2017 Rouge River Ecosystem Monitoring and Assessment Report

Prepared for:

Alliance of Rouge Communities

OURS TO PROTECT

Working together, restoring the river

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Complex Challenges . . . *PRACTICAL SOLUTIONS*

Acknowledgements

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The ARC is a voluntary public watershed entity currently comprised of 35 municipal governments, three counties, two colleges and several cooperating partners as authorized by Part 312 (Watershed Alliances) of the Michigan Natural Resources and Environmental Protection Act (MCL 324.101 to 324.90106) as amended by Act No. 517, Public Acts of 2004.

The purpose of the ARC is to build upon the accomplishments of the Rouge River National Wet Weather Demonstration Project by providing an institutional mechanism to encourage watershed-wide cooperation and mutual support to meet water quality permit requirements and to restore beneficial uses of the Rouge River to the area residents.

The current ARC members are listed below.

Auburn Hills
Beverly Hills
Bingham Farms
Birmingham
Bloomfield Hills
Bloomfield Twp.
Canton Twp.
Commerce Twp.
Dearborn Heights
Farmington
Farmington Hills
Franklin
Garden City
Henry Ford College
Inkster
Lathrup Village
Livonia
Melvindale
Northville
Northville Twp.
Novi
Oak Park
Oakland County
Orchard Lake
Plymouth
Plymouth Twp.
Redford Twp.
Rochester Hills
Romulus
Southfield
Troy
University of Michigan-Dearborn
Van Buren Twp.
Walled Lake
Washtenaw County
Wayne
Wayne County
Wayne County Airport Authority
West Bloomfield Twp.
Westland
Wixom

Document Review

The dual signatory process is an integral part of Environmental Consulting & Technology, Inc.'s (ECT's) Document Review Policy No. 9.03. All ECT documents undergo technical/peer review prior to dispatching these documents to any outside entity.

This document has been primarily authored and reviewed by the following employees:

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Author	Peer Review
Signature	Signature
9-24-18	10-31-18
Date	Date

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List of Acronyms and Abbreviations

ARC	Alliance of Rouge Communities
BMP	Best Management Practice
BOD	Biochemical oxygen demand
CSO	Combined sewer overflow
cfs	cubic foot per second
cfu	colony-forming unit
°C	Degree Celsius
DO	Dissolved oxygen
E. coli	*Escherichia coli*
ECT	Environmental Consulting & Technology, Inc.
EPA	U.S. Environmental Protection Agency
°F	Degree Fahrenheit
ft	foot
HUC	hydrologic unit code
LDC	Load duration curve
LOWESS	Locally weighted scatterplot smooth
MDEQ	Michigan Department of Environmental Quality
mg/L	Milligrams per liter
mL	Milliliter
MPN	Most probable number
NPDES	National Pollutant Discharge Elimination System
OSDS	Onsite sewage disposal systems
POR	Period of record
SAW	Stormwater, Asset Management and Wastewater
SOP	Standard operating procedure
SSO	Sanitary Sewer overflow
SWMA	Stormwater management area
TMDL	Total maximum daily load
TSS	Total suspended solids
USGS	U. S. Geological Survey
WRRF	Water Resource Recovery Facility
WQS	Water quality standard
YCUA	Ypsilanti Community Utilities Authority

Executive Summary

Ecosystem monitoring was conducted in Rouge River Watershed between 2014 and 2017 to assess water quality and habitat conditions, to determine progress toward meeting water quality standards (WQSs) and to determine focus areas for the implementation of stormwater best management practices (BMPs). Monitoring at this scale hadn't been completed since 2005.

Through the collection of bacteria, dissolved oxygen (DO), suspended sediment and stream flow data, water quality conditions were compared to those reported in the *Escherichia coli* (*E. coli)*, biota and DO total maximum daily load (TMDL) assessments published by the Michigan Department of Environmental Quality (MDEQ) in 2007. Bacteria and suspended sediment were sampled 20 times at 90 sites from May through September 2017. DO and stream flow were measured continuously at 6 sites from May through October 2017.

DO levels in the Main, Middle and Upper branches, including Johnson Creek, remain good with 98% to 100% of measurement above WQSs. However, a notable decrease in DO levels was seen on the Lower Branch where only 81% of measurements met the WQS. This decline in DO was likely caused by two sanitary sewer overflows (SSOs) that were found discharging to the Lower Rouge towards the end of the 2017 sampling season.

Given the excellent DO levels in the Main, Middle and Upper branches and in Johnson Creek, it is recommended that the MDEQ be petitioned to remove these branches from the State's impaired waters list. MDEQ has a policy of not delisting stream segments impacted by uncontrolled combined sewer outfalls; therefore, only certain segments may be eligible for delisting.

Across the watershed, average wet weather suspended sediment concentrations were notably improved when compared to levels reported in the 2007 Rouge River Biota TMDL. There was a 62% reduction in mean wet weather total suspended solids (TSS) concentrations when considering the entire watershed. Furthermore, of the 90 sites that were sampled, 75% met the criteria of 80 mg/L established in the Rouge River Biota TMDL.

Despite the relatively good suspended sediment concentrations, the watershed will likely remain impaired for not supporting a healthy biological community. This is likely due to a lack of appropriate substrate, flashy stream flows, a lack of connectivity and poor riparian zone management. It is possible that with improved stormwater management through the use of green infrastructure, flashiness will decrease and base flows will increase providing more stable habitat for aquatic species.

Although some improvements have been made in *E. coli* concentrations, conditions generally stayed the same when compared to previous sampling efforts. One stand out area was the Upper Branch where there has been a significant decrease in *E. coli* levels when compared to the 2007 Rouge River *E. coli* TMDL. This is reflected in a monthly decrease of 2,812 cfu/100 mL. However, no other subwatershed displayed a significant decrease in *E. coli*.

In terms of the individual sites, several met the *E. coli* water quality standards (WQSs) of 300 cfu/100 mL more than 60% of the time, with two sites achieving 95% compliance along the Sunken Bridge Drain in Bloomfield Hills and the Middle Branch in Plymouth. These “60% or better” sites are as follows:

Lower Branch

- McKinstry Drain in Canton Twp.

Main Branch

- Franklin Branch at 14 Mile Rd. in Franklin
- Main Branch tributary at 12 Mile in Beverly Hills
- Main Branch tributary at Maple Rd. in Birmingham
- Sunken Bridge Drain and its tributaries in Bloomfield Hills
- Main Branch in Firefighters Park in Troy

Middle Branch

- Middle Branch on the north and east sides of Plymouth
- Sump Drain in Northville Twp.
- Walled Lake Branch at Main St. in Northville
- Bishop Creek in Novi
- Johnson Creek at 7 Mile/Hines Dr. in Northville

Upper Branch

- Seeley Drain at 13 Mile in Farmington Hills

Unfortunately, an equal number of sites had only one or no samples meet the WQS during the study. Of these sites only 8% of the samples were above 10,000 cfu/00 mL and 52% fell between 1,000 and 10,000 cfu/100 mL. This provides an indication of the challenges with locating sources at certain sites (sources will be difficult to locate at sites with lower *E. coli* levels). The segments with the poorest *E. coli* concentrations are provided below.

Lower Branch

- Lower Branch at South Military St. in Dearborn
- Perrin Drain in Inkster
- Fowler Creek in Canton Twp.
- Fellows Creek and North Branch Fellows Creek in Canton Twp.

Main Branch

- Main Branch at Rotunda Dr. in Detroit
- Main Branch at Ann Arbor Trail in Dearborn Heights
- Tamarack Creek in Southfield
- Main Branch at Beech Rd. in Southfield
- Main Branch tributary at Inkster Rd. in Farmington Hills

Middle Branch

- South Branch Tonquish Creek in Plymouth

Upper Branch

- Upper Branch at Telegraph and Graham roads in Redford Twp.
- Bell Branch and tributaries in Redford Twp. and Livonia
- Tarabusi Creek in Farmington and Livonia

Addressing the *E. coli* issues in the watershed will involve a variety of actions by multiple agencies. First in the lower portion of the watershed, the correction of uncontrolled combined sewer outfalls should continue under National Pollutant Discharge Elimination System (NPDES) permits issued by the state to Dearborn, Dearborn Heights, Inkster, Redford Township, Wayne County and Detroit Water and Sewerage Department. Next, through implementation of the ARC's Collaborative Illicit Discharge Elimination Plan (IDEP), illicit sanitary sewer connections should be located and corrected. The target of these investigations should be based on 2017 monitoring results and the 2018 outfall screening results. In addition, the local communities and counties should continue to inspect and maintain sanitary sewers to prevent sanitary sewer overflows or exfiltration. The Oakland County Health Department should adopt an ordinance to require the periodic inspection of septic systems to better ensure they are functioning properly. Such an ordinance is already in place in Wayne and Washtenaw counties. Lastly, the public should continue to be educated to encourage proper disposal of pet waste and proper septic system maintenance to minimize impacts to the river.

1.0 Introduction

In the first half of the twentieth century, water quality in the lower sections of the Rouge River was negatively impacted by industrial growth creating serious pollution issues. In the last half of the century, rapid residential and commercial growth caused further water quality impacts in the upper portions of the river. Despite pollution control efforts since the 1940s, including the construction of the Detroit wastewater treatment facility to serve southeast Michigan including many of the Rouge River Watershed communities, pollution in the river continued. Within the last decade, significant restoration of water quality has been documented as a result of cooperative efforts at the local, state, and federal level (Table 1).

Recent regulatory action taken by the Michigan Department of Environmental Quality (MDEQ), as required by the US Environmental Protection Agency (EPA), has resulted in the establishment of measurable water quality criteria, Total Maximum Daily Loads (TMDLs), to improve conditions within the Rouge River Watershed. The Rouge River was placed on the Section

Table 1. Management Actions in the Rouge River Watershed

Level	Agency or Organization	Action	Year
Federal	EPA	Great Lakes Area of Concern Designation	1985
Federal	EPA	First grant to Wayne County for the Rouge River National Wet Weather Demonstration Project which began a 22-year effort to reduce untreated combined sewer and sanitary sewer overflows, manage stormwater and establish watershed-wide collaboration with municipalities	1992
Local	Rouge Program Office	Established the first subwatershed management plans for the Rouge River to address flow alterations and nonpoint source pollution	2001
Local	ARC	Formed a voluntary municipal watershed entity providing a mechanism to collaborate on stormwater permitting requirements and restoring the river	2006
State	MDEQ	TMDL established for *E. coli* in the Rouge River	2007
State	MDEQ	TMDL established for dissolved oxygen in Johnson Creek	2007
State	MDEQ	TMDL established for biota in the Rouge River	2007
Local	ARC	Developed the Rouge River Watershed Management Plan	2012

303(d) list due to impairment of recreational uses as indicated by the presence of elevated concentrations of *Escherichia coli* (*E. coli*). Additionally, aquatic life is impaired resulting in a biota TMDL for the entire watershed and dissolved oxygen (DO) TMDL to protect cold water fish in Johnson Creek. While a formal TMDL for DO has only been established for Johnson Creek, it is expected that other portions of the watershed will have a TMDL established as part of a strategy to protect warm water fish. As such, the entire Rouge River Watershed is listed as impaired for DO.

Prior to the Rouge River National Wet Weather Demonstration Project, water management focused almost exclusively on flood control. This focus resulted in detrimental impacts to water quality, including rapid transport of suspended sediments and overflows between sanitary sewer and stormwater systems. Due to clay soils and the large amount of impervious area, the Rouge River is a very flashy system. Runoff from paved surfaces carries fertilizers, sediments, pet waste and other pollutants into the river. Additionally, there are combined sewers that still overflow into the river at times as well as illicit and illegal discharges.

The Johnson Creek TMDL suggested that low DO in the river result from high total suspended solids (TSS) associated with transport of sediments within the watershed during high flows. Similarly, the TMDL for *E. coli* determined that potential major contributors to *E. coli* loads in the watershed include both wet and dry weather sources such as illicit connections, failing onsite disposal systems, sanitary sewer overflows, and combined sewer overflows (CSO). As such, pollution control in the watershed has focused on reducing the volume of stormwater entering sanitary sewage collection systems during rain events, establishing treatment facilities for combined sewer systems and identifying and eliminating illicit connections containing sanitary sewage.

The Rouge Project was an unqualified success, using any of several measures of achievement. Major progress was made in the control of pollution being discharged to the Rouge River. For example, CSO pollutant loads to the river were cut by 90 to 100% during most events. In previous years certain water quality standards (WQS) were violated most of the time at many places in the watershed. Now, the majority of the waters in the Rouge River Watershed meet many standards. Coupled with the water quality improvements, the ecosystem health continues to improve as well. This is demonstrated by several measures such as increased sightings of fish and wildlife along the river since 1999 (ECT, 2014).

1.1 Background

The Rouge River Watershed is largely urbanized, spanning approximately 466 square miles in Southeast Michigan, and home to more than 1.4 million people in 48 communities (Figure 1). Land within the watershed is more than 50% urban with less than 25% remaining undeveloped (see Section 1.1.4). The Rouge River is comprised of four major branches (Main, Upper, Middle, and Lower) with 126 river miles and numerous tributaries that span across Oakland, Wayne, and Washtenaw counties. These branches are divided into seven stormwater management areas (SWMAs): Lower 1, Lower 2, Middle 1, Middle 3, Upper, Main 1-2, and Main 3-4 (Figure 2).

Unique challenges face the Rouge River Watershed as it contains the most heavily populated and industrialized area within southeastern Michigan. These challenges are directly tied to land use and land cover across the watershed. The watershed encompasses various levels of urban land uses ranging from highly urbanized areas of Detroit, Livonia and Southfield to the developing areas of Troy, Canton Township and Novi, and rural areas of Salem, Superior and Van Buren townships.

1.1.1 Climate

Michigan's climate is a product of its latitude, its position on the North American continent, and its position relative to the Great Lakes. Average temperatures in the watershed range from 17.8°F at night during the coldest month of January to 83.4°F in July during the day (Catalfio et al., 2006). The Rouge River Watershed receives an average of 32 inches of precipitation annually, with snow contributing roughly 10% to 15% of the total.

1.1.2 Geology and Soils

The soils of the Rouge River Watershed range from sands that allow rapid infiltration to fine clays that allow little infiltration. As a result of this variation, stormwater BMPs must be chosen based on their effectiveness within a specific geologic setting. The watershed is characterized by hilly or moderately undulating topography to the north and west and by relatively flat land to the southeast.

Figure 1. Rouge River Watershed

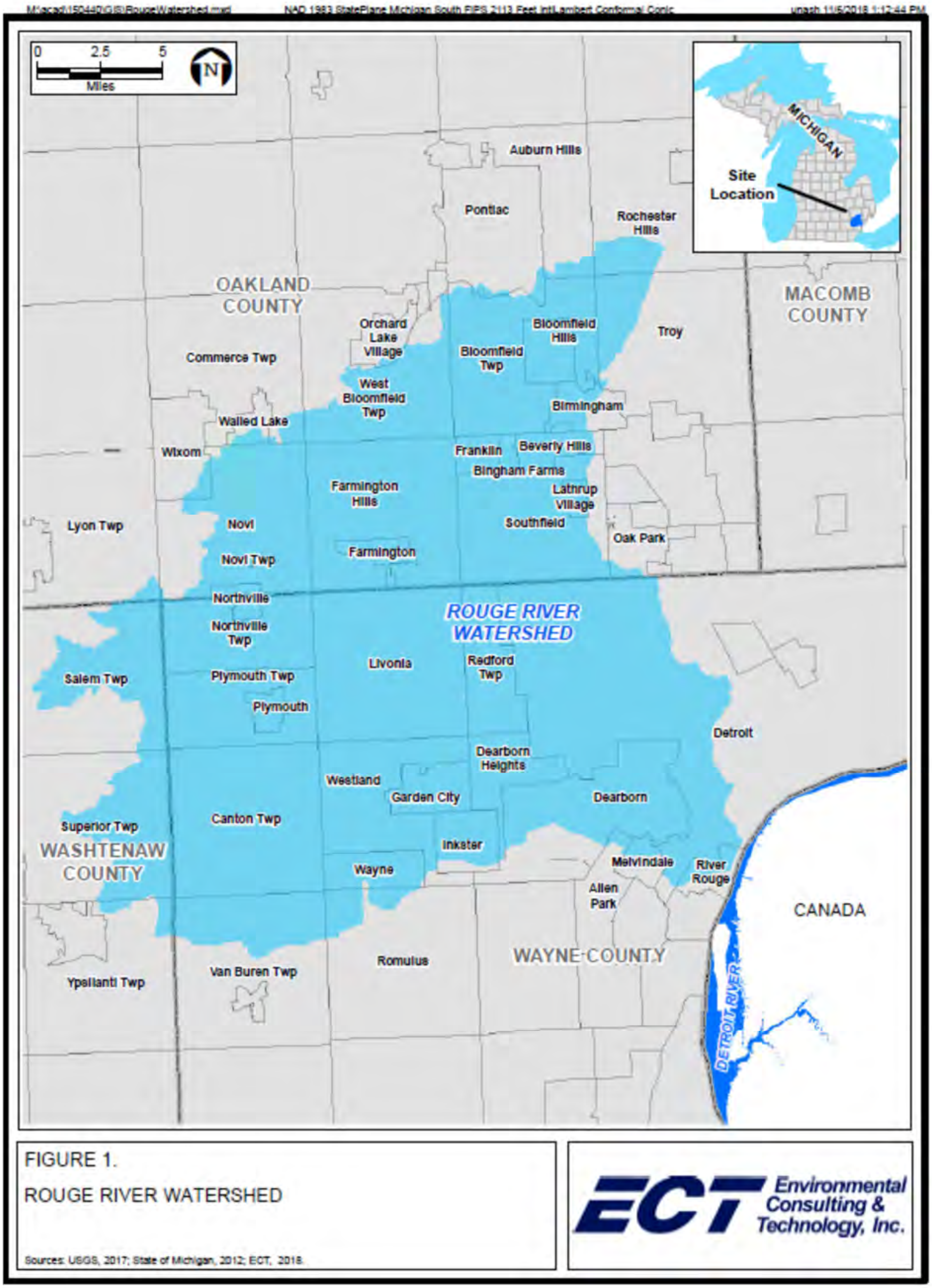
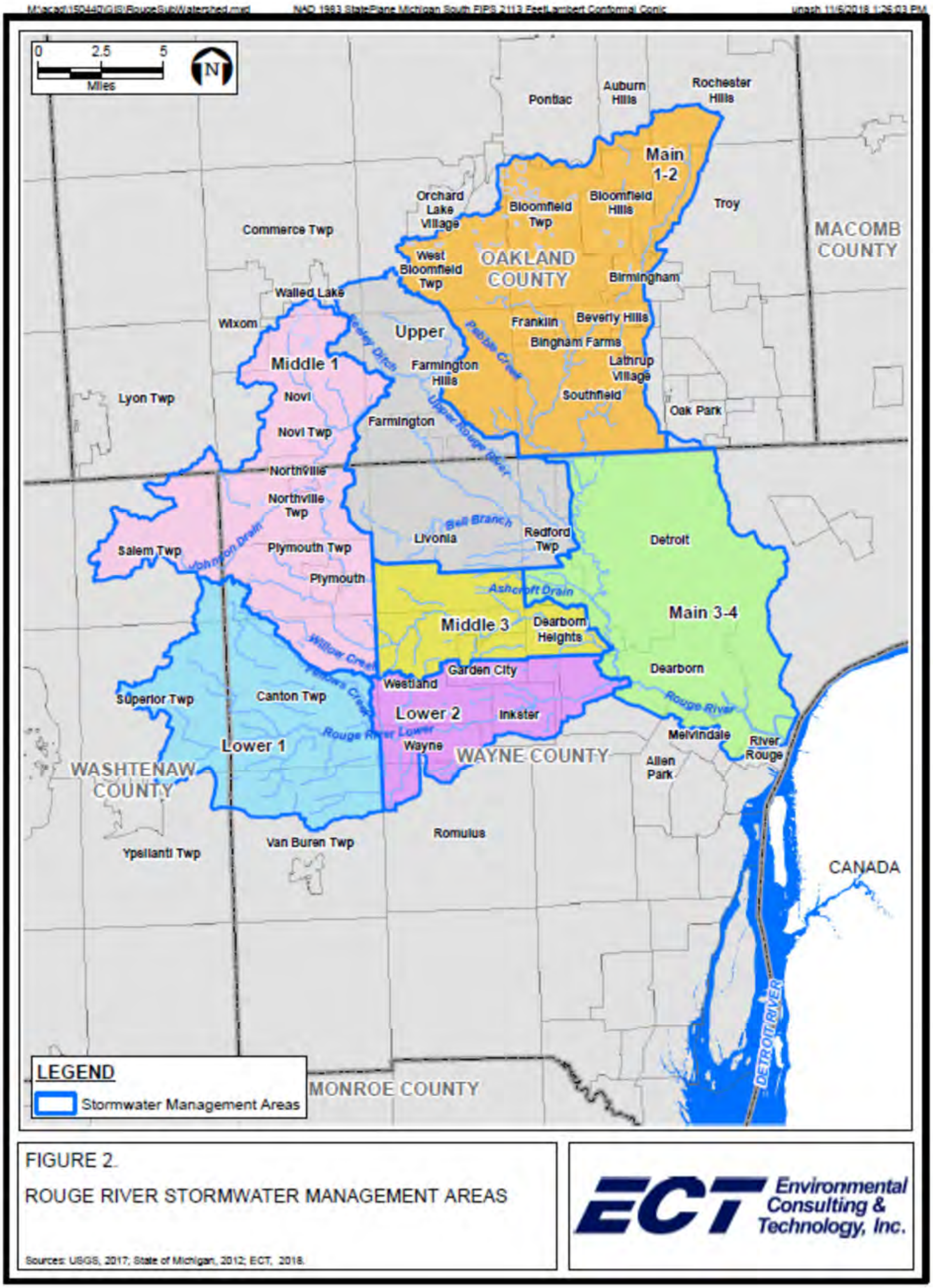


Figure 2. Rouge River Stormwater Management Areas



Most of the watershed was covered by waters of former glacial lakes. Lacustrine deposits of sand and clay make up the surface deposits in the southeastern two-thirds of the watershed. Areas to the northwest are principally morainal deposits of retreating glaciers. These sandy areas allow fairly rapid infiltration of stormwater. Water from glacial wells is moderately hard, with chloride and dissolved solid concentrations increasing with well depth (Twenter, 1975). Altitudes in the morainal areas range from 900 to more than 1,000 feet above sea level. Altitudes gradually lessen toward the southeast to about 600 feet above sea level and down to 574 feet at the mouth of the Rouge River (Beam & Braunscheidel, 1998). Figure 3 shows the bedrock geology of the Rouge River Watershed.

