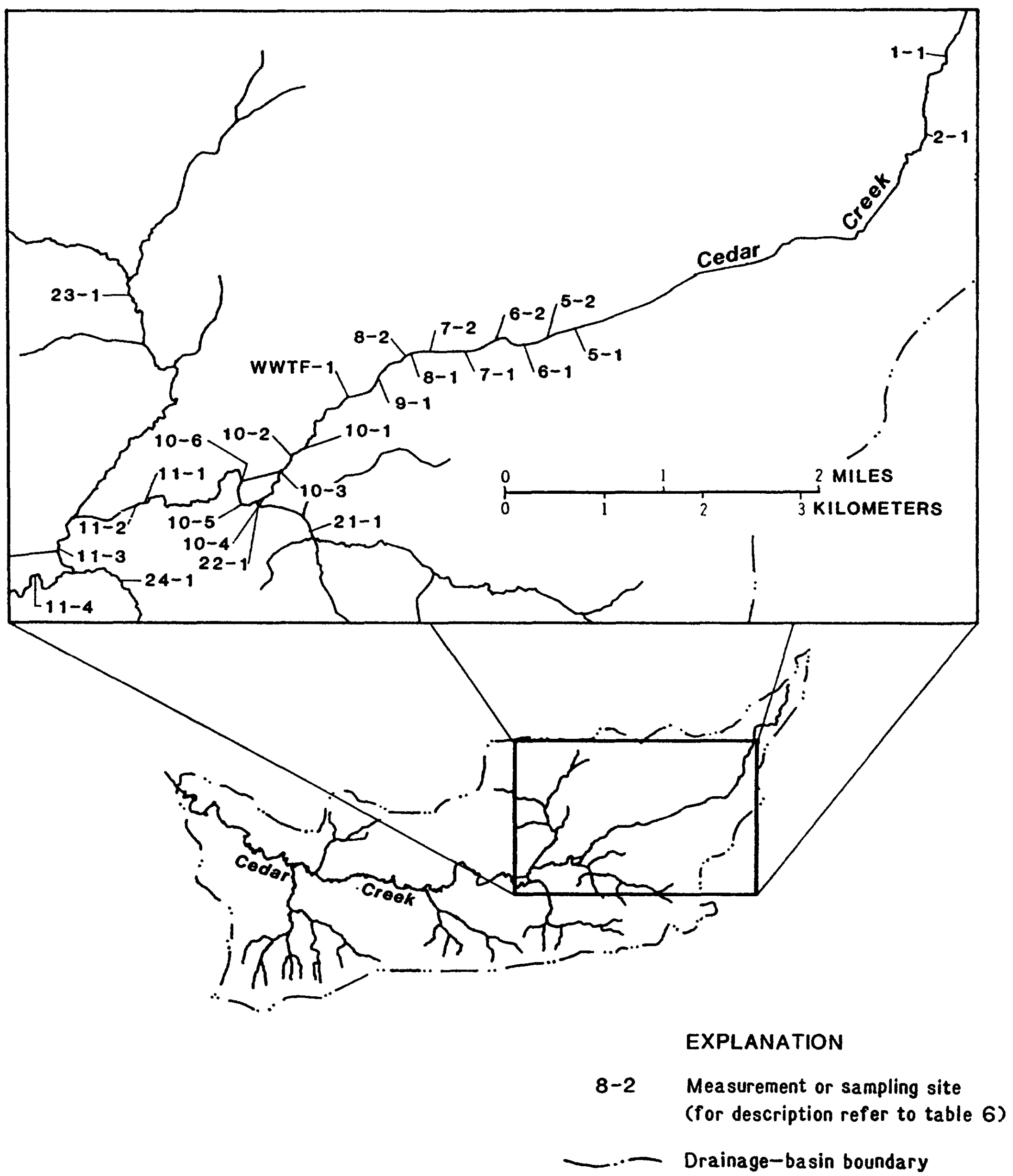

Figure 11.--Sediment-oxygen-demand measurement and bottom-material sampling sites in the upper part of the Cedar Creek study basin (from McFarlane and others, 1987, fig. 9).

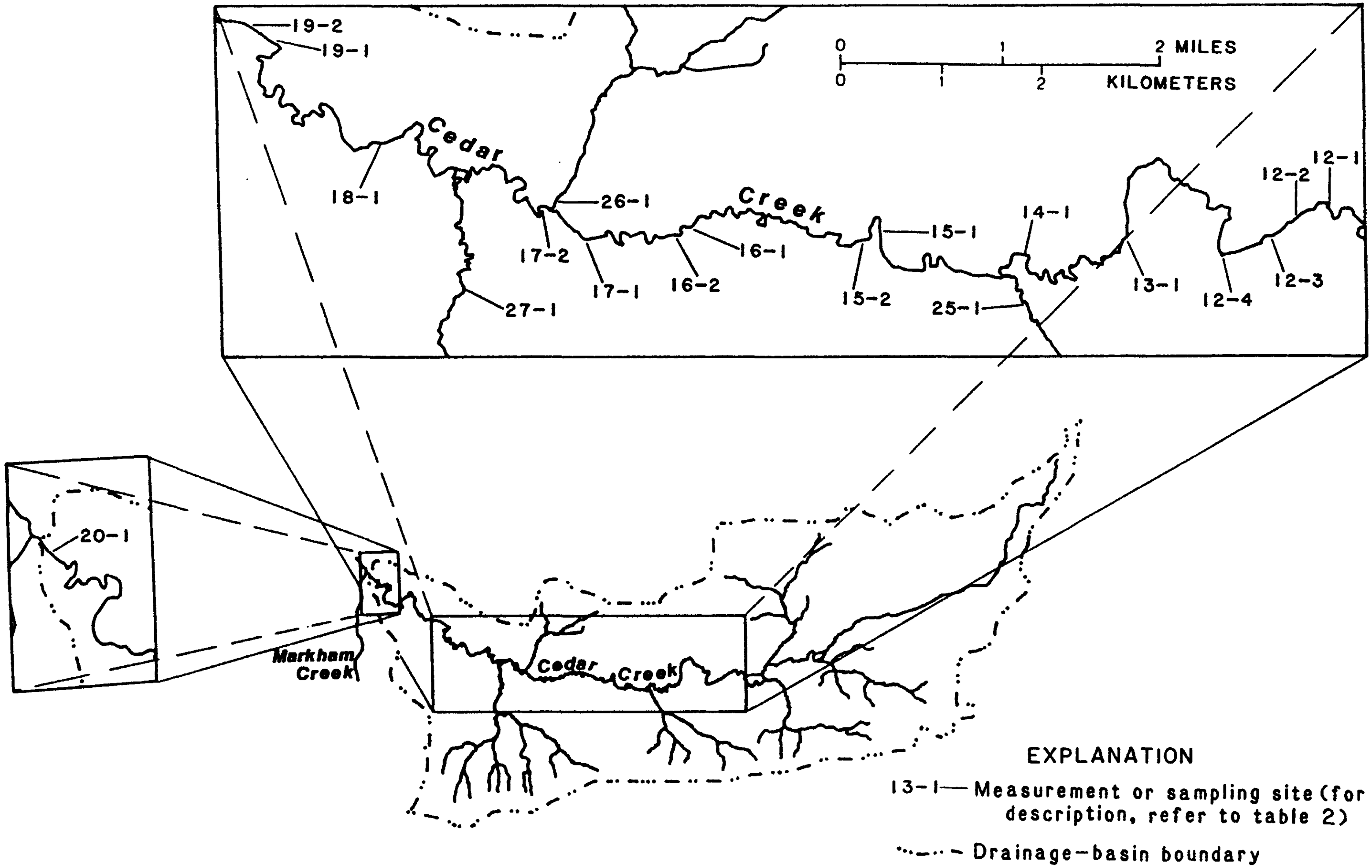

Figure 12.--Sediment-oxygen-demand measurement and bottom-material sampling sites in the lower part of the Cedar Creek study basin (modified from McFarlane and others, 1987, fig. 10).

Table 2.--Bottom-material site descriptions and computed sediment-oxygen-demand rates for Cedar Creek and its tributaries

[Site numbers correspond to those in figures 9 and 10 of this report; $(g/m^2)/d$, grams per square meter per day; dashes indicate no data]

Site number	River mile above mouth	Data base identification number	Site location	Date (month/day/year)	Time[1]	Sediment-oxygen-demand-rate $[(g/m^2)/d]$
1-1	45.2	405807090204201	Cedar Creek at Farnham Street at Galesburg			
			(20 ft downstream from culverts)	06/26/86		--
2-1	44.6	405744090205001	Cedar Creek at Fremont Street at Galesburg			
			(7 ft upstream from culverts)	07/22/85		1.5
			(10 ft upstream from culverts)	10/23/85		--
			(50 ft upstream from culverts)	06/17/86	1000	3.3
			(50 ft upstream from culverts)	06/17/86	1100	2.2
5-1	41.8	405641090232101	Cedar Creek at Dietrich Street at Galesburg			
			(25 ft upstream from bridge)	07/22/85		3.3
			(25 ft upstream from bridge)	10/23/85		--
5-2	41.7	405638090233301	Cedar Creek near Dietrich Street at Galesburg			
			(midway between Dietrich and McClure Streets)	06/26/86		4.7
6-1	41.6	405635090234401	Cedar Creek at McClure Street at Galesburg			
			(15 ft upstream from bridge)	07/22/85		2.2
			(10 ft downstream from bridge)	10/23/85		--
			(30 ft downstream from bridge)	06/16/86	1000	--
			(30 ft downstream from bridge)	06/16/86	1100	2.7
6-2	41.3	405637090235501	Cedar Creek near McClure Street at Galesburg			
			(midway between McClure and Linwood Streets)	06/25/86	1000	--
			(midway between McClure and Linwood Streets)	06/25/86	1100	1.1
7-1	41.1	405633090241001	Cedar Creek at Linwood Street at Galesburg			
			(upstream side of bridge)	06/27/85		1.0
			(upstream side of bridge)	10/23/85		--
			(upstream side of bridge)	08/29/86	1000	--
			(upstream side of bridge)	08/29/86	1100	--
7-2	40.9	405632090242301	Cedar Creek near Linwood Street at Galesburg			
			(750 ft downstream from bridge)	06/27/86	1100	--
8-1	40.8	405632090243301	Cedar Creek near U.S. Highway 34 at Galesburg			
			(200 ft upstream from northbound bridge)	06/27/86	1000	--
			(200 ft upstream from northbound bridge)	08/21/86	1000	--
			(200 ft upstream from northbound bridge)	08/21/86	1100	--

8-2	40.7	405631090243401	Cedar Creek at U.S. Highway 34 at Galesburg			
			(under northbound bridge)	06/26/85		2.3
			(100 ft upstream from northbound bridge)	07/25/85	1000	1.7
			(50 ft upstream from northbound bridge)	07/25/85	1100	4.0
			(under northbound bridge)	07/25/85	1200	1.7
			(50 ft upstream from northbound bridge)	10/23/85		--
			(5 ft downstream from southbound bridge)	07/17/86		1.8
			(50 ft upstream from northbound bridge)	08/19/86		--
9-1	40.5	405625090244701	Cedar Creek upstream from Galesburg wastewater-treatment facility at Galesburg			
			(upstream from facility's bridge)	06/26/85	1000	9.1
			(downstream from facility's bridge)	06/26/85	1100	7.5
			(under facility's bridge)	10/23/85		--
			(30 ft upstream from bridge)	06/19/86	1000	2.7
			(30 ft upstream from bridge)	06/19/86	1100	4.9
			(30 ft upstream from bridge)	08/12/86		--
			(30 ft upstream from bridge)	08/14/86	1000	1.4
			(30 ft upstream from bridge)	08/14/86	1100	1.0
WWTF-1	40.2	405617090250101	Cedar Creek at Galesburg wastewater-treatment-facility outfall at Galesburg			
			(10 ft downstream from outfall)	10/23/85		--
			(100 ft downstream from outfall)	08/08/86	1000	2.9
			(100 ft downstream from outfall)	08/08/86	1100	--
10-1	39.8	405601090252101	Cedar Creek at Old Pickard Road near Galesburg			
			(5 ft upstream from culverts)	10/23/85		--
			(10 ft downstream from culverts)	06/18/86	1000	--
			(10 ft downstream from culverts)	06/18/86	1100	--
			(100 ft upstream from culverts)	08/30/86	1000	5.7
			(100 ft upstream from culverts)	08/30/86	1100	--
10-2	39.7	405558090252401	Cedar Creek near Old Pickard Road near Galesburg			
			(500 ft downstream from culverts)	07/17/85		2.6
			(500 ft downstream from culverts)	09/02/86	1000	4.6
			(500 ft downstream from culverts)	09/02/86	1100	--
10-3	39.5	405554090252901	Cedar Creek upstream from high-flow diversion near Galesburg	10/23/85		--
				06/25/86		5.0
				07/22/86	1000	--
				07/22/86	1100	6.6
				08/12/86		--
10-4	39.3	405543090253901	Cedar Creek upstream from mouth of Tributary No. 1 near Galesburg	07/30/86		--
				10/08/86	1000	3.5
				10/08/86	1100	--

Table 2.--Bottom-material site descriptions and computed sediment-oxygen-demand rates for Cedar Creek and its tributaries--Continued

Site number	River mile above mouth	Data base identification number	Site location	Date (month/ day/ year)	Time[1]	Sediment-oxygen-demand-rate [(g/m²)/d]
10-5	39.2	405542090254601	Cedar Creek downstream from mouth of Tributary No. 1			
			near Galesburg	10/08/86	1000	--
				10/08/86	1100	--
10-6	39.0	405550090254601	Cedar Creek downstream from high-flow diversion			
			near Galesburg	09/04/86	1000	--
				09/04/86	1100	6.6
11-1	38.1	405543090262801	Cedar Creek at County Line Road near Galesburg			
			(55 ft upstream from bridge)	06/20/85	1000	4.4
			(5 ft downstream from bridge)	06/20/85	1100	3.9
			(30 ft upstream from bridge)	07/17/85		4.0
			(30 ft downstream from bridge)	10/23/85	1000	--
			(5 ft upstream from bridge)	10/23/85	1100	--
			(5 ft upstream from bridge)	06/20/86	1000	1.3
			(15 ft upstream from bridge)	06/20/86	1100	2.0
			(55 ft upstream from bridge)	08/19/86	1000	6.7
			(45 ft upstream from bridge)	08/19/86	1100	2.6
11-2	38.0	405542090263001	Cedar Creek near County Line Road near Galesburg			
			(150 ft downstream from bridge)	06/21/85	1000	3.5
			(150 ft downstream from bridge)	06/21/85	1100	2.7
11-3	37.3	405528090270401	Cedar Creek upstream from mouth of Tributary No. 3 near Galesburg			
			(1,500 ft upstream from mouth)	07/28/86	1000	3.1
			(1,500 ft upstream from mouth)	07/28/86	1100	3.6
			(1,500 ft upstream from mouth)	08/12/86		--
11-4	36.7	405519090271501	Cedar Creek downstream from mouth of Tributary No. 3 near Galesburg			
			(1,200 ft downstream from mouth)	07/28/86	1000	2.9
			(1,200 ft downstream from mouth)	07/28/86	1100	4.4
			(1,200 ft downstream from mouth)	08/12/86		--
12-1	35.7	405528090274401	Cedar Creek upstream from Road 1650 E near Coldbrook			
			(3/4 mile upstream from bridge)	07/29/86	1000	8.2
			(3/4 mile upstream from bridge)	07/29/76	1100	3.3
			(3/4 mile upstream from bridge)	08/12/86		--

12-2	35.4	405526090275901	Cedar Creek near Road 1650 E near Coldbrook			
			(1/2 mile upstream from bridge)	08/15/86	1000	1.9
			(1/2 mile upstream from bridge)	08/15/86	1100	--
12-3	35.2	405520090280901	Cedar Creek at Road 1650 E near Coldbrook			
			(upstream side of bridge)	06/25/85	1000	1.6
			(15 ft downstream from bridge)	06/25/86	1100	1.3
			(upstream side of bridge)	10/23/85		--
			(downstream side of bridge)	08/15/86	1000	--
			(downstream side of bridge)	08/15/86	1100	--
12-4	34.6	405516090283101	Cedar Creek downstream from Road 1650 E near Coldbrook			
			(3,000 ft downstream)	07/29/86	1000	--
			(3,000 ft downstream)	07/29/86	1100	--
			(3,000 ft downstream)	08/12/86		--
13-1	33.1	405520090291101	Cedar Creek at Road 1550 E near Coldbrook			
			(upstream bridge)	10/23/85		--
			(upstream bridge)	07/24/85		1.5
			(downstream bridge)	06/24/86	1000	--
			(downstream bridge)	06/24/86	1100	--
14-1	31.9	405516090295301	Cedar Creek at Road 1500 E near Coldbrook			
			(30 ft downstream from bridge)	06/19/85		3.9
			(30 ft downstream from bridge)	07/24/85		1.7
			(30 ft downstream from bridge)	10/23/85		--
15-1	30.3	405522090305401	Cedar Creek upstream from Road 1400 E near Coldbrook			
			(1/4 mile upstream from bridge)	07/16/86		2.3
			(1/4 mile upstream from bridge)	08/12/86		--
15-2	30.0	405520090310301	Cedar Creek at Road 1400 E near Coldbrook			
			(upstream bridge)	07/16/85		2.1
			(upstream bridge)	10/23/85		--
16-1	28.4	405524090321301	Cedar Creek at Road 1300 E near Coldbrook			
			(downstream bridge)	07/16/85		.4
			(downstream bridge)	10/23/85		--
16-2	28.3	405521090321801	Cedar Creek near Road 1300 E near Coldbrook			
			(400 ft downstream from bridge)	07/30/86	1000	.6
			(400 ft downstream from bridge)	07/30/86	1100	1.4
17-1	27.3	405520090325801	Cedar Creek upstream from Road 1200 E near Coldbrook			
			(1,500 ft upstream from bridge)	06/18/85		4.6
17-2	27.0	405530090331501	Cedar Creek at Road 1200 E near Coldbrook			
			(20 ft downstream from bridge)	06/17/85	1000	.4
			(10 ft downstream from bridge)	06/17/85	1100	3.8
			(10 ft downstream from bridge)	10/23/85		--
			(10 ft downstream from bridge)	08/08/86	1000	2.4
			(20 ft downstream from bridge)	08/08/86	1100	2.2

Table 2.--Bottom-material site descriptions and computed sediment-oxygen-demand rates for Cedar Creek and its tributaries--Continued

Site number	River mile above mouth	Data base identification number	Site location	Date (month/ day/ year)	Time[1]	Sediment-oxygen-demand-rate [(g/m²)/d]
18-1	24.7	405550090342301	Cedar Creek at Road 1100 E near Monmouth			
			(60 ft upstream from bridge)	06/17/85		1.3
			(60 ft upstream from bridge)	10/22/85		--
19-1	22.7	405625090351201	Cedar Creek at Old Highway 34 near Monmouth			
			(upstream bridge)	07/15/85		1.8
			(upstream bridge)	07/29/85		1.0
			(upstream bridge)	10/23/85		--
19-2	22.6	405627090351701	Cedar Creek at U.S. Highway 34 near Monmouth			
			(600 ft downstream from Old Highway 34 bridge)	10/23/85		--
20-1	19.0	405727090371401	Cedar Creek upstream from confluence with Markham Creek near Monmouth			
			(upstream confluence)	07/15/85		1.9
21-1	[2]39.3	405529090251701	Cedar Creek Tributary No. 1 at Road 1450 N at Galesburg			
			(under bridge)	09/03/86		2.9
22-1	[2]39.3	405542090253901	Cedar Creek Tributary No. 1 at Atchison, Topeka, and Santa Fe Railroad at Galesburg			
			(upstream bridge)	07/23/85		1.6
			(upstream bridge)	10/31/85		--
23-1	[2]37.7	405558090263901	Cedar Creek Tributary No. 2 at Road 2100 N near Galesburg			
			(20 ft downstream from culverts)	07/23/85		3.7
			(upstream culverts)	10/31/85		--
			(15 ft upstream from culverts)	09/05/86	1000	1.5
			(5 ft upstream from culverts)	09/05/86	1100	1.1
24-1	[2]37.0	405518090263901	Cedar Creek Tributary No. 3 at Atchison, Topeka, and Santa Fe Railroad near Galesburg			
			(downstream railroad bridge)	07/23/85		1.9
			(downstream railroad bridge)	10/31/85		--
25-1	[2]31.6	405507090295701	Cedar Creek Tributary No. 4 at U.S. Highway 34 near Cameron			
			(30 ft upstream from Road 1500 E culvert)	07/24/85		2.2
			(upstream from Road 1500 E culvert)	10/31/85		--

26-1	[2]27.1	405532090331001	Cedar Creek Triubutary No. 5 at Road 2040 N near Coldbrook (upstream bridge)	10/31/85	--
27-1	[2]25.8	405507090335001	Cedar Creek Tributary No. 6 at Road 2000 N near Monmouth (downstream bridge)	10/31/85	--

[1] Time is used to differentiate measurements made at the same site on the same date in the data base. Time does not actually refer to when a measurement was made.

[2] River miles indicate the location of the mouth of the tributary above the mouth of Cedar Creek.

Table 3.--Classification of general bottom-material quality in terms of sediment oxygen demand

[from Butts, 1986, p. 16; >, greater than]

Bottom-material quality	Sediment oxygen demand, in grams per square meter per day
Clean	0.0 - 0.5
Moderately clean	> .5 - 1.0
Slightly degraded	>1.0 - 2.0
Moderately polluted	>2.0 - 3.0
Polluted	>3.0 - 5.0
Grossly polluted	>5.0 - 10.0
Sewage sludge-like	>10.0

Table 4.--Classification of bottom-material constituent concentrations in Illinois

[from Kelly and Hite, 1984, p. 5, 24. Ranges of concentrations are based on 1, 2, 4, and 8 standard deviations above background mean, except for cadmium, which is based on 50, 65, 80, and 95 percent distributions for all samples. Concentrations are in milligrams per kilogram unless otherwise noted. ≥, greater than or equal to]

Constituent	Background mean	Slightly elevated	Elevated	Highly elevated	Extreme
Chemical oxygen demand	49,000	≥90,000	≥132,000	≥215,000	≥380,000
Total Kjeldahl nitrogen	1,380	≥2,300	≥3,200	≥5,100	≥8,800
Total volatile solids (in percent)	4.4	≥6.5	≥8.8	≥13	≥22
Arsenic	5.2	≥8.0	≥11	≥17	≥28
Chromium	9.8	≥16	≥23	≥38	≥60
Copper	15	≥38	≥60	≥100	≥200
Iron	13,000	≥18,000	≥23,000	≥32,000	≥50,000
Lead	17	≥28	≥38	≥60	≥100
Manganese	740	≥1,300	≥1,800	≥2,800	≥5,000
Mercury	.04	≥.07	≥.10	≥.17	≥.30
Zinc	50	≥80	≥100	≥170	≥300
Cadmium	≥.5	≥.5	≥1.0	≥2.0	≥20.0

Background mean concentrations were computed by Kelly and Hite (1984, p. 10) from samples collected at 94 sites in Illinois "that were judged to be unimpacted by point or non-point discharge with the exception of agricultural non-point inputs." Constituent concentrations were rated using this system. For cadmium, a similar rating scheme was used except that instead of 2, 4, and 8 standard deviations, concentrations were rated elevated, highly elevated, and extreme based on 65, 80, and 95 percent distributions, respectively (for all samples Kelly and Hite analyzed).

CHARACTERISTICS OF STORM RUNOFF

The quantity and quality of runoff discussed in this section of the report relate to the seven types of storm-related sources of runoff considered in this study. The seven sources were (1) flow from upstream of Galesburg (site 1), (2) overflow from the combined sewers, (3) discharge from the storm sewers and overland runoff from Galesburg, (4) effluent from the Galesburg wastewater-treatment facility (site WWTF), and (5 through 7) flow from three tributaries draining agricultural land (sites T21, T23, and T24). Flow from upstream of Galesburg is not discussed in detail in this section but is included because it is needed to isolate the contributions of runoff from Galesburg. The quality and quantity of storm runoff as they relate to the characteristics of the five storms also are discussed.

Total precipitation for the five sampled storms ranged from 0.37 to 3.76 inches. Maximum 1-hour intensities and antecedent moisture conditions also varied over a wide range. Table 5 lists the total accumulated precipitation, total precipitation for the largest storm, maximum 1-hour intensity, antecedent-precipitation index, and number of combined-sewer overflows for each of the 33 monitoring periods, which includes the 5 sampled storms in 1986.

The percent runoff from Galesburg ranged from 4 to 30 percent. Regression analyses indicated that the hourly intensity of a storm was the primary factor controlling the percent runoff, although antecedent-precipitation conditions and total precipitation also had some effect.

The first storm, which ended May 20, produced a total precipitation of 2.69 inches and a maximum 1-hour intensity of 0.70 inch per hour. This storm was the first big spring storm of the year. Previous storms had occurred, but none produced sufficient runoff to scour bottom material in Cedar Creek. Data were not available to calculate an antecedent-precipitation index for this storm. Total rainfall for the first half of May was approximately 1.5 inches, indicating that soil-moisture content may have been high. Sixty-three percent of the combined sewers overflowed with a total overflow volume of 1.2 to 2.5 million ft^3 (cubic feet) (appendix B). Fifteen percent of the total precipitation falling on the city of Galesburg reached the stream as runoff.

The second storm, which ended July 10, produced moderate precipitation that totaled 0.92 inch, with a maximum 1-hour intensity of 0.57 inch per hour; the antecedent-precipitation index was 21.23. For this storm, 76 percent of the combined sewers overflowed with a total volume of overflow of 0.11 to 0.47 million ft^3. Only 7 percent of the total precipitation falling on Galesburg reached the stream as runoff.

Table 5.--Precipitation characteristics of selected storms for combined-sewer monitoring periods during 1985 and 1986

[Determined from an area-weighted average of rain-gage site 1 and site RG2 using the Theissen method; dashes indicate no data; CSO, combined-sewer overflow]

Combined-sewer monitoring period From (month/day/year)	To	Total precipitation During period (inches)	Largest storm in period (inches)	Maximum 1-hour intensity (inch/hour)	Antecedent-precipitation index	Number[1] of CSO's
08/14/85	08/19/85	0.27	0.21	0.11	--	5
08/19/85	08/26/85	.65	.63	.34	19.33	15
08/26/85	09/11/85	.15	.08	.08	18.54	8
09/11/85	09/18/85	.59	.59	.25	.99	18
09/18/85	09/23/85	1.27	.70	.33	21.35	17
09/23/85	10/01/85	.43	.20	.10	54.79	17
10/01/85	10/06/85	.94	.94	.21	7.86	17
10/06/85	10/08/85	.18	.18	.18	30.23	14
10/08/85	10/10/85	.89	.32	.16	40.32	10
10/10/85	10/16/85	.23	.15	.05	86.12	6
10/16/85	10/20/85	1.69	1.59	.81	10.90	24
10/20/85	10/28/85	.65	.65	.65	45.88	25
10/28/85	11/05/85	1.92	1.92	.18	5.99	11
11/05/85	11/13/85	2.23	1.44	.33	39.93	26
11/13/85	11/19/85	2.23	1.21	.25	82.27	29
[2]05/08/86	05/20/86	2.93	2.69	.70	--	36
05/20/86	05/28/86	.42	.09	.06	20.90	1
05/28/86	06/09/86	.36	.36	.30	16.94	8
06/11/86	07/02/86	2.26	.91	.73	6.50	45
[2]07/02/86	07/10/86	1.27	.92	.57	21.23	37
07/10/86	07/14/86	1.21	.66	.51	81.17	39
[2]07/14/86	08/01/86	4.05	3.76	1.93	58.49	49
08/01/86	08/06/86	.79	.77	.23	82.20	15
08/06/86	08/08/86	.28	.25	.25	110.74	37
08/08/86	08/12/86	.11	.11	.06	47.42	1
08/12/86	08/18/86	.49	.34	.32	21.07	3
[2]08/18/86	08/27/86	.37	.37	.31	3.14	14
[2]08/27/86	09/12/86	1.16	.91	.70	.55	34
09/12/86	09/25/86	3.99	2.36	1.70	15.06	48
09/25/86	10/01/86	2.28	1.92	.56	88.26	45
10/01/86	10/08/86	2.12	2.02	.72	112.45	46
10/08/86	10/15/86	.23	.11	.08	13.05	1
10/15/86	10/29/86	1.42	1.07	.15	.55	2

[1] Number of combined sewers to overflow; not all combined sewers were checked during 1985 monitoring periods.

[2] Samples were collected during this monitoring period.

The third storm, which ended August 1, was the largest storm monitored and produced a total precipitation of 3.76 inches and a maximum 1-hour intensity of 1.93 inches per hour. This storm had an antecedent-precipitation index of 58.49, indicating that soil-moisture content was high. All of the combined sewers overflowed; the total overflow volume was 6.9 to 12.7 million ft^3. Thirty percent of the total precipitation falling on Galesburg reached the stream as runoff.

The fourth storm, which ended August 27, was a small storm that produced a total precipitation of 0.37 inch and a maximum 1-hour intensity of 0.31 inch per hour. This storm also had a low antecedent-precipitation index of 3.14. Twenty-nine percent of the combined sewers overflowed; the total overflow volume was 0.02 to 0.09 million ft^3. Only 4 percent of the total precipitation falling on Galesburg reached the stream as runoff.

The fifth storm, which ended on September 12, produced moderate precipitation that totaled 0.91 inch, with a maximum 1-hour intensity of 0.70 inch per hour; the antecedent-precipitation index was a very low 0.55. Sixty-nine percent of the combined sewers overflowed with a total overflow volume of 0.21 to 0.59 million ft^3. Eleven percent of the total precipitation falling on Galesburg reached the stream as runoff.

Rates and Volumes

Galesburg Combined-Sewer Overflows

Overflows occur with almost every storm event. Results show (table 5) that, during each of the 33 monitored periods, at least 1 combined sewer overflowed. Monitoring methods used during the 1986 data-collection period were more comprehensive than those used during the 1985 period. More combined sewers were monitored, several methods were used to determine overflow occurrence for each combined sewer, and improved peak-stage information was obtained. Statistical analyses were done using, primarily, the 1986 data. Results of stepwise-regression analysis indicated that the percentage of combined sewers that will overflow can be predicted fairly well from the natural logarithm of the maximum 1-hour intensity alone, as follows:

$$POF = (0.314 \ln (i) + 0.764) \times 100, \qquad (8)$$

where POF is the percentage of the combined sewers that overflow, and

i is the maximum 1-hour intensity, in inches per hour.

The value of the independent variable (i) can be such that the dependent variable (POF) is greater than 100. Assume in these cases that POF equals 100 indicating that all of the combined sewers probably overflowed. Solving the equation with 1986 data yielded values of POF with a multiple correlation coefficient of 0.89 and a standard error of estimate of 16 percent, which corresponds to about eight overflow points. These regression results indicate that 40 percent of the pipes will overflow with a 1-hour intensity of 0.3 inch per hour and about 70 percent of the pipes will overflow with a 1-hour intensity of 0.8 inch per hour. Measured results indicate that more than 70 percent of the pipes will overflow with a 1-hour intensity of 0.8 inch per hour. This is somewhat dependent, however, on both the total and the antecedent-precipitation conditions.

The ability to predict the number of pipes that will overflow is slightly improved when the independent variables for total and antecedent-precipitation conditions also are considered. The equation developed with all three characteristics is

$$POF = (0.175 \ln(i) + 0.162 \ln(T) + 0.044 \ln(A) + 0.516) \times 100, \qquad (9)$$

where T is the total precipitation, in inches;

A is the antecedent-precipitation index; and

all other variables are as described above.

As with equation 8, values of the independent variables (i,T,A) can be such that the resultant POF is greater than 100. This indicates that all of the combined sewers probably overflowed. This equation has a multiple correlation coefficient of 0.95 and a standard error of estimate of 12 percent, which corresponds to about six overflow points. The GSD has an ongoing program to modify combined-sewer overflow structures in an attempt to reduce the number of overflows. However, because there are many cross connections in the sewer system, the above equations should be useful (within standard error limits) until major modifications to the sewer system are made.

Overflow durations as high as 189 hours were measured. These very long durations generally were caused by an obstruction in the orifice leading to the interceptor sewer (fig. 5). Durations varied depending on the characteristics of the storm but generally were in the range of 2 to 8 hours. Peak discharges were highest for intense storm events. Peak overflow discharges as high as 34 ft^3/s (cubic feet per second) were estimated from peak stage results. Mean peak discharges for the five storms sampled in 1986 ranged from 1.35 to 16.7 ft^3/s.

Overflow volumes for individual combined sewers, calculated from measured duration values assuming a distribution of discharge over time similar to sites C6 and C22, were as high as 1,480,000 ft^3. Volumes, calculated assuming a maximum overflow duration for pipes without duration data and assuming a Gaussian-type distribution of discharge over time, were as large as 1,860,000 ft^3.

The storm with the greatest total precipitation occurred between July 14 and August 1, 1986. All of the pipes overflowed. However, this was not the storm that produced the largest combined-sewer overflow volume. That storm occurred between October 1 and 10, 1986, and produced a total precipitation equal to about half of that of the first storm; 94 percent of the pipes overflowed. The difference in the number of pipes that overflowed during these two storms is related to the antecedent-precipitation conditions. As table 5 shows, a significant amount of precipitation fell during the second half of

September. The ground was saturated and the sewer system had not recovered from the previous storms. The antecedent precipitation index for the October storm was almost twice that of the July storm.

Table 6 summarizes the storm-runoff volumes for the five storms sampled in 1986. Average overflow volumes from all of the combined sewers for the five sampled storms ranged from 23,300 to 6,890,000 ft^3, and maximum overflow volumes ranged from 85,400 to 12,700,000 ft^3.

Table 6.--Total volumes for the five storms sampled in 1986

Site code or source name	Volume of flow, in cubic feet				
	May 16-20	July 7-10	July 1 to August 1	August 26-27	September 11-12
1	2,040,000	131,000	386,000	24,600	42,100
Combined-sewer overflow[1]					
average	1,220,000	113,000	6,890,000	23,300	208,000
maximum	2,550,000	470,000	12,700,000	85,400	586,000
Storm-sewer discharge[2]					
using average CSO	8,740,000	1,730,000	20,300,000	296,000	2,600,000
using maximum CSO	7,410,000	1,370,000	14,500,000	234,000	2,220,000
8	12,000,000	1,970,000	27,600,000	344,000	2,850,000
WWTF	6,700,000	2,120,000	4,720,000	1,100,000	1,580,000
T21	4,730,000	213,000	8,400,000	112,000	343,000
11	30,600,000	5,630,000	53,300,000	2,090,000	4,680,000
T23	10,700,000	389,000	5,570,000	79,900	152,000
T24	6,930,000	235,000	5,230,000	50,600	99,300
14	56,200,000	6,860,000	74,700,000	2,650,000	4,910,000
18	63,800,000	6,760,000	94,900,000	2,460,000	5,650,000

[1] Average refers to combined-sewer-overflow volumes calculated assuming a distribution of discharge over time similar to that measured at sites C6 and C22 and assuming overflow durations for those pipes without duration data are equal to the average of the measured durations (excluding outliers).

Maximum refers to combined-sewer-overflow volumes calculated assuming a normal distribution of discharge over time and assuming overflow durations for those pipes without duration data are equal to the maximum measured duration (excluding outliers).

[2] Using average CSO refers to storm-sewer-discharge volumes calculated by subtracting the average combined-sewer-overflow volume, as described above, from the total runoff from the city of Galesburg.

Using maximum CSO refers to storm-sewer-discharge volumes calculated by subtracting the maximum combined-sewer-overflow volume, as described above, from the total runoff from the city of Galesburg.

Galesburg Storm-Sewer Discharges

The volume of flow from the storm sewers was estimated from the total volume of flow from Galesburg and the average and maximum combined-sewer overflow volumes. The difference between the total volume contributed by the city and the total volume contributed by overflow from the combined sewers was attributed to storm-sewer discharges and overland runoff (table 6). Storm-sewer discharge volumes, calculated from average combined-sewer overflow volumes, ranged from 296,000 to 20,300,000 ft^3. Storm-sewer discharge volumes, calculated from maximum combined-sewer overflow volumes, ranged from 234,000 to 14,500,000 ft^3.

Tributary and Wastewater-Treatment-Facility Effluent Discharges

Discharge rates from the three tributaries were variable throughout each storm event, and stage would rise and fall rapidly. Volumes were calculated on the basis of traveltimes so that only the flow contributing to the volume calculated for the next creek site downstream from the mouth of the tributary would be included. This method for calculating volume may have slightly overestimated the storm-related discharge volume from the tributaries. Volumes of flow from the tributaries ranged from 50,600 to 10,700,000 ft^3 for the five sampled storms (table 6).

Volumes of effluent from the wastewater-treatment facility were determined from GSD effluent-discharge records. The period of time used to calculate volume was based on the traveltime from the outfall pipe to site 11, so that only effluent contributing to the flow volume calculated for site 11 would be included. Effluent flow volumes ranged from 1,100,000 to 6,700,000 ft^3 for the five sampled storms (table 6).

Water Quality and Constituent Loads

Galesburg Combined-Sewer Overflows

Constituent concentrations determined from samples of combined-sewer overflow (McFarlane and others, 1987, p. 148-177) indicated that concentrations of oxygen-demanding solids, total suspended solids, zinc, and iron exceeded the State effluent standards (Illinois Pollution Control Board, 1986). These samples were grab samples and the averaging rule of the effluent standards indicates that concentrations determined from a grab sample shall not exceed five times the specified standard. A substantial amount of grease and floating material, including raw sewage, was observed in the creek and overflows, indicating that the combined-sewer overflows exceeded the standard against offensive discharges.

Concentrations of constituents in combined-sewer effluent were highly variable. Generally, concentrations were initially high or increased rapidly at the beginning of an overflow and then decreased to more dilute concentrations. In many cases, the concentrations determined from the second in the series of six samples were higher than the concentrations in the other five samples. All constituent concentrations are summarized by McFarlane and others (1987, p. 148-177). Appendix C, at the end of this report, lists the descriptive statistics determined from these combined-sewer samples and from all the storm-related samples collected during this phase of the study.

Constituent loads for samples from each of the five storms were calculated by using the total volume of overflow for the combined sewers and the median constituent concentrations. These loads are listed in appendix D at the end of this report. Constituent loads and discharge volumes from the combined sewers can differ depending on, among other things, land use, drainage area, lateral pipe size, position along the interceptor, orifice size, and condition of the sewer system. Because it was not possible to sample all of the combined-sewer overflows, those that were sampled were assumed to represent the characteristics of all the combined-sewer overflows.

Galesburg Storm-Sewer Discharges

Analyses of discharge samples from storm sewers indicate that concentrations of lead, iron, and total dissolved solids exceeded the State effluent standards (Illinois Pollution Control Board, 1986). Even though concentrations generally were lower than those determined from the combined sewers, estimated volumes of storm-sewer discharge were substantially higher, so the resulting constituent loads were often higher (appendix D).

Tributary and Wastewater-Treatment-Facility Effluent Discharges

Constituent concentrations determined from the samples collected at the three tributary sites (T21, T23, and T24) indicated copper, lead, manganese, and iron exceeded the State general-use water-quality standards. Wastewater-treatment-facility effluent samples indicated that concentrations did not exceed the State effluent standards for any of the constituents analyzed. Loads of several oxygen-demanding constituents (ultimate carbonaceous BOD, chemical oxygen demand, total organic carbon, total organic plus ammonia nitrogen, and volatile suspended solids) were substantially higher at site T24 than at either of the other two tributaries (appendix D). These increased loads were caused by increased concentrations that may have been derived from runoff from feedlots (hogs and cattle) just upstream from this site.

WATER QUALITY AND BOTTOM-MATERIAL QUALITY IN CEDAR CREEK

Water Quality

Cedar Creek was sampled at five locations (sites 1, 8, 11, 14, and 18). Several constituents were found to exceed the State general-use water-quality standards (Illinois Pollution Control Board, 1986). Concentrations of copper, lead, cadmium, zinc, iron, manganese, and total dissolved solids exceeded their respective standards in several subreaches of the creek (McFarlane and others, 1987, p. 148-177). Appendix C, at the end of this report, lists the constituents and gives a statistical summary of the water-quality results for the five storms sampled in 1986.

Constituent concentrations generally are influenced by the rate of discharge in a stream. This relation may result from increased constituent loads from runoff, increased loads from scour of bottom materials, decreased concentrations caused by dilution, or, more likely, a combination of these and other factors. In almost every case, there is some relation between concentration and discharge; however, it commonly is difficult to determine because of its complexity. The relation between concentration and discharge at the five sites in Cedar Creek was studied by use of regression methods. However, the data points are too variable and too few, in most instances, to yield conclusive results.

Regression analyses were performed for the concentration of each constituent by using discharge as the explanatory variable. Linear, logarithmic, semilogarithmic, and inverse functions were tested. These analyses were done for each site separately and then for all sites together. No relations were determined for sulfate, beryllium, phenols, and dissolved solids. Some trends were indicated for the other constituents, even though data were limited. Regression results for silver, boron, and specific conductance indicated that concentrations decreased with increasing discharge. Regression results for the remaining constituents (listed in appendix C) indicated that concentrations increased with increasing discharge. Regression results at a few sites contradicted the overall trend for some constituents.

Water quality of a stream is generally more evident during low-flow conditions. Because of this, the results of the low-flow phase of this study, described by Schmidt and others (1989), provide the best indicators of the water quality in Cedar Creek. The water-quality results indicated that, during low-flow periods measured in 1985, concentrations of iron, copper, manganese, phenols, and dissolved solids exceeded the State general-use water-quality standards (Illinois Pollution Control Board, 1986) in some subreaches of Cedar Creek.

Dissolved-oxygen concentrations also were less than the standard specified by the Illinois Pollution Control Board (1986) throughout most of the study reach. Dissolved oxygen is a primary indicator of water quality because it is necessary for the survival of most aquatic organisms. A steady-state, one-dimensional computer model was calibrated in the first phase of this study to determine the effects of environmental factors on water-quality degradation. Model-simulation results indicate that sediment oxygen demand is the primary factor that causes low dissolved-oxygen concentrations in Cedar Creek (Schmidt and others, 1989).

Bottom-Material Quality

Storm runoff can contribute significantly to the sediment loads in the creek. As discussed previously, the sediment contains materials having potentially high oxygen demands and constituent concentrations. A total of 70 sediment-oxygen-demand measurements were made at 45 locations in Cedar Creek and its tributaries (table 2 and figs. 11, 12). A total of 97 bottom-material samples were collected at these same locations, many in conjunction with the measurements of sediment oxygen demand. The locations and methods of measurement, as well as the results, are described by McFarlane and others (1987).

The highway construction and channel modifications along Cedar Creek by the IDOT (fig. 4) uncovered and loosened the topsoil in many areas adjacent to the creek, allowing storm runoff to transport a large amount of sediment to the creek. The sediment was deposited downstream from the channel modifications, and visual observations indicate that this had some effect on the aquatic habitat in the area. Most constituent concentrations, including those related to oxygen-demanding materials determined from samples of bottom-material from areas of deposition that primarily were affected by washoff from the highway construction (bottom-material sampling sites 15-1 to 18-1), were not elevated (McFarlane and others, 1987, p. 84-93). Most of the areas with elevated sediment oxygen demands or bottom-material constituent concentrations were upstream from the highway construction.

Sediment Oxygen Demand

Measured sediment oxygen demand ranged from 0.4 to 9.1 $(g/m^2)/d$ (grams per square meter per day). By use of the Illinois State Water Survey rating scheme (table 3) (Butts, 1986, p. 16), results from all but 3 of the 70 measurements indicated that the bottom-material quality was slightly degraded or worse--23 were slightly degraded, 17 were moderately polluted, 19 were polluted, and 8 were grossly polluted (fig. 13).

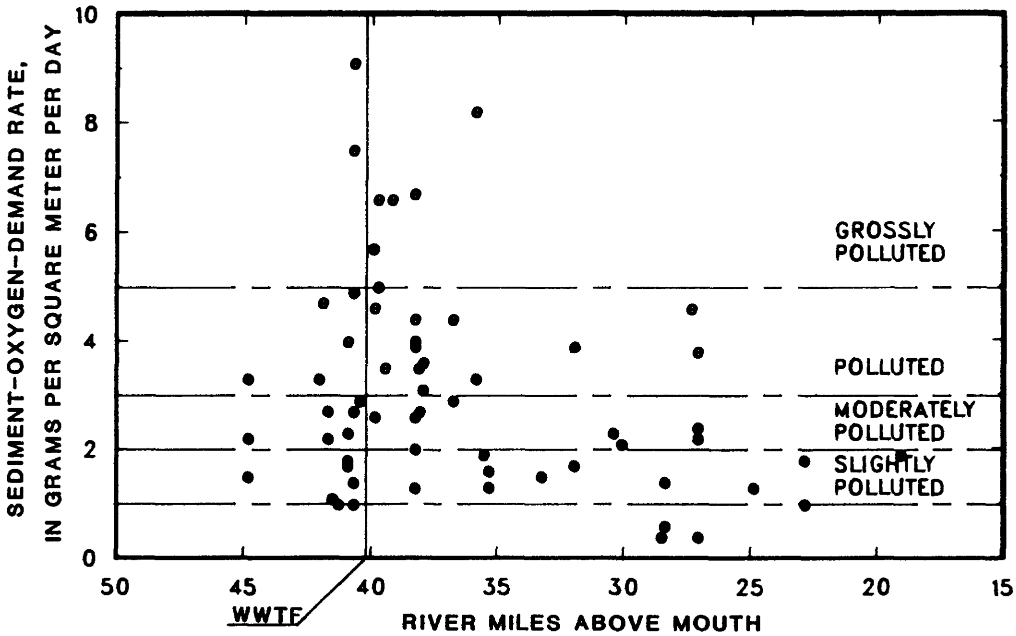

Figure 13.--Measured sediment-oxygen-demand rates in Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Butts, 1986).

Seven measurements of sediment oxygen demand were made in tributaries to Cedar Creek (figs. 11, 12)--three measurements at bottom-material sampling site 23-1 and one measurement at each of sites 21-1, 22-1, 24-1, and 25-1 (tributary measurements are not shown in fig. 13). Sediment oxygen demands in the tributaries ranged from 1.1 to 3.7 $(g/m^2)/d$. Bottom-material quality at sites 21-1 and 25-1 were moderately polluted (2.9 and 2.2 $(g/m^2)/d$, respectively) according to the Illinois State Water Survey rating scheme (Butts, 1986). One measurement at site 23-1 was polluted (3.7 $(g/m^2)/d$) and the remaining were slightly degraded according to this same rating scheme.

The Illinois State Water Survey also made some measurements of sediment oxygen demand in Cedar Creek in June and September 1985. The results of their measurements yielded values of 1.0 to 7.8 $(g/m^2)/d$ (Butts, 1986). The highest values were found close to the location where the highest values were found by the U.S. Geological Survey, upstream from the wastewater-treatment facility at bottom-material sampling site 9-1.

