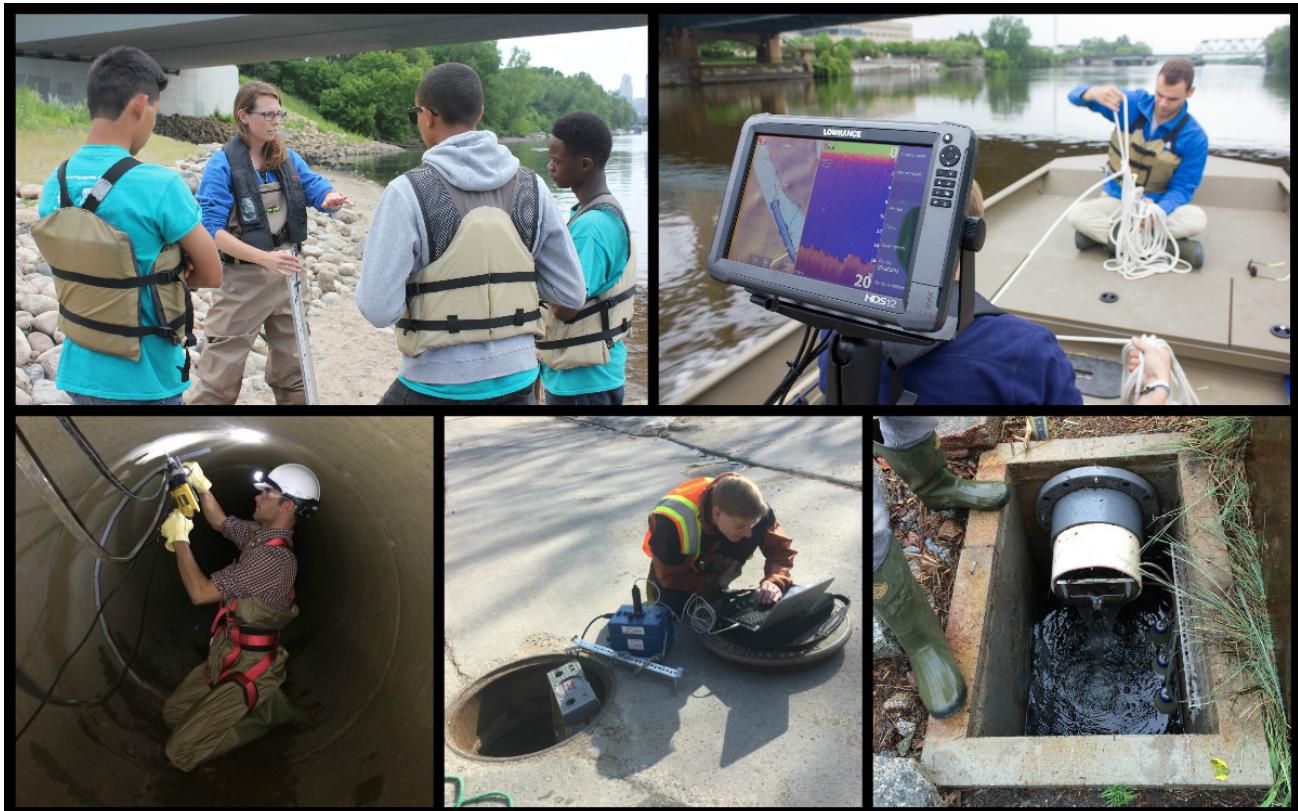




MISSISSIPPI  
WATERSHED  
MANAGEMENT  
ORGANIZATION

# Annual Monitoring Report 2015



**MWMO Watershed Bulletin: 2016-1**

## **Annual Monitoring Report 2015**

**Prepared by:** Jen Keville, Water Resources Specialist; Brian Jastram, Environmental Specialist; Brittany Faust, Environmental Specialist; Udai Singh, Water Resource Manager; Melissa Burton, Water Quality Monitoring Intern; and Anna Johnson, Water Quality Monitoring Intern

Completion Date: March 2016

### **Acknowledgements**

The Mississippi Watershed Management Organization (MWMO) thanks the following groups for their cooperation and assistance with MWMO monitoring activities: City of Minneapolis Department of Public Works, Regulatory Services and Environmental Services; City of Fridley Department of Public Works; City of Saint Anthony Village Public Works Department; City of Columbia Heights Public Works Department; Minnesota Department of Transportation; Anoka Conservation District; Minneapolis Park and Recreation Board; and Saint Anthony Falls Laboratory at the University of Minnesota.



### **Suggested citation:**

Mississippi Watershed Management Organization. 2016. *Annual Monitoring Report 2015*. MWMO Watershed Bulletin 2016-1. 116 pp.

**Front Cover: Monitoring demonstration at MWMO (top left), Bathymetric mapping (top right), Equipment maintenance at stormwater tunnel site (bottom left), Equipment installation at stormwater flow monitoring site (bottom middle), Tree trench BMP monitoring at Edison High School (Vchica 'fj[ \hbar).**

*Photographs by N. Busse, B. Faust and B. Jastram, MWMO*



---

**MISSISSIPPI  
WATERSHED  
MANAGEMENT  
ORGANIZATION**

2522 Marshall Street NE  
Minneapolis, Minnesota 55418

(612) 465 8780  
(612) 465 8785 fax

[www.mwmo.org](http://www.mwmo.org)



MISSISSIPPI  
WATERSHED  
MANAGEMENT  
ORGANIZATION

# Annual Monitoring Report 2015

## **Abstract**

In 2015, the Mississippi Watershed Management Organization (MWMO) continued monitoring precipitation, water quantity and water quality of stormwater drainage systems, and water quality of three wetlands (a.k.a. Kasota Ponds). The MWMO contracted the Anoka Conservation District to carry out water level monitoring activities on Sullivan Lake in Columbia Heights.

The MWMO continued monitoring the Mississippi River at five locations (cross-sections) in three different reaches to develop methods to fill hydraulic mixing data gaps in the 14-mile stretch of the Mississippi River in the MWMO. Staff also continued collecting water quality samples from the Mississippi River. Samples were collected from three different reaches and near the upstream and downstream boundaries of the MWMO watershed. In 2015, bathymetry data were also collected between the Upper St. Anthony Falls Lock and Dam and the Canadian Pacific Railway (CPR) Bridge in line with N 41<sup>st</sup> Avenue.



Protect it. Pass it on.

**MISSISSIPPI  
WATERSHED  
MANAGEMENT  
ORGANIZATION**

---

2522 Marshall Street NE  
Minneapolis, Minnesota 55418

(612) 465 8780  
(612) 465 8785 fax

[www.mwmo.org](http://www.mwmo.org)

## Table of Contents

<b>Acronyms and Abbreviations .....</b>	<b>vi</b>
<b>Glossary .....</b>	<b>viii</b>
<b>Executive Summary.....</b>	<b>1</b>
<b>Introduction .....</b>	<b>3</b>
<b>Background .....</b>	<b>4</b>
<b>Precipitation Monitoring.....</b>	<b>7</b>
<b>Stormwater Monitoring.....</b>	<b>11</b>
Methodology .....	13
<i>Water Level and Discharge Monitoring</i> .....	13
<i>Sample Collection, Handling, and Preservation</i> .....	14
<i>Sampling Quality Control</i> .....	15
<i>Laboratory Analyses</i> .....	15
<i>Parameter Information</i> .....	15
<i>Data Analysis</i> .....	15
<i>Remote Data Access Network</i> .....	15
Stormwater Water Quality Monitoring Results .....	16
Stormwater Site Descriptions and Water Quantity Results.....	18
11CHF .....	18
1NE ( <i>Excel Riverside Plant</i> ) .....	21
2NNBC ( <i>Old Bassett's Creek Tunnel Outlet</i> ).....	24
10SA ( <i>Saint Anthony Village</i> ) .....	26
4PP ( <i>I-35W Bridge</i> ).....	30
6UMN ( <i>University of Minnesota Coal Storage Facility</i> ).....	33
7LSTU ( <i>Bridal Veil Tunnel</i> ).....	36
<b>Lake Monitoring .....</b>	<b>38</b>
Sullivan Lake Water Elevation Monitoring.....	38
<b>Wetland Monitoring (Kasota Ponds).....</b>	<b>41</b>
Site Descriptions.....	41
Methodology .....	44
<i>Sample Collection, Handling, and Preservation</i> .....	44
<i>Sampling Quality Control</i> .....	44
<i>Laboratory Analyses</i> .....	44
Water Quality Monitoring Results .....	44
<b>Bacteria Monitoring.....</b>	<b>45</b>
Mississippi River Bacteria Monitoring .....	45
Site Descriptions.....	45

Methodology.....	49
<i>Sample Collection, Handling, and Preservation.....</i>	49
<i>Sampling Quality Control.....</i>	49
<i>Laboratory Analyses.....</i>	49
Water Elevation Monitoring .....	50
Mississippi River Bacteria Monitoring Results .....	51
<i>E. coli.....</i>	51
<i>Water Temperature, Dissolved Oxygen, pH, Transparency, Salinity, and Specific Conductivity.....</i>	53
Stormwater Bacteria Monitoring Results .....	53
<b>Mississippi River Monitoring For Hydraulic Mixing.....</b>	<b>54</b>
Site Selection.....	54
<i>Site (Cross-Section) Descriptions .....</i>	56
Methodology.....	56
<i>Data Collection.....</i>	56
<b>Mississippi River Water Quality Monitoring .....</b>	<b>57</b>
Site Descriptions .....	57
Methodology.....	57
<i>Sample Collection, Handling, and Preservation.....</i>	57
<i>Sampling Quality Control.....</i>	57
<i>Laboratory Analyses.....</i>	58
Mississippi River Water Quality Monitoring Results .....	58
<b>Mississippi River Bathymetry Mapping.....</b>	<b>58</b>
Methodology and Results .....	58
<b>Work Plan.....</b>	<b>60</b>
2014 Work Plan.....	60
2015 Work Plan.....	61
<b>References.....</b>	<b>63</b>
<b>Appendix A – Watershed Map .....</b>	<b>64</b>
<b>Appendix B – Laboratory Methods and Certification .....</b>	<b>65</b>
<b>Appendix C –Bacteria Monitoring Data .....</b>	<b>67</b>
<b>Appendix D – Stormwater Monitoring Data.....</b>	<b>82</b>
<b>Appendix E – Kasota Ponds Monitoring Data.....</b>	<b>104</b>
<b>Appendix F - Mississippi River Water Quality Data.....</b>	<b>105</b>

## List of Tables

Table 1. Water use classifications for waterbodies in the MWMO .....	5
Table 2. Pollutants in impaired waters .....	6
Table 3. 2015 monthly precipitation (inches) at several locations in the Upper Mississippi River basin .....	9
Table 4. 2015 monthly precipitation (inches) at several locations in the MWMO precipitation monitoring network .....	10
Table 5. Average, minimum, and maximum water elevations of Sullivan Lake from 2008 to 2015 .....	40
Table 6. Sites that exceeded 1,260 MPN/100mL in >10%.....	52
Table B.1. Laboratory methods and certification for each analyte.....	65
Table C.1. Physical parameters and bacteria monitoring data for Mississippi River sites .....	67
Table C.2. Physical parameters and bacteria monitoring data for stormwater sites .....	71
Table D.1. Monitoring data for 11CHF outfall.....	82
Table D.2. Monitoring data for 1NE outfall.....	86
Table D.3. Monitoring data for 2NNBC outfall .....	90
Table D.4. Monitoring data for 7LSTU outfall .....	90
Table D.5. Monitoring data for 4PP outfall.....	92
Table D.6. Monitoring data for 6UMN outfall .....	96
Table D.7. Monitoring data for 10SA stormwater drainage system.....	100
Table E.1. Monitoring data for Kasota Pond North.....	104
Table E.2. Monitoring data for Kasota Pond West.....	104
Table E.3. Monitoring data for Kasota Pond East .....	104
Table F.1. Monitoring data for river site MR848.1W (Ford) .....	105
Table F.2. Monitoring data for river site MR849.9W (Meeker) .....	105
Table F.3. Monitoring data for river site MR852.2E (Wash) .....	107
Table F.4. Monitoring data for river site MR854.9E (Boom) .....	109
Table F.5. Monitoring data for river site MWMO .....	109
Table F.6. Monitoring data for river site 857.6W (Shingle Down) .....	111
Table F.7. Monitoring data for river site 857.6W (Shingle Up) .....	113
Table F.8. Monitoring data for river site 859.1W (Upper) .....	115
5bbi U'A cb]hcfjb[ F Ydcfh&\$% .....	111

## List of Figures

Figure 1. Precipitation gauges in the Upper Mississippi River Basin.....	8
Figure 2. Monthly precipitation totals at the 1NE heated rain gauge compared to 30-year monthly precipitation normal at the Minneapolis St. Paul International Airport .....	10
Figure 3. Stormwater pipesheds monitored by the MWMO and corresponding monitoring site locations.....	12
Figure 4. Example of a typical MWMO stormwater monitoring site cabinet set up including automated sampling and real-time monitoring equipment.....	13
Figure 5. Typical area/velocity sensor (black rectangle) and cable configuration in a monitored stormwater pipe	14
Figure 6. Remote access real-time data monitoring network .....	17
Figure 7. Site 11CHF outfall to the river .....	18
Figure 8. 11CHF pipeshed boundary and monitoring site location.....	19
Figure 9. Discharge, level, and precipitation data for the 11CHF monitoring site in 2014 .....	20
Figure 10. Outfall to the river for the 1NE pipeshed. Monitoring cabinet can be seen in the upper right corner (green box).....	21
Figure 11. 1NE pipeshed boundary and monitoring site location .....	22
Figure 12. Discharge, level, and precipitation at the 1NE monitoring site in 2014 .....	23
Figure 13. The 2NNBC outfall to the original Basset's Creek channel before it enters the Mississippi River .....	24
Figure 14. 2NNBC pipeshed boundary and monitoring site location .....	25
Figure 15. Monitoring equipment and access manhole at the 10SA stormwater site .....	26
Figure 16. 10SA pipeshed boundary and monitoring site location .....	27
Figure 17. Discharge, level, and precipitation for the 10SA monitoring site.....	28
Figure 18. Specific conductivity data for the 10SA monitoring site. The black line shows continuous data collected from a sensor installed in the tunnel. Points represent values obtained using a YSI ProPlus multimeter .....	29
Figure 19. 4PP outfall to the river .....	30
Figure 20. 4PP pipeshed boundary and monitoring site location.....	31
Figure 21. Discharge and level data for the 4PP stormwater monitoring site in 2014 .....	32
Figure 22. 6UMN outfall to the river.....	33
Figure 23. 6UMN pipeshed boundary and monitoring site location .....	34
Figure 24. Discharge and level data for the 6UMN monitoring site in 2014 .....	35
Figure 25. 7LSTU outfall to the river.....	36
Figure 26. 7LSTU pipeshed boundary and monitoring site location.....	37
Figure 27. Lakes within the MWMO watershed .....	39
Figure 28. Water elevation at Sullivan Lake in 2014.....	40
Figure 29. Kasota Pond North.....	41
Figure 30. Kasota Pond East.....	42
Figure 31. Kasota Pond West.....	42
Figure 32. MWMO Kasota Ponds monitoring locations.....	43
Figure 33. MWMO bacteria sampling site MR859.1W (Camden) with staff gauge .....	45
Figure 34. MWMO bacteria sampling site MR 857.6W (MPRB Boat Launch) .....	46
Figure 35. MWMO bacteria sampling site MR 854.9W (North Loop) with staff gauge .....	46

Figure 36. MWMO bacteria sampling site MR853.5 (Saint Anthony Falls Laboratory) .....	47
Figure 37. MWMO bacteria sampling site MR852.2E (University of Minnesota Boat Launch) .....	47
Figure 38. MWMO bacteria sampling site MR849.9W (Lake Street Bridge) .....	48
Figure 39. MWMO bacteria sampling site MR848.1W (4300 West River Parkway) with staff gauge .....	48
Figure 40. Mississippi River water elevations at four monitoring sites upstream of Saint Anthony Falls, including one near the MWMO office building at RM856.6 .....	50
Figure 41. Mississippi River water elevations at three monitoring sites downstream of Saint Anthony Falls. ....	51
Figure 42. Diagram of a cross-section for river hydraulic mixing sampling. Each star represents a data collection point .....	54
Figure 43. River hydraulic mixing transect sites and river water quality sampling locations. Hydraulic mixing transects are shown with the black lines. Water quality sites are shown with blue circles.....	55
Figure 44. Section of Mississippi River in the MWMO that was mapped as part of the bathymetry project. Inset image shows a section of resulting bathymetric data..	59
Figure A.1. MWMO watershed boundary .....	64
Figure C.1. <i>E. coli</i> data for MR859.1W .....	74
Figure C.2. <i>E. coli</i> data for MR857.6W .....	74
Figure C.3. <i>E. coli</i> data for MR854.9W .....	75
Figure C.4. <i>E. coli</i> data for MR853.5E .....	75
Figure C.5. <i>E. coli</i> data for MR852.2E .....	76
Figure C.6. <i>E. coli</i> data for MR849.9W .....	76
Figure C.7. <i>E. coli</i> data for MR848.1W .....	77
Figure C.8. Dissolved oxygen, pH, transparency, and specific conductivity for MR859.1W.....	77
Figure C.9. Dissolved oxygen, pH, transparency, and specific conductivity for MR857.6W.....	78
Figure C.10. Dissolved oxygen, pH, transparency, and specific conductivity for MR854.9W .....	78
Figure C.11. Dissolved oxygen, pH, transparency, and specific conductivity for MR853.5E .....	79
Figure C.12. Dissolved oxygen, pH, transparency, and specific conductivity for MR852.2E .....	79
Figure C.13. Dissolved oxygen, pH, transparency, and specific conductivity for MR849.9W .....	80
Figure C.14. Dissolved oxygen, pH, transparency, and specific conductivity for MR848.1W .....	80

## Acronyms and Abbreviations

1NE	stormwater outfall near the Excel Riverside Plant in northeastern Minneapolis at RM 857.2E
2NNBC	Old Bassett's Creek Tunnel outlet at RM 854.8W
4PP	stormwater outfall near the I-35W Bridge at RM 853.2W
6UMN	stormwater outfall near the University of Minnesota Coal Storage Facility at RM 853.0E
7LSTU	Bridal Veil Tunnel outlet at RM 851.6E
10SA	Saint Anthony Village stormwater drainage system sampling location, the outlet to the river is several miles away at RM 853.2E
11CHF	stormwater outfall near the Minneapolis Public Works Fridley Water Treatment Plant's property in the Anoka County Riverfront Regional Park at RM 859E
µS	micro Siemens
a.k.a.	also known as
ACD	Anoka Conservation District
BMP	best management practice
C	celsius
cf	cubic foot
cfs	cubic feet per second
CFU	colony forming unit
cm	centimeter
D.O.	dissolved oxygen
DI	deionized
<i>E. coli</i>	<i>Escherichia coli</i>
EPA	Environmental Protection Agency
EQuIS	MPCA's water quality database
F	fahrenheit
ft	foot
GIS	geographic information system
GPS	global positioning system
in	inch
in/hr	inches per hour
KP	Kasota Ponds
L	liter
m	meter
MCES	Metropolitan Council Environmental Services
mg	milligram
mL	milliliter
MPCA	Minnesota Pollution Control Agency
MPN	most probable number
MPRB	Minneapolis Park and Recreation Board
MR	Mississippi River

MS4	municipal separate storm sewer system
MWMO	Mississippi Watershed Management Organization
n/a	not applicable
NAVD88	North American Vertical Datum, 1988
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PCBs	polychlorinated biphenyls
ppt	parts per trillion
PVC	polyvinyl chloride
RM	river mile upstream from the confluence of the Mississippi and Ohio Rivers in Cairo, IL
SAFL	Saint Anthony Falls Laboratory at the University of Minnesota
TCMA	Twin Cities Metropolitan Area
TMDL	total maximum daily load
USACE	United States Army Corps of Engineers

## Glossary

**Automatic sampler:** equipment that is programmed to collect water samples based on the parameters in the program. It allows for the collection of samples without staff being present during a precipitation or snow melt event

**Baseflow:** sustained flow in the stormwater drainage system that is the result of groundwater seepage or permitted discharge into the system

**Best Management Practice:** technique, measure, or structural control that is used to manage the quantity and improve the quality of stormwater runoff

**Composite sample:** a water sample that contains water collected during a precipitation or snow melt event at specific intervals throughout the event

**Confined space:** a space defined by the existence of all of the following conditions:

- Is large enough and so configured that an employee can bodily enter and perform assigned work
- Has limited or restricted means for entry or exit (for example, manholes)
- Is not designed for continuous employee occupancy

**Discharge:** rate of flow in a pipe or stream, expressed as a volume per unit time, most commonly cubic feet per second (cfs)

**Field data:** data collected at a monitoring site

**Flow-paced:** water samples collected with the automatic sampler after a specific volume of water has passed by the area velocity sensor

**Grab sample:** a single water sample submitted for analysis

**Illicit discharge:** any discharge to the stormwater drainage system that is not composed entirely of stormwater, except for discharges allowed under a NPDES permit or water used for firefighting operations

**Lab data:** data that are a result of laboratory processing of a sample (i.e. nutrients, solids, and metals)

**Outfall:** the end of a stormwater pipe, where the stormwater enters the receiving waterbody

**Pipeshed:** an area of land where water from precipitation or snow melt drains into a waterbody through a man-made conveyance system of stormwater pipes (as opposed to natural systems such as streams). A pipeshed is not as elevation- and landscape-driven as a watershed

**Rain event:** greater than 0.01 inches of rain, eight or more hours after the last precipitation. In rare cases, insignificant (<0.02 in) precipitation that occurred less than eight hours after the last precipitation, but after many dry hours, were eliminated from the dataset

**Real-time data:** data that are relayed from a monitoring site to a server and the internet where they can be viewed by MWMO staff as they are measured.

**Secchi tube:** a modified transparency tube that is designed to function like the traditional Secchi disk used in lake monitoring

**Specific Conductivity:** a measure of how well water can conduct electrical current for a unit length and unit cross-section at a certain temperature. Conductivity increases with amount of ions in water. These ions come from the breakdown of compounds and conduct electricity because they are positively or negatively charged when dissolved in water. Therefore, specific conductivity is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, etc, and can be used as an indicator of water pollution.

**Stormflow:** water flowing in stormwater pipes during storm (precipitation) and snow melt events. Stormflow in pipes is typically short in duration and has a high velocity

**Stormwater:** water that is not infiltrated during and immediately following a rain or snow melt event

**Stormwater drainage system:** a series of roadways, curbs, catch basins, pipes, and tunnels that carry stormwater or snow melt from the surface to a receiving waterbody

**Stormwater tunnel:** a large diameter walkable pipe designed to carry rain and melt event water to the nearest receiving waterbody. Note: sanitary and stormwater pipes are typically separated in Minnesota

**Tailwater:** a condition where the Mississippi River water level is high enough to enter outfalls and interfere with data collection

**Total Maximum Daily Load:** a calculation of the maximum amount of a pollutant that a waterbody can receive daily and still safely meet water quality standards

**Watershed:** an area of land where surface water (from rain or snow melt) runoff and groundwater drain into a waterbody. Watershed boundaries are defined by elevation

(This page intentionally left blank)

# Annual Monitoring Report 2015

## Executive Summary

The annual monitoring report details the monitoring activities and results of the Mississippi Watershed Management Organization's (MWMO) 2015 monitoring season. Each year, MWMO staff complete an annual monitoring report summarizing the year's monitoring activities and results and outlining the next year's work plan. Current and past reports are available on the MWMO website at [www.mwmo.org](http://www.mwmo.org).

The MWMO monitors water quality in the watershed's stormwater drainage system, the Mississippi River, and wetlands. 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 is necessary to characterize the impact 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 patterns and land use impacts on the MWMO watershed.

The 2015 monitoring season included: collection of precipitation data from eight monitoring locations, collection of bacteria samples from seven locations in the Mississippi River and seven stormwater drainage system sites, automated collection of water quantity and water quality data from five stormwater outfall sites draining to the Mississippi River and one stormwater pipe at the jurisdictional boundary of the Cities of Saint Anthony Village and Minneapolis, collection of water quality samples from the Mississippi River, and collection of water quality samples from three wetlands. The Anoka Conservation District (ACD) collected water elevation data at Sullivan Lake for the MWMO.

Portions of the 14-mile stretch of the Mississippi River in the MWMO are listed on the Federal Clean Water Act's Section 303(d) list of impaired waters for fecal coliform. The Minnesota Pollution Control Agency (MPCA) has moved from a fecal coliform standard to an *Escherichia coli* (*E. coli*) standard, therefore all fecal coliform impairments are now evaluated with *E. coli* data. Between April and November, bacteria samples were collected at least twice per month from seven monitoring locations in the Mississippi River and seven stormwater sampling sites within the MWMO watershed. Long-term monitoring of both the river and the stormwater drainage system is necessary to evaluate *E. coli* inputs from within the watershed compared to those inputs from upstream sources. The MPCA initiated the Upper Mississippi River Bacteria Total Maximum Daily Load (TMDL) Project in 2008 to develop daily *E. coli* load limits for the Mississippi River (MPCA, 2012). In 2014, the MPCA released its Upper Mississippi River Bacteria TMDL Study and Protection Plan (MPCA, 2014). This document designated the stretch of the Mississippi River within the MWMO as a Protection Reach and deferred it for a TMDL study.

In 2015, the MWMO continued monitoring the Mississippi River at five locations (cross-sections) in three different reaches to develop methods to fill hydraulic mixing data gaps in the 14-mile stretch of the Mississippi River in the MWMO. Beginning in March, staff visited each cross-section once or twice a month until December.

Each cross-section was divided into five lateral points equally spaced across the width of the river. Water temperature, pH, dissolved oxygen, salinity, and specific conductivity measurements were taken at each point by using a multiparameter sonde. Measurements were taken at three-foot increments starting at the water surface and ending at the bottom of the river.

MWMO staff began collecting water quality samples from the Mississippi River during 2014 and continued this sampling in 2015. The purpose of monitoring the water quality of the Mississippi River is to establish baseline water quality data that can be used for the management of the river. Water quality measurements and samples were collected at six sites, twice per month in April –November and once per month during January-March and December. Two new water quality monitoring sites, were added in fall of 2015. Monitoring sites on the Mississippi River and within the MWMO's boundary were selected to represent three distinct reaches of the river. Each site is located within a distinct river reach. Samples were collected from the middle of the river at three feet below the water surface and were analyzed for nutrients, sediment, inorganics, organics, and metals.

The MWMO continued monitoring water quantity and water quality of the watershed's stormwater drainage system by monitoring baseflow, snow melt events, and rain events in seven stormwater tunnels draining to the Mississippi River. Samples were analyzed for nutrients, sediment, inorganics, organics, and metals. Water quality standards do not exist for stormwater; therefore, data were not compared to standards but are presented in subsequent sections of the annual monitoring report. The MWMO will continue to monitor stormwater drainage systems to develop a record of baseline data with which to characterize stormwater quality within the watershed. The MWMO also provided stormwater data to the MPCA for TMDL projects within the watershed.

The MWMO contracted the ACD to conduct water level monitoring activities on Sullivan Lake in Columbia Heights. A volunteer, in coordination with ACD, conducted weekly water level monitoring during 2015 between April 15 and August 5. Lake water elevation was measured 17 times during 2015. Sullivan Lake water elevations can fluctuate dramatically because it receives a large amount of stormwater relative to its size and its outlet releases water in all but the lowest water conditions.

The MWMO also continued monitoring three wetlands known as Kasota Ponds. Samples were collected for nutrients, sediment, inorganics, and metals analyses. The MPCA water quality criteria indicate that wetland water quality should maintain background conditions. Background water quality has not yet been determined for MWMO wetlands.

MWMO staff collected bathymetric data on the Mississippi River between the Upper St. Anthony Falls Lock and Dam and the Canadian Pacific Railway (CPR) Bridge in line with N 41<sup>st</sup> Avenue. The purpose of collecting Mississippi River bathymetric data is to provide baseline data on the morphology of the river bed.

## **Introduction**

The annual monitoring report details the monitoring activities and results of the MWMO's 2015 monitoring season. During the first three months of the year, MWMO staff complete an annual monitoring report summarizing the previous year's monitoring activities and results and outlining the current year's work plan. Current and past reports are available on the MWMO website at [www.mwmo.org](http://www.mwmo.org).

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

- 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
  - Assess water resources for pollutants listed on the Minnesota Impaired Waters list for the TMDL process
- Collect rate and volume data for the Mississippi River and key subwatersheds
- Monitor performance of stormwater management practices
- Collaborate with stakeholders to identify and apply a standardized data collection and assessment approach
- 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
- Assess land use impact on water quality
- Participate in the technical development and update of statewide monitoring databases
- Make data accessible to the public and public entities and to MWMO staff for use as an education tool (e.g. BMP performance data)
- Develop an emergency monitoring plan in case of emergencies affecting water resources

The 2015 monitoring season included: collection of water quality samples from eight locations in the Mississippi River, automated collection of water quantity and water quality data from five stormwater outfall sites draining to the Mississippi River and one stormwater pipe at the jurisdictional boundary of the Cities of Saint Anthony Village and Minneapolis, and collection of water quality samples from three wetlands. The MWMO also contracted the ACD to carry out water level monitoring activities on Sullivan Lake in Columbia Heights.

In 2015, the MWMO continued monitoring the Mississippi River at five cross-sections in three different reaches to develop methods to fill hydraulic mixing data gaps in the MWMO's 14-mile stretch of the Mississippi River. From March until November, staff visited each of the cross-sections once or twice a month. Each cross-section was divided into five lateral points equally spaced across the width of the river. Water temperature, pH, D.O., salinity, and specific conductivity measurements were taken at each point by using a multiparameter sonde. Measurements were taken at three-foot increments starting at the water surface and ending at the bottom of the river.

Refer to [Figure A.1](#) in Appendix A for a map of the MWMO boundary. Descriptions of the sampling sites are found in subsequent sections of this report.

## Background

The MWMO was established in 1985 by a Joint Powers Agreement among member organizations. In 2012, the MWMO boundaries expanded to include portions of the Cities of Fridley and Columbia Heights and the City of Hilltop. The MWMO watershed boundaries are shown in [Figure A.1](#) in Appendix A. The MWMO is a unique organization in that it includes a 14 miles stretch of the Mississippi River as it runs through Minneapolis and St. Paul. The reach of the Mississippi River included in the MWMO extends from 1.25 miles upstream of the Interstate-694 (I-694) bridge in Fridley downstream to Lock & Dam No. 1 (Ford Dam). There are three lakes within the MWMO's boundaries: Loring Pond in Minneapolis, Sullivan Lake (formerly known as Sandy Lake) and Highland Lake in Columbia Heights.

Minnesota regulations require that the MWMO protect water quality in the watershed. Minnesota Rules Chapter 7050 requires that all waterbodies comply with state water quality standards. Furthermore, section 303(d) 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 stretch of the Mississippi River within the MWMO watershed is divided into two reaches for classification. [Table 1](#) highlights the most restrictive classifications.

The MWMO's stretch of the Mississippi River is listed on MPCA's 303(d) list of impaired waters for fecal coliform/*E.coli*, mercury, and polychlorinated biphenyls (PCBs). The MPCA divided the stretch of the Mississippi River flowing through the MWMO into three reaches. [Table 2](#) lists the impaired reaches of the river and the corresponding pollutants of concern. The MPCA has written a statewide TMDL for mercury (MPCA, 2007). Both Sullivan Lake and Highland Lake are listed on the 303(d) list of impaired water for nutrient/eutrophication and biological indicators. All three of the Kasota Ponds and Loring Pond are listed on the 2014 Proposed Impaired Waters List that has not yet been approved by the United States Environmental Protection Agency (EPA), for chloride impairments.

Protecting water quality in the Mississippi River is a complicated task. 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 stormwater drainage systems. The MWMO monitors stormwater drainage systems to determine the water quantity and water quality contributions of surface runoff from the watershed to the river. However, the entire Mississippi River basin upstream of the MWMO watershed boundary also contributes to water quality in the MWMO's stretch of the river.

**Table 1.** Water use classifications for waterbodies in the MWMO

<b>Waterbody</b>	<b>Water Use Classification</b>
Mississippi River, MWMO upstream boundary to Upper Saint Anthony Falls	1C, Domestic consumption (drinking water) 2Bd Aquatic life and recreation and source of 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
Sullivan (Sandy) Lake	2B Aquatic life and recreation
Highland (Unnamed) Lake	2B Aquatic life and recreation
Mallard Marsh	2D Aquatic life and recreation
Kasota Pond North	2D Aquatic life and recreation
Kasota Pond West	2D Aquatic life and recreation

**Table 2.** Pollutants in impaired waters

Impaired Waterbody	Pollutant
Mississippi River, MWMO upstream boundary to Upper Saint Anthony Falls	Fecal coliform/ <i>E.coli</i> , mercury in fish tissue, polychlorinated biphenyls (PCBs) in fish tissue
Mississippi River, Upper Saint Anthony Falls to Lower Saint Anthony Falls	Mercury in fish tissue, PCBs in fish tissue
Mississippi River, Lower Saint Anthony Falls to Lock & Dam 1 (Ford Dam)	Fecal coliform/ <i>E.coli</i> , mercury in fish tissue
Loring Pond	Chloride
Sullivan (Sandy) Lake	Nutrient/eutrophication biological indicators
Highland (Unnamed) Lake	Nutrient/eutrophication biological indicators
Mallard Marsh	Chloride
Kasota Pond North	Chloride
Kasota Pond West	Chloride

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 Saint Cloud and the Twin Cities Metro area. Since precipitation produces surface runoff, precipitation differences throughout the upper Mississippi River basin can affect water flow and water quality in the MWMO's stretch of the Mississippi River.

Thus, if large amounts of rainfall have washed pollutants from the land upstream into the river, it is possible that flows could increase and water quality could decline, even though it has not rained in the MWMO watershed. In cooperation with other federal and state agencies as well as watershed management organizations and districts, the MWMO plans to investigate the upstream impact on water quality to discern the effect of precipitation in other portions of the state on water quality in the MWMO's stretch of the Mississippi River.

Further complicating the investigation of water volume and quality in the river are the inputs of groundwater and the recharge to groundwater from the river. Groundwater may carry pollutants from upstream in the Mississippi

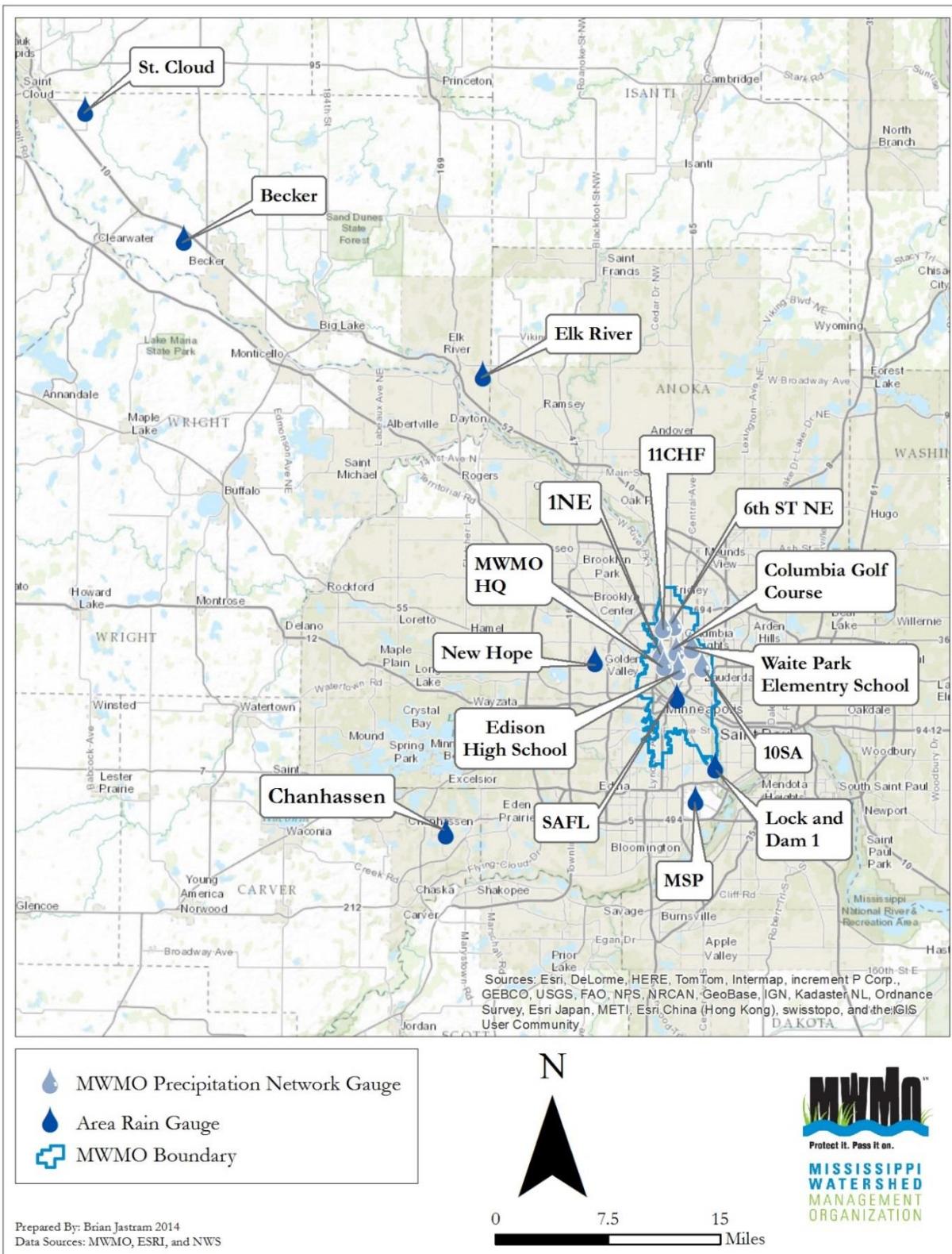
River basin to the MWMO's stretch of the river. Pollutants may also leach from the river into the groundwater system. It is quite difficult to track potential groundwater inputs from an area as large as the Mississippi River basin upstream of the MWMO to the MWMO's stretch of the river. The MWMO has long-term plans to coordinate with organizations and agencies in the upper portion of the basin to improve water quality in the Mississippi River.

## Precipitation Monitoring

Precipitation determines surface runoff and is arguably the greatest factor controlling surface water quality. As stated in the Background section of this monitoring report, water quality in the MWMO's stretch 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 MWMO collects precipitation data from a variety of sources, including gauges installed and operated by external entities as well as those operated by the MWMO itself. Figure 1 shows locations of those precipitation gauges. [Tables 3 and 4](#) show 2015 monthly precipitation values for several locations in the Upper Mississippi River Basin between St. Cloud and the Minneapolis St. Paul (MSP) International Airport. [Table 3](#) includes data from non-MWMO gauges only. Precipitation data at the St. Anthony Falls Laboratory (SAFL) site were collected by SAFL personnel. Precipitation at Lock & Dam No. 1 was measured by the United States Army Corps of Engineers (USACE). Precipitation data from precipitation monitoring sites in St. Cloud, Becker, Elk River, New Hope, Chanhassen, and the Minneapolis St. Paul International Airport were downloaded from either [http://www.dnr.state.mn.us/climate/historical/acis\\_stn\\_meta.html](http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html) or <http://climate.umn.edu/mapClim2007/MNlocApp.asp>.

[Table 4](#) shows monthly precipitation data from the MWMO network of precipitation gauges, located primarily within the MWMO watershed. Precipitation data at sites 1NE, 10SA, 11CHF, Edison High School, Columbia Golf Course, Waite Park Elementary School, and the MWMO Weather Station were collected by the MWMO. Precipitation data at site 6<sup>th</sup> ST NE were recorded and submitted by MWMO citizen volunteers. [Figure 2](#) shows 2015 monthly precipitation at the 1NE site in comparison to the 30-year monthly precipitation normals at Minneapolis St. Paul International Airport.



**Figure 1.** Precipitation gauges in the Upper Mississippi River Basin and MWMO boundary.

**Table 3.** 2015 monthly precipitation (inches) at several locations in the Upper Mississippi River basin

	<b>St.</b>	<b>Becker<sup>2</sup></b>	<b>Elk</b>	<b>New</b>	<b>SAFL<sup>5</sup></b>	<b>Lock &amp;</b>	<b>Chanhassen<sup>7</sup></b>	<b>Minneapolis</b>	<b>MSP 30 YR</b>
	<b>Cloud<sup>1</sup></b>		<b>River<sup>3</sup></b>	<b>Hope<sup>4</sup></b>		<b>Dam</b>		<b>St. Paul</b>	<b>MO Normal<sup>9</sup></b>
						<b>No. 1<sup>6</sup></b>		<b>International</b>	
								<b>Airport<sup>8</sup></b>	
<b>January</b>		0.24	0.15	0.09	0.34	0.02	0.17	0.37	0.34
<b>February</b>		0.35	0.31	0.48	0.38	0.00	0.13	0.39	0.35
<b>March</b>		0.38	0.34	0.51	0.80	0.38	0.54	0.78	0.67
<b>April</b>		1.67	1.05	0.69	1.81	1.82	2.35	2.22	2.42
<b>May</b>		6.03	5.85	3.48	4.46	3.54	3.70	4.96	3.55
<b>June</b>		4.66	4.43	3.02	3.37	2.78		3.66	4.40
<b>July</b>		7.18	6.02	3.82	8.30	5.71		7.89	7.32
<b>August</b>		3.10	8.74	4.63	2.98	2.18		2.71	2.99
<b>September</b>		2.24	2.12	1.11	3.79	2.91		3.19	4.65
<b>October</b>		3.14	3.81	4.47	2.93	2.45		2.54	2.61
<b>November</b>		3.10	2.71	2.23	4.56	3.28		4.73	4.52
<b>December</b>		1.02	1.99	1.20	1.65	1.61	0.99	1.97	2.32
<b>Total</b>		33.11	37.52	25.73	35.37	26.67	7.88	35.41	36.14
									30.61

<sup>1</sup> Location: Latitude 45.5441 Longitude -94.0708, Source: [http://www.dnr.state.mn.us/climate/historical/acis\\_stn\\_meta.html](http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html)

<sup>2</sup> Location: Latitude 45.4206 Longitude -93.9333, Source: [http://climate.umn.edu/hidradius/radius\\_new.asp](http://climate.umn.edu/hidradius/radius_new.asp)

<sup>3</sup> Location: Latitude 45.5272 Longitude -93.7110, Source: [http://www.dnr.state.mn.us/climate/historical/acis\\_stn\\_meta.html](http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html)

<sup>4</sup> Location: Latitude 45.0167 Longitude -93.3667, Source: [http://www.dnr.state.mn.us/climate/historical/acis\\_stn\\_meta.html](http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html)

<sup>5</sup> Location: Latitude 44.9823 Longitude -93.2549, Source: C Ellis, Saint Anthony Falls Laboratory (SAFL)

<sup>6</sup> Location: Latitude 44.9149 Longitude -93.2549, Source: <http://www.mvp-wc.usace.army.mil/projects/Lock1.shtml>

<sup>7</sup> Location: Latitude 44.8514 Longitude -93.5650, Source: [http://www.dnr.state.mn.us/climate/historical/acis\\_stn\\_meta.html](http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html)

<sup>8</sup> Location: Latitude 44.8830 Longitude: -93.2288, Source: [http://www.dnr.state.mn.us/climate/historical/acis\\_stn\\_meta.html](http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html)

<sup>9</sup> Location: Latitude 44.8830 Longitude: -93.2288, Source: [http://www.ncdc.noaa.gov/cdo-web/datasets/NORMAL\\_MLY/stations/GHCND:USW00014922/detail](http://www.ncdc.noaa.gov/cdo-web/datasets/NORMAL_MLY/stations/GHCND:USW00014922/detail)

**Table 4.** 2015 monthly precipitation (inches) at several locations in the MWMO precipitation monitoring network

	<b>1NE<sup>1</sup></b>	<b>10SA<sup>2</sup></b>	<b>11CHF<sup>3</sup></b>	<b>Edison</b>	<b>Columbia</b>	<b>Waite Park</b>	<b>6<sup>th</sup> ST</b>	<b>MWMO</b>
				<b>High School<sup>4</sup></b>	<b>Golf Course<sup>5</sup></b>	<b>Elementary School<sup>6</sup></b>	<b>NE<sup>7</sup></b>	<b>Weather Station<sup>8</sup></b>
<b>January</b>	0.06	0.11	0.03	0.05	0.09	0.05	0.12	0.04
<b>February</b>	0.00	0.00	0300		0.81		0.17	0.28
<b>March</b>	0.33	0.53	0366		1.86		0.51	0.78
<b>April</b>	1.71	1.82	1.56		3.46		1.91	
<b>May</b>	3.53	4.24	3.89				3.79	3.14
<b>June</b>	2.75	3.19	3.68				3.78	2.85
<b>July</b>	4.86	4.98	4.94	6.61	2.49	6.82	5.84	5.53
<b>August</b>	2.31	2.50	2.84	2.76	3.08	2.96	3.10	2.07
<b>September</b>	3.27	3.17	3.02	4.41	4.13	4.18	3.27	3.72
<b>October</b>	2.11	2.51	2.25	2.84	2.30	2.59	2.44	2.21
<b>November</b>	3.05	3.67	3.17	4.32	4.32	4.45	3.43	3.99
<b>December</b>	1.48	1.74	1.25	1.56	1.72	1.63	1.97	1.35
<b>Total</b>	25.4	28.46	26.96	22.55	24.26	22.68	30.33	25.96

<sup>1</sup> Location: Latitude 45.023 Longitude -93.277, Source: MWMO data, 1NE

<sup>2</sup> Location: Latitude 45.012 Longitude -93.220, Source: MWMO data, 10SA

<sup>3</sup> Location: Latitude 45.050 Longitude -93.274, Source: MWMO data, 11CHF

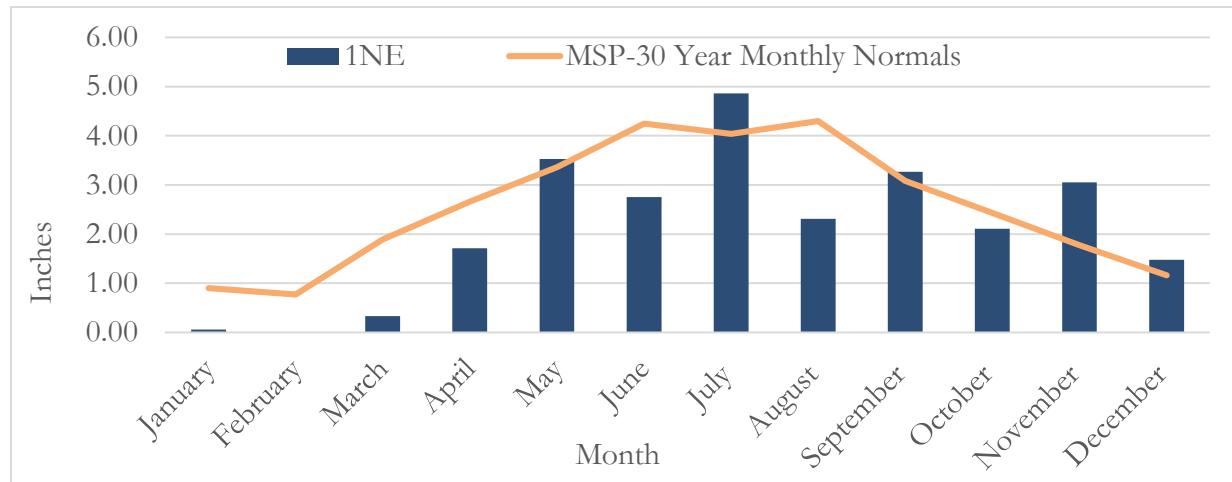
<sup>4</sup> Location: Latitude 45.012 Longitude -93.22, Source: MWMO Data, Edison High School

<sup>5</sup> Location: Latitude 45.027 Longitude -93.255, Source: MWMO Data, Columbia Golf Course

<sup>6</sup> Location: Latitude 45.030 Longitude -93.234, Source: MWMO Data, Waite Park Elementary School

<sup>7</sup> Location: Latitude 45.053 Longitude -93.259, Source: Citizen Volunteer, Minneapolis MN

<sup>8</sup> Location: Latitude 45.013 Longitude -93.272, Source: MWMO Data, MWMO Weather Station

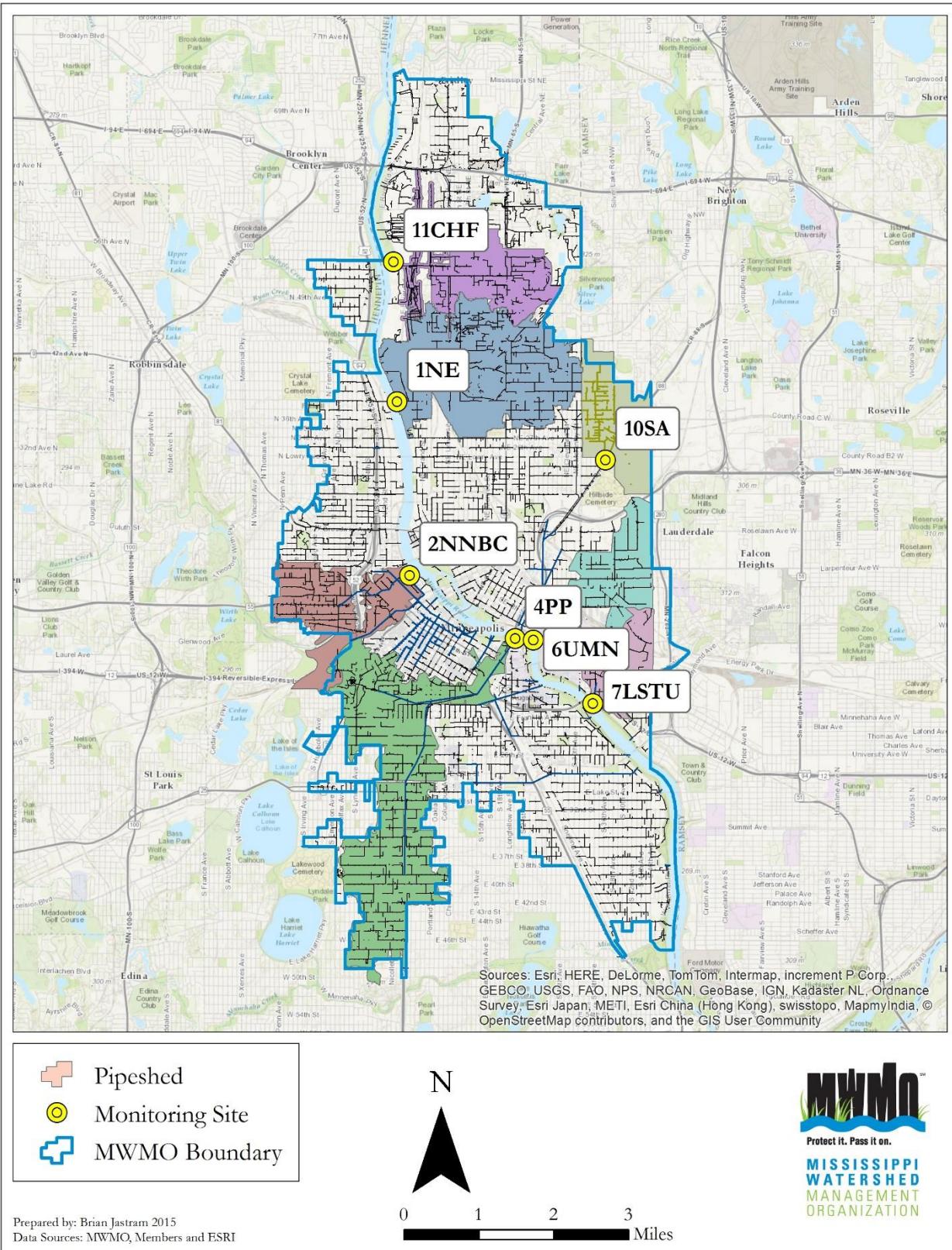


**Figure 2.** 2015 monthly precipitation totals at the 1NE heated rain gauge compared to 30-year monthly precipitation normals at the Minneapolis St. Paul International Airport

## **Stormwater Monitoring**

The MWMO monitors water quantity and quality at six stormwater outfalls into the Mississippi River and one stormwater pipe at the jurisdictional boundary of the Cities of Saint Anthony Village and Minneapolis. The monitored locations were chosen because they are the most extensive stormwater drainage systems (pipedsheds) within the watershed and they are accessible. A stormwater drainage system refers to the area that drains to one stormwater outfall. Land uses in the stormwater drainage systems affect water quality. The amount of impervious surface and potential pollution differs between industrial, residential, and commercial land uses. Refer to [Figure 3](#) for a map of the MWMO's stormwater sampling sites and pipedsheds.

Site descriptions and water quantity data for each stormwater site are provided in the following pages. Six of the MWMO's stormwater sites are monitored for real-time level and discharge measurements as well as water quality during both storm and baseflow conditions. Water quality data from the stormwater sites are discussed in this section and shown in Tables D.1 through D.7 in [Appendix D](#).



**Figure 3.** Stormwater pipeshed monitored by the MWMO and corresponding monitoring site locations.

## Methodology

### ***Water Level and Discharge Monitoring***

Water level in a stormwater pipe is very different from water level in the Mississippi River. Stormwater pipes respond quickly to rainfall, so water levels may rise many feet within a few minutes, depending on the size and intensity of the storm event. Some stormwater pipes only contain water during precipitation events, while others have baseflow throughout the year. Most stormwater pipes monitored by the MWMO have varying levels of baseflow year round.

Six MWMO stormwater monitoring sites are equipped with ISCO 6712 automatic samplers (Teledyne Isco, Inc., Lincoln, NE). An ISCO Area/Velocity sensor is installed in each of the six pipes and connected via cable to an ISCO 750 Area/Velocity Flow Module which is attached to the automated sampler. The sensor and flow module provide water level and velocity data which are then used with pipe area dimensions to compute discharge from the stormwater pipe. A typical automated stormwater site set-up is shown in Figures 4 and 5.



**Figure 4.** Example of a typical MWMO stormwater monitoring site cabinet set up including automated sampling and real-time monitoring equipment.



**Figure 5.** Typical area/velocity sensor (black rectangle) and cable configuration in a monitored stormwater tunnel

#### ***Sample Collection, Handling, and Preservation***

Grab and composite samples were collected from seven stormwater sites in the MWMO watershed. Staff followed sampling procedures outlined in the MWMO's Standard Operating Procedure for Stormwater Sampling (2011). For the majority of analytes, samples were collected in laboratory-cleansed (non-sterile) eight-liter plastic bottles. Samples were either collected directly into the bottle as grab samples or with automatic samplers as described below. For all samples, bottles were capped after filled, with headspace included.

