Enclosure 1

Michigan Department of Natural Resources and Environment - Water Resources Division

Total Maximum Daily Load for *E. coli* for the Lower Black River Watershed

St. Clair County, Michigan

December 10, 2010

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Tables and Figures

LIST OF ACRONYMS

BST	Bacterial source tracking
BPAC	St. Clair River Bi-national Public Advisory Council
CFU	Colony forming units
CGI	Michigan Center for Geographic Information
COC	Certificate of coverage
CSO	Combined sewer overflows
DAR	Drainage area ratio
DNRE	Michigan Department of Natural Resources and Environment
E. coli	*Escherichia coli*
HUC	Hydrologic Unit Code
IDEP	Illicit discharge elimination program
LA	Load allocations
LC	Loading capacity
LDC	Load duration curve
MDOT	Michigan Department of Transportation
mL	milliliter
MOS	Margin of safety
MS4	Municipal separate storm sewer system
NEW	St. Clair County Northeastern Watershed Advisory Group
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OSDS	On-site sewage disposal systems
SCCHD	St. Clair County Health Department
SSO	Sanitary sewer overflows
SWPPP	Storm water pollution prevent plan
SWQIF	Strategic Water Quality Initiatives Fund
TMDL	Total maximum daily load
USGS	United States Geological Survey
WLA	Waste load allocations
WMP	Watershed management plan
WQS	Water quality standard
WWTP	Waste water treatment plants
U.S. EPA	United States Environmental Protection Agency

1.0 INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (U.S. EPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of *Escherichia coli (E. coli)* that will result in the attainment of the applicable WQS in the lower portion of the Black River, which is located in St. Clair County, Michigan.

This TMDL covers the lower 4.9 miles of the main stem of the Black River, which is considered impaired since it is not meeting the *E. coli* WQS. This lower 4.9 mile section is referred to as the "impaired reach" throughout this document.

When determining the causes of the impairment on the Black River, it is important to identify the area that drains to the impaired reach. This drainage area extends 30 square miles across the communities of Port Huron and Clyde, Fort Gratiot, Kimball and Port Huron townships. The drainage area associated with the impaired reach is identified as the "impaired watershed" throughout this document.

2.0 PROBLEM STATEMENT

The TMDL reach for the Black River appears on the 2008 Section 303(d) list (LeSage and Smith, 2008) as:

BLACK RIVER AUID#: 040900010214-02
County: St. Clair Size: 2.49 miles
Location: Black River watershed
Use impairments: partial and total body contact recreation
Cause: *Escherichia coli*

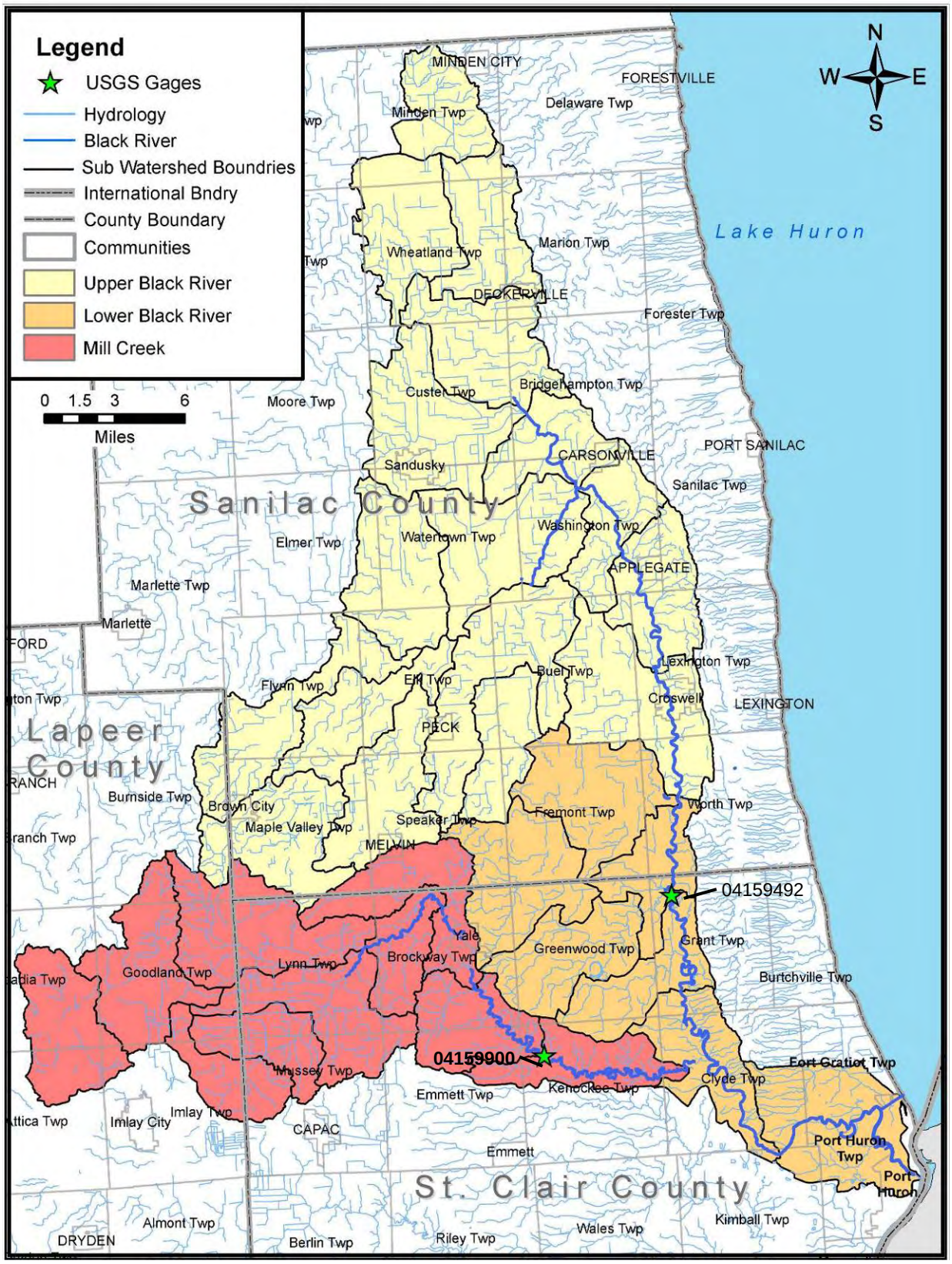
The Black River was originally placed on the Section 303(d) list during the 1998 listing cycle due to the presence of untreated combined sewer overflows (CSOs). The impaired section of the river was identified as the lower 2.49 miles of the river from its confluence with the St. Clair River upstream to the Interstate 94 crossing.

Since the original listing, *E. coli* concentrations have been reduced in the lower section of the Black River due to implementation of the City of Port Huron's Long-term Combined Sewer Overflow Control Program. However, recent monitoring data collected in 2009 by the U.S. EPA, in collaboration with the Michigan Department of Natural Resources and Environment (DNRE), confirmed exceedences of the Michigan WQSs for *E. coli* during the total body contact recreational season of May 1 to October 31. Data collected by St. Clair County Health Department (SCCHD) and the City of Port Huron from 2000 to 2009 also show elevated levels of *E. coli.* The 2009 data confirmed exceedences in the Black River just upstream of Strawberry Lane, which is upstream of the original 303(d) listed 2.49 miles. DNRE is planning to modify the 303(d) listing to extend the impaired reach to include 4.9 miles of the river from its confluence with the St. Clair River to just upstream of Strawberry Lane which is upstream of the confluence with the Black River canal.

2.1 Background

The headwaters of the Black River are found in Sanilac County. The river flows south into St. Clair County where it eventually outlets into the St. Clair River in the City of Port Huron. The Black River watershed encompasses 746 square miles. For the purposes of local watershed planning, the Black River watershed was divided into three separate drainage areas: the Upper Black River subwatershed, which is almost exclusively located in Sanilac County; Mill Creek subwatershed, which is situated in Lapeer and St. Clair Counties; and the Lower Black River subwatershed, which is located within St. Clair and Sanilac counties (see Figure 1).

Figure 1. Black River Watershed

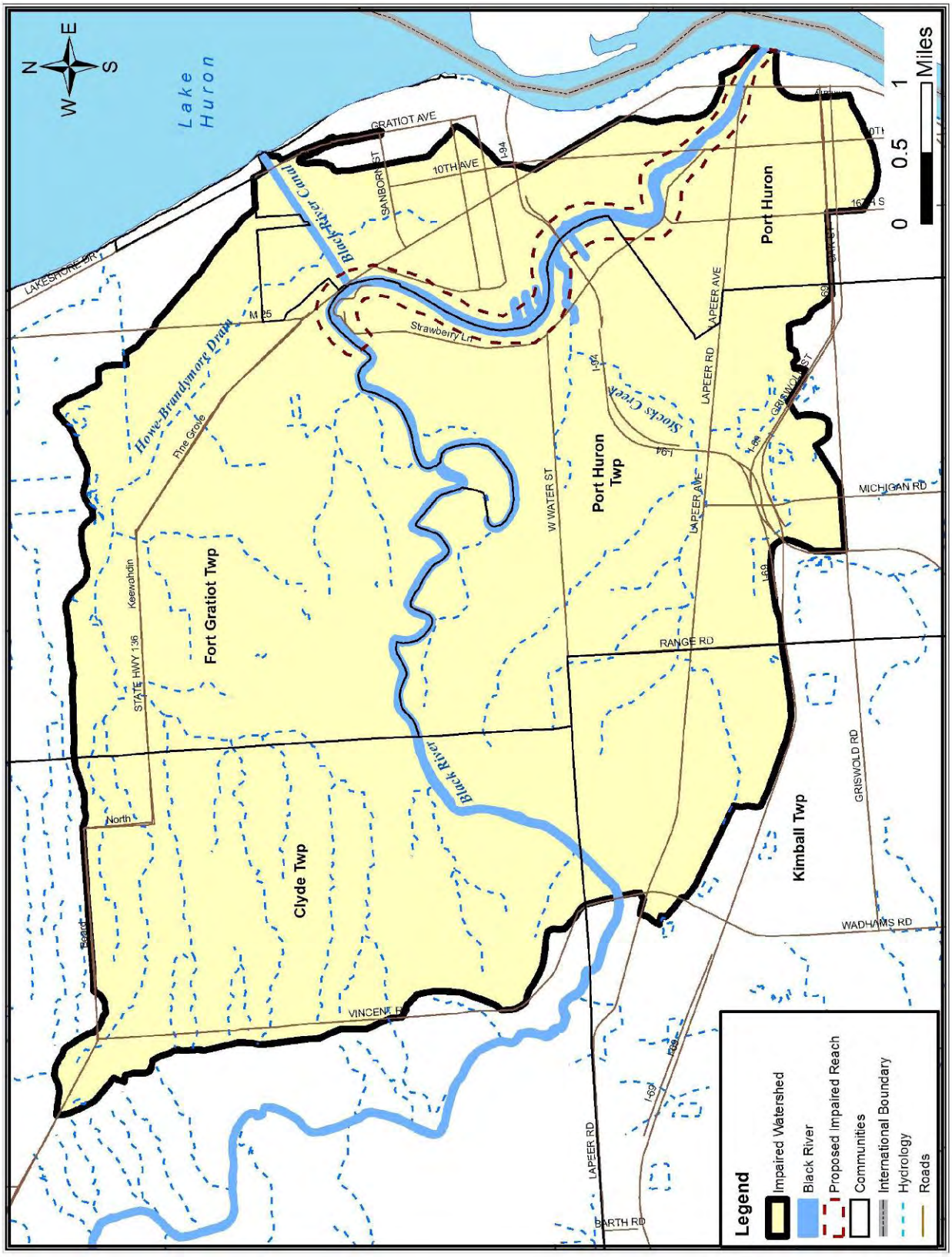


The impaired reach of the Black River is located within the Lower Black River subwatershed and drains an area of land that is approximately 30 square miles, which includes portions of the City of Port Huron, and Fort Gratiot, Clyde, Port Huron and Kimball townships. The impaired reach drainage area was determined based on the boundary of subbasin 34 of HUC 04090001 as provided by the Michigan Center for Geographic Information (CGI). This boundary was manually adjusted to account for the storm sewer service area based on maps provided by the City of Port Huron. The resulting drainage area is termed the impaired watershed throughout this document and is depicted in Figure 3.

The Howe-Brandymore Drain and Stocks Creek are the two main tributaries to the impaired reach (see Figure 3). Significant flow volumes to the Lower Black are also contributed by Lake Huron which is hydraulically connected to the impaired reach by way of the Black River canal. Further discussion regarding predicted flow contributions from the canal is presented in Section 4.1

Figure 2. Confluence of the Black River Canal with the Black River
Note: the Lake Huron water via the Black River canal in the background and the Black River water in the foreground (best viewed in color)

Figure 3. Black River: Proposed Impaired Reach and Watershed



3.0 NUMERIC TARGET

The impaired designated uses addressed by this TMDL are total and partial body contact recreation. The designated use rule (R 323.1100 of the Part 4 rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended) states that this water body is to be protected for total body contact recreation from May 1 to October 31 and year-round for partial body contact recreation. The target levels for these designated uses are the ambient *E. coli* standards established in Rule 62 of the WQS as follows:

> *R 323.1062 Microorganisms.*
> *Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 E. coli per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at 2 representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.*
>
> *Rule 62(2) All surface waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples, taken during the same sampling event, at representative locations within a defined sampling area.*

The target for sanitary wastewater discharges is:

> *Rule 62. (3) Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 milliliters, based on the geometric mean of all of 5 or more samples taken over a 30-day period, nor more than 400 fecal coliform bacteria per 100 milliliters, based on the geometric mean of all of 3 or more samples taken during any period of discharge not to exceed 7 days. Other indicators of adequate disinfection may be utilized where approved by the department.*

The targets for this TMDL are 300 *E. coli* per 100 milliliters (mL) expressed as a daily maximum load and concentration from May 1 to October 31 (i.e., daily target) and 130 *E. coli* per 100 mL as a 30-day geometric mean, expressed as a concentration (i.e., monthly target). An additional target is the partial body contact standard of 1,000 *E. coli* per 100 mL as a daily maximum concentration year-round. Achievement of the total body contact daily maximum target is expected to result in attainment of the partial body contact standard.

3.1 Linkage Analysis

Determining the link between the *E. coli* concentrations in the Black River and the potential sources is necessary to develop the TMDL. TMDLs must be established at a level necessary to attain and maintain the applicable WQS. Because the waste load allocations (WLA) provided herein, which are defined as the pollutant loads associated with point source discharges, are based on the daily target, a linkage analysis is needed to demonstrate these allocations also assure attainment of the monthly target.

The 1986 Ambient Water Quality Criteria for Bacteria (U.S. EPA 1986) defines the statistical relationship between the daily maximum and 30-day geometric mean criteria values. The assumption used to develop the 30-day geometric mean of 126 colony forming units (cfu) per 100 mL (rounded to 130 cfu per 100 mL as the Michigan criterion) is a log-normal distribution using a log standard deviation of 0.4. Using this assumption and a comparable recurrence interval (e.g., 30 days), a daily maximum projected from the 30-day geometric mean would be 713 cfu per 100 mL. Conversely, the Michigan daily maximum criterion of 300 cfu per 100 mL is comparable to a 30-day geometric mean of approximately 55 cfu per 100 mL. This relationship provides the basis for demonstrating that attaining the daily target in the TMDL will also achieve the monthly target.

4.0 DATA DISCUSSION

This portion of the document is divided into two main sections: discharge (i.e. stream flow) data and *E. coli* data. The discharge section describes the available discharge data for the Black River watershed and how discharge estimates were made for the ungaged impaired watershed. These data were collected to develop the *E. coli* loadings.

The monitoring section presents and summarizes the ambient *E. coli* data that were collected during 2009, as well as data from the City of Port Huron and the SCCHD. Further information on the *E. coli* data collection effort can be found in the document *St. Clair & Black River E. coli Monitoring to Support TMDL Development and Area of Concern Delisting Final Report*, which is included as Attachment A.

4.1 Discharge Data

The United States Geological Survey (USGS) operates two gaging stations within the Black River Watershed, Black River near Jeddo, MI (04159492) and Mill Creek near Avoca, MI (04159900) as shown in Figure 1. The Black River gage has been in operation since January 1, 1945. The Mill Creek gage has been operational since April 1, 1963; however, data for this station are not available for the period between October 1, 1975 and September 30, 1987. Discharge data for both stations was obtained for the periods when they were operating concurrently: April 1, 1963 through September 30, 1975, and October 1, 1987 through December 31, 2009.

Downstream of the confluence of Mill Creek and the Black River and just downstream of Strawberry Lane, the Black River canal discharges water from Lake Huron into the Black River. Flow within the canal is regulated by a tainter gate that is operated by the City of Port Huron (see Figure 4). The gate is generally open between April and November except when winds are strong from the northeast. During these conditions the gate is closed to prevent sediment from building up in the canal (MDNR 1975). Opening and closing of the gate is typically automatic, controlled by a wind sensor.

There was very limited information available to use in determining the hydraulic capacity of the canal. Functionality of the gate is not regularly monitored, except staff from the Port Huron wastewater treatment plant (WWTP) record whether or not the gate is open when they collect their routine *E. coli* samples during the summer months.

To estimate the amount of flow that could enter the Black River from the canal, average daily water surface elevations for Lake Huron were obtained from National Oceanic and Atmospheric Administration (NOAA) for 16 “open-gate” days. Average daily flows for the Black River at the mouth of the St. Clair River were also estimated using average daily flow data for two upstream USGS gages using the Drainage Area Ratio (DAR) method described in subsequent paragraphs.

It was assumed that flow through the canal is restricted by the amount of water that passes through the gate. It was further assumed that flow through the gate is a function of the water surface elevation in Lake Huron. This assumption neglects 1) potential backwater impacts of the Black River, which are unpredictable but which could be substantial, and 2) energy losses (i.e.: flow loss due to drag along the canal bottom and sides) through the canal.

Flow through the gate was calculated using a basic rectangular weir equation based on as-built drawings provided by the City of Port Huron. The calculated gate discharge was compared to

the flow within the Black River for each of the 16 confirmed “open-gate” days. Based on these rough hydraulic capacity calculations, it was determined that the canal can contribute a significant portion of the total flow (30% – 85%) of the Black River, especially during low flow conditions.

Flow within the impaired reach is also susceptible to back water effects from the St. Clair River. USGS confirmed that the water level within the St. Clair River can impact the hydraulic gradeline (and associated flow) within the Black River as far upstream as Wadhams Road which is about 11 miles upstream of the outlet (S. Blumer, personal communication, 5/1/2009).

Quantification of the backwater effects of the St. Clair River and flow through the canal would require substantial hydraulic and hydrologic modeling that was beyond the scope of this TMDL. Therefore, backwater effects from the St. Clair River and flow through the canal were not considered in the development of the flow duration curve for the impaired reach.

Figure 4. Black River Canal Gate Structure (facing Lake Huron)

The DAR method was used to estimate the flows and develop a flow duration curve for the impaired reach. The DAR is a simple, widely used analytical approach to developing discharge for ungaged watersheds/sites using discharge data from gaged watersheds. The downstream portions of the watershed are more urbanized than the drainage areas of the two USGS gages. Therefore, a modified DAR method, which takes into account the impervious surfaces within each area and reduces uncertainty in DAR flow estimates, was used for this project. The modified DAR is defined in the following equation:

$$DAR = \frac{A_{ungaged} \times c_{ungaged}}{A_{gaged} \times c_{gaged}}$$

Where:

$A_{ungaged}$ = Area of ungaged watershed/site

$C_{ungaged}$ = Runoff coefficient of ungaged watershed/site
A_{gaged} = Area of gaged watershed/site
$C_{ungaged}$ = Runoff coefficient of gaged watershed/site

Using the DAR method, discharge can be estimated for ungaged watersheds/sites using the following equation:

$$Q_{ungaged} = DAR \times Q_{gaged}$$

Where:
DAR = Drainage Area Ratio
Q_{gaged} = Discharge at gaged watershed/site
$Q_{ungaged}$ = Discharge at ungaged watershed/site

This results in discharge estimates for the impaired reach that are based on 1) the size and land use of the impaired watershed and 2) the measured discharge at upstream stream gages.

The two USGS gages are located upstream of the confluence of the Black River and Mill Creek. The impaired reach is located further downstream of this confluence. The modified DAR method was applied to each gage to determine the discharge of Mill Creek and the Black River at the point of confluence. Those discharges were summed to determine the total discharge of the Black River immediately downstream of the confluence and the modified DAR method was applied again to the summed discharge to determine the discharge of the Black River at the downstream end of the impaired reach. Finally, the modified DAR method was applied to the total Black River discharge to determine the discharge associated with the impaired watershed.

Runoff coefficient values for each drainage area were estimated based on land use. Michigan CGI land use data for 1992, in Geographic Information System format, was used to quantify the area of various land uses within the drainage areas. Typical runoff coefficients for each land use category were determined based on recommendations from the Michigan Department of Transportation's Stormwater Drainage Manual (MDOT 2006), as well as Lindeburg's Civil Engineering Reference Manual (Lindeburg 2006). The land use areas and runoff coefficients used in the modified DAR method are presented in Table 1.

Table 1. Total Area and Runoff Coefficients by Land Use Category

Land Use	Mill Creek at Confluence		Black River at Confluence		Total Black River		Impaired Reach	
	Area (ac)	Runoff Coefficient	Area (ac)	Runoff Coefficient	Area (ac)	Runoff Coefficient	Area (ac)	Runoff Coefficient
Open Water	594	0.95	987	0.95	2,086	0.95	403	0.95
Commercial/Industrial /Transportation	77	0.75	543	0.75	1,782	0.75	925	0.75
Forest	18,893	0.15	29,043	0.15	56,549	0.15	6,862	0.15
Wetlands	7,424	0.9	19,378	0.9	29,014	0.9	1,762	0.9
High Intensity Residential	78	0.6	423	0.6	1722	0.6	973	0.6
Low Intensity Residential	513	0.45	1,826	0.45	5,389	0.45	2,430	0.45
Agriculture	91,459	0.25	260,177	0.25	358,181	0.25	5,215	0.25
Transitional	39	0.4	91	0.4	130	0.4	0	0.4

Land Use	Mill Creek at Confluence		Black River at Confluence		Total Black River		Impaired Reach	
	Area (ac)	Runoff Coefficient	Area (ac)	Runoff Coefficient	Area (ac)	Runoff Coefficient	Area (ac)	Runoff Coefficient
Urban/Recreational/ Grasses	79	0.25	166	0.25	569	0.25	258	0.25
Quarries/Strip Mines/Gravel Pits	0	0.7	104	0.7	176	0.7	57	0.7
Total Area	**119,156**		**312,738**		**455,598**		**18,885**	
Area-Weighted Runoff Coefficients		**0.280**		**0.284**		**0.288**		**0.359**

Table 2 contains the drainage areas and modified DARs used to estimate the discharge at ungaged locations. Figures B1 through B4 (Attachment B) show the discharge data for each USGS gaging station. The flow duration curve (Figure B5) displays the statistically determined discharge that is exceeded a specific percentage of time. For example, the 95% exceedence flow represents a discharge expected to be exceeded 95% of the time and, therefore, represents low flow conditions. A 5% exceedence flow would be expected to be exceeded only 5% of the time and, therefore, represents high flow conditions. The plotted discharge values and flow percentiles are tabulated in Table B1 of Attachment B.

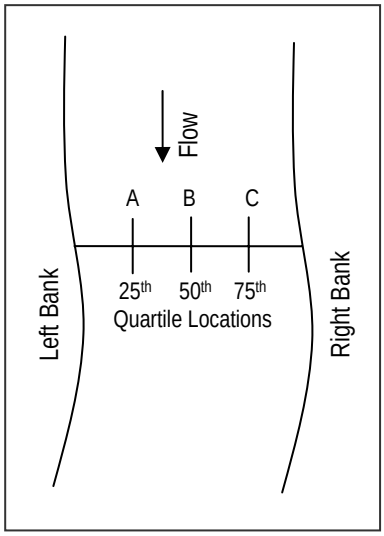
Table 2. Drainage Areas and Modified Drainage Area Ratios (DAR)

Location	Area (acres)	Area Weighted Runoff Coefficient	Modified DAR
At USGS Mill Creek near Avoca Station 04159900	107,901	0.280	
Mill Creek at Confluence with Black River	119,155	0.280	
Mill Creek at Confluence to Mill Creek USGS Ratio			1.10
At USGS Black River near Jeddo Station 04159492	295,912	0.284	
Black River at Confluence with Mill Creek	312,739	0.284	
Black River at Confluence to Black River USGS Ratio			1.06
Total Black River at Confluence (Black River + Mill Creek)	431,894	0.284	
Total Black River at mouth of St. Clair River	455,598	0.288	
Total Black River at mouth to (Black + Mill Creek at Confluence) Ratio			1.07
Impaired Reach of Black River only	18,886	0.359	
Impaired Reach to Total Black River at mouth Ratio			0.052

4.2 Monitoring Data

4.2.1 U.S. EPA Data Collection Effort

Five sites were monitored for *E. coli* on the Black River during 2009 as shown in Table 3 and Figure 5. All monitoring sites were sampled on a weekly basis during their respective monitoring period. At each site, a grab sample was collected at the 25th, 50th, and 75th quartile locations and identified as A, B and C, respectively (see sidebar).



Depiction of Quartile Locations

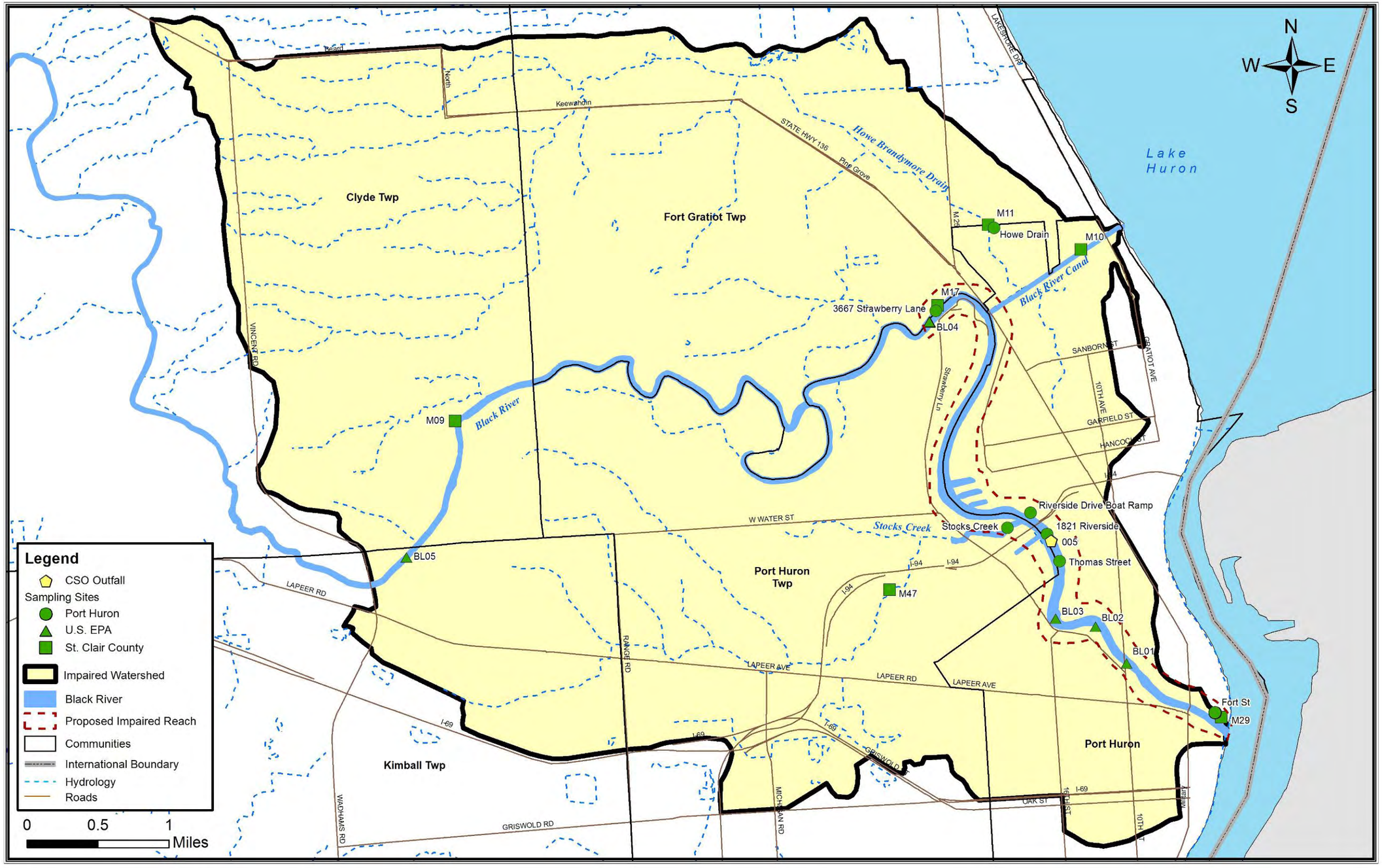
After several weeks of sampling, the analytical data was reviewed by the U.S. EPA and DNRE for the purpose of determining where to collect the samples for bacterial source tracking (BST) analysis. BST site selection criteria included previous elevated (>1,000 cfu/100 mL) *E. coli* concentrations, wet weather conditions and available funding. Because elevated *E. coli* concentrations on the Black River were infrequent during the U.S. EPA monitoring, BST analysis was not performed. For that reason, the BST analysis was made available for samples collected by the SCCHD and the City of Port Huron.

Table 3. Black River Transect Descriptions (listed upstream to downstream)

Site ID	Transect Description	Monitoring Period	
BL05	Downstream of Wadhams Road	07/07/09 – 08/25/09	8 weeks
BL04	Upstream of Strawberry Lane	05/05/09 – 08/25/09	17 weeks
BL03	at Runnels Street	05/05/09 – 08/25/09	17 weeks
BL02	at 13th Street	05/05/09 – 08/25/09	17 weeks
BL01	at 10th Street	05/05/09 – 08/25/09	17 weeks

On two occasions, both occurring after wet weather, samples were submitted by the County and/or the City for BST analysis. Eight samples from the Black River and its tributaries were collected for BST analysis. Only three samples had *E. coli* values above 1,000 cfu/100 mL and were analyzed for BST: two samples from the Howe-Brandymore Drain and one sample from Stocks Creek. Of the three samples, one from the Howe-Brandymore Drain had a positive result for the Human *Enterococcus* ID method, which indicates the presence of *E. coli* from a human source. This sample was taken on August 11, 2008, following approximately 1 inch of precipitation which fell over a 48 hour period. All project BST data and the associated *E. coli* and *Enterococcus* concentrations are reported in Appendix F of Attachment A. It should be noted that since comprehensive BST testing was not performed (multiple samples over a long period of time), a “negative” result at any given site does not mean that human contamination is not present at that site, only that it was not present in that particular sample.

Figure 5. Sampling Locations



Approximately 230 samples were collected and analyzed for *E. coli* from the Black River in 2009. The Black River daily and 30-day geometric means for each transect were compared to the Michigan WQSs for *E. coli*. Of the 76 daily geometric means calculated, the daily maximum WQS of 300 cfu/100 mLwas exceeded two times as displayed in Table 4. These exceedences occurred at Runnels Street (BL03) and upstream of Strawberry Lane (BL04). Both exceedences were associated with rain events. The exceedence at BL03 (301 cfu/100 mL) occurred on August 11, 2009, after over 1 inch of precipitation fell in the 48 hours prior to sample collection. The exceedence at BL04 (2,693 cfu/100 mL) occurred on July 21, 2009, after 0.3" of rain in the 48 hours prior to sample collection.

The Black River 30-day geometric means met Michigan's monthly WQS. All of the raw *E. coli* data and the corresponding daily and monthly geometric means are included in Appendix D of Attachment A.

Table 4. Black River Water Quality Exceedences

Transect	Daily Geometric Mean			30-Day Geometric Means		
	No. of Values	Exceedences (>300 cfu/100 mL)		No. of Values	Exceedences (>130 cfu/100 mL)	
		Number	%		Number	%
BL05 – Downstream of Wadhams Road	8	0	0%	4	0	0%
BL04 – Upstream of Strawberry Lane	17	1	6%	12	0	0%
BL03 – at Runnels Street	17	1	6%	12	0	0%
BL02 – at 13th Street	17	0	0%	12	0	0%
BL01 – at 10th Street	17	0	0%	12	0	0%
Totals	**76**	**2**	**2.6%**	**52**	**0**	**0%**

The Black River daily geometric means were grouped into three categories: those less than or equal to the *E. coli* detection limit of 10 cfu/100 mL, those between 11 cfu/100 mL and the daily maximum WQS of 300 cfu/100 mL and those greater than 300 cfu/100 mL. The average daily geometric means were also calculated. As shown in Table 5, the vast majority of the samples at each site had *E. coli* concentrations between 11 cfu/100 mL and 300 cfu/100 mL. Arithmetic mean values indicate the highest *E. coli* concentration was found just upstream of Strawberry Lane (BL04) which is the upstream limit of the impaired reach.

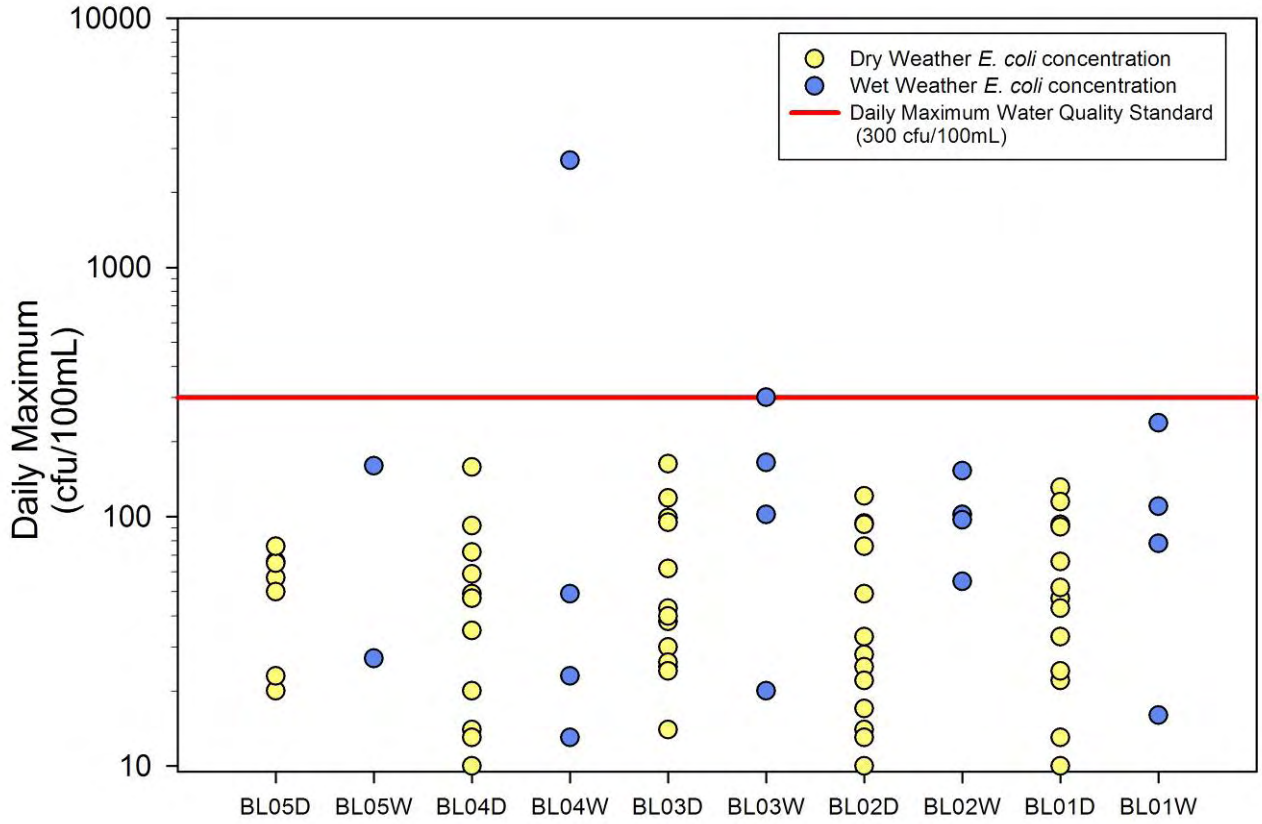
The daily geometric mean values were further evaluated based on weather conditions. Four wet weather events occurred during the 17 weeks of sampling on the Black River. The results during wet weather were slightly higher than results from data collected during dry conditions. These data are displayed in Figure 6.

Table 5. Black River Geometric Mean Statistics (sites listed upstream to downstream)

Sampling Sites	Daily Geometric Means (cfu/100 mL)				
	Number of Values	≤10*	11 - 300	> 300	Average
BL05 – Downstream of Wadhams Road	8	0	8	0	62
BL04 – Upstream of Strawberry Lane	17	2	14	1	198
BL03 – at Runnels Street	17	0	16	1	80
BL02 – at 13th Street	17	1	16	0	59
BL01 – at 10th Street	17	1	16	0	69

*10 cfu/100mL is the lower detection limit

Figure 6. Black River Geometric Mean Results by Weather Condition



4.2.2 County and City Data Collection Effort

In addition to data collected by the U.S.EPA and DNRE, *E. coli* data were also available from the SCCHD and the City of Port Huron and were collected prior to and during the project period. Those data were considered when determining the impaired status of the Black River and when determining possible *E. coli* sources.

St. Clair County Health Department

The SCCHD has monitored *E. coli* in the Black River watershed between May and September since 2005. In most cases, only one sample was collected from the shoreline at each site rather than a transect of three samples[1]. Samples were analyzed at the lab located within the SCCHD. The number of samples collected at each site, the monitoring period and the number of samples exceeding 300 cfu/100 mL are shown in Table 6.

Elevated *E. coli* concentrations (above 300 cfu/100 mL) were routinely found in the Howe-Brandymore Drain and in Stocks Creek, which were both sampled twice monthly. Elevated counts were also occasionally found at Fort Gratiot Township Park and at the outlet of the Black

[1] Many journal articles have documented that *E. coli* survives in river sediments after the source to the water column is removed (LaLiberte 1982, Whitman 2003). The sediment bound *E. coli* can be resuspended by wave action or during high river flows. This resuspended sediment cannot be avoided when sampling river systems during and following wet weather events; however in dry weather conditions, it can be avoided by sampling outside of the swash zone at beaches and away from river banks. It is possible that some of the elevated *E. coli* counts seen in SCCHD's and Port Huron's shoreline samples in 2008 and 2009 were the result of sample entrainment of suspended *E. coli* contaminated sediment.

River (both locations sampled weekly). A map of the monitoring locations and the complete data set can be found in Appendix A of Attachment A.

Table 6. St. Clair County Health Department *E. coli* Data Summary 2004 – 2009

Monitoring Site (SCCHD ID)	Number of Samples			Monitoring Period
	Total	300 - 999 cfu/100 mL	≥ 1,000 cfu/100 mL	
Black River (listed upstream to downstream)				
At Old North River Road (M09)	19	1 (5%)	0	2005 - 2009
At Fort Gratiot Township Park (M17)	68	4 (6%)	1 (1%)	2005 - 2009
At the outlet (M29)	55	8 (15%)	2 (4%)	2004 - 2008
Black River Tributaries				
Howe Brandymore Drain at Krafft Road (M11)	20	7 (35%)	8 (40%)	2005 - 2009
Stocks Creek behind Chippewa School (M47)	7	5 (71%)	2 (29%)	2009
Black River canal (M10)	52	2 (4%)	0	2005 - 2008

City of Port Huron

Since 2000, the City of Port Huron has monitored *E. coli* concentrations in the Black River between Memorial Day and Labor Day. At each location, the City collected a single grab sample from along the shoreline[2]. Samples were collected daily, Monday through Thursday, and analyzed at the Port Huron Water Reclamation Facility. A map of the monitoring locations can be found in Appendix A of Attachment A. Note, the City's combined sewer outfall 005 is located between the 1821 Riverside Street site (City 03) and Thomas Street site (City 02) as shown in Figure 5.

Considering the 2008 and 2009 data only, elevated *E. coli* concentrations (above 300 cfu/100 mL) were found frequently at most of the Black River and tributary locations monitored by the City (see Table 7). The elevated concentrations were often associated with rain events. Likewise, the elevated concentrations at the sites downstream of outfall 005 were often associated with discharges from outfall 005. The complete listing of the City's 2008 and 2009 data, along with rainfall and combined sewer discharge data, can be found in Appendix B of Attachment A. Rainfall and the City's combined sewer discharge data for 2008 and 2009 is included as Attachment C.

Table 7. City of Port Huron *E. coli* Data Summary 2008 – 2009

Monitoring Site (ID)	Number of Samples			Monitoring Period
	Total	300 - 999 cfu/100 mL	≥ 1,000 cfu/100 mL	
Black River (listed upstream to downstream)				
3667 Strawberry Lane (City 04)	114	5 (4%)	5 (4%)	2008 - 2009
Riverside Drive Boat Ramp (City 05)	55	6 (11%)	2 (4%)	2008
1821 Riverside St. (City 03)	59	7 (12%)	3 (5%)	2009
Thomas St. (City 02)	55	7 (13%)	8 (15%)	2009
Fort St. Mooring Facility (City 01)	114	6 (5%)	6 (5%)	2008 - 2009
Black River Tributaries				
Stocks Creek	55	14 (25%)	8 (15%)	2008

[2] Ibid

Monitoring Site (ID)	Number of Samples			Monitoring Period
	Total	300 - 999 cfu/100 mL	≥ 1,000 cfu/100 mL	
Howe Brandymore Drain	55	18 (33%)	16 (29%)	2008

The WQS exceedences found during the U.S. EPA's 2009 monitoring effort and supplemental data provided by the County and City support DNRE's assessment decision that the Black River is impaired for total and partial body contact recreation.

5.0 SOURCE ASSESSMENT

During completion of the monitoring effort described previously, informational meetings were conducted with representatives from the City of Port Huron and the SCCHD. Through these meetings, windshield surveys of the project area and illicit discharge identification in St. Clair County, a number of sources of *E. coli* are suspected to be impacting the impaired reach. These sources include human sewage emanating from illicit connections from the sanitary sewers to the storm sewers, sanitary sewer overflows (SSOs), untreated CSOs, failed on-site sewage disposal systems (OSDSs) and animal feces from domestic pets or wildlife. Descriptions of these potential sources are the subject of this section. Source control measures will be discussed in Section 10.0, while recommended corrective actions are discussed in Section 11.0.