Constituent Concentrations

The constituent concentrations used by Kelly and Hite (1984, p. 5, 16) to describe bottom-material quality are listed in table 4. Analysis of the bottom-material samples indicate that concentrations of all 12 constituents (percent volatiles, total organic plus ammonia nitrogen, chemical oxygen demand, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, and zinc) were elevated in at least one of the samples. Concentrations of all 12 constituents except arsenic and chemical oxygen demand were highly elevated in some samples. Concentrations of all constituents except arsenic, chemical oxygen demand, copper, and total organic plus ammonia nitrogen were extreme in some samples.

Concentrations of the 12 constituents and sediment oxygen demands in Cedar Creek are generally higher in areas of deposition than in areas of nondeposition. Samples were collected and measurements were made at a particular point; thus, they do not represent the characteristics of the entire cross section or subreach. However, more than one sample was collected or measurement made in most cross sections. Emphasis was placed on the subreach of the creek upstream from RM 35 (bottom-material sampling site 12-4) where 69 of the 97 samples were collected. Accordingly, any comparison, between different locations, of the number of samples with extreme constituent concentrations may be biased toward the upstream subreaches of the creek. Figures and discussion of the results for each of the 12 constituents follow (for clarity, results of tributary sampling are not included in the figures). Tables of the results are presented by McFarlane and others (1987, p. 90-93).

Nine bottom-material samples were collected from six tributaries to Cedar Creek (sites 21-1, 22-1, 23-1, 24-1, 25-1, 26-1, and 27-1; figs. 11, 12). The mercury concentration in one sample collected at site 21-1 was 0.43 mg/kg (milligrams per kilogram), which is considered extreme. The mercury concentration in one sample at site 22-1 was 0.22 mg/kg, and the cadmium concentration was 1.0 mg/kg; these concentrations are considered highly elevated and elevated, respectively. Both of these sampling sites are in Tributary No. 1 (fig. 3). All the remaining bottom-material-quality results from the tributary show that constituent concentrations are slightly elevated or below.

Mercury.--Bottom-material-quality results show that 76 percent of all the samples have mercury concentrations considered to be elevated or above; 62 percent are extreme (fig. 14). Of the samples collected upstream from RM 35, 77 percent of the mercury concentrations are extreme compared to 37 percent from samples collected downstream from RM 35. Mercury is very toxic to animals and aquatic organisms. Once ingested, mercury remains in the organism and can accumulate to toxic levels (Kelly and Hite, 1984, p. 64).

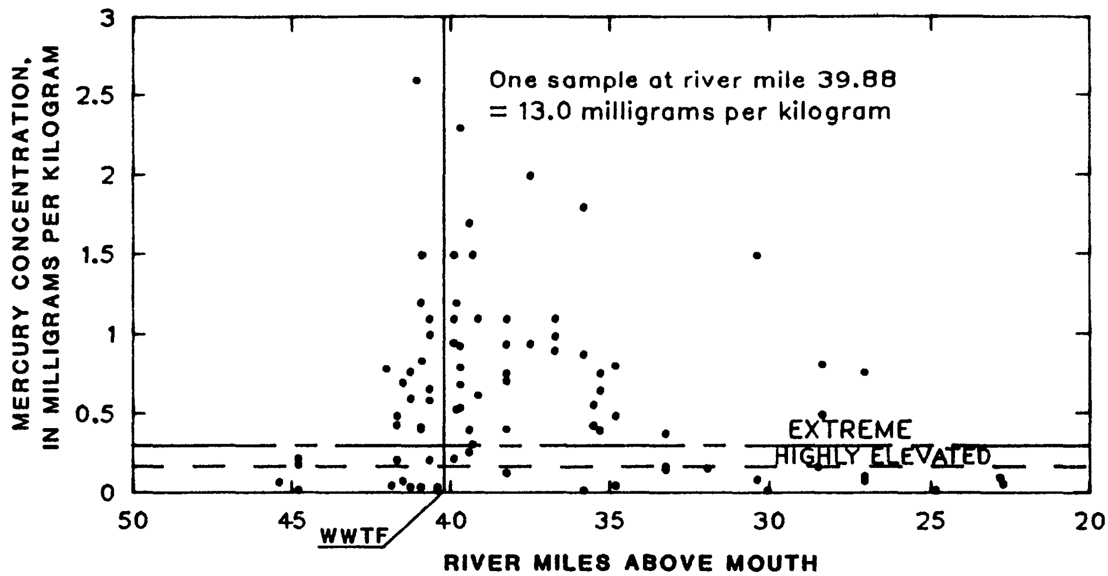

Figure 14.--Mercury concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

Lead.--Bottom-material-quality results show that 62 percent of all the samples have lead concentrations considered to be elevated or above; 29 percent are extreme (fig. 15). All of the extreme concentrations are from samples collected upstream from RM 35 and represent 41 percent of the upstream samples. Seventy-four percent of the samples collected downstream from RM 35 have lead concentrations that are slightly elevated or below. Lead is toxic to aquatic organisms; the degree of toxicity depends on other water-quality characteristics (pH, alkalinity, hardness, and so forth) and on the organisms involved (Kelly and Hite, 1984, p. 57).

Chromium.--Bottom-material-quality results show that 55 percent of all the samples have chromium concentrations that are elevated or above; 26 percent are extreme (fig. 16). One sample collected downstream from RM 35 has a concentration considered to be extreme; the remaining samples with extreme concentrations were collected upstream from RM 35 and represent 35 percent of the upstream samples. Most of the extreme chromium concentrations were downstream from the wastewater-treatment facility (Rm 40.2). Chromium, in trace amounts, is an essential metal for mammals, although some forms are toxic.

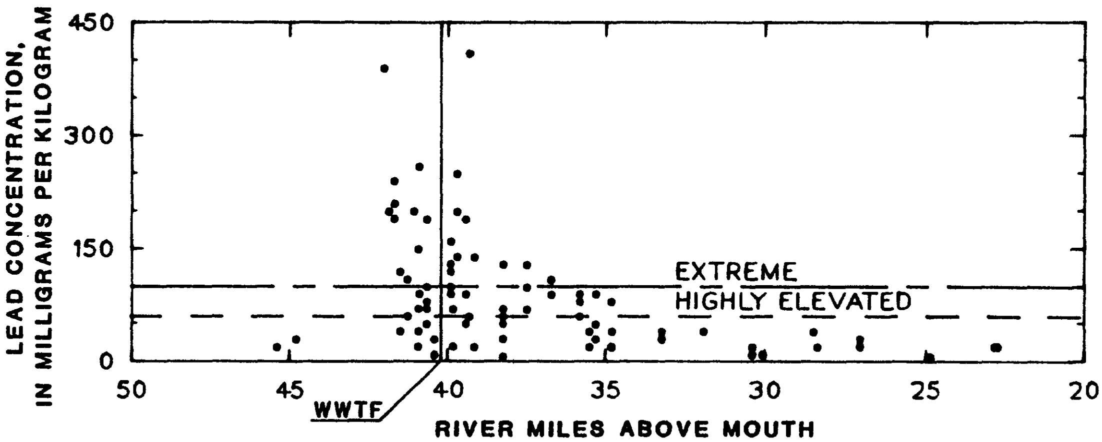

Figure 15.--Lead concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

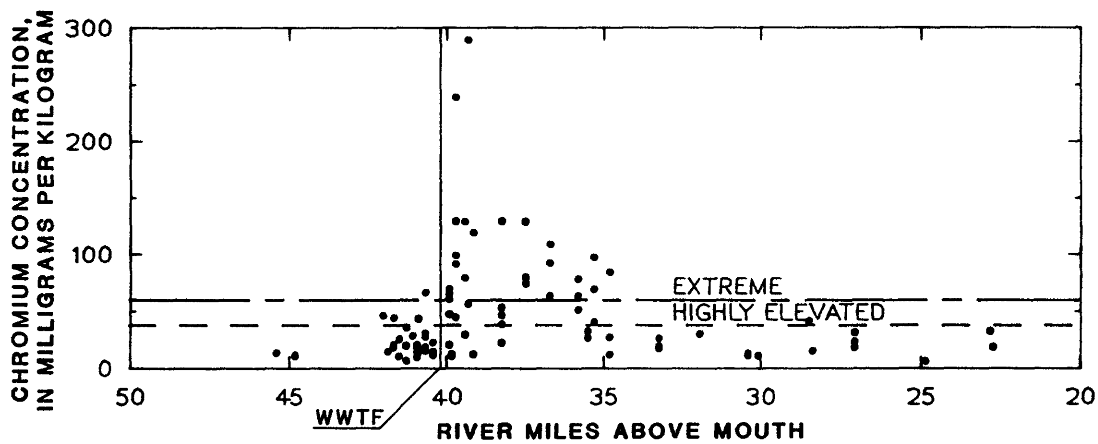

Figure 16.--Chromium concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

As with lead, chromium's toxicity to aquatic organisms depends on other water-quality characteristics and on the species of organism (Kelly and Hite, 1984, p. 47).

Cadmium.--Bottom-material-quality results show that 98 percent of all the samples have cadmium concentrations considered to be elevated or above; 13 percent are extreme (fig. 17). All extreme cadmium concentrations are from samples collected downstream from the wastewater-treatment facility (RM 40.2) and upstream from RM 35. The extreme concentrations represent 16 percent of the samples collected upstream from RM 35. Cadmium is relatively rare and highly toxic to most organisms (Kelly and Hite, 1984, p. 42-45).

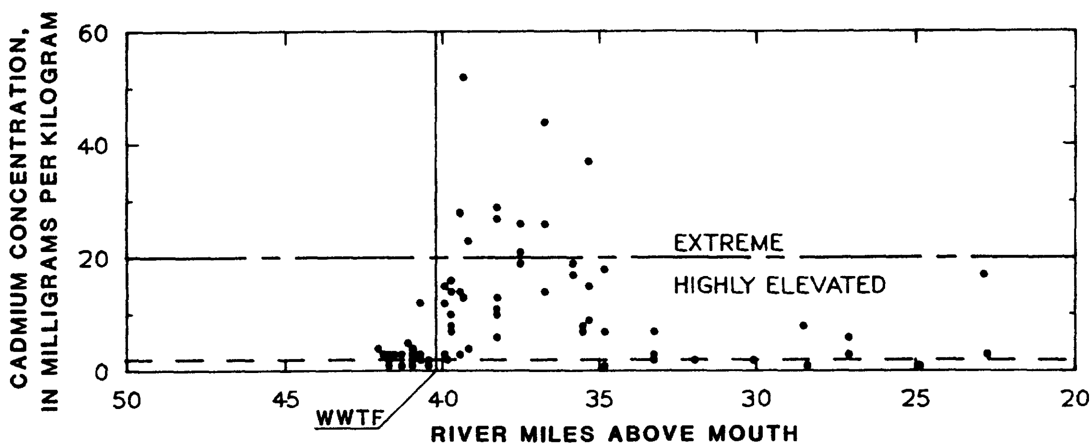

Figure 17.--Cadmium concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

Zinc.--Bottom-material-quality results show that 66 percent of all the samples have zinc concentrations considered to be elevated or above; 10 percent are extreme (fig. 18). All of the extreme zinc concentrations are from samples collected upstream from RM 35 and represent 14 percent of the upstream samples. Zinc is an essential trace metal in plants and animals but can be highly toxic to aquatic organisms (Kelly and Hite, 1984, p. 69).

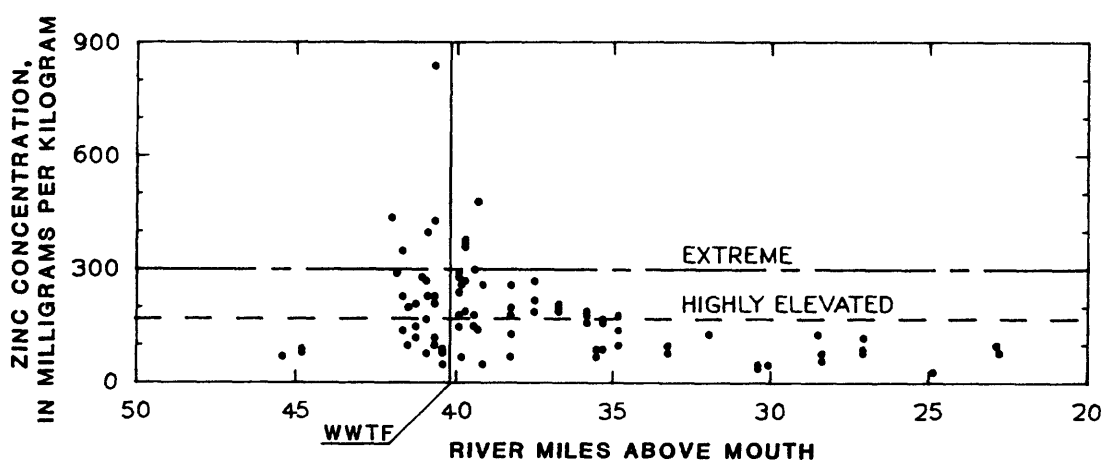

Figure 18.--Zinc concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

Copper.--Bottom-material-quality results show that 27 percent of all the samples have copper concentrations considered to be elevated or above; 5 percent are highly elevated, but there were no extreme concentrations (fig. 19). All of the elevated and highly elevated copper concentrations are from samples collected upstream from RM 35 and represent 45 percent of the upstream samples. All of the highly elevated concentrations were collected downstream from the wastewater-treatment facility (RM 40.2). Copper is a relatively common metal. It is an essential nutrient for most plants and animals but is toxic in high concentrations. The toxicity varies depending on oxidation states and water-quality parameters (Kelly and Hite, 1984, p. 50).

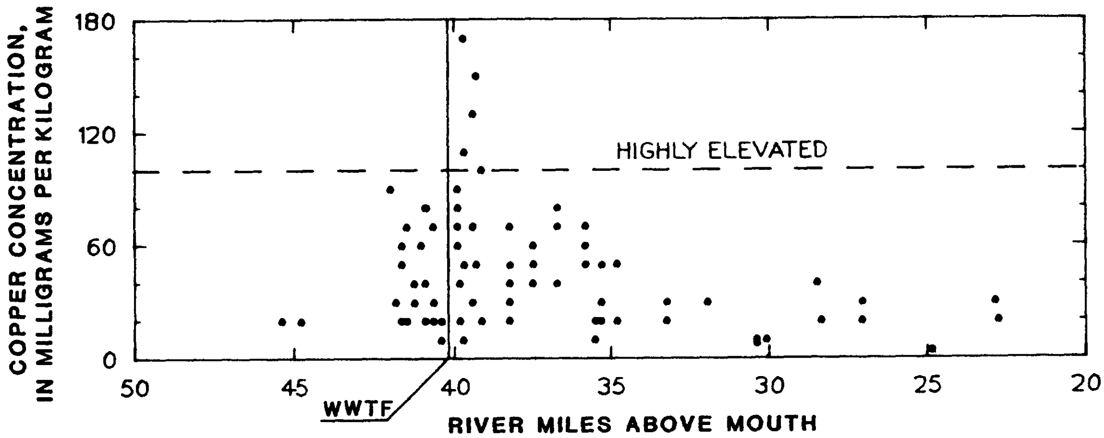

Figure 19.--Copper concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

Manganese and iron.--Manganese and iron are chemically similar elements. Bottom-material-quality results show that 4 and 9 percent of all the samples have manganese and iron concentrations, respectively, that are considered to be elevated or above (figs. 20 and 21). Results from one sample collected at RM 34.8 (bottom-material sampling site 12-4) indicated extreme concentrations of both constituents. Manganese and iron are naturally occurring constituents and elevated concentrations are not uncommon in Illinois. Manganese and iron generally are not considered toxic, but high concentrations make water unsuitable for some uses (Kelly and Hite, 1984, p. 54-56, 61-64; Windholz and others, 1976, p. 669-670, 743).

Arsenic.--Bottom-material-quality results show that only one sample, collected at RM 34.8 (site 12-4), had an arsenic concentration considered to be elevated (fig. 22). A few samples show slightly elevated concentrations, but most are nonelevated. Arsenic is toxic to animals and aquatic organisms (Kelly and Hite, 1984, p. 41).

Total organic plus ammonia nitrogen.--Bottom-material-quality results show that 6 percent of all the samples have total organic plus ammonia nitrogen concentrations considered to be elevated or above (fig. 23). One sample was hightly elevated, but none were extreme. All concentrations considered to be

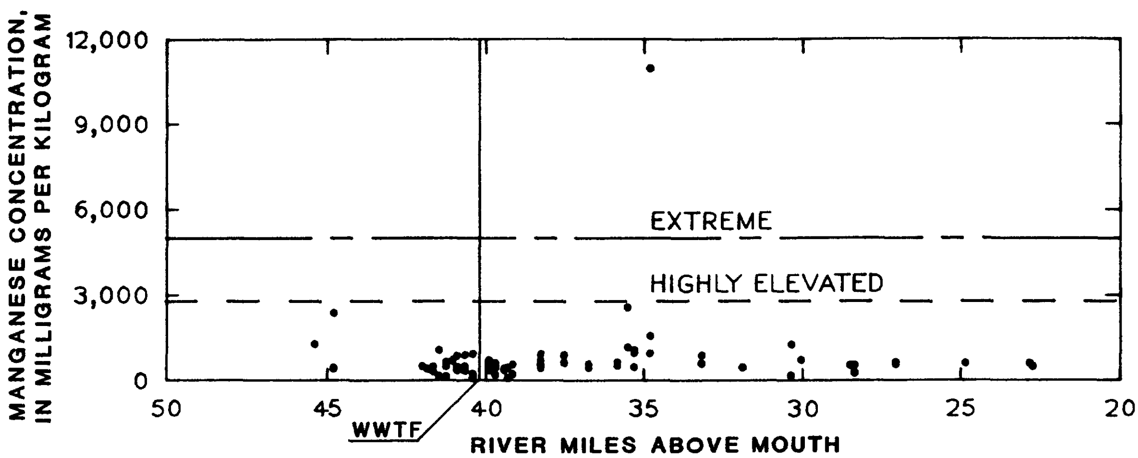

Figure 20.--Manganese concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

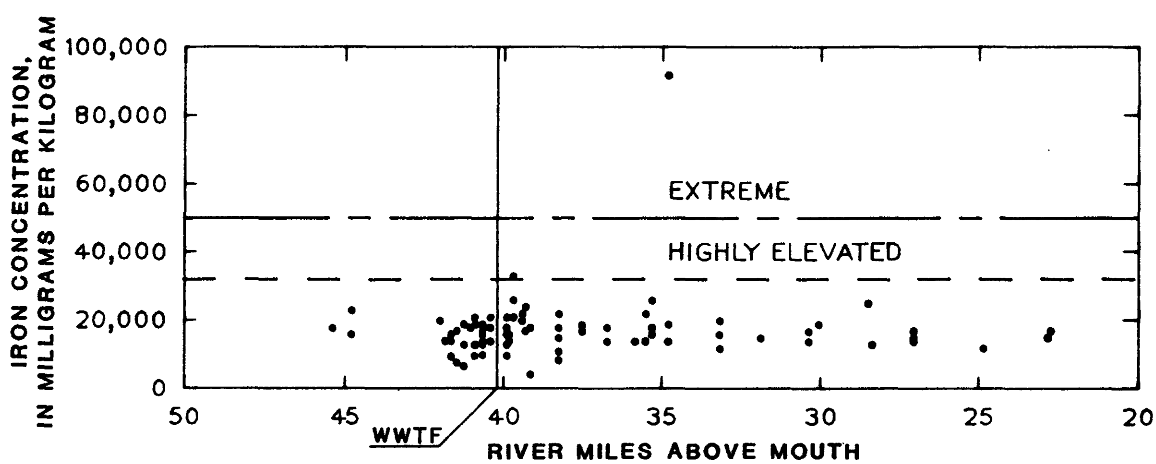

Figure 21.--Iron concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

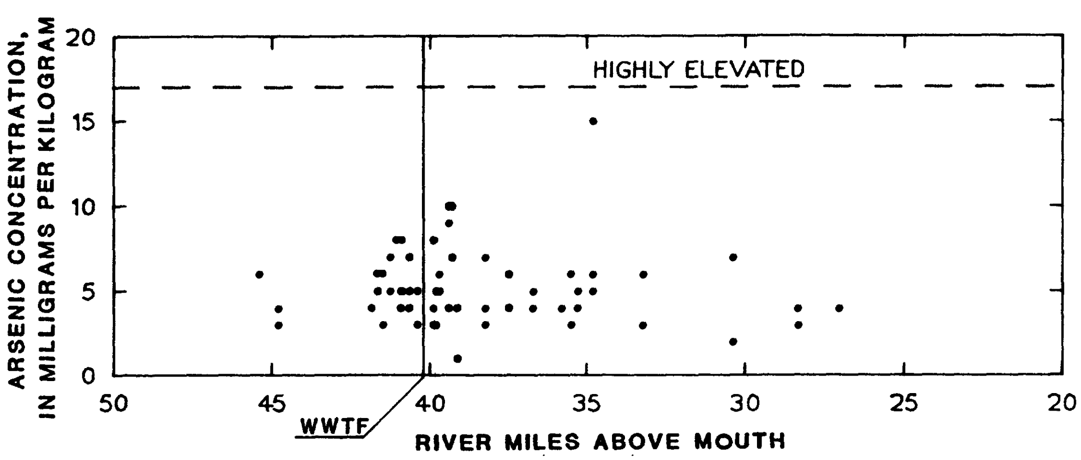

Figure 22.--Arsenic concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classification after Kelly and Hite, 1984).

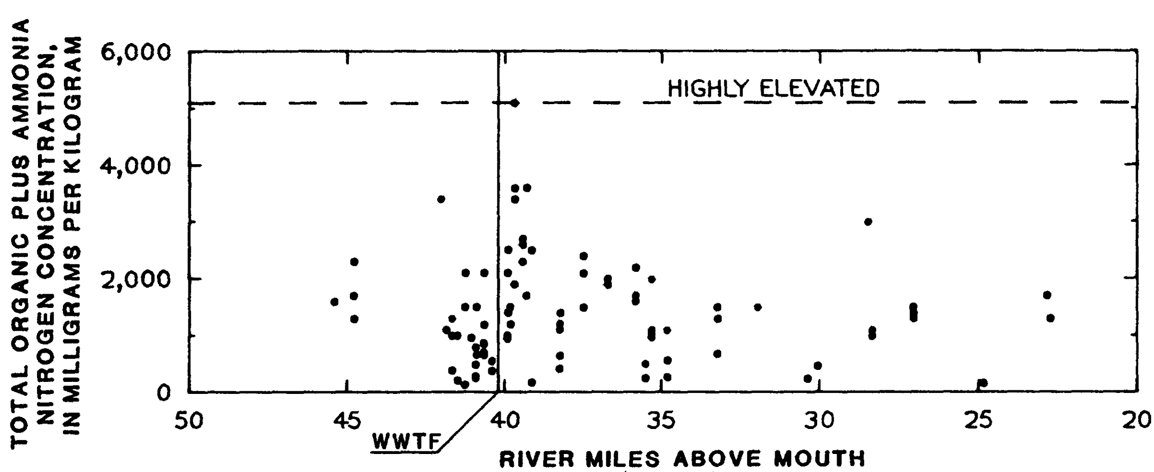

Figure 23.--Total organic plus ammonia nitrogen concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility ourfall; quality classification after Kelly and Hite, 1984).

elevated and above were collected upstream from RM 35 and represent 9 percent of the upstream samples. Dead plant material and human and animal wastes are sources of these constituents; agricultural runoff also can contain high nitrogen concentrations, especially ammonia. This material is converted by microbial action from organic nitrogen to ammonia to nitrite to nitrate, and oxygen is consumed in this process.

Chemical oxygen demand.--Bottom-material-quality results show that 6 percent of all the samples have chemical-oxygen-demand concentrations considered to be elevated (fig. 24). These were all collected upstream from RM 35 and represent 9 percent of the upstream samples. No samples had concentrations considered to be highly elevated or extreme. Chemical oxygen demand is an indicator of the amount of oxidizable material present (both biologically and chemically oxidizable).

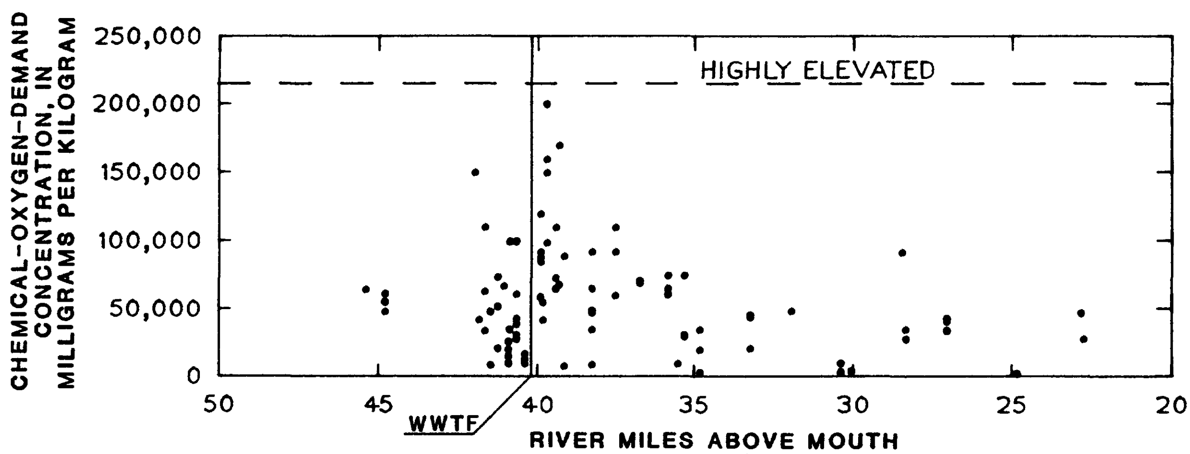

Figure 24.--Chemical-oxygen-demand concentrations in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment facility outfall; quality classification after Kelly and Hite, 1984).

Percent volatile solids.--Percent volatile solids is another indicator of the amount of material present that may contribute to the oxygen demand of the sediments. Bottom-material-quality results show that 21 percent of all the samples have a percentage of volatile solids considered to be elevated or above; 6 percent are highly elevated, and 1 percent are extreme (fig. 25). All but one of the concentrations that are elevated or above were collected upstream from RM 35 and represent 29 percent of the upstream samples.

Discussion

Visual observations indicate that elevated sediment oxygen demands and bottom-material constituent concentrations are associated with areas of deposition. This may be why chromium, mercury, lead, and manganese appear to be related somewhat to sediment oxygen demand on the basis of regression analyses. It should also be noted that storm runoff and wastewater-treatment-facility

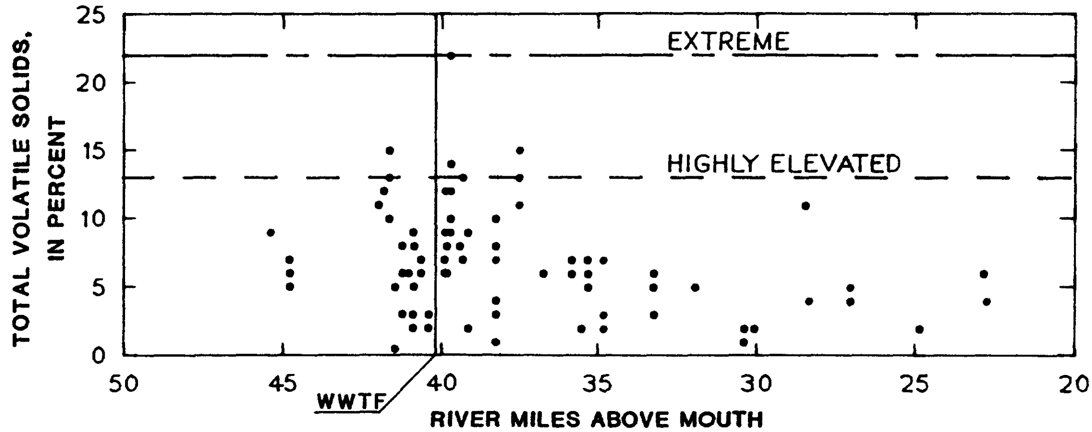

Figure 25.--Percent volatile solids in the bottom materials of Cedar Creek as a function of location (tributary results not shown; WWTF indicates wastewater-treatment-facility outfall; quality classifications after Kelly and Hite, 1984).

effluent from Galesburg are major sources of these metals (except manganese) and this suggests that Galesburg also is a major source of oxygen-demanding sediments.

High streamflows during storms can resuspend bottom materials. This process can add substantial amounts of suspended materials and their associated constituents to the streamflow. The maximum discharge rate at RM 31.9 (site 14) for the five sampled storms ranged from 44 to 1,070 ft^3/s. It was not possible to sample all sources of sediment to the creek during a storm; for this reason, results of mass-balance analyses are somewhat questionable. These results were used to indicate changes in contaminant loads that could be attributed to the intervening watershed. Results indicate that resuspended bottom materials are a probable source of the (water-column) constituent concentrations that exceed State general-use water-quality standards in Cedar Creek during periods of high flow.

CONTRIBUTIONS OF STORM RUNOFF TO CONSTITUENT LOADS AND BOTTOM MATERIALS IN CEDAR CREEK

Seven storm-related sources of constituents were monitored in this study: (1) Cedar Creek upstream from Galesburg (site 1), (2) combined-sewer overflows, (3) storm-sewer discharges, (4) the Galesburg wastewater-treatment-facility effluent (site WWTF), and (5 through 7) three tributaries that drain agricultural land (sites T21, T23, and T24). The constituent loads contributed by these seven sources are summarized in appendix D, at the end of this report.

Two values (maximum and average) were calculated for the total volume of overflow from the combined sewers. These two values were used to calculate two values for the total volume of discharge from the storm sewers (refer to section of this report titled "Runoff From Galesburg" under "Methods of Data Collection and Interpretation"). Calculation of constituent loads using these two volumes resulted in different total loads. Generally, these total loads were very similar, but because some differed significantly, both are presented in appendix D.

The percentage of total load contributed by each source is shown in appendix E, at the end of this report. Because total loads are given as two values (maximum and average), percentage contributions also are given as two values. These percentages give an estimated range for the percent contribution of constituent loads. When reviewing this information, it is important to consider the assumptions used in calculating the loads. These assumptions were (1) median concentrations best represent the general characteristics of each contaminant source; (2) the difference in flow volume between site 8 and site 1 represents the runoff contributed by the city of Galesburg; (3) distributions of discharge over time from all the combined sewers are somewhere between a Gaussian-type distribution and the mean-flow distribution measured at sites C6 and C22; (4) theoretical discharge calculations represent the flow from the combined sewers; (5) estimated volumes determined from drainage areas and runoff coefficients represent the actual volume; and (6) the quantity and quality of all runoff from Galesburg that was not accounted for by combined-sewer overflow is equal to that of the sampled storm-sewer discharges.

The results in appendix E give the best representation of the percentage of constituents contributed from each source. To view the results graphically, a mean contribution was calculated for several of the constituents. This mean was calculated by using the sum of all 10 values for the total load (five storms, two calculation methods) as the total. For the combined sewers and storm sewers, the sum of all 10 values was divided by the total to get the proportion of the total load from each of these sources. For the other sources (sites 1, WWTF, T21, T23, and T24), the sum of all five values was doubled and divided by the total to get the proportion of the total load from each of these sources. This mean contribution tends to average out the effects of differing precipitation characteristics. The figures representing the mean contribution are presented and discussed in the following pages.

Oxygen-Demanding Constituents

Five of the constituents that give some measure of the oxygen-demanding characteristics of the discharges are ultimate carbonaceous BOD, chemical oxygen demand, total organic carbon, total organic plus ammonia nitrogen, and volatile suspended solids. Ammonia also can contribute to the oxygen demand through nitrification. Ultimate carbonaceous BOD and chemical oxygen demand were determined for less than half of the samples because of laboratory constraints.

The percentages of total load contributed by each of the seven sources (appendix E) indicate that the combined sewers were not the primary source of these five constituents (ultimate carbonaceous BOD, chemical oxygen demand, total organic carbon, total organic plus ammonia nitrogen, and volatile suspended solids), except during the third storm when there was long duration of overflow from several of the combined sewers. The storm sewers did contribute a substantial amount of these constituents, especially during the first and fifth storms. In general, the primary sources of these oxygen-demanding materials were the tributaries and the wastewater-treatment-facility effluent. Tributary No. 3 (site T24) frequently contributed a larger percentage of the total load than did any of the other sources, possibly because of runoff from a small feedlot (hogs and cattle) that was just upstream from the sampling site. Because of feedlot runoff, many constituent concentrations may have been higher than would be expected in agricultural runoff. The results indicate that the wastewater-treatment facility contributed a substantial percentage of the total loads of these materials, especially during the second and fourth storms. This was due, in part, to the small amount of precipitation associated with these two storms. The base flow from the wastewater-treatment facility exceeded the volume of runoff from other sources. Another source of oxygen-demanding material is a sludge-application field used by the Galesburg wastewater-treatment facility. This field is drained by a ditch that enters Cedar Creek just upstream from bottom-material sampling site 9-1, the site where the highest sediment oxygen demands were measured.

Ultimate carbonaceous BOD.--Ultimate carbonaceous BOD is a measure of the amount of biologically oxidizable material that is present. The mean percentages of this constituent in the total load from each source indicates that wastewater-treatment-facility effluent and storm sewers are major contributors to the BOD loads (fig. 26). Decay rates for BOD give an indication of the biodegradability of the oxygen-demanding material. The rates determined were highly variable. The mean decay rate[1] for the wastewater-treatment-facility effluent was 0.10 reciprocal days; the mean decay rates for the other six sources ranged from 0.14 to 0.19 reciprocal days. This indicates that the wastewater-treatment-facility effluent was less easily decayed than were the other sources, so that the short-term demand exerted by a comparable amount of oxygen-demanding material would be slightly less from the wastewater-treatment-facility effluent than from the other sources.

The BOD concentrations in the combined sewers were very high [943 mg/L (milligrams per liter)] in some samples, and, although concentrations tend to fall off rapidly as the overflow continues, the contribution from the combined sewers to contaminant loads in Cedar Creek also is significant (fig. 26). Sampling methods for the combined sewers may have resulted in lower constituent concentrations than what actually was present. Material larger than 0.3-inch diameter could not be collected by the samplers, and solid material larger than this was observed in combined-sewer overflows and Cedar Creek on several occasions.

Chemical oxygen demand.--Chemical oxygen demand is a measure of the amount of material that can be oxidized biologically or chemically. Much of this can be material that will not exert an oxygen demand in the stream. Mean percentages of this constituent in the total load from each source indicate that Tributary No. 3 (site T24) contributes substantially more than the other sources. The storm sewers and combined sewers each contribute about equal

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[1]All rate coefficients in this report are determined using natural logarithms (base e).

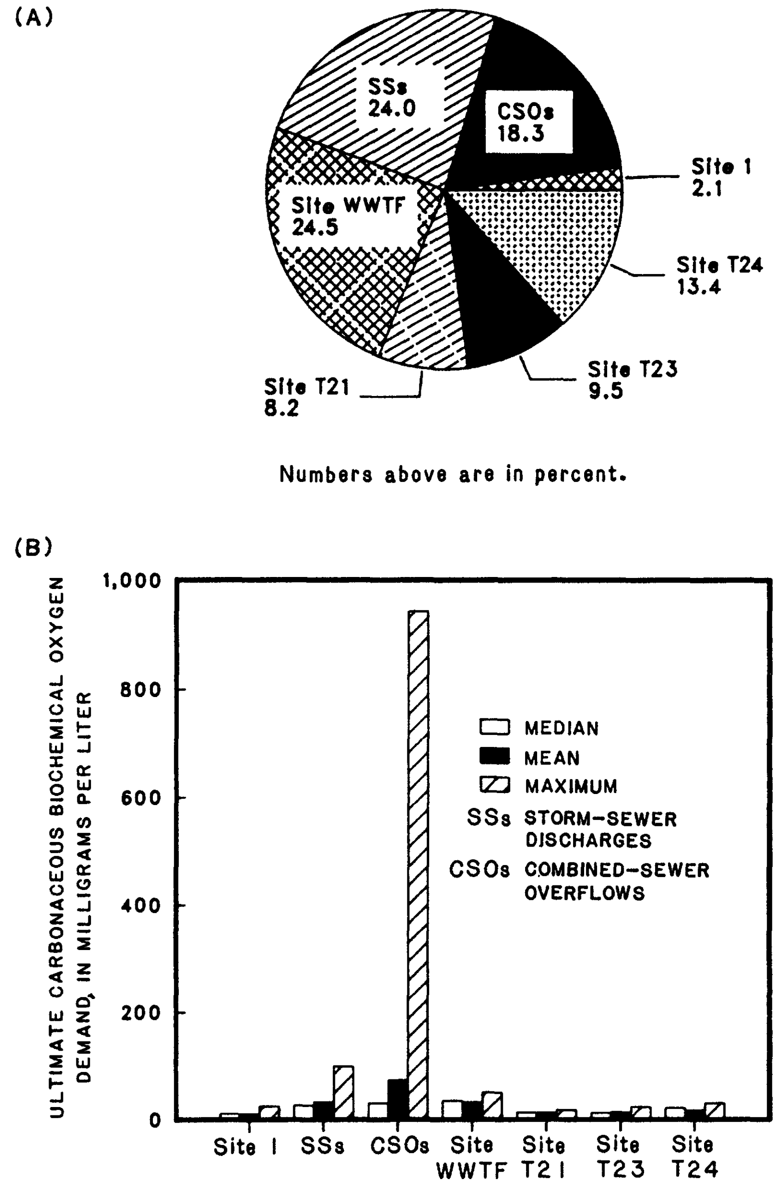


Figure 26.--Ultimate carbonaceous biochemical oxygen demand from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

percentages (fig. 27). Appendix E shows that the wastewater-treatment facility contributed 30 and 50 percent of the total loads for the second and fourth storms, respectively, but, if averaged over all storms, the contribution from the wastewater-treatment facility was only 5.9 percent. The highest median concentration was at site T24 (230 mg/L). The highest concentrations were from the combined sewers (1,300 mg/L), although runoff from storm sewers also contained high concentrations (960 mg/L).

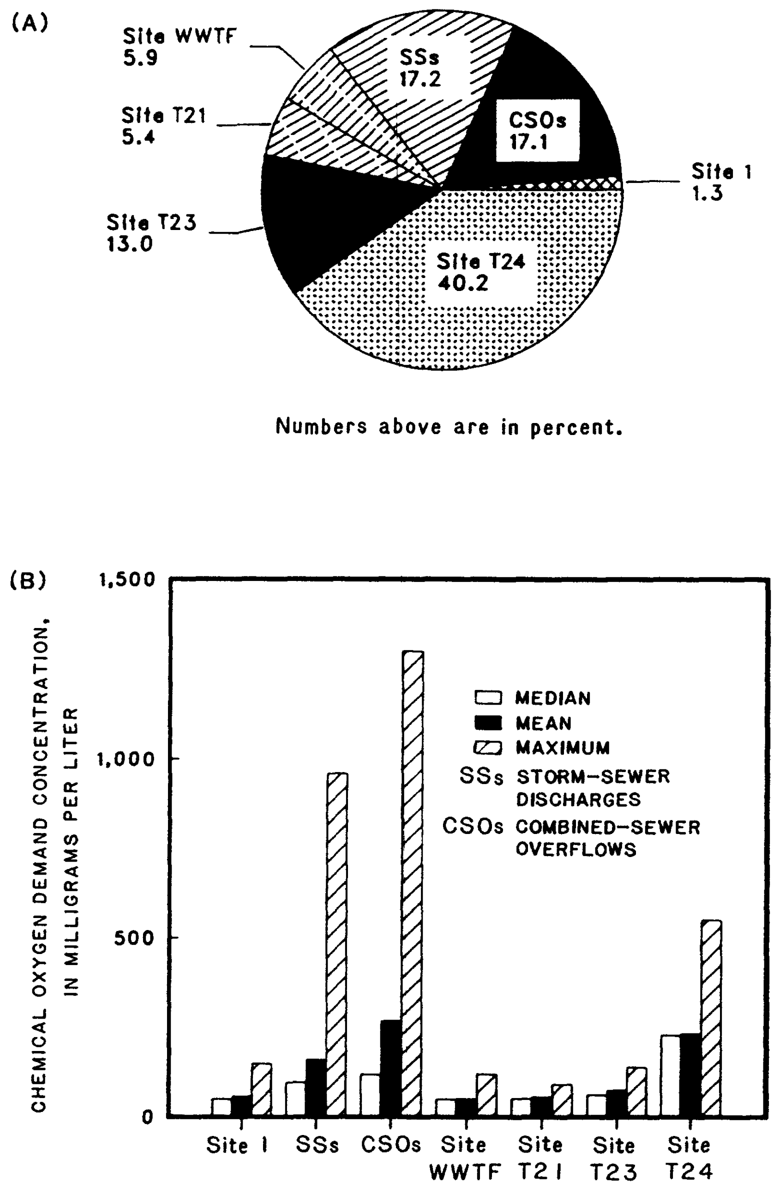


Figure 27.--Chemical oxygen demand from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

Volatile suspended solids.--Volatile suspended solids is another indicator of the amount of organic material present. Mean percentages of this constituent in the total load from each source indicate that the tributaries, especially sites T23 and T24, are major contributors of volatile suspended solids (fig. 28). The highest mean concentration was at site T24 (230 mg/L). The highest concentrations were from the combined sewers (860 mg/L), site T24 (720 mg/L), and storm sewers (640 mg/L).

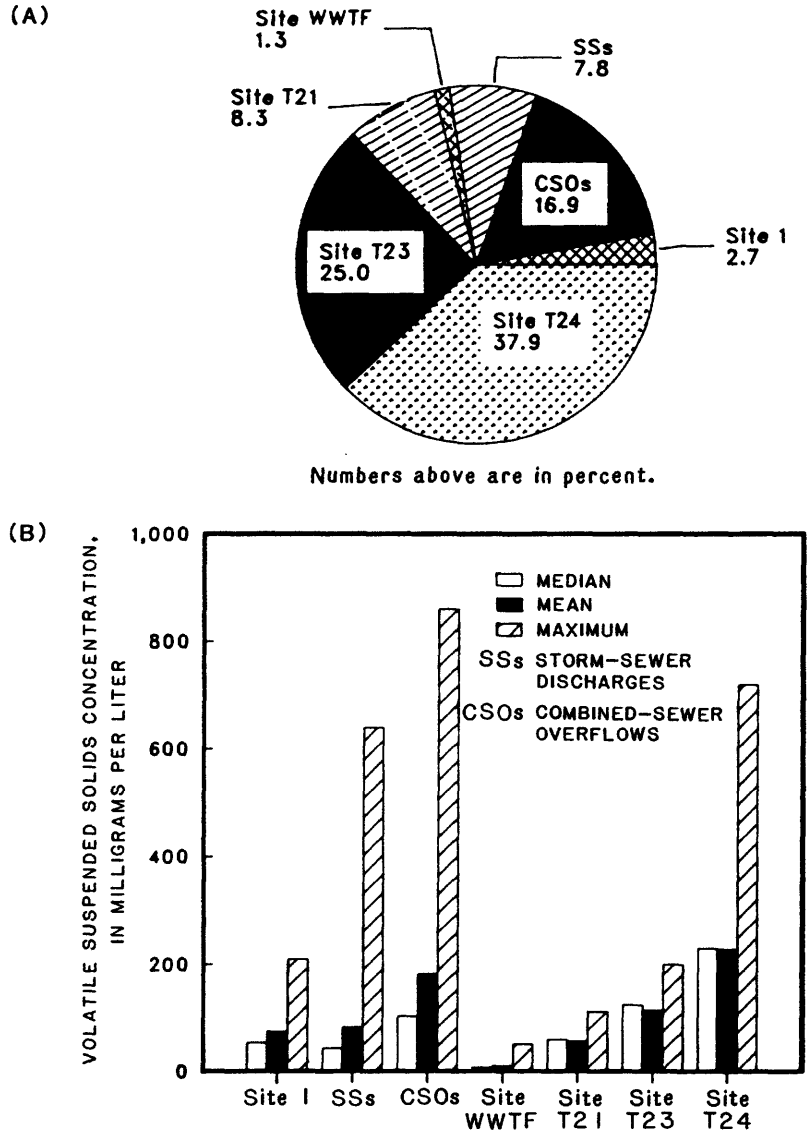


Figure 28.--Volatile suspended solids from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

Total organic plus ammonia nitrogen.--Total organic plus ammonia nitrogen is a measure of the amount of material present that could contribute to the oxygen demand in the creek through nitrification. Measurements described by Butts (1986) indicate that nitrification is a substantial part of sediment oxygen demands in some areas of Cedar Creek. Mean percentages of this constituent in the total load from each source indicate that Tributary No. 3 (site T24) is a major contributor of nitrogen loads (fig. 29). Tributary No. 2 (site T23), the storm sewers, and the combined sewers each contribute about equal percentages of the load. Again, the results in appendix E indicate

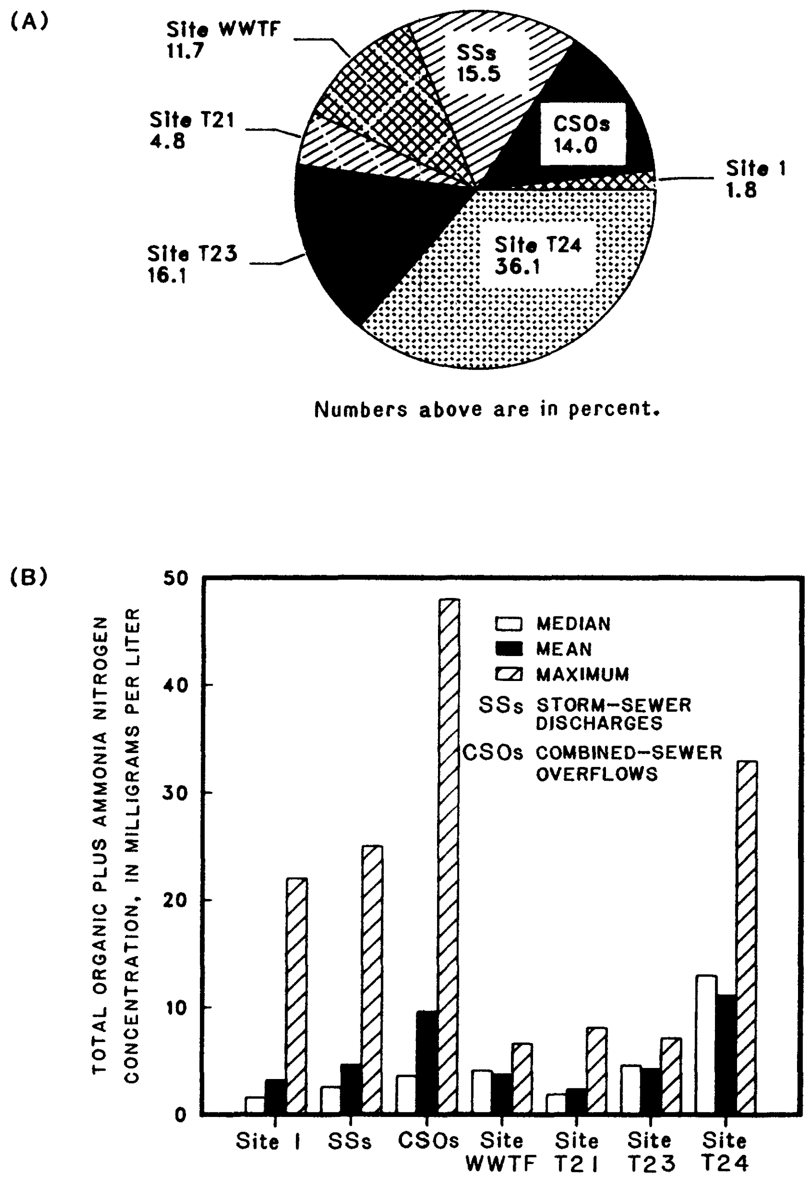
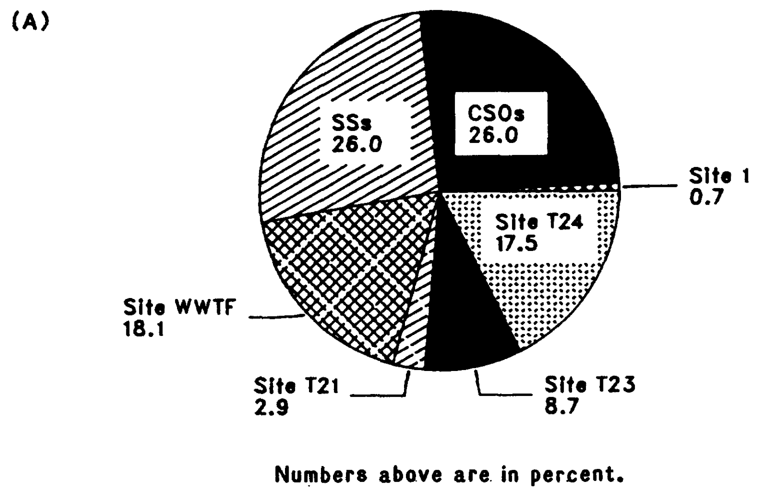


Figure 29.--Total organic plus ammonia nitrogen from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

that a larger percentage of the loads would be from the wastewater-treatment facility. The highest median concentration was at site T24 (13.0 mg/L), and the highest concentration was from the combined sewers (48 mg/L).

