Please take the time to read the following important information:

Pursuant to the following data limitations, the MWMO does not support interpretation of the data other than what is presented in the report. Data analysis and the resulting assumptions made for a given site will have limited levels of reliability at grab sample locations and during the first three to five years of flow-weighted monitoring. The MWMO will not use site data for decision-making until there are three to five years of flow-weighted records available. The MWMO does not support assumptions or findings that result from analysis of these data prior to these minimum criteria being met. Results from five years or more of flow-weighted monitoring will be used to establish a water quality baseline for stormwater discharges entering the Mississippi River, to determine pollutant loads entering the Mississippi River and to evaluate the effects of MWMO projects and programs on water quality.

ANNUAL MONITORING REPORT
2005

Mississippi Watershed Management Organization

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1.0 EXECUTIVE SUMMARY

This report details the results of the Mississippi Watershed Management Organization's (MWMO's) 2005 monitoring season. MWMO staff will complete an annual monitoring report summarizing the year's results and outlining the next year's work plan by May 1 of each year. The report is available on the MWMO website at www.mwmo.org.

The MWMO established the Monitoring Program to provide a scientific basis for identifying and evaluating water quality and quantity issues and implementing solutions to improve water quality and reestablish natural water regimes in the watershed. From 2003 to 2005, the formative stages of the MWMO's Monitoring Program were developed in partnership with the City of Minneapolis, the Minneapolis Park and Recreation Board, the University of Minnesota, Xcel Energy, and the Capitol Region Watershed District. The MWMO will continue to expand this network of partners. A full-time staff member was hired in 2005 to continue the development and implementation of the Monitoring Program.

The MWMO monitors water quality in the watershed's stormsewer system, the Mississippi River, and Loring Pond. Within these systems, major factors influencing water quality include: the amount of precipitation, timing of precipitation events, and land use practices in the watershed. Long-term monitoring of stormwater outfalls is necessary to characterize the impacts of various land use practices on surface water runoff within the MWMO and, ultimately, the Mississippi River. Water quality in the Mississippi River is also influenced by precipitation and land use practices in the entire Mississippi River basin upstream of the MWMO. Long-term monitoring of the river will aid the understanding of upstream weather pattern and land use impacts on the MWMO watershed.

The 2005 monitoring season included collection of water quality samples from six locations in the Mississippi River, one in Loring Pond, and five stormwater outfalls.

The MWMO reach of the Mississippi River is listed on the Minnesota 303(d) Impaired Waters list for fecal coliform impairment. Fecal coliform concentrations continued to exceed Minnesota water quality standards in 2005 during the months of August, September, and October. E. coli concentrations also exceeded water quality standards in June, September, and October. Long-term monitoring of the river and stormwater outfalls to the river is necessary to evaluate fecal coliform inputs from within the watershed compared to inputs from upstream sources.

Fecal coliform concentrations in Loring Pond exceeded Minnesota water quality standards in September 2005. September precipitation events resulted in high rainfall amounts, which impacted the concentrations of fecal coliform. Loring Pond is not listed on the Minnesota Impaired Waters list. Further monitoring is necessary to determine if Loring Pond is an impaired water. The MWMO will continue to monitor Loring Pond and notify the MPCA if another exceedance occurs in 2006 or 2007.

The MWMO completed its first full season of stormwater monitoring in 2005. Water quality standards do not exist for stormwater; therefore, data were not compared to standards but are presented in subsequent sections. The MWMO will continue to monitor stormwater outfalls to develop a record of baseline data to characterize stormwater quality within the watershed.

2.0 INTRODUCTION

This report details the results of the Mississippi Watershed Management Organization's (MWMO) 2005 monitoring season. MWMO staff will complete an annual monitoring report summarizing the year's results and outlining the next year's work plan by May 1 of each year. The report is available on the MWMO website at www.mwmo.org.

The MWMO established the monitoring program to provide a scientific basis for identifying and evaluating water quality and quantity issues and implementing solutions to improve water quality and reestablish natural water regimes in the watershed. The objectives of the program include:

- Monitor biological, chemical, and physical parameters of water resources in the watershed;
- Monitor water quality within the watershed:
  - Develop a record of baseline data to characterize water quality and identify pollutants that exceed water quality standards, and
  - Assess pollutants listed on the Minnesota "Polluted Waters" list for the Total Maximum Daily Load (TMDL) process;
- Assess the volume and rate of water movement in the watershed;
- Develop and agree upon a standardized set of parameters and sample collection, data analysis, and reporting standards with organizations in the watershed;
- Develop partnerships and collaborate with other organizations and/or agencies both inside and outside the watershed boundaries to improve water quality in the Mississippi River; and
- Assess land use impacts on water quality.

The 2005 monitoring season included collection of water quality samples from six locations in the Mississippi River, one in Loring Pond, and five stormwater outfalls. Refer to Figure 1 in Appendix A for the monitoring locations. The sampling sites are further described in subsequent sections.

3.0 BACKGROUND

The MWMO was established in 1985 by a Joint Powers Agreement among the member organizations. The MWMO watershed boundaries are shown in Figure 1 in Appendix A. The MWMO is a unique organization as it includes a reach of the Mississippi River, while other local watershed districts and organizations include land and water resources up to the river's shore but not extending into the river itself. The reach of the Mississippi River included in the MWMO extends from 53rd Avenue in north Minneapolis downstream to Lock and Dam 1 (Ford Dam) in south Minneapolis. Another unique feature of the MWMO is that its boundaries include only one lake, Loring Pond.

Minnesota regulations require that the MWMO protect water quality in the watershed. Minnesota Rules Chapter 7050 requires that all water bodies comply with state water quality standards. Furthermore, section 303D of the Federal Water Pollution Control Act (commonly known as the Clean Water Act) requires states to develop TMDLs for waters with impaired uses. Impaired waters are those waters that exceed water quality standards for their classified use. Some typical classifications include drinking water and aquatic life and recreation (swimming and fishing). According to Minnesota Rules Chapter 7050, the reach of the Mississippi River within the MWMO watershed is divided into two sections for classification. The most restrictive classifications are recorded in Table 1.

Table 1. Water use classifications for waterbodies in the MWMO

Waterbody	**Water Use Classification**
Mississippi River, MWMO upstream boundary to Upper Saint Anthony Falls	1C, 2Bd Domestic consumption (drinking water)
Mississippi River, Upper Saint Anthony Falls to Lock & Dam 1 (Ford Dam)	2B Aquatic life and recreation
Loring Pond	2B Aquatic life and recreation

The MWMO reach of the Mississippi River is listed on Minnesota's impaired waters list. The Minnesota Pollution Control Agency divided the reach of the Mississippi River flowing through the MWMO into three sections. Table 2 lists the impaired reaches of the river and the corresponding pollutants of concern. The Minnesota Pollution Control Agency has not yet written TMDLs for these reaches of the river.

Table 2. Impaired waters' pollutants

Impaired Mississippi River Reach	**Pollutant**
MWMO upstream boundary to Upper Saint Anthony Falls	Fecal coliform, Mercury, Polychlorinated biphenyls (PCBs)
Upper Saint Anthony Falls to Lower Saint Anthony Falls	Mercury, PCBs
Lower Saint Anthony Falls to Lock & Dam 1 (Ford Dam)	Fecal coliform, Mercury

Mercury and PCBs are listed for fish consumption advisories; therefore, this report will address fecal coliform only.

Protecting water quality in the Mississippi River is a complicated task. The reach of the Mississippi River flowing through the MWMO is densely urbanized with commercial, industrial, residential, park lands, and downtown Minneapolis land uses contributing to the volume and quality of the water entering the river through the stormsewer system. The MWMO monitors stormwater outfalls to determine the contributions of surface runoff in the watershed to water quality in the river. However, the entire Mississippi River basin upstream of the MWMO watershed contributes to water quality in the MWMO's reach of the river.

The upper Mississippi River is a large, dynamic river system that includes runoff from forested areas near the source at Lake Itasca, agricultural runoff from the Central region of Minnesota, and the urbanized areas of St. Cloud and the north Twin Cities Metro area. As precipitation produces surface runoff, precipitation differences throughout the upper Mississippi River basin can affect water flow and water quality in the MWMO's reach of the Mississippi River. It is possible that Mississippi River flows could increase, and water quality could periodically decline, even though it has not rained in the watershed, if large amounts of rainfall have washed pollutants from the land upstream of the watershed into the river. The MWMO, through coordination with other watershed organizations and districts, plans to investigate upstream impacts on water quality to discern the effects precipitation in other portions of the state has on water quality in the MWMO's reach of the Mississippi River.

Further complicating the investigation of water volume and quality in the river are inputs of groundwater, as well as recharge to groundwater from the river. Groundwater may carry pollutants from upstream in the Mississippi River basin to the MWMO reach of the river. Pollutants may also leach from the river into the groundwater system. It is quite difficult to track potential groundwater inputs from such a large area as the Mississippi River basin to the MWMO reach of the river. The MWMO has long-term plans to coordinate with organizations and agencies in the upper portion of the basin to improve water quality in the Mississippi River.

4.0 METHODOLOGY

In 2005, the MWMO examined water quality from four types of locations: rivers, lakes, stormwater outfalls, and best management practices (BMPs). River and lake samples were collected in the Mississippi River and Loring Pond. Stormwater outfall samples were collected from stormsewers at the point of discharge to the river. Sample collection locations for Best Management Practices vary with each practice. Mississippi River and stormwater samples were collected between May and October, Loring Pond samples were collected between June and October, and BMP samples were collected in September and October.

4.1 Sample Collection, Handling and Preservation

Mississippi River and Loring Pond

Grab samples were collected from six locations in the Mississippi River and one location in Loring Pond. Samples were collected in lab sterilized, 250-ml plastic bottles. Collection occurred away from shore, in approximately three feet of water. For the river, samples were taken in positive flow (no back eddies or stagnant water) and upstream of the monitoring technician to prevent contamination by the disturbed river bottom. To collect samples, the monitoring technician plunged an opened, inverted bottle to one foot below the water surface, turned it upward to fill, and brought it out of the water (Figure 2). The technician then poured some of the sample out to provide headspace for the laboratory.

Samples were labeled, stored on ice in a cooler, and delivered to the lab by the monitoring technician after the final sample was collected. Analyses conducted on these samples did not require preservation.

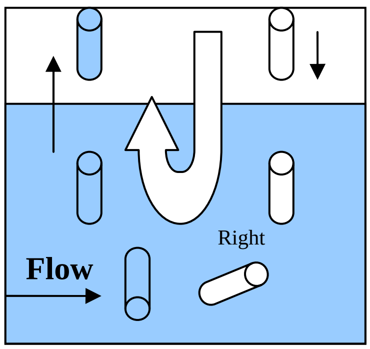

Figure 2. Diagram of sample collection method

Samples were collected weekly for base flow and up to three times per month for storm events.

Stormwater Outfalls

Grab samples were collected from five stormwater outfalls in the MWMO watershed. Samples were collected in lab cleansed (non-sterile) 1.5-gallon plastic bottles. Samples were collected with a one-gallon plastic bottle mounted on the end of a telescoping pole. The container was rinsed one time with the water to be sampled before the sample was collected. The bottle was capped after it was filled, with headspace included.

Samples were labeled and placed in a cooler for transport to the lab by the monitoring technician. Samples were dropped off at the lab after collection of the last sample. Laboratory personnel split the sample and preserved it as needed for the various analyses.

Outfall grab samples were collected for a maximum of three storm events per month and once per month during baseflow, if baseflow conditions were present.

Best Management Practices (BMPs)

Stormwater samples were collected from parking lot runoff routed through a 12-inch concrete pipe. Samples were collected with an ISCO 6712 automatic sampler (Teledyne Isco, Inc., Lincoln, NE). The sampler houses 24 one-liter plastic bottles for sample collection. Velocity, water level, and flow data were collected with an ISCO 750 area velocity meter (Teledyne Isco, Inc., Lincoln, NE) that attached to the automatic sampler. When the meter detected a water level above 1.3 inches it triggered the sampler to begin sampling. Once triggered, the sampler rinsed the sample tubing twice before drawing the sample into the containers. Four one-liter bottles were filled with the initial runoff from a storm event. Additional samples were collected on a flow-paced basis, with one liter (one bottle) collected every 3000 gallons throughout the storm event. The bottles were rinsed three times with deionized (DI) water free of pollutants between storm events. Once collected, the initial four bottles were composited as one sample into a 1.5-gallon plastic bottle, and the remaining samples were composited, with equal amounts poured into a 1.5-gallon bottle. In 2005, low precipitation and short duration storm events prevented the collection of the second composite samples.

Monitoring personnel collected samples from the automatic sampler at the earliest possible time following the storm event. The samples were composited into the two larger bottles, labeled, stored on ice in a cooler, and delivered to the lab following collection. Laboratory personnel split the samples and preserved them as needed for the various analyses.

BMP sampling consists of sample collection from storm events with varied rainfall intensity and duration (when possible) before BMP installation and again after installation to evaluate the performance of the BMP. In 2005, BMP sampling occurred for pre-installation.

4.2 Sampling Quality Control

Blank samples of DI water were submitted to the laboratories periodically to verify that sample containers were clean and samples were not contaminated during travel. Duplicate samples were submitted periodically to verify that sampling and laboratory procedures did not jeopardize the data.

4.3 Laboratory Analyses

The MWMO used two laboratories for analyses. Bacteria samples were analyzed at the Minneapolis Health Department Laboratory. All other samples were analyzed at the Metropolitan Council Environmental Services Laboratory. Refer to Table 3 in Appendix B for a list of sample parameters, the labs used, the analysis methods, and information regarding certification.

Each laboratory followed strict protocol for quality assurance and quality control. Information regarding laboratory protocol is available from MWMO staff.

4.4 Parameters Information

The MWMO has conducted extensive research regarding the parameters of concern. Parameter information included definitions, sources, impacts to various organisms, and water quality standards, as well as others. Refer to Table 4 in Appendix C for the comprehensive list of parameters information. Refer to Table 5 in Appendix D for unit conversions.

4.5 Data Analysis

The following data cleaning techniques were used to ensure quality data:

- Duplicates were omitted from analysis;
- Conductivity data measured before June 20, 2005 were omitted because the conductivity meter was not calibrated properly;
- Specific conductivity was calculated for June 20 – August 1, 2005 with the equation

$$SpecificConductivity(25C) = \frac{Conductivity}{1 + 0.0191 \times (Temperature - 25)}$$

  with temperature in degrees Celsius;
- Suspect data were flagged and verified with the laboratory;
- For values greater than the maximum detection level, the maximum detection level + 1 was used for analysis;
- Values less than the minimum detection level were changed to half the minimum detection level for analysis; and
- For approximate values, the approximate value was used for analysis.

For the Mississippi River and Loring Pond, grab sample data were compared to the Minnesota water quality standards for their most restricted water use classification. Water quality standards do not exist for stormwater; therefore, data were not compared to standards but are presented in subsequent sections.

4.6 Cold Climate Considerations

Minnesota is considered a cold climate state, requiring special consideration in runoff management. MWMO staff takes these facts into account when writing the annual work plan for the program. The Minnesota Stormwater Manual (Minnesota Stormwater Steering Committee, 2005) outlines the cold climate considerations in Chapter 9.

5.0 PRECIPITATION

Precipitation controls surface runoff and is arguably the greatest factor controlling surface water quality. As stated in 3.0 Background, water quality in the MWMO reach of the Mississippi River is affected by precipitation in the entire Mississippi River basin upstream of the MWMO, including tributary watersheds to the river. The following graph shows precipitation for six locations along the Mississippi River: two in the watershed (Lower Saint Anthony Falls and Lock & Dam 1) and four between St. Cloud and the MWMO northern boundary (Figure 3). Precipitation for the watershed only is show in Figure 4. The MWMO acknowledges a link between precipitation and the water quality data shown in the following sections. However, the MWMO does not support quantitative analysis of this relationship because precipitation data are not representative of the entire Mississippi River basin contributing to the MWMO watershed.

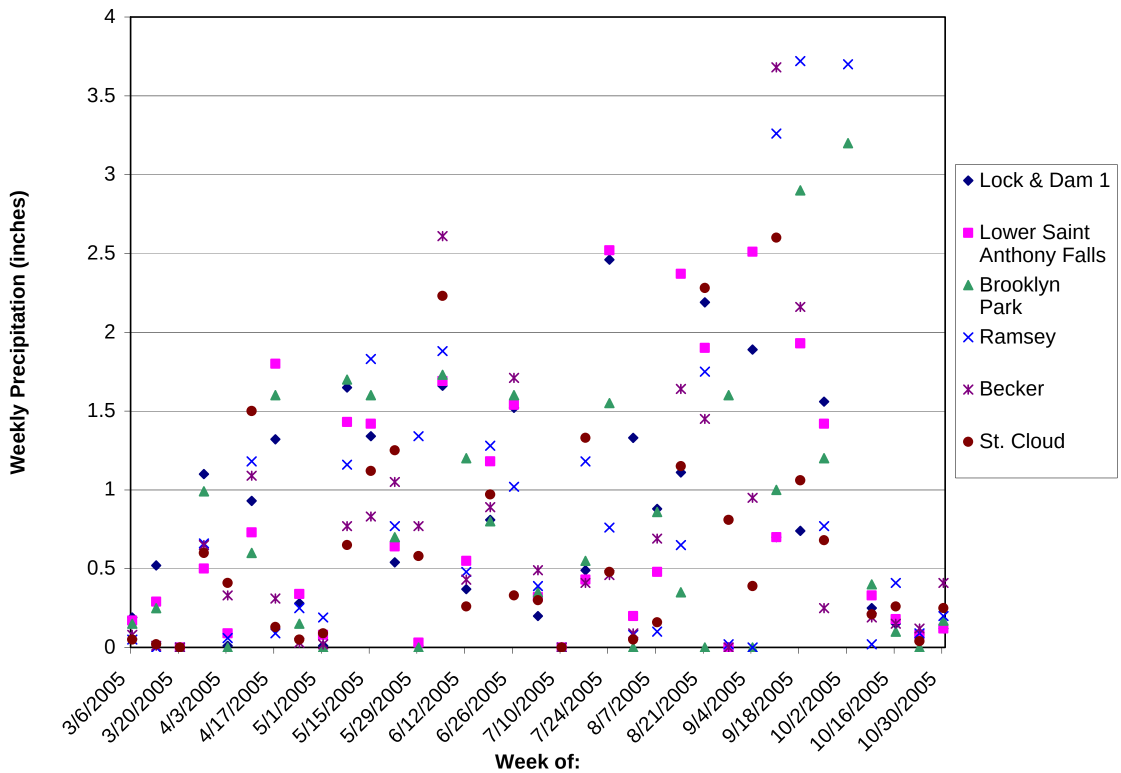

Figure 3. Precipitation for six locations along the Mississippi River. Precipitation values greater than 4 inches were omitted to improve the scale of the graph. Missing data for 9/4/06 includes 4.58 inches at Brooklyn Park and 4.52 inches at Ramsey. Missing data for 10/2/06 includes: 5.21 inches at Lock & Dam 1, 4.34 inches at Lower Saint Anthony Falls, 4.18 inches at Becker and 4.13 inches at St. Cloud.

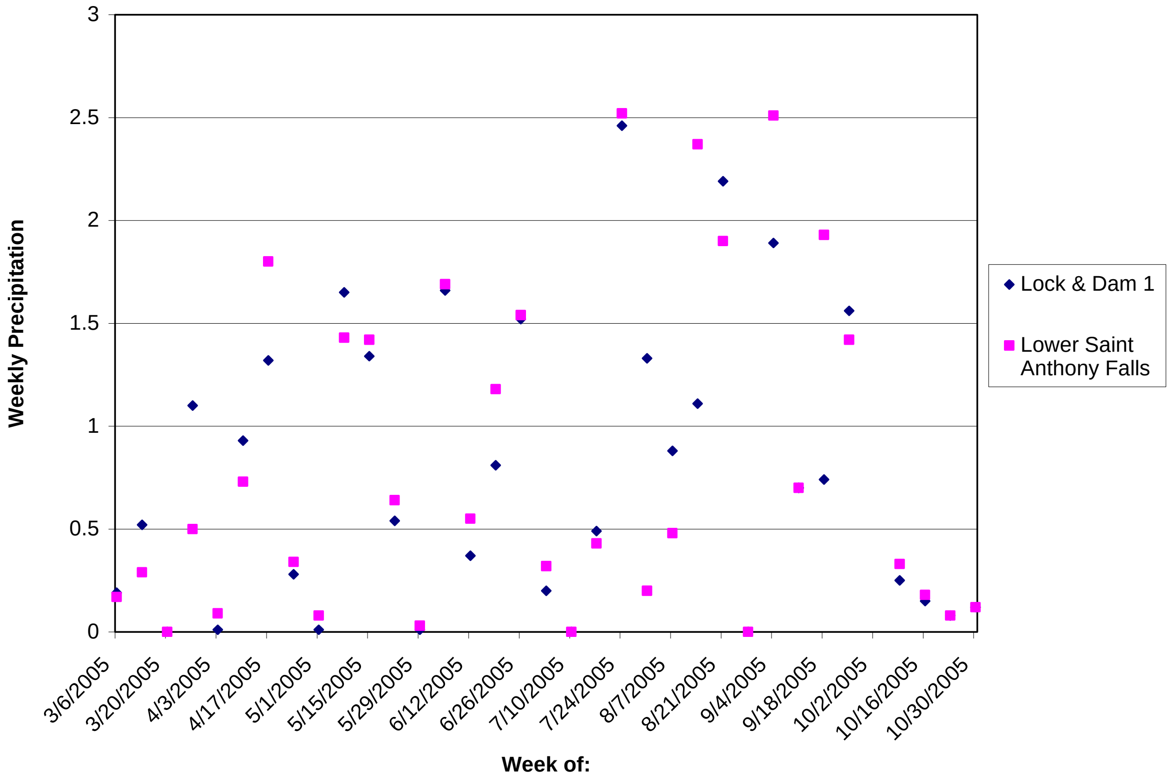

Figure 4. Precipitation for two locations in the MWMO watershed. Precipitation values greater than 4 inches were omitted to improve the scale of the graph. Missing data for 10/2/06 includes: 5.21 inches at Lock & Dam 1 and 4.34 inches at Lower Saint Anthony Falls.