The ISCO 6712 automatic samplers house twenty-four one-liter plastic bottles for composite sample collection. Samplers were programmed such that once the water level reached a certain level above baseflow, the sampler triggered to start sampling. Once triggered, the sampler rinsed the sample tubing before drawing the sample into the containers. Samples were collected on a flow-paced basis. Once collected, the bottles were composited by pouring an equal amount of water from each sampler bottle into an eight-liter plastic bottle by a monitoring specialist.

Dissolved oxygen, conductivity, salinity, temperature, and pH data were measured in the field using a YSI ProPlus sonde (YSI Inc., Yellow Springs, OH). The data were measured directly in the stormwater drainage system or in a separate container of stormwater. Transparency was measured using a Secchi tube.

Stormwater samples were collected for a minimum of three precipitation events per month, as long as that many events occurred. If baseflow conditions were present, samples were collected twice per month from March to November, and at least once per month during the winter months to assess baseflow concentration of parameters.

### ***Sampling Quality Control***

The MWMO staff followed the quality control protocol outlined in the MWMO Ambient Surface Water Monitoring Quality Assurance Project Plan (MPCA, 2010). Blank samples of DI water were submitted to laboratories quarterly to verify that sample containers were clean and samples were not contaminated during travel. In addition, ten percent of all samples were collected in duplicate to verify that sampling and laboratory procedures did not jeopardize the data. The ISCO bottles were rinsed twice with tap water and once with DI water between sample events.

### ***Laboratory Analyses***

Samples were analyzed at the Metropolitan Council Environmental Services (MCES) Laboratory. The laboratory followed strict protocols for quality assurance and quality control. Information regarding laboratory protocol is available from MWMO staff. Refer to [Table B.1](#) in Appendix B for a list of sample parameters, the laboratories used for analysis, the analysis methods, and information regarding certification.

### ***Parameter Information***

The MWMO has conducted extensive research regarding the parameters of concern. Parameter information includes definitions, sources, impact on various organisms, and water quality standards. Refer to the MWMO 2006 Annual Monitoring Report (MWMO, 2007) for the comprehensive list of parameters.

### ***Data Analysis***

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

- Suspect data were flagged and verified with the laboratory
- Statistical regression techniques were used to interpolate automated flow data that were missing due to equipment problems (MWMO, 2013)

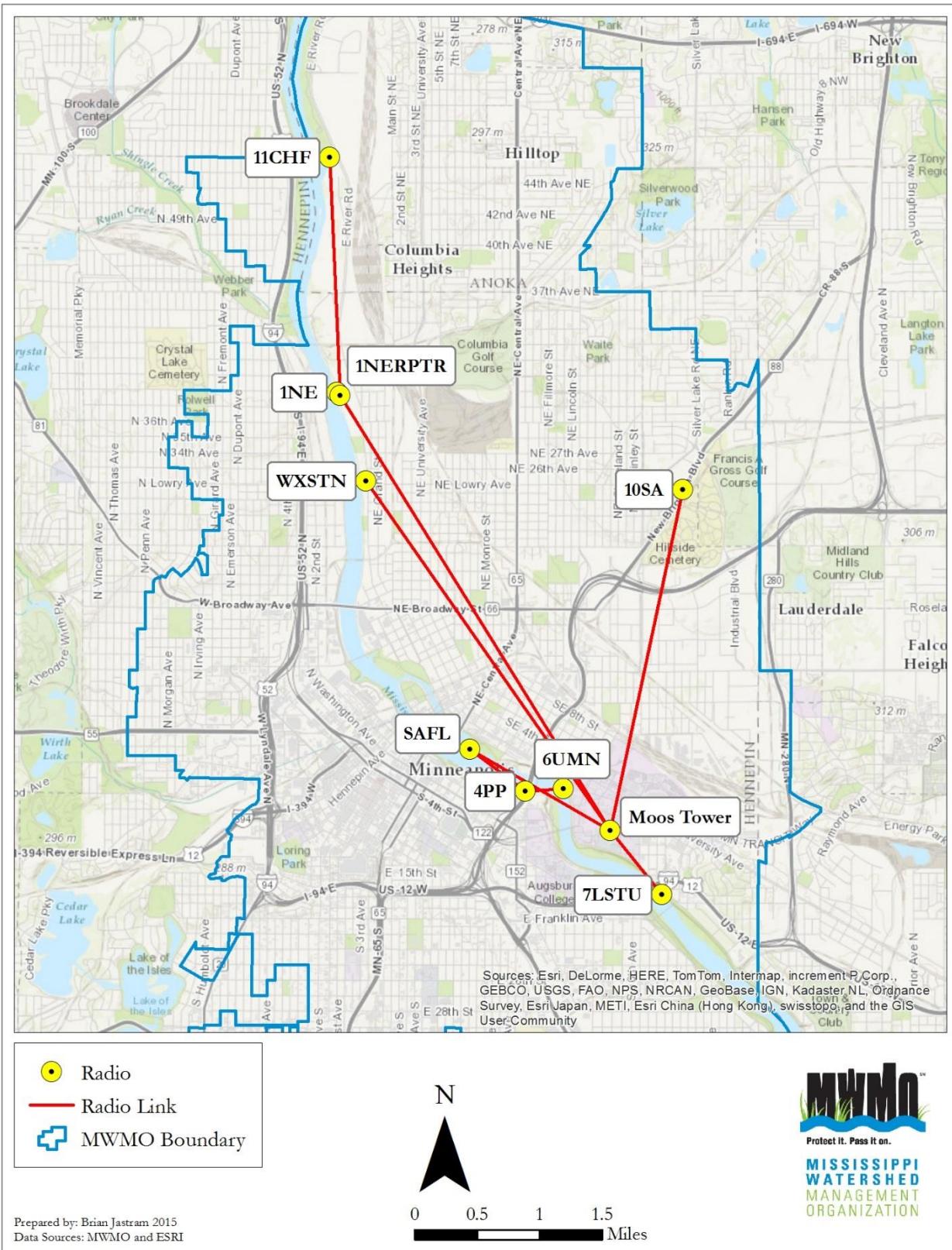
### ***Remote Data Access Network***

The MWMO, in collaboration with scientists at the University of Minnesota Saint Anthony Falls Lab, designed and deployed a remote data access network in 2008. The network was designed to collect real-time monitoring data from the stormwater sites. The network provides continuous data about stormwater level, velocity, flow, precipitation, and automated sample collection. The data are available instantaneously from any computer, allowing MWMO staff to respond more quickly to sample collection and equipment problems. The network uses

radios to link six automatic water samplers to the internet, enabling the MWMO staff to view stormwater and rainfall data, along with automated sample collection, from the office. Repeater radios are located at three additional locations: the SAFL roof, the Moos Tower roof on the University of Minnesota East Bank Campus, and the Xcel Riverside Generating Plant roof. Repeater radios provide line-of-sight communication between all of the monitoring sites. Refer to [Figure 6](#) for a map of the real-time monitoring network. Details about the specific equipment and software used in the remote data access network are included in the MMWO Annual Monitoring Report 2013 (MWMO, 2014).

### **Stormwater Water Quality Monitoring Results**

The MPCA does not have water quality criteria for stormwater drainage systems; therefore, data are not compared with standards. The MWMO monitors stormwater to characterize surface runoff in the watershed and determine land contributions to water quality in the Mississippi River. Samples are collected for bacteria, nutrients, sediment, inorganics, organics, and metals analyses. The MWMO will not draw conclusions or make assumptions based on this data until several years of accurate flow-weighted composite data are available. The MWMO has begun calculating annual pollutant loads at some stormwater monitoring sites where several years of data do exist. The 2015 water quality data are presented in Tables D.1 – D.7 in [Appendix D](#). Bacteria data are discussed in the Bacteria Monitoring section of this report. Specific information regarding individual stormwater sites can be found in the following pages.



**Figure 6.** Remote access real-time data monitoring network

## **Stormwater Site Descriptions and Water Quantity Results**

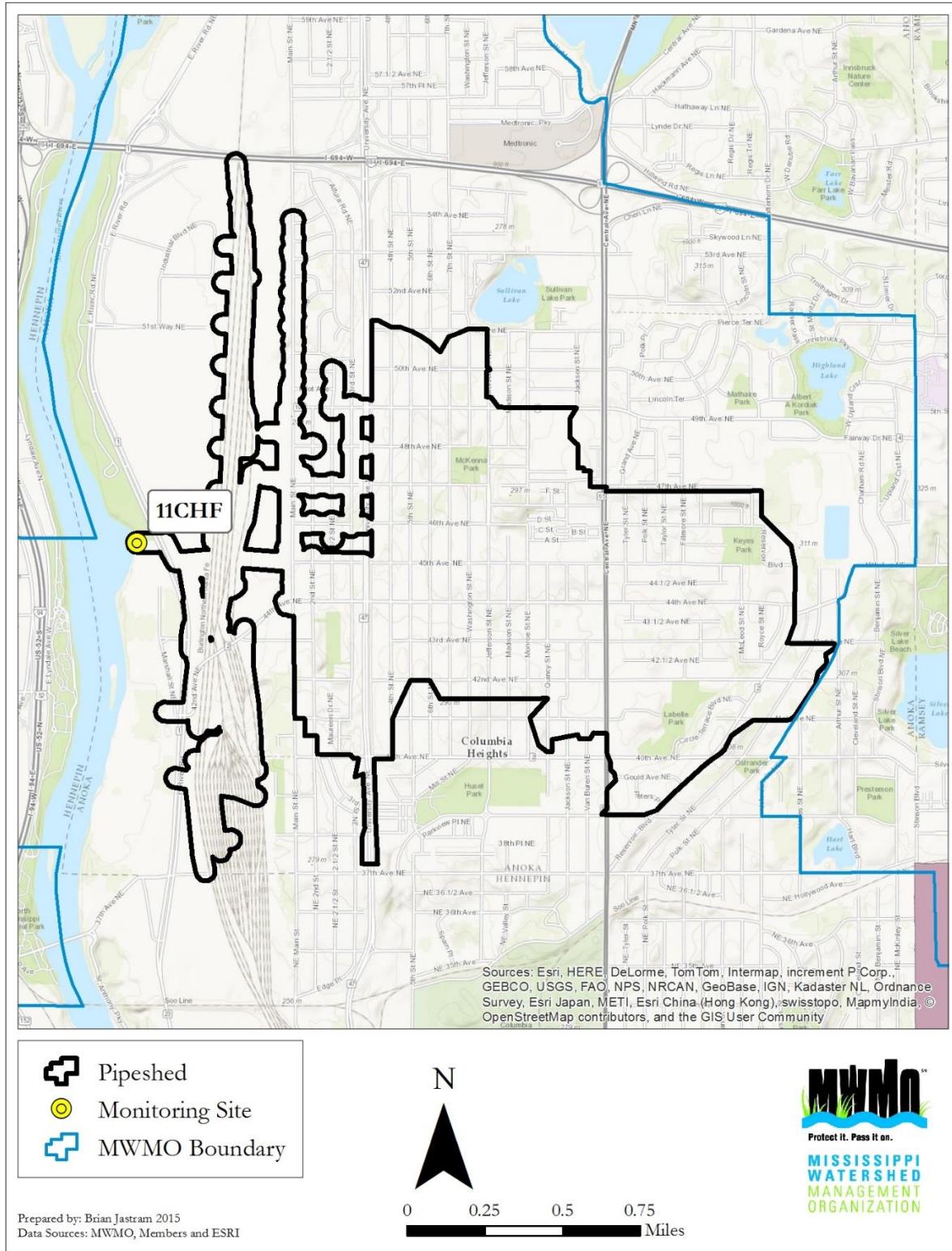
### **11CHF**

11CHF is the northernmost outfall monitored by the MWMO. Installation of the site was completed in October of 2014. The outfall is located on the east bank of the Mississippi River at RM 859, about 50 feet upstream from the northernmost edge of the Minneapolis Public Works Fridley Water Treatment Plant's property in the Anoka County Riverfront Regional Park. The outfall is an eight-foot diameter, round concrete pipe (Figure 7). The nearest intersection is 44<sup>th</sup> Ave NE and East River Road. The monitoring equipment is located 1,880 feet up the tunnel from the outfall on BAE Systems Inc. property just west of the Burlington Northern Santa Fe rail yard and north of the associated stormwater reservoir. This stormwater drainage system drains water from approximately 1,310 acres of parts of the cities of Columbia Heights, Hilltop, and Fridley (Figure 8). The pipeshed includes mainly industrial and residential land uses. The stormwater drainage system has continuous baseflow.

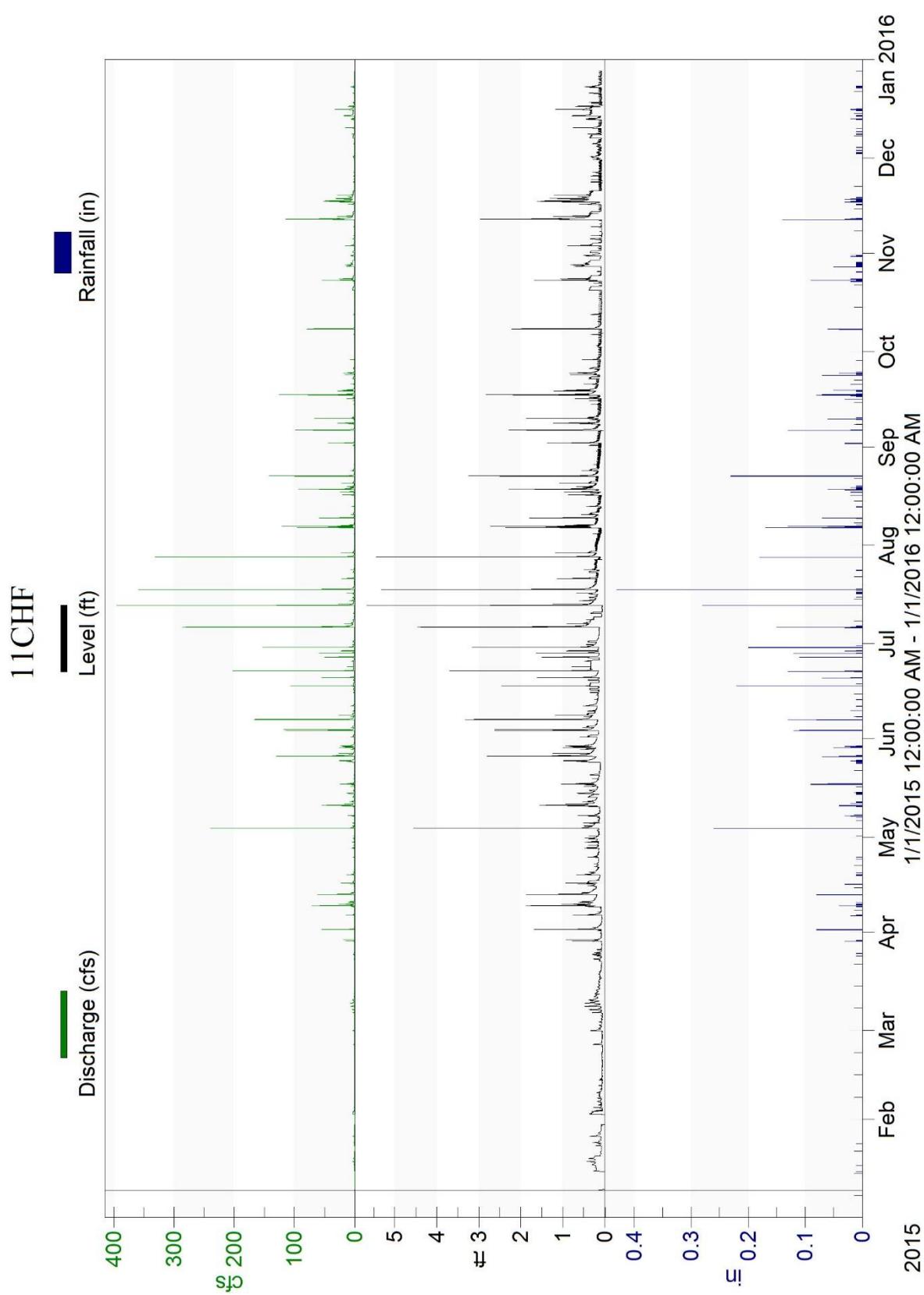


**Figure 7.** Site 11CHF outfall to the river

Level, discharge, and precipitation data from the 11CHF site are shown in Figure 9. Due to extreme cold temperatures, data at the 11CHF site did not begin to be recorded until mid-January of 2015. Subsequent cold weather caused the automatic sampler to shut off occasionally, resulting in short gaps in level and discharge data. 11CHF data are also affected by periodic, controlled releases of water from a stormwater reservoir into the tunnel through a small pipe located just upstream of the area/velocity sensor location. An automated precipitation gauge is also operated at this site.



**Figure 8.** 11CHF pipeshed boundary and monitoring site location



**Figure 9.** Discharge, level, and precipitation data for the 11CHF monitoring site in 2015

### **1NE (Xcel Riverside Plant)**

Prior to installation of the 11CHF site in the fall of 2014, 1NE was the northernmost outfall monitored by the MWMO. Equipment was initially installed at the site in 2006. The outfall is located on the east bank of the Mississippi River on the Xcel Riverside Power Plant property at RM 857.2 and is a 96-inch diameter, corrugated iron pipe (Figure 10). The stormwater drainage system drains water from approximately 2,240 acres of the Northeast Minneapolis Neighborhood as well as portions of Columbia Heights and Fridley (Figure 11). The pipeshed includes mainly residential and industrial land uses. The stormwater drainage system has continuous baseflow.

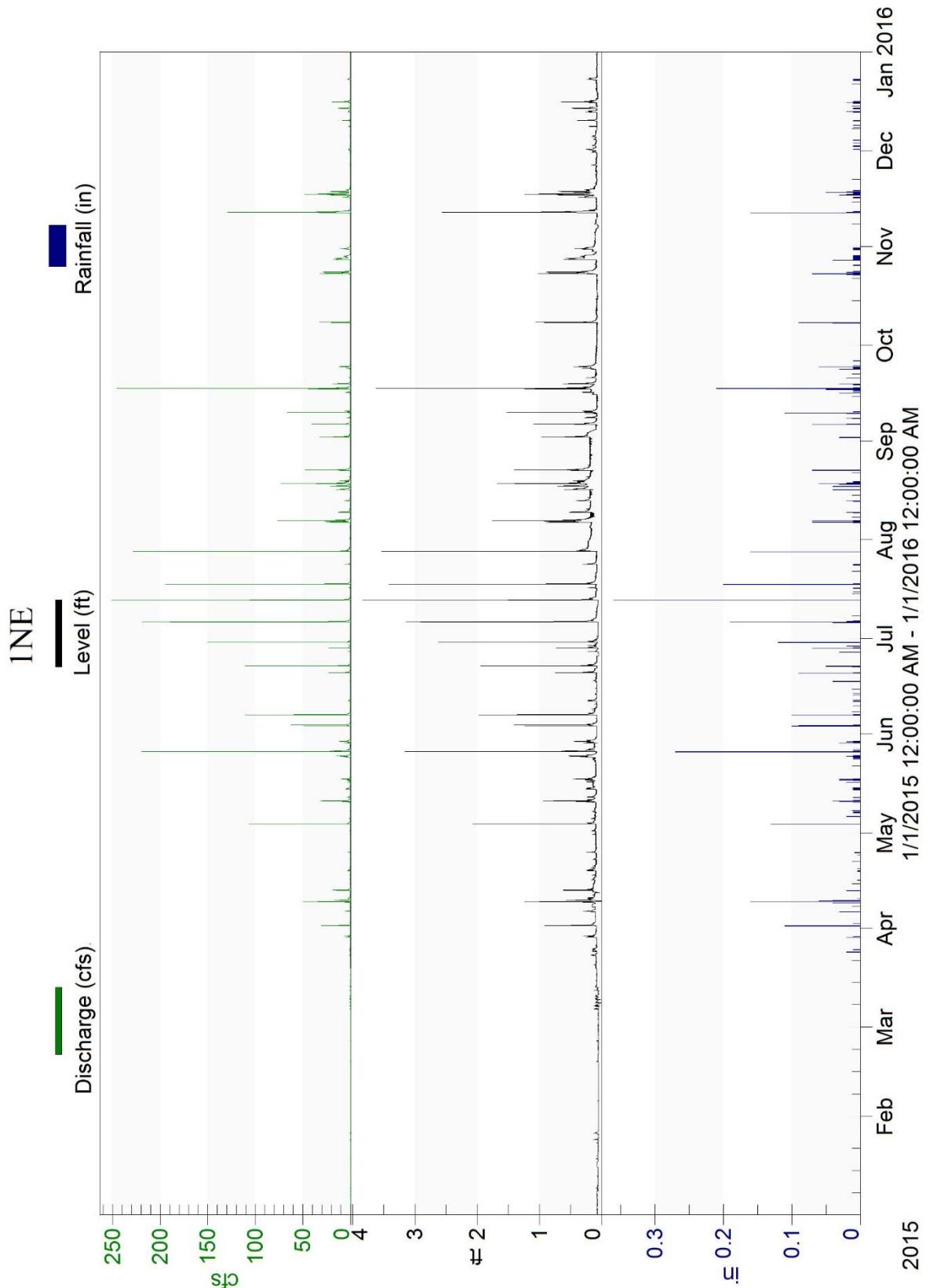


**Figure 10.** Outfall to the river for the 1NE pipeshed. Monitoring cabinet can be seen in the upper right corner (green box)

Water level, discharge, and precipitation data collected with automated equipment are presented in Figure 12. Cold weather caused the automated sampler to shut off occasionally, resulting in brief gaps in level and discharge data. During periods of time when the baseflow water level was very low (typically winter and fall) the sensor could not measure stormwater discharge. Those periods are represented as gaps in the discharge data.



**Figure 11.** 1NE pipeshed boundary and monitoring site location



**Figure 12.** Discharge, level, and precipitation at the 1NE monitoring site in 2015

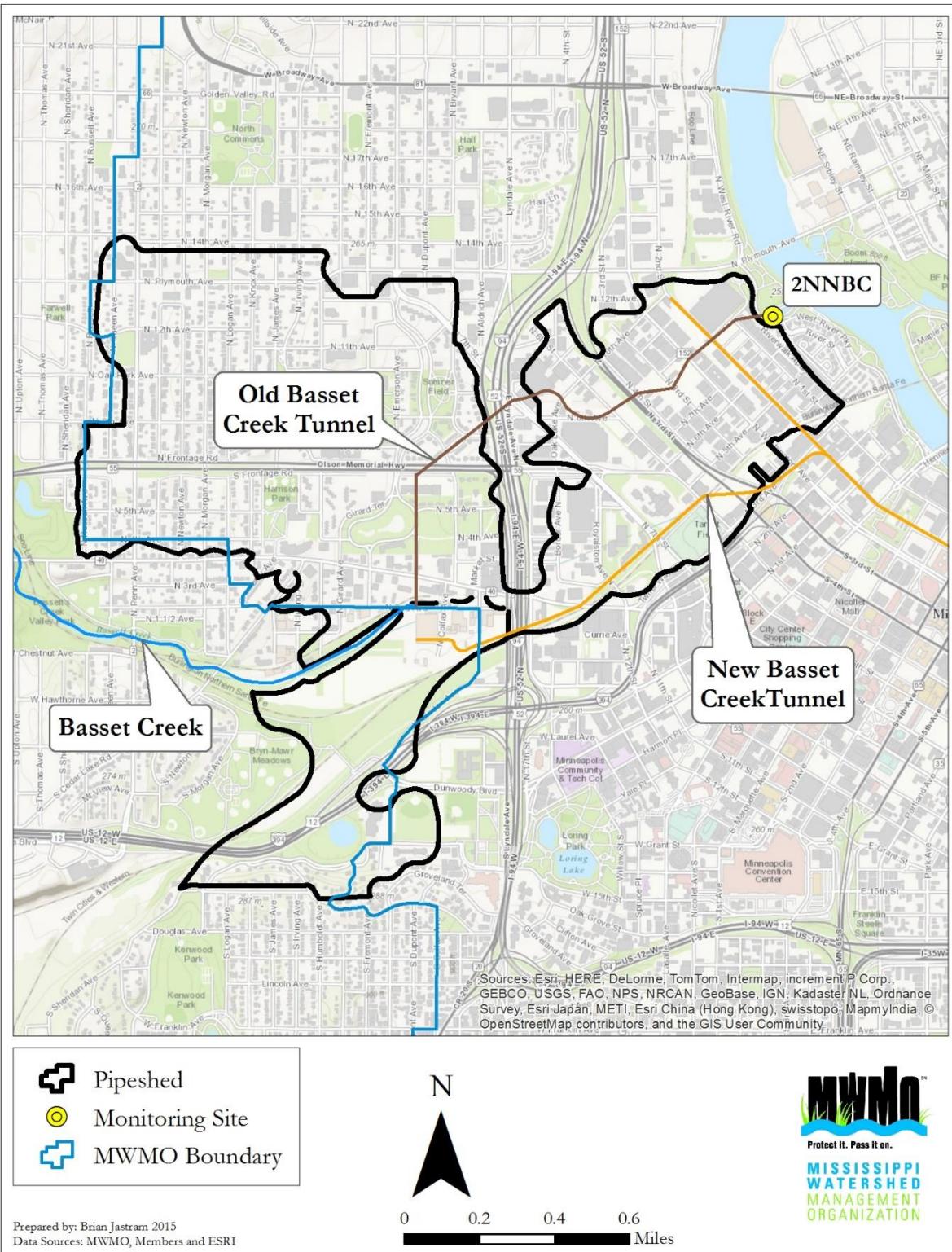
### **2NNBC (*Old Bassett's Creek Tunnel Outlet*)**

The 2NNBC outfall drains water from 1,067 acres of the Near North Minneapolis Neighborhoods and Bassett's Creek overflow. It enters the river in a park in the North Loop Neighborhood of Minneapolis on the west bank of the Mississippi River at RM 854.8. Land use is primarily residential and commercial. The semi-elliptical outfall is approximately 11 feet high and 15 feet wide (Figure 13). Bassett's Creek was buried and routed through this tunnel in 1890. In 1992, the creek was rerouted through a new tunnel that enters the Mississippi River below the surface water level, just downstream from Upper Saint Anthony Falls. Water from Bassett's Creek only flows through the original outfall during overflow periods. The 2NNBC pipeshed is shown in [Figure 14](#).



**Figure 13.** The 2NNBC outfall to the original Bassett's Creek channel before it enters the Mississippi River

The 2NNBC site does not have an automated sampler or area/velocity sensor but grab samples are collected during rain events and baseflow when possible. Throughout much of 2015, river water was present in the tunnel. Samples were not collected during that time unless, during precipitation or melt events, stormwater pushed the river water out of the tunnel such that stormwater could be sampled. An In-Situ Level Troll 500 (In-Situ Inc., Ft. Collins, CO) was installed at the outfall in October 2014 in order to obtain hourly water level measurements at the outfall.



**Figure 14.** 2NNBC pipeshed boundary and monitoring site location

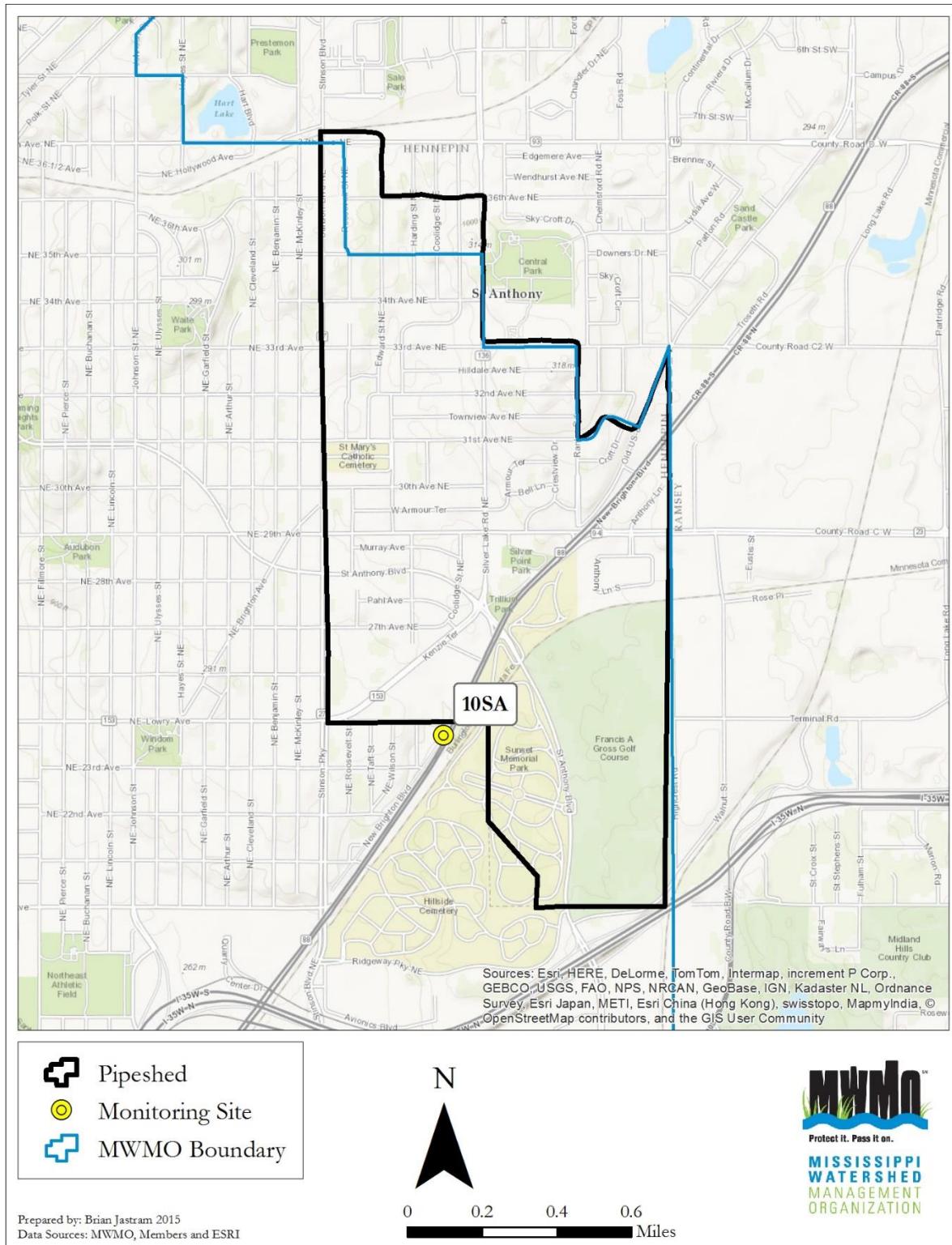
### **10SA (Saint Anthony Village)**

The 10SA monitoring site was established in 2007. 10SA differs from the other MWMO stormwater monitoring sites as it is located near the top of a stormwater drainage system rather than at the bottom near the outfall to the Mississippi River. The MWMO chose to monitor this location to investigate the quantity and quality of stormwater from the southern portion of Saint Anthony Village (602 acres) as it enters Minneapolis. The concrete stormwater pipe is 54 inches in diameter and is accessed from an open space in a residential neighborhood (Figure 15). The tunnel eventually drains into the Mississippi River several miles away on the east bank at RM 853.2. The monitored pipeshed is shown in [Figure 16](#). Land uses are mainly residential, commercial, and industrial. There is generally continuous baseflow in this stormwater drainage system although the amount is negligible in winter.

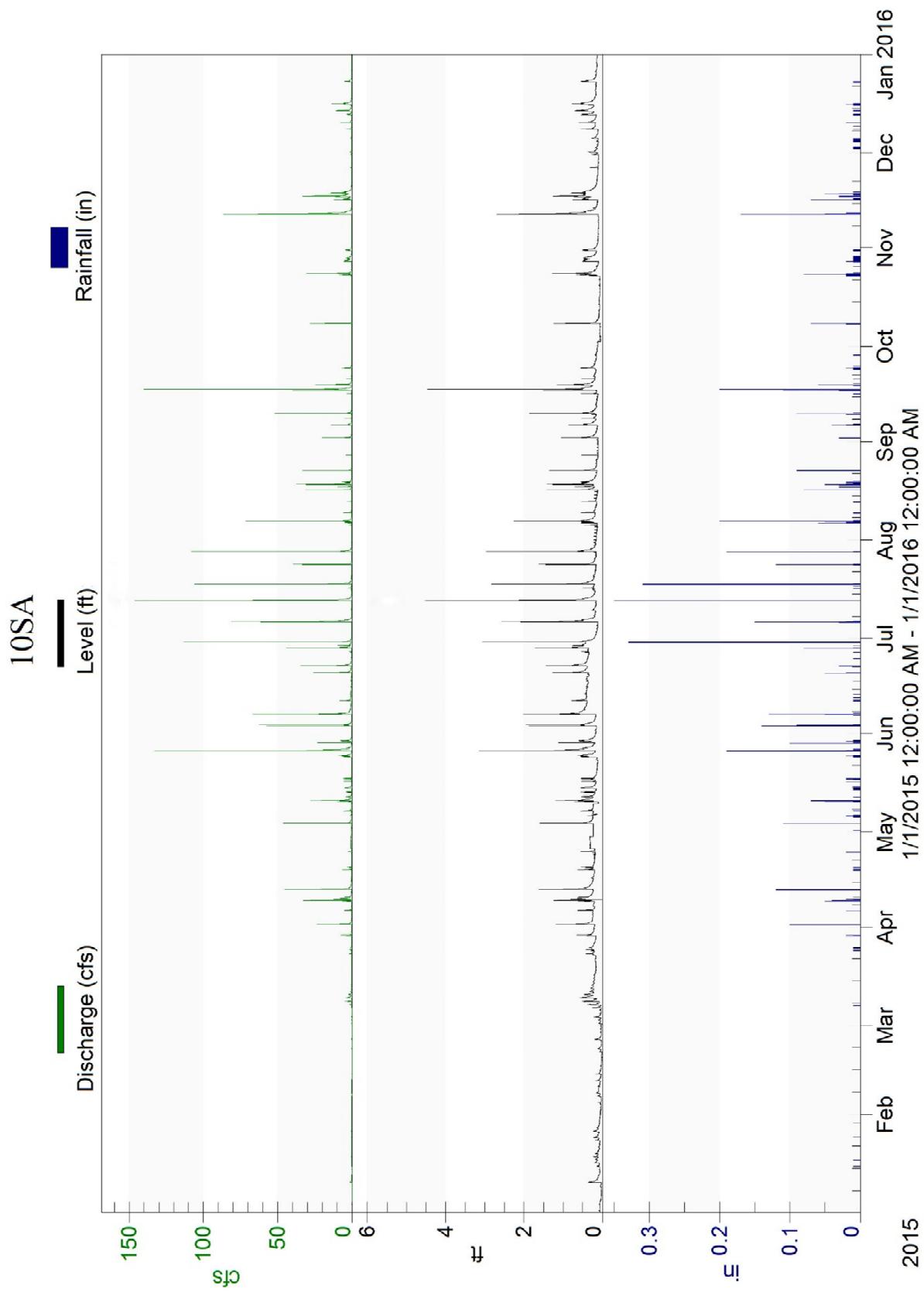


**Figure 15.** Monitoring equipment and access manhole at the 10SA stormwater site

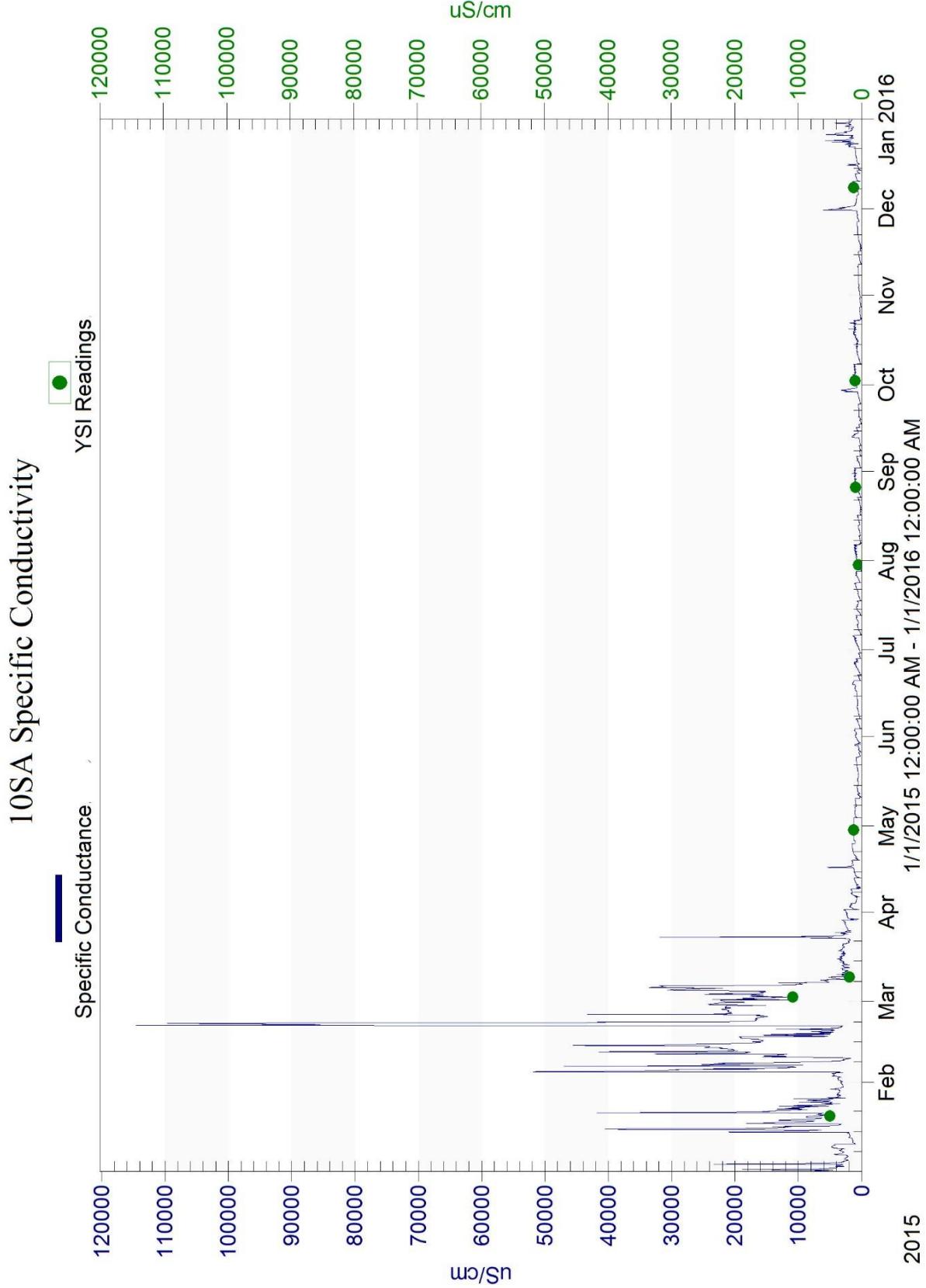
Level and discharge data for the 10SA site are shown in [Figure 17](#). The baseflow levels at this site are often negligible. Due to sensor limitations, discharge cannot be calculated during periods of very low baseflow. These periods are displayed as gaps in the discharge data. An automated tipping bucket precipitation gage at the site provides continuous rainfall data ([Figure 17](#)). Since 2011, the MWMO has also monitored specific conductivity of stormwater with continuous monitoring equipment (provided by the MPCA) at the 10SA site to provide the MPCA with detailed data for the Twin Cities Metro Area Chloride Project ([Figure 18](#)).



**Figure 16.** 10SA pipeshed boundary and monitoring site location



**Figure 17.** Discharge, level, and precipitation for the 10SA monitoring site in 2015



**Figure 18.** Specific conductivity data for the 10SA monitoring site in 2015. The black line shows continuous data collected from a sensor installed in the tunnel. Points represent values obtained using a YSI ProPlus multimeter

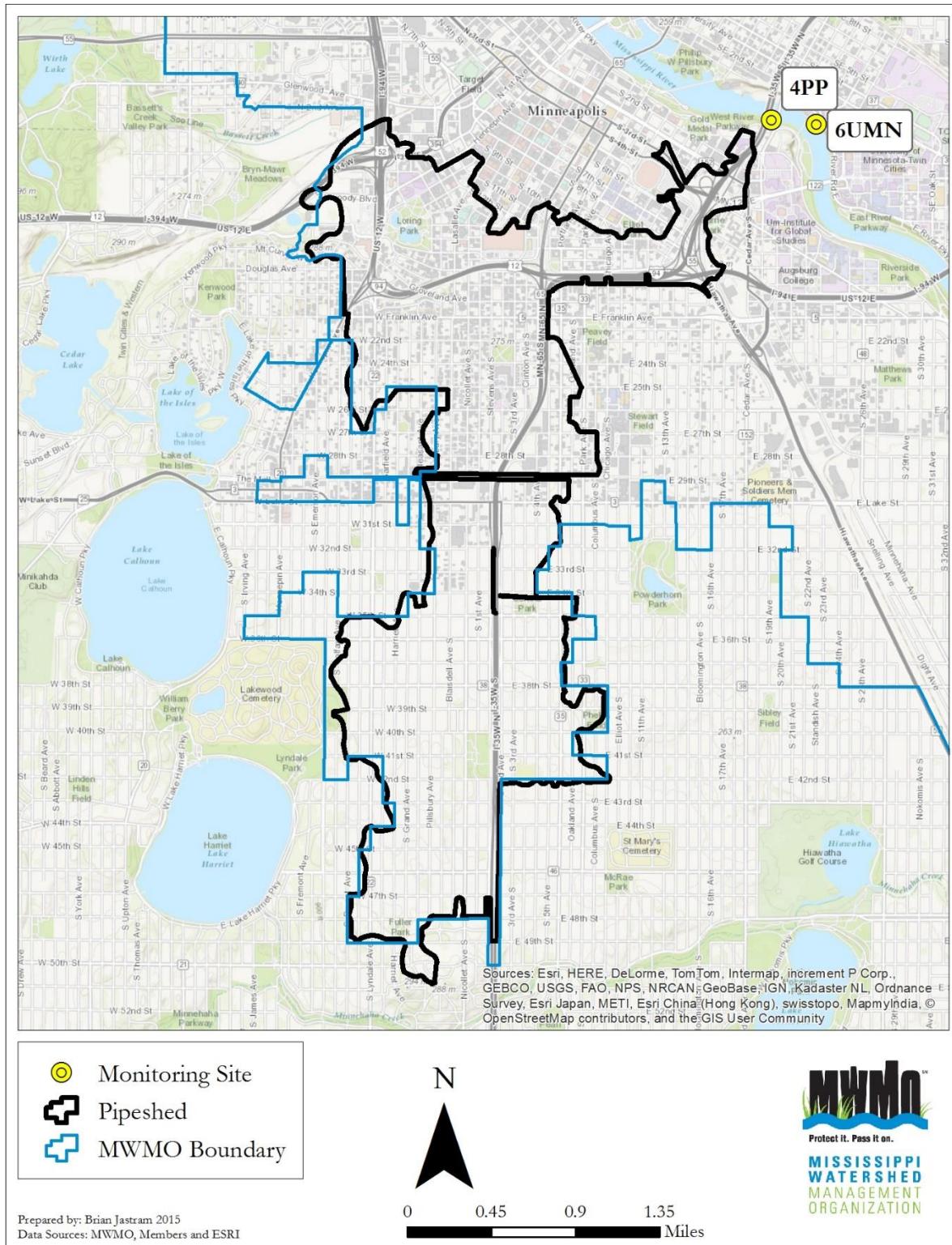
#### **4PP (I-35W Bridge)**

Established in 2008, this outfall site is located below Lower Saint Anthony Falls Lock and Dam on the west bank of the Mississippi River at RM 853.2. The semi-elliptical tunnel is 14 feet high and 14 feet wide (Figure 19). The system drains stormwater from approximately 2,780 acres of the Phillips and Powderhorn Neighborhoods and the southern portion of the Central Neighborhood in Minneapolis, as well as water from the I-35W interstate highway (Figure 20). Land use is primarily residential, commercial, and heavy industry. There is continuous baseflow in this stormwater drainage system.

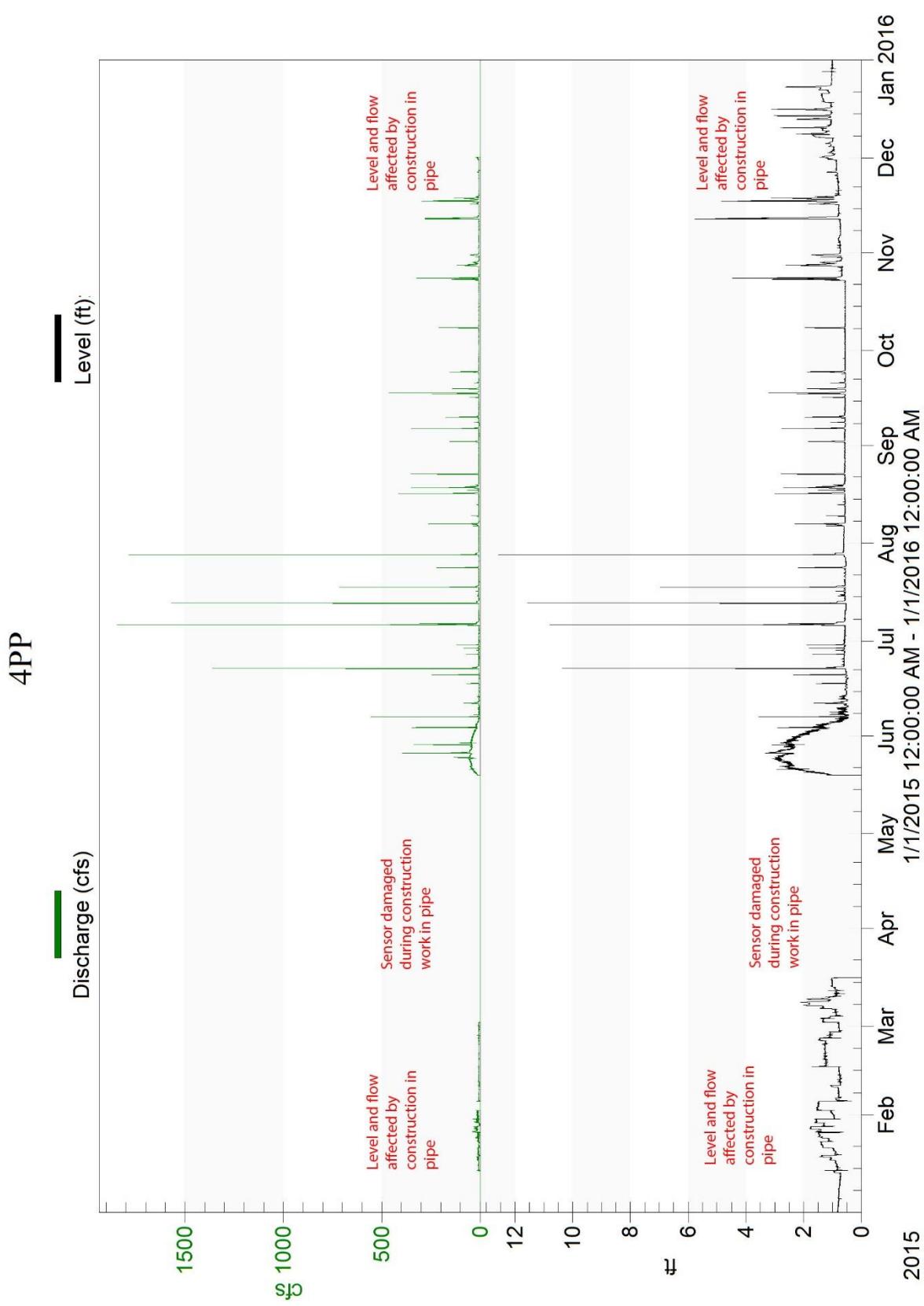


**Figure 19.** 4PP outfall to the river

Construction within the 4PP tunnel during winter and spring months, as well as high river levels, affected level and discharge values at the site during 2015. The monitoring equipment was damaged in March of 2015 during construction activities and could not be replaced until May due to the presence of river water in the tunnel. River water was present in the tunnel from mid-May to mid-June of 2015. Level and discharge data are shown in Figure 21.



**Figure 20.** 4PP pipeshed boundary and monitoring site location



**Figure 21.** Discharge and level data for the 4PP stormwater monitoring site in 2015

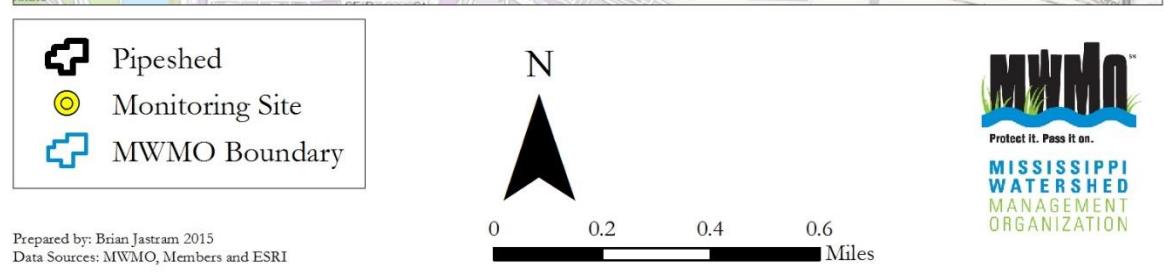
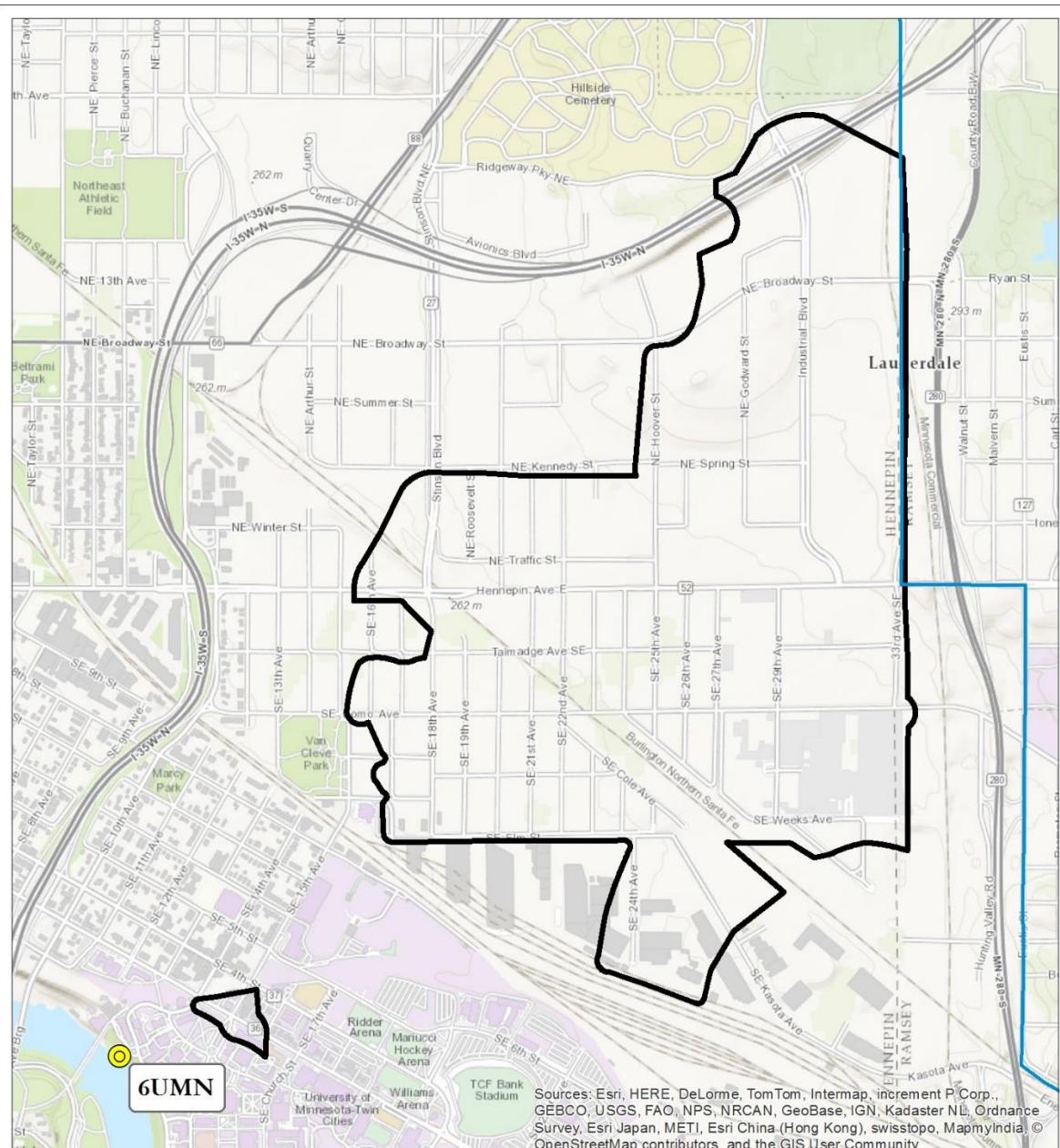
### **6UMN (University of Minnesota Coal Storage Facility)**

The 6UMN outfall site is located on the east bank of the Mississippi River at RM 853.0, downstream from Saint Anthony Falls, behind the University of Minnesota Coal Storage Facility. The monitoring site was established in 2006. This semi-elliptical tunnel is eight feet high and eight feet wide with a rounded top and slightly U-shaped base (Figure 22). The outfall drains water from approximately 765 acres of the City of Minneapolis and the University of Minnesota, Minneapolis Campus (Figure 23). Land use is primarily residential and commercial. There is continuous baseflow in this stormwater drainage system.



**Figure 22.** 6UMN outfall to the river

Level and discharge data for the 6UMN site are shown in Figure 24. Similar to other sites, level and discharge data at 6UMN were affected by high river levels. Tailwater was present in the tunnel from mid-May to mid-June (Figure 24).