5.1 Combined Sewer Overflows

Although much of St. Clair County is served by individual OSDSs, the impaired watershed is partially served by sanitary sewers operated by the City of Port Huron and the surrounding communities. A portion of this sewer system is served by combined sewers with the remainder of the City served by separate sanitary sewers. Discharge from the City's combined sewer outfalls is comprised of diluted raw sewage and occurs during rain events as small as 0.13 inch. There are five remaining uncontrolled combined sewer outfalls within the City's sewer system, one of which, outfall 005, discharges to the Black River (see Attachment C). There were 20 and 2 reported overflows to the Black River in 2008 and 2009 totaling 17.9 and 10.2 million gallons, respectively (DNRE 2009a). The breakdown of the estimated overflow volumes by date is included in Attachment C.

5.2 Sanitary Sewer Overflows

Port Huron Township reported an SSO in April 2008 which caused raw sewage to discharge to the Black River. This discharge was estimated at 1,000 gallons and was the result of a failure of the township's sanitary sewer system. The sewer was repaired quickly and further discharges from this location are not likely (DNRE 2009d).

5.3 Illicit Connections

The City of Port Huron has identified and eliminated illicit connections since 1984. An example of this effort is the 19 improper sanitary connections removed from County Drain No. 209 and the Gratiot Avenue storm sewer (Fred Kemp, personal communication, 9/27/2010). The City has also inspected individual properties to identify sources of storm water inflow to the combined sewer system and to ensure the absence of illicit connections to the storm sewer system. In addition, the City conducted a formal survey of their storm water outfalls and screened for the presence of illicit discharges in 2003 and 2004 based on information obtained from their annual storm water permit progress reports. Elevated levels of *E. coli* (> 1,000 cfu/100 mL) were found in several storm sewers and follow-up investigations revealed numerous illicit connections (Port Huron 2005). According to information obtained from the City's 2005, 2006, 2007 and 2008 annual storm water permit progress reports, 31 illicit connections were identified and corrected (Port Huron 2005, Port Huron 2006, Spicer 2007, Spicer 2008). All but one of these connections carried sanitary sewage to the storm water system. The other illicit connection emanated from a facility's floor drains.

Despite the City's illicit discharge elimination efforts to date, the elevated *E. coli* counts detected in their 2008 and 2009 samples may be attributed to unidentified illicit connections. If present, these connections will likely be found and corrected as the communities and county continue their illicit discharge elimination programs (IDEPs).

5.4 Failing Onsite Sewage Disposal Systems

The SCCHD completed an illicit discharge survey in 2007 and identified over 600 failed OSDS's across the County (ECT 2004, ECT 2007). Sixty-three of those systems were in the Lower Black River Watershed with approximately one-third of them in the impaired watershed. Most of these systems have been repaired or replaced, except a few upstream of the impaired watershed (Attachment D). Depending on the nature of the failures, these systems may have been discharging undertreated sewage to surface waters during dry weather conditions and the degree and extent of the OSDS failures may be exacerbated during wet weather conditions. The human *E. coli* identified in the Howe-Brandymore Drain during the 2009 U.S. EPA monitoring effort, as described in Section 4.2.1, was likely attributed to these failed OSDSs and impacted the impaired reach.

5.5 Animal Waste

Fecal matter from waterfowl can be a source of *E. coli* in water bodies. Staff from the City of Port Huron reported that they have to "watch where they step" during sample collection to avoid the Canada geese feces at the Riverside Boat Ramp monitoring site. A subsequent visit by the sampling staff confirmed the presence of a large flock of geese at the boat ramp and at the Stocks Creek outlet, as well. Although the presence of waterfowl is difficult to control, especially in a waterfront community, communities with National Pollutant Discharge Elimination System (NPDES) permits for storm water are required to educate residents and visitors not to feed the birds to prevent avian sources of *E. coli* from contaminating waterways.

Pet waste can also be another source of *E. coli* to surface waters if not properly collected and disposed of by pet owners. Pet waste can enter the storm water system via runoff. In other areas in southeast Michigan, dog waste has been observed in catch basins and used cat litter dumped on the side of an open drain. Although a pet waste survey has not been conducted in the project area, pet waste is still considered a potential *E. coli* source to a water body located in an urbanized watershed.

5.6 Load Duration Curves

Load duration curves (LDCs) were developed for the Black River to assist with the source assessment process. LDCs help assess under what stream flow conditions, ranging from low dry weather flows to peak wet weather flows, a target value is most frequently exceeded (and by how much), giving investigators insight into the possible sources of contaminants (U.S. EPA 2007).

LDCs were developed using discharge data for the entire Black River and *E. coli* data collected during the period from 2004 through 2009. As previously described in Tables 3, 6 and 7, *E. coli* data from the U.S. EPA was collected in 2009, *E. coli* data from the County was collected between 2004 and 2009, and *E. coli* data from the City was collected in 2008 and 2009. For the purpose of developing the LDCs, the U.S. EPA, County and City sampling sites were divided into four groups based on their proximity to one another (see Table 8). The site IDs noted in Table 8 correspond to those noted on the LDCs, which are included in Attachment E.

Table 8. Black River Sampling Sites for Load Duration Curve Evaluation

Site ID	Monitoring Site Location	Sampling Entity
Segment 1		
City 01	Fort St. Mooring Facility	Port Huron
M29	At the outlet	SCCHD
Segment 2		
City 02	At Thomas St.	Port Huron
City 03	At 1821 Riverside St.	Port Huron
City 05	Riverside Boat Ramp	Port Huron
BL01	At 10th Street	U.S. EPA
BL02	At 13th Street	U.S. EPA
BL03	At Runnels Street	U.S. EPA
Segment 3		
City 04	At 3667 Strawberry Lane	Port Huron
M17	At Fort Gratiot Township Park	SCCHD
BL04	Upstream of Strawberry Lane	U.S. EPA
Segment 4		
M09	At Old North River Road	SCCHD
BL05	Downstream of Wadhams Road	U.S. EPA

The target value used for the LDCs is the daily maximum WQS, 300 cfu/100 mL, for total body contact recreation. *E. coli* loads were calculated using the estimated flow data for the impaired reach as presented in Attachment B according to the following equation:

The daily load of *E. coli* ($\frac{cfu}{day}$) = Criteria x Flow x Y;

Where:

Criteria = WQS (300 cfu/100 mL) or the *E. coli* density for each sampling event[3]

Flow = River discharge ($\frac{ft^3}{\text{sec}}$)

Y= conversion factor ($\frac{28{,}317mL}{ft^3} \times \frac{86{,}400\,\text{sec}}{day}$)

The LDCs were evaluated for the number and magnitude of exceedences of the target value under all flow conditions (wet to dry). The data points above the curve indicate exceedences of the target value. Points above the curve toward the left side of the graph indicate target value exceedences during wet weather conditions (higher flows). Points above the curves toward the middle and right side of the figures indicate target value exceedences during midflow to dry weather conditions (lower flows).

The data trends in Table 9 show that many of the target value exceedences occur during wet weather and mid-range flows, with wet weather exceedences being more prevalent. The water

[3] It should be noted that the data points for the U.S. EPA sampled sites (BL01 through BL05) are based on a daily geometric mean. The other data points (Port Huron and St. Clair County sampled sites) are based on an individual *E. coli* sample result.

quality exceedences during dry weather and low flow conditions were notably fewer, with site City 02 (Thomas St.) being an exception.

Table 9. Load Duration Curve Evaluation (Target = 300 cfu/100 mL)

Sampling Site	Wet Weather: High Flow & Moist Conditions		Mid-Range Flow		Dry Weather: Dry & Low Flow Conditions		Flow Condition Associated With Exceedences
	Percent Greater Than Target	Percent Less Than or Equal to Target	Percent Greater Than Target	Percent Less Than or Equal to Target	Percent Greater Than Target	Percent Less Than or Equal to Target	
Segment 1							
City 01	19	81	3	97	8	92	All
M29	22	78	17	83	7	93	All
Segment 2							
City 02	46	54	22	78	38	62	All
City 03	25	75	0	100	23	77	Wet & Dry
City 05	24	76	21	79	4	96	All
BL01	0	100	0	100	0	100	None
BL02	0	100	0	100	0	100	None
BL03	13	87	0	100	0	100	Wet
Segment 3							
City 04	17	83	6	94	3	97	All
M17	10	90	16	84	0	100	Wet & Mid-Range
BL04	0	100	14	86	0	100	Mid-Range
Segment 4							
M09	20	80	0	100	0	100	Wet
BL05	0	100	0	100	0	100	None

Since flow data was not readily available, the Stocks Creek and Howe-Brandymore sites were not included in the LDC analysis. For these water bodies, *E. coli* data was assessed against the 48-hour rainfall volumes to determine the weather conditions in which exceedences occurred. This revealed that there were a high number of target value exceedences at these sites during dry and various wet weather conditions (see Table 10).

Table 10. Stocks Creek and Howe-Brandymore Drain *E. coli* Exceedence Distribution by Rainfall Volume

	Number of Samples > 300 cfu/100mL				
48-hr Rainfall Volume (inches):	Total	0	0.01 – 0.24	0.25 – 0.99	≥ 1.0
Howe-Brandymore Drain					
SCCHD site (M11)	6	3 (50%)	2 (33%)	1 (17%)	0
City site	34	8 (24%)	9 (26%)	14 (41%)	3 (9%)
Stocks Creek					
SCCHD site (M47)	7	4 (57%)	2 (29%)	1 (14%)	0
City site	22	4 (18%)	6 (27%)	9 (41%)	3 (14%)

6.0 LOADING CAPACITY DEVELOPMENT

The loading capacity (LC) represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The LC is defined as:

LC ($\frac{cfu}{day}$) = Criteria x Flow x Y;

Where:

Criteria = WQS for *E. coli* (300 cfu/100 mL)

Flow = River discharge ($\frac{ft^3}{\text{sec}}$) at the median flow in each flow exceedence interval

Y= conversion factor ($\frac{28{,}317 mL}{ft^3} \times \frac{86{,}400 \,\text{sec}}{day}$)

The LC was calculated for the impaired reach based on the above formula using flow data from the USGS gages located on the Black River near Jeddo and on Mill Creek near Avoca and watershed scaling using the modified DAR method as described in Section 4.1. The LC was limited to the portion of the Black River flow attributed to the impaired watershed. In other words, flow on the main stem of the Black River upstream of Wadhams Road was not accounted for in this TMDL. The resulting LC is depicted on a LDC (see Attachment F).

Discharge from the Black River Canal and back water effects from the St. Clair River were not included in the LC calculations since they could not be quantified based on available data. If the canal discharge could have been enumerated, the LC and subsequent WLAs would have been higher by some unknown amount. If back water effects could have been considered, then the LC and subsequent WLAs would have been lower by some unknown amount.

Concurrent with the selection of numerical limits, development of the LC requires identification of the critical conditions. The critical conditions are the set of environmental conditions (e.g., flow) used in developing the TMDL that have an acceptably low frequency of occurrence. The total daily allocations must be less than the LC during the occurrence of the critical conditions.

The critical conditions for the applicability of the WQS in Michigan are given in Rule 323.1090 (Applicability of WQS). Rule 323.1090 requires that the WQS apply at all flows equal to or exceeding the water body design flow. In general, the lowest monthly 95% exceedence flow is used as the design condition for developing pollutant loadings. As described further in Section 7.0, this TMDL provides allowable *E. coli* loadings under a variety of flow conditions including the 95% exceedence flow.

7.0 ALLOCATIONS

The LC is allocated into WLA for point sources, load allocations (LAs) for nonpoint sources and natural background levels and the margin of safety (MOS). The LC must include a MOS, either implicitly within the WLA or LA, or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, the definition of LC is denoted by the equation:

$$LC = \sum WLAs + \sum LAs + MOS$$

LCs are presented under a variety of flow conditions, each of which assures attainment of the target. Five flows (i.e., 5%, 25%, 50%, 75%, and 95%) were selected to develop LCs based upon the approach developed by Cleland (Cleland 2006). Flows along a gradient of 0% to 100% were partitioned into flow zones (e.g., high, moist, midrange, dry, and low, respectively) and the 5 exceedence flows represent the midpoint of their respective flow conditions (i.e., 5% is the midpoint of the high flow zone).

The MOS, WLAs and LAs for the Black River are presented in Table 11. A summary of the rationale behind each allocation is provided in Table 12 and a detailed description follows.

7.1 Margin of Safety

The MOS is the portion of the LC which accounts for the uncertainty associated with the relationship between the pollutant load and receiving water quality. In any TMDL, uncertainty may be associated with the estimation of pollutant loads, estimation of flows, the fate and transport of the pollutant once it enters the receiving water body and/or the effectiveness of control measures. The MOS can be expressed implicitly and/or explicitly.

In this TMDL, the MOS is expressed implicitly based on the conservative assumptions made in developing the TMDL. Of these assumptions, the most significant one is that flow from the Black River canal to the impaired reach was not accounted for in the development of the LC. As previously stated in Section 4.1, this unaccounted flow can be 30 to 85% of the Black River flow. Consequently, the LC is conservative and results in an implicit MOS.

Table 11. Loading Capacity and Load Allocations for the Black River

	NPDES Permit #	High	Moist	Mid	Low	Dry
Flow Exceedence Interval		5%	25%	50%	75%	95%
Median Flow (cfs)		100	20	7	3	1
		Daily Load of *E. coli* (cfu/day)				
Loading Capacity (LC)		7.36E+11	1.45E+11	4.95E+10	1.92E+10	8.43E+09††
Waste Load Allocations (WLA)						
WLA 1: General Industrial Storm Water Permits	MI0002160* MIS410136 MIS410439 MIS410555 MIS410564 MIS410689	3.83E+10	7.53E+09	2.57E+09	9.99E+08	0
WLA 2: General MS4 Permits and MDOT Individual Permit	MIG610268 MIG610274 MIG610252 MIG610055 MIG610266 MIG610265 MI0057364	6.98E+11	1.37E+11	4.69E+10	1.82E+10	0
WLA 3: Permits not authorized to discharge *E. coli*	MI0002160**	0	0	0	0	0
WLA 4: Wastewater Stabilization Lagoon Permits* **	MIG580398 MIG580270	1.44E+05	1.44E+05	1.44E+05	0	0
WLA 5: Individual Permit Authorized to discharge *E. coli*	MI0023833†	7.18E+05	7.18E+05	0	0	0
Load Allocations (LA) (nonpoint sources)		0	0	0	0	0

* Includes the storm water portion of this permit.
** Includes non-storm water portion of this permit.
*** Authorized to discharge only during certain periods of the year.
† Includes discharge from CSO outfall 005 only.
†† This LC is unallocated since all of the WLAs are associated with storm water.

Table 12. Allocation Rationale

Allocation	Rationale
Waste Load Allocations (WLA)	
WLA.1: General industrial storm water permits	Load based on an area-weighted percentage of the LC (See Section 7.2.1)
WLA 2: General municipal storm water permits (MS4) including MDOT individual permit	Load based on an area-weighted percentage of the LC (See Section 7.2.3)
WLA 3: Individual or general permits not authorizing storm water or sanitary wastewater	Zero allocation – these permits are not considered a source of *E. coli*
WLA 4: Wastewater stabilization lagoon permits	Load based on maximum historic discharge rate (See Section 7.2.2)
WLA 5: Port Huron CSO Outfall 005	Load based on 0.1% of 2008 discharge volume (17.90 million gallons per year)
Load Allocations (LA) (nonpoint sources)	No allocation – the entire watershed falls within the jurisdiction of municipal or industrial NPDES permits

7.2 Waste Load Allocations

WLA are assigned to each potential point source discharger of *E. coli* within the impaired watershed. The WLA is calculated using the WQS of 300 cfu/100 mL and a flow rate. For wastewater permits, the maximum actual or design flow rate for each permitted facility is typically utilized in the pollutant load calculation. For storm water permits, the estimated drainage area associated with the permit is typically utilized. WLAs can be facility specific (individual) or several permits can be grouped together and assigned an aggregate WLA. Aggregate WLAs are typically used for storm water dischargers. Both individual and aggregate WLAs are used in this TMDL.

Potential point source dischargers of *E. coli* are those facilities with NPDES permits as shown in Figure 7 and listed in Tables 11 and 13. WLAs were assigned to all individual or general NPDES permits as described in the sections below.

7.2.1 Individual NPDES Permits

There are three individual permits in the impaired watershed. The first individual permit (MI0057364) is for storm water discharge and held by the Michigan Department of Transportation (MDOT) for state-wide coverage of their municipal separate storm sewer system (MS4). Since U.S. EPA policy allows for aggregate storm water WLAs (U.S. EPA 2002), this permit was included in the aggregate WLAs for the general municipal storm water permits (see line WLA 2 on Table 11).

The second individual permit (MI0002160[4]) is for non-contact cooling water for E B Eddy Paper, Inc. Due to the nature of this discharge, it is not considered a source of *E. coli.* Therefore, a WLA of zero was assigned (see line WLA 3 on Table 11).

The remaining individual permit is for the Port Huron WWTP (MI0023833), which has a discharge to the Black River through CSO outfall 005 during wet weather conditions. Over the last several years, Port Huron made improvements to their sanitary sewer system; however,

[4] This permit also includes storm water discharges which drain to the Black River. Section 7.2.3 further discusses industrial storm water discharges.

there is still a small sanitary service area that still may discharge through outfall 005 during wet weather conditions. The volume of this discharge is so small that the City's current model estimates that it is zero. In the absence of a modeled value, DNRE staff who are familiar with the facility estimated that the flow would be less than 0.1% of the 2008 total annual discharge from outfall 005. To be conservative, 0.1% of the 2008 total annual discharge from outfall 005 (17,900 gallons/year) was used with the WQS to determine the WLA for this facility. This allocation was assigned to the high and moist flow zones, which is the only time this CSO is expected to discharge (see line WLA 5 on Table 11).

7.2.2 Wastewater Stabilization Lagoon Permits

There are two permitted wastewater stabilization lagoon permits within the impaired watershed, one at the Port Huron Fort Gratiot Middle School (MIG580398) and one at the Port Huron Indian Woods School (MIG580270). Based on DNRE discharge monitoring reports, these lagoons meet the full body *E. coli* standard of 300 cfu/100 mL.

The lagoon WLAs were based on the maximum recorded daily discharge rate for each facility for 2008 and 2009 and the *E. coli* standard of 300 cfu/100 mL. These lagoons are only permitted to discharge into the Black River during October, November, December, March, April and May, which is when flows are highest. Therefore, the lagoons only received WLAs for the three highest flow conditions (see line WLA 4 of Table 11).

7.2.3 Municipal and Industrial Storm Water Permits

Runoff within the impaired watershed drains either to a county, state, community or private storm sewer system or directly to waters of the state. MS4 drainage areas are not well defined within the impaired watershed; therefore, DNRE reviewed land use information and maps of MS4 discharge points to determine the extent of the area covered by MS4 and industrial storm water permits. Following this review, DNRE concluded that 17,904 acres (or 94.8% of the total) drained to the MS4 areas, while 982 acres (or 5.2% of the total) was associated with the industrial permits. This conclusion is based on the assumption that the industrial land use acreage[5] is equivalent to the area cover by the industrial permits.

Seven MS4 permits held by the City of Port Huron, MDOT, St. Clair County, and Fort Gratiot, Kimball, Port Huron and Clyde townships cover the 17,904 acres draining to MS4 areas. The drainage from the remaining 982 acres is covered by six general industrial storm water permits and one individual industrial permit as shown in Table 13.

The storm water WLAs were calculated by first subtracting the wastewater WLAs (WLA4 and WLA5) from the LC to determine the available remaining capacity. The available remaining capacity was then proportioned by land area to determine the WLAs associated with the industrial facilities and the MS4 areas. The dry flow zone was not assigned WLAs, since runoff is not expected during dry conditions. The resulting industrial and MS4 WLAs are shown in Table 11 on lines WLA 1 and WLA 2, respectively.

[5] Including commercial/industrial/transportation, quarries, strip mines and gravel pits.

Figure 7. NPDES Permit Locations without MS4 Permits (note the depicted locations are not necessarily the outfall locations)

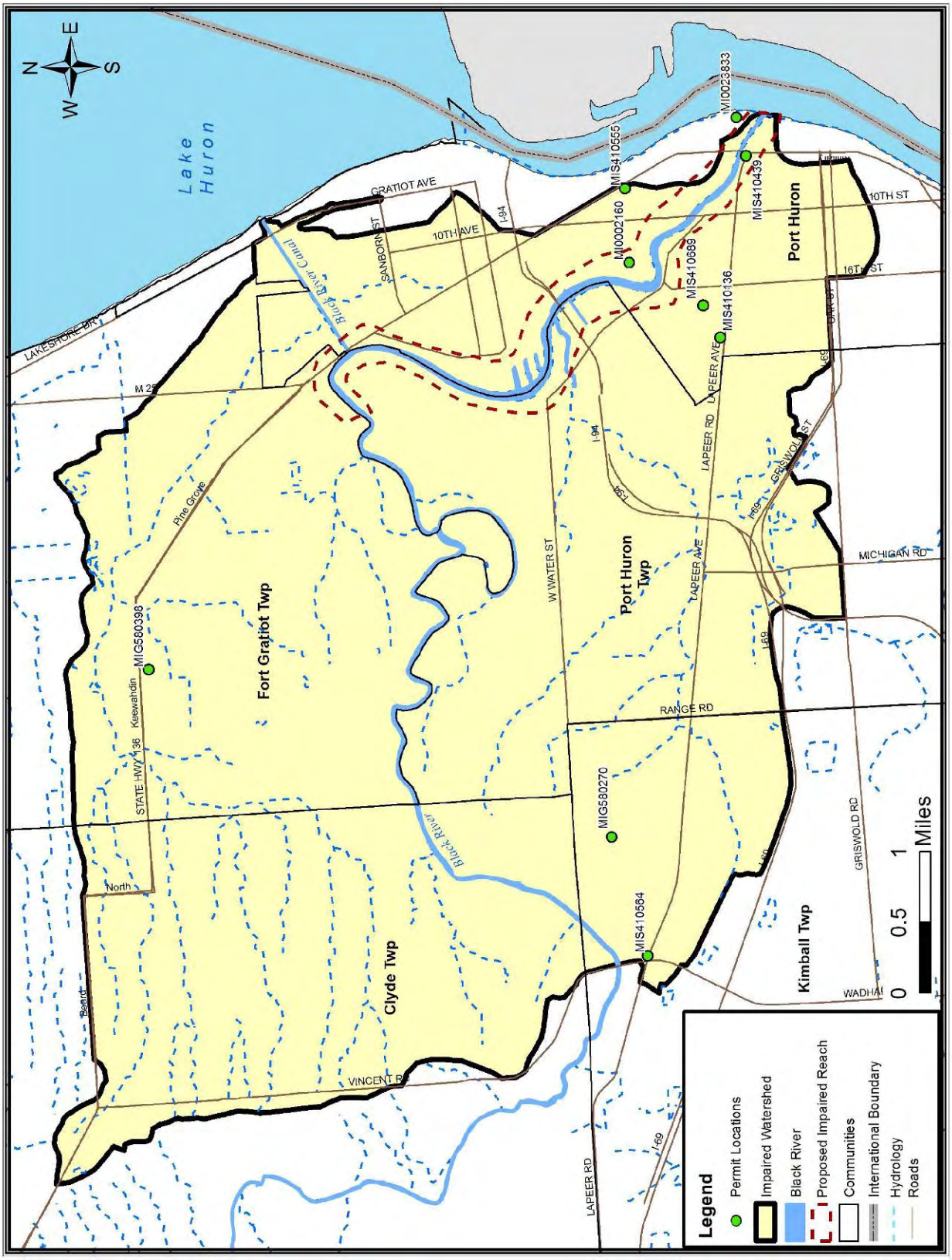


Table 13. NPDES Permits within the Impaired Watershed

Permit/ Certificate of Coverage Number	Facility Name
Individual Permit for Discharge of Sanitary Wastewater	
MI0023833	Port Huron WWTP**
General Permit MIG580000 - Wastewater Stabilization Lagoon Permits	
MIG580270	Port Huron Area Sch-Ind Wds
MIG580398	Port Huron Area SD-Ft Gratiot
General Permit MIG619000 - Municipal Separate Storm Sewer System (Watershed-Based)	
MIG610268	Kimball Twp MS4-St Clair
MIG610274	Port Huron MS4-St Clair
MIG610252	Port Huron Twp MS4-St Clair
MIG610055	St Clair County MS4***
MIG610266	Clyde Twp MS4-St Clair
MIG610265	Fort Gratiot Twp MS4-St Clair
Individual Permit for Discharge of Storm Water from a MS4	
MI0057364	MDOT State-wide MS4
General Permit MIS410000 - Storm Water from Industrial Activities (4-Yr Cycle Watersheds)	
MIS410136	Mueller Brass Co-Pt Huron
MIS410439	Desmond Marine LLC
MIS410555	Henkel Corp
MIS410564	Black River Concrete
MIS410689	Blue Water Area Transit
Individual Permit for Noncontact cooling water and sand filter back wash	
MI0002160	E B Eddy Paper Inc.*

*One of E B Eddy Paper's outfalls discharge to the Black River. This permit also includes storm water discharges.
**For CSO outfall 005 only.
***The St. Clair County Drain Commissioner's Office, St. Clair County Road Commission, Port Huron Area Schools and St. Clair County Community College are covered by this permit.

7.3 Load Allocation

A LA is assigned to non-regulated sources of E. coli. Non-regulated sources are those that are not covered under a NPDES permit. Given the rural nature of a portion of the impaired watershed, the DNRE expected that this TMDL would have a LA. However after an examination of maps showing permitted storm water outfalls, the DNRE determined that most of the rural and urbanized areas in the impaired watershed drain to the county's MS4 and City's MS4, respectively, and that the remaining areas are industrial land use subject to industrial storm water permits. Therefore, no LA was assigned in this TMDL.

8.0 SEASONALITY

Seasonality is addressed by expressing the TMDL in terms of both a total body contact recreation season that is defined as May 1 through October 31 by R 323.1100(2) and a partial body contact standard that applies year round as defined by R 323.1100(1) of the WQS. *E. coli* allocations developed to protect during the total body contact season are expected to assure attainment of the partial body contact standard. Seasonality is also addressed by using discharge data over a period of 34 years as described in Section 4.1. This allowed the LC and WLAs to represent a range of flow conditions.

9.0 MONITORING

The DNRE will conduct future monitoring in the Black River watershed as part of the 5-year rotating basin monitoring as resources allow, and when corrective actions have occurred to suggest that WQS may be met. When these results indicate that the water body may be meeting WQS, sampling will be conducted at the appropriate frequency (as defined in the Numeric Target section) to determine if the targets are being met. It is also expected that the City of Port Huron will continue their monitoring efforts as part of their NPDES permit and the SCCHD will continue monitoring as their programs are funded.

10.0 REASONABLE ASSURANCE ACTIVITIES

The permittees listed in Table 13 are responsible for meeting their NPDES permit limits and as such will be required to comply with any existing or future *E. coli* TMDL-related requirements. The MDOT MS4 permit requires the permittee to reduce the discharge of pollutants to the maximum extent practicable and employ Best Management Practices to comply with TMDL requirements. In addition, the general permits for noncontact cooling water require that Michigan's WQS are not violated as a result of the discharge. The DNRE may also require wastewater permittees to provide additional sampling or monitoring as deemed necessary to assure adequate operation of the treatment system. The following section describes the programs currently in place to address *E. coli* reductions.

10.1 Industrial Storm Water

Federal regulations require certain industries to apply for an NPDES permit if storm water associated with industrial activity at the facility discharges into a separate storm sewer system or directly to surface water. A storm water permit is not required if storm water does not discharge from the facility to a surface water of the state or is discharged into a sewer system that leads to a WWTP. The general industrial storm water permits identified in Table 13 (i.e. MIS410000) require that if there is a TMDL established by the DNRE for the receiving water that restricts a material that could impair or degrade water quality, then the required storm water pollution prevention plan (SWPPP) shall identify the level of control for those materials necessary to comply with the TMDL. Permittees are also required to estimate the current annual load of those materials via storm water discharges to the receiving stream. The SWPPP is required to be developed and implemented prior to DNRE issuing a certificate of coverage (COC).

Michigan's storm water permit authorization requires facilities to obtain a certified operator who will have supervision over the control structures at the facility, eliminate any unauthorized non-storm water discharges, and develop and implement a SWPPP for their facility that includes structural and nonstructural control measures. Prior to obtaining permit coverage, applicants must certify that they do not have any unauthorized discharges.

DNRE staff conducts inspections of a percentage of permitted industrial facilities annually to ensure that facilities comply with their permits. These inspections result in a reduction in unauthorized discharges and illicit connections. As additional facilities obtain industrial storm water permits, more illicit discharges will be eliminated.

10.2 CSO Control

The City of Port Huron is implementing their Long-term CSO Control Program under the DNRE Director's Final Order (issued 2/19/98) and 14 uncontrolled overflows (9 to the Black River) have already been eliminated through a sewer separation process. Recently, the area tributary to outfall 005 was separated in late 2008 with the exception of the Blue Water Bridge Plaza which is being separated in conjunction with the MDOT planned reconstruction of the Plaza. As such, discharges from this outfall have been nearly eliminated. Because this outfall continues to discharge a small volume of combined sewage, this outfall has yet to be certified as separated by the DNRE and is still designated an uncontrolled combined sewer outfall. All of Port Huron's CSOs are scheduled to be eliminated by December 31, 2016 (DNRE 2009b).

10.3 Municipal Storm Water

The U.S. EPA's Storm Water Phase II Rules require that all public entities operating MS4s within urbanized areas obtain municipal storm water permits, unless this requirement is waived

by the NPDES permitting authority. The State of Michigan's Phase II Watershed-Based Storm Water General Permit (MIG610000) and the Phase II Jurisdictional Storm Water General Permit (MIS040000) have been developed to meet the federal requirement for storm water permits.

Effective April 2008, both of the MS4 permits have additional requirements for outfalls draining to water bodies with approved *E. coli* TMDLs. These requirements include *E. coli* monitoring at major storm water outfalls, development of a plan to reduce *E. coli* in storm water and implementation of the plan.

All of the communities within the impaired watershed are Phase II MS4 communities and hold a COC under the watershed-based storm water permit (see Table 14). These communities and other stakeholders in the watershed have been working together for several years to manage the area's water resources on a watershed basis and to comply with federal regulations regarding the discharge of storm water. To this end, the communities, under the leadership of the SCCHD, formed the St. Clair County Northeastern Watershed Advisory Group (NEW). The NEW completed a Phase II watershed management plan (WMP) in 2006 as required under the permit. In the WMP, pathogens were identified as a priority pollutant requiring reduction (SCCHD 2006).

Table 14. Land Area Distribution by Community within the Impaired Watershed

Community	Area within the Watershed (square miles)	Percent of Total Watershed
Clyde Township	7.15	24%
Fort Gratiot Township	7.57	25%
Kimball Township	2.30	8%
Port Huron Township	7.93	27%
Port Huron, City	4.84	16%
Total	**29.79**	**100%**

10.3.1 Illicit Discharge Elimination

Under municipal storm water permits, permittees are required to develop and implement an IDEP to prohibit and effectively eliminate illicit discharges (including discharges of sanitary wastewater) to MS4s. Permittees throughout the impaired watershed have responded to this requirement by implementing various activities including:

- The inspection of known storm water outfalls and screening storm water discharges for signs of pollution;
- A survey of all open waterways within the county (streams, county drains and road ditches) for signs of pollution including evidence of failing septic systems;
- Dye testing of suspect facilities/residences to identify the source of an illicit discharge;
- Enacting a report-a-polluter hotline at the county-level and within the City of Port Huron to field pollution complaints; and
- Training municipal staff at the county and local level on how to detect illicit discharges.

The successes of the IDEPs are very apparent in St. Clair County. For example, in the impaired watershed, communities have eliminated an estimated 6.6 million gallons/year of untreated sewage from entering their storm sewer systems. This number is increased to 59 million gallons/year when considering the entire county (see Section 11.2).

10.3.2 Public Education & Involvement

Under the MS4 regulations, municipalities are required to develop a public education plan for the purpose of encouraging the public to reduce the discharge of pollutants in storm water to the maximum extent practicable. In response to the MS4 regulations, St. Clair County and the City of Port Huron maintain a 24-hour pollution complaint telephone line to encourage the public to report illegal dumping and water quality problems. Both agencies have also trained many of their field staff on how to identify illicit discharges in storm sewers. These suspected problems are then referred to the County's IDEP staff for investigation. These programs help reduce the number of water quality problems in the watershed.

10.4 Wastewater Stabilization Lagoons

Michigan regulates discharges containing treated or untreated human waste (i.e., sanitary wastewater) using fecal coliform. Sanitary wastewater discharges are required to meet 200 fecal coliform per 100 mL as a monthly average and 400 fecal coliform per 100 mL as a maximum. The *E. coli* criteria contained in the U.S. EPA's 1986 criteria (U.S. EPA 1986), upon which Michigan's criteria are based, were derived to approximate the degree of protection, e.g. no more than 8 illnesses per 1,000 swimmers, provided by the fecal coliform indicator level of 200 per 100 mL recommended by the U.S. EPA prior to the adoption of the 1986 criteria; therefore, the sanitary discharges are expected to be in compliance with the ambient *E. coli* partial and total body contact WQS if their NPDES permit limits for fecal coliform are met. They are responsible for maintaining compliance with their NPDES permit limitations for fecal coliform and to monitor their effluent according to their permit requirements.

11.0 IMPLEMENTATION PLAN

A TMDL Implementation Plan is not a requirement of the federal Clean Water Act but is included to give local stakeholders guidance on how to achieve the allocations described within this TMDL. The majority of the pollutant allocation in this TMDL is given to the MS4s as seen in Table 11; however, this is not meant to imply that the MS4s are solely responsible for the load reduction activities. Storm sewers are a conveyance mechanism for *E. coli*-impacted runoff to reach waterways due to sources originating within the sewer (i.e., wildlife) and throughout the watershed. Thus, everyone who works, lives or recreates in the watershed can have an impact on storm water runoff.

This plan is intended to be used by the local communities, county, consultants, agricultural professionals and citizens for decision-making support. When implemented correctly, the recommended activities should reduce *E. coli* concentrations to a point where allocations can be met. The recommended activities should be considered only as suggestions, as local personnel will have a better understanding of which will be most effective.

The current sources of *E. coli* to the impaired watershed, as discussed in Section 5.0, are listed in Table 15. The known and suspected causes of each of these sources are also listed in Table 15. Although listed below, CSOs are not considered a significant source of *E. coli* to the impaired reach. This is because the overflow through outfall 005 is expected to be small and occur very infrequently.

Table 15. *E. coli* Sources and Causes*

Sources	Causes
Known	
Failing OSDSs	• Lack of a preventative maintenance program • Insufficient funding to correct identified failures • Improper design and siting of the original system
CSOs	• Insufficient capacity during large wet weather events
Congestion of waterfowl in proximity of the impaired reach	• Feeding the ducks and geese encourages waterfowl congregation • Manicured lawns next to water bodies encourages waterfowl congregation
Suspected	
Illicit connections to the storm sewer system	• Improperly connected sanitary sewer leads • Cross connections between the storm and sanitary sewers
Pet waste in proximity of the impaired reach	• Improper waste disposal practices
Potential	
Sanitary sewer overflows	• Inadequate sanitary sewer system maintenance/ equipment failures

*Adapted from the St. Clair County's NEW Watershed Management Plan (Table 2.5)

11.1 General Pollution Control Strategies

Several best management practices (BMPs) are available to reduce *E. coli* in waterways and they can generally be divided into two groups: source control and in-drainage reduction. As the name implies, source control strategies focus on reducing pollution at the source. They can involve both structural and non-structural BMPs and they also can be often more cost-effective than in-drain reduction strategies. Examples of source control strategies for *E. coli* reduction are listed in Table 16.

Table 16. Example *E. coli* Source Control Strategies*

Strategy	Example
Illicit connection identification and removal	Outfall sampling, source tracking, dye testing
OSDS improvements	Inspection, repair, replacement
Proper livestock manure management	Storage and/or treatment facilities, disposal
Proper manure application	Injection methods, timing of application
Proper pasture management	Elimination of stream access, grazing rotation
Improved wildlife/waterfowl management	Population control (especially for geese)
Proper pet waste management	Educational programs, local ordinances
Highway/Road cleanup	Street sweeping, catch basin cleaning, road kill pick up
Low impact development techniques**	LID ordinances/practices for new developments
Runoff reduction**	Disconnect impervious areas using bioswales, rain barrels, porous pavement, rain gardens

*Modified from Ikenberry 2010.
**Some LID and runoff reduction strategies could be considered source control or in-drainage reduction.

In-drainage *E. coli* reduction strategies usually involve the use of structural BMPs to reduce bacterial loadings. This is done by intercepting runoff and/or treating it using physical, chemical or biological processes (Ikenberry 2010). Examples of in-drainage techniques are listed in Table 17.

Table 17. Example *E. coli* In-Drainage Strategies*

Strategy	Removal Mechanisms
Constructed wetlands	Ultraviolet (UV) light exposure, settling, predation, infiltration
Wet detention ponds	UV light exposure, settling, predation
Dry detention basins	UV light exposure, settling, infiltration
Vegetated filter strips	Filtration, infiltration
Riparian buffers	Exclusion from stream, filtration, infiltration
Infiltration trenches	Infiltration
Bioswales/bioretention	UV light exposure, settling, infiltration, drying
Proprietary storm water treatment devices/systems**	Varies with device, but usually settling and/or filtration

*Modified from Ikenberry 2010.
**Examples include hydrodynamic separation devices, gravity separators and catch basin inserts.

Pollutant removal rates for several source control and in-drainage strategies are provided in Tables 18 and 19, respectively. These rates vary greatly with both source control and in-drainage strategies. The rates provided assume that the BMP is designed, installed or carried-out properly, and maintained. The removal rates apply only to how the particular BMP performs and not by how much *E. coli* can be removed from the impaired reach.

Table 18. Source Control BMPs and Removal Rates (Ikenberry 2010)

BMP	Estimate *E. coli* Removal	Additional Comments
Manure injection	Up to 90%*	Removal will vary with injection method, application rates, land slope, weather, and other variables. Injection can offer up to 90% reduction in bacteria transport when compared to surface application.
Manure export/disposal	Up to 100%	Removing manure from the watershed would provide a 100% reduction from this source. However, if manure application is increased elsewhere, impacts to that watershed must be investigated.
Exclusion of livestock from streams	Up to 100%	The removal associated with this practice is proportional to the percent of livestock that is excluded. If all livestock are excluded from streams at all times, then bacteria reduction from this source would be 100%.
Septic system improvements	Up to 100%	Repair/replacement of all failing systems provides 100% reduction. Watershed-wide removal rate would be proportional to the percent of failing systems fixed.
Wildlife management	Varies	If there are known areas of waterfowl populations (e.g., Storm water ponds), management of geese populations would provide some bacteria reductions. Removal rates would be proportional to population reduction.
Street sweeping	Up to 22%*	Published literature contains conflicting information regarding potential bacteria reduction from street sweeping. This BMP should not be relied upon as a key part of the implementation strategy but may help reduce bacteria loads in highly impervious urban areas.
Pet waste management	Up to 75%*	Public education programs that stress the importance of picking up after your pets. Could include the adoption of local ordinances.
LID and runoff reduction BMPs	Varies	Proportional to the amount of runoff reduction obtained. Some LID and runoff reduction measures are included as in-drainage BMPs in Table 19.

* Source: VDEQ et al., 2009

Table 19. In-Drainage BMPs and Removal Rates (Ikenberry 2010)

BMP	Estimate *E. coli* Removal	Additional Comments
Constructed wetlands	78-99% ⌂Δ	Wetlands could act as a source of *E. coli* if not properly designed or maintained, including management of potential waterfowl populations.
Wet detention ponds	44-99% ⌂Δ	Ponds could act as a source of *E. coli* if not properly designed or maintained, including management of potential waterfowl populations.
Vegetated filter strips	43-57% ⌂	Vegetated filter strips are flat or very gently sloped segments of land intended to "treat" inflows to the stream. Filter strips should be distinguished from riparian buffers, which offer less removal potential.
Riparian buffers	Up to 40%*	The primary benefits of buffers are to "buffer" the stream from nearby land uses and activities, as the name suggests. Actual removal rates depend on the width of the buffer and the type and density of vegetation, as well as the portion of runoff that the buffer intercepts.

BMP	Estimate *E. coli* Removal	Additional Comments
Sand filters	36-83% ⌂Δ	Generally designed as part of the storm water infrastructure to capture and treat the first flush of runoff from impervious surfaces.
Bioswales and bioretention	69-99% *⌂Δ	Includes rain gardens. Should be used with caution or avoided in areas where possible groundwater contamination is a concern.
Pervious concrete; Porous asphalt	30-65% ◊	Requires careful design and construction and is only feasible in areas with adequate soil infiltration rates (at least 0.5 inches/hour).
Permeable pavers	65-100% ◊	Similar to pervious concrete and porous asphalt. Utilizes pre-cast permeable blocks to infiltrate water. Adequate soil infiltration rates required. Should be used with caution or avoided in areas where possible groundwater contamination is a concern.
Hydrodynamic devices	<30% ◊	Type of proprietary storm water treatment system.
Gravity separators	<30% ◊	Type of proprietary storm water treatment system.
Coagulation and/or flocculation	65-100% ◊	Chemical treatment of storm water. Usually implemented in conjunction with a storm water pond. Offers high removal, but addition of coagulation/ flocculation chemicals such as alum is required.

* Source: VDEQ et al. 2009
⌂ Source: U.S. EPA 2004
Δ Source: NCCES 2008
◊ Source: ISU 2010

11.2 Recommended Activities

Given the known and suspected *E. coli* sources and the water quality conditions in the impaired watershed, several activities are recommended for implementation. The recommended activities focus on source control BMPs, rather than in-drainage BMPs, as they are often the more cost effective pollutant reduction measures and the simplest to implement. The following activities are recommended for implementation:

- Replace failed OSDSs;
- Adopt and implement a county-wide OSDS inspection ordinance;
- Continue implementation of the IDEPs; and
- Develop and implement a public education program addressing waterfowl feeding.

Funding for OSDS Replacement (county or communities): Assist low-income homeowners in replacing their septic systems by applying for low interest loans.

