SOUTHBRANCH CREEK
1999 WATER QUALITY
BASELINE MONITORING REPORT

By

Water Quality Research Department

Milwaukee
Metropolitan
Sewerage District

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EXECUTIVE SUMMARY

Southbranch Creek, a tributary to the Milwaukee River, drains areas of the City of Milwaukee and the Villages of Brown Deer and River Hills. The Creek has a long history of severe flooding problems, with residential neighborhoods along the Creek periodically flooding during significant storms.

MMSD has jurisdiction over Southbranch Creek and has embarked on the Southbranch Creek Flood Control Improvements Project, which will contribute to environmentally responsible protection from flooding. Four floodwater detention basins, culvert replacements, deepening a section of the Creek and the acquisition and removal of ten residential properties are primary components of the plan.

Because minimal historic water quality data exist on Southbranch Creek, the MMSD Water Quality Research Department began surface water quality sampling in 1999 to obtain baseline data. The Southbranch Creek survey consists of 4 single depth sampling locations. A total of five surveys, all occurring in the fall of 1999, were conducted. Data collection will also continue for several more years on Southbranch Creek, both during the construction phase as well as afterwards, to document water quality improvements.

Several dozen variables were analyzed. Some parameters, including dissolved oxygen, suspended solids, and un-ionized ammonia were at levels conducive to acceptable water quality. Toxic pollutants (PAHs, PCBs, mercury) and heavy metals (copper, zinc, lead) were either not detected or were in very low concentrations. At times however, various constituents, including fecal coliform bacteria, phosphorus, and chloride, exceeded State of Wisconsin Criteria or recommended maximums. Additionally, with the limited data available, the MMSD Water Quality Index (WQI), which mathematically converts eleven variables into descriptive categories, classified Southbranch Creek sites as either “fair” or “bad” in 1999.

Tremendous changes began on Southbranch Creek in 1999. The comprehensive Southbranch Creek Flood Control Improvements Project began and the first of four floodwater detention basins was constructed. Water quality monitoring commenced to characterize baseline data of the Creek. More substantial alterations to Southbranch Creek will occur in subsequent years. Three additional floodwater detention basins are scheduled to be excavated. Water quality monitoring will continue as this Project moves forward. This Report serves as a starting point for water quality evaluation of the Southbranch.

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INTRODUCTION

Background

Southbranch Creek is an intermittent tributary to the Milwaukee River that drains an area of approximately 2.95 square miles within the City of Milwaukee and the Villages of Brown Deer and River Hills. The Creek, approximately 1.5 miles long, originates at a storm sewer outfall along West Bradley Road near North 59th Street. Flowing in a generally northeasterly direction through the Village of Brown Deer, its confluence with the Milwaukee River lies in the Village of River Hills. A North Tributary to the Creek originates at a storm sewer outfall at West Dean Road extended between North 72nd and North 68th Streets. The tributary generally flows easterly, much of the way through culverts. The tributary flow splits at North 55th Street, north of West Churchill Lane. One segment flows southward in an underground storm sewer along 55th Street, the other flows east and then south and joins with Southbranch Creek immediately downstream of North 54th Street (Figure 1).

Fifty-four percent of the Southbranch Creek watershed is within Brown Deer, forty-four percent is within Milwaukee, and the remaining two percent is within River Hills. The watershed drains by means of a storm sewer system and lies primarily in a densely urbanized setting. The Creek consists of both natural and channelized stretches, of which 0.5 mile is concrete lined.

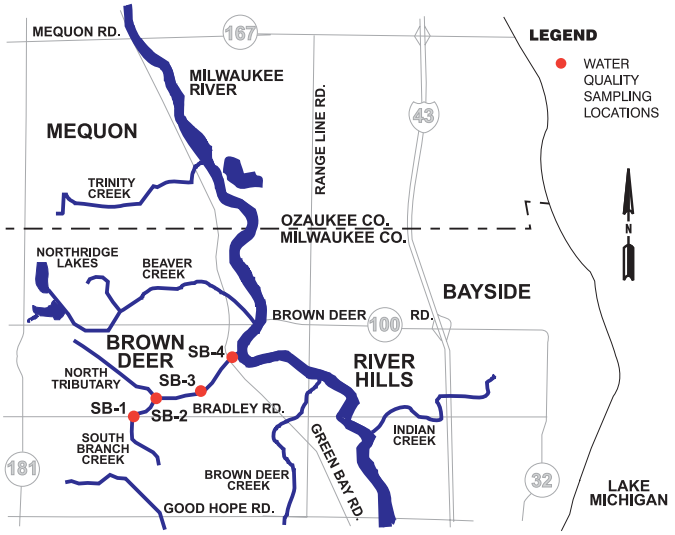

Figure 1 - Southbranch Creek General Map

The Southbranch Creek watershed is a relatively flat area with mean height above sea level varying by only approximately 50 feet. Many of the flooding problems in the Southbranch Creek watershed stem from urban development, the significant increase in impervious surfaces, undersized culverts, and insufficient channel capacity. These factors cause the Creek's natural carrying volume to be exceeded.

Stream flow varies considerably on Southbranch Creek depending on weather conditions and location on the Creek. For example, upstream at North 55th Street, base flow during normal non-rain conditions is less than 10 cubic feet per second (cfs). During extreme wet weather however, the upstream flow can swell to over 1000 cfs, and downstream at Green Bay Road and Teutonia Avenue, flows on Southbranch Creek can exceed 1700 cfs.

The measure of the peak flow runoff during rainfall, expressed as cubic feet per second per acre, has also increased dramatically on Southbranch Creek over the years. For example, before urban development along the Creek, the flow release rate was 0.34 cfs/acre. In 1990, after significant residential development, the computed release rate jumped approximately three fold to 0.90 cfs/acre.

Flooding History & Flood Management Project

Southbranch Creek has a long history of severe flooding problems. A majority (sixty percent) of the watershed contains impervious surfaces. Residential neighborhoods along the Creek periodically flood during significant storms. In particular, the residential neighborhood near Churchill Lane, between North 55th and North 47th Streets, has historically experienced flooding. Additionally, flooding along the North Tributary periodically results in floodwater extending to the doors of Dean Elementary School. Other areas of flooding have been noted as well. Annual flood damages attributed to the Creek could approximate $42,500 according to the Southeastern Wisconsin Regional Planning Commission (SEWRPC),

Community Assistance Planning (CAP) Report 152 (1990). Extensive flooding occurred as recently as June 1997 and August 1998 (rain gauges in Brown Deer registered approximately 9.8 inches of rainfall in a 26 hour period on June 20-21, 1997 and 8.0 inches of rainfall on August 5-6, 1998) with many homes experiencing significant flood damage. In response, the Village of Brown Deer has completed a stormwater management ordinance, which is pending approval.

Flooding in Brown Deer at 55th Street

Under Wisconsin Statutes §66.89, MMSD has the authority to plan, design, construct, and maintain floodwater conveyance facilities and watercourse channel modifications on those portions of watercourses where the District has jurisdiction. Jurisdictional streams have been defined to include all perennial streams and all intermittent streams, such as Southbranch Creek, which meet two of the following criteria:

- Currently have District-built channel modifications.
- Have significant risk of flood damage; and
- Provide drainage to more than one community.

A number of studies have been conducted to characterize flooding and propose solutions for Southbranch Creek, including studies by SEWRPC (1990), Camp Dresser & McKee (1998), and Earth Tech (1999).

Several flood management alternatives for Southbranch Creek were examined. The preferred option is known as "upstream detention". The Southbranch Creek Flood Control Improvements Project will contribute to environmentally responsible protection from flooding. The Project will reduce out-of-bank flooding during a 1% probability flood event (the percent probability that a flood will produce flows of a certain magnitude, often referred to as the 100 year flood). The construction of four floodwater detention basins, which are designed to reduce peak flows during heavy rains, are the centerpiece of the Project (Figure 2). Culvert replacement and deepening a section of the Creek are other components of the plan. The Project will minimize damages and flooding associated with a 1% flood event and reduce potential flood damages by an estimated $100,000 per 1% flood event. Highlights of the estimated $3.9 million cooperative Project include:

- A dry detention basin south of Churchill Lane in Brown Deer, between North 47th and North 51st Streets (22 acre-feet), and the acquisition and removal of ten residential properties.

- A wet detention basin north of Bradley Road and west of North 55th Street (Figure 3) located on Brown Deer Public Library and Brown Deer High School property (17 acre-feet/5.6 million gallon capacity).

- A recreational multi-use detention basin west of North 55th Street at Dean Elementary School (12 acre-feet/4.0 million gallon capacity).

- A recreational multi-use detention basin immediately south of Bradley Road, east of North 60th Street, and west of North 55th Street at Thoreau Elementary School (19 acre-feet/6.3 million gallon capacity).

- Culvert replacements at North 51st and North 55th Street crossings. Removal of the crossing and culvert at North 54th/ North 53rd Street and replacement with an open channel.

Figure 2 - Planned Detention Basins

The Churchill Lane detention basin occupies approximately four acres and is more aptly termed a floodplain lowering. This basin will store water (7 million gallons) only during and immediately after storm events. The initial construction phase for the Southbranch Creek Flood Control Improvements Project began at this location in the summer of 1999 and was completed by mid-November 1999. Ten homes were razed in the process of creating this storage area. Following excavation, dormant seeding was covered with fiber matting for the winter and trees and shrubs were planted in the spring of 2000.


Churchill Lane Detention Basin

The Brown Deer Public Library wet detention basin will also occupy approximately four acres and has a capacity of 5.6 million gallons. Since excavation within the channel banks is required, a Chapter 30 permit has been requested from the Wisconsin Department of Natural Resources (WDNR). Specifically, 900 feet of the existing eroded channel west of 55th Street and 600 feet of concrete-lined channel east of North 55th Street will be lowered. A condition of the required WDNR permit is that the detention basin be wet, so as to provide downstream water quality benefits (i.e., a sedimentation forebay, which captures and removes pollutants associated with suspended sediments). Additionally, the Brown Deer School District has requested that an aerator be placed in the wet detention basin as an aesthetic enhancement to its overall appearance. Under this recommended alternative, the flow at the North 55th Street crossing will be reduced from 1,060 cubic feet per second (cfs) to approximately 570 cfs during a 100-year flood event. Construction will begin in June of 2000 and will be completed within one construction season (Figure 3).

The Dean School detention basin will occupy approximately five acres and is also termed a floodplain lowering. A shallow floodplain will be excavated adjacent to Southbranch Creek's North Tributary. It will provide flood water detention (4 million gallons) during large rain events and baseball fields for youth recreation during dry periods. Facilitation of drainage will be accomplished with the use of an underdrain/ drainage tile system. Construction will begin in June 2000 to avoid conflict with the school year and is expected to be completed by November 2000.

The Thoreau Elementary School detention basin will occupy just less than three acres and will hold approximately 6.3 million gallons. It will provide soccer fields for youth recreation during dry conditions. Excavation is also scheduled to begin in June 2000 coinciding with the Library basin construction and should be completed by the end of the 2000 construction season.

Other miscellaneous improvements include replacing a culvert at North 51st Street, where the existing six-foot by nine-foot arch will be replaced with two seven-foot by 10-foot box culverts. The 52-inch diameter culvert at North 55th Street will also be replaced by a six-foot by 12-foot box culvert. Additionally, the North 54th/53rd Street crossing will be removed, and the existing 72-inch diameter corrugated metal pipe will be replaced with an open channel.

Water Quality Monitoring

Surface water quality (WQ) monitoring was proposed for the Southbranch Creek (SB) to coincide with the District's Southbranch Creek Flood Control Improvements Project. A primary goal is assessing water quality in closest proximity to the flood detention basins being constructed in the project area. Surface WQ monitoring was performed by the MMSD Water Quality Research Department. Water quality data obtained on the Southbranch will be useful in all phases of the flood control project. Data collected before the construction phase begins will provide a useful baseline that will characterize water quality in Southbranch Creek. Data gathered during the construction phase will be beneficial in determining any changes in water quality caused by MMSD's construction activities. Data obtained after the project is completed will be helpful in monitoring improvements in water quality due to MMSD's flood management program and will determine the effectiveness of local stormwater management efforts.

There is very little supporting historic water quality data on Southbranch Creek. The Milwaukee River Basin Integrated Management Plan (1992) classifies Southbranch Creek as "supporting partial body contact forms of recreational use because of shallow water depths, reduced aesthetics associated with the concrete lined channel and potential bacterial contamination". The MMSD 2010 Facilities Plan (1997) describes the habitat in the Southbranch watershed as "generally poor". Therefore, a substantial water quality monitoring program for Southbranch Creek will provide the District, its stakeholders, and customers with valuable environmental information. The Southbranch water quality monitoring strategy will also support the proposed "Operations Division: Year 2000 Strategic Plan – Issue 4 (1999)", specifically, "continue to implement monitoring and analysis programs that determine the impact of District operations on surface water quality…".