**Figure 23.** 6UMN pipeshed boundary and monitoring site location

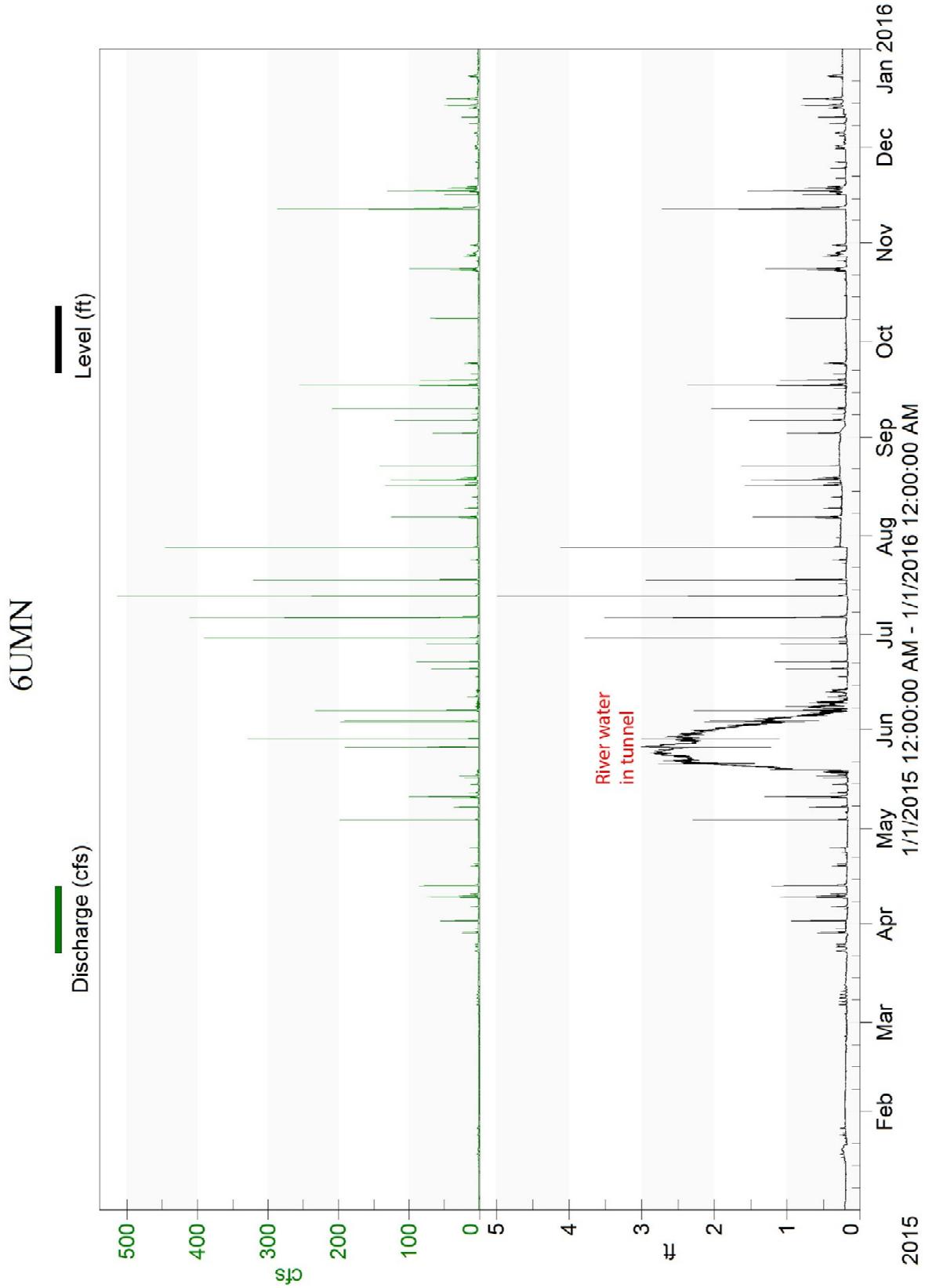


Figure 24. Discharge and level data for the 6UMN monitoring site in 2015

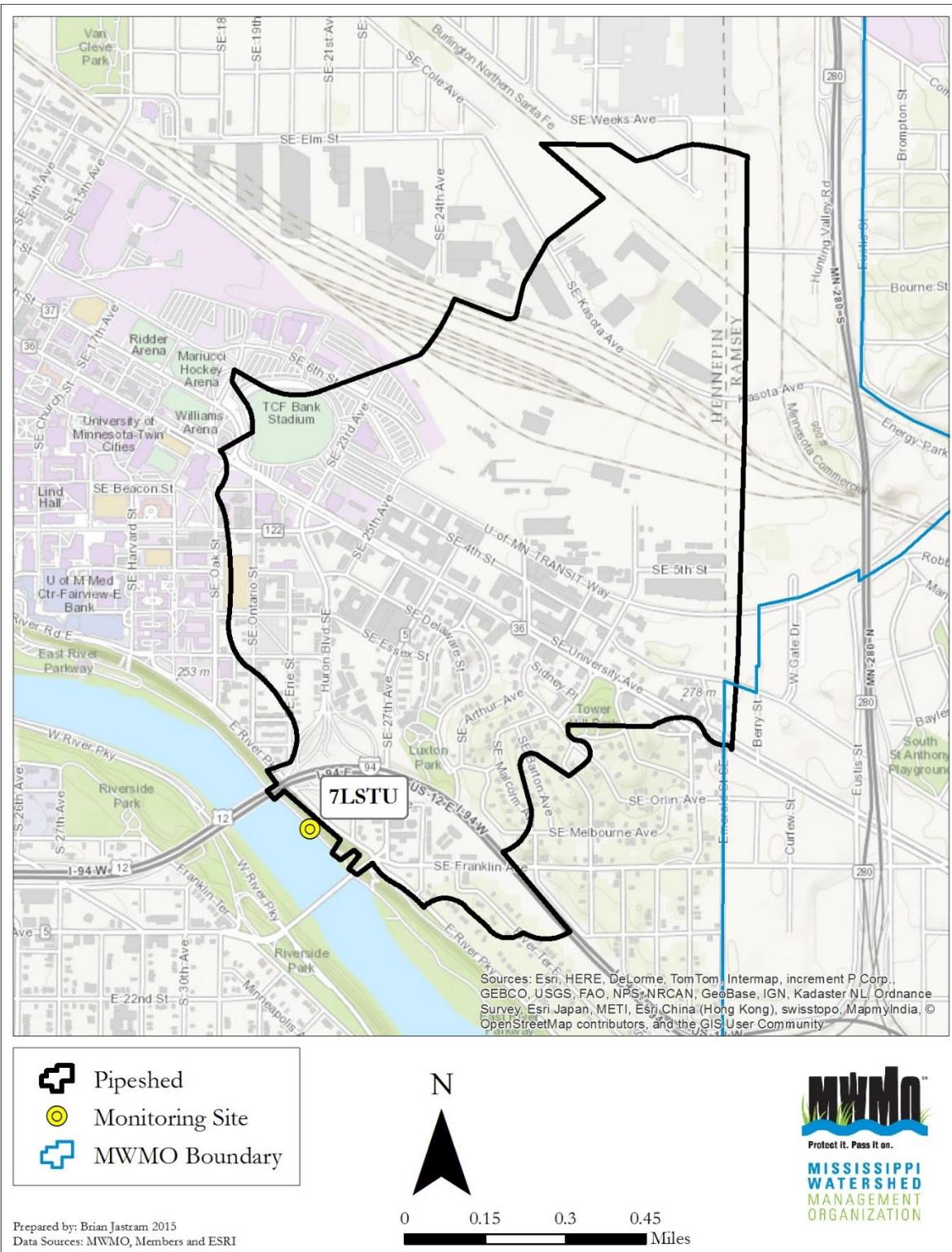
### **7LSTU (Bridal Veil Tunnel)**

7LSTU is the farthest downstream stormwater outfall monitored by the MWMO. The monitoring site was established in 2008 and is located on the east bank of the Mississippi River at RM 851.6, between the I-94 Bridge and Franklin Avenue Bridge. The cathedral-shaped tunnel is 10.37 feet high and 6.67 feet wide (Figure 25). At the mouth of the outfall, five square, concrete pillars baffle (slow) water flow, and an iron stilling basin captures floatable debris. The outfall drains water from approximately 600 acres of the City of Minneapolis and the University of Minnesota, Minneapolis Campus ([Figure 26](#)). Land uses within the pipeshed are a mix of residential, commercial, and industrial.



**Figure 25.** 7LSTU outfall to the river

The 7LSTU monitoring site is equipped with an automated sampler and area/velocity sensor; however, river water is almost constantly present in the tunnel, affecting level and discharge values. Therefore, level and discharge data are not displayed here but were used to determine appropriate times to take grab samples during events.



**Figure 26.** 7LSTU pipeshed boundary and monitoring site location

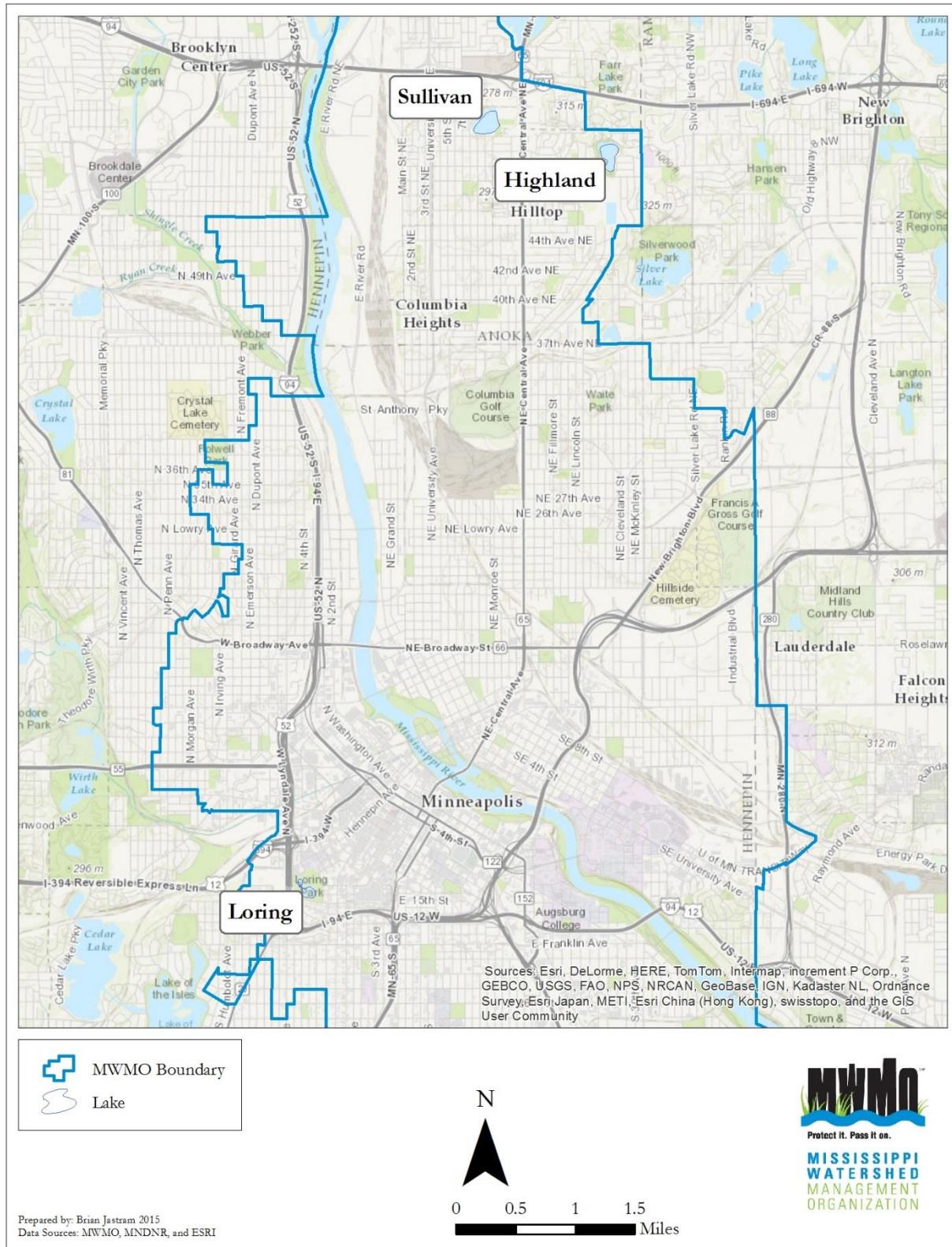
## Lake Monitoring

The MWMO has 3 lakes within its watershed boundary: Loring Pond in the City of Minneapolis, and Sullivan Lake and Highland Lake in the City of Columbia Heights ([Figure 27](#)). Since Loring Pond has been monitored by the Minneapolis Park and Recreation Board (MPRB) for several years, the MWMO did not monitor it during 2015. Previously, the MWMO monitored Loring Pond for *E. coli*; however, that monitoring was discontinued because the MPCA does not assess Loring Pond for *E. coli*. Refer to previous MWMO Annual Monitoring Reports at [www.mwmo.org](http://www.mwmo.org) for further details about MWMO historical monitoring at Loring Pond. MPRB data can be found in their Water Resources Reports found on the MPRB website (MPRB, 2015). Sullivan Lake, located in Columbia Heights, was historically monitored from 1993 to 2005 for water level, transparency, chlorophyll-a, and total phosphorus. The MWMO contracted the Anoka Conservation District (ACD) to conduct water elevation and water quality monitoring during 2013, to gain an understanding of more current lake conditions. Details of the history of Sullivan Lake monitoring, 2013 data, and historical water elevation data can be found in the Sullivan Lake Monitoring Report 2013 (MWMO, 2014). Sullivan Lake was monitored for water elevation only in 2015. Highland Lake was not monitored by the MWMO in 2015.

### Sullivan Lake Water Elevation Monitoring

A volunteer, in coordination with ACD, conducted weekly water level monitoring during 2015 between April 15 and August 5. A staff gauge is located on the west side of the lake near the outflow. It is surveyed each year by ACD and the Minnesota Department of Natural Resources (DNR) using datum NGVD 29 in feet. 2015 water elevation data, as well as all additional historical data, are available on the Minnesota DNR website using the “LakeFinder” feature at [www.dnr.state.mn.us/lakefind/index.html](http://www.dnr.state.mn.us/lakefind/index.html). The lake ID for Sullivan (Sandy) Lake is 02-0080.

Lake water elevation was measured 17 times during 2015. Sullivan Lake water elevations can fluctuate dramatically because it receives a large amount of stormwater relative to its size and its outlet releases water in all but the lowest water conditions. Water elevation data for 2015 are shown in [Figure 28](#). The Ordinary High Water Level (OHW), the elevation below which a DNR permit is needed to perform work, is 880.60 feet for Sullivan Lake. [Table 5](#) shows the average, minimum, and maximum water elevations of the lake for 2008 through 2015.



**Figure 27.** Lakes within the MWMO watershed



**Figure 28.** Water elevation at Sullivan Lake in 2015

**Table 5.** Average, minimum, and maximum water elevations in feet at Sullivan Lake from 2008 to 2015

Year	Average	Minimum	Maximum
2008	880.22	879.42	881.24
2009	879.92	879.36	880.52
2010	880.23	879.62	881.10
2011	880.36	879.29	881.25
2012	879.86	878.91	881.15
2013	880.00	879.23	880.93
2014	880.05	879.6	880.76
2015	880.11	879.69	880.85

## **Wetland Monitoring (Kasota Ponds)**

The MWMO monitored three locations in the Kasota Ponds wetlands (KP) in 2015. (See [Figure 32](#) for wetland sampling locations). In previous years, the MWMO monitored seven distinct locations at the three ponds. Statistical comparisons of data from all seven locations indicated that one site in each pond was sufficient to characterize water quality.

### **Site Descriptions**

**KPN (Kasota Pond North):** KPN is the northernmost pond. It is located west of Highway 280 and south of the intersection of North Hunting Valley Road and West Doswell Avenue. The area surrounding the pond is heavily vegetated with non-native species such as buckthorn and burdock. KPN is dense with cattails and aquatic plants during the summer months (Figure 29). The bottom of the pond contains organic matter, silt, and clay.



**Figure 29.** Kasota Pond North

**KPE (Kasota Pond East):** KPE is the largest of the ponds. It is also known as Mallard Marsh. It is located southwest of the intersection of Highway 280 and Kasota Avenue. There is a grassy buffer area surrounding most of the pond. Railroad tracks run alongside the west side of the pond, with approximately six feet of riprap between the tracks and the pond. Turtles, geese and ducks are frequently observed in KPE. This wetland is dense with cattails and aquatic plants during the summer months (Figure 30). The bottom of the pond contains organic matter, silt, and clay.

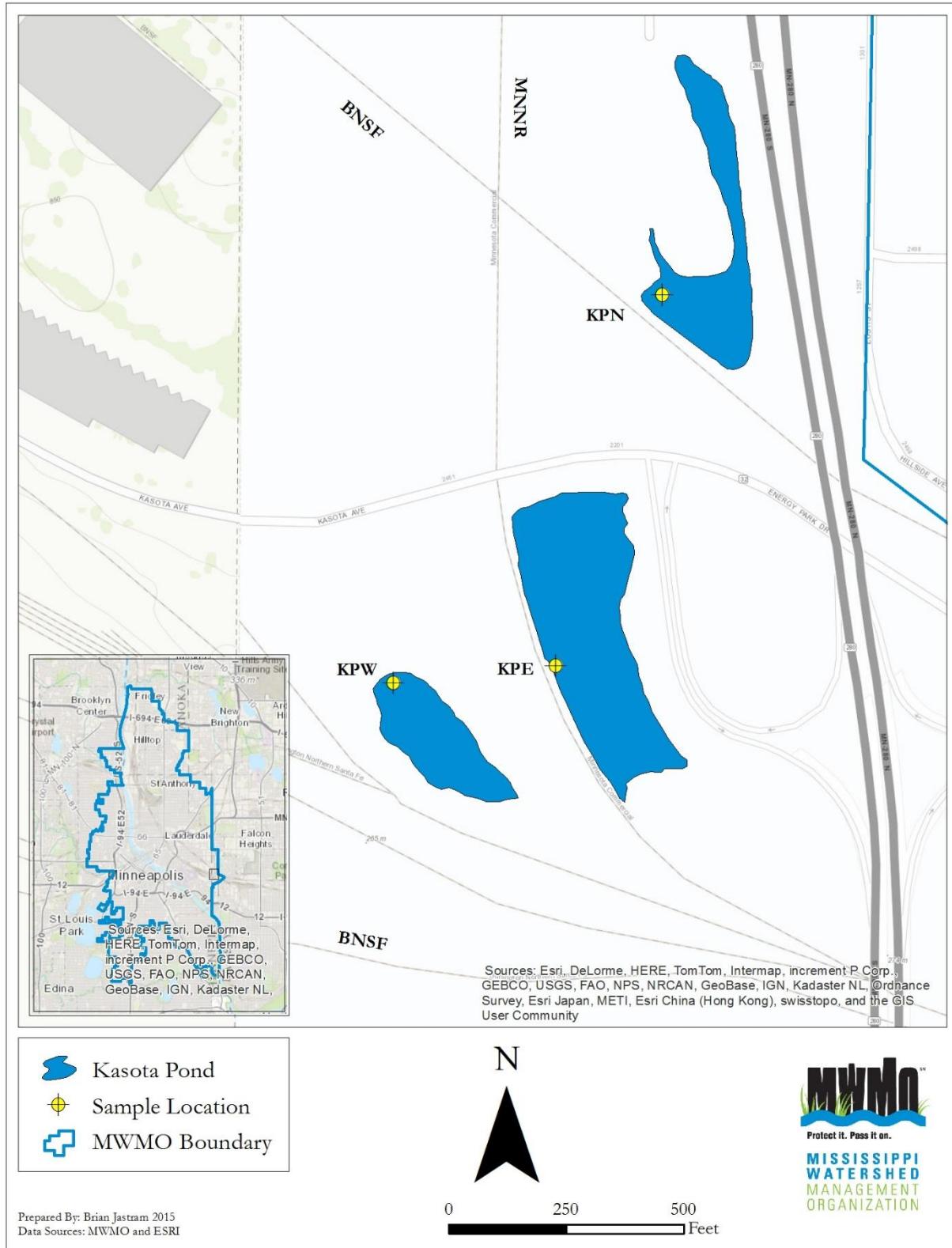


**Figure 30.** Kasota Pond East

**KPW (Kasota Pond West):** KPW is located just west of KPE. KPW receives runoff from a parking lot and the rail yard. Dense algal blooms are observed in KPW during the summer months, while other types of aquatic vegetation are seldom present in this pond (Figure 31). The pond has a sandy bottom.



**Figure 31.** Kasota Pond West



**Figure 32.** MWMO Kasota Ponds monitoring locations

## Bacteria Monitoring

### Mississippi River Bacteria Monitoring

The MWMO monitors seven locations in the Mississippi River. Six sites are MWMO long-term monitoring sites and are described in the following section. The seventh site—MR853.5E, located between Upper and Lower Saint Anthony Falls—was added in 2010 to provide data for development of the Upper Mississippi River Bacteria TMDL project that is managed by the MPCA. The monitoring sites are identified by the river mile upstream from the confluence of the Mississippi and Ohio Rivers in Cairo, Illinois, and from the nearest riverbank to the sample collection point. The “E” refers to the east bank and “W” refers to the west bank. The site with the highest river mile is the farthest upstream.

### Site Descriptions

**MR859.1W (Camden):** The Camden site is the northernmost bacteria monitoring site in the MWMO’s watershed. It is located in the North Mississippi Regional Park at the intersection of 53<sup>rd</sup> Avenue and North Lyndale in Minneapolis. The terrain surrounding the site is mostly deciduous forest with a grassland transition zone by the road. There is a concrete levy wall and boulders at the sampling site and an outfall just upstream. The river is shallow (three-five feet), rocky, and swift (in places) with sand and gravel bars up and downstream (Figure 33). Water levels fluctuate at this site more than at any other in the watershed. Storm events can raise the water level up to three feet. Waterfowl are commonly seen in the river and on shore. Rabbits, bald eagles, a Blanding’s Turtle and a beaver have also been observed.



**Figure 33.** MWMO bacteria sampling site MR859.1W (Camden) with staff gauge

**MR857.6W (MPRB Boat Launch):** 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, gravel, and large stones. The river is deeper here than at MR859.1W and can have a swift current after rainfall. The monitoring site is upstream of the dock foundation. It is located downstream of the mouth of Shingle Creek (Figure 34).



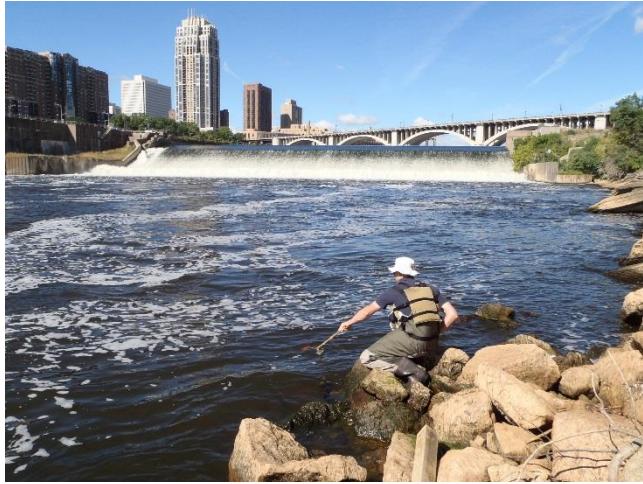
**Figure 34.** MWMO bacteria sampling site MR 857.6W (MPRB Boat Launch at North Mississippi Regional Park)

**MR854.9W (North Loop):** The North Loop site is downstream from the Plymouth Avenue Bridge. It is adjacent to a shaded park area with picnic tables, trails, grass, and trees. The riverbank 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 (Figure 35).



**Figure 35.** MWMO bacteria sampling site MR 854.9W (North Loop) with staff gauge

**MR853.5E (Saint Anthony Falls Laboratory):** The SAFL site is located between Upper and Lower Saint Anthony Falls. It is located near the bottom of the SAFL's outdoor stream laboratory. The shore is rocky (Figure 36).



**Figure 36.** MWMO bacteria sampling site MR853.5 (Near Saint Anthony Falls Laboratory)

**MR852.2E (University of Minnesota Boat Launch):** The University of Minnesota Boat Launch site is the first river site downstream from Lower Saint Anthony Falls. It is located in the Mississippi River Gorge, behind Coffman Union on the University of Minnesota East Bank Campus. The sampling site is 100 feet upstream of the boat launch and floating dock that is used by the rowing teams. The surrounding terrain consists of deciduous 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 (Figure 37). The site is a regular entrance point to the river for geese that graze on the grass in the open area. Goose droppings are common here.



**Figure 37.** MWMO bacteria sampling site MR852.2E (University of Minnesota Boat Launch)

**MR849.9W (Lake Street Bridge):** This site is located beneath the Lake Street Bridge over the Mississippi River. The elevation drops more than 70 feet from the street to the river. A small stormwater outfall and the Minneapolis Rowing Club boat facility are located just upstream of the site. There is tall grass along the river and trees on the sides of the gorge (Figure 38). There is a steep, three-foot riverbank leading to a rocky shore. The river bottom is sandy with limestone boulders and gravel (riprap).



**Figure 38.** MWMO bacteria sampling site MR849.9W (Lake Street Bridge)

**MR848.1W (4300 West River Parkway):** This monitoring site is the farthest downstream in the MWMO's watershed. 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 (Figure 39). Lock & Dam No. 1 is less than one mile downstream from the monitoring site.



**Figure 39.** MWMO bacteria sampling site MR848.1W (4300 West River Parkway) with staff gauge

## **Methodology**

### ***Sample Collection, Handling, and Preservation***

Grab samples were collected from three locations in the Kasota Ponds wetlands once a month throughout the year. Collection occurred away from shore, in approximately three feet of water. Samples were collected in laboratory-cleansed (non-sterile) four-liter plastic bottles. To collect samples, the monitoring specialist plunged an opened, inverted bottle one foot below the water surface, turned it upward to fill, and brought it out of the water. Dissolved oxygen, conductivity, salinity, water temperature, and pH data for each site were collected using a YSI ProPlus sonde (YSI Inc., Yellow Springs, OH). The multiparameter probe was placed in the water approximately one foot below the surface. Transparency was measured using a 100cm Secchi tube. When ice was present, staff conducted sampling activities by drilling a hole in the ice and using a capped, three-inch diameter PVC tube to collect the sample from the wetland.

### ***Sampling Quality Control***

The MWMO staff followed the quality control protocol outlined in the MWMO Ambient Surface Water Monitoring Quality Assurance Project Plan (MPCA, 2010). Blank samples of DI water were regularly submitted to the laboratory to verify that sample containers were clean and samples were not contaminated during travel. In addition, ten percent of all samples were collected in duplicate to verify that sampling and laboratory procedures did not jeopardize the data.

### ***Laboratory Analyses***

Samples were analyzed at the Metropolitan Council Environmental Services Laboratory. The laboratory followed strict protocols for quality assurance and quality control. Information regarding laboratory protocol is available from MWMO staff. Refer to [Table B.1](#) in Appendix B for a list of sample parameters, the laboratories used for analysis, the analysis methods, and information regarding certification.

## **Water Quality Monitoring Results**

The MWMO monitors the Kasota Ponds to characterize water quality in its wetlands. Samples are collected for nutrients, sediment, inorganics, and metals analyses. The MPCA water quality criteria indicate that wetland water quality should maintain background conditions. Background water quality has not yet been determined for MWMO wetlands. The data are presented in Tables E.1 – E.3 in [Appendix E](#).

## **Methodology**

### ***Sample Collection, Handling, and Preservation***

In 2015, grab samples were collected from seven locations in the Mississippi River (described above) and seven stormwater locations (see site descriptions in the Stormwater Monitoring section of this report) at least two times per month. Staff followed sampling procedures outlined in the MWMO's Standard Operating Procedure for Surface Water Sampling (2011). Samples were collected in lab-sterilized 125-milliliter (mL) plastic bottles. In the Mississippi River and at stormwater site 2NNBC, collection occurred away from shore, in approximately three feet of water. Samples were taken in positive flow (no back eddies or stagnant water) and upstream of the monitoring specialist to prevent contamination by the disturbed river bottom. To collect samples, the monitoring specialist plunged an opened, inverted bottle one foot below the water surface, turned it upward to fill, and brought it out of the water. At the other stormwater monitoring locations, the automated sampler was used to collect a grab sample. The grab sample was collected only after rinsing the sampler tubing three times. Samples were labeled, stored on ice in a cooler, and delivered to the laboratory by the monitoring specialist.

Dissolved oxygen, conductivity, salinity, water temperature, and pH data for each site were collected using a YSI ProPlus sonde (YSI Inc., Yellow Springs, OH). The multiparameter probe was placed in the water approximately one foot below the surface. Transparency was measured using a 100 cm Secchi tube.

### ***Sampling Quality Control***

The MWMO staff followed the quality control protocol outlined in the MWMO Ambient Surface Water Monitoring Quality Assurance Project Plan (MPCA, 2010). Blank samples of deionized (DI) water were submitted to laboratories at least four times in a year to verify that sample containers were clean and samples were not contaminated during travel. In addition, ten percent of all samples were collected in duplicate to verify that sampling and laboratory procedures did not jeopardize the data.

### ***Laboratory Analyses***

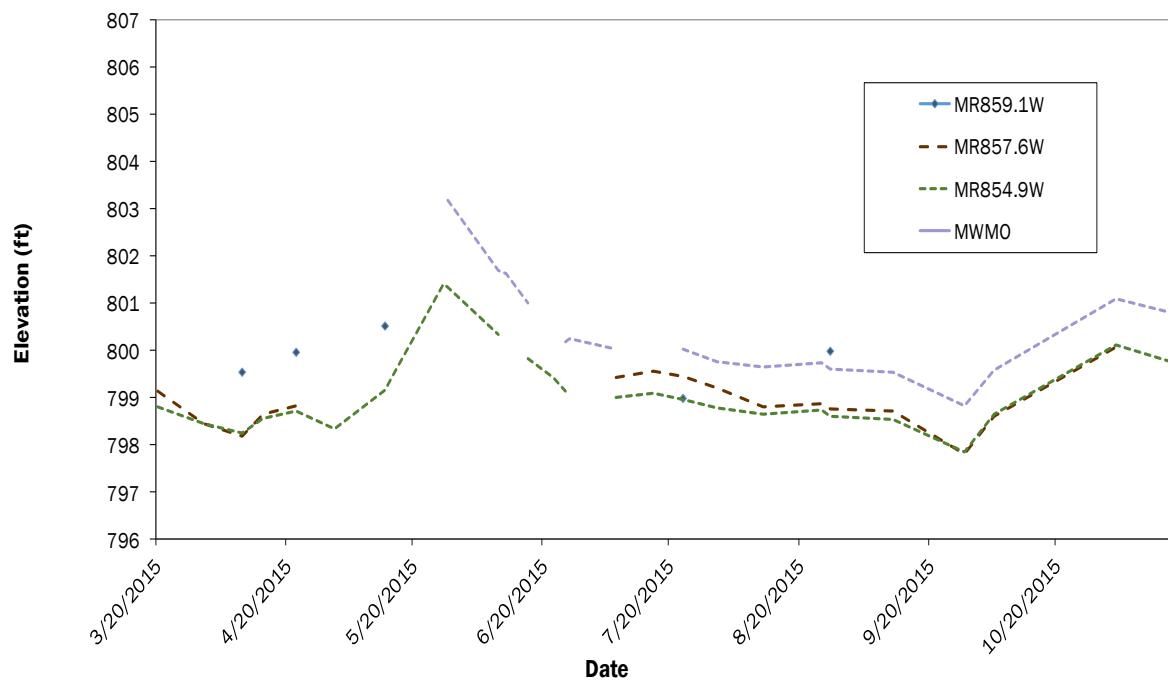
Bacteria samples were analyzed at the Three Rivers Park District Laboratory. The laboratory followed strict protocols for quality assurance and quality control. Information regarding laboratory protocol is available from MWMO staff.

Refer to [Table B.1](#) in Appendix B for a list of sample parameters, the laboratories used for analysis, the analysis methods, and information regarding certification.

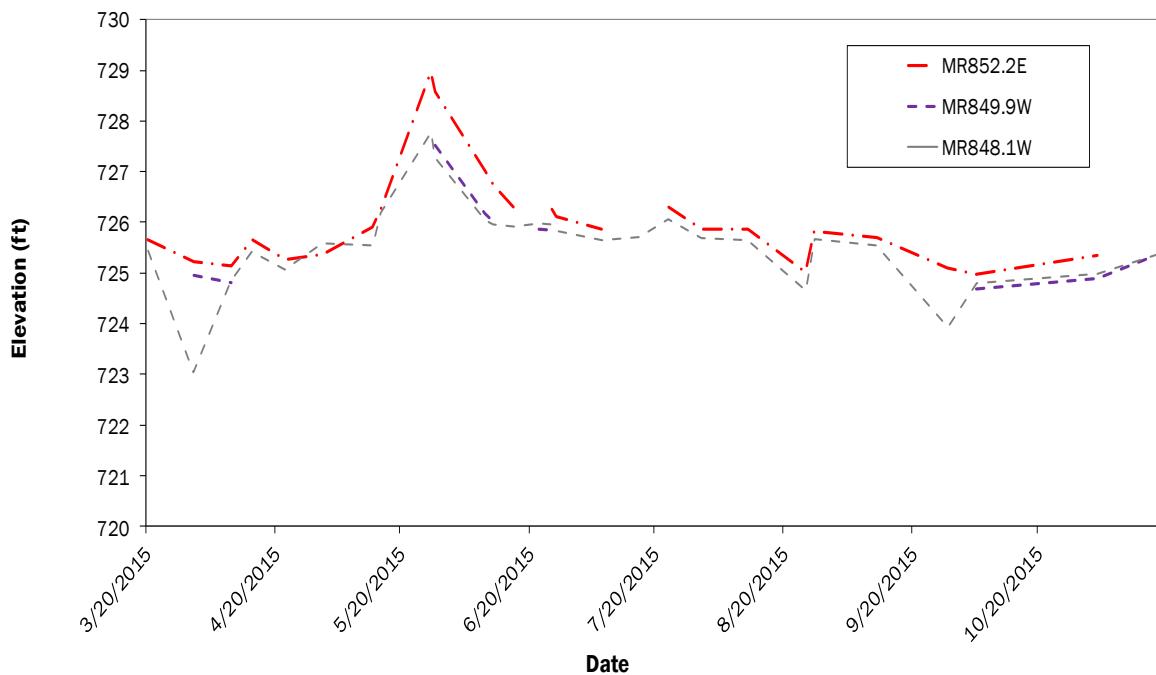
## Water Elevation Monitoring

The MWMO has monitored Mississippi River water elevations (commonly referred to as stage) at six of the bacteria sampling site locations since 2005. Mississippi River water elevations rise and fall in response to precipitation events and snow melt, and are also influenced by the dams at Saint Anthony Falls and Lock & Dam No. 1. Since the river pools behind the dams, control activities at the dam cause changes in river elevation, even in the absence of precipitation. The MWMO data are equivalent to data collected by agencies using the North American Vertical Datum, 1988 (NAVD88).

Staff gauges were installed on March 18, 2015. High flows in the spring of 2015 submerged and subsequently washed out some of the gages upstream of Saint Anthony Falls. The gauges were eventually replaced and additional gauges were installed at each site to accommodate both high and low flow conditions. Mississippi River water elevation data for the three monitoring locations above the Upper Saint Anthony Falls Lock and Dam are shown in Figure 40. Elevation data for the three sites below the lock and dam are shown in [Figure 41](#). Time periods with missing data were the result of either high river water levels (the staff gauges were submerged underwater) or low river water levels (water was below the lowest elevation of the staff gauge). Other gaps may be due to less frequent site visits to read a gauge compared with other gauge sites. Water elevation data were not recorded at site MR853.5E because of the site's close proximity to Saint Anthony Falls and deep water. The staff gauges were removed on November 17, 2015.



**Figure 40.** Mississippi River water elevations at four monitoring sites upstream of Saint Anthony Falls, including one near the MWMO office building at RM856.6



**Figure 41.** Mississippi River water elevations at three monitoring sites downstream of Saint Anthony Falls

## Mississippi River Bacteria Monitoring Results

### *E. coli*

Portions of the MWMO's reach of the Mississippi River are listed on the MPCA's list of impaired waters for fecal coliform pollution. In 2008, the MPCA changed the bacteria water quality standard from fecal coliform to *E. coli* for bacteria monitoring in Minnesota. The standard for *E. coli* in 2B and 2Bd waters is 126 CFU/100 mL for a monthly geometric mean of at least five samples. The MPCA *E. coli* standard also states that *E. coli* cannot exceed 1,260 CFU/100mL in more than 10% of the samples taken in one month. Three sites exceeded this latter standard in one or more months of 2015, as shown in [Table 6](#). However, the small number of samples collected each month greatly affected these results. The *E. coli* data are presented in more detail in [Figures C.1 through C.7](#) in Appendix C.

**Table 6.** Sites that exceeded 1,260 MPN/100mL in >10% of samples for the Mississippi River in 2015

Month	Sites that exceed 1,260 MPN/100 mL in > 10% of samples
April	None
May	None
June	MR849.9W, MR848.1W
July	None
August	None
September	MR857.6W
October	MR857.6W, MR849.9W
November	MR857.6W

Prior to 2013, the MWMO collected *E. coli* samples at river sites at least 5 times per month to compute a monthly geomean. During this time, data were being collected to contribute to the MPCA's TMDL assessment of the Upper Mississippi River. In early 2013, the MPCA released its Draft Upper Mississippi River Bacteria TMDL Study and Protection Plan (MPCA, 2013). This document designated the stretch of the Mississippi River within the MWMO as a Protection Reach and deferred it for a TMDL study. Although the reach is now under protection mode, the MWMO continued to sample *E. coli* at the 7 river sites at least twice per month during April through November of 2015, with the goal of maintaining a baseline of data. Refer to [Table C.1](#) in Appendix C for the monitoring data.

In previous years, the MWMO has targeted sampling equally during baseflow conditions and local rain events to ascertain the impact of precipitation on river bacteria levels. In 2015, monitoring staff began sampling consistently on every second and fourth Thursday of the month, regardless of precipitation conditions. In samples that happened to be taken during rain events, *E. coli* concentrations were typically an order of magnitude higher than baseflow values, but there were also instances of high baseflow values. Some potential causes of high baseflow *E. coli* values include water fowl congregating near the sampling site and sanitary overflow into the river. To lower the risk of exposure to high bacteria levels in the river, it is advisable to avoid swimming during rain and for 72 hours after a rain event.

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

As these results are highly dependent on precipitation, both in the watershed and upstream, 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 continue to collect data on the Mississippi River to provide information for development of TMDLs in the watershed.

#### ***Water Temperature, Dissolved Oxygen, pH, Transparency, Salinity, and Specific Conductivity***

The MWMO monitored dissolved oxygen, pH, water temperature, salinity, specific conductivity, and transparency at least two times per month throughout the 2015 sampling season at the river monitoring sites. 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 [Figures C.8 through C.14](#) in Appendix C for the monitoring data.

#### **Stormwater Bacteria Monitoring Results**

The MWMO monitors *E. coli* in the stormwater outfalls year round. Bacteria is sampled at stormwater outfalls concurrently with river bacteria sampling between April and November. In the winter months of December through March, the MWMO collects bacteria samples once a month during baseflow from those same outfalls. Stormwater site descriptions can be found in the Stormwater Monitoring section of this report. Sampling methods are detailed in the prior Methodology portion of this section. Rain sample *E. coli* concentrations were typically an order of magnitude higher than baseflow values, but there were also instances of high baseflow values. The most likely causes of high baseflow *E. coli* values are sanitary flow into the stormwater pipes or wildlife presence within the pipes. MWMO notifies the applicable member city when there are high baseflow *E. coli* values of concern. All stormwater *E. coli* data are shown in [Table C.2](#) in Appendix C.

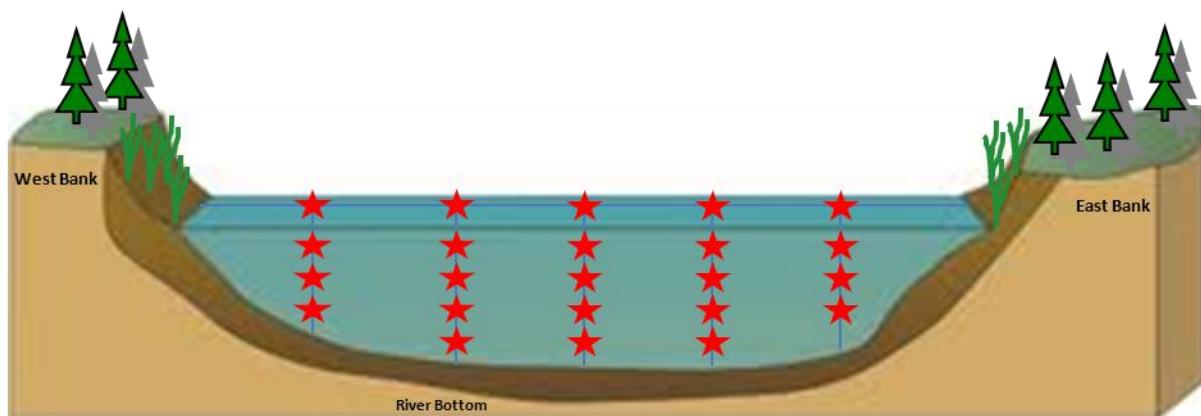
For the most part, both baseflow and stormflow bacteria concentrations appear to be higher at the stormwater sites than at the river sites. The data suggest that stormwater may be a large contributor of bacteria to the Mississippi River, particularly during storm events.

## Mississippi River Monitoring For Hydraulic Mixing

In 2006, the MWMO developed plans to better fulfill its responsibility for monitoring water quality in stormwater drainage systems and the Mississippi River (MWMO, 2006). For an accurate assessment of the water quality within the 14-mile stretch of the Mississippi River, the MWMO needed to know where, how, and when to sample the reaches of the river in the MWMO, given the patterns of hydraulic mixing as it passes through the watershed. The MWMO contracted Emmons & Olivier Resources, Inc. in 2006, to conduct a literature review to provide necessary information for the development of big river monitoring protocols (MWMO, 2008). The study provided findings and gaps in the hydraulic and pollutant mixing literature related to large river systems. Previously, there were no site specific data or models to address mixing in the MWMO's reaches of the Mississippi River.

In 2012-2015, the MWMO monitored the Mississippi River at five locations (cross-sections) in three different reaches to develop methods to fill hydraulic mixing data gaps in the 14-mile stretch of the Mississippi River in the MWMO.

In 2015, the MWMO continued monitoring the Mississippi River at the established five locations. Beginning in March, staff visited each cross-section 1-2 times per month through November. Each cross-section was divided into five lateral sections with mid-points equally spaced across the width of the river. Measurements were taken at the mid-points at three-foot depth increments starting at the water surface and ending just above the bottom of the river (Figure 42).

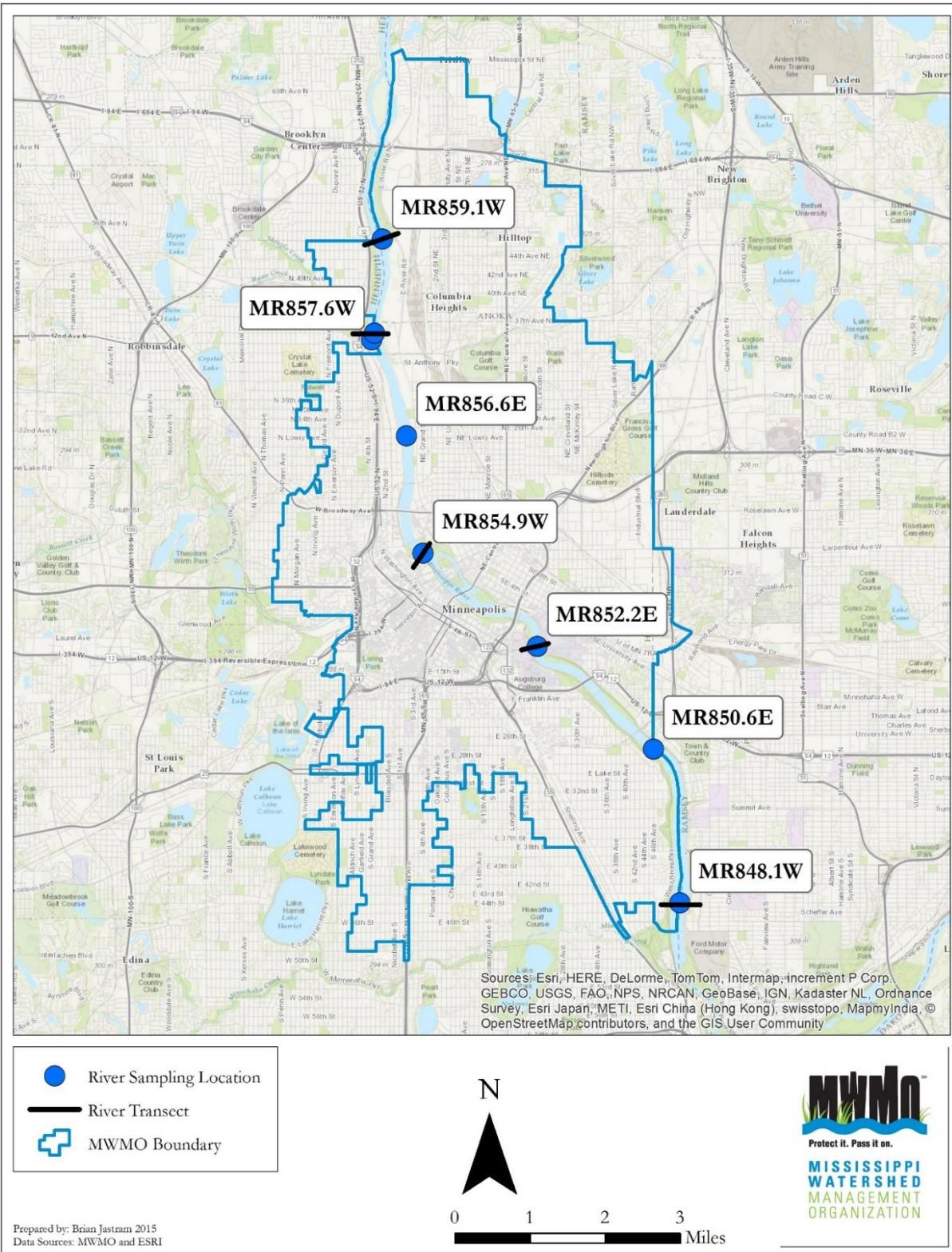


★ = Sampling Location

**Figure 42.** Diagram of a cross-section for river hydraulic mixing sampling. Each star represents a data collection point

### Site Selection

Figure 43 shows the locations of monitoring transects for hydraulic mixing. Site selection was based on the hydraulic characteristics of the four reaches in the 14-mile stretch of the Mississippi River in the MWMO (MWMO, 2008).



**Figure 43.** River hydraulic mixing transect sites and river water quality sampling locations. Hydraulic mixing transects are shown with the black lines. Water quality sites are shown with blue circles

## **Site (Cross-Section) Descriptions**

**MR859.1 (Camden):** This site is just upstream of the beginning of Reach #1 (RM 859.0-RM 857.8) and is the farthest upstream cross-section in the MWMO's watershed. The cross-section is 840 feet wide. The west end of the cross-section begins at monitoring site MR859.1W, near a concrete levy wall and a stormwater outfall, and terminates at the opposite bank. The river bottom is rocky.

**MR857.6 (2):** The west end of this cross-section is 200 feet upstream from the outlet of Shingle Creek and is marked by a triple stem *Populus sp.* (Maple) tree. It is located near the end of Reach # 1. The east end of the cross-section is marked by a *Populus sp.* (Cottonwood) tree with no bark on the bottom 10 feet of its trunk. The cross section is 525 feet wide. The river bottom is sandy and rocky.

**MR854.9 (2NNBC):** The west end of this cross-section is on the shore midway between the two farthest upstream barge tie-up piers. The east end of this cross-section terminates at the concrete steps on Boom Island. The cross-section is 575 feet wide and is near the end of Reach #2 (RM 857.8-RM 854.1). The river bed is silty and rocky.

**MR852.2 (Washington Avenue Bridge):** This cross-section is just downstream from the Washington Avenue Bridge and the beginning of Reach #4 (RM 853.4-RM 847.8) at Lower Saint Anthony Falls. The west end of this cross-section begins near the Bohemian Flats Park, next to the sheet pile wall in line with the park information pavilion. The east end of this transect terminates near a rectangular tunnel structure in the opposite bank. This cross-section is 525 feet wide. The river bottom is composed of sand, silt, and rocks.

**MR848.1 (6.1):** The west end of this cross-section begins at monitoring site MR848.1W (marked by a staff gauge) and terminates at the opposite bank near two small dead trees that are close together. This cross section is 1060 feet wide and is located near the end of Reach # 4. The river bottom is mostly sand.

Data were not collected from Reach #3 (RM 854.1 – RM 853.4), located between Upper and Lower Saint Anthony Falls, due to safety concerns.

## **Methodology**

### ***Data Collection and Results***

Each cross-section was divided laterally into five equal lengths, and measurements were taken at the mid-point of each ([Figure 42](#)) at three-foot depth increments from the water surface to the bottom of the river. Water temperature, pH, D.O., salinity, and specific conductivity data were collected using a multiparameter YSI ProPlus sonde mounted to a telescoping pole. Data were recorded when the values stabilized. The number of measurements made at each lateral position varied with the depth of the river. River sites were accessed with an 18-foot John boat, when conditions allowed. The water depth at site MR859.1 (Camden) is lower than at other sites; therefore, this site was monitored only when accessible by boat. Examples of results can be found in previous MWMO annual monitoring reports (MWMO 2015).

## **Mississippi River Water Quality Monitoring**

MWMO staff began collecting water quality samples from the Mississippi River during 2014. The purpose of monitoring the water quality of the Mississippi River is to establish baseline water quality data that can be used for the management of the river. In 2015, water quality measurements and samples were collected 1-2 times per month at eight sites (see [Figure 43](#) in previous section). Monitoring sites on the Mississippi River and within the MWMO's boundary were selected to represent three distinct reaches of the river. Each site is located within, at the beginning of, or at the end of a river reach. Samples were collected from the middle of the river, 3 feet below the surface as conditions allowed. Sampling occurred progressively from the most downstream site to the most upstream site.

### **Site Descriptions**

River water quality samples were taken at approximately the same locations as the hydraulic mixing monitoring transects. Refer to the site descriptions in the Hydraulic Mixing section of this report for details ([Figure 43](#)). At site MR857.6, an additional sample was taken downstream of where Shingle Creek enters the river. In addition, two new sites were added in August of 2015 to correspond with macroinvertebrate sampling sites related to a collaborative study with the Minneapolis Riverfront Partnership and the University of Minnesota with funding provided by the Legislative and Citizen's Commission on Minnesota's Resources. The new sites are located at MR850.6E (near Meeker Dam) and MR856.6E (near the MWMO office) ([Figure 43](#)). During winter months, some of the sampling locations were adjusted based upon access to open river water.

### **Methodology**

#### ***Sample Collection, Handling, and Preservation***

Samples were collected from the front of the boat in the middle of the river, three feet below the surface, using a Wildco® Beta Plus Horizontal Water Sampler (Wildco, Yulee, FL). The sampler was rinsed once with river water and then was filled two times to collect enough water to fill a laboratory-cleansed (non-sterile) eight-liter plastic bottle. The physical water parameters were collected from the river using a YSI ProPlus sonde (YSI Inc., Yellow Springs, OH) lowered into the water from the boat. The samples were stored in a cooler for transport to the laboratory. When boating to the sample site was not possible, samples were collected by lowering the Wildco® Beta Plus Horizontal Water Sampler from bridges or by filling a laboratory-cleansed (non-sterile) eight-liter plastic bottle from riverbanks.

#### ***Sampling Quality Control***

The MWMO staff followed the quality control protocol outlined in the MWMO Ambient Surface Water Monitoring Quality Assurance Project Plan (MPCA, 2010). Blank samples of DI water were submitted to laboratories regularly to verify that sample containers were clean and samples were not contaminated during travel. In addition, ten percent of all samples were collected in duplicate to verify that sampling and laboratory procedures did not jeopardize the data.

### **Laboratory Analyses**

All samples were analyzed at the Metropolitan Council Environmental Services (MCES) Laboratory. MCES followed strict protocols for quality assurance and quality control. Information regarding laboratory protocol is available from MWMO staff. Refer to [Table C.1](#) in Appendix C for a list of sample parameters, the laboratories used for analysis, the analysis methods, and information regarding certification.

### **Mississippi River Water Quality Monitoring Results**

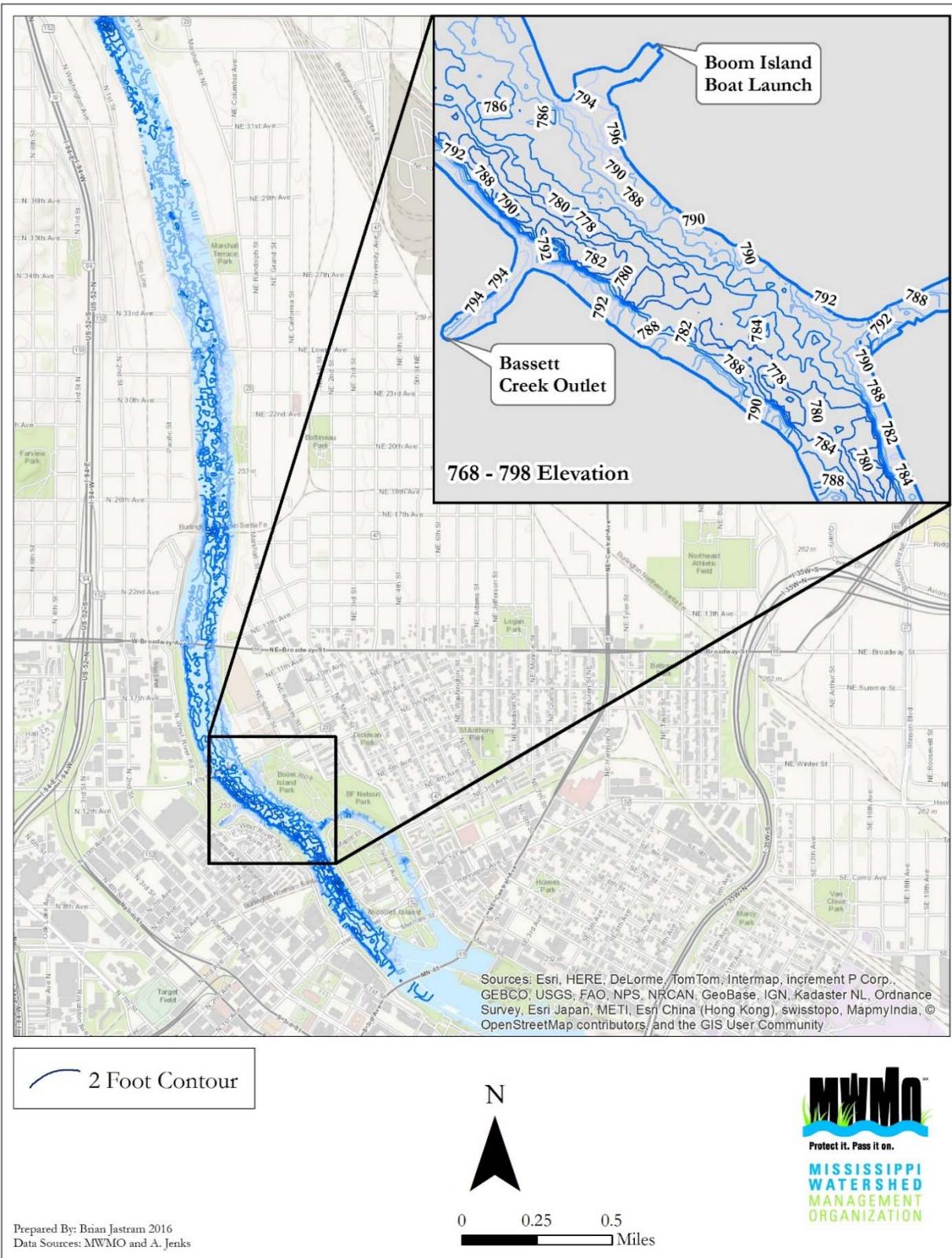
Samples were collected for nutrients, sediment, inorganics, organics, and metals analyses. Results are shown in [Tables F.1-F.8](#) in Appendix F.