In the past 8 years, the SCCHD has been proactively identifying failing septic systems using grant funding provided by the Clean Michigan Initiative grant program. The vast majority of the identified failing systems have been corrected or replaced by homeowners; however, some simply cannot afford to correct/replace their systems. SCCHD is aware of five uncorrected failing OSDSs remaining in the impaired watershed.

Assuming funding is the limiting barrier in correcting many failed OSDSs, the communities or county may wish to apply for a loan to aid homeowners. One such loan program available in Michigan is the Strategic Water Quality Initiatives Fund (SWQIF). This loan program provides

low interest funding to public agencies to fund the correction/replacement of private failed OSDSs. The program has provided over $13 million in loans since 2004. Reimbursable activities include the following (DNRE 2010):

- Fees for local health department permits and inspections;
- Installation of new on-site systems;
- Payment for project-specific piping and/or electrical work;
- Abandonment of existing septic tanks being replaced; and
- Payment for in-kind site restoration.

General information on the state of Michigan's program can be found at http://www.michigan.gov/deq/0,1607,7-135-3307_3515_4143---,00.html and a resource guide can be found at http://www.michigan.gov/documents/deq/deq-ess-mfs-formsguidance-SRFbook_248823_7.pdf.

OSDS Inspection Ordinance (county): Adopt and implement a county-wide OSDS inspection ordinance which would allow inspection of OSDSs at regular intervals.

In southeast Michigan, OSDS inspection ordinances have been enacted in Macomb, Washtenaw and Wayne counties, but such an ordinance does not exist in St. Clair County. These ordinances require that septic systems be inspected by a certified inspector at the time of property transfer to ensure they are operating properly. If a system is found to be failing, then it has to be repaired before the property transaction can be completed. A system failure is defined slightly differently from county to county, but includes situations where wastewater is not draining properly from the septic tank, sewage is backed up in the home, structural failures of the tank are observed, effluent is ponded on the ground, or when effluent is discharged to a storm sewer or water body. These ordinances allow for system failures to be recognized in a preventive manner.

Washtenaw County's Time of Sale OSDS and Well Inspection program has been in place since 2000. There were over 600 OSDSs inspections in both 2008 and 2009 as part of this program. The County reported an 11% and 15% OSDS failure rate in 2008 and 2009, respectively (WCEHD 2010). Macomb and Wayne County's programs report similar failure rates.

Additional information on Washtenaw County's Time of Sale Ordinance can be found at https://www.washtenaw.org/1727/Time-of-Sale-Program-TOS

Illicit Discharge Elimination Plan Implementation (county and communities): Continue implementing IDEPs, which require screening and elimination of illicit discharges and illicit connections.

Through implementation of this program the County has identified and corrected over 600 failed OSDS (22 in the impaired watershed) (see Section 5.4) and the City of Port Huron has identified and corrected 50 illicit connections (see Section 5.3). Using estimates of 2.52 persons per household[6] and 100 gallons of wastewater per person per day[7], this program has annually eliminated over 59 million gallons of untreated sewage from entering surface waters. Clearly,

[6] Southeast Michigan Council of Governments 2009 population estimate for St. Clair County.
[7] Recommended Standards for Wastewater Facilities (10 State Standards) 1997 Edition.

this program has been effective in eliminating sewage from waterways and continuing the program would have a beneficial impact to the impaired reach.

Public education to address Waterfowl Feeding (local communities): Post "Don't feed the Geese" signs at key locations, including at public boat ramps and parks.

As noted in Section 5.5, a large flock of Canada geese tend to congregate at the Riverside Boat Ramp presumably because they are fed by the public. With Canada geese able to excrete 4.9 x 10^{10} fecal coliform organisms/goose/day (U.S. EPA 2001), the impact on water quality can be significant. It is recognized that the impaired reach is in close proximity to Lake Huron and the St. Clair River, and a certain number of birds and waterfowl are expected to be present. However, educating the public on the impact of feeding waterfowl should reduce the number of waterfowl gathering at public access sites where people are most likely to come in contact with the river.

Example signage from the City of Dearborn

Source: Alliance of Rouge Communities

If signage does not prove effective, then communities may want to consider more aggressive deterrent methods. These could include scare devices/strategies and physical deterrents. These methods are described by the Virginia Cooperative Extension Service at http://pubs.ext.vt.edu/420/420-203/420-203.html.

Continued Water Quality Monitoring

The County and City should continue ambient water quality monitoring within the impaired watershed to determine the effectiveness of the implemented pollutant reduction activities. However, it is suggested they avoid collecting samples from the shoreline and move sampling locations to outside of the swash zone. This would ensure that samples do not contain artificially elevated *E. coli* concentrations. Instead, sampling should be done mid-stream to determine the ambient *E. coli* concentrations of the impaired reach. This will involve moving sampling locations to road crossings or using a boat to access the middle of the river. Sample collection from small streams, like Stocks Creek and the Howe-Brandymore Drain, can still be done from the shoreline, but with an extension pole, so as to capture the mid-flow region of the stream.

To fully determine the impact storm water is having on the Black River, sampling for *E. coli* can be done from individual storm drain outfalls. This type of sampling was done by the City of Port Huron in 2003 and 2004 and should be completed by all entities with storm water outfalls within the impaired watershed.

12.0 PUBLIC PARTICIPATION

Throughout the development of this TMDL, several public presentations were given to local stakeholders. Prior to the onset of the sampling effort in July 2008, presentations were made to the Macomb County Water Quality Board and the St. Clair County NEW Advisory Group. The purpose of these presentations was to make stakeholders aware of the project and to obtain input on the planned sampling locations.

Following completion of the 2008 sampling effort, two additional presentations were made to the NEW Advisory Group and St. Clair River Bi-national Public Advisory Council (BPAC) in February 2009. At these meetings the 2008 dataset was summarized and a discussion of the elements of a TMDL ensued. A third set of presentations was given to the NEW Advisory Group and the BPAC in November 2009 following the completion of the 2009 sampling effort. The entire project dataset and supplemental data from St. Clair County and the City of Port Huron were summarized at the third set of meetings, along with an explanation of the TMDL development process. A fourth set of meetings were held in September 2010 during the public notice period. Water quality conditions were revisited and the source assessment, LC and WLA methodology was explained. These six meeting dates were advertised on the DNRE's calendar and the presentations were announced via email to the numerous local stakeholders who participated in the regular meetings of the above mentioned groups. In addition, an announcement of the September 2010 meetings was mailed to the NPDES permittees not involved in the above mentioned groups.

Given that the City of Port Huron and St. Clair County were major stakeholders in the impaired watershed, interim meetings were held with City and County representatives in 2009 to gain a better understanding of their *E. coli* monitoring efforts and to discuss how the TMDL would impact their NPDES permits.

All meeting dates are listed in Table 20.

Table 20. Public Meeting Dates

Date	Host Organization
July 1, 2008	St. Clair County NEW Advisory Group
July 8, 2008	Macomb County Water Quality Board
February 11, 2009	St. Clair River BPAC
February 12, 2009	St. Clair County NEW Advisory Group
February 24, 2009	Anchor Bay Watershed Advisory Group
April 28, 2009	City of Port Huron and SCCHD
June 10, 2009	City of Port Huron and SCCHD
November 19, 2009	St. Clair River BPAC
November 19, 2009	St. Clair County NEW Advisory Group
September 16, 2010	St. Clair County NEW Advisory Group
September 23, 2010	St. Clair River BPAC

13.0 REFERENCES

City of Port Huron. Annual Report for City of Port Huron prepared in compliance with DNRE Phase II Storm Water Regulations. October 31, 2005.

City of Port Huron. Annual Report for City of Port Huron prepared in compliance with DNRE Phase II Storm Water Regulations. November 1, 2006

Cleland, B. 2006. Draft Expanded Technical Analysis Albrow Creek TMDL. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, & Wetlands.

DNRE 2009a. Michigan Department of Natural Resources and Environment's Combined Sewer and Sanitary Sewer Overflow System. Retrieved from *(The link provided was broken and has been removed.)* December 17, 2009.

DNRE 2009b. Michigan Department of Natural Resources and Environment's Combined Sewer and Sanitary Sewer Overflow System. Retrieved from *(The link provided was broken and has been removed.)* December 16, 2009.

DNRE 2009c. Michigan Department of Natural Resources and Environment's Combined Sewer and Sanitary Sewer Overflow System. Retrieved from *(The link provided was broken and has been removed.)* September 23, 2009.

DNRE 2009d. Michigan Department of Natural Resources and Environment's Combined Sewer and Sanitary Sewer Overflow System. Retrieved from *(The link provided was broken and has been removed.)* November 13, 2009.

DNRE 2010. Securing Financial Assistance through the Clean Water Revolving Loan Funds – A Guidance Document for Municipalities and Consultants. Revised May 2010.

Environmental Consulting & Technology, Inc. (ECT) St. Clair County Health Department Illicit Connection Elimination Project Final Report. August 2004.

Environmental Consulting & Technology, Inc. (ECT) St. Clair County Health Department Illicit Discharge Elimination Project Final Report. December 2007.

ISU 2010. Iowa Stormwater Control Manual. Iowa State University. April 1, 2010

LaLiberte, P. and D.J. Grimes. Survival of *Escherichia coli* in Lake Bottom Sediment. Applied and Environmental Microbiology, March 1982. p. 623-628.

LeSage, S. and J. Smith 2008. Water Quality and Pollution Control in Michigan: 2008 Sections 303(d), 305(b), and 314 Integrated Report. MI/DEQ/WB-08/007. Michigan Department of Natural Resources and Environment Water Bureau, April 2008.

LeSage, S. and J. Smith 2010. Water Quality and Pollution Control in Michigan: 2010 Sections 303(d), 305(b), and 314 Integrated Report. MI/DEQ/WB-10/001. Michigan Department of Environmental Quality Water Bureau, April 2010.

Lindeburg, Michael R. Civil Engineering Reference Manual for the PE Exam, 10th Edition. Professional Publications, Inc. Belmont, CA. 2006.

MDNR 1975. Michigan Department of Natural Resources, Bureau of Water Management. Black River Study: Wadhams to Mouth 1973, May 1975. Report No. 25060.

MDOT 2006. Michigan Department of Transportation Drainage Manual. Michigan Department of Transportation and Tetra Tech MPS. January 2006.

MRCC 2010. Midwestern Regional Climate Center 1971 – 2000 Precipitation Summary for Station 206680: Port Huron Sewage Treatment Plant. Retrieved from *(The link provided was broken and has been removed.)* September 7, 2010

NCCES 2008. Urban Waterways, Removal of Pathogens in Stormwater. North Carolina Cooperative Extension Service. 2008.

Southeast Michigan Council of Governments (SEMCOG). 2003. Land Cover/Land Use - SEMCOG data (update of MIRIS data) from 1:24,000 aerial photographs, 2000.

Spicer Group, Inc. 2007 Annual Progress Report for the Northeastern Watershed. November 1, 2007.

Spicer Group, Inc. 2008 Annual Progress Report for the Northeastern Watershed. November 1, 2008.

SCCHD 2006. St. Clair County Health Department. St. Clair County's Northeastern Watersheds Watershed Management Plan. November 2006.

U.S. EPA 1986. Ambient Water Quality Criteria for Bacteria - 1986. Report # EPA440/5-84-002.

U.S. EPA 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002. Office of Water (4503F), United States Environmental Protection Agency, Washington, DC. January 2001. p. 5-6.

U.S. EPA 2002. Establishing Total Maximum Daily Load Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs. Robert H. Wayland, III and James A. Hanlon, Office of Water, U.S. Environmental Protection Agency. November 22, 2002.

U.S. EPA 2004. Nonpoint Source News-Notes, Issue #73. United States Environmental Protection Agency. August 2004

U.S. EPA 2007. An Approach for Using Load Duration Curves in the Development of TMDLs. EPA 841-B-07-006. Office of Wetlands, Oceans and Watersheds – Watershed Branch (4503T), United States Environmental Protection Agency, Washington, DC. 68 pp.

U.S. EPA 2007. Options for Expressing Daily Loads in TMDLs – DRAFT. U.S. EPA Office of Wetlands, Oceans, and Watersheds. June 22, 2007.

VDEQ 2009. Smith Creek Water Quality Improvement Plan. Virginia Department of Environmental Quality and Virginia Department of Conservation and Recreation. February 20, 2009.

WCEHD 2010. 2009 Time of Sale Program Statistics presentation (provided by Molly Wade). Washtenaw County Environmental Health Division. February 2, 2010.

Whitman, R. L. and M. Nevers. Foreshore Sand as a Source of *Escherichia coli* in Nearshore Water of a Lake Michigan Beach. Applied and Environmental Microbiology, September 2003. p. 5555-5562.

Attachment A
St. Clair & Black River *E. coli* Monitoring
to Support TMDL Development and Area of Concern Delisting
Final Report

Attachment B
Discharge Data, Flow Duration Curve and Table of Percentile Flows

Figure B1. Discharge Data from USGS Gaging Station 04159492 located on the Black River, near Jeddo, Michigan

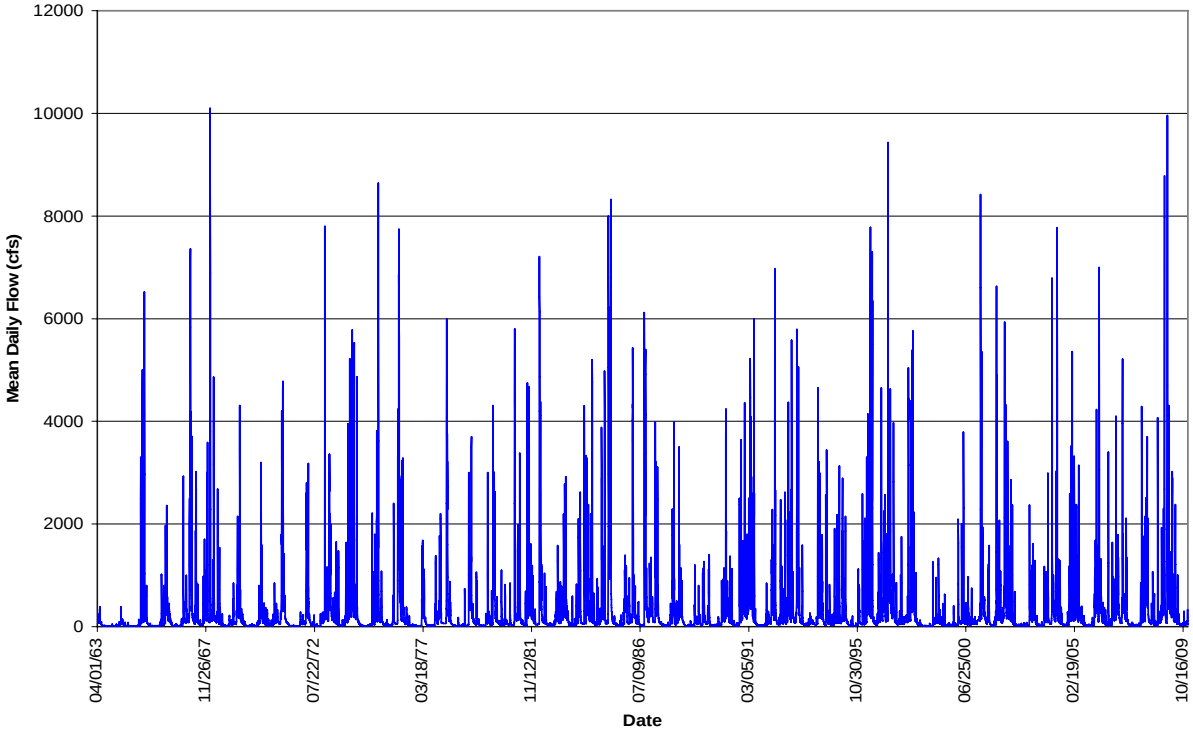


Figure B2. Discharge Data from USGS Gaging Station 04159900 located on Mill Creek, near Avoca, Michigan

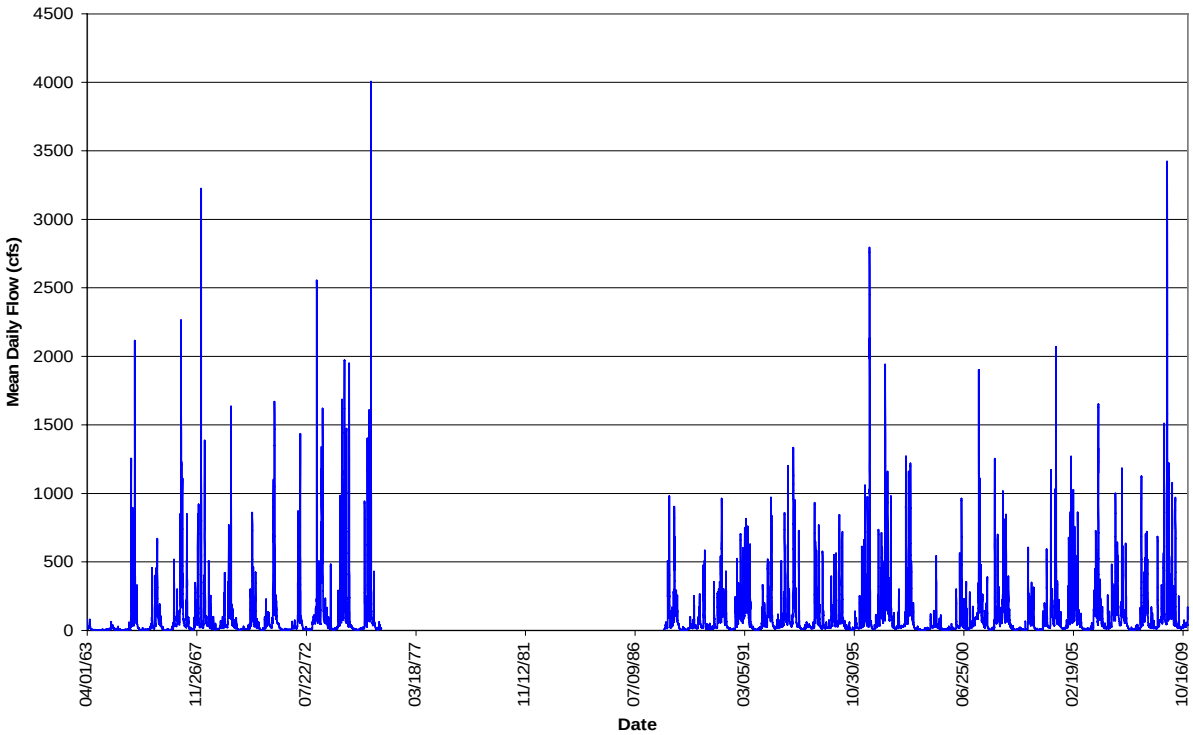


Figure B3. Estimated Discharge Data for the Black River at the Confluence with the St. Clair River

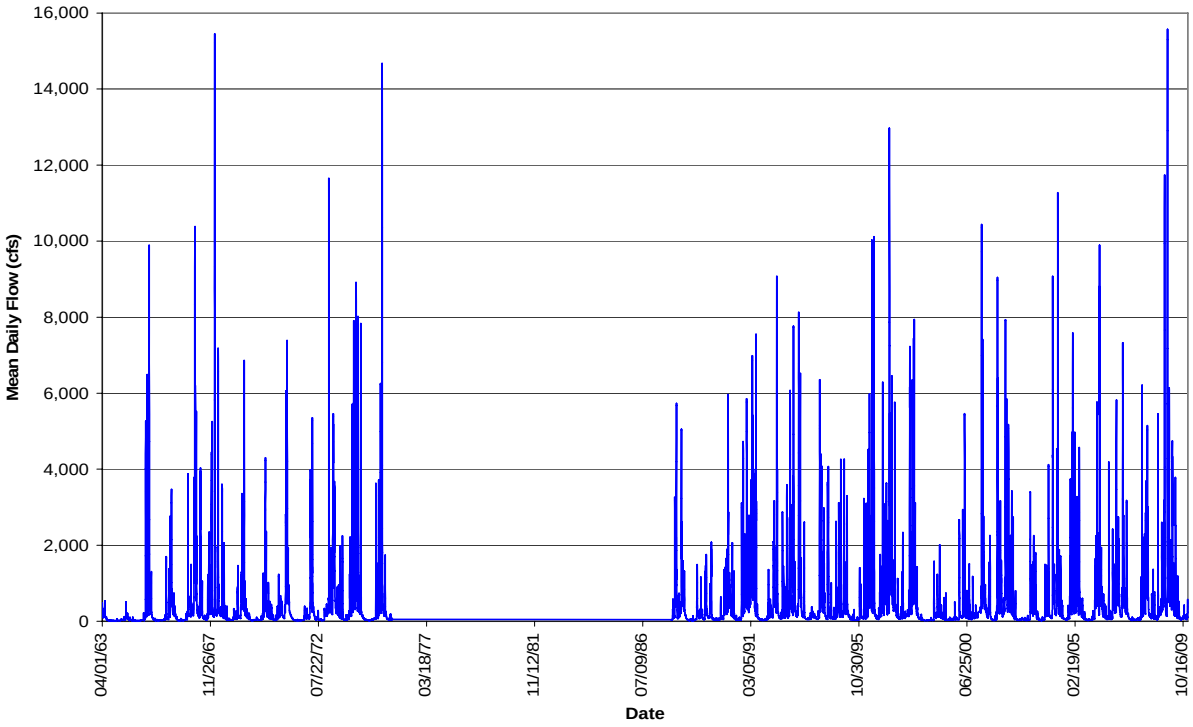


Figure B4. Estimated Discharge Data for the Impaired Reach of the Black River at the Confluence with the St. Clair River

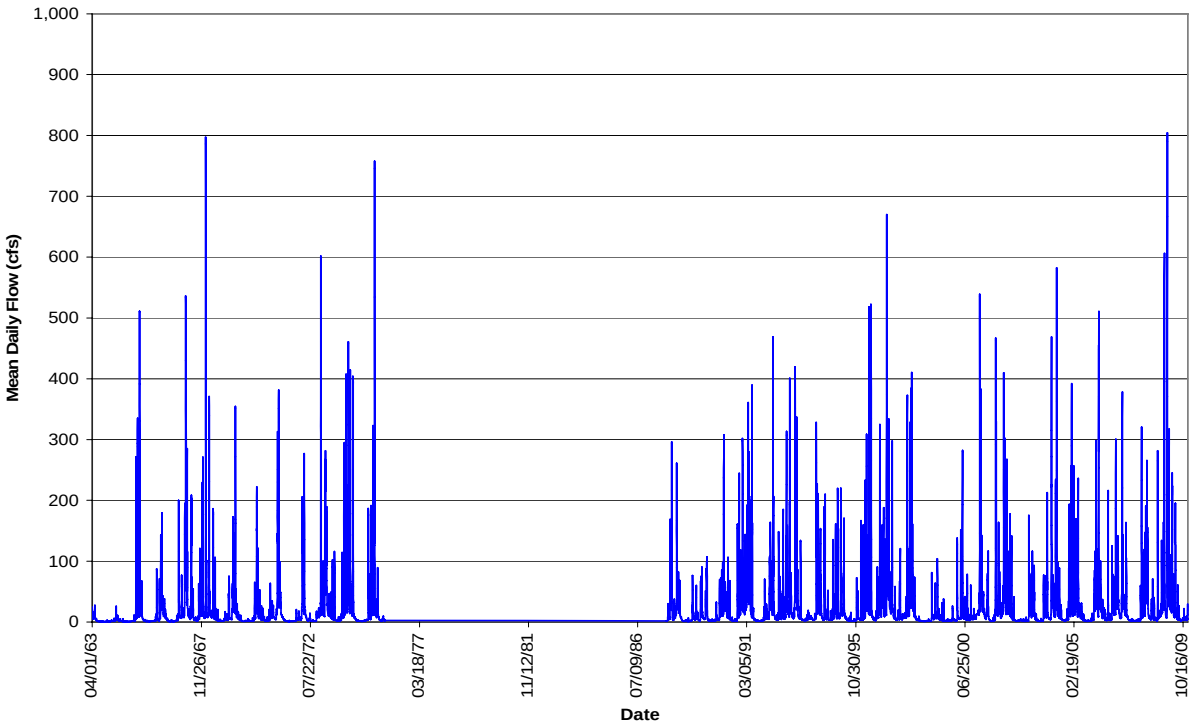


Figure B5. Flow Duration Curves for the Black River based on Discharge Data for the period 1963 – 2009

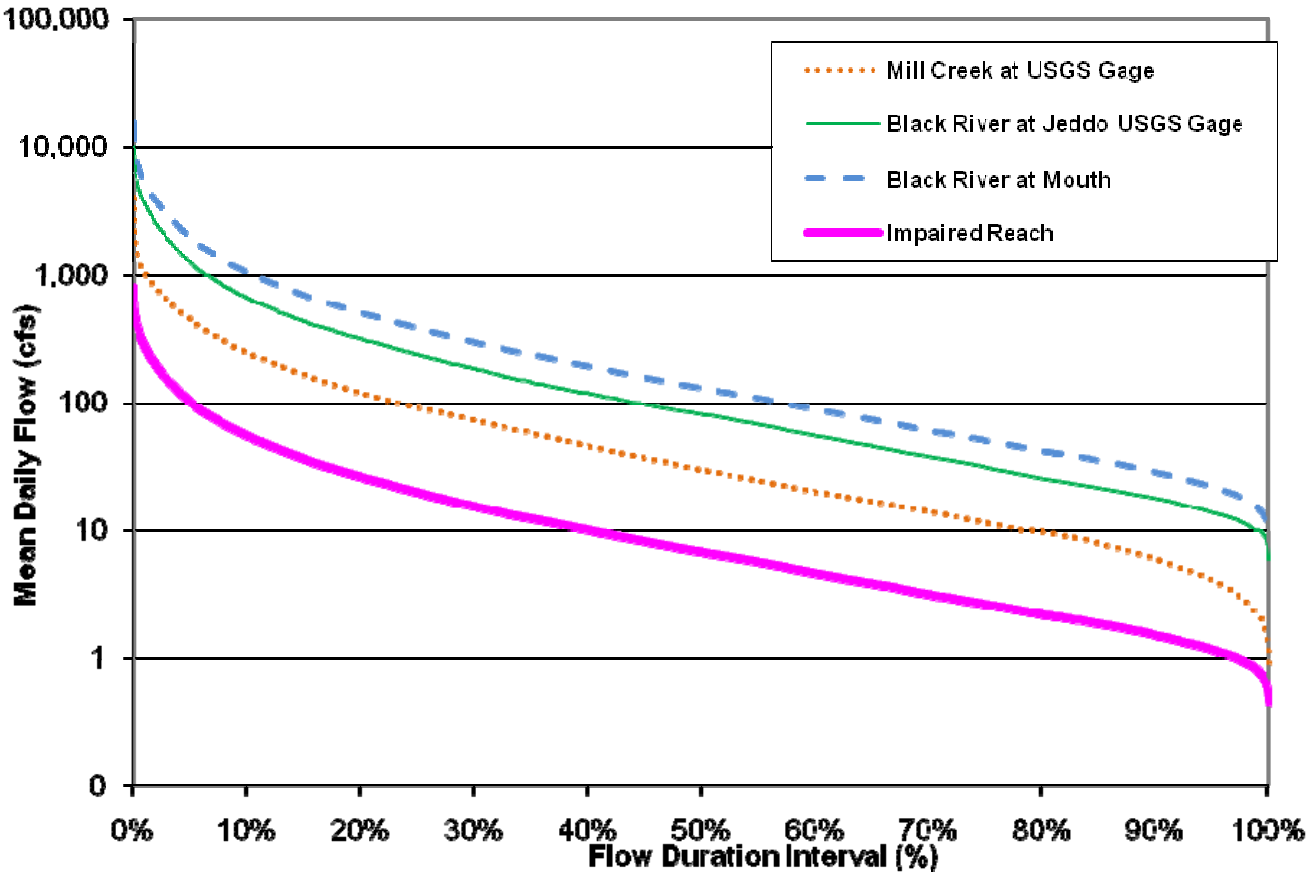


Table B1. Flow Percentiles for the Black River Watershed based on Discharge Data for the period 1963 - 2009

Percentile	Mill Creek USGS Station (cfs)	Black River USGS Station (cfs)	Total Black River (cfs)	Impaired Reach (cfs)
Maximum	3940	10100	15,297	790
1	1010	3700	5,293	273
5	444	1270	1,943	100
10	246	663	1,049	54
15	165	433	694	36
20	120	317	504	26
25	91	238	382	20
30	73	185	296	15
35	58	145	237	12
40	46	119	194	10
45	43	111	181	9
50	30	81	131	7
55	25	68	109	6
60	20	56	89	5
65	17	46	74	4
70	14	38	61	3
75	12	32	51	3
80	9.8	26	42	2
85	7.9	22	36	2
90	6	18	29	1
95	4.1	14	22	1
99	2.2	10	15	1
Minimum	0.9	5.8	9	0

Attachment C
Combined Sewer Overflow Details

Table C1. Port Huron's Uncontrolled Combined Sewer Outfalls

ID	Location Description	Receiving Water
003	Rawlins St. Station	St. Clair River
005	Riverside Dr. @ McPherson St.	Black River
014	Military @ 10th St.	St. Clair River
015	Military @ 16th St.	St. Clair River
017	Military @ Buena Vista	St. Clair River
024	Military, south of Connor St.	St. Clair River

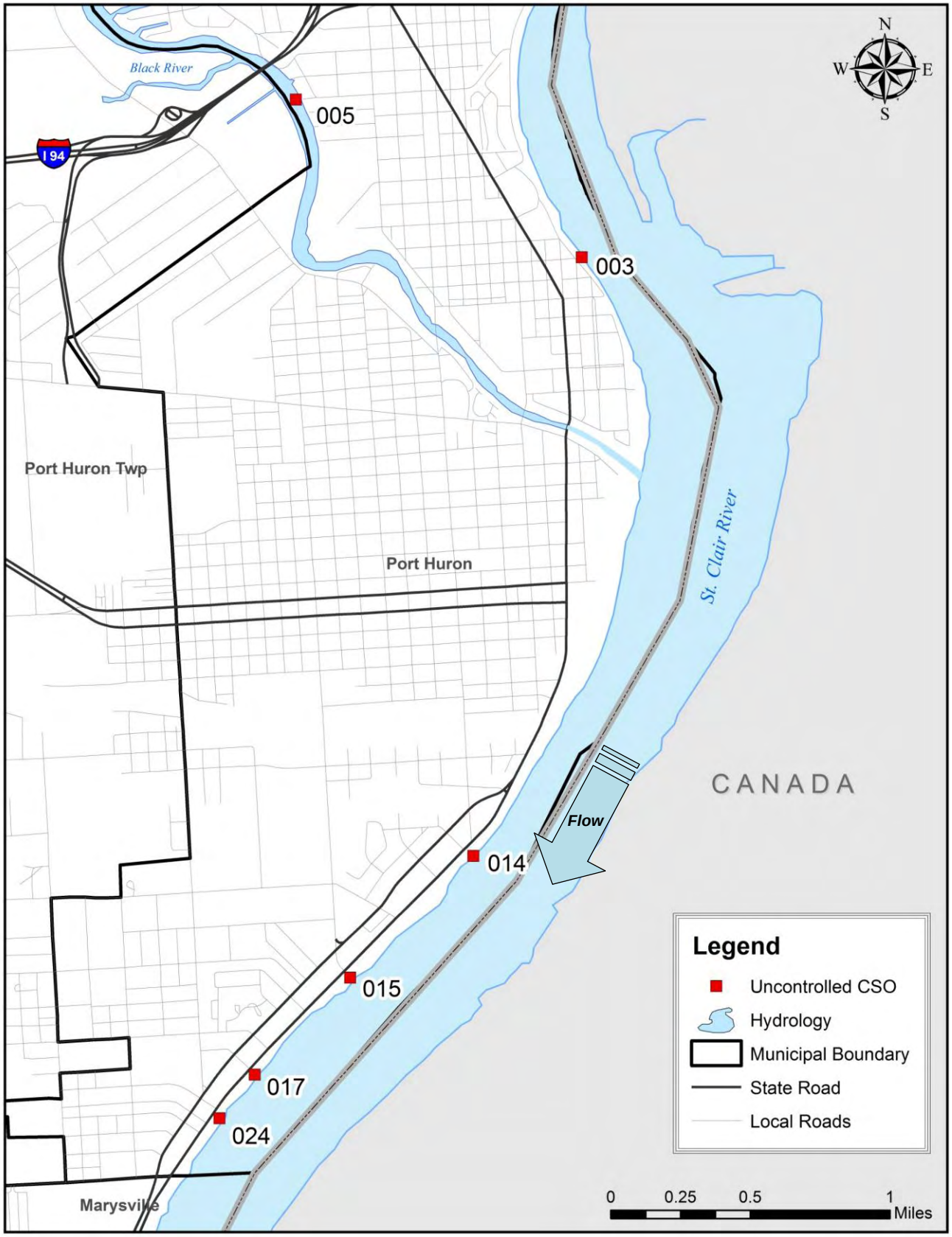
Table C2. Port Huron's Combined Sewer Overflow Details for Outfall 005 (DNRE 2009a)

Date*	Volume (millions of gallons)	Rainfall (inches)
1/8/2008	0.821	1.02
2/17/2008	0.046	0.70
6/10/2008	0.23	0.48
6/22/2008	0.86	1.05
6/26/2008	0.886	1.07
6/28/2008	0.479	0.73
7/2/2008	0.625	0.86
7/12/2008	0.395	0.65
7/19/2008	0.152	0.39
7/22/2008	0.447	0.70
7/23/2008	0.602	0.84
7/30/2008	0.447	0.70
8/5/2008	0.447	0.70
8/23/2008	0.222	0.47
9/3/2008	0.395	0.65
9/8/2008	1.237	1.32
9/13/2008	1.944	1.75
9/14/2008	2.395	1.99
11/3/2008	0.601	0.95
11/13/2008		0.64
11/14/2008		0.33
11/15/2008	4.669	1.73
12/9/2008		0.66
12/24/2008		0.40
2008 Total	**17.901**	

*includes all dates that any CSO outfall was discharging within the City.

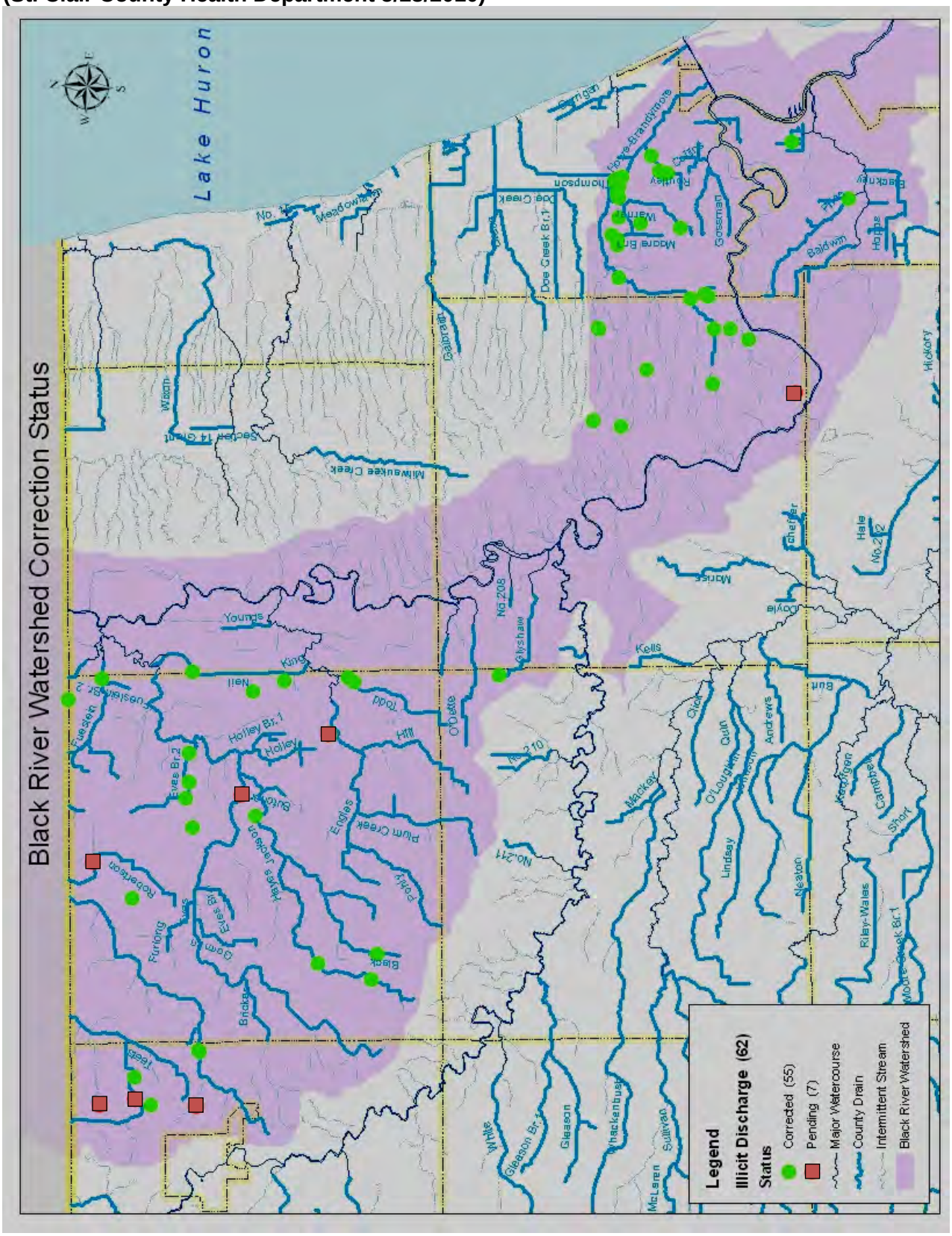
Date*	Volume (millions of gallons)	Rainfall (inches)
2/11/2009	6.994	2.01
2/26/2009		0.54
3/7/2009	3.163	1.51
3/10/2009		0.91
4/6/2009		1.23
4/20/2009		0.66
4/25/2009		1.44
4/28/2009		0.72
4/30/2009		0.43
5/16/2009		0.71
5/27/2009		0.41
5/28/2009		0.25
6/1/2009		0.13
6/8/2009		0.43
6/17/2009		1.91
6/19/2009		0.64
6/28/2009		0.45
6/29/2009		0.24
7/19/2009		0.59
7/23/2009		0.90
7/25/2009		1.06
7/26/2009		0.33
8/8/2009		1.36
8/9/2009		0.82
8/10/2009		0.81
8/20/2009		1.19
8/23/2009		0.32
8/28/2009		0.95
9/21/2009		1.08
9/28/2009		0.62
10/2/2009		0.43
10/9/2009		0.94
2009 Total	**10.157**	

Figure C1. Port Huron's Combined Sewer Outfall Locations



Attachment D
Failing Onsite Sewage Disposal Systems

Figure D1. Failed On-site Sewage Disposal Systems in the Lower Black River Watershed (St. Clair County Health Department 5/28/2010)



Attachment E
Load Duration Curves with Sampling Data

Figure E1. Load Duration Curve for Segment 1 of the Black River (based on discharge from the entire Black River)

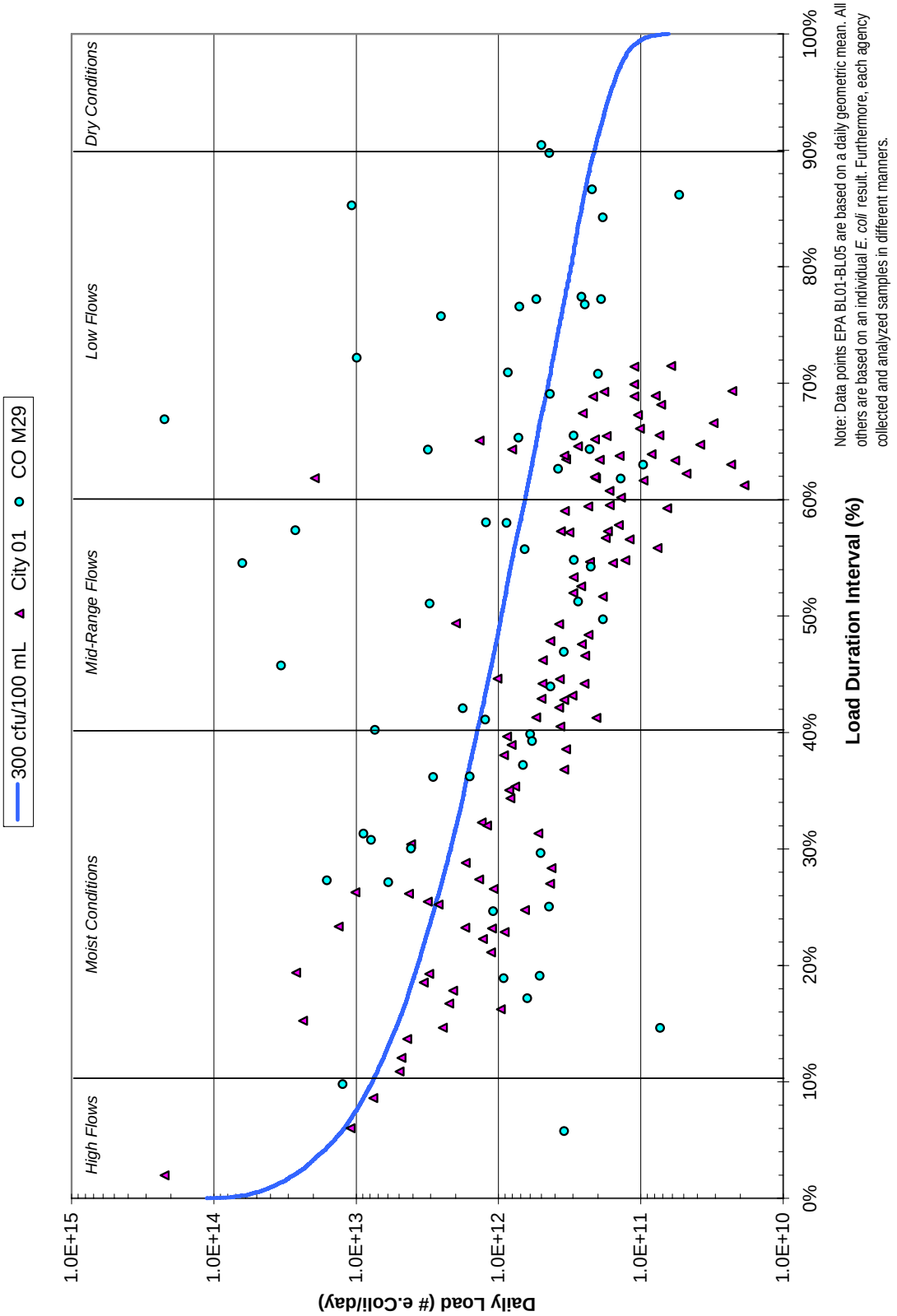


Figure E2. Load Duration Curve for Segment 2 of the Black River (based on discharge from the entire Black River)