6.0 MISSISSIPPI RIVER

The MWMO monitors six locations in the Mississippi River. Sites were selected based on even distribution in the river and accessibility. Sites in the Mississippi River Gorge required trails for access from the top of the bluff to the river, while others required parking near the sites. Five sites are located on Minneapolis Park and Recreation Board land, and one site is located on University of Minnesota property. This section provides site descriptions for each site as well as water quality monitoring results. Refer to Figure 1 in Appendix A for the site locations.

6.1 Site Descriptions

Camden (1) River Mile (R.M.) 859.1: The Camden site is the northernmost monitoring site in the MWMO's watershed. It is located in the North Mississippi Regional Park at the intersection of 53rd Avenue and North Lyndale in Minneapolis. The terrain surrounding the site is mostly deciduous forest with a grassland transition zone by the road. Footpaths lead from the paved trail by the road, through the forest to the river and along the river. The footpaths may cause minimal erosion. There is a concrete levy wall and boulders at the sampling site and an outfall just upstream. The river is shallow (3-5'), rocky, and swift (in places) with sandbars up and downstream. Water levels fluctuate at this site more than any other in the watershed. Storm events and ice can raise the water level three feet. Waterfowl are commonly seen in the river and on shore. Rabbits, bald eagles, and beavers have also been observed.

Mississippi Park and boat launch (2) R.M. 857.8: This site is located adjacent to MPRB land. A paved parking lot leads to the river and boat launch. During the warmer months, a floating dock rests directly upstream from the boat launch. Flat and forested terrain surround the parking lot and boat launch area with some grassy areas and paved and unpaved trails leading up and downstream, respectively. The river bottom near shore is silty mud. The river is deeper here than at site 1 and can have a swift current after rainfall. The monitoring site is upstream of the dock foundation.

North Loop (3.1) R.M. 854.9: The North Loop site is downstream from the Mississippi Park and Boat Launch site. It is adjacent to a shaded park area with picnic tables, trails, grass and trees. The river bank is steep and covered in brush. The shore and shallows at the sampling site are composed of loose rocks and sand. The monitoring site is at the base of a stairway that leads to the river.

University of Minnesota boat launch (4) R.M. 852.2: The University of Minnesota boat launch site is the first river site downstream from Saint Anthony Falls. It is located in the Mississippi River Gorge, behind Coffman Union on the East Bank campus. A paved path leading from a parking lot wraps around a grassy area and angles left down to the sampling site. The surrounding terrain consists of Cottonwood forest along the river and a large grassy area behind the trees. The gently sloping bank leads to a sandy shore that continues into the river. The site is a regular entrance point to the river for approximately one hundred geese that graze on the grass in the open area. Goose droppings are common here.

Lake Street Bridge (5) R.M. 849.9: This site is located beneath the Lake Street bridge. There is parking on the street by the bridge and a foot path leads down into the gorge to the sampling site. The elevation drops over seventy feet from the street to the river. Just upstream of the site are a small outfall and the Minneapolis rowing club boat facility. There is tall grass along the river and trees on the sides of the gorge. There is a steep, three-foot river bank leading to a rocky shore. The river bottom is composed of limestone boulders and gravel (riprap).

4300 West River Parkway (6.1) R.M. 848.2: This monitoring site is the farthest downstream in the MWMO's watershed. There is a parking lot and a paved path from the parking lot into the gorge. There are foot paths leading down the bluffs to the river. The site is surrounded by hardwood forest and is just upstream from a stormwater outfall. The shore and river bottom are made up of sand and large, flat limestone rocks. The Ford Dam is less than one mile downstream.

6.2 Water Level

Water level (typically referred to as stage) data show the rise and fall of the river in response to precipitation. These data are complicated by the dams at Saint Anthony Falls and Lock and Dam 1. The river pools behind the dams; therefore, control activities at the dam cause changes in river stage even without rainfall. Stage data for the six MWMO monitoring locations on the Mississippi River are shown in Figure 5. Stage values are based upon a selected benchmark of 100 feet. Data are comparable among dates for a single location but not comparable among locations.

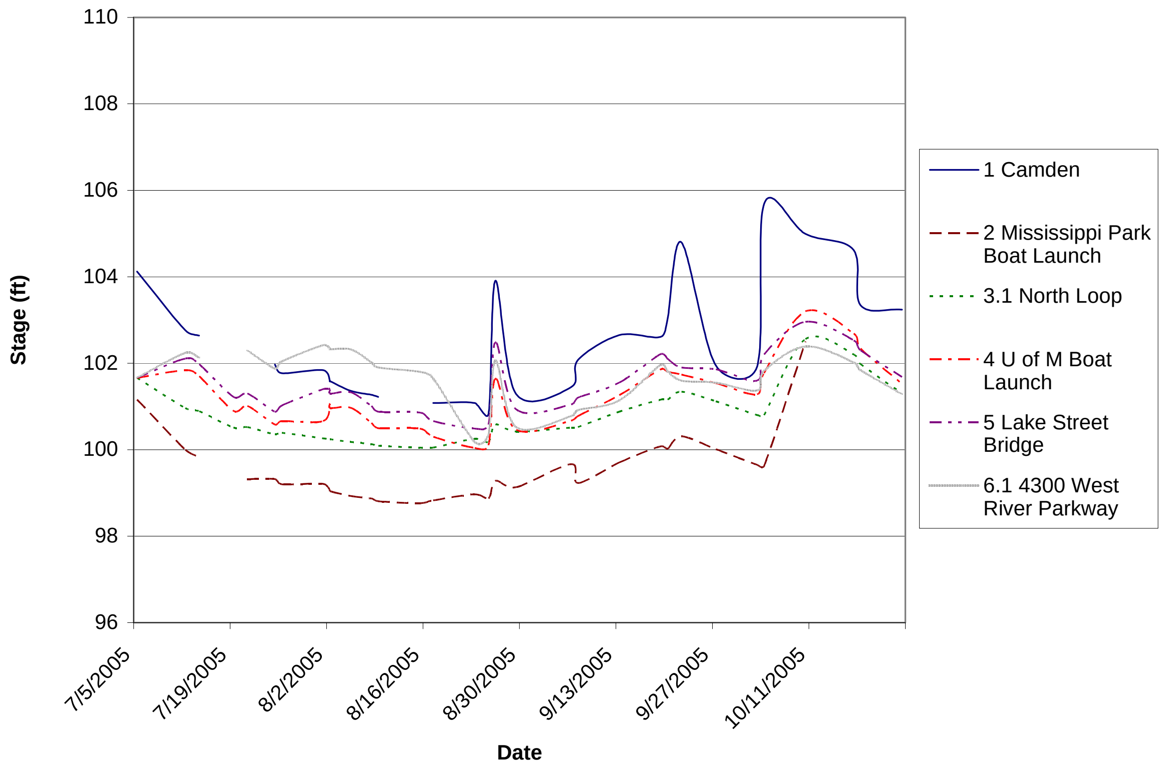

Figure 5. Mississippi River stage data based on a 100-foot benchmark

6.3 Monitoring Results

Fecal Coliform

As noted is Section 3.0 Background, the MWMO reach of the Mississippi River is listed as an impaired water for fecal coliform pollution. The MPCA fecal coliform standard for 2Bd and 2B waters is 200 colony forming units (CFU) /100 mL of water. This standard is a monthly geomean of at least five grab samples taken each month. The geomean is equal to the nth root of the product of the n terms:

$$Geomean_{\bar{y}} = \sqrt[n]{y_1 y_2 y_3 \ldots y_n}$$

The 2005 monitoring season results show that all of the Mississippi River sites exceeded the standard in September. Sites 3.1, 4, and 5 also exceeded the standard in August and sites 5 and 6 exceeded the standard in October (Figure 6). Above-average precipitation fell in September and October, which may have contributed to the exceedances.

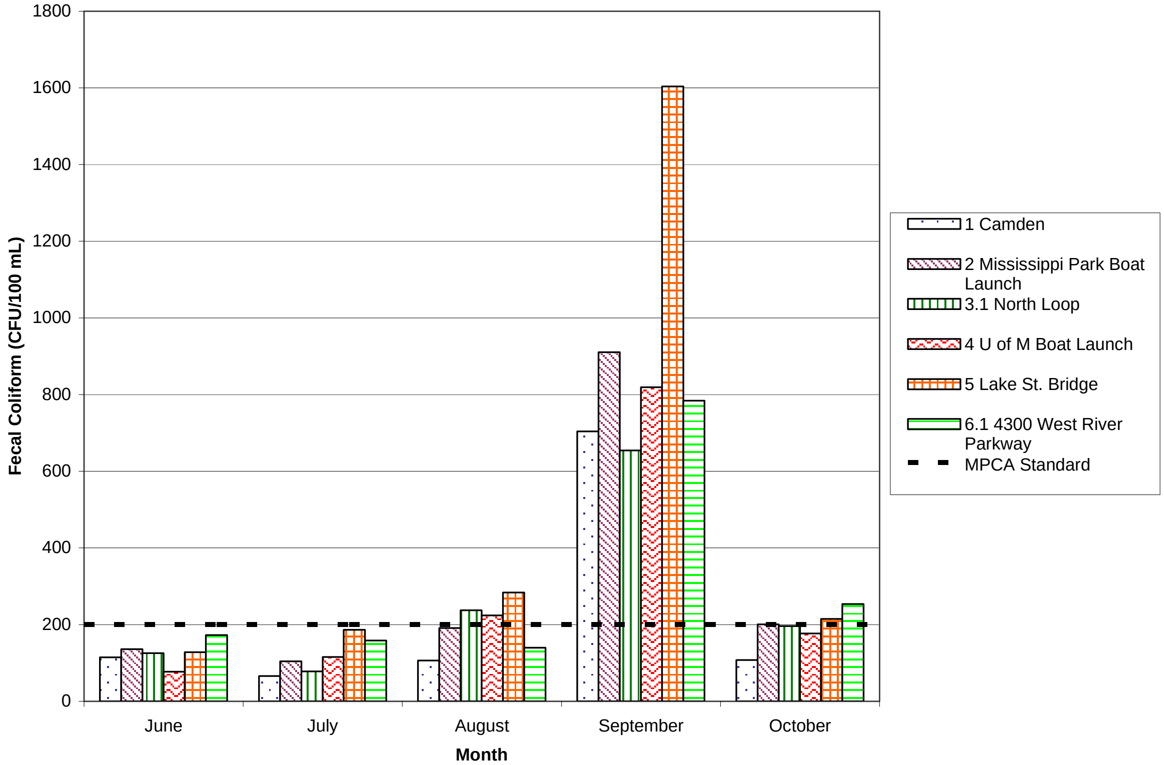

Figure 6. Fecal coliform monthly geomeans for the Mississippi River monitoring sites

The MPCA fecal coliform standard also states that fecal coliform cannot exceed 2000 CFU/100 mL in more than 10% of the samples taken in one month. All of the sites exceeded this standard in September. Table 6 presents a summary of fecal coliform exceedances. The fecal coliform concentrations for each sample collected are shown in Appendix E.

Table 6. Sites that exceed monthly fecal coliform standards in the Mississippi River

Month	Sites that exceed monthly geomean	Sites that exceed 2000 CFU/100 mL in > 10% of samples	Sites that do not exceed the standards
June	None	None	All
July	None	6.1	1, 2, 3.1, 4, 5
August	3.1, 4, 5	3.1, 5	1, 2, 6
September	All	All	None
October	5, 6.1	2, 4, 5, 6.1	1, 3.1

Two additional factors should be considered when evaluating these results. First, these results are based on a maximum of 7 samples collected per month. Had more samples been collected, the data may have exhibited different results. Second, two unique features of the MWMO watershed are the Upper and Lower Saint Anthony Falls. The Mississippi River water mixes as it flows over the falls, likely affecting water quality.

E. coli

The MPCA has proposed a change from fecal coliform to E. coli standards for bacteria monitoring in Minnesota. The proposed standard for E. coli in 2B and 2Bd waters is 126 CFU/100 mL for a monthly geomean of at least five samples. In anticipation of this changeover, the MWMO monitored e. coli concentrations to develop a historical record of e. coli in the Mississippi River. All of the sites exceeded the e. coli standard in September. Site 1 also exceeded the proposed standard in June, while sites 2 and 6.1 exceeded the proposed standard in October (Figure 7). The e. coli concentrations are shown in Appendix E.

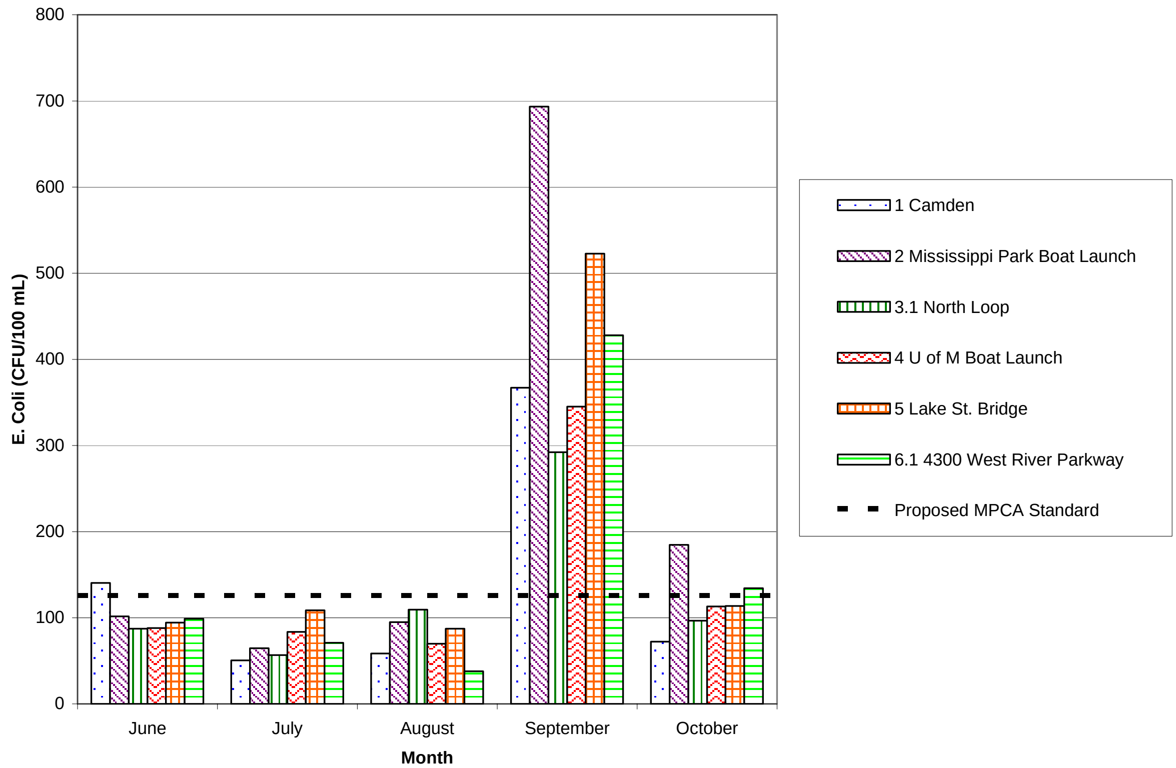

Figure 7. E. coli monthly geomeans for the Mississippi River monitoring sites

These results are highly dependant on precipitation, both in the watershed and upstream; therefore, results may differ drastically from year to year. The MWMO does not support interpretation or assumptions based solely on one year of data. The MWMO will collect data on the Mississippi River for 3-5 years to provide baseline data for development of TMDLs in the watershed.

Dissolved Oxygen, pH, Transparency, and Specific Conductivity

The MWMO monitored dissolved oxygen, pH, transparency, and specific conductivity on a weekly basis throughout the 2005 sampling season. These parameters are basic measures that indicate the health of a waterbody, as they contribute to survival of fish and other aquatic organisms and plants. Refer to Table 4 in Appendix C for important information regarding each parameter and to Appendix E for the monitoring data.

7.0 LORING POND

Loring Pond is the only lake in the MWMO watershed. It is not listed on the impaired waters list. This section provides an overview and history of Loring Pond as well as water quality results. Refer to Figure 1 in Appendix A for the location of Loring Pond.

7.1 Site Description

Loring Pond consists of two small ponds. The smaller north pond is connected to the larger pond, with a walking bridge spanning the connection. There is an outfall located on the large pond; however, water only flows out during high lake levels. The monitoring site is on the east side of the bridge on the north side of the large pond next to a large tree. The surrounding area has a garden, lawns, emergent plants along the lakeshore and trees throughout the park. The shore at the sampling site is exposed soil, and the pond bottom is sticky clay. In the warmer months, there is an abundance of submerged plants.

Loring Pond used to be a bog. In 1883 the area surrounding Loring Pond became Central Park, and in 1880 it was renamed Loring Park. The smaller north arm of the pond was a wetland until it was dredged in 1883-84. In 1976-77 the City of Minneapolis' new storm sewer construction diverted stormwater around the pond, resulting in a net annual loss of water from the pond. In 1997, a clay liner was installed to reduce seepage, and an augmentation well was employed to periodically pump ground-water into the pond to maintain consistent water levels. Aerators were also installed to increase dissolved oxygen levels. The MPRB monitors Minneapolis lakes, including Loring Pond, April through October and once in the winter.

7.2 Water Level

The MWMO monitors stage in Loring Pond with the MPRB staff gauge installed on the large pond outlet. Water level fluctuations throughout the 2005 sampling season are shown in Figure 8. Water levels were based upon a selected benchmark of 100 feet. Under ice conditions, the water level was consistently 107.38 feet (not shown).

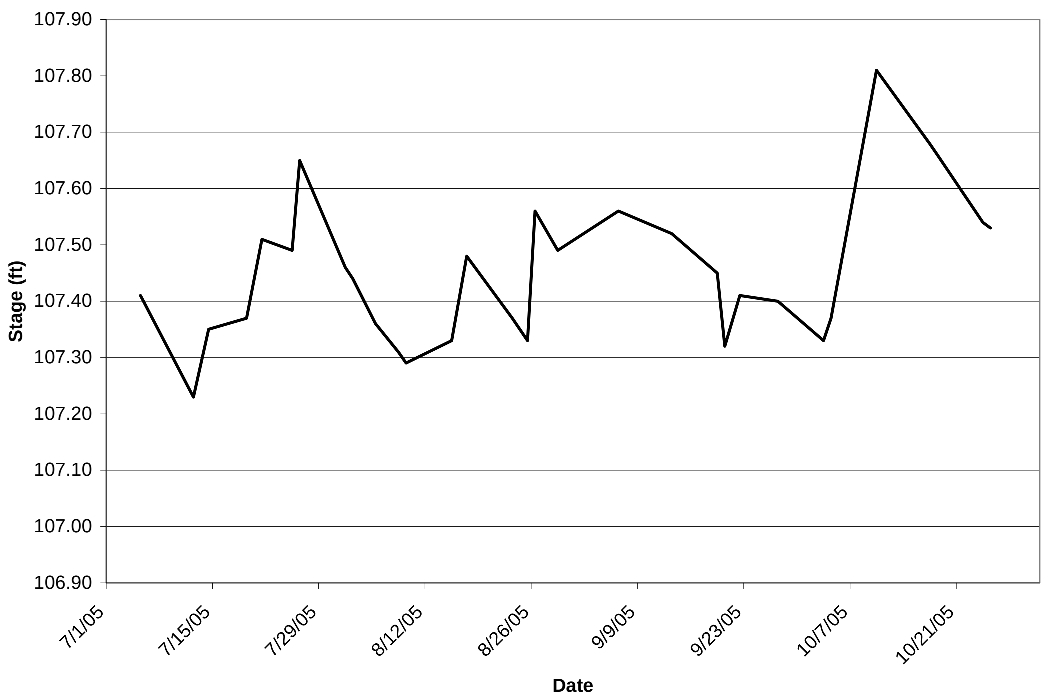

Figure 8. Loring Pond stage data based on a 100-foot benchmark

7.3 Monitoring Results

Fecal coliform

Loring Pond is classified as a 2B water; therefore, the same water quality standards apply as for the Mississippi River monitoring sites. Figure 9 shows that Loring Pond exceeded the fecal coliform standard in September. Fecal coliform and e. coli concentrations are shown in Figure 10. The results are highly dependant on precipitation; therefore, results may differ drastically from year to year. Above-average precipitation in September may have contributed to the exceedance. The MPCA lists waterbodies as impaired when 2 exceedances occur in a three-year period (MPCA, 2003). Loring Pond is not currently listed on the impaired waters list. The MWMO will continue to monitor Loring Pond and notify the MPCA if another exceedance occurs in 2006 or 2007.