### **Mississippi River Bathymetry Mapping**

The purpose of collecting Mississippi River bathymetric data is to provide baseline data on the Mississippi River. This mapping project recorded the morphology of the river bed. Rock piles, deep holes, navigation channels, dunes, pilings, and other structures were mapped. The mapping produced data that show one-foot contours, hardness, track, and vegetation.

### **Methodology and Results**

Data collection in 2015 began on June 2nd, and continued through June 9th. Data were collected on the Mississippi River between the upper Saint Anthony Falls Lock and Dam and the CPR Bridge just downstream from the N 42<sup>nd</sup> Ave Bridge. Bathymetric data were collected with a Lowrance HDS-5 Gen2 Fishfinder/Chartplotter (Navico, Inc., Minneapolis, MN) and stored on an SD card. A Lowrance Point-1 GPS/HDG Antenna (Navico, Inc., Minneapolis, MN) was used in combination with the HDS-5 to increase position accuracy. To facilitate efficient coverage of the area to be mapped, custom track files were loaded onto the HDS-5 and viewed on the chart. The boat was navigated along the course of custom parallel (25 meters apart) tracks covering the area between river banks. Data files were recorded for a maximum of one hour before starting a new file. The speed of the boat was kept at or below five miles per hour to ensure data quality. The recorded data files were uploaded to a BioBase (Navico, Inc., Minneapolis, MN) server via the ciBioBase Upload Tool and merged to form a single map of the river bottom ([Figure 44](#)).



**Figure 44.** Section of Mississippi River in the MWMO that was mapped as part of the bathymetry project. Inset image shows a section of resulting bathymetric data with elevation values displayed in feet

## **Work Plan**

### **2015 Work Plan Accomplishments**

Following is a list of work plan accomplishments for the year 2015:

- Completed the Annual Monitoring Report for 2014 (MWMO, 2015);
- Completed the initial pollutant loading calculations for the stormwater outfall sites;
- Collected precipitation data from five locations using heated precipitation gauges, two locations using non-heated gauges, and an additional non-heated gauge that is operated by a citizen volunteer;
- Continued to look for opportunities to expand the precipitation monitoring network using heated precipitation gauges and citizen precipitation recorders;
- Continued to monitor five stormwater sites using automatic samplers. The 2NNBC site was monitored by grab sampling when there was positive flow from the tunnel to the river. The 7LSTU site was monitored by automated or grab sampling depending on the presence of tailwater in the outfall;
- Continued monthly monitoring of three Kasota Ponds wetlands in St. Paul;
- Monitored seven sites on bi-weekly basis on the Mississippi River and seven stormwater sites for *E. coli* and submitted the data to the MPCA;
- Continued collecting water level data using a water level troll at the 2NNBC site to continuously monitor the water from the Old Bassett Creek tunnel to the Mississippi River;
- Prepared and signed a professional services agreement with Anoka Conservation District to coordinate water level monitoring for Sullivan Lake;
- Shared MWMO data through the MPCA's EQuIS database, the MWMO's annual monitoring report, and data requests;
- Developed a new contract with St. Anthony Falls Hydraulic Laboratory (SAFL) at University Of Minnesota to provide technical support for real time monitoring data network and other projects;
- Completed testing of low flow and high flow area velocity sensors in laboratory conditions at SAFL to verify the accuracy of measurements;
- Continued working on developing monitoring protocols for the Mississippi River through monitoring for hydraulic mixing and collecting data at five cross-sections on the river;
- Continued to sample the Mississippi River at six locations for water quality analysis and added two sampling locations, one in the middle of reach # 2 (between Upper St. Anthony Falls and Shingle Creek) and other one in the middle of reach # 4 (between Lower St. Anthony Falls and Lock and Dam #1);
- Collected Bathymetry data from the Upper St. Anthony Falls to Minneapolis Port section of the Mississippi River, right before the closure of Upper St. Anthony Falls Lock and Dam;
- Developed a new contract with the City of Minneapolis to continue assisting with their illicit discharge monitoring program and enhance their spill response activities;
- Continued to work with the MPCA on the Upper Mississippi River Bacteria TMDL Project and the Twin Cities Metro Area Chloride TMDL Project;
- Continued to work with the City of Minneapolis Health Department' staff to enhance their erosion and sediment control inspections program by providing funding to support two summer internships;

- Continued to work with the MWMO member cities and MWMO staff to assess monitoring needs and assist in developing additional monitoring plans for stormwater monitoring and lake monitoring;
- Worked with the Public Works Department staff from the City of Fridley and Project and Outreach Director from MWMO to install flow monitoring devices at two different locations in the 11CHF monitoring sites sub-watershed to collect water depth and flow data to enhance the calibration of Hydrologic and Hydraulic (H and H) model development;
- Installed flow monitoring devices at three different locations in the 1NE monitoring sites sub-watershed to collect water depth and flow data to enhance the calibration of Hydrologic and Hydraulic (H and H) model development;
- Continued to work with Capital Region Watershed District water quality monitoring staff to collaborate on monitoring work and confined space entry training;
- Collaborated with Minneapolis Riverfront Partnership on the Legislative Citizens Commission on Minnesota Resources (LCCMR) funded grant to assess the ecological impacts of St. Anthony Falls Lock Closure;
- Collaborated with Department of Bio-products and Biosystems Engineering at University of Minnesota to provide training in water resources monitoring for visiting scientists from Mizoram University in northeastern India; and
- Submitted abstracts, wrote technical papers, and presented papers titled “Water Resources Monitoring for an Urban Watershed” and “Integrated Watershed Management in a Highly Urbanized Setting” at 8<sup>th</sup> International Perspective on Water Resources and the Environment conference held from January 4-6, 2016 in Colombo, Sri Lanka.

## **2016 Work Plan**

The 2016 work plan for the MWMO’s monitoring program includes:

### **New Initiatives for 2016 monitoring season**

- Purchase necessary monitoring equipment and instrument St. Anthony Regional Treatment Research facility for evaluating the effectiveness of the innovative treatment technologies;
- Support Capital Improvement and Project implementation team to instrument the Edison High Phase 2 Stormwater Harvesting and Reuse project at the Edison high Football field and concession stand;
- Instrument the MWMO’s Stormwater Park and Learning center’s outdoor best management practices to monitor the effectiveness of the practices and use the instrumented facility for education and outreach;
- Support the MWMO and City of Minneapolis’s H and H Modeling effort by collecting flow monitoring data for specific sub watersheds;
- Purchase and become trained in on new monitoring database software (Kister’s WISKI). Begin implementation of new data management system, including migration of all historical data to the new database;
- Conduct biological surveys at the Kasota Ponds wetlands.

### **Ongoing monitoring efforts**

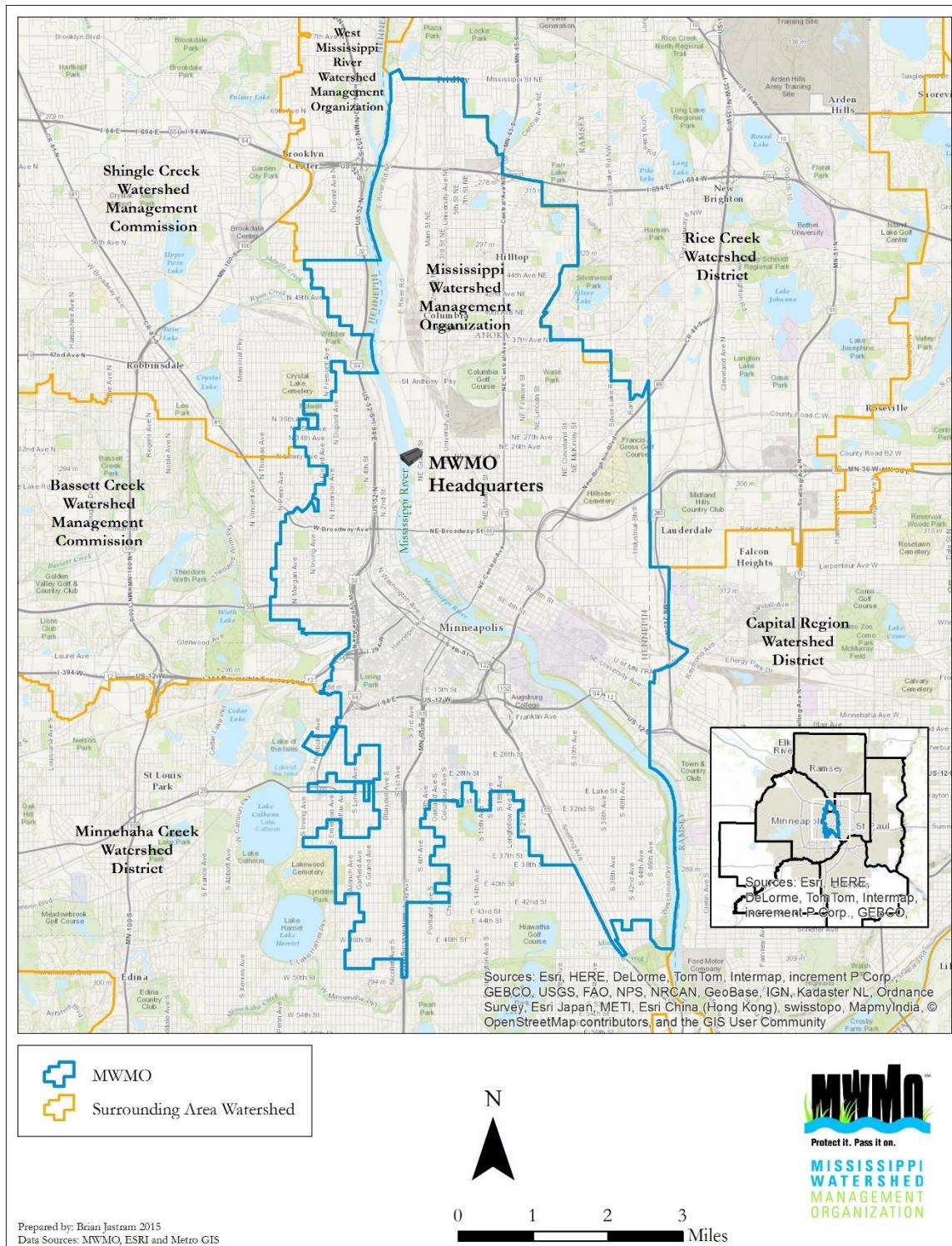
- Complete the Annual Monitoring Report for the 2015 monitoring season by March 31, 2016;

- Continue to work with the MWMO member cities to assess their monitoring needs and assist in developing additional monitoring plans for stormwater monitoring and lake monitoring;
- Continue to look for opportunities to expand the precipitation monitoring network using heated precipitation gauges and citizen precipitation recorders;
- Continue to monitor six stormwater outfall monitoring sites using automated samplers. The 2NNBC site will be monitored by grab sampling when there is positive flow from the tunnel to the river. The 7LSTU site will be monitored by automatic or grab sampling depending on the presence of tailwater in the outfall;
- Continue monthly monitoring of the Kasota Ponds wetlands in St. Paul;
- Continue biweekly monitoring of seven sites on the Mississippi River and seven stormwater sites for *E. coli* and submit the data to the MPCA;
- Continue development of monitoring protocols for the Mississippi River;
- Continue to sample the Mississippi River at eight locations for water quality analysis;
- Finalize the bathymetry data for the Mississippi River that was collected in fall 2014 and summer 2015 and collect additional bathymetry data in summer 2016;
- Continue working on pollutant loading calculations for the stormwater outfall sites;
- Continue to work with the MPCA on the Upper Mississippi River Bacteria TMDL Project and the Twin Cities Metro Area Chloride Project;
- Continue to work with the City of Minneapolis Health Department staff to enhance their erosion and sediment control inspections program;
- Share MWMO data through the MPCA's EQuIS database, the MWMO's annual monitoring report, and data requests.

## References

- Minneapolis Park and Recreation Board. 2014. Water Resources Reports at [http://www.minneapolisparks.org/park\\_care\\_improvements/water\\_resources/stormwater](http://www.minneapolisparks.org/park_care_improvements/water_resources/stormwater) (accessed 03/2016).
- Minnesota Pollution Control Agency. 2007. *Minnesota Statewide Mercury Total Maximum Daily Load*. Minnesota Pollution Control Agency, Saint Paul, MN, March 2007. 75 p. available at [www.pca.state.mn.us/publications/wq-iw4-01b.pdf](http://www.pca.state.mn.us/publications/wq-iw4-01b.pdf) (accessed 03/2016).
- Minnesota Pollution Control Agency. 2010. *Mississippi Watershed Management Organization Ambient Surface Water Monitoring Program Quality Assurance Project Plan*. 33 pp.
- Minnesota Pollution Control Agency. 2012. “TMDL Project: Upper Mississippi River – Bacteria”. *Minnesota’s Impaired Waters and TMDLs* available at <http://www.pca.state.mn.us/water/tmdl/upper-mississippi-river-bacteria-tmdl-project> (accessed 03/2016).
- Minnesota Pollution Control Agency. 2014. *Upper Mississippi River Bacteria TMDL Study & Protection Plan*. 283 pp. <https://www.pca.state.mn.us/sites/default/files/wq-iw8-08e.pdf> (accessed 3/2016).
- Mississippi Watershed Management Organization. 2007. *2006 Annual Monitoring Report*. 59 pp. available at [www.mwmo.org/reports/water-quality-monitoring](http://www.mwmo.org/reports/water-quality-monitoring) (accessed 03/2016).
- Mississippi Watershed Management Organization. 2008. *MWMO Big River Study Report*. 165 pp.
- Mississippi Watershed Management Organization. 2011. *Standard Operating Procedure for Stormwater Sampling*. MWMO SOP: Stormwater Sampling – 2011. 5 pp.
- Mississippi Watershed Management Organization. 2011. *Standard Operating Procedure for Surface Water Sampling*. MWMO SOP: Surface Water Sampling – 2011. 5 pp.
- Mississippi Watershed Management Organization. 2013. *Standard Operating Procedure for Data Processing*. MWMO SOP: Data Processing – 2013. 3 pp.
- Mississippi Watershed Management Organization. 2014. *Annual Monitoring Report 2013*. MWMO Watershed Bulletin 2014-1. 88 pp. available at [www.mwmo.org/reports/water-quality-monitoring](http://www.mwmo.org/reports/water-quality-monitoring) (accessed 03/2016).
- Mississippi Watershed Management Organization. 2014. *Sullivan Lake Monitoring Report 2013*. MWMO Watershed Bulletin 2014-4. 14 pp. available at [www.mwmo.org/reports/water-quality-monitoring](http://www.mwmo.org/reports/water-quality-monitoring) (accessed 03/2016).
- Mississippi Watershed Management Organization. 2015. *Annual Monitoring Report 2014*. MWMO Watershed Bulletin 2015-1. 107 pp. available at [www.mwmo.org/reports/water-quality-monitoring](http://www.mwmo.org/reports/water-quality-monitoring) (accessed 03/2016).

## Appendix A – Watershed Map



**Figure A.1.** MWMO watershed boundary, river monitoring sites for bacteria, and stormwater monitoring sites

## Appendix B – Laboratory Methods and Certification

**Table B.1.** Laboratory methods and certification for each analyte

Analyte	Lab	Method	Certified
Total Metals (Copper, Nickel, Lead, Zinc, Cadmium, Chromium, Mercury)	Metropolitan Council	EPA 200.8 with ATP, Rev. 5.4 (Mercury) EPA 245.7	Yes
Total Soluble Metals	Metropolitan Council	EPA 200.8 with ATP, Rev. 5.4 (Mercury) EPA 245.7	Yes
Total Chemical Oxygen Demand	Metropolitan Council	EPA 410.4 Rev 2.0	Yes
Carbonaceous Biological Oxygen Demand (CBOD) 5-Day	Metropolitan Council	SM 5210 B-2001, Hach 10360 Rev. 1.1	Yes
Total 5-day BOD	Metropolitan Council	SM 5210 B-2001, Hach 10360 Rev. 1.1	No*
Total Organic Carbon	Metropolitan Council	SM 5310 A & C	n/a
Total & Volatile Suspended Solids	Metropolitan Council	SM 2540 D and E - 1997	Yes
Total Dissolved Solids	Metropolitan Council	SM 2540 C	No
Total Alkalinity	Metropolitan Council	EPA 310.2, Rev. 1974	Yes
Total Hardness	Metropolitan Council	SM 2340 C-97	Yes
Total Chlorides	Metropolitan Council	SM 4500-CI E-97	Yes
Total Sulfates	Metropolitan Council	EPA 300.0 Rev 2.1	Yes

\*No = Indicates that the lab follows standard certification test methods but has not sought certification from the Minnesota Department of Health.

**Table B.1 continued.** Laboratory methods and certification for each analyte

Analyte	Lab	Method	Certified
Fluoride	Pace Analytical Services, Inc.	SM 4500-F SPADNS Method, Ref SM 20 <sup>th</sup> ed. P 4-82 and EPA 300.1, Rev. 2.1	Yes
Total Phosphorus plus Total Kjeldahl Nitrogen	Metropolitan Council	EPA 365.4 & EPA 351.2 Rev 2.0	Yes
Dissolved Phosphorus	Metropolitan Council	EPA 365.4	Yes
Orthophosphorus	Metropolitan Council	SM 4500-P E	Yes
Total Ammonia Nitrogen	Metropolitan Council	EPA 350.1 Rev 2.0	Yes
Nitrate & Nitrite Nitrogen	Metropolitan Council	4500 NO3 H-00	Yes
Total Volatile Organic Compounds	Metropolitan Council	EPA 624/625	Yes
Oil and Grease	Metropolitan Council	SM 5520 D	n/a
<i>E. coli</i>	Three Rivers Park District Water Resources Laboratory and Metropolitan Council	SM 9223 B and Colilert 18 with Quanti Tray/ 2000, IDEXX Laboratories, Inc.	Yes

## Appendix C –Bacteria Monitoring Data

**Table C.1.** Physical parameters and bacteria monitoring data for Mississippi River sites

River Mile	Sample Date	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	E. coli
			Sample Time	Temp (F)	Temp (F)	Oxygen (mg/L)	Conductivity (µS/cm)	Conductivity (µS/cm)	(cm)	(ppt)	(MPN/100 mL)
MR859.1W	3/31/2015 11:30	Base		55	45.0	15.42	252.1	381.5	8.69	> 100	0.18 < 1
MR859.1W	4/9/2015 11:28	Rain		38	43.5	13.63	228.1	354.0	8.32	19	0.17 210
MR859.1W	4/22/2015 11:06	Base		40	47.7	14.15	275.8	399.9	8.48	> 100	0.19 15
MR859.1W	5/13/2015 11:20	Base		50	57.6	11.12	330.8	416.5	8.07	89	0.20 44
MR859.1W	5/28/2015 11:23	Base		75	64.9	9.82	303.6	348.5	7.87	32	0.17 58
MR859.1W	6/9/2015 11:40	Base		75	72.0	8.94	367.6	388.5	7.90	35	0.19 111
MR859.1W	6/11/2015 11:35	Rain		75	71.6	8.43	379.4	402.4	7.93	43	0.19 86
MR859.1W	6/22/2015 12:01	Rain		70	75.2	7.73	386.6	394.3	7.92	50	0.19 488
MR859.1W	6/25/2015 11:57	Base		75	77.4	9.33	443.2	441.1	8.14	42	0.21 75
MR859.1W	7/9/2015 11:34	Base		60	75.9	8.79	443.8	449.0	8.19	85	0.21 102
MR859.1W	7/23/2015 11:59	Base		75	80.1	7.46	453.6	439.4	8.23	80	0.21 56
MR859.1W	8/13/2015 12:36	Base		70	79.2	2.09	456.2	446.1	8.16	79	0.21 272
MR859.1W	8/27/2015 11:10	Base		70	69.1	9.52	394.7	430.7	8.19	83	0.21 61
MR859.1W	9/14/2015 11:13	Base		60	68.9	9.88	415.7	454.5	8.10	91	0.22 90
MR859.1W	9/24/2015 10:31	Rain		60	68.9	8.53	351.1	384.1	7.97	> 100	0.18 260
MR859.1W	10/8/2015 11:27	Rain		50	61.7	9.98	330.0	393.9	8.22	> 100	0.19 687
MR859.1W	10/22/2015 11:48	Base		50	55.9	11.82	306.1	394.3	8.21	> 100	0.19 15
MR859.1W	11/12/2015 11:27	Rain		40	48.6	11.77	289.0	413.5	7.94	> 100	0.20 273
MR857.6W	3/31/2015 11:20	Base		55	44.2	15.11	270.2	414.0	8.61	> 100	0.20 7
MR857.6W	4/9/2015 11:17	Rain		38	43.5	13.21	270.7	420.1	8.24	36	0.20 326
MR857.6W	4/22/2015 11:07	Base		50	47.3	13.66	293.5	428.9	8.33	> 100	0.21 8
MR857.6W	5/13/2015 11:07	Base		50	57.0	10.85	355.9	452.0	8.01	78	0.22 49
MR857.6W	5/28/2015 11:10	Base		75	65.1	9.93	319.8	365.8	7.83	42	0.18 60
MR857.6W	6/9/2015 11:25	Base		75	72.1	8.76	387.3	408.4	7.94	38	0.20 129
MR857.6W	6/11/2015 11:15	Rain		75	71.6	7.72	401.0	425.7	7.91	34	0.20 276
MR857.6W	6/22/2015 11:57	Rain		70	74.8	8.03	407.4	417.3	7.80	49	0.20 1,046
MR857.6W	6/25/2015 11:44	Base		75	77.2	8.61	439.7	438.7	8.24	54	0.21 49
MR857.6W	7/9/2015 11:15	Base		60	74.7	8.77	421.6	432.8	8.16	98	0.21 60
MR857.6W	7/23/2015 11:40	Base		75	79.2	8.59	456.7	446.2	8.23	58	0.21 36
MR857.6W	8/13/2015 12:23	Base		70	78.4	2.54	428.4	421.9	8.17	88	0.20 365
MR857.6W	8/27/2015 11:05	Base		70	68.4	9.07	411.2	452.5	8.11	79	0.22 86
MR857.6W	9/14/2015 10:57	Base		60	67.5	9.19	384.1	427.2	8.02	84	0.21 79
MR857.6W	9/24/2015 10:15	Rain		60	68.4	8.40	389.5	428.7	8.00	> 100	0.21 1,643
MR857.6W	10/8/2015 11:14	Rain		50	60.8	9.08	368.1	444.8	8.08	> 100	0.22 1,733
MR857.6W	10/22/2015 0:04	Base		50	55.6	11.77	338.5	438.2	8.28	> 100	0.21 47
MR857.6W	11/12/2015 11:06	Rain		40	47.1	11.22	236.1	345.5	7.72	53	0.17 1,986

**Table C.1 continued.** Physical parameters and bacteria monitoring data for Mississippi River sites

River Mile	Sample Date	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity ( $\mu\text{S}/\text{cm}$ )	Specific Conductivity ( $\mu\text{S}/\text{cm}$ )	pH	Transparency (cm)	Salinity (ppt)	E. coli (MPN/100 mL)
	Sample Time										
MR854.9W	3/31/2015 11:00	Base	55	45.1	14.02	255.1	385.8	8.36	> 100	0.19	2
MR854.9W	4/9/2015 10:45	Rain	38	45.3	12.14	248.5	374.3	8.26	54	0.18	47
MR854.9W	4/22/2015 10:25	Base	50	48.0	12.41	280.0	404.4	8.16	63	0.20	5
MR854.9W	5/13/2015 10:45	Base	50	56.8	10.91	314.9	400.8	7.99	76	0.19	49
MR854.9W	5/28/2015 10:52	Base	75	64.9	9.77	290.7	333.1	7.91	38	0.16	99
MR854.9W	6/9/2015 11:10	Base	75	72.0	9.09	342.4	361.8	7.92	42	0.17	123
MR854.9W	6/11/2015 10:55	Rain	75	72.0	8.03	352.0	371.8	7.93	46	0.18	127
MR854.9W	6/22/2015 11:25	Rain	70	76.6	7.58	369.8	371.4	8.02	50	0.18	387
MR854.9W	6/25/2015 11:24	Base	75	78.1	8.50	406.0	401.3	8.15	55	0.19	44
MR854.9W	7/9/2015 10:53	Base	70	75.4	8.58	398.4	405.1	8.12	82	0.19	42
MR854.9W	7/23/2015 10:48	Base	75	79.9	7.23	407.2	395.1	8.16	46	0.19	37
MR854.9W	8/13/2015 10:58	Base	70	79.0	5.76	395.2	387.0	8.23	88	0.18	248
MR854.9W	8/27/2015 10:35	Base	70	72.0	8.03	352.0	371.8	7.93	47	0.18	64
MR854.9W	9/14/2015 10:38	Base	60	67.5	8.73	352.0	391.6	8.04	72	0.19	55
MR854.9W	9/24/2015 9:52	Rain	60	70.0	7.31	357.6	386.7	7.97	77	0.19	649
MR854.9W	10/8/2015 10:54	Rain	50	62.8	9.42	331.2	390.2	8.21	> 100	0.19	613
MR854.9W	10/22/2015 11:47	Base	50	57.2	10.40	320.0	404.9	8.21	> 100	0.20	55
MR854.9W	11/12/2015 10:42	Rain	40	70.3	6.61	356.4	383.2	7.89	> 100	0.18	411
MR853.5E	3/31/2015 10:20	Base	53	43.9	12.87	240.3	370.6	8.43	> 100	0.18	3
MR853.5E	4/9/2015 10:22	Rain	38	45.3	12.32	246.9	871.6	8.37	51	0.18	6
MR853.5E	4/22/2015 11:50	Base	45	47.5	12.26	265.5	386.4	8.23	57	0.19	8
MR853.5E	5/13/2015 10:25	Base	50	56.1	10.42	304.7	391.1	7.86	55	0.19	18
MR853.5E	5/28/2015 10:30	Base	75	64.4	11.72	261.1	301.3	7.85	35	0.14	41
MR853.5E	6/9/2015 10:20	Base	75	71.2	8.89	314.1	334.8	7.91	35	0.16	144
MR853.5E	6/11/2015 10:35	Rain	75	72.1	8.49	328.2	345.7	7.90	40	0.16	32
MR853.5E	6/22/2015 11:00	Rain	70	75.6	7.85	355.9	361.7	8.02	47	0.17	98
MR853.5E	6/25/2015 10:28	Base	75	76.3	7.85	383.4	386.1	8.10	40	0.18	33
MR853.5E	7/9/2015 10:30	Base	60	74.5	8.59	386.3	396.7	8.14	77	0.19	36
MR853.5E	7/23/2015 9:55	Base	75	78.6	7.78	388.3	382.0	8.22	57	0.18	20
MR853.5E	8/13/2015 10:02	Base	70	77.9	6.10	382.3	378.7	8.16	71	0.18	179
MR853.5E	8/27/2015 10:15	Base	70	75.6	7.85	355.9	361.7	8.02	62	0.17	39
MR853.5E	9/14/2015 10:15	Base	60	66.9	9.30	345.6	386.7	8.06	58	0.19	50
MR853.5E	9/24/2015 9:30	Rain	60	69.8	8.37	357.2	386.6	7.96	> 100	0.19	461
MR853.5E	10/8/2015 10:29	Rain	50	61.9	9.80	326.4	389.0	8.20	> 100	0.19	411
MR853.5E	10/22/2015 11:10	Base	50	57.2	10.62	308.0	390.3	8.30	> 100	0.19	39
MR853.5E	11/12/2015 10:23	Rain	40	48.2	11.81	247.9	356.9	7.90	> 100	0.17	461

**Table C.1 continued.** Physical parameters and bacteria monitoring data for Mississippi River sites

River Mile	Sample Date	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity ( $\mu\text{S}/\text{cm}$ )	Specific Conductivity ( $\mu\text{S}/\text{cm}$ )	pH	Transparency (cm)	Salinity (ppt)	<i>E. coli</i> (MPN/100 mL)
	Sample Time										
MR852.2E	3/31/2015 10:00	Base	45	44.4	12.87	263.6	403.3	8.39	> 100	0.19	43
MR852.2E	4/9/2015 10:00	Rain	38	45.3	12.34	238.4	359.6	8.33	56	0.17	93
MR852.2E	4/22/2015 10:34	Base	40	48.4	13.06	286.8	412.4	8.36	91	0.20	1
MR852.2E	5/13/2015 10:03	Base	50	55.8	11.20	314.3	406.2	7.77	89	0.20	105
MR852.2E	5/28/2015 10:05	Base	70	64.6	9.94	282.3	325.0	7.76	48	0.16	119
MR852.2E	6/9/2015 10:00	Base	75	71.2	9.10	357.9	381.6	7.83	34	0.18	156
MR852.2E	6/11/2015 10:10	Rain	75	71.4	8.69	354.1	376.3	7.80	51	0.18	588
MR852.2E	6/22/2015 10:33	Rain	70	74.5	8.19	328.1	337.4	7.84	45	0.16	649
MR852.2E	6/25/2015 10:10	Base	70	76.1	9.06	409.0	413.3	8.03	50	0.20	55
MR852.2E	7/9/2015 10:10	Base	70	73.9	9.22	409.3	423.1	8.05	71	0.20	93
MR852.2E	7/23/2015 9:00	Base	75	77.7	8.32	396.8	393.9	8.03	61	0.19	102
MR852.2E	8/13/2015 9:15	Base	70	77.2	7.13	402.7	402.2	8.03	69	0.19	63
MR852.2E	8/27/2015 9:55	Base	70	68.0	9.09	381.4	421.6	7.98	63	0.20	65
MR852.2E	9/14/2015 9:52	Base	60	66.9	9.12	361.4	404.5	7.84	68	0.19	83
MR852.2E	9/24/2015 9:05	Rain	60	69.8	9.15	367.2	397.8	7.91	90	0.19	687
MR852.2E	10/8/2015 10:07	Rain	50	63.0	9.25	345.4	405.5	8.05	> 100	0.20	984
MR852.2E	10/22/2015 10:28	Base	50	57.4	9.99	330.7	418.0	8.20	> 100	0.20	34
MR852.2E	11/12/2015 10:00	Rain	40	49.3	11.54	350.3	496.4	7.68	81	0.24	488
MR849.9W	3/31/2015 9:40	Base	45	44.6	13.14	249.4	380.2	8.57	> 100	0.18	1
MR849.9W	4/9/2015 9:40	Rain	38	44.6	13.41	216.3	329.8	8.47	25	0.16	461
MR849.9W	4/22/2015 9:32	Base	45	48.2	12.72	276.8	398.6	8.12	60	0.19	8
MR849.9W	5/13/2015 9:45	Base	50	55.4	10.94	310.0	402.3	7.80	84	0.19	33
MR849.9W	5/28/2015 9:50	Base	70	64.9	9.97	277.0	317.8	7.77	45	0.15	82
MR849.9W	6/9/2015 9:40	Base	70	71.4	9.01	328.2	349.2	7.87	34	0.17	115
MR849.9W	6/11/2015 9:50	Rain	75	72.0	8.36	333.2	352.3	7.81	47	0.17	613
MR849.9W	6/22/2015 10:09	Rain	70	73.6	8.12	287.5	298.7	7.79	42	0.14	1,733
MR849.9W	6/25/2015 9:52	Base	70	75.9	8.66	389.3	394.1	8.04	40	0.19	36
MR849.9W	7/9/2015 9:44	Base	60	73.9	8.74	394.0	407.4	8.00	66	0.19	65
MR849.9W	7/23/2015 8:40	Base	75	77.7	7.24	395.8	392.9	8.02	61	0.19	50
MR849.9W	8/13/2015 8:56	Base	70	78.3	7.10	394.5	389.1	8.11	74	0.19	167
MR849.9W	8/27/2015 9:35	Base	70	68.7	8.59	374.2	410.5	7.95	73	0.20	41
MR849.9W	9/14/2015 9:37	Base	60	68.0	8.78	357.4	395.4	8.03	68	0.19	41
MR849.9W	9/24/2015 8:41	Rain	60	70.2	9.16	354.2	381.7	7.93	84	0.18	1,203
MR849.9W	10/8/2015 9:45	Rain	50	63.0	10.33	338.1	396.9	8.04	> 100	0.19	1,986
MR849.9W	10/22/2015 10:08	Base	50	57.6	10.73	318.7	401.8	8.24	> 100	0.19	28
MR849.9W	11/12/2015 9:36	Rain	40	48.4	11.78	243.4	349.4	7.56	> 100	0.17	875

**Table C.1 continued.** Physical parameters and bacteria monitoring data for Mississippi River sites

River Mile	Sample Date	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	E. coli (MPN/100 mL)
	Sample Time										
MR848.1W	3/31/2015 9:11	Base	45	44.4	13.53	247.5	378.3	8.57	> 100	0.18	2
MR848.1W	4/9/2015 9:20	Rain	38	45.1	13.71	251.8	380.5	8.44	> 100	0.18	6
MR848.1W	4/22/2015 9:07	Base	45	48.9	12.09	279.1	397.2	7.77	91	0.19	6
MR848.1W	5/13/2015 9:25	Base	50	—	—	—	—	—	90	—	28
MR848.1W	5/28/2015 9:30	Base	70	64.9	9.93	282.2	323.6	7.64	45	0.15	60
MR848.1W	6/9/2015 9:20	Base	70	71.2	8.94	325.9	346.9	7.78	33	0.17	112
MR848.1W	6/11/2015 9:30	Rain	75	72.3	8.40	338.0	355.9	7.74	53	0.17	152
MR848.1W	6/22/2015 9:36	Rain	70	74.1	8.37	335.4	346.2	7.73	51	0.16	1,327
MR848.1W	6/25/2015 9:30	Base	70	75.6	8.45	389.4	395.3	7.96	41	0.19	40
MR848.1W	7/9/2015 9:26	Base	60	74.3	8.64	394.5	406.5	7.90	62	0.19	53
MR848.1W	7/23/2015 8:20	Base	75	78.1	7.33	400.8	396.0	7.87	55	0.19	34
MR848.1W	8/13/2015 8:35	Base	70	79.0	6.35	395.3	387.0	8.14	72	0.18	73
MR848.1W	8/27/2015 9:15	Base	70	69.4	8.56	375.6	408.6	8.04	79	0.20	41
MR848.1W	9/14/2015 9:18	Base	60	68.2	8.63	355.9	392.8	7.98	70	0.19	30
MR848.1W	9/24/2015 8:14	Rain	60	70.5	9.03	369.4	396.8	7.93	88	0.19	201
MR848.1W	10/8/2015 9:17	Rain	50	61.9	10.49	345.5	411.4	8.00	> 100	0.20	461
MR848.1W	10/22/2015 9:50	Base	50	57.2	10.63	319.7	405.2	8.25	> 100	0.20	46
MR848.1W	11/12/2015 9:10	Rain	40	48.7	11.78	236.5	338.2	7.82	87	0.16	770

**Table C.2.** Physical parameters and bacteria monitoring data for stormwater sites

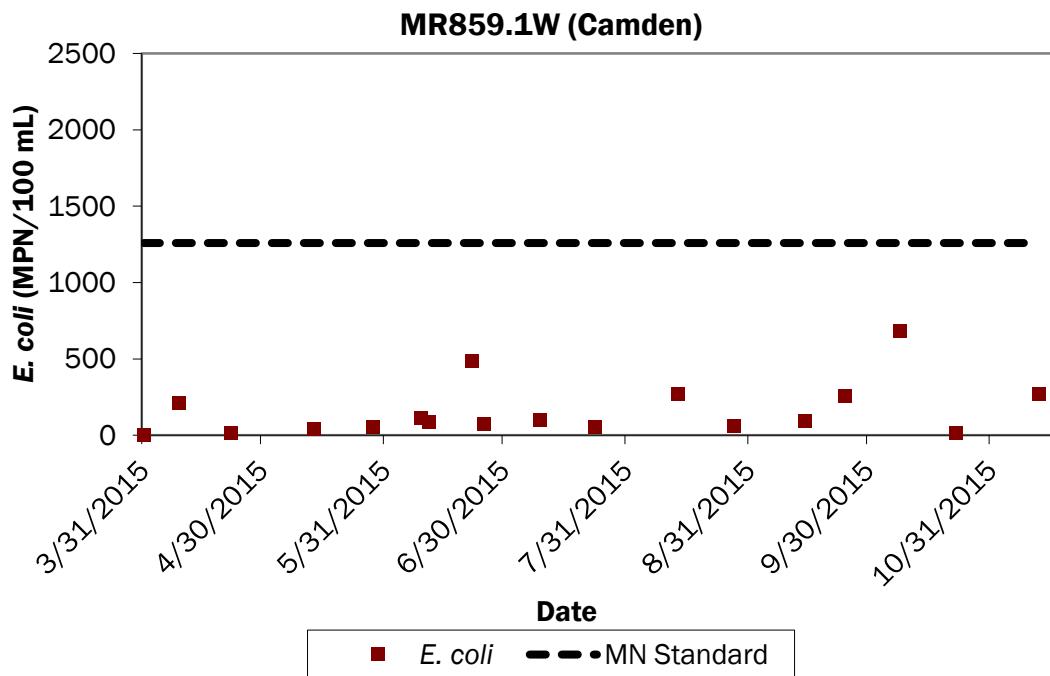
Site	Sample Date Sample Time	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	E. coli (MPN/ 100 mL)	Fluoride (mg/L)
10SA	2/9/2015 10:15	Base Grab	25	39.0	12.51	1,493.0	2,500.0	8.22	> 100	1.28	770	—
10SA	3/31/2015 9:50	Base Grab	35	42.8	11.60	1,432.0	2,248.0	8.12	36	0.25	125	—
10SA	4/9/2015 11:07	Rain Grab	40	42.1	12.94	543.0	862.0	8.10	19	0.07	370	—
10SA	4/22/2015 9:38	Base Grab	35	45.5	10.76	801.0	1,203.0	8.11	> 100	0.60	100	< 1.00
10SA	5/13/2015 10:10	Base Grab	50	53.1	10.94	459.1	615.6	8.08	17	0.30	180	0.95
10SA	5/28/2015 10:00	Base Grab	70	64.2	8.23	626.0	723.0	8.02	74	0.35	110	< 1.00
10SA	6/9/2015 11:12	Base Grab	75	64.0	7.75	601.0	687.0	7.76	95	0.34	60	—
10SA	6/11/2015 10:30	Rain Grab	70	63.3	8.36	236.8	276.8	7.79	36	0.13	1,790	—
10SA	6/22/2015 9:57	Rain Grab	70	70.0	7.75	165.0	178.3	7.65	40	0.08	4,610	—
10SA	6/25/2015 11:15	Base Grab	70	64.8	7.56	658.0	687.0	7.87	> 100	0.34	24	—
10SA	7/9/2015 10:04	Base Grab	75	66.0	8.85	681.0	771.0	8.13	> 100	0.38	80	0.12
10SA	7/23/2015 9:09	Base Grab	75	67.5	7.11	885.0	986.0	7.87	> 100	0.49	39	—
10SA	8/13/2015 11:20	Base Grab	70	72.0	5.20	396.7	419.0	8.15	90	0.20	1,110	0.16
10SA	8/27/2015 10:35	Base Grab	70	65.5	10.21	860.0	978.0	8.16	> 100	0.48	110	—
10SA	9/14/2015 9:45	Base Grab	60	65.8	10.41	480.5	545.0	8.20	> 100	0.26	240	0.23
10SA	9/24/2015 8:30	Rain Grab	60	66.0	8.56	131.5	148.8	7.58	61	0.07	24,200	—
10SA	10/8/2015 9:56	Rain Grab	55	60.4	9.34	194.1	235.5	7.56	41	0.11	> 24,200	—
10SA	11/12/2015 11:10	Rain Grab	40	47.7	11.50	160.0	232.5	7.58	—	0.11	6,130	—
11CHF	1/14/2015 9:20	Base Grab	20	47.1	12.13	684.0	1,000.3	7.68	> 100	0.50	< 1	—
11CHF	2/9/2015 9:05	Base Grab	25	37.2	12.80	582.0	1,008.0	7.61	7	0.49	< 1	—
11CHF	3/6/2015 8:51	Base Grab	20	38.5	12.40	1,508.0	2,547.0	7.42	> 100	1.31	2	—
11CHF	3/31/2015 8:55	Base Grab	35	45.7	11.08	827.0	1,240.0	7.61	> 100	0.62	14	—
11CHF	4/9/2015 11:44	Rain Grab	40	42.8	11.31	435.0	682.7	7.82	20	0.33	3,450	—
11CHF	4/22/2015 8:47	Base Grab	35	42.3	11.13	608.0	963.0	7.63	> 100	0.48	70	< 1.00
11CHF	5/13/2015 9:07	Base Grab	50	52.3	11.09	336.3	455.0	7.79	38	0.22	190	0.09
11CHF	5/28/2015 9:10	Base Grab	70	51.6	7.97	315.9	349.7	7.55	> 100	0.17	75	< 1.00
11CHF	6/9/2015 12:00	Base Grab	75	71.8	7.90	362.2	383.4	7.75	> 100	0.18	110	—
11CHF	6/11/2015 9:37	Rain Grab	60	63.3	8.44	189.5	221.8	7.42	52	0.11	3,870	—
11CHF	6/22/2015 9:00	Rain Grab	70	—	—	—	—	—	—	—	3,870	—
11CHF	6/25/2015 9:18	Base Grab	70	73.8	7.38	223.9	231.8	7.73	30	0.11	46	—
11CHF	7/9/2015 9:06	Base Grab	75	68.9	8.79	320.1	350.1	7.64	90	0.17	365	0.08
11CHF	8/13/2015 11:57	Base Grab	70	—	—	—	—	—	—	—	2,910	0.24
11CHF	8/27/2015 8:55	Base Grab	70	57.2	12.00	784.0	992.0	7.62	32	0.49	100	—
11CHF	9/14/2015 9:00	Base Grab	60	55.8	12.70	817.0	1,053.0	7.63	30	0.53	10	< 0.05
11CHF	9/24/2015 7:55	Rain Grab	60	66.0	9.31	120.4	136.2	7.67	31	0.06	14,140	—
11CHF	10/8/2015 9:32	Rain Grab	55	59.4	9.68	165.5	203.6	7.73	37	0.10	24,200	—
11CHF	10/22/2015 8:50	Base Grab	50	53.4	10.09	733.0	976.0	7.66	> 100	0.49	30	—
11CHF	11/12/2015 11:51	Rain Grab	40	48.2	10.83	108.2	155.7	7.85	—	0.07	5,790	—

**Table C.2 continued.** Physical parameters and bacteria monitoring data for stormwater sites

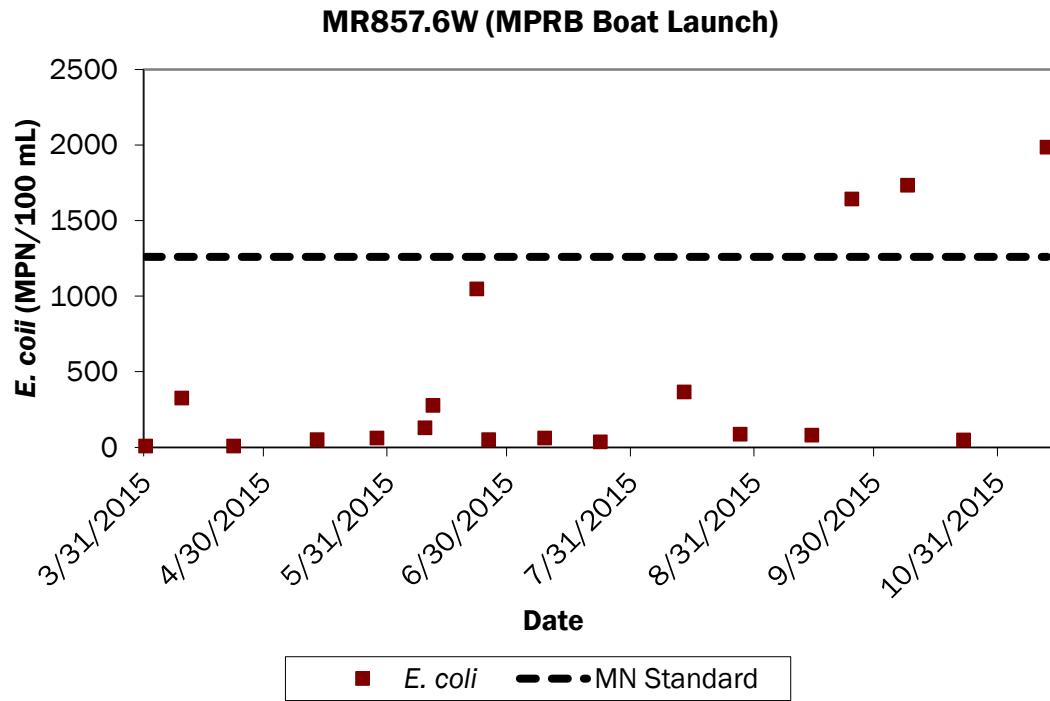
Site	Sample Date Sample Time	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	E. coli (MPN/ 100 mL)	Fluoride (mg/L)
1NE	1/14/2015 9:50	Base Grab	20	44.4	11.45	1,021.0	1,562.0	7.36	> 100	0.79	199	—
1NE	2/9/2015 9:36	Base Grab	25	41.2	12.17	975.0	1,573.0	7.80	> 100	0.79	> 2,420	—
1NE	3/6/2015 9:20	Base Grab	20	41.4	10.78	970.0	1,562.0	7.72	> 100	0.79	5	—
1NE	3/31/2015 9:20	Base Grab	35	45.0	11.73	1,021.0	1,546.0	7.79	98	0.78	> 2,420	—
1NE	4/9/2015 11:28	Rain Grab	40	41.9	13.16	380.6	606.1	8.03	10	0.29	1,140	—
1NE	4/22/2015 9:09	Base Grab	35	40.8	13.83	840.0	1,362.0	7.85	> 100	0.68	190	< 1.00
1NE	5/13/2015 9:38	Base Grab	50	48.4	11.80	945.0	1,357.0	7.80	> 100	0.68	5,170	0.20
1NE	6/9/2015 11:45	Base Grab	75	63.7	6.02	1,133.0	1,319.0	7.82	> 100	0.66	50	—
1NE	6/11/2015 10:02	Rain Grab	60	60.1	9.98	301.7	367.9	7.49	18	0.18	13,000	—
1NE	6/25/2015 10:06	Base Grab	70	56.3	12.19	1,090.0	1,395.0	7.71	> 100	0.70	> 2,420	—
1NE	7/9/2015 9:33	Base Grab	75	62.1	9.43	720.0	855.0	7.65	> 100	0.42	930	0.15
1NE	7/23/2015 11:07	Base Grab	75	59.7	10.79	1,113.0	1,365.0	8.00	> 100	0.69	1,986	—
1NE	8/13/2015 11:40	Base Grab	70	65.1	6.08	568.0	650.0	8.01	—	0.32	1,420	0.15
1NE	8/27/2015 9:45	Base Grab	70	59.0	11.34	1,107.0	1,396.0	7.91	> 100	0.69	8	—
1NE	9/14/2015 9:15	Base Grab	60	61.3	10.66	1,110.0	1,332.0	7.80	> 100	0.67	600	0.21
1NE	9/24/2015 8:05	Rain Grab	60	66.2	7.83	130.9	147.9	7.44	19	0.07	22,030	—
1NE	10/8/2015 9:10	Rain Grab	55	59.9	9.55	267.2	326.3	7.74	45	0.16	10,460	—
1NE	10/22/2015 9:04	Base Grab	50	56.8	9.78	1,073.0	1,366.0	7.63	> 100	0.69	1,660	—
1NE	11/12/2015 11:35	Rain Grab	40	49.3	12.01	279.7	396.7	7.55	31	0.19	1,780	—
2NNBC	2/9/2015 11:49	Base Grab	25	47.8	1.92	3,069.0	4,439.0	6.80	> 100	2.37	1	—
2NNBC	3/6/2015 10:45	Base Grab	25	41.9	6.36	2,255.0	3,594.0	7.46	82	1.89	613	—
2NNBC	4/9/2015 10:47	Rain Grab	40	41.5	11.62	293.7	470.8	7.82	9	0.23	860	—
2NNBC	4/22/2015 10:30	Base Grab	50	51.4	5.63	1,380.0	1,893.0	7.40	67	0.97	20	2.10
2NNBC	9/24/2015 10:25	Rain Grab	60	67.6	7.12	228.2	253.5	7.54	30	0.12	24,200	—
4PP	1/14/2015 10:50	Base Grab	20	50.0	10.47	1,225.0	1,719.0	8.30	24	0.87	< 1	—
4PP	2/9/2015 12:35	Base Grab	25	50.4	10.35	977.0	1,361.0	8.03	> 100	0.69	4	—
4PP	3/6/2015 11:10	Base Grab	25	49.8	11.19	940.0	1,321.0	8.02	> 100	0.66	20	—
4PP	3/31/2015 11:05	Base Grab	40	51.4	10.79	1,001.0	1,375.0	8.09	38	0.69	12	—
4PP	4/9/2015 10:30	Rain Grab	40	42.3	12.50	146.0	231.1	7.97	8	0.11	1,180	—
4PP	4/22/2015 10:05	Base Grab	45	51.6	11.11	975.0	1,336.0	7.82	> 100	0.67	20	< 1.00
4PP	5/13/2015 11:15	Base Grab	50	52.5	11.41	1,034.0	1,397.0	8.01	> 100	0.70	20	0.10
4PP	6/9/2015 10:45	Base Grab	75	—	—	—	—	—	—	—	180	—
4PP	6/11/2015 12:07	Rain Grab	70	59.9	9.11	598.0	731.0	7.62	~ 45	0.36	6,130	—
4PP	6/22/2015 11:08	Rain Grab	70	66.7	7.94	301.1	337.8	7.59	25	0.16	1,300	—
4PP	6/25/2015 10:58	Base Grab	75	57.2	10.63	1,158.0	1,468.0	7.98	> 100	0.74	76	—
4PP	7/9/2015 11:15	Base Grab	75	60.6	10.27	1,238.0	1,497.0	8.04	> 100	0.76	50	0.13
4PP	7/23/2015 10:15	Base Grab	75	60.4	9.44	1,086.0	1,318.0	8.03	> 100	0.66	49	—
4PP	8/13/2015 10:30	Base Grab	70	62.8	9.54	1,085.0	1,279.0	8.06	—	0.64	2,610	0.11
4PP	8/27/2015 11:38	Base Grab	70	60.8	11.22	1,122.0	1,356.0	7.99	> 100	0.68	170	—
4PP	9/14/2015 10:50	Base Grab	60	57.0	9.25	1,059.0	1,345.0	8.00	> 100	0.68	120	0.09
4PP	9/24/2015 10:05	Rain Grab	60	62.6	9.39	433.5	511.4	7.54	48	0.25	> 24,200	—
4PP	10/8/2015 11:17	Rain Grab	55	57.7	9.28	830.0	1,042.0	7.61	31	0.52	> 24,200	—
4PP	10/22/2015 11:30	Base Grab	50	54.3	9.88	1,026.0	1,350.0	7.96	> 100	0.68	80	—
4PP	11/12/2015 10:25	Rain Grab	40	49.6	10.22	601.0	848.0	7.36	69	0.42	2,100	—

**Table C.2 continued.** Physical parameters and bacteria monitoring data for stormwater sites

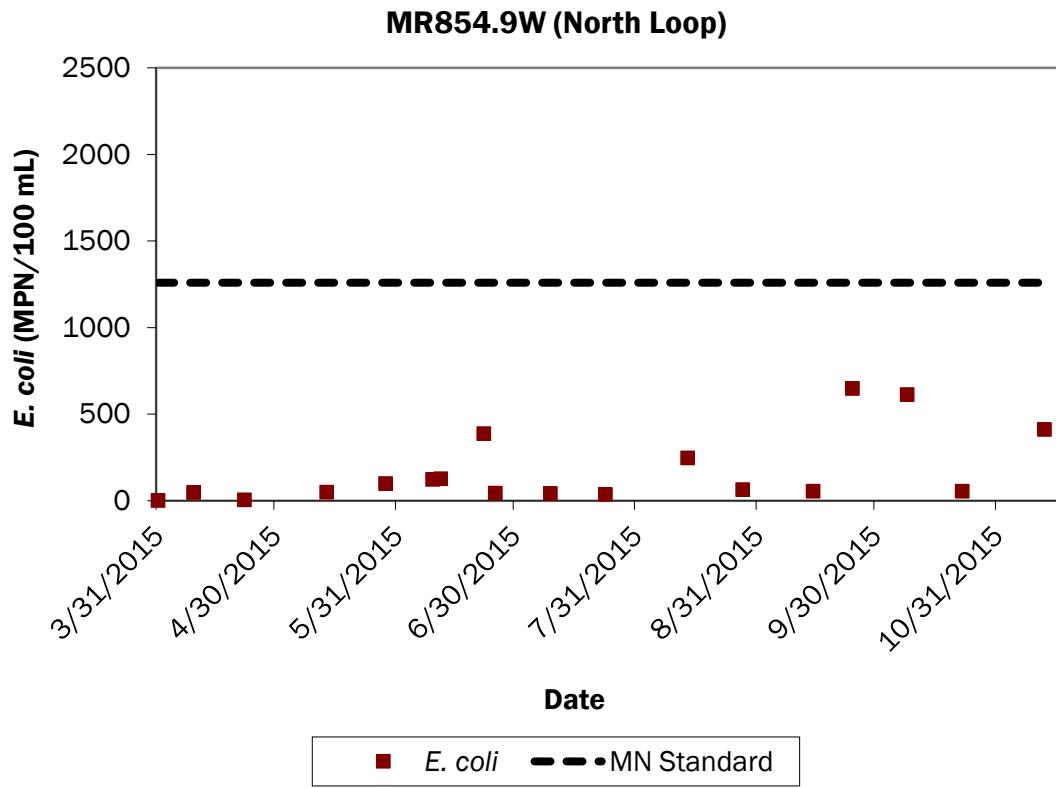
Site	Sample Date	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity ( $\mu\text{S}/\text{cm}$ )	Specific Conductivity ( $\mu\text{S}/\text{cm}$ )	pH	Transparency (cm)	Salinity (ppt)	E. coli (MPN/100 mL)	Fluoride (mg/L)
	Sample Time											
6UMN	1/14/2015 10:25	Base Grab	20	45.7	11.64	970.0	1,454.0	7.56	> 100	0.73	< 1	—
6UMN	2/9/2015 10:58	Base Grab	25	44.4	12.24	848.0	1,296.0	8.21	> 100	0.65	1	—
6UMN	3/6/2015 9:55	Base Grab	25	77.0	12.32	862.0	1,317.0	8.14	> 100	0.66	4	—
6UMN	3/31/2015 10:20	Base Grab	40	45.9	11.72	862.0	1,286.0	8.29	> 100	0.64	12	—
6UMN	4/9/2015 9:57	Rain Grab	40	41.4	12.95	90.7	146.0	8.17	3	0.07	160	—
6UMN	4/22/2015 10:03	Base Grab	35	42.3	12.85	794.0	1,257.0	8.16	> 100	0.63	30	< 1.00
6UMN	5/13/2015 10:40	Base Grab	50	52.0	12.17	901.0	1,225.0	8.16	> 100	0.61	20	0.21
6UMN	6/11/2015 11:28	Rain Grab	70	61.0	8.68	374.6	451.8	7.73	36	0.22	3,870	—
6UMN	6/22/2015 10:25	Rain Grab	70	68.5	8.41	184.7	202.8	7.73	21	0.10	3,260	—
6UMN	6/25/2015 11:49	Base Grab	70	60.3	9.97	930.0	1,132.0	7.92	> 100	0.57	44	—
6UMN	7/9/2015 10:37	Base Grab	75	58.8	10.12	1,061.0	1,316.0	8.10	35	0.66	15	0.18
6UMN	7/23/2015 9:25	Base Grab	75	59.9	10.39	1,051.0	1,283.0	8.05	> 100	0.64	88	—
6UMN	8/13/2015 9:35	Base Grab	70	63.3	9.11	1,013.0	1,184.0	7.80	> 100	0.59	460	0.21
6UMN	8/27/2015 11:05	Base Grab	70	59.7	11.51	1,055.0	1,292.0	8.06	> 100	0.65	20	—
6UMN	9/14/2015 10:15	Base Grab	60	59.4	10.90	1,025.0	1,262.0	8.08	> 100	0.63	< 10	0.02
6UMN	9/24/2015 8:50	Rain Grab	60	63.9	9.04	240.4	279.3	7.55	27	0.13	3,650	—
6UMN	10/8/2015 10:45	Rain Grab	55	58.8	9.49	6.3	780.0	7.65	> 100	0.38	1,150	—
6UMN	10/22/2015 10:45	Base Grab	50	54.7	8.92	948.0	1,241.0	8.05	> 100	0.62	< 10	—
6UMN	11/12/2015 9:25	Rain Grab	40	49.1	11.63	336.4	478.1	7.37	57	0.23	2,180	—
7LSTU	4/9/2015 9:18	Rain Grab	40	40.8	13.42	178.8	289.9	7.89	3	0.14	470	—
7LSTU	9/24/2015 9:40	Rain Grab	60	64.9	8.91	451.5	517.6	7.56	10	0.25	6,870	—