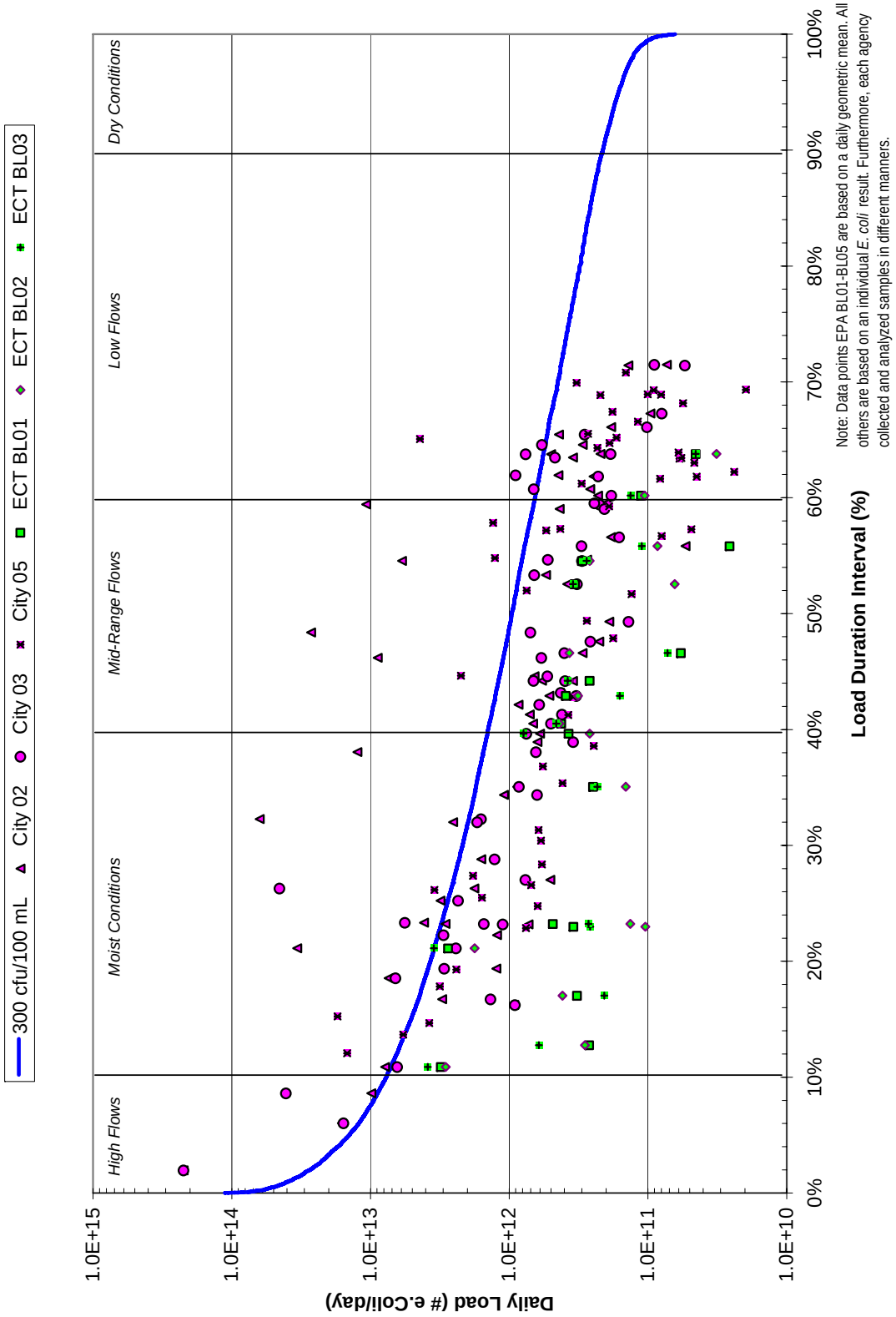


Figure E3. Load Duration Curve for Segment 3 of the Black River (based on discharge from the entire Black River)

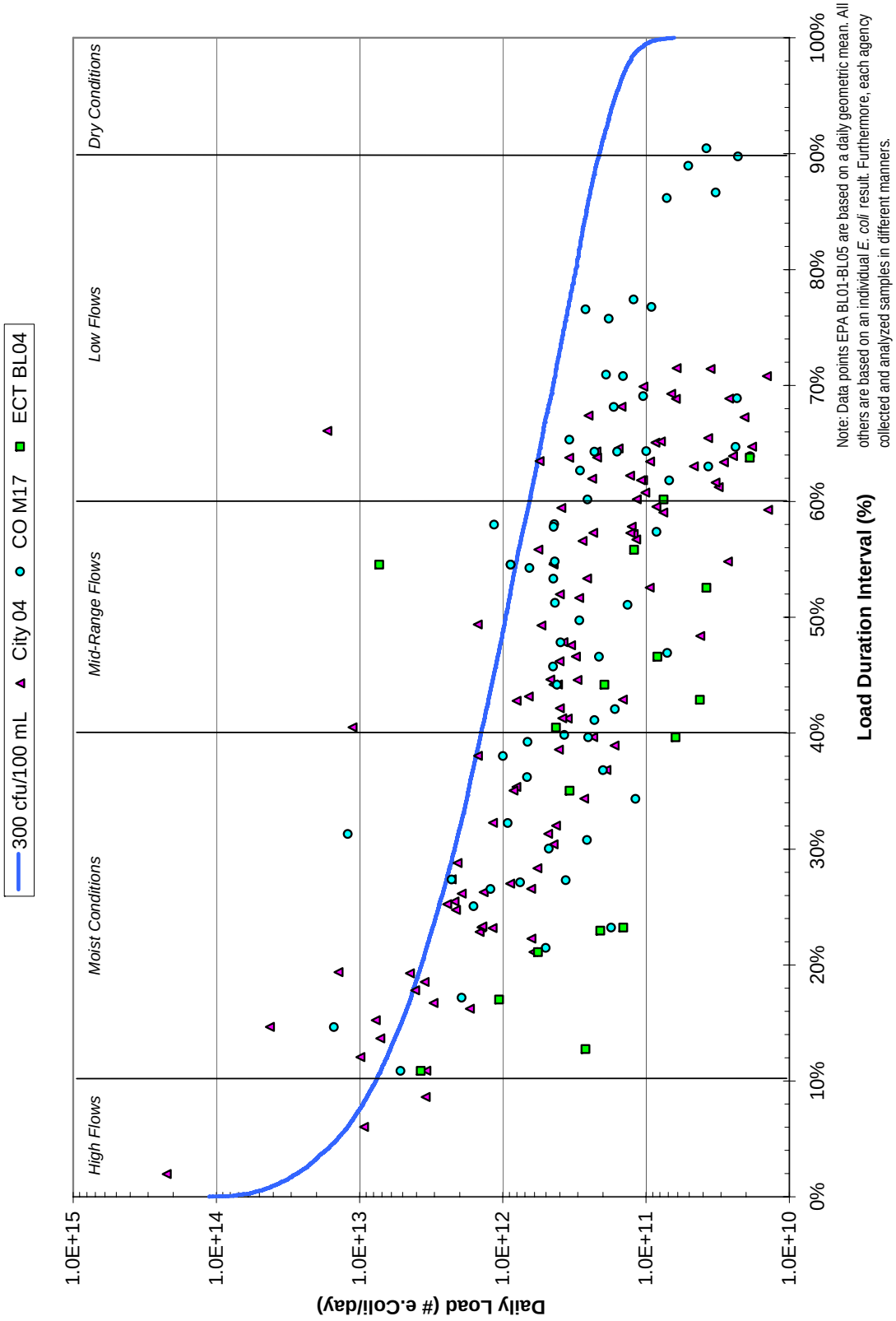
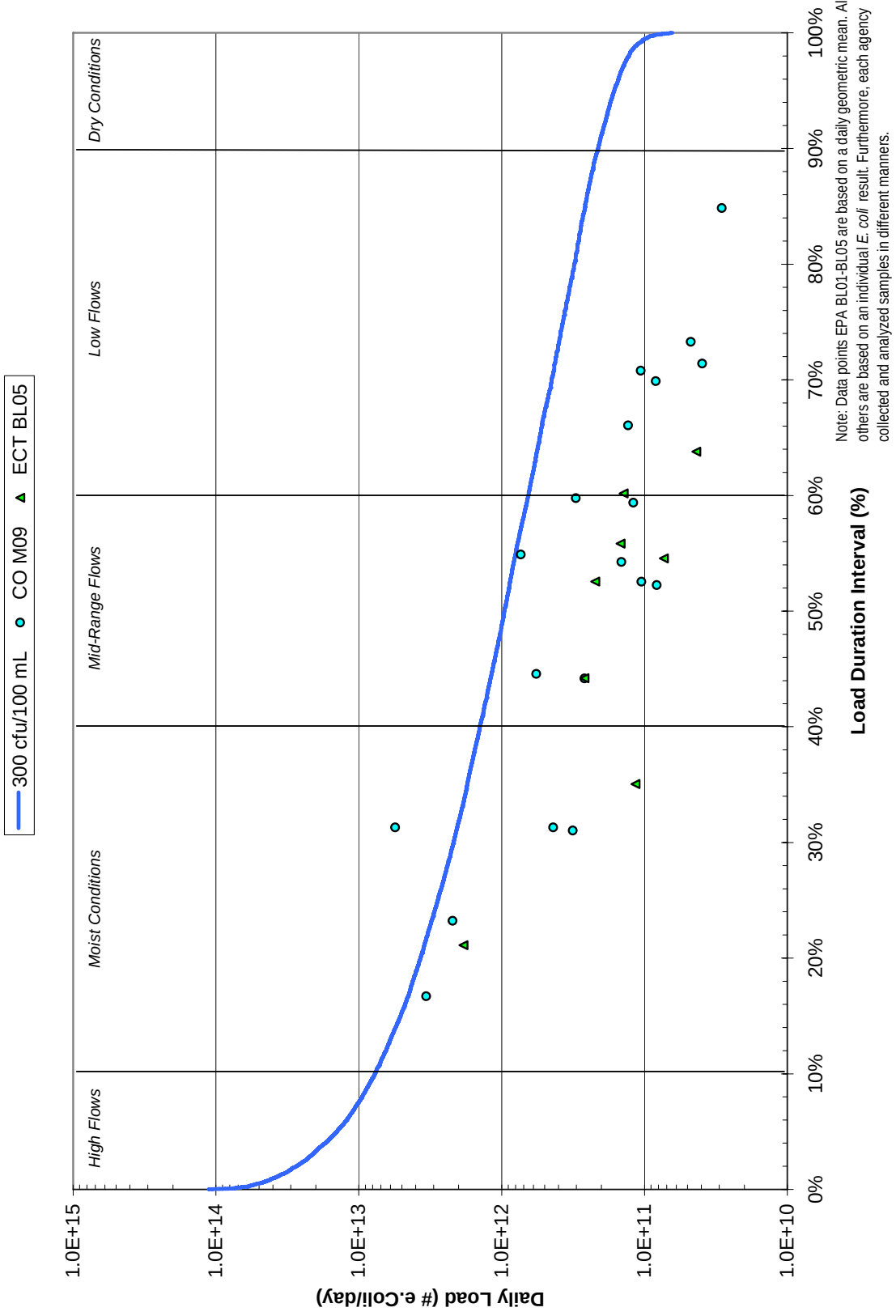
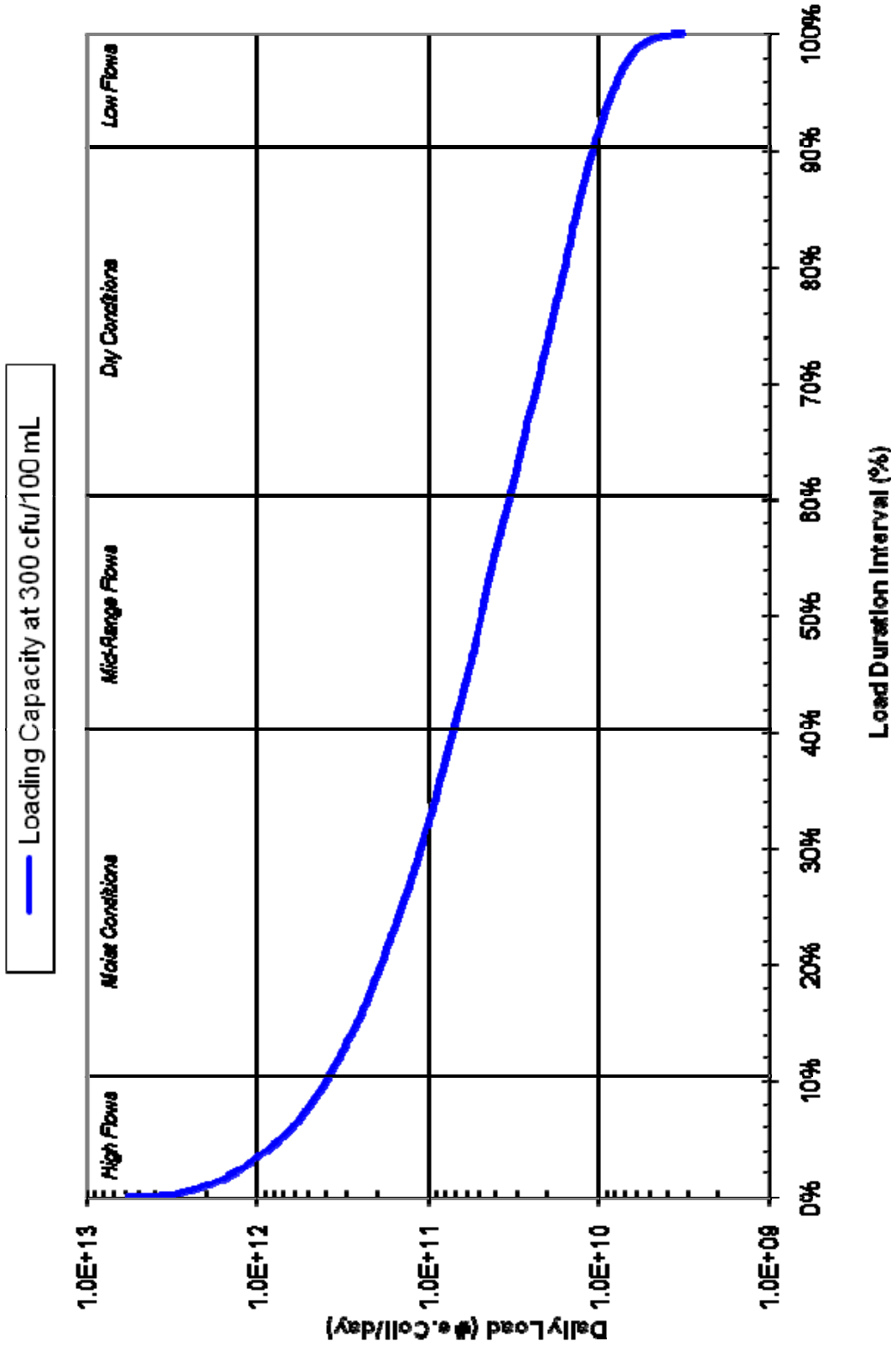


Figure E4. Load Duration Curve for Segment 4 of the Black River (based on discharge from the entire Black River)



Attachment F
Load Duration Curve for the Impaired Reach

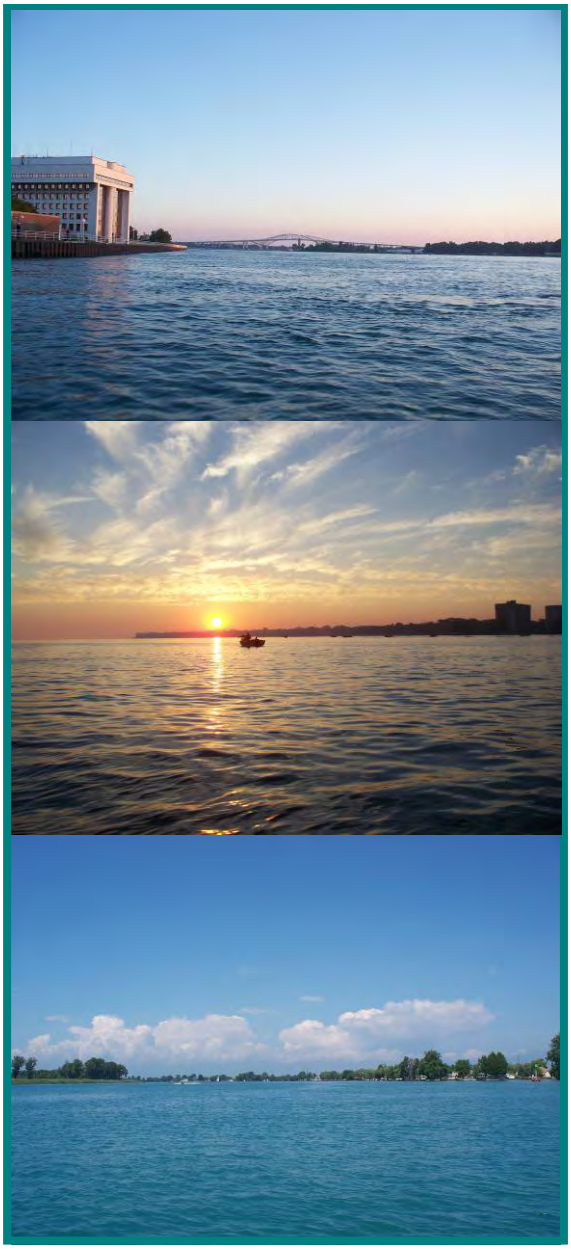
Figure F-1. Load Duration Curve for the Impaired Reach



Attachment A

ST. CLAIR RIVER & BLACK RIVER *E. COLI* MONITORING TO SUPPORT TMDL DEVELOPMENT AND AREA OF CONCERN DELISTING

FINAL REPORT



PREPARED FOR:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION V

AND

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER BUREAU

CONTRACT NO.: EP-C-08-003
TASK ORDER NO.: 2008-10

PREPARED BY:

RTI INTERNATIONAL
RESEARCH TRIANGLE PARK, NORTH CAROLINA

AND

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NOVEMBER 13, 2009

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TABLES AND FIGURES

Cover Photographs (top to bottom):
St. Clair River north of Marysville, St. Clair River near Port Huron, St. Clair River outlet

Acronyms & Acknowlegdements

LIST OF ACRONYMS

AOC	Area of concern
BUI	Beneficial use impairment
CFU	Colony forming units
CSO	Combined sewer overflows
DNA	Deoxyribonucleic acid
E. coli	*Escherichia coli*
ECT	Environmental Consulting & Technology, Inc.
EPA	U.S. Environmental Protection Agency
MDEQ	Michigan Department of Environmental Quality
OSDS	On-site sewage disposal systems
PCR	Polymerase chain reaction
QAPP	Quality Assurance Project Plan
SMC	Source Molecular Corporation
SSO	Sanitary sewer overflow
TMDL	Total maximum daily load
WQS	Water Quality Standard

ACKNOWLEDGEMENTS

The project team would like to thank Doug Martz of the Macomb County Water Quality Board and the St. Clair River Channel Keepers for providing background information and transportation on the St. Clair River and Black River throughout the sampling effort. We would also like to thank Patty Troy from the City of Port Huron for providing historical water quality data for the Black River and Kristin O. Jurs of the St. Clair County Health Department for providing historical data for the Black River, its tributaries and the St. Clair River.

Project Team:

- Julianne Socha, EPA Project Manager
- Christine Alexander, MDEQ Project Manager
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Executive Summary

The St. Clair and Black rivers were assessed for compliance with Michigan's Water Quality Standards (WQSs) for *Escherichia coli (E. coli)* concentration at various sampling sites. The monitoring for these rivers was prompted by their listings on the State of Michigan's impaired waters list. Twenty-five weeks of sampling were performed at 15 transects on the St. Clair River between July and October 2008 and between May and June 2009. Six of the 25 sampling events occurred during wet weather conditions. Seventeen consecutive weeks of sampling were performed at five locations on the Black River from May through August 2009. Of these 17 weeks, four occurred during wet weather conditions.

Analysis of the St. Clair River daily geometric mean data revealed that the full body contact standard of 300 cfu/100 mL was exceeded 0.3% of the time (1 out of 322 daily geometric means). This exceedence occurred near shore along the transect just downstream of the Black River confluence. This exceedence is likely attributed to a rainfall event of over 4", which occurred over the days prior to sample collection. The highest *E. coli* concentrations were found at the same transect based on average daily geometric mean values.

Analysis of the Black River data revealed that elevated levels of *E. coli* were found in the Black River. The full body contact standard was exceeded 2.6% of the time (2 out of 76 daily geometric means). Both of these exceedences occurred after rainfall events: one exceedence was at the site upstream of Strawberry Lane and the other was at the Runnels Street site.

Limited bacterial source tracking (BST) analysis was also conducted on the Black River. BST results indicated that *E. coli* from a human source(s) was present in the Howe-Brandymore Drain, which is a tributary of the Black River. This sample was collected during wet weather conditions.

Additional data from the St. Clair County Health Department and the City of Port Huron indicate that localized sources of *E. coli* are discharging to the St. Clair and Black rivers. Both Stocks Creek and the Howe Brandymore Drain, two tributaries of the Black River, had frequent elevated *E. coli* concentrations potentially stemming from failing septic systems. Shoreline samples along the Black River within the City of Port Huron were often elevated indicating potential sources of contamination from illicit connections to the city's storm sewer system, untreated combined sewer overflows, wildlife feces and/or from re-suspended sediment. Shoreline samples along the St. Clair River, in the vicinity of Marysville, were occasionally elevated indicating potential sources of contamination from sanitary sewer overflows and/or untreated combined sewer overflows.

Introduction

PROJECT OBJECTIVES

The primary objective of this monitoring effort was to collect ambient *E. coli* and bacterial source tracking (BST) data for use in development of a Total Maximum Daily Load (TMDL) for the St. Clair and Black rivers (see Figure 1). Additionally, these data are to be used in any delisting efforts for the St. Clair River Area of Concern (AOC). The *E. coli* data was analyzed to determine compliance with the State of Michigan's WQSs, while the BST data was used as an aid in determining the sources of any noted water quality problems. The project objective was accomplished by collecting routine grab samples from select locations along the St. Clair and Black rivers and analyzing them for *E. coli*. Based on the results of the *E. coli* analysis, samples were collected for BST analysis at a subset of locations.

This report is divided into several sections. The remainder of the Introduction section describes the roles of each agency that worked on the project, background information for the two water bodies and their respective drainage areas and a summary of supplemental data collected by the St. Clair County Health Department and the City of Port Huron. The Monitoring Design section discusses the monitoring site locations, analytical methods and sample collection methods. The Discussion & Results section summarizes the results of the *E. coli* and BST tracking analysis by weather conditions and compares the data to WQSs. The Quality Control section describes the degree to which the sampling effort met the data quality objectives described in the Quality Assurance Project Plan. Finally, the Conclusions section summarizes the findings of the sampling effort.

ROLES & RESPONSIBILITIES

The EPA and the MDEQ provided administrative and technical oversight throughout the project. As the prime contractor for the EPA, RTI International provided contractual and administrative support. Environmental Consulting & Technology, Inc. (ECT), a subcontractor to RTI, was responsible for preparation of the Quality Assurance Project Plan (QAPP), sample collection, data analysis and preparation of this report. Paragon Laboratories located in Livonia, Michigan was responsible for the *E. coli* analyses, while Source Molecular Corporation (SMC) located in Miami, Florida performed the bacterial source tracking analyses.

BACKGROUND

The St. Clair and Black rivers and Chrysler Beach are cited on Michigan's approved 2008 303(d) list for impairment of the partial and total body contact designated uses as summarized in Table 1.

Table 1. Impaired segments as indicated on Michigan's approved 2008 303(d) List.

Reach	Description	River AUID	Affected Uses	Pollutant/ Stressor
St. Clair River	Entire River from Lake Huron to Lake St. Clair	040900010001-01 040900010001-02 040900010001-03 040900010001-04 040900010001-05 040900010001-06 040900010001-07	-Partial and Total body contact recreation	*Escherichia coli*
St. Clair River Chrysler Beach	0.1 mile beach in Marysville, Michigan	040900010307-03	-Partial and Total body contact recreation	*Escherichia coli*
Black River	2.49 miles	040900010214-02	-Partial and Total body contact recreation	*Escherichia coli*

The target levels for the partial and total body contact designated uses are the ambient *E. coli* standards established in Rule 62 of the WQS as follows:

R 323.1062 Microorganisms. Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *E. coli* per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 *E. coli* per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.

Rule 62(2) provides that all waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 *E. coli* per 100 ml with compliance based on the geometric mean of 3 or more samples, taken during the same sampling event, at representative locations within a defined sampling area.

In addition to being listed on Michigan's 303(d) list, beach closings are one of the ten beneficial use impairments (BUI) for the St. Clair River AOC. The beach closing BUI covers the entire river from the U.S. to Canadian shoreline and extends from the Lake Huron outlet into the river delta region.

This project collected 16 weeks of *E. coli* data in 2008 and seventeen weeks of *E. coli* data in 2009 during the total body contact recreational season. These data were needed to assess existing conditions to support TMDL development and to gain information to assess the beach closing beneficial use impairment for the St. Clair River. *E. coli* sampling was conducted in accordance with Michigan Rule 62 which requires the collection of at least 3 samples from a representative area during the same sampling event. These 3 samples were collected from U.S. waters within the St. Clair River and the Black River. Additional samples were also collected from Canadian waters within the St. Clair River to assess water quality in the entire river.

No discussion of the project data as it relates to the beach closing impairment for the St. Clair River AOC is included in this report. Any decision regarding delisting of the AOC will be accomplished by other parties.

WATERSHED DESCRIPTIONS

St. Clair River

The St. Clair River is located in southeast Michigan and acts as a natural boundary between part of the United States and Canada. The international boundary between the two counties runs down the river, leaving Russell, Harsens, and Dickenson Islands on the U.S. side of the river and Stag, Fawn, and Walpole islands on the Canadian side of the river. The river length is approximately 40 miles from Lake Huron to Lake St. Clair (see Figure 1). The water-surface elevation falls approximately 5 ft within the river, which has an average discharge of about 182,000 cubic feet per second (ft^3/s). The water velocity is highest at the outlet of Lake Huron and is slowest in the river delta (Hamdy p. 224).

The tributary drainage area in Ontario totals 51,810 acres (81 square miles). The drainage area of all of the Michigan tributaries is 780,600 acres (1,220 square miles), making the total drainage area of the St. Clair River about 1,300 square miles (St. Clair River Remedial Action Plan, p. 5).

The St. Clair River receives discharges from numerous stormwater outfalls, several industrial point sources, and some combined sewers (during heavy rains). The Black, Pine, and Belle rivers discharge to the St. Clair River from the U.S. side. The Murphy Drain and Talfourd, Baby and Bowens Creeks discharge to the river from Ontario. The St. Clair River serves as the source of drinking water to approximately 86,500 people in southeast Michigan (PSC, App. B) and numerous industrial facilities utilize the river as a source of cooling water.

Black River

The headwaters of the Black River are found in Sanilac County. The river flows south into St. Clair County where it eventually outlets into the St. Clair River in Port Huron. The Black River watershed encompasses 746 square miles. For the purposes of watershed planning, the Black River watershed was divided into three separate drainage areas: the Upper Black River, which is almost exclusively located in Sanilac County; Mill Creek, which is situated in Lapeer and St. Clair Counties; and the Lower Black River, which is located within St. Clair and Sanilac Counties (see Figure 2). The sampling effort for this project took place within the downstream portion of the Lower Black River.

"The Lower Black River encompasses an area of land that is 151 square miles and contains approximately 205 miles of tributaries" (Northeastern Watersheds Watershed Management Plan, p. 1-5). "Slopes within the Lower Black River are generally level to shallow (0 to 3 percent) on water laid moraines and till plains, and steeper (6 to 12 percent) along the land bordering the river. Overall the surface runoff is considered slow to medium…The elevation remains around 580 from Wadhams Road to the St. Clair River, making the river very slowly moving in the lower reaches." (Northeastern Watersheds Watershed Management Plan, p. 1-23). All five of the sampling transects for this project fell within this slower moving area of the river.

Approximately 2.5 miles of the Black River from the I-94 crossing to the confluence with the St. Clair River, are listed on Michigan's 303(d) list as impaired due to elevated *E. coli* levels. Three of the five monitoring locations were placed within this impaired section of the Black River.

The average annual flow of the Black River is 301 ft^3/s as recorded at the USGS gaging station at the Jeddo Road crossing (Blumer, p. 283). This is approximately 10 miles upstream from the northernmost sampling location.

LAND USE

As described above, over 90% of the drainage area associated with the project area is located within the United States, with over ½ of the US drainage area being in St. Clair County. The primary land uses for St. Clair County are: Active agriculture (52%), Woodland/Grassland (29%), and residential (13%) according to statistics reported by SEMCOG for 2000.

Figure 1. Project Area Map

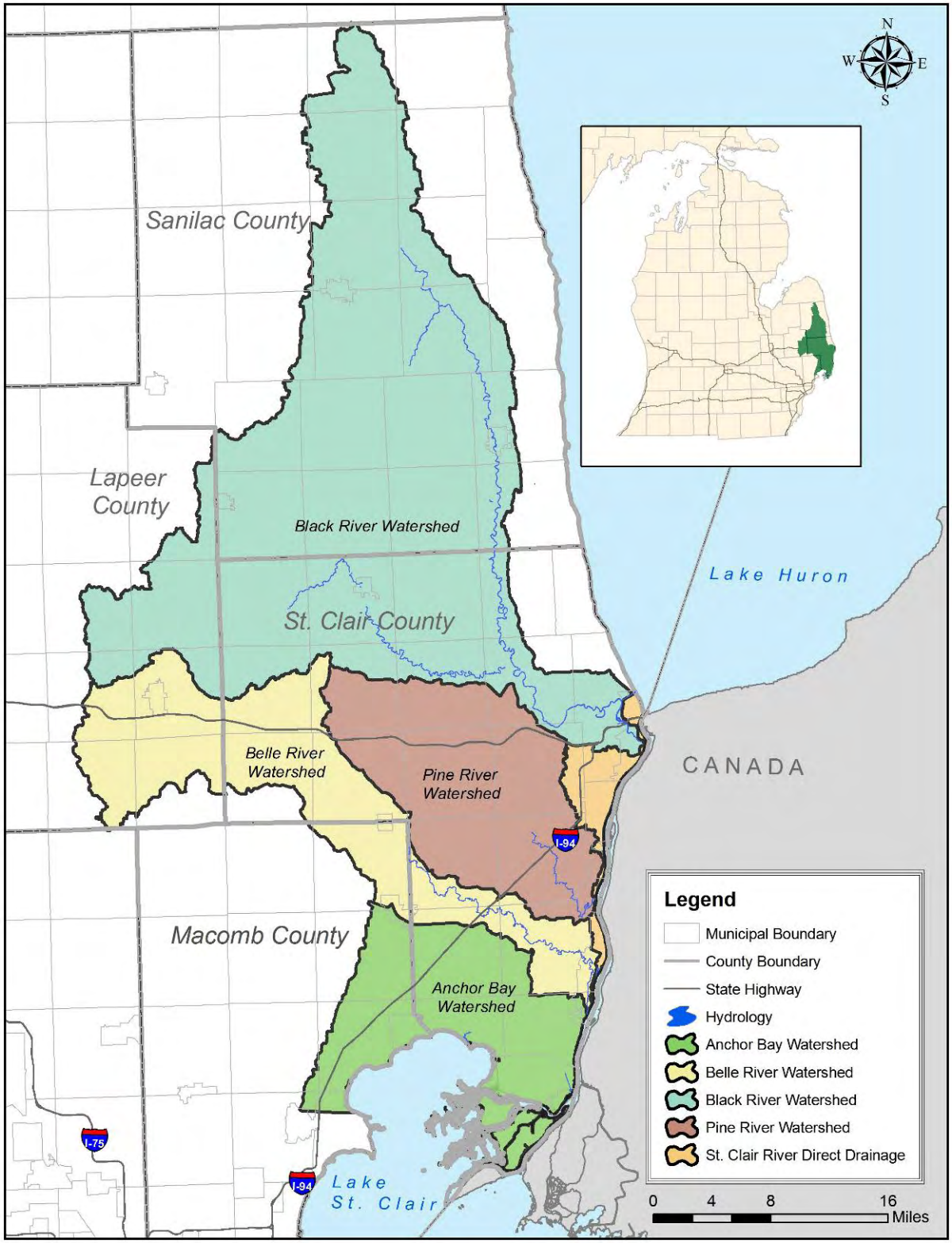
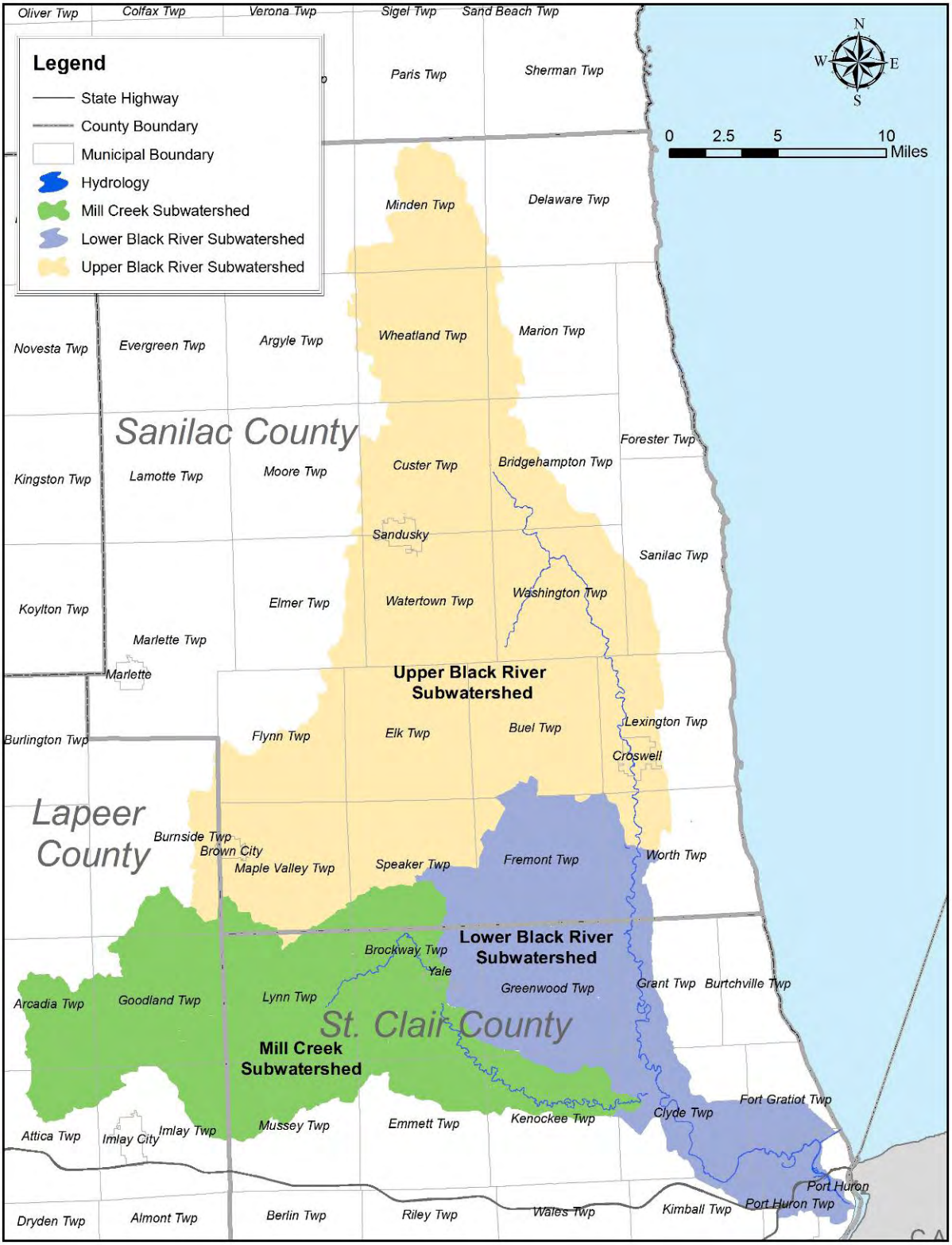


Figure 2. Black River Watershed Map



SECONDARY *E. COLI* DATA

In addition to data collected on behalf of the EPA and MDEQ, *E. coli* data was also available from the St. Clair County Health Department (SCCHD) and the City of Port Huron and was collected prior to and during the project period. This secondary data collection effort is described below and is used in this document to determine possible *E. coli* sources.

St. Clair County Health Department

The St. Clair County Health Department has monitored *E. coli* in the St. Clair River and in the Black River watershed between May and September since 2004 and 2005, respectively. In most cases, only one sample was collected from the shoreline at each site. The exception was the beach sites where three samples were collected weekly across the beach to calculate a daily geometric mean. Samples were analyzed at the lab located within the SCCHD. The number of samples collected at each site, the monitoring period and the number of samples exceeding 300 cfu/100 mL are shown in Table 2. A map of the monitoring locations can be found in Appendix A.

Elevated *E. coli* concentrations (above 300 cfu/100 mL) were routinely found at the Howe-Brandymore Drain and at Stocks Creek, which were both sampled bimonthly. Elevated counts were also occasionally found at Fort Gratiot Township Park and at the outlet of the Black River (both locations sampled weekly), and the Black River at Jeddo Road and at Fisher Road (both locations sampled bimonthly).

Very few samples were above 300 cfu/100 mL on the St. Clair River. The exception to this is at Chrysler Beach, which had 9% of samples above 300 cfu/100 mL. The complete set of SCCHD data can be found in Appendix B.

Table 2. St. Clair County Health Department *E. coli* Data Summary 2004 - 2009

Monitoring Site (SCCHD ID)	No. of Samples > 300 cfu/100 mL	Total No. of Samples	Monitoring Period
Black River			
At Fisher Road (M44)	2 (29%)	7	2009
At Jeddo Road (M08)	3 (16%)	19	2005 - 2009
At Norman Road (M45)	0	6	2009
At Old North River Road (M09)	1 (5%)	19	2005 - 2009
At Fort Gratiot Township Park (M17)	5 (7%)	68	2005 - 2009
At the outlet (M29)	5 (9%)	55	2005 - 2008
Black River Tributaries			
Howe Brandymore Drain at Krafft Road (M11)	15 (75%)	20	2005 - 2009
Stocks Creek near outlet (M47)	7 (100%)	7	2009
Black River canal (M10)	2 (4%)	52	2005 - 2008
St. Clair River Beaches (listed upstream to downstream)*			
Chrysler Beach (B2)	9 (9%)	102	2004 - 2009
Marine City Beach (B16)	1 (1%)	80	2004 - 2009
Marine City Diving Area (B17)	0	89	2004 - 2009
St. Clair River (listed upstream to downstream)			
Pine Grove Park (M31)	0	67	2004 - 2008
Marysville City Park (M25)	1 (1%)	79	2004 - 2009
St. Clair Boardwalk (M35)	0	81	2004 - 2009
Algonac Boardwalk (M01)	1 (1%)	78	2004 - 2009
Algonac State Park (M02)	0	81	2004 - 2009
St. Clair River Delta			
Johnnie Legas Pier on the N. Channel (M20)	0	30	2008 - 2009
Browns Landing on the Middle Channel (M12)	0	82	2004 - 2009
Frank Schoonovers Dock on the S. Channel (M18)	0	82	2004 - 2009
South of 1825 S. Channel Drive on the S. Channel (M34)	0	83	2004 - 2009

*Values based on daily geometric means.

City of Port Huron

Since 2000, the City of Port Huron has monitored *E. coli* concentrations on the Black River and St. Clair River between Memorial Day and Labor Day. At each location, the city collected a single grab sample from along the shoreline. Samples were collected daily, Monday through Thursday, and analyzed at the Port Huron Water Reclamation Facility. A map of the monitoring locations can be found in Appendix A.

Considering the 2008 and 2009 data only, elevated *E. coli* concentrations (above 300 cfu/100 mL) were found frequently at most of the Black River and tributary locations monitored by the city. The few elevated counts found on the St. Clair River were confined to the Lincoln Park and Mermaid Park sites, which are both downstream of three untreated combined sewer outfalls (see Table 3). The complete set of the city's data for 2008 and 2009 can be found in Appendix B.

Table 3. City of Port Huron *E. coli* Data Summary 2008 - 2009

Monitoring Site	No. of Samples > 300 cfu/100 mL	Total No. of Samples	Monitoring Period
Black River (listed upstream to downstream)			
3667 Strawberry Lane	10 (9%)	114	2008 - 2009
1821 Riverside St.	10 (17%)	59	2009
Riverside Drive Boat Ramp	8 (15%)	55	2008
Thomas St.	15 (27%)	55	2009
Fort St. Mooring Facility	12 (11%)	114	2008 - 2009
Black River Tributaries			
Stocks Creek	22 (40%)	55	2008
Howe Brandymore Drain	34 (62%)	55	2008
St. Clair River (listed upstream to downstream)			
Pine Grove Park (south end)	0	114	2008 - 2009
MOC Parking Lot	0	55	2009
Seaway Terminal	0	54	2009
Lincoln Park	3 (3%)	114	2008 - 2009
Mermaid Park	3 (5%)	55	2008

MONITORING SITE LOCATIONS

St. Clair River

The primary factors used to determine the monitoring locations on the St. Clair River were the location of known combined sewer outfalls, the international boundary, field crew safety and available budget. Even though the MDEQ and EPA do not have jurisdiction in Canadian waters, an assessment of the St. Clair River would have been incomplete if Canadian waters were not considered. Therefore, sampling occurred shore to shore across the international boundary. Twelve monitoring transects were placed along the river, with one placed at the most upstream and downstream ends of the river. Additionally, the St. Clair River Delta was sampled using one transect in each of the three major channels (North, Middle, and South Channels). Transect SR12, located in Port Huron, was placed immediately downstream of a combined sewer outfall, while transect SR08 was located downstream of a known sanitary sewer overflow from the City of Marysville's sanitary sewer system.