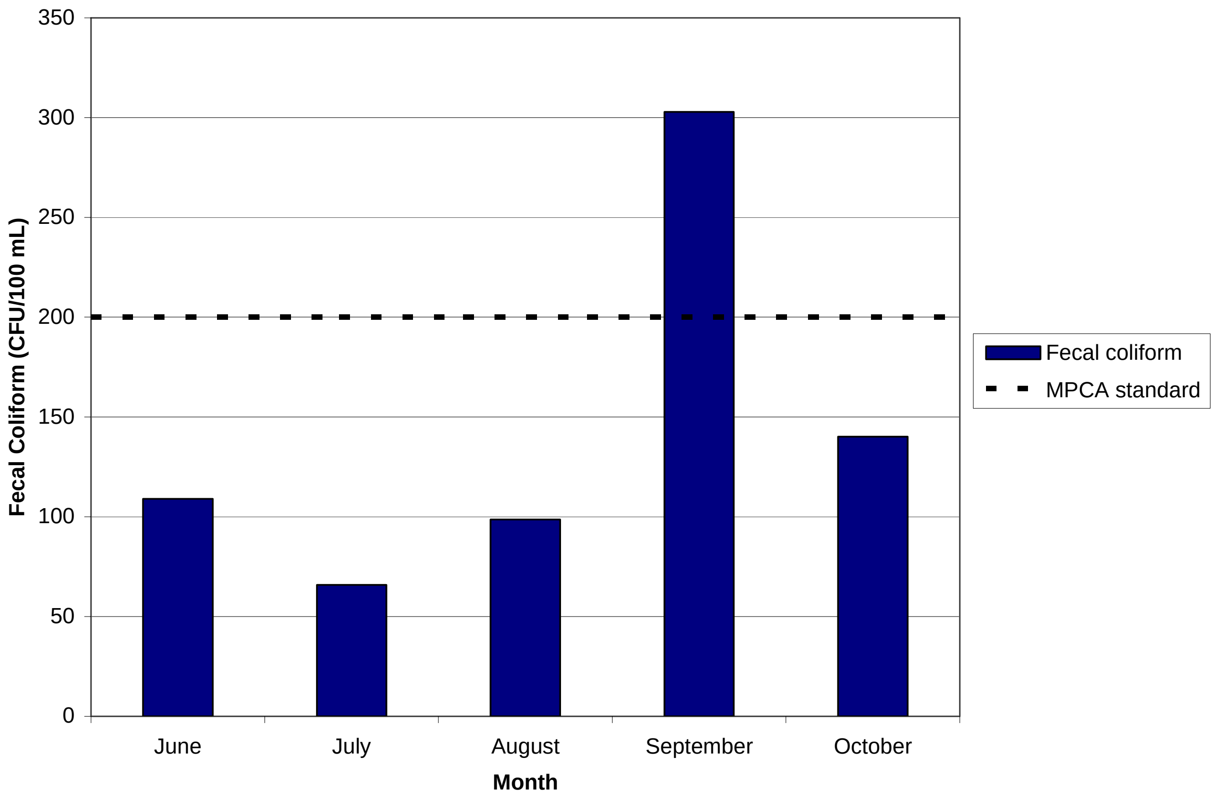

Figure 9. Fecal coliform monthly geomeans for Loring Pond

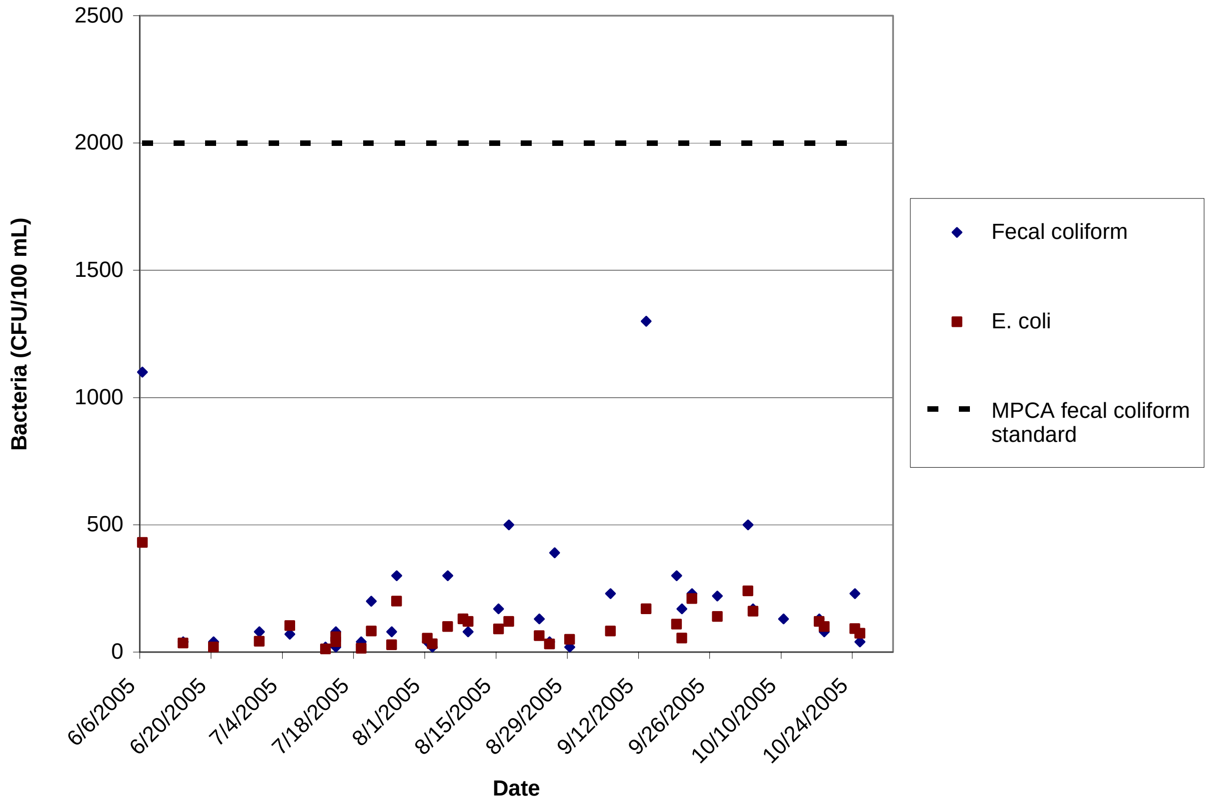

Figure 10. Fecal coliform and E. coli concentrations for Loring Pond

E. Coli

Loring Pond did not exceed the proposed MPCA water quality standard in 2005 (Figure 11).

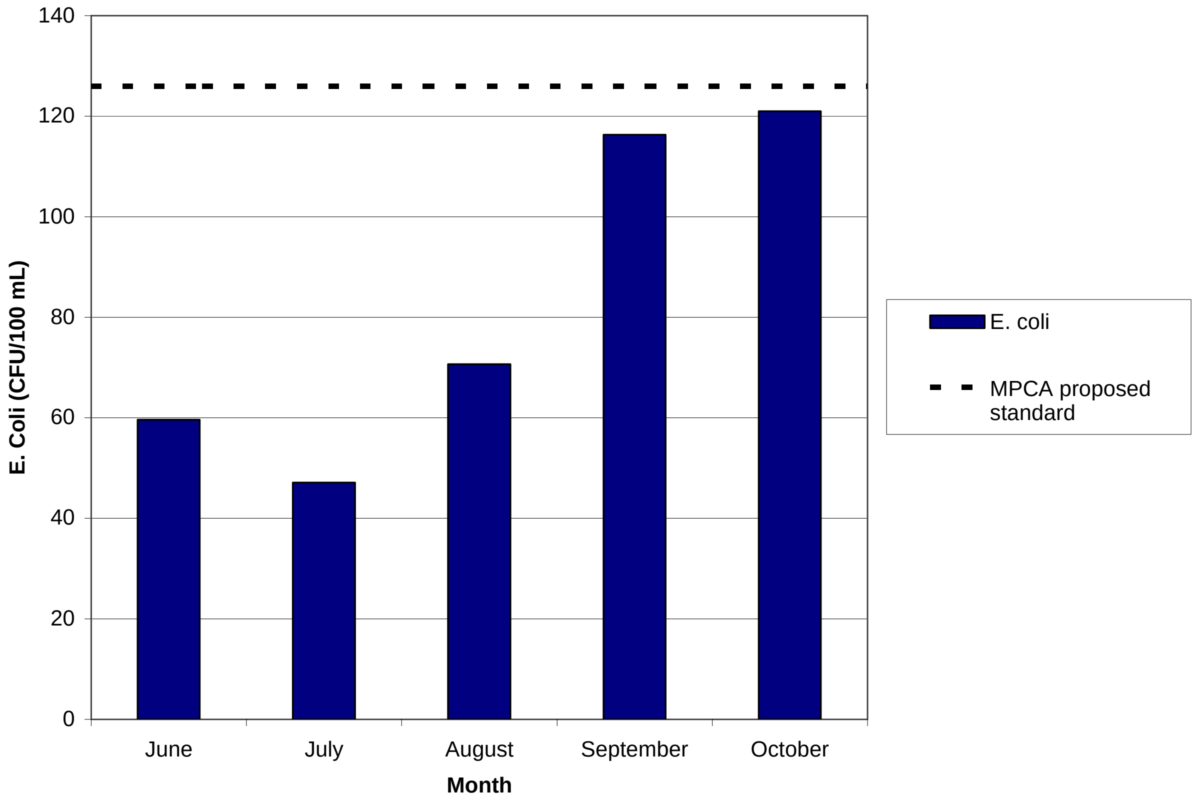

Figure 11. E. coli monthly geomeans for Loring Pond

Dissolved Oxygen, pH, Transparency, and Specific Conductivity

Dissolved oxygen, pH and specific conductivity often differ greatly in lakes compared with rivers due to the closed nature of the system. While rivers are always receiving "new" water from upstream, lakes contain the same water throughout the sampling season. Precipitation and occasional pumping of water from the recharge well are the major water inputs to Loring Pond. Figure 12 exhibits the dissolved oxygen, pH, transparency and specific conductivity data for Loring Pond.

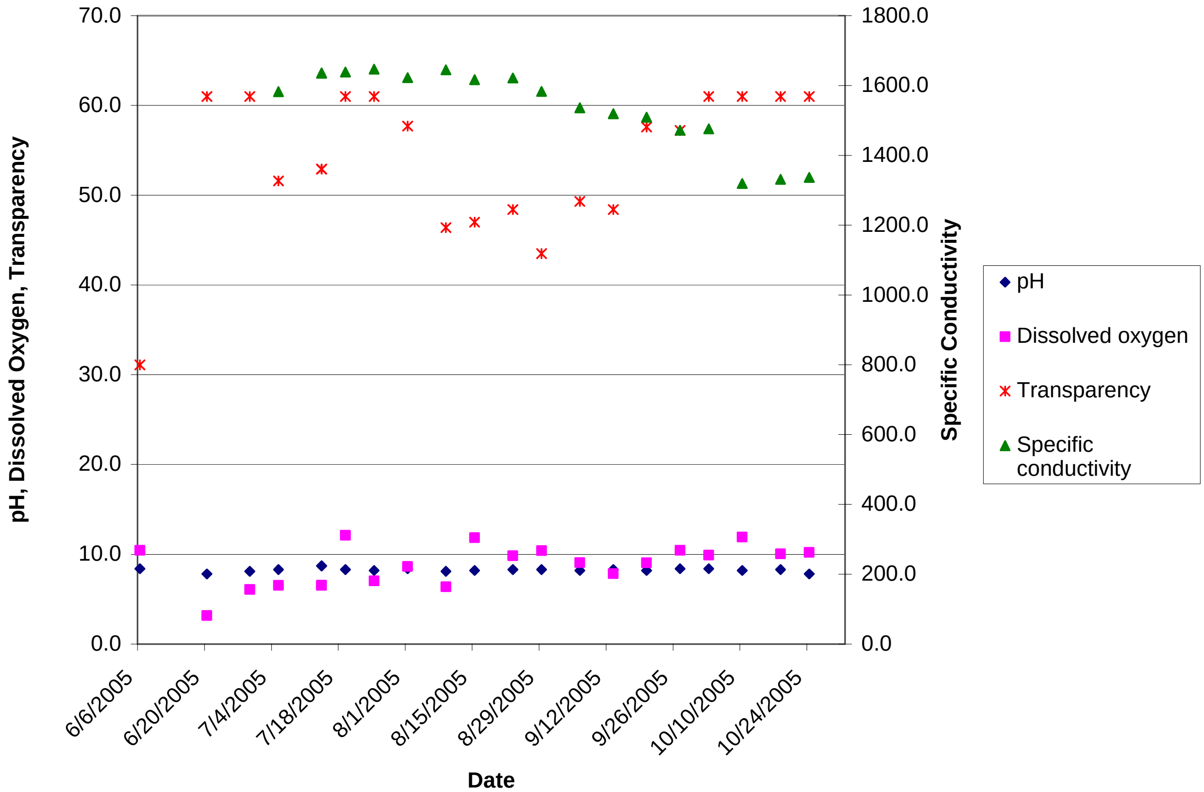

Figure 12. Dissolved oxygen in mg/L, pH, transparency in cm, and specific conductivity in µS data for Loring Pond

8.0 STORMWATER OUTFALLS

The MWMO monitored five stormwater outfalls into the Mississippi River. The monitored outfalls were chosen because they are the most extensive drainage systems within the watershed, and they are accessible. Site descriptions and water quality data for each stormwater outfall are provided in this section. Refer to Figure 1 in Appendix A for the outfall locations.

Land uses in the sewersheds affect water quality. A sewershed refers to the area that drains to one stormwater outfall. The amount of impervious surfaces and potential pollutants differ between land uses such as industrial and residential. A future objective of the monitoring program is to investigate the impacts of specific land uses on water quality. Refer to Table 7 in Appendix F for land uses in the sewersheds.

8.1 Site Descriptions

1NE (Excel Riverside Plant) R.M. 857.2: 1NE is the northernmost outfall monitored by the MWMO. The outfall is located on the east bank of the Mississippi River on the Excel Riverside Power Plant property. The stormsewer drains water for northeast Minneapolis. The outfall is a 96-inch diameter, corrugated steel pipe. The stormsewer has continuous base flow.

2NNBC (Old Bassetts Creek Outlet) R.M. 854.8: The 2NNBC outfall drains water from the Near North Minneapolis neighborhoods and Bassetts Creek and enters the river in a park in the North Loop neighborhood of Minneapolis on the west bank of the Mississippi River. Bassetts Creek was buried and routed through a tunnel in 1890. In 1992, the creek was rerouted through a new tunnel that enters the Mississippi River just downstream from Upper Saint Anthony Falls. There are paths leading from a parking lot to the outfall. The semi-elliptical outfall is approximately 11 feet high and 15 feet wide. Water from Bassetts Creek only flows through this original outfall during overflow periods. Bassetts Creek is monitored by the MPRB in cooperation with the Metropolitan Council, approximately one-quarter mile upstream of where the creek enters the City of Minneapolis stormsewer system.

4PP (35W Bridge) R.M. 853.2: This outfall is located below the Lower Saint Anthony Falls Lock and Dam on the West bank of the Mississippi River. It drains stormwater from the Phillips and Powderhorn neighborhoods in Minneapolis, as well as water from the 35W freeway. Access to the outfall is gained from the Lower Saint Anthony Falls Lock and Dam service road. The semi-elliptical tunnel is 14 feet high and 14 feet wide. There is continuous base flow in this stormsewer. Northern pike have been observed at the outfall of the stormsewer during spawning season.

6UMN (University of Minnesota Coal Storage Facility) R.M. 853.0: 6UMN is located on the East bank of the Mississippi River, downstream from Saint Anthony Falls, behind the University of Minnesota coal storage facility. The outfall drains water from the City of Minneapolis and the University of Minnesota. This semi-elliptical tunnel is eight feet high and eight feet wide with a rounded top and slightly U-shaped base. There is continuous base flow in this stormsewer.

7LSTU (Bridal Veil Tunnel) R.M. 851.6: 7LSTU is the farthest downstream outfall monitored by the MWMO. It is located on the East Bank of the Mississippi River, between the I94 Bridge and Franklin Avenue Bridge. The outfall drains water from the Cities of Lauderdale and Saint Paul and the University of Minnesota. The tunnel is cathedral shaped and 10 feet high and 6.5 feet wide. At the mouth of the outfall, five square, concrete pillars baffle (slow) water flow, and an iron stilling basin captures floatable debris.

8.2 Water Level

Water level in a stormwater outfall is very different from water levels in the Mississippi River and Loring Pond. Stormsewers respond to rainfall very quickly, with water levels rising many feet within a short time frame, sometimes only minutes depending on the size and intensity of the storm event. Some outfalls only contain water during precipitation events, while others have base flow throughout the year. As noted above, 1NE, 4PP and 6UMN have base flow throughout the year. Water levels (stage) for each stormwater outfall are listed in Tables 8-12, in Appendix F.

It should be noted that as the Mississippi River water level rises above the base of the stormwater outfalls, river tailwater affects the water level in the outfall.

8.3 Monitoring Results

The MPCA does not have water quality criteria for stormsewer systems; therefore, data are not compared with standards. The MWMO monitors stormwater outfalls to characterize surface runoff in the watershed and determine land contributions to water quality in the Mississippi River. Samples are collected for temperature, bacteria, nutrient, sediment, inorganic, organic, and metals analyses. The MWMO will not draw conclusions or make assumptions based on this data until 3-5 years of data are available. The data are presented in Tables 8-12 in Appendix F.

9.0 SPECIAL STUDIES

The MWMO installed an ISCO 6712 automated sampler (Teledyne Isco, Inc., Lincoln, NE) in a stormwater pipe draining a large parking lot in downtown Minneapolis in late September 2005. The purpose of the study is to collect samples pre- and post-construction of the BMP to evaluate the effectiveness of the BMP. A raingarden is scheduled to be constructed in the parking lot in Spring 2006. Due to a lack of significant rain events since installation, efforts to date have largely focused on determining the correct site programming for flow monitoring and sample collection.

9.1 Monitoring Results

Water level, velocity, and flow data are not included in this report, as the data collected was not sufficient to produce accurate results. A one-inch water level is required to obtain accurate velocity data with the flow meter. Rainfall events did not produce runoff meeting this requirement until winter (late in the monitoring season). However, grab samples of initial runoff were collected manually in September and with the automated sampler in October. The data is reported in Table 13 in Appendix G.

10.0 WORK PLAN

10.1 Assessment of 2005

The MWMO completed its monitoring objectives for 2005. Staff was hired to carry out the monitoring activities in the Mississippi River, Loring Pond, and the stormwater outfalls. Staff prepared for installation of automated samplers in the stormwater outfalls in 2006. Preparation consisted of training, purchasing equipment, and field assessments of the outfalls. Staff also began developing partnerships with organizations both inside and outside the watershed boundaries to prevent overlap of monitoring activities and provide a solid network of information regarding monitoring methodology and techniques.

10.2 2006 Work Plan

The MWMO will continue to monitor all the sites listed in this report. Some of the stormwater outfalls will be changed from manual grab sampling to automated sampling. Pre- and post-constructions samples will be collected for the BMP site. MWMO staff will develop documented monitoring procedures, including methodology and QA/QC. Data cleaning and analysis will be carried out for 2006 monitoring data. Staff will develop further partnerships to aid improvement of water quality in the watershed.

11.0 RECOMMENDATIONS

The MWMO staff and Board of Commissioners have agreed that additional assessments of the Mississippi River hydraulics and hydrology are needed to better understand the extent of impacts the stormsewer system inputs have on the river. A deeper understanding of mixing in the river, relative to where stormwater outfalls enter, and the effects of the Upper and Lower Saint Anthony Falls and Ford Dams on water quality will allow the staff and Board to make more informed decisions regarding monitoring locations and methodology. This information will also increase the reliability of data collected and solutions derived from the monitoring.

Future needs of the MWMO include 1) knowledge of the contribution of fecal coliform to the Mississippi River from within the MWMO boundaries relative to the remainder of the upper Mississippi River watershed for development of TMDLs for the current impairment and 2) knowledge of the inputs of phosphorus and turbidity to the river from the MWMO watershed relative to the rest of the Upper Mississippi River Basin for the Lake Pepin TMDL.

References

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Minnesota Pollution Control Agency. 2003. Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment. Minnesota Pollution Control Agency, St. Paul, MN.