Total ammonia nitrogen.--Total ammonia nitrogen can be converted to nitrite and to nitrate by a microbial process that uses oxygen. These compounds are nutrients for aquatic plants, and, as such, can support large growths of algae. The mean percentages of this constituent in the total load from each source indicate that the combined sewers and storm sewers are major contributors (fig. 30). Median concentrations are highest at site T24 (0.50 mg/L). Concentrations of ammonia are highest from the combined sewers and storm sewers (6.80 and 5.10 mg/L, respectively).



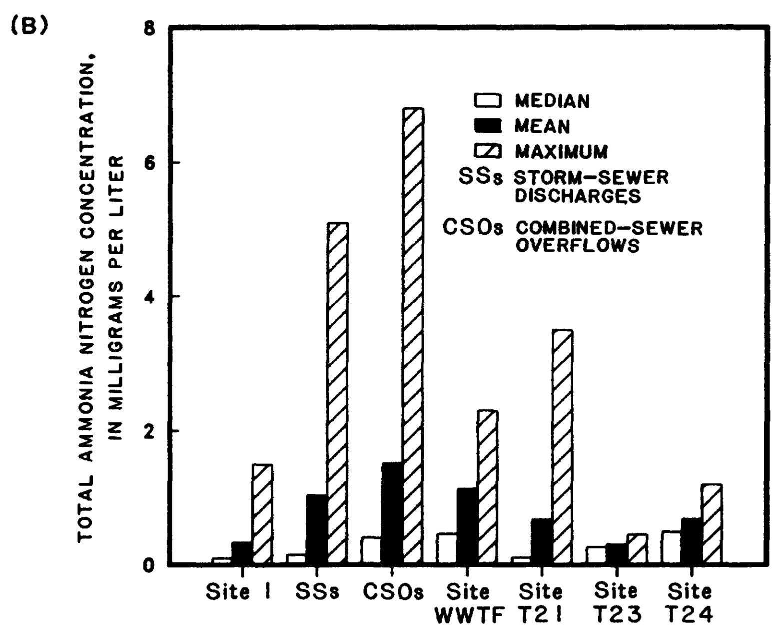


Figure 30.--Total ammonia nitrogen from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

Organic nitrogen.--Subtracting ammonia nitrogen loads from the total organic plus ammonia nitrogen loads gives the organic nitrogen loads. The results indicate that the mean percentages of this constituent in the total load from each source are comparable to those for total organic plus ammonia nitrogen. Tributary No. 3 (site T24) is the major contributor (38.2 percent), followed by Tributary No. 2 (site T23, 16 percent), and the storm sewers (14 percent).

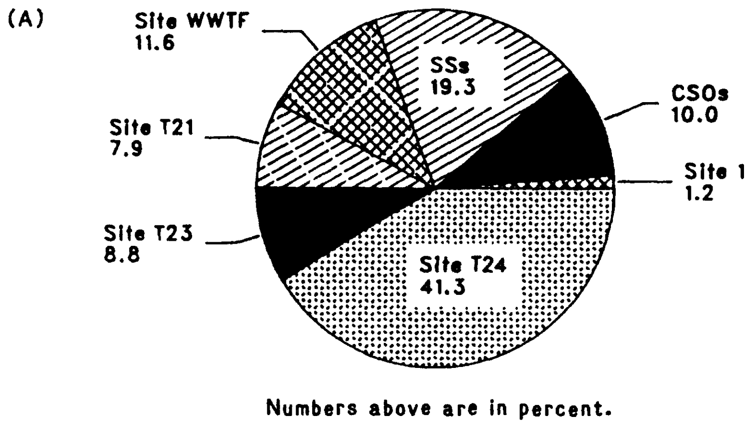
Total organic carbon.--Total organic carbon is an indicator of the amount of organic pollution present. Many of these organic compounds are biodegradable and thus can exert an oxygen demand in the creek. Mean percentages of this constituent in the total load from each source indicate that Tributary No. 3 (site T24) is the major contributor, followed by the storm sewers (fig. 31). The data in appendix E suggest that the wastewater-treatment facility is a more significant contributor than the mean percentages indicate. The median concentration was the highest at site T24 (53 mg/L). Median concentrations for the other sources were similar, but the highest concentrations were from the combined sewers (160 mg/L).

Dissolved solids.--Dissolved solids are of interest because concentrations in some subreaches of Cedar Creek exceeded the State general-use water-quality standard (1,000 mg/L). Mean percentages of this constituent in the total load from each source indicate that storm sewers and wastewater-treatment-facility effluent are major contributors of the total dissolved solids loads (fig. 32). The highest median concentration was from the wastewater-treatment-facility effluent (513 mg/L). Concentrations of dissolved solids from combined sewers ranged from 63 to 255 mg/L, which are low compared to other sources.

Suspended solids.--Suspended solids indicate the amount of solids a storm-related source of runoff transports to Cedar Creek. This suspended material may later settle to the streambed in areas of deposition. Mean percentages of this constituent in the total load from each source indicate that Tributary No. 3 (site T24) is the major contributor of suspended solids, almost 50 percent (fig. 33). The highest median concentration was from Tributary No. 3 (1,940 mg/L). Concentrations from the wastewater-treatment facility (site WWTF) were very low (9 to 78 mg/L) compared to other sources.

Arsenic and Metals

Concentrations of arsenic and 21 metals were determined from the water samples. Bottom-material samples were analyzed for 9 of the 22 elements. These nine elements were cadmium, chromium, copper, lead, iron, manganese, zinc, arsenic, and mercury. Tables of all the concentrations are listed in the report by McFarlane and others (1987). Six of the 22 elements (cadmium, copper, lead, iron, manganese, and zinc) were present in concentrations in the streamflow that exceeded the State general-use water-quality standards. Iron and manganese primarily are from natural sources; the tributaries are the major contributors to loads of these constituents. Arsenic is present naturally in small concentrations. Arsenic also is used widely in agriculture and industry, and it is released from the combustion of fossil fuels (Kelly and Hite, 1984, p. 41-42; Windholz and others, 1976, p. 107). Arsenic concentrations were very low or below the detection limit in both bottom-material and water samples.



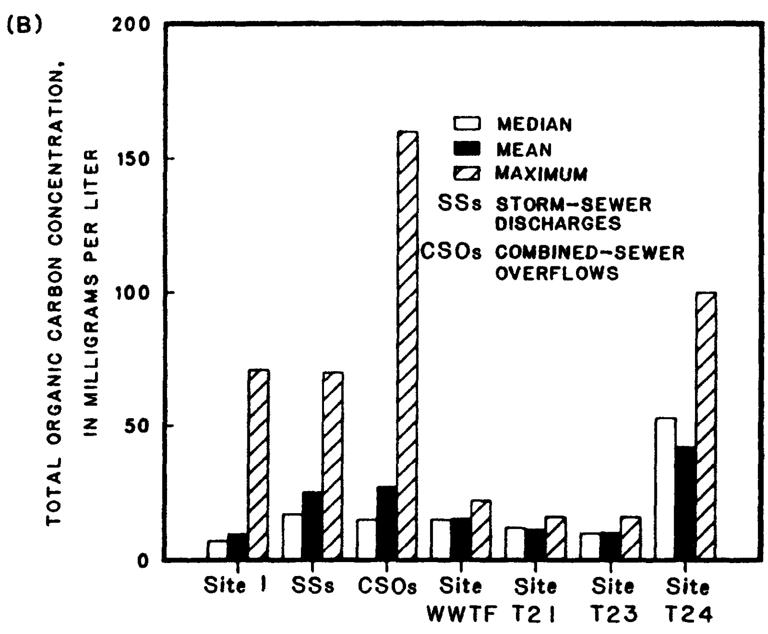
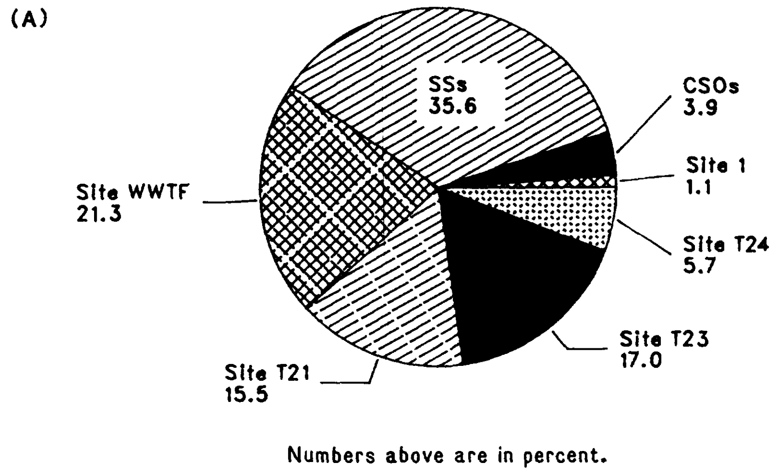


Figure 31.--Total organic carbon from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.



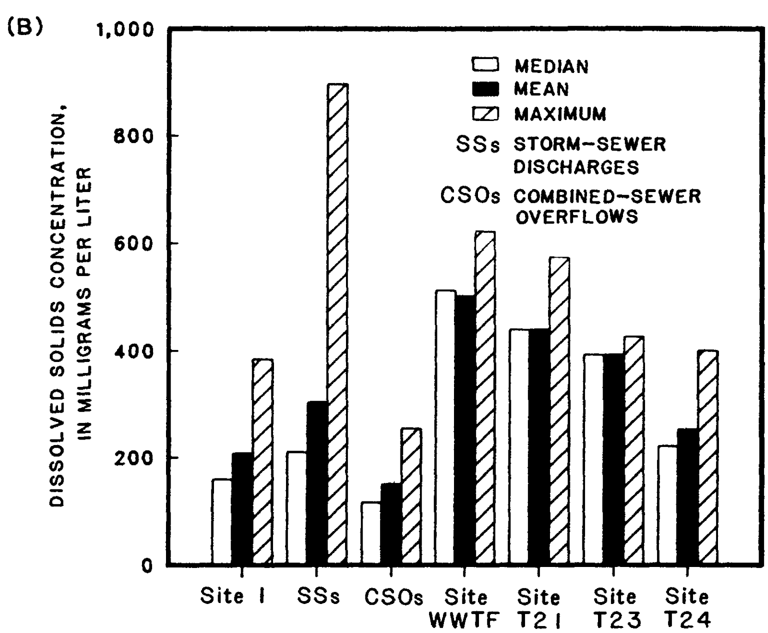


Figure 32.--Dissolved solids from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

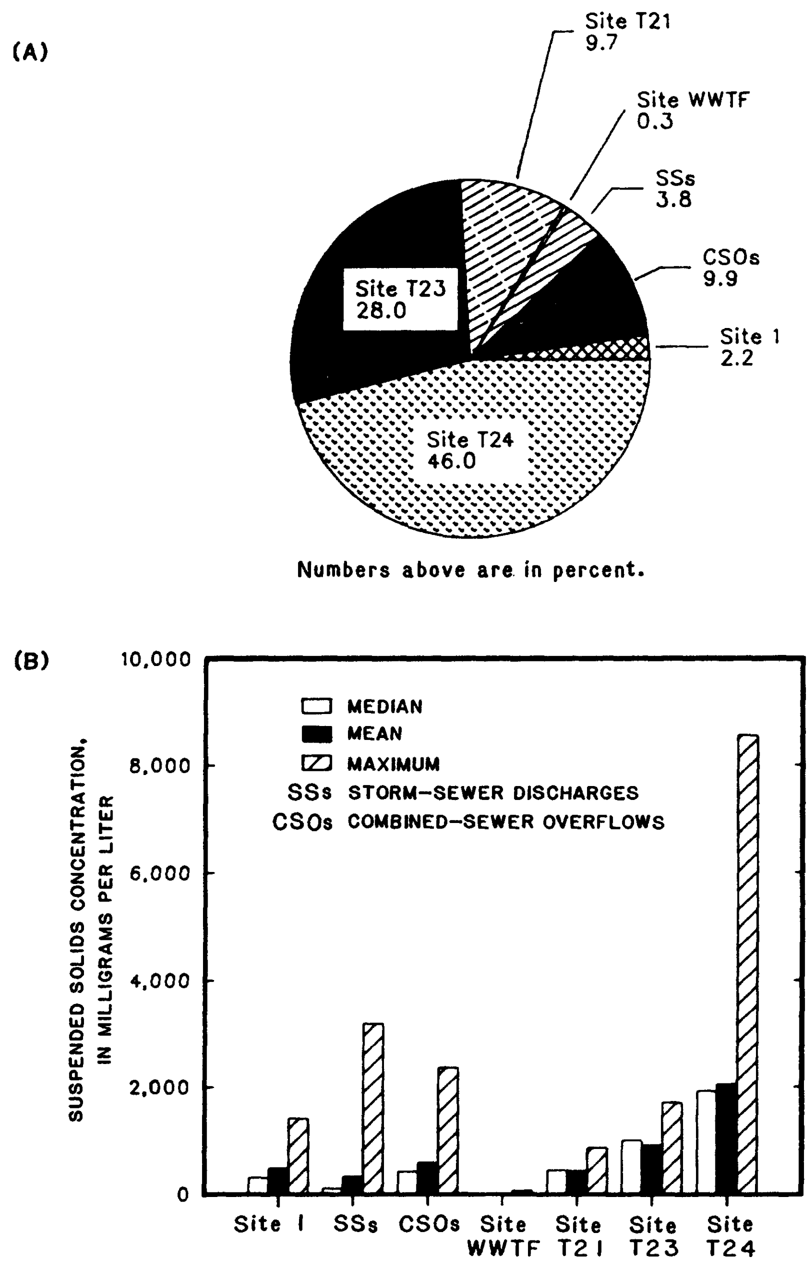


Figure 33.--Suspended solids from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

The following discussions relate to the remaining six constituents for which concentrations were determined in water and bottom-material samples.

Cadmium.--Mean percentages of this constituent in the total load from each source indicate that combined sewers contribute the largest percentage of cadmium loads (fig. 34). Storm sewers also contribute a large percentage of the loads. Most other sources had several samples with concentrations of cadmium that were below the analytical detection limit. Concentrations were highest from the combined sewers and storm sewers [27 and 25 μg/L (micrograms per liter), respectively]. The median concentrations are the same from all sources and are equal to the analytical detection limit (3.00 μg/L). Cadmium is used in metal plating, engraving, photoelectric cells, and nickel-cadmium storage batteries. Cadmium also is a product of the combustion of fossil fuels (Kelly and Hite, 1984, p. 42-45; Windholz and others, 1976, p. 205).

Chromium.--Mean percentages of this constituent in the total load from each source indicate that the storm sewers contributed more than half of the total chromium loads (fig. 35). Maximum and average concentrations were higher in water from the storm sewers, but the highest median concentration was at site T24 (16.0 μg/L). Chromium is used in metal plating, in photographic and dyeing processes, and in the manufacture of ceramics, paper, and paint. It also is used in hospitals as a blood tracer (Kelly and Hite, 1984, p. 47; Windholz and others, 1976, p. 288-289).

Copper.--Mean percentages of this constituent in the total load from each source indicate that more than half of the total copper loads are from the combined sewers (fig. 36). Appendix E, however, indicates that the storm sewers and wastewater-treatment-facility effluent contributed the largest percentage of the copper, except during the third storm when the combined sewers contributed 70 to 80 percent of the total load. The highest median copper concentration was in water from the combined sewers (59 μg/L). Copper is used in electrical components, chemical products, pipes, and as an alloy in brass and bronze. Copper also is used in the form of copper sulfate to control algae in lakes, ponds, and streams (Kelly and Hite, 1984, p. 50; Windholz and others, 1976, p. 325).

Lead.--Mean percentages of this constituent in the total load from each source indicate that the combined sewers contribute the largest percentage of the total lead loads (fig. 37). Appendix E, however, indicates that the storm sewers were a major source of lead, except during the third storm when combined sewers contributed a comparable percentage of the load. Concentrations of lead were at or below the detection limit in most samples collected from sites 1, WWTF, T21, T23, and T24. The highest median concentration was in water from the combined sewers (190 μg/L). The highest concentrations were in water from the storm sewers. Lead is used in numerous manufacturing processes including electrical devices, storage batteries, plastics, and as pigments for paints. The most abundant source of lead is from the combustion of leaded gasoline (Kelly and Hite, 1984, p. 59-60; Windholz and others, 1976, p. 708-709).

Zinc.--Mean percentages of this constituent in the total load from each source indicate that the combined sewers contribute the largest percentage of the zinc load (fig. 38). Appendix E, however, indicates that the storm sewers were the major source of zinc, except during the third storm when combined

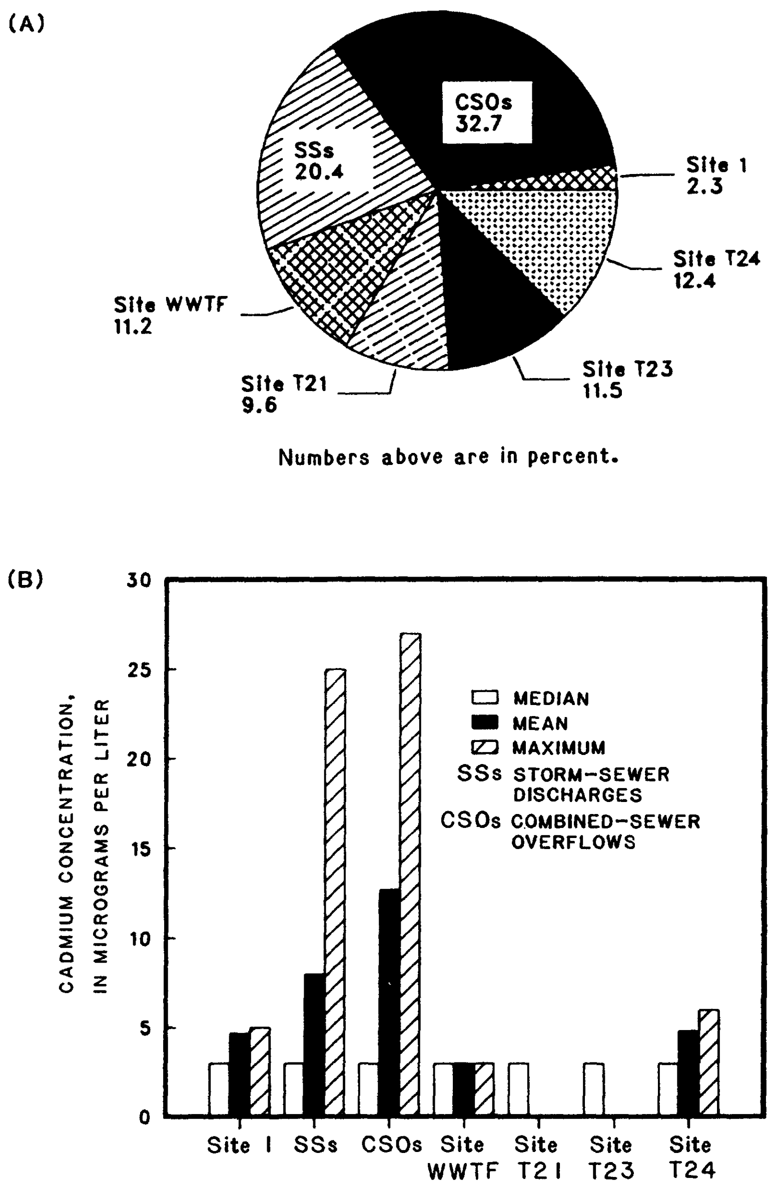


Figure 34.--Cadmium from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

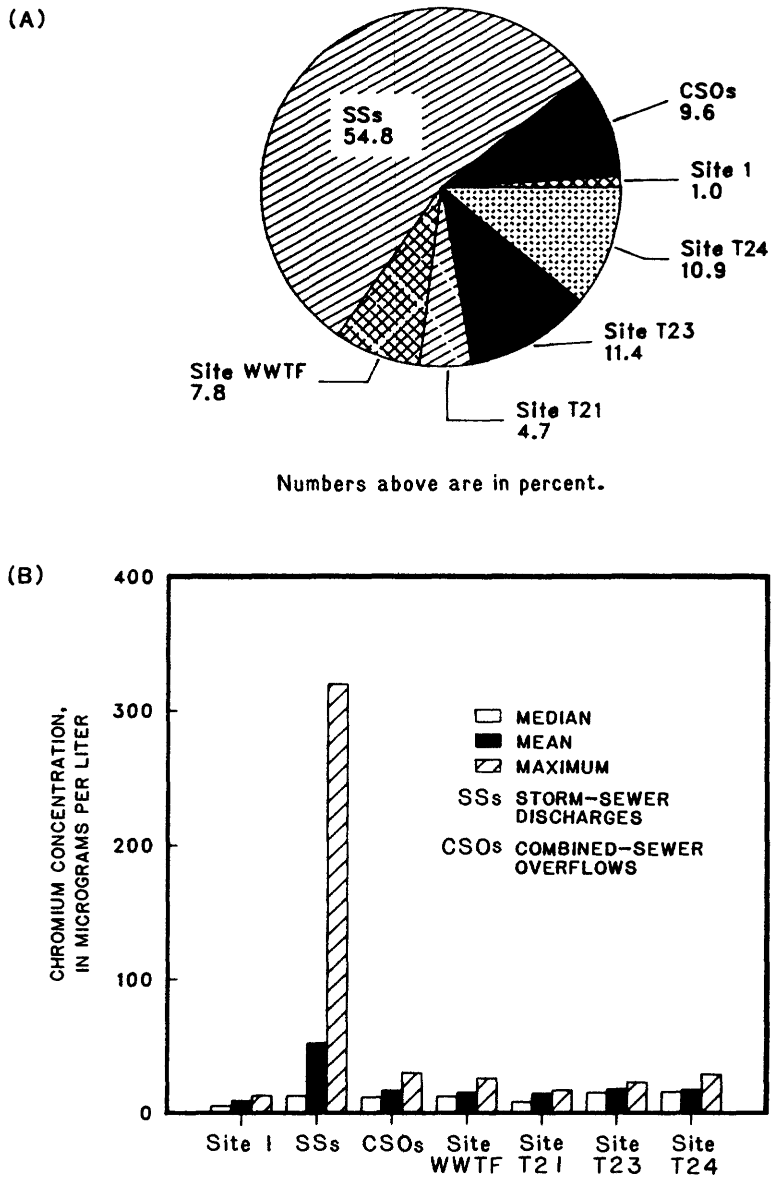
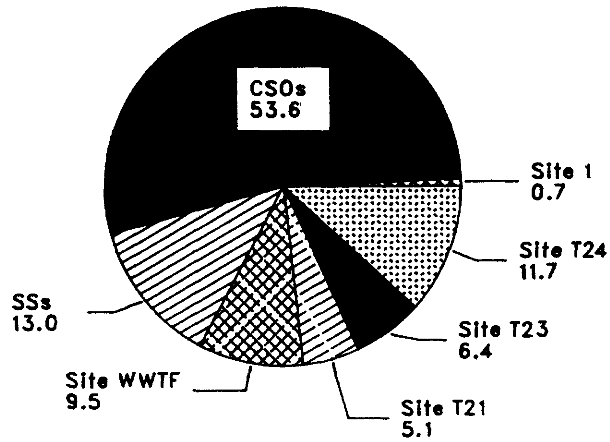


Figure 35.--Chromium from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

(A)



Numbers above are in percent.

(B)

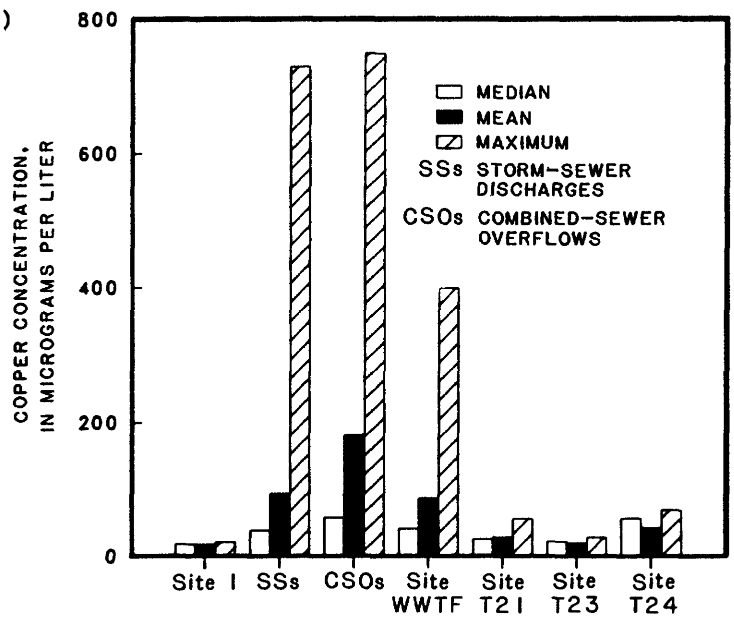


Figure 36.--Copper from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

(A)

(B)

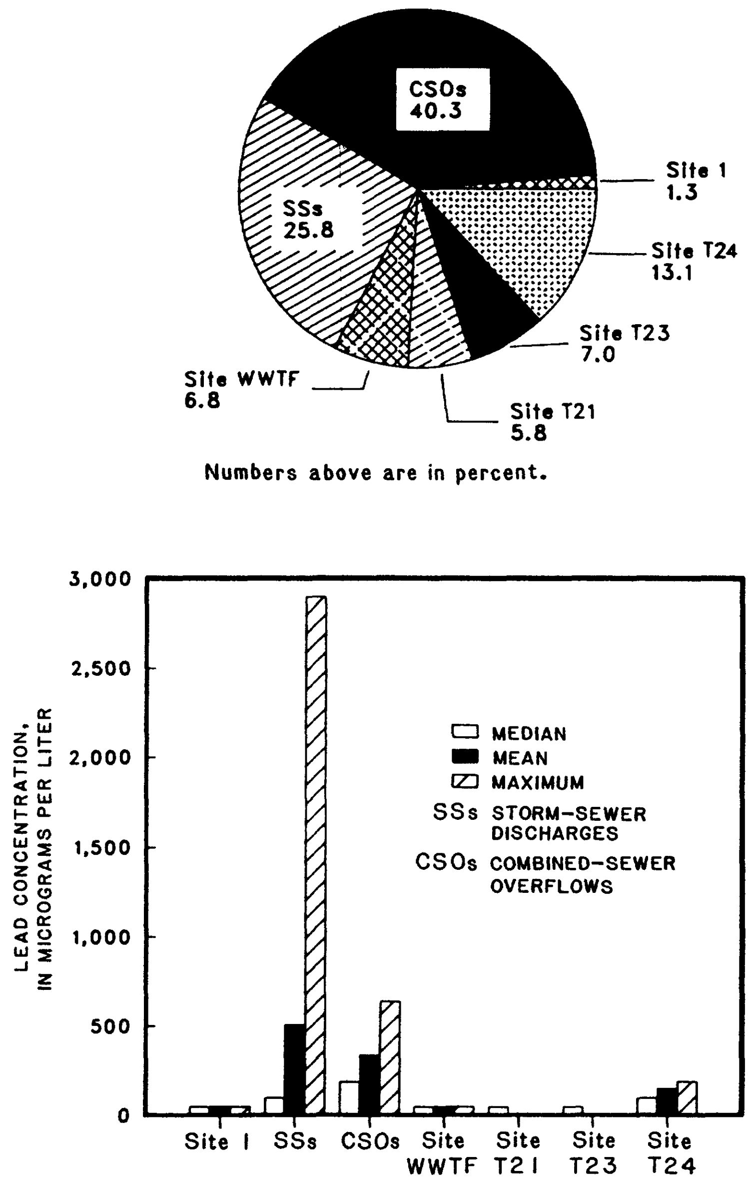


Figure 37.--Lead from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

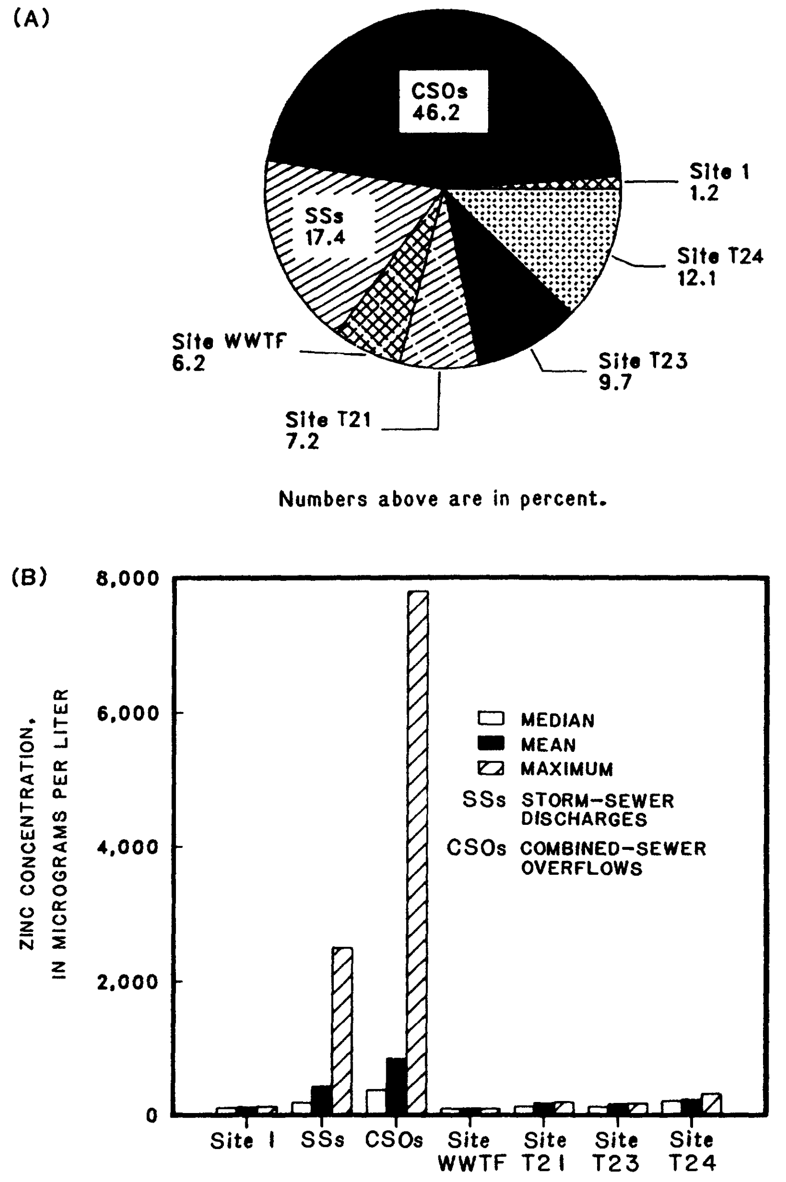


Figure 38.--Zinc from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

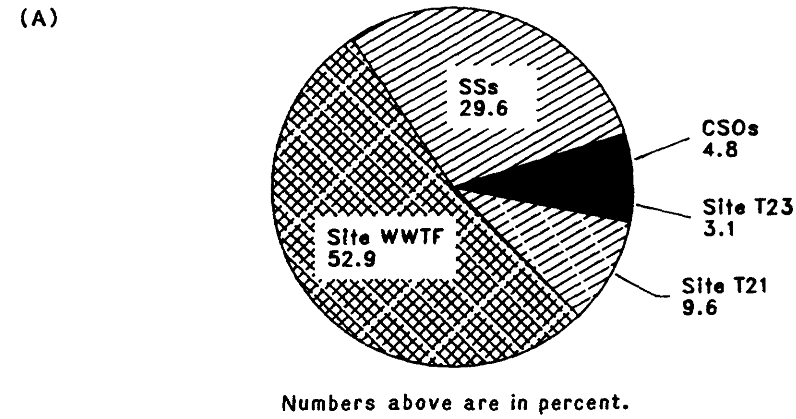
sewers contributed 60 to 70 percent of the loads. Maximum, mean, and median zinc concentrations were highest in water from the combined sewers (median, 380 µg/L). Zinc is used to galvanize iron, in electrical equipment, and in several chemical products such as paints, agricultural fertilizers, and pesticides (Kelly and Hite, 1984, p. 69; Windholz and others, 1976, p. 1306-1307).

Mercury.--Mercury was one of the constituents that was present in very high concentrations in bottom material (62 percent of the samples were considered extreme). Mean percentages of the constituent in the total load from each source indicate that the wastewater-treatment-facility effluent contributes more than half of the total mercury load (fig. 39). The data in appendix E also indicate that the wastewater-treatment-facility effluent contributes the largest percentage of the mercury load. The storm sewers also were a major contributor during the third and fifth storms. Maximum, mean, and median mercury concentrations were substantially higher from the wastewater-treatment facility than from any other source (median concentration, 0.14 µg/L). However, much of this could have been in the dissolved phase because wastewater-treatment-facility-effluent concentrations of suspended solids were low compared to other sources. Dissolved mercury is known to form a precipitate with many metals (Windholz and others, 1976, p. 767) and, thus, could have contributed to bottom-material concentrations. Mercury has many common uses including electrical switches, fluorescent lights, and dentistry. Mercury also is used in some manufacturing processes such as pharmaceuticals, paints, and agricultural pesticides (Kelly and Hite, 1984, p. 64-66; Windholz and others, 1976, p. 766-767).

Discussion

Most of the elevated sediment oxygen demands (fig. 13) occur upstream from bottom-material sampling site 11-1 (RM 38.1). However, a rate of 8.2 $(g/m^2)/d$ was measured once at RM 35.1. Site 11-1 is upstream from the mouths of Tributary No. 2 and Tributary No. 3 (RM 37.7 and RM 37.0, respectively). Tributary No. 1 is near the downstream end of a subreach of Cedar Creek with bottom materials having elevated sediment oxygen demands and constiutent concentrations. Constituent loads from Tributary No. 1 are small compared to the other sources. The locations of the elevated bottom-material constituent concentrations indicate that the major source of constituents is upstream from the three tributaries. Thus, the constituent loads are dominated by runoff from the city of Galesburg, wastewater-treatment-facility effluent, and runoff from the 4-mi^2 drainage area between site 8 and site 11. This small drainage area contains a sludge-application field that may contribute to loads of oxygen-demanding materials. Agricultural contributions are generally downstream from the subreaches with bottom materials having elevated sediment oxygen demands and constiutent concentrations. Storm sewers and combined sewers contribute about equally to the loads of oxygen-demanding materials that can be deposited in these subreaches. The contribution of oxygen-demanding material from storm-related discharges from the wastewater-treatment facility is less than that from the storm or combined sewers.

Elevated metals concentrations in bottom-material samples from the upstream subreaches of the creek indicate that metals associated with particulates settle to the streambed fairly rapidly. However, high stream velocities



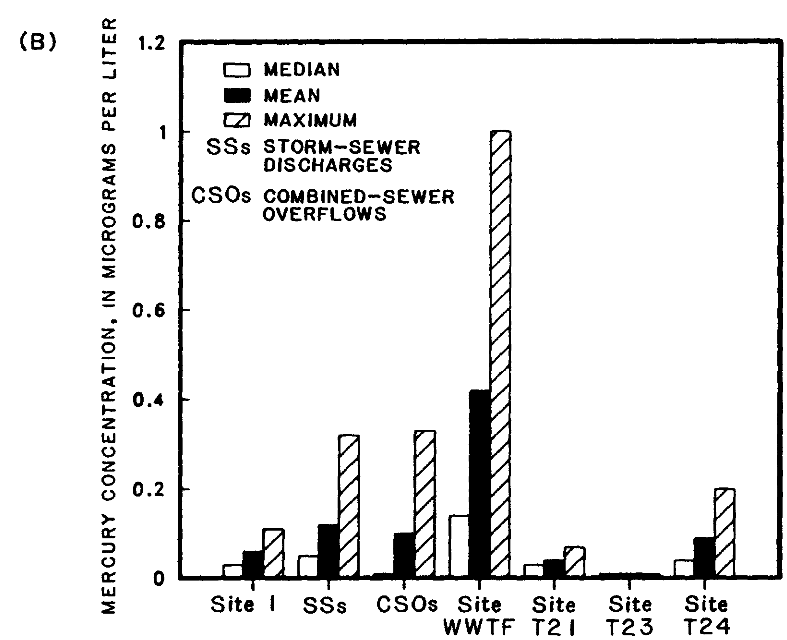


Figure 39.--Mercury from storm-related sources to Cedar Creek (A) average percentage of total loads and (B) descriptive statistics of concentration.

and resulting scour can resuspend them and transport then farther downstream. As discussed previously, some of the constituent concentrations that exceeded the water-quality standards may have been caused by contributions to the water column from scour of bottom materials.

The major sources of metals were the combined and storm sewers. Mercury is one exception to this, as it came primarily from wastewater-treatment-facility effluent even though suspended-solids concentrations were low compared to other sources. Mercury is often associated with suspended solids (U.S. Environmental Protection Agency, 1976). The third storm resulted in very long combined-sewer overflow durations and large volumes of overflow, as indicated by percent-contribution results. Data in appendix E indicate that the wastewater-treatment facility was a major source of several constituents during the second and fourth storms, partly because these were small storms and the base flow from the wastewater-treatment facility was larger than the volume of runoff from other sources.

SUMMARY AND CONCLUSIONS

The purpose of this study was to describe the water quality of Cedar Creek and the cause-and-effect relations among processes that affect water quality in the creek. This report describes the second phase of the study, which was an assessment of the stormflow water quality and storm-related constituent loads. In particular, this report describes the quality and quantity of storm-related flow in Cedar Creek and flow from seven storm-related sources of constituent loads to Cedar Creek. The seven sources are (1) flow from upstream of the city of Galesburg; (2) overflow from the 49 combined-sewer outfall pipes to Cedar Creek; (3) overland runoff and storm-sewer discharges from the city of Galesburg; (4) effluent discharge from the Galesburg wastewater-treatment facility; and (5 through 7) discharge from three tributaries draining predominantly agricultural land.

Dissolved-oxygen concentrations commonly are below the State water-quality standard in several subreaches of Cedar Creek. Results of low-flow simulations indicate that sediment oxygen demand is the primary cause of low dissolved-oxygen concentrations in Cedar Creek. Constituent loads and the percentage of the total load contributed by each of the seven sources are calculated and related to areas of Cedar Creek with bottom materials having elevated sediment oxygen demands and constituent concentrations.

Seventy-one storms were monitored from August through November 1985 and from May through October 1986. Samples of runoff were collected from five of the storms in 1986. Precipitation characteristics of the five storms were different. Total precipitation ranged from 0.37 to 4.05 inches. Maximum 1-hour intensity ranged from 0.31 to 1.93 inches per hour. Antecedent soil-moisture conditions also were variable. The percentage of the total precipitation over the city of Galesburg that reached the stream as runoff ranged from 4 to 30 percent.

Combined-sewer overflows were monitored during 33 periods in 1985 and 1986. One or more storms occurred during each of these monitoring periods. At least one combined sewer overflowed during each period. Results of regression analyses indicate that 40 percent of the combined sewers will overflow as a result of a storm having a maximum 1-hour rainfall intensity of 0.3 inch per hour and about 70 percent will overflow as a result of a storm having a maximum 1-hour rainfall intensity of 0.8 inch per hour. Durations of overflow generally ranged from about 2 to 8 hours, but overflows lasting as long as 189 hours were measured.

The overflow volume from each combined sewer was calculated by use of two methods that provided a possible range in overflow volume. Volumes were summed to determine a total overflow volume from all of the combined sewers.

The estimated total combined-sewer overflow volume ranged from 23,300 to 12,700,000 ft^3 for the five sampled storms. Runoff from Galesburg that was not accounted for by the combined-sewer overflows was considered to have a quality similar to that determined from samples of storm-sewer discharge. The total volume of storm-sewer discharge for the five sampled storms ranged from 234,000 to 20,300,000 ft^3.

Illinois' effluent standards for total suspended solids, zinc, iron, oxygen-demanding wastes, and offensive discharges were exceeded in the combined-sewer overflows. Concentrations of constituents in the combined-sewer overflows generally started off high and would decrease as the overflow continued. Constituent loads from the combined sewers were variable. This variability may be related to differences in land use, the size of lateral inflow pipes, the position along the length of the interceptor pipe, the size of orifice to the interceptor, the condition of the sewer system, and several other factors. Samples were collected from 8 of the 49 combined sewers and results were assumed to represent the quality characteristics of all of the combined sewers.

State effluent standards for lead, iron, and dissolved solids were exceeded in the storm-sewer discharges. Concentrations in the storm-sewer discharges generally were not as high as in the combined sewers. However, volumes were higher than from the combined-sewer overflows and constituent loads generally equaled or exceeded loads from the combined-sewer overflows. Samples were collected from seven storm sewers and the results were used to approximate the quality characterisitcs of all storm sewers and overland runoff.

Constituent concentrations from the three tributary sites indicate that State general-use water-quality standards for copper, lead, manganese, and iron were exceeded. Wastewater-treatment-facility effluent did not exceed any State effluent standards during the five sampled storms. Concentrations of copper, lead, cadmium, zinc, iron, manganese, and dissolved solids exceeded the State general-use water-quality standards in several subreaches of Cedar Creek.

Sediment oxygen demands ranged from 0.4 to 9.1 $(g/m^2)/d$. Of the 70 sediment-oxygen-demand measurements, 20 indicated the bottom-material quality was polluted and 7 of the measurements indicated grossly polluted bottom materials. Bottom-material samples indicated that concentrations of mercury, lead, chromium, cadmium, and zinc were extremely high. Subreaches with high sediment oxygen demands and high bottom-material constituent concentrations extend downstream from the concrete-lined channel at RM 42.2 (bottom-material sampling site 5-1) to approximately RM 35 (site 12-3). The highest sediment oxygen demands and highest metals concentrations were located upstream from RM 38.1 (site 11-1) and primarily in two areas of sediment deposition--one just upstream from the wastewater-treatment facility at RM 40.5 (site 9-1) and another downstream from the wastewater-treatment facility and just upstream from the channel modification at RM 39.5 (site 10-3).

Bottom-material samples from subreaches that primarily were affected by runoff from the construction of U.S. Highway 34 did not have elevated concentrations of most measured constituents, including those relating to oxygen-demanding materials. The subreaches affected by the highway construction were downstream from the subreaches having elevated sediment oxygen demands and constituent concentrations.

The locations of most of the elevated sediment oxygen demands are upstream from RM 38.1 (bottom-material sampling site 11-1), which is upstream from the mouths of Tributary No. 2 and Tributary No. 3 (RM 37.7 and RM 37.0, respectively). Tributary No. 1 is near the downstream end of the area having elevated sediment oxygen demands and constituent concentrations, but loads from Tributary No. 1 are small compared to the other sources. The distributions of the bottom materials with elevated constituent concentrations indicate that the major source of constituents is upstream from the three tributaries and, thus, is dominated by runoff from Galesburg and effluent from the wastewater-treatment facility. A sludge-application field upstream from the wastewater-treatment facility also may contribute to the loads of oxygen-demanding materials. Agricultural contributions are substantial, but, for the most part, they are downstream from the subreaches having elevated sediment oxygen demands and constituent concentrations. The major source of most metals is the combined sewers; chromium and mercury were exceptions to this. Chromium concentrations were primarily detected in runoff from the storm sewers, and mercury was primarily detected in runoff from the wastewater-treatment-facility effluent.