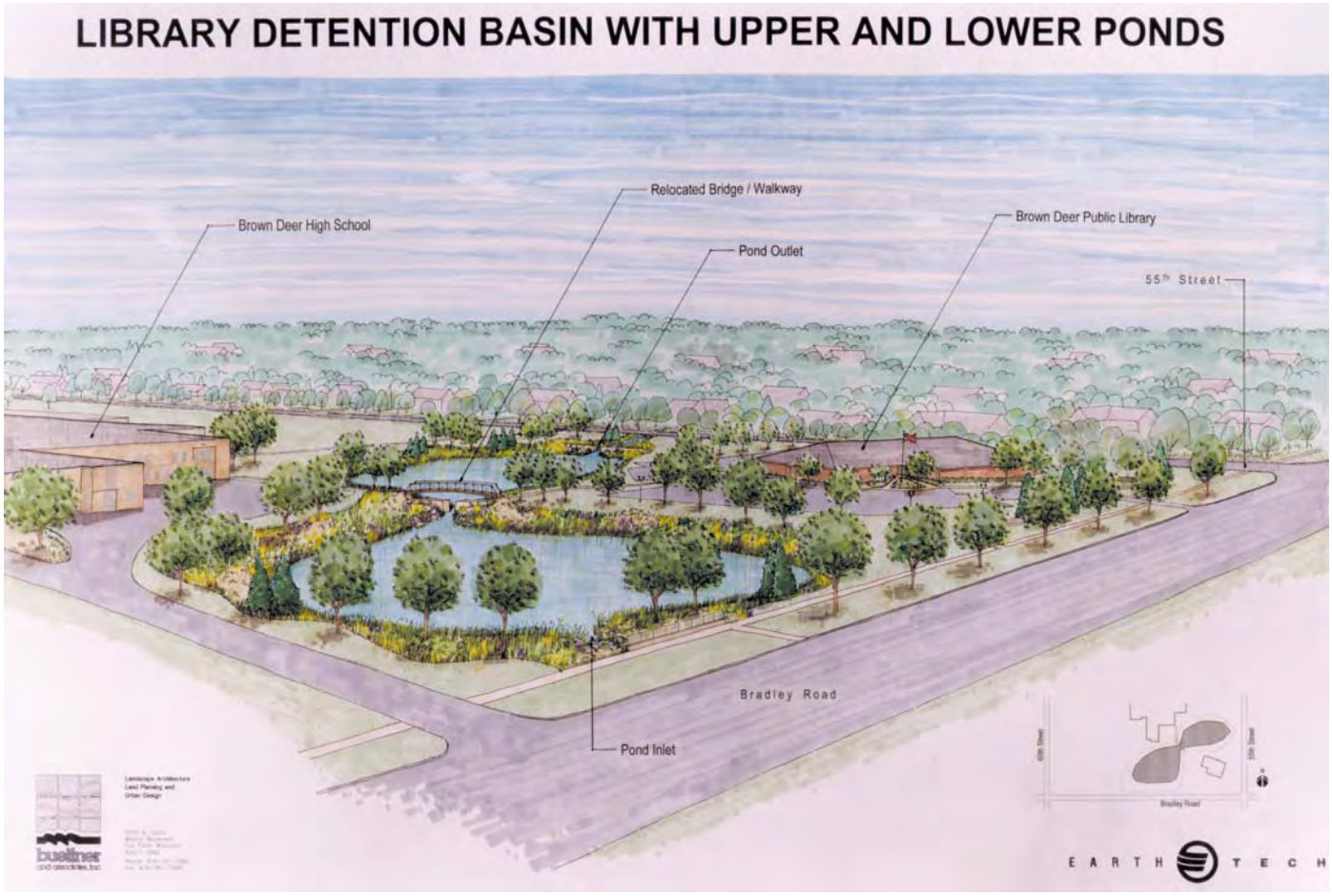

Figure 3 - Library Detention Basin

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METHODS

Sampling Locations

The Southbranch Creek survey consists of 4 single depth sampling locations (Figure 4). Site selection was determined by the MMSD Technical Services Division and was based primarily on future detention basin locations and relative ease of access (Table 1).

Table 1

SITE NUMBER	LOCATION
SB-01	Bridge @ Bradley Road, just west of Edgeworth Drive
SB-02	Bridge @ 55th Street, just north of Bradley Road
SB-03	Bridge @ 47th Street, just south of Churchill Lane
SB-04	Bridge @ Green Bay Court, just north of Green Bay Road & Teutonia Avenue

SB-01

Site SB-01 is strategically located on the north side of the bridge on Bradley Road just west of Edgeworth Drive. SB-01 is immediately downstream of a metal grating where Southbranch Creek exits from its storm sewer origin. SB-01 is the furthest upstream sampling site and is located immediately upstream of the planned wet detention basin, located north of Bradley Road and west of North 55th Street, that will bisect the land between Brown Deer High School and the Brown Deer Public Library. A second dry detention basin will be located just upstream of SB-01, immediately south of Bradley Road, east of North 60th Street, and west of North 55th Street at Thoreau Elementary School.

The riparian area surrounding SB-01 is buffered open space with perennial plants, shrubs, and a scattering of young and mature trees. The Creek substrate at SB-01 consists of sand and gravel with many rocks. Under normal baseline flows, water depth is less than one foot.

SB-02 is located at North 55th Street, just north of Bradley Road. A portion of the North Tributary to Southbranch Creek empties just upstream of this site by means of a flap gate and overland swale flow. The previously natural Creek channel becomes concrete lined here. This site is downstream of the planned Library and Thoreau floodwater detention basins. Another floodwater detention basin planned for the area near Dean School will also be upstream of SB-02 and will be located along the North Tributary.

SB-02

Sampled on the downstream (east) side of 55th Street, the area immediately surrounding SB-02 is comprised of an approximately 4 foot diameter

metal culvert, asphalt and a concrete lined channel. Residential properties border north and south of the site. Normal water depth is less than one foot under normal base flow.

SB-03

SB-03 is located on North 47th Street just downstream of the four acre Churchill Lane detention basin. This site will be critically important in measuring the total effects and improvements on water quality due to the four upstream floodwater detention basins.

The downstream (east) side of the street is sampled where a corrugated metal culvert and cement lined channel hold the Creek. Many mature deciduous trees, bushes, and greenspace are found in the immediate sampling area. Various residential homes are also in the general area of SB-03. Water depth is again shallow under normal base flow conditions, less than one foot (Figure 4).

SB-04

SB-04 is located at the bridge on Green Bay Court, just north of the Green Bay Road & Teutonia Avenue intersection. This site is the furthest downstream of the Southbranch Creek sampling sites. The Creek's confluence with the Milwaukee River is approximately 1,000 feet downstream.

The general surroundings at SB-04 represent the densest vegetation growth found at any Southbranch sampling location. Many mature and young deciduous trees, shrubs, and perennial plants form a thicket that buffers the riparian environment at the site. Sampling is conducted on the upstream (west) side of the bridge. Southbranch Creek's substrate is no longer concrete lined here, but consists of some rocks, gravel, and silt deposits. The Creek is slightly deeper here with water depths approaching one foot under normal base flow conditions.

Sampling Schedule and Variables

Surface water quality monitoring is budgeted for ten times per year at the above-designated sites. Highlights include:

- Sampling every 3 weeks (approximate).
- Surveys will commence in March/April and end in November.
- The variable list for the Southbranch Creek monitoring effort will be identical to other MMSD surface water quality surveys (see Appendix A).
- 5 surveys per year will be conducted with heavy metals analyses.
- Post Project sampling is anticipated for a minimum of 3 years to fully document water quality changes and improvements due to flood control efforts.

The sampling and analysis for Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs), and Mercury (Hg) will also be conducted two times per year in conjunction with the routinely sampled variables. This sampling will occur as 1 dry event, defined as 7 continuous days without significant (less than 1/10 inch) precipitation, and 1 wet event, defined as greater than 1/4 inch precipitation basin-wide in the Southbranch Creek watershed. Precipitation data for determining the occurrence of these events will be obtained from MMSD Weather Stations, WS

1205 at 41st and Good Hope Road and WS 1209 at 84th and Brown Deer Road.

Sampling Dates

The 1999 season was abbreviated with sampling commencing in late September and continuing approximately every two weeks until late November. A total of five surveys were conducted on the following dates:

- September 29, 1999.
- October 12, 1999 (dry event).
- October 27, 1999.
- November 10, 1999.
- November 23, 1999.

Field Measurements

Field water quality measurements (temperature, pH, specific conductance and dissolved oxygen) were obtained using the Hydrolab® H20 Multiprobe. Hydrolab® data can be found in Appendix B. Water quality samples for other analyses were collected and transported to the MMSD Central Laboratory. A statistical data summary can be found in Appendix D. General weather conditions were noted for all sampling dates as well.

It should be noted that the sampling period in the autumn of 1999 was considerably drier than normal. Average historical precipitation in Milwaukee for the months of September, October, and November (as measured at Mitchell Field) is 3.13, 2.32, and 2.12 inches respectively. Two MMSD Weather Stations, WS 1205 at 41st and Good Hope Road and WS 1209 at 84th and Brown Deer Road, registered an average total rainfall of 3.33, 0.73, and 0.83 inches in September, October, and November 1999 respectively. The majority of rain in September (approximately 2.5 inches) fell on two dates, September 27th and 28th, prior to our first Southbranch sampling date, September 29th. Precipitation data can be found in Appendix C.

RESULTS/DISCUSSION

Water Quality Standards and Criteria for Toxic Substances for Wisconsin surface waters (Chapters NR 104 and NR 105, Wisconsin Administrative Code) were established to preserve and/or enhance the quality of the state's waters. They protect the health of the public, fish, and aquatic community as well as the waterway as a whole. Standards and Criteria also serve as measuring tools when water resource management decisions are made and are utilized in this evaluation.

Dissolved Oxygen

The dissolved oxygen (DO) concentration in a waterbody is one of the key indicators of its overall health. The Wisconsin State Surface Water Warm Water Quality Standard governing Southbranch Creek requires a minimum of 5.0 mg/L DO to support full fish and aquatic life.

At no time on the sampling dates in 1999 for Southbranch Creek did the dissolved oxygen level register below the State Warm Water Standard (Figure 5). In 1999, Site SB-03 consistently had the highest dissolved oxygen readings while Site SB-02 was generally the next highest. Sites SB-01 and SB-04 typically had lower dissolved oxygen readings than SB-03 and SB-02.

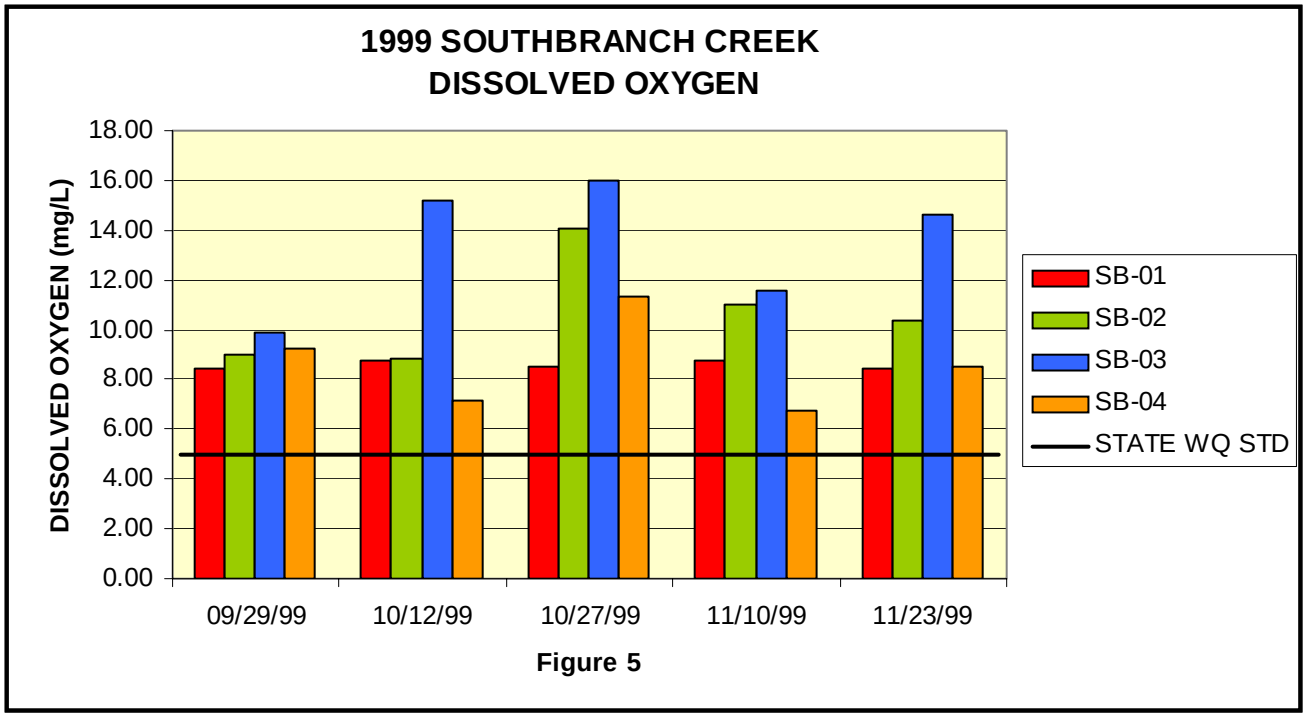


Figure 5

Fecal Coliform Bacteria

Fecal coliform bacteria are used as microbiological indicators of the safety of surface water for swimming or other body contact. The presence of fecal coliforms indicates contamination from the intestinal tracts of warm-blooded animals. The Wisconsin State Surface Water Warm Water Quality Standard for fecal coliform bacteria (Most Probable Number (MPN) fecal coliforms per 100 mL) on Southbranch Creek is a maximum of 200. This value is expressed as a geometric mean based on not less than five (5) samples per month (2.30 log fecal coliform per 100 mL).