The surficial geology (soil) of the Rouge River Watershed is primarily comprised of clays (ARC, 2009). Almost 95% of the watershed contains silt loam or smaller particles. These soils typically have low permeability and do not lend themselves to percolation of rainwater into the ground and later slow release to the stream. Rather, they function as relatively impermeable surfaces which shunt surface water over contours into the lowest point, such as streams and rivers. (Beam & Braunscheidel, 1998).

The soils within the Rouge River Watershed are categorized into hydrologic soil groups (Figure 4). Group A soils are well-drained sandy or gravelly materials with a high infiltration rate and low runoff potential. Group D soils have a very slow infiltration rate and thus high runoff potential. High water tables are also characteristic of these types of soils. Soils classified as Group B or C have characteristics intermediate of those soils in Groups A and D.

1.1.3 Hydrology

There are four subwatersheds within the Rouge River system: Lower, Middle, Upper and Main. Each subwatershed has multiple hydrologic unit codes (HUC) based on the reach (Figure 5). HUCs assign each reach and tributary of the Rouge River a unique ID.

Three main tributary branches (Upper, Middle, Lower) flow into the Main Branch of the Rouge River and ultimately empty into the Detroit River. The Main Branch is approximately 44 miles long and originates at the Sprague Drain in Troy. Moving upstream from the mouth of the Rouge River, four miles of the Main Branch from Michigan Avenue to the Turning Basin were

Figure 3. Rouge River Geology

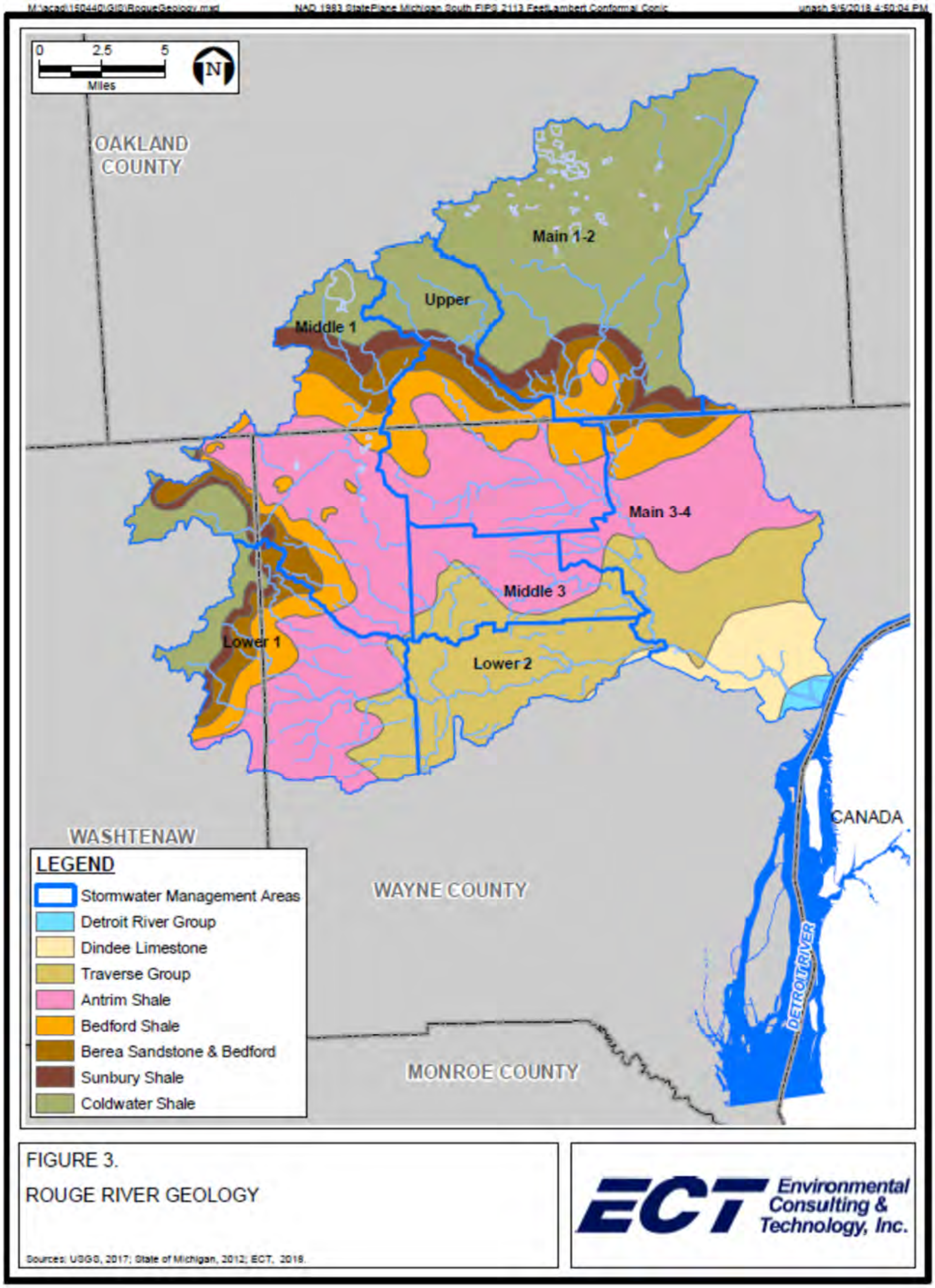


Figure 4. Rouge River Hydric Soil Groups

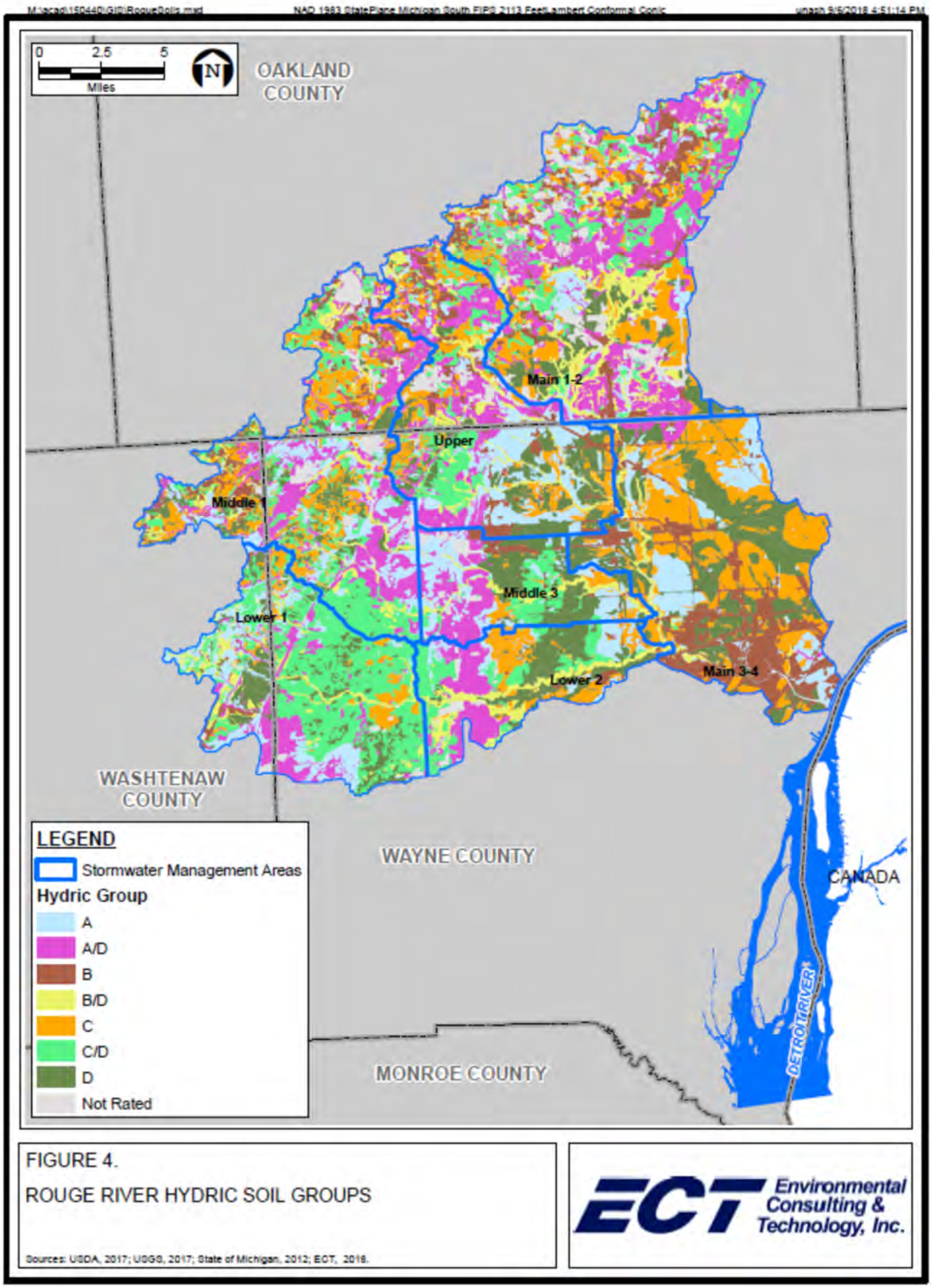
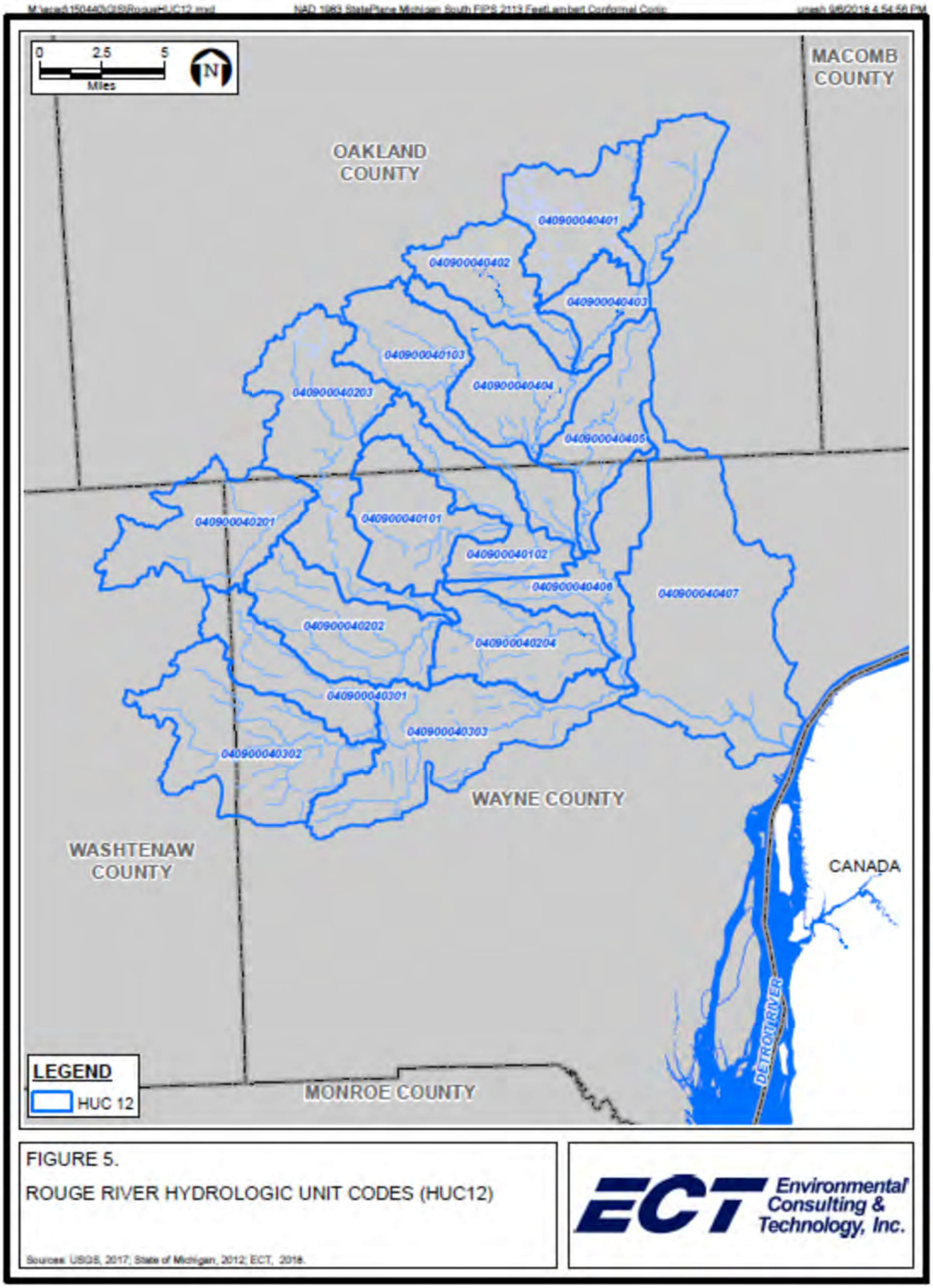


Figure 5. Rouge River Hydrologic Unit Codes (HUC12)



converted to a concrete channel in the 1970s to alleviate flooding in Dearborn, Dearborn Heights and Melvindale. The Lower Branch of the Rouge River joins the Main Branch in Dearborn, at Michigan Avenue and Evergreen (river mile 7.5). This branch is approximately 27 miles long and drains from the moraines in Washtenaw County, across glacial lake plain, which results in a higher number of tributaries streams (Beam & Braunscheidel, 1998).

The Middle Branch joins the Main Branch in Dearborn Heights, near Henry Ford Community College at Ann Arbor Trail and Outer Drive, (river mile 9.5). This branch is approximately 30 miles long and begins with two main tributaries: Bishop Creek and Walled Lake. The Walled Lake tributary contains Johnson Creek, the Rouge River's only coldwater stream (MDEQ, 2007a). The Upper Branch joins the Main Branch near the Redford Township/Detroit border, in Detroit's Eliza Howell Park (river mile 17). This branch is approximately 21 miles long and originates in wetlands from Novi and Farmington Hills (Beam & Braunscheidel, 1998).

Flooding has affected the development of the Rouge River Watershed throughout its history. The Wayne County parkways adjacent to the river were initially established to prevent the recurring property damage from frequent flooding. As development continued and the frequency and duration of flooding increased, the river was straightened in certain sections and "smoothed" to allow for expedient drainage and to shorten the duration of flooding.

Under natural pre-developed conditions, the areas adjacent to the river would flood regularly due to the hydraulic conductivity of soils in the region. As a result, there remains an extensive park system along most of the Wayne County sections of the Rouge River to buffer flooding from urban areas. However, development in upstream areas has resulted in the loss of these effective buffers against flooding through replacement by buildings and pavement. Consequently, floods have become more frequent.

Small to moderate quantities of groundwater are available nearly everywhere in the Rouge River basin from aquifers in the glacial drift or bedrock. The glacial drift is composed of clay, silt, sand, gravel, and stones deposited by glaciers and glacial melt waters. The relative proportions, degree of sorting, and thickness of these materials control the availability of water from the drift aquifers. Sands and gravels will generally yield larger quantities of water than deposits of clays, silts, or fine sand. The more favorable water-bearing rocks in the glacial drift are not extensive and therefore limit the aquifer as a source of abundant water supply. It is for this reason that the majority of watershed communities are served by the Detroit Water & Sewerage Department, which obtains its water from the Detroit River and Lake Huron (Beam & Braunscheidel, 1998).

Dams were constructed across the watershed for a variety of reasons including hydropower, recreational impoundments, and flood control, but they fragmented the watershed preventing fish passage. Prior to 1998, there were 62 dams in the watershed with only 9 of them allowing fish to pass. The two most downstream dams were deemed especially problematic because they isolate the watershed from the Detroit River and the Lake Erie ecosystem. These were at Wayne Road in the City of Wayne on the Lower Branch and at the Henry Ford Estate in Dearborn on the Main Branch (Beam & Braunscheidel, 1998).

To address this issue, the Wayne Road dam was removed by the ARC in 2013 along with the Danvers Pond dam in Farmington Hills in 2012. In addition, a fishway is currently under construction (2018) at the Henry Ford Estate dam which will allow travel around the historic dam. Collectively, these projects will open up fish passage between 279 miles of river and the Detroit River.

1.1.4 Land Use

Land use in the Rouge River Watershed consists primarily of low and medium density residential, however this varies from community to community (Table 2). Other significant land uses common in the watershed include commercial and industrial. The Middle and Lower Rouge River contain the largest relative proportions of forest/rural open and water/wetlands, which are expected to contribute to improved water quality.

Table 2. Land Use within the Rouge River Watershed

Land Use	Lower Branch		Middle Branch		Main Branch		Upper Branch	
	Acres	% Cover	Acres	% Cover	Acres	% Cover	Acres	% Cover
Barren Land	725	1.2	302	0.43	28	0.02	16	0.04
Cultivated Crops	5348	8.9	2227	3.2	4.7	0.00	34	0.08
Deciduous Forest	7262	12	5688	8.1	3353	2.8	1919	4.5
Developed, Open Space	10550	18	13302	19	28381	24	9380	22
Developed, Low Intensity	13614	23	17479	25	34143	29	14916	35
Developed, Medium Intensity	12634	21	16680	24	33169	28	10554	25
Developed, High Intensity	3627	6.0	6479	9.2	16026	13.5	4188	10
Emergent Herbaceuous Wetlands	323	0.54	352	0.50	70	0.06	38	0.09
Evergreen Forest	12	0.02	48	0.07	104	0.09	17	0.04
Hay/Pasture	3172	5.3	3733	5.3	82	0.07	50	0.12
Herbaceuous	591	0.99	442	0.63	103	0.09	156	0.37
Mixed Forest	46	0.08	93	0.13	299	0.25	74	0.18
Open Water	73	0.12	1015	1.4	1496	1.3	40	0.09
Shrub/Scrub	81	0.13	67	0.09	23	0.02	14	0.03
Woody Wetlands	1935	3.2	2615	3.7	1409	1.2	938	2.2
Total Acres	59993	100	70520	100	118692	100	42335	100

Source: USGS National Land Cover Database, 2014

A large percentage of natural features within the watershed have been altered or removed. Green infrastructure such as wetlands, woodlands, open space, and grasslands are vital to the health of the watershed. During the pre-settlement era, the Rouge River Watershed was comprised of abundant wetlands and permeable soil that reduced the frequency and severity of flooding caused by snowmelts and rainstorms. Although the river has always been subject to flooding in the lower portions, the headwater areas historically have had stable flows and clear, cool waters. This is evidenced by the presence of a federal whitefish and trout hatchery in Northville in the late 1800s. During pre-settlement times, tributaries flowed through a complex system of upland forests, meadows, and various types of wetlands. It has been estimated that prior to European settlement, 80% of the watershed was forested. From the pre-1800s to 1978 vegetative data has changed significantly with the largest proportion of land changing into urban or agricultural uses.