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APPENDIXES

APPENDIX A

Combined-Sewer and Storm-Sewer Data-Collection Sites and Their Physical Characteristics

[Combined-sewer and storm-sewer site codes correspond to those in figures 5-8 of this report; NPDES stands for National Pollutant Discharge Elimination System; dashes indicate no data; elevation, in feet, refers to distance above sea level]

Site code	Sewer: Rank[1]	Sewer: NPDES permit number	Location (direction of inflow) and site description of combined-sewer-overflow structures (station numbers[2])	Monitoring method[3]	Outfall elevation (feet)	Top of weir elevation (feet)
			Combined sewers			
C1	42	043	Lincoln Street (from northeast) -- box structure. Overflow appears to enter storm sewer to east, rather than flow down culvert to Cedar Creek.	a	---	762.55
C2	41	044	Lincoln Street (from southwest) -- box structure. Flow similar to C1.	a	---	---
C3	35	001	Lincoln Street (from south) -- raised pipe structure. At intersection of Lincoln Street and A,T, & SF Railroad. PVC pipe flows to side channel then to Cedar Creek.	b	756.10	---
C4	31	003	North Pearl Street (from north) -- weir structure. North of Cedar Creek on Pearl Street. Overflows directly to Cedar Creek.	a,b,c	750.57	752.75
C5	38	004	North Pearl Street (from south) -- raised pipe structure. South of Cedar Creek on Pearl Street. Overflows directly to Cedar Creek. Weir installed 09/03/86.	a,b,c	751.04	752.18
C6	20	005	Pine Street (from south) -- weir structure. South of Cedar Creek on railroad right-of-way just west of North Pearl Street. Overflows directly to Cedar Creek. (4057100902138)	a,b,c,d,e, f,h,i,j	749.87	751.32
C7	26	007	North Chambers Street (from north) -- weir structure. North of Cedar Creek on Chambers Street. Storm-sewer flow enters overflow structure downstream of the weir. Overflows directly to Cedar Creek.	a,c,d,e	750.68	752.22
C8	15	006	North Chambers Street (from south) -- weir structure. South of Cedar Creek on Chambers Street. Storm-sewer flow enters overflow structure downstream of the weir. Overflows directly to Cedar Creek.	a,c	749.97	751.87

C9	25	008	North Seminary Street (from north) -- weir structure. North of Cedar Creek on Seminary Street. Overflows directly to Cedar Creek. (4057080902151)	a,b,c,d,e,f	748.75	750.61
C10	14	009	North Seminary Street (from south) -- weir structure. South of Cedar Creek on Seminary Street. Overflows directly to Cedar Creek.	a,b,c,d,e	749.33	750.41
C11	12	010	North Kellogg Street (from north) -- weir structure. North of Cedar Creek on Kellogg Street. Overflows directly to Cedar Creek.	a,b,c,d,e	748.22	748.86
C12	32	011	North Kellogg Street (from south) -- weir structure. South of Cedar Creek on Kellogg Street. Overflows directly to Cedar Creek.	a,b,c,d,e	746.96	748.34
C13	28	012	North Prairie Street (from north) -- weir structure. North of Cedar Creek on Prairie Street. Overflows directly to Cedar Creek.	a,b,c,d,e	748.45	749.50
C14	33	013	North Prairie Street (from south) -- weir structure. South of Cedar Creek on Prairie Street. Overflows directly to Cedar Creek.	a,b,c,d,e	746.38	747.54
C15	24	014	North Cherry Street (from north) -- weir structure. North of Cedar Creek on Cherry Street. Overflows directly to Creek Creek.	a,b,c,d,e	748.84	749.68
C16	4	015	North Cherry Street (from southeast) -- weir structure. South of Cedar Creek on east side of Cherry Street. Overflows directly to Cedar Creek. (4057010902210)	a,b,c,d,e,f	746.23	747.21
C17	27	017	North Broad Street (from north) -- weir structure. North of Cedar Creek on Broad Street. Overflows directly to Cedar Creek.	a,b,c,d,e	750.15	751.07
C18	23	016	North Cherry Street (from southwest) -- weir structure. South of Cedar Creek on railroad right-of-way just west of Cherry Street. Overflows directly to Cedar Creek.	a,b,c,d,e	745.29	745.92
C19	21	020	North Cedar Street (from north) -- weir structure. North of Cedar Creek on Cedar Street. Overflows directly to Cedar Creek.	a,b,c,d,e	744.22	745.64
C20	13	019	North Broad Street (from southeast) -- weir structure. South of Cedar Creek on east side of Broad Street. Overflows directly to Cedar Creek. (4057000902214)	a,b,c,d,e,f	745.49	746.31
C21	9	018	North Broad Street (from southwest) -- weir structure. South of Cedar Creek on railroad right-of-way just west of Broad Street. Overflows directly to Cedar Creek.	a,b,c,d,e	745.11	746.36

Combined-Sewer and Storm-Sewer Data-Collection Sites and Their Physical Characteristics--Continued

Site code	Sewer Rank[1]	Sewer NPDES permit number	Location (direction of inflow) and site description of combined-sewer-overflow structures (station numbers[2])	Monitoring method[3]	Outfall elevation (feet)	Top of weir elevation (feet)
			Combined sewers--Continued			
C22	18	021	North Cedar Street (from south) -- weir structure. South of Cedar Creek on Cedar Street. Overflows directly to Cedar Creek. Weir raised 09/04/86. (4056590902222)	a,b,c,d,e, h,i,j	743.71	744.74 745.21
C23	34	022	North West Street (from north) -- weir structure. North of Cedar Creek on West Street. Overflows directly to Cedar Creek.	a,b,d,e	743.44	745.43
C24	10	024	North Academy Street (from south) -- weir structure. South of Cedar Creek on Academy Street just off road on east side. Overflows directly to Cedar Creek.	a,c,d,e	745.56	746.18
C25	8	023	North Academy Street (from north) -- weir structure. North of Cedar Creek on Academy Street. Overflows directly to Cedar Creek.	a,b,c,d,e	743.08	743.61
C26	19	026	Maple Avenue (from south) -- weir structure. South of Cedar Creek near grain elevators just north of railroad right-of-way, east of Maple Street and north of Main Street. Overflows directly to Cedar Creek.	c	---	741.78
C27	40	025	Maple Avenue (from north) -- weir structure. North of creek channel on Maple Street. Overflows directly to Cedar Creek.	a,c	---	746.59
C28	2	027	East Main Street (from north) -- weir structure. North of Cedar Creek on Main Street just west of Maple Street. Overflows directly to Cedar Creek. (4056510902245)	a,c,d,e,f	---	746.73
C29	5	029	South Henderson Street (from northeast) -- weir structure. North of Cedar Creek on Henderson Street near east edge of street. Overflows directly to Cedar Creek. (405647090230101)	a,b,c,d,e,f	739.88	741.54
C30	11	030	South Henderson Street (from south) -- weir structure. South of Cedar Creek on Henderson Street in median. Storm sewers flow into overflow structure downstream of the weir (via large pipes in manhole which discharge just downstream of weir). Overflows directly to Cedar Creek.	a	739.05	742.24

C31	1	028	South Henderson Street (from northwest) -- weir structure. North of Cedar Creek on Henderson Street in median. Overflows directly to Cedar Creek. (405647090230102)	a,b,c,d,e,f	739.82	741.37
C32	30	031	South Arthur Avenue (from north) -- weir structure. North of Cedar Creek just off end of Arthur Street. Overflows directly to Cedar Creek. (4056430902314)	a,b,c,d,e,f	737.61	741.53
C33	22	032	McClure Street (from south) -- raised pipe structure. South of Cedar Creek just east of McClure Street. Overflows directly to Cedar Creek. (4056350902343)	b	736.32	---
C34	--	---	Edwards Avenue (from north) -- weir structure. North of Cedar Creek about 800 feet west of McClure Street. Outfall pipe is completely silted in so that no combined sewage can flow to Cedar Creek at this time.	None	---	---
C35	3	034	Railroad Creek 36" brick sewer (from east) -- weir structure. In a vacant lot near Holton Street and Cross Street approximately 15 feet east of C36. Overflows to Railroad Creek which flows into Cedar Creek.	a	---	---
C36	29	002	Railroad Creek 24" sewer (from west) -- weir structure. In a vacant lot near Holton Street and Cross Street approximately 15 feet west of C35. Overflows to Railroad Creek which flows into Cedar Creek.	a	---	---
C37	47	035	Holton Street (from west) -- raised pipe structure. Located on Holton Street just south of West Tompkins Street. Overflows to Railroad Creek which flows into Cedar Creek. Weir installed 09/04/86.	a	---	---
C38	--	---	Monmouth Boulevard -- weir structure. This has been blocked and no longer can overflow.	None	---	---
C39	46	036	West Brooks Street (from west) -- weir structure. Located on Brooks Street just west of South Academy Street. Overflows to Railroad Creek which flows into Cedar Creek.	a	---	---
C40	39	037	South Academy Street (from east) -- weir structure. Located on east edge of Academy Street at intersection with Brooks Street. Overflows to Railroad Creek which flows into Cedar Creek.	a	---	---
C41	17	038	West Knox Street (from west) -- raised pipe structure. Located at the end of the driveway of the southwest corner house at the intersection of Knox Street and West Street. Overflows to Railroad Creek which flows into Cedar Creek. Weir installed 09/04/86.	a	---	---

Combined-Sewer and Storm-Sewer Data-Collection Sites and Their Physical Characteristics--Continued

Site code	Sewer: Rank[1]	Sewer: NPDES permit number	Location (direction of inflow) and site description of combined-sewer-overflow structures (station numbers[2])	Monitoring method[3]	Outfall elevation (feet)	Top of weir elevation (feet)
			Combined sewers--Continued			
C42	49	039	West First Street (from west) -- weir structure. Located at south end of football field just north of railroad right-of-way near First Street and Broad Street. Deep manhole carries much of storm drainage from railroad yard via large culvert. Overflows to Railroad Creek which flows into Cedar Creek.	a	---	---
C43	7	040	Depot Street (from west) -- weir structure. Located south of Depot Street at what would be Cherry Street (if continued on). Large weir across square 36-inch culvert. Often observed with reverse flow across weir into culvert from Railroad Creek. Overflows establish headwaters of Railroad Creek which flows into Cedar Creek.	a	---	---
C44	6	041	Depot Street (from east) -- weir structure. Located next to C43. Surcharging from Railroad Creek is a definite possibility. Overflows to Railroad Creek which flows into Cedar Creek.	a,d	---	---
C45	48	053	Ella Street (several inflows) -- raised pipe structure. Located in center of Lincoln Street intersection with Ella Street. Overflows to Pine Street storm sewer which flows into Cedar Creek. Weir installed 09/03/86.	c	---	---
C46	36	045	Cedar Avenue (from north) -- raised pipe structure. North of Cedar Creek near south end of Cedar Avenue. Overflows to Cedar Creek.	a,c	---	---
C47	16	033	West Main Street near Edwards Avenue (from north) -- weir structure. South of Main Street next to driveway east of 1650 West Main Street at Edwards Avenue. Overflows to storm sewer which flows into Cedar Creek.	a	---	---
C48	37	051	Fair Acres Drive (from west) -- raised pipe structure. Northwest corner of North West Street at Fair Acres Drive. Overflows to West Street storm sewer which flows into Cedar Creek.	c	---	---

C49	44	046	North Broad Street (from west) -- raised pipe structure. Located in median of Broad Street just north of Heritage Drive. Overflows to West Street storm sewer which flows into Cedar Creek.	c	---	---
C50	45	047	North Broad Street (from east) -- raised pipe structure. Located on east side of Broad Street north of Heritage Drive. Overflows to West Street storm sewer which flows into Cedar Creek.	c	---	---
C51	43	054	Frank Street pump station -- This is an automatic pump that is actuated when stage in a manhole rises to a certain level. The pump then transfers combined sewage to a storm sewer that flows to Cedar Creek. Operation of the pump was monitored by an electric power meter that indicated if the pump had been running by a change in the meter readings. Located on south side of Frank Street between Anderson Avenue and Lawndale Drive.	other	---	---
RR1	--	---	Railroad Creek. In a vacant lot approximately 30 feet north of C36 near Holton Street and Cross Street. This is a storm-water interceptor that receives overflow from nine combined sewers. Flows directly to Cedar Creek. (4056450902252)	h	---	---
			<u>Storm sewers</u>			
SS4	--	---	North Pearl Street. North of Cedar Creek and west of Pearl Street. Flows directly to Cedar Creek. (4057100902132)	g	---	---
SS7	--	---	North Chambers Street. North of Cedar Creek. Flows into C7 below weir. (4057100902143)	g	---	---
SS10	--	---	North Seminary Street. South of Cedar Creek and west side of Seminary Street. Flows directly to Cedar Creek. (4057080902152)	g	---	---
SS20	--	---	North Broad Street. South of Cedar Creek and west side of Broad Street. Flows directly to Cedar Creek. (4057000902215)	g	---	---
SS24	--	---	North Academy Street. South of Cedar Creek on Academy Street in southbound lane approximately 50 feet south of railroad siding tracks. Flows directly to Cedar Creek. (4056540902234)	h,i	---	---
SS34	--	---	Linwood Road. South of Cedar Creek and east side of Linwood Street. Flows directly to Cedar Creek. (4056330902409)	g	---	---

Combined-Sewer and Storm-Sewer Data-Collection Sites and Their Physical Characteristics--Continued

Site code	Sewer Rank[1]	NPDES permit number	Location (direction of inflow) and site description of combined-sewer-overflow structures (station numbers[2])	Monitoring method[3]	Outfall elevation (feet)	Top of weir elevation (feet)
			Storm sewers--Continued			
SS35	--	---	Storm sewer near C35. In a vacant lot approximately 100 feet east of C35 near Holton Street and Cross Street. Flows directly into Cedar Creek. (4056450902251)	h,i	---	---

[1] Rank indicates the frequency of overflows, where a rank of 1 indicates the greatest frequency and a rank of 49 the least. Ranking is from all 33 monitoring periods in 1985 and 1986 and is just an approximation.

[2] Station numbers refer to the site identifications used in the U.S. Geological Survey's National Water Information System computerized data base.

[3] Explanation of symbols used to define monitoring method:
- a Chalked weir
- b Chalked outfall at creek
- c Chalked outfall at manhole
- d Crest-stage gage
- e Flow timer
- f Single-stage sampler
- g Grab sample
- h Automatic pumping sampler
- i Dye-dilution discharge measurement equipment
- j Ultrasonic stage recorder

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986

[Dashes indicate no flow; * indicates volumes calculated from ultrasonic stage recorders; ft3/s is cubic feet per second. Footnotes listed at end of appendix B]

Monitored on 5/20

a: Mean duration = 4.46 hours (data from sites C29 and C30 were not used) or maximum duration = 10.98 hours
b: Mean peak discharge = 3.78 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1] Maximum	Average
C1	--	--	--	--
C2	--	--	--	--
C3	1.91	1.15	3,950	2,930
C4	a	2.35	46,400	14,000
C5	a	.09	1,780	535
C6	2.90	19.9	22,800*	22,800*
C7	.34	.49	300	222
C8	a	b	74,700	22,500
C9	a	1.10	21,700	6,530
C10	3.56	4.52	29,000	21,400
C11	4.09	1.22	8,980	6,650
C12	3.19	1.71	9,820	7,270
C13	--	--	--	--
C14	.10	.69	124	91
C15	7.38	5.03	66,800	49,400
C16	a	4.49	88,700	26,700
C17	a	3.63	71,700	21,600
C18	2.13	1.13	4,330	3,210
C19	a	5.00	98,800	29,700
C20	a	4.74	93,700	28,200
C21	5.20	6.04	56,500	41,800
C22	a	13.9	275,000	82,600
C23	8.83	8.50	135,000	100,000
C24	a	1.49	29,400	8,850
C25	4.20	6.10	46,100	34,100

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 5/20--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C26	a	7.27	144,000	43,200
C27	--	--	--	--
C28	a	2.94	58,100	17,500
C29	22.75	6.61	271,000	200,000
C30	31.30	b	213,000	158,000
C31	a	6.15	122,000	36,500
C32	3.95	.94	6,680	4,950
C33	4.08	1.35	9,910	7,340
C35	10.98	b	74,700	55,300
C36	8.48	b	57,700	42,700
C37	--	--	--	--
C39	--	--	--	--
C40	--	--	--	--
C41	a	b	74,700	22,500
C42	--	--	--	--
C43	a	b	74,700	22,500
C44	a	8.18	162,000	48,600
C45	--	--	--	--
C46	a	.90	17,800	5,350
C47	a	b	74,700	22,500
C48	--	--	--	--
C49	--	--	--	--
C50	--	--	--	--
C51	--	--	--	--
			2,550,000	1,220,000

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 7/2

a: Mean duration = 0.62 hours or maximum duration = 2.0 hours

b: Mean peak discharge = 5.90 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C1	a	b	21,200	4,870
C2	a	b	21,200	4,870
C3	0.14	0.01	2.5	1.9
C4	a	7.65	27,500	6,320
C5	a	.40	1,440	330
C6	a	9.65	34,700	7,970
C7	a	10.8	38,900	8,920
C8	a	b	21,200	4,870
C9	a	5.20	18,700	4,290
C10	1.01	6.22	11,300	8,370
C11	a	4.98	17,900	4,110
C12	a	7.94	28,600	6,560
C13	--	--	--	--
C14	.25	2.94	1,320	979
C15	a	3.49	12,600	2,880
C16	a	9.95	35,800	8,220
C17	a	4.85	17,500	4,010
C18	.41	3.79	2,800	2,070
C19	a	8.29	29,800	6,850
C20	a	8.32	30,000	6,870
C21	a	14.4	51,800	11,900
C22	a	18.1	65,200	14,900
C23	.04	.21	15	11
C24	a	1.25	4,500	1,030
C25	a	3.22	11,600	2,660
C26	2.0	9.07	32,700	24,200
C27	a	b	21,200	4,870
C28	a	3.73	13,400	3,080
C29	.27	5.42	2,630	1,950
[2]C30	29.52	b	314,000	232,000

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 7/2--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C31	a	8.64	31,100	7,140
C32	.44	2.04	1,620	1,200
C33	.92	2.06	3,410	2,520
C35	62.53	b	664,000	491,000
C36	.71	b	7,540	5,580
C37	a	b	21,200	4,870
C39	a	b	21,200	4,870
C40	a	b	21,200	4,870
C41	a	b	21,200	4,870
C42	a	b	21,200	4,870
C43	a	b	21,200	4,870
C44	a	2.72	9,790	2,250
C45	--	--	--	--
C46	a	b	21,200	4,870
C47	a	b	21,200	4,870
C48	a	b	21,200	4,870
C49	a	b	21,200	4,870
C50	--	--	--	--
C51	--	--	--	--
			1,820,000	948,000

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 7/10

a: Mean duration = 0.61 hour or maximum duration = 2.21 hours

b: Mean peak discharge = 3.60 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C1	--	--	--	--
C2	--	--	--	--
C3	a	0.54	2,150	439
C4	a	.64	2,550	520
C5	--	--	--	--
C6	0.41	.37	273	202
C7	a	.32	1,270	260
C8	a	b	14,300	2,930
C9	a	21.5	85,500	17,500
C10	a	12.1	48,100	9,830
C11	a	.70	2,780	569
C12	.06	1.08	117	86
C13	a	.54	2,150	439
C14	.06	.54	58	43
C15	a	2.45	9,750	1,990
C16	a	5.39	21,400	4,380
C17	a	4.13	16,400	3,360
C18	a	.28	1,110	228
C19	a	2.04	8,120	1,660
C20	a	2.47	9,830	2,010
C21	a	5.03	20,000	4,090
C22	a	3.00	11,900	2,440
C23	--	--	--	--
C24	a	.22	875	179
C25	a	4.67	18,600	3,790
C26	a	4.23	16,800	3,440
C27	a	b	14,300	2,930
C28	a	5.89	23,400	4,790
C29	.33	3.10	1,840	1,360
C30	2.21	b	14,300	10,600

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 7/10--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1] Maximum	Average
C31	a	b	14,300	2,930
C32	.41	b	2,660	1,970
[2]C33	.62	b	4,020	2,970
[2]C35	.91	b	5,900	4,360
[2]C36	.47	b	3,050	2,250
C37	--	--	--	--
C39	a	b	14,300	2,930
C40	a	b	14,300	2,930
[2]C41	a	b	14,300	2,930
C42	--	--	--	--
C43	a	b	14,300	2,930
C44	a	5.12	20,400	4,160
C45	--	--	--	--
C46	--	--	--	--
[2]C47	a	b	14,300	2,930
C48	--	--	--	--
C49	--	--	--	--
C50	--	--	--	--
C51	--	--	--	--
			470,000	113,000

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 7/14

a: Mean duration = 1.72 hours or maximum duration = 6.75 hours

b: Mean peak discharge = 5.88 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1] Maximum	Average
C1	--	--	--	--
C2	--	--	--	--
C3	0.33	4.92	2,920	2,160
C4	a	10.8	131,000	24,700
C5	a	.01	122	23
C6	a	3.00	36,500	6,870
C7	4.70	1.78	15,100	11,100
C8	a	b	71,400	13,500
C9	a	.79	9,600	1,810
C10	a	12.1	147,000	27,700
C11	a	2.90	35,200	6,640
C12	1.16	6.49	13,600	10,000
C13	a	.06	729	137
C14	.43	4.78	3,700	2,740
C15	a	5.94	72,200	13,600
C16	a	3.56	43,300	8,160
C17	a	5.38	65,400	12,300
C18	a	1.63	19,800	3,730
C19	a	5.87	71,300	13,400
C20	a	10.3	125,000	23,600
C21	a	11.9	145,000	27,300
C22	a	2.46	29,900	5,640
C23	.68	4.23	5,180	3,830
C24	a	1.25	15,200	2,860
C25	4.26	5.77	44,200	32,700
C26	a	11.1	135,000	25,400
C27	a	b	71,400	13,500
C28	a	17.6	214,000	40,300
C29	a	6.07	73,800	13,900
C30	6.75	b	71,400	52,900

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 7/14--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C31	.53	10.3	9,830	7,270
C32	.85	.81	1,240	917
C33	1.38	2.46	6,110	4,520
C35	1.81	b	19,200	14,200
C36	1.42	b	15,000	11,100
C37	--	--	--	--
C39	a	b	71,400	13,500
C40	a	b	71,400	13,500
C41	a	b	71,400	13,500
C42	--	--	--	--
C43	a	b	71,400	13,500
C44	a	16.3	198,000	37,300
C45	--	--	--	--
C46	--	--	--	--
C47	a	b	71,400	13,500
C48	--	--	--	--
C49	--	--	--	--
C50	--	--	--	--
C51	--	--	--	--
			2,280,000	543,000

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 8/1

a: Mean duration = 5.70 hours (data from site C43 were not used)
or maximum duration = 12.44 hours
b: Mean peak discharge = 16.7 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C1	a	b	374,000	127,000
C2	a	b	374,000	127,000
C3	4.74	15.6	133,000	98,500
C4	a	31.8	712,000	241,000
C5	a	2.14	47,900	16,200
C6	5.14	20.4	159,000*	159,000*
C7	11.07	b	333,000	246,000
C8	5.49	b	165,000	122,000
C9	4.55	8.91	73,000	54,000
C10	4.08	23.1	170,000	126,000
C11	a	11.8	264,000	89,600
C12	3.09	15.6	86,800	64,200
C13	2.29	1.00	4,120	3,050
C14	2.30	18.4	76,200	56,400
C15	2.62	16.3	76,900	56,900
C16	8.76	19.8	312,000	231,000
C17	2.53	10.1	46,000	34,000
C18	2.72	b	81,800	60,500
C19	2.90	5.47	28,600	21,100
C20	8.46	32.0	487,000	361,000
C21	2.99	20.5	110,000	81,600
C22	4.37	19.0	108,000*	108,000*
C23	8.96	22.3	360,000	266,000
C24	7.86	.46	6,510	4,820
C25	7.99	9.91	143,000	105,000
C26	7.67	15.6	215,000	159,000
C27	7.55	b	227,000	168,000
C28	7.87	18.0	255,000	189,000
C29	3.12	31.8	179,000	132,000
C30	6.48	b	195,000	144,000

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 8/1--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C31	12.44	32.1	719,000	532,000
C32	4.94	34.2	304,000	225,000
C33	8.37	3.28	49,400	36,600
C35	7.20	b	216,000	160,000
C36	7.16	b	215,000	159,000
C37	a	b	374,000	127,000
C39	a	b	374,000	127,000
C40	a	b	374,000	127,000
C41	a	b	374,000	127,000
C42	a	b	374,000	127,000
C43	24.00	b	721,000	534,000
C44	a	25.0	560,000	190,000
C45	a	b	374,000	127,000
C46	1.13	2.46	5,000	3,700
C47	a	b	374,000	127,000
C48	a	b	374,000	127,000
C49	a	b	374,000	127,000
C50	a	b	374,000	127,000
C51	a	b	374,000	127,000
			12,700,000	6,890,000

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 8/8

a: Mean duration = 1.47 hours or maximum duration = 9.52 hours

b: Mean peak discharge = 5.32 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C1	a	b	91,200	10,400
C2	a	b	91,200	10,400
C3	1.24	1.97	4,400	3,250
C4	a	b	91,200	10,400
C5	a	1.22	20,900	2,390
C6	.54	b	5,170	3,830
C7	1.37	3.82	9,420	6,970
C8	a	b	91,200	10,400
C9	.93	3.56	5,960	4,410
C10	.46	6.86	5,680	4,200
C11	3.94	3.01	21,300	15,800
C12	.54	6.20	6,030	4,460
C13	.21	.82	310	229
C14	.37	6.37	4,240	3,140
C15	.53	b	5,080	3,760
C16	.89	6.37	10,200	7,550
C17	.17	7.97	2,440	1,800
C18	.43	.37	286	212
C19	.43	b	4,120	3,050
C20	.16	13.0	3,740	2,770
C21	9.52	5.06	86,700	64,200
C22	1.25	10.5	23,600	17,500
C23	.70	5.26	6,630	4,900
C24	a	b	91,200	10,400
C25	.56	4.83	4,870	3,600
C26	a	13.2	226,000	25,800
C27	.29	b	2,780	2,060
C28	8.82	3.46	54,900	40,600
C29	.33	1.66	986	730
C30	1.29	b	12,400	9,140

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 8/8--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C31	1.93	11.4	39,600	29,300
C32	.53	2.15	2,050	1,520
C33	a	3.28	56,200	6,420
[2]C35	1.32	b	12,600	9,350
[2]C36	.89	b	8,520	6,310
C37	--	--	--	--
C39	--	--	--	--
C40	--	--	--	--
[2]C41	a	b	91,200	10,400
C42	--	--	--	--
C43	--	--	--	--
C44	--	--	--	--
C45	--	--	--	--
C46	--	--	--	--
[2]C47	a	b	91,200	10,400
C48	--	--	--	--
C49	--	--	--	--
C50	--	--	--	--
C51	--	--	--	--
			1,290,000	362,000

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 8/27

a: Mean duration = 0.90 hours or maximum duration = 3.48 hours

b: Mean peak discharge = 1.35 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C1	--	--	--	--
C2	a	b	8,460	1,620
C3	--	--	--	--
C4	--	--	--	--
C5	--	--	--	--
C6	--	--	--	--
C7	--	--	--	--
C8	a	b	8,460	1,620
C9	--	--	--	--
C10	--	--	--	--
C11	--	--	--	--
C12	--	--	--	--
C13	--	--	--	--
C14	--	--	--	--
C15	--	--	--	--
C16	0.53	0.28	267	198
C17	--	--	--	--
C18	--	--	--	--
C19	--	--	--	--
C20	3.48	1.49	9,330	6,910
C21	.35	.05	32	23
C22	a	1.09	6,830	1,310
C23	--	--	--	--
C24	a	b	8,460	1,620
C25	.25	3.84	1,730	1,280
C26	--	--	--	--
C27	--	--	--	--
C28	a	b	8,460	1,620
C29	--	--	--	--
C30	.46	b	1,120	827

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 8/27--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C31	.33	.30	178	132
C32	--	--	--	--
C33	--	--	--	--
C35	--	--	--	--
C36	--	--	--	--
C37	--	--	--	--
C39	--	--	--	--
C40	--	--	--	--
C41	a	b	8,460	1,620
C42	--	--	--	--
C43	a	b	8,460	1,620
C44	a	2.42	15,200	2,900
C45	--	--	--	--
C46	--	--	--	--
C47	--	--	--	--
C48	--	--	--	--
C49	--	--	--	--
C50	--	--	--	--
C51	--	--	--	--
			85,400	23,300

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 9/12

a: Mean duration = 1.13 hours or maximum duration = 5.13 hours

b: Mean peak discharge = 4.11 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C1	a	b	38,000	6,190
C2	a	b	38,000	6,190
C3	--	--	--	--
C4	--	--	--	--
C5	--	--	--	--
C6	0.45	4.23	3,430	2,540
C7	5.13	.37	3,420	2,530
C8	.64	b	4,730	3,500
C9	.10	5.85	1,050	779
C10	.67	4.17	5,030	3,720
C11	.61	1.35	1,480	1,100
C12	.34	4.20	2,570	1,900
C13	--	--	--	--
C14	.18	1.54	499	369
C15	.98	2.45	4,320	3,200
C16	1.23	3.63	8,040	5,950
C17	.28	3.03	1,530	1,130
C18	a	.09	831	135
C19	.30	2.82	1,520	1,130
C20	.29	4.64	2,420	1,790
C21	2.68	6.71	32,400	24,000
C22	1.51	13.3	24,800*	24,800*
C23	--	--	--	--
C24	.79	1.03	1,460	1,080
C25	.99	4.31	7,680	5,680
C26	.58	4.23	4,420	3,270
C27	a	b	38,000	6,190
C28	.11	3.46	685	507
C29	a	.80	7,390	1,200
C30	2.74	b	20,300	15,000

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 9/12--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C31	2.57	5.32	24,600	18,200
C32	a	1.37	12,700	2,060
C33	.67	3.28	3,960	2,930
C35	1.89	b	14,000	10,300
C36	1.33	b	9,840	7,280
C37	--	--	--	--
C39	--	--	--	--
C40	a	b	38,000	6,190
C41	a	b	38,000	6,190
C42	--	--	--	--
C43	a	b	38,000	6,190
C44	a	16.6	153,000	25,000
C45	--	--	--	--
C46	--	--	--	--
C47	--	--	--	--
C48	--	--	--	--
C49	--	--	--	--
C50	--	--	--	--
C51	--	--	--	--
			586,000	208,000

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 9/25

a: Mean duration = 3.79 hours (data from sites C8, C14, C16, C21, C30, C31, C35, C43, and C44 were not used) or maximum duration = 13.69 hours
b: Mean peak discharge = 13.9 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C1	a	b	343,000	70,200
C2	a	b	343,000	70,200
C3	6.68	15.6	188,000	139,000
C4	11.81	31.8	676,000	500,000
C5	2.87	.33	1,700	1,260
C6	6.84	19.6	241,000	179,000
C7	3.25	18.1	106,000	78,400
C8	20.28	b	507,000	375,000
C9	.32	12.9	7,430	5,500
C10	2.05	20.7	76,400	56,500
C11	2.07	9.91	36,900	27,300
C12	1.70	20.5	62,700	46,400
C13	3.46	2.85	17,700	13,100
C14	26.85	13.0	628,000	465,000
C15	1.47	14.0	37,000	27,400
C16	22.83	b	571,000	423,000
C17	2.02	7.69	28,000	20,700
C18	1.17	4.96	10,400	7,730
C19	1.59	12.8	36,600	27,100
C20	2.48	33.0	147,000	109,000
C21	36.47	24.4	1,600,000	1,190,000
C22	6.34	19.2	219,000	162,000
C23	9.33	25.1	422,000	312,000
C24	12.80	1.41	32,500	24,000
C25	3.41	5.36	32,900	24,300
C26	2.37	15.6	66,500	49,200
C27	.70	b	17,500	13,000
C28	9.73	6.83	120,000	88,500
C29	2.10	8.92	33,700	25,000
C30	24.93	b	624,000	462,000

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 9/25--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C31	24.25	b	607,000	449,000
C32	3.45	14.9	92,500	68,500
C33	6.77	3.28	40,000	29,600
C35	22.77	b	570,000	422,000
C36	13.69	b	343,000	253,000
C37	.75	b	18,800	13,900
C39	2.04	b	51,000	37,800
C40	.83	b	20,800	15,400
C41	1.42	b	35,500	26,300
[2]C42	.53	b	13,300	9,810
C43	25.18	b	630,000	466,000
C44	22.44	22.3	901,000	667,000
C45	--	--	--	--
C46	.61	3.16	3,470	2,570
C47	2.16	b	54,000	40,000
C48	1.09	b	27,300	20,200
C49	2.53	b	63,300	46,800
[2]C50	2.63	b	65,800	48,700
C51	5.20	b	130,000	96,300
			10,900,000	7,700,000

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 10/1

a: Mean duration = 6.03 hours (data from sites C4, C9, C13, C16, C20, C23, C35, C36, C43, C44, C49, C50 were not used) or maximum duration = 19.30 hours

b: Mean peak discharge = 6.48 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C1	--	--	--	--
C2	--	--	--	--
C3	a	7.27	253,000	58,400
C4	31.42	5.85	331,000	245,000
C5	8.32	.50	7,490	5,540
C6	18.73	6.31	213,000	157,000
C7	6.25	1.32	14,900	11,000
C8	3.83	b	44,700	33,100
C9	20.57	2.60	96,300	71,200
C10	2.90	9.71	50,700	37,500
C11	4.32	2.09	16,300	12,000
C12	2.96	8.04	42,800	31,700
C13	66.14	b	771,000	571,000
C14	.39	2.67	1,870	1,390
C15	1.5	3.18	8,590	6,350
C16	22.04	25.7	1,020,000	754,000
C17	1.36	3.76	9,200	6,810
C18	.21	1.03	389	288
C19	1.63	6.08	17,800	13,200
C20	22.93	8.48	350,000	259,000
C21	10.37	13.3	248,000	184,000
C22	6.67	.28	3,360	2,490
C23	26.29	22.4	1,060,000	784,000
C24	4.12	1.41	10,500	7,740
C25	4.08	3.41	25,000	18,500
C26	4.31	4.92	38,200	28,200
C27	a	b	225,000	52,000
C28	6.06	2.94	32,100	23,700
C29	.69	5.56	6,910	5,110
C30	a	b	225,000	52,000

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 10/1--Continued

Site	Overflow duration, in hours	Peak discharge, in ft³/s	Combined-sewer overflow volume, in cubic feet[1] Maximum	Average
C31	17.30	5.62	175,000	130,000
C32	15.84	6.03	172,000	127,000
C33	17.97	3.28	106,000	78,500
C35	59.47	b	694,000	513,000
C36	81.88	b	955,000	707,000
C37	a	b	225,000	52,000
C39	.64	b	7,470	5,520
C40	a	b	225,000	52,000
C41	.34	b	3,970	2,930
C42	--	--	--	--
C43	57.83	b	675,000	499,000
C44	27.90	17.8	894,000	661,000
C45	--	--	--	--
C46	.09	b	1,050	777
C47	5.40	b	63,000	46,600
C48	3.64	b	42,500	31,400
C49	30.17	b	352,000	260,000
[2]C50	30.39	b	354,000	262,000
C51	19.3	b	225,000	167,000
			10,300,000	7,030,000

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 10/8

a: Mean duration = 7.17 hours (data from sites C3, C4, C5, C6, C13, C23, C30, C31, C32, C33, C36, C43, C44, C49, C50, and C51 were not used) or maximum duration = 18.74 hours
b: Mean peak discharge = 7.28 ft^3/s

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1] Maximum	Average
C1	13.36	b	175,000	130,000
C2	10.31	b	135,000	100,000
C3	51.09	15.6	1,430,000	1,060,000
C4	65.27	b	855,000	633,000
C5	37.00	b	485,000	359,000
C6	62.09	16.6	1,860,000	1,370,000
C7	18.74	9.93	335,000	248,000
C8	7.25	b	95,000	70,300
C9	10.87	6.23	122,000	90,200
C10	4.11	6.74	49,900	36,900
C11	12.93	2.66	61,900	45,800
C12	4.05	4.47	32,600	24,100
C13	94.75	2.58	440,000	326,000
C14	1.64	5.45	16,100	11,900
C15	2.28	4.79	19,700	14,500
C16	3.45	3.12	19,400	14,300
C17	4.01	3.24	23,400	17,300
C18	1.64	1.56	4,610	3,410
C19	2.41	6.50	28,200	20,900
C20	3.98	9.27	66,400	49,100
C21	3.27	7.30	43,000	31,800
C22	10.11	b	132,000	98,000
C23	38.93	22.4	1,570,000	1,160,000
C24	a	1.75	59,000	16,700
C25	a	5.99	202,000	57,200
C26	a	13.2	445,000	126,000
C27	a	b	246,000	69,500
C28	a	4.01	135,000	38,300
C29	a	6.16	208,000	58,800
C30	188.54	b	2,470,000	1,830,000

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

Monitored on 10/8--Continued

Site	Overflow duration, in hours	Peak discharge, in ft^3/s	Combined-sewer overflow volume, in cubic feet[1]	
			Maximum	Average
C31	35.83	11.6	748,000	554,000
C32	30.90	3.36	187,000	138,000
C33	25.17	.56	25,400	18,800
C35	18.54	b	243,000	180,000
C36	41.35	b	542,000	401,000
C37	--	--	--	--
C39	6.09	b	79,800	59,100
[2]C40	.41	b	5,370	3,980
C41	3.60	b	47,200	34,900
C42	--	--	--	--
C43	77.32	b	1,010,000	750,000
C44	41.17	19.4	1,440,000	1,060,000
C45	--	--	--	--
C46	a	2.14	72,200	20,400
C47	13.23	b	173,000	128,000
C48	8.56	b	112,000	83,000
C49	61.31	b	803,000	595,000
C50	69.71	b	913,000	676,000
C51	52.80	b	692,000	512,000
			18,900,000	13,300,000

APPENDIX B

Galesburg Combined-Sewer Overflow Characteristics for 11 Monitoring Periods in 1986--Continued

[1] Maximum overflow volume = duration x 3,600 x peak discharge x 0.5,

where: duration is in hours and missing values (a) are set to the maximum duration for the storm (excluding any outliers),

peak discharge is in cubic feet per second and missing values (b) are set to the arithmetic mean for the storm,

3,600 converts hours to seconds, and

0.5 accounts for Gaussian-type distribution.

Average overflow volume = duration x 3,600 x peak discharge x 0.37,

where: duration is in hours and missing values (a) are set to the arithmetic mean duration for the storm (excluding outliers),

0.37 accounts for the distribution similar to that measured for sites C6 and C22, and

all others are as described above.

[2] These combined sewers are listed in table 14 of the report by McFarlane and others (1987, p. 139-147) as having no data or no flow when records indicate that flow did occur.

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986

[Dashes indicate no data; units given with constituent code at end of table--mg/L, milligrams per liter and μg/L, micrograms per liter; low, high, mean, and standard deviation calculated from values greater than the analytical detection limit. Footnotes are listed at end of appendix C]

Results for Cedar Creek at Farnham Street at Galesburg; Site 1

storm number 1, May 16-20

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	10	400.00	700.00	540.00	122.384	465.00	
BOD	3	17.00	25.00	21.00	4.000	21.0	
COD	3	70.00	150.00	98.33	44.814	75.00	
TSS	10	57.00	1,420.00	590.50	500.313	642.50	
VSS	10	5.00	185.00	86.90	70.918	122.50	
NH_3	6/10	.15	1.50	.45	.523	.23/	0.16
TKN	10	.40	22.00	5.07	6.338	4.25	
NOx	10	.12	12.00	7.55	4.121	7.70	
P	10	.11	6.90	1.26	2.030	.89	
TOC	9	2.80	71.00	14.23	21.696	10.00	
HRD	3	200.00	230.00	216.67	15.275	220.00	
Ca	3	50.00	58.00	55.00	4.359	57.00	
Mg	3	18.00	21.00	19.33	1.528	19.00	
Na	3	14.00	24.00	20.67	5.774	24.00	
K	3	3.80	5.20	4.27	.808	3.80	
Cl	1	38.00	38.00	38.00	.00	38.00	
SO_4	1	24.00	24.00	24.00	.00	24.00	
F	3	.10	.20	.17	.058	.20	
As	3	5.00	7.00	5.67	1.155	5.00	
Ba	3	200.00	300.00	233.33	57.735	200.00	
Be	0/3	--	--	--	--	-- /	2.00
B	0/3	--	--	--	--	-- /	50.00
Cd	2/3	4.00	5.00	4.50	.707	4.50/	4.00
Cr	3	11.00	13.00	11.67	1.155	11.00	
Co	3	10.00	10.00	10.00	.00	10.00	
Cu	3	14.00	21.00	17.33	3.512	17.00	
Fe	3	7,900.00	11,000.00	9,566.67	1,563.117	9,800.00	
Pb	0/3	--	--	--	--	-- /	50.00
Mn	3	540.00	1,100.00	733.33	317.700	560.00	
Ni	3	13.00	16.00	14.67	1.528	15.00	
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	100.00	100.00	100.00	.00	100.00	
V	3	19.00	26.00	21.67	3.786	20.00	
Zn	2/3	110.00	130.00	120.00	14.142	120.00/	110.00
Al	3	6,200.00	8,600.00	7,333.33	1,205.543	7,200.00	
PHNL	1	10.00	10.00	10.00	.00	10.00	
TDS	1	385.00	385.00	385.00	.00	385.00	
Hg	1/3	.05	.05	.05	.00	.05/	.01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Farnham Street at Galesburg; Site 1--Continued

storm number 2, July 7-10

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	1	260.00	260.00	260.00	0	260.00
BOD	1	11.00	11.00	11.00	0	11.00
COD	1	51.00	51.00	51.00	0	51.00
TSS	1	566.00	566.00	566.00	0	566.00
VSS	1	56.00	56.00	56.00	0	56.00
NH_3	0/1	--	--	--	--	-- / 0.10
TKN	1	2.50	2.50	2.50	0	2.50
NOx	1	2.70	2.70	2.70	0	2.70
P	1	.41	.41	.41	0	.41
TOC	1	8.20	8.20	8.20	0	8.20
HRD	1	200.00	200.00	200.00	0	200.00
Ca	1	55.00	55.00	55.00	0	55.00
Mg	1	15.00	15.00	15.00	0	15.00
Na	1	9.40	9.40	9.40	0	9.40
K	1	1.60	1.60	1.60	0	1.60
Cl	1	15.00	15.00	15.00	0	15.00
SO_4	1	20.00	20.00	20.00	0	20.00
F	0/1	--	--	--	--	-- / .10
As	1	1.00	1.00	1.00	0	1.00
Ba	1	100.00	100.00	100.00	0	100.00
Be	1	4.00	4.00	4.00	0	4.00
B	1	50.00	50.00	50.00	0	50.00
Cd	0/1	--	--	--	--	-- / 3.00
Cr	0/1	--	--	--	--	-- / 5.00
Co	0/1	--	--	--	--	-- / 5.00
Cu	1	15.00	15.00	15.00	0	15.00
Fe	1	4,700.00	4,700.00	4,700.00	0	4,700.00
Pb	1	50.00	50.00	50.00	0	50.00
Mn	1	350.00	350.00	350.00	0	350.00
Ni	0/1	--	--	--	--	-- / 5.00
Ag	0/1	--	--	--	--	-- / 3.00
Sr	1	70.00	70.00	70.00	0	70.00
V	0/1	--	--	--	--	-- / 5.00
Zn	1	110.00	110.00	110.00	0	110.00
Al	1	3,100.00	3,100.00	3,100.00	0	3,100.00
PHNL	1	10.00	10.00	10.00	0	10.00
TDS	1	160.00	160.00	160.00	0	160.00
Hg	1	.02	.02	.02	0	.02

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Farnham Street at Galesburg; Site 1--Continued

storm number 3, July 31 to August 1

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	15	90.00	820.00	492.67	303.279	550.00	
BOD	10	1.80	14.00	7.77	5.274	7.30	
COD	10	7.00	130.00	54.10	43.981	45.50	
TSS	15	27.00	1,160.00	445.20	449.924	174.00	
VSS	15	6.00	210.00	73.27	76.361	30.00	
NH_3	7/15	.15	.41	.28	.086	.27/	0.10
TKN	14/15	.60	5.00	2.33	1.459	1.85/	1.60
NOx	15	.67	6.40	3.67	2.316	3.30	
P	15	.12	2.00	.64	.559	.59	
TOC	14	2.40	16.00	7.09	4.042	7.00	
HRD	3	91.00	250.00	187.00	84.481	220.00	
Ca	3	24.00	78.00	56.00	28.355	66.00	
Mg	3	7.40	15.00	11.80	3.940	13.00	
Na	3	1.20	2.70	1.97	.751	2.00	
K	3	2.00	7.60	3.90	3.205	2.10	
Cl	1	2.20	2.20	2.20	.00	2.20	
SO_4	0/1	--	--	--	--	-- /	10.00
F	0/3	--	--	--	--	-- /	.10
As	4	.00	5.00	2.75	2.062	3.00	
Ba	3	100.00	200.00	166.67	57.735	200.00	
Be	0/3	--	--	--	--	-- /	.50
B	0/3	--	--	--	--	-- /	50.00
Cd	1/3	5.00	5.00	5.00	.00	5.00/	3.00
Cr	2/3	5.00	6.00	5.50	.707	5.50/	5.00
Co	3	6.00	10.00	7.67	2.082	7.00	
Cu	3	21.00	22.00	21.33	.577	21.00	
Fe	3	8,500.00	9,700.00	9,200.00	624.500	9,400.00	
Pb	0/3	--	--	--	--	-- /	100.00
Mn	3	620.00	900.00	756.67	140.119	750.00	
Ni	3	10.00	12.00	11.00	1.000	11.00	
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	40.00	50.00	43.33	5.774	40.00	
V	3	15.00	20.00	16.67	2.887	15.00	
Zn	3	120.00	130.00	126.67	5.774	130.00	
Al	3	5,300.00	7,300.00	6,066.67	1,078.579	5,600.00	
PHNL	1	10.00	10.00	10.00	.00	10.00	
TDS	1	80.00	80.00	80.00	.00	80.00	
Hg	2/3	.05	.11	.08	.042	.08/	.05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Farnham Street at Galesburg; Site 1--Continued

storm number 4, no samples collected

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	3	130.00	800.00	470.00	335.1119	480.00
BOD	3	2.30	13.00	8.00	5.3842	8.70
COD	3	21.00	44.00	34.67	12.0968	39.00
TSS	3	197.00	556.00	359.00	182.0412	324.00
VSS	3	31.00	62.00	49.00	16.0935	54.00
NH_3	2/3	.10	.12	.11	.0141	.11/ 0.10
TKN	3	1.00	1.60	1.30	.3000	1.30
NOx	3	.45	2.20	1.28	.8780	1.20
P	3	.28	.56	.43	.1419	.46
TOC	3	3.90	12.00	7.70	4.0731	7.20
HRD	1	110.00	110.00	110.00	.00	110.00
Ca	1	32.00	32.00	32.00	.00	32.00
Mg	1	7.60	7.60	7.60	.00	7.60
Na	1	3.30	3.30	3.30	.00	3.30
K	1	1.30	1.30	1.30	.00	1.30
Cl	0	--	--	--	--	--
SO_4	0	--	--	--	--	--
F	0/1	--	--	--	--	-- / .10
As	1	1.00	1.00	1.00	.00	1.00
Ba	1	100.00	100.00	100.00	.00	100.00
Be	0/1	--	--	--	--	-- / .50
B	0/1	--	--	--	--	-- / 50.00
Cd	0/1	--	--	--	--	-- / 3.00
Cr	0/1	--	--	--	--	-- / 5.00
Co	0/1	--	--	--	--	-- / 5.00
Cu	1	15.00	15.00	15.00	.00	15.00
Fe	1	5,300.00	5,300.00	5,300.00	.00	5,300.00
Pb	0/1	--	--	--	--	-- / 50.00
Mn	1	380.00	380.00	380.00	.00	380.00
Ni	0/1	--	--	--	--	-- / 5.00
Ag	0/1	--	--	--	--	-- / 3.00
Sr	1	30.00	30.00	30.00	.00	30.00
V	1	10.00	10.00	10.00	.00	10.00
Zn	0/1	--	--	--	--	-- / 100.00
Al	1	3,600.00	3,600.00	3,600.00	.00	3,600.00
PHNL	0	--	--	--	--	--
TDS	0	--	--	--	--	--
Hg	0/1	--	--	--	--	-- / .05