There were multiple Southbranch sites and dates in 1999 that exceeded the Wisconsin State Warm Water Standard for fecal coliform bacteria based on collection of single samples (Figure 6). Of the twenty fecal coliform measurements, 13 (65%) were greater than the State Standard. Each Southbranch site exceeded the State Standard for fecal coliforms at least twice. Every fecal coliform determination at SB-04 exceeded the Standard. SB-02 and SB-03 exceeded it 3 out of 5 times (60%) while SB-01 exceeded the Standard 2 of the 5 sampling dates (40%). Possible sources of fecal contamination in the Southbranch Creek area include discharges from storm sewers and pet and wildlife waste.

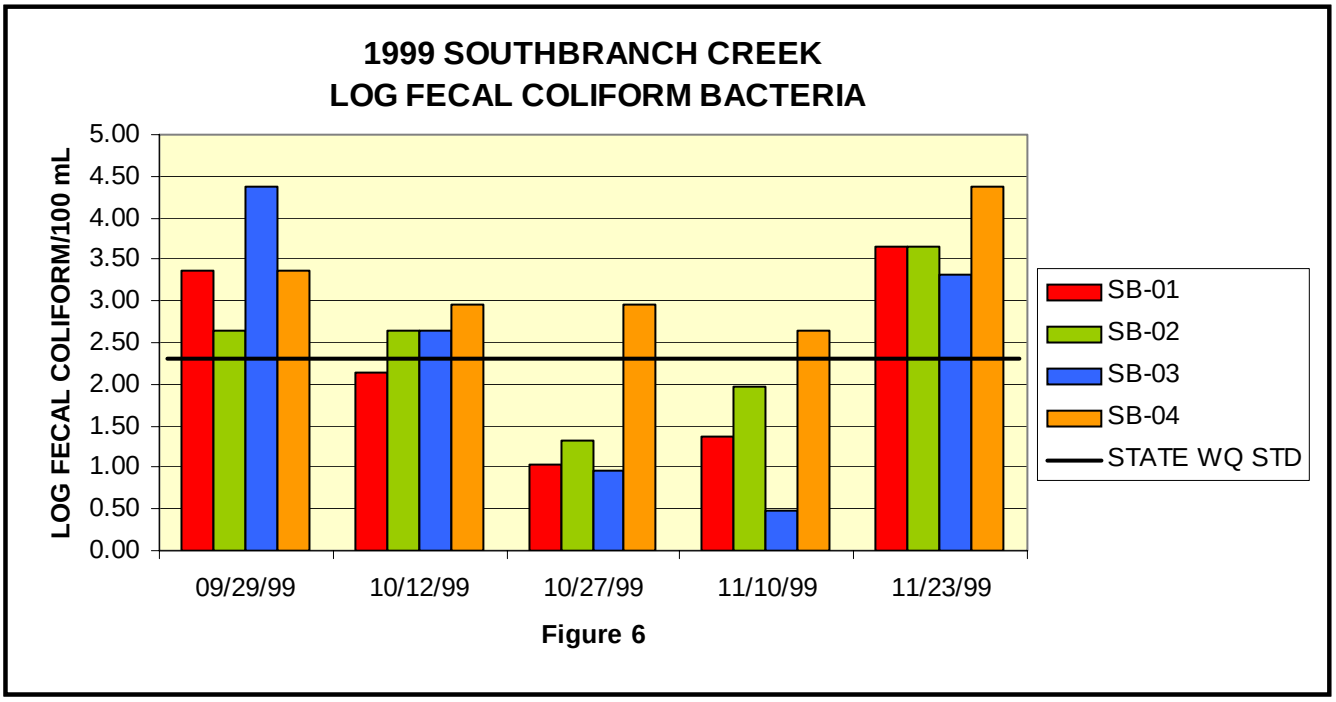


Figure 6

Suspended Solids

Solids are another important water quality variable to monitor. High concentrations of solids can have serious negative water quality impacts. Elevated solids levels can adversely affect drinking water, aquatic organisms, and light penetration. Suspended solids (SS) are the solid phase which are not dissolved, and generally are those materials that give water its turbidity. While there is no Wisconsin State Water Quality Standard for suspended solids, the American Fisheries Society (1979) recommends the maximum concentration of suspended solids for a high level of protection not exceed 25 mg/L.

At no time in 1999 did the measured suspended solids levels reach the recommended maximum of 25 mg/L on Southbranch Creek (Figure 7). The highest recorded suspended solids concentration was 24 mg/L, which occurred on October 27, 1999 at SB-03. Interestingly, this was midway during a period with very little precipitation. While there was a tendency towards generally higher suspended solids concentrations at SB-03, (60% of the highest SS data came from SB-03) no real SS patterns or trends were observed. One conceivable explanation for this elevated level of suspended solids at SB-03 is that the Churchill Lane floodwater detention basin (immediately upstream) was under construction during this time. It is possible that a small amount of solid material could have gotten into the Creek during construction and caused an increase in the suspended solids concentration. Other possible sources of increased suspended solids include storm water discharges, plant materials in the water, and stirring up of the site with the water sampler itself.

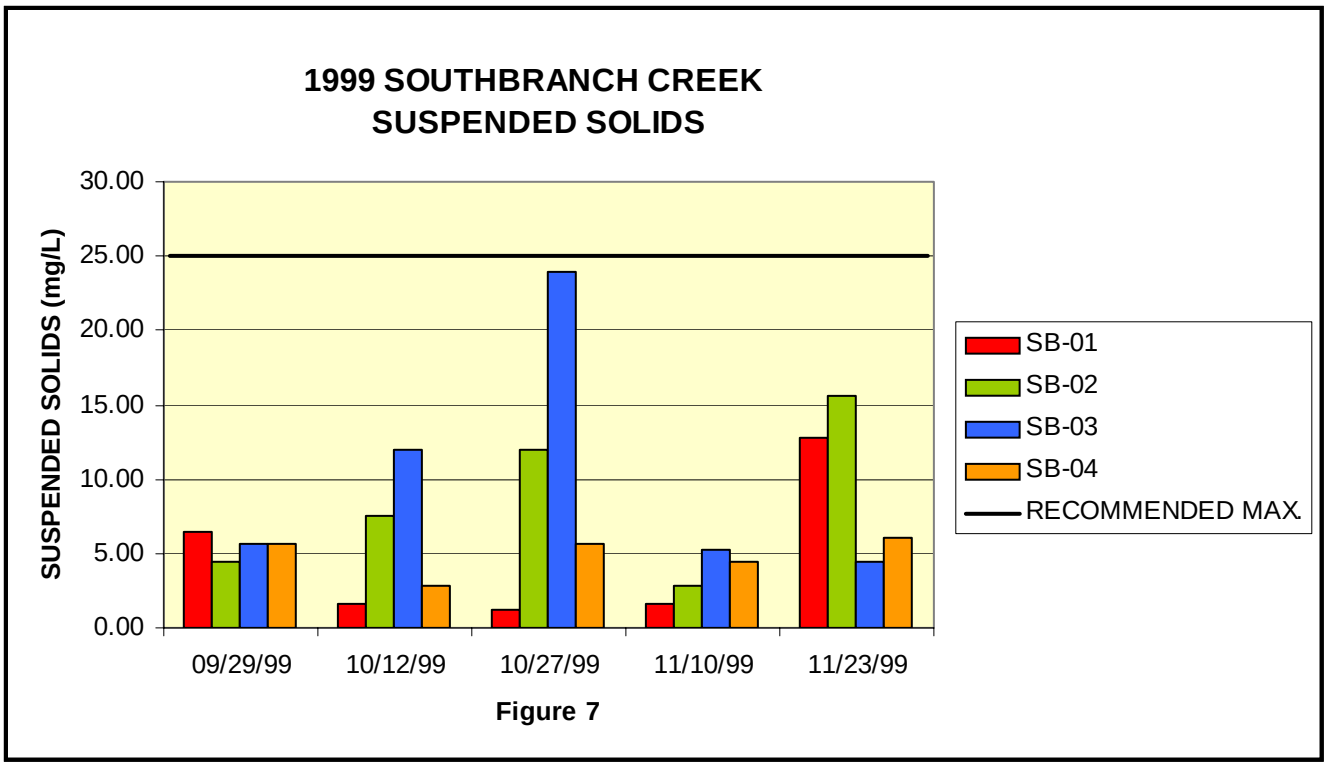


Figure 7

Phosphorus

Phosphorus in the form of phosphate is a major nutrient required for plant nutrition and is essential for life. High phosphate concentrations however can overstimulate excess plant growth, which can lead to the accelerated aging of a waterway. Soluble phosphorus is the form most readily available to aquatic plant communities. While there are no Wisconsin State Surface Water Quality Standards for phosphorus, the recommended maximum concentrations for total phosphorus and soluble phosphorus are 0.02 mg/L and 0.01 mg/L respectively.

All phosphorus data on Southbranch Creek in 1999, both total and soluble phosphorus, exceeded the recommended maximum concentrations at every site on every sampling date (Figures 8 & 9). Much of the phosphorus data were several fold higher than the recommended amounts. Excess phosphorus could originate from run off of nearby areas. Upstream and adjacent drainage areas in the Southbranch Creek watershed have significant areas maintained in turf grass. Over-fertilization could be one source of elevated phosphorus. Additionally, many Canada geese frequent grassy surroundings along the Southbranch, and their droppings may increase phosphorus amounts as well.