1.1.5 Sewer Infrastructure

The Rouge River Watershed is served by combined sanitary sewers that carry wastewater and stormwater, separate sanitary sewers, and onsite sewage disposal systems (OSDSs) which typically serve residential properties. Combined sewers will overflow to the Rouge River due to the inflow of stormwater runoff during heavy rain events. Many of the combined sewer areas are now controlled by various treatment facilities; however, control facilities are still needed to reduce sewer overflows from areas of Dearborn, Dearborn Heights, Detroit, Highland Park, Inkster, and Redford Township (ARC, 2012).

Sanitary sewer overflows (SSOs) also occur in portions of the watershed. SSOs can occur in separated sanitary sewers that are subject to large amounts of stormwater infiltration during heavy rain events, or if a sanitary sewer becomes blocked by an obstruction. SSOs can occur from local wastewater collection systems operated by the watershed communities and from the three interceptor transport systems in the watershed: Evergreen – Farmington Sanitary Sewer System, Rouge Valley Sewage Disposal System, and Western Townships Utilities Authority system.

The Evergreen – Farmington System transports wastewater from portions of Farmington Hills, Beverly Hills, Auburn Hills, West Bloomfield Township, and Troy to the Great Lakes Water Authority's Water Resource Recovery Facility (WRRF) for treatment and disposal to the Detroit River. The Rouge Valley Sewage Disposal System also transports wastewater to the WRRF from portions of Canton Township, Dearborn Heights, Garden City, Inkster, Livonia, Northville, Northville Township, Novi, Plymouth, Plymouth Township, Redford Township, Romulus, Van Buren Township, Wayne, and Westland. The Western Townships Utility Authority transports wastewater from portions of Canton, Northville and Plymouth townships to the Ypsilanti Community Utilities Authority (YCUA) for treatment and disposal to the Lower Branch. Improvements to the Evergreen –Farmington Sanitary Sewer System, the Rouge Valley Sewage Disposal System, and numerous community wastewater collection systems are being implemented under Final Orders of Abatement issued by MDEQ to reduce the frequency of SSOs from the respective sanitary sewer systems.

There are over 10,000 septic systems within the watershed which provide sewage treatment for individual properties. The communities with the most septic systems are Bloomfield Township, Farmington Hills, Franklin, Southfield and West Bloomfield Township. These communities are all located within the Upper and/or Main SWMAs (ARC 2012).

1.2 2017 Data Collection

Through a MDEQ Stormwater, Asset Management and Wastewater (SAW) grant obtained by the ARC, water quality monitoring and sample collection was performed throughout 2017 within the Rouge River. Water quality monitoring was performed by Environmental Consulting & Technology, Inc. (ECT) on behalf of the ARC to determine the current conditions of the Rouge River and its tributaries, as well as to demonstrate progress toward meeting the goals of the *E. coli*, DO and biota TMDLs. In addition, macroinvertebrate monitoring was conducted by Friends of the Rouge in Winter, Spring and Fall during 2014, 2015, 2016 and 2017.

The water quality monitoring effort targeted several parameters including continuous flow and DO measurements at select locations in collaboration with the U.S. Geological Survey (USGS), as well as manual sample collection for TSS and *E. coli* analysis. The study design allows for the characterization of the quality of surface water in the Rouge River Watershed during dry and wet weather conditions. These data are used in this report to evaluate trends, analyze the effectiveness of control measures, and to inform future decision-making. Furthermore, several monitoring locations provide the opportunity to evaluate progress towards TMDL goals and identify future focus areas.

2.0 Methodology

Multiple data collection efforts were conducted in 2017 for both water quantity and water quality. Sampling occurred at monitoring sites located throughout the watershed within Oakland, Washtenaw, and Wayne counties.

2.1 Data Collection

Locations from previous TMDL efforts were used as the initial base map for the monitoring location selection. Additional locations were added, moved, or removed based on comparability with other historic data and potential future project needs. The resulting monitoring locations are described in Table 3 and shown in Figures 6 and 7.

Table 3. Monitoring Locations

Station ID	Waterbody	Intersection	Coordinates	SWMA	County
Lower Branch					
L05D[1,2] (04168400)	Lower Branch	South Military St. & Morley Ave.	42.308582, -83.252712	Lower 2	WC
US1 (04168000)	Lower Branch	John Daly St. & Lower Rouge Pkwy Dr.	42.300629, -83.300559	Lower 2	WC
LW03	Perrin Drain	Inkster Rd. & Avondale St.	42.302771, -83.305465	Lower 2	WC
G97	Lower Branch	Michigan Ave. & Henry Ruff Rd.	42.290030, -83.339159	Lower 2	WC
L06	Lower Branch	South Wayne Rd. & Michigan Ave.	42.284978, -83.383583	Lower 2	WC
G64	McClaughrey Drain	Annapolis St. & Treadwell St.	42.273615, -83.400887	Lower 2	WC
LW07	Hunter Drain	South Newburg Rd. & Hillcrest Dr.	42.285603, -83.407092	Lower 2	WC
LW08	Bingell Drain	Michigan Ave. & Hannan Rd.	42.278955, -83.423370	Lower 2	WC
LW09	Bingell Drain	Van Born Rd. & Hannan Rd.	42.265233, -83.429126	Lower 1	WC
US9[3] (04167625)	Lower Branch	Hannan Rd. & Michigan Ave.	42.28439, -83.42732	Lower 2	WC
G92	Lower Branch	Michigan Ave. & Haggerty Rd.	42.279900, -83.446952	Lower 1	WC
L51	McKinstry Drain	Michigan Ave. & South Morton Taylor Rd.	42.276348, -83.465606	Lower 1	WC
G94	Sines Drain	Michigan Ave. & Sheldon Rd.	42.281770, -83.476143	Lower 1	WC

Station ID	Waterbody	Intersection	Coordinates	SWMA	County
L01	Lower Branch	South Beck Rd. & Lindenhurst Blvd. - northern stream crossing	42.283485, -83.505433	Lower 1	WC
G93[3]	Fowler Creek	S. Beck Rd. & Lindenhurst Blvd. - Southern stream crossing	42.282302, -83.505405	Lower 1	WC
G200	Lower Branch	Denton Rd. & Hudson Dr.	42.297201, -83.525834	Lower 1	WC
L02	Fellows Creek	Palmer Rd. & South Lotz Rd.	42.294140, -83.436054	Lower 1	WC
LW12	Truesdell Drain	West of Haggerty Rd.	42.300940, -83.453644	Lower 1	WC
LW13	Fellows Creek	Cherry Hill Rd. & North Haggerty Rd.	42.308552, -83.443875	Lower 1	WC
LW14	North Branch Fellows Creek	North Canton Center Rd. & Ford Rd.	42.323079, -83.487962	Lower 1	WC
Main Branch					
MN01	Main Branch	Melon St. & Schaeffer Hwy.	42.290580, -83.167527	Main 3-4	WC
M12	Main Branch	Greenfield Rd. & Butler Rd.	42.294618, -83.179241	Main 3-4	WC
US8	Main Branch	Rotunda Dr. & Republic Dr.	42.301095, -83.199398	Main 3-4	WC
G42	Main Branch	Ann Arbor Trail & Walter Cassidy Dr.	42.336059, -83.247163	Main 3-4	WC
US7[1,2] (04166500)	Main Branch	Plymouth Rd. & Rouge Park Dr.	42.371776, -83.255556	Main 3-4	WC
G43	Main Branch	Fenkell Ave. & Virgil St.	42.400043, -83.271583	Main 3-4	WC
M15	Main Branch	West 7 Mile Rd. & Berg Rd.	42.429135, -83.269132	Main 3-4	WC
MN08	Evans Ditch	Berg Rd. & West 8 Mile Rd.	42.444080, -83.268760	Main 1-2	OC
MN09	Tamarack Creek	Tamarack Trail & Hiawatha Trail	42.466608, -83.252509	Main 1-2	OC
MN10	Evans Ditch	Tamarack Trail & West 10 Mile Rd.	42.471861, -83.253591	Main 1-2	OC
US5[1,2] (04166100)	Main Branch	Beech Rd. & Shiawassee St.	42.447867, -83.297672	Main 1-2	OC
MN12	Main Branch tributary	Inkster Rd. & West 9 Mile Rd.	42.456262, -83.313634	Main 1-2	OC
MN13	Main Branch tributary	Inkster Rd. & Spring Valley Dr.	42.457364, -83.317543	Main 1-2	OC
MN14	Pebble Creek tributary	West 10Mile Rd. & Samoset Trail	42.471354, -83.303989	Main 1-2	OC
MN15	Pebble Creek	West 11 Mile Rd.& Mel Bauman Blvd.	42.485820, -83.308736	Main 1-2	OC
MN16	Pebble Creek	West 13 Mile Rd. & Middlebelt Rd.	42.514245, -83.342398	Main 1-2	OC
MN17	Pebble Creek tributary	West 11 Mile Rd. & Franklin Rd.	42.484291, -83.288878	Main 1-2	OC
MN18	Pebble Creek tributary	West 13 Mile Rd. & Cheviot Hills Dr.	42.509759, -83.299754	Main 1-2	OC
G59A	Main Branch	Civic Center Dr. & Telegraph Rd.	42.479135, -83.284474	Main 1-2	OC

Station ID	Waterbody	Intersection	Coordinates	SWMA	County
G46	Franklin Branch	12 Mile Rd. & Wildbrook Dr.	42.501224, -83.278604	Main 1-2	OC
H60	Franklin Branch	West 13 Mile Rd. & Bingham Rd.	42.515456, -83.279595	Main 1-2	OC
G461[3]	Franklin Branch	West 14 Mile Rd. & Franklin Rd.	42.529993, -83.305529	Main 1-2	OC
MN23	Franklin Branch tributary	West Maple Rd.& Middlebelt Rd.	42.535364, -83.329512	Main 1-2	OC
MN24	Franklin Branch	Site North of Brookridge Dr. & Cold Spring Ln.	42.531156, -83.334984	Main 1-2	OC
MN25	Franklin Branch tributary	Walnut Lake Rd. & Doherty St.	42.559470, -83.357840	Main 1-2	OC
M03	Main Branch tributary	12 Mile Rd. & Lahser Rd.	42.510152, -83.262320	Main 1-2	OC
MN27	Main Branch	Evergreen Rd. & Riverside Dr.	42.527673, -83.241951	Main 1-2	OC
MN28	Main Branch tributary	West Maple Rd. & Baldwin Rd.	42.545581, -83.224560	Main 1-2	OC
MN29	Sunken Bridge Drain	Tamarack Way & Kingswood Campus Dr.	42.574731, -83.245461	Main 1-2	OC
MN30	Sunken Bridge Drain	Lone Pine Rd. & Thetford Ln.	42.564881, -83.264538	Main 1-2	OC
MN31	Sunken Bridge Drain tributary	Vaughan Rd. & Orchard Ridge Rd.	42.573539, -83.258766	Main 1-2	OC
MN32	Sunken Bridge Drain tributary	Devon Brook Dr. & Telegraph Rd.	42.589847, -83.278999	Main 1-2	OC
MN33	Sunken Bridge Drain tributary	Stonycroft Ln. & East Long Lake Rd.	42.585555, -83.237172	Main 1-2	OC
M01	Main Branch	Big Beaver Rd.	42.560498, -83.214754	Main 1-2	OC
MN35[3]	Main Branch	Firefighters Park	42.609323, -83.179803	Main 1-2	OC
MN36	Sprague Drain	Squirrel Rd. & East Square Lake Rd.	42.603743, -83.222664	Main 1-2	OC
Middle Branch					
D06[1] (04167150)	Middle Branch	Ford Rd. & Edward N Hines Dr.	42.330724, -83.248019	Middle 3	WC
US2[2] (04167000)	Middle Branch	Inkster Rd. & Edward N Hines Dr.	42.348262, -83.312538	Middle 3	WC
MD03	Tonquish Creek	Wayne Rd. & Joy Rd.	42.351892, -83.386037	Middle 3	WC
MD04	Willow Creek	Warren Rd. & N Newburgh Rd	42.333045, -83.412775	Middle 3	WC
D62[3]	South Branch Tonquish Creek	Joy Rd. & Manton Ave.	42.351646, -83.462714	Middle 1	WC
MD06	South Branch Tonquish Creek	Ann Arbor Rd. & S Main St.	42.359590, -83.469624	Middle 1	WC
MD07	Middle Branch	Wayne Rd. & Edward Hines Dr.	42.358514, -83.386578	Middle 3	WC
US10	Middle Branch	Edward Hines Dr. & Haggerty Rd. [West of I-275]	42.371621, -83.445615	Middle 1	WC
MD09	Middle Branch	Plymouth Rd. & Edward Hines Dr.	42.376143, -83.454400	Middle 1	WC

Station ID	Waterbody	Intersection	Coordinates	SWMA	County
D03[1,2] (04166700)	Johnson Creek	7 Mile Rd./Edward Hines Dr.	42.425697, -83.481137	Middle 1	WC
MD11	Johnson Creek	West 6 Mile Rd. & Beck Rd.	42.411955, -83.511146	Middle 1	WC
MD12	Sump Drain	West 6 Mile Rd. & Lake View Circle	42.408146, -83.519346	Middle 1	WC
MD13[3]	Johnson Creek	Napier Rd. & Last Dr.	42.381706, -83.555045	Middle 1	WASH County
MD14	Walled Lake Branch	S. Main St. & Beal St.	42.428915, -83.478230	Middle 1	WC
MD15	Thornton Creek	Ashbury Dr. & Chase Dr.	42.447750, -83.469200	Middle 1	OC
MD16	Walled Lake Branch	W 10 Mile Rd. & Myrtle Ct.	42.461387, -83.464450	Middle 1	OC
MD17	Walled Lake Branch	12 Mile Rd. & Taft Rd.	42.495015, -83.495897	Middle 1	OC
MD18[3]	Ingersol Creek	Meadowbrook Rd. & Chattman St.	42.458972, -83.454809	Middle 1	OC
MD19	Bishop Creek	12 Mile Rd. & Novi Rd.	42.495584, -83.469970	Middle 1	OC
Upper Branch					
U05[1] (04166470)	Upper Branch	Telegraph Rd. & River Circle	42.392683, -83.276665	Upper	WC
U04	Bell Branch	Beech Daly Rd. & Ross Dr.	42.392142, -83.295563	Upper	WC
U03	Bell Branch	Inkster Rd. & Meadowbrook St.	42.405507, -83.315252	Upper	WC
UP04	Bell Branch	5 Mile Rd.& Ellen Dr.	42.396943, -83.390460	Upper	WC
UP05[3]	Bell Branch Tributary	West 6 Mile Rd. & Wayne Rd.	42.411201, -83.392861	Upper	WC
U15	Bell Branch Tributary	West 6 Mile Rd. & Farmington Rd.	42.411557, -83.379109	Upper	WC
U17	Tarabusi Creek	West 7 Mile Rd. & Osmus St.	42.426445, -83.363430	Upper	WC
UP08	Tarabusi Creek	Brittany Hill Dr. & Grand River Ave.	42.467299, -83.408839	Upper	OC
U02	Upper Branch	Graham Rd. & Telegraph Rd.	42.398208, -83.278385	Upper	WC
G71	Upper Branch	Inkster Rd. & Margareta St.	42.424304, -83.316061	Upper	WC
G19	Bell Branch Tributary	West 8 Mile Rd. & Milburn St.	42.441280, -83.348802	Upper	OC
G72[3]	Upper Branch	Folsom Rd. & Tuck Rd.	42.449199, -83.346448	Upper	OC
UP16	Minnow Pond Drain	Ravenwood St. & Nottingwood St.	42.507190, -83.368318	Upper	OC
UP15	Seeley Drain	West 13 Mile Rd. & Haggerty Rd.	42.514159, -83.436991	Upper	OC
US3[2] (04166300)	Upper Branch	Shiawassee St. & Farmington Rd.	42.464520, -83.368684	Upper	OC

Monitoring Parameters: TSS and *E. coli* sampled at all stations; [1]DO; [2]Flow, continuous; [3]Flow, manual; (USGS ID)