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Farnham Street at Galesburg; Site 1--Continued

samples collected for storms 1, 2, 3, and 5 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	29	90.00	820.00	498.62	248.146	480.00	
BOD	17	1.80	25.00	10.34	6.911	11.00	
COD	17	7.00	150.00	58.29	42.154	51.00	
TSS	29	27.00	1,420.00	490.55	436.770	324.00	
VSS	29	5.00	210.00	74.86	68.470	54.00	
NH_3	15/29	.10	1.50	.33	.339	.24/	0.10
TKN	28/29	.40	22.00	3.20	4.066	1.85/	1.60
NOx	29	.12	12.00	4.73	3.615	4.90	
P	29	.11	6.90	.82	1.262	.56	
TOC	27	2.40	71.00	9.58	12.869	7.20	
HRD	8	91.00	250.00	190.12	57.819	210.00	
Ca	8	24.00	78.00	52.50	17.436	56.00	
Mg	8	7.40	21.00	14.50	5.007	15.00	
Na	8	1.20	24.00	10.07	9.621	6.35	
K	8	1.30	7.60	3.42	2.155	2.95	
Cl	3	2.20	38.00	18.40	18.141	15.00	
SO_4	2/3	20.00	24.00	22.00	2.828	22.00/	20.00
F	3/8	.10	.20	.17	.058	.20/	.10
As	9	.00	7.00	3.33	2.345	3.00	
Ba	8	100.00	300.00	175.00	70.711	200.00	
Be	1/8	4.00	4.00	4.00	.00	4.00/	1.50
B	1/8	50.00	50.00	50.00	.00	50.00/	50.00
Cd	3/8	4.00	5.00	4.67	.577	5.00/	3.00
Cr	5/8	5.00	13.00	9.20	3.493	11.00/	5.50
Co	6/8	6.00	10.00	8.83	1.835	10.00/	8.50
Cu	8	14.00	22.00	18.25	3.327	19.00	
Fe	8	4,700.00	11,000.00	8,287.50	2,231.871	8,950.00	
Pb	1/8	50.00	50.00	50.00	.00	50.00/	50.00
Mn	8	350.00	1,100.00	650.00	256.069	590.00	
Ni	6/8	10.00	16.00	12.83	2.317	12.50/	11.50
Ag	0/8	--	--	--	--	-- /	3.00
Sr	8	30.00	100.00	66.25	30.208	60.00	
V	7/8	10.00	26.00	17.86	5.080	19.00/	17.00
Zn	6/8	110.00	130.00	121.67	9.832	125.00/	115.00
Al	8	3,100.00	8,600.00	5,862.50	1,874.595	5,900.00	
PHNL	3	10.00	10.00	10.00	.00	10.00	
TDS	3	80.00	385.00	208.33	158.140	160.00	
Hg	4/8	.02	.11	.06	.038	.05/	.03

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Highway 34 at Galesburg; Site 8

storm number 1, May 16-20

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	9	510.00	780.00	652.22	86.859	670.00	
BOD	2	18.00	19.00	18.50	.707	18.50	
COD	3	30.00	42.00	36.33	6.028	37.00	
TSS	9	13.00	303.00	134.11	95.980	130.00	
VSS	9	2.00	50.00	27.22	16.954	33.00	
NH_3	9	.10	.30	.20	.082	.25	
TKN	9	.50	2.00	1.56	.557	1.80	
ONOx	9	1.60	7.70	3.20	2.555	2.00	
P	9	.10	.41	.25	.106	.27	
TOC	9	3.20	9.50	6.50	2.132	6.30	
HRD	3	260.00	350.00	306.67	45.092	310.00	
Ca	3	61.00	82.00	71.67	10.504	72.00	
Mg	3	26.00	36.00	31.00	5.000	31.00	
Na	3	26.00	28.00	26.67	1.155	26.00	
K	3	2.00	2.50	2.30	.265	2.40	
Cl	1	53.00	53.00	53.00	.00	53.00	
SO_4	1	86.00	86.00	86.00	.00	86.00	
F	3	.20	.30	.27	.058	.30	
As	3	2.00	3.00	2.33	.577	2.00	
Ba	3	70.00	100.00	90.00	17.321	100.00	
Be	0/3	--	--	--	--	-- /	1.00
B	3	110.00	130.00	120.00	10.000	120.00	
Cd	1/3	4.00	4.00	4.00	.00	4.00/	3.00
Cr	3	7.00	12.00	8.67	2.887	7.00	
Co	1/3	6.00	6.00	6.00	.00	6.00/	5.00
Cu	3	10.00	33.00	18.33	12.741	12.00	
Fe	3	1,000.00	4,600.00	2,600.00	1,833.030	2,200.00	
Pb	0/3	--	--	--	--	-- /	50.00
Mn	3	97.00	360.00	229.00	131.503	230.00	
Ni	2/3	7.00	10.00	8.50	2.121	8.50/	7.00
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	130.00	160.00	146.67	15.275	150.00	
V	1/3	8.00	8.00	8.00	.00	8.00/	5.00
Zn	1/3	150.00	150.00	150.00	.00	150.00/	100.00
Al	3	440.00	2,200.00	1,206.67	901.628	980.00	
PHNL	1	10.00	10.00	10.00	.00	10.00	
TDS	1	439.00	439.00	439.00	.00	439.00	
Hg	3	.05	.09	.06	.023	.05	

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Highway 34 at Galesburg; Site 8--Continued

storm number 2, no samples collected

storm number 3, July 31 to August 1

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	14	130.00	890.00	552.86	309.48	715.00	
BOD	10	2.00	37.00	11.72	11.81	6.25	
COD	10	6.00	360.00	102.50	131.19	20.00	
TSS	14	4.00	4,090.00	995.86	1,425.28	84.50	
VSS	14	2.00	540.00	132.07	181.38	17.00	
NH_3	14	.15	.53	.25	.10	.22	
TKN	14	.70	8.20	3.05	2.75	1.15	
NOx	14	.59	3.80	1.84	1.14	2.15	
P	14	.12	2.30	.76	.80	.27	
TOC	14	4.00	32.00	11.06	9.10	5.90	
HRD	4	160.00	590.00	335.00	181.93	295.00	
Ca	3	86.00	180.00	118.00	53.70	88.00	
Mg	3	14.00	31.00	22.33	8.50	22.00	
Na	3	3.50	9.50	6.77	3.04	7.30	
K	3	2.90	5.10	4.30	1.22	4.90	
Cl	1	22.00	22.00	22.00	.00	22.00	
SO_4	1	38.00	38.00	38.00	.00	38.00	
F	2/3	.10	.20	.15	.07	.15/	0.10
As	3	5.00	12.00	8.00	3.61	7.00	
Ba	3	200.00	700.00	500.00	264.58	600.00	
Be	1/3	2.00	2.00	2.00	.00	2.00/	.50
B	3	70.00	140.00	113.33	37.86	130.00	
Cd	3	10.00	16.00	13.67	3.21	15.00	
Cr	3	28.00	42.00	33.33	7.57	30.00	
Co	3	10.00	20.00	16.67	5.77	20.00	
Cu	3	65.00	87.00	74.00	11.53	70.00	
Fe	3	15,000.00	42,000.00	31,000.00	14,177.45	36,000.00	
Pb	3	210.00	380.00	300.00	85.44	310.00	
Mn	3	710.00	2,300.00	1,636.67	827.06	1,900.00	
Ni	3	25.00	60.00	44.33	17.79	48.00	
Ag	2/3	3.00	5.00	4.00	1.41	4.00/	3.00
Sr	3	70.00	180.00	126.67	55.08	130.00	
V	3	20.00	70.00	47.00	25.24	51.00	
Zn	3	360.00	730.00	493.33	205.51	390.00	
Al	3	7,300.00	26,000.00	17,100.00	9,382.43	18,000.00	
PHNL	0	--	--	--	--	--	
TDS	1	161.00	161.00	161.00	.00	161.00	
Hg	1/3	.05	.05	.05	.00	.05/	.01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Highway 34 at Galesburg; Site 8--Continued

storm number 4, August 26-27

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	1	340.00	340.00	340.000	0.00	340.00
BOD	2	5.50	14.00	9.750	6.0104	9.75
COD	2	12.00	42.00	27.000	21.2132	27.00
TSS	2	8.00	16.00	12.000	5.6569	12.00
VSS	2	4.00	6.00	5.000	1.4142	5.00
NH_3	2	.13	.29	.210	.1131	.21
TKN	2	.80	1.00	.900	.1414	.90
NOx	2	.59	.88	.735	.2051	.73
P	2	.26	1.70	.980	1.0182	.98
TOC	2	3.30	14.00	8.650	7.5660	8.65
HRD	0	--	--	--	--	--
Ca	0	--	--	--	--	--
Mg	0	--	--	--	--	--
Na	0	--	--	--	--	--
K	0	--	--	--	--	--
Cl	0	--	--	--	--	--
SO_4	0	--	--	--	--	--
F	0	--	--	--	--	--
As	0	--	--	--	--	--
Ba	0	--	--	--	--	--
Be	0	--	--	--	--	--
B	0	--	--	--	--	--
Cd	0	--	--	--	--	--
Cr	0	--	--	--	--	--
Co	0	--	--	--	--	--
Cu	0	--	--	--	--	--
Fe	0	--	--	--	--	--
Pb	0	--	--	--	--	--
Mn	0	--	--	--	--	--
Ni	0	--	--	--	--	--
Ag	0	--	--	--	--	--
Sr	0	--	--	--	--	--
V	0	--	--	--	--	--
Zn	0	--	--	--	--	--
Al	0	--	--	--	--	--
PHNL	0	--	--	--	--	--
TDS	0	--	--	--	--	--
Hg	0	--	--	--	--	--

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Highway 34 at Galesburg; Site 8--Continued

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	5	230.00	760.00	378.000	217.1866	310.00	
BOD	5	5.40	15.00	9.760	3.9202	9.80	
COD	5	13.00	39.00	31.000	10.2713	34.00	
TSS	5	16.00	337.00	106.200	130.7180	56.00	
VSS	5	4.00	47.00	17.400	17.1406	12.00	
NH_3	2/5	.11	.23	.170	.0849	.17/	0.10
TKN	5	.70	1.50	1.120	.3633	1.00	
NOx	5	.58	1.10	.770	.2218	.71	
P	5	.15	.45	.286	.1069	.28	
TOC	5	4.20	10.00	7.960	2.2367	8.60	
HRD	1	110.00	110.00	110.000	.00	110.00	
Ca	1	32.00	32.00	32.000	.00	32.00	
Mg	1	7.00	7.00	7.000	.00	7.00	
Na	1	7.10	7.10	7.100	.00	7.10	
K	1	2.20	2.20	2.200	.00	2.20	
Cl	1	9.40	9.40	9.400	.00	9.40	
SO_4	1	21.00	21.00	21.000	.00	21.00	
F	1	.10	.10	.100	.00	.10	
As	2	.00	1.00	.500	.7071	.50	
Ba	1	40.00	40.00	40.000	.00	40.00	
Be	0/1	--	--	--	--	-- /	.50
B	0/1	--	--	--	--	-- /	50.00
Cd	1	6.00	6.00	6.000	.00	6.00	
Cr	1	8.00	8.00	8.000	.00	8.00	
Co	0/1	--	--	--	--	-- /	5.00
Cu	1	27.00	27.00	27.000	.00	27.00	
Fe	1	1,000.00	1,000.00	1,000.000	.00	1,000.00	
Pb	0/1	--	--	--	--	-- /	50.00
Mn	1	100.00	100.00	100.000	.00	100.00	
Ni	0/1	--	--	--	--	-- /	5.00
Ag	0/1	--	--	--	--	-- /	3.00
Sr	1	60.00	60.00	60.000	.00	60.00	
V	0/1	--	--	--	--	-- /	5.00
Zn	0/1	--	--	--	--	-- /	100.00
Al	1	540.00	540.00	540.000	.00	540.00	
PHNL	1	15.00	15.00	15.000	.00	15.00	
TDS	1	156.00	156.00	156.000	.00	156.00	
Hg	0	--	--	--	--	--	

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Highway 34 at Galesburg; Site 8--Continued

samples collected for storms 1, 3, 4, and 5 combined

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	29	130.00	890.00	546.21	252.13	630.00	
BOD	19	2.00	37.00	11.71	9.04	9.80	
COD	20	6.00	360.00	67.15	97.59	34.00	
TSS	30	4.00	4,090.00	523.47	1,057.53	78.50	
VSS	30	2.00	540.00	73.03	134.37	16.00	
NH_3	27/30	.10	.53	.22	.09	.23/	0.21
TKN	30	.50	8.20	2.14	2.07	1.35	
NOx	30	.58	7.70	2.00	1.79	1.85	
P	30	.10	2.30	.54	.63	.27	
TOC	30	3.20	32.00	9.01	6.72	6.80	
HRD	8	110.00	590.00	296.25	143.62	295.00	
Ca	7	32.00	180.00	85.86	45.81	82.00	
Mg	7	7.00	36.00	23.86	10.32	26.00	
Na	7	3.50	28.00	15.34	10.76	9.50	
K	7	2.00	5.10	3.14	1.30	2.50	
Cl	3	9.40	53.00	28.13	22.44	22.00	
SO_4	3	21.00	86.00	48.33	33.71	38.00	
F	6/7	.10	.30	.20	.09	.20/	.20
As	8	.00	12.00	4.00	3.93	2.50	
Ba	7	40.00	700.00	258.57	273.40	100.00	
Be	1/7	2.00	2.00	2.00	.00	2.00/	1.00
B	6/7	70.00	140.00	116.67	25.03	125.00/	120.00
Cd	5/7	4.00	16.00	10.20	5.31	10.00/	6.00
Cr	7	7.00	42.00	19.14	14.08	12.00	
Co	4/7	6.00	20.00	14.00	7.12	15.00/	6.00
Cu	7	10.00	87.00	43.43	30.42	33.00	
Fe	7	1,000.00	42,000.00	14,542.86	17,476.35	4,600.00	
Pb	3/7	210.00	380.00	300.00	85.44	310.00/	100.00
Mn	7	97.00	2,300.00	813.86	910.08	360.00	
Ni	5/7	7.00	60.00	30.00	23.33	25.00/	10.00
Ag	2/7	3.00	5.00	4.00	1.41	4.00/	3.00
Sr	7	60.00	180.00	125.71	45.04	130.00	
V	4/7	8.00	70.00	37.25	28.37	35.50/	8.00
Zn	4/7	150.00	730.00	407.50	240.05	375.00/	150.00
Al	7	440.00	26,000.00	7,922.86	10,166.73	2,200.00	
PHNL	2	10.00	15.00	12.50	3.54	12.50	
TDS	3	156.00	439.00	252.00	161.97	161.00	
Hg	4/6	.05	.09	.06	.02	.05/	.05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at County Line Road near Galesburg; Site 11

storm number 1, May 16-20

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	10	300.00	830.00	616.00	201.616	730.00
BOD	3	35.00	72.00	53.67	18.502	54.00
COD	3	180.00	320.00	243.33	70.946	230.00
TSS	10	27.00	2,410.00	993.80	908.794	1,052.00
VSS	10	.00	340.00	145.00	126.875	171.00
NH_3	10	.22	1.10	.71	.299	.68
TKN	10	1.40	11.00	5.62	3.543	6.40
NOx	10	1.50	8.50	5.07	2.957	5.20
P	10	.74	5.60	2.64	1.587	2.70
TOC	10	5.70	15.00	9.49	2.695	9.80
HRD	3	290.00	460.00	383.33	86.217	400.00
Ca	3	91.00	140.00	110.33	26.083	100.00
Mg	3	16.00	34.00	25.33	9.018	26.00
Na	3	19.00	47.00	30.67	14.572	26.00
K	3	4.20	6.20	5.30	1.015	5.50
Cl	1	68.00	68.00	68.00	.00	68.00
SO_4	1	68.00	68.00	68.00	.00	68.00
F	3	.20	.50	.33	.153	.30
As	3	8.00	12.00	9.33	2.309	8.00
Ba	3	300.00	600.00	466.67	152.753	500.00
Be	1/3	2.00	2.00	2.00	.00	2.00/ 1.00
B	3	80.00	200.00	130.00	62.450	110.00
Cd	3	17.00	46.00	31.00	14.526	30.00
Cr	3	79.00	170.00	123.00	45.574	120.00
Co	3	10.00	20.00	13.33	5.774	10.00
Cu	3	120.00	220.00	180.00	52.915	200.00
Fe	3	14,000.00	24,000.00	19,000.00	5,000.000	19,000.00
Pb	3	240.00	450.00	326.67	109.697	290.00
Mn	3	750.00	1,500.00	1,150.00	377.492	1,200.00
Ni	3	31.00	43.00	36.00	6.245	34.00
Ag	1/3	6.00	6.00	6.00	.00	6.00/ 3.00
Sr	3	90.00	180.00	143.33	47.258	160.00
V	3	23.00	36.00	28.33	6.807	26.00
Zn	3	440.00	730.00	540.00	164.621	450.00
Al	3	7,600.00	12,000.00	9,866.67	2,203.028	10,000.00
PHNL	1	5.00	5.00	5.00	.00	5.00
TDS	1	464.00	464.00	464.00	.00	464.00
Hg	3	.01	.38	.14	.211	.02

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at County Line Road near Galesburg; Site 11--Continued

storm number 2, July 7-10

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	8	310.00	880.00	655.00	227.031	745.00	
BOD	5	23.00	33.00	28.80	4.494	31.00	
COD	5	77.00	120.00	106.60	19.540	120.00	
TSS	8	484.00	1,340.00	859.25	292.664	775.00	
VSS	8	50.00	140.00	95.50	32.368	89.00	
NH_3	8	.42	.63	.51	.067	.50	
TKN	8	4.00	7.10	5.36	1.036	5.30	
NOx	8	2.00	9.40	6.32	3.153	7.55	
P	8	1.30	4.80	3.12	1.260	3.45	
TOC	8	12.00	19.00	15.37	2.446	15.00	
HRD	5	180.00	350.00	292.00	77.910	340.00	
Ca	5	55.00	92.00	78.20	15.255	84.00	
Mg	5	12.00	32.00	24.20	9.445	30.00	
Na	5	19.00	76.00	52.60	28.527	70.00	
K	5	2.90	6.60	5.14	1.790	6.20	
Cl	1	28.00	28.00	28.00	.00	28.00	
SO_4	1	27.00	27.00	27.00	.00	27.00	
F	5	.10	.30	.24	.089	.30	
As	5	3.00	7.00	4.20	1.643	4.00	
Ba	5	200.00	300.00	240.00	54.772	200.00	
Be	5	3.00	7.00	5.40	1.817	6.00	
B	5	120.00	260.00	206.00	74.027	260.00	
Cd	5	9.00	30.00	19.20	8.408	18.00	
Cr	5	28.00	84.00	51.80	22.186	43.00	
Co	1/5	10.00	10.00	10.00	.00	10.00/	5.00
Cu	5	57.00	110.00	86.40	23.437	83.00	
Fe	5	6,800.00	14,000.00	9,760.00	2,875.413	9,400.00	
Pb	4/5	110.00	200.00	155.00	38.730	155.00/	140.00
Mn	5	300.00	650.00	458.00	145.842	390.00	
Ni	3/5	8.00	45.00	21.33	20.551	11.00/	8.00
Ag	1/5	8.00	8.00	8.00	.00	8.00/	3.00
Sr	5	80.00	150.00	126.00	33.615	150.00	
V	5	6.00	26.00	13.20	7.727	11.00	
Zn	5	210.00	310.00	276.00	44.497	300.00	
Al	5	4,000.00	8,300.00	5,600.00	1,764.936	5,200.00	
PHNL	0/1	--	--	--	--	-- /	5.00
TDS	1	193.00	193.00	193.00	.00	193.00	
Hg	3/5	.02	.05	.03	.015	.03/	.02

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at County Line Road near Galesburg; Site 11--Continued

storm number 3, July 31 to August 1

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	14	340.00	840.00	632.14	160.201	635.00
BOD	9	4.20	25.00	11.17	7.689	7.70
COD	9	14.00	300.00	86.11	109.208	23.00
TSS	14	10.00	5,120.00	1,110.07	1,800.017	115.50
VSS	14	4.00	500.00	119.86	183.006	17.00
NH_3	14	.28	.80	.43	.129	.38
TKN	14	1.60	10.00	4.51	3.328	2.20
NOx	14	1.50	6.80	4.14	1.821	3.70
P	14	.58	5.10	2.29	1.580	1.60
TOC	14	7.40	33.00	15.76	9.943	8.60
HRD	3	250.00	350.00	303.33	50.332	310.00
Ca	3	64.00	97.00	83.67	17.388	90.00
Mg	3	21.00	26.00	23.00	2.646	22.00
Na	3	19.00	59.00	39.67	20.033	41.00
K	3	6.50	9.70	8.40	1.682	9.00
Cl	1	59.00	59.00	59.00	.00	59.00
SO_4	1	38.00	38.00	38.00	.00	38.00
F	3	.30	.60	.47	.153	.50
As	3	6.00	11.00	9.33	2.887	11.00
Ba	3	400.00	800.00	633.33	208.167	700.00
Be	0/3	--	--	--	--	-- / 2.00
B	3	160.00	240.00	210.00	43.589	230.00
Cd	3	16.00	63.00	38.67	23.544	37.00
Cr	3	69.00	100.00	84.00	15.524	83.00
Co	3	10.00	30.00	20.00	10.000	20.00
Cu	3	62.00	180.00	120.67	59.003	120.00
Fe	3	18,000.00	27,000.00	23,666.67	4,932.883	26,000.00
Pb	3	110.00	320.00	240.00	113.578	290.00
Mn	3	860.00	1,900.00	1,553.33	600.444	1,900.00
Ni	3	23.00	52.00	41.33	15.948	49.00
Ag	2/3	4.00	4.00	4.00	.00	4.00/ 4.00
Sr	3	130.00	170.00	146.67	20.817	140.00
V	3	34.00	49.00	43.33	8.145	47.00
Zn	3	180.00	540.00	410.00	199.750	510.00
Al	3	13,000.00	17,000.00	15,333.33	2,081.666	16,000.00
PHNL	1	5.00	5.00	5.00	.00	5.00
TDS	1	310.00	310.00	310.00	.00	310.00
Hg	2/3	.08	.17	.12	.064	.12/ .08

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at County Line Road near Galesburg; Site 11--Continued

storm number 4, August 26-27

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	7	520.00	850.00	731.43	110.8195	740.00	
BOD	5	15.00	24.00	20.60	3.5071	21.00	
COD	5	39.00	59.00	48.80	7.6289	51.00	
TSS	8	17.00	359.00	172.50	124.5586	160.50	
VSS	8	6.00	53.00	27.75	16.9179	24.50	
NH_3	8	.23	.52	.30	.0947	.28	
TKN	8	2.00	3.40	2.44	.4838	2.25	
NOx	8	2.60	5.20	3.76	.9884	3.45	
P	8	1.70	3.80	2.56	.8123	2.40	
TOC	8	9.50	16.00	11.94	2.2747	11.50	
HRD	3	280.00	330.00	310.00	26.4575	320.00	
Ca	3	70.00	81.00	76.00	5.5678	77.00	
Mg	3	27.00	31.00	29.33	2.0817	30.00	
Na	3	43.00	66.00	52.33	12.0968	48.00	
K	3	7.20	9.20	7.93	1.1015	7.40	
Cl	1	90.00	90.00	90.00	.00	90.00	
SO_4	1	62.00	62.00	62.00	.00	62.00	
F	3	.60	.70	.63	.0577	.60	
As	3	2.00	3.00	2.33	.5774	2.00	
Ba	3	100.00	200.00	133.33	57.7350	100.00	
Be	1/3	3.00	3.00	3.00	.00	3.00/	2.00
B	3	240.00	270.00	250.00	17.3205	240.00	
Cd	3	5.00	11.00	7.67	3.0551	7.00	
Cr	3	25.00	39.00	31.33	7.0946	30.00	
Co	2/3	7.00	8.00	7.50	.7071	7.50/	7.00
Cu	3	28.00	53.00	38.00	13.2288	33.00	
Fe	3	2,700.00	4,600.00	3,666.67	950.4385	3,700.00	
Pb	0/3	--	--	--	--	-- /	100.00
Mn	3	200.00	250.00	223.33	25.1661	220.00	
Ni	3	11.00	12.00	11.33	.5774	11.00	
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	140.00	150.00	146.67	5.7735	150.00	
V	2/3	7.00	12.00	9.50	3.5355	9.50/	10.00
Zn	2/3	100.00	120.00	110.00	14.1421	110.00/	100.00
Al	3	2,300.00	3,200.00	2,833.33	472.5816	3,000.00	
PHNL	1	15.00	15.00	15.00	.00	15.00	
TDS	1	549.00	549.00	549.00	.00	549.00	
Hg	3	.07	.14	.12	.0404	.14	

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at County Line Road near Galesburg; Site 11--Continued

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	4	410.00	870.00	620.00	202.9778	600.00
BOD	3	19.00	20.00	19.33	.5774	19.00
COD	3	34.00	38.00	36.00	2.0000	36.00
TSS	4	9.00	404.00	116.25	192.5017	26.00
VSS	4	2.00	60.00	18.00	28.0832	5.00
NH_3	4	.63	.77	.68	.0645	.67
TKN	4	2.10	3.20	2.60	.5354	2.55
NOx	4	2.10	7.60	4.43	2.6850	4.00
P	4	1.20	3.00	2.07	.9069	2.05
TOC	4	11.00	14.00	12.25	1.2583	12.00
HRD	1	150.00	150.00	150.00	.00	150.00
Ca	1	40.00	40.00	40.00	.00	40.00
Mg	1	11.00	11.00	11.00	.00	11.00
Na	1	27.00	27.00	27.00	.00	27.00
K	1	4.10	4.10	4.10	.00	4.10
Cl	1	37.00	37.00	37.00	.00	37.00
SO_4	1	34.00	34.00	34.00	.00	34.00
F	1	.30	.30	.30	.00	.30
As	1	3.00	3.00	3.00	.00	3.00
Ba	1	70.00	70.00	70.00	.00	70.00
Be	0/1	--	--	--	--	-- / 2.00
B	1	120.00	120.00	120.00	.00	120.00
Cd	1	3.00	3.00	3.00	.00	3.00
Cr	0/1	--	--	--	--	-- / 5.00
Co	0/1	--	--	--	--	-- / 10.00
Cu	1	23.00	23.00	23.00	.00	23.00
Fe	1	2,000.00	2,000.00	2,000.00	.00	2,000.00
Pb	0/1	--	--	--	--	-- / 50.00
Mn	1	130.00	130.00	130.00	.00	130.00
Ni	0/1	--	--	--	--	-- / 5.00
Ag	0/1	--	--	--	--	-- / 3.00
Sr	1	80.00	80.00	80.00	.00	80.00
V	0/1	--	--	--	--	-- / 5.00
Zn	0/1	--	--	--	--	-- / 100.00
Al	1	1,300.00	1,300.00	1,300.00	.00	1,300.00
PHNL	1	10.00	10.00	10.00	.00	10.00
TDS	1	259.00	259.00	259.00	.00	259.00
Hg	1	.07	.07	.07	.00	.07

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at County Line Road near Galesburg; Site 11--Continued

Samples collected for storms 1, 2, 3, 4, and 5 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	43	300.00	880.00	647.67	177.520	700.00	
BOD	25	4.20	72.00	22.66	15.281	20.00	
COD	25	14.00	320.00	95.60	90.311	51.00	
TSS	44	9.00	5,120.00	777.23	1,152.553	259.50	
VSS	44	.00	500.00	95.14	126.262	42.50	
NH_3	44	.22	1.10	.51	.220	.48	
NOx	44	1.50	9.40	4.71	2.431	4.20	
P	44	.58	5.60	2.55	1.346	2.55	
TKN	44	1.40	11.00	4.37	2.783	3.05	
TOC	44	5.70	33.00	13.25	6.319	12.00	
HRD	15	150.00	460.00	306.67	79.702	320.00	
Ca	15	40.00	140.00	82.73	22.852	84.00	
Mg	15	11.00	34.00	24.33	7.575	26.00	
Na	15	19.00	76.00	43.87	21.098	43.00	
K	15	2.90	9.70	6.31	2.049	6.50	
Cl	5	28.00	90.00	56.40	24.765	59.00	
SO_4	5	27.00	68.00	45.80	18.089	38.00	
F	15	.10	.70	.39	.181	.30	
As	15	2.00	12.00	5.80	3.489	4.00	
Ba	15	70.00	800.00	331.33	224.908	300.00	
Be	7/15	2.00	7.00	4.57	2.070	4.00/	2.00
B	15	80.00	270.00	194.67	66.961	230.00	
Cd	15	3.00	63.00	22.07	16.744	17.00	
Cr	14/15	25.00	170.00	69.57	41.006	66.50/	64.00
Co	9/15	7.00	30.00	13.89	7.721	10.00/	10.00
Cu	15	23.00	220.00	98.07	62.060	83.00	
Fe	15	2,000.00	27,000.00	12,653.33	8,518.456	11,000.00	
Pb	10/15	110.00	450.00	232.00	108.095	220.00/	140.00
Mn	15	130.00	1,900.00	746.67	606.579	570.00	
Ni	12/15	8.00	52.00	27.50	16.844	27.00/	12.00
Ag	4/15	4.00	8.00	5.50	1.915	5.00/	3.00
Sr	15	80.00	180.00	134.67	32.042	150.00	
V	13/15	6.00	49.00	23.08	14.852	23.00/	14.00
Zn	13/15	100.00	730.00	342.31	183.265	310.00/	300.00
Al	15	1,300.00	17,000.00	7,560.00	5,028.036	6,300.00	
PHNL	4/5	5.00	15.00	8.75	4.787	7.50/	5.00
TDS	5	193.00	549.00	355.00	147.481	310.00	
Hg	12/15	.01	.38	.10	.103	.07/	.05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1500 E near Coldbrook; Site 14

storm number 1, May 16-20

Con- stit- uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	9	680.00	780.00	746.67	35.000	750.00	
BOD	3	20.00	32.00	25.33	6.110	24.00	
COD	3	69.00	170.00	116.33	50.797	110.00	
TSS	9	76.00	1,920.00	755.89	705.149	524.00	
VSS	9	8.00	228.00	89.67	79.269	72.00	
NH_3	9	.18	.78	.38	.204	.30	
TKN	9	1.60	9.80	4.56	2.920	4.00	
NOx	9	7.00	11.00	9.34	1.408	9.20	
P	9	.56	4.10	2.50	1.449	3.00	
TOC	9	4.00	15.00	9.01	3.232	9.90	
HRD	3	290.00	330.00	310.00	20.000	310.00	
Ca	3	71.00	82.00	76.33	5.508	76.00	
Mg	3	28.00	30.00	29.00	1.000	29.00	
Na	3	48.00	52.00	50.67	2.309	52.00	
K	3	6.90	8.00	7.43	.551	7.40	
Cl	1	72.00	72.00	72.00	.00	72.00	
SO_4	1	49.00	49.00	49.00	.00	49.00	
F	3	.50	.60	.57	.058	.60	
As	3	4.00	6.00	5.00	1.000	5.00	
Ba	3	200.00	500.00	333.33	152.753	300.00	
Be	0/3	--	--	--	--	-- /	0.50
B	3	190.00	220.00	210.00	17.321	220.00	
Cd	3	6.00	25.00	14.67	9.609	13.00	
Cr	3	27.00	100.00	60.00	37.000	53.00	
Co	2/3	9.00	10.00	9.50	.707	9.50/	9.00
Cu	3	34.00	130.00	76.00	49.112	64.00	
Fe	3	8,000.00	26,000.00	16,666.67	9,018.500	16,000.00	
Pb	1/3	150.00	150.00	150.00	.00	150.00/	100.00
Mn	3	430.00	1,200.00	800.00	385.876	770.00	
Ni	3	10.00	32.00	20.67	11.015	20.00	
Ag	1/3	5.00	5.00	5.00	.00	5.00/	3.00
Sr	3	140.00	160.00	150.00	10.000	150.00	
V	3	13.00	39.00	26.00	13.000	26.00	
Zn	3	120.00	310.00	203.33	97.125	180.00	
Al	3	5,200.00	17,000.00	11,066.67	5,900.282	11,000.00	
PHNL	1	5.00	5.00	5.00	.00	5.00	
TDS	1	485.00	485.00	485.00	.00	485.00	
Hg	3	.01	.10	.05	.045	.05	

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1500 E near Coldbrook; Site 14--Continued

storm number 2, July 7-10

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	12	620.00	830.00	755.83	79.023	785.00	
BOD	6	17.00	33.00	22.67	6.377	21.00	
COD	6	52.00	110.00	69.83	24.903	56.50	
TSS	11	80.00	1,290.00	617.91	341.335	564.00	
VSS	11	10.00	180.00	68.55	48.134	52.00	
NH_3	12	.19	3.33	.64	.863	.33	
TKN	12	2.80	6.30	3.95	1.084	3.90	
NOx	12	5.70	8.80	7.67	1.035	7.90	
P	12	2.10	3.20	2.74	.281	2.70	
TOC	12	10.00	17.00	12.42	2.429	11.50	
HRD	6	270.00	330.00	308.33	25.626	315.00	
Ca	6	66.00	80.00	75.50	5.648	77.00	
Mg	6	26.00	32.00	29.33	2.658	29.50	
Na	6	46.00	71.00	57.67	9.266	60.00	
K	6	5.30	6.50	5.78	.436	5.75	
Cl	2	83.00	84.00	83.50	.707	83.50	
SO_4	2	54.00	68.00	61.00	9.899	61.00	
F	6	.30	.30	.30	.00	.30	
As	6	3.00	5.00	4.17	.753	4.00	
Ba	6	200.00	300.00	233.33	51.640	200.00	
Be	4/6	2.00	2.00	2.00	.00	2.00/	2.00
B	6	210.00	240.00	225.00	10.488	225.00	
Cd	6	8.00	17.00	11.67	3.559	10.50	
Cr	6	12.00	53.00	32.00	17.550	28.00	
Co	0/6	--	--	--	--	-- /	5.00
Cu	6	41.00	330.00	98.67	113.924	53.00	
Fe	6	6,600.00	14,000.00	9,900.00	3,382.307	8,850.00	
Pb	0/6	--	--	--	--	-- /	50.00
Mn	6	300.00	570.00	411.67	119.903	365.00	
Ni	3/6	8.00	13.00	10.33	2.517	10.00/	6.50
Ag	0/6	--	--	--	--	-- /	3.00
Sr	6	130.00	150.00	143.33	8.165	145.00	
V	6	9.00	21.00	15.50	5.128	16.00	
Zn	6	140.00	230.00	168.33	33.116	155.00	
Al	6	4,100.00	9,600.00	6,800.00	2,590.753	6,650.00	
PHNL	2	5.00	5.00	5.00	.00	5.00	
TDS	2	464.00	5,420.00	2,942.00	3,504.421	2,942.00	
Hg	5/6	.02	.07	.04	.022	.03/	.02

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1500 E near Coldbrook; Site 14--Continued

storm number 3, July 31 to August 1

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	12	140.00	780.00	500.00	216.963	465.00
BOD	8	2.90	22.00	10.34	6.935	8.90
COD	8	12.00	280.00	96.37	102.934	51.50
TSS	12	24.00	3,130.00	1,135.25	1,264.111	383.00
VSS	12	6.00	325.00	124.58	129.262	56.50
NH_3	12	.18	.49	.26	.080	.24
TKN	12	1.30	12.00	5.56	4.285	4.60
NOx	12	1.20	7.40	4.02	2.376	3.30
P	12	.56	3.20	1.91	1.142	1.75
TOC	12	5.40	54.00	27.04	18.170	24.50
HRD	3	230.00	270.00	243.33	23.094	230.00
Ca	3	56.00	67.00	60.33	5.859	58.00
Mg	3	20.00	25.00	22.33	2.517	22.00
Na	3	21.00	38.00	27.33	9.292	23.00
K	3	8.90	9.50	9.27	.321	9.40
Cl	1	36.00	36.00	36.00	.00	36.00
SO_4	1	33.00	33.00	33.00	.00	33.00
F	3	.30	.50	.37	.115	.30
As	3	6.00	9.00	7.67	1.528	8.00
Ba	3	500.00	800.00	700.00	173.205	800.00
Be	3	2.00	4.00	3.33	1.155	4.00
B	3	210.00	270.00	240.00	30.000	240.00
Cd	3	11.00	21.00	16.33	5.033	17.00
Cr	3	29.00	51.00	42.33	11.719	47.00
Co	3	10.00	30.00	20.00	10.000	20.00
Cu	3	63.00	91.00	76.67	14.012	76.00
Fe	3	37,000.00	51,000.00	45,333.33	7,371.115	48,000.00
Pb	3	160.00	240.00	190.00	43.589	170.00
Mn	3	1,300.00	3,000.00	2,200.00	854.400	2,300.00
Ni	3	35.00	52.00	44.00	8.544	45.00
Ag	1/3	6.00	6.00	6.00	.00	6.00/ 3.00
Sr	3	140.00	140.00	140.00	.00	140.00
V	3	62.00	78.00	70.00	8.000	70.00
Zn	3	280.00	310.00	293.33	15.275	290.00
Al	3	23,000.00	31,000.00	28,000.00	4,358.899	30,000.00
PHNL	1	10.00	10.00	10.00	.00	10.00
TDS	1	242.00	242.00	242.00	.00	242.00
Hg	3	.11	.23	.15	.069	.11

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1500 E near Coldbrook; Site 14--Continued

storm number 4, August 26-27

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	1	800.00	800.00	800.00	0.00	800.00
BOD	2	13.00	14.00	13.50	.70711	13.50
COD	2	29.00	47.00	38.00	12.72792	38.00
TSS	2	21.00	30.00	25.50	6.36396	25.50
VSS	2	5.00	6.00	5.50	.70711	5.50
NH_3	2	.11	.49	.30	.26870	.30
TKN	2	1.50	3.20	2.35	1.20208	2.35
NOx	2	3.60	8.00	5.80	3.11127	5.80
P	2	1.60	2.70	2.15	.77782	2.15
TOC	2	7.50	14.00	10.75	4.59619	10.75
HRD	0	--	--	--	--	--
Ca	0	--	--	--	--	--
Mg	0	--	--	--	--	--
Na	0	--	--	--	--	--
K	0	--	--	--	--	--
Cl	0	--	--	--	--	--
SO_4	0	--	--	--	--	--
F	0	--	--	--	--	--
As	0	--	--	--	--	--
Ba	0	--	--	--	--	--
Be	0	--	--	--	--	--
B	0	--	--	--	--	--
Cd	0	--	--	--	--	--
Cr	0	--	--	--	--	--
Co	0	--	--	--	--	--
Cu	0	--	--	--	--	--
Fe	0	--	--	--	--	--
Pb	0	--	--	--	--	--
Mn	0	--	--	--	--	--
Ni	0	--	--	--	--	--
Ag	0	--	--	--	--	--
Sr	0	--	--	--	--	--
V	0	--	--	--	--	--
Zn	0	--	--	--	--	--
Al	0	--	--	--	--	--
PHNL	0	--	--	--	--	--
TDS	0	--	--	--	--	--
Hg	0	--	--	--	--	--

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1500 E near Coldbrook; Site 14--Continued

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	11	380.00	880.00	669.09	192.429	670.00	
BOD	7	10.00	22.00	15.43	4.791	15.00	
COD	8	27.00	63.00	43.50	15.693	38.50	
TSS	11	20.00	748.00	398.00	294.326	478.00	
VSS	11	3.00	80.00	46.00	31.045	60.00	
NH_3	11	.32	1.20	.76	.283	.83	
TKN	11	1.70	4.30	2.89	1.018	3.00	
NOx	11	2.00	6.90	4.55	2.112	3.80	
P	11	1.20	4.00	2.56	1.231	2.40	
TOC	11	8.10	15.00	11.48	2.788	13.00	
HRD	3	250.00	310.00	286.67	32.146	300.00	
Ca	3	63.00	75.00	70.33	6.429	73.00	
Mg	3	23.00	30.00	27.00	3.606	28.00	
Na	3	51.00	75.00	66.33	13.317	73.00	
K	3	8.30	12.00	10.43	1.914	11.00	
Cl	1	95.00	95.00	95.00	.00	95.00	
SO_4	1	58.00	58.00	58.00	.00	58.00	
F	3	.70	.90	.83	.115	.90	
As	3	3.00	4.00	3.67	.577	4.00	
Ba	3	200.00	200.00	200.00	.00	200.00	
Be	0/3	--	--	--	--	-- /	0.50
B	3	200.00	260.00	236.67	32.146	250.00	
Cd	3	6.00	9.00	7.33	1.528	7.00	
Cr	3	16.00	30.00	22.67	7.024	22.00	
Co	0/3	--	--	--	--	-- /	5.00
Cu	3	34.00	39.00	36.00	2.646	35.00	
Fe	3	6,600.00	8,600.00	7,400.00	1,058.301	7,000.00	
Pb	0/3	--	--	--	--	-- /	50.00
Mn	3	400.00	530.00	470.00	65.574	480.00	
Ni	2/3	15.00	16.00	15.50	.707	15.50/	15.00
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	130.00	150.00	143.33	11.547	150.00	
V	3	10.00	15.00	11.67	2.887	10.00	
Zn	3	110.00	110.00	110.00	.00	110.00	
Al	3	4,000.00	5,600.00	4,700.00	818.535	4,500.00	
PHNL	1	5.00	5.00	5.00	.00	5.00	
TDS	1	525.00	525.00	525.00	.00	525.00	
Hg	2/5	.14	.19	.16	.035	.16/	.05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1500 E near Coldbrook; Site 14--Continued

samples collected for storms 1, 2, 3, 4, and 5 combined

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	45	140.00	880.00	665.56	182.83	740.00	
BOD	26	2.90	33.00	16.53	7.86	16.50	
COD	27	12.00	280.00	72.70	63.18	55.00	
TSS	45	20.00	3,130.00	703.38	795.94	504.00	
VSS	45	3.00	325.00	79.40	84.85	56.00	
NH_3	46	.11	3.33	.50	.50	.32	
TKN	46	1.30	12.00	4.17	2.77	3.55	
NOx	46	1.20	11.00	6.22	2.77	6.90	
P	46	.56	4.10	2.41	1.08	2.70	
TOC	46	4.00	54.00	15.27	11.73	11.00	
HRD	15	230.00	330.00	291.33	34.82	300.00	
Ca	15	56.00	82.00	71.60	8.09	73.00	
Mg	15	20.00	32.00	27.40	3.62	28.00	
Na	15	21.00	75.00	51.93	16.05	52.00	
K	15	5.30	12.00	7.74	2.09	7.40	
Cl	5	36.00	95.00	74.00	22.75	83.00	
SO_4	5	33.00	68.00	52.40	12.90	54.00	
F	15	.30	.90	.47	.22	.30	
As	15	3.00	9.00	4.93	1.71	4.00	
Ba	15	200.00	800.00	340.00	213.14	200.00	
Be	7/15	2.00	4.00	2.57	.98	2.00/	2.00
B	15	190.00	270.00	227.33	21.87	220.00	
Cd	15	6.00	25.00	12.33	5.64	11.00	
Cr	15	12.00	100.00	37.80	22.49	30.00	
Co	5/15	9.00	30.00	15.80	9.12	10.00/	5.00
Cu	15	34.00	330.00	77.20	74.64	61.00	
Fe	15	6,600.00	51,000.00	117,840.00	5,371.11	10,000.00	
Pb	4/15	150.00	240.00	180.00	40.82	165.00/	50.00
Mn	15	300.00	3,000.00	858.67	797.24	530.00	
Ni	11/15	8.00	52.00	23.27	15.28	16.00/	13.00
Ag	2/15	5.00	6.00	5.50	.71	5.50/	3.00
Sr	15	130.00	160.00	144.00	8.28	140.00	
V	15	9.00	78.00	27.73	23.38	19.00	
Zn	15	110.00	310.00	188.67	75.30	160.00	
Al	15	4,000.00	31,000.00	11,473.33	9,377.36	8,500.00	
PHNL	5	5.00	10.00	6.00	2.24	5.00	
TDS	5	242.00	5,420.00	1,427.20	2,234.76	485.00	
Hg	13/17	.01	.23	.09	.07	.07/	.05