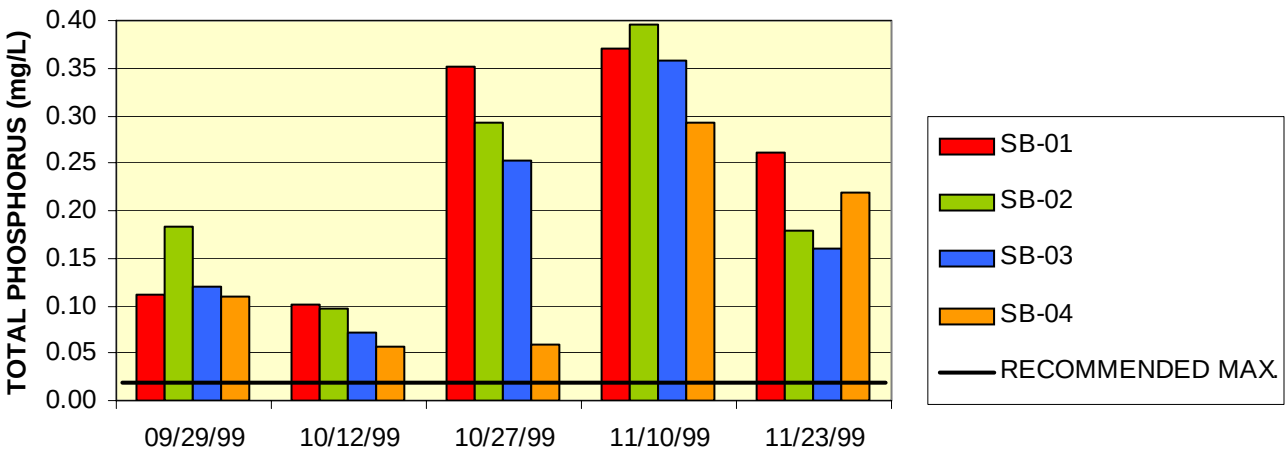


Figure 8

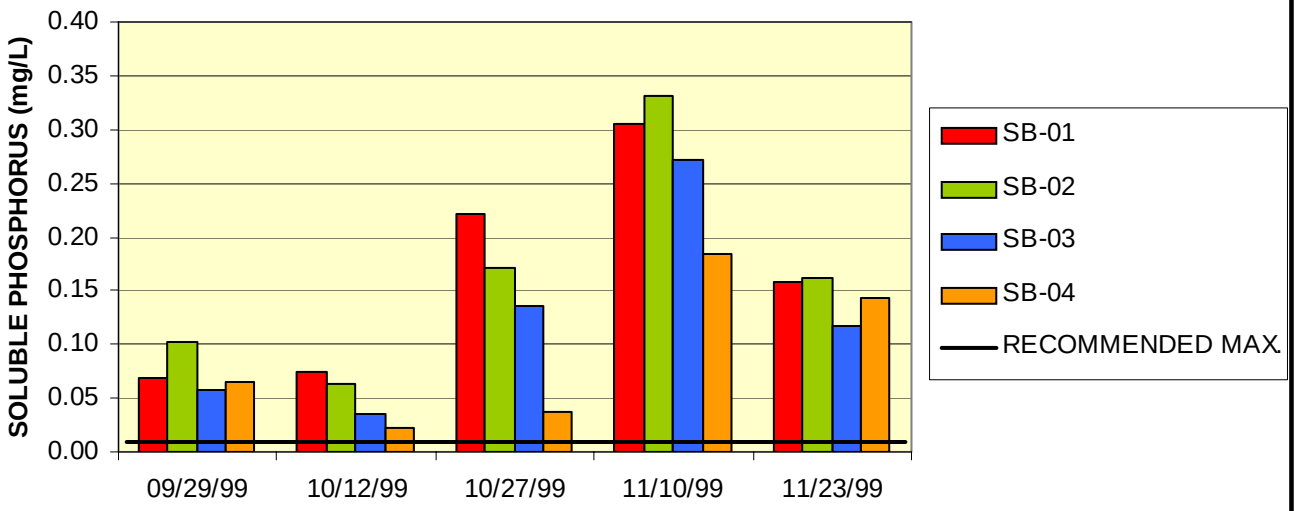

1999 SOUTHBRANCH CREEK
SOLUBLE PHOSPHORUS
SOLUBLE PHOSPHORUS (mg/L)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
09/29/99
10/12/99
10/27/99
11/10/99
11/23/99
SB-01
SB-02
SB-03
SB-04
RECOMMENDED MAX.

Figure 9

Un-ionized Ammonia

Ammonia is a compound normally found in low concentrations in most waters. Present in wastewater discharges, it can be formed from the degradation of nitrogenous organic matter. The un-ionized form of ammonia (NH_3) is potentially toxic to fish and aquatic life depending on its concentration and the accompanying water pH and temperature levels. The Wisconsin State Surface Water Warm Water Chronic Criterion for un-ionized ammonia is 0.040 mg/L.

All un-ionized ammonia data on Southbranch Creek in 1999 were well below the Wisconsin State Warm Water Chronic Criterion of 0.04 mg/L (Figure 10). In fact, on sampling dates 10/12/99 and 11/10/99 all sites registered values below the method detection limit (0.0002 mg/L). Also, on 10/27/99, only SB-01 had detectable un-ionized ammonia, 0.00025 mg/L. The highest concentration of un-ionized ammonia, 0.0184 mg/L, occurred on 11/23/99 at SB-03 and is associated with a higher than normal pH of 9.05.

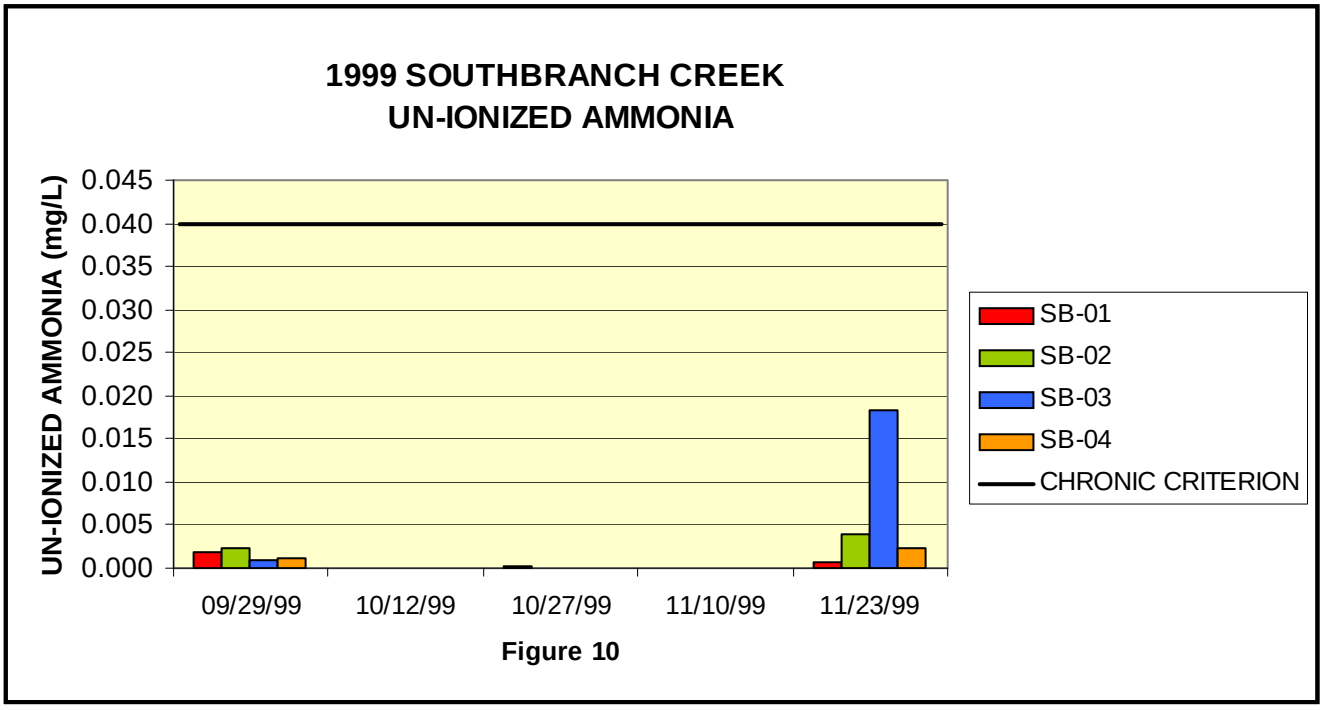
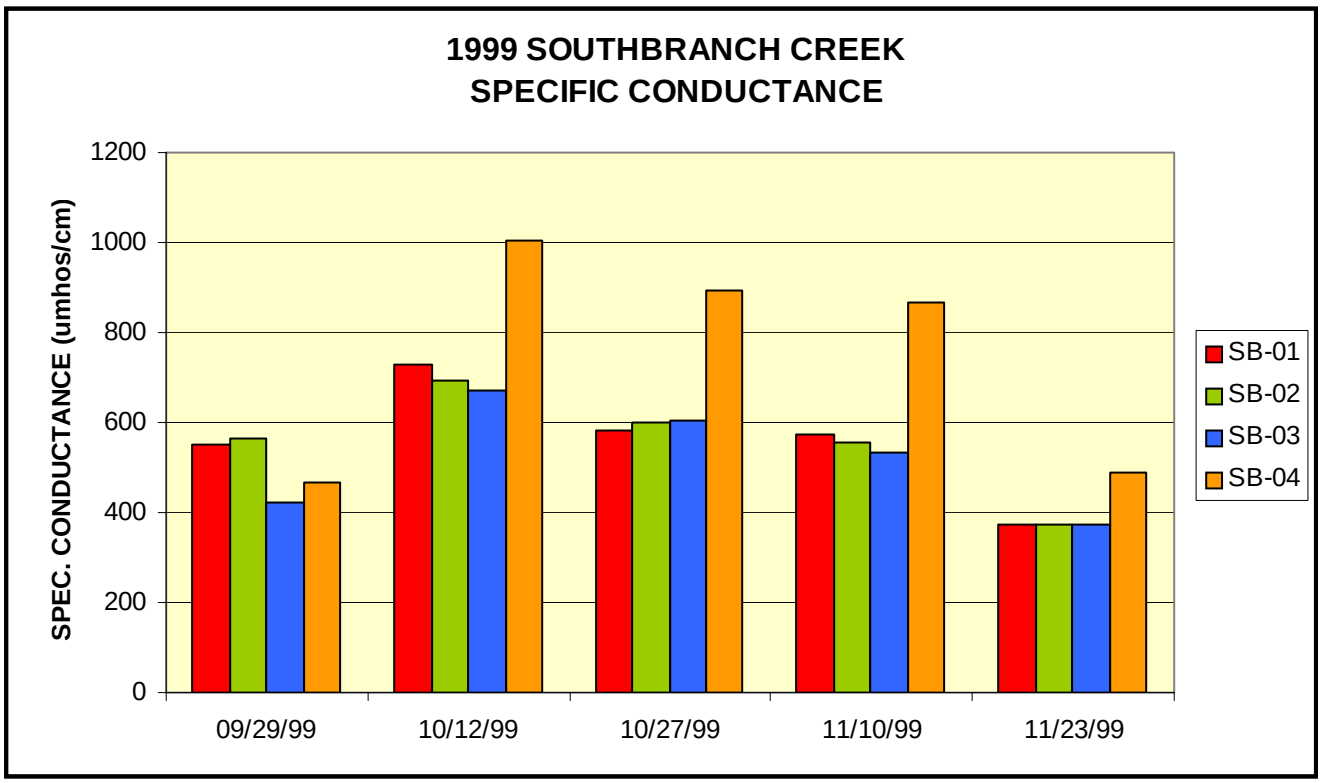


Figure 10

Specific Conductance

Specific conductance can be used as a pollutant tracer and is helpful in monitoring changes in the chemical makeup of the water column. Conductance measurements provide an indication of water ion and dissolved solids concentrations.

On all the sampling dates in 1999, SB-04 recorded the highest specific conductance on 4 of the 5 (80%) surveys (Figure 11). Since SB-04 is the furthest downstream, it subsequently reflects the total accumulation of pollutant loading on Southbranch Creek. It could reasonably be expected to contain higher concentrations of various ions that could be measured by specific conductance. SB-04 also is located adjacent to the busy Teutonia Avenue and Green Bay Road intersection. Road run-off could potentially contribute substances that might increase specific conductance. On a majority of dates, SB-01, SB-02, and SB-03 had values similar to one another for this parameter.



Chloride

Chlorides have electrochemical and catalytic functions in both plant and animal metabolic processes. They also act as a good tracer of water quality. Excessively high concentrations of chloride can cause osmotic shock in freshwater organisms. It is recommended that the maximum concentration of chloride not exceed 25 mg/L (American Fisheries Society, 1979).

All chloride data on Southbranch Creek in 1999 exceeded the recommended maximum concentration at every site and on every sampling date (Figure 12). Identical to specific conductance, chloride values were at their maximum on 4 of the 5 (80%) survey dates at SB-04. The furthest downstream and also located adjacent to a bustling intersection (Teutonia Avenue and Green Bay Road), SB-04 reflects the total accumulation of pollutant loading on Southbranch Creek. SB-04 could reasonably be expected to potentially contain a higher concentration of chloride than other Southbranch sampling locations. Large concentrations of chlorides in fresh water typically come from roadway salt, irrigation, and domestic and industrial discharges.