Figure 6. Rouge River Sampling Sites *E. coli* and Total Suspended Solids

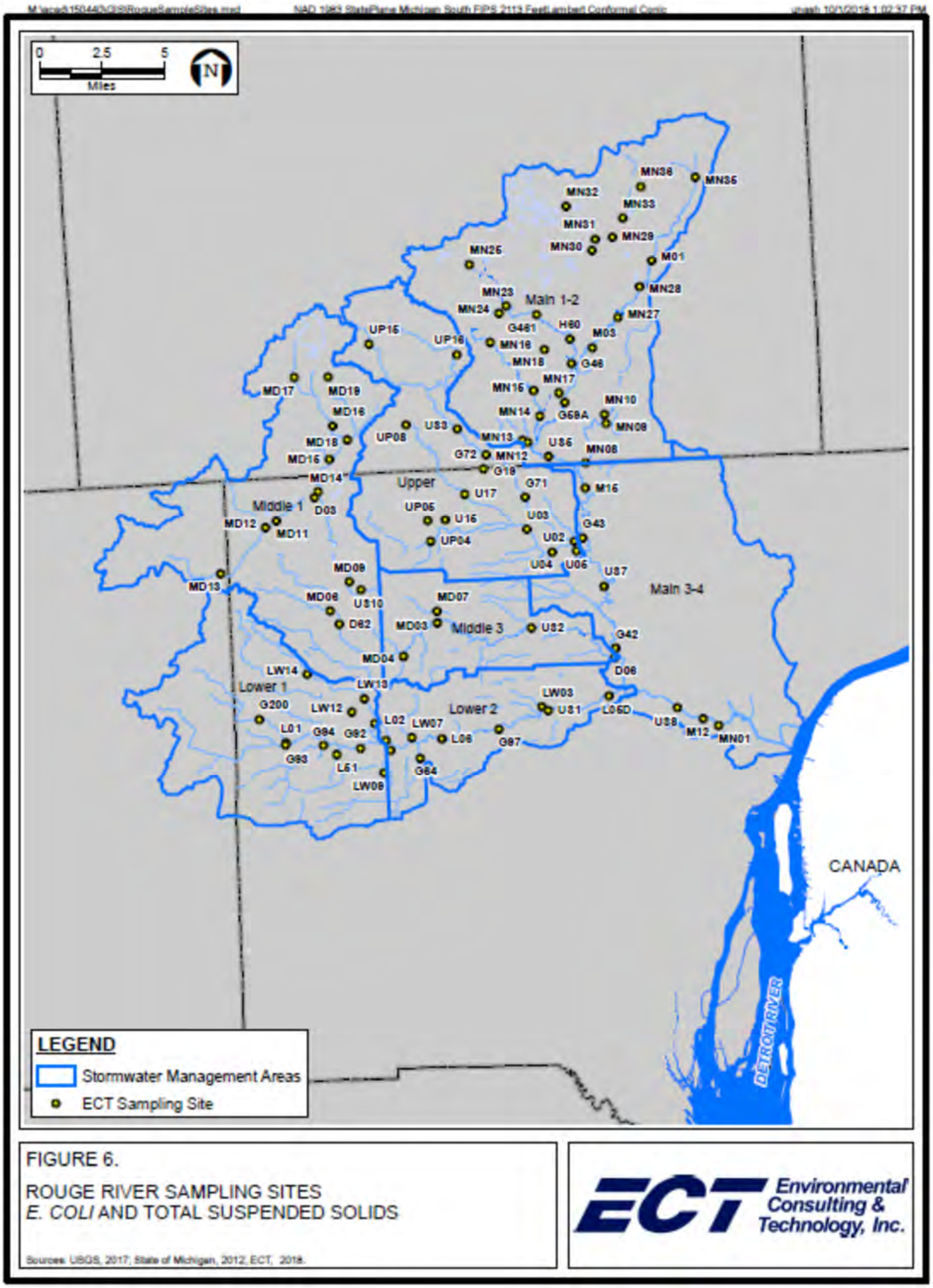
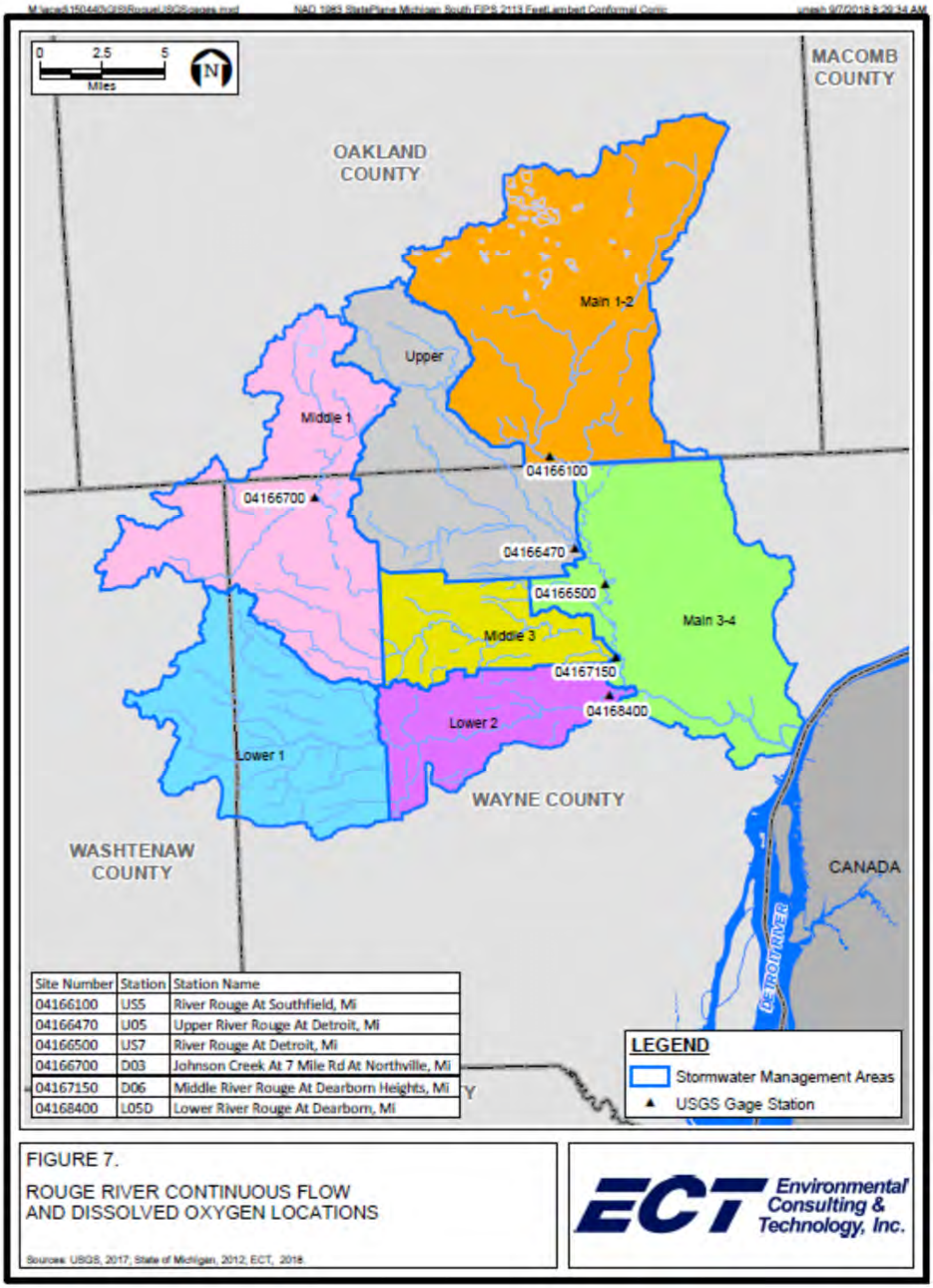


Figure 7. Rouge River Continuous Flow and Dissolved Oxygen Locations



Continuous flow monitoring – USGS collected continuous flow measurements at six locations in the watershed from May 1 through October 30. These locations were all on main branches of the river. This data was used to characterize flow conditions as they relate to the manual sample collection events.

Continuous DO monitoring – USGS collected continuous DO measurements in addition to flow at the six locations from May 1 through October 30. Included in these locations was a site on Johnson Creek, a designated coldwater stream, which currently has a TMDL in place for not attaining the DO WQS (7 mg/L).

Manual *in situ* flow monitoring – ECT collected *in situ* velocity and stream gage measurements at nine locations identified in Table 3 during the weekly sample collection efforts.

Manual sample collection – ECT collected samples for *E. coli* and TSS at 90 locations throughout the watershed between May and September. These samples were collected from mid-stream approximately 2” below the surface of the stream. Bottom sediment was not to be disturbed during sample collection efforts.

2.1.1 Water Quantity Monitoring

USGS collected continuous flow data (recorded every 15 minutes) at six locations in the watershed. Five of these locations were used historically, and one location was added to provide information specific to Johnson Creek. The locations are described and shown in Figure 7. USGS collected flow data following agency standard operating procedures (SOPs).

ECT took discrete flow measurements during routine sampling. A vertical reference point was used to measure the stream level during each sampling event. Velocity measurements were taken at twenty points across the width of the stream. All information was recorded on data sheets for calculation of the flow rate. The flow rate was calculated using the level data, average velocity reading and the stream bottom profile. The stream bottom profile was determined at least twice during the data collection period during periods of low or normal flow.

2.1.2 Water Quality Monitoring

ECT collected grab samples for analysis for *E. coli* and TSS. Samples were collected for 20 weekly events from May through September 2017. Samples were collected using either a sampling pole or a rope with a bottle holding mechanism. Samples were collected from the horizontal mid-point of the stream on the upstream side of the bridge crossing, when possible. If the downstream side of the bridge crossing was used, it was noted on the field form for that site. Samples were collected directly into the laboratory bottles.

DO readings were collected via continuous *in situ* data sondes with data logging every 15 minutes. These readings were collected from the horizontal mid-point of the stream.

Data collection methods are further described in the Rouge River TMDL Assessment Monitoring Quality Assurance Project Plan (ECT, 2017).

2.1.3 Macroinvertebrate Monitoring

Friends of the Rouge and Wayne County conducted macroinvertebrate across the watershed in 2014, 2015, 2016 and 2017 using trained volunteers. The sampling program is certified by the Michigan Clean Water Corps and follows procedures contained in a quality assurance project plan (FOTR, 2009).

2.2 Data Analysis

Based on the objectives of this report, data were analyzed to determine water quality improvements since the establishment of the TMDL, data trends and potential drivers of parameters of interest, and changes in *E. coli* concentrations with rainfall events. The data requirements and limitations associated with examining these variables are described in the following sections, where applicable. Results and conclusions are grouped for discussion by subwatershed. Furthermore, to understand the influence of point sources on the water quality of a reach, discussion and interpretation of data may include samples collected upstream and downstream, where available.

To assist with data analysis and to realize the impacts of storm events on the parameters of interest, data was categorized by sample collection events into wet versus dry conditions. Wet weather samples were those that follow a 0.25-inch or larger storm event over the previous 24 hours. Dry weather samples were categorized as such when the sampling event was preceded by no more than 0.05" of precipitation over the previous 48 hours. Similarly, data analyses are also interpreted in light of flow measurements, where available, to understand the impacts of rainfall on water quality in the watershed.

2.2.1 TMDL Evaluation

In order to evaluate progress toward the TMDL goals, daily maximum values and other criteria described in the 2007 TMDL for *E. coli* for the Rouge River and the 2007 TMDL for DO for Johnson Creek were assessed as described below.

2.2.1.1 E. coli

As described in the 2007 TMDL for *E. coli* for the Rouge River (MDEQ, 2007a), WQSs for *E. coli* under the designated use rule R 323.1062 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, are as follows:

> "*All waters of the state protected for total body contact recreation shall not contain more than 130 E. coli per 100 mL, 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 mL. 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.*"

To evaluate compliance with this standard, an analysis similar to that performed in the TMDL (MDEQ, 2017a) was performed. ECT plotted the 2017 *E. coli* results on a logarithmic scale base

10 for comparison with the maximum value of 300 *E. coli*/100 mL. While ECT did not collect 3 or more samples during the same sampling event at each location, this evaluation was considered suitable to estimate TMDL compliance. Stations were similarly grouped by creeks or drainage areas to assess daily maximum values for comparison with the TMDL numeric target.

Unfortunately, ECT was unable to obtain all the data collected in 2005 and 2006 for the establishment of the TMDL and were unable to create similar box and whisker plots. Instead, bar graphs of the averages, with calculated standard error, were plotted from the data that was obtained for visual comparison between these two sampling periods.

2.2.1.2 Dissolved Oxygen

As described in the 2007 TMDL for DO for the Johnson Creek (MDEQ, 2007b), WQSs for DO under the designated use rule R 323.1064 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, are as follows:

> *"…a minimum of 7 mg/L of dissolved oxygen shall be maintained at all times in all inland waters designated by these rules to be protected for coldwater fish. In all other waters, except for inland lakes as prescribed by R 323.1065, a minimum of 5 mg/L of dissolved oxygen shall be maintained."*

To evaluate compliance with this standard, an analysis similar to that performed in the TMDL (MDEQ, 2017b) was performed. ECT plotted minimum DO values (mg/L) from continuous monitoring for comparison with the minimum value of 7 mg/L (Johnson Creek) or 5 mg/L.

Michigan has also established criteria for DO concentrations in order for all surface waters within the state to support the designation of cold and warmwater fisheries. To determine whether water bodies are supporting this use and should not be considered impaired, all 2017 continuous monitoring DO data were evaluated to determine what percentage of these measurements did not meet the WQSs of 5 mg/L and 7 mg/L. Michigan considers water bodies to support the designated use based on this criteria if less than 10% of all measurements for a period of record exhibit DO concentrations less than the WQS (MDEQ, 2018).

2.2.1.3 Total Dissolved Solids

The 2007 TMDL for Biota for the River Rouge Watershed established a primary numeric target for biota based on biological community assessment. A secondary numeric target based on TSS is used to assess improvements in the watershed. This secondary target is a mean annual in-stream TSS concentration of 80 mg/L for wet weather events. The secondary numeric target is intended to help guide proper control over excessive TSS loads from runoff, as well as the runoff discharge rates and volumes that affect increased stream flow instability, streambank erosion, and increased suspended sediment concentrations. The secondary numeric target is intended to link a measurable in-stream parameter to the hydrologic changes in the watershed and the resultant habitat changes that are heavily impacting the biological communities in this system.

In addition to this secondary target, Alabaster and Lloyd (1982) provided the following water quality goals for TSS for the protection of fish communities:

Optimum: ≤ 25 mg/L
Good to Moderate: > 25 to 80 mg/L
Less than Moderate: > 80 to 400 mg/L
Poor: ≥ 400 mg/L

2.2.2 Trend Analysis

It is well-established that water quality monitoring data do not typically follow a normal distribution; therefore, statistical analyses require careful consideration. In order to select appropriate statistical methods, data collected in the Rouge River Watershed were evaluated by normality tests and other data exploration techniques. Through this evaluation, it was determined that the data fit a non-normal distribution and were not effectively transformed for parametric analysis. Further exploration determined that the best measure of the central tendency of the dataset was the median – typical of non-normal, skewed distributions. As such, non-parametric tests were used to inform hypotheses concerning the data, including non-parametric regression modeling and Seasonal Kendall trend tests on residuals from LOWESS of Y on X. For temporal evaluation using the Seasonal Kendall trend test, several assumptions were used when processing the data. When multiple samples were collected on a single day, the median value of all those samples was assumed to be the representative sample when three or more samples were collected. When less than three samples were collected, the mean value was used. This was a necessary step as the Mann-Kendall analysis required only one data point at a given instant of time. Datasets were restricted with varying seasons (months) based on consistency of datasets across years.

2.2.3 Load Duration Curves

In order to illustrate *E. coli* results in the context of representative flow conditions and daily water quality targets, load duration curves (LDCs) were created following the same method described in the 2007 TMDL, with one main exception owing to the difference in data availability. For 2007 TMDL LDCs, individual data points represented the geometric mean of 3 individual samples taken in the same location and in the same day. While these datapoints were used for updated LDCs, the 2017 data points to which they were compared were based on a single sample taken at each location.

Where possible, comparisons were made between 2005 and 2017 monitoring results. However, not all sites described in the 2007 TMDL (i.e. 2005 results) were sampled in 2017. Moreover, several of the USGS stations used to define the historical flow record and estimate daily flow were taken offline since 2005, meaning that LDCs could not be created for all sites that were monitored in 2017. This list includes all sites located in the Upper Branch. Still, of the 62 stations included in the 2007 TMDL, 26 were both sampled in 2017 and had daily flow data available for creation of 2017 LDCs. In addition, 2017 LDCs were created for 38 new sites not included in the 2007 TMDL.

3.0 Results

Water quality and stream flow values are summarized in Table 4 by subwatershed. The Lower Branch exhibits the highest *E. coli* concentrations in the watershed, based on median and mean values. Following a similar degraded water quality trend, the Lower Branch also exhibits the lowest DO concentrations in the watershed, while dissolved oxygen is highest in the Main Rouge by measure of both median and mean. The hypothesized primary controls on DO are temperature and TSS. As shown in Table 4, temperature is relatively consistent across the watershed. However, the Lower Branch exhibits higher TSS concentrations than other subwatersheds. Possible controls on *E. coli*, TSS, and DO concentrations are explored further by trend analysis in Sections 3.1.3 and 3.2.3.

Table 4. Summary Statistics for Water Quality Parameters in the Rouge River Watershed

Parameter	Units	Lower Branch				Main Branch			
		n	Median	Mean	SD	n	Median	Mean	SD
Dissolved oxygen, Minimum	mg/L	882	6.3	6.7	2.2	2,793	8.3	8.7	2.7
Flow, Mean	cfs	882	56	92	109	2,831	91	157	239
Temperature, Mean	°C	882	18	17	5.8	2,790	13	12	8.0
Total suspended solids	mg/L	358	19	32	52	671	8.5	21	55
Escherichia coli	cfu/100 mL	359	794	3,060	5,636	669	495	1,608	3,638

N = number of values, SD = standard deviation

Table 5. Summary Statistics for Water Quality Parameters in the Rouge River Watershed

Parameter	Units	Middle Branch				Upper Branch			
		n	Median	Mean	SD	n	Median	Mean	SD
Dissolved oxygen, Minimum	mg/L	1,076	7.4	7.7	2	366	6.9	7.1	1.2
Flow, Mean	cfs	892	49	86	155	220	21	54	104
Temperature, Mean	°C	1,076	18	17	6.4	366	19	18	42
Total suspended solids	mg/L	377	7.5	18	42	276	8.5	15	26
Escherichia coli	cfu/100 mL	377	399	1,689	3,544	276	767	1,321	2,032

N = number of values, SD = standard deviation

3.1 *E. coli* Analysis

3.1.1 *E. coli* TMDL Evaluation

To evaluate progress toward meeting the goals in TMDL assessment, graphical representations of the daily maximum values were created in the same format as those presented in Appendix A of MDEQ, 2007a. To explore specific locations that exhibited peak concentrations over the course of the 2017 study, geometric means under both wet and dry conditions were determined for each location (Table 5). Since sampling events for this study were limited (e.g. study design focused on spatial coverage within the watershed as opposed to obtaining three samples per sampling event at each location), results are not directly comparable with TMDL guidance. However, the values established in the TMDL can be used as guidance for interpreting the sampling results, with *E. coli* concentrations of 130 cfu/100 mL as the desirable long-term monthly geometric mean value. Furthermore, separating these data by weather condition allows for some interpretation of potential *E. coli* sources. High geometric means during dry conditions or under all conditions suggest the possibility of illicit connections, while locations with high geometric means during wet conditions suggest illicit discharges including failing sewage infrastructure or septic systems or nonpoint pollution sources such as runoff impacted by pet and wildlife feces or agricultural sources.

Table 6. Wet and dry geometric means for *E. coli* concentrations (cfu/100 mL)

Lower Branch Geomeans		
Station	**Dry**	**Wet**
G92	379	1,809
L02	544	3,919
LW09	N/A	1,314
LW12	450	1,857
LW13	1,309	3,026
LW14	1,178	2,335
G200	522	1,523
G93	918	1,625
G94	554	4,126
L01	571	2,913
L51	104	1,906
G64	394	1,762
G97	507	4,292
L05D	16,241	15,909
L06	817	2,701
LW03	2,274	9,501
LW07	N/A	N/A
LW08	571	2,498

Main Branch Geomeans					
Station	**Dry**	**Wet**	**Station**	**Dry**	**Wet**
G46	441	12,582[2]	**M01**	391	8,664[1]
G461	199	2,755[1]	**MN28**	294	933[1]
G59A	433	24,196[2]	**MN29**	600	5,172[1]
H60	308	7,270[1]	**MN30**	109	N/A
M03	156	10,137[2]	**MN31**	76	1,785[1]
MN08	583	11,220[2]	**MN32**	238	3,448[1]
MN09	892	7,975[2]	**MN33**	91	2,481[1]
MN10	546	16,067[2]	**MN35**	218	2,489[1]
MN12	441	3,448[1]	**MN36**	N/A	N/A
MN13	1,255	3,076[1]	**G43**	611	1,422
MN14	381	5,282[2]	**M15**	554	1,969
MN15	461	8,199[2]	**G42**	727	1,347[2]
MN16	398	24,196[1]	**M12**	509	3,141[2]
MN17	484	11,772[2]	**MN01**	421	1,627[2]
MN18	632	24,196[1]	**US7**	455	1,562[2]
MN23	416	1,723[1]	**US8**	1,374	2,989[2]
MN24	601	4,611[1]			
MN25	355	813[1]			

US1	505	2968		**MN27**	256	1324[2]
US9	424	1388		**US5**	900	5446[2]

Middle Branch Geomeans		
Station	**Dry**	**Wet**
D06	1,149	2,695
MD03	673	1,763
MD04	762	4,197
MD07	197	309
US2	544	1,341
D03	177	712
D62	2,321	6,057
MD06	3,969	6,757
MD09	56	115
MD11	288	422
MD12	150	302
MD13	405	527
MD14	252	620
MD15	440	1,194
MD16	1,695	1,974
MD17	242	227
MD18	800	938
MD19	121	1,063
US10	147	249

Upper Branch Geomeans		
Station	**Dry**	**Wet**
UP08	535	634
UP15	179	218
UP16	632	617
US3	570	1,155
G19	193	920[2]
G71	858	269[2]
G72	602	510[2]
U02	904	2,437[2]
U03	872	1,229[2]
U04	759	1,856[2]
U05	727	3,428[2]
U15	603	550[2]
U17	753	644[2]
UP04	1,299	1,716[2]
UP05	548	550[2]

Key	
E. coli (cfu/100 mL)	
0 – 130	(green)
130 – 1,000	(white)
1,001 – 2,000	(yellow)
2,001 – 10,000	(orange)
> 10,000	(red)
Bold Values: Dry Geomean > Wet Geomean	

[1] Not enough data to obtain geomean, n = 1
[2] n = 2

3.1.1.1 *E. coli* Lower Branch

Twenty stations were sampled in the Lower Branch in 2017 (Figure 8, Figures A1-1 through A1-9). Station L51, located on the McKinstry Drain in Canton Township, was the site with the greatest number of *E. coli* values (70%) below the WQS of 300 cfu/100 ml (Figure A1-4 and Table 6). Of the six observations that were above the WQS, three were between 300 – 999 cfu/100 ml and three were between 1000 – 10,000 cfu/100 ml. The other sites within the Lower Branch rarely met the WQS in 2017, with many regularly approaching concentrations of 10,000 cfu/100 ml (Figures A1-1 through A1-3, A1-5 through A1-9, Table 6).