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1100 E near Monmouth; Site 18

storm number 1, May 16-20

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	9	530.00	730.00	623.33	69.282	640.00
BOD	3	23.00	26.00	24.67	1.528	25.00
COD	3	180.00	230.00	206.67	25.166	210.00
TSS	9	137.00	3,700.00	2,201.22	1,311.403	2,350.00
VSS	9	9.00	320.00	189.67	123.501	200.00
NH_3	9	.20	.61	.42	.147	.46
TKN	9	1.60	11.00	7.38	3.781	8.60
NOx	9	5.00	11.00	6.97	2.480	5.60
P	9	.76	4.40	2.87	1.488	3.40
TOC	9	5.90	22.00	14.40	6.564	14.00
HRD	3	330.00	360.00	343.33	15.275	340.00
Ca	3	79.00	88.00	85.00	5.196	88.00
Mg	3	30.00	35.00	32.00	2.646	31.00
Na	3	25.00	34.00	28.33	4.933	26.00
K	3	6.80	9.70	8.20	1.453	8.10
Cl	1	58.00	58.00	58.00	.00	58.00
SO_4	1	50.00	50.00	50.00	.00	50.00
F	3	.40	.50	.43	.058	.40
As	3	6.00	8.00	7.33	1.155	8.00
Ba	3	600.00	700.00	666.67	57.735	700.00
Be	2/3	2.00	2.00	2.00	.00	2.00/ 2.00
B	3	90.00	120.00	106.67	15.275	110.00
Cd	3	8.00	10.00	8.67	1.155	8.00
Cr	3	24.00	36.00	31.00	6.245	33.00
Co	3	20.00	30.00	23.33	5.774	20.00
Cu	3	54.00	66.00	60.00	6.000	60.00
Fe	3	21,000.00	40,000.00	31,000.00	9,539.392	32,000.00
Pb	0/3	--	--	--	--	-- / 100.00
Mn	3	2,100.00	2,800.00	2,400.00	360.555	2,300.00
Ni	3	42.00	51.00	45.33	4.933	43.00
Ag	1/3	4.00	4.00	4.00	.00	4.00/ 3.00
Sr	3	170.00	190.00	180.00	10.000	180.00
V	3	55.00	68.00	60.33	6.807	58.00
Zn	2/3	2,800.00	2,900.00	2,850.00	70.711	2,850.00/2,800.00
Al	3	15,000.00	23,000.00	19,333.33	4,041.452	20,000.00
PHNL	1	15.00	15.00	15.00	.00	15.00
TDS	1	426.00	426.00	426.00	.00	426.00
Hg	0/3	--	--	--	--	-- / 0.01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1100 E near Monmouth; Site 18--Continued

storm number 2, July 7-10

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	12	460.00	830.00	753.33	135.535	810.00	
BOD	5	11.00	14.00	12.40	1.140	12.00	
COD	6	37.00	50.00	44.00	4.690	44.00	
TSS	12	300.00	532.00	428.50	79.187	456.00	
VSS	12	26.00	80.00	55.50	15.635	60.00	
NH_3	12	.11	.31	.15	.053	.13	
TKN	12	2.60	3.40	3.03	.284	3.05	
NOx	12	4.00	9.00	8.00	1.660	8.65	
P	12	1.30	2.80	2.14	.342	2.20	
TOC	12	6.70	11.00	9.52	1.492	9.85	
HRD	6	210.00	330.00	308.33	48.339	330.00	
Ca	6	52.00	80.00	74.50	11.077	79.00	
Mg	6	3.20	32.00	25.20	11.798	32.00	
Na	6	23.00	61.00	51.33	14.194	57.00	
K	6	4.80	5.50	5.18	.232	5.20	
Cl	1	78.00	78.00	78.00	.00	78.00	
SO_4	1	60.00	60.00	60.00	.00	60.00	
F	6	.20	.30	.28	.041	.30	
As	6	4.00	5.00	4.17	.408	4.00	
Ba	6	200.00	200.00	200.00	.00	200.00	
Be	1/6	2.00	2.00	2.00	.00	2.00/	2.00
B	6	120.00	210.00	190.00	34.641	200.00	
Cd	5/6	3.00	6.00	4.20	1.095	4.00/	4.00
Cr	6	7.00	16.00	10.00	3.688	8.50	
Co	0/6	--	--	--	--	-- /	5.00
Cu	6	22.00	70.00	39.00	17.889	32.50	
Fe	6	5,200.00	9,800.00	7,583.33	1,640.020	8,000.00	
Pb	0/6	--	--	--	--	-- /	50.00
Mn	6	300.00	430.00	383.33	55.737	405.00	
Ni	0/6	--	--	--	--	-- /	5.00
Ag	0/6	--	--	--	--	-- /	3.00
Sr	6	110.00	160.00	146.67	18.619	150.00	
V	6	10.00	17.00	13.67	2.805	14.00	
Zn	5/6	100.00	210.00	134.00	43.359	120.00/	120.00
Al	6	3,600.00	6,600.00	4,883.33	1,088.883	5,050.00	
PHNL	1	15.00	15.00	15.00	.00	15.00	
TDS	1	535.00	535.00	535.00	.00	535.00	
Hg	5/6	.02	.14	.06	.045	.05/	.05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1100 E near Monmouth; Site 18--Continued

storm number 3, July 31 to August 1

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	15	160.00	730.00	454.67	218.37	380.00
BOD	9	4.00	29.00	12.14	9.80	5.20
COD	9	12.00	600.00	157.11	194.01	46.00
TSS	15	57.00	7,180.00	2,368.07	2,636.34	592.00
VSS	15	8.00	670.00	231.13	243.82	62.00
NH_3	15	.10	.88	.29	.23	.20
TKN	15	1.30	19.00	5.25	4.94	2.60
NOx	15	1.20	6.80	3.55	2.49	1.50
P	15	.55	5.60	1.85	1.55	.86
TOC	15	4.70	96.00	26.92	27.41	13.00
HRD	3	230.00	460.00	320.00	122.88	270.00
Ca	3	58.00	120.00	83.67	32.35	73.00
Mg	3	20.00	41.00	28.00	11.36	23.00
Na	3	12.00	18.00	14.00	3.46	12.00
K	3	7.90	12.00	9.60	2.14	8.90
Cl	1	22.00	22.00	22.00	.00	22.00
SO_4	1	26.00	26.00	26.00	.00	26.00
F	3	.20	.30	.27	.06	.30
As	3	6.00	12.00	9.33	3.06	10.00
Ba	3	800.00	1,700.00	1,133.33	493.29	900.00
Be	3	3.00	6.00	4.00	1.73	3.00
B	3	150.00	220.00	173.33	40.41	150.00
Cd	3	11.00	16.00	13.67	2.52	14.00
Cr	3	21.00	30.00	24.33	4.93	22.00
Co	3	30.00	70.00	43.33	23.09	30.00
Cu	3	70.00	130.00	92.33	32.81	77.00
Fe	3	40,000.00	81,000.00	55,000.00	22,605.31	44,000.00
Pb	3	130.00	220.00	163.33	49.33	140.00
Mn	3	3,500.00	8,000.00	5,066.67	2,542.31	3,700.00
Ni	3	50.00	100.00	67.00	28.58	51.00
Ag	3	4.00	7.00	5.33	1.53	5.00
Sr	3	130.00	240.00	170.00	60.83	140.00
V	3	82.00	150.00	105.33	38.70	84.00
Zn	3	270.00	530.00	363.33	144.68	290.00
Al	3	23,000.00	41,000.00	30,333.33	9,451.63	27,000.00
PHNL	1	20.00	20.00	20.00	.00	20.00
TDS	1	147.00	147.00	147.00	.00	147.00
Hg	2/3	.08	.11	.09	.02	.09/ 0.08

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1100 E near Monmouth; Site 18--Continued

storm number 4, August 26-27

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	1	760.0	760.0	760.00	0.00	760.00
BOD	2	8.6	12.0	10.30	2.4042	10.30
COD	2	24.0	31.0	27.50	4.9497	27.50
TSS	2	89.0	103.0	96.00	9.8995	96.00
VSS	2	13.0	15.0	14.00	1.4142	14.00
NH_3	0/2	--	--	--	--	-- / 0.10
TKN	2	1.2	2.7	1.95	1.0607	1.95
NOx	2	3.6	7.9	5.75	3.0406	5.75
P	2	1.7	2.0	1.85	.2121	1.85
TOC	2	5.5	8.3	6.90	1.9799	6.90
HRD	0	--	--	--	--	--
Ca	0	--	--	--	--	--
Mg	0	--	--	--	--	--
Na	0	--	--	--	--	--
K	0	--	--	--	--	--
Cl	0	--	--	--	--	--
SO_4	0	--	--	--	--	--
F	0	--	--	--	--	--
As	0	--	--	--	--	--
Ba	0	--	--	--	--	--
Be	0	--	--	--	--	--
B	0	--	--	--	--	--
Cd	0	--	--	--	--	--
Cr	0	--	--	--	--	--
Co	0	--	--	--	--	--
Cu	0	--	--	--	--	--
Fe	0	--	--	--	--	--
Pb	0	--	--	--	--	--
Mn	0	--	--	--	--	--
Ni	0	--	--	--	--	--
Ag	0	--	--	--	--	--
Sr	0	--	--	--	--	--
V	0	--	--	--	--	--
Zn	0	--	--	--	--	--
Al	0	--	--	--	--	--
PHNL	0	--	--	--	--	--
TDS	0	--	--	--	--	--
Hg	0	--	--	--	--	--

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1100 E near Monmouth; Site 18--Continued

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	10	400.00	960.00	714.00	251.3607	770.00	
BOD	8	8.90	17.00	12.74	2.7323	13.00	
COD	8	26.00	71.00	38.00	15.0143	33.00	
TSS	10	16.00	1,930.00	279.00	587.3345	76.50	
VSS	10	4.00	200.00	30.90	59.9230	12.00	
NH_3	9/10	.22	.96	.43	.2222	.39/	0.40
TKN	10	1.50	3.60	2.38	.6015	2.40	
NOx	10	2.00	5.40	3.41	1.3868	3.00	
P	10	1.10	3.00	2.16	.8249	2.55	
TOC	10	7.60	19.00	11.43	3.8239	10.00	
HRD	3	320.00	340.00	333.33	11.5470	340.00	
Ca	3	78.00	81.00	80.00	1.7321	81.00	
Mg	3	31.00	33.00	32.33	1.1547	33.00	
Na	3	79.00	86.00	82.00	3.6056	81.00	
K	3	9.90	11.00	10.63	.6351	11.00	
Cl	1	110.00	110.00	110.00	.00	110.00	
SO_4	1	60.00	60.00	60.00	.00	60.00	
F	3	.80	.90	.87	.0577	.90	
As	3	2.00	2.00	2.00	.00	2.00	
Ba	3	90.00	100.00	93.33	5.7735	90.00	
Be	0/3	--	--	--	--	-- /	.50
B	3	260.00	290.00	273.33	15.2753	270.00	
Cd	0/3	--	--	--	--	-- /	3.00
Cr	3	8.00	12.00	9.67	2.0817	9.00	
Co	2/3	7.00	9.00	8.00	1.4142	8.00/	7.00
Cu	3	18.00	35.00	27.67	8.7369	30.00	
Fe	3	810.00	1,300.00	1,070.00	246.3737	1,100.00	
Pb	0/3	--	--	--	--	-- /	50.00
Mn	3	130.00	180.00	153.33	25.1661	150.00	
Ni	3	12.00	14.00	13.00	1.0000	13.00	
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	160.00	160.00	160.00	.00	160.00	
V	2	5.00	5.00	5.00	.00	5.00	
Zn	1/3	50.00	50.00	50.00	.00	50.00/	50.00
Al	3	410.00	650.00	563.33	133.1666	630.00	
PHNL	1	15.00	15.00	15.00	.00	15.00	
TDS	1	601.00	601.00	601.00	.00	601.00	
Hg	0/3	--	--	--	--	-- /	.05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek at Road 1100 E near Monmouth; Site 18--Continued

samples collected for storms 1, 2, 3, 4, and 5 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	47	160.00	960.00	624.89	219.04	660.00	
BOD	27	4.00	29.00	13.62	6.95	12.00	
COD	28	12.00	600.00	94.89	125.75	43.00	
TSS	48	16.00	7,180.00	1,322.00	1,851.23	438.00	
VSS	48	4.00	670.00	128.69	170.51	51.00	
NH_3	45/48	.10	.96	.31	.21	.22/	0.22
TKN	48	1.20	19.00	4.36	3.65	2.80	
NOx	48	1.20	11.00	5.36	2.87	5.35	
P	48	.55	5.60	2.18	1.18	2.20	
TOC	48	4.70	96.00	16.16	17.08	10.00	
HRD	15	210.00	460.00	322.67	57.00	330.00	
Ca	15	52.00	120.00	79.53	14.78	79.00	
Mg	15	3.20	41.00	28.55	8.93	32.00	
Na	15	12.00	86.00	45.40	25.59	52.00	
K	15	4.80	12.00	7.76	2.53	7.90	
Cl	4	22.00	110.00	67.00	36.86	68.00	
SO_4	4	26.00	60.00	49.00	16.04	55.00	
F	15	.20	.90	.43	.24	.30	
As	15	2.00	12.00	5.40	2.97	4.00	
Ba	15	90.00	1,700.00	458.67	446.46	200.00	
Be	6/15	2.00	6.00	3.00	1.55	2.50/	2.00
B	15	90.00	290.00	186.67	61.26	200.00	
Cd	11/15	3.00	16.00	8.00	4.36	8.00/	4.00
Cr	15	7.00	36.00	17.00	10.03	13.00	
Co	8/15	7.00	70.00	27.00	19.63	25.00/	7.00
Cu	15	18.00	130.00	51.60	29.08	50.00	
Fe	15	810.00	81,000.00	20,447.33	22,760.62	8,300.00	
Pb	3/15	130.00	220.00	163.33	49.33	140.00/	50.00
Mn	15	130.00	8,000.00	1,677.33	2,175.30	430.00	
Ni	9/15	12.00	100.00	41.78	27.65	43.00/	13.00
Ag	4/15	4.00	7.00	5.00	1.41	4.50/	3.00
Sr	15	110.00	240.00	160.67	29.15	160.00	
V	14	5.00	150.00	42.07	42.72	16.50	
Zn	11/15	50.00	2,900.00	682.73	1,079.83	210.00/	120.00
Al	15	410.00	41,000.00	11,999.33	12,198.47	5,200.00	
PHNL	4	15.00	20.00	16.25	2.50	15.00	
TDS	4	147.00	601.00	427.25	200.28	480.50	
Hg	7/15	.02	.14	.07	.04	.05/	.05

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 1 at Road 1450 N at Galesburg; Site T21

storm number 1, no samples collected

storm number 2, July 7-10

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	7	380.00	720.00	520.00	132.916	490.00
BOD	3	13.00	18.00	15.00	2.646	14.00
COD	3	77.00	92.00	85.67	7.767	88.00
TSS	7	288.00	872.00	532.57	230.887	500.00
VSS	7	36.00	112.00	70.29	30.885	64.00
NH_3	6/7	.11	3.50	.84	1.314	.34/ 0.30
TKN	7	1.60	8.10	3.37	2.194	2.50
NOx	7	2.90	16.00	5.83	4.521	4.40
P	7	.37	2.00	.91	.523	.78
TOC	7	6.40	16.00	11.29	3.198	11.00
HRD	3	200.00	280.00	236.67	40.415	230.00
Ca	3	54.00	73.00	62.33	9.713	60.00
Mg	3	16.00	23.00	19.67	3.512	20.00
Na	3	14.00	26.00	20.00	6.000	20.00
K	3	4.90	6.10	5.50	.600	5.50
Cl	1	24.00	24.00	24.00	.00	24.00
SO_4	1	47.00	47.00	47.00	.00	47.00
F	3	.10	.20	.17	.058	.20
As	3	11.00	31.00	18.33	11.015	13.00
Ba	3	100.00	200.00	166.67	57.735	200.00
Be	0/3	--	--	--	--	-- / 2.00
B	3	180.00	290.00	240.00	55.678	250.00
Cd	0/3	--	--	--	--	-- / 3.00
Cr	3	12.00	17.00	14.67	2.517	15.00
Co	2/3	5.00	7.00	6.00	1.414	6.00/ 5.00
Cu	3	26.00	28.00	27.00	1.000	27.00
Fe	3	8,500.00	13,000.00	10,833.33	2,254.625	11,000.00
Pb	0/3	--	--	--	--	-- / 100.00
Mn	3	380.00	550.00	490.00	95.394	540.00
Ni	3	5.00	14.00	10.33	4.726	12.00
Ag	0/3	--	--	--	--	-- / 3.00
Sr	3	120.00	130.00	123.33	5.774	120.00
V	3	11.00	21.00	17.33	5.508	20.00
Zn	3	170.00	200.00	183.33	15.275	180.00
Al	3	4,000.00	7,900.00	6,266.67	2,025.669	6,900.00
PHNL	1	10.00	10.00	10.00	.00	10.00
TDS	1	306.00	306.00	306.00	.00	306.00
Hg	1/3	.01	.01	.01	.00	.01/ .01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 1 at Road 1450 N at Galesburg; Site T21--Continued

storm number 3, no samples collected

storm number 4, August 26-27

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	1	570.00	570.00	570.00	0	570.00
BOD	1	4.10	4.10	4.10	0	4.10
COD	1	18.00	18.00	18.00	0	18.00
TSS	1	10.00	10.00	10.00	0	10.00
VSS	1	3.00	3.00	3.00	0	3.00
NH_3	0/1	--	--	--	--	-- / 0.10
TKN	1	.70	.70	.70	0	.70
NOx	1	3.40	3.40	3.40	0	3.40
P	1	.16	.16	.16	0	.16
TOC	1	5.80	5.80	5.80	0	5.80
HRD	0	--	--	--	--	--
Ca	0	--	--	--	--	--
Mg	0	--	--	--	--	--
Na	0	--	--	--	--	--
K	0	--	--	--	--	--
Cl	0	--	--	--	--	--
SO_4	0	--	--	--	--	--
F	0	--	--	--	--	--
As	0	--	--	--	--	--
Ba	0	--	--	--	--	--
Be	0	--	--	--	--	--
B	0	--	--	--	--	--
Cd	0	--	--	--	--	--
Cr	0	--	--	--	--	--
Co	0	--	--	--	--	--
Cu	0	--	--	--	--	--
Fe	0	--	--	--	--	--
Pb	0	--	--	--	--	--
Mn	0	--	--	--	--	--
Ni	0	--	--	--	--	--
Ag	0	--	--	--	--	--
Sr	0	--	--	--	--	--
V	0	--	--	--	--	--
Zn	0	--	--	--	--	--
Al	0	--	--	--	--	--
PHNL	0	--	--	--	--	--
TDS	0	--	--	--	--	--
Hg	0	--	--	--	--	--

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 1 at Road 1450 N at Galesburg; Site T21--Continued

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	7	390.00	870.00	591.43	196.6747	530.00	
BOD	4	10.00	16.00	12.75	2.7538	12.50	
COD	4	23.00	55.00	44.00	14.3062	49.00	
TSS	7	90.00	648.00	422.86	182.8254	462.00	
VSS	7	16.00	68.00	50.57	18.0264	54.00	
NH_3	2/7	.22	.22	.22	.00	.22/	0.10
TKN	7	1.00	2.10	1.61	.4375	1.80	
NOx	6/7	1.00	2.20	1.60	.4517	1.55/	1.40
P	7	.29	.82	.63	.1699	.68	
TOC	7	7.50	16.00	12.07	2.7451	12.00	
HRD	3	240.00	450.00	326.67	109.6966	290.00	
Ca	3	60.00	110.00	81.00	25.9422	73.00	
Mg	3	22.00	44.00	31.00	11.5326	27.00	
Na	3	23.00	44.00	31.33	11.1505	27.00	
K	3	5.40	6.20	5.77	.4041	5.70	
Cl	1	48.00	48.00	48.00	.00	48.00	
SO_4	1	130.00	130.00	130.00	.00	130.00	
F	3	.20	.30	.23	.0577	.20	
As	3	7.00	8.00	7.33	.5774	7.00	
Ba	3	100.00	200.00	133.33	57.7350	100.00	
Be	1/3	4.00	4.00	4.00	.00	4.00/	.50
B	3	320.00	630.00	443.33	164.4182	380.00	
Cd	0/3	--	--	--	--	-- /	3.00
Cr	0/3	--	--	--	--	-- /	5.00
Co	1/3	7.00	7.00	7.00	.00	7.00/	5.00
Cu	3	18.00	57.00	31.67	21.9621	20.00	
Fe	3	4,900.00	6,700.00	5,700.00	916.5151	5,500.00	
Pb	0/3	--	--	--	--	-- /	50.00
Mn	3	310.00	400.00	366.67	49.3288	390.00	
Ni	3	9.00	13.00	10.67	2.0817	10.00	
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	130.00	240.00	173.33	58.5947	150.00	
V	3	13.00	14.00	13.33	.5774	13.00	
Zn	0/3	--	--	--	--	-- /	100.00
Al	3	3,000.00	4,500.00	3,666.67	763.7626	3,500.00	
PHNL	1	10.00	10.00	10.00	.00	10.00	
TDS	1	574.00	574.00	574.00	.00	574.00	
Hg	1/3	.07	.07	.07	.00	.07/	.05

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 1 at Road 1450 N at Galesburg; Site T21--Continued

samples collected from storms 2, 4, and 5 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	15	380.00	870.00	556.67	159.493	530.00	
BOD	8	4.10	18.00	12.51	4.248	13.50	
COD	8	18.00	92.00	56.38	27.759	52.50	
TSS	15	10.00	872.00	446.53	234.019	462.00	
VSS	15	3.00	112.00	56.60	29.413	60.00	
NH_3	8/15	.11	3.50	.68	1.146	.26/	0.11
TKN	15	.70	8.10	2.37	1.770	1.90	
NOx	14/15	1.00	16.00	3.84	3.738	3.15/	2.90
P	15	.16	2.00	.73	.416	.71	
TOC	15	5.80	16.00	11.29	3.173	12.00	
HRD	6	200.00	450.00	281.67	88.863	260.00	
Ca	6	54.00	110.00	71.67	20.285	66.50	
Mg	6	16.00	44.00	25.33	9.832	22.50	
Na	6	14.00	44.00	25.67	10.132	24.50	
K	6	4.90	6.20	5.63	.480	5.60	
Cl	2	24.00	48.00	36.00	16.971	36.00	
SO_4	2	47.00	130.00	88.50	58.690	88.50	
F	6	.10	.30	.20	.063	.20	
As	6	7.00	31.00	12.83	9.218	9.50	
Ba	6	100.00	200.00	150.00	54.772	150.00	
Be	1/6	4.00	4.00	4.00	.00	4.00/	1.25
B	6	180.00	630.00	341.67	156.386	305.00	
Cd	0/6	--	--	--	--	-- /	3.00
Cr	3/6	12.00	17.00	14.67	2.517	15.00/	8.50
Co	3/6	5.00	7.00	6.33	1.155	7.00/	5.00
Cu	6	18.00	57.00	29.33	14.137	26.50	
Fe	6	4,900.00	13,000.00	8,266.67	3,205.412	7,600.00	
Pb	0/6	--	--	--	--	-- /	50.00
Mn	6	310.00	550.00	428.33	95.795	395.00	
Ni	6	5.00	14.00	10.50	3.271	11.00	
Ag	0/6	--	--	--	--	-- /	3.00
Sr	6	120.00	240.00	148.33	46.224	130.00	
V	6	11.00	21.00	15.33	4.131	13.50	
Zn	3/6	170.00	200.00	183.33	15.275	180.00/	135.00
Al	6	3,000.00	7,900.00	4,966.67	1,975.517	4,250.00	
PHNL	2	10.00	10.00	10.00	.00	10.00	
TDS	2	306.00	574.00	440.00	189.505	440.00	
Hg	2/6	.01	.07	.04	.042	.04/	.03

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 2 at Road 2100 N near Galesburg; Site T23

storm number 1, May 16-20

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	6	480.00	720.00	603.33	88.015	590.00	
BOD	3	12.00	24.00	16.33	6.658	13.00	
COD	3	63.00	140.00	111.00	41.869	130.00	
TSS	6	860.00	1,720.00	1,215.00	327.277	1,130.00	
VSS	6	92.00	200.00	150.33	45.527	160.00	
NH_3	6	.19	.46	.31	.118	.28	
TKN	6	3.60	7.10	5.30	1.349	5.55	
NOx	6	5.20	6.10	5.77	.314	5.80	
P	6	.82	1.60	1.22	.340	1.20	
TOC	6	7.60	16.00	11.12	3.062	11.50	
HRD	4	230.00	330.00	277.50	45.735	275.00	
Ca	3	57.00	79.00	69.33	11.240	72.00	
Mg	3	26.00	33.00	29.33	3.512	29.00	
Na	3	15.00	26.00	20.00	5.568	19.00	
K	3	5.80	7.00	6.53	.643	6.80	
Cl	1	31.00	31.00	31.00	.00	31.00	
SO_4	1	50.00	50.00	50.00	.00	50.00	
F	3	.20	.30	.27	.058	.30	
As	3	6.00	8.00	6.67	1.155	6.00	
Ba	3	200.00	400.00	300.00	100.000	300.00	
Be	0/3	--	--	--	--	-- /	2.00
B	3	170.00	320.00	240.00	75.498	230.00	
Cd	0/3	--	--	--	--	-- /	3.00
Cr	3	13.00	23.00	18.00	5.000	18.00	
Co	3	8.00	10.00	9.33	1.155	10.00	
Cu	3	17.00	29.00	25.00	6.928	29.00	
Fe	3	13,000.00	24,000.00	19,666.67	5,859.465	22,000.00	
Pb	0/3	--	--	--	--	-- /	50.00
Mn	3	670.00	1,000.00	806.67	172.143	750.00	
Ni	3	13.00	24.00	18.00	5.568	17.00	
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	130.00	170.00	150.00	20.000	150.00	
V	3	26.00	45.00	37.67	10.214	42.00	
Zn	2/3	160.00	180.00	170.00	14.142	170.00/	160.00
Al	3	8,400.00	17,000.00	13,800.00	4,703.190	16,000.00	
PHNL	1	5.00	5.00	5.00	.00	5.00	
TDS	1	360.00	360.00	360.00	.00	360.00	
Hg	1/3	.01	.01	.01	.00	.01/	.01

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 2 at Road 2100 N near Galesburg; Site T23--Continued

storm number 2, no samples collected

storm number 3, no samples collected

storm number 4, August 26-27

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	1	560.00	560.00	560.00	0	560.00
BOD	1	6.00	6.00	6.00	0	6.00
COD	1	21.00	21.00	21.00	0	21.00
TSS	1	13.00	13.00	13.00	0	13.00
VSS	1	2.00	2.00	2.00	0	2.00
NH_3	1	.30	.30	.30	0	.30
TKN	1	1.10	1.10	1.10	0	1.10
NOx	1	4.00	4.00	4.00	0	4.00
P	1	.23	.23	.23	0	.23
TOC	1	5.50	5.50	5.50	0	5.50
HRD	0	--	--	--	--	--
Ca	0	--	--	--	--	--
Mg	0	--	--	--	--	--
Na	0	--	--	--	--	--
K	0	--	--	--	--	--
Cl	0	--	--	--	--	--
SO_4	0	--	--	--	--	--
F	0	--	--	--	--	--
As	0	--	--	--	--	--
Ba	0	--	--	--	--	--
Be	0	--	--	--	--	--
B	0	--	--	--	--	--
Cd	0	--	--	--	--	--
Cr	0	--	--	--	--	--
Co	0	--	--	--	--	--
Cu	0	--	--	--	--	--
Fe	0	--	--	--	--	--
Pb	0	--	--	--	--	--
Mn	0	--	--	--	--	--
Ni	0	--	--	--	--	--
Ag	0	--	--	--	--	--
Sr	0	--	--	--	--	--
V	0	--	--	--	--	--
Zn	0	--	--	--	--	--
Al	0	--	--	--	--	--
PHNL	0	--	--	--	--	--
TDS	0	--	--	--	--	--
Hg	0	--	--	--	--	--

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 2 at Road 2100 N near Galesburg; Site T23--Continued

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	1	630.00	630.00	630.00	0	630.00
BOD	0	--	--	--	--	--
COD	1	24.00	24.00	24.00	0	24.00
TSS	1	53.00	53.00	53.00	0	53.00
VSS	1	12.00	12.00	12.00	0	12.00
NH_3	0/1	--	--	--	--	-- / 0.10
TKN	1	1.20	1.20	1.20	0	1.20
NOx	1	3.20	3.20	3.20	0	3.20
P	1	.31	.31	.31	0	.31
TOC	1	9.00	9.00	9.00	0	9.00
HRD	1	320.00	320.00	320.00	0	320.00
Ca	1	76.00	76.00	76.00	0	76.00
Mg	1	32.00	32.00	32.00	0	32.00
Na	1	14.00	14.00	14.00	0	14.00
K	1	4.40	4.40	4.40	0	4.40
Cl	1	34.00	34.00	34.00	0	34.00
SO_4	1	33.00	33.00	33.00	0	33.00
F	1	.30	.30	.30	0	.30
As	1	1.00	1.00	1.00	0	1.00
Ba	1	100.00	100.00	100.00	0	100.00
Be	1	3.00	3.00	3.00	0	3.00
B	0/1	--	--	--	--	-- / 50.00
Cd	0/1	--	--	--	--	-- / 3.00
Cr	0/1	--	--	--	--	-- / 5.00
Co	0/1	--	--	--	--	-- / 5.00
Cu	1	7.00	7.00	7.00	0	7.00
Fe	1	950.00	950.00	950.00	0	950.00
Pb	0/1	--	--	--	--	-- / 50.00
Mn	1	130.00	130.00	130.00	0	130.00
Ni	0/1	--	--	--	--	-- / 5.00
Ag	0/1	--	--	--	--	-- / 3.00
Sr	1	160.00	160.00	160.00	0	160.00
V	0/1	--	--	--	--	-- / 5.00
Zn	0/1	--	--	--	--	-- / 50.00
Al	1	660.00	660.00	660.00	0	660.00
PHNL	1	5.00	5.00	5.00	0	5.00
TDS	1	427.00	427.00	427.00	0	427.00
Hg	0/1	--	--	--	--	-- / .05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 2 at Road 2100 N near Galesburg; Site T23--Continued

samples collected for storms 1, 4, and 5 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	8	480.00	720.00	601.25	76.80	590.00	
BOD	4	6.00	24.00	13.75	7.50	12.50	
COD	5	21.00	140.00	75.60	56.81	63.00	
TSS	8	13.00	1,720.00	919.50	613.19	1,015.00	
VSS	8	2.00	200.00	114.50	76.75	125.00	
NH_3	7/8	.19	.46	.31	.11	.30/	0.27
TKN	8	1.10	7.10	4.26	2.23	4.55	
NOx	8	3.20	6.10	5.22	1.06	5.75	
P	8	.23	1.60	.98	.53	1.00	
TOC	8	5.50	16.00	10.15	3.28	10.00	
HRD	5	230.00	330.00	286.00	43.93	300.00	
Ca	4	57.00	79.00	71.00	9.76	74.00	
Mg	4	26.00	33.00	30.00	3.16	30.50	
Na	4	14.00	26.00	18.50	5.45	17.00	
K	4	4.40	7.00	6.00	1.19	6.30	
Cl	2	31.00	34.00	32.50	2.12	32.50	
SO_4	2	33.00	50.00	41.50	12.02	41.50	
F	4	.20	.30	.28	.05	.30	
As	4	1.00	8.00	5.25	2.99	6.00	
Ba	4	100.00	400.00	250.00	129.10	250.00	
Be	1/4	3.00	3.00	3.00	.00	3.00/	2.00
B	3/4	170.00	320.00	240.00	75.50	230.00/	200.00
Cd	0/4	--	--	--	--	-- /	3.00
Cr	3/4	13.00	23.00	18.00	5.00	18.00/	15.50
Co	3/4	8.00	10.00	9.33	1.15	10.00/	9.00
Cu	4	7.00	29.00	20.50	10.63	23.00	
Fe	4	950.00	24,000.00	14,987.50	10,510.34	17,500.00	
Pb	0/4	--	--	--	--	-- /	50.00
Mn	4	130.00	1,000.00	637.50	366.37	710.00	
Ni	3/4	13.00	24.00	18.00	5.57	17.00/	15.00
Ag	0/4	--	--	--	--	-- /	3.00
Sr	4	130.00	170.00	152.50	17.08	155.00	
V	3/4	26.00	45.00	37.67	10.21	42.00/	34.00
Zn	2/4	160.00	180.00	170.00	14.14	170.00/	130.00
Al	4	660.00	17,000.00	10,515.00	7,609.96	12,200.00	
PHNL	2	5.00	5.00	5.00	.00	5.00	
TDS	2	360.00	427.00	393.50	47.38	393.50	
Hg	1/4	.01	.01	.01	.00	.01/	.01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 3 at Atchison, Topeka, & Santa Fe Railroad near Galesburg; site T24

storm number 1, May 16-20

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	6	140.00	280.0	201.67	56.006	195.00
BOD	3	22.00	31.0	26.00	4.583	25.00
COD	3	250.00	550.0	443.33	167.730	530.00
TSS	6	1,990.00	4,840.0	3,113.33	1,253.071	2,540.00
VSS	6	190.00	560.0	370.00	139.284	350.00
NH_3	6	.58	1.2	.89	.214	.94
TKN	6	10.00	33.0	18.17	8.060	16.00
NOx	6	1.60	3.8	2.73	.789	2.80
P	6	3.50	9.4	5.27	2.211	4.65
TOC	5	53.00	100.0	78.40	22.367	81.00
HRD	3	180.00	270.0	216.67	47.258	200.00
Ca	3	49.00	74.0	58.33	13.650	52.00
Mg	3	15.00	20.0	17.00	2.646	16.00
Na	3	2.10	4.4	2.90	1.300	2.20
K	3	7.90	10.0	8.63	1.185	8.00
Cl	1	21.00	21.0	21.00	.00	21.00
SO_4	1	42.00	42.0	42.00	.00	42.00
F	3	.20	.3	.23	.058	.20
As	3	8.00	14.0	10.67	3.055	10.00
Ba	3	1,000.00	1,200.0	1,100.00	100.000	1,100.00
Be	3	4.00	5.0	4.67	.577	5.00
B	1/3	50.00	50.0	50.00	.00	50.00/ 50.00
Cd	2/3	3.00	4.0	3.50	.707	3.50/ 3.00
Cr	3	22.00	29.0	26.00	3.606	27.00
Co	3	30.00	40.0	33.33	5.774	30.00
Cu	3	58.00	68.0	64.00	5.292	66.00
Fe	3	32,000.00	44,000.0	37,000.00	6,244.998	35,000.00
Pb	0/3	--	--	--	--	-- / 100.00
Mn	3	2,700.00	3,200.0	3,033.33	288.675	3,200.00
Ni	3	42.00	49.0	44.67	3.786	43.00
Ag	1/3	3.00	3.0	3.00	.00	3.00/ 3.00
Sr	3	120.00	170.0	143.33	25.166	140.00
V	3	81.00	91.0	86.00	5.000	86.00
Zn	3	220.00	320.0	263.33	51.316	250.00
Al	3	29,000.00	36,000.0	31,666.67	3,785.939	30,000.00
PHNL	1	20.00	20.0	20.00	.00	20.00
TDS	1	222.00	222.0	222.00	.00	222.00
Hg	1/3	.20	.2	.20	.00	.20/ .01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 3 at Atchison, Topeka, & Santa Fe Railroad near Galesburg; site T24--Continued

storm number 2, no samples collected

storm number 3, July 31 to August 1

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	6	150.00	280.00	198.33	46.22	185.00	
BOD	3	17.00	26.00	22.33	4.73	24.00	
COD	3	210.00	410.00	316.67	100.66	330.00	
TSS	6	1,280.00	8,570.00	3,291.67	2,691.61	2,275.00	
VSS	6	150.00	720.00	334.17	208.77	242.50	
NH_3	6	.16	.71	.49	.20	.52	
TKN	6	10.00	25.00	16.33	5.20	15.50	
NOx	6	1.40	3.80	2.38	.88	2.20	
P	6	1.70	4.60	3.00	.95	3.00	
TOC	6	32.00	96.00	60.67	21.67	55.00	
HRD	3	190.00	250.00	213.33	32.15	200.00	
Ca	3	49.00	73.00	58.00	13.08	52.00	
Mg	3	14.00	19.00	16.67	2.52	17.00	
Na	3	2.10	3.90	2.90	.92	2.70	
K	3	4.80	10.00	8.23	2.97	9.90	
Cl	1	13.00	13.00	13.00	.00	13.00	
SO_4	1	26.00	26.00	26.00	.00	26.00	
F	3	.10	.20	.13	.06	.10	
As	3	7.00	13.00	10.00	3.00	10.00	
Ba	3	500.00	1,200.00	866.67	351.19	900.00	
Be	2/3	4.00	4.00	4.00	.00	4.00/	4.00
B	3	80.00	110.00	96.67	15.28	100.00	
Cd	3	5.00	6.00	5.67	.58	6.00	
Cr	3	12.00	18.00	15.33	3.06	16.00	
Co	3	20.00	40.00	30.00	10.00	30.00	
Cu	3	33.00	70.00	56.67	20.55	67.00	
Fe	3	17,000.00	37,000.00	29,666.67	11,015.14	35,000.00	
Pb	3	100.00	190.00	150.00	45.83	160.00	
Mn	3	1,600.00	3,500.00	2,566.67	950.44	2,600.00	
Ni	3	25.00	45.00	34.00	10.15	32.00	
Ag	0/3	--	--	--	--	-- /	3.00
Sr	3	110.00	150.00	126.67	20.82	120.00	
V	3	40.00	88.00	68.33	25.15	77.00	
Zn	3	180.00	310.00	246.67	65.06	250.00	
Al	3	12,000.00	29,000.00	23,000.00	9,539.39	28,000.00	
PHNL	1	10.00	10.00	10.00	.00	10.00	
TDS	1	137.00	137.00	137.00	.00	137.00	
Hg	1/3	.05	.05	.05	.00	.05/	.01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 3 at Atchison, Topeka, & Santa Fe Railroad near Galesburg; site T24--Continued

storm number 4, August 26-27

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	7	620.00	620.00	620.00	0.00	620.00
BOD	3	3.30	4.80	4.17	.777	4.40
COD	4	13.00	19.00	14.75	2.872	13.50
TSS	7	43.00	176.00	99.71	40.570	91.00
VSS	7	6.00	27.00	16.00	6.272	15.00
NH_3	0/7	--	--	--	--	-- / 0.10
TKN	7	.30	1.00	.63	.236	.60
NOx	7	13.00	13.00	13.00	.00	13.00
P	7	.15	.23	.18	.025	.18
TOC	7	1.70	5.40	2.54	1.306	2.00
HRD	3	350.00	380.00	363.33	15.275	360.00
Ca	3	80.00	86.00	83.00	3.000	83.00
Mg	3	37.00	40.00	38.33	1.528	38.00
Na	3	11.00	12.00	11.33	.577	11.00
K	3	1.70	2.00	1.87	.153	1.90
Cl	1	20.00	20.00	20.00	.00	20.00
SO_4	1	38.00	38.00	38.00	.00	38.00
F	3	.30	.30	.30	.00	.30
As	3	1.00	2.00	1.67	.577	2.00
Ba	3	200.00	200.00	200.00	.00	200.00
Be	0/3	--	--	--	--	-- / .50
B	3	50.00	50.00	50.00	.00	50.00
Cd	0/3	--	--	--	--	-- / .50
Cr	3	9.00	12.00	11.00	1.732	12.00
Co	1/3	7.00	7.00	7.00	.00	7.00/ 5.00
Cu	3	9.00	9.00	9.00	.00	9.00
Fe	3	2,900.00	5,800.00	4,200.00	1,473.092	3,900.00
Pb	0/3	--	--	--	--	-- / 50.00
Mn	3	150.00	280.00	223.33	66.583	240.00
Ni	3	7.00	10.00	8.67	1.528	9.00
Ag	0/3	--	--	--	--	-- / 3.00
Sr	3	170.00	180.00	173.33	5.774	170.00
V	3	15.00	19.00	16.67	2.082	16.00
Zn	1/3	120.00	120.00	120.00	.00	120.00/ 100.00
Al	3	3,000.00	5,600.00	4,533.33	1,361.372	5,000.00
PHNL	0/1	--	--	--	--	-- / 5.00
TDS	1	401.00	401.00	401.00	.00	401.00
Hg	3	.04	.12	.07	.046	.04

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results for Cedar Creek Tributary No. 3 at Atchison, Topeka, & Santa Fe Railroad near Galesburg; site T24--Continued

storm number 5, no samples collected

samples collected for storms 1, 3, and 4 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	19	140.00	620.0	354.74	211.64	240.00	
BOD	9	3.30	31.0	17.50	10.65	22.00	
COD	10	13.00	550.0	233.90	216.23	230.00	
TSS	19	43.00	8,570.0	2,059.37	2,195.23	1,940.00	
VSS	19	6.00	720.0	228.26	213.23	230.00	
NH_3	12/19	.16	1.2	.69	.29	.67/	0.50
TKN	19	.30	33.0	11.13	9.70	13.00	
NOx	19	1.40	13.0	6.41	5.21	3.20	
P	19	.15	9.4	2.68	2.51	2.90	
TOC	18	1.70	100.0	42.99	37.54	53.00	
HRD	9	180.00	380.0	264.44	79.86	250.00	
Ca	9	49.00	86.0	66.44	15.68	73.00	
Mg	9	14.00	40.0	24.00	10.93	19.00	
Na	9	2.10	12.0	5.71	4.30	3.90	
K	9	1.70	10.0	6.24	3.66	7.90	
Cl	3	13.00	21.0	18.00	4.36	20.00	
SO_4	3	26.00	42.0	35.33	8.33	38.00	
F	9	.10	.3	.22	.08	.20	
As	9	1.00	14.0	7.44	4.85	8.00	
Ba	9	200.00	1,200.0	722.22	443.78	900.00	
Be	5/9	4.00	5.0	4.40	.55	4.00/	4.00
B	7/9	50.00	110.0	70.00	26.46	50.00/	50.00
Cd	5/9	3.00	6.0	4.80	1.30	5.00/	3.00
Cr	9	9.00	29.0	17.44	7.14	16.00	
Co	7/9	7.00	40.0	28.14	11.58	30.00/	30.00
Cu	9	9.00	70.0	43.22	27.95	58.00	
Fe	9	2,900.00	44,000.0	23,622.22	16,214.10	32,000.00	
Pb	3/9	100.00	190.0	150.00	45.83	160.00/	100.00
Mn	9	150.00	3,500.0	1,941.11	1,395.85	2,600.00	
Ni	9	7.00	49.0	29.11	16.92	32.00	
Ag	1/9	3.00	3.0	3.00	.00	3.00/	3.00
Sr	9	110.00	180.0	147.78	26.35	150.00	
V	9	15.00	91.0	57.00	33.75	77.00	
Zn	7/9	120.00	320.0	235.71	70.44	250.00/	220.00
Al	9	3,000.00	36,000.0	19,733.33	13,070.58	28,000.00	
PHNL	2/3	10.00	20.0	15.00	7.07	15.00/	10.00
TDS	3	137.00	401.0	253.33	134.76	222.00	
Hg	5/9	.04	.2	.09	.07	.05/	.04

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Galesburg wastewater-treatment-facility outfall at Galesburg; site WWTF

storm number 1, no samples collected

storm number 2, July 7-10

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	12	790.00	1,050.00	938.33	92.130	950.00	
BOD	6	13.00	44.00	27.50	12.438	27.00	
COD	6	27.00	51.00	38.50	11.640	37.50	
TSS	12	10.00	27.00	14.42	4.680	13.50	
VSS	12	6.00	13.00	9.08	2.109	9.00	
NH_3	7/12	.19	.61	.45	.126	.47/	0.32
TKN	12	1.60	4.80	2.97	1.082	2.40	
NOx	12	9.74	14.00	12.14	1.830	12.00	
P	12	4.10	10.00	4.87	1.635	4.50	
TOC	12	11.00	17.00	13.50	1.977	13.00	
HRD	6	280.00	290.00	286.67	5.164	290.00	
Ca	6	70.00	73.00	71.67	1.366	72.00	
Mg	6	25.00	27.00	26.00	.894	26.00	
Na	6	80.00	110.00	96.00	12.837	96.00	
K	6	7.50	9.50	8.52	.875	8.55	
Cl	2	110.00	140.00	125.00	21.213	125.00	
SO_4	2	61.00	68.00	64.50	4.950	64.50	
F	6	.30	.90	.63	.294	.65	
As	1/6	1.00	1.00	1.00	.00	1.00/	1.00
Ba	6	40.00	50.00	45.00	5.477	45.00	
Be	4/6	2.00	4.00	3.25	.957	3.50/	2.50
B	6	290.00	340.00	308.33	19.408	305.00	
Cd	0/6	--	--	--	--	-- /	14.50
Cr	6	11.00	20.00	14.67	3.327	14.50	
Co	1/6	6.00	6.00	6.00	.00	6.00/	5.00
Cu	6	33.00	400.00	110.17	144.037	43.00	
Fe	6	230.00	320.00	266.67	33.862	260.00	
Pb	1/6	50.00	50.00	50.00	.00	50.00/	50.00
Mn	6	40.00	60.00	47.83	7.441	47.00	
Ni	1/6	14.00	14.00	14.00	.00	14.00/	5.00
Ag	1/6	3.00	3.00	3.00	.00	3.00/	3.00
Sr	6	120.00	130.00	123.33	5.164	120.00	
V	0/6	--	--	--	--	-- /	5.00
Zn	0/6	--	--	--	--	-- /	100.00
Al	2/6	50.00	90.00	70.00	28.284	70.00/	50.00
PHNL	1/2	15.00	15.00	15.00	.00	15.00/	10.00
TDS	2	580.00	623.00	601.50	30.406	601.50	
Hg	6	.11	1.00	.47	.358	.43	

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Galesburg wastewater-treatment-facility outfall at Galesburg; site WWTF--Continued

storm number 3, no samples collected

storm number 4, no samples collected

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	7	660.00	770.00	742.86	38.1725	750.00
BOD	4	35.00	51.00	40.00	7.3937	37.00
COD	4	51.00	120.00	71.00	32.9747	56.50
TSS	7	9.00	78.00	22.29	24.8979	16.00
VSS	7	4.00	51.00	12.57	17.0182	7.00
NH_3	7	1.00	2.30	1.83	.4821	2.00
TKN	7	3.90	6.60	5.04	.8619	4.90
NOx	7	4.30	8.90	6.33	1.5250	6.40
P	7	3.30	4.00	3.66	.2370	3.60
TOC	7	15.00	22.00	18.29	2.2887	18.00
HRD	4	210.00	240.00	220.00	14.1421	215.00
Ca	4	54.00	59.00	56.00	2.1602	55.50
Mg	4	19.00	21.00	19.75	.9574	19.50
Na	4	62.00	66.00	64.25	1.7078	64.50
K	4	7.70	9.30	8.67	.7136	8.85
Cl	2	80.00	83.00	81.50	2.1213	81.50
SO_4	2	33.00	40.00	36.50	4.9497	36.50
F	4	.70	.90	.82	.0957	.85
As	2/4	1.00	1.00	1.00	.00	1.00/ 1.00
Ba	4	40.00	60.00	45.00	10.0000	40.00
Be	3/4	2.00	5.00	3.33	1.5275	3.00/ 4.00
B	4	170.00	270.00	230.00	43.2049	240.00
Cd	1/4	3.00	3.00	3.00	.00	3.00/ 3.00
Cr	2/4	8.00	26.00	17.00	12.7279	17.00/ 6.50
Co	0/4	--	--	--	--	-- / 5.00
Cu	4	29.00	100.00	52.50	32.1299	40.50
Fe	4	200.00	1,000.00	450.00	376.9173	300.00
Pb	0/4	--	--	--	--	-- / 50.00
Mn	4	25.00	130.00	54.75	50.3810	32.00
Ni	1/4	10.00	10.00	10.00	.00	10.00/ 7.50
Ag	0/4	--	--	--	--	-- / 3.00
Sr	4	100.00	110.00	105.00	5.7735	105.00
V	0/4	--	--	--	--	-- / 5.00
Zn	1/4	100.00	100.00	100.00	.00	100.00/ 100.00
Al	4	70.00	210.00	125.00	61.9139	110.00
PHNL	2	15.00	35.00	25.00	14.1421	25.00
TDS	2	359.00	446.00	402.50	61.5183	402.50
Hg	1/4	.14	.14	.14	.00	.14/ .05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Galesburg wastewater-treatment-facility outfall at Galesburg; site WWTF--Continued

samples collected for storms 2 and 5 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	19	660.00	1,050.0	866.32	122.7106	820.00	
BOD	10	13.00	51.0	32.50	12.0761	35.50	
COD	10	27.00	120.0	51.50	26.8214	50.50	
TSS	19	9.00	78.0	17.32	15.3371	14.00	
VSS	19	4.00	51.0	10.37	10.1117	8.00	
NH_3	14/19	.19	2.3	1.14	.7914	.80/	0.47
TKN	19	1.60	6.6	3.74	1.4190	4.10	
NOx	19	4.30	14.0	10.00	3.3365	10.00	
P	19	3.30	10.0	4.43	1.4204	4.10	
TOC	19	11.00	22.0	15.26	3.1241	15.00	
HRD	10	210.00	290.0	260.00	35.5903	280.00	
Ca	10	54.00	73.0	65.40	8.2489	70.00	
Mg	10	19.00	27.0	23.50	3.3417	25.00	
Na	10	62.00	110.0	83.30	19.0091	82.00	
K	10	7.50	9.5	8.58	.7757	8.85	
Cl	4	80.00	140.0	103.25	27.9687	96.50	
SO_4	4	33.00	68.0	50.50	16.6633	50.50	
F	10	.30	.9	.71	.2470	.85	
As	3/10	1.00	1.0	1.00	.00	1.00/	1.00
Ba	10	40.00	60.0	45.00	7.0711	40.00	
Be	7/10	2.00	5.0	3.29	1.1127	3.00/	3.00
B	10	170.00	340.0	277.00	49.6767	290.00	
Cd	1/10	3.00	3.0	3.00	.00	3.00/	3.00
Cr	8/10	8.00	26.0	15.25	5.6758	14.50/	12.50
Co	1/10	6.00	6.0	6.00	.00	6.00/	5.00
Cu	10	29.00	400.0	87.10	112.9459	42.00	
Fe	10	200.00	1,000.0	340.00	238.6536	260.00	
Pb	1/10	50.00	50.0	50.00	.00	50.00/	50.00
Mn	10	25.00	130.0	50.60	29.8262	43.50	
Ni	2/10	10.00	14.0	12.00	2.8284	12.00/	5.00
Ag	1/10	3.00	3.0	3.00	.00	3.00/	3.00
Sr	10	100.00	130.0	116.00	10.7497	120.00	
V	0/10	-	-	-	-	- /	5.00
Zn	1/10	100.00	100.0	100.00	.00	100.00/	100.00
Al	6/10	50.00	210.0	106.67	57.1548	90.00/	60.00
PHNL	3/4	15.00	35.0	21.67	11.5470	15.00/	15.00
TDS	4	359.00	623.0	502.00	121.5319	513.00	
Hg	7/10	.11	1.0	.42	.3494	.25/	.14