Minnesota Stormwater Steering Committee. 2005. The Minnesota Stormwater Manual. Minnesota Pollution Control Agency, St. Paul, MN. http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html

APPENDIX A

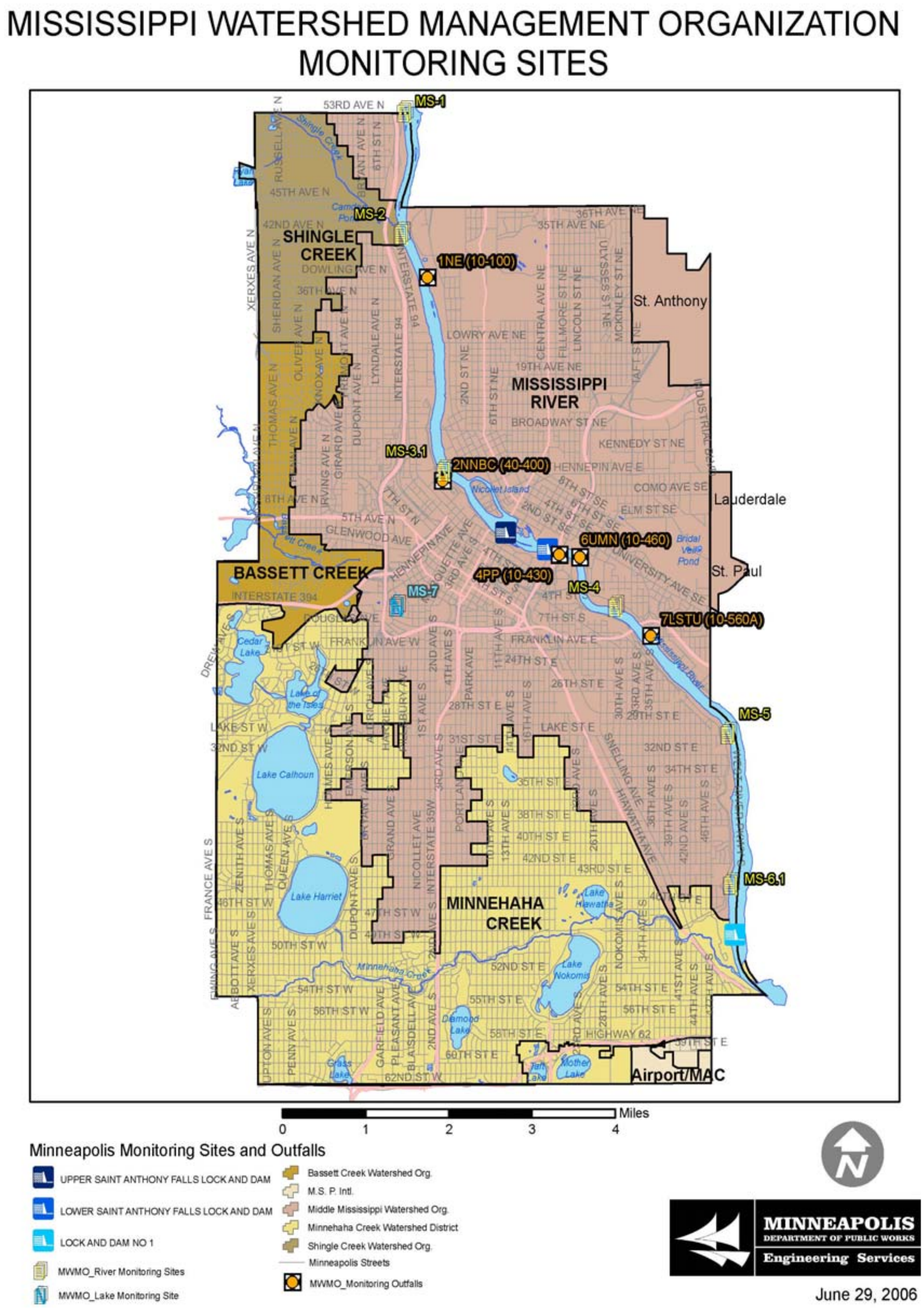

Figure 1. MWMO watershed and monitoring sites

APPENDIX B

Table 3. Laboratory information for each analyte

Analyte	Lab	Method	Certified
Total Metals (Copper, Nickel, Lead, Zinc, Cadmium, Chromium, Mercury)	Metropolitan Council	EPA 200.8 with ATP (Mercury) EPA 245.7	Yes
Total Soluble Metals	Metropolitan Council	EPA 200.8 with ATP (Mercury) EPA 245.7	Yes
Total Chemical Oxygen Demand	Metropolitan Council	EPA 410.4	Yes
Carbonaceous Biological Oxygen Demand (CBOD) 5-Day	Metropolitan Council	Standard Methods 5210B 18th Edition	Yes
Total 5-day BOD	Metropolitan Council	Standard Methods 5210B 18th Edition	No*
Total Organic Carbon	Metropolitan Council	EPA 415.1 wet oxidation; auto sampler; settled sample; NDIR detection	NA
Total & Volatile Suspended Solids	Metropolitan Council	EPA 160.2 ATP	Yes
Total Dissolved Solids	Metropolitan Council	Standard Methods 2540C 18th Edition	No
Total Alkalinity	Metropolitan Council	EPA 310.2	Yes
Total Hardness	Metropolitan Council	Standard Methods 314B 15th Edition	NA
Total Chlorides	Metropolitan Council	EPA 325.2	No
Total Sulfates	Metropolitan Council	Standard Methods 425C 15th Edition	No
Fluoride	Minneapolis Department of Health	Standard Methods 20th Edition 4500-F^- D. SPADNS Method, Ref SM 20th ed.P 4-82	No

Table 3 continued. Laboratory information for each analyte

Analyte	Lab	Method	Certified
Total Phosphorus plus Total Kjeldahl Nitrogen	Metropolitan Council	EPA 351.2 & 365.4 ATP	Yes
Dissolved Phosphorus	Metropolitan Council	EPA 351.2 & 365.4 ATP	Yes
Orthophosphorus	Metropolitan Council	EPA 365.2	Yes
Total Ammonia Nitrogen	Metropolitan Council	EPA 350.1	Yes
Nitrate & Nitrite Nitrogen	Metropolitan Council	EPA 353.1 Chloroform preservation	Yes
Total Volatile Organic Compounds	Metropolitan Council	EPA 624/625	Yes
Oil and Grease	Metropolitan Council	Soxhlet extraction using Freon, dry at 130C and weigh Standard Methods 503C 15th Ed.	NA
Fecal Coliform	Metropolitan Council	Standard Methods 20th Edition 9221E fecal coliform test using EC medium. SM 20th ed. P 9-54	Yes
E. coli	Minneapolis Department of Health	EPA method 1603	Yes

*No indicates that the lab follows standard certification test methods but has not sought certification from the Minnesota Department of Health.
NA = The Minnesota Department of Health does not have certification for the analyte.

APPENDIX C

Table 4. Parameters information

Parameter	Definition	Sources	Transport to Water	Pollution Concerns for Humans	Pollution Concerns for Wildlife	Pollution Concerns for Plants	Risk Threshold for Humans	Risk Threshold for Wildlife	Risk Threshold for Plants
Mercury	Mercury (Hg) is a heavy, silver-white, poisonous metallic element that is liquid at ordinary temperatures and is used especially in scientific instruments.	Combustion point sources such as waste incineration and boilers account for 85% of anthropogenic mercury emissions. Other sources include chlor-alkali production and smelting.	Emitted mercury vapor is converted to soluble forms and deposited by rain onto soil and water.	Subacute (moderate) exposure causes tremors, emotional changes, insomnia, and psychotic reactions characterized by delirium, hallucinations and suicidal tendency.	Mercury bioaccumulates in fish. Birds fed inorganic mercury show a reduction in food intake and subsequent poor growth.	Terrestrial plants are generally insensitive to the toxic effects of mercury compounds.	Urine mercury levels of 5 µg/g creatinine are the safe limit. Urine mercury levels are reported in micrograms/gram of creatinine (a component of urine used as an indicator of kidney function).	Microorganisms: for inorganic mercury *7 5 micrograms/l.	Aquatic plants: concentrations approaching 1 mg/l for inorganic mercury but much lower concentrations for organic mercury*8.
Lead	Lead (Pb) is a soft, heavy metallic element found mostly in combination and used especially in pipes, cable sheaths, batteries, solder and shields against radioactivity.	Lead pollution occurs through the mining, smelting and refining of lead and the burning of petroleum fuels containing lead. Other sources include: lead shot, fishing weights, metal protection, paints and stains, manufacturing and atmospheric deposition.	Lead is transported to water by surface water runoff, atmospheric deposition, recreational activities, residential painting and scraping.	Higher (see thresholds) levels of lead in the blood can damage kidneys, blood and the nervous system. At very high levels lead poisoning can cause mental retardation, coma, convulsions or death.	Typical symptoms of lead toxicity in young stages of fish include spinal deformity and blackening of the tail region. Arrested development and delayed hatching have been observed in frog and toad eggs exposed to lead.	Lead can be toxic to plants.	Higher blood lead levels are equal to or greater than 25 micrograms per deciliter.	Lead salts are acutely toxic to aquatic invertebrates: >0.1mg/L freshwater organisms: >40 mg/L The maximum acceptable toxicant limit (MATC) is between 0.04 and 0.198 mg/liter.	Canadian pond-weed and duckweed sustained 50% damage at lead acetate concentrations of 136 and 16.3 mg/liter respectively.
Zinc	Zinc (Zn) is a bluish white, crystalline, metallic element of low to medium hardness. It is an essential micronutrient for both plants and animals and is used especially as a protective coating for iron and steel.	Sources of Zinc include: most rocks and many minerals, erosion, igneous emissions, forest fires, mining, zinc production facilities, iron and steel production, metal corrosion, metal protection, road salts and manufacturing.	Zinc is transported to surface water via atmospheric deposition.	Zinc poisoning can cause gastrointestinal distress, nausea and diarrhea.		Zinc toxicity in plants generally causes disturbances in metabolism.		Zinc is acutely toxic to freshwater invertebrates in the range from 0.07 mg/liter for a water flea to 575 mg/liter for an isopod. Acutely lethal concentrations for freshwater fish are in the range of 0.066–2.6 mg/liter.	The critical leaf tissue concentration of zinc for an effect on growth in most species of plants is in the range of 200–300 mg/kg dw.
Nickel	Nickel (Ni) is a silver-white, hard, metallic element capable of a high polish and resistant to corrosion that is used chiefly in alloys and as a catalyst.	Sources of nickel include: batteries, metal protection, fossil fuel combustion, incinerators, gasoline consumption, asphalt, manufacturing and atmospheric deposition.	Nickel is transported to water via wastewater from various industrial processes. Acid rain may leach nickel as well as other metals from plants and soil.	Nickel can increase the risk of lung and nasal cancers and cause severe damage to the respiratory system, frontal headaches, vertigo, nausea, vomiting, dermatitis, insomnia and irritability.	Nickel toxicity in aquatic invertebrates varies considerably, according to species and abiotic factors. Nickel can be acutely toxic to aquatic organisms.	Nickel can be toxic to terrestrial plants.	There is evidence of a cancer risk in workers who had been exposed to soluble nickel concentrations of the order of 1-2 mg/m3.	Nickel can be acutely toxic to water fleas at 0.5 mg/liter, some freshwater snail species at 0.2 mg/liter and in a bivalve at 1100 mg/liter. Fish generaly fall within the range of 4-20 mg/liter.	Nickel levels exceeding 50 mg/kg dry weight are toxic for most plants.
Copper	Copper (Cu) is a common reddish metallic element that can be drawn or stretched into wire and is one of the best conductors of heat and electricity.	Copper is widely distributed in nature in the elemental state and in compounds. Other sources include smelting operations, municipal incinerators and copper mines.	Copper is transported to water through corrosion of household plumbing systems, erosion of natural deposits and mining and smelting operations.	High doses of copper have been shown to cause stomach and intestinal distress, liver and kidney damage, and anemia.			The main risk of acute exposure to copper is from fumes (metal fume fever). Acute exposure has not been reported from ingestion.		
Cadmium	Cadmium (Cd) is a bluish white, malleable, ductile, toxic, metallic element used especially in protective platings and in bearing metals.	Cadmium is widely distributed in the earth's crust. Volcanic activity is a major natural source of atmospheric cadmium release. The largest human aquatic source is smelting of non-ferrous metal ores.	Cadmium is transported to rivers by weathering, erosion, industrial sources and atmospheric deposition.	Symptoms of chronic cadmium poisoning include: bone lesions, spontaneous fractures, skeletal deformities, decreased height and pain resulting from pressure on bones. Severe poisoning can cause death.	Cadmium can bioaccumulate in mussels and fish.				
Chromium	Chromium (Cr) is a blue-white, metallic element found naturally only in combination and used especially in alloys and in electroplating.	Chromium occurs everywhere in nature. Other sources include: electroplating, metal corrosion, metal protection, wood preservatives, paints and stains, and manufacturing.	Chromium is transported to water by weathering, erosion, industrial sources and atmospheric deposition.	Oral ingestion of chromium causes liver and kidney necrosis and poisoning of blood-forming organs.	Chromium (VI) can have high to moderate acute toxic effects on birds or land animals. This can mean death of birds, animals or fish.	Chromium (VI) can have high to moderate acute toxic effects on plants. This can mean death or low growth rates in plants.	In adult human subjects, the lethal oral dose is 50 -70 mg soluble chromates/kg body weight.		
Soluble Metals Copper, Nickel, Lead, Zinc, Cadmium and Chromium	Soluble metals is a measurement of all metals and metal compounds that dissolved in a water sample. Aluminum, chromium and iron are some metals with soluble compounds.	Soluble metals can be found in toys, paper products, paints, art materials and residual oil fly ash (ROFA).	Soluble metals are transported to water directly from metal etching industries and indirectly from atmospheric deposition of dust and ROFA.						

*Not to exceed 200 organisms per 100 milliliters as a geometric mean of not less than five samples in any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 2000 organisms per 100 milliliters. The standard applies only between April 1 and October 31.

**CS: "Chronic Standard" the highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity.

***MS: "Maximum standard" is the highest concentration of a toxicant in water to which aquatic organisms can be exposed for a brief time with zero to slight mortality. The MS equals the FAV divided by two.

****FAV: "Final acute value" is an estimate of the concentration of a pollutant corresponding to the cumulative probability of 0.05 in the distribution of all the acute toxicity values for the genera or species from the acceptable acute toxicity tests conducted on a pollutant.

*5 EPA has established National Secondary Drinking Water Regulations that set non-mandatory water quality standards for 15 contaminants. EPA does not enforce these "secondary maximum contaminant levels" or "SMCLs." They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color and odor. These contaminants are not considered to present a risk to human health at the SMCL.

*6 Secondary standards are unenforceable but recommended guidelines for contaminants that may cause cosmetic or aesthetic effects in drinking water.

*7 "Inorganic mercury occurs as salts of its divalent and monovalent cationic forms" such as Mercuric chloride (HgCl2), Mercurous chloride (Hg2Cl2) and Mercuric sulfide (HgS).

*8 "Organic mercury compounds, sometimes called organomercurials, are those containing covalent bonds between carbon and mercury. Examples are methylmercury, dimethylmercury and methylmercury chloride."

Table 4 continued. Parameters information

Parameter	Minnesota Standard for 2b Waters	Minnesota Standard for 2bd Waters	EPA Standard	Lab Testing Method	Sources
Mercury	Mercury: in micrograms per liter (µg/l) at a hardness of 200 mg/l CS**: 0.0069 MS***: 2.4 FAV****: 4.9	Mercury: in µg/l at a hardness of 200 mg/l CS: 0.0069 MS: 2.4 FAV: 4.9		EPA 200.8 with ATP (Mercury) EPA 245.7	Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Class 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd Standards.) http://www.inchem.org/documents/ehc/ehc/ehc118.htm (Sources, Transport, Effects) http://drcranton.com/mercury/Mercury_test_results.htm (Human Threshold) http://limnology.wisc.edu/personnel/ggsass/Ice_angler_Hg.pdf http://www.talktransplant.co.uk/transcaretemplates/glossary.aspx (Definition of Creatinine) http://www.ccohs.ca/oshanswers/chemicals/chem_profiles/mercury/health_mercury.html (Use of Creatinine) http://www.greenfacts.org/glossary/mno/organic-mercury-compounds.htm (Organic Mercury Definition) http://www.inchem.org/documents/cicads/cicads/cicad50.htm (Inorganic Mercury Definition)
Lead	Lead: in µg/l at a hardness of 200 mg/l CS: 7.7 MS: 197 FAV: 396	Lead: in µg/l at a hardness of 200 mg/l CS: 7.7 MS: 197 FAV: 396		EPA 200.8 with ATP (Mercury) EPA 245.7	Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Clas 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd Standards.) http://www.m-w.com/cgi-bin/dictionary (Definition) http://www.inchem.org/documents/ehc/ehc/ehc85.htm#SectionNumber:1.2 (Health and Thresholds) http://www.inchem.org/documents/ehc/ehc/ehc003.htm#PartNumber:8 (Human Symptoms) http://www.epa.gov/glnpo/bnsdocs/mercsrce/merc_srce.html#II. (Human, Ssource)
Zinc	Zinc: in µg/l at a hardness of 200 mg/l CS: 191 MS: 211 FAV: 421	Zinc: in µg/l at a hardness of 200 mg/l CS: 191 MS: 211 FAV: 421		EPA 200.8 with ATP (Mercury) EPA 245.7	Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Clas 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd Standards.) http://www.m-w.com/dictionary/Zinc (Definition) http://www.inchem.org/documents/ehc/ehc/ehc221.htm#4.1.2 (Source and Transport) http://www.inchem.org/documents/ehc/ehc/ehc221.htm#1.8 (Thresholds)
Nickel	Nickel: in µg/l at a hardness of 200 mg/l CS: 283 MS: 2549 FAV: 5098	Nickel: in µg/l at a hardness of 200 mg/l CS: 283 MS: 2549 FAV: 5098	**Drinking water:** 10-day health advisory child 1.0 mg/liter 10-day health advisory adult 3.5 mg/liter Acceptable daily intake 0.35 mg/liter	EPA 200.8 with ATP (Mercury) EPA 245.7	Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Clas 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd Standards.) http://www.m-w.com/dictionary/Nickel (Definition) http://www.inchem.org/documents/hsg/hsg/hsg062.htm#SectionNumber:2.1 (Transport) http://www.epa.gov/OGWDW/dwh/c-ioc/nickel.html (Health and Transport) http://www.inchem.org/documents/hsg/hsg/hsg062.htm (Health Tthresholds)
Copper	Copper: in µg/l at a hardness of 200 mg/l CS: 15 MS: 34 FAV: 68	Copper: in µg/l at a hardness of 200 mg/l Cs: 15 MS: 34 FAV: 68		EPA 200.8 with ATP (Mercury) EPA 245.7	Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Clas 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd Sstandards.) http://www.google.com/search?hl=en&lr=&oi=defmore&defl=en&q=define: copper nickel lead…. http://www.m-w.com/cgi-bin/dictionary (Definition) http://www.epa.gov/OGWDW/dwh/t-ioc/copper.html (Human Concerns, Sources, and Drinking Water Standards) http://www.epa.gov/safewater/mcl.html (Health and Sources) http://www.inchem.org/ (Health Tthreshold)
Cadmium	Cadmium: in µg/l at a hardness of 200 mg/l CS: 2.0 MS: 73 FAV: 146	Cadmium: in µg/l at a hardness of 200 mg/l CS: 2.0 MS: 73 FAV: 146		EPA 200.8 with ATP (Mercury) EPA 245.7	Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Clas 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd Sstandards) http://www.m-w.com/dictionary/Cadmium (Definition) http://www.inchem.org/documents/pims/chemical/cadmium.htm#PartTitle:2.%20%20%20%20SUMMARY (Human) http://www.lenntech.com/Periodic-chart-elements/Cd-en.htm (Wildlife)
Chromium	Chromium (+3) µg/l at a hardness of 200 mg/l CS: 356 MS: 3064 FAV: 6120	Chromium (+3) µg/l at a hardness of 200 mg/l CS: 356 MS: 3064 FAV: 6120		EPA 200.8 with ATP (Mercury) EPA 245.7	Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Clas 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd Standards.) http://www.m-w.com/dictionary/Chromium (Definition) http://www.inchem.org/documents/ehc/ehc/ehc61.htm (Human Threshold) http://www.npi.gov.au/database/substance-info/profiles/25.html#environmentaleffects (Pollution Effects Plants and Animals)
Soluble Metals Copper, Nickel, Lead, Zinc, Cadmium and Chromium				EPA 200.8 with ATP (Mercury) EPA 245.7	http://www.cdc.gov/niosh/nmam/pdfs/chapter-m.pdf (Definition and Source) http://www.epa.gov/ORD/NRMRL/pubs/600r01056/600R01056chap6.pdf (Source)

*Not to exceed 200 organisms per 100 milliliters as a geometric mean of not less than five samples in any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 2000 organisms per 100 milliliters. The standard applies only between April 1 and October 31.

**CS: "Chronic Standard" the highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity.

***MS: "Maximum standard" is the highest concentration of a toxicant in water to which aquatic organisms can be exposed for a brief time with zero to slight mortality. The MS equals the FAV divided by two.

****FAV: "Final acute value" is an estimate of the concentration of a pollutant corresponding to the cumulative probability of 0.05 in the distribution of all the acute toxicity values for the genera or species from the acceptable acute toxicity tests conducted on a pollutant.