Figure 8. ***E. coli*** **Distribution Rouge River Lower Branch**

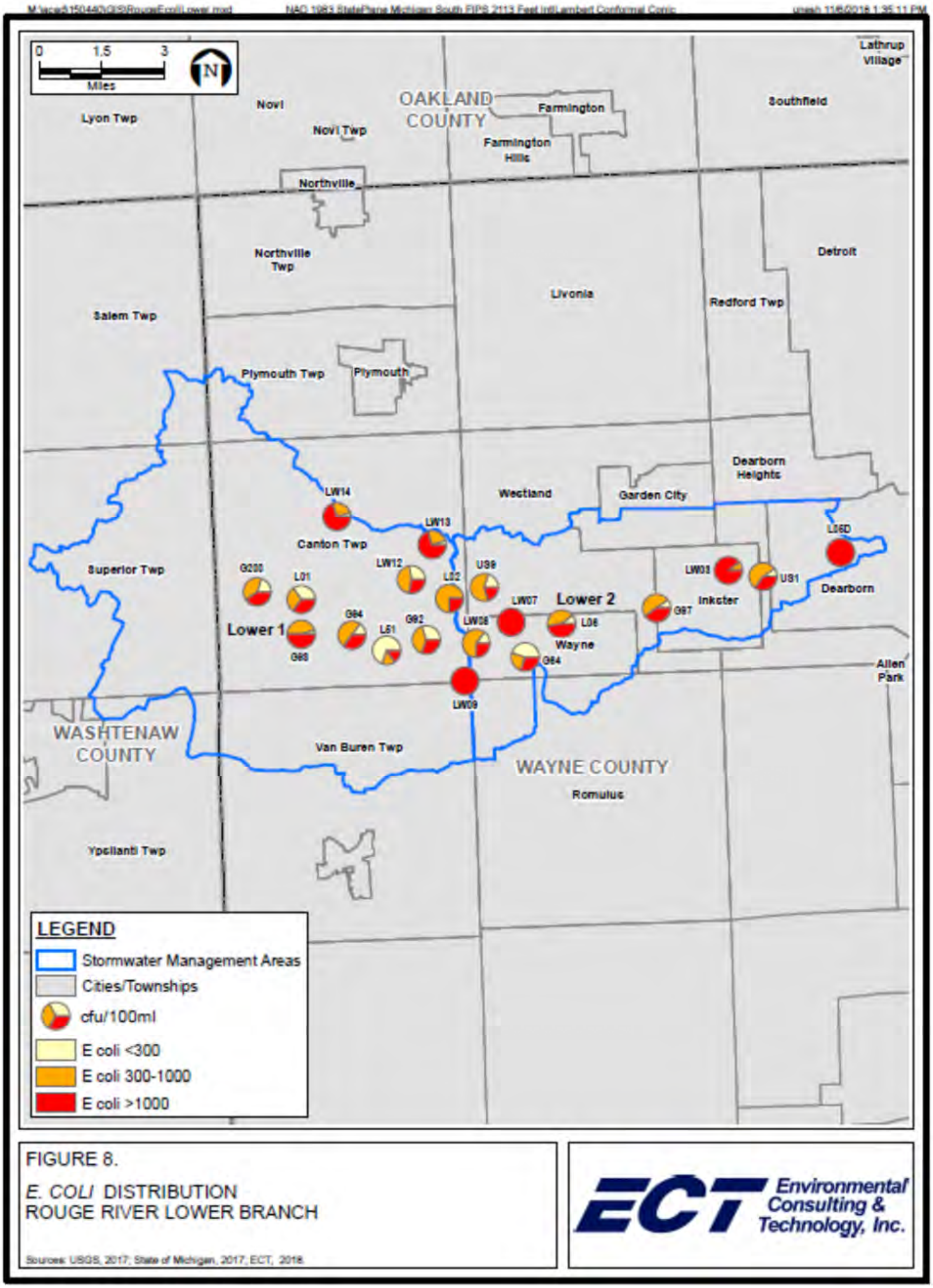


Table 7. Lower Branch Distribution of *E. coli* Results

Station	Number of Observations					Percent Compliance	Number of Exceedances
	Total	<300	300-999	1,000-10,000	>10,000		
G200	20	4	8	8	0	20	16
G64	20	9	5	3	3	45	11
G92	20	6	8	6	0	30	14
G93	20	1	9	10	0	5	19
G94	20	3	10	6	1	15	17
G97	20	2	10	7	1	10	18
L01	20	7	6	5	2	35	13
L02	20	0	15	5	0	0	20
L05D	20	0	0	5	15	0	20
L06	19	2	8	7	2	11	17
L51	20	14	3	3	0	70	6
LW03	20	0	2	13	5	0	20
LW07	1	0	0	1	0	0	1
LW08	20	3	12	5	0	15	17
LW09	1	0	0	1	0	0	1
LW12	18	5	8	5	0	28	13
LW13	20	1	5	14	0	5	19
LW14	20	1	5	14	0	5	19
US1	20	2	11	5	2	10	18
US9	20	4	12	4	0	20	16

Bold stations have 60% or more values below the WQS (300 cfu/100 mL)

Several of the stations in the Lower Branch exhibited a large distribution and spread of *E. coli* concentrations (Figure A2-1). More than 70% of the observations were between 300 and 10,000 cfu/100 ml (Table 6) and only 18% of the observations were below the WQS. The largest distribution of *E. coli* concentrations was observed at stations L05D and LW03. Stations G64, G94, G97, L01, L05D, L06, LW03, and US1 exhibited one or more concentrations of *E. coli* greater than 10,000 cfu/100 ml (Table 6).

Most of the stations in the Lower Branch exhibited higher *E. coli* concentrations during wet weather, with geometric means for L02, LW13, LW14, G94, L01, G97, L06, LW03, LW08, and US1 above 2,000 cfu/100 ml during wet weather events (Table 5). One station, LW03 (Perrin Drain near Elm Circle Drive), increases 4-fold to concentrations approaching 10,000 cfu/100 ml during wet weather. Additionally, LW03 appeared to be consistently high during dry weather conditions. This is either caused by illicit connections, uncontrolled CSOs upstream of this location or failing sanitary sewer infrastructure. Two stations (LW13 and LW14) exhibit consistently higher *E. coli* concentrations, regardless of weather conditions, and may represent illicit discharges or failing sewage infrastructure in the area.

Station L05D (Lower Branch at S. Military Street) exhibited extremely high *E. coli* concentrations during dry and wet weather, with geometric means of 16,241 and 15,909 cfu/100 ml, respectively. These were likely the result of illicit discharges discovered toward the end of the sampling season.

Two substantial illicit discharges were found draining to the Lower Branch between stations US1 and L05D. One discharge emanated from a Wayne County combined sewer where mechanical issues caused sewage to drain to the river regardless of weather conditions. The second emanated from a storm sewer, owned by the City of Inkster, where blockage in a sanitary sewer caused sewage to flow into the storm drain via a high-level overflow during all weather conditions. These discharges were corrected by the end of September 2017.

Making the impact of these illicit discharges worse, the YCUA wastewater treatment plant stopped discharging to the Lower Branch on September 5, 2017 as their effluent pump station underwent repairs. This flow can comprise 95% of the baseflow of the Lower and would have likely diluted the illicit discharges accordingly. This flow wasn't reestablished until January 8, 2018.

Additional sampling in October 2017 revealed a dramatic decrease in *E. coli* levels at L05D. Prior to the corrections, the mean *E. coli* concentration was 16 times higher downstream (L05D) than upstream (US1). After the corrections, the mean was only 3 times higher as shown in Table 7. These October results were despite the lower baseflow due to the continued construction at the YCUA effluent pump station.

Table 8. Comparison of *E. coli* Levels at L05D before and after Illicit Discharge Eliminations

Site	Mean *E. coli* Concentrations (cfu/100 ml)	
	Before Corrections (n = 20)	After Corrections (n = 4)
US1. Lower Branch at John Daly Rd.	974	267
L05D. Lower Branch at Military St.	15,638	758

3.1.1.2 *E. coli* Main Branch

There are high *E. coli* concentrations in all weather conditions throughout the Main Branch subwatershed (Figure 9, Figures A1-10 through A1-17). In general, the stations clustered in the Sunken Bridge Drain and in the Main Branch near this drain have low *E. coli* concentrations with many of the stations below the WQS for most of the sampling season (Figure A1-17). In this cluster, the highest *E. coli* concentrations were observed at station MN29 in Sunken Bridge Drain, near Tamarack Way and Kingswood Campus Drive. Station MN32, further upstream, also had higher *E. coli* concentrations compared to the rest of the stations in this cluster. In general, *E. coli* concentrations were lower in the spring and higher in late summer and early fall.

Several stations (G461, M03, MN28, MN30, MN31, MN33, and MN35) in the Main Branch exhibit more than 60% of *E. coli* concentrations under the WQS for this sampling period (Table 8). Station MN30 (Sunken Bridge Drain at Lone Pine Road and Thetford Lane) met the *E. coli* WQS 100% of the time and MN31 (Sunken Bridge Drain at Vaughan and Orchard Ridge roads) met the WQS 90% of the time with only two observations falling between 1,000 – 10,000 cfu/100 ml (Table 8).

With the exception of a few single observations at each station, the distribution and spread of *E. coli* concentrations across the Main Branch was narrow (Figure A2-2). More than 70% of the observations fell below 1,000 cfu/100 ml, 34% of those were below the WQS, and only 26 observations out of 669 total observations were above the greater than 10,000 cfu/100 ml (Table 8).

Wet weather conditions appear to account for the majority of increased *E. coli* concentrations in the Main Branch; however, *E. coli* concentrations remain below 10,000 cfu/100 ml even under wet weather conditions. This behavior suggests that illicit discharges, including failing sewage infrastructure and/or failing septic systems and nonpoint sources, may contribute to a large portion of the overall *E. coli* load in the Main Branch, especially during wet weather conditions.

Two other stations in the subwatershed, MN13 (at Inkster Rd.) and US8 (at Rotunda Dr.), exhibit consistently higher *E. coli* concentrations regardless of weather conditions (Table 5). MN13 may be influenced by illicit discharges. US8 is located in the last 7 miles of the river and may be impacted by CSOs.

Figure 9. *E. coli* Distribution Rouge River Main Branch

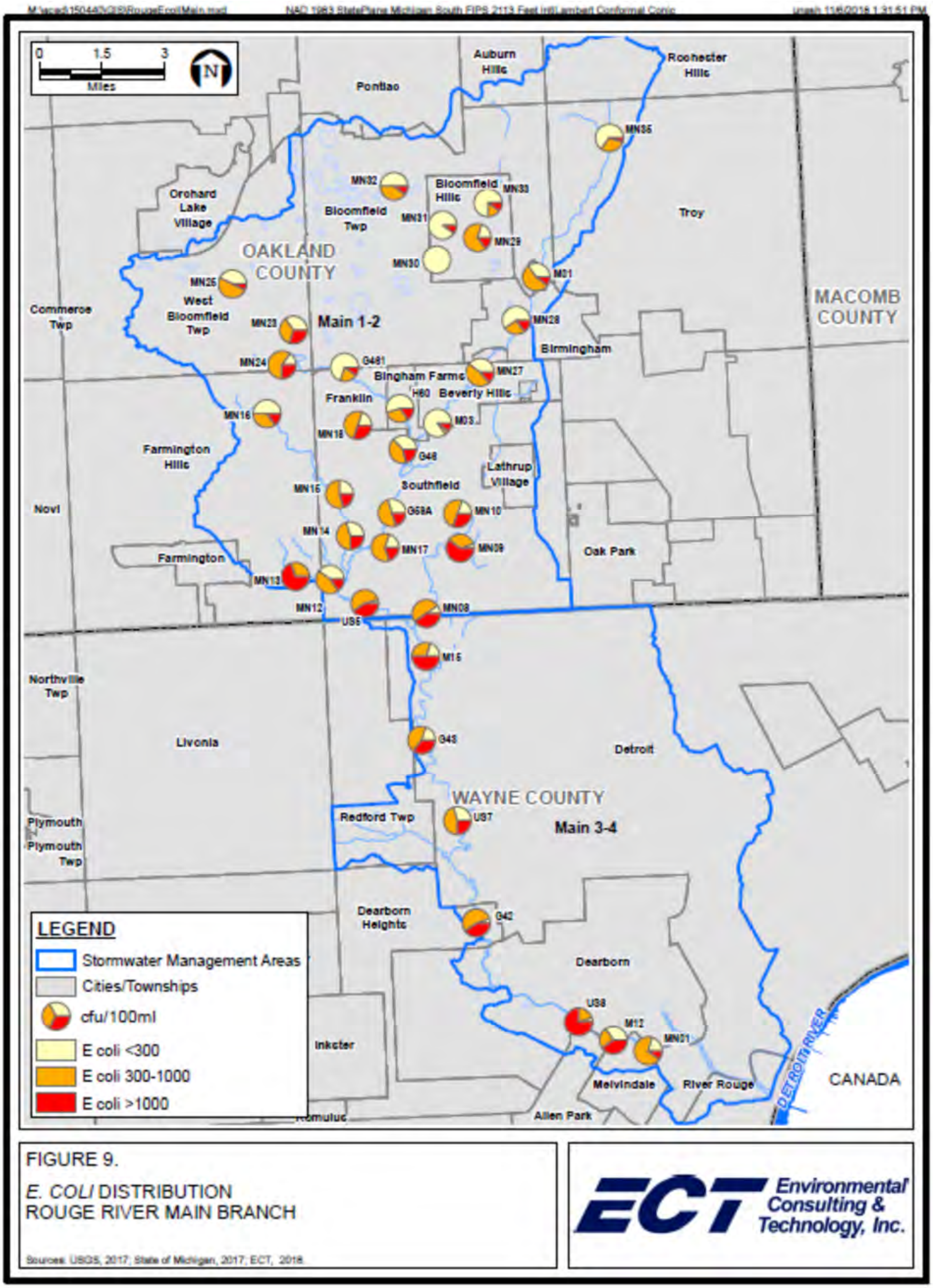


Table 9. Main Branch Distribution of *E. coli* Results

Station	Number of Observations					Percent Compliance	Number of Exceedances
	Total	<300	300-999	1,000-10,000	>10,000		
G42	20	1	11	8	0	5	19
G43	20	4	9	6	1	20	16
G46	19	7	8	2	2	37	12
G461	20	14	4	2	0	70	6
G59A	20	6	10	2	2	30	14
H60	20	11	6	3	0	55	9
M01	20	7	11	2	0	35	13
M03	20	17	1	1	1	85	3
M12	20	7	5	7	1	35	13
M15	20	4	6	9	1	20	16
MN01	19	4	13	2	0	21	15
MN08	20	2	10	5	3	10	18
MN09	20	1	7	12	0	5	19
MN10	20	4	10	4	2	20	16
MN12	20	8	9	2	1	40	12
MN13	20	0	6	14	0	0	20
MN14	20	6	9	4	1	30	14
MN15	20	5	11	3	1	25	15
MN16	20	10	7	2	1	50	10
MN17	20	4	12	3	1	20	16
MN18	20	4	10	5	1	20	16
MN23	20	7	7	6	0	35	13
MN24	20	3	12	5	0	15	17
MN25	14	6	7	1	0	43	8
MN27	15	6	7	2	0	40	9
MN28	20	12	5	3	0	60	8
MN29	20	4	13	2	1	20	16
MN30	2	2	0	0	0	100	0
MN31	20	18	0	2	0	90	2
MN32	20	10	8	2	0	50	10
MN33	20	15	3	2	0	75	5
MN35	20	13	6	1	0	65	7
MN36	0	0	0	0	0	0	0
US5	20	1	11	6	2	5	19
US7	20	6	9	3	2	30	14
US8	20	1	4	13	2	5	19

Bold stations have 60% or more values below the WQS (300 cfu/100 mL)

3.1.1.3 *E. coli* Middle Branch

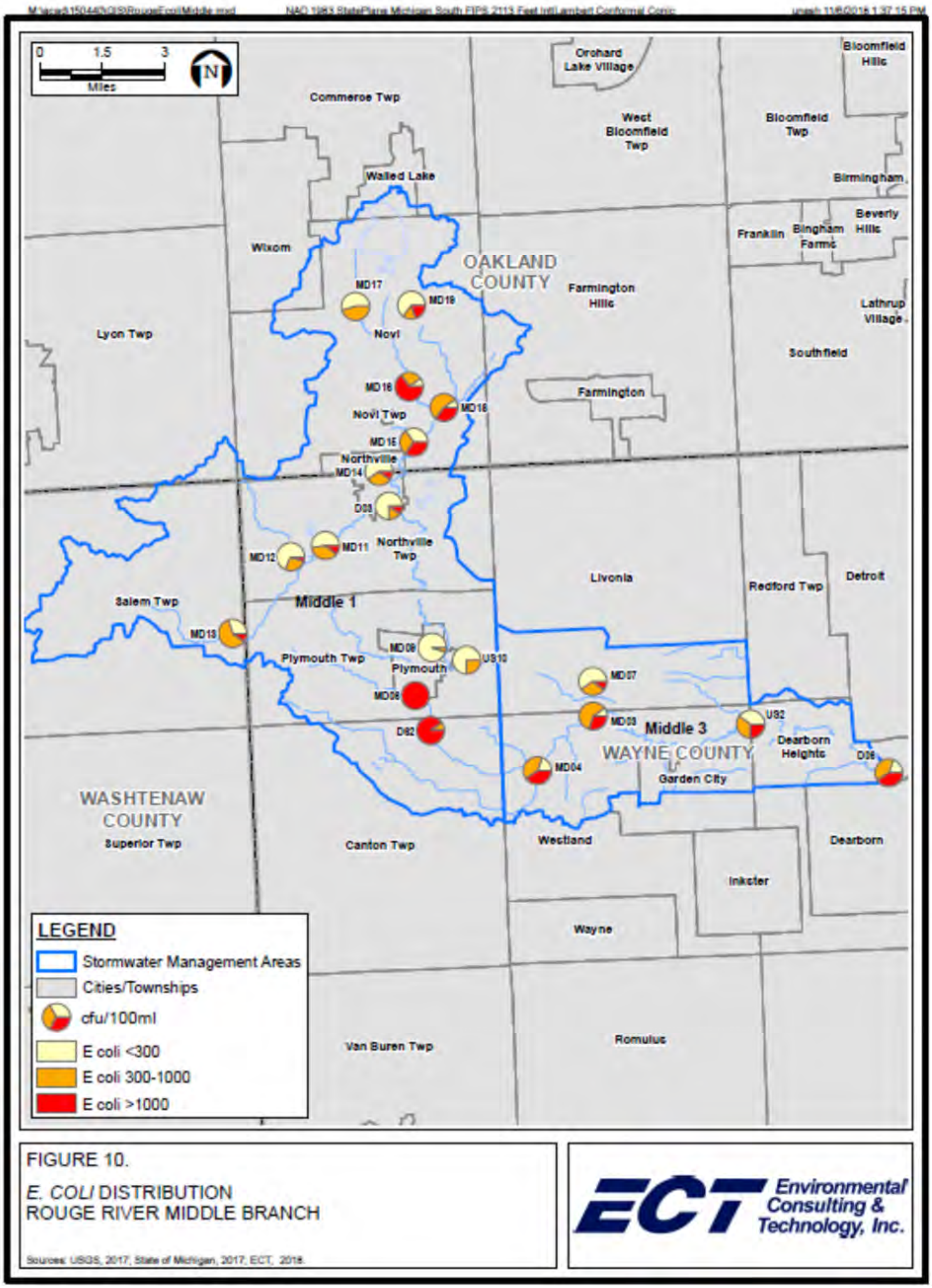
There are high *E. coli* concentrations in all weather conditions at several stations throughout the Middle Branch (Figure 10, Figures A1-18 through A1-24). Several stations met the *E. coli* WQS more than 60% of the time (Table 9). These stations included D03, MD09, MD12, MD14, MD19, US10 (Table 6; Figures A1-19, A1-22, A1-23, and A1-24). Station MD09 (at Plymouth Rd./Hines Drive) met the WQS 95% of the time, with only one observation between 300 – 999 cfu/100 ml. For those stations that did not meet the WQS, *E. coli* concentrations were generally lower as compared to the values reported in 2007 (Figures A1-18, A1-20, A1-21, A1-22, A1-23, A1-24). This is discussed further in Section 3.1.3.3.