There were multiple sampling sites associated with each transect, based on the width of the river. The left and right most sites (when looking upstream) were generally within 50 feet of the shorelines. Sampling site "A" always corresponds to the left most sample nearest to the U.S. mainland. In some cases, both sites "A" and "B" were within 50 feet of the shoreline where the shipping channel was almost as wide as the river. Generally, only two samples were collected in the shipping channel, one on either side of the international boundary. The sampling transects and their corresponding sampling sites are described in Table 4 and Figures 3a, 3b, and 3c.

Table 4. St. Clair River Transect Descriptions (listed upstream to downstream)

Transect ID	Sampling Sites	Transect Description	Sampling Interval	
			Dates Sampled	Duration
SR11	A – F	Outlet of Lake Huron at the Fort Gratiot Lighthouse and Beach at the Sarnia Yacht Club	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR10	A – F	Just downstream of the Black River confluence	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR12	A – C	In Port Huron near Center Avenue	05/05/09 – 06/30/09	8 weeks
SR09	A – F	North of Marysville and the DTE power plant	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR08	A – F	Chrysler Beach and just downstream of Talford Creek on the Canadian side	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR07	A – F	North of the City of St. Clair and North of Mooretown	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR06	A – F	Just downstream of the Pine River	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR05	A – F	Downstream of Bowens Creek on the Canadian side	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR04	A – F	Just upstream of Clay Creek on the Canadian side	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR03	A – F	Just downstream of the Belle River and at the Dam Channel on the east side of Fawn Island	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR02	A – F	Roberts Landing and the Canadian Coast Guard facility	07/15/08 – 10/28/08	16 weeks
SR01	A – F	McRae's Big River Grille and just downstream of Channel Ecarte	07/15/08 – 10/28/08 05/05/09 – 06/30/09	16 weeks 8 weeks
SR00	A – C	South Channel on the south end of Harsens Island	07/15/08 – 10/28/08	16 weeks
NC00	A – C	North Channel at Colony Marine	07/15/08 – 10/28/08	16 weeks
MC00	A – C	Middle Channel at the first cottage south of the North Channel	07/15/08 – 10/28/08	16 weeks

Samples were collected on the St. Clair River over two separate sampling seasons. The first season lasted for 16 consecutive weeks from July 15 – October 28, 2008. The second season lasted for 8 consecutive weeks from May 5 – June 30, 2009.

Black River

Several factors were considered during selection of the monitoring sites for the Black River including: combined sewer outfall locations, flow conditions (the St. Clair River keeps the Black River surcharged with water for several miles inland), drainage characteristics, location of existing monitoring locations (sampled by the City of Port Huron and St. Clair County), field crew safety during sampling and available budget. Five sites were selected, three of which were located downstream of a CSO (BL01, BL02, and BL03). The sampling sites are depicted in Figure 4 and in Table 5.

Sampling in the Black River started in May of 2009. A total of 17 weeks of data were collected for stations BL01 – BL04. A fifth sampling location (BL05) was added partially through the sampling season for a total of 8 weeks of sampling.

Table 5. Black River Transect Descriptions (listed upstream to downstream)

Site ID	Transect Description	Sampling Interval	
BL05	Downstream of Wadhams Road	07/07/09 – 08/25/09	8 weeks
BL04	Upstream of Strawberry Lane	05/05/09 – 08/25/09	17 weeks
BL03	at Runnels Street	05/05/09 – 08/25/09	17 weeks
BL02	at 13th Street	05/05/09 – 08/25/09	17 weeks
BL01	at 10th Street	05/05/09 – 08/25/09	17 weeks

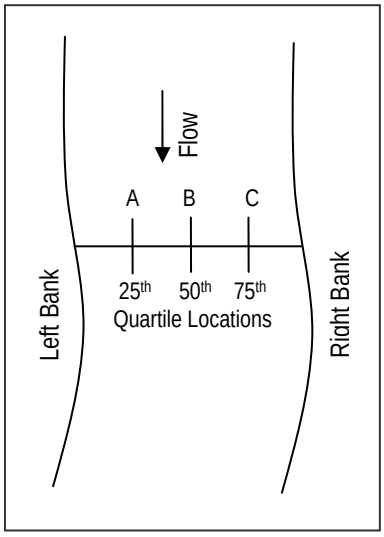
A more detailed description of both the St. Clair and Black River monitoring locations, including latitude and longitude information and maps are contained in Appendix C.

Sampling Frequency & Methods

All monitoring sites were sampled on a weekly basis during their respective monitoring period. For the locations on the main stem of the St. Clair River, six grab samples were taken across each river transect, with three samples collected on either side of the international boundary. Cross section SR12, consisted of samples on the U.S. side of the international boundary while three grab samples were taken at each transect in the St. Clair River delta.

After sampling was complete in 2008, secondary data was provided to the Project Team indicating elevated *E. coli* values on the Black River in Port Huron. Upon review of the data, it was determined that sampling should be conducted on the Black River during the monitoring period of 2009. Five cross sections were selected on the Black River (BL01 – BL05), and at each of the 5 transects a grab sample was collected at the 25th, 50th, and 75th quartile locations and identified as A, B and C, respectively (see sidebar).

After several weeks of sampling, the analytical data was reviewed by the Project Team for the purpose of determining where to collect the samples for bacterial source tracking (BST) analysis. BST site selection criteria included previous elevated (>1,000 cfu/100 mL) *E. coli* concentrations, weather conditions and budget. Because elevated *E. coli* concentrations on the St. Clair River or the Black River were infrequent, BST analysis was not



Depiction of Quartile Locations

performed at these sites. For that reason, the Project Team made the BST analysis available for samples collected by the St. Clair County Health Department and the City of Port Huron. On two separate occasions, both occurring after wet weather, samples were submitted by the County and/or the city for BST analysis. The results of these analyses are discussed in the Results section.

ANALYTICAL METHODS

Three analytical methods were utilized during this project – one traditional microbiological method was used to quantify the samples for *E. coli* density and two genetic microbial source tracking methods were used to identify the sources of the *E. coli* bacteria. *E. coli* enumeration was conducted using EPA method 1103.1. Multiple dilutions of each sample were analyzed yielding results between 10 and 360,000 colony forming units/100 mL (cfu/100 mL).

The genetic methods, the Human *Enterococcus* ID™ and the Human *Bacteroidetes* ID™, used the same process (polymerase chain reaction) to detect biomarkers for human contamination. Results for both tests were reported as either "positive" or "negative" for a biomarker that is found only in bacteria from the human gastrointestinal system. *Bacteroidetes* organisms will not survive long outside of the host organism, but are found in higher numbers in fecal samples. Therefore, a "positive" for the Human *Bacteroidetes* ID™ test indicates the presence of recent and likely a geographically close source of fecal pollution from human source(s). *Enterococcus* organisms survive longer than *Bacteroidetes*, but are found in fewer numbers in fecal samples. Therefore, presence of the human *Enterococcus* biomarker indicates *E. coli* contamination from a human source that may have occurred days prior and/or a longer distance upstream of the sampling point. A “positive” result for either test indicates the presence of *E. coli* from human source(s). It should be noted that false negatives can occur with either test when low numbers of the target organisms are present.

Figure 3a. Upper St. Clair River Monitoring Locations

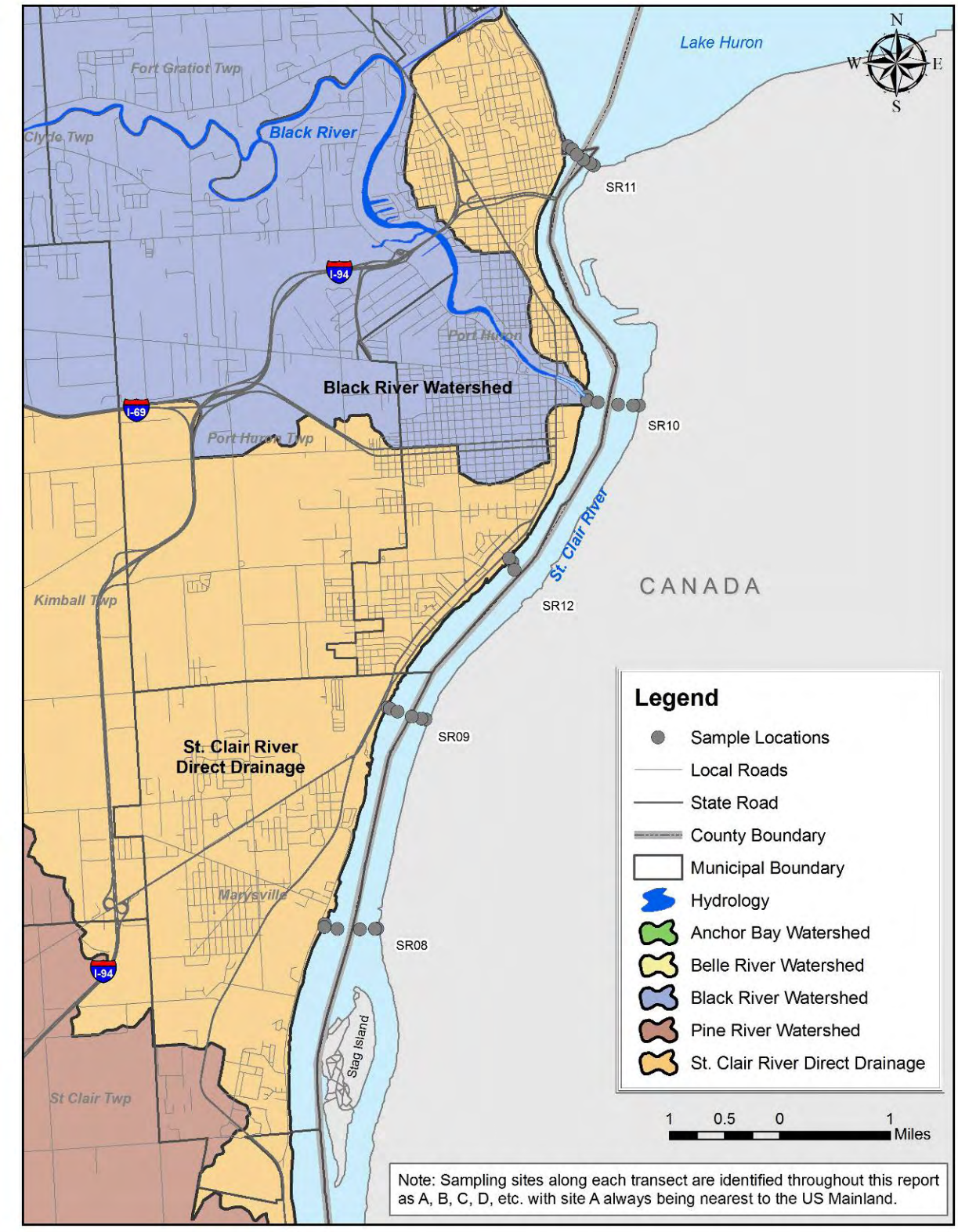


Figure 3b. Middle St. Clair River Monitoring Locations

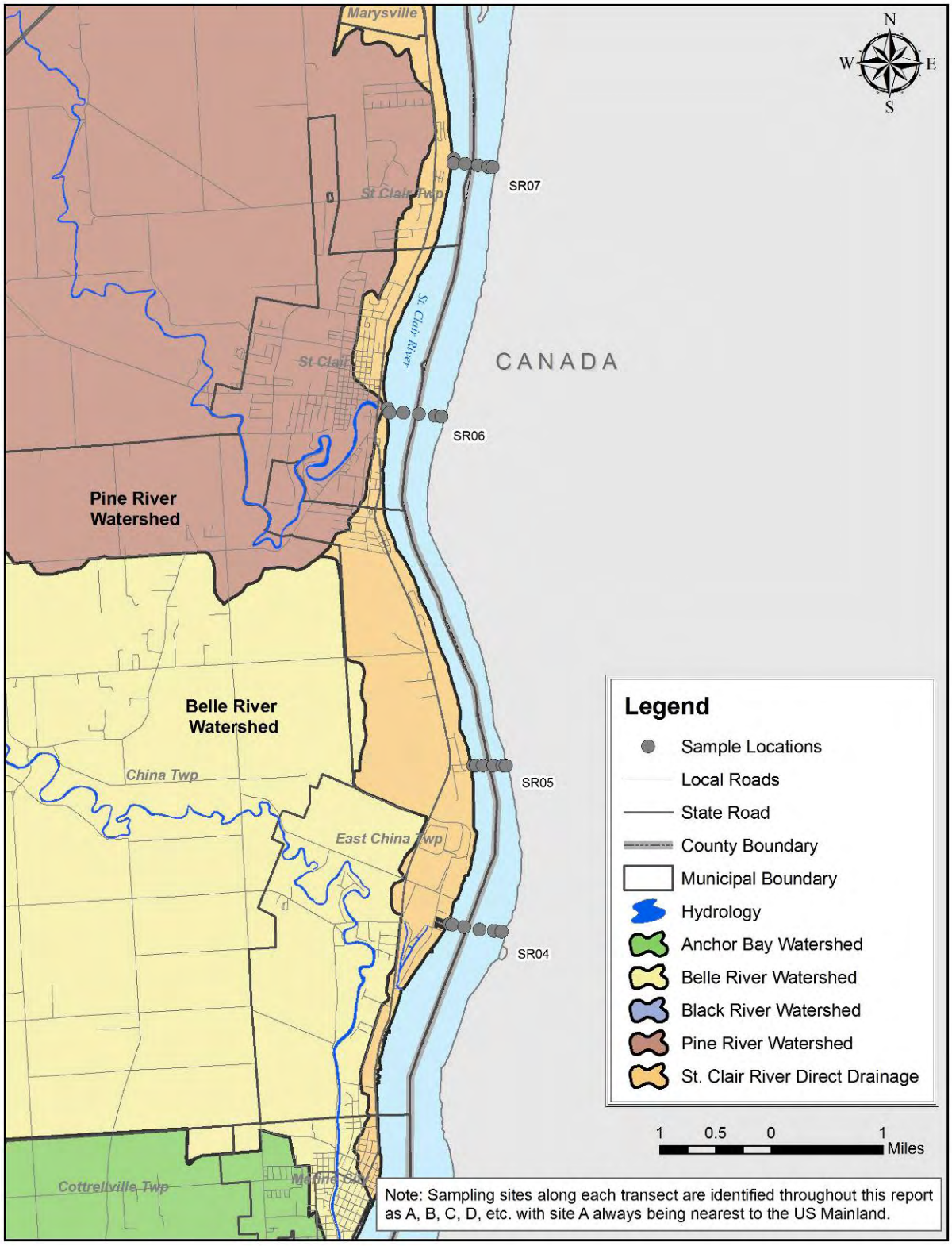
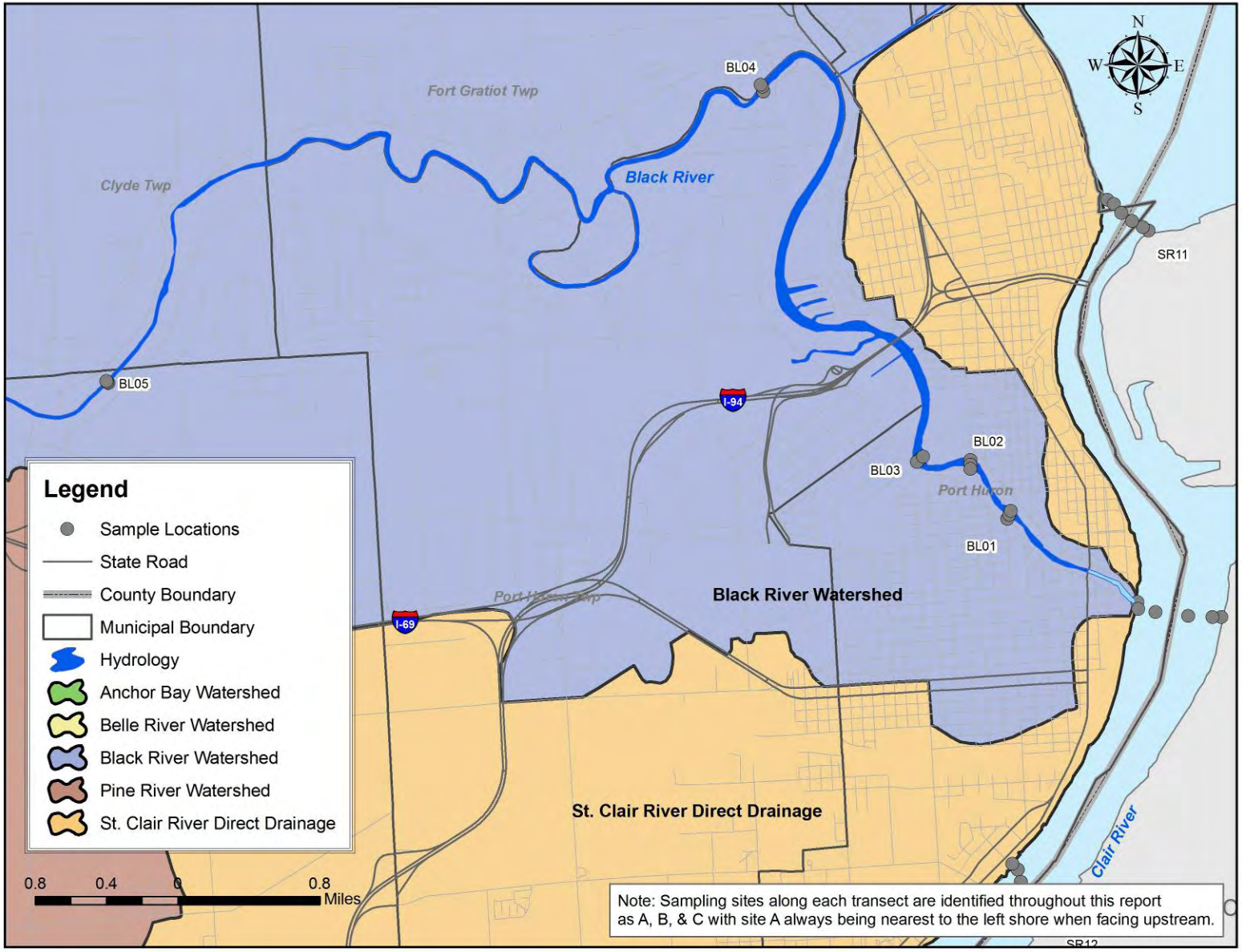


Figure 3c. Lower St. Clair River Monitoring Locations

Figure 4. Black River Monitoring Locations



Results & Discussion

The *E. coli* data is presented below in a variety of different manners. Summary statistics are provided in tables and graphs displaying the measure of central tendency (number of samples, average geometric mean and range) for each monitoring site. The frequency of WQS exceedances is also calculated and displayed. On the St. Clair River, only data from U.S. waters was used in the comparison to the WQSs.

Approximately 230 samples were collected and analyzed for *E. coli* from the Black River, while 1,761 samples were collected and analyzed from the St. Clair River. Three samples were analyzed for BST analysis: two samples from the Howe-Brandymore Drain and one sample from Stocks Creek. The complete *E. coli* and BST data sets can be found in Appendices D and E, respectively.

ST. CLAIR RIVER *E. COLI* CONCENTRATIONS

For the purpose of calculating geometric mean values, results for the St. Clair River transects were divided into two groups based on the location of the international boundary. This resulted in separate geometric means for samples collected in U.S. and Canadian waters. A minimum of three *E. coli* values were used for the geometric mean calculation per the Michigan WQSs.

The daily and 30-day geometric means for each transect were compared to the Michigan WQSs for *E. coli*. This comparison was made for samples taken in U.S. waters only. Of the 322 daily geometric means calculated, the WQS was exceeded once. This exceedence occurred at the transect directly downstream of the Black River (SR10) as shown in Table 6. This exceedence was associated with a rain event that measured over 4" for the weekend prior to sampling with 1.94" of that total falling on September 14th within 48 hours of sampling (as recorded in Port Huron and reported by www.accuweather.com). The St. Clair River 30-day geometric means met Michigan's WQS.

Table 6. St. Clair River Water Quality Exceedences (U.S. Waters only)

Transect	Daily Geometric Mean			30-Day Geometric Means		
	No. of Values	Exceedences (>300 cfu/100 mL)		No. of Values	Exceedences (>130 cfu/100 mL)	
		Number	Percent		Number	Percent
SR11 – Outlet of Lake Huron	24	0	0%	15	0	0%
SR10 – Downstream of Black River	25	1	4%	16	0	0%
SR12 – Port Huron near Center Ave	9	0	0%	4	0	0%
SR09 – DTE power plant	25	0	0%	16	0	0%
SR08 – Chrysler Beach	25	0	0%	16	0	0%
SR07 – North of St. Clair	25	0	0%	16	0	0%
SR06 – Downstream of Pine River	25	0	0%	16	0	0%
SR05 – Downstream of Bowens Cr	25	0	0%	16	0	0%
SR04 – upstream of Clay Creek	25	0	0%	16	0	0%
SR03 – Downstream of Belle River	25	0	0%	16	0	0%
SR02 – Roberts Landing	16	0	0%	12	0	0%
SR01 – McRae's Big River Grille	25	0	0%	16	0	0%
SR00 – South Channel	16	0	0%	12	0	0%
NC00 – North Channel	16	0	0%	12	0	0%
MC00 – Middle Channel	16	0	0%	12	0	0%
Totals	322	1	0.3%	211	0	0%

The daily geometric means were grouped into three categories: those less than or equal to the lower detection limit of 10 cfu/100 mL, those between 11 cfu/100 mL and the daily WQS of 300 cfu/100 mL and those greater than 300 cfu/100 mL. The average daily geometric means were also calculated. As shown in Table 7, the vast majority of the samples had *E. coli* concentrations below the detection limit. Arithmetic mean values indicate the highest *E. coli* concentrations, 46 cfu/100 mL, were found downstream of the Black River station (SR10) in US waters and upstream of Clay Creek in Canadian waters.

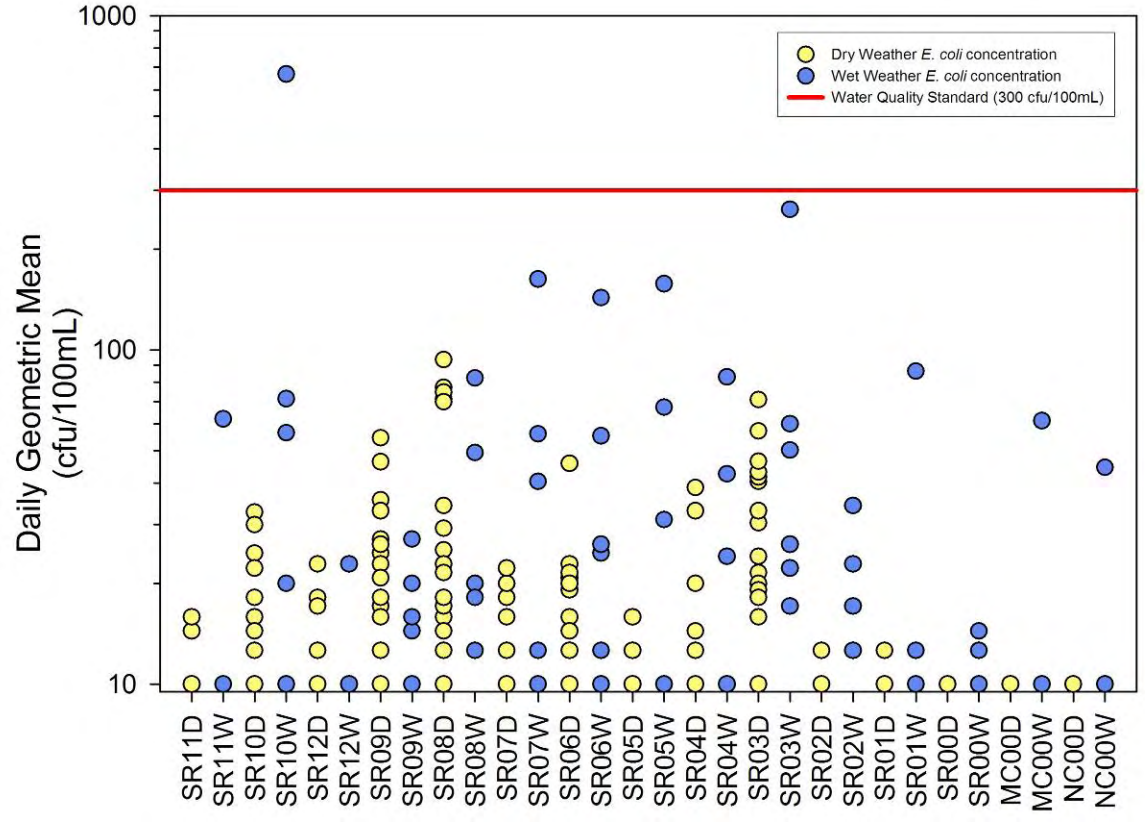
Table 7. St. Clair River Geometric Mean Statistics

Transect	Sampling Site Groupings	Country	Number of values	Daily Geometric Means (cfu/100 mL)			
				≤10*	11 - 300	> 300	Average
SR11 – Outlet of Lake Huron	A – C	US	24	20	4	0	13
	D – F	CA	24	17	7	0	12
SR10 – Downstream of Black River	A – C	US	25	8	16	1	46
	D – F	CA	25	9	16	0	18
SR12 – Port Huron near Center Ave	A – C	US	9	4	5	0	15
SR09 – DTE power plant	A – C	US	25	5	20	0	21
	D – F	CA	25	17	8	0	12
SR08 – Chrysler Beach Talford Creek	A – C	US	25	3	22	0	34
	D – F	CA	25	10	15	0	16
SR07 – North of St. Clair North of Mooretown	A – C	US	25	12	13	0	21
	D – F	CA	25	14	11	0	15
SR06 – Downstream of Pine River	A – C	US	25	5	20	0	24
	D – F	CA	25	18	7	0	13
SR05 – Downstream of Bowens Creek	A – C	US	25	17	8	0	20
	D – F	CA	25	16	9	0	13
SR04 – upstream of Clay Creek	A – C	US	25	17	8	0	18
	D – F	CA	25	8	17	0	33
SR03 – Downstream of Belle River At Dam Channel	A – C	US	25	4	21	0	39
	D – F	CA	25	17	8	0	13
SR02 – Roberts Landing	A – C	US	16	11	5	0	13
	D – F	CA	16	14	2	0	11
SR01 – McRae's Big River Grille	A – C	US	25	20	5	0	13
	D – F	CA	25	21	4	0	12
SR00 – South Channel	A – C	US	16	14	2	0	10
NC00 – North Channel	A – C	US	16	15	1	0	12
MC00 – Middle Channel	A – C	US	16	15	1	0	13

*The minimum detection limit = 10 cfu/100 mL

The daily geometric mean values were further evaluated based on weather conditions. Wet weather conditions were defined by events with rainfall volumes totaled 0.2" or more over the 30 hour period that preceded the start of a sampling event. Six wet weather events were sampled during the twenty-five weeks of sampling on the St. Clair River. The calculated daily geometric mean results are displayed in Figure 5. The data collected under dry weather conditions was consistently low, whereas the data collected during events designated as wet weather was much more variable. In spite of the increased variability of the wet weather data, the WQSs were still not exceeded. As mentioned above, the only exception to this was the data collected on September 16, 2008 downstream of the Black River (SR10).

Figure 5. St. Clair River Geometric Mean Results by Weather Condition



BLACK RIVER *E. COLI* CONCENTRATIONS

The Black River daily and 30-day geometric means for each transect were compared to the Michigan WQSs for *E. coli*. Of the 76 daily geometric means calculated, the WQS was exceeded two times (2.6% of the time), as displayed in Table 8. These exceedences occurred at Runnels Street (BL03) and upstream of Strawberry Lane (BL04). Both exceedences were associated with rain events. The exceedence at BL03 occurred on August 11, 2009 after over 1 inch of precipitation fell in the 48 hours prior to sample collection. The highest exceedence observed, 2,693 cfu/100 mL occurred at BL04 on July 21, 2009 after 0.3" of rain in the 48 hours prior to sample collection. This result was inconsistent with concentrations at BL02 and BL05 and seemed to be very high for such a small amount of precipitation.

The Black River 30-day geometric means met Michigan's monthly WQS.

Table 8. Black River Water Quality Exceedences

Transect	Daily Geometric Mean			30-Day Geometric Means		
	No. of Values	Exceedences (>300 cfu/100 mL)		No. of Values	Exceedences (>130 cfu/100 mL)	
		Number	Percent		Number	Percent
BL05 – Downstream of Wadhams Road	8	0	0%	4	0	0%
BL04 – Upstream of Strawberry Lane	17	1	6%	12	0	0%
BL03 – at Runnels Street	17	1	6%	12	0	0%
BL02 – at 13th Street	17	0	0%	12	0	0%
BL01 – at 10th Street	17	0	0%	12	0	0%
Totals	76	2	2.6%	52	0	0%

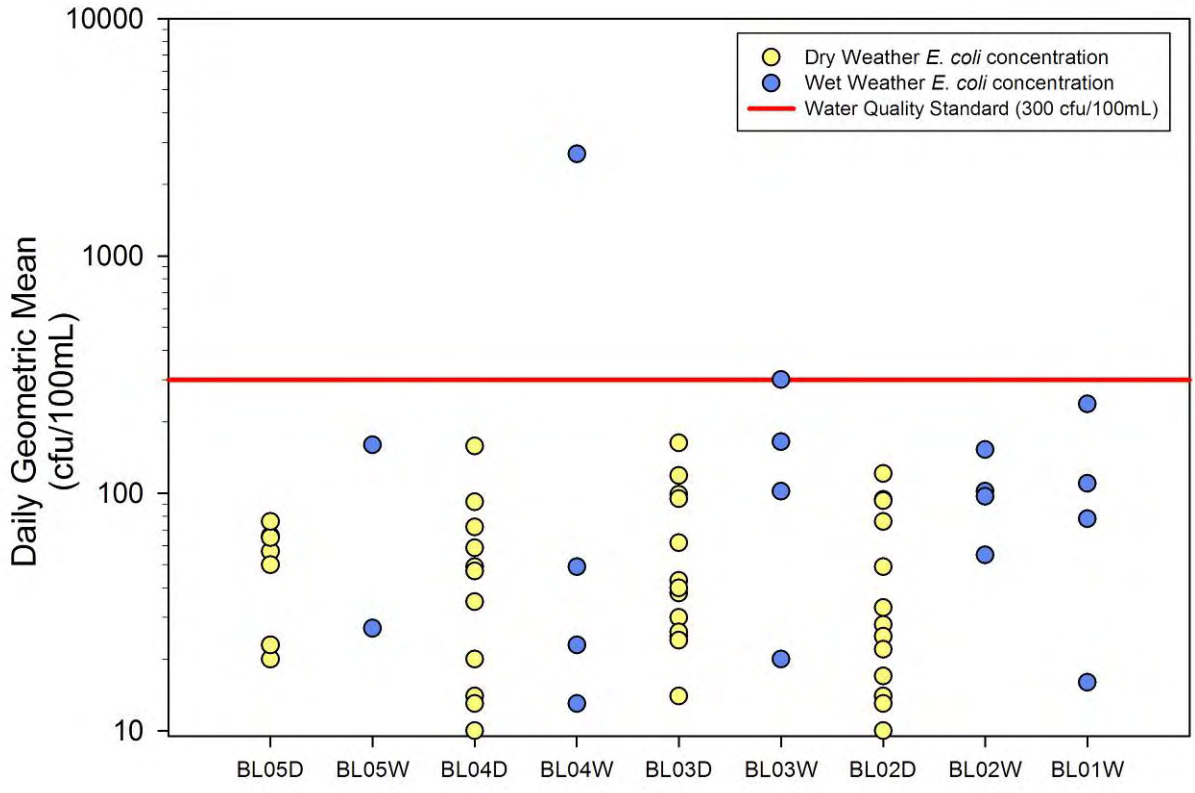
As with the St. Clair River, the Black River daily geometric means were grouped into three categories: those less than or equal to the lower detection limit of 10 cfu/100 mL, those between 11 cfu/100 mL and the daily WQS of 300 cfu/100 mL and those greater than 300 cfu/100 mL. The average daily geometric means were also calculated. As shown in Table 9, the vast majority of the samples at each site had *E. coli* concentrations between 11 cfu/100 mL and 300 cfu/100 mL. Arithmetic mean values indicate the highest *E. coli* concentration was found upstream of Strawberry Lane (BL04).

Table 9. Black River Geometric Mean Statistics (sites listed upstream to downstream)

Sampling Sites	Daily Geometric Means (cfu/100 mL)				
	Number of Values	≤10*	11 - 300	> 300	Average
BL05 – Downstream of Wadhams Road	8	0	8	0	62
BL04 – Upstream of Strawberry Lane	17	2	14	1	198
BL03 – at Runnels Street	17	0	16	1	80
BL02 – at 13th Street	17	1	16	0	59
BL01 – at 10th Street	17	1	16	0	69

The daily geometric mean values were further evaluated based on weather conditions as with the St. Clair River. Four wet weather events occurred during the 17 weeks of sampling on the Black River. The results during wet weather were slightly higher than those data collected during dry conditions. This data is displayed in Figure 6.

Figure 6. Black River Geometric Mean Results by Weather Condition



BACTERIAL SOURCE TRACKING RESULTS

It should be emphasized that bacterial source testing was only used on a limited number of samples at a select number of locations. Since comprehensive testing was not performed (multiple samples over a long period of time), a "negative" result at any given site doesn't mean that human contamination is not present at that site, only that it was not present in that particular sample. All project BST data, the associated *E. coli* and *Enterococcus* concentrations are reported in Appendix F.

St. Clair River

Due to the consistently low *E. coli* results, BST analysis was not performed on the St. Clair River samples.

Black River

Eight total samples from the Black River and its tributaries were collected for BST analysis. Only three samples had *E. coli* values above 1,000 cfu/100 mL and were analyzed for BST. Of the three samples, one from the Howe-Brandymore Drain had a positive result for the Human Enterococcus ID method.

Quality Control Review

All project efforts from sample collection to laboratory analysis were performed under the guidance of a Quality Assurance Project Plan (QAPP), which was approved by the MDEQ and EPA prior to the start of sampling. An analysis of the data precision and completeness is provided below.

PRECISION

Field precision, or the ability of the sampling team to collect two samples with a high degree of similarity, was assessed by the collection and submission for analysis of field duplicate samples. Field duplicate samples were collected from the same location, at the same time, using the same sampling method, and were then independently analyzed in the same manner. One duplicate sample was collected for every ten *E. coli* samples.

For quantitative microbiological analysis, precision is calculated using the method outlined in Standard Methods for the Examination of Wastewater, 18th Edition, section 9020B.4.b:

$$RPD_{bacteria} = (\log X_1 - \log X_2)$$

The $RPD_{bacteria}$ should be lower than $3.27 \sum R_{log} / n$, where R_{log} is the difference in the natural log of replicate samples for the first or most recent set of 15 samples, and where n is the number of samples.

All but two of the reviewed duplicate sample sets fell within the acceptable range for precision as described above. The ten analytical results closest to each out of range duplicate were flagged (see Appendix D). This resulted in 20 flagged sample results. The blank and duplicate sampling results are provided in Appendix E.

ACCURACY

Accuracy was assessed by the laboratory staff through the analysis of positive and negative controls. Negative controls were also used by field staff in the form of blank samples. One blank sample was collected for every twenty *E. coli* samples throughout the course of the field effort. All blanks were handled and analyzed in the same manner as the river samples. None of the 101 blanks were found to be at or above the sample detection limit of 10 cfu/100 mL.

COMPLETENESS

Every effort was made to obtain valid data for each sampling point at all times. Completeness was measured by dividing the number of usable sample results by the total number of sample results. The completeness objective for this project was 90%.

As mentioned above, two of the duplicate samples collected from the St. Clair and Black rivers did not meet the precision requirements. The laboratory and field crew reviewed their procedures and found no erroneous behavior, thus it was the project QA/QC manager's opinion that the analytical results from the 10 samples collected closest to the erroneous duplicate sample were kept and used in calculations, but flagged.

This resulted in a total project completeness factor of 99%. Thus, the project completeness objective was met (see Table 10).

Table 10. Completeness Calculations

	No. of samples collected	No. of samples flagged	No. of usable samples	% Complete
St. Clair River and Delta	1,761	20	1,741	98.9%
Black River	328	0	328	100%
Total	2,089	20	2,069	99%

DEVIATIONS FROM THE QAPP

No deviations to the QAPP occurred throughout the course of the project.

Conclusions

St. Clair River

The ambient *E. coli* concentrations in the St. Clair River are very low. There was only 1 exceedance (0.3%) of Michigan's Water Quality Standards for *E. coli* on the St. Clair River based on 25 weeks of monitoring data collected in 2008 and 2009. This exceedence occurred downstream of the confluence of the Black River following an extreme rain event totaling more than 4 inches over a 4 day period. The highest *E. coli* concentrations in U.S. and Canadian waters were found downstream of the Black River and upstream of Clay Creek, respectively.

Despite the low *E. coli* concentrations documented along sample transects by the EPA/MDEQ, individual shoreline samples and beach samples collected by the City of Port Huron and St. Clair County Health Department indicate occasional elevated *E. coli* concentrations. These additional data suggest that localized sources of *E. coli* are entering the St. Clair River, although they generally did not cause elevated concentrations in the transect samples. These sources likely include sanitary sewer overflows and untreated combined sewer overflows.

Black River

The ambient *E. coli* concentrations in the Black River are fairly low. However, there were two exceedances (2.6%) of Michigan's Water Quality Standards for *E. coli* based on 17 weeks of monitoring data collected in 2009. One of these exceedences occurred on the Black River at Strawberry Lane and the other occurred at Runnels Street. The highest *E. coli* concentration was found upstream of Strawberry Lane. *E. coli* from human sources was found in a tributary to the Black River, the Howe Brandymore Drain, as indicated by the BST results.

Despite the fairly low ambient concentrations, shoreline and tributary samples collected by the City of Port Huron and St. Clair County Health Department frequently had elevated *E. coli* concentrations. This indicates that localized sources of *E. coli* are entering the Black River. These sources likely include untreated combined sewer overflows, failing septic systems, illicit connections to the storm sewer system, pet, farm animal and wildlife feces, and re-suspended sediment.

References

Blumer, S.P., T.E. Behrendt, C.R. Whited, J.M. Ellis, R.J. Minnerick, and R.L. LeuVoy (2005). *Water Resources Data, Michigan, Water Year 2004: Water-Data Report MI-04-1.* Lansing, MI: USGS.

Holtschlag, David J., John A. Koschik (2001). *Steady-State Flow Distribution and Monthly Flow Duration in Selected Branches of St. Clair and Detroit Rivers within the Great Lakes Waterway: Water-Resources Investigations Report 01-4135*. Lansing, MI: USGS.

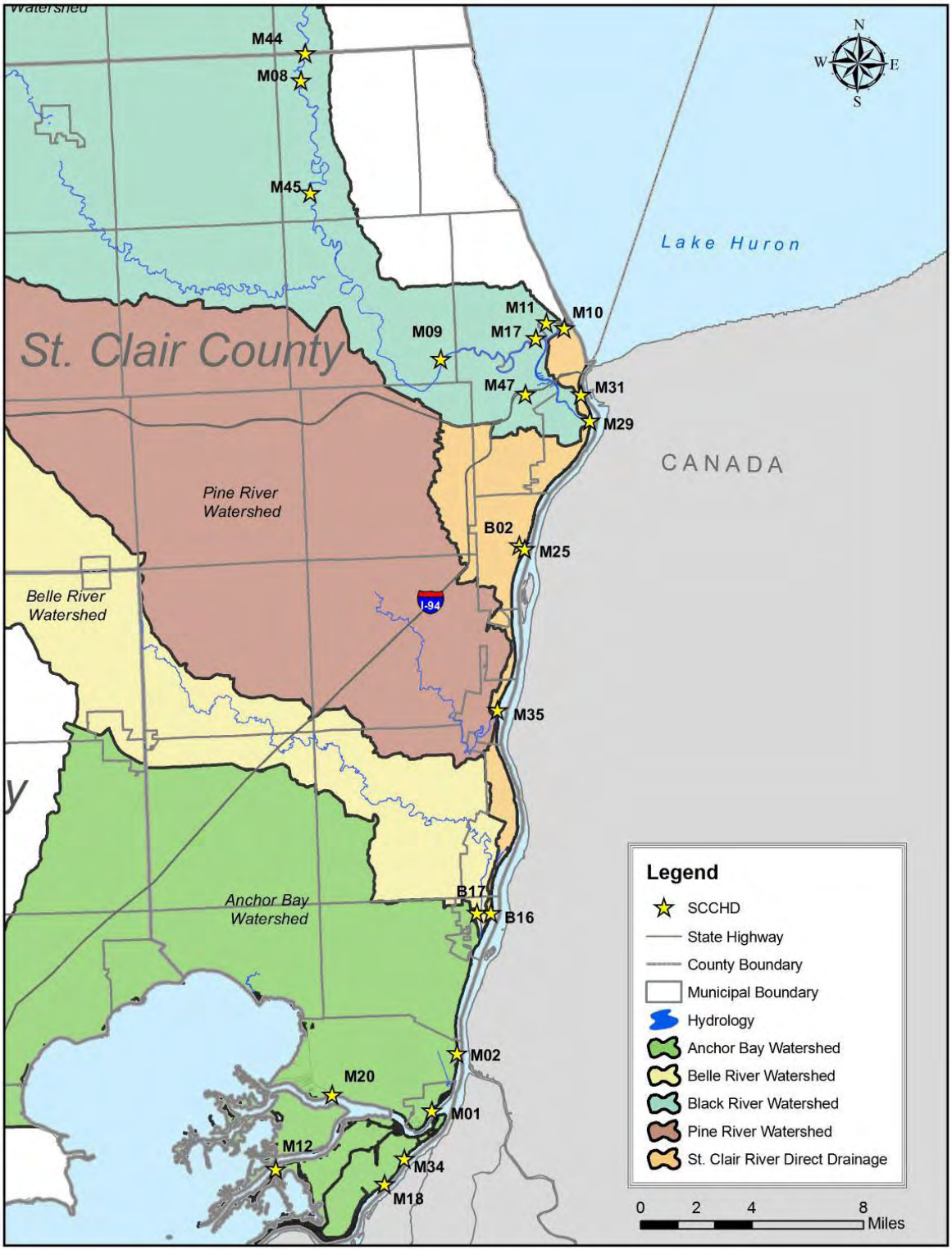
Public Sector Consultants (PSC) (2009). *Huron to Erie Alliance for Real-time Monitoring and Information: A Recommended Framework for Governance and Funding.*

St. Clair County's Northeastern Watersheds Watershed Management Plan (2006). Retrieved from http://www.stclaircounty.org/offices/health/Water_Northeastern.aspx

St. Clair River Area of Concern Remedial Action Plan Stage 1: Environmental Conditions and Problem Definitions (1992). Retrieved from http://www.epa.gov/glnpo/aoc/stclair/1992_SCR%20RAP%20Stg%201.pdf.