*5 EPA has established National Secondary Drinking Water Regulations that set non-mandatory water quality standards for 15 contaminants. EPA does not enforce these "secondary maximum contaminant levels" or "SMCLs." They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color and odor. These contaminants are not considered to present a risk to human health at the SMCL.

*6 Secondary standards are unenforceable but recommended guidelines for contaminants that may cause cosmetic or aesthetic effects in drinking water.

Table 4 continued. Parameters information

Parameter	Definition	Sources	Transport to Water	Pollution Concerns for Humans	Pollution Concerns for Wildlife	Pollution Concerns for Plants	Risk Threshold for Humans	Risk Threshold for Wildlife	Risk Threshold for Plants
Fluoride	Fluoride is a chemical compound. To form fluoride, the gaseous element Fluorine (F) combines with other more electropositive elements (like sodium) or radicals (atoms with an unpaired electron).	Fluoride is a mineral found naturally in soil and water. Fluoride is added to drinking water and can also come from industrial, agricultural, dental or medical sources.	Fluoride is transported to water when it is added to domestic water supplies. Fluoride is usually transported through the water cycle complexed with aluminum. Fluoride is not readily leached from soils.	Too much fluoride in the diet can cause vomiting, abdominal pain, diarrhea, cyanosis, severe weakness, dyspnoea, muscle spasms, paresis and paralysis, cardiovascular disorders, convulsions, coma and death.	Fluoride poisoning causes fish to become apathetic, lose weight, have periods of violent movement and wander aimlessly. Finally there is a loss of equilibrium accompanied by tetany and death.	Adverse effects of toxic concentrations on plants include: chlorosis, peripheral necrosis, leaf distortion and malformation of abnormal fruit development.			Fluoride can affect plants at concentrations as low as 20mg/kg dry weight.
Total Chlorides	Total Chlorides is a measurement of all the chloride ions in a sample. Chloride ions are formed when the element chlorine picks up one electron from the anion Cl^{-1}. Chloride = 1chlorine atom + 1 electron.	Chloride can be found naturally in soil and rocks. Other sources of chloride include: fertilizers, salts, chlorine, plastics, human and animal waste, effluent from industrial plants and the drilling of oil and gas wells.	Chlorides are transported to water by surface water runoff, leaching of animal waste into ground water, salts, treated wastewater and atmospheric deposition.			Chloride is relatively nontoxic. At high concentrations (1000 mg/L), it is corrosive and can be harmful to vegetation and microinvertebrates. Chloride concentration in the ocean is 35,000 mg/L.			
Total Kjeldahl Nitrogen	Total Kjeldahl Nitrogen is nitrogen in the form of organic proteins or their decomposition product ammonia, as measured by the Kjeldahl Method.	Sources of nitrogen include: fertilizers, animal manure, legumes (soybeans and alfalfa), domestic effluents, atmospheric deposition and soil nitrogen. Earth's atmosphere is 78% nitrogen gas.	Nitrogen is transported to water via surface water runoff from agriculture fields, atmospheric deposition, point source pollution (sewage treatment plants), erosion, plant materials, animal waste and fertilizers.						
Total Ammonia Nitrogen	Total ammonia nitrogen consists of two forms of ammonia, NH_3 and NH_4^+. The first is unionized ammonia and the second is ionized. Free ammonia (NH_3-N) and ionized-ammonia (NH_4^+-N) represent two forms of reduced inorganic nitrogen which exist in equilibrium.	Sources of ammonia nitrogen include: fertilizers, pesticides, human and animal waste, cleaning products, fossil fuel and biomass combustion, coal to coke plants, metallurgic operations, ceramic production, strip mining, chemical synthesis, waste gas treatment, explosives production, refrigeration equipment production, oil refineries, food processing, atmospheric deposition and plant materials.	Total ammonia nitrogen is transported to water by atmospheric deposition, surface water runoff and point source pollution.	Toxic concentrations of ammonia in humans may cause loss of equilibrium, convulsions, coma and death.	Most fish are extremely sensitive to even minute levels of NH_3 contamination.			NH_3 has been reported toxic to fresh water organisms at concentrations ranging from 0.53 22.8 mg/L	
Nitrate-Nitrogen	Nitrate-nitrogen (NO_3-N) is a commonly used lawn and agricultural fertilizer. It is also a chemical formed in the decomposition of waste materials, such as manure and sewage.	Nitrate and nitrite sources include: gasoline consumption, fertilizers, pesticides, soil treatments, soil erosion, sanitary waste, manufacturing, animal waste, atmospheric deposition and plant materials.	Nitrogen is transported to water via agricultural runoff, atmospheric deposition, point source pollution (sewage treatment plants), erosion, decay of plant materials, and animal waste.	Excess nitrates in drinking water have been linked to human health problems, including heart conditions and birth defects.	Nitrate reactions in fresh water can cause oxygen depletion.				
Nitrite-Nitrogen	Nitrite is an unstable form of nitrogen that might be found in small amounts along with nitrate. Bacteria in water quickly convert nitrites [NO_2^-] to nitrates [NO_3^-].	Nitrate and nitrite sources include: gasoline consumption, fertilizers, pesticides, soil treatments, soil erosion, sanitary waste, manufacturing, animal waste, atmospheric deposition and plant materials.	Nitrogen is transported to water via surface water runoff from agriculture fields, atmospheric deposition, point source pollution (sewage treatment plants), erosion, decay of plant materials, and animal waste.	Nitrites react directly with hemoglobin in human blood and other warm-blooded animals to produce methemoglobin. Methemoglobin destroys the ability of red blood cells to transport oxygen.	Nitrites can produce a serious condition in fish called "brown blood disease" in which nitrite in the blood turns the blood a chocolate-brown color.		Water with nitrite levels exceeding 1.0 mg/l should not be used for feeding babies.	Nitrite-nitrogen levels below 90 mg/l and nitrate levels below 0.5 mg/l seem to have no effect on warm water fish.	

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Table 4 continued. Parameters information

Parameter	Minnesota Standard for 2b Waters	Minnesota Standard for 2bd Waters	EPA Standard	Lab Testing Method	Sources
Fluoride				Standard Methods 20th Edition 4500-F- D. SPADNS Method, Ref SM 20th ed.P 4-82.	http://www.google.com/search?hl=en&lr=&oi=defmore&defl=en&q=define:fluoride (Definition) http://www.inchem.org/documents/ehc/ehc/ehc36.htm#SubSectionNumber:1.1.2 (Sources) http://www.greenfacts.org/fluoride/fluorides-3/02-environment.htm (Transport)
Total Chlorides	Chloride: in mg/l CS: 230 MS: 860 FAV: 1720	Chloride: in mg/l CS: 230 MS: 860 FAV: 1720 Not to exceed 230 mg/L more than once every three years.	**Drinking water**: 250 mg/L	EPA 325.2	Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Class 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd standards.) http://www.kgs.ku.edu/Hydro/Publications/2005/OFR05_34/OFR2005_34.pdf (Sources and Transport)
Total Kjeldahl Nitrogen				EPA 351.2 & 365.4 ATP	Stormwater Management Program and Annual Report (Minneapolis Public Works Department, 2005) http://co.water.usgs.gov/midconherb/html/st.louis.hypoxia.html (Sources)
Total Ammonia Nitrogen	Ammonia unionized: µg/l CS: 40 MS: None FAV : None	Ammonia unionized: µg/l CS: 40 MS: None FAV : None		EPA350.1	http://www.water-research.net/Watershed/ammonia.htm (Definition, Sources and Thresholds.) http://bridge.ecn.purdue.edu/~piwc/w3-research/free-ammonia/nh3.html (Definition and Information) http://www.inchem.org/documents/ehc/ehc/ehc54.htm#SectionNumber:1.3 (Ammonia)
Nitrate-Nitrogen				EPA 353.1 Chloroform preservation	http://www.uwsp.edu/cnr/gndwater/privatewells/Nitrate%20and%20Nitrite%20Nitrogen.htm http://www.water-research.net/nitrite.htm# (Sources and Chemical Compound) http://www.state.ky.us/nrepc/water/wcpno.htm (Transport) Clean Waters fact sheet #1 (Connecticut Sea Grant, 1999)
Nitrite-Nitrogen				EPA 353.1 Chloroform preservation	http://www.state.ky.us/nrepc/water/wcpno.htm (Definition, Sources, Transport and Risks)

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Table 4 continued. Parameters information

Parameter	Definition	Sources	Transport to Water	Pollution Concerns for Humans	Pollution Concerns for Wildlife	Pollution Concerns for Plants	Risk Threshold for Humans	Risk Threshold for Wildlife	Risk Threshold for Plants
Total Phosphorus	Total phosphorus includes dissolved and particulate phosphorus. Phosphorus (P) is a highly reactive, poisonous, nonmetallic element occurring naturally in phosphates.	Sources of phosphorus include: agricultural drainage, wastewater, certain industrial discharges, fossil fuel combustion, incinerators, gasoline consumption, fertilizers, pesticides, soil treatments, soil erosion, sanitary waste, manufacturing, animal waste, atmospheric deposition and plant materials.	Phosphorus is transported to water via surface water runoff from agricultural fields, atmospheric deposition, point source pollution (sewage treatment plants), erosion, plant materials, animal waste and fertilizers.		Excessive algal blooms caused by an overabundance of limiting nutrients (phosphorus) decreases dissolved oxygen in water bodies and kills fish.	Dense algal blooms block light, killing plants and increasing nutrients avalable to algae which further increases algae blooms.			
Orthophosphate	Orthophosphate (also known as phosphoric acid) is inorganic phosphate or phosphate that is not associated with organic material.	Sources of orthophosphate include: rocks and soils, human and animal waste, pulp and paper mills, vegetable and fruit processing plants, chemical and fertilizer manufacturing plants, detergents, agricultural runoff and some lawn fertilizers.	Orthophosphate is transported to water directly by point sources and indirectly by surface water runoff.						
Total Sulfates	Total sulfates is a measurement of all the sulfates in a sample. Sulfates are mineral salts containing sulfur.	Sulfates occur as microscopic particles (aerosols) resulting from fossil fuel and biomass combustion. Sulfates are released from decaying plants and animals, mines, tanneries, steel and pulp mills, and textile plants. Sulfates are also a large component of seawater.	Sulfates are transported into water by household and industrial wastewater and surface water runoff.	Ingesting water that contains over 500 mg/L sulfates can cause diarrhea, intestinal pain, dehydration and slight decrease in normal stomach acidity.		One concern is that sulfates increase the acidity of the atmosphere and form acid rain. High concentrations of sulfates can damage aquatic plants.			
Total Hardness	Total hardness is defined as the sum of calcium and magnesium concentrations, both expressed as calcium carbonate [CaCO3], in milligrams per liter.	Calcium carbonate comes from chalk, limestone, marble, coral and calcite. Calcium carbonate (calcite) comprises about 4% of the earth's crust by weight.	Slightly acidic water dissolves calcium carbonate and carries it to water bodies.						
Total Alkalinity	Total alkalinity is the total concentration of bases (molecules with one or two nitrogen containing ring structures) in water expressed as parts per million (ppm) or milligrams per liter (mg/L) of calcium carbonate CaCO3. Alkalinity is different than hardness because it includes sodium and potassium carbonate.	Sources of alkalinity are similar to sources of hardness. Alkalinity can come from chalk, limestone, marble, coral and calcite. Sodium is the sixth most abundant element in the earth's crust at about 2.6-3%. Potassium is the seventh most abundant and makes up about 1.5% by weight of the earth's crust.	Slightly acidic water dissolves calcium carbonate, sodium carbonate and potassium carbonate and carries them to water bodies.						
Total Organic Carbon	Total organic carbon is the mass of carbon present in a water sample, excluding the carbon present as CO2 and/or carbonates. Organic carbon is carbon that has been incorporated in an organism.	Organic carbon (organic matter) sources include: decomposing plant and animal material, humic substances, agricultural runoff, and municipal and industrial effluents.	Organic carbon is transported to water by atmospheric deposition, surface water runoff and point sources.						

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Table 4 continued. Parameters information

Parameter	Minnesota Standard for 2b Waters	Minnesota Standard for 2bd Waters	EPA Standard	Lab Testing Method	Sources
Total Phosphorus				EPA 351.2 & 365.4 ATP	
Orthophosphate				EPA 365.2	http://bcn.boulder.co.us/basin/data/NUTRIENTS/info/TP.html http://www.ci.falls-church.va.us/services/aboutorthophosphate.html http://www.epa.gov/dclead/phosphoric_acid_health_effects_sheet_FINAL.pdf http://extoxnet.orst.edu/faqs/safedrink/phos.htm http://www.water-research.net/phosphate.htm
Total Sulfates			Sulfate in drinking water currently has a secondary maximum contaminant level (SMCL)*5 of 250 milligrams per liter (mg/L), based on aesthetic effects (i.e., taste and odor).	Standard Methods 425C 15th Edition	Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Clas 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd standards.) http://en.wikipedia.org/wiki/Sulfates http://www.epa.gov/safewater/sulfate.html http://www.dhfs.state.wi.us/eh/ChemFS/fs/Sulfates.htm (Sources, Human Concerns and Transport)
Total Hardness				Standard Methods 314B 15th Edition	http://www.bfhd.wa.gov/info/tds.php (Definition) http://www.deq.state.mi.us/documents/deq-ead-tas-whitings.pdf (Sources) http://www.lenntech.com/Periodic-chart-elements/Ca-en.htm (Information)
Total Alkalinity				EPA 310.2	http://msucares.com/pubs/infosheets/is1334.htm (Definition) http://www.webelements.com/webelements/elements/text/K/key.html (Definition of Potassium) http://images.antiagingconference.com/files/1103/aagateway/glossaryofterms.asp (Definition)
Total Organic Carbon				EPA 415.1 wet oxidation; auto sampler; settled sample; NDIR detection	http://www.fleckvalves.com/water%20dictionary.htm (Definition) http://bcn.boulder.co.us/basin/data/COBWQ/info/TOC.html (Information) http://www.wwnorton.com/college/geo/earth2/glossary/o.htm#19 (Definition of Organic Carbon) http://www.nsc.org/ehc/glossar1.htm http://www.sfrc.ufl.edu/Extension/ssfor11.htm

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Table 4 continued. Parameters information

Parameter	Definition	Sources	Transport to Water	Pollution Concerns for Humans	Pollution Concerns for Wildlife	Pollution Concerns for Plants	Risk Threshold for Humans	Risk Threshold for Wildlife	Risk Threshold for Plants
Total Volatile Suspended Solids	Total Volatile Suspended Solids (VSS) is a measure representing the sum of all the VSS in a sample. VSS are those solids lost on ignition (heating to 550 degrees C).	Sources of VSS include: fuel combustion, road salts, asphalt, fertilizers, pesticides, soil treatments, paints and stains, plastics, sanitary waste, manufacturing, animal waste and atmospheric deposition.	VSS are transported to water directly from spills and indirectly from surface water runoff and atmospheric deposition.						
Total Dissolved Solids	Total Dissolved Solids (TDS) is that portion of solids in water that can pass through a 2 micron filter.	Sources of TDS include: fuel combustion, road salts, asphalt, fertilizers, pesticides, soil treatments, sanitary waste, plant materials and atmospheric deposition.	TDS are transported to water by point sources from industry and nonpoint sources from surface water runoff.						
Total Suspended Solids	Total suspended solids (TSS) include all particles suspended in water which will not pass through a filter.	Sources of TSS include: sanitary and industrial wastewater, soil erosion, fossil fuel and biomass combustion, fertilizers, pesticides, soil treatments, atmospheric deposition and plant materials.	TSS is transported to water by point sources from industry and by nonpoint sources from surface water runoff.		Total suspended solids blanket river beds destroying fish habitat, smother fish and insect eggs, clog gills, suffocate newly-hatched larvae, reduce growth rates and lower resistance to disease.				
Oil and grease	Oil is a greasy liquid of vegetable, animal, mineral or synthetic origin. Grease is a lubricant composed of oil and thickened with a soap or other thickener to a semisolid or solid consistency.	Sources of oil and grease pollution include: incomplete combustion, tire particles, food preparation, asphalt and manufacturing, and urban runoff from: vehicles, parking lots, roads, machinery, filling stations and garages.	Oil and grease are transported to water from spills, watercraft, vehicles, atmospheric deposition and surface water runoff.		Oil spills cause wildlife to suffer loss of insulative capability, dehydration, GI tract disorders, destruction of red blood cells, pneumonia, skin and eye irritation, and impaired reproduction.	Aquatic plants are subject to contact, smothering, toxicity and chronic long-term effects that may result from the physical and chemical properties of spilled oil.			
Fecal Coliform	Fecal coliform is a bacteria that lives in the intestinal tract of warm blooded animals.	Fecal coliform is found in the fecal material of warm-blooded animals. Major sources include agriculture and feed lots.	Fecal coliform is transported to water from domestic sewage and nonpoint runoff.	Fecal coliform can cause Typhoid Fever, viral and bacterial Gastroenteritis and Hepatitis A.			Body Contact: <200 colonies/ 100ml		
Escherichia Coli (E. Coli)	E. coli is a bacteria that is distinguished from total coliform by its ability to grow at elevated temperatures.	E. coli is found in the fecal material of warm-blooded animals. Major sources include agriculture and feed lots.	E. coli is transported to water from domestic sewage and nonpoint source runoff.	E. coli can inflame intestinal walls.			The exact amount harmful to humans is not known but believed to be very small.		

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Table 4 continued. Parameters information

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Total Volatile Suspended Solids				EPA 160.2 ATP	http://www.bfhd.wa.gov/info/tss.php (Source and Definition) http://www.uic.edu/classes/cmeng/cmeng420/tssSOP.pdf (Definition)
Total Dissolved Solids			The U.S. Environmental Protection Agency sets a secondary standard *6 of 500 mg/l TDS in drinking water.	Standard Methods 2540C 18th Edition	http://www.bfhd.wa.gov/info/tds.php (Definition) http://www.epa.gov/safewater/mcl.html#mcls (Standard)
Total Suspended Solids				EPA 160.2 ATP	http://www.deq.state.mi.us/documents/deq-swq-npdes-TotalSuspendedSolids.pdf (Definition and Sources)
Oil and Grease	Oil: µg/l CS: 500 MS: 5000 FAV: 10,000	Oil: µg/l CS: 500 MS: 5000 FAV: 10,000		Soxhlet extraction using Freon, dry at 130C and weigh.	Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Class 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd Standards.) web.mit.edu/environment/ehs/topic/spcc_ref/glossary.html (Definition) www.climatechangenorth.ca/H1_Glossary.html (Definition) www.fi.edu/fellows/fellow2/jan99/new/oilvocab.html (Definition) www.oilanalysis.com/dictionary/default.asp (Definition) wordnet.princeton.edu/perl/webwn (Definition) www.oilanalysis.com/dictionary/default.asp (Definition) http://www.stormwaterauthority.org/pollutants/default.aspx (Dources) http://www.epa.gov/oilspill/pdfs/chap5.pdf (Effects on Wildlife)
Fecal Coliform	Not to exceed 200 colonies/100mL*	Not to exceed 200 colonies/100mL*	**Drinking water** <1 colonies/100mL **Body contact** <200 colonies/ 100mL **Fishing and boating** <1000 colonies/100mL **Domestic water supply for treatment** <2000 colonies/100mL	Standard Methods 20th Edition 9221E fecal coliform test using EC medium. SM 20th ed. pp: 9-54.	Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Class 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd standards.) http://www.state.ky.us/nrepc/water/wcpfcol.htm http://www.switzerland.k12.in.us/Watershed/fecal.html http://www.oasisdesign.net/water/quality/coliform.htm http://www.epa.gov/ost/pc/ambientwqc/bacteria1986.pdf
Escherichia Coli (E. Coli)	Proposed 126 colonies/100mL	Proposed 126 colonies/100mL	**Drinking water** Maximum Contaminant Level: 0.0	EPA method 1603	Minnesota Rules Chapter Minnesota Rules Chapter Minnesota Rules Chapter 7050.0222 Specific Standards of Quality and Purity for Class 2 Waters of the State; Aquatic Life and Recreation. (2b and 2bd standards.) http://www.state.ky.us/nrepc/water/wcpfcol.htm (xx) http://www.switzerland.k12.in.us/Watershed/fecal.html http://www.oasisdesign.net/water/quality/coliform.htm http://www.epa.gov/ost/pc/ambientwqc/bacteria1986.pdf http://www.about-ecoli.com/page3.htm (risks to people) http://www.epa.gov/safewater/mcl.html#mcls (MCL Drinking water)

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Table 4 continued. Parameters information

Parameter	Definition	Sources	Transport to Water	Pollution Concerns for Humans	Pollution Concerns for Wildlife	Pollution Concerns for Plants
Total Chemical Oxygen Demand	Total chemical oxygen demand (COD) is a measurement of the amount of oxygen required to degrade the organic compounds in water.	Sources of organic compounds include: organic material, paints and stains, manufacturing, atmospheric deposition and plant materials.	Organic compouds are transported to water via surface water runoff, atmospheric deposition, and point and nonpoint source pollution.			
Carbonaceous Biological Oxygen Demand	Carbonaceous (consisting of or containing carbon) Biological Oxygen Demand (CBOD) is caused by the breakdown of organic molecules such as cellulose and sugars into carbon dioxide and water.	Sources of organic molecules include: human and animal waste, plant materials, soil erosion, lawn fertilizers, paper, urban runoff, atmospheric deposition and industrial sources.	Organic compounds are transported to water directly from point sources and indirectly from surface water runoff. CBOD increases when the availability of sunlight and nutrients are increased in a water body.			
Total 5-day BOD	Total 5-day Biochemical (or biological) Oxygen Demand (BOD) measures the amount of oxygen consumed by biochemical oxidation of waste contaminants in a 5-day period.	Sources of BOD causing waste include: human and animal waste, plant materials, soil erosion, lawn fertilizers, paper, urban runoff, atmospheric deposition and industrial sources.	BOD is transported to water directly from point sources and indirectly from surface water runoff. BOD increases when the availability of sunlight and nutrients are increased in a water body.			
Temperature	Temperature is a measure of the degree of heat intensity.	The sun and water used in industrial cooling processes are two major sources of heat to water bodies.	Sun rays transfer heat to water to a greater effect in cities because of the loss of vegitation/shade. The Urban Heat Island Effect (UHIE) in general increases the transport of heat to water. Blacktop and power plants transfer heat to water.	Warmer water allows for faster growth of bacteria.	Warm water holds less oxygen than cold water. Warmer temperatures increase metabolic rates of organisms. These two factors stress aquatic species.	Temperature affects plant communities. Changing the temperature range of an aquatic system can transform plant communities.
Dissolved Oxygen	Dissolved oxygen (D.O.) is oxygen that has been dissolved in water and is therefore freely available to aquatic organisms.	Dissolved oxygen comes from the atmosphere and photosynthesis. D.O. is depleted when microorganisms decompose organic material.	Waves and tumbling water mix air into the water where oxygen readily dissolves. Aquatic plants and algae release D.O. as a byproduct of photosynthesis.		Oxygen is essential for fish, invertebrate, plant and aerobic bacteria respiration. Lower levels of D.O. mean more stress on aquatic organisms.	Aquatic plants use oxygen at night and on very cloudy days for respiration, otherwise they produce oxygen as a byproduct.
pH	pH is a measure of the acidity of a solution. pH is equal to the negative logarithm of the concentration of hydrogen ions in a solution. A pH of 7 is neutral, less than 7 is acidic and greater than 7 is basic.	Sulfur dioxide (SO2) and nitrogen oxides (NOx) are sources of acidity and come from fossil fuel combustion. Burning coal produces fly ash that contains metal oxides, which raise the pH of water.	Acids are transported to water through wet and dry deposition of acid from the atmosphere. Bases are transported to water by air pollution (fly ash from coal burning) and water pollution (soaps and oxides).			
Conductivity	Conductivity is a measure of a solution's ability to carry an electrical current. The measure-ment is used in fresh water analyses to obtain a rapid estimate of dissolved solids or salts content of a water sample.	Conductivity and dissolved solids share the same sources: fossil fuel combustion, incinerators, road salts, asphalt, fertilizers, pesticides, soil treatments, sanitary waste, animal waste, atmospheric deposition and plant materials.	Point sources from industry and nonpoint sources from surface water runoff.			