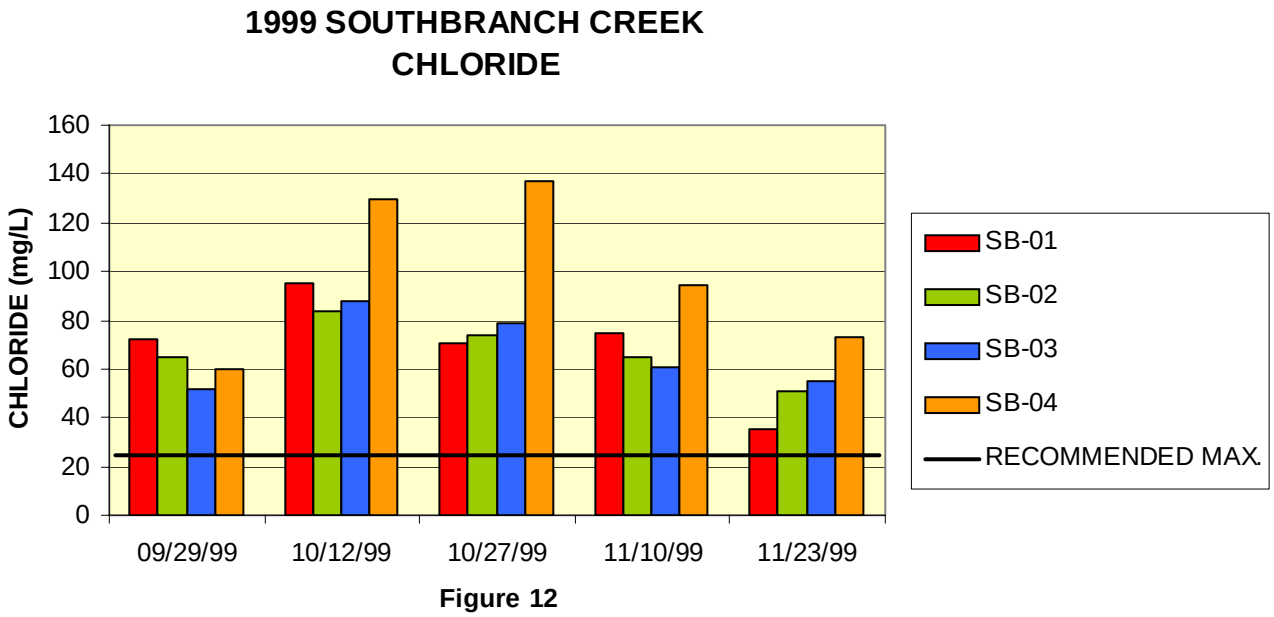


Figure 12

Toxic Pollutants (PAHs, PCBs, Mercury)

These chemicals are of environmental concern for both aquatic systems as well as human health. PAHs are formed from the incomplete combustion of fossil fuels and organic matter. They are also a component of many petroleum products, creosote, asphalt, cigarette smoke and vehicle exhaust. A majority of PAHs are considered carcinogenic and high concentrations in sediment are associated with high incidences of liver tumors in fish. PCBs are found in many electrical and hydraulic fluids. They are persistent, fat soluble chemicals that can also bioaccumulate. Mercury can be released from fuel combustion and industrial processes. It is also present in many fungicides, bactericides, paints, and paper products. PCBs and mercury can both have acute and chronic toxic effects on aquatic organisms as well as humans.

One survey was conducted on October 12, 1999 during a dry event (7 continuous days without significant, less than 1/10 inch, precipitation) that included sampling for PAHs, PCBs, and mercury. Upon analysis, none of these variables were detected.

Heavy Metals

In high concentrations, heavy metals including cadmium, chromium, nickel, copper, zinc, and lead are also of environmental consideration and can be moderately to highly toxic to plants, fish, and other aquatic organisms, as well as to humans. Heavy metals potentially can have both chronic and acute toxic effects. Some metals are known to be carcinogenic. Two metal analytes, chromium and nickel, were either equal to or below the method detection limits (9.4 ug/L and 14.3 ug/L respectively). Several other metals, including cadmium (detection limit 0.1 ug/L), copper (detection limit 10 ug/L), zinc (detection limit 4.3 ug/L), and lead (detection limit 1.9 ug/L) were either in very low concentrations or below the limit of detection. No heavy metals were shown to be toxic according to Wisconsin State Chronic Criteria. Copper, zinc and lead data are presented below.

Copper in the environment has its origins from natural as well as human sources. Major cultural inputs of copper include preservatives, industrial processes, pesticides, and corrosion of copper piping. The Wisconsin State Surface Water Warm Water Chronic Criterion for copper is 29 ug/L. Copper data for the 1999 sampling period on Southbranch Creek were below the State Warm Water Chronic Criterion and are presented below (Figure 13).

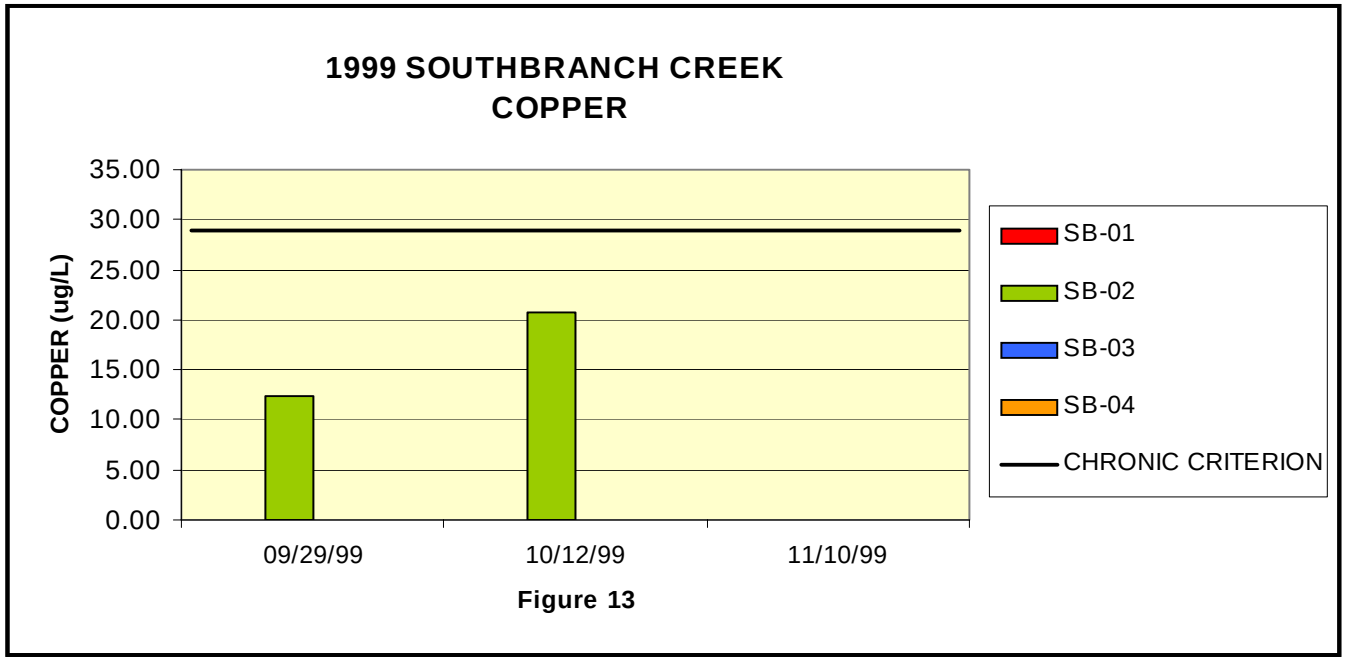


Figure 13

Zinc is fairly common in nature. Industrial and cultural sources include galvanized pipes, brass, other alloys, rubber vulcanization, paints, cosmetics, drugs, fertilizers and insecticides. The Wisconsin State Surface Water Warm Water Chronic Criterion for zinc is 113 ug/L. All 1999 zinc data on Southbranch Creek were also below the State Warm Water Chronic Criterion and are presented below (Figure 14).

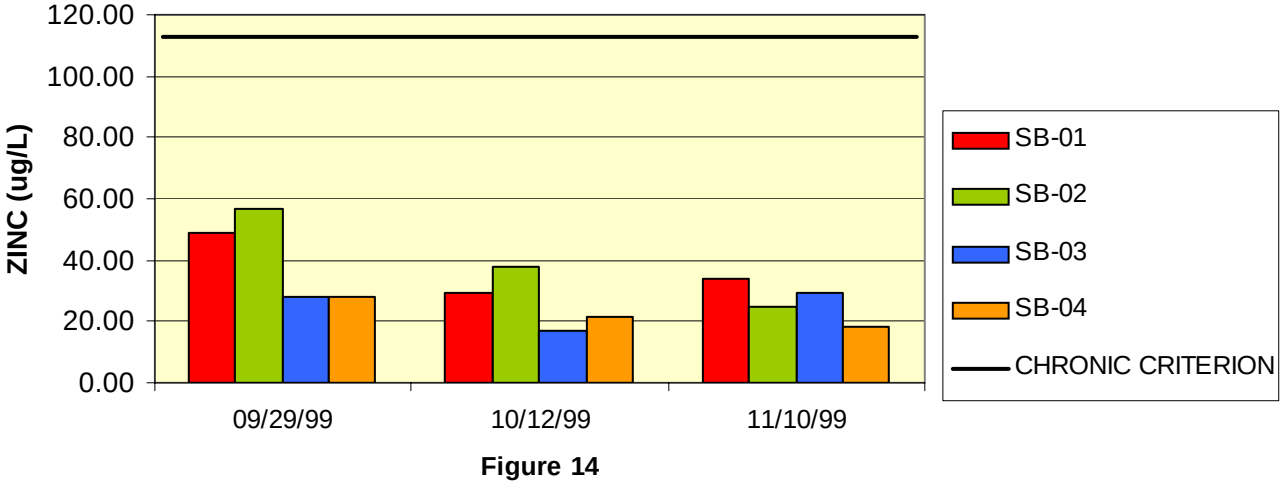


Figure 14

Lead also occurs naturally or as a result of human inputs. Precipitation, dry decomposition, the burning of coal and leaded gasoline, battery production, lead-based paints, industrial and domestic wastewater discharges, and urban runoff affect lead concentration levels. The Wisconsin State Warm Water Chronic Criterion for lead is 35 ug/L.

Most of the lead data on Southbranch Creek in 1999 were well below the Wisconsin State Warm Water Chronic Criterion (Figure 15). In fact, several sampling dates and sites registered values below the method detection limit of 1.9 ug/L. One exception was SB-04 on 10/12/99 when the lead concentration measured 47 ug/L. It is unknown why this date and site had a significantly higher concentration of lead.

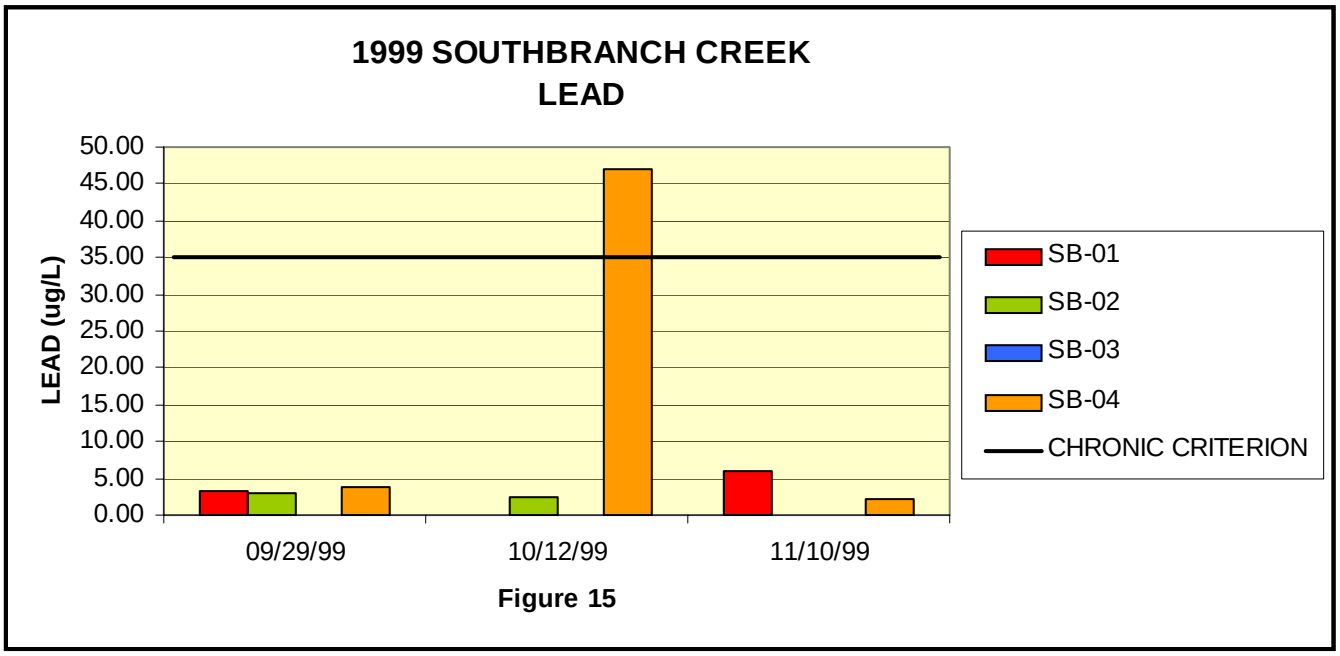


Figure 15

Water Quality Index (WQI)

The MMSD Water Quality Research Department has developed a Water Quality Index (WQI) that is based on nationally recognized indices, and is used as an assessment tool for evaluating river and Creek water quality. Eleven variables are mathematically translated into descriptive categories, i.e., excellent, good, fair, bad, or very bad water quality. A more detailed explanation of the MMSD WQI can be found in: MMSD Development of a Water Quality Index for the Milwaukee Metropolitan Sewerage District, 1994.

The WQI was run on the 1999 Southbranch Creek database. The monthly WQI values are presented below (Figure 16). It should be noted that it is difficult to draw definitive water quality conclusions with such a limited amount of data.