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled combined-sewer overflows

storm number 1, May 16-20

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	12	130.00	530.00	289.17	123.910	325.00	
BOD	6	22.00	943.00	194.50	367.340	51.00	
COD	6	25.00	950.00	294.17	350.206	155.00	
TSS	12	102.00	1,670.00	768.17	501.938	669.00	
VSS	12	54.00	660.00	235.83	205.424	134.00	
NH_3	10/12	.22	6.20	3.54	2.245	4.10/	3.75
TKN	12	1.40	33.00	12.98	11.555	10.65	
NOx	11/12	.10	.64	.27	.199	.18/	.16
P	12	.14	6.70	2.79	2.490	2.20	
TOC	12	5.70	52.00	22.27	14.798	21.00	
HRD	4	90.00	350.00	230.00	134.412	240.00	
Ca	4	27.00	110.00	69.75	40.451	71.00	
Mg	4	5.40	22.00	13.55	9.190	13.40	
Na	4	2.20	25.00	10.80	10.381	8.00	
K	4	.50	3.70	1.97	1.389	1.85	
Cl	2	4.00	15.00	9.50	7.778	9.50	
SO_4	1/2	16.00	16.00	16.00	.00	16.00/	13.00
F	2/5	.20	.30	.25	.071	.25/	.10
As	4	2.00	18.00	6.50	7.681	3.00	
Ba	4	30.00	700.00	230.00	314.854	95.00	
Be	0/4	--	--	--	--	-- /	.75
B	1/4	120.00	120.00	120.00	.00	120.00/	50.00
Cd	2/4	13.00	27.00	20.00	9.899	20.00/	8.00
Cr	4	11.00	30.00	17.50	8.737	14.50/	14.50
Co	3/4	5.00	10.00	7.33	2.517	7.00/	6.00
Cu	4	22.00	690.00	203.50	324.638	51.00	
Fe	4	1,500.00	18,000.00	7,725.00	7,234.812	5,700.00	
Pb	4	120.00	540.00	292.50	184.639	255.00	
Mn	4	88.00	430.00	274.50	151.924	290.00	
Ni	3/4	6.00	36.00	16.67	16.773	8.00/	7.00
Ag	3/4	4.00	14.00	7.33	5.774	4.00/	4.00
Sr	4	30.00	120.00	65.00	40.415	55.00	
V	4	5.00	27.00	12.50	9.849	9.00	
Zn	4	180.00	1,200.00	515.00	464.004	340.00	
Al	4	800.00	8,600.00	3,375.00	3,538.714	2,050.00	
PHNL	2	5.00	60.00	32.50	38.891	32.50	
TDS	2	103.00	205.00	154.00	72.125	154.00	
Hg	2/4	.05	.33	.19	.198	.19/	.03

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled combined-sewer overflows--Continued

storm number 2, July 7-10

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	14	90.00	350.00	142.14	65.888	125.00	
BOD	7	15.00	64.00	34.29	18.053	27.00	
COD	8	15.00	240.00	66.63	71.881	49.00	
TSS	14	20.00	835.00	311.29	256.444	278.00	
VSS	14	5.00	196.00	66.93	56.790	53.00	
NH_3	10/15	.10	1.10	.42	.326	.37/	0.20
TKN	15	1.40	31.00	5.02	7.436	3.00	
NOx	15	.11	1.10	.44	.230	.41	
P	15	.11	5.30	.98	1.309	.62	
TOC	15	.00	63.00	17.07	17.508	8.90	
HRD	8	40.00	360.00	154.13	126.313	113.00	
Ca	8	14.00	100.00	45.00	35.112	32.50	
Mg	8	1.50	23.00	9.79	8.677	7.90	
Na	8	3.90	18.00	8.30	5.036	6.45	
K	8	.70	2.30	1.41	.594	1.30	
Cl	2	6.10	20.00	13.05	9.829	13.05	
SO_4	1/2	27.00	27.00	27.00	.00	27.00/	18.50
F	1/8	.20	.20	.20	.00	.20/	.10
As	6/8	2.00	24.00	6.83	8.519	4.00/	2.50
Ba	8	20.00	200.00	65.00	59.522	50.00	
Be	3/8	4.00	6.00	5.00	1.000	5.00/	1.25
B	5/8	60.00	170.00	94.00	45.056	70.00/	65.00
Cd	1/8	11.00	11.00	11.00	.00	11.00/	3.00
Cr	5/8	10.00	21.00	14.20	4.438	13.00/	10.50
Co	1/8	8.00	8.00	8.00	.00	8.00/	5.00
Cu	8	14.00	170.00	60.13	50.340	42.00	
Fe	8	400.00	9,000.00	3,345.00	3,333.754	1,900.00	
Pb	3/8	200.00	450.00	360.00	138.924	430.00/	100.00
Mn	8	41.00	570.00	203.88	207.129	111.00	
Ni	2/8	8.00	13.00	10.50	3.536	10.50/	5.00
Ag	1/8	140.00	140.00	140.00	.00	140.00/	3.00
Sr	8	20.00	70.00	40.00	20.702	30.00	
V	2/8	7.00	10.00	8.50	2.121	8.50/	5.00
Zn	8	120.00	900.00	311.25	256.706	205.00	
Al	8	190.00	4,100.00	1,355.00	1,473.286	510.00	
PHNL	1/2	10.00	10.00	10.00	.00	10.00/	7.50
TDS	2	75.00	255.00	165.00	127.279	165.00	
Hg	1/8	.05	.05	.05	.00	.05/	.01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled combined-sewer overflows--Continued

storm number 3, July 31 to August 1

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	17	80.00	600.00	234.12	151.536	220.00	
BOD	9	11.00	66.00	30.33	16.867	30.00	
COD	8	38.00	1,300.00	565.62	611.696	205.00	
TSS	16	71.00	2,380.00	862.81	739.878	515.50	
VSS	16	18.00	860.00	308.50	312.436	141.50	
NH_3	17	.26	6.80	1.59	1.931	.69	
TKN	17	.90	48.00	15.29	16.201	5.60	
NOx	12/17	.37	2.50	.82	.569	.62/	0.60
P	17	.22	7.30	2.34	2.458	.84	
TOC	17	5.90	160.00	42.48	44.622	17.00	
HRD	6	94.00	950.00	392.33	326.706	305.00	
Ca	6	30.00	300.00	120.83	102.263	91.00	
Mg	6	4.70	46.00	20.73	16.452	17.50	
Na	6	2.00	32.00	10.12	11.425	6.85	
K	6	1.00	8.80	3.72	2.914	3.10	
Cl	1	24.00	24.00	24.00	.00	24.00	
SO_4	2	11.00	20.00	15.50	6.364	15.50	
F	3/5	.20	.30	.23	.058	.20/	.20
As	6	14.00	660.00	271.67	289.840	220.00	
Ba	6	40.00	800.00	366.67	337.204	350.00	
Be	0/6	--	--	--	--	-- /	.50
B	4/6	70.00	270.00	157.50	83.815	145.00/	100.00
Cd	6	3.00	21.00	12.00	7.266	13.00	
Cr	6	6.00	30.00	19.67	10.596	21.50	
Co	3/6	20.00	20.00	20.00	.00	20.00/	12.50
Cu	6	45.00	750.00	392.83	344.297	375.00	
Fe	6	2,900.00	23,000.00	12,850.00	9,120.252	13,050.00	
Pb	6	140.00	640.00	403.33	235.514	435.00	
Mn	6	170.00	830.00	458.33	264.758	400.00	
Ni	6	7.00	43.00	25.50	18.534	27.00	
Ag	3/6	3.00	8.00	6.00	2.646	7.00/	3.00
Sr	6	20.00	430.00	166.67	166.453	115.00	
V	4/6	10.00	35.00	25.50	10.970	28.50/	18.00
Zn	6	260.00	7,800.00	2,035.00	2,869.214	1,130.00	
Al	6	1,200.00	22,000.00	8,066.67	7,949.256	6,300.00	
PHNL	2	5.00	25.00	15.00	14.142	15.00	
TDS	1	238.00	238.00	238.00	.00	238.00	
Hg	3/6	.05	.11	.08	.030	.08/	.03

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled combined-sewer overflows--Continued

storm number 4, August 26-27

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	3	110.00	200.00	140.00	51.9615	110.00
BOD	1	31.00	31.00	31.00	.00	31.00
COD	1	120.00	120.00	120.00	.00	120.00
TSS	3	90.00	508.00	356.67	231.6405	472.00
VSS	3	25.00	132.00	90.33	57.2917	114.00
NH_3	3	.33	1.80	.86	.8163	.45
TKN	3	2.40	10.00	5.37	4.0649	3.70
NOx	3	.66	.81	.72	.0794	.69
P	3	.73	2.70	1.41	1.1150	.81
TOC	3	20.00	79.00	42.00	32.2335	27.00
HRD	1	130.00	130.00	130.00	.00	130.00
Ca	1	41.00	41.00	41.00	.00	41.00
Mg	1	7.60	7.60	7.60	.00	7.60
Na	1	3.90	3.90	3.90	.00	3.90
K	1	2.50	2.50	2.50	.00	2.50
Cl	1	4.40	4.40	4.40	.00	4.40
SO_4	1	14.00	14.00	14.00	.00	14.00
F	0/1	--	--	--	--	-- / 0.10
As	1	6.00	6.00	6.00	.00	6.00
Ba	1	80.00	80.00	80.00	.00	80.00
Be	0/1	--	--	--	--	-- / .50
B	1	80.00	80.00	80.00	.00	80.00
Cd	0/1	--	--	--	--	-- / 3.00
Cr	1	12.00	12.00	12.00	.00	12.00
Co	0/1	--	--	--	--	-- / 5.00
Cu	1	71.00	71.00	71.00	.00	71.00
Fe	1	5,400.00	5,400.00	5,400.00	.00	5,400.00
Pb	1	170.00	170.00	170.00	.00	170.00
Mn	1	220.00	220.00	220.00	.00	220.00
Ni	1	8.00	8.00	8.00	.00	8.00
Ag	0/1	--	--	--	--	-- / 3.00
Sr	1	40.00	40.00	40.00	.00	40.00
V	1	7.00	7.00	7.00	.00	7.00
Zn	1	420.00	420.00	420.00	.00	420.00
Al	1	2,200.00	2,200.00	2,200.00	.00	2,200.00
PHNL	1	15.00	15.00	15.00	.00	15.00
TDS	1	117.00	117.00	117.00	.00	117.00
Hg	0/1	--	--	--	--	-- / .01

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled combined-sewer overflows--Continued

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	9	70.00	370.0	145.56	103.333	100.00
BOD	6	10.00	207.0	73.00	76.194	44.00
COD	6	24.00	400.0	149.33	136.940	101.50
TSS	9	36.00	1,330.0	408.78	408.758	276.00
VSS	9	8.00	440.0	98.00	135.754	45.00
NH_3	9	.13	3.1	.61	.947	.23
TKN	9	1.00	14.0	3.63	4.201	1.80
NOx	8/9	.22	.4	.29	.069	.29/ 0.27
P	9	.24	2.8	.89	.840	.58
TOC	9	4.80	46.0	15.86	13.712	12.00
HRD	2	51.00	170.0	110.50	84.146	110.50
Ca	2	16.00	56.0	36.00	28.284	36.00
Mg	2	2.60	7.4	5.00	3.394	5.00
Na	2	2.10	3.3	2.70	.849	2.70
K	2	.60	.7	.65	.071	.65
Cl	1	2.80	2.8	2.80	.00	2.80
SO_4	0/1	--	--	--	--	-- / 10.00
F	0/2	--	--	--	--	-- / .10
As	2	1.00	6.0	3.50	3.536	3.50
Ba	2	20.00	70.0	45.00	35.355	45.00
Be	1/2	2.00	2.0	2.00	.00	2.00/ 2.00
B	0/2	--	--	--	--	-- / 50.00
Cd	1/2	4.00	4.0	4.00	.00	4.00/ 3.50
Cr	0/2	--	--	--	--	-- / 5.00
Co	0/2	--	--	--	--	-- / 5.00
Cu	2	18.00	73.0	45.50	38.891	45.50
Fe	2	840.00	4,900.0	2,870.00	2,870.854	2,870.00
Pb	1/2	220.00	220.0	220.00	.00	220.00/ 135.00
Mn	2	56.00	240.0	148.00	130.108	148.00
Ni	0/2	--	--	--	--	-- / 5.00
Ag	0/2	--	--	--	--	-- / 3.00
Sr	2	20.00	30.0	25.00	7.071	25.00
V	0/2	--	--	--	--	-- / 5.00
Zn	2	100.00	440.0	270.00	240.416	270.00
Al	2	390.00	1,900.0	1,145.00	1,067.731	1,145.00
PHNL	1	10.00	10.0	10.00	.00	10.00
TDS	1	63.00	63.0	63.00	.00	63.00
Hg	1/3	.00	.0	.00	.00	.00 / .05

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled combined-sewer overflows--Continued

samples collected from storms 1, 2, 3, 4, and 5 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	55	70.00	600.00	203.09	127.844	140.00
BOD	29	10.00	943.00	73.86	171.724	31.00
COD	29	15.00	1,300.00	270.31	401.148	120.00
TSS	54	20.00	2,380.00	595.00	556.241	438.00
VSS	54	5.00	860.00	182.52	225.256	104.00
NH3	49/56	.10	6.80	1.52	1.916	.48/ 0.41
TKN	56	.90	48.00	9.64	12.056	3.60
NOx	49/56	.10	2.50	.49	.384	.40/ .37
P	56	.11	7.30	1.79	2.052	.81
TOC	56	.00	160.00	27.04	30.078	15.00
HRD	21	40.00	950.00	231.33	217.869	140.00
Ca	21	14.00	300.00	70.33	67.187	44.00
Mg	21	1.50	46.00	13.07	11.715	7.60
Na	21	2.00	32.00	8.55	7.999	5.70
K	21	.50	8.80	2.16	1.930	1.30
Cl	7	2.80	24.00	10.90	8.658	6.10
SO4	5/8	11.00	27.00	17.60	6.189	16.00/ 12.50
F	6/21	.20	.30	.23	.052	.20/ .10
As	19/21	1.00	660.00	90.00	198.608	6.00/ 5.00
Ba	21	20.00	800.00	181.43	251.322	70.00
Be	4/21	2.00	6.00	4.25	1.708	4.50/ .50
B	11/21	60.00	270.00	118.18	63.058	100.00/ 60.00
Cd	10/21	3.00	27.00	12.70	7.818	13.00/ 3.00
Cr	16/21	6.00	30.00	16.94	8.070	14.50/ 12.00
Co	7/21	5.00	20.00	12.86	6.842	10.00/ 5.00
Cu	21	14.00	750.00	181.62	261.255	59.00
Fe	21	400.00	23,000.00	6,947.62	7,105.940	4,200.00
Pb	15/21	120.00	640.00	337.33	188.167	280.00/ 190.00
Mn	21	41.00	830.00	285.48	224.954	220.00
Ni	12/21	6.00	43.00	19.33	16.030	10.00/ 7.00
Ag	7/21	3.00	140.00	25.71	50.533	7.00/ 3.00
Sr	21	20.00	430.00	79.52	103.173	40.00
V	11/21	5.00	35.00	16.00	11.225	10.00/ 5.00
Zn	21	100.00	7,800.00	843.81	1,648.940	380.00
Al	21	190.00	22,000.00	3,677.62	5,215.227	1,800.00
PHNL	7/8	5.00	60.00	18.57	19.518	10.00/ 10.00
TDS	7	63.00	255.00	150.86	79.876	117.00
Hg	7/22	.00	.33	.10	.109	.05/ .01

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled storm sewers

storm number 1, May 16-20

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	12	300.00	1,010.00	558.33	230.29	520.00	
BOD	6	27.00	66.00	48.00	13.55	50.00	
COD	6	180.00	960.00	390.00	303.97	245.00	
TSS	12	58.00	3,200.00	855.17	1132.93	234.00	
VSS	12	26.00	640.00	196.67	225.11	74.00	
NH_3	12	.34	4.30	1.74	1.24	1.45	
TKN	12	4.30	25.00	10.38	6.86	7.65	
NOx	10/12	.10	1.30	.42	.42	.20/	0.13
P	12	.57	4.50	1.46	1.18	1.04	
TOC	11	2.40	63.00	34.04	20.67	35.00	
HRD	6	140.00	960.00	401.67	308.44	265.00	
Ca	6	43.00	290.00	120.83	95.80	75.00	
Mg	6	7.30	57.00	24.38	17.58	19.50	
Na	6	8.40	49.00	25.57	17.82	19.50	
K	6	5.40	13.00	8.67	2.94	9.05	
Cl	2	55.00	91.00	73.00	25.46	73.00	
SO_4	2	32.00	100.00	66.00	48.08	66.00	
F	4/6	.10	.20	.15	.06	.15/	.10
As	6	2.00	30.00	11.17	11.87	6.00	
Ba	6	40.00	1,000.00	290.00	374.70	125.00	
Be	1/6	7.00	7.00	7.00	.00	7.00/	.50
B	6	50.00	210.00	141.67	59.47	145.00	
Cd	4/6	3.00	19.00	8.25	7.54	5.50/	3.00
Cr	6	11.00	37.00	19.17	10.52	14.00	
Co	3/6	6.00	30.00	15.33	12.86	10.00/	5.50
Cu	6	35.00	290.00	112.00	95.99	84.50	
Fe	6	1,100.00	58,000.00	16,916.67	22,355.98	7,350.00	
Pb	4/6	110.00	1,500.00	652.50	606.65	500.00/	230.00
Mn	6	140.00	3,900.00	1,128.33	1,456.38	585.00	
Ni	6	17.00	71.00	31.50	20.71	25.00	
Ag	1/6	4.00	4.00	4.00	.00	4.00/	3.00
Sr	6	70.00	240.00	125.00	60.91	115.00	
V	5/6	6.00	100.00	36.00	39.01	21.00/	14.50
Zn	6	190.00	2,500.00	781.67	908.99	350.00	
Al	6	460.00	33,000.00	9,268.33	12,772.95	3,720.00	
PHNL	2	20.00	35.00	27.50	10.61	27.50	
TDS	2	304.00	535.00	419.50	163.34	419.50	
Hg	3/6	.11	.28	.17	.09	.13/	.06

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled storm sewers--Continued

storm number 2, July 7-10

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	8	70.00	280.00	172.50	69.23	180.00
BOD	6	9.40	79.00	23.57	27.34	12.50
COD	6	20.00	360.00	90.83	133.66	30.00
TSS	8	21.00	1,620.00	309.75	537.28	120.50
VSS	8	7.00	220.00	46.25	71.25	20.50
NH_3	5/8	.12	.23	.18	.05	.19/ 0.12
TKN	8	.50	6.30	2.10	1.82	1.55
NOx	7/8	.55	1.40	.86	.29	.79/ .76
P	8	.10	1.40	.43	.41	.31
TOC	8	2.70	70.00	15.66	22.45	8.00
HRD	6	34.00	710.00	186.50	259.58	96.50
Ca	6	12.00	220.00	58.67	80.07	29.00
Mg	6	1.20	42.00	10.12	15.75	5.40
Na	6	1.80	18.00	9.30	5.90	8.50
K	6	.60	8.00	2.47	2.79	1.60
Cl	4	2.10	22.00	10.37	8.56	8.70
SO_4	1/4	23.00	23.00	23.00	.00	23.00/ 10.00
F	2/6	.10	.10	.10	.00	.10/ .10
As	5/6	1.00	26.00	6.20	11.08	1.00/ 1.00
Ba	6	20.00	500.00	111.67	190.73	40.00
Be	0/6	--	--	--	--	-- / .50
B	3/6	90.00	170.00	126.67	40.41	120.00/ 70.00
Cd	1/6	25.00	25.00	25.00	.00	25.00/ 3.00
Cr	2/6	11.00	99.00	55.00	62.23	55.00/ 5.00
Co	0/6	--	--	--	--	-- / 5.00
Cu	4/6	8.00	730.00	249.75	339.65	130.50/ 9.50
Fe	6	430.00	26,000.00	5,538.33	10,069.22	1,705.00
Pb	2/6	100.00	2,900.00	1,500.00	1,979.90	1,500.00/ 50.00
Mn	6	33.00	2,000.00	416.33	778.67	112.00
Ni	1/6	48.00	48.00	48.00	.00	48.00/ 5.00
Ag	0/6	--	--	--	--	-- / 3.00
Sr	6	10.00	160.00	55.00	53.94	45.00
V	1/6	34.00	34.00	34.00	.00	34.00/ 5.00
Zn	4/6	160.00	2,100.00	655.00	963.52	180.00/ 160.00
Al	6	240.00	12,000.00	2,616.67	4,617.52	800.00
PHNL	2/4	10.00	10.00	10.00	.00	10.00/ 7.50
TDS	4	83.00	170.00	127.75	41.40	129.00
Hg	4/6	.03	.16	.09	.06	.08/ .04

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled storm sewers--Continued

storm number 3, July 31 to August 1

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	8	240.00	1,410.00	1,120.00	524.976	1,405.00	
BOD	5	2.60	40.00	16.94	19.278	3.10	
COD	5	3.00	180.00	53.60	77.468	4.00	
TSS	8	2.00	420.00	107.37	192.344	4.00	
VSS	7/8	2.00	102.00	30.57	48.117	3.00/	2.50
NH_3	2/8	.11	.24	.17	.092	.17/	.10
TKN	8	.30	4.60	1.37	1.497	.85	
NOx	8	.88	5.70	4.36	1.941	5.30	
P	8	.02	.88	.19	.312	.04	
TOC	8	2.10	18.00	6.44	6.589	3.25	
HRD	3	250.00	610.00	483.33	202.320	590.00	
Ca	3	80.00	140.00	120.00	34.641	140.00	
Mg	3	12.00	63.00	45.67	29.160	62.00	
Na	3	10.00	83.00	58.33	41.861	82.00	
K	3	1.40	4.50	2.43	1.790	1.40	
Cl	2	16.00	140.00	78.00	87.681	78.00	
SO_4	2	40.00	240.00	140.00	141.421	140.00	
F	3/4	.20	.20	.20	.00	.20/	.20
As	1/3	2.00	2.00	2.00	.00	2.00/	1.00
Ba	3	40.00	70.00	50.00	17.321	40.00	
Be	0/3	--	--	--	--	-- /	.50
B	3	130.00	470.00	353.33	193.477	460.00	
Cd	2/3	3.00	8.00	5.50	3.536	5.50/	3.00
Cr	3	13.00	110.00	64.33	48.748	70.00	
Co	2/3	6.00	7.00	6.50	.707	6.50/	6.00
Cu	3	8.00	23.00	13.00	8.660	8.00	
Fe	2/3	70.00	4,000.00	2,035.00	2,778.930	2,035.00/	70.00
Pb	1/3	140.00	140.00	140.00	.00	140.00/	50.00
Mn	3	7.00	370.00	130.00	207.868	13.00	
Ni	2/3	12.00	14.00	13.00	1.414	13.00/	12.00
Ag	1/3	3.00	3.00	3.00	.00	3.00/	3.00
Sr	3	70.00	170.00	136.67	57.735	170.00	
V	1/3	9.00	9.00	9.00	.00	9.00/	5.00
Zn	1/3	150.00	150.00	150.00	.00	150.00/	50.00
Al	1/3	1,700.00	1,700.00	1,700.00	.00	1,700.00/	50.00
PHNL	0/1	--	--	--	--	-- /	5.00
TDS	2	211.00	897.00	554.00	485.075	554.00	
Hg	2/3	.05	.14	.09	.064	.09/	.05

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled storm sewers--Continued

storm number 4, August 26-27

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	9	140.00	580.00	291.11	131.856	250.00	
BOD	3	19.00	23.00	21.33	2.082	22.00	
COD	4	56.00	320.00	150.50	116.977	113.00	
TSS	9	37.00	380.00	184.78	97.724	170.00	
VSS	9	11.00	128.00	65.67	38.288	54.00	
NH_3	8/9	.11	.63	.37	.193	.40/	0.36
TKN	9	1.30	14.00	5.07	4.389	3.10	
NOx	9	1.10	2.80	1.69	.494	1.60	
P	9	.26	1.90	.73	.556	.38	
TOC	9	11.00	70.00	34.78	23.456	19.00	
HRD	4	100.00	180.00	142.50	38.622	145.00	
Ca	4	34.00	54.00	42.75	10.308	41.50	
Mg	4	4.90	15.00	9.15	4.270	8.35	
Na	4	5.50	22.00	11.85	7.818	9.95	
K	4	2.40	9.10	4.30	3.220	2.85	
Cl	2	6.30	8.30	7.30	1.414	7.30	
SO_4	2	16.00	20.00	18.00	2.828	18.00	
F	1/4	.10	.10	.10	.00	.10/	.10
As	4	1.00	5.00	3.75	1.893	4.50	
Ba	4	40.00	90.00	55.00	23.805	45.00	
Be	3/4	2.00	4.00	3.00	1.000	3.00/	2.50
B	3/4	80.00	130.00	100.00	26.458	90.00/	85.00
Cd	2/4	3.00	4.00	3.50	.707	3.50/	3.00
Cr	3/4	32.00	320.00	167.33	144.780	150.00/	91.00
Co	2/4	6.00	7.00	6.50	.707	6.50/	5.50
Cu	4	25.00	110.00	67.75	39.076	68.00	
Fe	4	2,300.00	5,800.00	3,650.00	1,621.727	3,250.00	
Pb	2/4	120.00	290.00	205.00	120.208	205.00/	110.00
Mn	4	120.00	290.00	200.00	78.740	195.00	
Ni	2/4	9.00	11.00	10.00	1.414	10.00/	7.00
Ag	1/4	3.00	3.00	3.00	.00	3.00/	3.00
Sr	4	30.00	70.00	45.00	17.321	40.00	
V	2/4	7.00	11.00	9.00	2.828	9.00/	6.00
Zn	4	170.00	310.00	222.50	63.966	205.00	
Al	4	1,400.00	4,000.00	2,300.00	1,160.460	1,900.00	
PHNL	2	10.00	35.00	22.50	17.678	22.50	
TDS	2	181.00	266.00	223.50	60.104	223.50	
Hg	2/4	.01	.12	.06	.078	.06/	.01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled storm sewers--Continued

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	20	110.00	1,140.00	465.00	353.025	340.00	
BOD	11	10.00	100.00	39.55	30.911	27.00	
COD	11	45.00	320.00	126.64	94.282	100.00	
TSS	20	30.00	900.00	188.25	203.330	121.50	
VSS	20	10.00	225.00	55.40	53.222	38.50	
NH_3	9/20	.10	5.10	1.36	2.043	.15/	0.10
TKN	20	.90	11.00	3.18	2.659	2.05	
NOx	19/20	.16	4.00	1.49	1.110	1.20/	1.08
P	20	.18	2.10	.66	.577	.43	
TOC	20	9.50	68.00	26.92	18.545	20.50	
HRD	9	81.00	510.00	220.22	146.740	170.00	
Ca	9	25.00	120.00	60.11	32.367	50.00	
Mg	9	4.00	50.00	17.40	16.217	12.00	
Na	9	6.50	50.00	22.01	17.601	13.00	
K	9	1.10	9.40	4.07	2.708	3.30	
Cl	3	9.30	91.00	39.43	44.869	18.00	
SO_4	3	20.00	130.00	63.33	58.595	40.00	
F	5/9	.10	.30	.20	.071	.20/	.10
As	9	2.00	6.00	3.67	1.225	3.00	
Ba	9	30.00	100.00	65.56	27.437	60.00	
Be	3/9	.50	5.00	2.50	2.291	2.00/	1.00
B	8/9	60.00	470.00	162.50	138.950	115.00/	100.00
Cd	1/9	4.00	4.00	4.00	.00	4.00/	3.00
Cr	8/9	6.00	88.00	28.87	27.972	18.00/	12.00
Co	3/9	5.00	7.00	6.33	1.155	7.00/	5.00
Cu	9	11.00	180.00	51.78	52.127	31.00	
Fe	9	1,700.00	7,400.00	3,544.44	2,046.406	2,800.00	
Pb	5/9	110.00	280.00	192.00	74.632	210.00/	110.00
Mn	9	90.00	2,300.00	532.22	718.745	200.00	
Ni	7/9	7.00	16.00	11.29	2.690	11.00/	11.00
Ag	0/9	-	-	-	-	- /	3.00
Sr	9	30.00	170.00	74.44	47.463	60.00	
V	4/9	5.00	10.00	7.25	2.062	7.00/	5.00
Zn	9	110.00	440.00	220.00	109.430	210.00	
Al	9	520.00	2,500.00	1,364.44	653.129	1,400.00	
PHNL	2	5.00	10.00	7.50	3.536	7.50	
TDS	3	117.00	662.00	350.67	280.678	273.00	
Hg	2/9	.07	.32	.19	.177	.19/	.05

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from all of the sampled storm sewers--Continued

samples collected from storms 1, 2, 3, 4, and 5 combined

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	57	70.00	1,410.00	508.07	410.59	340.00
BOD	31	2.60	100.00	32.68	25.66	27.00
COD	32	3.00	960.00	160.87	190.12	98.00
TSS	57	2.00	3,200.00	333.81	620.49	133.00
VSS	56/57	2.00	640.00	82.91	126.16	44.00/ 44.00
NH_3	36/57	.10	5.10	1.04	1.38	.45/ .15
TKN	57	.30	25.00	4.59	5.04	2.60
NOx	53/57	.10	5.70	1.67	1.59	1.20/ 1.10
P	57	.02	4.50	.74	.79	.45
TOC	56	2.10	70.00	25.05	21.03	17.00
HRD	28	34.00	960.00	268.96	231.01	175.00
Ca	28	12.00	290.00	76.75	65.38	52.00
Mg	28	1.20	63.00	19.19	19.09	12.00
Na	28	1.80	83.00	22.49	22.23	13.50
K	28	.60	13.00	4.57	3.45	3.25
Cl	13	2.10	140.00	36.65	43.93	16.00
SO_4	10/13	16.00	240.00	66.10	71.97	36.00/ 23.00
F	15/29	.10	.30	.17	.06	.20/ .10
As	25/28	1.00	30.00	5.92	7.81	3.00/ 3.00
Ba	28	20.00	1,000.00	120.36	204.06	50.00
Be	7/28	.50	7.00	3.36	2.17	3.00/ .50
B	23/28	50.00	470.00	169.13	127.70	130.00/ 115.00
Cd	10/28	3.00	25.00	8.00	7.76	4.00/ 3.00
Cr	22/28	6.00	320.00	52.32	71.61	25.50/ 13.00
Co	10/28	5.00	30.00	9.10	7.46	7.00/ 5.00
Cu	26/28	8.00	730.00	94.12	149.14	45.00/ 39.50
Fe	27/28	70.00	58,000.00	6,862.96	12,182.94	2,600.00/2,550.00
Pb	14/28	100.00	2,900.00	508.57	781.06	225.00/ 100.00
Mn	28	7.00	3,900.00	544.57	882.12	170.00
Ni	18/28	7.00	71.00	20.11	16.45	13.00/ 11.00
Ag	3/28	3.00	4.00	3.33	.58	3.00/ 3.00
Sr	28	10.00	240.00	83.57	57.43	65.00
V	13/28	5.00	100.00	20.77	26.75	9.00/ 5.00
Zn	24/28	110.00	2,500.00	430.42	612.07	205.00/ 195.00
Al	26/28	240.00	33,000.00	3,634.23	6,880.99	1,400.00/1,400.00
PHNL	8/11	5.00	35.00	16.87	11.93	10.00/ 10.00
TDS	13	83.00	897.00	304.38	245.58	211.00
Hg	13/28	.01	.32	.12	.09	.11/ .05

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from Railroad Creek storm sewer; site RR1

storm number 1, May 16-20

Con- stit- uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	5	300.00	390.0	324.00	37.148	310.00
BOD	3	13.00	61.0	29.67	27.154	15.00
COD	3	31.00	190.0	90.67	86.604	51.00
TSS	5	38.00	510.0	195.60	189.264	126.00
VSS	5	17.00	140.0	55.00	48.826	44.00
NH_3	5	.24	.5	.35	.102	.35
TKN	5	1.60	5.0	2.66	1.367	2.30
NOx	5	.33	1.2	.96	.365	1.10
P	5	.23	1.2	.53	.391	.39
TOC	5	7.00	15.0	9.54	3.280	8.50
HRD	3	130.00	250.0	173.33	66.583	140.00
Ca	3	40.00	79.0	53.33	22.234	41.00
Mg	3	8.30	14.0	10.37	3.156	8.80
Na	3	12.00	13.0	12.67	.577	13.00
K	3	3.20	4.2	3.67	.503	3.60
Cl	1	17.00	17.0	17.00	.00	17.00
SO_4	1	34.00	34.0	34.00	.00	34.00
F	3	.20	.2	.20	.00	.20
As	3	10.00	19.0	13.67	4.726	12.00
Ba	3	40.00	100.0	66.67	30.551	60.00
Be	0/3	--	--	--	--	-- / 0.50
B	3	90.00	120.0	110.00	17.321	120.00
Cd	1/3	8.00	8.0	8.00	.00	8.00/ 3.00
Cr	2/3	5.00	18.0	11.50	9.192	11.50/ 5.00
Co	1/3	10.00	10.0	10.00	.00	10.00/ 5.00
Cu	3	13.00	63.0	31.33	27.538	18.00
Fe	3	1,400.00	7,200.0	3,433.33	3,265.476	1,700.00
Pb	1/3	210.00	210.0	210.00	.00	210.00/ 100.00
Mn	3	64.00	400.0	186.33	185.689	95.00
Ni	2/3	6.00	12.0	9.00	4.243	9.00/ 6.00
Ag	0/3	--	--	--	--	-- / 3.00
Sr	3	70.00	90.0	80.00	10.000	80.00
V	1/3	11.00	11.0	11.00	.00	11.00/ 5.00
Zn	2/3	100.00	420.0	260.00	226.274	260.00/ 100.00
Al	3	470.00	3,100.0	1,403.33	1,471.813	640.00
PHNL	0	--	--	--	--	--
TDS	1	225.00	225.0	225.00	.00	225.00
Hg	0/3	--	--	--	--	-- / .01

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from Railroad Creek storm sewer; site RR1--Continued

storm number 2, July 7-10

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]
SPCN	7	170.00	270.00	222.86	45.722	210.00
BOD	4	9.30	33.00	22.07	12.197	23.00
COD	4	27.00	160.00	82.75	63.757	72.00
TSS	7	36.00	640.00	230.71	274.893	70.00
VSS	7	13.00	104.00	43.00	38.423	20.00
NH_3	3/7	.10	.27	.19	.085	.20/ 0.10
TKN	7	.80	4.20	2.07	1.288	1.60
NOx	7	.82	1.60	1.09	.325	.91
P	6/7	.19	1.20	.54	.385	.48/ .33
TOC	7	4.20	23.00	9.77	6.178	7.60
HRD	4	93.00	310.00	173.25	98.635	145.00
Ca	4	30.00	100.00	56.25	31.983	47.50
Mg	4	4.50	11.00	7.15	2.793	6.55
Na	4	5.80	11.00	8.23	2.298	8.05
K	4	1.70	4.70	3.05	1.261	2.90
Cl	2	7.80	16.00	11.90	5.798	11.90
SO_4	2	27.00	39.00	33.00	8.485	33.00
F	0/4	--	--	--	--	-- / .10
As	4	3.00	36.00	18.50	13.675	17.50
Ba	4	30.00	100.00	62.50	33.040	60.00
Be	0/4	--	--	--	--	-- / .50
B	4	60.00	100.00	77.50	17.078	75.00
Cd	0/4	--	--	--	--	-- / 3.00
Cr	3/4	13.00	20.00	15.67	3.786	14.00/ 13.50
Co	0/4	--	--	--	--	-- / 5.00
Cu	4	17.00	57.00	30.00	18.673	23.00
Fe	4	980.00	6,300.00	3,345.00	2,536.684	3,050.00
Pb	2/4	110.00	210.00	160.00	70.711	160.00/ 80.00
Mn	3	59.00	550.00	230.33	277.078	82.00
Ni	1/4	260.00	260.00	260.00	.00	260.00/ 5.00
Ag	0/4	--	--	--	--	-- / 3.00
Sr	4	50.00	70.00	62.50	9.574	65.00
V	2/4	6.00	9.00	7.50	2.121	7.50/ 5.50
Zn	2/4	300.00	340.00	320.00	28.284	320.00/ 200.00
Al	4	440.00	3,000.00	1,417.50	1,201.010	1,115.00
PHNL	2	5.00	40.00	22.50	24.749	22.50
TDS	2	171.00	180.00	175.50	6.364	175.50
Hg	2/4	.05	.05	.05	.00	.05/ .03

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from Railroad Creek storm sewer; site RR1--Continued

storm number 3, no samples collected

storm number 4, no samples collected

storm number 5, September 11-12

Constituent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	3	170.00	290.00	230.00	60.0000	230.00	
BOD	2	13.00	35.00	24.00	15.5563	24.00	
COD	2	68.00	160.00	114.00	65.0538	114.00	
TSS	3	170.00	688.00	387.33	268.8668	304.00	
VSS	3	46.00	122.00	77.33	39.7157	64.00	
NH_3	2/3	.15	.23	.19	.0566	.19/	0.15
TKN	3	1.00	3.70	2.37	1.3503	2.40	
NOx	3	.52	.84	.66	.1650	.61	
P	3	.33	1.30	.85	.4895	.93	
TOC	3	13.00	23.00	18.33	5.0332	19.00	
HRD	1	250.00	250.00	250.00	.00	250.00	
Ca	1	74.00	74.00	74.00	.00	74.00	
Mg	1	16.00	16.00	16.00	.00	16.00	
Na	1	11.00	11.00	11.00	.00	11.00	
K	1	4.70	4.70	4.70	.00	4.70	
Cl	1	13.00	13.00	13.00	.00	13.00	
SO_4	1	27.00	27.00	27.00	.00	27.00	
F	1	.20	.20	.20	.00	.20	
As	1	11.00	11.00	11.00	.00	11.00	
Ba	1	100.00	100.00	100.00	.00	100.00	
Be	1	.50	.50	.50	.00	.50	
B	1	130.00	130.00	130.00	.00	130.00	
Cd	0/1	--	--	--	--	-- /	3.00
Cr	1	13.00	13.00	13.00	.00	13.00	
Co	0/1	--	--	--	--	-- /	5.00
Cu	1	120.00	120.00	120.00	.00	120.00	
Fe	1	7,000.00	7,000.00	7,000.00	.00	7,000.00	
Pb	1	200.00	200.00	200.00	.00	200.00	
Mn	1	1,000.00	1,000.00	1,000.00	.00	1,000.00	
Ni	1	10.00	10.00	10.00	.00	10.00	
Ag	0/1	--	--	--	--	-- /	3.00
Sr	1	90.00	90.00	90.00	.00	90.00	
V	1	9.00	9.00	9.00	.00	9.00	
Zn	1	270.00	270.00	270.00	.00	270.00	
Al	1	2,600.00	2,600.00	2,600.00	.00	2,600.00	
PHNL	1	15.00	15.00	15.00	.00	15.00	
TDS	1	215.00	215.00	215.00	.00	215.00	
Hg	0	--	--	--	--	--	

APPENDIX C

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

Results from Railroad Creek storm sewer; site RR1--Continued

samples collected from storms 1, 2, and 5 combined

Con-stit-uent code[1]	Number of samples[2]	Low	High	Mean	Standard deviation	Median[3]	
SPCN	15	170.00	390.00	258.00	64.387	270.00	
BOD	9	9.30	61.00	25.03	16.824	15.00	
COD	9	27.00	190.00	92.33	63.975	68.00	
TSS	15	36.00	688.00	250.33	241.312	140.00	
VSS	15	13.00	140.00	53.87	41.433	44.00	
NH_3	10/15	.10	.50	.27	.115	.25/	0.20
TKN	15	.80	5.00	2.33	1.256	2.30	
NOx	15	.33	1.60	.96	.341	.91	
P	14/15	.19	1.30	.60	.399	.45/	.39
TOC	15	4.20	23.00	11.41	5.993	9.90	
HRD	8	93.00	310.00	182.87	78.561	160.00	
Ca	8	30.00	100.00	57.37	25.037	50.50	
Mg	8	4.50	16.00	9.46	3.963	8.55	
Na	8	5.80	13.00	10.24	2.699	11.00	
K	8	1.70	4.70	3.49	1.043	3.40	
Cl	4	7.80	17.00	13.45	4.132	14.50	
SO_4	4	27.00	39.00	31.75	5.852	30.50	
F	4/8	.20	.20	.20	.00	.20/	.15
As	8	3.00	36.00	15.75	9.794	13.50	
Ba	8	30.00	100.00	68.75	29.970	70.00	
Be	1/8	.50	.50	.50	.00	.50/	.50
B	8	60.00	130.00	96.25	25.600	95.00	
Cd	1/8	8.00	8.00	8.00	.00	8.00/	3.00
Cr	6/8	5.00	20.00	13.83	5.193	13.50/	13.00
Co	1/8	10.00	10.00	10.00	.00	10.00/	5.00
Cu	8	13.00	120.00	41.75	36.962	23.00	
Fe	8	980.00	7,200.00	3,835.00	2,727.966	3,150.00	
Pb	4/8	110.00	210.00	182.50	48.563	205.00/	105.00
Mn	7	59.00	1,000.00	321.43	356.514	95.00	
Ni	4/8	6.00	260.00	72.00	125.358	11.00/	5.50
Ag	0/8	--	--	--	--	-- /	3.00
Sr	8	50.00	90.00	72.50	13.887	70.00	
V	4/8	6.00	11.00	8.75	2.062	9.00/	5.50
Zn	5/8	100.00	420.00	286.00	118.237	300.00/	185.00
Al	8	440.00	3,100.00	1,560.00	1,189.009	1,170.00	
PHNL	3	5.00	40.00	20.00	18.028	15.00	
TDS	4	171.00	225.00	197.75	26.273	197.50	
Hg	2/7	.05	.05	.05	.00	.05/	.01

Descriptive Statistics for the Samples Collected During the Five Storms Sampled in 1986--Continued

[1] Constituent codes refer to the following list.

Name	Description
SPCN	Specific conductance (microsiemens per centimeter)
BOD	Oxygen demand, biochemical ultimate Carbonaceous (mg/L)
COD	Chemical oxygen demand, total (mg/L)
TSS	Total suspended solids (mg/L)
VSS	Volatile solids, total suspended (mg/L)
NH_3	Nitrogen, ammonia total (mg/L)
TKN	Nitrogen total organic plus ammonia (mg/L)
NOx	Nitrogen, NO_2 + NO_3 total (mg/L)
P	Phosphorus, total (mg/L)
TOC	Carbon, total organic (mg/L)
HRD	Hardness (mg/L)
Ca	Calcium, total recoverable (mg/L)
Mg	Magnesium, total recoverable (mg/L)
Na	Sodium, total recoverable (mg/L)
K	Potassium, total recoverable (mg/L)
Cl	Chloride, total recoverable (mg/L)
SO_4	Sulfate, total recoverable (mg/L)
F	Fluoride, total recoverable (mg/L)
As	Arsenic, total recoverable (μg/L)
Ba	Barium, total recoverable (μg/L)
Be	Beryllium, total recoverable (μg/L)
B	Boron, total recoverable (μg/L)
Cd	Cadmium, total recoverable (μg/L)
Cr	Chromium, total recoverable (μg/L)
Co	Cobalt, total recoverable (μg/L)
Cu	Copper, total recoverable (μg/L)
Fe	Iron, total recoverable (μg/L)
Pb	Lead, total recoverable (μg/L)
Mn	Manganese, total recoverable (μg/L)
Ni	Nickel, total recoverable (μg/L)
Ag	Silver, total recoverable (μg/L)
Sr	Strontium, total recoverable (μg/L)
V	Vanadium, total recoverable (μg/L)
Zn	Zinc, total recoverable (μg/L)
Al	Aluminum, total recoverable (μg/L)
PHNL	Phenols, total (μg/L)
TDS	Solids, dissolved (mg/L)
Hg	Mercury, total (μg/L)

[2] Number of samples in the form of number above detection limit/number of samples total

[3] Medians determined from samples above detection limit/all samples with those below detection limit set equal to the detection limit.