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Table 4 continued. Parameters information

Parameter	Minnesota Standard for 2b Waters	Minnesota Standard for 2bd Waters	EPA Standard	Lab Testing Method	Sources
Total Chemical Oxygen Demand				EPA 410.4	Minneapolis Public Works (Sources) http://www.scpscience.com/products/Water%20Analysis/cod.asp (Definition)
Carbonaceous Biological Oxygen Demand				Standard Methods 5210B 18th Edition	http://www.weblife.org/humanure/glossary.html http://www.deq.state.mi.us/documents/deq-swq-npdes-BiochemicalOxygenDemand.pdf (Sources and Transport)
Total 5-day BOD				Standard Methods 5210B 18th Edition	http://www.waterandagroindustry.org/forum/forum.asp?ofact=0&ofmsgid=&ofdisp=0&ofpage=&ofrand=1083578 http://water.usgs.gov/owq/FieldManual/Chapter7/7.0.html (Definition) http://www.fivecreeks.org/monitor/bod.html
Temperature			Temperature is a non-priority pollutant and is species dependent.	Thermometer	http://www.lenntech.com/aquatic/heat.htm (Wildlife)
Dissolved Oxygen	MPCA: 5 mg/L	MPCA: 5 mg/L		Dissolved Oxygen meter	http://library.marist.edu/diglib/EnvSci/archives/hudsmgmt/ny-njharborestuaryprogram/glossary.html (Definition) http://www.cotf.edu/ete/modules/waterq/wqdissolvedo2.html (Everything else)
pH					http://www.policyalmanac.org/environment/archive/acid_rain.shtml (Transportation, Source)
Conductivity					http://www.enr.state.nc.us/neuse/files/glossary.htm (Definition)

*Not to exceed 200 organisms per 100 milliliters as a geometric mean of not less than five samples in any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 2000 organisms per 100 milliliters. The standard applies only between April 1 and October 31.

**CS: "Chronic Standard" the highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity.

***MS: "Maximum standard" is the highest concentration of a toxicant in water to which aquatic organisms can be exposed for a brief time with zero to slight mortality. The MS equals the FAV divided by two.

****FAV: "Final acute value" is an estimate of the concentration of a pollutant corresponding to the cumulative probability of 0.05 in the distribution of all the acute toxicity values for the genera or species from the acceptable acute toxicity tests conducted on a pollutant.

*5 EPA has established National Secondary Drinking Water Regulations that set non-mandatory water quality standards for 15 contaminants. EPA does not enforce these "secondary maximum contaminant levels" or "SMCLs." They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color and odor. These contaminants are not considered to present a risk to human health at the SMCL.

*6 Secondary standards are unenforceable but recommended guidelines for contaminants that may cause cosmetic or aesthetic effects in drinking water.

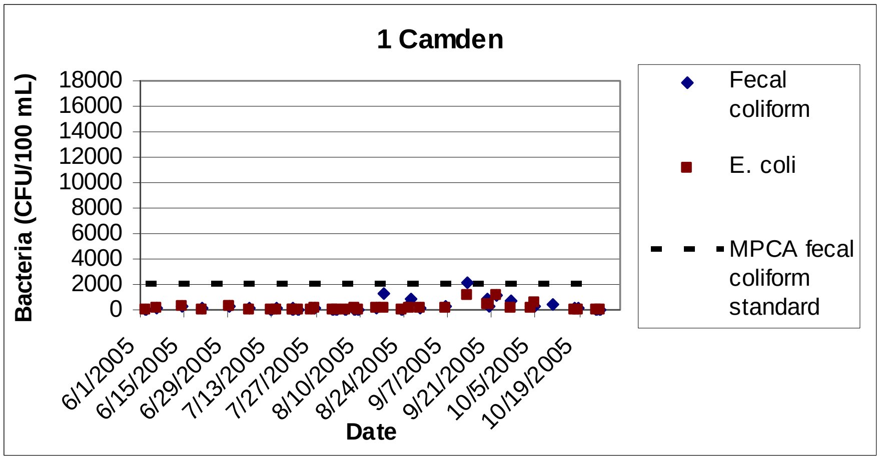
APPENDIX D

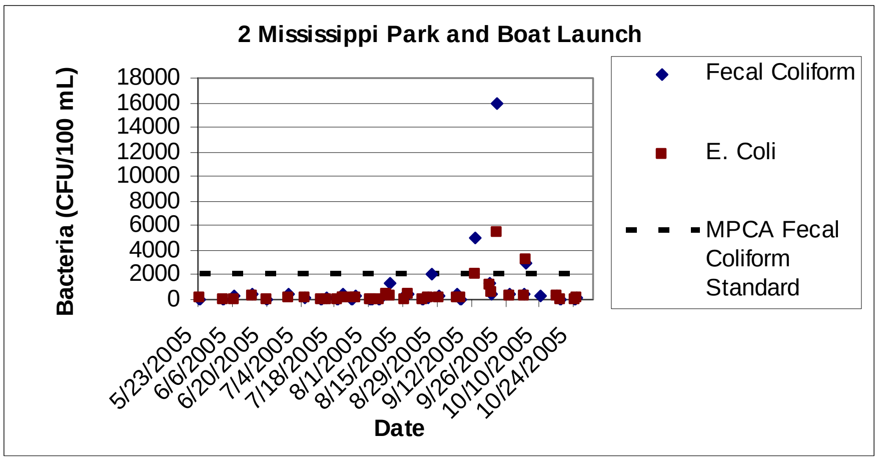
Table 5. Unit conversions

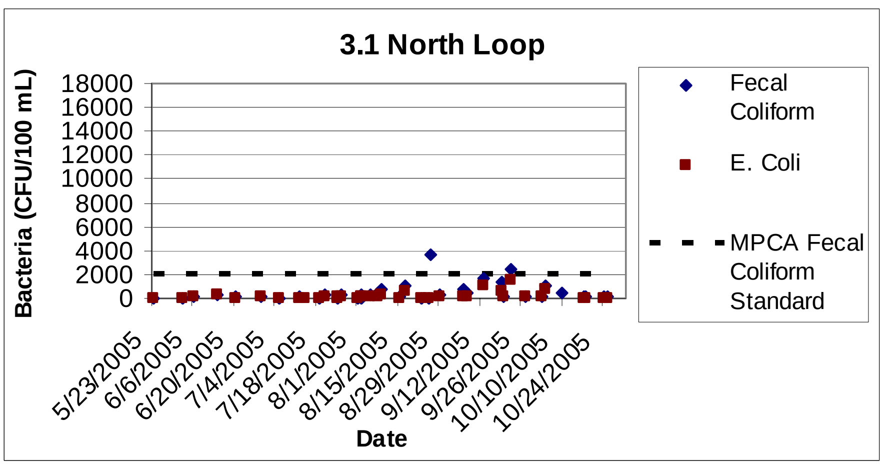
Unit	Unit Conversion
1 L	1000 mL
1 gallon	3.78 L
1 g	1000 mg
1 mg	1000 µg
1 mg/L	1 ppm
1 µg/L	1 ppb
1 m	100 cm
1 in	2.54 cm
1 ft	12 in

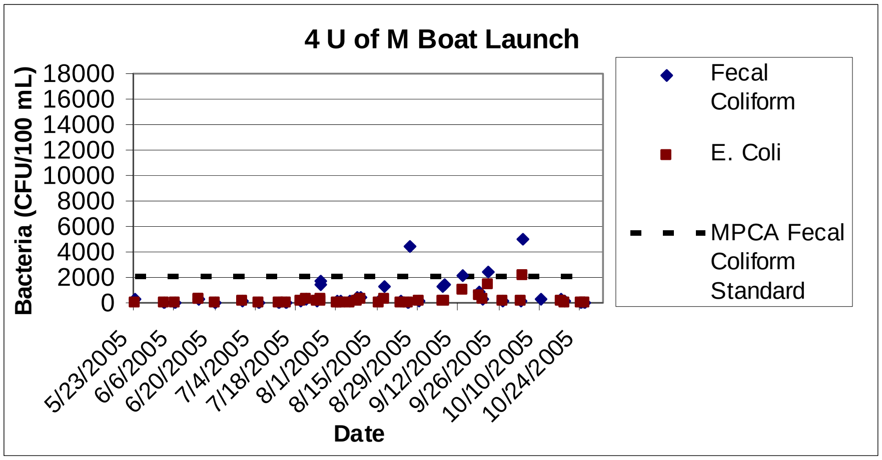
APPENDIX E

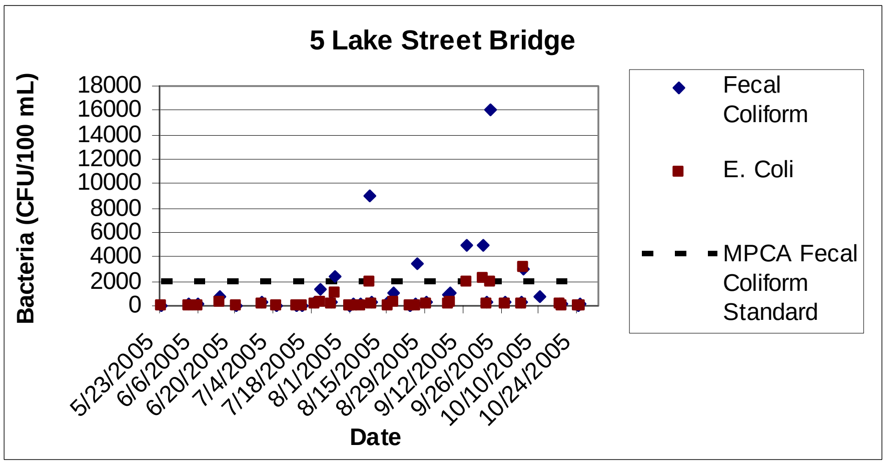
Mississippi River fecal coliform and e. coli concentrations

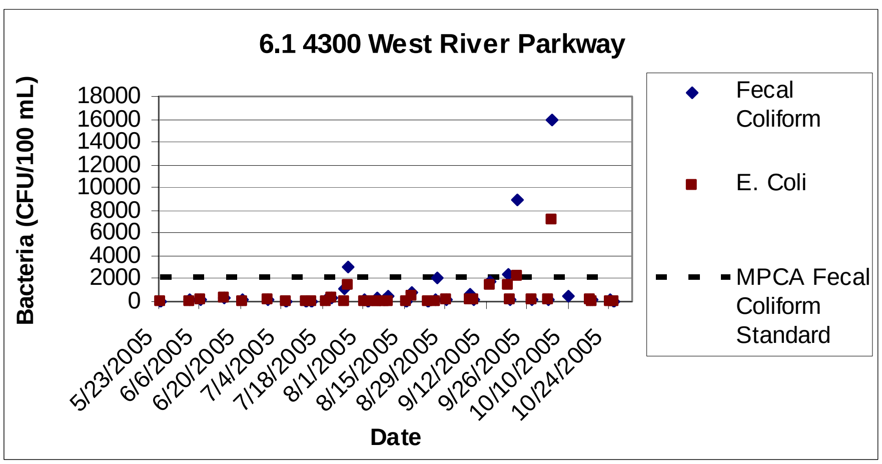




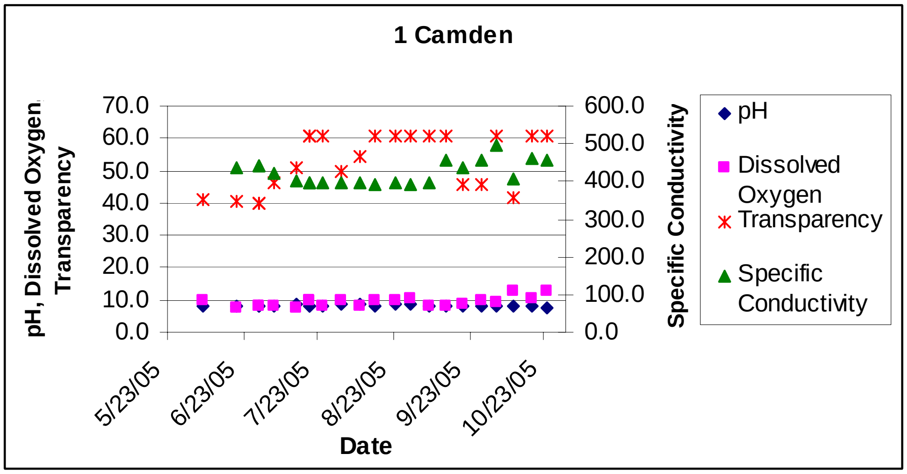


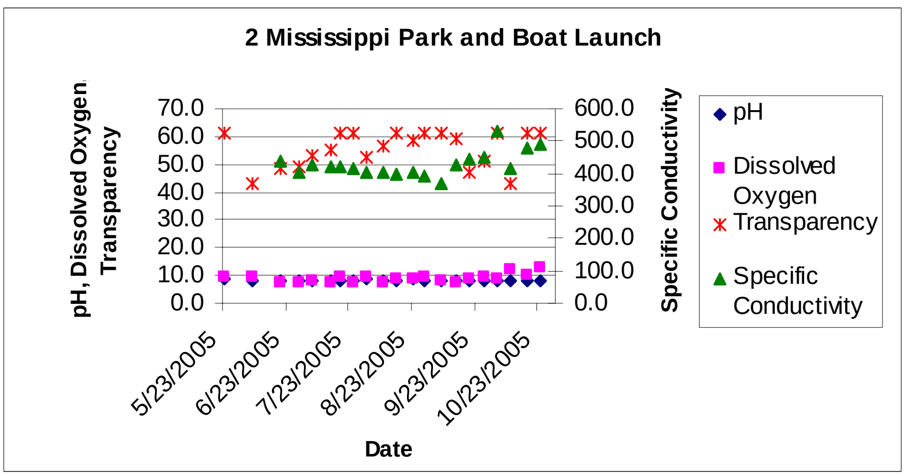

4 U of M Boat Launch
Bacteria (CFU/100 mL)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
5/23/2005
6/6/2005
6/20/2005
7/4/2005
7/18/2005
8/1/2005
8/15/2005
8/29/2005
9/12/2005
9/26/2005
10/10/2005
10/24/2005
Date
Fecal Coliform
E. Coli
MPCA Fecal Coliform Standard

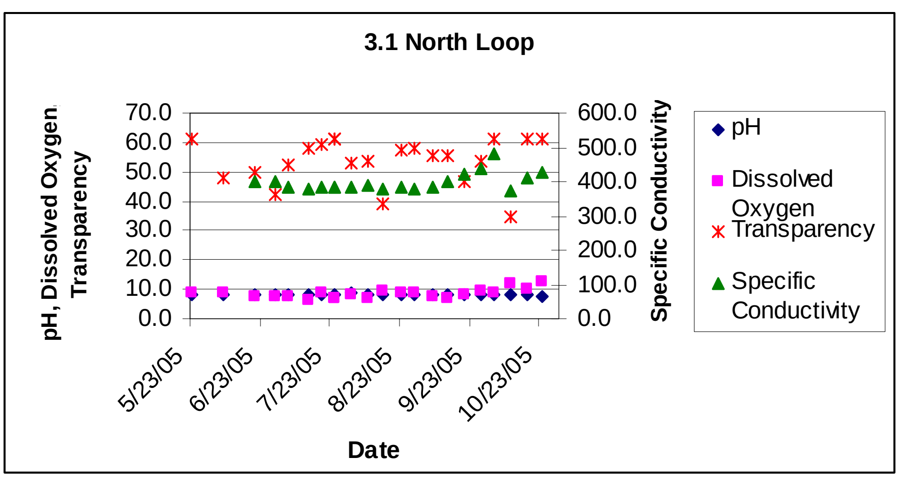

5 Lake Street Bridge
Bacteria (CFU/100 mL)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
5/23/2005
6/6/2005
6/20/2005
7/4/2005
7/18/2005
8/1/2005
8/15/2005
8/29/2005
9/12/2005
9/26/2005
10/10/2005
10/24/2005
Date
Fecal Coliform
E. Coli
MPCA Fecal Coliform Standard

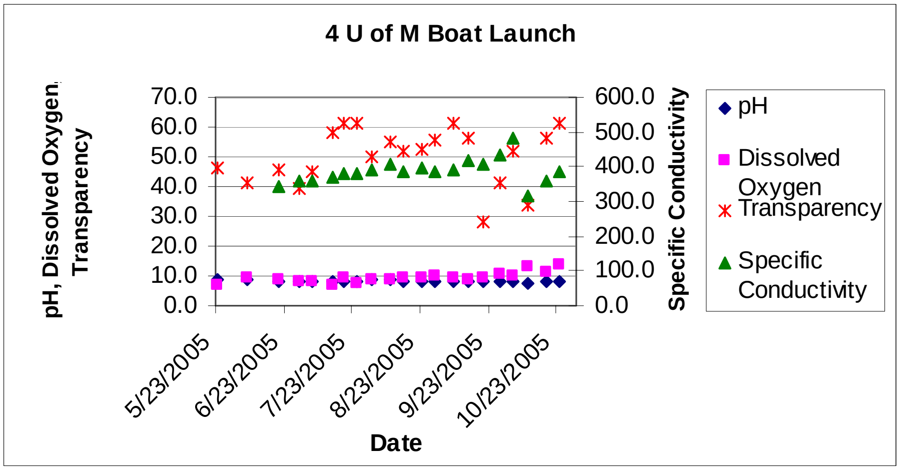

6.1 4300 West River Parkway
Bacteria (CFU/100 mL)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
5/23/2005
6/6/2005
6/20/2005
7/4/2005
7/18/2005
8/1/2005
8/15/2005
8/29/2005
9/12/2005
9/26/2005
10/10/2005
10/24/2005
Date
Fecal Coliform
E. Coli
MPCA Fecal Coliform Standard