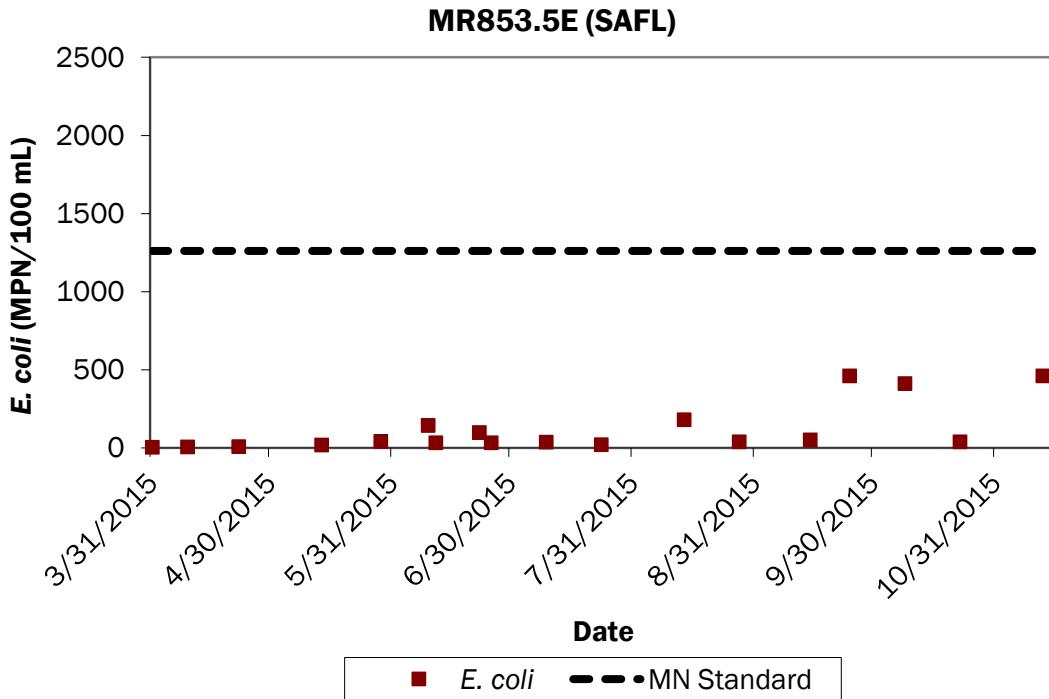
**Figure C.1.** *E.coli* data for MR859.1W



**Figure C.2.** *E.coli* data for MR857.6W



**Figure C.3.** *E. coli* data for MR854.9W



**Figure C.4.** *E. coli* data for MR853.5E

### MR852.2E (University of Minnesota Boat Launch)

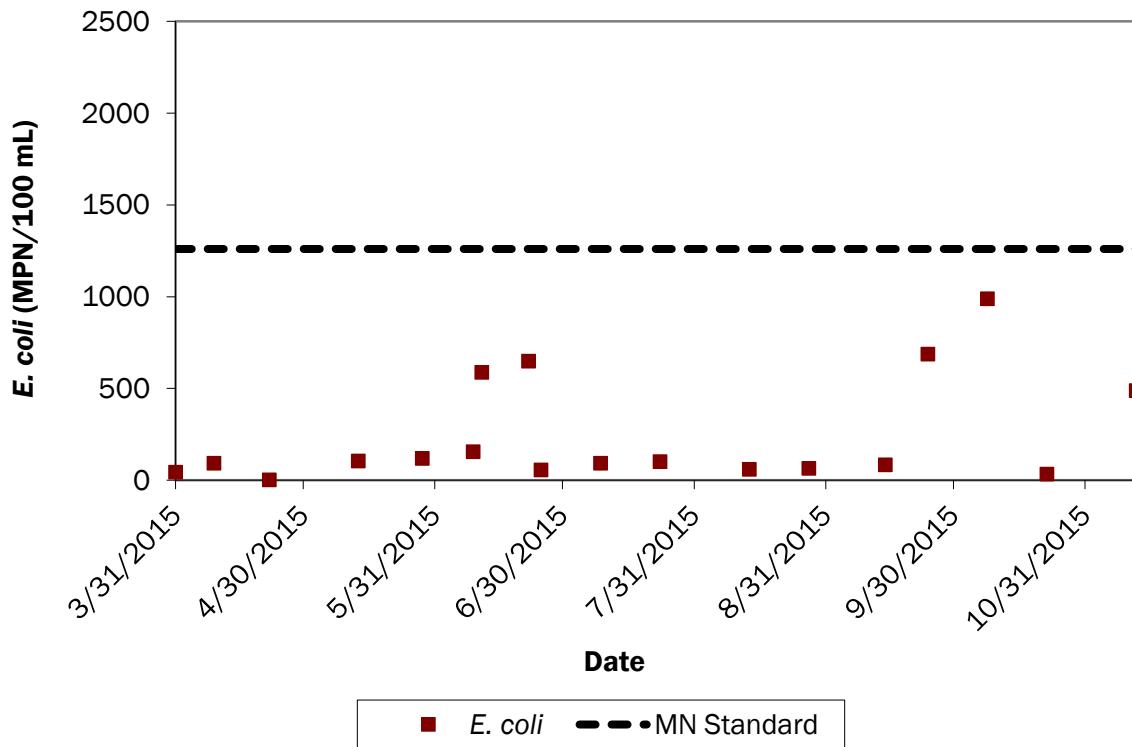


Figure C.5. *E. coli* data for MR852.2E

### MR849.9W (Lake Street Bridge)

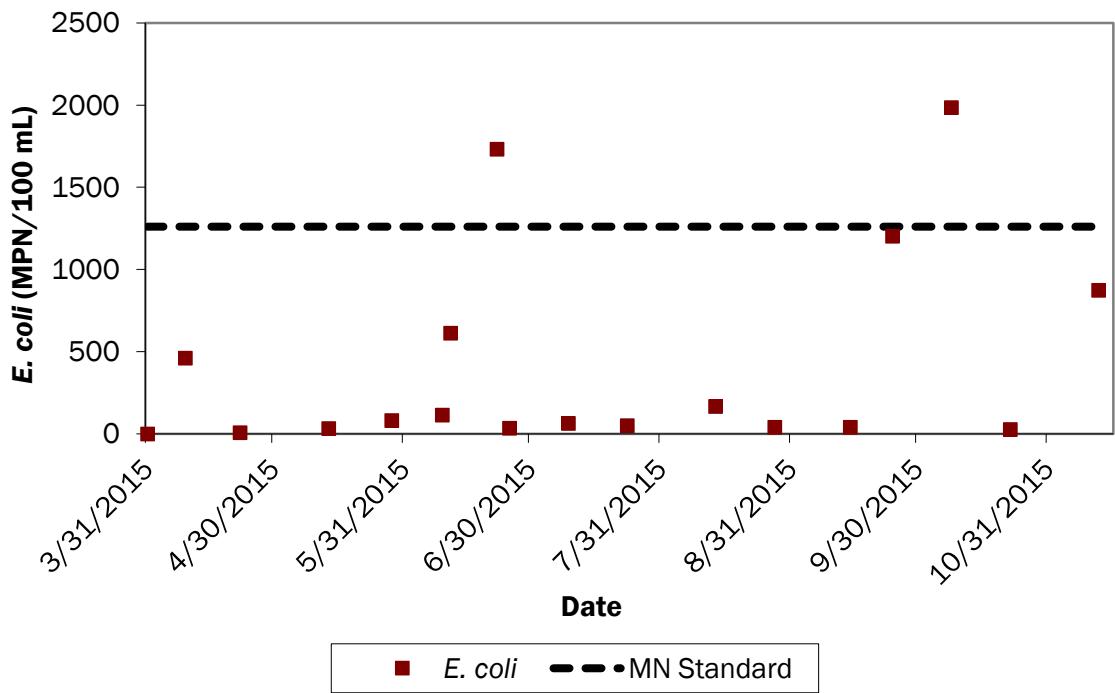
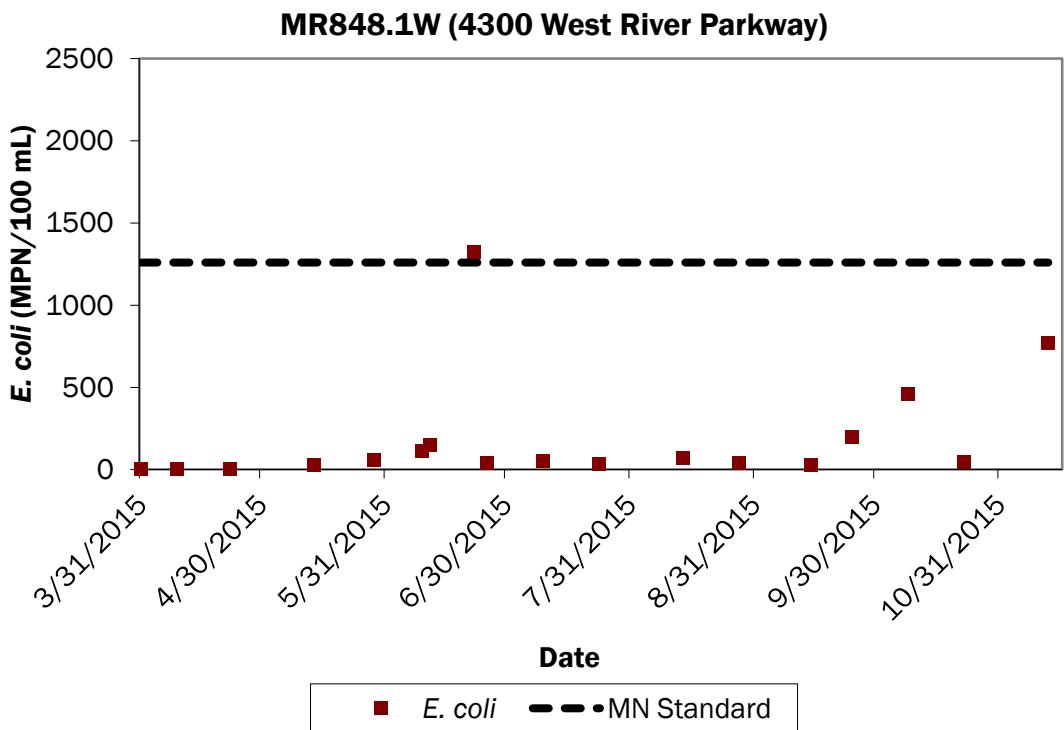
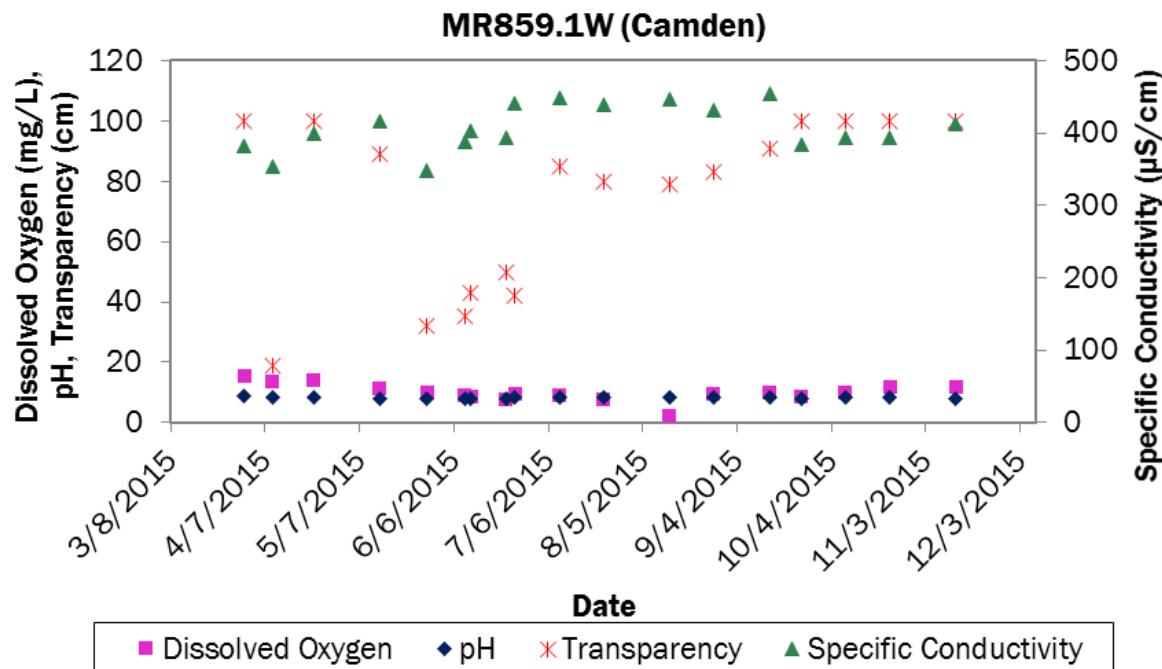


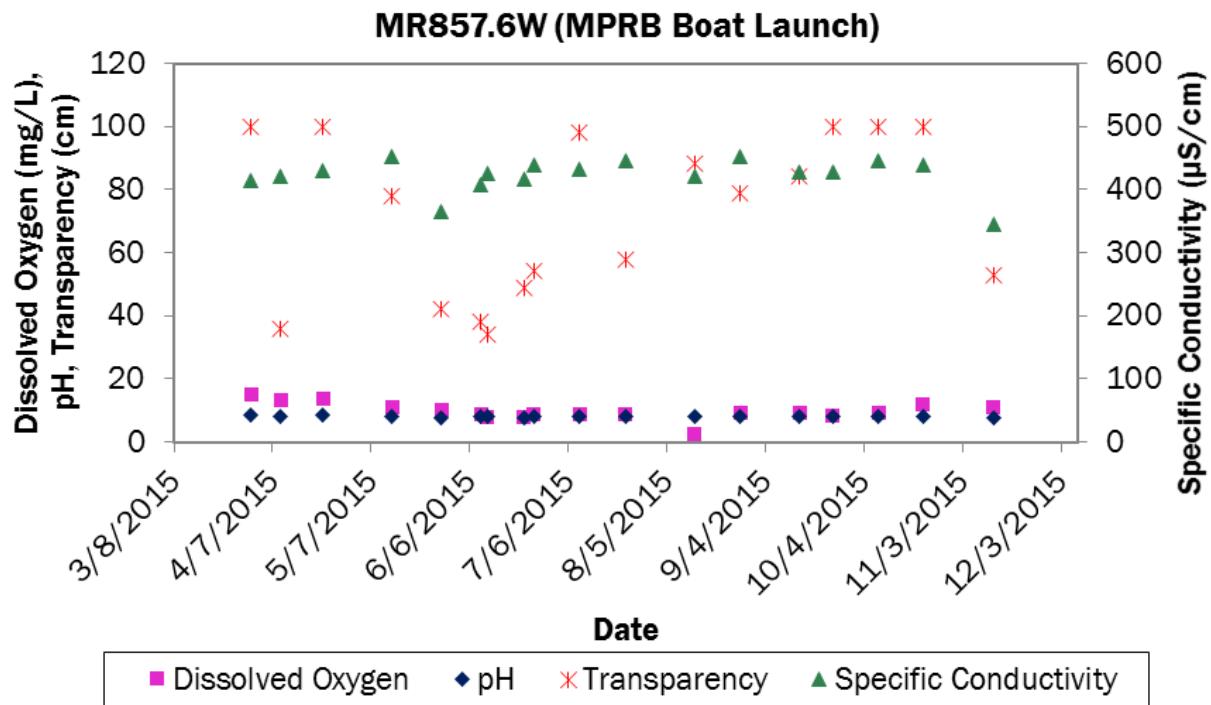
Figure C.6. *E. coli* data for MR849.9W



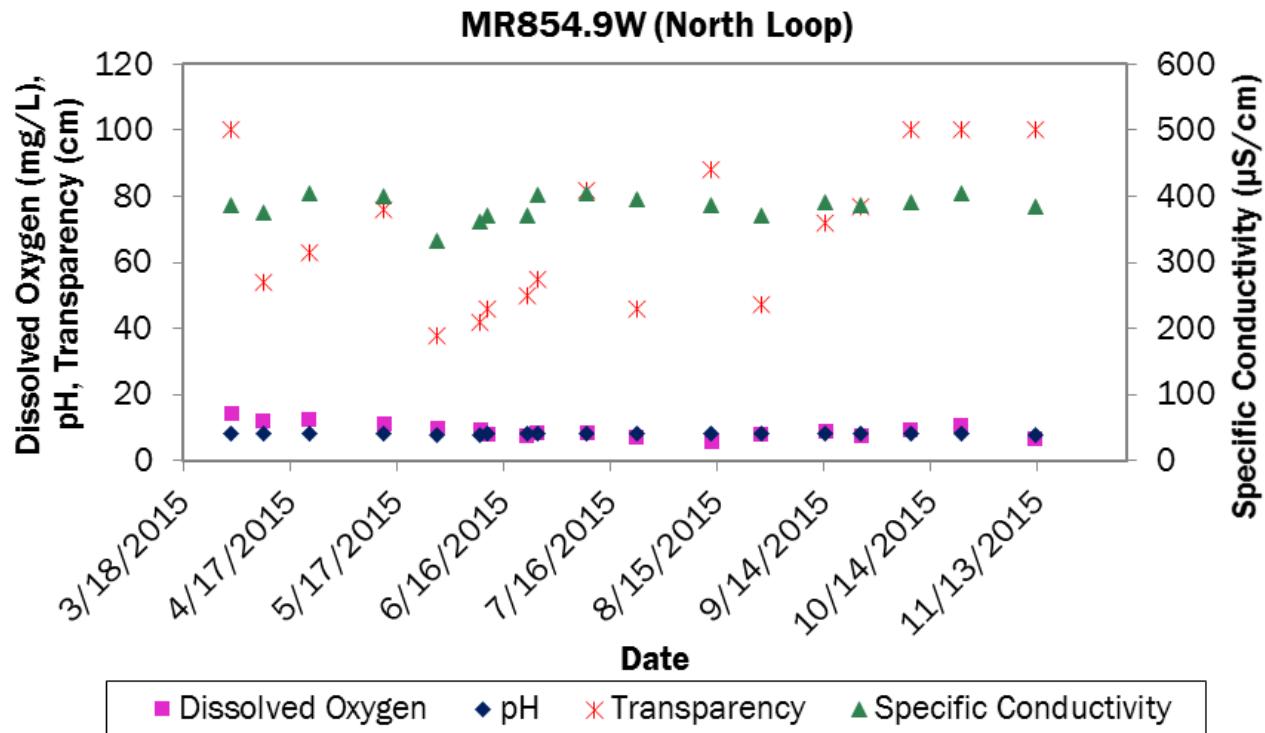
**Figure C.7.** E.coli data for MR848.1W



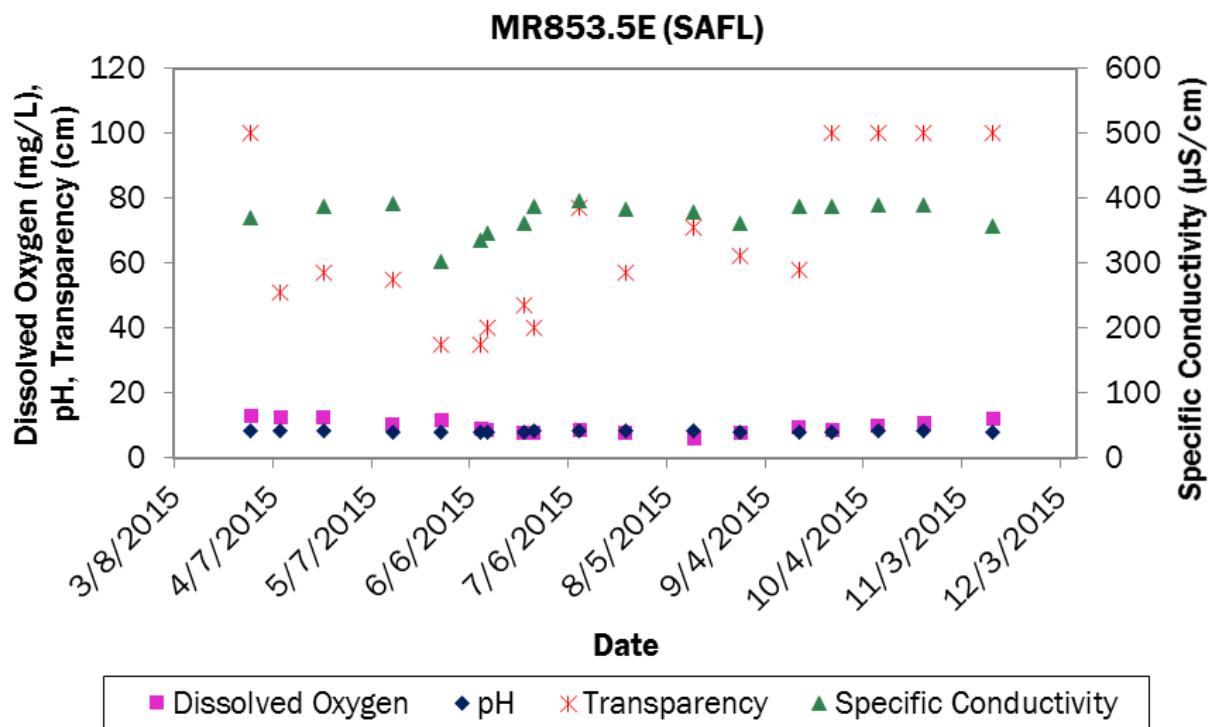
**Figure C.8.** Dissolved oxygen, pH, transparency, and specific conductivity for MR859.1W



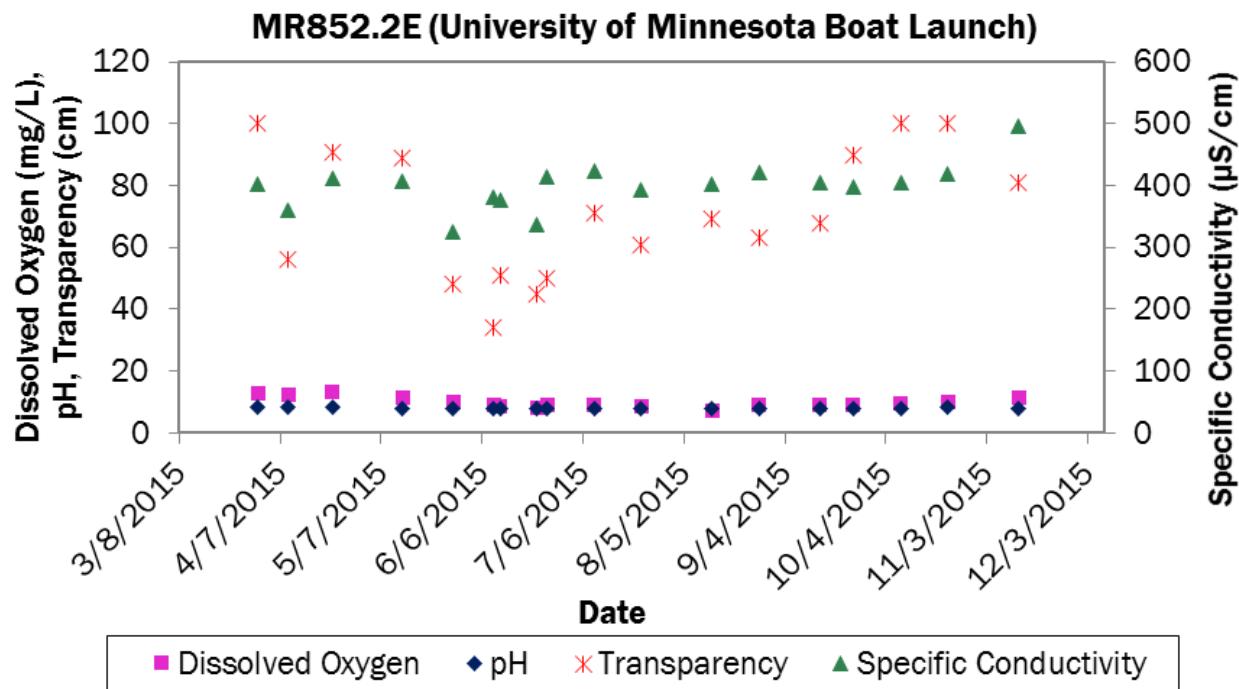
**Figure C.9.** Dissolved oxygen, pH, transparency, and specific conductivity for MR857.6W



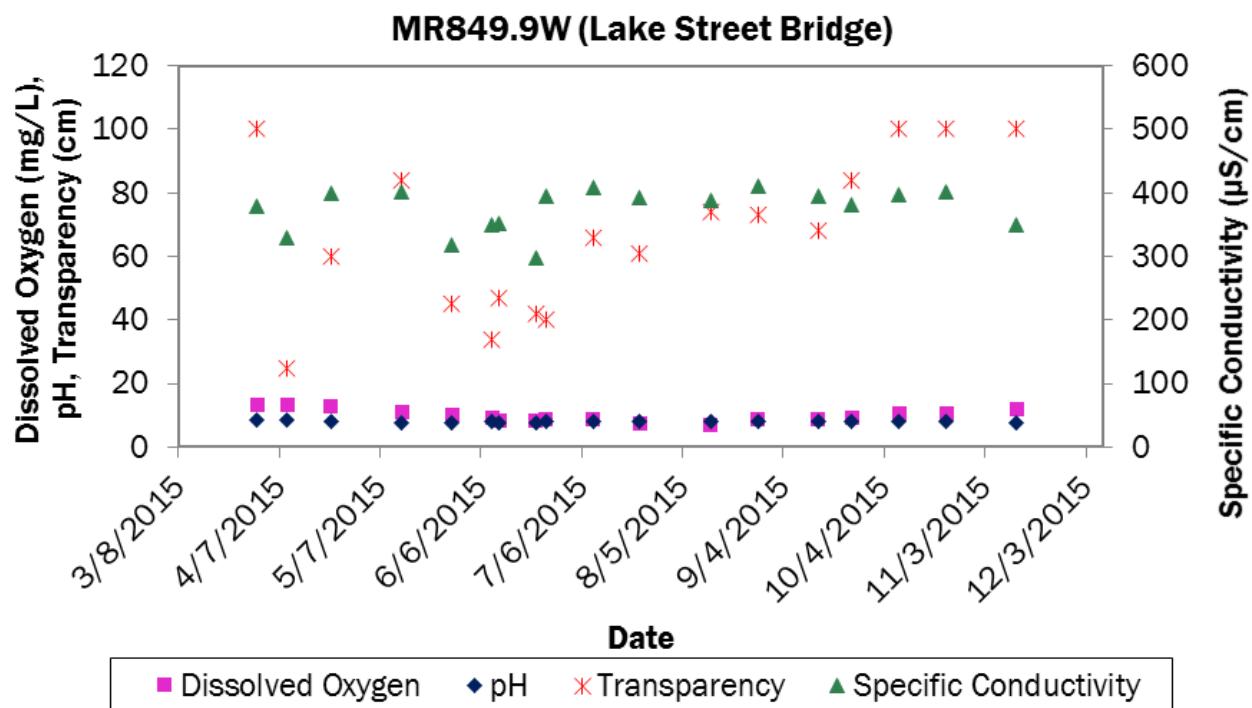
**Figure C.10.** Dissolved oxygen, pH, transparency, and specific conductivity for MR854.9W



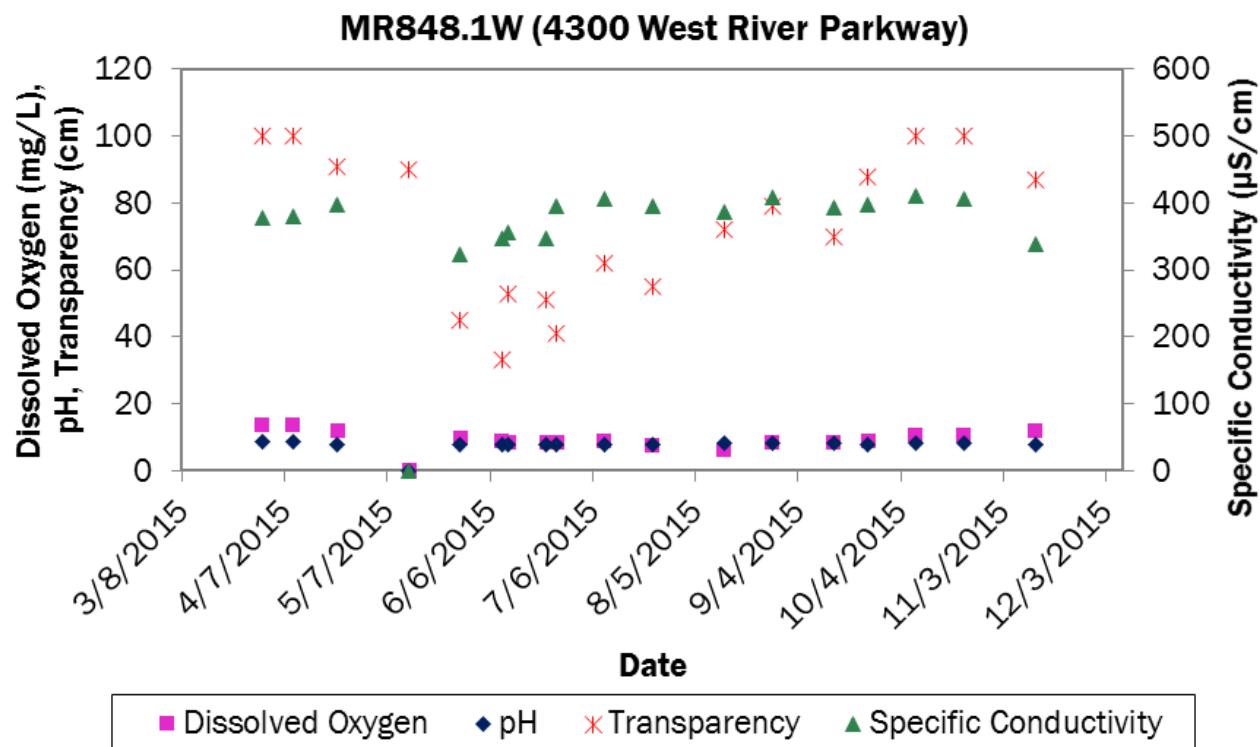
**Figure C.11.** Dissolved oxygen, pH, transparency, and specific conductivity for MR853.5E



**Figure C.12.** Dissolved oxygen, pH, transparency, and specific conductivity for MR852.2E



**Figure C.13.** Dissolved oxygen, pH, transparency, and specific conductivity for MR849.9W



**Figure C.14.** Dissolved oxygen, pH, transparency, and specific conductivity for MR 848.1W

(This page intentionally left blank)

## Appendix D – Stormwater Monitoring Data

**Table D.1.** Monitoring data for 11CHF outfall

Start Date Start Time	End Date End Time	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity ( $\mu\text{S}/\text{cm}$ )	Specific Conductivity ( $\mu\text{S}/\text{cm}$ )	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
1/14/2015 9:20	1/14/2015 9:21	Grab	20	47.1	12.13	684.0	1,000.3	7.68	> 100	0.50	~ 1	< 1	582	> 100.0	~ 0.024	~ 0.028	0.032	0.18	< 0.02	< 0.03	1.65
1/23/2015 11:00	1/23/2015 11:01	Grab	30	45.1	9.86	1,767.0	2,671.0	7.74	> 100	1.38	~ 1	~ 1	1,430	70.4	0.064	0.101	0.070	0.56	0.09	0.04	2.51
1/23/2015 15:04	1/26/2015 19:29	Composite	28	32.4	11.03	2,402.0	4,567.0	7.10	—	2.38	266	~ 48	2,390	26.8	0.255	0.744	—	4.00	0.57	0.19	0.50
2/9/2015 9:05	2/9/2015 9:06	Grab	24	37.2	12.80	582.0	1,008.0	7.61	7	0.49	74	~ 8	375	44.6	0.069	0.241	0.062	1.40	0.83	0.06	1.76
2/24/2015 8:45	2/24/2014 8:46	Grab	20	34.9	13.10	1,001.0	1,814.0	7.74	> 100	0.91	~ 2	~ 1	1,010	76.1	~ 0.043	0.072	0.042	0.51	~ 0.03	< 0.03	2.70
3/6/2015 8:51	3/6/2015 8:52	Grab	20	38.5	12.40	1,508.0	2,547.0	7.42	> 100	1.31	~ 1	< 1	1,420	73.3	0.063	0.081	0.071	0.65	0.08	0.05	2.46
3/6/2015 8:53	3/6/2015 8:54	Grab	20	38.5	12.40	1,508.0	2,547.0	7.42	> 100	1.31	< 1	~ 1	1,420	73.3	0.067	0.125	0.048	0.62	0.06	0.06	2.48
3/6/2015 14:30	3/8/2015 18:00	Composite	40	46.0	4.48	3,409.0	5,077.0	7.07	6	2.73	267	86	2,180	27.1	0.480	1.140	—	6.20	1.45	0.2	0.29
3/9/2015 9:30	3/12/2015 8:00	Composite	40	46.0	5.82	1,115.0	1,660.0	7.36	10	0.84	100	~ 30	850	24.4	0.485	0.726	—	4.10	1.39	0.11	0.71
3/17/2015 9:05	3/17/2015 9:06	Grab	30	41.0	11.95	473.0	765.7	7.18	91	0.37	3	3	406	25.7	0.094	0.129	0.073	0.82	0.14	0.05	1.06
3/23/2015 11:51	3/25/2015 1:41	Composite	30	33.1	13.54	1,818.0	3,408.0	7.47	—	1.75	229	~ 77	1,800	19.9	0.265	0.821	—	4.20	0.28	0.07	0.48
3/29/2015 4:55	3/29/2015 13:10	Composite	40	42.1	11.59	291.3	462.4	7.96	—	0.22	532	228	282	12.1	0.193	1.070	—	5.90	0.44	0.09	0.87
4/6/2015 7:15	4/6/2015 13:30	Composite	40	39.9	12.71	259.3	427.3	7.79	—	0.21	148	52	234	10.5	0.214	0.363	0.172	2.60	0.69	0.08	0.72
4/9/2015 3:06	4/9/2015 19:25	Composite	35	36.1	14.11	174.2	307.6	7.66	10	0.15	221	48	151	7.7	0.080	0.312	0.078	2.00	0.34	0.03	0.31
4/12/2015 21:25	4/12/2015 22:45	Composite	55	55.4	9.46	130.1	168.8	7.96	—	0.08	854	240	99	5.8	0.108	1.110	0.105	4.80	0.62	< 0.03	0.43
4/17/2015 9:50	4/17/2015 10:00	Grab	60	57.7	9.24	649.0	871.0	7.39	> 100	0.43	7	3	477	37.6	0.095	0.189	0.064	1.10	0.08	0.06	1.18
4/18/2015 23:21	4/19/2015 20:45	Composite	40	44.6	9.50	244.6	372.3	7.40	—	0.18	80	30	219	11.6	0.125	0.433	—	3.30	0.55	0.11	0.60
4/30/2015 8:55	4/30/2015 8:56	Grab	60	52.7	10.00	759.0	1,023.0	7.78	> 100	0.51	~ 2	~ 2	767	42.0	0.061	0.111	0.039	1.50	~ 0.03	< 0.03	1.66
5/7/2015 13:25	5/8/2015 2:20	Composite	60	55.8	5.64	306.1	394.7	7.09	—	0.19	329	209	—	15.9	0.331	1.480	0.215	7.60	0.09	0.04	0.11
5/10/2015 19:50	5/10/2015 23:45	Composite	50	53.1	8.13	124.4	166.5	6.90	16	0.08	76	40	93	4.2	0.070	0.398	0.036	2.60	0.18	0.03	0.25
5/13/2015 9:07	5/13/2015 9:08	Grab	50	52.3	11.09	336.3	455.0	7.79	38	0.22	8	5	249	12.6	0.051	0.131	0.015	0.97	~ 0.02	0.03	0.43
5/13/2015 10:42	5/14/2015 6:02	Composite	53	55.4	7.91	290.5	377.0	7.51	—	0.18	16	10	202	11.7	0.069	0.237	0.035	1.60	0.09	< 0.03	0.08
5/14/2015 16:12	5/15/2015 3:07	Composite	53	55.2	8.89	152.9	198.9	7.24	—	0.09	24	13	108	5.1	0.054	0.184	0.033	1.20	0.15	< 0.03	0.21
5/16/2015 21:37	5/18/2015 4:07	Composite	40	51.6	6.94	150.8	206.1	7.28	—	0.11	201	75	122	7.1	~ 0.043	0.620	—	3.40	~ 0.03	< 0.03	0.17
5/24/2015 13:57	5/25/2015 14:57	Composite	60	61.3	6.72	181.0	217.1	7.31	33	0.10	22	15	125	4.5	0.094	0.271	—	1.30	0.10	< 0.03	0.12
5/26/2015 9:57	5/26/2015 18:47	Composite	70	59.9	7.94	96.0	117.2	6.93	14	0.01	50	18	57	2.2	~ 0.037	0.194	—	1.20	0.17	< 0.03	0.15
5/28/2015 9:10	5/28/2015 9:11	Grab	70	51.6	7.97	315.9	349.7	7.55	> 100	0.17	~ 2	~ 2	173	7.1	0.060	0.087	0.038	0.66	0.09	0.04	0.33
5/29/2015 9:35	5/30/2015 1:45	Composite	60	59.4	8.09	160.2	197.1	7.29	—	0.09	13	8	111	3.7	0.090	0.207	—	1.40	0.20	0.03	0.23
6/3/2015 12:55	6/4/2015 2:40	Composite	65	64.0	7.83	138.0	159.9	7.61	23	0.08	74	33	91	3.9	0.203	0.414	0.127	1.90	0.13	< 0.03	< 0.05
6/6/2015 23:45	6/7/2015 3:01	Composite	70	72.0	7.07	84.7	89.4	7.49	25	0.04	82	24	55	2.1	0.083	0.256	—	1.70	0.22	< 0.03	0.19
6/10/2015 9:00	6/10/2015 9:01	Grab	70	64.8	8.67	421.9	484.8	7.29	> 100	0.23	~ 2	~ 2	279	16.5	0.076	0.109	0.055	0.69	0.09	0.14	0.78
6/17/2015 11:30	6/18/2015 2:35	Composite	73	68.2	6.04	236.6	261.2	7.44	—</												

**Table D.1 continued.** Monitoring data for 11CHF outfall

Start Date Start Time	End Date End Time	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
			Temp (F)	Temp (F)	Oxygen (mg/L)	(µS/cm)	Conductivity (µS/cm)	(cm)	(ppt)	Suspended Solids (mg/L)	Suspended Solids (mg/L)	Dissolved Solids (mg/L)	(mg/L)	Phosphorus (mg/L)	Phosphorus (mg/L)	Phosphate (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrogen (mg/L)			
6/25/2015 9:18	6/25/2015 9:19	Grab	70	73.8	7.38	223.9	231.8	7.73	30	0.11	20	11	125	5.0	0.041	0.156	~ 0.008	1.20	0.11	< 0.03	0.14
6/26/2015 17:36	6/26/2015 18:16	Composite	80	74.7	4.60	150.8	154.6	7.42	—	0.07	733	189	117	—	0.195	0.880	—	4.40	0.20	< 0.03	< 0.05
6/27/2015 23:31	6/28/2015 16:26	Composite	80	73.8	3.39	84.2	87.2	7.37	—	0.02	128,000	1,130	62	2.9	0.163	0.342	—	2.40	0.25	0.07	0.12
6/29/2015 19:31	6/29/2015 21:56	Composite	70	68.0	6.85	87.0	96.1	7.45	—	0.04	209	49	62	2.8	0.066	0.439	0.032	2.30	0.26	0.03	0.21
7/6/2015 1:16	7/6/2015 4:41	Composite	75	73.0	7.53	61.0	63.7	7.73	—	0.03	66	19	44	1.6	0.068	0.256	0.046	1.35	0.12	< 0.03	0.22
7/9/2015 9:06	7/9/2015 9:07	Grab	75	68.9	8.79	320.1	350.1	7.64	90	0.17	5	3	208	12.5	0.048	0.084	0.031	0.60	< 0.02	< 0.03	0.52
7/12/2015 23:21	7/12/2015 23:56	Composite	75	71.2	8.32	44.9	47.8	7.57	—	0.02	150	52	40	1.7	0.102	0.407	0.097	1.90	0.11	< 0.03	0.31
8/6/2015 11:41	8/7/2015 5:46	Composite	70	70.7	7.48	89.7	96.2	7.91	13	0.04	99	30	51	2.8	0.066	0.301	0.054	1.55	0.08	0.06	0.27
8/9/2015 13:56	8/9/2015 15:56	Composite	70	73.2	6.13	92.7	96.5	8.10	—	0.04	37	15	232	—	0.076	0.218	0.060	1.20	0.09	0.08	0.27
8/13/2015 5:00	8/13/2015 5:01	Grab	75	—	—	—	—	—	—	—	735	72	—	—	—	—	—	—	—	—	—
8/14/2015 9:06	8/14/2015 9:07	Grab	75	57.9	11.33	701.0	878.0	7.88	> 100	0.43	~ 2	~ 1	537	88.8	~ 0.028	~ 0.029	0.029	0.26	< 0.02	< 0.03	1.43
8/16/2015 18:16	8/16/2015 21:56	Composite	65	68.5	6.14	132.9	146.0	7.76	—	0.07	730	41	104	—	0.085	0.674	—	2.30	~ 0.04	0.09	0.63
8/18/2015 14:26	8/19/2015 5:51	Composite	60	64.6	8.21	61.7	71.1	7.80	37	0.03	40	12	39	1.7	~ 0.030	0.120	0.029	0.66	< 0.02	< 0.03	0.16
8/22/2015 18:01	8/23/2015 1:01	Composite	60	61.3	7.11	59.7	71.6	7.22	21	0.03	125	32	56	2.5	0.092	0.222	—	1.20	0.13	< 0.03	0.24
8/27/2015 8:55	8/27/2015 8:56	Grab	70	57.2	12.00	784.0	992.0	7.62	32	0.49	18	4	590	76.7	~ 0.020	~ 0.047	~ 0.005	3.80	0.38	< 0.03	1.47
8/27/2015 9:25	8/27/2015 9:26	Grab	70	62.6	6.84	783.0	923.0	7.67	1	0.46	4,810	400	569	98.9	0.051	10.300	< 0.005	13.00	0.54	0.06	1.28
9/2/2015 3:26	9/2/2015 7:21	Composite	70	72.5	8.97	97.1	101.9	7.71	—	0.05	47	8	60	3.0	0.105	0.296	0.095	1.60	0.33	0.06	0.44
9/6/2015 5:06	9/6/2015 12:06	Composite	70	74.5	5.52	89.2	91.7	7.70	38	0.04	42	15	61	2.6	0.087	0.173	—	0.99	0.20	0.05	0.26
9/8/2015 11:05	9/8/2015 15:30	Composite	60	65.5	7.63	231.4	263.8	7.75	—	0.13	23	6	155	19.6	0.065	0.157	0.060	1.10	0.31	0.08	0.40
9/9/2015 12:56	9/10/2015 9:10	Composite	60	68.7	7.06	125.7	137.8	7.18	—	0.06	128	42	—	—	~ 0.034	0.306	0.023	2.20	0.18	0.08	0.26
9/14/2015 9:00	9/14/2015 9:01	Grab	65	55.8	12.70	817.0	1,053.0	7.63	30	0.53	8	~ 3	652	87.2	< 0.020	0.050	< 0.005	1.30	0.42	< 0.03	1.55
9/17/2015 5:41	9/17/2015 8:16	Composite	70	72.0	7.41	69.6	73.6	7.33	—	0.03	105	34	52	3.7	0.076	0.224	0.068	1.40	0.30	< 0.03	0.40
9/17/2015 10:11	9/18/2015 2:31	Composite	60	55.8	12.70	817.0	1,053.0	7.63	32	0.53	41	12	50	2.5	~ 0.029	0.147	~ 0.008	1.00	0.30	< 0.03	0.28
9/18/2015 14:21	9/19/2015 2:41	Composite	60	63.7	8.10	131.4	153.0	7.52	—	0.07	15	6	78	7.1	~ 0.049	0.114	—	0.87	0.32	0.04	0.28
9/22/2015 9:15	9/22/2015 9:16	Grab	68	57.4	10.87	683.0	863.0	7.48	57	0.43	9	~ 3	512	71.5	< 0.020	0.062	< 0.005	0.95	0.23	< 0.03	1.32
9/23/2015 15:16	9/24/2015 10:21	Composite	60	66.0	6.55	104.2	117.9	7.05	—	0.06	38	16	72	3.5	~ 0.045	0.157	—	1.10	~ 0.04	0.07	0.29
10/8/2015 4:06	10/8/2015 9:16	Composite	55	62.8	9.33	95.9	112.9	7.06	15	0.05	60	26	84	3.9	0.248	0.412	0.231	2.60	0.63	0.03	0.56
10/13/2015 8:48	10/14/2015 8:49	Grab	48	51.4	11.44	696.0	956.0	8.14	> 100	0.47	< 1	~ 1	588	99.2	~ 0.024	~ 0.023	0.023	0.22	< 0.02	< 0.03	1.66
10/20/2015 8:30	10/21/2015 12:00	Composite	55	—	—	—	—	—	—	—	23	10	133	8.9	~ 0.034	0.190	0.013	1.70	0.13	< 0.03	0.14
10/23/2015 6:06	10/24/2015 18:41	Composite	50	50.9	5.25	86.3	119.4	7.40	17	0.06	47	29	95	4.5	0.201	0.488	—	2.10	< 0.02	< 0.03	< 0.05
10/27/2015 19:16	10/28/2015 20:46	Composite	40	43.7	9.74	60.2	93.2	7.79	25	0.04	15	~ 14	66	2.4	0.179	0.315	—	1.00	< 0.02	< 0.03	< 0.05
10/30/2015 10:00	10/30/2015 10:01	Grab	40	50.0	9.92	339.1	475.5	7.70	—												

**Table D.1 continued.** Monitoring data for 11CHF outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)	
1/14/2015 9:20	1/14/2015 9:21	Grab	309	83.0	500	< 5	1.6	< 1.0	< 1.0	< 0.0050	< 0.0050	0.0009	0.0011	< 0.0001	< 0.0001	0.0020	~ 0.0013	< 0.0002	< 0.0002	0.0002	0.0003	—	
1/23/2015 11:00	1/23/2015 11:01	Grab	261	633.8	364	15	3.6	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—	
1/23/2015 15:04	1/26/2015 19:29	Composite	76	1,275.6	128	164	16.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2/9/2015 9:05	2/9/2015 9:06	Grab	110	121.3	186	14	4.5	< 1.0	< 1.0	0.0016	0.0064	0.0014	0.0052	~ 0.0001	0.0026	0.0096	0.0189	< 0.0002	< 0.0002	0.0003	0.0049	—	
2/24/2015 8:45	2/24/2014 8:46	Grab	338	358.9	444	~ 6	2.9	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—	
3/6/2015 8:51	3/6/2015 8:52	Grab	296	727.6	384	< 5	3.5	1.3	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—	
3/6/2015 14:30	3/8/2015 18:00	Composite	82	1,575.0	156	200	19.1	—	—	—	0.0406	—	0.0158	—	0.0288	—	0.2060	—	0.0007	—	0.0144	—	
3/9/2015 9:30	3/12/2015 8:00	Composite	84	470.3	140	87	13.5	—	—	—	0.0157	—	0.0071	—	0.0073	—	0.1160	—	< 0.0002	—	0.0046	—	
3/17/2015 9:05	3/17/2015 9:06	Grab	116	139.1	160	18	4.0	1.9	2.7	—	—	—	—	—	—	—	—	—	—	—	—	—	
3/23/2015 11:51	3/25/2015 1:41	Composite	53	951.7	84	252	28.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3/29/2015 4:55	3/29/2015 13:10	Composite	26	103.6	72	380	19.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4/6/2015 7:15	4/6/2015 13:30	Composite	34	89.9	64	124	20.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4/9/2015 3:06	4/9/2015 19:25	Composite	26	70.8	44	107	9.2	6.6	7.6	—	0.0216	—	0.0090	—	0.0126	—	0.1390	—	< 0.0002	—	0.0097	—	
4/12/2015 21:25	4/12/2015 22:45	Composite	31	28.5	68	316	12.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4/17/2015 9:50	4/17/2015 10:00	Grab	141	149.9	192	28	7.9	5.5	6.8	0.0027	0.0039	0.0140	0.0156	~ 0.0002	0.0012	0.0256	0.0464	< 0.0002	< 0.0002	0.0007	0.0012	—	
4/18/2015 23:21	4/19/2015 20:45	Composite	41	74.1	48	123	23.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4/30/2015 8:55	4/30/2015 8:56	Grab	202	172.4	260	15	6.3	1.6	2.2	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/7/2015 13:25	5/8/2015 2:20	Composite	66	65.3	369	51.8	—	94.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/10/2015 19:50	5/10/2015 23:45	Composite	20	26.7	28	123	12.2	16.0	22.0	—	0.0162	—	0.0054	—	0.0098	—	0.1140	—	< 0.0002	—	0.0055	—	
5/13/2015 9:07	5/13/2015 9:08	Grab	83	84.6	104	29	9.4	4.2	5.8	—	0.0034	—	0.0017	—	0.0008	—	0.0166	—	< 0.0002	—	0.0007	—	
5/13/2015 10:42	5/14/2015 6:02	Composite	71	63.9	78	46	13.8	—	10.0	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/14/2015 16:12	5/15/2015 3:07	Composite	32	32.0	50	48	10.7	8.4	11.0	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/16/2015 21:37	5/18/2015 4:07	Composite	33	34.0	52	181	15.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/24/2015 13:57	5/25/2015 14:57	Composite	37	34.8	40	54	12.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/26/2015 9:57	5/26/2015 18:47	Composite	19	17.4	36	40	4.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/28/2015 9:10	5/28/2015 9:11	Grab	59	63.7	63	~ 13	5.8	1.7	2.5	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/29/2015 9:35	5/30/2015 1:45	Composite	38	33.6	34	39	7.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6/3/2015 12:55	6/4/2015 2:40	Composite	27	23.9	30	65	9.0	—	—	—	0.0098	—	0.0054	—	0.0044	—	0.0635	—	< 0.0002	—	0.0030	—	
6/6/2015 23:45	6/7/2015 3:01	Composite	24	9.2	22	45	4.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6/10/2015 9:00	6/10/2015 9:01	Grab	93	48.3	121	12	6.4	1.7	2.1	—	0.0033	—	0.0025	—	0.0007	—	0.0129	—	< 0.0002	—	0.0005	—	
6/17/2015 11:30	6/18/2015 2:35	Composite	43	290.0	58	118	9.7	—	—	—	—	0.0138	—	0.0149	—	0.0080	—	0.1830	—	< 0.0002	—	0.0139	—
6/20/2015 5:51	6/20/2015 14:16	Composite	27	12.6	38	104	9.2	—	—	—	—	0.0072	—	0.0040	—	0.0062	—	0.0470	—	< 0.0002	—	0.0040	—
6/22/2015 8:01	6/23/2015 3:36	Composite	24	14.2	30	35	5.4	—	—	—	—	0.0072	—	0.0040	—	0.0062	—	0.0470	—	< 0.0002	—	0.0040	—