In reviewing the 1999 monthly mean WQI values for Southbranch Creek, fifty percent of them fell into the "fair" category while the other half were in the "bad" range. No monthly WQI values fell into the "very bad" or "good" categories. In terms of the sampling month, there was an overall tendency toward higher WQI values in October and slightly lower numbers in September. Of the three months sampled, November registered most of the lowest WQI data. In terms of the different Southbranch Creek sites, there were no dramatic differences in WQI numbers. Overall SB-04 was inclined to be slightly better than sites SB-02 and SB-01 in most instances. Site SB-03 exhibited little overall variance compared to site SB-01. Again the limited database precludes any conclusive analysis.

Specifically, the sub-index data that are primarily responsible for driving the WQI lower on Southbranch Creek are total and soluble phosphorus, chlorides and fecal coliform bacteria. Nearly all sampling dates at all sites produced poor sub-index values for total and soluble phosphorus as well as for chlorides. Secondarily, the fecal coliform bacteria sub-index numbers also played a role in lowering approximately one third of the WQI monthly values.

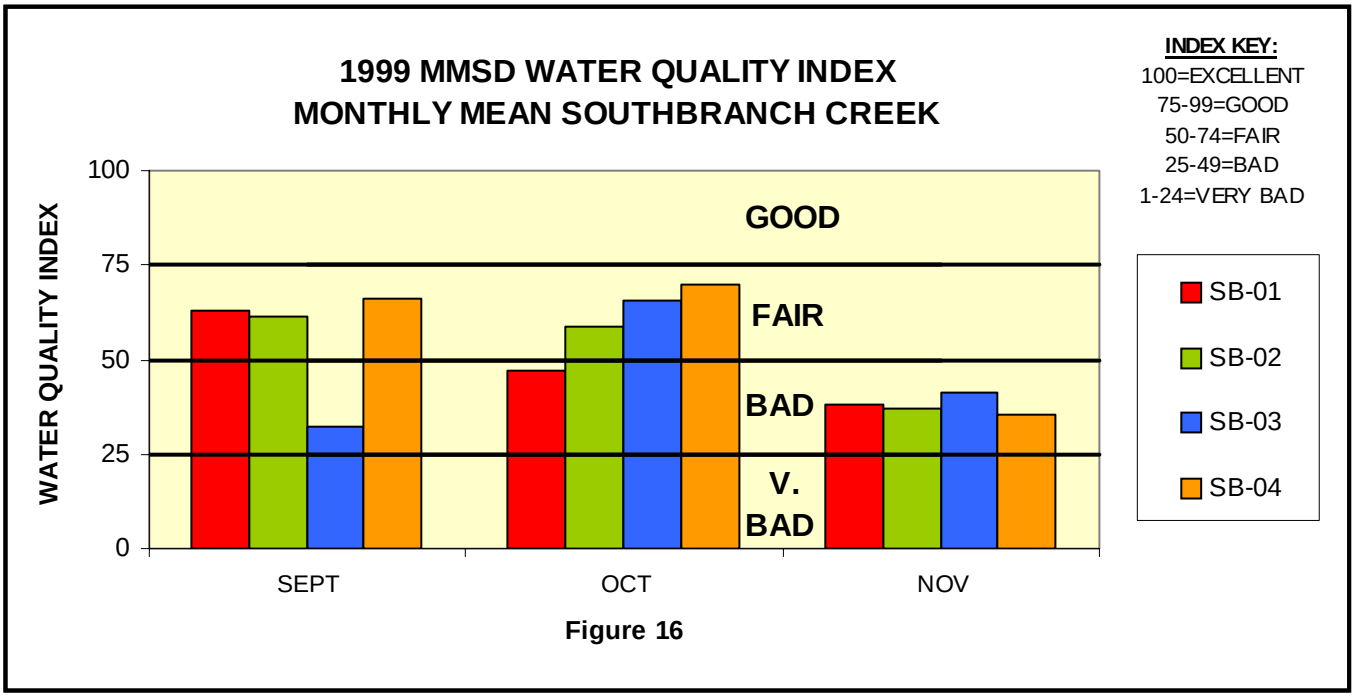


Figure 16

SUMMARY

The year 1999 marked the beginning of tremendous changes on Southbranch Creek. It saw the commencement of the comprehensive Southbranch Creek Flood Control Improvements Project. Selected homes were razed and the first of four floodwater detention basins was constructed. Water quality monitoring began to characterize the baseline water quality of the Creek.

Several dozen variables were analyzed. Some parameters, including dissolved oxygen, suspended solids, and un-ionized ammonia were at levels conducive to acceptable water quality. Toxic pollutants (PAHs, PCBs, mercury) and heavy metals (cadmium, chromium, nickel, copper, zinc, and lead) were either not detected or were in very low concentrations. At times however, various constituents including fecal coliform bacteria, phosphorus, and chloride exceeded State of Wisconsin Criteria or recommended maximums. Additionally, with the limited data available, the MMSD Water Quality Index (WQI), which mathematically converts eleven variables into descriptive categories, classified Southbranch Creek sites as either "fair" or "bad" in 1999.

More substantial alterations to Southbranch Creek will occur in the year 2000. Three additional floodwater detention basins are scheduled to be excavated. Water quality will continue to be monitored on a regular basis as the Southbranch Creek Flood Control Improvements Project moves forward. It is expected that the water quality of the Creek will improve with these modifications. Additionally, the elimination of the severe historical flooding during significant storms along Southbranch Creek will be realized.

REFERENCES

1. A Review of the EPA Red Book: Quality Criteria for Water. American Fisheries Society. Water Quality Section. 1979.

2. Contract documents for Dean School Detention Basin (W016GX010), November 1999 and Churchill Lane Detention Basin Project (W012GX052). June 1999.

3. Environmental Analysis and Decision on the Need for an Environmental Impact Statement (EIS). Earth Tech, June 18, 1999.

4. Milwaukee Metropolitan Sewerage District Watercourse System Plan Update. March 2000.

5. Milwaukee Metropolitan Sewerage District Watercourse System Plan Update. June 1999.

6. Milwaukee Metropolitan Sewerage District Watercourse System Plan Update. September 1999.

7. Milwaukee Metropolitan Sewerage District Watercourse System Plan Update. November 1999.

8. MMSD Development of a Water Quality Index for the Milwaukee Metropolitan Sewerage District. 1994.

9. MMSD 2010 Facilities Plan. 1997.

10. MMSD 2000 Strategic Plan. 1999.

11. Southeastern Wisconsin Regional Planning Commission (SEWRPC), Community Assistance Planning (CAP) Report 152. 1990.

12. Watercourse Management Plan for Southbranch Creek and Beaver Creek in the Village of Brown Deer, Wisconsin. Camp Dresser & McKee, May 1998.

13. Water Quality Monitoring Program and Budget. Milwaukee Metropolitan Sewerage District. 1999.

14. Wisconsin Department of Natural Resources (WDNR) Milwaukee River Basin Integrated Management Plan. 1992.

APPENDIX A

SOUTHBRANCH CREEK
NUMBER OF SAMPLES GENERATED BY VARIABLE PER SURVEY

Test Description	SB Creek (4 Sites)
Depth	4
Temperature	4
Dissolved Oxygen	4
pH	4
Specific Conductance	4
Total Kjeldahl Nitrogen	4
Ammonia-Nitrogen	4
Nitrate-Nitrogen	4
Nitrite-Nitrogen	4
Total Phosphorus	4
Dissolved Phosphorus	4
Total Organic Carbon	4
Total Inorganic Carbon	4
Dissolved Organic Carbon	4
Biochemical Oxygen Demand-5 Day	4
Biochemical Oxygen Demand-20 Day	4
Total Alkalinity	4
Hardness (Calculated from Ca + Mg)	4
Total Solids	4
Total Suspended Solids	4
Volatile Suspended Solids	4
Turbidity	4
Chlorides	4
Fecal Coliform Bacteria	4
Chlorophyll *a*	4
Copper	4
Lead	4
Chromium	4
Zinc	4
Cadmium	4
Calcium	4
Magnesium	4
Arsenic	4
Mercury *****	4
Nickel	4
Selenium	4
Silver	4
PCBs *****	4
PAHs *****	4

***** Sampled 2 times/year (wet & dry events)

APPENDIX B

1999 SOUTHBRANCH CREEK
HYDROLAB® DATA

DATE	SITE	TEMP.	pH	SP. COND.	DISS. OXY.
09/29/99	SB-01S	15.57	7.74	549	8.41
09/29/99	SB-02S	15.52	7.81	564	9.04
09/29/99	SB-03S	14.62	7.80	424	9.89
09/29/99	SB-04S	13.60	7.83	467	9.24
10/12/99	SB-01S	14.93	7.72	729	8.75
10/12/99	SB-02S	12.45	7.62	693	8.81
10/12/99	SB-03S	11.46	8.29	671	15.20
10/12/99	SB-04S	11.07	7.36	1006	7.18
10/27/99	SB-01S	12.79	7.40	582	8.53
10/27/99	SB-02S	10.38	7.83	600	14.03
10/27/99	SB-03S	8.72	8.35	603	16.01
10/27/99	SB-04S	6.17	7.46	895	11.37
11/10/99	SB-01S	13.92	7.65	574	8.78
11/10/99	SB-02S	12.79	7.81	556	11.01
11/10/99	SB-03S	12.16	7.64	532	11.55
11/10/99	SB-04S	9.88	7.25	867	6.77
11/23/99	SB-01S	12.91	7.57	372	8.40
11/23/99	SB-02S	13.27	7.85	373	10.35
11/23/99	SB-03S	12.84	9.05	372	14.65
11/23/99	SB-04S	10.69	7.57	491	8.54

APPENDIX C

1999 SOUTHBRANCH CREEK RAINFALL (DAILY & MONTHLY TOTALS)
MMSD WEATHER STATION DATA

6945 N. 41ST ST.				8463 N. GRANVILLE RD.		
(~41ST, SOUTH OF GOOD HOPE RD.)				(~84TH, SOUTH OF BROWN DEER RD.)		
	WS 1205	MONTHLY		WS 1209	MONTHLY	
DATE	AMT (IN.)	TOTAL (IN.)		AMT (IN.)	TOTAL (IN.)	
09/27/99	1.47			1.08		
09/28/99	1.31			1.13		
09/29/99	0			0		
09/30/99	0	**SEPT.=3.75**		0	**SEPT.=2.91**	
10/01/99	0.11			0.13		
10/02/99	0.1			0.11		
10/03/99	0.29			0.21		
10/04/99	0.02			0		
10/05/99	0			0		
10/06/99	0			0		
10/07/99	0			0		
10/08/99	0			0		
10/09/99	0			0		
10/10/99	0			0		
10/11/99	0			0		
10/12/99	0			0		
10/13/99	0.05			0.06		
10/14/99	0			0		
10/15/99	0			0		
10/16/99	0.21			0.17		
10/17/99	0			0		
10/18/99	0			0		
10/19/99	0			0		
10/20/99	0			0		
10/21/99	0			0		
10/22/99	0			0		
10/23/99	0			0		
10/24/99	0			0		
10/25/99	0			0		
10/26/99	0			0		
10/27/99	0			0		
10/28/99	0			0		
10/29/99	0			0		
10/30/99	0.01			0		
10/31/99	0	**OCT.=0.79**		0	**OCT.=0.68**	
11/01/99	0			0		
11/02/99	0			0		
11/03/99	0			0		
11/04/99	0			0		
11/05/99	0			0		
11/06/99	0			0		
11/07/99	0			0		
11/08/99	0			0		
11/09/99	0			0		
11/10/99	0.31			0.38		
11/11/99	0			0		
11/12/99	0			0		
11/13/99	0			0		
11/14/99	0			0		
11/15/99	0			0		
11/16/99	0			0		
11/17/99	0			0		
11/18/99	0			0		
11/19/99	0.05			0.07		
11/20/99	0.01			0		
11/21/99	0			0		
11/22/99	0			0		
11/23/99	0.31			0.48		
11/24/99	0	**NOV.=0.70**		0	**NOV.=0.95**	