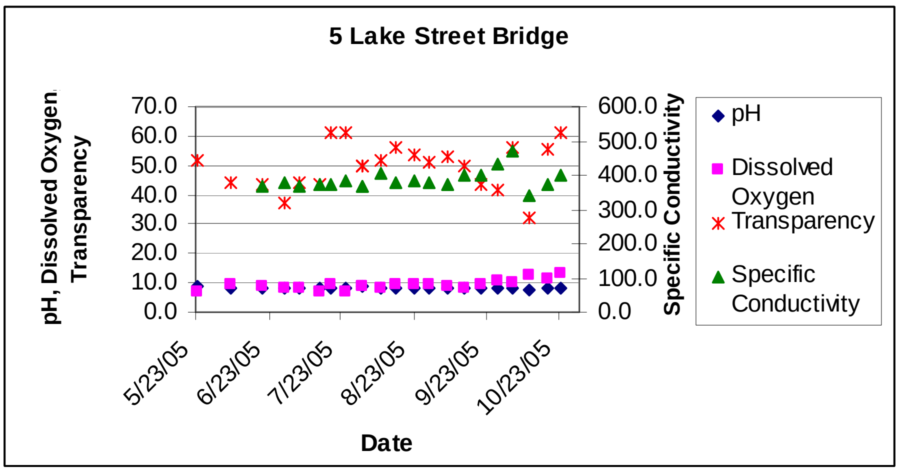
Mississippi River dissolved oxygen (mg/L), pH, transparency (cm) and specific conductivity (µS) monitoring results

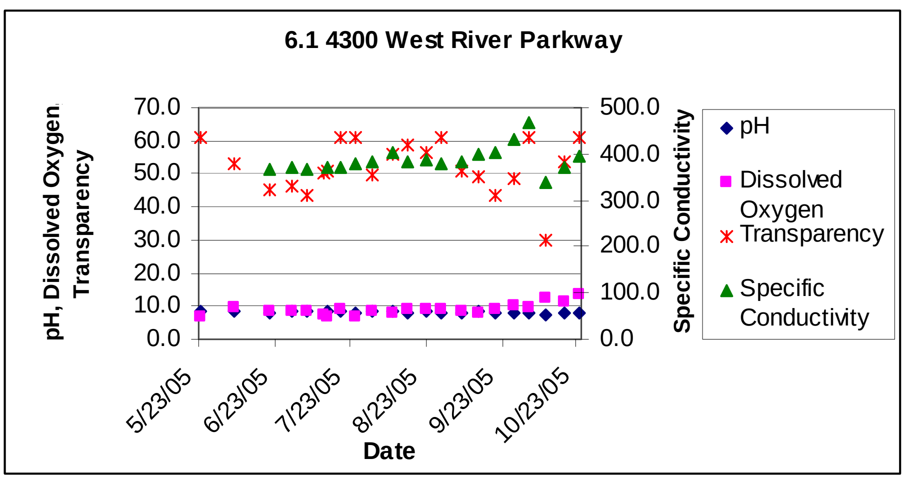







4 U of M Boat Launch
pH, Dissolved Oxygen, Transparency
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Specific Conductivity
pH
Dissolved Oxygen
Transparency
Specific Conductivity
5/23/2005
6/23/2005
7/23/2005
8/23/2005
9/23/2005
10/23/2005
Date


5 Lake Street Bridge
pH, Dissolved Oxygen Transparency
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Specific Conductivity
pH
Dissolved Oxygen
Transparency
Specific Conductivity
5/23/05
6/23/05
7/23/05
8/23/05
9/23/05
10/23/05
Date


6.1 4300 West River Parkway
pH, Dissolved Oxygen Transparency
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
500.0
400.0
300.0
200.0
100.0
0.0
Specific Conductivity
pH
Dissolved Oxygen
Transparency
Specific Conductivity
5/23/05
6/23/05
7/23/05
8/23/05
9/23/05
10/23/05
Date

APPENDIX F

Table 7. Stormwater sewersheds' major land uses

Stormwater Sewershed	Major Land Uses
1NE Excel Power Plant	Residential, Industrial
2NNBC Old Bassetts Creek	Residential, Commercial
4PP 35W Bridge	Residential, Heavy Industry
6UMN U of M Coal Storage Facility	Residential, Commercial
7LSTU Franklin Bridge	Residential, Industrial, Commercial

Table 8. Monitoring data for 1NE outfall

Date	Sample Time	Sample Type	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (uS)	Specific Conductivity (uS)	pH	Transparency (cm)	Salinity (ppt)	Width of water (ft)	Fecal Coliform (counts/100 mL)	E. coli (counts/100 mL)	Fluoride (mg/L)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Ortho Phosphorous (mg/L)
6/2/05	No sample																			
6/14/05	No sample																			
7/12/05	No sample																			
7/21/05	No sample																			
7/26/05	No sample																			
8/2/05	No sample																			
8/5/05	12:30		64.2								16000	1900	0.55							
8/8/05	12:35		69.6								5000	4800	0.16							
8/10/05	11:40		64.4	9.04	532.0	614.0	8.1	61.00		1.33										
		FILT																	0.09	0.09
8/11/05	15:05	LIQ	68.9	8.40	280.4	306.8	8.0	9.50		2.50				65	14	246	29	0.373		
		FILT																	0.149	0.112
8/18/05	No sample						8.0													
8/25/05	No sample																			
8/26/05	11:03		68.4							3.00	2001									
8/30/05	10:47	LIQ	60.3	9.37	949.0	1153.0	8.0	61.00	0.6	1.00				1	1	748	158	0.041		
		FILT																	0.046	0.034
9/7/05	13:40		65.1							1.33	16001	11000	0.05							
9/8/05	11:30	LIQ	64.9	8.55	400.3	458.8	7.9	22.00		1.50				16	5		38	0.164		
		FILT																	0.067	0.06
9/12/05	11:10	LIQ	68.9	8.19	314.9	344.7	7.4	2.40	0.2	3.00				932	92	275	18	1.12		
		FILT																	0.116	0.09
9/19/05	11:26		66.4								5000	2900	0.34							
9/22/05	11:00		65.3							2.50	16001	17000	0.05							
9/28/05	10:50	LIQ	60.1	9.58	113.3	138.2	7.7	10.40	0.1	4.00				65	17	96	9	0.367		
		FILT																	0.226	0.192
9/30/05	10:30	LIQ	61.0	9.60	887.0	1068.0	7.9	61.00	0.5	1.33				7	1	693	98	0.067		
		FILT																	0.058	0.0025
10/4/05	11:20		65.5							3.00	16001	8700	0.21							
10/13/05	No sample																			
10/17/05	No sample									1.00										
10/25/05	11:15		55.0							1.25	300	48	0.32							
10/26/05	9:55	LIQ	55.4	10.02	977.0	1267.0	7.7			1.33				0.5	0.5	841	164	0.035		
		FILT																	0.023	0.02
11/8/05	No sample									1.42										
11/15/05	No sample									2.00										
11/21/05	No sample									1.33										
11/28/05	12:20		47.1							3.00										
11/29/05	No sample		44.6							2.12										
12/6/05	No sample									1.00										
12/13/05	No sample									1.08										
12/20/05	No sample									1.00										
12/28/05	No sample									1.08										

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
Green font indicates value was greater than the maximum detetion limit. MDL+1 was the value used for analysis.
Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
Maroon font equals values was ~. Value used for analysis was the ~value.
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 8 continued. Monitoring data for 1NE outfall

Date	Sample Time	Sample Type	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Alkalinity (mg/L CaCO3)	Chloride ion (mg/L)	Hardness (mg/L CaCO3)	COD (mg/L)	Total Organic Carbon (mg/L)	CBOD 5-day (mg/L)	TBOD 5-day (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Oil and Grease (mg/L)
6/2/05	No sample																			
6/14/05	No sample																			
7/12/05	No sample																			
7/21/05	No sample																			
7/26/05	No sample																			
8/2/05	No sample																			
8/5/05	12:30																			
8/8/05	12:35																			
8/10/05	11:40																			
		FILT																		
8/11/05	15:05	LIQ	2	0.27	0.18	0.97	81	35	104	115	22	11	16	0.0223	0.0076	0.0124	0.0870	0.00002	0.0070	4
		FILT												0.0078	0.0033	0.0002	0.0216	0.00002	0.0025	
8/18/05	No sample																			
8/25/05	No sample																			
8/26/05	11:03																			
8/30/05	10:47	LIQ	0.74	0.25	0.04	1.13	330	99	210	17	3	1.1	0.5							0.5
		FILT																		
9/7/05	13:40																			
9/8/05	11:30	LIQ	1.1	0.2	0.13	1.18	114	46	160	55	10.9	5.3	7							0.5
		FILT																		
9/12/05	11:10	LIQ	3.5	0.41	0.12	1.32	69	47	104	227	22.7		27							8
		FILT																		
9/19/05	11:26																			
9/22/05	11:00																			
9/28/05	10:50	LIQ	1.2	0.07	0.08	0.33	38	11	50	69	10.4	13	12							2
		FILT																		
9/30/05	10:30	LIQ	0.66	0.07	0.015	3.26	300	97	218	11	4.7	<1.0	0.5							2
		FILT																		
10/4/05	11:20																			
10/13/05	No sample																			
10/17/05	No sample																			
10/25/05	11:15																			
10/26/05	9:55	LIQ	0.84	0.11	0.015	3.73	345	102	528	11	3.2	1.1	0.5	0.0030	0.0086	0.0001	0.0082	0.00002	0.0005	3
		FILT												0.0035	0.0090	0.0002	0.0077	0.00002	0.0005	
11/8/05	No sample																			
11/15/05	No sample																			
11/21/05	No sample																			
11/28/05	12:20							64												
11/29/05	No sample																			
12/6/05	No sample																			
12/13/05	No sample																			
12/20/05	No sample																			
12/28/05	No sample																			

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
Green font indicates value was greater than the maximum detetion limit. MDL+1 was the value used for analysis.
Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
Maroon font equals values was ~. Value used for analysis was the ~value.
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 9. Monitoring results for 2NNBC outfall

Date	Sample Time	Sample Type	Water Temp (C)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (uS)	Specific Conductivity (uS)	pH	Transparency (cm)	Salinity (ppt)	Stage (ft)	Fecal Coliform (counts/100 mL)	E. coli (counts/100 mL)	Fluoride (mg/L)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Ortho Phosphorous (mg/L)
5/23/05	No Sample										1.76										
6/2/05	10:15										3.26	130	62	0.59							
6/14/05	11:08		21.5	70.7							4.26	16000	4900	0.05							
6/20/05	10:25		23.1	73.6	6.75	495.2	513.8	8.0	59.20												
7/12/05	No Sample										2.78										
7/20/05	10:10	LIQ	22.8	73.0	6.77	301.5	314.7	7.9	13.30	0.2	3.18				45	16	232	21	0.36		
		FILT																		0.207	0.188
7/20/05	10:10	LIQ	22.8	73.0	6.77	301.5	314.7	7.9	13.30	0.2	3.18				39	9	226	21	0.37		
		FILT																		0.212	0.198
7/21/05	No Sample		24.4	75.9							3.21										
7/26/05	11:20		21.5	70.7							3.28	16001	3100	0.33							
8/2/05	11:12		26.0	78.8							3.47	800	440	1.03							
8/4/05	10:30		25.2	77.4	4.36	740.0	737.0	7.8	39.30	0.4	3.57										
8/5/05	11:07		25.2	77.4							3.51	3000	2300	0.63							
8/8/05	12:00		24.1	75.4							3.57	16001	8200	0.28							
8/8/05	12:00		24.1	75.4							3.57	16001	8100	0.3							
8/10/05	11:15										3.45										
8/11/05	14:30	LIQ	24.7	76.5	6.01	507.0	508.0	7.9	19.80	0.2	3.55				122	15	363	41	0.436		
		FILT																		0.225	0.133
8/17/05	No Sample																				
8/18/05	9:25	LIQ						7.7	61.00		1.80				14	4	553	70	0.203		
		FILT																		0.149	0.117
8/25/05	11:37		25.3	77.5							3.50	500	420	1.04							
8/26/05	10:25		21.3	70.3							3.15	6200									
8/30/05	No Sample										3.45										
9/7/05	10:40		21.4	70.5							3.15	16000	5500	1.26							
9/8/05	10:28	LIQ	23.0	73.4	5.11	798.0	829.0	7.6	55.50	0.4	3.19				12	3	496	66	0.206		
		FILT																		0.125	0.117
9/12/05	13:20	LIQ	24.4	75.9	6.64	701.0	709.0	7.7	32.20	0.3	1.41				22	6	395	70	0.42		
		FILT																		0.367	0.298
9/19/05	10:33		21.0	69.8							2.52	2400	23000	0.34							
9/22/05	No Sample										2.76										
9/28/05	10:15	LIQ	17.3	63.1	8.20	288.8	338.8	7.5	13.20	0.2	2.40				65	20	219	31	0.322		
		FILT																		0.159	0.128
9/30/05	No Sample		19.0	66.2	6.69	571.0	644.0	7.4		0.3											
10/4/05	10:50		20.2	68.4							2.15	16001	26000	0.23							
10/13/05	10:10	LIQ	15.0	59.0	8.50	415.6	513.0	7.0	17.30	0.2	4.05				33	10	347	40	0.295		
		FILT																		0.124	0.101
10/17/05	10:43		15.1	59.2							3.58	1300	310	0.31							
10/25/05	10:25		15.7	60.3							2.63	80	88	0.63							
10/26/05	No Sample		15.3	59.5	6.90	644.0	789.0	7.7	61.00	0.4	2.54										
11/8/05	No Sample										2.07										
11/15/05	No Sample		11.8	53.2							2.18										
11/21/05	No Sample		10.2	50.4							2.39										
11/28/05	11:45										2.14										
11/29/05	No Sample		7.0	44.6							2.40										
12/6/05	No Sample										3.10										
12/13/05	No Sample																				
12/20/05	No Sample										2.00										
12/28/05	No Sample		3.9	39.0							2.02										

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
Green font indicates value was greater than the maximum detetion limit. MDL+1 was the value used for analysis.
Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
Maroon font equals values was ~. Value used for analysis was the ~value.
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 9 continued. Monitoring results for 2NNBC outfall

Date	Sample Time	Sample Type	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Alkalinity (mg/L CaCO3)	Chloride ion (mg/L)	Hardness (mg/L CaCO3)	COD (mg/L)	Total Organic Carbon (mg/L)	CBOD 5-day (mg/L)	TBOD 5-day (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Oil and Grease (mg/L)
5/23/05	No Sample																			
6/2/05	10:15																			
6/14/05	11:08																			
6/20/05	10:25																			
7/12/05	No Sample																			
7/20/05	10:10	LIQ	1.9	0.44	0.08	0.71	86	35	98	72	20.1	15	19	0.0151	0.0043	0.0103	0.067	0.00007	0.004	3
		FILT												0.0093	0.0029	0.0009	0.027	0.00002	0.0028	
7/20/05	10:10	LIQ	1.8	0.45	0.07	0.7	81	36	98	77	20.1	17	19	0.0152	0.0044	0.0113	0.065	0.00007	0.0042	1
		FILT												0.0092	0.0029	0.001	0.027	0.00002	0.0024	
7/21/05	No Sample																			
7/26/05	11:20																			
8/2/05	11:12																			
8/4/05	10:30																			
8/5/05	11:07																			
8/8/05	12:00																			
8/8/05	12:00																			
8/10/05	11:15																			
8/11/05	14:30	LIQ	2.3	0.22	0.12	1.21	127	63	160	101	20.6	22	22	0.0201	0.005	0.016	0.078	0.0002	0.0048	4
		FILT												0.0112	0.0037	0.0015	0.027	0.00006	0.0031	
8/17/05	No Sample																			
8/18/05	9:25	LIQ	0.91	0.22	0.05	0.89	247	75	342	31	7.2	3.3	3.7	0.0115	0.0041	0.0037	0.028	0.00002	0.0012	0.5
		FILT												0.0036	0.0037	0.0008	0.0154	0.00002	0.0008	
8/25/05	11:37																			
8/26/05	10:25																			
8/30/05	No Sample																			
9/7/05	10:40																			
9/8/05	10:28	LIQ	1	0.2	0.07	1.01	211	81	312	23	5.3	1.4	2.3							0.5
		FILT																		
9/12/05	13:20	LIQ	1.5	0.29	0.15	2.13	153	84	246	50	12.3		10							4
		FILT																		
9/19/05	10:33																			
9/22/05	No Sample																			
9/28/05	10:15	LIQ	1.6	0.32	0.15	0.55	75	45	112	72	11.8	18	22							0.5
		FILT																		
9/30/05	No Sample																			
10/4/05	10:50																			
10/13/05	10:10	LIQ	1.4	0.07	0.11	1.11	173	54	214	66	14.3	14	18							0.5
		FILT																		
10/17/05	10:43																			
10/25/05	10:25																			
10/26/05	No Sample																			
11/8/05	No Sample																			
11/15/05	No Sample																			
11/21/05	No Sample																			
11/28/05	11:45								106												
11/29/05	No Sample																			
12/6/05	No Sample																			
12/13/05	No Sample																			
12/20/05	No Sample																			
12/28/05	No Sample																			

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
Green font indicates value was greater than the maximum detetion limit. MDL+1 was the value used for analysis.
Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
Maroon font equals values was ~. Value used for analysis was the ~value.
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 10. Monitoring results for 4PP outfall

Date	Sample Time	Sample Type	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (uS)	Specific Conductivity (uS)	pH	Transparency (cm)	Salinity (ppt)	Stage (ft)	Fecal Coliform (counts/100 mL)	E. coli (counts/100 mL)	Fluoride (mg/L)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Ortho Phosphorous (mg/L)
5/23/05	12:50		55.6	7.10			8.6			0.25	140	146								
5/23/05	13:00	LIQ	55.6	7.10			8.6			0.25			0.25	1	1	806	93	0.05		
		FILT																	0.034	
6/2/05	9:35									1.21	10	1	0.25							
6/14/05	No sample									3.09										
7/12/05	10:16		56.5							0.09	1400	23								
7/13/05	11:13	LIQ	55.4	9.48	1062.0	1377.8	8.2	61.00		0.25				1	1		100	0.046		
		FILT																	0.019	0.024
7/20/05	9:43	LIQ	67.5	7.60	377.3	419.8	8.0	27.80	0.2	0.46				41	16	307	27	0.548		
		FILT																	0.306	0.292
7/21/05	11:35		58.6							0.26	2200	230	0.4							
7/26/05	10:37		63.7							0.48	220	7	0.29							
7/27/05	10:30	LIQ	60.3	9.10	1000.0	1216.0	7.7	61.00	0.6	0.24				3	1	762	77	0.094		
		FILT																	0.05	0.041
8/2/05	10:30		58.1							0.25	300	68	0.28							
8/4/05	9:45	LIQ	62.4	7.87	841.0	996.0	7.9	61.00	0.5	0.26				13	3	587	72	0.148		
		FILT																	0.055	0.055
8/4/05	9:45	LIQ	62.4	7.87	841.0	996.0	7.9	61.00	0.5	0.26				6	3	580	72	0.147		
		FILT																	0.058	0.058
8/5/05	10:30		57.7							0.28	1300	3400	0.32							
8/8/05	11:17		67.8							0.42	16001	8600	0.27							
8/10/05	10:45	LIQ	60.4	9.03	965.0	1170.0	7.8	61.00	0.6	0.27				0.5	0.5	691	88	0.081		
		FILT																	0.047	0.039
8/11/05	13:55	LIQ	69.6	8.17	226.4	242.0	8.1	13.40	0.1	0.74				76	22	215	23	0.152		
		FILT																	0.149	0.114
8/17/05	11:05									0.37	16001	23000	Lab error							
8/18/05	8:50	LIQ					8.0	25.50		1.04				68	18	234	21	0.23		
		FILT																	0.124	0.096
8/25/05	10:45		56.7							0.25	300	45	0.2							
8/26/05	9:55		68.0							0.85	2001									
8/30/05	9:55	LIQ	57.0	9.39	1071.0	1359.0	8.1	61.00	0.7	0.23				1	0.5	808	95			
		FILT																		0.025
9/7/05	11:35		64.9							0.87	16001	8600	0.17							
9/8/05	9:48	LIQ	61.2	8.35	532.0	640.0	7.9	26.00	0.3	0.45				19	8	461	47	0.115		
		FILT																	0.041	0.037
9/12/05	12:10	LIQ		7.52	535.0	613.0	7.7	11.30	0.3	0.60				104	38	388	54	0.459		
		FILT																	0.188	0.129
9/19/05	10:00		64.8							0.49	16001	15000	0.24							
9/22/05	10:05		61.3							0.29	9000	3600	0.32							
9/28/05	9:45	LIQ	59.5	10.14	69.2	84.8	7.7	12.10	0	1.21				87	21	72	7	0.301		
		FILT																	0.125	0.101
9/30/05	9:33	LIQ	55.6	10.54	1054.0	1365.0	7.9	>60	0.7	0.23				1	0.5	844	96	0.052		
		FILT																	0.032	0.025
10/4/05	10:05		67.1							1.09	16001	19000	0.2							
10/13/05	10:35	LIQ		9.66	762.0	960.0	7.4		0.5	2.02				3	1	566	69	0.118		
		FILT																	0.099	0.078
10/17/05	No sample									1.01										
10/25/05	9:55		53.2							0.31	10	1	0.14							
10/26/05	11:05	LIQ	53.2	10.31	961.0	1285.0	8.0			0.24				1	1	772	66	0.071		
		FILT																	0.031	0.033
11/9/05	No sample									0.25										
11/15/05	No sample		51.8							0.27										
11/21/05	No sample		52.0							0.24										
11/28/05	11:20		45.3							0.91										
11/29/05	No sample		48.9							0.24										
12/6/05	No sample		47.1							0.26										
12/12/05	No sample		49.1							0.29										
12/19/05	No sample		46.8							0.27										
12/28/05	No sample		49.5							0.25										