**Table D.1 continued.** Monitoring data for 11CHF outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Soluble Oil and Grease (mg/L)
6/25/2015 9:18	6/25/2015 9:19	Grab	58	24.8	67	28	6.7	4.0	6.4	—	—	—	—	—	—	—	—	—	—	—	—	—
6/26/2015 17:36	6/26/2015 18:16	Composite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6/27/2015 23:31	6/28/2015 16:26	Composite	22	7.3	24	81	11.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6/29/2015 19:31	6/29/2015 21:56	Composite	25	9.2	32	94	9.9	11.0	16.0	—	—	—	—	—	—	—	—	—	—	—	—	—
7/6/2015 1:16	7/6/2015 4:41	Composite	11	4.5	18	61	8.2	7.6	12.0	—	0.0094	—	0.0044	—	0.0102	—	0.0790	—	< 0.0002	—	0.0040	—
7/9/2015 9:06	7/9/2015 9:07	Grab	89	47.0	102	24	5.4	1.9	2.8	—	0.0023	—	0.0015	—	0.0005	—	0.0106	—	< 0.0002	—	0.0005	—
7/12/2015 23:21	7/12/2015 23:56	Composite	13	3.2	—	80	8.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/6/2015 11:41	8/7/2015 5:46	Composite	27	8.5	29	63	8.3	6.1	> 8.1	—	0.0141	—	0.0045	—	0.0075	—	0.0908	—	< 0.0002	—	0.0042	—
8/9/2015 13:56	8/9/2015 15:56	Composite	28	7.6	—	—	8.9	6.1	> 8.3	—	—	—	—	—	—	—	—	—	—	—	—	—
8/13/2015 5:00	8/13/2015 5:01	Grab	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/14/2015 9:06	8/14/2015 9:07	Grab	280	74.8	416	< 5	2.6	1.1	0.7	—	—	—	—	—	—	—	—	—	—	—	—	—
8/16/2015 18:16	8/16/2015 21:56	Composite	—	17.0	—	—	18.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/18/2015 14:26	8/19/2015 5:51	Composite	20	6.3	20	36	4.7	2.9	4.5	—	—	—	—	—	—	—	—	—	—	—	—	—
8/22/2015 18:01	8/23/2015 1:01	Composite	21	4.9	20	41	5.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/27/2015 8:55	8/27/2015 8:56	Grab	288	—	428	32	9.6	> 8.7	> 8.6	—	0.0013	—	0.0067	—	0.0007	—	0.0232	—	< 0.0002	—	0.0006	—
8/27/2015 9:25	8/27/2015 9:26	Grab	206	97.5	368	404	10.6	21.0	26.0	—	0.1430	—	0.1030	—	0.2220	—	1.0500	—	0.0038	—	0.0868	—
9/2/2015 3:26	9/2/2015 7:21	Composite	27	100.4	34	62	13.0	10.0	14.0	—	—	—	—	—	—	—	—	—	—	—	—	—
9/6/2015 5:06	9/6/2015 12:06	Composite	25	8.1	30	35	6.4	—	—	—	0.0073	—	0.0028	—	0.0033	—	0.0528	—	< 0.0002	—	0.0017	—
9/8/2015 11:05	9/8/2015 15:30	Composite	68	6.3	90	24	5.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/9/2015 12:56	9/10/2015 9:10	Composite	31	25.4	—	92	9.4	7.0	9.1	—	—	—	—	—	—	—	—	—	—	—	—	—
9/14/2015 9:00	9/14/2015 9:01	Grab	332	14.6	460	65	18.9	> 26.0	> 26.0	—	0.0014	—	0.0061	—	0.0006	—	0.0090	—	< 0.0002	—	0.0007	—
9/17/2015 5:41	9/17/2015 8:16	Composite	19	103.6	28	59	6.7	6.5	10.0	—	—	—	—	—	—	—	—	—	—	—	—	—
9/17/2015 10:11	9/18/2015 2:31	Composite	21	4.9	28	32	4.9	3.4	4.7	—	—	—	—	—	—	—	—	—	—	—	—	—
9/18/2015 14:21	9/19/2015 2:41	Composite	41	5.3	46	21	5.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/22/2015 9:15	9/22/2015 9:16	Grab	260	46.0	386	45	14.6	23.0	24.5	—	—	—	—	—	—	—	—	—	—	—	—	—
9/23/2015 15:16	9/24/2015 10:21	Composite	28	80.0	32	47	7.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/8/2015 4:06	10/8/2015 9:16	Composite	28	8.7	28	90	18.2	18.0	23.0	—	0.0096	—	0.0031	—	0.0042	—	0.0664	—	< 0.0002	—	0.0022	—
10/13/2015 8:48	10/14/2015 8:49	Grab	315	79.3	476	~ 8	2.1	0.4	0.6	—	0.0016	—	0.0017	—	< 0.0001	—	0.0018	—	< 0.0002	—	0.0003	—
10/20/2015 8:30	10/21/2015 12:00	Composite	75	25.0	80	40	8.0	3.3	7.3	—	—	—	—	—	—	—	—	—	—	—	—	—
10/23/2015 6:06	10/24/2015 18:41	Composite	30	10.0	46	94	18.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/27/2015 19:16	10/28/2015 20:46	Composite	24	7.6	20	62	14.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/30/2015 10:00	10/30/2015 10:01	Grab	155	31.1	184	25	7.6	2.2	2.8	—	—	—	—	—	—	—	—	—	—	—	—	—
10/31/2015 2:31	10/31/2015 10:56	Composite	29	9.4	32	53	15.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/1/2015 2:56	11/1/2015 18:16	Composite	54	20.1	120	32	9.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/9/2015 11:25	11/9/2015 11:26	Grab	256	100.8	304	~ 13	6.0	1.8	1.9	—	< 0.0050	—	0.0019	—	0.0015	—	0.0092	—	< 0.0002	—	0.0007	—
11/11/2015 16:50	11/12/2015 14:49	Composite	14	4.6	12	33	7.9</															

**Table D.2.** Monitoring data for 1NE outfall

Start Date Start Time	End Date End Time	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
			Temp (F)	Temp (F)	Oxygen (mg/L)	(µS/cm)	Conductivity (µS/cm)	(cm)	(ppt)	Suspended Solids (mg/L)	Suspended Solids (mg/L)	Dissolved Solids (mg/L)	(mg/L)	Phosphorus (mg/L)	Total Phosphorus (mg/L)	Phosphate (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrogen (mg/L)			
1/14/2015 9:50	1/14/2015 9:51	Grab	20	44.4	11.45	621.0	1,562.0	7.36	> 100	0.79	~ 1	< 1	939	204.0	< 0.020	0.086	0.014	0.88	~ 0.06	< 0.03	0.94
1/23/2015 10:35	1/23/2015 10:36	Grab	30	44.6	11.82	1,105.0	1,682.0	8.00	> 100	0.85	~ 1	< 1	1,010	180.0	< 0.020	< 0.020	0.013	0.49	0.07	< 0.03	0.87
2/9/2015 9:36	2/9/2015 9:37	Grab	24	41.2	12.17	975.0	1,573.0	7.80	> 100	0.79	< 1	~ 1	972	181.0	~ 0.028	~ 0.045	0.033	0.86	0.36	< 0.03	0.66
2/24/2015 9:15	2/24/2015 9:16	Grab	20	42.3	11.56	926.0	1,464.0	7.88	> 100	0.74	~ 1	< 1	911	171.0	< 0.020	< 0.020	~ 0.008	0.59	0.06	< 0.03	0.88
3/6/2015 9:20	3/6/2015 9:21	Grab	20	41.4	10.78	970.0	1,562.0	7.72	> 100	0.79	~ 1	~ 1	979	171.0	< 0.020	< 0.020	~ 0.005	0.65	0.08	< 0.03	0.77
3/17/2015 9:40	3/17/2015 9:41	Grab	30	40.6	12.37	919.0	1,494.0	7.18	> 100	0.57	~ 1	~ 1	916	164.0	0.051	~ 0.035	0.026	0.72	0.22	< 0.03	0.72
3/29/2015 5:17	3/29/2015 15:44	Composite	40	54.0	9.77	823.0	1,088.0	7.47	—	0.54	576	216	592	16.0	0.120	1.200	—	5.80	0.21	0.07	0.80
4/6/2015 8:00	4/6/2015 10:00	Composite	40	57.0	9.07	784.0	994.0	7.75	—	0.49	83	25	—	0.080	0.273	—	2.00	0.14	0.05	1.04	
4/9/2015 2:30	4/10/2015 1:30	Composite	35	44.6	12.10	330.7	504.4	7.64	—	0.24	81	~ 23	271	10.1	0.067	0.275	0.072	1.70	0.14	0.04	0.30
4/12/2015 21:33	4/13/2015 8:24	Composite	55	55.4	9.32	405.5	526.4	7.74	—	0.26	105	42	296	43.3	0.075	0.383	0.050	2.10	0.25	< 0.03	1.68
4/17/2015 11:30	4/17/2015 11:31	Grab	60	49.8	11.59	983.0	1,382.0	7.81	> 100	0.70	3	~ 2	863	159.5	0.166	0.243	0.128	1.15	0.18	< 0.03	0.76
4/19/2015 3:18	4/19/2015 22:18	Composite	40	45.7	9.84	393.5	588.7	7.26	—	0.29	15	8	—	29.3	0.117	0.265	—	1.90	< 0.02	0.04	0.69
4/30/2015 9:37	4/30/2015 9:38	Grab	60	47.8	12.05	965.0	1,399.0	7.86	> 100	0.70	< 1	~ 1	861	172.0	~ 0.030	~ 0.049	0.012	0.63	0.17	< 0.03	0.78
5/3/2015 17:26	5/4/2015 0:01	Composite	55	58.8	7.24	386.3	479.1	7.38	—	0.23	724	248	299	5.6	0.143	2.280	0.075	11.00	0.34	0.05	0.58
5/10/2015 14:08	5/11/2015 6:23	Composite	50	54.1	8.06	281.4	371.5	6.92	—	0.18	126	52	205	7.7	0.079	0.479	0.055	3.20	< 0.02	< 0.03	0.51
5/13/2015 9:38	5/13/2015 9:39	Grab	50	48.4	11.80	945.0	1,357.0	7.80	> 100	0.68	~ 2	~ 2	802	130.0	~ 0.024	0.063	0.018	0.61	0.13	< 0.03	0.35
5/14/2015 15:56	5/15/2015 1:11	Composite	55	56.1	8.58	381.5	490.1	7.17	—	0.24	20	~ 10	267	33.8	0.061	0.208	0.045	1.10	~ 0.06	0.04	0.71
5/16/2015 22:26	5/18/2015 5:11	Composite	40	53.8	8.70	479.8	636.2	7.25	—	0.31	69	31	368	55.4	0.074	0.685	—	5.70	0.12	0.03	0.32
5/26/2015 11:51	5/26/2015 23:31	Composite	70	60.1	8.41	115.5	140.8	7.19	10	0.07	164	39	77	4.2	~ 0.033	0.372	—	1.80	0.06	0.03	0.14
5/29/2015 5:06	5/30/2015 0:51	Composite	60	59.2	6.67	266.1	328.3	7.25	—	0.16	42	16	191	29.4	0.092	0.266	—	1.60	0.14	0.04	0.33
6/7/2015 0:01	6/7/2015 10:56	Composite	70	69.8	5.95	119.6	129.3	7.37	22	0.06	128	34	71	5.7	0.059	0.295	—	1.80	~ 0.04	< 0.03	0.16
6/10/2015 9:25	6/10/2015 9:26	Grab	70	59.5	9.36	1,087.0	1,336.0	7.74	98	0.67	4	3	865	147.0	0.145	0.204	0.145	2.10	1.16	0.08	1.75
6/20/2015 6:31	6/21/2015 5:21	Composite	65	72.5	4.50	454.1	477.0	6.99	—	0.23	62	34	279	47.6	0.056	0.392	—	2.40	0.11	0.10	0.30
6/22/2015 7:56	6/22/2015 9:26	Composite	65	72.3	5.28	170.8	179.8	7.28	—	0.08	80	29	93	15.7	~ 0.037	0.298	—	1.60	~ 0.04	< 0.03	0.13
6/25/2015 10:06	6/25/2015 10:07	Grab	70	56.3	12.19	1,090.0	1,395.0	7.71	> 100	0.70	~ 1	~ 1	821	138.0	~ 0.044	0.059	0.038	0.76	0.26	< 0.03	1.28
6/26/2015 19:41	6/29/2015 0:46	Composite	80	71.4	4.53	263.3	280.0	7.07	—	0.13	44	25	166	12.0	0.147	0.282	—	2.00	< 0.02	< 0.03	0.20
7/6/2015 2:01	7/6/2015 4:16	Composite	75	74.7	6.46	75.7	77.7	7.45	18	0.04	108	34	49	2.2	~ 0.024	0.338	~ 0.007	1.70	< 0.02	< 0.03	0.07
7/9/2015 9:33	7/9/2015 9:34	Grab	75	62.1	9.43	720.0	855.0	7.65	> 100	0.42	~ 1	~ 1	592	113.0	0.170	0.186	0.150	1.50	0.10	0.03	0.93
7/12/2015 23:26	7/13/2015 2:21	Composite	75	72.3	8.03	85.6	90.1	7.44	13	0.04	112	24	69	3.2	< 0.020	0.274	~ 0.006	1.50	< 0.02	< 0.03	0.17
7/18/2015 0:56	7/18/2015 4:26	Composite	70	75.6	6.13	131.5	133.5	7.74	—	0.06	84	20	87	8.5	0.078	0.288	—	1.40	0.20	0.05	0.29
7/23/2015 11:07	7/23/2015 11:08	Grab	70	59.7	10.79	1,11															

**Table D.2 continued.** Monitoring data for 1NE outfall

Start Date Start Time	End Date End Time	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
7/24/2015 5:56	7/24/2015 7:41	Composite	75	81.7	5.10	567.0	540.0	7.47	—	0.26	38	18	326	32.1	0.138	0.544	—	2.40	0.15	0.24	0.10
7/28/2015 6:41	7/28/2015 12:16	Composite	80	78.4	7.50	156.2	153.8	7.69	18	0.07	78	18	80	7.8	0.069	0.257	—	1.00	< 0.02	< 0.03	0.38
8/6/2015 12:01	8/7/2015 5:11	Composite	70	71.2	5.83	189.3	201.6	7.48	14	0.10	97	35	114	9.8	0.055	0.323	0.021	1.80	< 0.02	0.05	0.31
8/9/2015 14:21	8/9/2015 18:31	Composite	70	73.2	6.99	339.3	353.8	7.52	—	0.17	16	7	—	—	0.056	0.150	0.045	0.93	~ 0.04	0.04	0.84
8/14/2015 9:30	8/14/2015 9:31	Grab	75	61.3	10.13	1,045.0	1,253.0	7.65	> 100	0.63	~ 1	~ 1	770	125.0	~ 0.040	0.065	0.043	0.80	0.34	< 0.03	0.94
8/16/2015 18:11	8/16/2015 23:16	Composite	70	70.9	5.93	353.8	378.2	7.28	—	0.18	38	19	229	21.2	0.076	0.331	0.061	1.90	< 0.02	0.10	1.08
8/18/2015 12:06	8/19/2015 6:16	Composite	60	65.8	7.82	155.6	176.4	7.53	27	0.08	38	10	92	8.7	0.056	0.150	0.046	0.68	< 0.02	< 0.03	0.26
8/22/2015 18:11	8/23/2015 3:11	Composite	60	63.0	7.07	211.5	248.6	7.34	21	0.12	41	13	130	15.5	~ 0.046	0.218	—	1.20	0.08	0.06	0.64
8/27/2015 9:45	8/27/2015 9:46	Grab	70	59.0	11.34	1,107.0	1,396.0	7.91	> 100	0.69	1	1	826	142.0	0.027	0.023	0.023	0.76	0.15	< 0.03	1.49
9/2/2015 3:16	9/2/2015 4:36	Composite	70	73.6	7.91	405.0	420.5	7.35	—	0.20	34	15	260	27.6	0.060	0.315	—	2.10	0.14	0.07	1.11
9/6/2015 6:21	9/6/2015 8:46	Composite	70	74.3	5.00	127.5	131.2	7.31	26	0.06	64	21	76	4.8	0.104	0.256	—	1.30	0.17	0.06	0.29
9/9/2015 21:01	9/10/2015 9:41	Composite	60	66.2	7.03	92.8	104.8	7.27	—	0.05	120	37	67	4.9	0.056	0.298	0.052	1.60	0.15	0.03	0.26
9/14/2015 9:15	9/14/2015 9:16	Grab	65	61.3	10.66	1,110.0	1,332.0	7.80	> 100	0.67	< 1	< 1	813	140.0	~ 0.024	< 0.020	0.013	0.45	0.09	< 0.03	1.40
9/16/2015 6:11	9/17/2015 8:26	Composite	70	72.3	7.07	174.3	183.3	7.29	19	0.09	107	37	110	15.1	0.129	0.349	—	1.80	0.16	0.05	0.42
9/17/2015 11:16	9/17/2015 13:36	Composite	60	66.4	7.51	54.0	60.8	7.31	—	0.03	168	40	48	2.2	0.051	0.380	0.029	2.00	0.16	< 0.03	0.25
9/18/2015 22:11	9/18/2015 23:06	Composite	60	66.4	7.51	54.0	60.8	7.31	—	0.03	110	38	54	3.8	0.056	0.180	—	0.88	0.06	< 0.03	0.24
9/22/2015 9:46	9/22/2015 9:47	Grab	68	62.4	7.98	82.8	98.0	7.11	> 100	0.05	1	< 1	663	128.0	0.246	0.302	0.217	1.45	0.22	0.12	1.17
9/23/2015 15:26	9/24/2015 6:51	Composite	68	67.1	5.04	272.5	304.2	7.02	—	0.15	47	17	—	28.0	0.052	0.267	—	1.60	< 0.02	0.16	0.14
10/8/2015 4:06	10/8/2015 5:16	2 Grabs	55	64.6	8.97	156.1	179.7	7.11	—	0.08	167	77	—	—	0.374	0.735	—	4.70	—	0.06	0.99
10/13/2015 9:17	10/13/2015 9:18	Grab	50	53.1	9.13	987.0	1,323.0	7.67	> 100	0.67	< 1	~ 1	832	142.0	< 0.020	< 0.020	0.015	0.34	< 0.02	< 0.03	1.38
10/23/2015 7:01	10/23/2015 23:23	Composite	50	52.2	4.50	184.0	250.1	7.04	12	0.12	70	31	183	14.2	0.363	0.735	—	2.20	< 0.02	< 0.03	< 0.05
10/27/2015 19:41	10/28/2015 3:11	Composite	50	42.3	3.88	120.3	190.4	7.39	—	0.09	19	14	129	8.0	0.396	0.508	—	1.10	< 0.02	< 0.03	< 0.05
10/28/2015 9:31	10/29/2015 4:01	Composite	40	49.8	9.61	149.4	209.8	7.43	13	0.10	27	~ 14	144	11.4	0.209	0.405	0.199	1.00	< 0.02	< 0.03	< 0.05
10/30/2015 9:12	10/30/2015 9:13	Grab	40	54.7	9.72	716.0	937.0	7.44	> 100	0.46	~ 2	~ 2	519	96.1	0.093	0.140	0.083	0.76	0.13	0.03	0.65
10/30/2015 12:16	11/1/2015 6:01	Composite	55	63.7	6.30	437.1	508.5	7.27	25	0.25	12	9	331	80.2	0.498	0.321	—	1.40	0.20	< 0.03	0.23
11/9/2015 9:15	11/9/2015 9:16	Grab	60	55.6	9.41	1,068.0	1,381.0	7.61	85	0.70	4	3	928	258.0	< 0.020	0.105	~ 0.008	2.75	1.01	0.32	0.89
11/11/2015 16:35	11/12/2015 7:50	Composite	40	51.3	8.71	86.5	119.0	7.28	22	0.06	49	~ 25	62	7.7	0.087	0.237	—	1.00	< 0.02	0.05	0.17
11/16/2015 7:50	11/18/2015 6:35	Composite	50	60.8	8.14	169.9	205.2	7.33	10	0.10	79	18	105	18.5	0.054	0.239	—	1.10	< 0.02	0.04	0.31
11/24/2015 9:30	11/24/2015 9:31	Grab	34	51.1	10.73	883.0	1,217.0	7.82	87	0.61	~ 2	~ 2	759	148.0	~ 0.034	0.064	0.024	1.45	0.18	0.06	1.72
12/9/2015 9:15	12/9/2015 9:20	Grab	35	48.2	10.62	588.0	847.0	7.79	> 100	0.42	4	3	510	89.4	0.146	0.178	0.113	1.10	0.24	0.07	0.91
12/14/2015 11:05	12/14/2015 16:59	Composite	30	49.6	12.21	224.2	315.9	7.76	—	0.15	84	24	204	22.4	~ 0.027	0.323	0.028	1.50	< 0.0		

**Table D.2 continued.** Monitoring data for 1NE outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)
1/14/2015 9:50	1/14/2015 9:51	Grab	380	180.0	556	~ 6	3.2	< 1.0	< 1.0	< 0.0050	< 0.0050	0.0037	0.0040	< 0.0001	< 0.0001	0.0023	0.0026	< 0.0002	< 0.0002	~ 0.0001	0.0002	—
1/23/2015 10:35	1/23/2015 10:36	Grab	383	222.4	556	~ 10	3.8	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
2/9/2015 9:36	2/9/2015 9:37	Grab	386	228.7	524	~ 9	3.8	< 1.0	< 1.0	0.0011	0.0013	0.0036	0.0035	~ 0.0001	~ 0.0002	0.0200	0.0026	< 0.0002	< 0.0002	< 0.0001	~ 0.0001	—
2/24/2015 9:15	2/24/2015 9:16	Grab	392	184.6	556	~ 6	3.3	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
3/6/2015 9:20	3/6/2015 9:21	Grab	398	249.2	516	< 5	3.5	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
3/17/2015 9:40	3/17/2015 9:41	Grab	388	207.9	532	~ 11	3.8	< 1.0	1.1	—	—	—	—	—	—	—	—	—	—	—	—	—
3/29/2015 5:17	3/29/2015 15:44	Composite	41	293.1	120	382	18.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4/6/2015 8:00	4/6/2015 10:00	Composite	191	163.0	244	102	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4/9/2015 2:30	4/10/2015 1:30	Composite	60	42.6	88	98	11.7	6.8	10.0	—	0.0209	—	0.0055	—	0.0131	—	0.1370	—	0.0009	—	0.0075	—
4/12/2015 21:33	4/13/2015 8:24	Composite	86	82.3	124	83	13.9	10.0	14.0	—	—	—	—	—	—	—	—	—	—	—	—	—
4/17/2015 11:30	4/17/2015 11:31	Grab	356	167.5	516	33	10.7	3.0	3.9	0.0015	0.0020	0.0035	0.0037	~ 0.0001	~ 0.0003	0.0068	0.0097	< 0.0002	< 0.0002	0.0003	0.0002	—
4/19/2015 3:18	4/19/2015 22:18	Composite	91	100.7	128	62	15.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4/30/2015 9:37	4/30/2015 9:38	Grab	400	158.3	508	~ 6	3.9	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
5/3/2015 17:26	5/4/2015 0:01	Composite	56	102.3	128	532	28.3	—	88.0	—	0.1150	—	0.0300	—	0.1060	—	0.7250	—	0.0014	—	0.0391	—
5/10/2015 14:08	5/11/2015 6:23	Composite	63	61.5	88	114	12.6	15.0	23.0	—	0.0135	—	0.0039	—	0.0098	—	0.0769	—	< 0.0002	—	0.0045	—
5/13/2015 9:38	5/13/2015 9:39	Grab	315	183.0	464	~ 12	6.1	1.3	1.8	—	0.0016	—	0.0037	—	~ 0.0002	—	0.0058	—	< 0.0002	—	0.0004	—
5/14/2015 15:56	5/15/2015 1:11	Composite	99	75.0	292	48	12.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5/16/2015 22:26	5/18/2015 5:11	Composite	109	94.6	188	91	16.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5/26/2015 11:51	5/26/2015 23:31	Composite	35	20.4	388	82	6.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5/29/2015 5:06	5/30/2015 0:51	Composite	75	39.2	94	53	9.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6/7/2015 0:01	6/7/2015 10:56	Composite	34	14.3	34	49	5.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6/10/2015 9:25	6/10/2015 9:26	Grab	373	157.0	544	~ 7	5.5	3.9	4.5	—	0.0023	—	0.0033	—	0.0009	—	0.0078	—	< 0.0002	—	0.0002	—
6/20/2015 6:31	6/21/2015 5:21	Composite	81	57.7	138	67	11.4	—	—	—	0.0121	—	0.0028	—	0.0051	—	0.0551	—	< 0.0002	—	0.0025	—
6/22/2015 7:56	6/22/2015 9:26	Composite	37	15.6	56	45	5.8	—	—	—	0.0120	—	0.0032	—	0.0093	—	0.0555	—	< 0.0002	—	0.0050	—
6/25/2015 10:06	6/25/2015 10:07	Grab	388	152.5	556	5	3.5	0.6	0.7	—	—	—	—	—	—	—	—	—	—	—	—	—
6/26/2015 19:41	6/29/2015 0:46	Composite	61	38.1	72	69	12.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7/6/2015 2:01	7/6/2015 4:16	Composite	20	7.4	24	81	10.5	16.0	20.0	—	0.0158	—	0.0046	—	0.0153	—	0.0915	—	< 0.0002	—	0.0050	—
7/9/2015 9:33	7/9/2015 9:34	Grab	241	91.7	376	44	12.8	1.4	1.4	—	0.0023	—	0.0029	—	~ 0.0002	—	0.0201	—	< 0.0002	—	0.0004	—
7/12/2015 23:26	7/13/2015 2:21	Composite	21	9.6	20	64	5.1	8.0	9.1	—	—	—	—	—	—	—	—	—	—	—	—	—
7/18/2015 0:56	7/18/2015 4:26	Composite	29	10.2	42	47	4.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7/23/2015 11:07	7/23/2015 11:08	Grab	378	151.0	496	19	3.7	0.9	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—

**Table D.2 continued.** Monitoring data for 1NE outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Carbon Demand (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)
7/24/2015 5:56	7/24/2015 7:41	Composite	—	—	—	—	14.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7/28/2015 6:41	7/28/2015 12:16	Composite	39	13.1	48	39	5.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/6/2015 12:01	8/7/2015 5:11	Composite	49	23.6	60	75	4.4	> 7.5	> 8.3	—	0.0175	—	0.0040	—	0.0119	—	0.0952	—	< 0.0002	—	0.0047	—
8/9/2015 14:21	8/9/2015 18:31	Composite	86	38.1	—	—	9.4	5.0	6.6	—	—	—	—	—	—	—	—	—	—	—	—	—
8/14/2015 9:30	8/14/2015 9:31	Grab	341	137.8	260	~ 6	4.8	0.7	1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
8/16/2015 18:11	8/16/2015 23:16	Composite	87	40.7	114	73	13.3	9.9	15.0	—	—	—	—	—	—	—	—	—	—	—	—	—
8/18/2015 12:06	8/19/2015 6:16	Composite	38	17.3	52	39	5.4	2.8	4.7	—	—	—	—	—	—	—	—	—	—	—	—	—
8/22/2015 18:11	8/23/2015 3:11	Composite	57	24.8	80	40	7.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/27/2015 9:45	8/27/2015 9:46	Grab	389	144.3	518	~ 10	3.3	0.6	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—
9/2/2015 3:16	9/2/2015 4:36	Composite	114	40.1	142	80	21.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/6/2015 6:21	9/6/2015 8:46	Composite	35	10.6	40	40	7.2	—	—	—	0.0099	—	0.0027	—	0.0073	—	0.0680	—	< 0.0002	—	0.0026	—
9/9/2015 21:01	9/10/2015 9:41	Composite	27	8.2	34	57	6.6	5.9	6.2	—	—	—	—	—	—	—	—	—	—	—	—	—
9/14/2015 9:15	9/14/2015 9:16	Grab	372	154.5	548	~ 9	3.7	0.8	0.8	—	0.0014	—	0.0034	—	0.0005	—	0.0067	—	< 0.0002	—	0.0002	—
9/16/2015 6:11	9/17/2015 8:26	Composite	44	14.1	58	77	9.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/17/2015 11:16	9/17/2015 13:36	Composite	18	3.3	22	81	4.2	4.4	5.3	—	—	—	—	—	—	—	—	—	—	—	—	—
9/18/2015 22:11	9/18/2015 23:06	Composite	28	6.1	30	51	4.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/22/2015 9:46	9/22/2015 9:47	Grab	288	96.2	418	37	12.0	1.4	1.3	—	—	—	—	—	—	—	—	—	—	—	—	—
9/23/2015 15:26	9/24/2015 6:51	Composite	76	22.4	—	66	12.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/8/2015 4:06	10/8/2015 5:16	2 Grabs	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/13/2015 9:17	10/13/2015 9:18	Grab	393	142.4	548	17	3.6	1.0	0.6	—	0.0014	—	0.0034	—	~ 0.0002	—	0.0033	—	< 0.0002	—	0.0002	—
10/23/2015 7:01	10/23/2015 23:23	Composite	63	24.3	72	130	25.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/27/2015 19:41	10/28/2015 3:11	Composite	47	17.0	52	74	17.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/28/2015 9:31	10/29/2015 4:01	Composite	58	17.4	68	68	17.0	15.0	17.0	—	—	—	—	—	—	—	—	—	—	—	—	—
10/30/2015 9:12	10/30/2015 9:13	Grab	251	92.2	338	25	8.0	1.9	2.5	—	—	—	—	—	—	—	—	—	—	—	—	—
10/30/2015 12:16	11/1/2015 6:01	Composite	117	36.4	196	51	16.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/9/2015 9:15	11/9/2015 9:16	Grab	356	103.6	608	28	11.4	1.6	3.4	—	< 0.0050	—	0.0027	—	0.0002	—	0.0081	—	< 0.0002	—	0.0004	—
11/11/2015 16:35	11/12/2015 7:50	Composite	29	7.2	44	39	7.5	—	—	—	0.0087	—	0.0023	—	0.0079	—	0.0485	—	< 0.0002	—	0.0038	—
11/16/2015 7:50	11/18/2015 6:35	Composite	53	13.8	76	55	5.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/24/2015 9:30	11/24/2015 9:31	Grab	340	103.7	494	22	10.2	1.5	1.3	—	—	—	—	—	—	—	—	—	—	—	—	—
12/9/2015 9:15	12/9/2015 9:20	Grab	195	82.4	284	21	8.1	2.3	3.6	—	0.0026	—	0.0022	—	0.0009	—	0.0197	—	< 0.0002	—	0.0009	—
12/14/2015 11:05	12/14/2015 16:59	Composite	55	41.6	104	70	10.5	7.4	9.5	—	0.0283	—	0.0072	—	0.0278	—	0.1320	—	~ 0.0003	—	0.0079	—
12/16/2015 2:30	12/16/2015 21:00	Composite	85	215.4	164	96	8.1	3.9	6.2	—	—	—	—	—	—	—	—	—	—	—	—	—
12/22/2015 10:10	12/22/2015 10:11	Grab	359	149.8	580	30	10.7	1.2	2.4	—	—	—	—	—	—	—	—	—	—	—	—	—

**Table D.3.** Monitoring data for 2NNBC outfall

Start Date Start Time	End Date End Time	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
2/9/2015 11:49	2/9/2015 11:50	Grab	24	46.4	1.92	3,069.0	4,439.0	6.80	> 100	2.37	< 1	~ 1	1,320	179.0	0.862	0.952	0.540	1.80	0.44	0.05	4.14
2/24/2015 10:57	2/24/2015 10:58	Grab	20	48.2	0.90	7,776.0	11,210.0	6.82	21	6.38	10	5	1,470	176.0	0.514	0.880	0.329	2.20	0.62	0.09	2.81
3/6/2015 10:45	3/6/2015 10:46	Grab	25	41.9	6.36	2,255.0	3,594.0	7.46	82	1.89	9	3	1,990	93.5	0.946	1.210	0.600	2.20	0.43	0.18	2.74
3/17/2015 10:42	3/17/2015 10:43	Grab	30	47.3	4.70	1,549.0	2,260.0	7.18	73	1.16	8	4	1,055	118.0	0.244	0.962	0.149	5.60	0.54	0.25	2.52
5/26/2015 12:30	5/26/2015 12:31	Grab	58	59.2	9.78	68.1	84.0	7.96	10	0.04	239	47	52	3.9	0.072	0.471	—	1.20	0.28	0.03	0.33

**Table D.4.** Monitoring data for 7LSTU outfall

Start Date Start Time	End Date End Time	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
5/26/2015 12:06	5/26/2015 21:03	Composite	75	65.5	7.69	212.9	242.5	7.69	5	0.19	186	51	—	—	0.103	0.566	—	2.00	—	—	—
10/28/2015 13:55	10/28/2015 13:56	Grab	50	—	—	—	—	—	—	17	7	—	—	< 0.020	0.112	—	0.85	< 0.02	< 0.03	0.41	

**Table D.3 continued.** Monitoring data for 2NNBC outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)
2/9/2015 11:49	2/9/2015 11:50	Grab	282	492.3	544	43	12.9	< 1.0	< 1.0	0.0032	0.0048	0.0018	0.0020	0.0006	0.0010	0.0084	0.0101	< 0.0002	< 0.0002	0.0022	0.0027	—
2/24/2015 10:57	2/24/2015 10:58	Grab	324	553.5	584	41	11.4	2.7	5.6	—	—	—	—	—	—	—	—	—	—	—	—	—
3/6/2015 10:45	3/6/2015 10:46	Grab	334	812.9	424	61	13.4	2.6	3.4	—	—	—	—	—	—	—	—	—	—	—	—	—
3/17/2015 10:42	3/17/2015 10:43	Grab	269	387.9	450	37	9.3	1.2	2.0	—	—	—	—	—	—	—	—	—	—	—	—	—
5/26/2015 12:30	5/26/2015 12:31	Grab	30	9.7	44	84	4.4	—	—	0.0264	—	0.0065	—	0.0448	—	0.1530	—	~ 0.0005	—	0.0095	—	—

**Table D.4 continued.** Monitoring data for 7LSTU outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)
5/26/2015 12:06	5/26/2015 21:03	Composite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/28/2015 13:55	10/28/2015 13:56	Grab	—	188.0	344	—	9.4	—	—	0.0061	—	0.0021	—	0.0041	—	0.0336	—	~ 0.0003	—	0.0017	—	—

**Table D.5.** Monitoring data for 4PP outfall

Start Date Start Time	End Date End Time	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
			Temp (F)	Temp (F)	Oxygen (mg/L)	(µS/cm)	Conductivity (µS/cm)	(cm)	(ppt)	Suspended Solids (mg/L)	Suspended Solids (mg/L)	Dissolved Solids (mg/L)	(mg/L)	Phosphorus (mg/L)	Total Phosphorus (mg/L)	Phosphate (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrogen (mg/L)			
1/14/2015 10:50	1/14/2015 10:51	Grab	20	54.5	10.47	1,225.0	1,719.0	8.30	24	0.87	475	~ 14	818	106.0	< 0.020	0.186	0.014	0.47	~ 0.04	< 0.03	0.72
1/17/2015 15:45	1/18/2015 22:40	Composite	30	55.6	9.32	3,662.0	5,067.0	7.88	31	2.74	56	8	2,720	91.0	< 0.020	0.105	~ 0.006	1.00	0.12	0.13	0.88
1/23/2015 14:55	1/25/2015 4:50	Composite	40	53.6	91.90	2,031.0	2,865.0	7.28	30	1.50	30	~ 12	1,540	8.1	< 0.020	0.114	—	0.99	0.07	0.06	0.74
2/9/2015 12:35	2/9/2015 12:36	Grab	24	55.0	10.35	977.0	1,361.0	8.03	> 100	0.69	~ 1	~ 1	734	88.7	< 0.020	~ 0.034	0.020	0.44	~ 0.05	< 0.03	0.90
2/24/2015 11:35	2/24/2015 11:36	Grab	20	44.6	10.40	949.0	1,510.0	8.01	93	0.76	38	~ 1	776	86.9	~ 0.032	0.107	0.035	0.56	~ 0.05	< 0.03	0.58
3/6/2015 11:10	3/6/2015 11:11	Grab	25	54.3	11.19	940.0	1,321.0	8.02	> 100	0.66	17	~ 4	750	83.4	~ 0.030	0.084	0.010	0.64	0.14	< 0.03	0.61
3/17/2015 11:05	3/17/2015 11:06	Grab	30	55.4	10.75	968.0	1,340.0	7.60	> 100	0.76	3	~ 1	746	85.5	~ 0.040	~ 0.035	0.024	0.36	~ 0.04	< 0.03	0.92
4/16/2015 10:16	4/16/2015 10:17	Grab	60	57.7	10.65	957.0	1,291.0	8.02	> 100	0.65	~ 1	~ 1	712	43.0	~ 0.030	0.055	0.028	0.60	< 0.02	< 0.03	0.46
4/30/2015 12:00	4/30/2015 12:01	Grab	60	57.4	10.43	1,025.0	1,389.0	8.18	> 100	0.70	< 1	~ 1	761	68.0	~ 0.034	0.055	0.008	0.46	~ 0.04	< 0.03	1.15
5/13/2015 11:15	5/13/2015 11:16	Grab	50	57.7	11.41	1,034.0	1,397.0	8.01	> 100	0.70	< 1	~ 1	767	84.6	~ 0.030	0.052	0.017	0.32	~ 0.03	< 0.03	0.96
5/26/2015 12:50	5/26/2015 12:51	Grab	58	66.2	9.90	93.3	114.8	7.70	14	0.05	63	17	62	32.9	0.071	0.219	—	1.30	0.36	0.03	0.35
6/10/2015 11:35	6/10/2015 11:36	Grab	70	60.1	10.12	1,192.0	1,565.0	8.05	> 100	0.79	~ 2	~ 2	902	95.0	0.063	0.106	0.026	0.82	0.06	< 0.03	1.26
6/20/2015 6:06	6/20/2015 10:56	Composite	70	85.3	5.33	242.0	248.0	7.06	—	0.12	92	31	166	11.0	< 0.020	0.277	—	2.00	0.11	< 0.03	0.09
6/25/2015 10:58	6/25/2015 10:59	Grab	75	63.5	10.63	1,158.0	1,468.0	7.98	> 100	0.74	3	~ 1	782	93.0	~ 0.032	0.052	0.024	0.53	~ 0.05	< 0.03	0.88
7/6/2015 1:06	7/6/2015 4:51	Composite	75	83.5	6.57	138.8	144.6	7.43	27	0.07	99	25	91	7.2	< 0.020	0.236	0.004	1.35	~ 0.03	< 0.03	0.33
7/9/2015 11:15	7/9/2015 11:16	Grab	75	67.8	10.27	1,238.0	1,497.0	8.04	> 100	0.76	~ 1	~ 1	807	91.7	~ 0.037	~ 0.046	0.023	0.53	~ 0.04	< 0.03	1.05
7/12/2015 23:31	7/13/2015 2:46	Composite	80	84.9	7.44	126.6	130.4	7.56	29	0.06	87	30	68	4.9	~ 0.033	0.160	0.023	1.10	< 0.02	< 0.03	0.17
7/18/2015 1:01	7/18/2015 4:06	Composite	70	90.7	6.79	151.9	148.8	7.56	—	0.07	68	21	95	7.6	0.030	0.250	—	1.65	0.19	0.03	0.33
7/23/2015 10:15	7/23/2015 10:16	Grab	70	67.6	9.44	1,086.0	1,318.0	8.03	> 100	0.66	~ 1	1	812	93.2	~ 0.030	0.038	0.023	0.58	< 0.02	< 0.03	0.85
7/24/2015 3:56	7/24/2015 9:01	Composite	80	96.4	6.95	423.6	396.5	7.60	—	0.19	60	24	233	20.3	0.073	0.259	—	1.80	0.28	0.08	0.37
7/28/2015 6:46	7/28/2015 10:41	Composite	70	57.9	9.21	62.7	84.4	7.96	—	0.04	—	—	—	3.8	0.051	0.274	—	1.80	< 0.02	< 0.03	0.20
8/6/2015 11:46	8/7/2015 6:06	Composite	70	81.1	6.76	446.0	475.4	7.45	17	0.23	100	30	263	28.2	0.124	0.426	0.127	2.10	0.14	0.06	0.62
8/9/2015 14:36	8/9/2015 15:46	Composite	75	84.4	5.56	582.0	602.0	7.49	—	0.29	43	16	—	—	< 0.020	0.147	—	1.40	~ 0.04	0.06	0.87
8/14/2015 11:15	8/14/2015 11:16	Grab	80	72.5	9.96	1,192.0	1,375.0	8.00	> 100	0.69	< 1	< 1	744	89.8	~ 0.028	~ 0.039	0.024	0.34	~ 0.03	< 0.03	0.99
8/16/2015 17:56	8/16/2015 23:51	Composite	70	83.8	6.40	218.5	227.0	7.21	16	0.11	150	45	131	10.7	0.071	0.314	0.065	1.80	< 0.02	0.05	0.61
8/18/2015 11:36	8/18/2015 21:36	Composite	60	75.9	8.20	165.7	185.0	7.47	27	0.09	31	10	100	9.6	~ 0.031	0.105	0.030	0.59	< 0.02	< 0.03	0.26
8/22/2015 20:46	8/23/2015 1:26	Composite	55	73.4	6.10	205.6	235.1	7.11	—	0.11	102	27	137	12.6	0.075	0.337	—	1.70	0.08	< 0.03	0.59
8/27/2015 11:38	8/27/2015 11:39	Grab	70	68.0	11.22	1,122.0	1,356.0	7.99	> 100	0.68	< 1	< 1	748	86.3	~ 0.037	~ 0.037	0.025	0.45	~ 0.05	< 0.03	1.23
9/2/2015 3:11	9/2/2015 8:26	Composite	70	82.9	9.01	357.4	374.3	7.44	—	0.18	59	25	231	19.8	0.094	0.228	0.076	1.60	0.35	0.07	0.76
9/6/2015 6:16	9/6/2015 13:31	Composite	75	85.3	5.74	259.1	265.5	7.33	53	0.13	57	18	160	14.4	0.062	0.203	—	1.10	0.22		

**Table D.5 continued.** Monitoring data for 4PP outfall

Start Date Start Time	End Date End Time	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
9/16/2015 3:51	9/16/2015 6:41	Composite	75	83.5	5.51	693.0	723.0	7.24	—	0.35	66	27	412	41.3	~ 0.027	0.243	—	2.00	< 0.02	0.08	0.76
9/17/2015 6:21	9/17/2015 8:41	Composite	79	81.3	7.41	142.2	151.0	7.81	11	0.07	151	43	101	8.5	0.064	0.305	0.054	1.90	0.23	0.03	0.64
9/17/2015 11:41	9/17/2015 18:21	Composite	60	76.8	6.81	133.9	148.3	7.56	19	0.07	79	21	74	7.3	~ 0.027	0.153	0.032	0.90	0.15	< 0.03	0.33
9/18/2015 18:41	9/19/2015 0:56	Composite	60	71.4	7.70	268.4	313.5	7.46	—	0.15	21	9	178	18.5	~ 0.029	0.085	—	0.54	0.07	< 0.03	0.46
9/22/2015 10:15	9/22/2015 10:16	Grab	65	65.5	9.79	1,081.0	1,338.0	7.83	> 100	0.67	~ 1	~ 1	755	86.4	~ 0.030	~ 0.045	0.018	0.36	~ 0.03	< 0.03	0.96
9/24/2015 3:11	9/24/2015 10:41	Composite	65	78.4	7.15	348.4	380.1	7.44	—	0.18	40	14	208	20.1	~ 0.036	0.162	—	0.84	< 0.02	0.04	0.51
10/8/2015 4:01	10/8/2015 7:31	Composite	55	67.3	9.37	262.8	319.5	7.33	—	0.15	146	53	211	17.4	0.282	0.575	0.244	3.40	0.59	0.05	0.88
10/13/2015 11:05	10/13/2015 11:06	Grab	50	58.6	10.33	987.0	1,319.0	7.92	> 100	0.66	~ 1	~ 1	736	86.2	0.019	0.039	0.023	0.33	< 0.02	< 0.03	1.02
10/23/2015 5:21	10/23/2015 11:36	Composite	50	58.8	4.51	232.0	309.2	6.86	15	0.15	82	38	213	17.2	0.145	0.751	—	2.60	< 0.02	< 0.03	< 0.05
10/27/2015 19:16	10/28/2015 10:06	Composite	50	42.4	7.69	208.8	341.8	7.65	—	0.16	14	~ 10	182	17.7	0.085	0.197	—	0.83	< 0.02	< 0.03	< 0.05
10/28/2015 0:01	10/29/2015 10:51	Composite	40	55.2	11.51	403.9	562.1	7.71	22	0.27	19	15	314	31.7	0.096	0.205	0.082	0.88	< 0.02	< 0.03	< 0.05
10/30/2015 11:15	10/30/2015 11:16	Grab	40	58.1	9.84	1,004.0	1,349.0	7.81	> 100	0.68	4	~ 1	734	87.0	~ 0.020	~ 0.045	0.011	0.38	~ 0.02	< 0.03	0.99
10/30/2015 12:36	10/31/2015 15:16	Composite	65	62.2	8.03	556.0	715.0	7.43	—	0.35	196	17	385	42.6	0.095	0.241	—	0.72	~ 0.04	< 0.03	< 0.05
11/9/2015 10:35	11/9/2015 10:36	Grab	60	58.8	11.00	1,017.0	1,355.0	7.85	> 100	0.68	3	~ 1	746	87.3	< 0.020	~ 0.048	~ 0.008	0.42	~ 0.04	< 0.03	0.88
11/11/2015 15:45	11/12/2015 0:50	Composite	40	54.7	11.82	104.5	146.1	7.68	25	0.07	86	26	96	7.8	0.119	0.259	0.110	1.20	0.17	< 0.03	0.28
11/16/2015 12:05	11/17/2015 2:40	Composite	50	60.6	10.25	146.9	191.8	7.32	45	0.09	40	~ 14	82	9.8	~ 0.037	0.134	—	0.79	< 0.02	< 0.03	< 0.05
11/24/2015 11:05	11/24/2015 11:06	Grab	34	56.1	10.55	1,002.0	1,381.0	8.03	69	0.70	30	~ 1	744	89.3	~ 0.024	~ 0.044	0.020	0.42	~ 0.02	< 0.03	0.84
11/30/2015 11:50	12/1/2015 6:05	Composite	30	51.6	11.27	1,996.0	2,895.0	7.91	—	1.51	—	~ 150	—	53.3	~ 0.034	0.277	—	1.70	0.10	0.08	0.63
12/9/2015 11:10	12/9/2015 11:11	Grab	30	51.6	11.27	1,996.0	2,895.0	7.91	92	1.51	9	3	759	83.9	~ 0.044	0.069	0.018	0.53	~ 0.04	< 0.03	0.71
12/22/2015 10:49	12/22/2015 10:50	Grab	32	56.8	9.84	1,064.0	1,451.0	8.16	—	0.75	50	~ 2	788	123.0	< 0.020	~ 0.030	~ 0.009	0.55	~ 0.05	0.03	1.04

**Table D.5 continued.** Monitoring data for 4PP outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)
1/14/2015 10:50	1/14/2015 10:51	Grab	75	360.8	352	~ 6	2.0	1.5	1.6	< 0.0050	< 0.0050	0.0014	0.0069	< 0.0001	0.0022	< 0.0008	0.0181	< 0.0002	< 0.0002	0.0146	0.0198	—
1/17/2015 15:45	1/18/2015 22:40	Composite	263	1,350.7	496	41	5.7	6.7	9.4	0.0037	0.0102	0.0024	0.0052	< 0.0001	0.0038	0.0141	0.0573	< 0.0002	~ 0.0003	0.0006	0.0036	—
1/23/2015 14:55	1/25/2015 4:50	Composite	260	689.2	436	39	4.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2/9/2015 12:35	2/9/2015 12:36	Grab	289	225.0	472	~ 5	2.3	< 1.0	< 1.0	< 0.0003	~ 0.0006	0.0017	0.0020	< 0.0001	~ 0.0002	~ 0.0013	0.0024	< 0.0002	< 0.0002	< 0.0001	0.0009	< 6
2/24/2015 11:35	2/24/2015 11:36	Grab	280	271.0	500	< 5	2.2	1.0	1.3	—	—	—	—	—	—	—	—	—	—	—	—	—
3/6/2015 11:10	3/6/2015 11:11	Grab	292	206.5	484	< 5	2.2	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
3/17/2015 11:05	3/17/2015 11:06	Grab	298	218.2	476	~ 6	2.2	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
4/16/2015 10:16	4/16/2015 10:17	Grab	290	189.7	488	< 5	2.4	< 1.0	< 1.0	—	~ 0.0005	—	0.0022	—	~ 0.0002	—	0.0045	—	< 0.0002	—	0.0004	—
4/30/2015 12:00	4/30/2015 12:01	Grab	294	233.3	498	< 5	2.5	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
5/13/2015 11:15	5/13/2015 11:16	Grab	293	243.6	496	< 5	2.7	< 1.0	< 1.0	—	0.0006	—	0.0021	—	< 0.0001	—	< 0.0050	—	< 0.0002	—	0.0003	—
5/26/2015 12:50	5/26/2015 12:51	Grab	28	13.8	124	45	4.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6/10/2015 11:35	6/10/2015 11:36	Grab	291	287.8	524	~ 8	4.1	0.9	1.0	—	0.0022	—	0.0032	—	~ 0.0004	—	0.0346	—	< 0.0002	—	0.0005	—
6/20/2015 6:06	6/20/2015 10:56	Composite	42	35.5	70	79	8.7	—	—	—	0.0228	—	0.0042	—	0.0163	—	0.1280	—	< 0.0002	—	0.0071	—
6/25/2015 10:58	6/25/2015 10:59	Grab	287	261.2	512	< 5	2.2	0.7	0.8	—	—	—	—	—	—	—	—	—	—	—	—	—
7/6/2015 1:06	7/6/2015 4:51	Composite	27	17.4	46	78	10.4	14.0	18.0	—	0.0200	—	0.0041	—	0.0216	—	0.1085	—	~ 0.0003	—	0.0059	—
7/9/2015 11:15	7/9/2015 11:16	Grab	283	274.5	480	~ 12	2.5	0.6	0.7	—	0.0016	—	0.0027	—	~ 0.0004	—	0.0262	—	< 0.0002	—	0.0003	—
7/12/2015 23:31	7/13/2015 2:46	Composite	21	10.4	28	45	5.3	7.7	9.3	—	—	—	—	—	—	—	—	—	—	—	—	—
7/18/2015 1:01	7/18/2015 4:06	Composite	32	18.7	46	67	3.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7/23/2015 10:15	7/23/2015 10:16	Grab	283	269.0	508	13	2.0	0.6	0.4	—	—	—	—	—	—	—	—	—	—	—	—	—
7/24/2015 3:56	7/24/2015 9:01	Composite	73	56.4	120	67	8.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7/28/2015 6:46	7/28/2015 10:41	Composite	14	8.1	—	61	4.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/6/2015 11:46	8/7/2015 6:06	Composite	95	73.2	148	83	10.9	7.4	> 8.4	—	0.0245	—	0.0050	—	0.0240	—	0.1440	—	< 0.0002	—	0.0066	—
8/9/2015 14:36	8/9/2015 15:46	Composite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/14/2015 11:15	8/14/2015 11:16	Grab	287	225.9	506	4	2.5	1.0	0.9	—	—	—	—	—	—	—	—	—	—	—	—	—
8/16/2015 17:56	8/16/2015 23:51	Composite	42	28.0	64	92	9.5	6.7	13.0	—	—	—	—	—	—	—	—	—	—	—	—	—
8/18/2015 11:36	8/18/2015 21:36	Composite	24	22.4	60	36	3.5	2.3	3.9	—	—	—	—	—	—	—	—	—	—	—	—	—
8/22/2015 20:46	8/23/2015 1:26	Composite	42	29.9	74	74	5.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/27/2015 11:38	8/27/2015 11:39	Grab	286	231.9	488	< 5	2.0	1.1	0.4	—	—	—	—	—	—	—	—	—	—	—	—	—
9/2/2015 3:11	9/2/2015 8:26	Composite	71	50.2	120	69	14.4	11.0	12.0	—	—	—	—	—	—	—	—	—	—	—	—	—
9/6/2015 6:16	9/6/2015 13:31	Composite	61	34.7	94	46	5.4	—	—	—	0.0145	—	0.0026	—	0.0124	—	0.0769	—	~ 0.0002	—	0.0037	—
9/9/2015 21:11	9/10/2015 6:26	Composite	59	36.8	98	38	5.7	4.2	5.9	—	—	—	—	—	—	—	—	—	—	—	—	—
9/14/2015 10:50	9/14/2015 10:51	Grab	298	224.2	486	~ 7	2.3	0.8	0.4	—	< 0.0010	—	0.0021	—	~ 0.0003	—	0.0061	—	< 0.0002	—	~ 0.0002	—

**Table D.5 continued.** Monitoring data for 4PP outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)
9/16/2015 3:51	9/16/2015 6:41	Composite	150	104.8	—	75	12.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/17/2015 6:21	9/17/2015 8:41	Composite	38	18.1	54	91	6.6	7.0	1.8	—	—	—	—	—	—	—	—	—	—	—	—	—
9/17/2015 11:41	9/17/2015 18:21	Composite	35	16.3	48	34	3.8	2.9	5.0	—	—	—	—	—	—	—	—	—	—	—	—	—
9/18/2015 18:41	9/19/2015 0:56	Composite	73	46.7	118	31	4.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/22/2015 10:15	9/22/2015 10:16	Grab	282	214.0	488	~ 10	2.5	1.1	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—
9/24/2015 3:11	9/24/2015 10:41	Composite	76	50.8	122	50	5.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/8/2015 4:01	10/8/2015 7:31	Composite	62	42.1	102	135	28.3	> 26.0	> 26.0	—	0.0269	—	0.0048	—	0.0154	—	0.1390	—	~ 0.0003	—	0.0057	—
10/13/2015 11:05	10/13/2015 11:06	Grab	299	230.5	504	~ 6	2.3	0.7	0.4	—	0.0020	—	0.0018	—	~ 0.0003	—	0.0034	—	< 0.0002	—	0.0002	—
10/23/2015 5:21	10/23/2015 11:36	Composite	69	41.3	124	128	18.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/27/2015 19:16	10/28/2015 10:06	Composite	69	45.0	88	37	8.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/28/2015 0:01	10/29/2015 10:51	Composite	114	80.1	188	52	10.7	11.0	13.0	—	—	—	—	—	—	—	—	—	—	—	—	—
10/30/2015 11:15	10/30/2015 11:16	Grab	277	215.2	440	< 5	2.6	1.1	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—
10/30/2015 12:36	10/31/2015 15:16	Composite	154	97.1	256	83	6.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	< 8
11/9/2015 10:35	11/9/2015 10:36	Grab	287	233.3	488	< 5	2.3	0.8	0.4	—	< 0.0050	—	0.0023	—	0.0008	—	< 0.0050	—	< 0.0002	—	0.0003	—
11/11/2015 15:45	11/12/2015 0:50	Composite	33	18.0	52	70	9.3	11.0	13.0	—	0.0130	—	0.0026	—	0.0137	—	0.0706	—	< 0.0002	—	0.0064	—
11/16/2015 12:05	11/17/2015 2:40	Composite	45	22.2	66	32	3.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/24/2015 11:05	11/24/2015 11:06	Grab	288	203.5	488	< 5	2.6	0.5	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—
11/30/2015 11:50	12/1/2015 6:05	Composite	174	838.5	580	58	6.7	—	—	—	0.0518	—	0.0248	—	0.0354	—	0.3230	—	0.0008	—	0.0237	—
12/9/2015 11:10	12/9/2015 11:11	Grab	285	229.5	516	~ 6	3.2	1.8	2.3	—	0.0015	—	0.0024	—	0.0008	—	0.0083	—	< 0.0002	—	< 0.0005	—
12/22/2015 10:49	12/22/2015 10:50	Grab	154	312.5	436	~ 8	3.6	1.5	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—