APPENDIX D

Constituent Loads from Sources of Runoff to Cedar Creek for Selected Storms in 1986

[Storm No. indicates the five sampled storms in 1986 where 1 = May 16-20, 2 = July 7-10, 3 = July 31 to August 1, 4 = August 26-27, and 5 = September 11-12; Maximum refers to loads based on volumes of combined-sewer overflow calculated assuming a Gaussian-type flow distribution and assuming maximum durations for missing duration results; and Average refers to loads based on volumes of combined-sewer overflow calculated assuming a distribution similar to that measured at sites C6 and C22 and assuming average durations for missing duration results]

Storm		Combined-sewer overflows		Storm-sewer discharges		Site	Site	Site	Site	Total loads	
No.	Site 1	Maximum	Average	Maximum	Average	WWTF	T21	T23	T24	Maximum	Average
	Ultimate carbonaceous biochemical oxygen demand loads, in pounds per storm										
1	2,670	8,120	3,880	23,100	27,300	14,800	3,990	8,680	10,800	72,200	72,100
2	90	792	190	1,070	1,350	3,570	186	304	323	6,340	6,010
3	176	23,800	12,900	2,810	3,930	10,500	7,080	4,350	7,840	56,600	46,800
4	16.9	165	45.1	321	407	2,440	94.4	62.3	13.9	3,110	3,080
5	22.9	1,610	571	3,740	4,380	3,650	268	119	136	9,550	9,150
	Chemical oxygen demand loads, in pounds per storm										
1	9,600	25,000	12,000	110,000	130,000	21,000	16,000	87,000	230,000	500,000	510,000
2	420	1,400	350	2,600	3,200	5,000	1,200	1,500	3,700	16,000	15,000
3	1,100	160,000	88,000	3,600	5,100	15,000	28,000	22,000	110,000	340,000	270,000
4	78	640	170	1,700	2,100	3,500	370	310	44	6,600	6,600
5	100	3,700	1,300	14,000	16,000	5,600	1,000	600	1,500	27,000	26,000
	Total suspended solids loads, in pounds per storm										
1	81,800	106,000	51,000	108,000	128,000	5,860	136,000	755,000	1,100,000	2,290,000	2,260,000
2	2,650	8,160	1,960	10,300	13,000	1,790	6,650	24,600	30,900	85,100	81,600
3	4,190	409,000	222,000	3,620	5,070	4,130	242,000	353,000	743,000	1,760,000	1,570,000
4	498	2,520	687	2,480	3,140	961	3,230	5,060	289	15,000	13,900
5	852	10,100	3,580	16,800	19,700	1,580	9,890	9,630	13,000	61,900	58,200
	Volatile suspended solids loads, in pounds per storm										
1	15,600	21,300	10,200	34,200	40,400	3,350	17,700	107,000	151,000	350,000	345,000
2	442	1,560	374	1,750	2,210	1,190	851	3,040	3,560	12,400	11,700
3	723	112,000	60,900	2,260	3,170	2,360	31,500	43,500	79,200	272,000	221,000
4	82.9	608	166	789	998	549	420	623	49	3,120	2,890
5	142	1,650	584	5,340	6,250	690	1,160	1,190	1,500	11,700	11,500
	Total ammonia nitrogen loads, in pounds per storm										
1	20.4	597	286	671	791	197	32.5	187	407	2,110	1,920
2	.82	5.87	1.41	10.3	13	42.4	3.99	6.68	8.22	78.3	76.5
3	2.41	547	297	90.5	127	138	57.7	95.6	170	1,100	888
4	.15	2.40	.65	5.26	6.65	32.3	.77	1.37	.32	42.6	42.2
5	.26	8.41	2.99	13.9	16.2	197	2.14	2.61	3.47	228	225

Total organic plus ammonia nitrogen loads, in pounds per storm

1	540	1,700	810	3,500	4,200	1,700	560	3,700	6,900	19,000	18,000
2	13	88	21	130	170	320	33	110	210	900	880
3	39	4,400	2,400	770	1,100	1,200	1,000	1,600	5,100	14,000	12,000
4	2.5	20	5.4	45	57	280	13	23	1.7	390	380
5	3.4	66	23	280	330	480	39	43	87	1,000	1,000

Total nitrite plus nitrate nitrogen loads, in pounds per storm

1	981	25.5	12.2	62.5	73.7	4,180	856	3,870	1,210	11,200	11,200
2	40.1	12	2.89	65	82.1	1,590	58.5	140	44.7	1,950	1,960
3	79.5	476	258	4,800	6,720	2,950	1,520	2,000	718	12,500	14,200
4	7.52	3.68	1.00	23.4	29.6	687	20.3	28.7	41.1	812	815
5	3.15	9.88	3.51	150	176	631	30	54.6	18.9	898	917

Total phosphorus loads, in pounds per storm

1	114	350	168	483	570	1,710	210	802	2,010	5,680	5,580
2	4.58	18.2	4.37	26.9	34	596	10.4	24.2	46.2	726	720
3	14.2	666	361	40.7	57	1,210	372	346	979	3,630	3,340
4	.86	4.32	1.18	5.55	7.02	282	4.96	4.96	.58	303	302
5	1.21	21.2	7.53	59.6	69.8	355	14.6	9.44	19.5	481	477

Total organic carbon loads, in pounds per storm

1	1,300	3,300	1,600	16,000	19,000	6,300	3,500	7,700	35,000	73,000	74,000
2	59	260	63	680	860	1,700	150	240	790	3,900	3,900
3	170	13,000	7,300	2,900	4,100	4,400	6,300	3,500	18,000	48,000	44,000
4	11	140	39	280	350	1,000	84	50	7.6	1,600	1,500
5	19	440	160	2,800	3,300	1,800	260	95	330	5,700	6,000

Hardness loads as calcium carbonate, in pounds per storm

1	28,000	38,000	18,000	120,000	140,000	120,000	77,000	180,000	87,000	650,000	660,000
2	1,700	3,300	800	8,300	10,000	38,000	3,100	7,300	3,300	65,000	64,000
3	5,300	240,000	130,000	530,000	750,000	83,000	140,000	100,000	65,000	1,200,000	1,300,000
4	320	750	200	2,100	2,700	19,000	1,800	1,500	1,200	27,000	27,000
5	550	4,000	1,400	24,000	28,000	21,000	6,200	2,800	1,400	60,000	61,000

Total recoverable calcium loads, in pounds per storm

1	7,300	11,000	5,400	35,000	41,000	29,000	20,000	48,000	22,000	170,000	170,000
2	460	950	230	2,500	3,100	9,500	800	1,800	920	17,000	17,000
3	1,600	72,000	39,000	130,000	180,000	21,000	35,000	26,000	17,000	300,000	320,000
4	86	230	64	610	770	4,800	460	370	260	6,800	6,800
5	150	1,300	470	6,900	8,100	5,500	1,600	700	390	17,000	17,000

Total recoverable magnesium loads, in pounds per storm

1	2,400	2,100	1,000	9,000	11,000	10,000	6,600	19,000	6,900	57,000	58,000
2	120	230	56	460	580	3,400	270	740	260	5,500	5,400
3	310	14,000	7,500	56,000	79,000	7,400	12,000	11,000	5,600	110,000	120,000
4	23	41	11	120	150	1,700	160	150	120	2,300	2,300
5	39	180	65	1,700	1,900	1,900	580	290	110	4,800	4,900

Constituent Loads from Sources of Runoff to Cedar Creek for Selected Storms in 1986--Continued

Storm No.	Site 1	Combined-sewer overflows		Storm-sewer discharges		Site WWTF	Site T21	Site T23	Site T24	Total loads	
		Maximum	Average	Maximum	Average					Maximum	Average
Total recoverable sodium loads, in pounds per storm											
1	3,100	1,300	610	9,000	11,000	34,000	7,200	13,000	950	69,000	69,000
2	52	190	45	730	920	13,000	270	410	48	15,000	15,000
3	48	5,400	2,900	74,000	100,000	24,000	13,000	5,900	880	120,000	150,000
4	9.8	30	8.3	150	180	5,600	170	85	36	6,100	6,100
5	17	99	35	1,800	2,100	6,400	580	160	20	9,100	9,300
Total recoverable potassium loads, in pounds per storm											
1	480	290	140	4,200	4,900	3,700	1,700	4,500	3,500	18,000	19,000
2	24	38	9.2	140	170	1,100	73	150	120	1,600	1,600
3	51	2,500	1,300	1,300	1,800	2,600	2,900	2,200	3,200	15,000	14,000
4	4.5	6.9	1.9	42	53	610	39	31	6.2	740	750
5	7.8	24	8.4	460	540	870	120	60	49	1,600	1,700
Total recoverable chloride loads, in pounds per storm											
1	1,900	1,509	720	34,000	40,000	40,000	11,000	22,000	7,400	120,000	120,000
2	120	380	92	740	940	17,000	480	790	250	20,000	20,000
3	360	4,800	2,600	71,000	99,000	28,000	19,000	11,000	5,600	140,000	170,000
4	23	33	8.9	110	130	6,600	250	160	54	7,200	7,200
5	39	220	79	2,500	2,900	8,000	770	310	110	12,000	12,000
Total recoverable sulfate loads, in pounds per storm											
1	2,500	2,100	990	31,000	36,000	21,000	26,000	28,000	15,000	120,000	130,000
2	160	540	130	860	1,100	8,500	1,200	1,000	500	13,000	13,000
3	480	12,000	6,700	130,000	180,000	15,000	46,000	14,000	11,000	230,000	270,000
4	31	67	18	260	330	3,500	620	210	110	4,800	4,800
5	53	460	160	5,500	6,500	3,600	1,900	390	210	12,000	13,000
Total recoverable fluoride loads, in pounds per storm											
1	26	16	7.6	46	55	360	59	200	87	790	790
2	.82	2.9	.71	8.6	11	86	2.7	7.3	2.9	110	110
3	2.4	160	86	180	250	250	100	100	33	830	820
4	.15	.53	.15	1.5	1.8	58	1.4	1.5	.95	64	64
5	.26	3.7	1.3	14	16	84	4.3	2.8	1.2	110	110
Total recoverable arsenic loads, in pounds per storm											
1	0.64	0.48	0.23	2.8	3.3	0.42	2.8	4.0	4.3	16	16
2	.03	.07	.02	.09	.11	.13	.17	.15	.13	.77	.74
3	.07	170	95	.91	1.3	.29	5.0	2.1	3.3	180	110
4	.00	.03	.01	.07	.08	.07	.07	.03	.01	.28	.27
5	.01	.13	.05	.42	.49	.10	.15	.06	.06	.93	.92

Total recoverable barium loads, in pounds per storm

1	26	15	7.2	58	68	17	44	200	480	840	840
2	1.6	1.5	.35	3.4	4.3	6.0	2.7	6.1	14	35	35
3	4.8	280	150	36	51	12	79	87	290	790	670
4	.31	.37	.10	.66	.83	2.8	1.0	1.2	.63	7.0	6.9
5	.53	1.70	.58	8.30	9.7	4.0	2.1	2.4	5.9	25	25

Total recoverable beryllium loads, in pounds per storm

1	0.25	0.12	0.06	0.23	0.27	1.3	0.37	1.3	2.2	5.7	5.6
2	.01	.04	.01	.04	.05	.33	.03	.05	.06	.56	.54
3	.01	.40	.22	.45	.63	.88	.66	.70	1.3	4.4	4.4
4	.00	.00	.00	.04	.05	.21	.01	.01	.00	.27	.28
5	.00	.07	.03	.14	.16	.39	.01	.02	.02	.65	.63

Total recoverable boron loads, in pounds per storm

1	6.4	8.0	3.8	67	79	120	90	150	22	470	480
2	.41	1.9	.46	6.0	7.6	40	3.3	4.9	.73	57	57
3	1.2	79	43	420	580	85	160	70	33	850	970
4	.08	.32	.09	1.2	1.6	20	2.1	1.0	.16	25	25
5	.13	1.8	.65	14	16	24	8.1	1.9	.31	50	51

Total recoverable cadmium loads, in pounds per storm

1	0.51	1.3	0.61	1.4	1.6	1.3	0.89	2.0	1.3	8.6	8.2
2	.03	.09	.02	.26	.32	.40	.04	.07	.05	.94	.93
3	.07	10	5.6	2.7	3.8	.88	1.6	1.0	2.0	18	15
4	.00	.02	.00	.04	.06	.21	.02	.02	.01	.32	.32
5	.01	.13	.05	.42	.49	.30	.06	.03	.02	.97	.96

Total recoverable chromium loads, in pounds per storm

1	1.4	2.3	1.1	6.5	7.6	5.2	2.5	12	12	42	42
2	.05	.31	.07	.43	.54	1.9	.20	.38	.25	3.5	3.4
3	.12	17	9.3	63	89	3.7	4.5	5.4	5.2	99	120
4	.01	.06	.02	1.3	1.7	.86	.06	.08	.04	2.4	2.8
5	.01	.18	.07	1.7	2.0	.64	.11	.15	.11	2.9	3.1

Total recoverable cobalt loads, in pounds per storm

1	1.3	0.96	0.46	2.5	3.0	2.1	1.5	6.7	13	28	28
2	.07	.15	.04	.43	.54	.66	.07	.22	.44	2.0	2.0
3	.17	9.9	5.4	5.4	7.6	1.5	2.6	3.1	9.8	33	30
4	.01	.03	.01	.08	.10	.34	.04	.05	.02	.57	.57
5	.02	.18	.07	.69	.81	.49	.11	.09	.19	1.8	1.8

Total recoverable copper loads, in pounds per storm

1	2.2	8.1	3.9	39	46	18	7.8	19	29	120	130
2	.16	1.2	.30	.81	1.0	5.7	.36	.56	.91	9.7	9.0
3	.51	300	160	7.2	10	12	14	8.0	22	360	230
4	.03	.32	.09	.99	1.3	2.9	.19	.12	.03	4.6	4.7
5	.05	1.7	.59	4.3	5.0	4.0	.43	.22	.38	11	11

Constituent Loads from Sources of Runoff to Cedar Creek for Selected Storms in 1986--Continued

Storm No.	Site 1	Combined-sewer overflows Maximum	Combined-sewer overflows Average	Storm-sewer discharges Maximum	Storm-sewer discharges Average	Site WWTF	Site T21	Site T23	Site T24	Total loads Maximum	Total loads Average
Total recoverable iron loads, in pounds per storm											
1	1,200	910	430	3,400	4,000	110	2,200	15,000	15,000	38,000	38,000
2	73	56	13	150	180	34	150	420	490	1,400	1,400
3	230	10,000	5,600	63	89	77	4,000	6,100	11,000	31,000	27,000
4	14	22	6.1	47	60	18	53	87	15	260	250
5	24	100	37	390	450	30	120	170	210	1,000	1,000
Total recoverable lead loads, in pounds per storm											
1	6.4	41	19	110	130	21	15	33	43	270	260
2	.41	2.9	.71	4.3	5.4	6.6	1.3	1.2	1.5	18	17
3	2.4	340	190	45	63	15	26	17	52	500	370
4	.08	1	.28	1.6	2.0	3.4	.35	.25	.16	6.8	6.5
5	.13	4.9	1.8	15	18	4.9	1.1	.47	.62	27	27
Total recoverable manganese loads, in pounds per storm											
1	71	46	22	270	320	18	120	500	1,400	2,400	2,400
2	4.8	3.3	.78	9.6	12	6.2	7.2	17	39	87	87
3	18	320	170	12	16	13	210	250	850	1,700	1,500
4	.91	1.2	.32	2.8	3.6	3.0	2.8	3.5	.82	15	15
5	1.6	5.4	1.9	28	32	3.2	8.4	6.7	16	69	70
Total recoverable nickel loads, in pounds per storm											
1	1.9	1.1	0.53	12	14	2.1	3.3	11	19	50	51
2	.09	.15	.04	.43	.54	.66	.16	.36	.54	2.4	2.4
3	.27	21	12	11	15	1.5	5.8	5.2	10	55	50
4	.02	.04	.01	.10	.13	.34	.08	.08	.03	.69	.69
5	.03	.18	.07	1.5	1.8	.74	.21	.14	.23	3.0	3.2
Total recoverable silver loads, in pounds per storm											
1	0.38	0.64	0.30	1.4	1.6	1.3	0.89	2.0	1.3	7.9	7.8
2	.03	.09	.02	.26	.32	.40	.04	.07	.04	.93	.92
3	.07	2.4	1.3	2.7	3.8	.88	1.6	1.0	.98	9.6	9.6
4	.00	.02	.00	.04	.06	.21	.02	.02	.01	.32	.32
5	.01	.11	.04	.42	.49	.30	.06	.03	.02	.95	.95
Total recoverable strontium loads, in pounds per storm											
1	13	8.8	4.2	53	63	50	38	100	61	320	330
2	.49	.88	.21	3.9	4.9	16	1.6	3.8	2.1	29	29
3	.96	91	49	150	220	35	68	54	39	440	470
4	.09	.21	.06	.58	.74	8.2	.91	.77	.55	11	11
5	.16	.91	.33	8.3	9.7	10	3.2	1.5	.90	25	26

Total recoverable vanadium loads, in pounds per storm											
1	2.6	1.4	0.69	6.7	7.9	2.1	4.0	28	37	82	83
2	.14	.15	.04	.43	.54	.66	.27	.83	1.2	3.7	3.7
3	.36	14	7.7	4.5	6.3	1.5	7.1	12	25	65	60
4	.03	.03	.01	.09	.11	.34	.09	.17	.06	.81	.81
5	.04	.18	.07	.69	.81	.49	.28	.32	.49	2.5	2.5
Total recoverable zinc loads, in pounds per storm											
1	14	54	26	160	190	42	40	110	110	530	530
2	.94	6	1.4	14	17	13	2.4	3.2	3.5	43	41
3	3.1	900	490	45	63	29	71	45	82	1,200	780
4	.18	2	.55	3.0	3.8	6.9	.94	.65	.35	14	13
5	.30	9.9	3.5	29	34	9.9	2.1	1.2	1.5	54	53
Total recoverable aluminum loads, in pounds per storm											
1	920	330	160	1,700	2,000	25	1,300	11,000	13,000	28,000	28,000
2	48	15	3.6	68	86	6.6	92	300	420	950	960
3	130	5,000	2,700	45	63	18	2,200	4,200	9,100	21,000	18,000
4	9.1	9.6	2.6	28	35	4.1	30	61	17	160	160
5	16	42	15	190	230	11	75	120	180	630	650
Total phenols loads, in pounds per storm											
1	1.27	5.17	2.48	12.7	15	6.27	2.95	3.34	6.49	38.2	37.8
2	.08	.22	.05	.64	.81	1.32	.13	.12	.22	2.73	2.73
3	.24	11.9	6.45	9.05	12.7	4.42	5.24	1.74	4.90	37.5	35.7
4	.02	.05	.01	.33	.42	1.03	.07	.03	.05	1.58	1.63
5	.03	.37	.13	1.04	1.22	2.47	.21	.05	.09	4.26	4.20
Dissolved solids loads, in pounds per storm											
1	20,400	24,500	11,700	194,000	229,000	215,000	130,000	263,000	77,700	925,000	947,000
2	1,310	4,840	1,160	11,000	13,900	79,600	5,850	9,560	2,630	115,000	114,000
3	3,860	92,800	50,300	501,000	702,000	151,000	231,000	137,000	58,600	1,180,000	1,330,000
4	246	624	170	3,260	4,130	35,200	3,080	1,960	567	44,900	45,400
5	421	4,280	1,520	37,800	44,300	39,700	9,420	3,730	1,110	96,500	100,000
Total mercury loads, in pounds per storm											
1	0.00	0.00	0.00	0.03	0.03	0.06	0.01	0.01	0.00	0.11	0.11
2	.00	.00	.00	.00	.00	.06	.00	.00	.00	.06	.06
3	.00	.02	.01	.05	.06	.04	.02	.00	.00	.13	.13
4	.00	.00	.00	.00	.00	.01	.00	.00	.00	.01	.01
5	.00	.00	.00	.01	.01	.00	.00	.00	.00	.01	.01

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek

[Storm No. indicates the five sampled storms in 1986 where 1 = May 16-20, 2 = July 7-10, 3 = July 31 to August 1, 4 = August 26-27, and 5 = September 11-12; maximum total loads are based on volumes of combined-sewer overflow calculated assuming a Gaussian-type flow distribution and assuming maximum overflow durations for missing duration results; average total loads are based on volumes of combined-sewer overflow calculated assuming a flow distribution similar to that measured for sites C6 and C22 and assuming average overflow durations for missing duration results]

Note.--Because of rounding the sum of the percentages from all seven sources does not always equal 100.

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Carbonaceous biochemical oxygen demand				
			Based on maximum total loads				
1	3.7	11.3	32.0	20.5	5.5	12.0	15.0
2	1.4	12.5	16.9	56.4	2.9	4.8	5.1
3	.3	42.1	5.0	18.6	12.5	7.7	13.9
4	.5	5.3	10.3	78.4	3.0	2.0	.4
5	.2	16.9	39.2	38.2	2.8	1.2	1.4
			Based on average total loads				
1	3.7	5.4	37.9	20.5	5.5	12.0	15.0
2	1.5	3.2	22.5	59.4	3.1	5.1	5.4
3	.4	27.6	8.4	22.4	15.1	9.3	16.8
4	.5	1.5	13.2	79.2	3.1	2.0	.5
5	.3	6.2	47.9	39.9	2.9	1.3	1.5

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Chemical oxygen demand				
			Based on maximum total loads				
1	1.9	5.0	22.1	4.2	3.2	17.4	46.1
2	2.7	8.8	16.4	31.6	7.6	9.5	23.4
3	.3	47.1	1.1	4.4	8.2	6.5	32.4
4	1.2	9.6	25.6	52.7	5.6	4.7	.7
5	.4	14.0	52.8	21.1	3.8	2.3	5.7
			Based on average total loads				
1	1.9	2.4	25.7	4.2	3.2	17.2	45.5
2	2.7	2.3	20.8	32.5	7.8	9.8	24.1
3	.4	32.7	1.9	5.6	10.4	8.2	40.9
4	1.2	2.6	32.0	53.3	5.6	4.7	.7
5	.4	5.0	61.3	21.5	3.8	2.3	5.7
			Total suspended solids				
			Based on maximum total loads				
1	3.6	4.6	4.7	0.3	5.9	32.9	48.0
2	3.1	9.6	12.1	2.1	7.8	28.9	36.3
3	.2	23.3	.2	.2	13.8	20.1	42.2
4	3.3	16.8	16.5	6.4	21.5	33.6	1.9
5	1.4	16.3	27.2	2.6	16.0	15.6	21.0
			Based on average total loads				
1	3.6	2.3	5.7	0.3	6.0	33.4	48.7
2	3.2	2.4	15.9	2.2	8.2	30.2	37.9
3	.3	14.1	.3	.3	15.4	22.4	47.2
4	3.6	5.0	22.6	6.9	23.3	36.5	2.1
5	1.5	6.1	33.8	2.7	17.0	16.5	22.3

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Volatile suspended solids				
			Based on maximum total loads				
1	4.5	6.1	9.8	1.0	5.1	30.6	43.1
2	3.6	12.6	14.1	9.6	6.9	24.5	28.7
3	.3	41.2	.8	.9	11.6	16.0	29.2
4	2.7	19.5	25.3	17.6	13.5	20.0	1.6
5	1.2	14.1	45.8	5.9	9.9	10.2	12.9
			Based on average total loads				
1	4.5	3.0	11.7	1.0	5.1	31.0	43.7
2	3.8	3.2	18.9	10.2	7.3	26.1	30.5
3	.3	27.5	1.4	1.1	14.2	19.7	35.8
4	2.9	5.7	34.6	19.0	14.5	21.6	1.7
5	1.2	5.1	54.3	6.0	10.1	10.3	13.0
			Total ammonia nitrogen				
			Based on maximum total loads				
1	1.0	28.3	31.8	9.3	1.5	8.9	19.3
2	1.0	7.5	13.2	54.2	5.1	8.5	10.5
3	.2	49.7	8.2	12.5	5.2	8.7	15.4
4	.4	5.6	12.4	75.9	1.8	3.2	.8
5	.1	3.7	6.1	86.5	.9	1.1	1.5
			Based on average total loads				
1	1.1	14.9	41.2	10.3	1.7	9.7	21.2
2	1.1	1.8	17.0	55.4	5.2	8.7	10.7
3	.3	33.5	14.3	15.5	6.5	10.8	19.2
4	.4	1.5	15.8	76.5	1.8	3.2	.8
5	.1	1.3	7.2	87.7	1.0	1.2	1.5

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total organic plus ammonia nitrogen				
			Based on maximum total loads				
1	2.9	9.1	18.8	9.1	3.0	19.9	37.1
2	1.4	9.7	14.4	35.4	3.7	12.2	23.2
3	.3	31.2	5.5	8.5	7.1	11.3	36.1
4	.6	5.2	11.7	72.7	3.4	6.0	.4
5	.3	6.6	28.0	48.1	3.9	4.3	8.7
			Based on average total loads				
1	2.9	4.4	22.8	9.2	3.0	20.1	37.5
2	1.5	2.4	19.4	36.5	3.8	12.5	23.9
3	.3	19.3	8.8	9.6	8.0	12.9	41.0
4	.7	1.4	14.9	73.2	3.4	6.0	.4
5	.3	2.3	32.8	47.7	3.9	4.3	8.7
			Total nitrite plus nitrate nitrogen				
			Based on maximum total loads				
1	8.8	0.2	0.6	37.4	7.7	34.6	10.8
2	2.1	.6	3.3	81.5	3.0	7.2	2.3
3	.6	3.8	38.3	23.5	12.1	15.9	5.7
4	.9	.5	2.9	84.6	2.5	3.5	5.1
5	.4	1.1	16.7	70.3	3.3	6.1	2.1
			Based on average total loads				
1	8.8	0.1	0.7	37.4	7.7	34.6	10.8
2	2.0	.1	4.2	81.2	3.0	7.1	2.3
3	.6	1.8	47.2	20.7	10.7	14.0	5.0
4	.9	.1	3.6	84.3	2.5	3.5	5.0
5	.3	.4	19.2	68.8	3.3	6.0	2.1

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total phosphorus				
			Based on maximum total loads				
1	2.0	6.2	8.5	30.1	3.7	14.1	35.4
2	.6	2.5	3.7	82.0	1.4	3.3	6.4
3	.4	18.4	1.1	33.4	10.3	9.5	27.0
4	.3	1.4	1.8	93.0	1.6	1.6	.2
5	.3	4.4	12.4	73.9	3.0	2.0	4.1
			Based on average total loads				
1	2.0	3.0	10.2	30.6	3.8	14.4	36.0
2	.6	.6	4.7	82.8	1.4	3.4	6.4
3	.4	10.8	1.7	36.2	11.1	10.4	29.3
4	.3	.4	2.3	93.5	1.6	1.6	.2
5	.3	1.6	14.6	74.4	3.1	2.0	4.1
			Total organic carbon				
			Based on maximum total loads				
1	1.8	4.5	21.9	8.6	4.8	10.5	47.9
2	1.5	6.7	17.5	43.8	3.9	6.2	20.4
3	.4	26.9	6.0	9.1	13.1	7.3	37.3
4	.7	8.9	17.8	63.6	5.3	3.2	.5
5	.3	7.7	48.7	31.3	4.5	1.7	5.7
			Based on average total loads				
1	1.7	2.2	25.5	8.5	4.7	10.3	47.0
2	1.5	1.6	22.3	44.0	3.9	6.2	20.5
3	.4	16.7	9.4	10.1	14.4	8.0	41.1
4	.7	2.5	22.7	64.9	5.4	3.2	.5
5	.3	2.7	55.3	30.2	4.4	1.6	5.5

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Hardness as calcium carbonate				
			Based on maximum total loads				
1	4.3	5.8	18.5	18.5	11.8	27.7	13.4
2	2.6	5.1	12.8	58.5	4.8	11.2	5.1
3	.5	20.6	45.6	7.1	12.0	8.6	5.6
4	1.2	2.8	7.9	71.2	6.7	5.6	4.5
5	.9	6.7	40.0	35.0	10.3	4.7	2.3
			Based on average total loads				
1	4.3	2.8	21.5	18.5	11.8	27.7	13.4
2	2.6	1.2	15.6	59.2	4.8	11.4	5.1
3	.4	10.2	58.9	6.5	11.0	7.9	5.1
4	1.2	.7	10.1	71.1	6.7	5.6	4.5
5	.9	2.3	45.6	34.2	10.1	4.6	2.3
			Total recoverable calcium				
			Based on maximum total loads				
1	4.2	6.4	20.3	16.8	11.6	27.9	12.8
2	2.7	5.6	14.8	56.1	4.7	10.6	5.4
3	.5	23.8	43.0	6.9	11.6	8.6	5.6
4	1.3	3.4	8.9	70.4	6.7	5.4	3.8
5	.9	7.9	41.7	33.3	9.7	4.2	2.4
			Based on average total loads				
1	4.2	3.1	23.7	16.8	11.6	27.8	12.7
2	2.7	1.4	18.4	56.5	4.8	10.7	5.5
3	.5	12.2	56.3	6.6	11.0	8.1	5.3
4	1.3	.9	11.3	70.5	6.8	5.4	3.8
5	.9	2.8	47.9	32.5	9.5	4.1	2.3

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable magnesium				
			Based on maximum total loads				
1	4.3	3.8	16.1	17.9	11.8	33.9	12.3
2	2.2	4.2	8.4	62.0	4.9	13.5	4.7
3	.3	13.2	52.7	7.0	11.3	10.3	5.3
4	1.0	1.8	5.2	73.5	6.9	6.5	5.2
5	.8	3.8	35.4	39.6	12.1	6.0	2.3
			Based on average total loads				
1	4.2	1.8	19.3	17.6	11.6	33.4	12.1
2	2.2	1.0	10.7	62.7	5.0	13.6	4.8
3	.3	6.1	64.3	6.0	9.8	9.0	4.6
4	1.0	.5	6.5	73.5	6.9	6.5	5.2
5	.8	1.3	38.9	38.9	11.9	5.9	2.3
			Total recoverable sodium				
			Based on maximum total loads				
1	4.5	1.9	13.1	49.6	10.5	19.0	1.4
2	.4	1.3	5.0	88.4	1.8	2.8	.3
3	.0	4.4	60.1	19.5	10.5	4.8	.7
4	.2	.5	2.5	92.1	2.8	1.4	.6
5	.2	1.1	19.8	70.5	6.4	1.8	.2
			Based on average total loads				
1	4.4	0.9	15.7	48.7	10.3	18.6	1.4
2	.4	.3	6.2	88.2	1.8	2.8	.3
3	.0	2.0	68.2	16.4	8.9	4.0	.6
4	.2	.1	3.0	92.0	2.8	1.4	.6
5	.2	.4	22.6	68.7	6.2	1.7	.2

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable potassium				
			Based on maximum total loads				
1	2.6	1.6	22.9	20.1	9.3	24.5	19.1
2	1.5	2.3	8.5	66.9	4.4	9.1	7.3
3	.3	16.9	8.8	17.6	19.7	14.9	21.7
4	.6	.9	5.7	82.5	5.3	4.2	.8
5	.5	1.5	28.9	54.7	7.5	3.8	3.1
			Based on average total loads				
1	2.5	0.7	25.9	19.6	9.0	23.8	18.5
2	1.5	.6	10.3	66.8	4.4	9.1	7.3
3	.4	9.3	12.8	18.5	20.6	15.7	22.8
4	.6	.3	7.1	81.8	5.2	4.2	.8
5	.5	.5	32.6	52.6	7.2	3.6	3.0
			Total recoverable chloride				
			Based on maximum total loads				
1	1.6	1.3	28.9	34.0	9.3	18.7	6.3
2	.6	1.9	3.7	86.0	2.4	4.0	1.3
3	.3	3.4	50.8	20.0	13.6	7.9	4.0
4	.3	.5	1.5	91.3	3.5	2.2	.7
5	.3	1.8	20.9	67.0	6.4	2.6	.9
			Based on average total loads				
1	1.5	0.6	32.5	32.5	8.9	17.9	6.0
2	.6	.5	4.8	86.4	2.4	4.0	1.3
3	.2	1.6	59.8	16.9	11.5	6.6	3.4
4	.3	.1	1.8	91.3	3.5	2.2	.7
5	.3	.6	23.8	65.5	6.3	2.5	.9

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable sulfate				
			Based on maximum total loads				
1	2.0	1.7	24.7	16.7	20.7	22.3	11.9
2	1.3	4.2	6.7	66.6	9.4	7.8	3.9
3	.2	5.3	56.9	6.6	20.1	6.1	4.8
4	.6	1.4	5.4	72.9	12.9	4.4	2.3
5	.4	3.8	45.4	29.7	15.7	3.2	1.7
			Based on average total loads				
1	1.9	0.8	27.8	16.2	20.1	21.6	11.6
2	1.3	1.0	8.7	67.5	9.5	7.9	4.0
3	.2	2.5	65.9	5.5	16.8	5.1	4.0
4	.6	.4	6.8	72.6	12.9	4.4	2.3
5	.4	1.2	50.7	28.1	14.8	3.0	1.6
			Total recoverable fluoride				
			Based on maximum total loads				
1	3.3	2.0	5.8	45.3	7.4	25.2	11.0
2	.7	2.6	7.7	77.3	2.4	6.6	2.6
3	.3	19.4	21.8	30.3	12.1	12.1	4.0
4	.2	.8	2.3	90.6	2.2	2.3	1.5
5	.2	3.4	12.7	76.2	3.9	2.5	1.1
			Based on average total loads				
1	3.3	1.0	6.9	45.3	7.4	25.2	10.9
2	.7	.6	9.9	77.2	2.4	6.6	2.6
3	.3	10.5	30.4	30.4	12.2	12.2	4.0
4	.2	.2	2.8	90.7	2.2	2.3	1.5
5	.2	1.2	14.6	76.5	3.9	2.5	1.1

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable arsenic				
			Based on maximum total loads				
1	4.1	3.1	18.1	2.7	18.1	25.9	27.8
2	3.9	9.1	11.7	16.9	22.1	19.5	16.9
3	.0	93.6	.5	.2	2.8	1.2	1.8
4	.0	10.7	25.0	25.0	25.0	10.7	3.6
5	1.1	14.0	45.2	10.8	16.1	6.5	6.5
			Based on average total loads				
1	4.1	1.5	21.0	2.7	17.8	25.5	27.4
2	4.1	2.7	14.9	17.6	23.0	20.3	17.6
3	.1	88.7	1.2	.3	4.7	2.0	3.1
4	.0	3.7	29.6	25.9	25.9	11.1	3.7
5	1.1	5.4	53.3	10.9	16.3	6.5	6.5
			Total recoverable barium				
			Based on maximum total loads				
1	3.1	1.8	6.9	2.0	5.2	23.8	57.1
2	4.5	4.2	9.6	17.0	7.6	17.3	39.7
3	.6	35.5	4.6	1.5	10.0	11.0	36.8
4	4.4	5.3	9.5	40.2	14.3	17.2	9.0
5	2.1	6.8	33.3	16.0	8.4	9.6	23.7
			Based on average total loads				
1	3.1	0.9	8.1	2.0	5.2	23.7	57.0
2	4.6	1.0	12.3	17.1	7.7	17.4	39.9
3	.7	22.3	7.6	1.8	11.7	12.9	43.0
4	4.5	1.5	12.1	40.8	14.6	17.5	9.2
5	2.1	2.3	38.5	15.9	8.3	9.5	23.4

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable beryllium				
			Based on maximum total loads				
1	4.3	2.1	4.0	22.5	6.4	22.5	38.1
2	1.8	7.1	7.1	58.9	5.4	8.9	10.7
3	.2	9.1	10.2	20.0	15.0	15.9	29.5
4	.0	.0	14.8	77.8	3.7	3.7	.0
5	.0	10.8	21.5	60.0	1.5	3.1	3.1
			Based on average total loads				
1	4.3	1.0	4.7	22.6	6.4	22.6	38.3
2	1.9	1.9	9.3	61.1	5.6	9.3	11.1
3	.2	5.0	14.3	20.0	15.0	15.9	29.5
4	.0	.0	17.9	75.0	3.6	3.6	.0
5	.0	4.8	25.4	61.9	1.6	3.2	3.2
			Total recoverable boron				
			Based on maximum total loads				
1	1.4	1.7	14.5	25.9	19.4	32.4	4.7
2	.7	3.3	10.5	69.9	5.8	8.6	1.3
3	.1	9.3	49.5	10.0	18.9	8.3	3.9
4	.3	1.3	4.8	80.5	8.4	4.0	.6
5	.3	3.6	27.9	47.8	16.1	3.8	.6
			Based on average total loads				
1	1.4	0.8	16.8	25.5	19.1	31.8	4.7
2	.7	.8	13.2	69.7	5.7	8.5	1.3
3	.1	4.4	59.7	8.7	16.5	7.2	3.4
4	.3	.4	6.4	79.9	8.4	4.0	.6
5	.3	1.3	31.3	47.0	15.9	3.7	.6

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable cadmium				
			Based on maximum total loads				
1	5.9	14.9	16.1	14.9	10.2	23.0	14.9
2	3.2	9.6	27.7	42.6	4.3	7.4	5.3
3	.4	54.8	14.8	4.8	8.8	5.5	11.0
4	.0	6.3	12.5	65.6	6.3	6.3	3.1
5	1.0	13.4	43.3	30.9	6.2	3.1	2.1
			Based on average total loads				
1	6.2	7.4	19.5	15.8	10.8	24.4	15.8
2	3.2	2.2	34.4	43.0	4.3	7.5	5.4
3	.5	37.5	25.4	5.9	10.7	6.7	13.4
4	.0	.0	18.8	65.6	6.3	6.3	3.1
5	1.0	5.2	51.0	31.3	6.3	3.1	2.1
			Total recoverable chromium				
			Based on maximum total loads				
1	3.3	5.5	15.5	12.4	6.0	28.8	28.6
2	1.4	8.8	12.2	54.0	5.7	10.8	7.1
3	.1	17.2	63.7	3.7	4.5	5.5	5.3
4	.4	2.5	53.9	35.7	2.5	3.3	1.7
5	.3	6.2	58.6	22.1	3.8	5.2	3.8
			Based on average total loads				
1	3.3	2.6	18.2	12.4	6.0	28.7	28.7
2	1.5	2.1	15.9	56.0	5.9	11.2	7.4
3	.1	7.9	75.9	3.2	3.8	4.6	4.4
4	.4	.7	61.4	31.0	2.2	2.9	1.4
5	.3	2.3	64.7	20.7	3.6	4.9	3.6

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable cobalt				
			Based on maximum total loads				
1	4.6	3.4	8.9	7.5	5.3	23.9	46.3
2	3.4	7.4	21.1	32.4	3.4	10.8	21.6
3	.5	30.5	16.6	4.6	8.0	9.5	30.2
4	1.8	5.3	14.0	59.6	7.0	8.8	3.5
5	1.1	10.2	39.0	27.7	6.2	5.1	10.7
			Based on average total loads				
1	4.6	1.6	10.7	7.5	5.3	23.9	46.3
2	3.4	2.0	26.5	32.4	3.4	10.8	21.6
3	.6	17.9	25.2	5.0	8.6	10.3	32.5
4	1.8	1.8	17.5	59.6	7.0	8.8	3.5
5	1.1	3.9	45.5	27.5	6.2	5.1	10.7
			Total recoverable copper				
			Based on maximum total loads				
1	1.8	6.6	31.7	14.6	6.3	15.4	23.6
2	1.6	12.4	8.4	58.8	3.7	5.8	9.4
3	.1	82.5	2.0	3.3	3.8	2.2	6.0
4	.7	7.0	21.6	63.3	4.1	2.6	.7
5	.5	15.3	38.8	36.1	3.9	2.0	3.4
			Based on average total loads				
1	1.7	3.1	36.5	14.3	6.2	15.1	23.0
2	1.8	3.3	11.1	63.4	4.0	6.2	10.1
3	.2	70.6	4.4	5.3	6.2	3.5	9.7
4	.6	1.9	27.9	62.2	4.1	2.6	.6
5	.5	5.5	46.9	37.5	4.0	2.1	3.6

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable iron				
			Based on maximum total loads				
1	3.2	2.4	9.0	0.3	5.8	39.7	39.7
2	5.3	4.1	10.9	2.5	10.9	30.6	35.7
3	.7	31.8	.2	.2	12.7	19.4	35.0
4	5.5	8.6	18.4	7.0	20.7	34.0	5.9
5	2.3	9.6	37.4	2.9	11.5	16.3	20.1
			Based on average total loads				
1	3.2	1.1	10.5	0.3	5.8	39.5	39.5
2	5.4	1.0	13.2	2.5	11.0	30.9	36.0
3	.8	20.7	.3	.3	14.8	22.5	40.6
4	5.5	2.4	23.7	7.1	20.9	34.4	5.9
5	2.3	3.6	43.2	2.9	11.5	16.3	20.2
			Total recoverable lead				
			Based on maximum total loads				
1	2.4	15.2	40.8	7.8	5.6	12.2	16.0
2	2.3	15.9	23.6	36.2	7.1	6.6	8.2
3	.5	68.4	9.0	3.0	5.2	3.4	10.5
4	1.2	14.6	23.4	49.7	5.1	3.7	2.3
5	.5	18.1	55.3	18.1	4.1	1.7	2.3
			Based on average total loads				
1	2.4	7.1	48.6	7.9	5.6	12.3	16.1
2	2.4	4.1	31.5	38.6	7.6	7.0	8.8
3	.7	52.0	17.2	4.1	7.1	4.7	14.2
4	1.2	4.3	30.7	52.1	5.4	3.8	2.5
5	.5	6.7	66.6	18.1	4.1	1.7	2.3

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable manganese				
			Based on maximum total loads				
1	2.9	1.9	11.1	0.7	4.9	20.6	57.7
2	5.5	3.8	11.0	7.1	8.3	19.5	44.8
3	1.1	19.1	.7	.8	12.6	14.9	50.8
4	6.1	8.0	18.6	20.0	18.6	23.3	5.5
5	2.3	7.8	40.4	4.6	12.1	9.7	23.1
			Based on average total loads				
1	2.9	0.9	13.1	0.7	4.9	20.4	57.1
2	5.5	.9	13.8	7.1	8.3	19.5	44.8
3	1.2	11.1	1.0	.9	13.8	16.4	55.7
4	6.1	2.1	24.1	20.1	18.7	23.4	5.5
5	2.3	2.7	45.8	4.6	12.0	9.6	22.9
			Total recoverable nickel				
			Based on maximum total loads				
1	3.8	2.2	23.8	4.2	6.5	21.8	37.7
2	3.8	6.3	18.0	27.6	6.7	15.1	22.6
3	.5	38.3	20.1	2.7	10.6	9.5	18.3
4	2.9	5.8	14.5	49.3	11.6	11.6	4.3
5	1.0	5.9	49.5	24.4	6.9	4.6	7.6
			Based on average total loads				
1	3.7	1.0	27.0	4.1	6.4	21.2	36.7
2	3.8	1.7	22.6	27.6	6.7	15.1	22.6
3	.5	24.1	30.1	3.0	11.7	10.4	20.1
4	2.9	1.4	18.8	49.3	11.6	11.6	4.3
5	.9	2.2	55.9	23.0	6.5	4.3	7.1

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable silver				
			Based on maximum total loads				
1	4.8	8.1	17.7	16.4	11.3	25.3	16.4
2	3.2	9.7	28.0	43.0	4.3	7.5	4.3
3	.7	24.9	28.0	9.1	16.6	10.4	10.2
4	.0	6.3	12.5	65.6	6.3	6.3	3.1
5	1.1	11.6	44.2	31.6	6.3	3.2	2.1
			Based on average total loads				
1	4.9	3.9	20.6	16.7	11.5	25.7	16.7
2	3.3	2.2	34.8	43.5	4.3	7.6	4.3
3	.7	13.5	39.5	9.1	16.6	10.4	10.2
4	.0	.0	18.8	65.6	6.3	6.3	3.1
5	1.1	4.2	51.6	31.6	6.3	3.2	2.1
			Total recoverable strontium				
			Based on maximum total loads				
1	4.0	2.7	16.4	15.4	11.7	30.9	18.8
2	1.7	3.1	13.6	55.6	5.6	13.2	7.3
3	.2	20.8	34.2	8.0	15.5	12.3	8.9
4	.8	1.9	5.1	72.5	8.0	6.8	4.9
5	.6	3.6	33.2	40.0	12.8	6.0	3.6
			Based on average total loads				
1	3.9	1.3	19.1	15.2	11.5	30.4	18.5
2	1.7	.7	16.8	55.0	5.5	13.1	7.2
3	.2	10.5	47.2	7.5	14.6	11.6	8.4
4	.8	.5	6.5	72.4	8.0	6.8	4.9
5	.6	1.3	37.6	38.8	12.4	5.8	3.5

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable vanadium				
			Based on maximum total loads				
1	3.2	1.7	8.2	2.6	4.9	34.2	45.2
2	3.8	4.1	11.7	17.9	7.3	22.6	32.6
3	.6	21.7	7.0	2.3	11.0	18.6	38.8
4	3.7	3.7	11.1	42.0	11.1	21.0	7.4
5	1.6	7.2	27.7	19.7	11.2	12.9	19.7
			Based on average total loads				
1	3.2	0.8	9.6	2.6	4.9	34.0	45.0
2	3.8	1.1	14.7	17.9	7.3	22.6	32.6
3	.6	12.8	10.5	2.5	11.8	20.0	41.7
4	3.7	1.2	13.6	42.0	11.1	21.0	7.4
5	1.6	2.8	32.4	19.6	11.2	12.8	19.6
			Total recoverable zinc				
			Based on maximum total loads				
1	2.6	10.2	30.2	7.9	7.5	20.8	20.8
2	2.2	13.9	32.5	30.2	5.6	7.4	8.1
3	.3	76.6	3.8	2.5	6.0	3.8	7.0
4	1.3	14.3	21.4	49.2	6.7	4.6	2.5
5	.6	18.4	53.8	18.4	3.9	2.2	2.8
			Based on average total loads				
1	2.6	4.9	35.7	7.9	7.5	20.7	20.7
2	2.3	3.4	41.0	31.4	5.8	7.7	8.4
3	.4	62.6	8.0	3.7	9.1	5.7	10.5
4	1.3	4.1	28.4	51.6	7.0	4.9	2.6
5	.6	6.7	64.8	18.9	4.0	2.3	2.9

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Total recoverable aluminum				
			Based on maximum total loads				
1	3.3	1.2	6.0	0.1	4.6	38.9	46.0
2	5.1	1.6	7.2	.7	9.7	31.6	44.2
3	.6	24.2	.2	.1	10.6	20.3	44.0
4	5.7	6.0	17.6	2.6	18.9	38.4	10.7
5	2.5	6.6	30.0	1.7	11.8	18.9	28.4
			Based on average total loads				
1	3.2	0.6	7.0	0.1	4.6	38.7	45.8
2	5.0	.4	9.0	.7	9.6	31.4	43.9
3	.7	14.7	.3	.1	11.9	22.8	49.4
4	5.7	1.6	22.0	2.6	18.9	38.4	10.7
5	2.5	2.3	35.5	1.7	11.6	18.5	27.8
			Total phenols				
			Based on maximum total loads				
1	3.3	13.5	33.3	16.4	7.7	8.7	17.0
2	2.9	8.1	23.4	48.4	4.8	4.4	8.1
3	.6	31.7	24.1	11.8	14.0	4.6	13.1
4	1.3	3.2	20.9	65.2	4.4	1.9	3.2
5	.7	8.7	24.4	58.0	4.9	1.2	2.1
			Based on average total loads				
1	3.4	6.6	39.7	16.6	7.8	8.8	17.2
2	2.9	1.8	29.7	48.4	4.8	4.4	8.1
3	.7	18.1	35.6	12.4	14.7	4.9	13.7
4	1.2	.6	25.8	63.2	4.3	1.8	3.1
5	.7	3.1	29.0	58.8	5.0	1.2	2.1

APPENDIX E

Selected Constituent Loads as Percentage of Total Loads from Sources of Storm-Related Runoff to Cedar Creek--Continued

Storm No.	Site 1	Combined-sewer overflows	Storm-sewer discharges	Site WWTF	Site T21	Site T23	Site T24
			Dissolved solids				
			Based on maximum total loads				
1	2.2	2.6	21.0	23.3	14.1	28.4	8.4
2	1.1	4.2	9.6	69.3	5.1	8.3	2.3
3	.3	7.9	42.6	12.8	19.7	11.7	5.0
4	.5	1.4	7.3	78.3	6.9	4.4	1.3
5	.4	4.4	39.2	41.2	9.8	3.9	1.2
			Based on average total loads				
1	2.2	1.2	24.2	22.7	13.7	27.8	8.2
2	1.1	1.0	12.2	69.8	5.1	8.4	2.3
3	.3	3.8	52.6	11.3	17.3	10.3	4.4
4	.5	.4	9.1	77.6	6.8	4.3	1.3
5	.4	1.5	44.2	39.6	9.4	3.7	1.1
			Total mercury				
			Based on maximum total loads				
1	0.0	0.0	27.3	54.5	9.1	9.1	0.0
2	.0	.0	.0	100.0	.0	.0	.0
3	.0	15.4	38.5	30.8	15.4	.0	.0
4	.0	.0	.0	100.0	.0	.0	.0
5	.0	.0	100.0	.0	.0	.0	.0
			Based on average total loads				
1	0.0	0.0	27.3	54.5	9.1	9.1	0.0
2	.0	.0	.0	100.0	.0	.0	.0
3	.0	7.7	46.2	30.8	15.4	.0	.0
4	.0	.0	.0	100.0	.0	.0	.0
5	.0	.0	100.0	.0	.0	.0	.0