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
Green font indicates value was greater than the maximum detetion limit. MDL+1 was the value used for analysis.
Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
Maroon font equals values was ~. Value used for analysis was the ~value.
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 10 continued. Monitoring results for 4PP outfall

Date	Sample Time	Sample Type	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Alkalinity (mg/L CaCO3)	Chloride ion (mg/L)	Hardness (mg/L CaCO3)	COD (mg/L)	Total Organic Carbon (mg/L)	CBOD 5-day (mg/L)	TBOD 5-day (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Oil and Grease (mg/L)
5/23/05	12:50																			
5/23/05	13:00	LIQ	0.36	0.03	0.015	1.55	295	221		17	1.7		0.5							0.5
		FILT																		
6/2/05	9:35																			
6/14/05	No sample																			
7/12/05	10:16																			
7/13/05	11:13	LIQ	0.37	0.02	0.04	1.37	287	215	474	11	1.7	1.3	1							
		FILT												0.0021	0.006	0.000035	0.0073	0.00002	0.0007	
7/20/05	9:43	LIQ	2.6	0.58	0.17	1.38	88	54	134	107	25	22	22	0.0229	0.0064	0.0103	0.075	0.00006	0.0042	3
		FILT												0.0151	0.0052	0.0013	0.037	0.00002	0.0032	
7/21/05	11:35																			
7/26/05	10:37																			
7/27/05	10:30	LIQ	0.64	0.11	0.06	1.3	243	201	414	12	2.3	0.5	0.5	0.0032	0.0044	0.001	0.03	0.00002	0.0001	0.5
		FILT												0.0025	0.0044	0.000035	0.022	0.00002	0.001	
8/2/05	10:30																			
8/4/05	9:45	LIQ	1.2	0.08	0.1	1.08	204	137	340	28	7.5	3.7	4.9	0.0131	0.0054	0.0029	0.065	0.00002	0.0007	0.5
		FILT												0.0072	0.0052	0.0005	0.023	0.00002	0.0009	
8/4/05	9:45	LIQ	1.1	0.09	0.1	0.99	203	140	336	25	7.4	3.4	4.7	0.0077	0.0054	0.0023	0.021	0.00002	0.001	0.5
		FILT												0.0049	0.005	0.0003	0.011	0.00002	0.0005	
8/5/05	10:30																			
8/8/05	11:17																			
8/10/05	10:45	LIQ	0.51	0.04	0.09	1.04	237	182	410	15	2.1	0.5	0.5							0.5
		FILT																		
8/11/05	13:55	LIQ	1.1	0.46	0.11	0.9	84	37	100	116	20.3	17	22	0.039	0.0053	0.0269	0.117	0.0001	0.0079	7
		FILT												0.0195	0.003	0.0011	0.032	0.00002	0.0044	
8/17/05	11:05																			
8/18/05	8:50	LIQ	1.8	0.44	0.11	1.03	73	44	104	115	20.6	17	22	0.037	0.0046	0.0157	0.092	0.00002	0.0074	5
		FILT												0.0228	0.0031	0.0012	0.019	0.00002	0.0048	
8/25/05	10:45																			
8/26/05	9:55																			
8/30/05	9:55	LIQ	0.46	0.05	0.015	1.1	284	216	482	15	1.4	0.5	0.5							0.5
		FILT																		
9/7/05	11:35																			
9/8/05	9:48	LIQ	1.6	0.21	0.16	1.13	141	95	226	59	10.1	8.8	8.8							0.5
		FILT																		
9/12/05	12:10	LIQ	4	0.63	0.16	1.62	97	72	176	202	36.3		44							8
		FILT																		
9/19/05	10:00																			
9/22/05	10:05																			
9/28/05	9:45	LIQ	1.3	0.22	0.06	0.35	30	12	40	61	7.2	10	14							0.5
		FILT																		
9/30/05	9:33	LIQ	0.54	0.04	0.015	1.31	285	212	452	2.5	1.5	0.5	0.5							3
		FILT																		
10/4/05	10:05																			
10/13/05	10:35	LIQ	1.5	0.07	0.08	1.19	204	132	330	27	6.9	5.7	6.6							0.5
		FILT																		
10/17/05	No sample																			
10/25/05	9:55																			
10/26/05	11:05	LIQ	0.38	0.08	0.07	1.37	262	194	450	20	2	0.5	0.5	0.0017	0.0052	0.0002	0.0098	0.00002	0.0005	0.5
		FILT												0.0028	0.0055	0.0003	0.0098	0.00002	0.0006	
11/9/05	No sample																			
11/15/05	No sample																			
11/21/05	No sample																			
11/28/05	11:20								79											
11/29/05	No sample																			
12/6/05	No sample																			
12/12/05	No sample																			
12/19/05	No sample																			
12/28/05	No sample																			

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
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Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
Maroon font equals values was ~. Value used for analysis was the ~value.
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 11. Monitoring results for 6UMN outfall

Date	Sample Time	Sample Type	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (uS)	Specific Conductivity (uS)	pH	Transparency (cm)	Salinity (ppt)	Stage (ft)	Fecal Coliform (counts/100 mL)	E. coli (counts/100 mL)	Fluoride (mg/L)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Ortho Phosphorous (mg/L)
5/23/05	11:25		64.9	5.00			8.7	61.00		4.27	10	13								
5/23/05	11:25	LIQ	64.9	5.00			8.7	61.00		4.27			0.3	8	3	629	67	0.04		
		FILT																	0.03	
6/2/05	No sample									5.79										
6/14/05	No sample									7.63										
7/12/05	9:47		69.8							4.35	1700	70								
7/13/05	10:15	LIQ	64.9	7.00	934.0	1071.1	8.2	61.00		4.61				7	3		77	0.05		
		FILT																	0.017	0.009
7/20/05	9:13	LIQ	72.1	9.10	400.0	421.7	8.3	12.40	0.20	3.67				41	8	323	32	0.208		
		FILT																	0.102	0.087
7/21/05	11:11		76.1							3.39	300	160	0.3							
7/26/05	10:08		70.9							3.17	500	480	0.16							
7/27/05	10:00	LIQ	57.0	10.21	1035.0	1313.5	7.9	61.00	0.70	3.26				2	1	816	98	0.023		
		FILT																	0.005	0.013
8/2/05	10:05		58.5							3.46	80	25	0.24							
8/4/05	9:10	LIQ	60.1	9.45		1174.0	8.2	61.00	0.60	3.11				2	1	744	89	0.05		
		FILT																	0.03	0.022
8/5/05	10:05		58.1							3.38	170	7	0.53							
8/8/05	10:55		68.9							3.06	800	480	0.22							
8/10/05	10:00	LIQ	58.3	10.00	1042.0	1299.0	7.8	61.00	0.70	2.87				1	1	853	100	0.044		
		FILT																	0.022	0.021
8/11/05	13:30	LIQ	72.3	8.53	363.0	380.0	8.2	9.40	0.02	3.41				150	26	256	29	0.358		
		FILT																	0.08	0.065
8/17/05	10:40									2.73	800	270	Lab error							
8/18/05	8:25	LIQ					7.8	30.40		2.59				20	10	442	41	0.237		
		FILT																	0.159	0.056
8/25/05	9:55		57.0							2.56	80	55	0.25							
8/26/05	9:25		68.0							4.05										
8/30/05	9:15	LIQ	57.4	9.77	1044.0	1317.0	8.2	61.00	0.70	2.79				1	1	773	94			
		FILT																		
9/7/05	11:50		67.3							3.29	9000	2500	0.11							
9/8/05	9:10	LIQ	59.7	9.33	746.0	912.0	7.9	26.50		2.98				13	6	602	88	0.072		
		FILT																	0.026	0.017
9/12/05	12:40	LIQ	64.8	8.54	613.0	704.0	7.8	9.40	0.30	2.88				74	16	504	50	0.35		
		FILT																	0.213	0.199
9/19/05	9:30		64.8							4.29	1700	800	0.37							
9/22/05	9:40		59.5							4.27	16000	13000	0.31							
9/28/05	8:50	LIQ	60.8	10.71	248.8	301.4	7.5	11.60	0.10	4.25				80	25	104	13	0.261		
		FILT																	0.114	0.089
9/30/05	8:48	LIQ	55.4	10.74	1039.0	1349.0	7.9	61.00	0.70	3.81				7	1	871	98			
		FILT																		0.014
10/4/05	9:25		66.0							4.37	3000	17000	0.43							
10/13/05	No sample																			
10/17/05	No sample									6.46										
10/25/05	No sample									4.75										
10/26/05	No sample									4.58										
11/9/05	No sample									3.45										
11/15/05	No sample		50.9							4.13										
11/21/05	No sample		48.7							4.49										
11/28/05	10:00		46.4							4.07										
11/29/05	No sample		49.5							4.54										
12/6/05	No sample		44.4							3.89										
12/12/05	No sample		50.0							4.43										
12/19/05	No sample		49.8							3.55										
12/28/05	No sample		50.7							3.89										

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
Green font indicates value was greater than the maximum detetion limit. MDL+1 was the value used for analysis.
Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
Maroon font equals values was ~. Value used for analysis was the ~value.
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 11 continued. Monitoring results for 6UMN outfall

Date	Sample Time	Sample Type	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Alkalinity (mg/L CaCO3)	Chloride ion (mg/L)	Hardness (mg/L CaCO3)	COD (mg/L)	Total Organic Carbon (mg/L)	CBOD-5day (mg/L)	TBOD 5-day (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Oil and Grease (mg/L)
5/23/05	11:25																			
5/23/05	11:25	LIQ	0.61	0.01	0.015	4.06	296	116		17	4		1.1							1
		FILT																		
6/2/05	No sample																			
6/14/05	No sample																			
7/12/05	9:47																			
7/13/05	10:15	LIQ	0.58	0.01	0.015	4.15	296	115	352	16	4.2	1.3	1.1	0.002	0.0067	0.0002	0.0056	0.00002	0.0035	
		FILT												0.0028	0.007	0.000035	0.0061	0.00002	0.0028	
7/20/05	9:13	LIQ	1.1	0.2	0.08	2.04	126	45	182	50	11	5.4	6.8	0.0123	0.0056	0.0057	0.044	0.00002	0.0046	1
		FILT												0.0069	0.0034	0.0001	0.0138	0.00002	0.0024	
7/21/05	11:11																			
7/26/05	10:08																			
7/27/05	10:00	LIQ	0.46	0.01	0.015	4.54	319	164	542	11	2	0.5	0.5	0.0023	0.0076	0.0001	0.005	0.00002	0.0046	1
		FILT												0.0022	0.0074	0.000035	0.0048	0.00002	0.0031	
8/2/05	10:05																			
8/4/05	9:10	LIQ	0.83	0.03	0.015	4.18	313	132	478	10	4.3	1.4	1.4	0.0032	0.0074	0.000035	0.0107	0.00002	0.0039	0.5
		FILT												0.0029	0.0076	0.000035	0.0062	0.00002	0.0024	
8/5/05	10:05																			
8/8/05	10:55																			
8/10/05	10:00	LIQ	0.74	0.01	0.015	4.58	318	163	546	15	2.6	2.5	2.6							0.5
		FILT																		
8/11/05	13:30	LIQ	1.8	0.1	0.04	0.81	134	35	164	91	13	10	14	0.017	0.0089	0.0175	0.1	0.0001	0.008	2
		FILT												0.0051	0.0049	0.0002	0.0166	0.00002	0.0017	
8/17/05	10:40																			
8/18/05	8:25	LIQ	1.1	0.15	0.04	1.91	173	72	248	56	12.8	8.7	11	0.0091	0.0077	0.0033	0.039	0.00002	0.0044	0.5
		FILT												0.0061	0.0069	0.0002	0.0177	<.00004	0.0019	
8/25/05	9:55																			
8/26/05	9:25																			
8/30/05	9:15	LIQ	0.41	0.01	0.015	4.61	343	160	396	14	1.8	1	0.5							0.5
		FILT																		
9/7/05	11:50																			
9/8/05	9:10	LIQ	1.3	0.04	0.09	3.16	228	104	242	41	8.4	5	6.4							0.5
		FILT																		
9/12/05	12:40	LIQ	1.5	0.21	0.06	3.12	171	82	260	80	14.2		14							6
		FILT																		
9/19/05	9:30																			
9/22/05	9:40																			
9/28/05	8:50	LIQ	1.3	0.15	0.06	0.57	49	18	66	101	7.4	11	10							3
		FILT																		
9/30/05	8:48	LIQ	0.45	0.01	0.015	5.69	320	163	530	2.5	1.8	0.5	0.5							0.5
		FILT																		
10/4/05	9:25																			
10/13/05	No sample																			
10/17/05	No sample																			
10/25/05	No sample																			
10/26/05	No sample																			
11/9/05	No sample																			
11/15/05	No sample																			
11/21/05	No sample																			
11/28/05	10:00								100												
11/29/05	No sample																			
12/6/05	No sample																			
12/12/05	No sample																			
12/19/05	No sample																			
12/28/05	No sample																			

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
Green font indicates value was greater than the maximum detetion limit. MDL+1 was the value used for analysis.
Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
Maroon font equals values was ~. Value used for analysis was the ~value.
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 12. Monitoring results for 7LSTU outfall

Date	Sample Time	Sample Type	Water Temp (C)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (uS)	Specific Conductivity (uS)	pH	Transparency (cm)	Salinity (ppt)	Stage (ft)	Fecal Coliform (counts/100 mL)	E. coli (counts/100 mL)	Fluoride (mg/L)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Ortho Phosphorous (mg/L)
5/23/05	10:00										1.88										
6/2/05	No sample										2.54										
6/14/05	No sample										4.23										
7/12/05	No sample										1.67										
7/20/05	8:26	LIQ	21.3	70.3	9.29	606.0	652.1	8.3	12.60	0.3	1.09				62	20	407	33	0.438		
		FILT																		0.154	0.117
7/21/05	No sample		20.4	68.7							0.85										
7/26/05	9:19		20.8	69.4							0.29	5000	3300	0.05							
8/2/05	No sample		19.5	67.1							0.85										
8/4/05	8:30		19.6	67.3	8.00		541.0				0.67										
8/5/05	No sample		18.9	66.0							0.81										
8/8/05	10:05		22.4	72.3							0.50	16001	11000	0.27							
8/10/05	9:35										0.28										
8/11/05	12:55	LIQ	22.4	72.3	8.08	132.6	138.0	8.1	12.00	0.1	0.77				87	37	208	11	0.612		
		FILT																		0.191	0.126
8/17/05	No sample																				
8/18/05	7:45	LIQ						7.7	25.00		-1.06				19	9	163	16	0.176		
		FILT																		0.127	0.102
8/25/05	No sample		17.8	64.0							0.01										
8/26/05	8:32		20.3	68.5							2.09										
8/30/05	No sample										0.24										
9/7/05	No sample																				
9/8/05	No sample										0.42										
9/12/05	No sample										0.20										
9/19/05	8:50		19.5	67.1							1.76	16001	14000	0.32							
9/22/05	8:50		19.8	67.6							1.54	16001	5300	0.25							
9/28/05	8:10	LIQ	16.4	61.5	9.81	158.4	189.6	7.3	11.20	0.1	1.30				71	41	75	10	0.253		
		FILT																		0.11	0.078
9/30/05	No sample										1.20										
10/4/05	8:55		19.9	67.8							1.80	16001	5800	0.23							
10/13/05	No sample										3.30										
10/17/05	No sample										2.45										
10/25/05	No sample										2.02										
10/26/05	No sample										1.78										
11/8/05	No sample																				
11/9/05	No sample										0.86										
11/15/05	No sample		9.8	49.6							1.38										
11/21/05	No sample		4.2	39.6							1.75										
11/28/05	9:10		7.4	45.3							1.30										
11/29/05	No sample		2.9	37.2							1.84										
12/6/05	No sample										1.88										
12/12/05	No sample										1.86										
12/19/05	No sample										1.86										
12/28/05	No sample		1.3	34.3							1.25										

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
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LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 12 continued. Monitoring results for 7LSTU outfall

Date	Sample Time	Sample Type	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Alkalinity (mg/L CaCO3)	Chloride ion (mg/L)	Hardness (mg/L CaCO3)	COD (mg/L)	Total Organic Carbon (mg/L)	CBOD-5day (mg/L)	TBOD 5-day (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)
5/23/05	10:00																		
6/2/05	No sample																		
6/14/05	No sample																		
7/12/05	No sample																		
7/20/05	8:26	LIQ	2	0.31	0.04	0.39	116	106	166	80	15.5	14	19	0.0141	0.0045	0.014	0.07	0.00005	0.0041
		FILT												0.0051	0.003	0.0003	0.0154	0.00002	0.0019
7/21/05	No sample																		
7/26/05	9:19																		
8/2/05	No sample																		
8/4/05	8:30																		
8/5/05	No sample																		
8/8/05	10:05																		
8/10/05	9:35																		
8/11/05	12:55	LIQ	2.4	0.35	0.09	0.82	95	25	100	112	18.2	18	22	0.0199	0.0054	0.021	0.113	0.0002	0.0066
		FILT												0.0083	0.0029	0.0003	0.026	0.00002	0.0032
8/17/05	No sample																		
8/18/05	7:45	LIQ	1.3	0.38	0.09	0.91	60	19	78	74	18.5	9.2	11	0.0105	0.003	0.0049	0.052	0.00002	0.0037
		FILT												0.008	0.0026	0.0005	0.0196	0.00002	0.0028
8/25/05	No sample																		
8/26/05	8:32																		
8/30/05	No sample																		
9/7/05	No sample																		
9/8/05	No sample																		
9/12/05	No sample																		
9/19/05	8:50																		
9/22/05	8:50																		
9/28/05	8:10	LIQ	1.5	0.28	0.06	0.48	32	10	46	99	11.3	20	23						
		FILT																	
9/30/05	No sample																		
10/4/05	8:55																		
10/13/05	No sample																		
10/17/05	No sample																		
10/25/05	No sample																		
10/26/05	No sample																		
11/8/05	No sample																		
11/9/05	No sample																		
11/15/05	No sample																		
11/21/05	No sample																		
11/28/05	9:10							136											
11/29/05	No sample																		
12/6/05	No sample																		
12/12/05	No sample																		
12/19/05	No sample																		
12/28/05	No sample																		

< 5 samples for the geometric mean
All duplicates are omitted from analysis.
Conductivity measured before 6/20 was omitted because the conductivity meter was not properly calibrated.
Specific conductivity calculated for 6/20 through 7/27 using Specific Conductance (25 C) = Conductivity/(1+TC * (T-25)) with TC = 0.0191 (approximate value to use when many commom salts, including NaCl present or for seawater.
Red font indicates suspect data.
Green font indicates value was greater than the maximum detetion limit. MDL+1 was the value used for analysis.
Blue font indicates the value was below the minimum detection limit, and 1/2 the MDL was used as the value for analysis.
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LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

APPENDIX G

Table 13. BMP monitoring results

Sample Date and Time	Sample Type	Fluoride (mg/L)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Ortho Phosphorous (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Alkalinity (mg/L CaCO3)	Chloride ion (mg/L)	Hardness (mg/L CaCO3)
9/7/05 9:00	LIQ	0.18	182	30	84	12	0.235			1.7	0.51	0.09	0.84	27	5	26
9/7/05 9:00	FILT							0.048	0.034							
10/12/05 15:53	LIQ		70	32	87	26	0.136			3.4	1.94	0.06	3.33		3	40
10/12/05 15:53	FILT															
10/17/05 13:00	LIQ		142	46	113	20	0.252			3.3	1.52	0.07	1.43		7	40
10/17/05 13:00	FILT															

Blue font indicates the value was below the minimum detection limit and 1/2 the MDL was used as the value for analysis
Maroon font equals values was ~. Value used for analysis was the ~value
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate

Table 13 continued. BMP monitoring results

Sample Date and Time	Sample Type	COD (mg/L)	Total Organic Carbon (mg/L)	CBOD 5-day (mg/L)	TBOD 5-day (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Mercury (ug/L)	Oil and Grease (mg/L)
9/7/05 9:00	LIQ	114	13.1	6.7	10	0.033	0.0081	0.0171	0.153	0.00007	0.0083		4
9/7/05 9:00	FILT					0.0072	0.0012	0.0001	0.009	0.00002	0.0018		
10/12/05 15:53	LIQ	99			13	0.0164	0.005	0.0085	0.134	0.00009	0.0039	0.012	
10/12/05 15:53	FILT					0.0074	0.0024	0.0002	0.053	0.00004	0.0017		
10/17/05 13:00	LIQ	142			21	0.027	0.0079	0.0159	0.171	0.00005	0.0077	0.012	
10/17/05 13:00	FILT					0.0089	0.002	0.0002	0.033	0.00002	0.0017		

Blue font indicates the value was below the minimum detection limit and 1/2 the MDL was used as the value for analysis
Maroon font equals values was ~. Value used for analysis was the ~value
LIQ = Analysis performed on sample as received
FILT = Sample filtered through 0.45 membrane filter; analysis performed on fitrate