**Table D.6.** Monitoring data for 6UMN outfall

Start Date Start Time	End Date End Time	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
			Temp (F)	Temp (F)	Oxygen (mg/L)	(μS/cm)	Conductivity (μS/cm)	(cm)	(ppt)	Suspended Solids (mg/L)	Suspended Solids (mg/L)	Dissolved Solids (mg/L)	(mg/L)	Phosphorus (mg/L)	Phosphorus (mg/L)	Phosphate (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrogen (mg/L)			
1/14/2015 10:25	1/14/2015 10:26	Grab	20	45.7	11.64	970.0	1,454.0	7.56	> 100	0.73	~ 1	~ 1	787	72.7	< 0.020	~ 0.020	0.010	0.31	< 0.02	< 0.03	1.04
1/23/2015 9:35	1/23/2015 9:36	Grab	30	45.5	11.82	926.0	1,391.0	8.18	> 100	0.70	~ 1	~ 1	767	74.4	~ 0.020	~ 0.026	0.028	0.41	~ 0.03	< 0.03	0.95
2/9/2015 10:58	2/9/2015 10:59	Grab	24	44.4	12.24	848.0	1,296.0	8.21	> 100	0.65	~ 1	~ 1	733	73.1	< 0.020	~ 0.024	0.014	0.33	~ 0.02	< 0.03	0.97
2/24/2015 10:15	2/24/2015 10:16	Grab	20	45.3	10.60	876.0	1,321.0	8.17	> 100	0.66	3	~ 1	734	71.0	< 0.020	~ 0.022	0.011	0.42	< 0.02	< 0.03	0.90
3/6/2015 9:55	3/6/2015 9:56	Grab	20	44.4	12.32	862.0	1,317.0	8.14	> 100	0.66	< 1	< 1	752	65.5	< 0.020	< 0.020	0.011	0.45	< 0.02	< 0.03	0.91
3/11/2015 15:00	3/12/2015 5:00	Composite	50	—	—	—	—	—	—	—	6	~ 2	1,020	57.5	~ 0.028	0.068	—	0.68	~ 0.03	< 0.03	0.70
3/17/2015 11:41	3/17/2015 11:42	Grab	30	46.0	12.06	859.0	1,280.0	7.70	> 100	0.64	8	~ 3	722	66.9	~ 0.035	~ 0.042	0.021	0.42	~ 0.04	< 0.03	0.87
3/23/2015 11:00	3/25/2015 12:53	Composite	30	34.9	11.87	1,858.0	3,321.0	7.65	—	1.71	242	72	1,760	41.6	0.075	0.704	—	3.60	0.24	0.07	1.04
3/29/2015 4:29	3/29/2015 13:42	Composite	40	44.6	12.14	737.0	1,124.0	8.00	—	0.56	372	168	628	32.5	0.182	1.040	—	3.70	0.38	0.05	0.77
4/1/2015 20:26	4/1/2015 23:06	Composite	55	54.7	10.23	365.8	478.8	8.04	—	0.23	573	187	266	16.7	0.142	0.906	0.129	4.70	0.79	0.08	0.90
4/6/2015 7:30	4/6/2015 9:00	Composite	40	41.0	13.15	529.0	857.0	8.12	—	0.42	45	17	—	38.2	0.079	0.220	—	1.50	0.38	0.05	0.84
4/9/2015 2:31	4/9/2015 18:21	Composite	35	40.1	14.88	151.9	249.7	7.97	6	0.12	150	42	135	10.2	0.072	0.336	0.077	1.40	0.19	0.05	0.46
4/12/2015 21:24	4/13/2015 4:31	Composite	60	54.3	10.03	161.2	212.2	7.80	—	0.10	284	76	119	8.6	0.070	0.403	0.081	2.10	0.50	< 0.03	0.29
4/16/2015 9:35	4/16/2015 9:36	Grab	60	52.2	12.27	954.0	1,296.0	8.23	> 100	0.65	< 1	~ 1	728	68.7	~ 0.023	~ 0.032	0.016	0.38	< 0.02	< 0.03	1.08
4/30/2015 10:58	4/30/2015 10:59	Grab	60	52.9	10.89	916.0	1,232.0	8.14	70	0.62	~ 1	~ 1	706	68.4	< 0.020	~ 0.045	< 0.005	0.41	< 0.02	< 0.03	0.96
5/3/2015 17:31	5/3/2015 22:33	Composite	55	54.9	10.73	223.5	291.9	7.68	—	0.14	443	154	193	12.2	0.211	1.740	0.176	6.70	0.80	0.05	0.83
5/7/2015 13:20	5/7/2015 20:32	composite	60	58.3	6.70	399.4	498.2	7.22	—	0.24	204	158	—	25.6	0.089	0.668	0.054	4.30	~ 0.05	0.08	0.68
5/10/2015 12:39	5/11/2015 2:52	Composite	50	53.6	9.99	155.8	207.2	7.20	—	0.10	81	40	112	8.8	0.059	0.223	0.037	1.60	0.24	0.03	0.43
5/13/2015 10:40	5/13/2015 10:41	Grab	50	52.0	12.17	901.0	1,225.0	8.16	> 100	0.61	~ 1	~ 1	678	67.0	~ 0.041	0.064	0.023	0.37	< 0.02	< 0.03	0.89
5/14/2015 15:39	5/14/2015 22:55	Composite	50	56.3	10.05	436.4	558.9	7.50	—	0.27	25	9	302	26.9	~ 0.045	0.140	0.033	1.00	0.17	0.06	0.59
5/16/2015 21:19	5/18/2015 3:33	Composite	40	51.1	8.18	500.0	689.0	7.57	—	0.34	114	68	378	34.2	< 0.020	0.277	—	2.10	< 0.02	0.03	0.43
5/26/2015 12:07	5/26/2015 20:43	Composite	70	62.4	9.17	88.2	104.4	7.41	12	0.05	72	18	55	3.6	~ 0.037	0.174	—	1.00	0.25	0.04	0.24
6/10/2015 10:55	6/10/2015 10:56	Grab	70	58.8	10.70	1,056.0	1,308.0	8.09	> 100	0.66	~ 2	~ 1	748	72.2	< 0.020	~ 0.030	0.015	0.38	~ 0.02	< 0.03	1.05
6/20/2015 5:58	6/20/2015 7:33	Composite	65	70.9	7.13	341.6	365.1	6.99	—	0.17	91	31	200	17.7	0.055	0.248	—	1.90	0.21	0.12	0.32
6/22/2015 7:38	6/22/2015 9:49	Composite	65	70.5	7.39	230.0	247.1	7.19	—	0.12	47	15	135	11.6	< 0.020	0.196	—	1.20	0.06	0.03	0.42
6/25/2015 11:49	6/25/2015 11:50	Grab	70	60.3	9.97	930.0	1,132.0	7.92	> 100	0.57	4	~ 1	702	71.9	< 0.020	< 0.020	< 0.005	0.34	< 0.02	< 0.03	0.96
6/27/2015 23:25	6/28/2015 4:38	Composite	80	69.8	5.68	269.1	291.7	7.44	—	0.14	117	38	177	—	~ 0.027	0.323	—	1.80	0.19	0.08	0.82
6/29/2015 19:33	6/29/2015 20:37	Composite	70	68.0	8.08	80.1	88.5	7.25	8	0.04	197	43	54	4.3	~ 0.034	0.369	0.021	3.20	0.28	< 0.03	0.38
7/6/2015 1:27	7/6/2015 3:47	Composite	75	71.4	7.45	87.6	93.2	7.60	25	0.04	51	16	56	4.0	~ 0.032	0.174	0.023	1.30	0.29	0.03	0.42
7/9/2015 10:37	7/9/2015 10:38	Grab	75	58.8	10.12	1,061.0	1,316.0	8.10	35	0.66	21	3	717	71.8	< 0.020	~ 0.045	0.012	0.55	< 0.02	< 0.03	0.87
7/12/2015 23:15	7/12/2015 23:15</																				

**Table D.6 continued.** Monitoring data for 6UMN outfall

Start Date Start Time	End Date End Time	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
			Temp (F)	Temp (F)	Oxygen (mg/L)	(µS/cm)	Conductivity (µS/cm)	(cm)	(ppt)	Suspended Solids (mg/L)	Suspended Solids (mg/L)	Dissolved Solids (mg/L)	(mg/L)	Phosphorus (mg/L)	Phosphorus (mg/L)	Phosphate (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrogen (mg/L)	(mg/L)		
7/18/2015 0:53	7/18/2015 11:05	Composite	70	75.6	7.21	166.3	168.8	7.57	29	0.08	20	5	92	7.3	0.055	0.140	—	0.85	0.19	0.04	0.40
7/23/2015 9:25	7/23/2015 9:26	Grab	70	59.9	10.39	1,051.0	1,283.0	8.05	> 100	0.64	~ 1	~ 1	710	71.3	~ 0.021	~ 0.026	0.018	0.44	< 0.02	< 0.03	0.83
7/28/2015 6:36	7/28/2015 9:45	Composite	75	64.4	8.71	65.8	76.0	7.86	28	0.03	63	16	44	3.0	0.053	0.161	—	0.64	< 0.02	< 0.03	0.21
8/6/2015 12:13	8/7/2015 2:13	Composite	70	69.8	7.45	203.9	220.7	7.35	—	0.10	178	58	—	—	0.065	0.393	0.026	2.40	0.10	0.06	0.51
8/14/2015 10:40	8/14/2015 10:41	Grab	80	61.9	10.31	1,094.0	1,304.0	8.03	> 100	0.66	~ 1	< 1	705	73.3	< 0.020	< 0.020	0.014	0.46	< 0.02	< 0.03	0.95
8/16/2015 18:10	8/16/2015 9:19	Composite	70	69.8	7.81	122.4	132.5	6.86	—	0.06	140	44	113	5.1	0.069	0.370	0.067	2.40	0.08	0.05	7.10
8/18/2015 12:45	8/19/2015 4:28	Composite	60	63.5	8.90	118.1	137.9	7.50	—	0.06	61	18	74	6.2	~ 0.030	0.151	0.036	0.71	< 0.02	< 0.03	0.22
8/22/2015 20:41	8/23/2015 0:38	Composite	60	61.7	7.80	160.8	191.8	7.31	—	0.09	99	24	123	9.5	0.058	0.363	—	2.00	0.07	0.03	0.36
8/27/2015 11:05	8/27/2015 11:06	Grab	70	59.7	11.51	1,055.0	1,292.0	8.06	> 100	0.65	~ 1	~ 1	712	74.0	< 0.020	< 0.020	0.011	0.47	~ 0.02	< 0.03	0.95
9/2/2015 3:14	9/2/2015 8:10	Composite	70	71.4	9.52	285.6	303.8	7.59	—	0.14	41	12	174	15.6	0.114	0.245	0.106	1.30	0.29	0.05	0.65
9/6/2015 6:35	9/6/2015 12:00	Composite	75	73.2	6.23	187.8	195.8	7.52	—	0.09	90	25	122	8.8	0.054	0.264	—	1.40	0.17	0.06	0.46
9/9/2015 21:15	9/9/2015 23:03	Composite	60	64.0	8.91	75.0	86.9	7.52	—	0.04	94	26	57	3.8	~ 0.030	0.165	0.024	1.20	0.28	< 0.03	0.28
9/14/2015 10:15	9/14/2015 10:16	Grab	70	59.4	10.90	1,025.0	1,262.0	8.08	> 100	0.63	~ 1	< 1	715	74.5	< 0.020	~ 0.026	~ 0.007	0.32	~ 0.03	< 0.03	0.87
9/17/2015 6:23	9/17/2015 7:55	Composite	79	70.5	8.43	124.0	133.3	7.64	—	0.06	191	47	94	7.7	~ 0.049	0.275	0.045	1.60	0.25	< 0.03	0.51
9/17/2015 11:48	9/17/2015 15:11	Composite	60	64.6	7.60	67.1	77.3	7.40	18	0.04	93	22	50	2.9	~ 0.021	0.141	< 0.005	0.93	0.21	< 0.03	0.29
9/18/2015 20:08	9/18/2015 23:20	Composite	60	63.0	9.19	108.3	127.3	7.39	—	0.06	56	17	65	4.7	~ 0.027	0.110	—	0.60	~ 0.05	< 0.03	0.25
9/22/2015 9:35	9/22/2015 9:36	Grab	65	59.9	9.97	1,039.0	1,268.0	7.73	> 100	0.64	5	~ 1	721	73.2	< 0.020	~ 0.040	~ 0.009	0.32	< 0.02	< 0.03	1.02
9/24/2015 3:38	9/24/2015 7:23	Composite	68	67.3	8.92	463.4	516.7	7.58	—	0.25	44	14	—	—	0.063	0.221	—	0.98	< 0.02	0.05	0.69
10/8/2015 4:15	10/8/2015 5:27	Composite	55	60.8	9.60	181.8	219.6	7.29	—	0.10	118	39	—	—	0.153	0.434	—	2.70	0.64	0.05	0.82
10/13/2015 10:22	10/13/2015 10:23	Grab	50	53.8	10.58	869.0	1,155.0	7.90	> 100	0.58	~ 1	~ 1	682	70.8	< 0.020	~ 0.041	0.012	0.34	< 0.02	< 0.03	0.92
10/23/2015 8:33	10/23/2015 23:39	Composite	50	52.5	8.48	106.5	144.0	7.00	14	0.07	67	26	106	7.9	0.051	0.324	—	1.90	< 0.02	< 0.03	< 0.05
10/27/2015 20:02	10/28/2015 21:24	Composite	40	44.1	12.63	104.3	160.1	7.57	35	0.08	15	8	94	6.9	0.057	0.123	0.043	0.68	< 0.02	0.03	0.31
10/30/2015 10:50	10/30/2015 10:51	Grab	40	51.1	10.60	855.0	1,181.0	7.85	> 100	0.59	3	< 1	648	65.9	~ 0.025	~ 0.039	0.012	0.28	< 0.02	< 0.03	0.91
10/31/2015 5:07	10/31/2015 9:34	Composite	65	58.8	9.00	158.4	196.2	7.47	—	0.09	14	7	112	8.4	0.057	0.109	—	0.55	< 0.02	< 0.03	0.10
11/9/2015 10:00	11/9/2015 10:01	Grab	60	53.4	10.76	902.0	1,204.0	7.85	> 100	0.60	~ 1	~ 1	673	69.2	~ 0.023	< 0.020	< 0.005	0.34	~ 0.03	< 0.03	0.94
11/11/2015 16:03	11/12/2015 2:35	Composite	40	46.8	11.18	68.7	101.1	7.19	23	0.05	72	18	82	4.3	0.077	0.168	0.068	0.91	0.18	< 0.03	0.24
11/16/2015 7:00	11/18/2015 19:30	Composite	20	39.0	12.38	89.4	149.9	7.63	—	0.07	32	9	88	5.9	0.050	0.116	—	0.51	< 0.02	< 0.02	0.10
11/24/2015 10:35	11/24/2015 10:36	Grab	34	50.5	9.93	897.0	1,247.0	8.18	> 100	0.63	~ 2	~ 1	668	72.1	< 0.020	~ 0.029	0.014	0.31	< 0.02	< 0.06	0.85
11/30/2015 12:30	12/1/2015 15:30	Composite	30	46.9	10.93	3,201.0	4,707.0	7.75	—	2.52	34	15	2,420	30.7	0.071	0.200	—	1.40	0.20	< 0.30	0.72
12/9/2015 10:15	12/9/2015 10:16	Grab	30	46.9	10.93	3,201.0	4,707.0	7.75	> 100	2.52	~ 1	~ 1	668	67.6	0.081	0.051	0.014	0.41	~ 0.02	< 0.06	1.05
12/14/2015 10:00	12																				

**Table D.6 continued.** Monitoring data for 6UMN outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)
1/14/2015 10:25	1/14/2015 10:26	Grab	331	218.8	496	< 5	2.6	< 1.0	< 1.0	< 0.0050	< 0.0050	0.0051	0.0053	< 0.0001	~ 0.0002	0.0016	0.0021	< 0.0002	< 0.0002	0.0002	~ 0.0001	—
1/23/2015 9:35	1/23/2015 9:36	Grab	337	187.9	512	~ 6	2.3	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
2/9/2015 10:58	2/9/2015 10:59	Grab	324	233.7	456	~ 5	2.0	< 1.0	< 1.0	0.0009	0.0010	0.0048	0.0051	< 0.0001	0.0006	~ 0.0014	0.0027	< 0.0002	< 0.0002	0.0002	0.0002	—
2/24/2015 10:15	2/24/2015 10:16	Grab	335	223.4	496	< 5	2.2	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
3/6/2015 9:55	3/6/2015 9:56	Grab	342	225.8	468	< 5	2.1	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
3/11/2015 15:00	3/12/2015 5:00	Composite	281	423.3	424	~ 14	3.7	—	—	—	0.0068	—	0.0057	—	0.0007	—	0.0137	—	< 0.0002	—	0.0026	—
3/17/2015 11:41	3/17/2015 11:42	Grab	343	204.1	492	~ 7	2.4	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
3/23/2015 11:00	3/25/2015 12:53	Composite	135	894.1	232	175	12.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3/29/2015 4:29	3/29/2015 13:42	Composite	100	258.3	208	264	12.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4/1/2015 20:26	4/1/2015 23:06	Composite	60	95.3	96	318	15.1	< 30.0	< 30.0	—	0.0920	—	0.0217	—	0.0514	—	0.6020	—	0.0008	—	0.0296	—
4/6/2015 7:30	4/6/2015 9:00	Composite	167	137.6	232	72	15.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4/9/2015 2:31	4/9/2015 18:21	Composite	39	43.4	72	103	7.6	5.8	7.3	—	0.0296	—	0.0082	—	0.0177	—	0.1830	—	~ 0.0003	—	0.0119	—
4/12/2015 21:24	4/13/2015 4:31	Composite	44	32.8	78	111	8.1	7.2	12.5	—	—	—	—	—	—	—	—	—	—	—	—	—
4/16/2015 9:35	4/16/2015 9:36	Grab	316	199.4	472	< 5	2.2	< 1.0	< 1.0	—	0.0008	—	0.0054	—	~ 0.0002	—	0.0042	—	< 0.0002	—	0.0002	—
4/30/2015 10:58	4/30/2015 10:59	Grab	329	194.3	448	< 5	2.5	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
5/3/2015 17:31	5/3/2015 22:33	Composite	44	49.7	88	306	22.1	39.0	51.0	—	0.0845	—	0.0191	—	0.0638	—	0.4970	—	0.0009	—	0.0244	—
5/7/2015 13:20	5/7/2015 20:32	composite	107	72.0	—	185	19.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5/10/2015 12:39	5/11/2015 2:52	Composite	38	29.2	80	62	10.5	12.0	14.0	—	0.0139	—	0.0033	—	0.0063	—	0.0779	—	< 0.0002	—	0.0033	—
5/13/2015 10:40	5/13/2015 10:41	Grab	314	186.4	444	< 5	4.0	1.1	1.2	—	0.0017	—	0.0049	—	~ 0.0003	—	0.0069	—	< 0.0002	—	0.0002	—
5/14/2015 15:39	5/14/2015 22:55	Composite	128	78.2	200	35	9.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5/16/2015 21:19	5/18/2015 3:33	Composite	175	91.1	256	76	10.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5/26/2015 12:07	5/26/2015 20:43	Composite	26	10.3	40	42	2.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6/10/2015 10:55	6/10/2015 10:56	Grab	327	191.8	484	< 5	2.7	0.7	0.4	—	0.0011	—	0.0050	—	~ 0.0003	—	0.0043	—	< 0.0002	—	0.0002	—
6/20/2015 5:58	6/20/2015 7:33	Composite	68	50.2	112	63	6.9	—	—	—	0.0206	—	0.0056	—	0.0111	—	0.1320	—	< 0.0002	—	0.0057	—
6/22/2015 7:38	6/22/2015 9:49	Composite	47	31.4	80	47	5.4	—	—	—	0.0156	—	0.0044	—	0.0108	—	0.0945	—	< 0.0002	—	0.0065	—
6/25/2015 11:49	6/25/2015 11:50	Grab	308	192.8	500	< 5	2.4	0.8	0.8	—	—	—	—	—	—	—	—	—	—	—	—	—
6/27/2015 23:25	6/28/2015 4:38	Composite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6/29/2015 19:33	6/29/2015 20:37	Composite	22	6.8	32	109	9.7	13.0	16.0	—	—	—	—	—	—	—	—	—	—	—	—	—
7/6/2015 1:27	7/6/2015 3:47	Composite	15	9.4	30	64	8.7	9.4	11.0	—	0.0121	—	0.0035	—	0.0083	—	0.0832	—	~ 0.0002	—	0.0035	—
7/9/2015 10:37	7/9/2015 10:38	Grab	307	205.9	472	~ 13	3.2	0.4	0.3	—	0.0024	—	0.0063	—	0.0009	—	0.0080	—	< 0.0002	—	0.0008	—
7/12/2015 23:15	7/12/2015 23:15	Grab	—	—	—	—	20.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

**Table D.6 continued.** Monitoring data for 6UMN outfall

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Carbonaceous Organic Carbon (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)	
7/18/2015 0:53	7/18/2015 11:05	Composite	32	17.5	50	30	3.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
7/23/2015 9:25	7/23/2015 9:26	Grab	302	188.5	440	~ 13	2.6	1.1	0.6	—	—	—	—	—	—	—	—	—	—	—	—	
7/28/2015 6:36	7/28/2015 9:45	Composite	19	6.2	26	28	4.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
8/6/2015 12:13	8/7/2015 2:13	Composite	—	24.2	70	—	9.3	—	7.5	—	0.0293	—	0.0090	—	0.0198	—	0.2080	—	~ 0.0004	—	0.0089	—
8/14/2015 10:40	8/14/2015 10:41	Grab	334	186.7	464	< 5	2.6	0.7	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—
8/16/2015 18:10	8/16/2015 9:19	Composite	< 10	11.8	44	103	9.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/18/2015 12:45	8/19/2015 4:28	Composite	37	12.9	44	42	4.9	3.5	5.2	—	—	—	—	—	—	—	—	—	—	—	—	—
8/22/2015 20:41	8/23/2015 0:38	Composite	46	20.0	70	100	6.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/27/2015 11:05	8/27/2015 11:06	Grab	321	201.1	428	~ 5	2.2	0.9	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—
9/2/2015 3:14	9/2/2015 8:10	Composite	74	34.3	102	58	13.2	9.7	13.0	—	—	—	—	—	—	—	—	—	—	—	—	—
9/6/2015 6:35	9/6/2015 12:00	Composite	54	22.0	68	58	6.5	—	—	—	0.0151	—	0.0054	—	0.0097	—	0.0967	—	~ 0.0002	—	0.0039	—
9/9/2015 21:15	9/9/2015 23:03	Composite	23	6.4	34	43	4.4	3.7	4.8	—	—	—	—	—	—	—	—	—	—	—	—	—
9/14/2015 10:15	9/14/2015 10:16	Grab	316	192.0	492	~ 11	2.3	0.5	0.4	—	< 0.0010	—	0.0052	—	~ 0.0003	—	0.0059	—	< 0.0002	—	0.0003	—
9/17/2015 6:23	9/17/2015 7:55	Composite	41	11.4	50	94	6.8	6.0	6.4	—	—	—	—	—	—	—	—	—	—	—	—	—
9/17/2015 11:48	9/17/2015 15:11	Composite	24	3.9	28	42	3.5	3.0	4.2	—	—	—	—	—	—	—	—	—	—	—	—	—
9/18/2015 20:08	9/18/2015 23:20	Composite	12	10.3	42	40	3.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/22/2015 9:35	9/22/2015 9:36	Grab	306	211.4	460	~ 13	2.7	1.3	0.7	—	—	—	—	—	—	—	—	—	—	—	—	—
9/24/2015 3:38	9/24/2015 7:23	Composite	—	65.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/8/2015 4:15	10/8/2015 5:27	Composite	—	24.8	—	112	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/13/2015 10:22	10/13/2015 10:23	Grab	333	166.6	500	~ 11	2.3	0.6	0.3	—	0.0009	—	0.0041	—	~ 0.0002	—	0.0078	—	< 0.0002	—	~ 0.0002	—
10/23/2015 8:33	10/23/2015 23:39	Composite	39	12.4	148	82	10.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/27/2015 20:02	10/28/2015 21:24	Composite	45	13.8	48	29	7.0	6.3	7.6	—	—	—	—	—	—	—	—	—	—	—	—	—
10/30/2015 10:50	10/30/2015 10:51	Grab	310	154.2	460	~ 6	2.9	0.6	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—
10/31/2015 5:07	10/31/2015 9:34	Composite	52	18.0	66	23	6.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/9/2015 10:00	11/9/2015 10:01	Grab	320	156.6	476	< 5	2.5	1.2	0.7	—	< 0.0050	—	0.0045	—	~ 0.0002	—	< 0.0050	—	< 0.0002	—	0.0003	—
11/11/2015 16:03	11/12/2015 2:35	Composite	32	8.1	52	39	7.0	6.6	7.4	—	0.0088	—	0.0025	—	0.0067	—	0.0542	—	< 0.0002	—	0.0033	—
11/16/2015 7:00	11/18/2015 19:30	Composite	42	12.9	54	24	3.8	—	—	—	0.0077	—	0.0023	—	0.0052	—	0.0424	—	< 0.0002	—	0.0028	—
11/24/2015 10:35	11/24/2015 10:36	Grab	318	168.9	476	< 5	2.6	0.7	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—
11/30/2015 12:30	12/1/2015 15:30	Composite	149	1,374.0	228	49	5.1	—	—	—	0.0103	—	0.0048	—	0.0051	—	0.0823	—	~ 0.0003	—	0.0070	—
12/9/2015 10:15	12/9/2015 10:16	Grab	306	158.0	494	< 5	2.8	0.6	0.5	—	0.0012	—	0.0046	—	~ 0.0003	—	0.0057	—	< 0.0002	—	< 0.0005	—
12/14/2015 10:00	12/14/2015 23:34	Composite	87	88.4	140	34	4.3	2.4	3.1	—	0.0106	—	0.0040	—	0.0081	—	0.0599	—	< 0.0002	—	0.0042	—
12/16/2015 1:09	12/16/2015 20:40	Composite	102	597.4	176	53	5.1	2.7	4.4	—	—	—	—	—	—	—	—	—	—	—	—	—
12/22/2015 9:55	12/22/2015 9:56	Grab	323	290.4	484	~ 5	3.1	0.9	0.7	—	—	—	—	—	—	—	—	—	—	—	—	—

**Table D.7.** Monitoring data for 10SA stormwater drainage system

Start Date Start Time	End Date End Time	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
			Temp (F)	Temp (F)	Oxygen (mg/L)	(µS/cm)	Conductivity (µS/cm)	(cm)	(ppt)	Suspended Solids (mg/L)	Suspended Solids (mg/L)	Dissolved Solids (mg/L)	(mg/L)	Phosphorus (mg/L)	Phosphorus (mg/L)	Phosphate (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrogen (mg/L)	(mg/L)		
1/23/2015 15:11	1/26/2015 17:51	Composite	28	47.8	9.63	3,556.0	5,150.0	7.17	—	2.78	67	~ 31	2,780	27.7	0.213	0.391	—	2.30	0.29	0.12	0.46
2/9/2015 10:15	2/9/2015 10:16	Grab	24	39.0	12.51	1,493.0	2,500.0	8.22	> 100	1.28	~ 1	~ 1	1,340	33.5	0.191	0.209	0.181	0.53	0.07	0.06	0.24
3/7/2015 11:36	3/9/2015 13:22	Composite	50	55.0	4.47	7,328.0	9,544.0	7.06	—	5.39	128	~ 54	5,190	25.0	0.459	0.794	—	5.10	1.58	0.09	0.14
3/10/2015 16:26	3/11/2015 23:16	Composite	50	53.8	8.49	1,633.0	2,170.0	7.44	—	1.12	23	~ 10	1,130	14.7	0.338	0.445	—	2.50	0.42	0.06	0.50
3/17/2015 10:15	3/17/2015 10:16	Grab	30	40.5	13.10	151.0	247.0	7.45	81	1.27	3	~ 2	1,280	26.0	0.104	0.151	0.081	1.20	0.12	0.04	0.80
3/29/2015 4:16	3/29/2015 22:17	Composite	40	52.3	10.48	984.0	1,335.0	7.63	3	0.64	417	160	690	13.2	0.082	0.803	—	5.10	0.25	0.04	0.50
4/1/2015 20:22	4/1/2015 21:02	Composite	55	66.6	6.92	880.0	990.0	7.81	—	0.49	1,860	450	528	12.3	0.086	2.510	0.067	10.00	0.91	0.07	0.68
4/6/2015 7:55	4/6/2015 7:56	Grab	40	55.2	9.02	331.3	431.1	7.68	—	0.21	—	—	—	10.9	0.093	0.289	—	2.40	0.58	0.06	0.69
4/9/2015 1:30	4/9/2015 8:50	Composite	35	40.5	13.46	355.9	580.4	7.87	—	0.28	154	40	284	11.0	0.054	0.324	0.066	1.80	0.21	0.03	0.49
4/9/2015 16:00	4/9/2015 20:05	Composite	35	37.4	14.01	172.0	296.5	7.68	9	0.14	60	~ 19	147	5.5	~ 0.033	0.180	0.043	0.98	0.17	< 0.03	0.23
4/16/2015 9:00	4/16/2015 9:01	Grab	60	50.5	10.88	869.0	1,210.0	8.07	50	0.61	8	6	635	26.4	0.220	0.405	0.209	3.80	1.88	0.08	0.61
4/18/2015 23:09	4/19/2015 21:42	Composite	40	46.9	8.66	598.0	878.0	7.26	—	0.43	33	~ 14	488	18.7	0.071	0.243	—	2.60	0.43	0.08	0.68
4/30/2015 10:15	4/30/2015 10:16	Grab	60	52.2	11.39	860.0	1,168.0	7.90	> 100	0.58	~ 1	~ 1	668	73.1	~ 0.020	~ 0.040	~ 0.007	0.32	< 0.02	< 0.03	1.91
5/7/2015 13:27	5/7/2015 18:52	Composite	60	59.9	6.14	512.0	625.0	7.12	—	0.31	138	82	—	30.5	0.146	0.600	0.100	3.50	0.10	< 0.03	0.53
5/10/2015 12:42	5/11/2015 1:32	Composite	50	54.3	9.13	126.1	166.2	7.20	20	0.08	101	40	84	4.0	0.074	0.314	0.047	2.05	0.44	< 0.03	0.26
5/13/2015 10:10	5/13/2015 10:11	Grab	50	53.1	10.94	459.1	615.6	8.08	17	0.30	108	58	347	23.2	0.240	0.721	0.212	1.50	~ 0.04	< 0.03	0.06
5/14/2015 16:16	5/15/2015 0:46	Composite	55	55.8	9.13	229.5	296.3	7.28	—	0.14	28	14	150	5.9	0.057	0.178	0.047	1.10	0.16	0.04	0.30
5/16/2015 21:21	5/17/2015 21:31	Composite	40	55.0	7.60	294.6	384.5	7.47	—	0.19	294	79	217	8.6	~ 0.025	0.602	—	3.30	~ 0.02	0.08	0.20
5/24/2015 14:01	5/25/2015 12:31	composite	60	61.3	8.37	256.2	306.9	7.34	42	0.15	19	11	179	7.9	0.073	0.193	—	1.20	< 0.02	< 0.03	0.20
5/26/2015 10:50	5/26/2015 15:55	Composite	50	59.5	8.58	127.3	156.4	7.81	14	0.07	78	16	80	2.8	~ 0.044	0.199	—	1.30	0.21	< 0.03	0.22
5/26/2015 16:21	5/27/2015 6:31	Composite	70	62.4	8.62	240.2	284.0	7.40	41	0.14	12	5	149	6.9	0.050	0.115	0.043	0.74	0.10	< 0.03	0.35
5/28/2015 10:00	5/28/2015 10:01	Grab	70	64.2	8.23	626.0	723.0	8.02	74	0.35	5	3	383	21.9	0.072	0.131	0.050	0.95	< 0.02	< 0.03	0.74
5/29/2015 3:26	5/29/2015 7:16	Composite	65	68.2	18.92	226.2	249.6	7.71	—	0.12	219	40	138	5.6	0.070	0.517	—	2.20	< 0.02	0.04	0.38
5/29/2015 12:56	5/30/2015 7:06	Composite	60	60.1	8.47	278.5	339.1	7.41	—	0.16	10	6	192	9.3	0.088	0.148	—	0.92	0.10	< 0.03	0.31
6/3/2015 13:06	6/4/2015 5:56	Composite	65	65.7	8.25	188.5	214.1	7.60	32	0.10	58	18	107	5.3	0.068	0.290	0.028	1.50	0.10	< 0.03	0.26
6/6/2015 23:41	6/8/2015 5:11	Composite	70	72.9	7.23	261.2	273.4	7.40	38	0.13	35	11	208	7.6	0.069	0.161	—	1.10	0.10	< 0.03	0.27
6/10/2015 10:25	6/10/2015 10:26	Grab	70	63.0	9.22	739.0	869.0	7.98	94	0.43	5	4	500	30.3	0.051	0.134	0.041	0.95	0.07	0.05	1.03
6/20/2015 5:51	6/20/2015 16:36	Composite	65	73.9	6.36	230.7	238.2	7.30	27	0.11	68	23	138	4.8	0.102	0.295	—	1.70	0.27	0.10	0.31
6/22/2015 7:36	6/22/2015 8:41	Composite	65	75.2	6.35	172.2	175.6	7.20	—	0.08	30	13	84	4.4	0.059	0.228	—	1.30	0.13	0.04	0.32
6/25/2015 11:15	6/25/2015 11:16	Grab	70	64.8	7.56	658.0	687.0	7.87	> 100	0.34	~ 2	~ 1	534	30.6	0.113	0.146	0.096	0.79	< 0.02	< 0.03	1.13
6/27/2015 23:21	6/28/2015 10:36	Composite	80	73.8	5.64	178.2	184.5	7.48	40	0.09	38	16	113	3.9	0.074	0.178	—	1.50	0.50	0.04	0.43
6/29/2015 19:26	6/30/																				

**Table D.7 continued.** Monitoring data for 10SA stormwater drainage system

Start Date Start Time	End Date End Time	Sample Type	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity ( $\mu\text{S}/\text{cm}$ )	Specific Conductivity ( $\mu\text{S}/\text{cm}$ )	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
7/12/2015 23:11	7/13/2015 6:36	Composite	75	72.0	7.86	94.0	99.2	7.55	22	0.05	58	14	63	2.9	~ 0.041	0.170	0.026	0.94	0.09	< 0.03	0.28
7/18/2015 0:56	7/18/2015 7:36	Composite	70	77.0	6.17	144.2	144.2	7.33	31	0.07	44	11	84	4.0	~ 0.047	0.145	—	0.92	0.17	0.04	0.29
7/23/2015 9:09	7/23/2015 9:10	Grab	70	67.5	7.11	885.0	986.0	7.87	> 100	0.49	4	3	560	35.1	0.156	0.191	< 0.005	1.10	~ 0.05	0.04	1.51
7/24/2015 5:11	7/24/2015 6:51	Composite	75	81.5	5.25	167.8	160.2	7.36	—	0.07	72	24	94	4.9	0.097	0.301	—	2.20	0.65	0.06	0.24
7/28/2015 6:41	7/28/2015 12:16	Composite	80	75.6	7.65	110.5	111.8	7.71	22	0.05	43	12	58	3.1	~ 0.038	0.182	—	0.94	< 0.02	< 0.03	0.17
8/6/2015 11:56	8/7/2015 10:06	Composite	70	71.4	6.87	176.5	187.8	7.28	—	0.09	93	25	69	5.8	< 0.020	0.246	< 0.005	1.90	< 0.02	0.12	0.25
8/14/2015 9:56	8/14/2015 9:57	Grab	75	71.8	8.00	509.0	540.0	7.97	> 100	0.26	3	3	308	14.4	0.129	0.132	0.096	0.69	< 0.02	< 0.03	0.88
8/16/2015 18:06	8/16/2015 21:01	Composite	70	72.5	6.98	102.5	107.5	7.69	—	0.05	50	19	95	—	~ 0.041	0.166	—	1.30	0.07	0.04	0.40
8/18/2015 12:51	8/19/2015 4:16	Composite	60	65.8	8.60	95.5	108.3	7.53	—	0.05	23	9	60	3.0	~ 0.024	0.122	0.025	0.75	< 0.02	< 0.03	0.15
8/22/2015 20:41	8/23/2015 0:21	Composite	60	63.0	7.37	130.7	153.6	7.39	—	0.07	442	64	95	4.6	0.050	0.274	—	1.40	~ 0.06	< 0.03	0.28
8/27/2015 10:35	8/27/2015 10:36	Grab	70	65.5	10.21	860.0	978.0	8.16	> 100	0.48	4	~ 2	555	36.5	0.145	0.143	< 0.005	0.66	~ 0.03	< 0.03	1.23
9/2/2015 4:16	9/2/2015 8:56	Composite	70	73.8	9.03	150.0	155.5	7.45	—	0.07	46	17	103	3.9	~ 0.045	0.197	—	1.50	0.21	< 0.03	0.37
9/6/2015 5:51	9/6/2015 16:06	Composite	70	74.3	7.06	182.5	188.0	7.44	—	0.09	31	13	110	5.2	0.052	0.164	—	1.10	0.13	0.06	0.47
9/9/2015 12:51	9/10/2015 9:26	Composite	60	66.0	8.68	136.2	154.2	7.51	—	0.07	45	15	101	3.9	~ 0.033	0.175	0.020	1.30	0.16	< 0.03	0.23
9/14/2015 9:45	9/14/2015 9:46	Grab	67	65.8	10.41	480.5	545.0	8.20	> 100	0.26	~ 2	~ 2	317	18.7	0.136	0.165	0.124	1.20	~ 0.02	< 0.03	0.85
9/16/2015 3:52	9/17/2015 0:31	Composite	60	74.3	7.06	182.5	188.0	7.44	19	0.09	121	26	44	2.7	~ 0.033	0.154	—	1.15	0.26	0.04	0.40
9/22/2015 10:35	9/22/2015 10:36	Grab	68	66.4	8.26	395.8	445.7	7.94	> 100	0.21	3	~ 2	260	17.0	0.058	0.098	0.046	0.57	< 0.02	0.03	0.90
9/24/2015 2:32	9/24/2015 9:56	Composite	60	67.1	8.57	257.1	287.5	7.36	—	0.14	5	3	—	—	0.051	0.101	—	0.59	~ 0.04	0.06	0.56
10/8/2015 3:47	10/8/2015 5:37	Composite	55	61.7	9.63	116.5	139.0	7.26	—	0.07	93	41	—	—	0.163	0.339	—	2.60	0.68	0.03	0.79
10/13/2015 9:45	10/13/2015 9:46	Grab	50	57.4	9.89	560.0	708.0	7.98	> 100	0.35	~ 2	~ 2	412	26.8	0.080	0.103	0.064	0.56	< 0.02	< 0.03	0.76
10/23/2015 5:17	10/25/2015 19:17	Composite	50	51.3	8.39	116.8	160.8	6.84	22	0.08	34	19	113	5.5	0.145	0.342	—	1.90	< 0.02	< 0.03	2.67
10/27/2015 19:37	10/29/2015 9:32	Composite	40	46.4	11.37	104.9	155.5	7.50	44	0.07	8	6	94	4.5	0.139	0.227	0.110	0.74	< 0.02	< 0.03	0.07
10/31/2015 3:12	11/2/2015 2:37	Composite	60	51.4	9.32	181.7	249.3	7.64	—	0.12	7	6	148	8.7	0.125	0.179	—	0.53	< 0.02	< 0.03	< 0.05
11/11/2015 16:30	11/13/2015 1:05	Composite	40	42.6	11.85	92.6	145.6	7.16	29	0.07	42	~ 19	75	4.6	0.090	0.192	—	0.87	0.08	< 0.03	0.31
11/13/2015 12:00	11/19/2015 21:00	Composite	20	39.9	12.65	138.7	228.4	7.63	—	0.11	12	4	126	7.2	0.067	0.104	—	0.53	~ 0.04	< 0.03	0.43
11/24/2015 10:01	11/24/2015 10:02	Grab	34	49.3	10.44	671.0	951.0	8.11	> 100	0.47	~ 1	~ 1	547	45.3	0.072	0.095	0.061	0.80	~ 0.04	0.03	1.56
11/30/2015 11:30	12/1/2015 16:00	Composite	30	51.1	4.00	4,799.0	6,612.0	7.67	—	3.63	49	17	—	17.8	0.061	0.181	—	1.50	0.26	0.06	0.61
12/14/2015 11:05	12/14/2015 12:55	Composite	30	57.9	10.62	237.3	297.3	7.84	—	0.14	39	16	158	7.3	~ 0.034	0.152	0.031	0.85	< 0.02	0.03	0.07
12/14/2015 16:05	12/15/2015 10:50	Composite	30	48.7	11.44	441.7	631.5	8.05	—	0.31	9	5	341	18.1	0.070	0.115	0.034	0.89	< 0.02	0.04	0.14
12/16/2015 1:40	12/16/2015 15:15	Composite	20	46.8	11.91	671.0	988.0	8.23	15	0.49	33	12	845	10.8	~ 0.041	0.123	0.029	1.10	0.08	< 0.03	0.42
12/22/2015 10:55	12/22/2015 10:56	Grab	32	45.3	10.99	1,773.0	2,674.0	8.18	> 100	1.79	4	~ 2	1,400	64.9	~ 0.048	0.081	0.033	1.20	~ 0.05	0.06	1.44

**Table D.7 continued.** Monitoring data for 10SA stormwater drainage system

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)	
1/23/2015 15:11	1/26/2015 17:51	Composite	103	1,537.8	184	96	11.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2/9/2015 10:15	2/9/2015 10:16	Grab	260	669.4	328	~ 11	3.4	< 1.0	< 1.0	0.0022	0.0025	0.0019	0.0021	~ 0.0003	0.0007	0.0065	0.0079	< 0.0002	< 0.0002	0.0018	0.0033	—	
3/7/2015 11:36	3/9/2015 13:22	Composite	116	3,044.0	188	209	16.2	—	—	—	0.0380	—	0.0093	—	0.0092	—	0.1500	—	~ 0.0005	—	0.0227	—	
3/10/2015 16:26	3/11/2015 23:16	Composite	95	638.9	160	54	9.1	—	—	—	0.0110	—	0.0028	—	0.0017	—	0.0684	—	< 0.0002	—	0.0040	—	
3/17/2015 10:15	3/17/2015 10:16	Grab	114	691.4	204	28	6.4	1.7	2.3	—	—	—	—	—	—	—	—	—	—	—	—	—	
3/29/2015 4:16	3/29/2015 22:17	Composite	39	362.6	108	339	13.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4/1/2015 20:22	4/1/2015 21:02	Composite	58	305.2	140	868	17.2	39.0	32.0	—	0.1740	—	0.0628	—	0.0936	—	1.0400	—	0.0015	—	0.0963	—	
4/6/2015 7:55	4/6/2015 7:56	Grab	47	87.2	60	113	21.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4/9/2015 1:30	4/9/2015 8:50	Composite	45	132.1	40	115	11.5	7.1	7.6	—	0.0225	—	0.0070	—	0.0084	—	0.1200	—	< 0.0002	—	0.0125	—	
4/9/2015 16:00	4/9/2015 20:05	Composite	21	29.1	60	61	7.1	4.5	5.7	—	0.0141	—	0.0038	—	0.0052	—	0.0750	—	< 0.0002	—	0.0100	—	
4/16/2015 9:00	4/16/2015 9:01	Grab	147	274.3	220	39	10.6	> 8.0	> 8.0	—	0.0152	—	0.0019	—	~ 0.0004	—	0.0096	—	< 0.0002	—	0.0010	—	
4/18/2015 23:09	4/19/2015 21:42	Composite	76	206.4	116	97	23.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4/30/2015 10:15	4/30/2015 10:16	Grab	371	145.6	540	< 5	2.6	1.2	< 1.0	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/7/2015 13:27	5/7/2015 18:52	Composite	128	97.0	—	149	24.0	—	31.0	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/10/2015 12:42	5/11/2015 1:32	Composite	22	27.6	52	77	11.0	12.0	16.0	—	0.0129	—	0.0039	—	0.0047	—	0.0626	—	< 0.0002	—	0.0051	—	
5/13/2015 10:10	5/13/2015 10:11	Grab	275	36.6	320	72	3.9	5.4	7.4	—	0.0207	—	0.0048	—	0.0044	—	0.0472	—	< 0.0002	—	0.0035	—	
5/14/2015 16:16	5/15/2015 0:46	Composite	50	52.4	92	56	10.6	7.5	9.1	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/16/2015 21:21	5/17/2015 21:31	Composite	53	78.5	60	187	14.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/24/2015 14:01	5/25/2015 12:31	composite	56	51.0	76	43	12.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/26/2015 10:50	5/26/2015 15:55	Composite	25	25.3	32	43	4.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/26/2015 16:21	5/27/2015 6:31	Composite	56	41.9	80	22	5.7	2.5	3.7	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/28/2015 10:00	5/28/2015 10:01	Grab	167	108.3	186	18	7.4	3.1	3.8	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/29/2015 3:26	5/29/2015 7:16	Composite	41	46.7	50	84	8.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5/29/2015 12:56	5/30/2015 7:06	Composite	75	53.8	76	26	7.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6/3/2015 13:06	6/4/2015 5:56	Composite	39	19.2	46	40	6.4	5.5	7.2	—	0.0091	—	0.0021	—	0.0044	—	0.0334	—	< 0.0002	—	0.0041	—	
6/6/2015 23:41	6/8/2015 5:11	Composite	64	38.6	66	33	5.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6/10/2015 10:25	6/10/2015 10:26	Grab	201	130.6	240	20	7.6	3.0	3.7	—	0.0034	—	0.0016	—	~ 0.0004	—	0.0041	—	< 0.0002	—	0.0004	—	
6/20/2015 5:51	6/20/2015 16:36	Composite	47	34.1	52	55	9.2	—	—	—	—	0.0115	—	0.0032	—	0.0040	—	0.0483	—	< 0.0002	—	0.0034	—
6/22/2015 7:36	6/22/2015 8:41	Composite	31	23.5	40	52	8.2	—	—	—	—	0.0124	—	0.0029	—	0.0035	—	0.0466	—	< 0.0002	—	0.0065	—
6/25/2015 11:15	6/25/2015 11:16	Grab	215	154.9	284	19	6.9	1.1	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	
6/27/2015 23:21	6/28/2015 10:36	Composite	34	23.8	44	40	8.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6/29/2015 19:26	6/30/2015 0:46	Composite	22	15.8	38	62	8.6	8.5	11.0	—	—	—	—	—	—	—	—	—	—	—	—	—	
7/6/2015 1:16	7/6/2015 8:36	Composite	22	8.3	22	33	5.8	4.2	5.8	—	0.0048	—	0.0019	—	0.0026	—	0.0229	—	< 0.0002	—	0.0053	—	
7/9/2015 10:04	7/9/2015 10:05	Grab	192	100.6	234	25	6.6	0.9	1.3	—	0.0034	—	0.0017	—	~ 0.0003	—	0.0050	—	< 0.0002	—	0.0005	—	

**Table D.7 continued.** Monitoring data for 10SA stormwater drainage system

Start Date Start Time	End Date End Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)	Oil and Grease (mg/L)
7/12/2015 23:11	7/13/2015 6:36	Composite	23	9.4	26	38	4.9	4.4	5.6	—	—	—	—	—	—	—	—	—	—	—	—	—
7/18/2015 0:56	7/18/2015 7:36	Composite	30	15.8	38	33	4.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7/23/2015 9:09	7/23/2015 9:10	Grab	253	137.4	296	28	6.5	1.5	1.8	—	—	—	—	—	—	—	—	—	—	—	—	—
7/24/2015 5:11	7/24/2015 6:51	Composite	33	18.2	40	69	8.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7/28/2015 6:41	7/28/2015 12:16	Composite	27	11.0	30	34	6.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/6/2015 11:56	8/7/2015 10:06	Composite	46	21.4	46	87	12.3	7.3	> 8.4	—	0.0171	—	0.0048	—	0.0071	—	0.0839	—	< 0.0002	—	0.0053	—
8/14/2015 9:56	8/14/2015 9:57	Grab	154	63.6	174	22	8.8	1.9	2.5	—	—	—	—	—	—	—	—	—	—	—	—	—
8/16/2015 18:06	8/16/2015 21:01	Composite	—	10.0	—	—	9.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/18/2015 12:51	8/19/2015 4:16	Composite	28	9.7	30	40	4.7	3.0	4.7	—	—	—	—	—	—	—	—	—	—	—	—	—
8/22/2015 20:41	8/23/2015 0:21	Composite	35	15.4	46	80	8.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/27/2015 10:35	8/27/2015 10:36	Grab	281	122.8	344	~ 12	5.5	0.4	0.5	—	—	—	—	—	—	—	—	—	—	—	—	—
9/2/2015 4:16	9/2/2015 8:56	Composite	42	12.8	48	48	9.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/6/2015 5:51	9/6/2015 16:06	Composite	52	16.0	56	36	7.9	—	—	—	0.0114	—	0.0020	—	0.0018	—	0.0307	—	< 0.0002	—	0.0017	—
9/9/2015 12:51	9/10/2015 9:26	Composite	42	15.6	44	37	6.9	4.2	5.9	—	—	—	—	—	—	—	—	—	—	—	—	—
9/14/2015 9:45	9/14/2015 9:46	Grab	182	51.8	222	27	5.8	0.8	1.5	—	0.0420	—	0.0011	—	~ 0.0004	—	0.0067	—	< 0.0002	—	0.0003	—
9/16/2015 3:52	9/17/2015 0:31	Composite	23	6.0	27	43	5.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/22/2015 10:35	9/22/2015 10:36	Grab	142	45.2	156	22	5.6	1.2	1.3	—	—	—	—	—	—	—	—	—	—	—	—	—
9/24/2015 2:32	9/24/2015 9:56	Composite	75	29.7	—	37	9.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/8/2015 3:47	10/8/2015 5:37	Composite	30	14.8	—	111	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/13/2015 9:45	10/13/2015 9:46	Grab	217	85.7	280	19	6.9	1.2	1.5	—	0.0146	—	0.0015	—	~ 0.0002	—	0.0095	—	< 0.0002	—	0.0004	—
10/23/2015 5:17	10/25/2015 19:17	Composite	29	14.8	32	62	13.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/27/2015 19:37	10/29/2015 9:32	Composite	42	14.8	32	31	9.0	6.8	8.3	—	—	—	—	—	—	—	—	—	—	—	—	—
10/31/2015 3:12	11/2/2015 2:37	Composite	64	26.3	68	26	8.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/11/2015 16:30	11/13/2015 1:05	Composite	39	11.4	38	25	5.6	—	—	—	0.0055	—	0.0018	—	0.0027	—	0.0260	—	< 0.0002	—	0.0029	—
11/13/2015 12:00	11/19/2015 21:00	Composite	66	17.6	68	~ 14	4.7	—	—	—	< 0.0055	—	0.0012	—	0.0011	—	0.0140	—	< 0.0002	—	0.0021	—
11/24/2015 10:01	11/24/2015 10:02	Grab	275	105.1	336	14	7.1	1.2	1.0	—	—	—	—	—	—	—	—	—	—	—	—	—
11/30/2015 11:30	12/1/2015 16:00	Composite	109	2,079.4	184	64	5.0	—	—	—	0.0141	—	0.0036	—	0.0056	—	0.1110	—	~ 0.0002	—	0.0122	—
12/14/2015 11:05	12/14/2015 12:55	Composite	50	51.1	68	31	4.9	2.4	4.2	—	0.0090	—	0.0024	—	0.0040	—	0.0424	—	< 0.0002	—	0.0037	—
12/14/2015 16:05	12/15/2015 10:50	Composite	135	89.2	158	20	6.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12/16/2015 1:40	12/16/2015 15:15	Composite	81	237.6	92	41	5.5	2.9	4.3	—	—	—	—	—	—	—	—	—	—	—	—	—
12/22/2015 10:55	12/22/2015 10:56	Grab	337	601.0	456	29	8.3	3.2	3.1	—	—	—	—	—	—	—	—	—	—	—	—	—

## **Appendix E – Kasota Ponds Monitoring Data**

**Table E.1.** Monitoring data for Kasota Pond North

**Table E.2.** Monitoring data for Kasota Pond West

Date	Sample Time	Air Temp (F)	Water Temp (F)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Chloride Ion (mg/L CaCO3)	Hardness (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
1/16/2015	9:43	30	35.1	4.08	937.0	1,691.0	7.50	0.84	5	4	968	0.121	< 0.005	1.25	0.13	< 0.03	< 0.05	380.9	316	0.0006	0.0008	0.0012	0.0014	< 0.0001	~ 0.0002	0.0040	0.0055	< 0.0002	< 0.0002	0.0002	0.0003
2/6/2015	9:35	20	35.6	10.92	989.0	1,766.0	7.16	0.88	13	13	900	0.143	< 0.005	1.70	< 0.02	< 0.03	< 0.05	498.7	328	0.0006	0.0009	0.0011	0.0013	< 0.0001	~ 0.0002	0.0033	0.0037	< 0.0002	< 0.0002	~ 0.0001	0.0002
3/6/2015	10:09	22	34.2	8.56	1,100.0	2,020.0	7.02	1.01	17	13	1,070	0.393	~ 0.007	3.10	~ 0.04	< 0.03	< 0.05	503.4	360	—	0.0007	—	0.0014	—	~ 0.0003	—	0.0188	—	< 0.0002	—	0.0004
4/1/2015	9:37	50	47.7	12.30	1,294.0	1,881.0	7.84	0.96	6	4	964	0.078	< 0.005	1.00	< 0.02	< 0.03	< 0.05	580.8	308	—	< 0.0010	—	0.0015	—	~ 0.0006	—	0.0038	—	< 0.0002	—	< 0.0005
5/20/2015	10:05	50	57.6	8.76	1,452.0	1,831.0	7.94	0.94	14	12	973	0.141	< 0.005	1.60	< 0.02	< 0.03	0.09	459.7	308	—	0.0012	—	0.0015	—	~ 0.0004	—	0.0034	—	< 0.0002	—	0.0003
6/19/2015	9:35	70	72.5	8.78	1,538.0	1,617.0	8.11	0.82	13	10	817	0.100	~ 0.005	1.70	< 0.02	< 0.03	< 0.05	439.9	268	—	0.0028	—	0.0015	—	0.0005	—	0.0048	—	< 0.0002	—	0.0002
7/14/2015	9:15	75	76.6	7.39	1,248.0	1,254.0	7.75	0.62	13	10	642	0.123	< 0.005	1.80	< 0.02	< 0.03	< 0.05	338.4	192	—	< 0.0010	—	0.0013	—	0.0007	—	0.0036	—	< 0.0002	—	0.0002
8/20/2015	9:43	55	68.2	1.23	1,118.0	1,232.0	7.11	0.62	23	21	661	0.151	~ 0.007	2.75	< 0.02	< 0.03	< 0.05	308.3	187	—	0.0012	—	0.0009	—	0.0007	—	0.0098	—	< 0.0002	—	0.0003
9/9/2015	9:55	65	70.5	4.54	1,127.0	1,210.0	7.73	0.60	82	59	632	0.338	< 0.005	4.70	< 0.02	< 0.03	< 0.05	321.2	178	—	0.0036	—	0.0020	—	0.0039	—	0.0203	—	< 0.0002	—	0.0010
10/26/2015	11:13	50	51.6	9.49	882.0	1,206.0	7.69	0.60	25	23	619	0.286	~ 0.006	2.30	< 0.02	< 0.03	< 0.05	293.1	200	—	0.0006	—	0.0010	—	~ 0.0003	—	0.0025	—	< 0.0002	—	0.0002
11/19/2015	9:45	30	44.8	8.41	750.0	1,140.0	7.45	0.57	10	9	575	0.097	< 0.005	1.90	< 0.02	< 0.03	< 0.05	294.6	214	—	< 0.0050	—	0.0013	—	0.0005	—	< 0.0050	—	< 0.0002	—	0.0010
12/15/2015	9:45	35	35.6	12.70	698.0	1,243.0	7.87	0.61	7	6	628	~ 0.046	< 0.005	1.15	< 0.02	< 0.03	< 0.05	290.0	243	—	0.0005	—	0.0009	—	~ 0.0002	—	0.0030	—	< 0.0002	—	0.0002