APPENDIX D

1999 Summary Statistics- Southbranch Creek
Site SB-01-Bradley Rd., West of Edgeworth Dr.
Water Quality Data

VARIABLE	PH	TEMP	DO	AMMONIA	NITRITE	NITRATE	TKN	PHOS	SOLPHOS	SOLSIL	CHLA
units	su	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/m3
STATISTICS											
Mean	7.6	14.0	8.6	0.127	0.067	1.03	0.48	0.239	0.165	ND	3.56
Standard Error	0.1	0.5	0.1	0.048	0.028	0.37	0.10	0.057	0.045	ND	1.25
Median	7.7	13.9	8.5	0.100	0.063	0.68	0.46	0.261	0.158	ND	2.84
Mode	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Standard Deviation	0.1	1.2	0.2	0.083	0.055	0.83	0.22	0.128	0.101	ND	2.79
Sample Variance	0.0	1.5	0.0	0.007	0.003	0.69	0.05	0.016	0.010	ND	7.79
Kurtosis	0.8	-2.3	-3.0	ND	-2.398	4.37	-0.30	-2.967	-1.255	ND	-2.95
Skewness	-1.1	0.3	0.3	1.293	0.257	2.07	0.34	-0.199	0.512	ND	0.33
Range	0.3	2.8	0.4	0.160	0.124	1.98	0.57	0.270	0.238	0.00	5.86
Minimum	7.4	12.8	8.4	0.060	0.008	0.52	0.21	0.101	0.068	0.00	0.92
Maximum	7.7	15.6	8.8	0.220	0.132	2.50	0.78	0.371	0.306	0.00	6.78
Count	5	5	5	3	4	5	5	5	5	0	5
Confidence Level(95.0%)	0.2	1.5	0.2	0.207	0.088	1.03	0.27	0.159	0.125	ND	3.47

VARIABLE	SS	VSS	TS	FECAL	SPEC	CHLOR	AA_CD	CR	CU	NI	AA_PB
units	mg/L	mg/L	mg/L	MPN/100 ml	umhos/cm	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
STATISTICS											
Mean	4.7	1.8	342.0	1415	561	69.6	0.2	9.4	10.0	14.3	3.7
Standard Error	2.2	0.5	35.5	907	57	9.6	0.1	0.0	0.0	0.0	1.2
Median	1.6	1.8	363.0	140	574	72.1	0.1	9.4	10.0	14.3	3.2
Mode	1.6	ND	ND	ND	ND	ND	0.1	9.4	10.0	14.3	ND
Standard Deviation	5.0	1.0	79.5	2029	127	21.5	0.1	0.0	0.0	0.0	2.1
Sample Variance	25.0	0.9	6318.0	4115489	16175	462.3	0.0	0.0	0.0	0.0	4.6
Kurtosis	1.2	-4.3	-0.2	0	2	2.4	ND	ND	ND	ND	ND
Skewness	1.4	0.0	-0.3	1	0	-0.9	1.7	ND	ND	-2.4	1.1
Range	11.6	2.0	210.0	4589	357	59.7	0.2	0.0	0.0	0.0	4.2
Minimum	1.2	0.8	233.0	11	372	35.6	0.1	9.4	10.0	14.3	1.9
Maximum	12.8	2.8	443.0	4600	729	95.3	0.3	9.4	10.0	14.3	6.1
Count	5	4	5	5	5	5	3	3	3	3	3
Confidence Level(95.0%)	6.2	1.5	98.7	2519	158	26.7	0.3	0.0	0.0	0.0	5.3

APPENDIX D

1999 Summary Statistics- Southbranch Creek
Site SB-01-Bradley Rd., West of Edgeworth Dr.
Water Quality Data

VARIABLE	ZN	CA	MG	AA_AG	AA_AS	AA_SE	DS	LFC	HARD	SCHII	TURB
units	ug/L	mg/L	mg/L	ug/L	ug/L	ug/L	mg/L	MPN/100 ml	mg/L	meters	mg/L
STATISTICS											
Mean	37.6	50.82	19.65	0.3	1.9	2.6	337.3	2.3	208	ND	5.6
Standard Error	5.9	6.33	3.34	0.0	0.0	0.0	37.6	0.5	29	ND	3.3
Median	34.2	49.86	20.66	0.3	1.9	2.6	361.8	2.1	210	ND	3.9
Mode	ND	ND	ND	0.3	1.9	2.6	ND	ND	ND	ND	ND
Standard Deviation	10.2	10.97	5.78	0.0	0.0	0.1	84.0	1.2	51	ND	7.4
Sample Variance	104.9	120.36	33.42	0.0	0.0	0.0	7060.8	1.4	2588	ND	54.9
Kurtosis	ND	ND	ND	ND	ND	ND	-0.2	-2.7	ND	ND	4.2
Skewness	1.3	0.39	-0.76	ND	ND	1.7	-0.4	0.2	0	ND	2.0
Range	19.6	21.88	11.43	0.0	0.0	0.1	221.2	2.6	102	0.0	17.9
Minimum	29.5	40.36	13.44	0.3	1.9	2.6	220.2	1.0	156	0.0	0.7
Maximum	49.1	62.24	24.87	0.3	1.9	2.7	441.4	3.7	258	0.0	18.6
Count	3	3	3	3	3	3	5	5	3	0	5
Confidence Level(95.0%)	25.4	27.25	14.36	0.0	0.0	0.1	104.3	1.5	126	ND	9.2

VARIABLE	BOD5	BOD20	IXLITE	TNOC	TNIC	TNDOC	TALK				
units	mg/L	mg/L	meters	mg/L	mg/L	mg/L	mg/L				
STATISTICS											
Mean	1.5	ND	ND	4.0	30.3	3.0	134				
Standard Error	0.4	ND	ND	1.0	4.0	0.7	17				
Median	1.1	ND	ND	3.2	33.1	2.1	146				
Mode	1.1	ND	ND	ND	ND	ND	ND				
Standard Deviation	0.9	ND	ND	2.1	9.0	1.6	39				
Sample Variance	0.8	ND	ND	4.6	80.8	2.7	1483				
Kurtosis	4.9	ND	ND	3.0	0.6	2.7	0				
Skewness	2.2	ND	ND	1.7	-1.1	1.7	-1				
Range	2.1	0.0	0.0	5.2	21.8	4.0	97				
Minimum	1.0	0.0	0.0	2.5	16.2	1.7	75				
Maximum	3.1	0.0	0.0	7.7	38.0	5.7	172				
Count	5	0	0	5	5	5	5				
Confidence Level(95.0%)	1.1	ND	ND	2.7	11.2	2.0	48				

ND = No Data

APPENDIX D

1999 Summary Statistics- Southbranch Creek
Site SB-02-55th St., North of Bradley Rd.
Water Quality Data

VARIABLE	PH	TEMP	DO	AMMONIA	NITRITE	NITRATE	TKN	PHOS	SOLPHOS	SOLSIL	CHLA
units	su	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/m3
STATISTICS											
Mean	7.8	12.9	10.6	0.255	0.087	0.85	0.52	0.229	0.166	ND	3.62
Standard Error	0.0	0.8	0.9	0.035	0.033	0.28	0.12	0.052	0.046	ND	1.19
Median	7.8	12.8	10.4	0.255	0.087	0.52	0.55	0.184	0.161	ND	2.49
Mode	7.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Standard Deviation	0.1	1.8	2.1	0.049	0.066	0.62	0.26	0.116	0.103	ND	2.67
Sample Variance	0.0	3.4	4.4	0.002	0.004	0.38	0.07	0.013	0.011	ND	7.13
Kurtosis	4.4	1.5	1.6	ND	-4.677	0.94	0.00	-0.408	1.923	ND	4.51
Skewness	-2.1	0.2	1.3	ND	0.029	1.33	0.72	0.605	1.233	ND	2.10
Range	0.2	5.1	5.2	0.070	0.136	1.49	0.64	0.298	0.269	0.00	6.44
Minimum	7.6	10.4	8.8	0.220	0.020	0.35	0.27	0.097	0.063	0.00	1.90
Maximum	7.9	15.5	14.0	0.290	0.156	1.84	0.91	0.395	0.332	0.00	8.34
Count	5	5	5	2	4	5	5	5	5	0	5
Confidence Level(95.0%)	0.1	2.3	2.6	0.445	0.105	0.77	0.32	0.144	0.128	ND	3.31

VARIABLE	SS	VSS	TS	FECAL	SPEC	CHLOR	AA_CD	CR	CU	NI	AA_PB
units	mg/L	mg/L	mg/L	MPN/100 ml	umhos/cm	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
STATISTICS											
Mean	8.5	3.8	346.8	1115	557	67.7	0.2	9.4	14.3	14.3	2.5
Standard Error	2.4	0.6	34.7	875	52	5.4	0.1	0.0	3.3	0.0	0.3
Median	7.6	3.8	344.0	430	564	65.2	0.1	9.4	12.3	14.3	2.5
Mode	ND	ND	ND	430	ND	ND	0.1	9.4	ND	14.3	ND
Standard Deviation	5.3	1.2	77.5	1957	116	12.0	0.2	0.0	5.6	0.0	0.6
Sample Variance	28.2	1.3	6012.7	3831249	13563	144.0	0.0	0.0	31.9	0.0	0.4
Kurtosis	-1.6	0.9	-0.6	5	2	0.4	ND	ND	ND	ND	ND
Skewness	0.4	0.0	-0.2	2	-1	-0.1	1.7	ND	1.4	-2.4	0.0
Range	12.8	2.8	200.0	4579	320	32.3	0.4	0.0	10.7	0.0	1.2
Minimum	2.8	2.4	241.0	21	373	51.0	0.1	9.4	10.0	14.3	1.9
Maximum	15.6	5.2	441.0	4600	693	83.3	0.5	9.4	20.7	14.3	3.1
Count	5	4	5	5	5	5	3	3	3	3	3
Confidence Level(95.0%)	6.6	1.8	96.3	2430	145	14.9	0.5	0.0	14.0	0.0	1.5

ND = No Data

APPENDIX D

1999 Summary Statistics- Southbranch Creek
Site SB-02-55th St., North of Bradley Rd.
Water Quality Data

VARIABLE	ZN	CA	MG	AA_AG	AA_AS	AA_SE	DS	LFC	HARD	SCHII	TURB
units	ug/L	mg/L	mg/L	ug/L	ug/L	ug/L	mg/L	MPN/100 ml	mg/L	meters	mg/L
STATISTICS											
Mean	39.8	52.30	19.58	0.3	2.0	2.8	338.3	2.4	211	ND	5.5
Standard Error	9.3	5.29	2.74	0.0	0.1	0.2	35.5	0.4	24	ND	1.8
Median	37.9	48.84	19.20	0.3	1.9	2.6	341.2	2.6	201	ND	3.9
Mode	ND	ND	ND	0.3	1.9	2.6	ND	2.6	ND	ND	ND
Standard Deviation	16.1	9.17	4.74	0.0	0.1	0.3	79.3	0.9	42	ND	3.9
Sample Variance	257.8	84.05	22.51	0.0	0.0	0.1	6285.9	0.8	1770	ND	15.4
Kurtosis	ND	ND	ND	ND	ND	ND	-0.1	0.3	ND	ND	3.1
Skewness	0.5	1.46	0.36	ND	1.7	1.7	-0.4	0.2	1	ND	1.8
Range	31.9	17.33	9.47	0.0	0.2	0.6	208.0	2.3	82	0.0	9.5
Minimum	24.9	45.37	15.04	0.3	1.9	2.6	225.4	1.3	175	0.0	2.7
Maximum	56.8	62.69	24.51	0.3	2.1	3.2	433.4	3.7	257	0.0	12.2
Count	3	3	3	3	3	3	5	5	3	0	5
Confidence Level(95.0%)	39.9	22.77	11.79	0.0	0.3	0.8	98.4	1.1	104	ND	4.9

VARIABLE	BOD5	BOD20	IXLITE	TNOC	TNIC	TNDOC	TALK				
units	mg/L	mg/L	meters	mg/L	mg/L	mg/L	mg/L				
STATISTICS											
Mean	1.6	ND	ND	3.7	31.9	3.2	134				
Standard Error	0.6	ND	ND	1.1	4.1	0.9	17				
Median	0.9	ND	ND	3.1	32.3	2.2	143				
Mode	ND	ND	ND	ND	ND	ND	ND				
Standard Deviation	1.4	ND	ND	2.4	9.2	2.0	38				
Sample Variance	2.0	ND	ND	5.5	85.1	4.1	1470				
Kurtosis	4.7	ND	ND	3.4	1.7	3.9	2				
Skewness	2.2	ND	ND	1.8	-1.2	2.0	-1				
Range	3.4	0.0	0.0	5.8	23.6	4.9	104				
Minimum	0.7	0.0	0.0	2.0	17.0	1.8	73				
Maximum	4.1	0.0	0.0	7.8	40.6	6.7	177				
Count	5	0	0	5	5	5	5				
Confidence Level(95.0%)	1.8	ND	ND	2.9	11.5	2.5	48				