Appendix A
County and City Monitoring Locations

St. Clair County Health Department's Monitoring Locations



City of Port Huron's Monitoring Locations

Appendix B
County and City *E. coli* Data

St Clair County Health Department *E. coli* Monitoring Data

Black River

Black River at Fisher Road (M44)	
Date	*E. coli* (cfu/100mL)
06/09/09	649
06/24/09	93
07/07/09	201
08/05/09	135
08/12/09	1,553
08/19/09	161
09/02/09	47

Black River at Jeddo Road (M08)	
Date	*E. coli* (cfu/100mL)
05/19/05	25
06/23/05	84
07/28/05	89
06/27/06	276
07/27/06	435
08/28/06	1,120
06/14/07	108
07/26/07	59
08/28/07	145
05/20/08	22
06/24/08	1,046
07/16/08	461
08/21/08	201
06/09/09	184
06/24/09	162
07/07/09	162
08/05/09	210
08/19/09	64
09/02/09	45

Black River at Norman Road (M45)	
Date	*E. coli* (cfu/100mL)
06/09/09	162
06/24/09	93
07/07/09	194
08/05/09	66
08/19/09	51
09/02/09	26

Black River at Old North River Road (M09)	
Date	*E. coli* (cfu/100mL)
05/19/05	46
06/23/05	146
07/28/05	53
06/27/06	276
07/27/06	138
08/28/06	816
06/14/07	54
07/26/07	33
08/28/07	36
05/20/08	28
06/24/08	64
07/16/08	56
08/20/08	74
06/09/09	214
06/24/09	225
07/07/09	66
08/06/09	75
08/18/09	36
09/02/09	28

Black River at Fort Gratiot Twp Park (M17)	
Date	*E. coli* (cfu/100mL)
05/18/05	44
05/26/05	37
06/02/05	44
06/08/05	66
06/15/05	133
06/22/05	78
06/29/05	186
07/07/05	192
07/13/05	225
07/20/05	138
07/28/05	238
08/03/05	0
08/10/05	86
08/18/05	68
08/24/05	10
05/24/06	20
06/01/06	91
06/07/06	142
06/14/06	86
06/22/06	122
06/28/06	488
07/12/06	326
07/19/06	133
07/26/06	101
08/02/06	54
08/09/06	172
08/14/06	91
08/23/06	151
08/31/06	119
05/21/07	44
05/29/07	51
06/07/07	38
06/13/07	35
06/20/07	147
06/27/07	68
07/11/07	108
07/18/07	79
07/25/07	40
08/01/07	55
08/09/07	162
08/15/07	32
08/22/07	7
05/28/08	19
06/02/08	0
06/03/08	34
06/11/08	866
06/17/08	142
06/24/08	1,778
07/02/08	276
07/08/08	115
07/15/08	105
07/22/08	37
07/29/08	186
08/06/08	124
08/12/08	15
08/19/08	13
08/27/08	10
05/27/09	20
06/01/09	194
06/09/09	17
06/16/09	59
06/23/09	219
06/30/09	53
07/07/09	105
07/13/09	157
07/21/09	326
07/29/09	142
08/04/09	119

Black River Outlet (M29)	
Date	*E. coli* (cfu/100mL)
05/19/04	68
06/03/04	62
06/09/04	61
06/16/04	1,733
06/23/04	129
06/30/04	1,046
07/08/04	365
07/14/04	222
07/19/04	86
07/28/04	517
08/04/04	579
08/11/04	33
08/18/04	31
08/25/04	46
09/01/04	32
05/18/05	37
05/26/05	51
06/02/05	24
06/08/05	166
06/15/05	147
06/22/05	70
06/29/05	866
07/07/05	35
07/13/05	0
07/20/05	91
07/28/05	72
08/03/05	0
08/03/05	0
08/10/05	26
08/17/05	47
08/24/05	0
05/24/06	59
06/01/06	326
06/07/06	44
06/14/06	37
06/22/06	155
06/28/06	61
07/12/06	34
07/19/06	39
07/26/06	44
08/02/06	17
08/09/06	172
08/14/06	135
08/23/06	38
08/31/06	291
05/29/07	66
06/07/07	33
06/13/07	47
06/20/07	41
06/27/07	36
07/11/07	120
07/18/07	248
07/25/07	308
08/01/07	23
08/09/07	816
08/15/07	49
05/28/08	11
06/03/08	29
06/11/08	115
06/17/08	19
06/24/08	64
07/02/08	142
07/08/08	60
07/15/08	32
07/22/08	38
07/29/08	37
08/06/08	326
08/12/08	28
08/19/08	31
08/27/08	47

Black River Tributaries

Howe-Brandymore Drain at Krafft Road (M11)	
Date	*E. coli* (cfu/100mL)
05/19/05	687
06/23/05	1,414
07/28/05	1,414
06/27/06	1,300
07/27/06	1,300
08/28/06	1,120
06/14/07	1,046
07/26/07	980
08/28/07	435
05/20/08	517
06/24/08	365
07/16/08	649
08/20/08	125
06/09/09	2,419
06/23/09	248
07/06/09	147
08/04/09	228
08/11/09	2,419
08/18/09	133
09/02/09	387

Stocks Creek near outlet (M47)	
Date	*E. coli* (cfu/100mL)
06/09/09	2,419
06/24/09	921
07/07/09	816
08/06/09	821
08/11/09	1,733
08/19/09	326
09/02/09	365

Black River canal (M10)	
Date	*E. coli* (cfu/100mL)
05/24/05	76
06/06/05	74
06/13/05	161
06/20/05	17
06/27/05	2
07/05/05	21
07/11/05	25
07/18/05	46
07/25/05	32
08/01/05	6
08/08/05	6
08/16/05	2
08/22/05	36
05/22/06	52
05/30/06	23
06/05/06	5
06/12/06	11
06/19/06	1
06/26/06	36
07/11/06	9
07/17/06	10
07/25/06	3
07/31/06	36
08/07/06	15
08/15/06	72
08/21/06	81
08/30/06	105
06/07/07	3
06/11/07	3
06/20/07	548
06/25/07	1
07/02/07	6
07/09/07	11
07/16/07	4
07/23/07	2
07/30/07	15
08/06/07	6
08/13/07	186
05/27/08	140
06/02/08	1
06/09/08	4
06/16/08	4
06/23/08	2
07/01/08	17
07/07/08	1
07/14/08	3
07/21/08	2
07/29/08	4
08/04/08	7
08/11/08	261
08/19/08	435
08/26/08	17

Samples > 300 cfu/100mL

St. Clair River Beaches

Chrysler Beach (B2)	
Date	*E. coli* Daily Geomean (cfu/100mL)
05/18/04	66
05/26/04	517
06/02/04	38
06/08/04	135
06/15/04	71
06/22/04	33
06/29/04	145
07/07/04	32
07/13/04	16
07/20/04	14
07/28/04	197
08/03/04	13
08/10/04	26
08/17/04	27
08/24/04	13
08/31/04	19
05/25/05	27
06/01/05	36
06/07/05	55
06/14/05	25
06/21/05	12
06/28/05	10
07/06/05	15
07/12/05	16
07/19/05	27
07/27/05	40
08/02/05	41
08/09/05	17
08/17/05	27
08/23/05	38
09/01/05	34
05/23/06	6
05/31/06	10
06/06/06	2
06/13/06	10
06/20/06	35
06/28/06	10
07/05/06	11
07/12/06	742
07/13/06	89
07/18/06	22
07/26/06	852
07/27/06	20
08/01/06	151
08/08/06	34
08/14/06	26
08/22/06	18
08/29/06	58
05/23/07	7
05/29/07	9
06/06/07	9
06/12/07	15
06/19/07	9
06/26/07	9
07/05/07	10
07/10/07	160
07/19/07	136
07/24/07	15
07/31/07	27
08/08/07	373
08/09/07	215
08/14/07	34
08/22/07	2
08/28/07	12

Chrysler Beach (B2)	
Date	*E. coli* Daily Geomean (cfu/100mL)
05/19/08	6
05/27/08	7
06/02/08	28
06/09/08	82
06/16/08	17
06/23/08	14
07/01/08	17
07/08/08	16
07/14/08	39
07/21/08	29
07/28/08	27
08/04/08	19
08/11/08	15
08/18/08	66
08/25/08	45
05/12/09	24
05/18/09	108
05/26/09	12
06/01/09	17
06/10/09	7
06/15/09	3
06/22/09	69
06/30/09	50
07/06/09	15
07/13/09	54
07/20/09	45
07/28/09	139
08/05/09	270
08/12/09	46
08/17/09	304
08/18/09	415
08/19/09	173
08/20/09	1,518
08/24/09	39
08/25/09	304
08/26/09	802
08/27/09	34
08/31/09	30
09/01/09	97

Marine City Beach (B16)	
Date	*E. coli* Daily Geomean (cfu/100mL)
05/18/04	7
05/26/04	314
06/02/04	26
06/08/04	4
06/15/04	31
06/22/04	7
06/29/04	6
07/07/04	4
07/13/04	3
07/20/04	1
07/28/04	38
08/03/04	2
08/10/04	3
08/17/04	2
08/24/04	3
08/31/04	5
05/25/05	9
06/01/05	7
06/07/05	13
06/14/05	16
06/21/05	2
06/28/05	1
07/06/05	3
07/12/05	1
07/19/05	19
07/27/05	22
08/02/05	1
08/09/05	11
08/17/05	2
08/23/05	2
09/01/05	10
05/23/06	3
05/31/06	1
06/06/06	2
06/13/06	1
06/20/06	2
06/27/06	10
07/05/06	7
07/11/06	6
07/18/06	6
07/26/06	6
08/01/06	5
08/08/06	4
08/14/06	1
08/22/06	15
08/29/06	33
05/23/07	1
05/29/07	1
06/06/07	2
06/12/07	1
06/19/07	7
06/26/07	2
07/05/07	4
07/10/07	3
07/19/07	11
07/24/07	2
07/31/07	5
08/08/07	24
08/14/07	3
08/22/07	5
08/28/07	1

Marine City Beach (B16)	
Date	*E. coli* Daily Geomean (cfu/100mL)
05/19/08	2
05/27/08	2
06/02/08	2
06/09/08	19
06/16/08	2
06/23/08	6
07/01/08	5
07/08/08	5
07/14/08	3
07/21/08	2
07/28/08	1
08/04/08	4
08/11/08	10
08/18/08	7
08/25/08	13
05/12/09	7
05/18/09	14
05/26/09	3
06/02/09	2
06/10/09	2
06/15/09	1
06/22/09	24
06/30/09	8
07/06/09	6
07/13/09	3
07/20/09	16
07/28/09	11
08/05/09	3
08/13/09	6
08/17/09	2
08/24/09	3
08/31/09	3

Marine City Diving Area (B17)	
Date	*E. coli* Daily Geomean (cfu/100mL)
05/18/04	6
05/26/04	223
06/02/04	30
06/08/04	13
06/15/04	39
06/22/04	7
06/29/04	6
07/07/04	9
07/13/04	3
07/20/04	3
07/27/04	6
08/03/04	1
08/10/04	7
08/17/04	3
08/24/04	9
08/31/04	2
05/25/05	10
06/01/05	5
06/07/05	17
06/14/05	17
06/21/05	6
06/28/05	3
07/06/05	5
07/12/05	5
07/19/05	16
07/27/05	26
08/02/05	5
08/09/05	19
08/17/05	3
08/23/05	6
09/01/05	7
05/23/06	2
05/31/06	6
06/06/06	2
06/13/06	2
06/20/06	3
06/27/06	13
07/05/06	6
07/11/06	4
07/18/06	5
07/26/06	5
08/01/06	5
08/08/06	25
08/14/06	3
08/22/06	19
08/29/06	21
05/23/07	1
05/29/07	1
06/06/07	1
06/12/07	2
06/19/07	5
06/26/07	2
07/05/07	3
07/10/07	4
07/19/07	19
07/24/07	2
07/31/07	2
08/08/07	23
08/14/07	2
08/22/07	2
08/28/07	4

Marine City Diving Area (B17)	
Date	*E. coli* Daily Geomean (cfu/100mL)
05/15/08	10
05/19/08	6
05/27/08	14
06/02/08	5
06/09/08	12
06/16/08	4
06/23/08	4
07/01/08	6
07/08/08	4
07/14/08	42
07/21/08	8
07/28/08	5
08/04/08	2
08/11/08	9
08/18/08	7
08/25/08	10
05/12/09	10
05/18/09	14
05/26/09	2
06/02/09	1
06/10/09	7
06/15/09	3
06/22/09	18
06/30/09	12
07/06/09	9
07/13/09	4
07/20/09	19
07/27/09	9
08/05/09	7
08/13/09	9
08/17/09	2
08/24/09	6
08/31/09	3

Samples > 300 cfu/100mL

St. Clair River

Pine Grove Park (M31)	
Date	*E. coli* (cfu/100mL)
06/03/04	15
06/09/04	1
06/16/04	10
06/23/04	2
06/30/04	1
07/08/04	2
07/14/04	2
07/19/04	1
07/28/04	2
08/04/04	17
08/11/04	1
08/18/04	2
08/25/04	3
09/01/04	1
05/18/05	1
05/26/05	1
06/02/05	2
06/08/05	1
06/15/05	3
06/22/05	6
06/29/05	1
07/07/05	1
07/13/05	1
07/28/05	1
08/03/05	0
08/10/05	1
08/18/05	1
08/24/05	1
05/24/06	1
06/01/06	1
06/07/06	1
06/14/06	1
06/22/06	1
06/28/06	1
07/12/06	2
07/19/06	1
07/26/06	1
08/02/06	1
08/09/06	1
08/14/06	2
08/23/06	1
08/31/06	2
05/29/07	1
06/07/07	1
06/13/07	1
06/20/07	1
06/27/07	1
07/11/07	1
07/18/07	1
07/25/07	1
08/01/07	1
08/09/07	9
08/15/07	1
05/28/08	1
06/03/08	1
06/11/08	1
06/17/08	1
06/24/08	1
07/02/08	1
07/08/08	1
07/15/08	1
07/22/08	1
07/29/08	1
08/06/08	1
08/12/08	0
08/19/08	6
08/27/08	0

Marysville City Park (M25)	
Date	*E. coli* (cfu/100mL)
06/02/04	17
06/08/04	12
06/15/04	53
06/22/04	21
06/29/04	7
07/07/04	20
07/13/04	31
07/20/04	11
07/27/04	121
08/03/04	2,419
08/10/04	35
08/17/04	35
08/24/04	9
08/31/04	6
05/25/05	0
06/01/05	0
06/07/05	57
06/21/05	12
06/28/05	17
07/05/05	10
07/12/05	50
07/19/05	42
07/27/05	37
08/02/05	93
08/09/05	51
08/17/05	114
08/23/05	225
05/23/06	4
05/31/06	33
06/06/06	4
06/13/06	31
06/20/06	28
06/27/06	16
07/11/06	28
07/18/06	44
07/26/06	80
08/01/06	25
08/08/06	111
08/14/06	32
08/22/06	64
08/29/06	38
05/30/07	0
06/12/07	0
06/19/07	10
06/26/07	12
07/10/07	12
07/24/07	50
07/31/07	49
08/08/07	205
08/14/07	58
05/27/08	0
06/02/08	27
06/09/08	4
06/16/08	1
06/23/08	21
07/01/08	21
07/08/08	11
07/14/08	21
07/21/08	26
07/28/08	5
08/04/08	29
08/11/08	21
08/18/08	9
08/25/08	37

St. Clair Boardwalk (M35)	
Date	*E. coli* (cfu/100mL)
06/02/04	29
06/08/04	37
06/15/04	44
06/22/04	11
06/29/04	10
07/07/04	16
07/13/04	9
07/20/04	11
07/27/04	9
08/03/04	9
08/10/04	1
08/17/04	4
08/24/04	6
08/31/04	1
05/25/05	0
06/01/05	0
06/07/05	22
06/14/05	16
06/21/05	10
06/28/05	11
07/06/05	12
07/12/05	7
07/19/05	20
07/27/05	162
08/02/05	3
08/09/05	3
08/17/05	3
08/23/05	6
05/23/06	20
05/31/06	28
06/06/06	93
06/13/06	3
06/20/06	12
06/27/06	10
07/11/06	10
07/18/06	2
07/26/06	11
08/01/06	11
08/08/06	12
08/14/06	24
08/22/06	24
08/29/06	29
05/30/07	0
06/06/07	5
06/12/07	46
06/19/07	22
06/26/07	1
07/10/07	2
07/24/07	19
07/31/07	4
08/08/07	53
08/14/07	2
05/27/08	1
06/02/08	14
06/09/08	22
06/16/08	2
06/23/08	9
07/01/08	6
07/08/08	5
07/14/08	15
07/21/08	23
07/28/08	228
08/04/08	23
08/11/08	7
08/18/08	6
08/25/08	34

Algonac Boardwalk (M01)	
Date	*E. coli* (cfu/100mL)
06/02/04	11
06/08/04	10
06/15/04	66
06/22/04	9
06/29/04	3
07/07/04	11
07/13/04	34
07/20/04	3
07/27/04	11
08/03/04	3
08/10/04	4
08/17/04	2
08/24/04	2
08/31/04	3
05/25/05	22
06/01/05	3
06/07/05	10
06/14/05	10
06/21/05	4
06/28/05	4
07/06/05	15
07/12/05	5
07/27/05	17
08/02/05	50
08/09/05	70
08/17/05	1
08/23/05	5
05/23/06	2
05/31/06	46
06/06/06	6
06/13/06	12
06/20/06	2
06/27/06	7
07/11/06	7
07/18/06	3
07/26/06	7
08/01/06	4
08/16/06	3
08/22/06	1
08/29/06	10
05/30/07	2
06/06/07	1
06/12/07	2
06/19/07	816
06/26/07	4
07/10/07	17
07/24/07	4
07/31/07	2
08/08/07	11
08/14/07	2
05/27/08	2
06/02/08	2
06/09/08	12
06/16/08	1
06/23/08	12
07/01/08	8
07/08/08	12
07/14/08	3
07/21/08	1
07/28/08	1
08/04/08	2
08/11/08	7
08/18/08	0
08/25/08	3

Algonac State Park (M02)	
Date	*E. coli* (cfu/100mL)
05/18/04	14
06/02/04	22
06/08/04	9
06/15/04	147
06/22/04	42
06/29/04	6
07/07/04	12
07/13/04	96
07/20/04	7
07/27/04	26
08/03/04	5
08/10/04	8
08/17/04	3
08/24/04	56
08/31/04	5
05/25/05	0
06/01/05	0
06/07/05	0
06/14/05	10
06/21/05	1
06/28/05	15
07/06/05	10
07/12/05	7
07/19/05	67
07/27/05	51
08/02/05	4
08/09/05	9
08/17/05	3
08/23/05	3
05/23/06	1
05/31/06	133
06/06/06	6
06/13/06	18
06/20/06	3
07/11/06	118
07/18/06	36
07/26/06	10
08/01/06	91
08/08/06	6
08/16/06	11
08/22/06	10
08/29/06	58
05/30/07	6
06/06/07	5
06/12/07	7
06/19/07	2
06/26/07	185
07/10/07	3
07/24/07	56
07/31/07	6
08/08/07	84
08/14/07	6
05/27/08	12
06/02/08	1
06/09/08	26
06/16/08	2
06/23/08	6
07/01/08	9
07/08/08	13
07/14/08	3
07/21/08	5
07/28/08	11
08/04/08	20
08/11/08	12
08/18/08	2
08/25/08	1

Samples > 300 cfu/100mL

St. Clair River (continued)

Pine Grove Park (M31)	
Date	*E. coli* (cfu/100mL)

Marysville City Park (M25)	
Date	*E. coli* (cfu/100mL)
05/26/09	1
06/02/09	2
06/10/09	5
06/15/09	2
06/22/09	40
06/30/09	20
07/06/09	15
07/13/09	38
07/20/09	96
07/28/09	75
08/05/09	57
08/13/09	20
08/17/09	47
08/24/09	35
08/31/09	3

St. Clair Boardwalk (M35)	
Date	*E. coli* (cfu/100mL)
05/26/09	8
06/02/09	5
06/10/09	1
06/15/09	1
06/22/09	22
06/30/09	6
07/06/09	1
07/13/09	7
07/20/09	41
07/28/09	16
08/05/09	11
08/13/09	4
08/17/09	4
08/24/09	6
08/31/09	1

Algonac Boardwalk (M01)	
Date	*E. coli* (cfu/100mL)
05/27/09	14
06/02/09	6
06/10/09	6
06/15/09	3
06/22/09	28
06/29/09	7
07/13/09	1
07/20/09	5
07/28/09	1
08/05/09	2
08/13/09	16
08/17/09	1
08/24/09	1
08/31/09	2

Algonac State Park (M02)	
Date	*E. coli* (cfu/100mL)
05/27/09	1
06/02/09	4
06/10/09	28
06/15/09	7
06/22/09	57
06/29/09	11
07/06/09	9
07/13/09	2
07/20/09	7
07/28/09	6
08/05/09	5
08/13/09	105
08/17/09	13
08/24/09	5
08/31/09	4

St. Clair River Delta

Johnnie Legas Pier on the N. Channel (M20)	
Date	*E. coli* (cfu/100mL)
05/15/08	1
05/27/08	5
06/02/08	12
06/09/08	55
06/16/08	1
06/23/08	5
07/01/08	9
07/08/08	17
07/14/08	7
07/21/08	23
07/28/08	10
08/04/08	6
08/11/08	2
08/18/08	6
08/25/08	7
05/27/09	3
06/02/09	1
06/10/09	2
06/15/09	2
06/22/09	40
06/29/09	40
07/06/09	24
07/13/09	3
07/20/09	7
07/28/09	44
08/05/09	1
08/13/09	14
08/17/09	10
08/24/09	14
08/31/09	3

Browns Landing on the Middle Channel (M12)	
Date	*E. coli* (cfu/100mL)
05/18/04	10
06/02/04	26
06/08/04	18
06/15/04	66
06/22/04	44
06/29/04	70
07/07/04	91
07/13/04	43
07/20/04	34
07/27/04	84
08/03/04	110
08/10/04	96
08/17/04	38
08/24/04	39
08/31/04	25
06/01/05	11
06/07/05	6
06/14/05	15
06/21/05	20
06/28/05	30
07/06/05	13
07/12/05	50
07/19/05	88
07/27/05	43
08/02/05	86
08/09/05	32
08/17/05	22
08/23/05	6
05/23/06	15
05/31/06	12
06/08/06	105
06/13/06	5
06/20/06	12
06/27/06	27
07/11/06	24
07/18/06	33
07/26/06	19
08/01/06	33
08/08/06	7
08/16/06	37
08/22/06	16
08/29/06	16

Frank Schoonovers Dock South Channel (M18)	
Date	*E. coli* (cfu/100mL)
05/18/04	43
06/02/04	23
06/08/04	1
06/15/04	24
06/22/04	1
06/29/04	1
07/07/04	4
07/13/04	4
07/20/04	1
07/27/04	2
08/03/04	3
08/10/04	1
08/17/04	1
08/24/04	6
08/31/04	5
06/01/05	1
06/07/05	3
06/14/05	3
06/21/05	4
06/28/05	1
07/06/05	3
07/12/05	1
07/19/05	4
07/27/05	2
08/02/05	3
08/09/05	1
08/17/05	12
08/23/05	1
05/23/06	1
05/31/06	6
06/06/06	2
06/13/06	1
06/20/06	6
06/27/06	4
07/11/06	1
07/18/06	32
07/26/06	1
08/01/06	25
08/08/06	1
08/16/06	4
08/22/06	3
08/29/06	5

South of 1825 S. Channel Drive on the South Channel (M34)	
Date	*E. coli* (cfu/100mL)
05/18/04	44
06/02/04	20
06/08/04	119
06/15/04	127
06/22/04	35
06/29/04	10
07/07/04	41
07/13/04	16
07/20/04	23
07/27/04	5
08/03/04	6
08/10/04	6
08/17/04	2
08/24/04	7
08/31/04	6
05/25/05	7
06/01/05	2
06/07/05	12
06/14/05	7
06/21/05	2
06/28/05	3
07/06/05	48
07/12/05	4
07/19/05	13
07/27/05	47
08/02/05	10
08/09/05	10
08/17/05	2
08/23/05	3
05/23/06	4
05/31/06	14
06/06/06	1
06/13/06	3
06/20/06	10
06/27/06	10
07/11/06	5
07/18/06	5
07/26/06	6
08/01/06	24
08/08/06	1
08/16/06	8
08/22/06	2
08/29/06	12

Samples > 300 cfu/100mL

St. Clair River Delta (continued)

Johnnie Legas Pier on the N. Channel (M20)	
Date	*E. coli* (cfu/100mL)

Browns Landing on the Middle Channel (M12)	
Date	*E. coli* (cfu/100mL)
05/30/07	12
06/06/07	9
06/12/07	4
06/19/07	3
06/26/07	3
07/10/07	1
07/24/07	1
07/31/07	14
08/08/07	31
08/14/07	3
05/15/08	1
05/27/08	0
06/02/08	1
06/09/08	10
06/16/08	10
06/23/08	49
07/01/08	17
07/08/08	10
07/14/08	12
07/21/08	70
07/28/08	26
08/04/08	31
08/11/08	26
08/18/08	7
08/25/08	11
05/27/09	5
06/02/09	7
06/10/09	52
06/15/09	25
06/22/09	73
06/29/09	62
07/06/09	17
07/13/09	7
07/20/09	32
07/28/09	61
08/05/09	6
08/13/09	12
08/17/09	10
08/24/09	12
08/31/09	17

Frank Schoonovers Dock South Channel (M18)	
Date	*E. coli* (cfu/100mL)
05/30/07	1
06/06/07	1
06/12/07	1
06/19/07	7
06/26/07	1
07/10/07	31
07/24/07	5
07/31/07	3
08/08/07	16
08/14/07	1
05/15/08	1
05/27/08	1
06/02/08	1
06/09/08	5
06/16/08	2
06/23/08	20
07/01/08	1
07/08/08	2
07/14/08	2
07/21/08	1
07/28/08	1
08/04/08	1
08/11/08	9
08/18/08	1
08/25/08	2
05/27/09	5
06/02/09	1
06/10/09	1
06/15/09	1
06/22/09	3
06/29/09	3
07/06/09	1
07/13/09	2
07/20/09	1
07/28/09	7
08/05/09	1
08/13/09	2
08/17/09	2
08/24/09	1
08/31/09	1

South of 1825 S. Channel Drive on the South Channel (M34)	
Date	*E. coli* (cfu/100mL)
05/30/07	12
06/06/07	1
06/12/07	1
06/19/07	16
06/26/07	3
07/10/07	24
07/24/07	7
07/31/07	5
08/08/07	37
08/14/07	3
05/15/08	2
05/27/08	4
06/02/08	16
06/09/08	24
06/16/08	4
06/23/08	18
07/01/08	7
07/08/08	29
07/14/08	11
07/21/08	11
07/28/08	3
08/04/08	6
08/11/08	8
08/18/08	2
08/25/08	4
05/27/09	10
06/02/09	13
06/10/09	9
06/15/09	1
06/22/09	13
06/29/09	50
07/06/09	7
07/13/09	20
07/20/09	4
07/28/09	15
08/05/09	3
08/13/09	3
08/17/09	12
08/24/09	4
08/31/09	4

Samples > 300 cfu/100mL

City of Port Huron *E. coli* Monitoring Data

		Black River Locations - 2008														
		Howe Drain - at foot bridge on Krafft Road N 43 01' 30" W 82 27' 00"		3667 Strawberry Ln. N 43 01' 00" W 82 27' 30"		Mouth of Stocks Creek N 42 59' 30" W 82 27' 00"		Riverside Drive - Boat Ramp N 42 59' 45" W 82 26' 45"			Fort Street Mooring Facility N 42 58' 30" W 82 25' 15"		Precip.	CSO*	CSO* Time	CSO*	Canal
	Date	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	H_2O Temp. Deg. F	Time	*E. coli* #/100 ml	(inches rainfall)	Event y/n	Event Began	Duration Hours	Open y/n
May-08	27	0945	365	1010	15	1003	178	0953	145	50	1046	9	0.00	n			n
	28	1020	111	1053	24	1044	209	1034	24	58	1129	12	0.00	n			y
	29	0943	118	1016	65	1007	249	0957	12	59	1048	24	0.00	n			y
	30												0.00	n			
	31												0.00	n			
Jun-08	1												0.00	n			
	2	0944	387	1013	15	1004	72	0955	31	63	1049	30	0.00	n			y
	3	0927	2407	0956	52	0948	89	0939	22	61	1030	102	0.39	n			y
	4	1002	629	1032	48	1025	70	1016	2452	62	1109	756	0.00	n			y
	5	0937	156	1006	49	0958	221	0950	30	64	1049	102	0.06	n			y
	6												0.45	n			
	7												0.00	n			
	8												0.36	n			
	9	1051	1741	1136	50	1125	387	1113	222	73	1214	130	0.11	n			y
	10	1041	9677	1126	222	1117	649	1105	395	68	1203	488	0.48	y	0900	4.0	y
	11	1031	1164	1111	2419	1102	1,120	1051	216	72	1152	141	0.00	n			y
	12	1034	195	1115	291	1107	437	1153	225	73	1159	148	0.00	n			y
	13												0.18	n			
	14												0.29	n			
	15												0.12	n			
	16	1046	260	1127	140	1117	184	1101	72	73	1216	133	0.09	n			y
	17	1100	875	1144	74	1133	523	1115	81	73	1225	126	0.15	n			y
	18	1052	713	1142	138	1132	922	1118	72	66	1223	86	0.05	n			y
	19	1032	226	1121	225	1111	775	1057	66	65	1200	69	0.03	n			y
	20												0.00	n			
	21												0.59	n			
	22												1.05	y	1500	4.0	
	23	1039	363	1125	62	1115	>2419	1100	83	69	1211	579	0.00	n			y
	24	1038	295	1118	71	1110	731	1058	90	70	1200	77	0.00	n			y
	25	1038	334	1133	73	1124	442	1106	74	72	1213	54	0.03	n			y
	26	0947	744	1020	81	1012	395	1005	49	72	1058	67	1.07	y	1700	4.0	y
	27												0.00	n			
	28												0.73	y	0400	5.0	
	29												0.06	n			
	30	1133	406	1215	461	1206	384	1152	688	70	1250	225	0.03	n			n
Jul-08	1	1029	160	1114	345	1104	430	1053	187		1153	238	0.00	n			y
	2	1032	131	1119	276	1110	353	1057	222		1157	166	0.74	y	2200	5.0	y
	3	1106	2452	1141	238	1132	5199	1123	172	68	1212	345	0.12	y			y
	4												0.00	n			
	5												0.00	n			
	6												0.00	n			
	7	1027	276	1114	190	1104	298	1054	82	71	1152	82	0.00	n			y
	8	1119	289	1150	110	1143	304	1133	52	72	1224	126	0.00	n			y
	9	1036	212	1119	135	1109	140	1055	253	71	1201	101	0.00	n			y
	10	1115	300	1200	96	1152	91	1136	176	73	1242	150	0.03	n			y
	11												0.00	n			
	12												0.65	y	1400	2.0	
	13												0.00	n			
	14	1052	630	1132	153	1124	394	1110	109	73	1212	155	0.00	n			y
	15	1101	534	1142	93	1132	157	1121	35	74	1220	45	0.00	n			y
	16	1043	587	1125	70	1116	109	1102	220	75	1201	75	0.15	n			y
	17	1113	1462	1154	40	1145	143	1132	142	78	1231	140	0.10	n			y
	18												0.00	n			
	19												0.39	y	1700	4.0	
	20												0.10	n			
	21	1110	285	1154	79	1137	64	1126	84	75	1247	46	0.00	n			y
	22	1044	223	1124	35	1115	127	1101	106	76	1159	64	0.70	y	1900	5.0	y
	23	1115	>2419	1152	461	1144	>2419	1133	1034	71	1225	1414	0.86	y	0900	7.0	n
	24	1030	2069	1106	378	1058	2069	1048	306	74	1143	231	0.00	n			y
	25												0.00	n			
	26												0.00	n			
	27												0.00	n			
	28	1121	164	1201	98	1153	168	1141	44	76	1235	62	0.00	n			y
	29	1115	566	1151	53	1144	64	1132	551	77	1225	60	0.00	n			y
	30	1111	>2419	1156	461	1149	186	1133	85	76	1243	613	0.70	y	1000	2.0	y
	31	1050	>2419	1126	119	1118	1642	1107	570	76	1233	260	0.00	n			y

Samples > 300 cfu/100mL

* Data is inclusive of all Port Huron CSOs

Black River Locations - 2008

		Howe Drain - at foot bridge on Krafft Road N 43 01' 30" W 82 27' 00"		3667 Strawberry Ln. N 43 01' 00" W 82 27' 30"		Mouth of Stocks Creek N 42 59' 30" W 82 27' 00"		Riverside Drive - Boat Ramp N 42 59' 45" W 82 26' 45"			Fort Street Mooring Facility N 42 58' 30" W 82 25' 15"		Precip.	CSO*	CSO* Time	CSO*	Canal
	Date	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	H_2O Temp. Deg. F	Time	*E. coli* #/100 ml	(inches rainfall)	Event y/n	Event Began	Duration Hours	Open y/n
Aug-08	1												0.05	n			
	2												0.00	n			
	3												0.00	n			
	4	1214	86	1254	47	1246	62	1234	32	77	1328	71	0.00	n			y
	5	1059	500	1145	53	1138	44	1125	20	79	1224	70	0.70	y	1730	2.0	y
	6	1116	>2419	1205	120	1157	>2419	1139	125	77	1250	435	0.01	n			y
	7	1050	192	1138	44	1128	192	1115	94	77	1217	117	0.06	n			y
	8												0.00	n			
	9												0.15	n			
	10												0.26	n			
	11	1121	1195	1200	44	1156	205	1141	60	71	1240	119	0.05	n			n
	12	1048	600	1129	5	1119	263	1108	65	73	1211	51	0.00	n			y
	13	1057	273	1136	3	1128	76	1114	69	75	1218	18	0.30	n			y
	14	1054	>2419	1139	17	1130	>2419	1115	52	81	1229	72	0.00	n			n
	15												0.00	n			
	16												0.00	n			
	17												0.00	n			
	18	1101	>2419	1138	16	1132	12	1118	40	76	1215	47	0.00	n			y
	19	0936	953	1004	10	0957	73	0949	104		1043	21	0.01	n			y
	20	1002	156	1034	10	1025	69	1015	101	77	1113	5	0.00	n			y
	21	0942	96	1025	5	1018	64	1009	13	78	1059	15	0.00	n			y
	22												0.00	n			
	23												0.38	n			
	24												0.09	y	0100	2.0	
	25	1055	1045	1131	10	1124	208	1115	472	78	1202	48	0.00	n			n
	26	0948	550	1031	6	1023	53	1015	85		1106	29	0.00	n			n
	27	0815	1379	0855	13	0845	63	0829	32	65	0933	45	0.00	n			y
	28	0930	621	1009	3	1002	111	0953	153	76	1105	42	0.09	n			n
	29																
	30																
	31																

Samples > 300 cfu/100mL

* Data is inclusive of all Port Huron CSOs

Black River Locations - 2009

		3667 Strawberry Ln. N 43° 01' 00" W 82° 27' 30"			1821 Riverside Party Time Marina N 42° 59' 37" W 82° 26' 37"			Thomas Street N 42° 59' 27" W 82° 26' 31"			Fort Street Mooring Facility N 42° 58' 30" W 82° 25' 15"			Precip.	CSO*	CSO* Time	CSO*	Canal
	Date	Time	*E. coli* #/100 ml	TSS mg/L	Time	*E. coli* #/100 ml	H_2O Temp. Deg. F	Time	*E. coli* #/100 ml	TSS mg/L	Time	*E. coli* #/100 ml	TSS mg/L	(inches rainfall)	Event y/n	Event Began	Duration Hours	Open y/n
May-09	25													0.00				
	26	1122	34.5	13.6	1105	78.0	60	1055	122.2	16.0	1215	118.7	16.0	0.00	n			y
	27	1139	45.7	12.6	1104	106.3	62	1055	184.2	12.0	1218	139.6	12.4	0.41	y	0300	2.0	y
	28	1137	260.2	16.5	1114	488.4	64	1104	547.5	12.0	1215	248.9	10.4	0.25	y	0300	2.0	y
	29													0.00	n			
	30													0.00	n			
	31													0.00	n			
Jun-09	1	1144	290.9	23.0	1129	124.6	59	1122	> 2419	32.0	1229	178.5	20.4	0.13	y	1300	2.0	y
	2	1150	> 2419	21.2	1135	108.1	60	1125	145.5	17.4	1238	79.4	16.6	T	n			y
	3	1201	158.8	23.8	1147	102.4	60	1139	104.0	16.6	1249	72.8	15.8	0.00	n			y
	4	1136	111.2	19.2	1117	99.2	60	1110	87.0	17.6	1218	62.6	16.0	0.00	n			y
	5													0.00	n			
	6													0.00	n			
	7													T	n			
	8	1140	109.2	22.2	1126	159.6	59	1120	> 2419	13.8	1225	132.6	14.8	0.43	y	1300	2.0	y
	9	1147	136.6	19.2	1133	147.6	62	1126	279.2	11.8	1221	166.6	11.8	0.00	n			y
	10	1151	109.2	24.0	1140	58.4	63	1132	59.0	14.2	1229	61.8	10.8	0.00	n			y
	11	1156	105.6	19.2	1142	91.0	61	1134	60.2	13.6	1244	51.8	12.8	0.04	n			y
	12													0.00	n			
	13													0.00	n			
	14													0.10	n			
	15	1145	76.8	16.0	1130	135.4	60	1122	167.2	15.0	1236	94.4	10.2	0.00	n			y
	16	1133	85.6	10.8	1120	110.8	62	1111	82.0	9.8	1217	68.2	9.6	0.00	n			y
	17	1236	116.6	21.6	1216	1373.4	62	1209	333.8	15.6	1322	256.2	12.8	1.91	y	1100	13.0	y
	18	1212	>2419	304.0	1155	>2419	60	1148	>2419	282.0	1303	>2419	339.0	0.02	n			y
	19													0.27	n			
	20													0.37	y	0100	13.0	
	21													0.00	n			
	22	1205	230.6	51.2	1148	387.0	64	1140	397.8	37.6	1245	270.8	33.0	0.00	n			y
	23	1310	144.6	23.6	1206	270.8	66	0904	331.6	21.6	1320	209.2	25.0	0.00	n			y
	24	1150	202.6	18.0	1135	90.6	68	1126	202.6	19.6	1228	147.6	20.8	0.00	n			y
	25	1238	135.4	24.0	1223	551.0	70	1213	402.8	30.0	1323	1297.6	24.4	0.03	n			y
	26													0.00	n			
	27													0.00	n			
	28													0.45	y	0700	2.0	
	29	1213	33.6	17.2	1200	70.0	68	1154	127.2	14.8	1255	164.0	18.8	0.24	y	1730	2.5	y
	30	1205	48.8	15.6	1152	157.2	64	1146	125.2	10.0	1248	182.0	16.4	0.11	n			y
Jul-09	1	1228	58.0	17.6	1209	273.2	64	1203	112.4	20.4	1308	118.0	15.2	0.07	n			y
	2	1220	114.0	13.6	1203	107.6	63	1157	70.0	18.0	1257	107.6	20.4	0.05	n			y
	3													0.02	n			
	4													0.00	n			
	5													0.00	n			
	6	1209	86.4	10.8	1154	93.2	65	1148	159.6	12.4	1301	122.0	13.6	0.00	n			y
	7	1242	103.6	14.0	1228	167.6	64	1218	145.6	11.6	1336	123.6	14.8	0.00	n			y
	8	1233	96.0	13.2	1219	74.8	64	1213	64.4	8.4	1317	74.8	10.8	0.00	n			y
	9	1227	165.2	12.0	1213	42.4	67	1206	58.4	6.4	1315	115.2	14.0	0.00	n			y
	10													0.00	n			
	11													0.09	n			
	12													0.00	n			
	13	1244	91.2	17.2	1226	233.2	65	1220	191.6	10.2	1320	104.8	18.4	0.00	n			y
	14	1238	218.8	20.0	1225	116.8	66	1218	20.8	8.2	1324	29.6	12.4	0.00	n			y
	15	1240	111.2	14.0	1228	64.4	66	1221	74.0	9.6	1333	48.0	9.2	0.00	n			y
	16	1327	176.4	20.0	1315	100.8	68	1310	>4838.4	9.6	1407	105.8	8.0	0.00	n			y
	17													T	n			
	18													0.05	n			
	19													0.59	y	2300	4.0	
	20	1336	291.0	13.6	1323	245	68	1314	182.0	13.6	1415	176	6.0	0.00	y			y
	21	1111	164.0	13.2	1057	110	62	1050	2190.0	8.4	1143	58.0	11.0	0.06	n			
	22	1004	164.0	22.8	0946	195	64	0939	102.0	9.4	1040	84.4	12.0	0.14	n			
	23	0828	265.0	20.8	0815	252	62	0808	338.0	17.6	0858	285	12.8	0.90	y	1300	6.0	
	24													0.00	n			
	25													1.06	y	1700	4.0	
	26													0.33	y	1900	4.0	
	27	1256	270.8	20.0	1243	166.4	66	1237	208.0	12.0	1340	222.4	20.4	0.00	n			y
	28	1239	145.6	12.4	1227	147.2	66	0800	151.6	9.6	1324	145.6	12.4	0.11	n			y
	29	1243	180.0	18.4	1229	245.2	68	1223	>9676.8	10.4	1325	201.6	11.6	0.22	n			y
	30	1248	92.4	17.6	1235	140.0	69	1228	198.0	9.2	1351	86.4	10.0	0.00	n			y
	31													0.00	n			