Table 10. Middle Branch Distribution of *E. coli* Results

Station	Number of Observations					Percent Compliance	Number of Exceedances
	Total	<300	300-999	1,000-10,000	>10,000		
D03	20	15	3	2	0	75	5
D06	20	4	8	4	4	20	16
D62	20	0	2	14	4	0	20
MD03	20	2	12	6	0	10	18
MD04	20	4	8	7	1	20	16
MD06	19	0	0	16	3	0	19
MD07	20	11	7	2	0	55	9
MD09	20	19	1	0	0	95	1
MD11	19	10	7	2	0	53	9
MD12	19	13	5	1	0	68	6
MD13	20	6	12	2	0	30	14
MD14	20	12	6	2	0	60	8
MD15	20	7	6	7	0	35	13
MD16	20	2	5	13	0	10	18
MD17	20	11	9	0	0	55	9
MD18	20	2	11	7	0	10	18
MD19	20	13	3	4	0	65	7
US10	20	15	5	0	0	75	5
US2	20	8	7	4	1	40	12

Bold stations have 60% or more values below the WQS (300 cfu/100 mL)

Figure 10. E. coli Distribution Rouge River Middle Branch



The overall distribution and spread of E. coli concentrations at each station in the Middle Branch was small and most were under 1,000 cfu/100 ml (Figure A2-3). Only a few of the stations had values above 10,000 cfu/100 ml. More than 70% of the total observations were below 1,000 cfu/100 ml and 40% of the total observations met the WQS (Table 9).

Several stations, including D06 and MD16, exhibit relatively higher *E. coli* concentrations regardless of weather conditions (Table 5). These locations may indicate illicit connections within the area. Other stations on the South Branch of Tonquish Creek, D62 (Joy Rd.) and MD06 (Ann Arbor Rd.) exhibit consistently high concentrations with an approximately 2-fold increase under wet weather conditions. Based on this behavior, illicit discharges, including failing sewage infrastructure and/or failing septic systems, are likely primarily responsible for these conditions.

3.1.1.4 *E. coli* Upper Branch

There are high *E. coli* concentrations in all weather conditions at several stations throughout the Upper Branch (Figure 11, Figures A1-27 through A1-29). Overall improvement has been observed in most of the stations sampled within this subwatershed as compared to the 2007 TMDL assessment. However, the stations are generally not in compliance with the WQS with the exception of station UP15, Seeley Drain at Haggerty Road (Figure A1-29). This station met the WQS 85% of the sampling period, with one observation between 300 – 999 cfu/100 ml and two observations between 1,000 – 10,000 cfu/100ml (Table 10). All other stations exceeded the WQS for most of the sampling period (Figures A1-25, A1-26, A1-27, A1-28, and A1-29).

Station UP04, Bell Branch near 5 Mile Road, was the only station with a single observation that exceeded 10,000 cfu/100 ml (Figure A2-4). Of the combined 276 recorded observations for *E. coli* in the Upper Branch, more than 80% of them fell between 300 and 10,000 cfu/100 ml and only 16% of the total observations were below the WQS (Table 10).

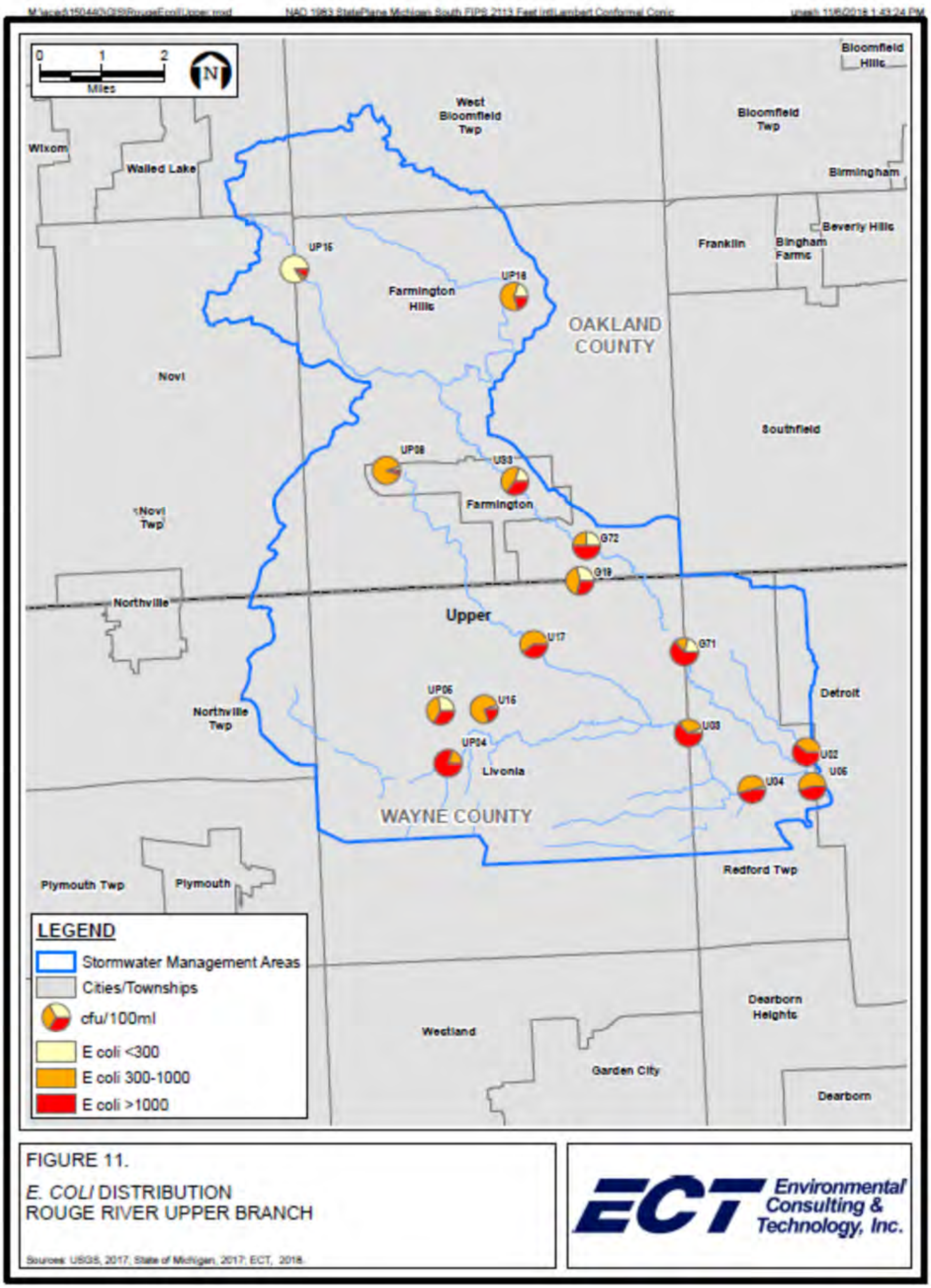
Most stations within the Upper Branch indicate mild increases in *E. coli* concentrations with rain events, as seen in the Middle Branch. This behavior suggests that illicit discharges, including failing sewage infrastructure and/or failing septic systems, may contribute to a large portion of the overall *E. coli* load in the Upper Branch. At two locations (U02 and U05), concentrations of *E. coli* reach greater than 2,000 cfu/100 ml during wet weather conditions. These locations may be of interest for further investigation of characteristics of the contributing area to pinpoint major sources for these increased concentrations.

Table 11. Upper Branch Distribution of *E. coli* Results

Station	Number of Observations					Percent Compliance	Number of Exceedances
	Total	<300	300-999	1,000-10,000	>10,000		
G19	7	2	3	2	0	29	5
G71	20	4	4	12	0	20	16
G72	20	5	5	10	0	25	15
U02	20	0	8	12	0	0	20
U03	16	1	5	10	0	6	15
U04	20	1	10	9	0	5	19
U05	20	0	11	9	0	0	20
U15	20	1	15	4	0	5	19
U17	20	0	12	8	0	0	20
UP04	15	0	3	11	1	0	15
UP05	18	5	7	6	0	28	13
UP08	20	1	18	1	0	5	19
UP15	20	17	1	2	0	85	3
UP16	20	4	12	4	0	20	16
US3	20	4	9	7	0	20	16

Bold stations have 60% or more values below the WQS (300 cfu/100 mL)

Figure 11. *E. coli* Distribution Rouge River Upper Branch



3.1.2 *E. coli* Regression Analysis

Trend analysis was performed with two major objectives: to evaluate temporal trends for parameters where adequate periods of record exist, and to explore association between variables to better understand drivers of parameters of interest. Nonparametric regression was used to evaluate association between *E. coli* and flow as well as *E. coli* and TSS under all weather conditions. Results from these analyses are included in Table 11 and discussed in the sections below.

Table 12. Summary of *E. coli* regression analysis results

Analysis	Significant Trend			
	Lower Branch	Main Branch	Middle Branch	Upper Branch
E. coli temporal changes	No	Yes, decreased over the past 5 years	No	Yes, decreased since 2007
E. coli and flow all weather	No	Yes, positive relationship	No	N/A
E. coli and TSS all weather	No	Yes, positive relationship	N/A	Yes, positive relationship

3.1.2.1 *E. coli* Regressions Lower Branch

A seasonal trend analysis for the Lower Rouge subwatershed of the *E. coli* concentrations included in the 2007 TMDL and those collected by ECT in 2017 indicate that there has not been a significant decrease in *E. coli* concentrations over time ($p<0.05$).

Based on analysis of the 2017 monitoring data, concentrations of *E. coli* in the Lower Branch do not have a significant relationship with flow when analyzed for all samples. While the Lower Branch exhibits the highest *E. coli* and TSS concentrations in the watershed (Table 3), *E. coli* and TSS concentrations from 2017 monitoring data were not found to have a significant relationship when analyzed for all samples. As such, TSS concentrations are not a good indicator of *E. coli* concentrations in the Lower Branch. Trends and drivers related specifically to TSS are further discussed in Section 3.2.3.1.

3.1.2.2 *E. coli* Regressions Main Branch

A seasonal trend analysis for the Main Branch subwatershed of the *E. coli* concentrations included in the 2007 TMDL and those collected by ECT in 2017 indicate that there has not been a significant decrease in *E. coli* concentrations over this period of time ($p<0.05$). However, there is evidence that *E. coli* concentrations have decreased recently over the past 5 years. Data collected at US7 (USGS-04166500) available from the EPA Water Quality Data Portal (https://www.waterqualitydata.us/portal/) in 2012 indicated that *E. coli* concentrations have decreased significantly over the past 5 years ($p = 0.046$, $\alpha<0.05$), with a decrease in monthly concentrations during the period of May through August of approximately 1,187 cfu/100 mL per month when compared to 2017 data.

Based on analysis of the 2017 monitoring data, concentrations of *E. coli* in the Main Branch have a significant positive relationship with flow when analyzed for all samples, as shown in Figure 12. TSS concentrations in the subwatershed appear to be controlled by the fraction associated with human waste, with *E. coli* and TSS exhibiting a strong positive relationship (Figure 13). In fact, several locations where peak TSS concentrations were measured are tightly clustered with locations where peak *E. coli* concentrations were measured (i.e. G59A, MN12, MN13, MN13, MN16, and MN17, Figures A2-2 and A2-6). Some of these communities (Southfield and Farmington Hills) where peak concentrations were found are estimated to contain approximately 1,536 and 2,000 septic systems, respectively (ARC, 2012). Given the generally unsuitable conditions for traditional septic tank drain fields (Figure 15), septic systems in these areas may be providing inadequate removal of TSS and associated contaminants. Similarly, failing sewage infrastructure and illicit connections may be contributing to elevated *E. coli* concentrations in the Main Branch.

Figure 12. Main Branch Subwatershed: Relationship between *E. coli* and Flow for all weather conditions

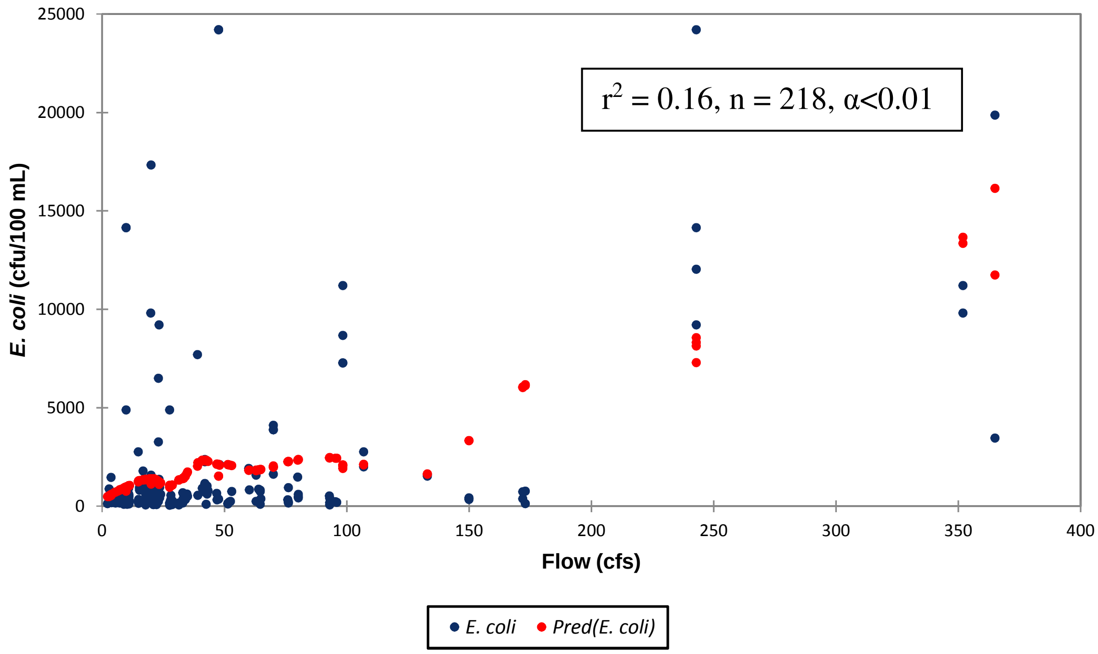
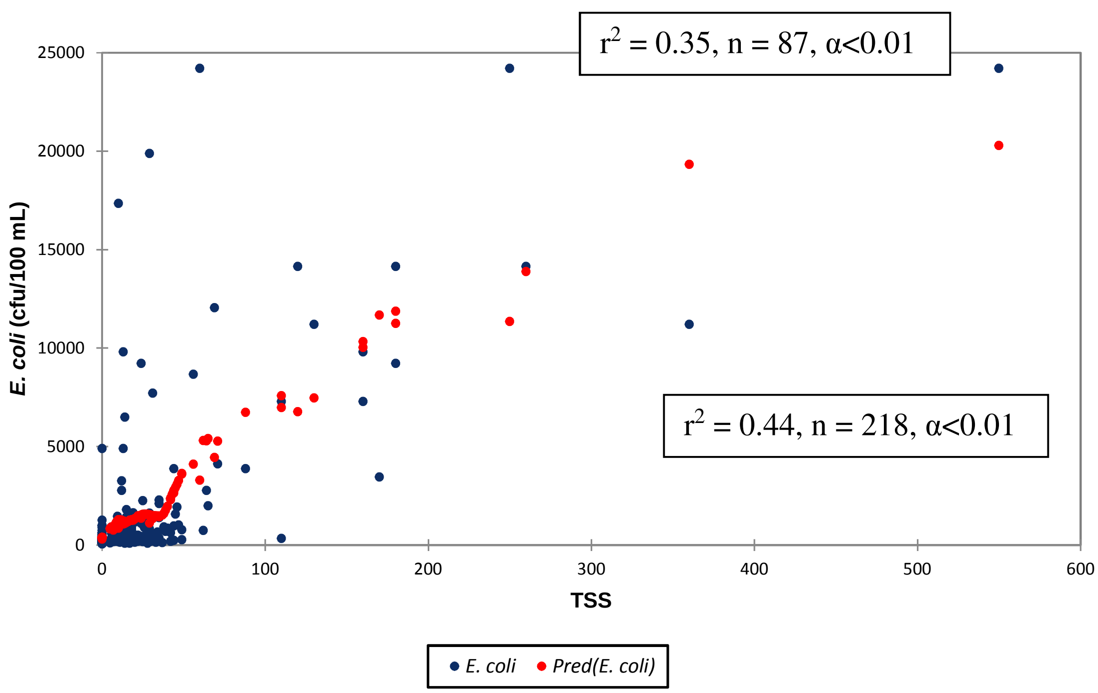


Figure 13. Main Branch Subwatershed: Relationship between *E. coli* and TSS for all weather conditions



3.1.2.3 *E. coli* Regressions Middle Branch

A seasonal trend analysis for the Middle Branch subwatershed of the *E. coli* concentrations included in the 2007 TMDL and those collected by ECT in 2017 indicate that there has not been a significant decrease in *E. coli* concentrations over time ($\alpha<0.05$). Furthermore, concentrations of *E. coli* in the Middle Branch do not have a significant relationship with flow when analyzed for all samples from 2017 monitoring data.

3.1.2.4 *E. coli* Regressions Upper Branch

A seasonal trend analysis for the Upper Rouge subwatershed of the *E. coli* concentrations included in the 2007 TMDL and those collected by ECT in 2017 indicate that *E. coli* concentrations have decreased significantly with time ($p=0.025$, $\alpha<0.05$), with a decrease in monthly concentrations during the period of May through September of approximately 2,812 cfu/100 mL per month.

Adequate flow data for the Upper Branch were not available to evaluate relationships between flow and *E. coli* concentrations. TSS concentrations in the watershed appear to be controlled by the fraction associated with human waste, with *E. coli* and TSS exhibiting a positive relationship under all conditions (Figure 14). Several communities in the Upper Branch (Northville Township, Plymouth Township, and Novi) are estimated to contain approximately 1,707 septic systems in total (ARC, 2012). As such, potentially failing septic systems as well as failing sewage infrastructure and illicit connections should be investigated for their potential contribution to elevated *E. coli* concentrations in the Upper Branch.