**Table E.3.** Monitoring data for Kasota Pond East

## Appendix F: Mississippi River Water Quality Data

**Table F.1.** Monitoring data for river site MR848.1W (Ford).

Sample Date	Sample Type	Air Temp	Water Temp	Dissolved Oxygen	Conductivity ( $\mu\text{S}/\text{cm}$ )	Specific Conductivity ( $\mu\text{S}/\text{cm}$ )	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
Sample Time		(F)	(F)	(mg/L)																
3/16/2015 10:35	Grab	50	41.7	13.87	258.9	414.1	7.20	> 100	0.20	~ 2	~ 1	241	15.9	< 0.020	~ 0.024	~ 0.008	0.60	< 0.02	< 0.03	0.79
6/8/2015 9:38	Grab	70	70.0	9.03	308.2	333.4	7.61	42	0.16	22	6	202	12.1	~ 0.042	0.082	0.021	1.00	< 0.02	< 0.03	0.60
9/8/2015 19:30	Grab	70	79.2	7.59	423.4	413.6	8.23	67	0.20	12	~ 5	248	14.9	< 0.020	0.067	~ 0.008	0.90	< 0.02	< 0.03	0.14
12/7/2015 9:25	Grab	40	37.0	15.23	216.1	374.6	8.08	> 100	0.18	5	~ 2	229	15.0	0.050	0.065	0.018	0.84	0.06	< 0.03	0.75

**Table F.2.** Monitoring data for river site MR849.9W (Meeker).

Sample Date	Sample Type	Air Temp	Water Temp	Dissolved Oxygen	Conductivity ( $\mu\text{S}/\text{cm}$ )	Specific Conductivity ( $\mu\text{S}/\text{cm}$ )	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
Sample Time		(F)	(F)	(mg/L)																
8/21/2015 9:15	Grab	60	68.0	10.10	366.0	404.4	7.84	67	0.19	11	4	246	14.6	0.055	0.093	0.050	0.84	< 0.02	< 0.03	0.47
9/8/2015 10:00	Grab	70	77.7	7.40	411.7	408.7	8.07	69	0.19	11	~ 5	255	14.5	~ 0.026	0.070	0.011	0.83	< 0.02	< 0.03	0.20
9/16/2015 9:40	Grab	75	70.0	9.97	361.2	390.2	7.95	75	0.19	9	3	230	11.9	~ 0.023	0.060	0.022	0.79	< 0.02	< 0.03	0.33
9/30/2015 8:55	Grab	50	67.8	10.07	353.4	391.5	7.95	90	0.19	6	3	233	13.4	~ 0.041	0.052	0.025	0.67	< 0.02	< 0.03	0.40
10/12/2015 9:25	Grab	60	61.5	10.59	327.7	391.9	7.84	> 100	0.19	~ 2	~ 2	236	14.2	0.078	~ 0.034	0.013	0.67	< 0.02	< 0.03	0.36
10/27/2015 9:52	Grab	50	53.2	11.87	300.9	402.5	8.09	> 100	0.19	3	~ 1	232	15.3	~ 0.023	~ 0.045	0.011	0.58	< 0.02	< 0.03	0.42
11/10/2015 9:15	Grab	50	47.7	13.10	261.3	379.2	7.65	> 100	0.18	4	~ 2	226	13.4	< 0.020	~ 0.042	0.015	0.61	< 0.02	< 0.03	0.54
11/25/2015 9:00	Grab	45	36.3	16.42	206.9	364.7	8.05	67	0.17	14	4	202	14.4	~ 0.034	0.085	0.031	0.94	~ 0.03	< 0.03	0.98
12/7/2015 9:40	Grab	40	37.2	14.40	216.7	375.2	8.14	> 100	0.16	4	~ 2	232	15.2	~ 0.042	0.066	0.018	0.75	~ 0.06	< 0.03	0.77
12/21/2015 9:10	Grab	30	32.9	18.90	216.4	407.2	8.06	> 100	0.19	3	~ 1	245	17.5	0.051	0.073	0.023	0.77	< 0.02	< 0.03	1.13

**Table F.1 continued.** Monitoring data for river site MR848.1W (Ford).

Sample Date	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
3/16/2015 10:35	Grab	171	20.4	220	20	6.3	1.3	1.7	—	~ 0.0006	—	0.0006	—	< 0.0001	—	< 0.0050	—	< 0.0002	—	0.0002
6/8/2015 9:38	Grab	141	12.6	158	38	11.9	1.4	1.4	—	< 0.0050	—	0.0014	—	0.0006	—	< 0.0050	—	< 0.0002	—	0.0007
9/8/2015 19:30	Grab	174	21.2	186	27	7.9	1.9	2.4	—	< 0.0050	—	0.0011	—	~ 0.0004	—	0.0063	—	< 0.0002	—	0.0003
12/7/2015 9:25	Grab	142	19.0	174	24	11.6	1.1	1.1	—	0.0007	—	0.0008	—	~ 0.0002	—	0.0080	—	< 0.0002	—	< 0.0005

**Table F.2 continued.** Monitoring data for river site MR849.9W (Meeker).

Sample Date	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
8/21/2015 9:15	Grab	160	20.5	182	30	9.3	1.3	1.4	—	—	—	—	—	—	—	—	—	—	—	
9/8/2015 10:00	Grab	168	20.0	186	21	8.0	1.7	2.1	—	< 0.0050	—	0.0009	—	~ 0.0003	—	0.0050	—	< 0.0002	—	0.0002
9/16/2015 9:40	Grab	165	17.9	182	32	8.4	1.2	1.5	—	—	—	—	—	—	—	—	—	—	—	
9/30/2015 8:55	Grab	154	18.8	176	28	10.3	1.0	1.3	—	—	—	—	—	—	—	—	—	—	—	
10/12/2015 9:25	Grab	164	18.8	180	23	9.2	0.7	0.8	—	0.0008	—	0.0012	—	~ 0.0002	—	0.0031	—	< 0.0002	—	0.0002
10/27/2015 9:52	Grab	159	18.8	178	27	8.6	0.5	1.0	—	—	—	—	—	—	—	—	—	—	—	
11/10/2015 9:15	Grab	151	14.9	164	24	9.9	0.8	0.8	—	—	—	—	—	—	—	—	—	—	—	
11/25/2015 9:00	Grab	138	15.3	160	28	11.3	1.0	1.2	—	—	—	—	—	—	—	—	—	—	—	
12/7/2015 9:40	Grab	142	20.4	172	24	11.6	1.0	1.1	—	0.0008	—	0.0008	—	~ 0.0002	—	0.0087	—	< 0.0002	—	< 0.0005
12/21/2015 9:10	Grab	160	18.5	180	31	11.7	0.7	0.8	—	—	—	—	—	—	—	—	—	—	—	

**Table F.3.** Monitoring data for river site MR852.2E (Wash).

Sample Date Sample Time	Sample Type	Air Temp	Water Temp	Dissolved Oxygen	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
		(F)	(F)	(mg/L)																
1/23/2015 9:07	Grab	35	32.2	15.81	260.9	496.6	7.40	> 100	0.24	~ 1	~ 1	296	21.6	< 0.020	< 0.020	~ 0.008	0.59	0.07	< 0.03	0.96
2/24/2015 9:27	Grab	20	32.5	17.18	271.3	514.0	7.62	—	0.24	14	~ 2	314	22.8	~ 0.032	0.069	0.026	0.75	~ 0.06	< 0.03	1.07
3/16/2015 11:30	Grab	50	40.3	14.56	249.4	408.2	7.75	> 100	0.20	3	~ 2	236	3.0	~ 0.031	~ 0.036	~ 0.006	0.69	< 0.02	< 0.03	0.86
4/23/2015 9:42	Grab	40	47.3	13.00	266.4	389.1	8.27	92	0.19	5	~ 2	227	16.4	< 0.020	~ 0.043	< 0.005	0.70	< 0.02	< 0.03	0.40
5/8/2015 8:57	Grab	55	63.5	8.24	349.8	408.0	7.67	88	0.20	6	3	228	16.8	< 0.020	~ 0.046	< 0.005	0.82	~ 0.06	< 0.03	0.30
5/22/2015 9:26	Grab	60	58.6	11.10	243.3	302.2	7.71	20	0.14	45	9	188	12.0	~ 0.044	0.123	0.029	1.15	~ 0.03	< 0.03	0.64
6/8/2015 10:10	Grab	70	70.0	9.63	301.7	326.1	7.78	36	0.16	24	6	204	14.4	~ 0.039	0.081	0.024	0.98	< 0.02	< 0.03	0.63
6/26/2015 8:42	Grab	70	76.6	8.18	387.6	389.4	7.95	52	0.19	17	5	225	13.2	0.063	0.088	—	0.92	0.02	< 0.03	0.83
7/10/2015 9:08	Grab	75	74.8	7.21	394.1	403.5	7.89	—	0.19	9	4	238	14.3	~ 0.030	0.076	0.027	0.77	< 0.02	< 0.03	0.34
7/24/2015 10:14	Grab	80	79.2	8.46	395.7	387.1	7.90	59	0.18	14	4	229	12.1	0.052	0.096	0.042	1.00	< 0.02	< 0.03	0.35
8/10/2015 9:45	Grab	75	76.5	6.60	386.2	388.5	8.06	68	0.19	10	4	228	12.4	~ 0.040	0.081	0.041	0.87	~ 0.02	< 0.03	0.38
8/21/2015 9:42	Grab	60	68.0	9.77	365.2	403.5	8.12	67	0.19	11	4	243	14.4	0.049	0.089	0.045	0.85	< 0.02	< 0.03	0.46
9/8/2015 10:15	Grab	70	77.4	7.44	410.4	408.7	8.06	66	0.19	12	~ 4	244	14.4	< 0.020	0.059	0.014	0.83	< 0.02	< 0.03	0.20
9/16/2015 10:00	Grab	75	69.8	9.87	360.1	389.6	7.92	74	0.19	8	3	221	11.6	~ 0.024	0.070	0.024	0.79	< 0.02	< 0.03	0.34
9/30/2015 9:15	Grab	50	66.2	10.30	344.8	389.6	7.88	91	0.19	7	3	227	13.3	~ 0.045	0.052	0.026	0.71	< 0.02	< 0.03	0.43
10/12/2015 9:38	Grab	60	60.8	9.19	324.7	392.5	7.97	> 100	0.19	4	~ 2	234	14.2	< 0.020	~ 0.037	0.014	0.63	< 0.02	< 0.03	0.40
10/27/2015 10:02	Grab	50	52.9	12.71	299.1	401.9	7.96	> 100	0.19	5	~ 1	229	15.1	0.020	0.033	0.010	0.61	~ 0.03	< 0.03	0.43
11/10/2015 9:30	Grab	50	60.3	9.58	328.6	400.0	8.24	> 100	0.19	4	~ 2	231	13.3	< 0.020	~ 0.030	0.013	0.65	< 0.02	< 0.03	0.41
11/25/2015 9:18	Grab	45	36.1	15.29	202.4	357.5	8.08	64	0.17	13	3	217	14.3	~ 0.027	0.091	0.026	0.95	~ 0.03	< 0.03	1.00
12/7/2015 10:00	Grab	40	37.4	14.41	216.4	373.7	8.17	> 100	0.16	5	~ 2	231	15.0	~ 0.023	0.050	0.015	0.83	0.06	< 0.03	0.78
12/21/2015 9:25	Grab	30	32.9	16.17	229.8	432.6	8.16	95	0.21	17	~ 2	260	19.5	0.053	0.127	0.018	0.90	< 0.02	< 0.03	1.13

**Table F.3 continued.** Monitoring data for river site MR852.2E (Wash).

Sample Date Sample Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
1/23/2015 9:07	Grab	201	22.0	244	18	7.5	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	
2/24/2015 9:27	Grab	205	25.6	236	15	7.1	1.3	1.5	0.0006	0.0012	~ 0.0004	0.0009	< 0.0001	0.0026	< 0.0100	< 0.0100	< 0.0002	< 0.0002	0.0003	0.0021
3/16/2015 11:30	Grab	170	22.9	216	19	6.2	1.4	1.8	—	0.0009	—	0.0006	—	~ 0.0001	—	< 0.0050	—	< 0.0002	—	~ 0.0002
4/23/2015 9:42	Grab	156	18.8	190	29	7.8	1.8	2.3	—	0.0006	—	0.0007	—	~ 0.0001	—	0.0018	—	< 0.0002	—	0.0004
5/8/2015 8:57	Grab	159	21.1	184	24	9.8	1.9	3.0	—	0.0009	—	0.0009	—	~ 0.0003	—	0.0027	—	< 0.0002	—	0.0002
5/22/2015 9:26	Grab	125	11.2	148	38	13.2	1.5	2.4	—	0.0017	—	0.0019	—	0.0007	—	0.0048	—	< 0.0002	—	0.0009
6/8/2015 10:10	Grab	137	12.8	156	39	13.0	1.3	1.6	—	< 0.0050	—	0.0014	—	0.0008	—	< 0.0050	—	< 0.0002	—	0.0008
6/26/2015 8:42	Grab	159	15.1	181	29	9.9	—	—	—	—	—	—	—	—	—	—	—	—	—	
7/10/2015 9:08	Grab	154	19.4	181	33	9.2	1.2	1.8	—	0.0016	—	0.0013	—	~ 0.0003	—	0.0032	—	< 0.0002	—	0.0003
7/24/2015 10:14	Grab	152	18.1	174	35	10.5	1.4	1.9	—	—	—	—	—	—	—	—	—	—	—	
8/10/2015 9:45	Grab	158	18.7	176	33	9.0	1.7	1.7	—	0.0011	—	0.0010	—	~ 0.0004	—	0.0086	—	< 0.0002	—	0.0004
8/21/2015 9:42	Grab	160	21.1	186	31	9.4	1.4	1.3	—	—	—	—	—	—	—	—	—	—	—	
9/8/2015 10:15	Grab	167	19.7	188	26	8.4	1.7	2.0	—	< 0.0050	—	0.0010	—	~ 0.0004	—	0.0047	—	< 0.0002	—	0.0003
9/16/2015 10:00	Grab	167	18.8	170	27	8.0	0.9	1.2	—	—	—	—	—	—	—	—	—	—	—	
9/30/2015 9:15	Grab	179	18.5	180	30	10.3	1.0	1.3	—	—	—	—	—	—	—	—	—	—	—	
10/12/2015 9:38	Grab	164	19.0	184	16	9.4	0.7	1.0	—	0.0007	—	< 0.0010	—	~ 0.0001	—	0.0017	—	< 0.0002	—	0.0003
10/27/2015 10:02	Grab	165	18.6	179	27	8.6	0.7	1.2	—	—	—	—	—	—	—	—	—	—	—	
11/10/2015 9:30	Grab	150	14.9	171	23	10.0	1.2	1.0	—	—	—	—	—	—	—	—	—	—	—	
11/25/2015 9:18	Grab	138	14.5	152	21	11.4	0.8	1.2	—	—	—	—	—	—	—	—	—	—	—	
12/7/2015 10:00	Grab	141	16.2	172	26	12.3	1.3	1.1	—	0.0008	—	0.0008	—	~ 0.0003	—	0.0112	—	< 0.0002	—	< 0.0005
12/21/2015 9:25	Grab	161	24.7	188	36	11.6	1.0	0.8	—	—	—	—	—	—	—	—	—	—	—	

**Table F.4.** Monitoring data for river site MR854.9W (Boom).

Sample Date	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
		Temp	Temp	Oxygen	(µS/cm)	Conductivity	(cm)	(ppt)	Suspended	Suspended	Dissolved	Solids	(mg/L)	Phosphorus	(mg/L)	Phosphorus	Phosphate	Kjeldahl	Nitrogen	(mg/L)
Sample Time		(F)	(F)	(mg/L)	(µS/cm)			(cm)	(ppt)	Solids	(mg/L)	Solids	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	Nitrogen	(mg/L)	(mg/L)
1/23/2015 9:27	Grab	35	33.1	15.16	268.4	503.2	7.45	> 100	0.24	~ 1	~ 1	286	19.7	< 0.020	~ 0.026	~ 0.009	0.65	0.08	< 0.03	0.95
2/24/2015 9:55	Grab	20	33.6	15.67	264.8	491.3	7.29	> 100	0.23	~ 1	< 1	297	20.2	< 0.020	~ 0.022	~ 0.008	0.66	~ 0.05	< 0.03	1.10
3/16/2015 12:42	Grab	50	40.3	15.57	244.7	401.2	7.90	> 100	0.19	3	~ 1	233	15.0	~ 0.031	~ 0.036	~ 0.006	0.63	< 0.02	< 0.03	0.85
4/23/2015 10:35	Grab	40	47.8	12.67	262.9	380.9	8.33	90	0.18	5	3	228	15.7	< 0.020	0.058	< 0.005	0.73	~ 0.02	< 0.03	0.35
5/8/2015 10:05	Grab	55	64.2	8.27	349.9	404.4	8.00	86	0.19	7	3	233	16.7	0.027	~ 0.048	< 0.005	0.81	0.08	< 0.03	0.29
5/22/2015 10:21	Grab	60	58.5	10.82	237.1	295.2	7.78	36	0.14	43	8	184	10.7	~ 0.043	0.125	0.028	1.10	~ 0.03	< 0.03	0.50
6/8/2015 11:00	Grab	70	70.0	8.36	291.7	315.4	7.80	52	0.15	23	6	61	10.9	~ 0.040	0.089	0.024	0.97	< 0.02	< 0.03	0.54
6/29/2015 10:25	Grab	70	77.7	8.02	394.0	391.2	7.97	64	0.19	15	~ 4	229	14.3	0.054	0.081	0.037	0.86	~ 0.06	< 0.03	0.88
7/10/2015 10:20	Grab	75	75.7	2.16	393.7	398.7	7.99	72	0.19	8	3	231	14.0	~ 0.030	0.076	0.024	0.75	< 0.02	< 0.03	0.35
7/24/2015 11:20	Grab	80	79.5	7.70	392.0	382.0	8.07	67	0.18	12	4	225	11.8	0.062	0.089	0.043	0.94	< 0.02	< 0.03	0.34
8/10/2015 10:30	Grab	75	77.0	4.98	389.6	389.7	7.86	68	0.19	11	4	177	12.4	0.049	0.090	0.042	0.83	< 0.02	< 0.03	0.37
8/21/2015 10:27	Grab	60	68.7	8.47	361.1	396.1	8.10	73	0.19	11	3	239	13.7	0.063	0.094	0.046	0.84	< 0.02	< 0.03	0.43
9/8/2015 11:15	Grab	70	77.5	7.57	404.9	402.7	8.10	85	0.19	10	~ 4	245	13.8	< 0.020	0.059	0.014	0.87	< 0.02	< 0.03	0.21
9/16/2015 11:00	Grab	75	70.3	8.61	356.4	383.2	7.89	86	0.18	8	3	226	10.9	~ 0.020	0.054	0.020	0.81	< 0.02	< 0.03	0.29
9/30/2015 10:15	Grab	50	65.5	8.89	339.2	386.5	7.98	95	0.19	7	3	229	13.0	~ 0.044	0.079	0.025	0.73	< 0.02	< 0.03	0.45
10/12/2015 10:30	Grab	60	60.1	9.95	317.0	386.6	8.00	> 100	0.19	3	~ 1	230	13.7	< 0.020	~ 0.038	0.012	0.64	< 0.02	< 0.03	0.36
10/27/2015 11:25	Grab	50	52.7	11.40	294.4	396.4	8.08	> 100	0.19	~ 2	~ 1	230	14.5	~ 0.022	~ 0.031	0.010	0.56	< 0.02	< 0.03	0.40
11/10/2015 10:15	Grab	50	48.0	13.57	253.5	366.1	7.92	> 100	0.18	4	~ 2	226	12.4	~ 0.027	~ 0.034	0.012	0.62	< 0.02	< 0.03	0.41
11/25/2015 10:10	Grab	45	35.8	15.61	187.1	332.9	8.04	70	0.16	13	4	196	12.5	~ 0.035	0.082	0.036	0.88	< 0.02	< 0.03	0.73
12/7/2015 11:00	Grab	40	37.2	14.31	209.9	363.6	8.14	> 100	0.17	5	~ 2	215	14.2	~ 0.030	0.065	0.015	0.81	~ 0.04	< 0.03	0.72
12/21/2015 9:50	Grab	30	32.9	16.53	218.7	411.0	8.21	> 100	0.19	8	~ 2	245	17.8	~ 0.036	0.054	0.017	0.76	< 0.02	< 0.03	1.38

**Table F.5.** Monitoring data for river site MWMO.

Sample Date	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
		Temp	Temp	Oxygen	(µS/cm)	Conductivity	(cm)	(ppt)	Suspended	Suspended	Dissolved	Solids	(mg/L)	Phosphorus	(mg/L)	Phosphorus	Phosphate	Kjeldahl	Nitrogen	(mg/L)
Sample Time		(F)	(F)	(mg/L)	(µS/cm)			(cm)	(ppt)	Solids	(mg/L)	Solids	(mg/L)	(mg/L)	(mg/L)	(mg/L)	Nitrogen	(mg/L)	(mg/L)	
8/21/2015 10:45	Grab	60	69.3	8.93	364.3	397.1	8.17	76	0.19	12	3	244	13.8	~ 0.049	0.094	0.045	0.92	< 0.02	< 0.03	0.44
9/8/2015 11:30	Grab	70	77.5	7.62	405.2	402.9	8.10	80	0.19	12	~ 4	245	13.9	~ 0.021	0.071	0.015	0.82	< 0.02	< 0.03	0.21
9/16/2015 11:15	Grab	75	71.8	8.77	361.6	382.8	8.02	89	0.18	8	3	185	11.1	~ 0.022	0.058	0.022	0.77	< 0.02	< 0.03	0.30
9/30/2015 10:30	Grab	50	65.8	8.93	339.6	384.9	8.06	83	0.18	7	3	216	13.0	~ 0.032	0.052	0.025	0.71	< 0.02	< 0.03	0.45
10/12/2015 11:07	Grab	60	60.4	9.86	316.0	383.5	8.11	> 100	0.18	3	~ 1	227	13.6	0.046	~ 0.031	0.012	0.70	< 0.02	< 0.03	0.35
10/27/2015 11:45	Grab	50	52.9	12.04</td																

**Table F.4 continued.** Monitoring data for river site MR854.9W (Boom).

Sample Date Sample Time	Sample Type	Alkalinity (mg/L CaCO3)	Chloride Ion (mg/L)	Hardness (mg/L CaCO3)	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
1/23/2015 9:27	Grab	196	18.5	216	20	7.5	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	
2/24/2015 9:55	Grab	200	22.1	276	~ 13	7.1	1.1	< 1.0	~ 0.0005	~ 0.0006	~ 0.0005	0.0007	< 0.0001	< 0.0001	< 0.0100	< 0.0100	< 0.0002	< 0.0002	0.0002	~ 0.0001
3/16/2015 12:42	Grab	170	19.2	172	20	6.4	1.4	1.7	—	0.0007	—	0.0006	—	~ 0.0001	—	< 0.0050	—	< 0.0002	—	~ 0.0001
4/23/2015 10:35	Grab	155	17.9	174	28	7.5	2.1	2.8	—	0.0006	—	0.0008	—	~ 0.0001	—	0.0017	—	< 0.0002	—	0.0011
5/8/2015 10:05	Grab	160	19.2	165	24	9.9	1.8	2.8	—	0.0007	—	0.0009	—	~ 0.0002	—	0.0017	—	< 0.0002	—	0.0003
5/22/2015 10:21	Grab	119	10.5	172	39	13.4	1.5	2.6	—	0.0017	—	0.0018	—	0.0007	—	0.0049	—	< 0.0002	—	0.0010
6/8/2015 11:00	Grab	132	12.7	146	35	11.8	1.6	1.4	—	< 0.0050	—	0.0013	—	0.0008	—	< 0.0050	—	< 0.0002	—	0.0007
6/29/2015 10:25	Grab	161	15.9	208	32	9.7	1.2	1.9	—	—	—	—	—	—	—	—	—	—	—	
7/10/2015 10:20	Grab	153	17.6	182	30	9.5	0.9	1.6	—	0.0011	—	0.0013	—	~ 0.0002	—	0.0024	—	< 0.0002	—	0.0003
7/24/2015 11:20	Grab	152	17.4	168	26	10.7	1.2	1.6	—	—	—	—	—	—	—	—	—	—	—	
8/10/2015 10:30	Grab	163	17.4	178	30	9.0	1.4	2.0	—	0.0009	—	0.0010	—	~ 0.0004	—	0.0084	—	< 0.0002	—	0.0003
8/21/2015 10:27	Grab	161	20.2	184	31	9.5	1.1	1.4	—	—	—	—	—	—	—	—	—	—	—	
9/8/2015 11:15	Grab	168	19.0	180	25	7.9	1.3	2.2	—	< 0.0050	—	0.0010	—	~ 0.0003	—	0.0045	—	< 0.0002	—	0.0003
9/16/2015 11:00	Grab	169	18.1	178	32	7.9	0.9	1.3	—	—	—	—	—	—	—	—	—	—	—	
9/30/2015 10:15	Grab	150	17.6	170	34	10.1	1.3	1.3	—	—	—	—	—	—	—	—	—	—	—	
10/12/2015 10:30	Grab	159	17.9	178	23	9.3	0.7	1.0	—	0.0007	—	< 0.0010	—	~ 0.0001	—	~ 0.0013	—	< 0.0002	—	0.0002
10/27/2015 11:25	Grab	161	17.6	174	25	8.7	0.6	0.9	—	—	—	—	—	—	—	—	—	—	—	
11/10/2015 10:15	Grab	144	15.0	170	47	10.5	0.9	0.9	—	—	—	—	—	—	—	—	—	—	—	
11/25/2015 10:10	Grab	125	13.3	148	33	11.5	1.0	1.2	—	—	—	—	—	—	—	—	—	—	—	
12/7/2015 11:00	Grab	137	15.0	164	24	12.2	1.4	1.1	—	0.0007	—	0.0008	—	~ 0.0002	—	0.0071	—	< 0.0002	—	< 0.0005
12/21/2015 9:50	Grab	160	16.7	184	30	11.7	0.9	0.7	—	—	—	—	—	—	—	—	—	—	—	

**Table F.5 continued.** Monitoring data for river site MWMO.

Sample Date Sample Time	Sample Type	Alkalinity (mg/L CaCO3)	Chloride Ion (mg/L)	Hardness (mg/L CaCO3)	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
8/21/2015 10:45	Grab	159	19.4	190	27	9.3	1.5	1.3	—	—	—	—	—	—	—	—	—	—	—	
9/8/2015 11:30	Grab	170	19.0	186	25	8.1	1.7	2.0	—	< 0.0050	—	0.0009	—	~ 0.0003	—	0.0042	—	< 0.0002	—	0.0002
9/16/2015 11:15	Grab	166	17.5	172	26	7.7	0.8	1.4	—	—	—	—	—	—	—	—	—	—	—	
9/30/2015 10:30	Grab	160	17.1	174	31	10.1	1.0	1.2	—	—	—	—	—	—	—	—	—	—	—	
10/12/2015 11:07	Grab	163	17.1	178	22	9.4	0.7	0.9	—	0.0005	—	~ 0.0006	—	0.0006	—	0.0032	—	< 0.0003	—	0.0002
10/27/2015 11:45	Grab	163	16.9	180	26	8.4	1.0	1.0	—	—	—	—	—	—	—	—	—	—	—	
11/10/2015 10:35	Grab	152	14.9	170	24	10.2	0.9	1.0	—	—	—	—	—	—	—	—	—	—	—	
11/25/2015 10:30	Grab	131	13.3	144	28	11.4	1.2	1.2	—	—	—	—	—	—	—	—	—	—	—	
12/7/2015 11:25	Grab	141	14.2	164	24	11.4	1.1	1.0	—	0.0008	—	0.0009	—	~ 0.0002	—	0.0074	—	< 0.0002	—	< 0.0005
12/21/2015 10:25	Grab	154	16.9	168	33	11.9	1.0	0.8	—	—	—	—	—	—	—	—	—	—	—	

**Table F.6.** Monitoring data for river site MR857.6W (Shingle Down).

Sample Date	Sample Type	Air Temp	Water Temp	Dissolved Oxygen	Conductivity ( $\mu\text{S}/\text{cm}$ )	Specific Conductivity ( $\mu\text{S}/\text{cm}$ )	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
Sample Time		(F)	(F)	(mg/L)																
1/23/2015 9:55	Grab	35	32.9	13.58	559.0	1,051.0	7.25	> 100	0.51	~ 2	~ 1	573	53.1	< 0.020	< 0.020	0.010	0.85	0.20	< 0.03	0.87
3/16/2015 12:57	Grab	50	40.5	15.47	240.1	392.7	7.71	> 100	0.19	4	~ 2	226	14.2	~ 0.030	~ 0.038	~ 0.007	0.64	~ 0.03	< 0.03	0.86
4/23/2015 10:50	Grab	40	48.4	13.30	263.4	378.1	8.41	92	0.18	5	3	218	15.4	~ 0.035	~ 0.049	~ 0.005	0.74	< 0.02	< 0.03	0.36
5/8/2015 10:25	Grab	55	63.3	9.34	338.2	395.5	8.06	90	0.19	7	3	223	16.0	< 0.020	0.050	< 0.005	0.83	0.08	< 0.03	0.29
5/22/2015 10:45	Grab	60	58.3	10.97	236.3	294.8	7.81	31	0.14	40	8	185	11.2	0.091	0.117	0.029	1.10	~ 0.02	< 0.03	0.57
6/8/2015 11:20	Grab	70	69.8	9.10	293.4	317.4	7.72	32	0.15	25	~ 5	194	11.3	~ 0.036	0.096	0.028	0.96	< 0.02	< 0.03	0.62
6/29/2015 10:45	Grab	70	77.4	8.13	382.9	381.5	7.99	64	0.18	12	3	231	12.9	0.060	0.090	0.039	0.93	< 0.02	< 0.03	0.78
7/10/2015 10:40	Grab	75	76.1	3.64	396.8	400.4	8.08	72	0.19	8	3	236	14.9	~ 0.029	0.076	0.027	0.78	< 0.02	< 0.03	0.38
7/24/2015 11:41	Grab	80	79.5	8.21	386.7	376.7	8.13	57	0.18	11	3	227	11.3	~ 0.049	0.101	0.044	0.96	< 0.02	< 0.03	0.35
8/10/2015 10:55	Grab	75	76.8	4.60	380.7	381.2	7.96	80	0.18	10	4	226	12.0	0.051	0.086	0.041	0.86	~ 0.02	< 0.03	0.38
8/21/2015 10:53	Grab	60	69.4	9.11	363.8	395.2	8.18	72	0.19	13	~ 5	243	13.9	0.057	0.093	0.044	0.86	< 0.02	< 0.03	0.43
9/8/2015 11:42	Grab	70	77.5	7.96	405.0	402.9	8.15	75	0.19	11	~ 4	245	14.0	~ 0.023	0.079	0.016	0.80	< 0.02	< 0.03	0.21
9/16/2015 11:26	Grab	75	71.2	8.76	356.9	380.4	7.96	93	0.18	8	3	227	11.1	~ 0.025	0.059	0.023	0.82	< 0.02	< 0.03	0.31
9/30/2015 10:45	Grab	50	65.5	9.03	334.6	381.0	8.15	90	0.18	8	3	236	12.6	~ 0.034	0.063	0.027	0.71	< 0.02	< 0.03	0.46
10/12/2015 11:25	Grab	60	60.8	9.12	316.3	382.3	8.14	> 100	0.18	3	~ 1	230	13.3	~ 0.023	~ 0.030	0.012	0.63	< 0.02	< 0.03	0.35
10/27/2015 11:58	Grab	50	53.1	11.21	293.1	393.0	8.09	> 100	0.19	~ 2	~ 1	227	14.2	~ 0.020	~ 0.032	~ 0.008	0.59	< 0.02	< 0.03	0.39
11/10/2015 10:45	Grab	50	47.7	14.28	261.6	379.5	8.18	> 100	0.18	5	~ 2	226	12.3	< 0.020	~ 0.032	0.011	0.69	< 0.02	< 0.03	0.48
11/25/2015 10:40	Grab	45	35.8	14.58	192.8	342.8	8.06	69	0.16	13	3	211	13.8	~ 0.029	0.084	0.028	0.89	~ 0.03	< 0.03	0.89
12/7/2015 11:34	Grab	40	36.9	13.94	208.2	362.6	8.15	> 100	0.17	5	~ 2	226	13.8	~ 0.039	0.065	0.016	0.81	~ 0.04	< 0.03	0.73
12/21/2015 11:20	Grab	30	32.5	15.54	282.2	534.7	8.19	> 100	0.25	6	~ 2	312	26.0	< 0.020	0.059	0.016	0.83	< 0.02	< 0.03	1.55

**Table F.6 continued.** Monitoring data for river site MR857.6W (Shingle Down).

Sample Date	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
Sample Time																				
1/23/2015 9:55	Grab	234	143.8	324	20	6.6	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	
3/16/2015 12:57	Grab	165	16.7	204	17	6.6	1.4	1.8	—	0.0006	—	0.0007	—	~ 0.0001	—	< 0.0050	—	< 0.0002	—	
4/23/2015 10:50	Grab	157	17.7	174	29	8.0	2.2	2.9	—	~ 0.0006	—	0.0008	—	< 0.0001	—	~ 0.0012	—	< 0.0002	—	
5/8/2015 10:25	Grab	152	17.4	178	22	9.4	1.8	3.0	—	0.0008	—	0.0009	—	~ 0.0002	—	0.0018	—	< 0.0002	—	
5/22/2015 10:45	Grab	118	10.0	142	37	13.3	1.4	2.0	—	0.0016	—	0.0017	—	0.0006	—	0.0042	—	< 0.0002	—	
6/8/2015 11:20	Grab	135	10.8	148	38	11.8	1.2	1.4	—	< 0.0050	—	0.0014	—	0.0007	—	< 0.0050	—	< 0.0002	—	
6/29/2015 10:45	Grab	162	14.2	180	24	9.4	1.1	1.6	—	—	—	—	—	—	—	—	—	—	—	
7/10/2015 10:40	Grab	159	16.6	184	32	9.4	1.3	1.7	—	0.0015	—	0.0013	—	~ 0.0002	—	0.0020	—	< 0.0002	—	
7/24/2015 11:41	Grab	153	16.3	170	33	10.9	1.1	1.7	—	—	—	—	—	—	—	—	—	—	—	
8/10/2015 10:55	Grab	155	16.3	178	30	9.1	1.2	1.7	—	0.0010	—	0.0010	—	~ 0.0004	—	0.0084	—	< 0.0002	—	
8/21/2015 10:53	Grab	160	19.0	180	30	9.5	1.4	1.3	—	—	—	—	—	—	—	—	—	—	—	
9/8/2015 11:42	Grab	179	17.9	184	22	7.8	1.7	1.9	—	< 0.0050	—	0.0009	—	~ 0.0003	—	0.0043	—	< 0.0002	—	
9/16/2015 11:26	Grab	159	17.2	172	27	7.9	1.0	1.3	—	—	—	—	—	—	—	—	—	—	—	
9/30/2015 10:45	Grab	154	16.8	176	33	10.2	0.9	1.3	—	—	—	—	—	—	—	—	—	—	—	
10/12/2015 11:25	Grab	158	17.0	178	23	9.4	0.8	1.0	—	0.0011	—	< 0.0010	—	~ 0.0001	—	~ 0.0014	—	< 0.0002	—	
10/27/2015 11:58	Grab	161	17.2	172	20	8.6	0.5	0.9	—	—	—	—	—	—	—	—	—	—	—	
11/10/2015 10:45	Grab	144	15.1	164	25	10.2	1.1	0.9	—	—	—	—	—	—	—	—	—	—	—	
11/25/2015 10:40	Grab	131	12.9	156	23	11.2	0.8	1.1	—	—	—	—	—	—	—	—	—	—	—	
12/7/2015 11:34	Grab	139	13.7	168	31	10.9	1.3	1.1	—	0.0017	—	0.0009	—	~ 0.0002	—	0.0070	—	< 0.0002	—	
12/21/2015 11:20	Grab	181	40.0	220	27	11.0	1.0	0.9	—	—	—	—	—	—	—	—	—	< 0.0005	—	

**Table F.7.** Monitoring data for river site MR857.6W (Shingle Up).

Sample Date Sample Time	Sample Type	Air Temp	Water Temp	Dissolved Oxygen	Conductivity (µS/cm)	Specific Conductivity (µS/cm)	pH	Transparency (cm)	Salinity (ppt)	Total Suspended Solids (mg/L)	Volatile Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)
		(F)	(F)	(mg/L)																
3/16/2015 13:06	Grab	50	40.6	15.40	244.0	397.1	7.68	> 100	0.19	4	~ 1	236	14.5	~ 0.036	~ 0.038	~ 0.006	0.63	~ 0.02	< 0.03	0.85
4/23/2015 10:57	Grab	40	48.4	12.65	263.8	378.5	8.34	99	0.18	5	~ 2	220	15.4	< 0.020	~ 0.037	< 0.005	0.73	~ 0.03	< 0.03	0.37
5/8/2015 10:35	Grab	55	63.3	9.28	342.6	400.6	8.07	98	0.19	6	3	230	16.8	< 0.020	~ 0.048	< 0.005	0.78	0.08	< 0.03	0.30
5/22/2015 10:50	Grab	60	58.3	10.80	238.3	297.3	7.82	35	0.14	39	7	187	11.0	~ 0.039	0.118	0.030	1.10	~ 0.04	< 0.03	0.59
6/8/2015 11:25	Grab	70	70.0	9.09	305.3	329.9	7.75	29	0.16	26	6	202	13.2	0.065	0.088	0.028	1.00	< 0.02	< 0.03	0.71
6/29/2015 10:50	Grab	70	77.5	8.23	395.6	393.7	8.02	68	0.19	14	4	241	14.5	0.062	0.084	0.040	0.90	0.07	< 0.03	0.96
7/10/2015 10:46	Grab	75	76.3	8.21	398.1	401.1	8.10	77	0.19	8	3	235	14.9	~ 0.035	0.076	0.027	0.78	< 0.02	< 0.03	0.34
7/24/2015 11:51	Grab	80	79.9	8.08	396.6	383.8	8.14	63	0.18	11	4	232	12.4	0.058	0.108	0.049	0.95	< 0.02	< 0.03	0.36
8/10/2015 11:20	Grab	75	77.0	5.31	386.6	386.5	7.98	60	0.18	11	4	229	12.7	0.054	0.078	0.043	0.83	~ 0.03	< 0.03	0.34
8/21/2015 10:56	Grab	60	69.6	9.07	367.6	398.7	8.19	69	0.19	11	4	239	14.2	~ 0.046	0.089	0.047	0.83	< 0.02	< 0.03	0.46
9/8/2015 11:50	Grab	70	77.5	8.06	408.2	406.3	8.15	76	0.19	10	~ 4	247	14.4	< 0.020	0.075	0.016	0.79	< 0.02	< 0.03	0.21
9/16/2015 11:35	Grab	75	71.4	9.00	361.2	384.0	8.03	95	0.18	9	4	232	11.5	~ 0.034	0.062	0.025	0.77	< 0.02	< 0.03	0.29
9/30/2015 10:55	Grab	50	65.3	9.20	332.8	379.6	8.07	91	0.18	5	~ 2	234	12.9	~ 0.037	0.056	0.027	0.67	< 0.02	< 0.03	0.45
10/12/2015 11:32	Grab	60	60.8	9.21	314.8	380.3	8.15	> 100	0.18	~ 2	~ 1	222	13.4	~ 0.021	~ 0.035	0.010	0.65	< 0.02	< 0.03	0.33
10/27/2015 12:04	Grab	50	53.1	11.47	294.5	394.6	8.13	> 100	0.19	~ 2	~ 1	230	14.9	< 0.020	< 0.020	—	0.64	< 0.02	< 0.03	0.89
11/10/2015 10:52	Grab	50	48.6	11.84	263.6	377.3	7.98	> 100	0.18	4	~ 2	227	13.3	< 0.020	~ 0.023	0.012	0.66	< 0.02	< 0.03	0.43
11/25/2015 10:45	Grab	45	36.0	14.52	211.5	375.2	8.08	69	0.18	13	3	225	15.5	~ 0.034	0.087	0.034	0.93	~ 0.03	< 0.03	1.11
12/7/2015 11:40	Grab	40	36.9	14.04	219.1	381.1	8.18	> 100	0.18	5	~ 2	230	16.1	~ 0.036	0.066	0.020	0.85	~ 0.06	< 0.03	0.86
12/21/2015 10:55	Grab	30	32.2	16.36	204.0	388.4	8.23	> 100	0.18	8	~ 2	237	16.1	~ 0.022	~ 0.039	0.016	0.82	< 0.02	< 0.03	1.09

**Table F.7 continued.** Monitoring data for river site MR857.6W (Shingle Up).

Sample Date	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
Sample Time																				
3/16/2015 13:06	Grab	167	17.6	184	18	6.7	1.4	1.9	—	0.0007	—	0.0006	—	~ 0.0001	—	< 0.0050	—	< 0.0002	—	0.0003
4/23/2015 10:57	Grab	154	18.6	182	27	8.0	2.1	2.7	—	~ 0.0006	—	0.0008	—	~ 0.0001	—	~ 0.0012	—	< 0.0002	—	0.0002
5/8/2015 10:35	Grab	161	17.6	186	19	9.4	1.8	2.9	—	0.0007	—	0.0009	—	~ 0.0002	—	~ 0.0013	—	< 0.0002	—	0.0002
5/22/2015 10:50	Grab	119	9.7	148	37	13.2	1.2	2.0	—	0.0013	—	0.0016	—	~ 0.0005	—	0.0029	—	< 0.0002	—	0.0007
6/8/2015 11:25	Grab	138	11.5	160	39	13.1	1.9	2.1	—	< 0.0050	—	0.0014	—	0.0007	—	< 0.0050	—	< 0.0002	—	0.0009
6/29/2015 10:50	Grab	165	14.1	184	32	9.7	1.1	1.7	—	—	—	—	—	—	—	—	—	—	—	
7/10/2015 10:46	Grab	157	16.1	180	30	9.4	1.1	1.7	—	0.0014	—	0.0017	—	~ 0.0002	—	0.0021	—	< 0.0002	—	0.0003
7/24/2015 11:51	Grab	163	15.8	174	39	10.4	1.4	1.7	—	—	—	—	—	—	—	—	—	—	—	
8/10/2015 11:20	Grab	155	16.2	178	30	9.3	1.3	1.8	—	0.0009	—	0.0010	—	~ 0.0003	—	0.0078	—	< 0.0002	—	0.0003
8/21/2015 10:56	Grab	161	18.2	186	30	9.3	1.3	1.5	—	—	—	—	—	—	—	—	—	—	—	
9/8/2015 11:50	Grab	168	18.0	186	21	8.0	1.7	2.0	—	< 0.0050	—	0.0009	—	~ 0.0003	—	0.0049	—	< 0.0002	—	0.0002
9/16/2015 11:35	Grab	166	16.7	178	31	8.1	0.8	1.3	—	—	—	—	—	—	—	—	—	—	—	
9/30/2015 10:55	Grab	158	15.9	175	29	10.2	1.2	1.2	—	—	—	—	—	—	—	—	—	—	—	
10/12/2015 11:32	Grab	160	16.0	178	24	9.4	0.8	0.9	—	0.0006	—	< 0.0010	—	~ 0.0001	—	~ 0.0009	—	< 0.0002	—	~ 0.0001
10/27/2015 12:04	Grab	162	16.8	182	23	8.7	0.6	1.0	—	—	—	—	—	—	—	—	—	—	—	
11/10/2015 10:52	Grab	154	14.3	170	23	10.1	0.7	0.9	—	—	—	—	—	—	—	—	—	—	—	
11/25/2015 10:45	Grab	144	14.2	148	31	11.6	0.8	1.1	—	—	—	—	—	—	—	—	—	—	—	
12/7/2015 11:40	Grab	144	14.3	176	27	12.6	0.9	1.1	—	0.0007	—	0.0011	—	~ 0.0002	—	0.0075	—	< 0.0002	—	< 0.0005
12/21/2015 10:55	Grab	149	17.5	172	37	11.8	0.8	0.8	—	—	—	—	—	—	—	—	—	—	—	

**Table F.8.** Monitoring data for river site MR859.1W (Upper).

Sample Date Sample Time	Sample Type	Air	Water	Dissolved	Conductivity	Specific	pH	Transparency	Salinity	Total	Volatile	Total	Sulfate	Dissolved	Total	Ortho	Total	Ammonia	Nitrite N	Nitrate N
		Temp (F)	Temp (F)	Oxygen (mg/L)	(μS/cm)	Conductivity (μS/cm)	(cm)	(ppt)		Suspended Solids (mg/L)	Suspended Solids (mg/L)	Dissolved Solids (mg/L)	(mg/L)	Phosphorus (mg/L)	Phosphorus (mg/L)	Phosphate (mg/L)	Kjeldahl Nitrogen (mg/L)	Nitrogen (mg/L)	(mg/L)	
1/23/2015 10:35	Grab	35	33.6	13.41	345.4	639.4	7.43	> 100	0.31	~ 1	~ 1	355	29.4	< 0.020	< 0.020	0.010	0.70	0.11	< 0.03	0.81
3/16/2015 12:37	Grab	50	44.8	14.90	269.0	408.3	7.77	> 100	0.20	3	~ 2	238	16.0	~ 0.030	~ 0.033	~ 0.007	0.60	< 0.02	< 0.03	0.86
4/23/2015 10:18	Grab	40	46.8	13.18	269.0	395.8	8.46	> 100	0.19	3	~ 2	228	17.4	~ 0.021	0.054	< 0.005	0.71	< 0.02	< 0.03	0.37
5/8/2015 11:50	Grab	55	63.3	9.21	357.0	417.3	7.48	> 100	0.20	7	3	238	18.7	< 0.020	~ 0.048	< 0.005	0.77	~ 0.04	< 0.03	0.27
5/22/2015 11:10	Grab	60	58.3	10.74	227.7	283.9	7.76	37	0.14	40	8	178	9.8	~ 0.033	0.121	0.026	1.10	~ 0.03	< 0.03	0.40
6/8/2015 11:40	Grab	70	70.0	9.09	303.6	328.0	7.79	38	0.16	26	6	147	12.9	~ 0.047	0.096	0.028	1.00	< 0.02	< 0.03	0.74
6/29/2015 11:15	Grab	70	78.1	8.77	460.4	455.4	8.08	64	0.22	13	3	245	17.8	0.062	0.080	0.041	0.88	< 0.02	< 0.03	1.06
7/10/2015 10:50	Grab	75	75.9	7.81	416.0	420.9	8.09	> 100	0.20	7	3	246	16.9	~ 0.034	0.078	0.029	0.80	< 0.02	< 0.03	0.40
7/24/2015 11:55	Grab	80	80.8	8.35	442.4	425.6	8.17	69	0.20	10	3	262	16.3	0.061	0.098	0.052	0.94	< 0.02	< 0.03	0.36
8/10/2015 11:35	Grab	75	77.9	8.77	456.0	452.0	7.92	76	0.22	9	4	269	18.5	~ 0.042	0.084	0.045	0.92	~ 0.03	< 0.03	0.35
8/21/2015 11:10	Grab	60	70.3	9.16	385.7	415.0	8.22	—	0.20	7	3	250	16.0	0.057	0.090	0.048	0.82	< 0.02	< 0.03	0.45
9/8/2015 11:20	Grab	70	72.9	8.75	398.9	417.1	8.06	65	0.20	10	~ 4	254	15.6	< 0.020	0.074	0.015	0.77	< 0.02	< 0.03	0.17
9/16/2015 11:38	Grab	75	73.2	9.18	424.3	442.2	8.10	> 100	0.21	5	~ 2	264	17.1	~ 0.035	0.055	0.024	0.78	< 0.02	< 0.03	0.29
9/30/2015 11:00	Grab	50	65.1	9.21	337.1	385.9	8.09	88	0.19	5	~ 2	238	14.1	0.052	~ 0.049	0.026	0.67	< 0.02	< 0.03	0.43
10/12/2015 11:35	Grab	60	60.3	9.98	319.7	388.5	8.19	> 100	0.19	~ 2	~ 1	234	14.5	< 0.020	~ 0.029	0.011	0.63	< 0.02	< 0.03	0.32
10/27/2015 12:05	Grab	50	53.1	11.79	327.5	439.2	8.10	> 100	0.21	~ 1	~ 1	256	19.3	< 0.020	0.050	0.011	0.60	< 0.02	< 0.03	0.40
11/10/2015 11:05	Grab	50	48.7	12.01	264.0	376.9	8.03	> 100	0.18	4	~ 2	226	13.3	< 0.020	~ 0.024	0.012	0.63	< 0.02	< 0.03	0.52
11/25/2015 10:35	Grab	45	38.1	14.41	250.1	425.6	8.12	72	0.20	11	3	257	19.6	0.055	0.094	0.045	0.96	0.06	< 0.03	1.46
12/7/2015 11:15	Grab	40	39.2	13.70	250.9	418.2	8.18	92	0.20	5	~ 2	254	19.6	< 0.020	0.068	0.020	0.88	~ 0.05	< 0.03	1.11
12/21/2015 11:35	Grab	30	32.5	15.27	258.2	488.5	8.25	> 100	0.23	6	~ 2	291	25.6	0.052	0.080	0.022	0.87	< 0.02	0.02	1.62

**Table F.8 continued.** Monitoring data for river site MR859.1W (Upper).

Sample Date Sample Time	Sample Type	Alkalinity (mg/L CaCO <sub>3</sub> )	Chloride Ion (mg/L)	Hardness (mg/L CaCO <sub>3</sub> )	Chemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Carbonaceous Biological Oxygen Demand 5-day (mg/L)	Total Biological Oxygen Demand 5-day (mg/L)	Soluble Copper (mg/L)	Total Copper (mg/L)	Soluble Nickel (mg/L)	Total Nickel (mg/L)	Soluble Lead (mg/L)	Total Lead (mg/L)	Soluble Zinc (mg/L)	Total Zinc (mg/L)	Soluble Cadmium (mg/L)	Total Cadmium (mg/L)	Soluble Chromium (mg/L)	Total Chromium (mg/L)
1/23/2015 10:35	Grab	209	52.5	232	21	7.2	< 1.0	< 1.0	—	—	—	—	—	—	—	—	—	—	—	
3/16/2015 12:37	Grab	171	20.8	120	19	6.3	1.4	1.9	—	0.0007	—	~ 0.0006	—	< 0.0001	—	< 0.0050	—	< 0.0002	—	
4/23/2015 10:18	Grab	163	19.1	145	25	7.8	2.2	3.1	—	—	—	—	—	—	—	—	—	—	—	
5/8/2015 11:50	Grab	168	21.1	194	20	9.9	2.2	2.8	—	0.0007	—	0.0010	—	~ 0.0002	—	0.0016	—	< 0.0002	—	
5/22/2015 11:10	Grab	113	10.9	56	39	13.5	1.4	2.3	—	0.0016	—	0.0017	—	0.0006	—	0.0052	—	< 0.0002	—	
6/8/2015 11:40	Grab	137	11.3	154	36	13.2	1.8	1.8	—	< 0.0050	—	0.0015	—	0.0008	—	< 0.0050	—	< 0.0002	—	
6/29/2015 11:15	Grab	172	17.1	194	24	9.6	1.1	1.7	—	—	—	—	—	—	—	—	—	—	—	
7/10/2015 10:50	Grab	160	19.9	186	30	9.3	1.4	1.9	—	0.0013	—	0.0013	—	~ 0.0002	—	0.0024	—	< 0.0002	—	
7/24/2015 11:55	Grab	165	22.8	182	36	10.2	1.6	1.9	—	—	—	—	—	—	—	—	—	—	—	
8/10/2015 11:35	Grab	169	28.8	196	31	9.1	1.6	2.3	—	0.0016	—	0.0023	—	~ 0.0004	—	0.0080	—	~ 0.0002	—	
8/21/2015 11:10	Grab	166	20.5	188	29	9.1	0.9	1.4	—	—	—	—	—	—	—	—	—	—	—	
9/8/2015 11:20	Grab	174	19.8	186	23	7.8	1.6	2.0	—	< 0.0050	—	0.0010	—	~ 0.0003	—	0.0053	—	< 0.0002	—	
9/16/2015 11:38	Grab	169	28.0	192	28	8.0	1.0	1.3	—	—	—	—	—	—	—	—	—	—	—	
9/30/2015 11:00	Grab	164	16.8	174	28	10.0	0.8	1.1	—	—	—	—	—	—	—	—	—	—	—	
10/12/2015 11:35	Grab	162	17.9	178	26	9.2	0.9	1.1	—	0.0008	—	< 0.0010	—	~ 0.0001	—	0.0031	—	< 0.0002	—	
10/27/2015 12:05	Grab	168	24.1	186	24	8.7	0.9	1.1	—	—	—	—	—	—	—	—	—	—	—	
11/10/2015 11:05	Grab	144	14.2	170	23	10.2	0.9	0.8	—	—	—	—	—	—	—	—	—	—	—	
11/25/2015 10:35	Grab	158	18.9	180	23	11.0	1.4	1.3	—	—	—	—	—	—	—	—	—	—	—	
12/7/2015 11:15	Grab	155	19.1	184	23	10.7	1.3	1.2	—	0.0008	—	0.0009	—	~ 0.0002	—	0.0076	—	< 0.0002	—	
12/21/2015 11:35	Grab	177	26.0	208	35	11.2	0.8	0.8	—	—	—	—	—	—	—	—	—	—	—	