Samples > 300 cfu/100mL

* Data is inclusive of all Port Huron CSOs

		Black River Locations - 2009															
		3667 Strawberry Ln. N 43° 01' 00" W 82° 27' 30"			1821 Riverside Party Time Marina N 42° 59' 37" W 82° 26' 37"			Thomas Street N 42° 59' 27" W 82° 26' 31"			Fort Street Mooring Facility N 42° 58' 30" W 82° 25' 15"			Precip.	CSO*	CSO* Time	CSO*	Canal
	Date	Time	*E. coli* #/100 ml	TSS mg/L	Time	*E. coli* #/100 ml	H_2O Temp. Deg. F	Time	*E. coli* #/100 ml	TSS mg/L	Time	*E. coli* #/100 ml	TSS mg/L	(inches rainfall)	Event y/n	Event Began	Duration Hours	Open y/n
Aug-09	1													0.00	n			
	2													0.00	n			
	3	1251	38.4	18.4	1238	110.0	66	1232	90.4	11.6	1330	74.8	16.8	0.00	n			y
	4	1257	54.0	14.8	1245	85.2	69	1239	106.0	7.6	1339	64.0	10.8	0.00	n			y
	5	1308	118.0	14.8	1258	444.8	66	1251	218.8	15.6	1348	104.8	10.0	0.00	n			y
	6	1305	>9676.8	17.2	1253	58.4	66	1245	106.0	12.0	1347	58.4	12.0	0.00	n			y
	7													0.00				
	8													1.36	y	1300	6.0	
	9													0.82	y	2200	3.0	
	10	1315	64.4	18.0	1302	257.6	70	1256	384.0	8.4	1402	182.8	14.4	0.71	y			y
	11	1310	52.8	21.2	1258	208.4	68	1253	2908.0	8.8	1354	97.2	11.6	0.10	y	0000	4.0	y
	12	1312	1102.0	23.2	1257	230.4	69	1251	97.2	12.0	1355	2068.8	12.8	0.00	n			y
	13	1400	156.4	27.2	1341	5199	74	1335	204.8	13.2	1446	1164	13.2	0.00	n			y
	14													0.00	n			
	15													0.00	n			
	16													0.00	n			
	17	0916	12.4	22.0	0904	208.0	68	0858	7945.0	11.2	0949	69.2	12.4	0.00	n			
	18	0841	32.4	25.6	0829	111.2	68	0818	130.8	12.0	0913	90.4	11.2	0.04	n			
	19	1324	33.6	16.0	1313	91.2	72	1308	192.4	8.8	1355	151.6	10.4	T	n			
	20	0851	48.0	26.8	0839	315.6	68	0834	123.6	9.2	0922	78.8	12.0	1.19	y	1300	6.0	
	21													0.00	n			
	22													0.00	n			
	23													0.32	y	1300	2.0	
	24	0846	53.6	30.0	0835	112.4	63	0830	122.0	9.6	0915	>9676	12.0	0.00	n			
	25	0913	116.8	31.2	0902	98.4	63	0857	116.8	13.6	0945	182.8	12.4	0.00	n			
	26	0853	182.8	27.2	0840	404.0	64	0835	265.2	8.8	0930	74.8	12.4	0.39	n			
	27	0928	85.2	24.4	0917	317.6	62	0911	161.6	12.4	0958	151.6	11.2	0.01	n			
	28													0.95	y	2300	4.0	
	29													0.00	y			
	30													0.06	n			
	31	1323	20.8	17.6	1311	161.6	62	1305	248.0	11.2	1401	98.4	9.6	0.00	n			y
Sep-09	1	1343	12.4	8.0	1314	48.0	68	1309	58.0	5.2	1417	63.2	6.8	0.00	n			
	2	1146	25.2	15.6	1134	38.4	65	1128	98.4	5.6	1239	78.8	7.6	0.00	n			
	3	1318	43.6	9.2	1304	64.0	67	1258	52.0	6.0	1412	43.6	7.2	0.00	n			

Samples > 300 cfu/100mL

* Data is inclusive of all Port Huron CSOs

		St. Clair River Locations - 2008										
		South End of Pine Grove Park N 42° 59' 15" W 82° 25' 30"			Lincoln Park N 42 56' 15" W 82 27' 00"		Mermaid Park Gratiot Blvd. - Marysville N 42 56' 00" W 82 27' 30"		Precip. (inches rainfall)	CSO* Event y/n	CSO* Time Event Began	CSO* Duration Hours	Canal Open y/n
	Date	Time	*E. coli* #/100 ml	H_2O Temp. deg. F	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml					
May-08	27	0927	6	50	1035	4	1030	6	0.00	n			n
	28	1007	0	53	1118	1	1114	6	0.00	n			y
	29	0927	0	53	1039	22	1034	10	0.00	n			y
	30								0.00	n			
	31								0.00	n			
Jun-08	1								0.00	n			
	2	0931	0	56	1038	12	1033	9	0.00	n			y
	3	0914	0	55	1021	28	1017	23	0.39	n			y
	4	0948	1	56	1059	22	1054	27	0.00	n			y
	5	0924	0	58	1039	27	1034	17	0.06	n			y
	6								0.45	n			
	7								0.00	n			
	8								0.36	n			
	9	1032	0	62	1204	59	1157	30	0.11	n			y
	10	1024	32	60	1152	201	1146	201	0.48	y	0900	4.0	y
	11	1015	0	61	1139	50	1132	59	0.00	n			y
	12	1018	1	62	1145	62	1139	30	0.00	n			y
	13								0.18	n			
	14								0.29	n			
	15								0.12	n			
	16	1030	0	63	1155	48	1149	53	0.09	n			y
	17	1044	0	62	1213	44	1207	48	0.15	n			y
	18	1037	0	60	1210	37	1204	35	0.05	n			y
	19	1018	0	62	1148	39	1142	31	0.03	n			y
	20								0.00	n			
	21								0.59	n			
	22								1.05	y	1500	4.0	
	23	1025	0	62	1156	54	1148	42	0.00	n			y
	24	1023	0	63	1147	20	1142	16	0.00	n			y
	25	1022	0	64	1201	36	1155	31	0.03	n			y
	26	0930	0	65	1044	11	1039	11	1.07	y	1700	4.0	y
	27								0.00	n			
	28								0.73	y	0400	5.0	
	29								0.06	n			
	30	1114	18	63	1241	43	1235	31	0.03	n			n
Jul-08	1	1014	1	64	1143	36	1136	29	0.00	n			y
	2	1019	0		1146	33	1139	11	0.74	y	2200	5.0	y
	3	1052	1	63	1205	46	1200	37	0.12	y			y
	4								0.00	n			
	5								0.00	n			
	6								0.00	n			
	7	1020	0	66	1142	6	1135	13	0.00	n			y
	8	1103	<1	66	1214	1	1209	10	0.00	n			y
	9	1020	<1	66	1148	29	1141	13	0.00	n			y
	10	1100	1	68	1225	11	1220	6	0.03	n			y
	11								0.00	n			
	12								0.65	y	1400	2.0	
	13								0.00	n			
	14	1034	<1	67	1158	17	1152	15	0.00	n			y
	15	1047	<1	68	1209	13	1203	7	0.00	n			y
	16	1022	<1	69	1150	3	1145	4	0.15	n			y
	17	1053	1	69	1221	56	1215	43	0.10	n			y
	18								0.00	n			
	19								0.39	y	1700	4.0	
	20								0.10	n			
	21	1056	<1	70	1238	41	1232	54	0.00	n			y
	22	1029	<1	71	1150	50	1144	37	0.70	y	1900	5.0	y
	23	1101	>201	69	1217	1300	1213	770	0.86	y	0900	7.0	n
	24	1012	1	70	1132	26	1126	44	0.00	n			y
	25								0.00	n			
	26								0.00	n			
	27								0.00	n			
	28	1104	24	71	1225	5	1220	4	0.00	n			y
	29	1101	1	70	1215	2	1210	1	0.00	n			y
	30	1054	2	70	1234	308	1230	387	0.70	y	1000	2.0	y
	31	1036	<1	71	1223	29	1219	16	0.00	n			y

Samples > 300 cfu/100mL

* Data is inclusive of all Port Huron CSOs

St. Clair River Locations - 2008

		South End of Pine Grove Park N 42° 59' 15" W 82° 25' 30"			Lincoln Park N 42 56' 15" W 82 27' 00"		Mermaid Park Gratiot Blvd. - Marysville N 42 56' 00" W 82 27' 30"		Precip.	CSO*	CSO*	CSO*	Canal
	Date	Time	*E. coli* #/100 ml	H_2O Temp. deg. F	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	(inches rainfall)	Event y/n	Time Event Began	Duration Hours	Open y/n
Aug-08	1								0.05	n			
	2								0.00	n			
	3								0.00	n			
	4	1159	2	73	1318	44	1313	35	0.00	n			y
	5	1044	<1	74	1214	32	1208	28	0.70	y	1730	2.0	y
	6	1059	2	72	1233	115	1226	124	0.01	n			y
	7	1031	<1	72	1205	70	1200	39	0.06	n			y
	8								0.00	n			
	9								0.15	n			
	10								0.26	n			
	11	1107	1	69	1229	38	1224	36	0.05	n			n
	12	1033	1	70	1156	39	1151	42	0.00	n			y
	13	1044	<1	71	1208	73	1203	45	0.30	n			y
	14	1040	<1	77	1218	111	1214	84	0.00	n			n
	15								0.00	n			
	16								0.00	n			
	17								0.00	n			
	18	1044	<1	72	1202	59	1157	58	0.00	n			Y
	19	0920	4		1027	249	1022	152	0.01	n			y
	20	0949	2	76	1055	>2419	1053	30	0.00	n			y
	21	0920	<1	76	1051	53	1046	>2419	0.00	n			y
	22								0.00	n			
	23								0.38	n			
	24								0.09	y	0100	2.0	
	25	1041	1	76	1153	80	1148	105	0.00	n			n
	26	0935	<1	76	1057	20	1053	30	0.00	n			n
	27	0757	<1	65	0923	46	0916	41	0.00	n			y
	28	0916	1.0	76	1052	52	1048	40	0.09	n			n
	29												
	30												
	31												

Samples > 300 cfu/100mL
* Data is inclusive of all Port Huron CSOs

St. Clair River Locations - 2009

		South End of Pine Grove Park N 42° 59' 15" W 82° 25' 30"			MOC Parking Lot N 42° 58' 42" W 82° 25' 7"		Seaway Terminal N 42° 57' 37" W 82° 25' 32"			Lincoln Park N 42° 56' 15" W 82° 27' 00"		Precip.	CSO*	CSO*	CSO*	Canal
	Date	Time	*E. coli* #/100 ml	H_2O Temp. deg. F	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	TSS mg/L	Time	*E. coli* #/100 ml	(inches rainfall)	Event y/n	Time Event Began	Duration Hours	Open y/n
May-09	25											0.00				
	26	1043	< 1	54	1038	< 1	1208	5.3	3.2	1158	7.5	0.00	n			y
	27	1042	< 1	55	1038	< 1	1206	6.4	1.2	1159	27.1	0.41	y	0300	2	y
	28	1054	< 1	56	1048	< 1	1204	27.1	3.0	1156	30.6	0.25	y	0300	2	y
	29											0.00	n			
	30											0.00	n			
	31											0.00	n			
Jun-09	1	1111	< 1	55	1105	< 1	1221	8.7	2.8	1211	25.4	0.13	y	1300	2.0	y
	2	1115	< 1	54	1105	< 1	1230	5.3	5.8	1220	11.1	T	n			y
	3	1130	< 1	54	1124	< 1	1240	3.1	2.6	1232	9.9	0.00	n			y
	4	1055	< 1	55	1049	< 1	1211	3.1	3.6	1202	7.5	0.00	n			y
	5											0.00	n			
	6											0.00	n			
	7											T	n			
	8	1109	> 200.5	55	1103	5.3	1212	8.7	2.2	1201	> 200.5	0.43	y	1300	2.0	y
	9	1112	<1	56	1103	<1	1212	4.2	2.0	1205	38.4	0.00	n			y
	10	1121	<1	54	1115	<1	1220	12.4	2.8	1210	22.2	0.00	n			y
	11	1125	<1	54	1115	<1	1230	6.4	2.0	1220	9.9	0.04	n			y
	12											0.00	n			
	13											0.00	n			
	14											0.10	n			
	15	1110	<1	55	1104	<1	1220	4.2	2.6	1215	9.9	0.00	n			y
	16	1101	<1	56	1053	<1	1202	NA	1.2	1155	8.7	0.00	n			y
	17	1159	6.4	56	1153	94.5	1307	62.4	1.4	1301	200.5	1.91	y	1100	13.0	y
	18	1139	<1	54	1133	>200.5	1248	>200.5	93.6	1236	>200.5	0.02	n			y
	19											0.27	n			
	20											0.37	y	0100	13.0	
	21											0.00	n			
	22	1129	<1	57	1122	>200.5	1236	53.1	6.6	1230	>200.5	0.00	n			y
	23	1156	<1	59	1150	<1	1310	38.4	4.8	1301	38.4	0.00	n			y
	24	1118	<1	61	1106	<1	1217	28.1	5.2	1210	40.2	0.00	n			y
	25	1202	2.0	60	1150	7.5	1314	45.3	4.2	1306	56.0	0.03	n			y
	26											0.00	n			
	27											0.00	n			
	28											0.45	y	0700	2.0	
	29	1139	<1	61	1127	<1	1250	9.9	3.6	1244	45.3	0.24	y	1730	2.5	y
	30	1137	<1	60	1130	1.0	1238	8.7	3.2	1231	53.1	0.11	n			y

Samples > 300 cfu/100mL
* Data is inclusive of all Port Huron CSOs

St. Clair River Locations - 2009

		South End of Pine Grove Park N 42° 59' 15" W 82° 25' 30"			MOC Parking Lot N 42° 58' 42" W 82° 25' 7"		Seaway Terminal N 42° 57' 37" W 82° 25' 32"			Lincoln Park N 42° 56' 15" W 82° 27' 00"		Precip. (inches rainfall)	CSO* Event y/n	CSO* Time Event Began	CSO* Duration Hours	Canal Open y/n
	Date	Time	*E. coli* #/100 ml	H_2O Temp. deg. F	Time	*E. coli* #/100 ml	Time	*E. coli* #/100 ml	TSS mg/L	Time	*E. coli* #/100 ml					
Jul-09	1	1154	<1	60	1147	2.0	1300	13.7	4.4	1253	20.7	0.07	n			y
	2	1142	1.0	58	1135	<1	1248	16.4	5.2	1241	19.2	0.05	n			y
	3											0.02	n			
	4											0.00	n			
	5											0.00	n			
	6	1138	<1	60	1132	<1	1246	6.4	5.6	1235	25.4	0.00	n			y
	7	1208	>200.5	60	1200	>200.5	1321	3.1	2.8	1309	19.2	0.00	n			y
	8	1205	<1	60	1158	<1	1308	3.1	3.0	1301	118.4	0.00	n			y
	9	1157	>200.5	61	1150	<1	1303	5.3	4.6	1256	27.1	0.00	n			y
	10											0.00	n			
	11											0.09	n			
	12											0.00	n			
	13	1208	<1	63	1200	4.2	1313	1.0	4.8	1305	23.8	0.00	n			y
	14	1208	<1	63	1200	2.0	1316	3.1	6.0	1309	36.4	0.00	n			y
	15	1208	<1	63	1201	2.0	1325	2.0	2.2	1319	7.5	0.00	n			y
	16	1300	<1	64	1253	2.0	1355	3.1	2.8	1348	22.2	0.00	n			y
	17											T	n			
	18											0.05	n			
	19											0.59	y	2300	4.0	
	20	1303	1.0	62	1251	2.0	1404	15.0	2.4	1358	62.4	0.00	y			y
	21	1043	<1	60	1035	1.0	1135	3.1	3.0	1130	118.4	0.06	n			
	22	0930	<1	60	0923	<1	1029	4.2	3.0	1023	36.4	0.14	n			
	23	0800	1.0	60	0754	2.0	0851	23.8	3.3	0844	47.8	0.90	y	1300	6.0	
	24											0.00	n			
	25											1.06	y	1700	4.0	
	26											0.33	y	1900	4.0	
	27	1223	<1	66	1211	7.5	1329	22.2	3.8	1322	78.2	0.00	n			y
	28	1212	<1	64	1204	1.0	1316	13.7	5.0	1309	53.1	0.11	n			y
	29	1218	1.0	64	1207	>1	1316	9.9	3.2	1310	53.1	0.22	n			y
	30	1219	<1	64	1209	1.0	1342	5.3	3.2	1332	50.4	0.00	n			y
	31											0.00	n			
Aug-09	1											0.00	n			
	2											0.00	n			
	3	1221	2.0	65	1214	1.0	1322	2.0	5.6	1315	28.8	0.00	n			y
	4	1232	1.0	64	1226	<1	1332	3.1	2.0	1326	34.4	0.00	n			y
	5	1241	3.1	63	1234	<1	1340	>200.5	2.8	1334	45.3	0.00	n			y
	6	1234	<1	64	1228	1.0	1339	<1	2.2	1331	16.4	0.00	n			y
	7											0.00	n			
	8											1.36	y	1300	6.0	
	9											0.82	y	2200	3.0	
	10	1246	<1	66	1240	<1	1352	5.3	1.8	1346	40.6	0.71	y			y
	11	1242	<1	64	1236	1.0	1345	16.4	2.0	1336	42.9	0.10	y	0000	4.0	y
	12	1242	2.0	65	1237	2.0	1347	5.3	3.0	1341	17.8	0.00	n			y
	13	1323	<1	67	1311	<1	1437	6.4	5.0	1430	5.3	0.00	n			y
	14											0.00	n			
	15											0.00	n			
	16											0.00	n			
	17	0849	<1	66	0843	1.0	0941	30.6	3.7	0935	6.4	0.00	n			
	18	0811	<1	64	0804	<1	0906	9.9	1.4	0902	2.0	0.04	n			
	19	1300	<1	68	1253	1.0	1347	3.1	2.2	1341	2.0	T	n			
	20	0826	2	66	0820	2.0	0915	1.0	1.6	0909	1.0	1.19	y	1300	6.0	
	21											0.00	n			
	22											0.00	n			
	23											0.32	y	1300	2.0	
	24	0822	2.0	61	0816	1.0	0908	9.9	2.3	0903	12.4	0.00	n			
	25	0849	1.0	62	0843	7.5	0937	6.4	2.2	0932	5.3	0.00	n			
	26	0828	8.7	63	0819	3.1	0922	4.2	2.4	0911	1.0	0.39	n			
	27	0904	2.0	62	0858	3.1	0951	13.7	4.6	0945	8.7	0.01	n			
	28											0.95	y	2300	4.0	
	29											0.00	y			
	30											0.06	n			
	31	1256	<1	62	1250	<1	1354	6.4	2.8	1347	4.2	0.00	n			y
Sep-09	1	1257	<1	62	1248	<1	1409	2.0	6.2	1403	78.2	0.00	n			
	2	1120	<1	62	1114	1.0	1231	<1	2.2	1213	129.8	0.00	n			
	3	1250	<1	66	1243	2.0	1405	4.2	4.4	1353	56.0	0.00	n			

Samples > 300 cfu/100mL

* Data is inclusive of all Port Huron CSOs

Appendix C
Monitoring Site Descriptions

Black River

BL01 – at 10th Street (between the 72" and 60" outfalls)
BL02 – at 13th Street (between the 60" and 96" outfalls)
BL03 – upstream of railroad bridge
BL04 – upstream of Strawberry Lane
BL05 – downstream of Wadhams Road

SITE ID	Longitude	Latitude
BL01A	-82.433237	42.979929
BL01B	-82.432973	42.980261
BL01C	-82.432794	42.980568

SITE ID	Longitude	Latitude
BL02A	-82.437156	42.984074
BL02B	-82.437156	42.984460
BL02C	-82.437167	42.984795

SITE ID	Longitude	Latitude
BL03A	-82.443097	42.984733
BL03B	-82.442684	42.984963
BL03C	-82.442371	42.985206

SITE ID	Longitude	Latitude
BL04A	-82.459196	43.015199
BL04B	-82.459276	43.015548
BL04C	-82.459449	43.015783

SITE ID	Longitude	Latitude
BL05A	-82.532600	42.992633
BL05B	-82.532732	42.992712
BL05C	-82.532834	42.992806

St. Clair River Transects and Sampling Sites

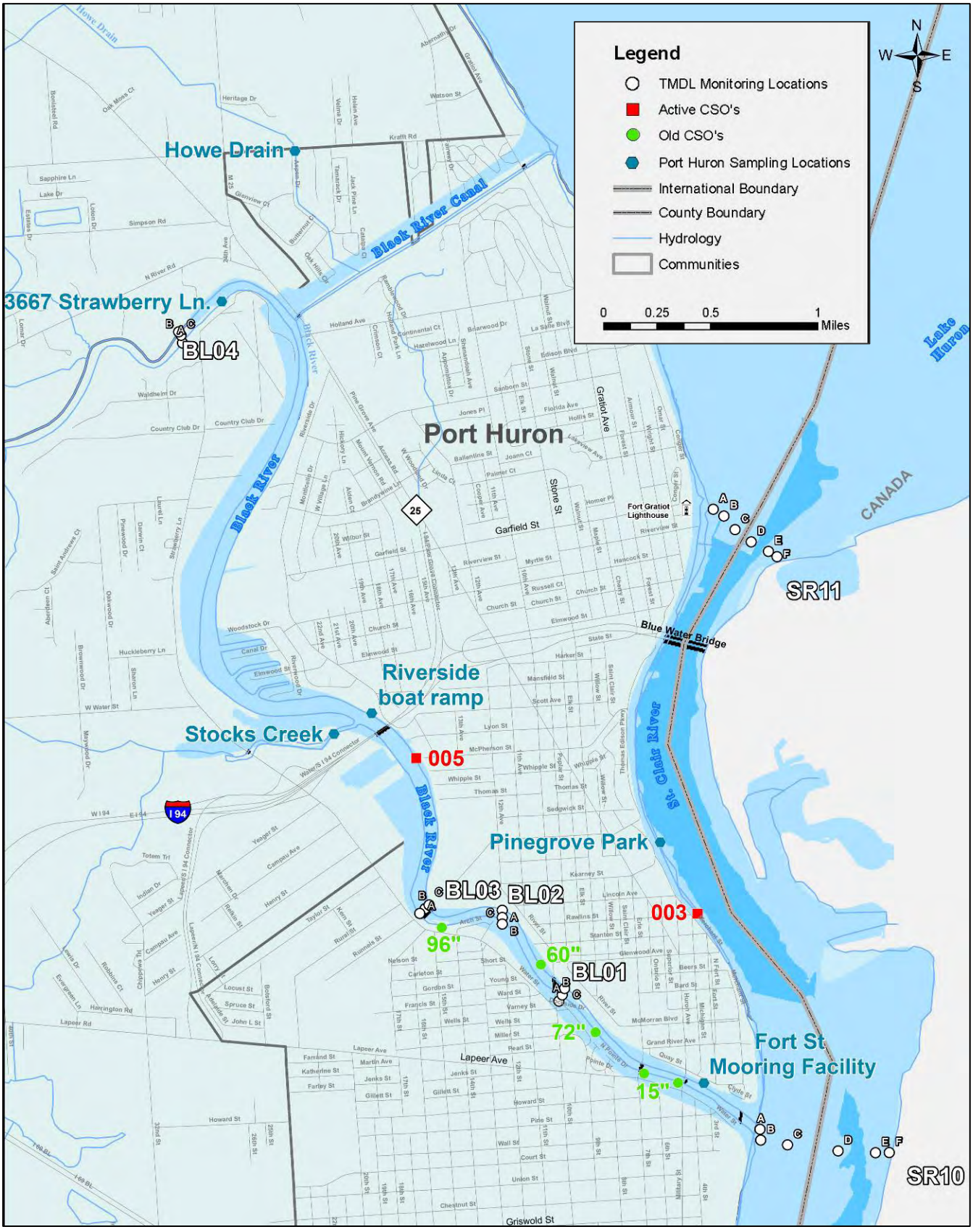
SR11 – (US) At the Fort Gratiot Lighthouse (3 samples; A, B & C).
(Canada) Beach at the Sarnia Yacht Club (3 samples; D, E & F).

SR10 – (US) Just downstream of the Black River in Port Huron (3 samples; A, B & C).
(Canada) At the cell tower straight across from Black River (3 samples; D, E & F).

SITE ID	Longitude	Latitude
SR11A	-82.421300	43.005742
SR11B	-82.420548	43.005373
SR11C	-82.419758	43.004636
SR11D	-82.418612	43.003977
SR11E	-82.417413	43.003451
SR11F	-82.416789	43.003157

SITE ID	Longitude	Latitude
SR10A	-82.418964	42.972891
SR10B	-82.418934	42.972352
SR10C	-82.417014	42.972058
SR10D	-82.413381	42.971684
SR10E	-82.410699	42.971542
SR10F	-82.409705	42.971534

See maps on following two pages


Legend
TMDL Monitoring Locations
Active CSO's
Old CSO's
Port Huron Sampling Locations
International Boundary
County Boundary
Hydrology
Communities
0 0.25 0.5 1 Miles
N
W
E
S
Howe Drain
3667 Strawberry Ln.
BL04
Black River Canal
Black River
Port Huron
Lake Huron
CANADA
SR11
SR10
Fort Gratiot Lighthouse
Blue Water Bridge
St. Clair River
Riverside boat ramp
Stocks Creek
005
Pinegrove Park
BL03
BL02
BL01
003
96"
60"
72"
15"
Fort St Mooring Facility
Griswold St
Lapeer Ave
Gratiot Ave
Stone St
Garfield St
Lapeer/I 194 Connector
I 194

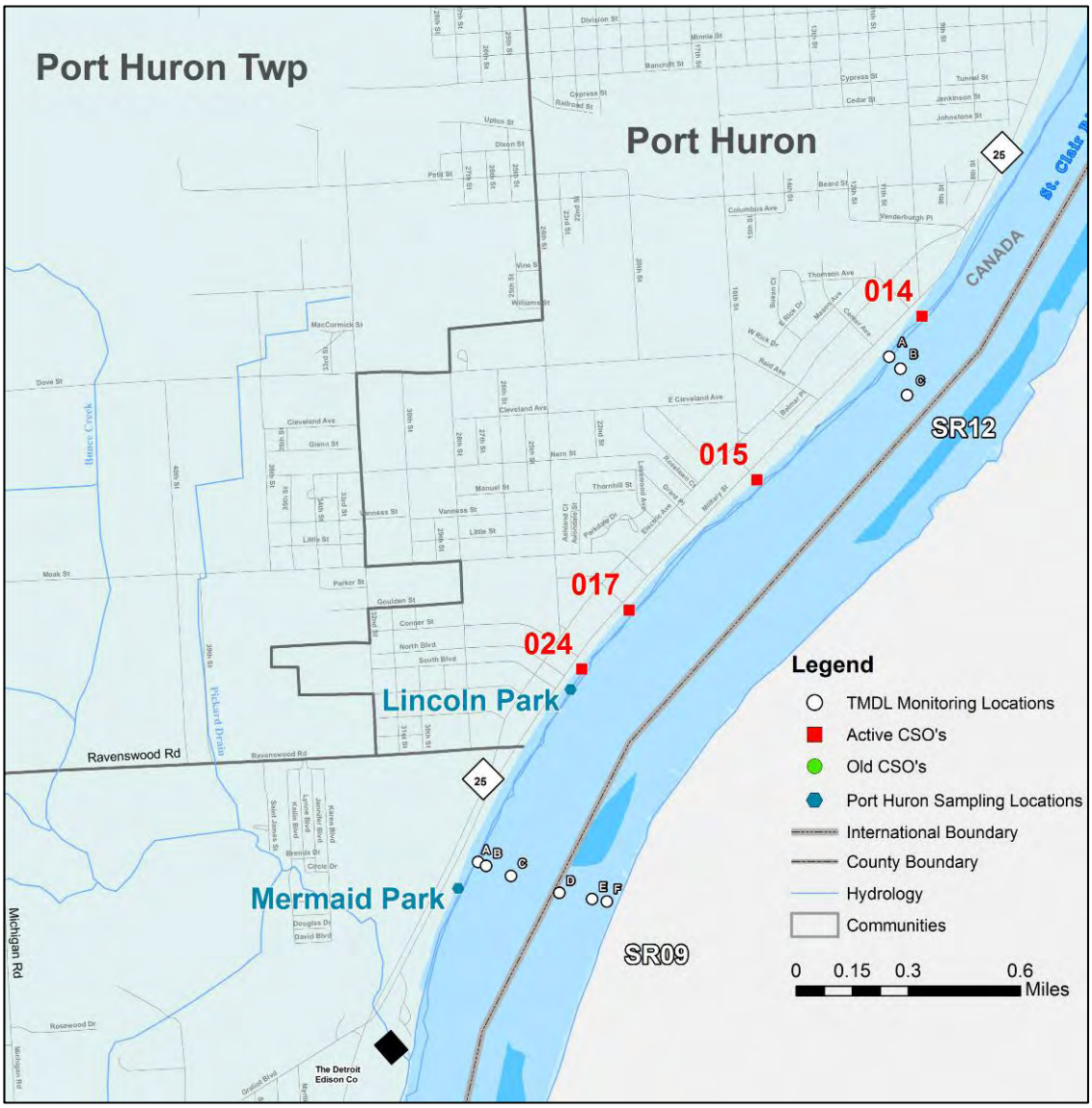

N
W
E
S
Howe Drain
M21
M17
3667 Strawberry Ln.
3667 Strawberry
BL04
M09
BL05
M47
Black River
Stocks Creek
Baldwin Drain
Legend
Port Huron Sampling Locations
SCCHD Sample Locations
EPA TMDL Sample Locations
Active CSO
Old CSO
Hydrology
Jurisdictional Boundary
Roads
0 0.15 0.3 0.6
Miles

SR12 – (US) Port Huron near Center Ave.

SR09 – (US) North of Marysville and the DTE power plant (3 samples; A, B & C).
(Canada) Straight across at the seawall (3 samples; D, E & F).

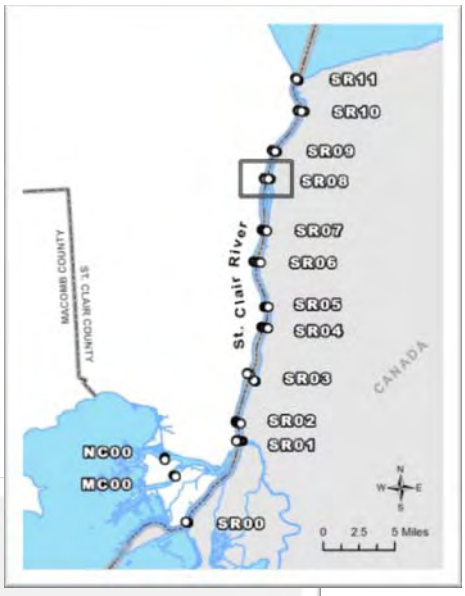
SITE ID	Longitude	Latitude
SR12A	-82.433693	42.951857
SR12B	-82.433614	42.951335
SR12C	-82.432564	42.950346

SITE ID	Longitude	Latitude
SR09A	-82.455844	42.932658
SR09B	-82.455435	42.932492
SR09C	-82.454134	42.932077
SR09D	-82.451595	42.931379
SR09E	-82.449880	42.931110
SR09F	-82.449104	42.931005



SR08 – (US) South of the Marysville Water Plant at Chrysler Beach (3 samples; A, B & C).
(Canada) Just downstream of Talford Creek (3 samples; D, E & F).

SITE ID	Longitude	Latitude
SR08A	-82.467981	42.904427
SR08B	-82.468033	42.904037
SR08C	-82.465722	42.903715
SR08D	-82.461688	42.903621
SR08E	-82.459054	42.903621
SR08F	-82.458592	42.903644

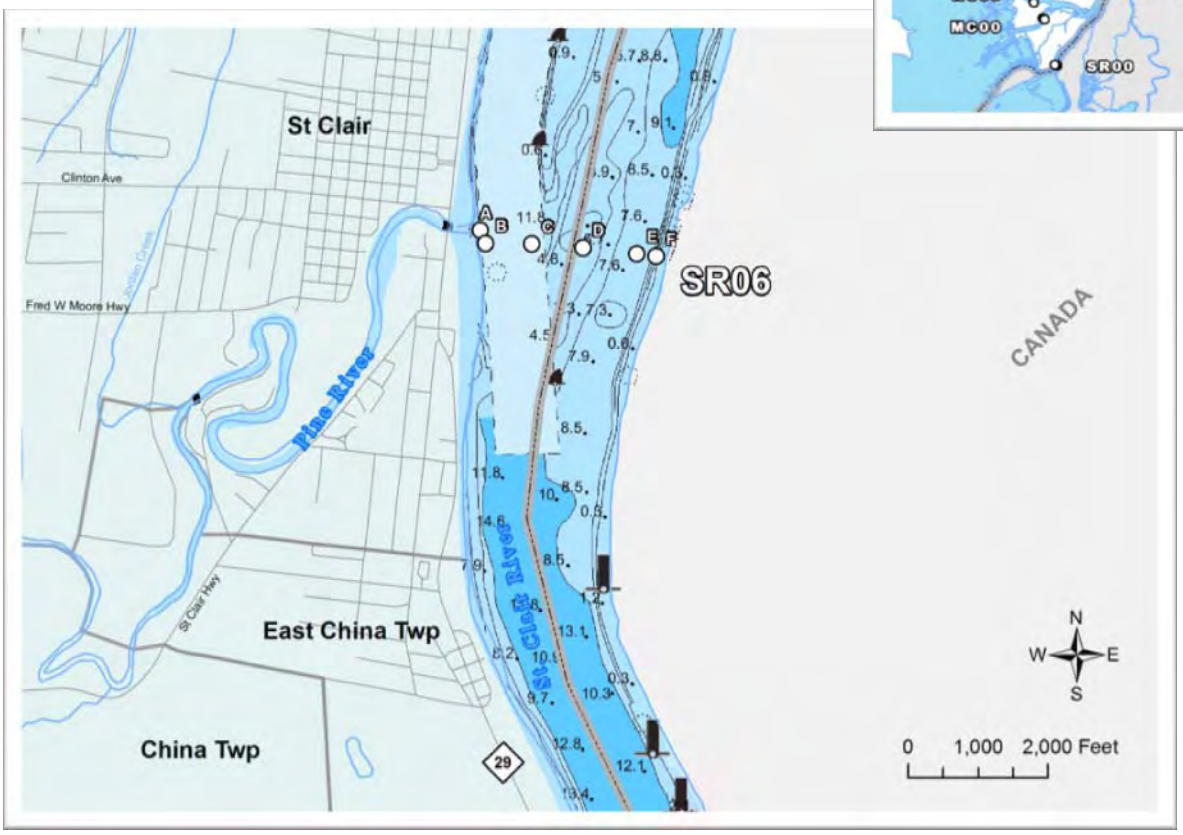


SR07 – (US) North of the City of St. Clair at the south end of the Apt. complex (3 samples; A, B & C).
(Canada) North of Mooretown at the blue roof boathouse (3 samples; D, E & F).

SITE ID	Longitude	Latitude
SR07A	-82.472039	42.852216
SR07B	-82.472164	42.851651
SR07C	-82.470099	42.851567
SR07D	-82.467825	42.851342
SR07E	-82.466077	42.851120
SR07F	-82.465240	42.851063

SR06 – (US) Just downstream of the Pine River in the City of St. Clair (3 samples; A, B & C).
(Canada) Straight across from the Pine River at the wood dock (3 samples; D, E & F).

SITE ID	Longitude	Latitude
SR06A	-82.484720	42.820085
SR06B	-82.484436	42.819561
SR06C	-82.481949	42.819306
SR06D	-82.479219	42.819306
SR06E	-82.476334	42.819011
SR06F	-82.475295	42.818903



SR05 – (US) North of the DTE power at the inland smoke stacks (3 samples; A, B & C).
(Canada) South of the fixed barge and Bowens Creek (3 samples; D, E & F).

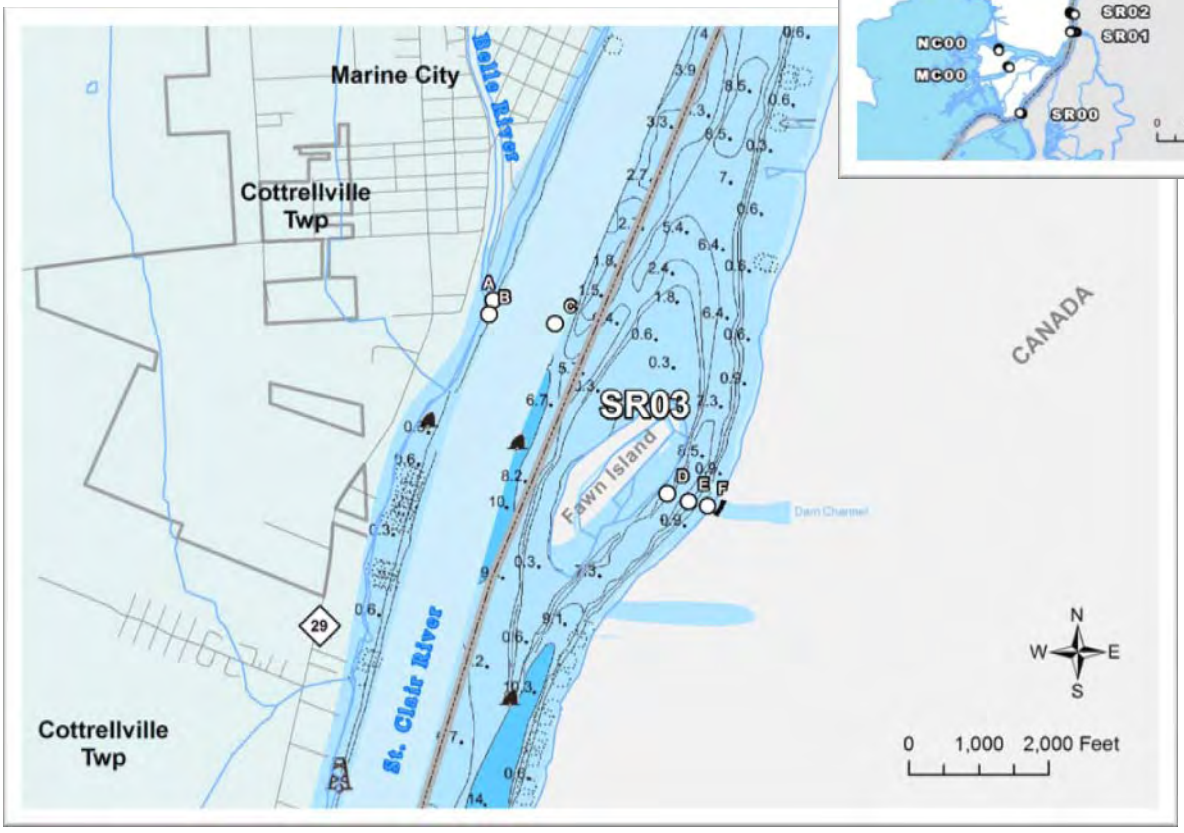
SR04 – (US) Straight across from Clay Creek at the 1st canal to the north (3 samples; A, B & C).
(Canada) North of the horseshoe shaped canal at Clay Creek (3 samples; D, E & F).

SITE ID	Longitude	Latitude
SR05A	-82.471052	42.773616
SR05B	-82.470553	42.773608
SR05C	-82.469309	42.773563
SR05D	-82.467463	42.773556
SR05E	-82.465881	42.773514
SR05F	-82.465325	42.773489

SITE ID	Longitude	Latitude
SR04A	-82.475840	42.753179
SR04B	-82.475362	42.753029
SR04C	-82.473265	42.752724
SR04D	-82.470574	42.752294
SR04E	-82.468106	42.752140
SR04F	-82.466700	42.751988

SR03 – (US) Just downstream of the Belle River, south of Marine City (3 samples; A, B & C). (Canada) At the Dam Channel on the east side of Fawn Island (3 samples; D, E & F).

SITE ID	Longitude	Latitude
SR03A	-82.496852	42.706661
SR03B	-82.497099	42.706100
SR03C	-82.491497	42.705275
SR03D	-82.487752	42.698842
SR03E	-82.486612	42.698504
SR03F	-82.485599	42.698313



SR02 – (US) North of Algonac State Park at Roberts Landing (3 samples; A, B & C).
(Canada) Straight across at the red Canadian Coast Guard facility (3 samples; D, E & F).

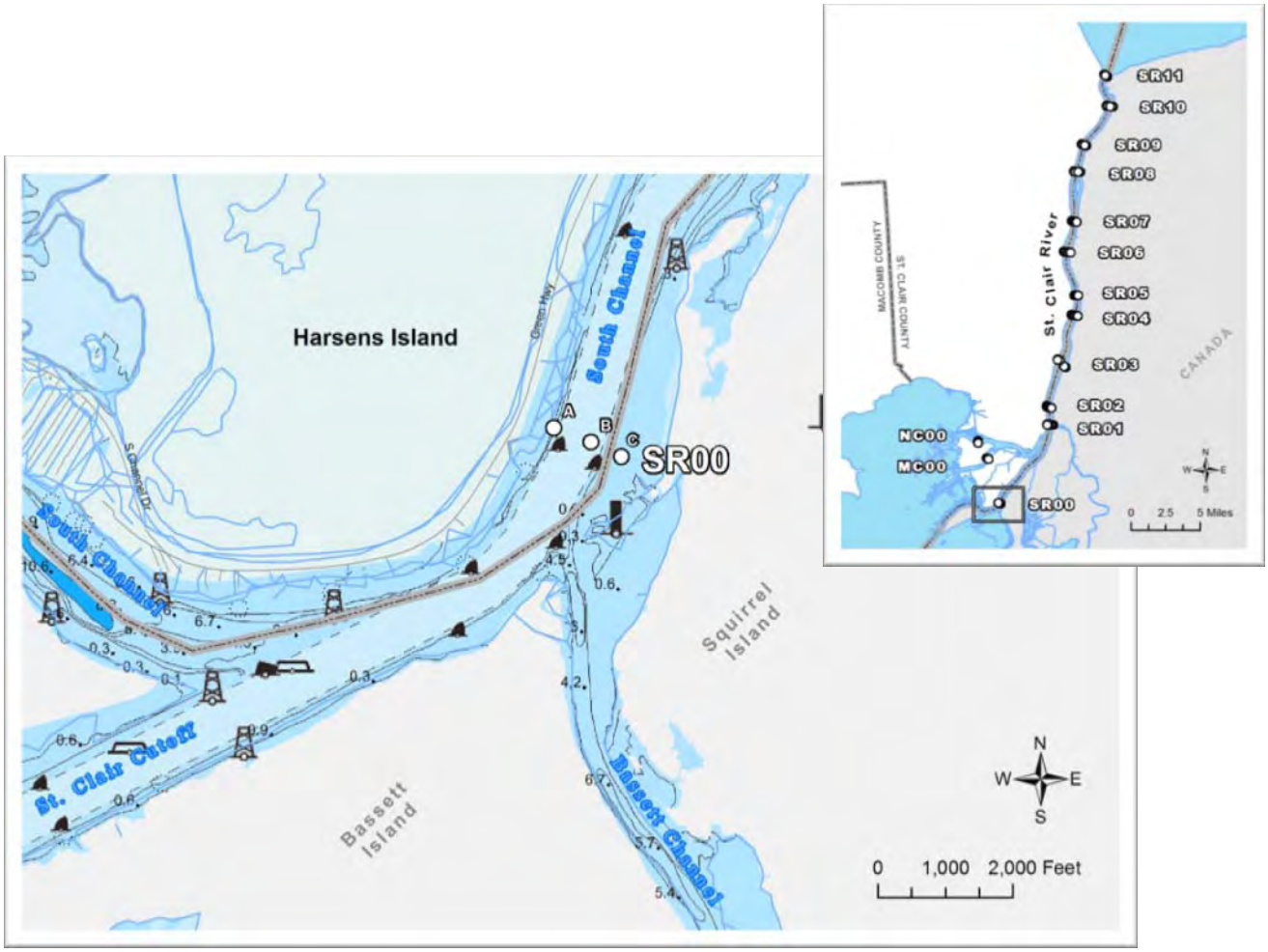
SR01 – (US) At McRae's Big River Grille restaurant (3 samples; A, B & C).
(Canada) Just downstream of Channel Ecarte (3 samples; D, E & F).