Figure 14. Upper Rouge Subwatershed: Relationship between *E. coli* and TSS for all weather conditions

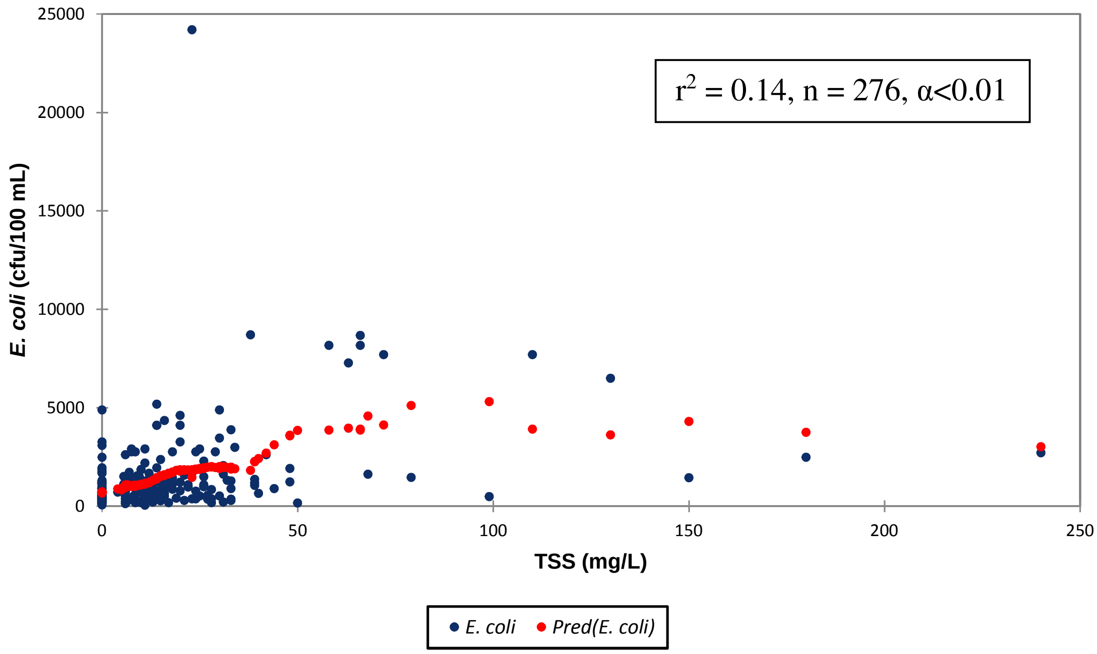
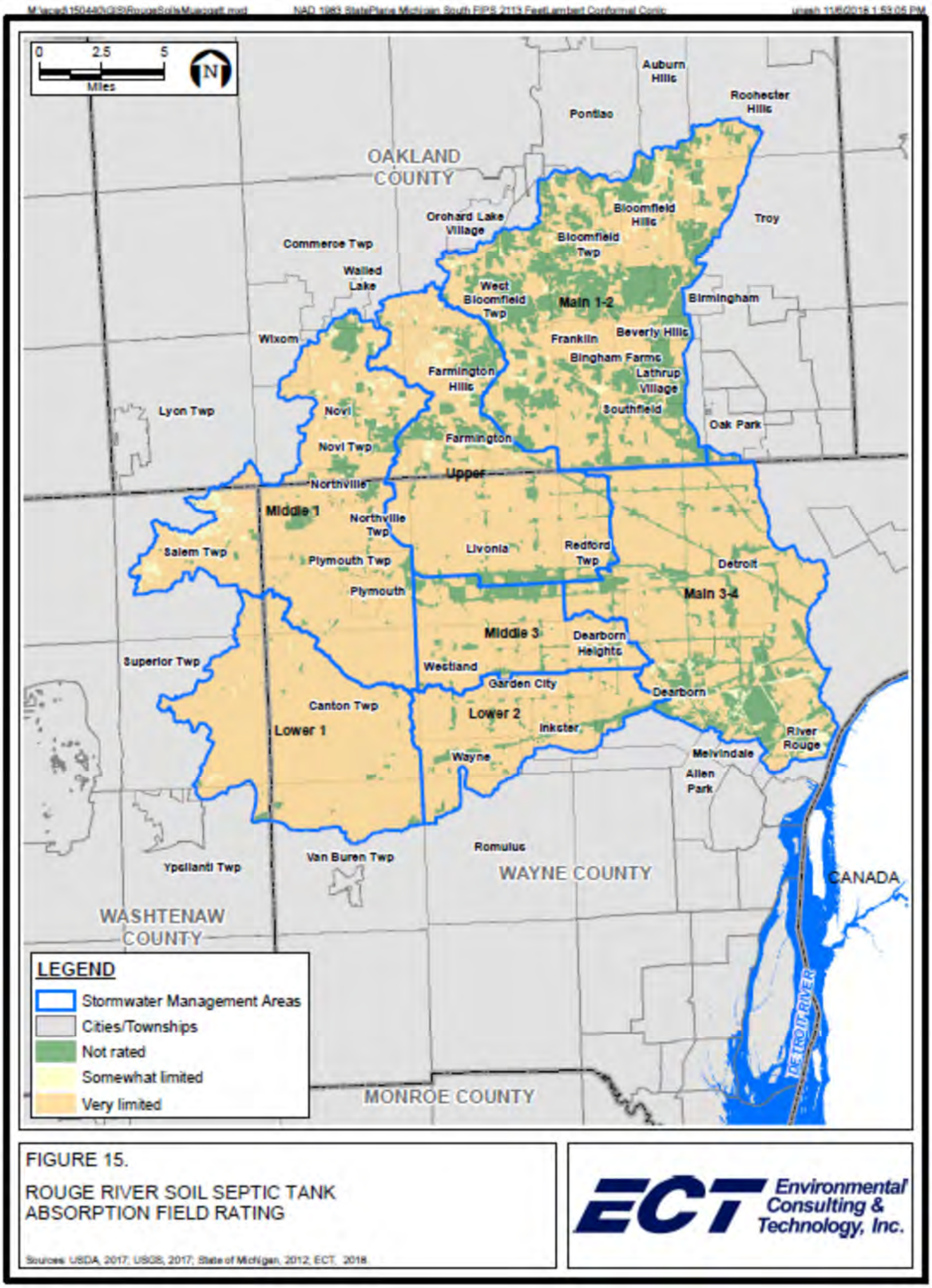


Figure 15. Rouge River Soil Septic Tank Absorption Field Rating



3.1.3 *E. coli* Load Duration Curves

LDCs were reviewed to compare, where possible, changes in *E. coli* concentrations from 2005 to 2017 as a function of flow regime as well as to characterize new 2017 sampling sites in terms of *E. coli* concentration, flow regime, and the WQS of 300 cfu/100 ml. A qualitative review of comparison LDCs shows that changes, if any, were mostly small, though several exceptions exist including improvements and degradations. For new 2017 sites, several site groupings were identified where *E. coli* concentrations were particularly higher or lower than the WQS. Also, several individual sites in which flow condition seemed to dictate *E. coli* concentrations were identified, suggesting specific sources. Individual LDCs are provided in Appendix C, while results are summarized qualitatively in the tables below. The tables are updated versions of those included in the 2007 TMDL, and qualitative descriptions of trends prior to 2005 were included where applicable.

3.1.3.1 *E. coli* LDCs Lower

Table 12 summarizes Lower Branch LDCs for sites in which historic comparisons could be made. Several sites, including G200, L51 and L02, show variable tendencies as a function of flow. Site G200 (Lower Branch at Denton Road), which exhibited little change from 2005 to 2017, had results that were notably higher during wet weather than dry. Site L51 (McKinstry Drain at Michigan Ave), which had results in 2005 scattered uniformly around the standard, showed a noticeable improvement during mid-range and dry conditions with concentrations at or below the standard. Site L02 (Fellows Creek at Palmer Road) exhibited the opposite pattern, where uniformly elevated concentrations in 2005 appear to have transitioned to improvements during wet weather but increases during dry weather, sometimes beyond the already high concentrations in 2005. Lastly, results from site L05D (Lower Branch at S. Military Street) were notably high in both 2005 and 2017, though 2017 results were more consistently elevated. At this site, most of the 2017 concentrations were what represented the very upper range of the 2005 concentrations. These consistently high results were likely caused by the illicit discharges corrected in September 2017 and lower baseflow due to the flow diversion at the YCUA outfall previously discussed in Section 3.1.1.1.

Table 13. Lower Branch Load Duration Curve Comparisons

Lower Branch					
Field ID	**From**	**To**	**WET WEATHER (High-flow and Moist Conditions)**	**Mid-Range Flow**	**DRY WEATHER (Dry and Low-flow conditions)**
Denton Road (G200)	2005	2017	No change, results still at or slightly above daily target		No change, results still scattered around daily target
Beck Road (L01)	2005	2017	No change, results still scattered around or above daily target		
Fowler Creek at Beck Road (G93)	2005	2017	No change, central tendency still slightly above daily target		
Sines Drain at Sheldon Road (G94)	2005	2017	Little change, more results below daily target, central tendency still slightly above daily target		
McKinstry Drain at Michigan Ave (L51)	2005	2017	No change	Improvement, with results now below daily target	Improvement, central tendency at or below daily target
Haggerty Road (G92)	2005	2017	No change	Possible improvement, too few samples to be conclusive	Possible improvement in low flow conditions, no change otherwise
Fellows Creek at Palmer Road (L02)	2005	2017	Improvement, all results below daily target compared to all above in 2005	No change	No change, results still above daily target
McClaughrey Drain at Annapolis (G64)	2005	2017	No change	Possible improvement, too few samples to be conclusive	No change
Wayne Road (L06)	1994-1996	1997-1999	Little change in wet and mid-range conditions, results exceed daily target		Too few samples to compare, results exceed daily target
	1997-1999	2000-2004	Data not available		
	2000-2004	2005	Little change in wet and mid-range conditions, results exceed daily target		Too few samples to compare, results exceed daily target.
	2005	2017	No change, central tendency still slightly above daily target		Possible improvement in low flow conditions
S. Military Street (L05D)	1994-1996	1997-1999	Slight improvement in wet and mid-range conditions, results exceed daily target		Too few samples to compare
	1997-1999	2000-2004	Continuing improvement in wet conditions, results approaching daily target	Slight worsening in mid-range conditions, results exceed daily target	Too few samples to compare
	2000-2004	2005	Worsening in wet conditions, results exceed daily target	Little change in mid-range conditions, results exceed daily target	Too few samples to compare
	2005	2017	No change, results still much greater than daily target		Slight worsening, with most 2017 results at or above 2005 results

Green highlight = improvement in concentrations from 2005 to 2017, concentrations below or near WQS.
Red highlight = worsening (increased) concentrations from 2005 to 2017.
No highlight = no change (regardless of concentrations above or below WQS or too few samples to compare.

For the remaining new Lower Branch sites for which LDCs could be computed, results indicated fairly uniform elevation above the WQS, with some sites higher than others. Sites LW03, LW13, LW14 and US1 all resulted in particularly high *E. coli* concentrations with no apparent dependence on flow. Central tendencies of LW08, LW12 and US9 were all higher than the standard but not by as much, also with no apparent dependence on flow.

3.1.3.2 *E. coli* LDCs Main

Table 13 summarizes Main Branch LDCs for sites in which historic comparisons could be made. In general, changes from 2005 to 2017 were minimal, with most results still near or slightly above the WQS. In terms of improvements, changes were greatest at site M03 (Main Branch at Lahser Road), where improvements were seen mostly in wet and dry flow conditions, with 2017 central tendencies either at or slightly below the standard. Sites M01 and US5, on the other hand, showed *E. coli* concentrations consistently greater than the WQS under dry conditions, with these changes representing a slight worsening condition at US5 compared to 2005 results.

Table 14. Main Branch Load Duration Curve Comparisons

Main Branch					
Field ID	**From**	**To**	**WET WEATHER (High-flow and Moist Conditions)**	**Mid-Range Flow**	**DRY WEATHER (Dry and Low-flow conditions)**
Adams Road (M01)	2005	2017	Possible slight improvement in moist conditions, not enough samples to make conclusions for high flow conditions		No change
Lahser Road (M03)	1994-1996	1997-1999	Too few samples collected from 1994-1996 to compare to 1997-1999		
	1997-1999	2000-2004	Some improvement from 1997-1999 to 2005 in all weather where most results are near the daily target		
	2000-2004	2005			
	2005	2017	Slight improvement in all but high flow conditions, most results are below the daily target		
Franklin Branch at Franklin Road (G461)	2005	2017	Slight improvement in moist conditions, most results at or below daily target		No change, most results at or below daily target
Franklin Branch at 13 Mile Road (H60)	2005	2017	Slight improvement in moist conditions, most results at or below daily target		No change, most results at or below daily target
Franklin Branch at 12 Mile Road (G46)	2005	2017	No change		
Beech Road (US5)	1997-1999		No *E. coli* data were collected		
	1994-1996	2000-2004	Little change in wet and mid-range conditions where most results do not exceed the daily target		Significant improvement in dry conditions, most results are near the daily target
	2000-2004	2005	Slight worsening in wet condition, results exceed daily target	Little change in mid-range and dry conditions, where most results remain near daily target	
	2005	2017	No change, central tendency still slightly above daily target		
7 Mile Road at Bonnie Brook (M15)	2005	2017	No change, central tendency still slightly above daily target		
Fenkell Road (G43)	2005	2017	Possible slight improvement though difference is small, central tendency sill at or slightly above daily target		
Plymouth Road (US7)	1994-1996	1997-1999	Too few samples collected from 1994-1996 to compare to 1997-1999		
	1997-1999	2000-2004	Some improvement in wet and mid-range conditions, results are near the daily target		Little change in dry conditions, where most results approaching daily target
	2000-2004	2005	Little change in all weather conditions, results approaching daily target		
	2005	2017	Slight improvement in moist conditions, results near target	No change	Slight improvement in dry conditions, results near target
Ann Arbor Trail (G42)	2005	2017	Slight improvement in moist conditions, results approaching target	No change, results near target but still above	

Green highlight = improvement in concentrations from 2005 to 2017, concentrations below or near WQS.
Red highlight = worsening (increased) concentrations from 2005 to 2017.
No highlight = no change (regardless of concentrations above or below WQS or too few samples to compare.

Of the Main Branch sites that were newly monitored in 2017, two groupings seemed to appear, one of conditions generally meeting the WQS and one where the WQS was not met. Sites MN31, MN32, MN33 and MN35, all located in the upper reaches of the Main Branch, showed results that were consistently lower than the WQS across all flow conditions. Conversely, the central tendencies for concentrations at sites MN08, MN09, MN10 and MN13, which were generally located in Southfield, were all greater than WQS, also across all flow conditions.

3.1.3.3 *E. coli* LDCs Middle

Table 14 summarizes Middle Branch LDCs for sites in which historic comparisons could be made. For all four sites, no clear changes were apparent. Notably however, sites D62 (Tonquish Creek at Joy Road) and D06 (Middle Branch at Hines Dr/Ford Road) showed concentrations across all flow conditions that were consistently higher than the WQS in 2005 and 2017.

Conversely, site D03 (Middle Branch at 7 Mile Road/Hines Drive) showed concentrations that were mostly below the WQS, especially during mid-range and dry conditions. Although exceedances occurred here during wet weather, average concentrations appeared to hover near or just above the WQS.

Table 15. Middle Branch Load Duration Curve Comparisons

Middle Branch					
Field ID	**From**	**To**	**WET WEATHER (High-flow and Moist Conditions)**	**Mid-Range Flow**	**DRY WEATHER (Dry and Low-flow conditions)**
Tonquish Creek at Joy Road (D62)	2005	2017	No change, results above target in all conditions		
Inkster Road (US2)	2005	2017	Little change, more results at or below the target though similar central tendencies in all conditions		
Hines/Ford Road (D06)	1994-1996	1997-1999	Too few samples collected from 1994-1996 to compare to 1997-1999		
	1997-1999	2000-2004	Improvement in wet and mid-range conditions, results near daily target		Not much change in dry conditions, results near daily target
	2000-2004	2005	Might be slight worsening in wet condition, results exceed daily target.	Little change in mid-range and dry conditions, results approaching daily target.	
	2005	2017	No change, most results above daily target		
7 Mile/Sheldon (D03)	2005	2017	Little to no change, more results at or below the target though similar central tendencies in all conditions		

Green highlight = improvement in concentrations from 2005 to 2017, concentrations below or near WQS.
Red highlight = worsening (increased) concentrations from 2005 to 2017.
No highlight = no change (regardless of concentrations above or below WQS or too few samples to compare.

Of the Middle Branch sites that were newly monitored in 2017, several results stood out. First, in terms of flow-dependent results, concentrations at sites MD07 and MD19 were different from wet to dry conditions, though in opposite directions. Site MD07 (Middle Branch at Wayne Road), while having most results near or below the WQS, had average concentrations during dry conditions very near the standard, while concentrations during moist conditions were either far below the standard or just above. Conversely, concentrations at site MD19 (Bishop Creek At 12 Mile Road), though generally at or below the standard, were especially low during dry conditions with the greatest exceedances occurring during high flow conditions. Lastly, concentrations at sites MD09 (Middle Branch at Plymouth Road) and US10 (Middle Branch at Hines Drive/Haggerty Road) were consistently at or below the standard, while those at MD06 (S. Branch Tonquish Creek at Ann Arbor Road) and MD16 (Walled Lake Branch at 10 Mile Road) were above, especially so at site MD06.

3.1.3.4 *E. coli* LDCs Upper

No LDCs were created for Upper Branch sites due to the discontinuing (prior to 2017) of all long-term USGS flow stations in this watershed consistent with previously developed LDCs. In order to create an LDC, historical data is required to establish the statistical background that describes the long-term behavior of flow during wet and dry conditions. Without this data there is no basis to evaluate current data to an established location for a specific sample date to current wet and dry conditions. There is also a significant difference between the contributing areas of the two stations in question, making their flow characteristics incomparable. Since no historical data exist with the new station established downstream of the discontinued station utilized in the 2005 TMDL, LDCs could not be created for the Upper Branch.

3.2 DO and TSS Analysis

3.2.1 DO and TSS TMDL Evaluation

To evaluate DO concentrations to the targets established in the TMDL and compare to WQSs, graphical representations of the daily maximum values were created and statistics for DO monitoring data were compiled.

To evaluate TSS data for meeting the TMDL target established in the Biota TMDL, the distribution and spread of TSS concentrations within each subwatershed was plotted (Appendix B). Mean TSS concentrations during wet weather conditions for 2017 are compared to 2006 concentrations used in the TMDL (Table 15). To assist with determining target locations for TSS loads across the watershed, mean TSS concentrations during wet weather conditions for 2017 for all site locations are included in Table 16.

Table 16. Mean TSS concentrations in the Rouge Watershed during wet weather conditions in 1994-2001 and 2017

		Lower Branch		Main Branch		Middle Branch		Upper Branch	
Parameter	**Units**	1994-2001 Wet Weather Mean[1]	2017 Wet Weather Mean	1994-2001 Wet Weather Mean[1]	2017 Wet Weather Mean	1994-2001 Wet Weather Mean[1]	2017 Wet Weather Mean	1994-2001 Wet Weather Mean[1]	2017 Wet Weather Mean
Total suspended solids	mg/L	191	50	114	96	95	34	152	26

[1]MDEQ 2007c

Table 17. Mean TSS concentrations (mg/L) at monitoring stations in the Rouge River Watershed during wet weather conditions in 2017

Lower Branch	
Station	Mean Wet TSS
G92	34
L02	44
LW09	N/A
LW12	125
LW13	35
LW14	21
G200	39
G93	57
G94	49
L01	84
L51	32
G64	32
G97	65
L05D	49
L06	52
LW03	25
LW07	N/A
LW08	55
US1	60
US9	45

Main Branch			
Station	Mean Wet TSS	Station	Mean Wet TSS
G46	310[2]	M01	56[1]
G461	12[1]	MN28	23[1]
G59A	400[2]	MN29	98[1]
H60	160[1]	MN30	N/A
M03	115[2]	MN31	12[1]
MN08	112[2]	MN32	10[1]
MN09	235[2]	MN33	34[1]
MN10	140[2]	MN35	20[1]
MN12	61[1]	MN36	N/A
MN13	28[1]	G43	53
MN14	80[2]	M15	59
MN15	125[2]	G42	101[2]
MN16	86[1]	M12	46[2]
MN17	395[2]	MN01	21[2]
MN18	140[1]	US7	87[2]
MN23	30[1]	US8	56[2]
MN24	10[1]		
MN25	N/A		
MN27	43[2]		
US5	108[2]		

Middle Branch	
Station	Mean Wet TSS
D06	96
MD03	94
MD04	72
MD07	11
US2	46
D03	26
D62	67
MD06	25
MD09	5
MD11	20
MD12	25
MD13	14
MD14	20
MD15	35
MD16	27
MD17	7
MD18	21
MD19	22
US10	9

Upper Branch	
Station	Mean Wet TSS
UP08	3
UP15	17
UP16	5
US3	16
G19	N/A
G71	16[2]
G72	24[2]
U02	15[2]
U03	9[2]
U04	9[2]
U05	128[2]
U15	5[2]
U17	7[2]
UP04	90[2]
UP05	20[2]

[1]n = 1
[2]n = 2

Across the watershed, TSS concentrations during wet weather conditions have decreased dramatically. Within the entire Rouge Watershed, TSS concentrations have decreased by approximately 62% from mean concentrations of 138 mg/l in 2006 to 52 mg/L in 2017. When concentrations within each subwatershed are compared, it appears that concentrations in the Main Branch are the highest within the watershed (96 mg/L). The Upper, Lower and Middle subwatersheds are within the “good to moderate” range (25 to 80 mg/L); however, the Main Branch is in the “less than moderate” range (80 to 400 mg/L). This indicates that three of the subwatersheds are meeting the 80 mg/L goal established in the Biota TMDL. On an individual site basis, approximately 75% of the wet weather means met the “good to moderate” goal of 80 mg/L.

3.2.1.1 DO and TSS Lower Branch

Compared to other Rouge River subwatersheds, the mean DO concentration was lowest in the Lower Branch in 2017 with a mean concentration of 6.2 mg/L and 22% of the values below the WQS (Figure A1-30). This is far worse that previous years (2003 to 2016) where attainment for the WQS ranged from 92 to 100% (Table 17). This may be due to the known illicit discharges that were addressed during late 2017 which likely resulted in increased BOD in waters within the region, thereby decreasing DO concentrations.