ND = No Data

APPENDIX D

1999 Summary Statistics- Southbranch Creek
Site SB-03, 47th St., South of Churchill Ln.
Water Quality Data

VARIABLE	PH	TEMP	DO	AMMONIA	NITRITE	NITRATE	TKN	PHOS	SOLPHOS	SOLSIL	CHLA
units	su	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/m3
STATISTICS											
Mean	8.2	12.0	13.5	0.080	0.059	0.51	0.56	0.192	0.123	ND	9.10
Standard Error	0.2	1.0	1.2	0.000	0.021	0.27	0.09	0.051	0.041	ND	1.56
Median	8.3	12.2	14.7	0.080	0.048	0.24	0.66	0.161	0.118	ND	10.62
Mode	ND	ND	ND	0.080	ND	0.24	ND	ND	ND	ND	ND
Standard Deviation	0.6	2.2	2.6	0.000	0.041	0.60	0.20	0.113	0.092	ND	3.49
Sample Variance	0.3	4.7	6.8	0.000	0.002	0.36	0.04	0.013	0.009	ND	12.20
Kurtosis	0.2	1.3	-1.9	ND	1.334	3.26	-2.70	-0.533	1.538	ND	2.63
Skewness	0.7	-0.6	-0.7	ND	1.315	1.76	-0.63	0.720	1.189	ND	-1.64
Range	1.4	5.9	6.1	0.000	0.092	1.52	0.42	0.285	0.236	0.00	8.67
Minimum	7.6	8.7	9.9	0.080	0.025	0.02	0.31	0.072	0.035	0.00	3.24
Maximum	9.1	14.6	16.0	0.080	0.117	1.54	0.73	0.357	0.271	0.00	11.91
Count	5	5	5	2	4	5	5	5	5	0	5
Confidence Level(95.0%)	0.7	2.7	3.2	0.000	0.066	0.75	0.24	0.141	0.115	ND	4.34

VARIABLE	SS	VSS	TS	FECAL	SPEC	CHLOR	AA_CD	CR	CU	NI	AA_PB
units	mg/L	mg/L	mg/L	MPN/100 ml	umhos/cm	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
STATISTICS											
Mean	10.2	3.6	330.8	5308	520	66.7	0.1	9.4	10.0	14.3	1.9
Standard Error	3.7	0.4	43.9	4689	55	7.1	0.0	0.0	0.0	0.0	0.0
Median	5.6	3.4	323.0	430	532	60.9	0.1	9.4	10.0	14.3	1.9
Mode	ND	ND	ND	ND	ND	ND	0.1	9.4	10.0	14.3	1.9
Standard Deviation	8.3	0.9	98.2	10485	123	15.9	0.0	0.0	0.0	0.0	0.0
Sample Variance	68.4	0.7	9639.7	109924859	15238	253.1	0.0	0.0	0.0	0.0	0.0
Kurtosis	2.2	1.5	-2.7	5	-2	-2.0	ND	ND	ND	ND	ND
Skewness	1.6	1.2	0.2	2	0	0.6	ND	ND	ND	-2.4	ND
Range	19.6	2.0	214.0	23997	299	36.7	0.0	0.0	0.0	0.0	0.0
Minimum	4.4	2.8	234.0	3	372	51.3	0.1	9.4	10.0	14.3	1.9
Maximum	24.0	4.8	448.0	24000	671	88.0	0.1	9.4	10.0	14.3	1.9
Count	5	4	5	5	5	5	2	3	3	3	2
Confidence Level(95.0%)	10.3	1.4	121.9	13018	153	19.8	0.0	0.0	0.0	0.0	0.0

ND = No Data

APPENDIX D

1999 Summary Statistics- Southbranch Creek
Site SB-03, 47th St., South of Churchill Ln.
Water Quality Data

VARIABLE	ZN	CA	MG	AA_AG	AA_AS	AA_SE	DS	LFC	HARD	SCHII	TURB
units	ug/L	mg/L	mg/L	ug/L	ug/L	ug/L	mg/L	MPN/100 ml	mg/L	meters	mg/L
STATISTICS											
Mean	24.9	46.55	16.53	0.3	1.9	2.7	320.6	2.4	184	ND	8.7
Standard Error	3.8	7.06	3.62	0.0	0.0	0.1	41.3	0.7	33	ND	4.6
Median	28.0	47.11	17.28	0.3	1.9	2.6	317.8	2.6	189	ND	5.3
Mode	ND	ND	ND	0.3	1.9	2.6	ND	ND	ND	ND	ND
Standard Deviation	6.6	12.23	6.27	0.0	0.0	0.1	92.3	1.6	56	ND	10.2
Sample Variance	43.7	149.49	39.34	0.0	0.0	0.0	8528.1	2.7	3173	ND	104.7
Kurtosis	ND	ND	ND	ND	ND	ND	-2.3	-2.0	ND	ND	3.6
Skewness	-1.6	-0.21	-0.54	ND	ND	1.7	0.2	0.0	0	ND	1.8
Range	12.1	24.43	12.48	0.0	0.0	0.2	207.6	3.9	112	0.0	25.2
Minimum	17.3	34.05	9.91	0.3	1.9	2.6	228.4	0.5	126	0.0	1.1
Maximum	29.4	58.48	22.39	0.3	1.9	2.8	436.0	4.4	238	0.0	26.3
Count	3	3	3	2	3	3	5	5	3	0	5
Confidence Level(95.0%)	16.4	30.37	15.58	0.0	0.0	0.3	114.7	2.0	140	ND	12.7

VARIABLE	BOD5	BOD20	IXLITE	TNOC	TNIC	TNDOC	TALK				
units	mg/L	mg/L	meters	mg/L	mg/L	mg/L	mg/L				
STATISTICS											
Mean	2.0	ND	ND	4.6	29.0	3.9	123				
Standard Error	0.5	ND	ND	0.9	3.8	0.6	17				
Median	1.6	ND	ND	4.1	31.9	3.7	138				
Mode	ND	ND	ND	4.1	ND	ND	ND				
Standard Deviation	1.0	ND	ND	2.0	8.6	1.4	39				
Sample Variance	1.0	ND	ND	4.1	73.7	2.1	1502				
Kurtosis	4.1	ND	ND	4.2	0.1	2.9	-2				
Skewness	2.0	ND	ND	2.0	-1.0	1.6	0				
Range	2.5	0.0	0.0	5.0	21.1	3.7	94				
Minimum	1.3	0.0	0.0	3.1	16.0	2.7	72				
Maximum	3.8	0.0	0.0	8.1	37.1	6.3	166				
Count	5	0	0	5	5	5	5				
Confidence Level(95.0%)	1.3	ND	ND	2.5	10.7	1.8	48				

ND = No Data

APPENDIX D

1999 Summary Statistics- Southbranch Creek
Site SB-04, Green Bay Ct., N. of Green Bay Rd. and Teutonia Ave.
Water Quality Data

VARIABLE	PH	TEMP	DO	AMMONIA	NITRITE	NITRATE	TKN	PHOS	SOLPHOS	SOLSIL	CHLA
units	su	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/m3
STATISTICS											
Mean	7.5	10.3	8.6	0.225	0.038	0.44	0.56	0.147	0.091	ND	4.76
Standard Error	0.1	1.2	0.8	0.135	0.011	0.22	0.12	0.046	0.032	ND	1.59
Median	7.5	10.7	8.5	0.225	0.050	0.25	0.57	0.109	0.065	ND	3.05
Mode	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Standard Deviation	0.2	2.7	1.8	0.191	0.025	0.50	0.26	0.104	0.071	ND	3.57
Sample Variance	0.0	7.2	3.4	0.036	0.001	0.25	0.07	0.011	0.005	ND	12.72
Kurtosis	0.6	1.8	0.1	ND	-2.418	2.48	1.49	-1.661	-2.080	ND	3.58
Skewness	0.8	-0.7	0.8	ND	-0.525	1.58	0.65	0.720	0.589	ND	1.89
Range	0.6	7.4	4.6	0.270	0.058	1.25	0.72	0.235	0.163	0.00	8.60
Minimum	7.3	6.2	6.8	0.090	0.006	0.02	0.24	0.057	0.022	0.00	2.32
Maximum	7.8	13.6	11.4	0.360	0.064	1.27	0.96	0.292	0.185	0.00	10.92
Count	5	5	5	2	5	5	5	5	5	0	5
Confidence Level(95.0%)	0.3	3.3	2.3	1.715	0.031	0.62	0.33	0.129	0.088	ND	4.43

VARIABLE	SS	VSS	TS	FECAL	SPEC	CHLOR	AA_CD	CR	CU	NI	AA_PB
units	mg/L	mg/L	mg/L	MPN/100 ml	umhos/cm	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
STATISTICS											
Mean	4.9	2.1	445.6	5718	745	98.9	0.2	9.4	10.0	14.3	17.7
Standard Error	0.6	0.5	71.2	4581	111	15.2	0.1	0.0	0.0	0.0	14.7
Median	5.6	2.2	469.0	930	867	94.3	0.1	9.4	10.0	14.3	3.8
Mode	5.6	ND	ND	930	ND	ND	0.1	9.4	10.0	14.3	ND
Standard Deviation	1.3	1.0	159.2	10244	249	34.0	0.1	0.0	0.0	0.0	25.4
Sample Variance	1.7	1.0	25336.3	104931770	61826	1157.3	0.0	0.0	0.0	0.0	646.0
Kurtosis	0.9	0.9	-2.7	5	-3	-2.6	ND	ND	ND	ND	ND
Skewness	-1.3	-0.6	-0.2	2	0	0.1	1.7	ND	ND	-2.4	1.7
Range	3.2	2.4	355.0	23570	539	77.2	0.2	0.0	0.0	0.0	44.8
Minimum	2.8	0.8	257.0	430	467	59.8	0.1	9.4	10.0	14.3	2.2
Maximum	6.0	3.2	612.0	24000	1006	137.0	0.3	9.4	10.0	14.3	47.0
Count	5	4	5	5	5	5	3	3	3	3	3
Confidence Level(95.0%)	1.6	1.6	197.6	12719	309	42.2	0.2	0.0	0.0	0.0	63.1

ND = No Data

APPENDIX D

1999 Summary Statistics- Southbranch Creek
Site SB-04, Green Bay Ct., N. of Green Bay Rd. and Teutonia Ave.
Water Quality Data

VARIABLE	ZN	CA	MG	AA_AG	AA_AS	AA_SE	DS	LFC	HARD	SCHII	TURB
units	ug/L	mg/L	mg/L	ug/L	ug/L	ug/L	mg/L	MPN/100 ml	mg/L	meters	mg/L
STATISTICS											
Mean	22.6	56.93	21.48	0.3	1.9	2.8	440.7	3.3	231	ND	5.8
Standard Error	2.9	11.85	5.99	0.0	0.0	0.2	71.6	0.3	54	ND	0.9
Median	21.8	59.20	23.23	0.3	1.9	2.6	464.6	3.0	243	ND	5.7
Mode	ND	ND	ND	0.3	1.9	2.6	ND	3.0	ND	ND	ND
Standard Deviation	5.0	20.52	10.38	0.0	0.0	0.3	160.0	0.7	94	ND	1.9
Sample Variance	24.8	421.24	107.77	0.0	0.0	0.1	25612.5	0.5	8830	ND	3.7
Kurtosis	ND	ND	ND	ND	ND	ND	-2.7	2.4	ND	ND	2.3
Skewness	0.7	-0.49	-0.74	ND	ND	1.7	-0.2	1.5	-1	ND	1.1
Range	9.9	40.86	20.54	0.0	0.0	0.5	357.8	1.7	187	0.0	5.2
Minimum	18.0	35.36	10.33	0.3	1.9	2.6	251.4	2.6	131	0.0	3.7
Maximum	27.9	76.22	30.87	0.3	1.9	3.1	609.2	4.4	317	0.0	8.9
Count	3	3	3	3	3	3	5	5	3	0	5
Confidence Level(95.0%)	12.4	50.98	25.79	0.0	0.0	0.7	198.7	0.8	233	ND	2.4

VARIABLE	BOD5	BOD20	IXLITE	TNOC	TNIC	TNDOC	TALK				
units	mg/L	mg/L	meters	mg/L	mg/L	mg/L	mg/L				
STATISTICS											
Mean	2.5	ND	ND	5.0	34.6	4.2	153				
Standard Error	0.9	ND	ND	1.2	5.3	1.0	23				
Median	1.7	ND	ND	4.2	36.9	3.3	173				
Mode	1.4	ND	ND	ND	ND	ND	ND				
Standard Deviation	1.9	ND	ND	2.6	11.9	2.3	52				
Sample Variance	3.7	ND	ND	6.9	140.5	5.3	2725				
Kurtosis	4.7	ND	ND	4.3	-2.2	3.7	-3				
Skewness	2.1	ND	ND	2.0	-0.2	1.9	0				
Range	4.5	0.0	0.0	6.4	28.1	5.7	107				
Minimum	1.4	0.0	0.0	3.2	20.0	2.5	94				
Maximum	5.9	0.0	0.0	9.6	48.1	8.1	201				
Count	5	0	0	5	5	5	5				
Confidence Level(95.0%)	2.4	ND	ND	3.3	14.7	2.9	65				

ND = No Data