SITE ID	Longitude	Latitude
SR02A	-82.514187	42.658171
SR02B	-82.514112	42.657015
SR02C	-82.511794	42.656317
SR02D	-82.509729	42.655797
SR02E	-82.507820	42.655585
SR02F	-82.504053	42.655625

SITE ID	Longitude	Latitude
SR01A	-82.513749	42.638665
SR01B	-82.514112	42.637736
SR01C	-82.511489	42.637655
SR01D	-82.508598	42.637608
SR01E	-82.506464	42.637685
SR01F	-82.505354	42.637480

SR00 – (US) At the south end of Harsens Island on the South Channel (2 samples; A & B).
(Canada) Just north of the orange triangle beacon (1 sample; C).

SITE ID	Longitude	Latitude
SR00A	-82.586042	42.557056
SR00B	-82.583982	42.556435
SR00C	-82.582307	42.555806

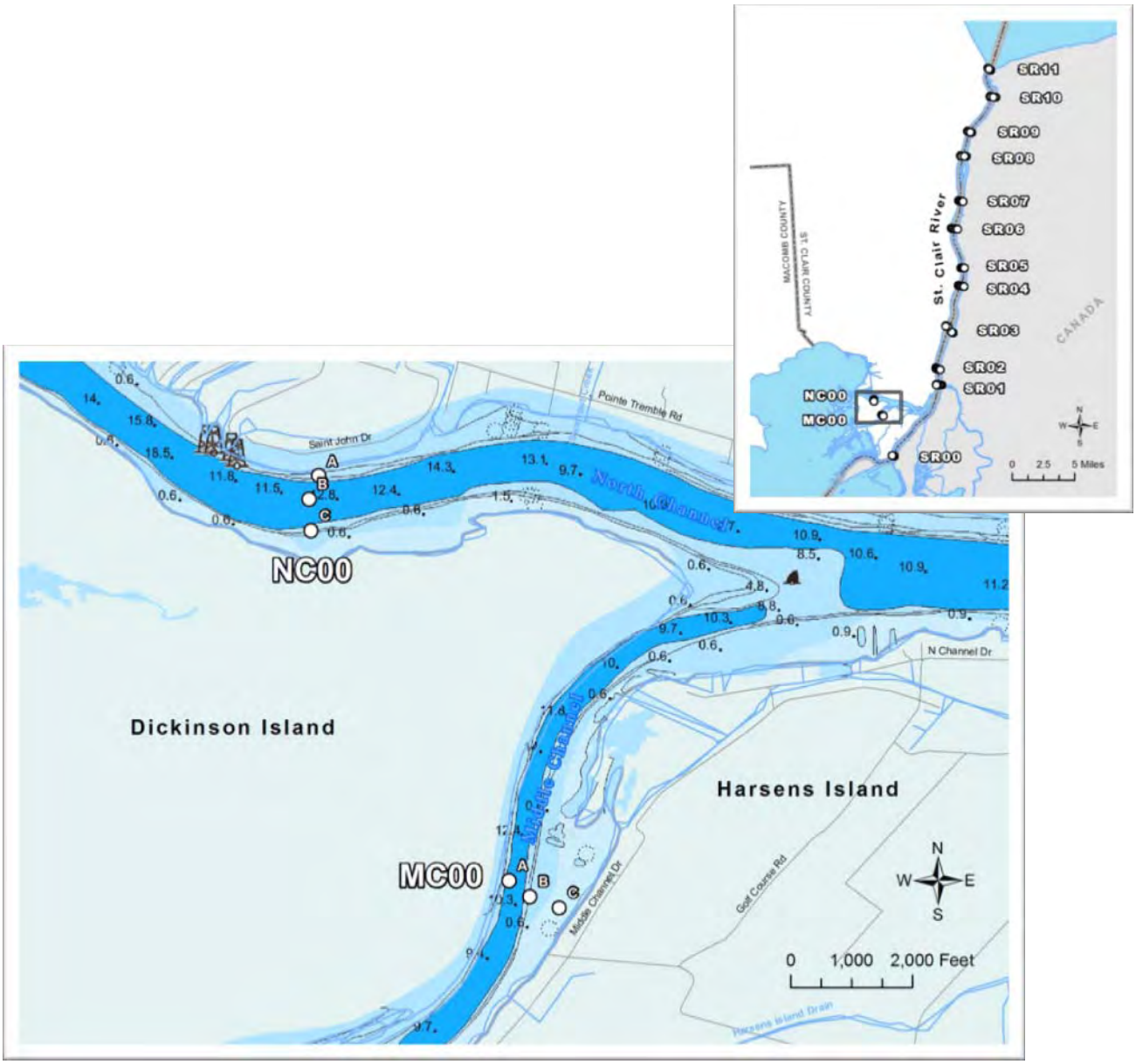


MC00 – (US) On the Middle Channel at the first cottage south of the North Channel (3 samples; A, B & C).

NC00 – (US) On the North Channel at Colony Marine (3 samples; A, B & C).

SITE ID	Longitude	Latitude
MC00A	-82.601437	42.604260
MC00B	-82.600176	42.603512
MC00C	-82.598381	42.602977

SITE ID	Longitude	Latitude
NC00A	-82.612631	42.622823
NC00B	-82.613245	42.621776
NC00C	-82.613156	42.620336



Appendix D – *E. coli* Data

Station ID		07/15/08	07/22/08	07/29/08	08/05/08	08/12/08	08/19/08	08/26/08	09/02/08	09/09/08	09/16/08	09/23/08	09/30/08	10/07/08	10/14/08	10/21/08	10/28/08
		E. coli Results (cfu/100 mL)															
SR00 South Channel	A	10	10	10	10	10	10	10	10	10	10	10	20	10	10	10	10
	B	10	10	10	10	10	10	10	10	10	30	10	10	10	10	10	10
	C	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Daily Geomean		***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***14***	***10***	***13***	***10***	***10***	***10***	***10***
SR01 Chenal Encarte	A	10	10	10	10	20	10	10	10	10	40	10	10	10	10	10	10
	B	10	10	10	10	10	10	10	10	20	230	10	20	10	10	10	10
	C	10	10	10	10	10	10	10	10	10	70	10	10	10	10	10	10
	D	10	10	10	10	10	10	30	10	20	10	10	10	10	10	10	10
	E	10	10	10	10	10	10	10	10	10	50	10	10	10	10	10	10
	F	10	10	10	10	10	10	20	10	10	80	10	40	10	10	10	10
US Geomean		***10***	***10***	***10***	***10***	***13***	***10***	***10***	***10***	***13***	***86***	***10***	***13***	***10***	***10***	***10***	***10***
Canadian Geomean		***10***	***10***	***10***	***10***	***10***	***10***	***18***	***10***	***13***	***34***	***10***	***16***	***10***	***10***	***10***	***10***
Daily Geomean		***10***	***10***	***10***	***10***	***11***	***10***	***13***	***10***	***13***	***54***	***10***	***14***	***10***	***10***	***10***	***10***
SR02 Roberts Landing	A	10	10	10	10	10	10	10	10	20	100	10	50	10	10	10	10
	B	10	10	10	10	10	10	10	10	30	10	10	10	10	10	10	10
	C	10	20	10	10	10	10	10	10	20	40	10	10	10	10	20	10
	D	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	E	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	F	10	10	10	10	10	10	10	10	10	100	10	20	10	10	10	10
US Geomean		***10***	***13***	***10***	***10***	***10***	***10***	***10***	***10***	***23***	***34***	***10***	***17***	***10***	***10***	***13***	***10***
Canadian Geomean		***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***22***	***10***	***13***	***10***	***10***	***10***	***10***
Daily Geomean		***10***	***11***	***10***	***10***	***10***	***10***	***10***	***10***	***15***	***27***	***10***	***15***	***10***	***10***	***11***	***10***
SR03 d/s of Belle River	A	100	10	280	30	100	170	70	80	310	140	70	10	10	10	40	60
	B	10	10	10	60	10	110	20	10	70	1,000	10	50	10	10	10	10
	C	10	180	10	20	10	10	10	10	10	130	10	10	10	10	10	10
	D	10	30	10	10	10	10	10	20	20	10	10	10	10	10	10	10
	E	10	10	10	10	10	10	10	10	30	70	10	10	10	10	10	10
	F	10	10	10	10	20	110	10	10	20	80	10	70	10	10	30	10
US Geomean		***22***	***26***	***30***	***33***	***22***	***57***	***24***	***20***	***60***	***263***	***19***	***17***	***10***	***10***	***16***	***18***
Canadian Geomean		***10***	***14***	***10***	***10***	***13***	***22***	***10***	***13***	***23***	***38***	***10***	***19***	***10***	***10***	***14***	***10***
Daily Geomean		***15***	***19***	***17***	***18***	***16***	***36***	***16***	***16***	***37***	***100***	***14***	***18***	***10***	***10***	***15***	***13***
SR04 d/s Clay Creek	A	10	10	10	10	290	30	10	10	10	20	10	20	10	10	10	10
	B	10	10	10	10	20	10	10	10	70	220	10	70	10	10	10	10
	C	10	10	10	10	10	10	10	10	110	130	10	10	10	10	10	10
	D	10	10	10	10	10	10	10	20	80	10	10	10	10	10	10	20
	E	10	10	10	30	10	10	10	30	200	1,700	10	50	10	10	10	10
	F	10	10	10	10	40	40	10	10	300	700	80	400	10	10	40	10
US Geomean		***10***	***10***	***10***	***10***	***39***	***14***	***10***	***10***	***43***	***83***	***10***	***24***	***10***	***10***	***10***	***10***
Canadian Geomean		***10***	***10***	***10***	***14***	***16***	***16***	***10***	***18***	***169***	***228***	***20***	***58***	***10***	***10***	***16***	***13***
Daily Geomean		***10***	***10***	***10***	***12***	***25***	***15***	***10***	***13***	***85***	***138***	***14***	***38***	***10***	***10***	***13***	***11***
SR05 d/s of Bowens Creek	A	10	10	10	10	20	10	20	10	180	700	10	50	10	10	10	20
	B	10	10	10	10	20	10	20	10	170	280	10	20	10	10	10	20
	C	10	10	10	10	10	10	10	20	10	20	10	30	10	10	10	10
	D	10	10	10	10	10	10	10	20	10	90	10	10	10	10	10	10
	E	10	10	10	10	30	20	20	10	100	50	10	10	10	10	10	10
	F	10	10	10	10	10	10	10	40	20	10	10	10	10	10	20	10
US Geomean		***10***	***10***	***10***	***10***	***16***	***10***	***16***	***13***	***67***	***158***	***10***	***31***	***10***	***10***	***10***	***16***
Canadian Geomean		***10***	***10***	***10***	***10***	***14***	***13***	***13***	***20***	***27***	***36***	***10***	***10***	***10***	***10***	***13***	***10***
Daily Geomean		***10***	***10***	***10***	***10***	***15***	***11***	***14***	***16***	***43***	***75***	***10***	***18***	***10***	***10***	***11***	***13***

Precipitation occurred on the sample collection day and/or the day before.

Station ID		05/05/09	05/12/09	05/19/09	05/26/09	06/02/09	06/09/09	06/16/09	06/23/09	06/30/09	07/07/09	07/14/09	07/21/09	07/28/09	08/04/09	08/11/09	08/18/09	08/25/09	Project Geomean
		E. coli Results (cfu/100 mL)																	
SR00 South Channel	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Daily Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*10*
SR01 Chenal Encarte	A	10	10	10	10	10	10	10	20	10	-	-	-	-	-	-	-	-	
	B	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	F	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
US Geomean		*10*	*10*	*10*	*10*	*10*	*10*	*10*	*13*	*10*	-	-	-	-	-	-	-	-	*11*
Canadian Geomean		*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	-	-	-	-	-	-	-	-	*11*
Daily Geomean		*10*	*10*	*10*	*10*	*10*	*10*	*10*	*11*	*10*	-	-	-	-	-	-	-	-	*11*
SR02 Roberts Landing	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
US Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*12*
Canadian Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*11*
Daily Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*11*
SR03 d/s of Belle River	A	10	60	120	10	80	100	10	210	180	-	-	-	-	-	-	-	-	
	B	10	110	60	10	100	100	110	170	70	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	F	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
US Geomean		*10*	*40*	*42*	*10*	*43*	*46*	*22*	*71*	*50*	-	-	-	-	-	-	-	-	*28*
Canadian Geomean		*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	-	-	-	-	-	-	-	-	*12*
Daily Geomean		*10*	*20*	*20*	*10*	*21*	*22*	*15*	*27*	*22*	-	-	-	-	-	-	-	-	*18*
SR04 d/s Clay Creek	A	90	10	10	20	10	10	10	10	10	-	-	-	-	-	-	-	-	
	B	40	10	10	10	10	10	10	80	10	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	20	10	10	10	10	10	10	110	60	-	-	-	-	-	-	-	-	
	F	10	10	20	10	30	50	50	390	60	-	-	-	-	-	-	-	-	
US Geomean		*33*	*10*	*10*	*13*	*10*	*10*	*10*	*20*	*10*	-	-	-	-	-	-	-	-	*14*
Canadian Geomean		*13*	*10*	*13*	*10*	*14*	*17*	*17*	*75*	*33*	-	-	-	-	-	-	-	-	*19*
Daily Geomean		*20*	*10*	*11*	*11*	*12*	*13*	*13*	*39*	*18*	-	-	-	-	-	-	-	-	*16*
SR05 d/s of Bowens Creek	A	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	B	10	10	10	10	10	10	10	20	10	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	10	10	10	10	10	20	10	10	20	-	-	-	-	-	-	-	-	
	F	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
US Geomean		*10*	*10*	*10*	*10*	*10*	*10*	*10*	*13*	*10*	-	-	-	-	-	-	-	-	*14*
Canadian Geomean		*10*	*10*	*10*	*10*	*10*	*13*	*10*	*10*	*13*	-	-	-	-	-	-	-	-	*12*
Daily Geomean		*10*	*10*	*10*	*10*	*10*	*11*	*10*	*11*	*11*	-	-	-	-	-	-	-	-	*13*

Precipitation occurred on the sample collection day and/or the day before.

Station ID		07/15/08	07/22/08	07/29/08	08/05/08	08/12/08	08/19/08	08/26/08	09/02/08	09/09/08	09/16/08	09/23/08	09/30/08	10/07/08	10/14/08	10/21/08	10/28/08
		E. coli Results (cfu/100 mL)															
SR06 d/s of Pine River	A	70	10	70	30	20	10	10	20	130	100	30	150	10	60	50	20
	B	10	10	10	30	20	20	10	10	130	490	10	10	10	20	20	10
	C	10	10	10	10	10	10	10	10	10	60	10	10	10	10	10	10
	D	10	10	10	10	10	10	10	10	20	10	10	20	10	10	10	10
	E	10	10	10	10	10	10	10	20	100	10	10	10	10	10	10	10
	F	10	10	10	10	30	10	10	10	90	30	10	20	10	10	10	10
US Geomean		***19***	***10***	***19***	***21***	***16***	***13***	***10***	***13***	***55***	***143***	***14***	***25***	***10***	***23***	***22***	***13***
Canadian Geomean		***10***	***10***	***10***	***10***	***14***	***10***	***10***	***13***	***56***	***14***	***10***	***16***	***10***	***10***	***10***	***10***
Daily Geomean		***14***	***10***	***14***	***14***	***15***	***11***	***10***	***13***	***56***	***45***	***12***	***20***	***10***	***15***	***15***	***11***
SR07 u/s of Baby Creek	A	10	10	10	10	10	10	60	10	160	110	20	60	10	10	20	10
	B	10	20	20	10	40	10	10	10	110	560	40	110	10	110	10	20
	C	10	10	10	10	10	10	10	10	10	70	10	10	10	10	10	20
	D	10	10	10	10	10	10	10	10	10	20	10	10	10	10	10	10
	E	10	10	10	10	10	10	30	40	100	40	10	20	10	10	10	10
	F	40	10	10	10	20	20	10	40	140	30	10	50	20	10	10	20
US Geomean		***10***	***13***	***13***	***10***	***16***	***10***	***18***	***10***	***56***	***163***	***20***	***40***	***10***	***22***	***13***	***16***
Canadian Geomean		***16***	***10***	***10***	***10***	***13***	***13***	***14***	***25***	***52***	***29***	***10***	***22***	***13***	***10***	***10***	***13***
Daily Geomean		***13***	***11***	***11***	***10***	***14***	***11***	***16***	***16***	***54***	***69***	***14***	***30***	***11***	***15***	***11***	***14***
SR08 d/s of Talford Creek	A	10	10	10	200	100	110	10	180	10	700	10	80	50	10	60	40
	B	10	10	10	180	460	380	40	190	60	20	30	150	10	80	10	30
	C	10	80	10	10	10	10	10	10	10	40	10	10	10	20	10	10
	D	10	40	10	10	10	10	10	10	10	10	10	60	10	10	10	10
	E	50	10	10	10	20	30	10	30	10	20	10	10	10	10	10	20
	F	30	10	20	10	10	10	30	20	110	1,100	40	60	10	10	10	20
US Geomean		***10***	***20***	***10***	***71***	***77***	***75***	***16***	***70***	***18***	***82***	***14***	***49***	***17***	***25***	***18***	***23***
Canadian Geomean		***25***	***16***	***13***	***10***	***13***	***14***	***14***	***18***	***22***	***60***	***16***	***33***	***10***	***10***	***10***	***16***
Daily Geomean		***16***	***18***	***11***	***27***	***31***	***33***	***15***	***36***	***20***	***71***	***15***	***40***	***13***	***16***	***13***	***19***
SR09 u/s of Edison Plant	A	20	50	10	150	110	270	60	150	80	10	30	40	10	10	20	50
	B	10	10	10	30	90	60	60	10	10	10	40	20	10	10	30	10
	C	10	40	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	D	10	50	10	20	10	10	10	10	10	10	10	10	10	10	10	10
	E	10	10	10	10	10	40	20	10	10	10	10	50	10	10	10	10
	F	10	10	10	10	10	40	10	30	140	10	10	10	10	10	10	10
US Geomean		***13***	***27***	***10***	***36***	***46***	***55***	***33***	***25***	***20***	***10***	***23***	***20***	***10***	***10***	***18***	***17***
Canadian Geomean		***10***	***17***	***10***	***13***	***10***	***25***	***13***	***14***	***24***	***10***	***10***	***17***	***10***	***10***	***10***	***10***
Daily Geomean		***11***	***22***	***10***	***21***	***22***	***37***	***20***	***19***	***22***	***10***	***15***	***18***	***10***	***10***	***13***	***13***
SR10 d/s of Black River	A	10	10	10	60	20	10	10	30	260	6,100	10	10	10	10	10	20
	B	10	10	10	10	20	20	10	10	140	4,900	10	10	10	10	10	10
	C	20	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	D	20	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	E	10	10	10	10	20	40	100	40	320	30	10	10	10	10	10	10
	F	10	10	10	10	40	10	40	40	190	20	40	60	10	10	200	30
US Geomean		***13***	***10***	***10***	***18***	***16***	***13***	***10***	***14***	***71***	***669***	***10***	***10***	***10***	***10***	***10***	***13***
Canadian Geomean		***13***	***10***	***10***	***10***	***20***	***16***	***34***	***25***	***85***	***18***	***16***	***18***	***10***	***10***	***27***	***14***
Daily Geomean		***13***	***10***	***10***	***13***	***18***	***14***	***18***	***19***	***78***	***110***	***13***	***13***	***10***	***10***	***16***	***13***

Precipitation occurred on the sample collection day and/or the day before.
Daily geometric mean > 300 cfu/100mL
Flagged for Quality Control reasons

Station ID		05/05/09	05/12/09	05/19/09	05/26/09	06/02/09	06/09/09	06/16/09	06/23/09	06/30/09	07/07/09	07/14/09	07/21/09	07/28/09	08/04/09	08/11/09	08/18/09	08/25/09	Project Geomean
		E. coli Results (cfu/100 mL)																	
SR06 d/s of Pine River	A	20	80	10	10	10	20	20	80	90	-	-	-	-	-	-	-	-	
	B	20	10	30	10	10	10	10	120	20	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	10	10	10	10	10	10	10	70	10	-	-	-	-	-	-	-	-	
	F	10	10	10	10	10	20	10	30	10	-	-	-	-	-	-	-	-	
US Geomean		***16***	***20***	***14***	***10***	***10***	***13***	***13***	***46***	***26***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***18***
Canadian Geomean		***10***	***10***	***10***	***10***	***10***	***13***	***10***	***28***	***10***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***12***
Daily Geomean		***13***	***14***	***12***	***10***	***10***	***13***	***11***	***36***	***16***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***15***
SR07 u/s of Baby Creek	A	10	10	10	10	10	10	10	20	10	-	-	-	-	-	-	-	-	
	B	10	10	20	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	10	10	10	10	10	10	10	10	30	-	-	-	-	-	-	-	-	
	F	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
US Geomean		***10***	***10***	***13***	***10***	***10***	***10***	***10***	***13***	***10***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***15***
Canadian Geomean		***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***14***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***13***
Daily Geomean		***10***	***10***	***11***	***10***	***10***	***10***	***10***	***11***	***12***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***14***
SR08 d/s of Talford Creek	A	10	30	240	50	80	20	20	10	20	-	-	-	-	-	-	-	-	
	B	20	10	340	50	50	50	10	10	30	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	20	40	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	F	10	20	10	10	10	20	10	10	10	-	-	-	-	-	-	-	-	
US Geomean		***13***	***14***	***93***	***29***	***34***	***22***	***13***	***10***	***18***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***26***
Canadian Geomean		***13***	***20***	***10***	***10***	***10***	***13***	***10***	***10***	***10***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***14***
Daily Geomean		***13***	***17***	***31***	***17***	***18***	***16***	***11***	***10***	***13***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***19***
SR09 u/s of Edison Plant	A	20	20	100	10	20	30	10	20	20	-	-	-	-	-	-	-	-	
	B	10	20	20	10	30	30	30	30	20	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	30	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	F	10	10	10	10	10	20	10	10	10	-	-	-	-	-	-	-	-	
US Geomean		***13***	***16***	***27***	***10***	***18***	***21***	***14***	***26***	***16***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***19***
Canadian Geomean		***10***	***10***	***10***	***10***	***10***	***13***	***10***	***10***	***10***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***12***
Daily Geomean		***11***	***13***	***16***	***10***	***13***	***16***	***12***	***16***	***13***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***15***
SR10 d/s of Black River	A	10	60	30	50	50	110	40	10	100	-	-	-	-	-	-	-	-	
	B	20	10	10	70	30	10	20	270	180	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
	E	140	50	20	10	10	20	10	10	10	-	-	-	-	-	-	-	-	
	F	10	10	10	10	10	30	10	20	10	-	-	-	-	-	-	-	-	
US Geomean		***13***	***18***	***14***	***33***	***25***	***22***	***20***	***30***	***56***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***19***
Canadian Geomean		***24***	***17***	***13***	***10***	***10***	***18***	***10***	***13***	***10***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***16***
Daily Geomean		***17***	***18***	***13***	***18***	***16***	***20***	***14***	***19***	***24***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***17***

Precipitation occurred on the sample collection day and/or the day before.
Daily geometric mean > 300 cfu/100mL
Flagged for Quality Control reasons

Station ID		07/15/08	07/22/08	07/29/08	08/05/08	08/12/08	08/19/08	08/26/08	09/02/08	09/09/08	09/16/08	09/23/08	09/30/08	10/07/08	10/14/08	10/21/08	10/28/08
		E. coli Results (cfu/100 mL)															
SR11 Lake Huron outlet	A	10	10	10	10	10	10	30	10	10	2,400	10	30	10	10	10	20
	B	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	20
	C	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	D	10	10	10	10	10	20	10	10	10	10	10	10	10	10	10	10
	E	10	10	10	10	10	10	10	10	10	10	10	10	10	10	20	10
	F	10	10	10	10	10	10	30	10	40	40	10	140	10	10	10	10
US Geomean		***10***	***10***	***10***	***10***	***10***	***10***	***14***	***10***	***10***	***62***	***10***	***14***	***10***	***10***	***10***	***16***
Canadian Geomean		***10***	***10***	***10***	***10***	***10***	***13***	***14***	***10***	***16***	***16***	***10***	***24***	***10***	***10***	***13***	***10***
Daily Geomean		***10***	***10***	***10***	***10***	***10***	***11***	***14***	***10***	***13***	***31***	***10***	***19***	***10***	***10***	***11***	***13***
SR12	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Daily Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MC00 Middle Channel	A	10	10	10	10	10	10	10	10	10	110	10	10	10	10	10	10
	B	10	10	10	10	10	10	10	10	10	30	10	10	10	10	10	10
	C	10	10	10	10	10	10	10	10	10	70	10	10	10	10	10	10
Daily Geomean		***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***61***	***10***	***10***	***10***	***10***	***10***	***10***
NC00 North Channel	A	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	B	10	-	10	10	10	10	10	10	10	110	10	10	10	10	10	10
	C	10	-	10	10	10	10	10	10	10	80	10	10	10	10	10	10
Daily Geomean		***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***44***	***10***	***10***	***10***	***10***	***10***	***10***
BL01 at 10th St.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Daily Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BL02 at 13th St.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Daily Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BL03 at railroad bridge	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Daily Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BL04 u/s of Strawberry Ln	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Daily Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BL05 d/s of Wadhams Rd	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Daily Geomean		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Precipitation occurred on the sample collection day and/or the day before.
Daily geometric mean > 300 cfu/100mL
Flagged for Quality Control reasons

Station ID		05/05/09	05/12/09	05/19/09	05/26/09	06/02/09	06/09/09	06/16/09	06/23/09	06/30/09	07/07/09	07/14/09	07/21/09	07/28/09	08/04/09	08/11/09	08/18/09	08/25/09	Project Geomean
		E. coli Results (cfu/100 mL)																	
SR11 Lake Huron outlet	A	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	-	
	B	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	-	
	D	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	-	
	E	10	50	10	10	10	10	10	10	-	-	-	-	-	-	-	-	-	
	F	10	30	10	10	10	10	10	10	-	-	-	-	-	-	-	-	-	
US Geomean		***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***11***
Canadian Geomean		***10***	***25***	***10***	***10***	***10***	***10***	***10***	***10***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***12***
Daily Geomean		***10***	***16***	***10***	***10***	***10***	***10***	***10***	***10***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***11***
SR12	A	10	10	10	10	60	50	120	40	10	-	-	-	-	-	-	-	-	
	B	20	10	10	10	10	10	10	30	10	-	-	-	-	-	-	-	-	
	C	10	10	10	10	10	10	10	10	10	-	-	-	-	-	-	-	-	
Daily Geomean		***13***	***10***	***10***	***10***	***18***	***17***	***23***	***23***	***10***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***14***
MC00 Middle Channel	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Daily Geomean		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***11***
NC00 North Channel	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Daily Geomean		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***11***
BL01 at 10th St.	A	10	30	50	100	70	20	10	170	30	210	10	100	10	30	220	50	10	
	B	20	40	10	100	120	260	10	220	230	140	10	110	80	60	210	190	10	
	C	10	30	20	80	90	20	40	60	70	10	10	120	100	80	290	160	130	
Daily Geomean		***13***	***33***	***22***	***93***	***91***	***47***	***16***	***131***	***78***	***66***	***10***	***110***	***43***	***52***	***238***	***115***	***24***	***49***
BL02 at 13th St.	A	10	10	10	80	80	20	90	220	100	210	50	190	10	50	110	20	10	
	B	30	10	20	60	70	10	130	100	170	20	70	120	160	120	190	10	50	
	C	10	10	110	90	150	10	90	80	10	190	10	40	10	20	170	50	10	
Daily Geomean		***14***	***10***	***28***	***76***	***94***	***13***	***102***	***121***	***55***	***93***	***33***	***97***	***25***	***49***	***153***	***22***	***17***	***43***
BL03 at railroad bridge	A	90	10	30	60	120	170	10	120	250	30	90	120	10	60	300	210	10	
	B	10	50	10	10	100	10	80	140	180	150	10	80	60	80	350	100	140	
	C	30	30	10	90	80	10	10	260	100	190	90	110	110	50	260	80	10	
Daily Geomean		***30***	***25***	***14***	***38***	***99***	***26***	***20***	***163***	***165***	***95***	***43***	***102***	***40***	***62***	***301***	***119***	***24***	***56***
BL04 u/s of Strawberry Ln	A	20	40	290	10	120	10	40	100	20	150	130	1,100	30	110	10	10	10	
	B	10	10	10	10	40	30	30	180	10	10	80	4,800	140	20	120	10	10	
	C	10	20	130	10	160	10	10	220	10	80	10	3,700	50	20	100	20	10	
Daily Geomean		***13***	***20***	***72***	***10***	***92***	***14***	***23***	***158***	***13***	***49***	***47***	***2,693***	***59***	***35***	***49***	***13***	***10***	***38***
BL05 d/s of Wadhams Rd	A	-	-	-	-	-	-	-	-	-	120	210	20	10	270	740	60	60	
	B	-	-	-	-	-	-	-	-	-	30	10	100	20	100	550	90	10	
	C	-	-	-	-	-	-	-	-	-	80	90	10	40	10	10	80	20	
Daily Geomean		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	***66***	***57***	***27***	***20***	***65***	***160***	***76***	***23***	***50***

Precipitation occurred on the sample collection day and/or the day before.
Daily geometric mean > 300 cfu/100mL
Flagged for Quality Control reasons

Appendix E – BST Data

Monitoring Location	Date	*E. coli* Conc. (cfu/100mL)	Human Enterococcus Marker (+/-)	Human Bacteroidetes Marker (+/-)
Howe-Brandymore	07/21/09 08/11/09	1,203 > 2,419	- +	- -
Stocks Creek	08/11/09	1,733	-	-
BL04A	08/11/09	< 10	NA	NA
BL04C	08/11/09	100	NA	NA
BL05A	08/11/09	740	NA	NA

NA = Not Analyzed
+ = Positive
- = Negative

Appendix F – Blank and Duplicate *E. coli* Analytical Data

Week	Blank Sample ID	Blank Sample Result		Corresponding Duplicate Sample ID	Corresponding Duplicate Sample Result		Regular Sample Result	
1				MC00A-d	<	10	<	10
	SR02A-b	<	10	SR02A-d	<	10	<	10
				SR03B-d		30		10
	SR05D-b	<	10	SR05D-d	<	10	<	10
				SR07F-d		40		40
	SR08E-b	<	10	SR08E-d		10		50
				SR10C-d	<	10		20
2				MC00B-d	<	10	<	10
	SR01A-b	<	10	SR01A-d	<	10	<	10
				SR03C-d	<	10	<	10
	SR05E-b	<	10	SR05E-d	<	10	<	10
				SR06F-d	<	10		20
	SR08D-b	<	10	SR08D-d	<	10	<	10
				SR10B-d		10	<	10
3				MC00C-d	<	10	<	10
	SR01B-b	<	10	SR01B-d	<	10	<	10
				SR03D-d	<	10	<	10
	SR05F-b	<	10	SR05F-d	<	10	<	10
				SR06E-d	<	10		10
	SR08D-b	<	10	SR08D-d	<	10	<	10
				SR10A-d		10	<	10
	SR11B-b	<	10	SR11B-d	<	10		10
4				NC00C-d	<	10	<	10
	SR01C-b	<	10	SR01C-d	<	10	<	10
				SR03E-d		10	<	10
	SR04F-b	<	10	SR04F-d		10		10
				SR06D-d	<	10	<	10
	SR08B-b	<	10	SR08B-d		140		180
				SR09A-d		240		150
	SR11C-b	<	10	SR11C-d	<	10	<	10

Flagged for Quality Control.

Week	Blank Sample			Corresponding Duplicate Sample			Regular Sample	
	ID	Result		ID	Result		Result	
5				NC00B-d		10	<	10
	SR01C-b	<	10	SR01C-d	<	10	<	10
				SR03A-d		80		100
	SR04E-b	<	10	SR04E-d	<	10		10
				SR06D-d	<	10	<	10
	SR08F-b	<	10	SR08F-d		10	<	10
				SR09E-d	<	10		10
	SR11D-b	<	10	SR11D-d	<	10	<	10
6				SR01B-d		10	<	10
	SR02A-b	<	10	SR02A-d		10	<	10
				SR04D-d		10		10
	SR06E-b	<	10	SR06E-d	<	10		10
				SR07D-d		10	<	10
	SR09C-b	<	10	SR09D-d	<	10	<	10
				SR11E-d		30		10
	NC00C-b	<	10	NC00C-d	<	10	<	10
7				SR01A-d		10	<	10
	SR02B-b	<	10	SR02B-d	<	10	<	10
				SR04C-d	<	10	<	10
	SR06F-b	<	10	SR06F-d		10	<	10
				SR07D-d	<	10	<	10
	SR09D-b	<	10	SR09D-d	<	10	<	10
				SR11F-d	<	10		30
8				SR00C-d	<	10	<	10
	SR02C-b	<	10	SR02C-d	<	10	<	10
				SR04B-d		10		10
	SR05F-b	<	10	SR05F-d		40		40
				SR07D-d		30		10
	SR09E-b	<	10	SR09E-d		20	<	10
				SR10A-d		30		30
9				SR00B-d		20	<	10
	SR02D-b	<	10	SR02D-d		10	<	10
				SR04A-d		40	<	10
	SR05E-b	<	10	SR05E-d		50		100
				SR07C-d		20		10
	SR09F-b	<	10	SR09F-d		180		140
				SR10B-d		120		140
10				SR00A-d	<	10	<	10
	SR02E-b	<	10	SR02E-d	<	10	<	10
				SR03F-d		60		80
	SR05D-b	<	10	SR05D-d		50		90
				SR07B-d		110		560
	SR08A-b	<	10	SR08A-d		800		700
				SR10C-d		10	<	10

Flagged for Quality Control.

Week	Blank Sample			Corresponding Duplicate Sample			Regular Sample	
	ID	Result		ID	Result		Result	
11	SR02F-b	<	10	SR02F-d	<	10	<	10
				SR03D-d	<	10	<	10
	SR05C-b	<	10	SR05C-d	<	10	<	10
				SR07A-d	<	10		20
	SR08B-b	<	10	SR08B-d		30		30
				SR10D-d		20	<	10
				MC00A-d	<	10	<	10
12	SR01F-b	<	10	SR01F-d	<	10		40
				SR03D-d	<	10	<	10
	SR05B-b	<	10	SR05B-d		20		20
				SR06A-d	<	10		150
	SR08C-b	<	10	SR08C-d	<	10		10
				SR10E-d		50	<	10
	SR11A-b	<	10	SR11A-d		20		30
				MC00B-d	<	10		10
13	SR01E-b	<	10	SR01E-d	<	10	<	10
				SR03C-d	<	10		10
	SR05A-b	<	10	SR05A-d	<	10	<	10
				SR06B-d	<	10	<	10
	SR08D-b	<	10	SR08D-d	<	10	<	10
				SR10F-d	<	10	<	10
	SR11B-b	<	10	SR11B-d		10	<	10
				MC00C-d	<	10	<	10
14	SR01D-b	<	10	SR01D-d		10	<	10
	SR02F-b	<	10	SR02F-d	<	10	<	10
				SR03B-d	<	10	<	10
	SR04F-b	<	10	SR04F-d		40	<	10
				SR06C-d	<	10	<	10
	SR08E-b	<	10	SR08E-d	<	10	<	10
				SR09A-d		80		10
				NC00A-d	<	10	<	10

Flagged for Quality Control.

Week	Blank Sample			Corresponding Duplicate Sample			Regular Sample	
	ID	Result		ID	Result		Result	
15	SR01C-b	<	10	SR01C-d	<	10	<	10
				SR03A-d		40		40
	SR04E-b	<	10	SR04E-d		10	<	10
				SR06D-d	<	10	<	10
	SR08F-b	<	10	SR08F-d		10		10
				SR09B-d	<	10		30
	SR11D-b	<	10	SR11D-d	<	10		10
				NC00B-d	<	10	<	10
16	SR01B-b	<	10	SR01B-d	<	10	<	10
				SR02A-d	<	10	<	10
	SR04D-b	<	10	SR04D-d	<	10		20
				SR06E-d	<	10	<	10
	SR07F-b	<	10	SR07F-d	<	10		20
				SR09C-d		10		10
	SR11E-b	<	10	SR11E-d	<	10	<	10
				NC00C-d	<	10	<	10
17	SR01A-b	<	10	SR01A-d	<	10	<	10
				SR04C-d	<	10	<	10
	SR06E-b	<	10	SR06E-d	<	10	<	10
				SR07A-d		10	<	10
	SR09C-b	<	10	SR09C-d	<	10	<	10
				SR10E-d		70		140
	SR11A-b	<	10	SR11A-d	<	10	<	10
				BL03B-d		40		30
18				SR03F-d	<	10	<	10
	SR05C-b	<	10	SR05C-d	<	10		10
				SR07B-d		10	<	10
	SR08A-b	<	10	SR08A-d		30		30
				SR10F-d		10		10
	SR11B-b	<	10	SR11B-d	<	10	<	10
	BL02C-b	<	10	BL02C-d		10		10
19	SR01B-b	<	10	SR01B-d	<	10		10
				SR03F-d	<	10	<	10
	SR05D-b	<	10	SR05D-d	<	10	<	10
				SR07F-d	<	10	<	10
	SR08B-b	<	10	SR08B-d		400		340
	SR11C-b	<	10	SR11C-d	<	10	<	10
				SR12A-d		20		10
				BL01C-d		50		20

Flagged for Quality Control.

Week	Blank Sample			Corresponding Duplicate Sample			Regular Sample	
	ID	Result		ID	Result		Result	
20				SR03D-d	<	10	<	10
	SR05E-b	<	10	SR05E-d	<	10	<	10
				SR06A-d	<	10	<	10
	SR08C-b	<	10	SR08C-d	<	10	<	10
	SR11D-b	<	10	SR11D-d	<	10	<	10
				SR12B-d	<	10		10
				BL01B-d	<	10		100
	BL04A-b	<	10	BL04A-d	<	10		10
21				SR01D-d	<	10	<	10
	SR04B-b	<	10	SR04B-d		10	<	10
				SR05A-d		10	<	10
	SR07C-b	<	10	SR07C-d	<	10	<	10
				SR09E-d	<	10		10
	SR10D-b	<	10	SR10D-d	<	10	<	10
				BL01C-d		220		90
	BL04B-b	<	10	BL04B-d		190		40
22				SR01C-d	<	10	<	10
	SR04A-b	<	10	SR04A-d	<	10		10
				SR05B-d		10		10
	SR07D-b	<	10	SR07D-d	<	10	<	10
				SR09F-d		10		20
	SR10E-b	<	10	SR10E-d		20		20
				SR11A-d	<	10	<	10
	BL04C-b	<	10	BL04C-d	<	10	<	10
23				SR01B-d	<	10	<	10
	SR03F-b	<	10	SR03F-d	<	10	<	10
				SR05C-d	<	10	<	10
	SR07E-b	<	10	SR07E-d	<	10	<	10
				SR08A-d		10		20
	SR10F-b	<	10	SR10F-d		10		10
				SR11B-d	<	10	<	10
	BL03A-b	<	10	BL03A-d		100	<	10
24				SR01A-d		20		20
	SR03E-b	<	10	SR03E-d	<	10	<	10
				SR05D-d	<	10	<	10
	SR07F-b	<	10	SR07F-d	<	10	<	10
				SR08B-d	<	10	<	10
				SR11C-d	<	10	<	10
	SR12A-b	<	10	SR12A-d		40		40
	BL03B-b	<	10	BL03B-d		60		140

Flagged for Quality Control.

Week	Blank Sample			Corresponding Duplicate Sample			Regular Sample	
	ID	Result		ID	Result		Result	
25	SR03D-b	<	10	SR03D-d	<	10	<	10
				SR05E-d		10		20
	SR06A-b	<	10	SR06A-d		80		90
				SR08C-d	<	10	<	10
	SR12B-b	<	10	SR12B-d	<	10		10
	BL03C-b	<	10	BL03C-d		50		100
26				BL02B-d		130		20
	BL05A-b	<	10	BL05A-d		70		120
27				BL02C-d		40	<	10
	BL05B-b	<	10	BL05B-d		60	<	10
28				BL01A-d		10		100
	BL05C-b	<	10	BL05C-d		20		10
29	BL04A-b	<	10	BL01B-d		160		80
				BL04A-d		180		50
30				BL01C-d		170		80
	BL04B-b	<	10	BL04B-d		20		20
31	BL04C-b	<	10	BL04C-d	<	10		100
32	BL03A-b	<	10	BL03A-d		260		210
33	BL03B-b	<	10	BL03B-d		170		140

Flagged for Quality Control.