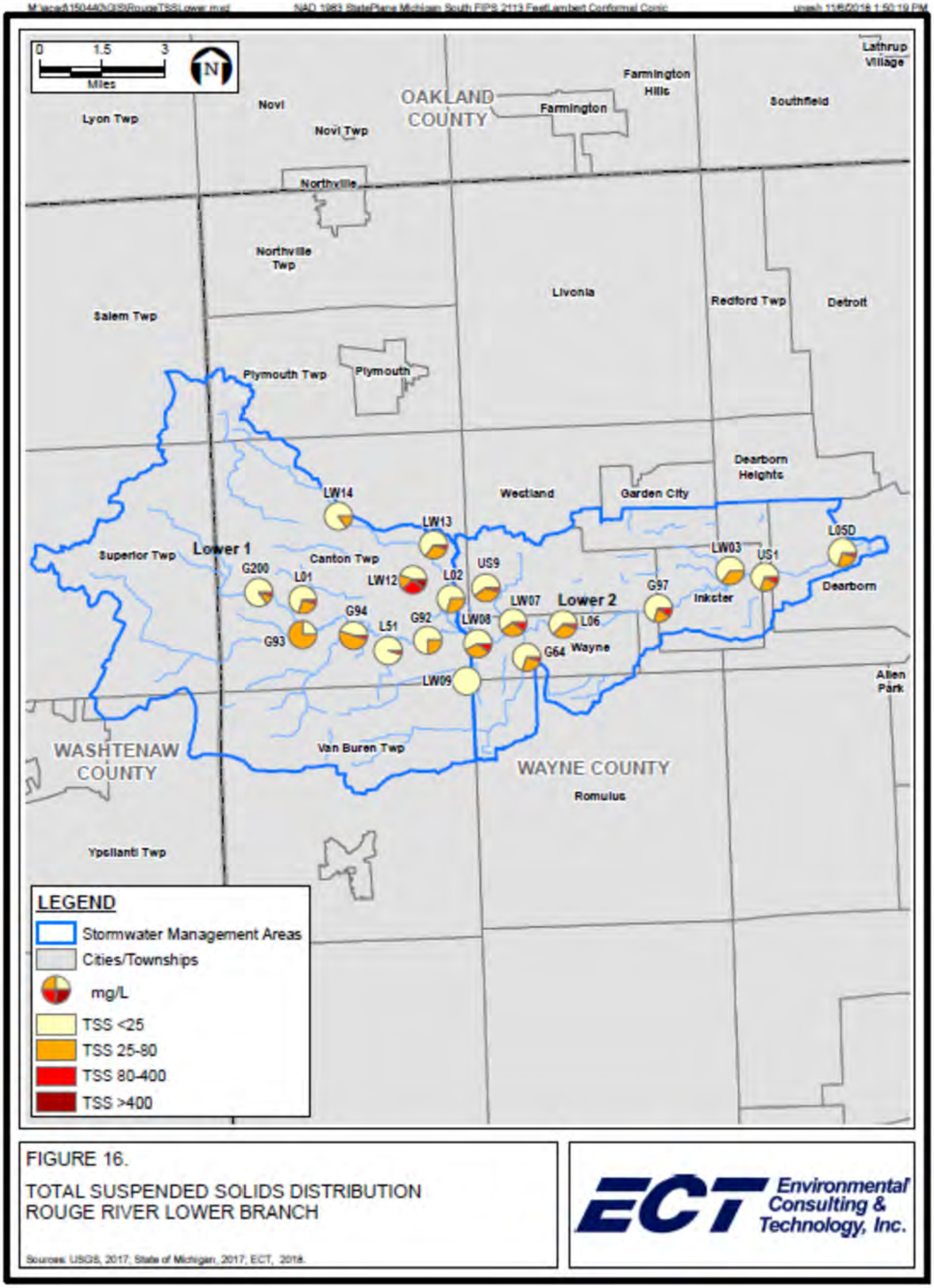
Table 18. Summary of DO Data from the Lower Branch

Year	Number of observations (n)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Percent > 5 mg/L
L05D/4168400 Lower Rouge at S. Military St. in Dearborn					
1994	13,246	0.0	15.7	3.7	29
1995	10,387	0.0	11.5	5.5	66
1996	10,083	0.0	29.7	4.0	31
1997	16,085	0.0	14.3	5.9	57
1998	13,125	0.6	10.9	5.8	67
1999	17,371	1.9	10.5	5.9	75
2000	14,010	2.3	9.1	6.7	97
2001	16,909	1.1	10.5	6.2	65
2002	17,622	1.7	14.9	6.6	85
2003	17,196	2.1	10.8	7.0	97
2004	17,073	0.4	12.7	7.3	99
2005	17,139	0.5	15.8	6.7	92
2006	17,548	3.9	12.7	7.3	100
2013	17,647	2.1	11.8	7.1	98
2015	23,281	1.6	12.7	7.3	98
2016	26,062	1.5	16.3	8.5	93
2017	17,653	1.2	11.2	6.2	78

While other subwatersheds exhibit similar seasonal variation, there is a subsequent drop in DO concentrations during September 2017 that is unique to the Lower Branch. It is reasonable to assume that the observed drop in DO concentrations in early September were the result of the illicit discharges and the lower baseflow resulting from the flow diversion at YCUA described previously.

Mean wet and dry weather TSS concentrations in the Lower Branch (all sites) were 50 and 26 mg/L, respectively, in 2017. Wet weather values fell approximately 74% when compared to data collected between 1994 and 2001 as reported in the Biota TMDL. Across the stations sampled within the Lower Branch in 2017, individual TSS concentrations consistently fell within the “good to less than moderate” range (25 - 400 mg/L) (Figure 16, Figure A2-5). All sites had mean

Figure 16. Total Suspended Solids Distribution Rouge River Lower Branch



wet weather concentrations below 80 mg/L with the exception of station LW12, Truesdell Drain in Canton Township, and station L01, tributary of the Lower Branch at Beck Road in Canton Township. (Table 16). At these sites, the mean wet weather concentrations were above the criteria at 125 mg/L and 84 mg/L, respectively.

Statistical testing for temporal trends in TSS concentrations using the available period of record (POR) of 2015 through 2017 cannot confirm a trend in the data. As such, analysis of the monitoring data does not suggest a decrease or increase in TSS concentrations over the POR analyzed. The mean TSS value for all weather conditions during 2017 (31.5 mg/L) falls within the range of the historical mean values for TSS at L05D from 1994 to 2007 (Catalfio et al., 2007). Mean wet weather TSS for 2017 (50 mg/L) is much lower than that reported for a wet weather event in 2007 at L05D (104 mg/L) (Catalfio et al., 2007).

3.2.1.2 DO and TSS Main Branch

The mean DO concentrations during 2017 in the Main Branch were 8.0 mg/L and 9.2 mg/L in Southfield and Detroit, respectively. The mean value in Detroit was the best in the watershed. No values were below the WQS in Southfield and only approximately 2% of the values were below the WQS in Detroit (Table 18). These values are consistent with what was seen in the past 10 years.

Table 19. Summary of DO Data from the Main Branch

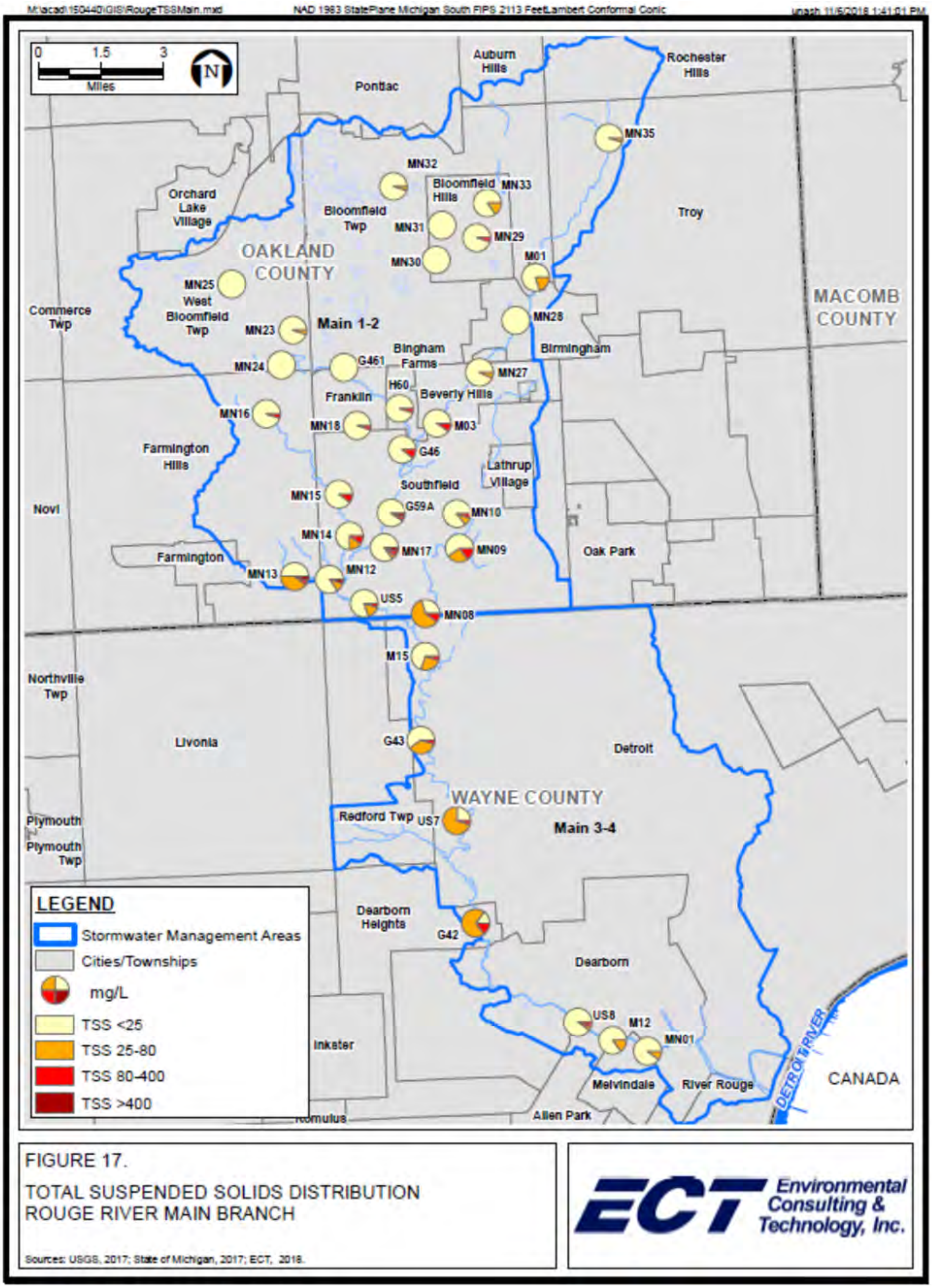
Year	Number of observations (n)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Percent > 5 mg/L
US7/04166500 Main Rouge at Plymouth Rd. in Detroit					
1994	15,222	0.0	10.5	5.7	63
1995	10,544	0.4	14.9	5.9	77
1996	12,718	0.0	12.9	5.9	64
1997	16,362	0.0	11.3	5.5	60
1998	15,291	0.7	14.7	5.4	60
1999	13,404	1.3	9.2	5.8	77
2000	14,191	1.6	9.5	6.6	96
2001	14,602	2.3	11.0	6.9	84
2002	17,533	0.7	11.4	6.2	73
2003	16,969	0.7	11.2	7.2	95
2004	17,616	1.4	11.3	7.1	99

Year	Number of observations (n)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Percent > 5 mg/L
US7/04166500 Main Rouge at Plymouth Rd. in Detroit					
2005	17,390	0.1	13.8	6.5	80
2007	17,685	0.5	11.1	6.8	94
2011	26,272	0.9	13.5	8.3	96
2012	34,763	2.8	15.7	9.1	94
2013	17,185	2.3	11.8	7.2	97
2014	34,855	2.2	16.3	9.6	99
2015	34,865	1.2	16.4	9.2	99
2016	34,422	0.2	15.1	9.2	93
2017	34,336	1.0	16.1	9.2	98
US5/04166100 Main Rouge at Beech Rd. in Southfield					
1997	14,269	2.7	12.4	6.8	96
1998	14,527	3.1	11.5	8.0	100
1999	11,847	4.9	11.4	7.7	100
2000	9,834	5.6	11.0	7.9	100
2001	16,093	4.9	11.5	8.4	100
2002	17,664	4.5	13.2	8.5	100
2003	16,056	5.3	11.9	8.5	100
2004	17,253	5.9	13.4	8.5	100
2005	17,254	4.5	15.0	8.3	100
2017	17,043	4.5	11.5	8.0	100

DO concentrations fell in 2017 primarily during the month of June, with occasional rebounds from July through August (Figures A1-31 and A1-32). Statistical testing for temporal trends in DO concentrations cannot confirm a trend in the data. This indicates that concentrations have been relatively steady at both sites since 2007. However, there have been marked improvements in the portion of values meeting the WQS at US8 when looking at data collected between 2001 and 2005.

Mean wet and dry weather TSS concentrations in the Main Branch (all sites) were 96 and 13.0 mg/L, respectively, in 2017. Wet weather concentrations fell approximately 16% when compared to data collected between 1994 and 2001 as reported in the Biota TMDL. TSS concentrations from 2017 sampling in the Main Branch exhibit the greatest spread as compared to other subwatersheds (Figure A2-6). Four stations had one sample above 400 mg/L (Figure 17). Nonetheless, 55% of the sites had mean wet weather concentrations below 80 mg/L (Table 16).

Figure 17. Total Suspended Solids Distribution Rouge River Main Branch



However, it should be noted that many of the sites only had 1 or 2 wet weather values which limits data interpretation.

An adequate POR with raw data for statistical testing for temporal trends in TSS concentrations was not available for the Main Branch. However, the mean TSS value for all weather conditions during 2017 (21.1 mg/L) falls within the range of historical mean values for TSS at US7 and US5 from 1994 to 2007 (Catalfio et al., 2007). Mean wet weather TSS for 2017 (96 mg/L) is higher than that reported for wet weather events in 2007 at US7 (80.2 mg/L) and at US5 (64.2 mg/L) (Catalfio et al., 2007). This is likely due to several stations in the region that exhibit mean wet weather TSS concentrations of greater than 300 mg/L (G46, G59, and MN17).

3.2.1.3 DO and TSS Middle Branch

The mean DO concentrations in the Middle Branch were 7.2 mg/L and 8.9 mg/L in Dearborn Heights and Northville, respectively (Figures A1-33 and A1-34). No values were below the WQS on Johnson Creek and only 3% of the values were below the WQS at the confluence of the Middle Branch with the Main Branch (Table 19).

Table 20. Summary of DO Data from the Middle Branch

Year	Number of observations (n)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Percent > 5 mg/L
D06/04167150 Middle Branch at Ford Road in Dearborn Heights					
1994	9,112	0.5	11.1	7.5	88
1995	12,058	0.3	10.7	7.2	96
1996	12,149	0.2	11.5	7.1	97
1997	15,148	0.0	12.3	6.5	75
1998	12,037	0.3	10.5	6.8	90
1999	16,228	2.5	11.6	6.7	91
2000	17,662	1.1	10.6	7.1	98
2001	16,361	2.2	10.3	7.0	94
2002	15,842	3.3	12.2	7.9	99
2003	17,242	2.8	11.5	7.5	97
2004	17,518	1.8	11.4	7.6	99
2005	17,725	2.3	13.8	7.5	96
2008	16761	3.40	13.0	7.6	99
2011	17252	3.2	11.6	7.3	98
2015	24825	1.2	14.4	8.3	99

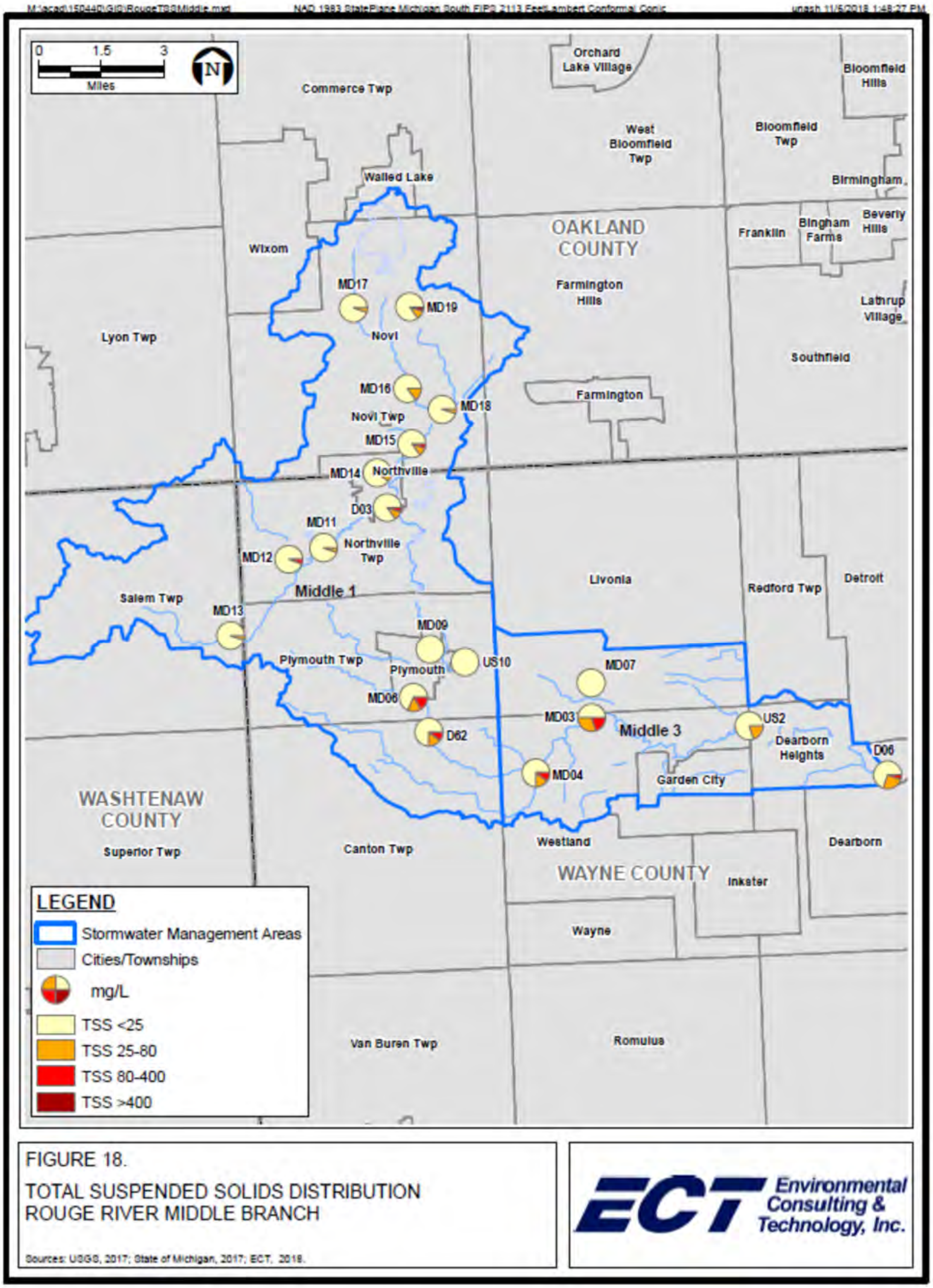
Year	Number of observations (n)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Percent > 5 mg/L
D06/04167150 Middle Branch at Ford Road in Dearborn Heights					
2016	26260	3.5	15.0	9.1	98
2017	17656	2.9	10.3	7.2	97
D03/04166700 Johnson Creek at 7 Mile Road/Hines Drive in Northville					
Year	Number of observations (n)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Percent > 7 mg/L
2017	17637	6.20	12.0	8.9	100

At both sites, DO concentrations fell in 2017 from June through early October. In Johnson Creek, DO concentrations fell for a maximum of two days before rebounding, and dropped to a minimum of approximately 6 mg/L. Statistical testing for temporal trends in DO concentrations cannot confirm a trend in the data at D06. This indicates that concentrations have stayed relatively steady at this station since 2011.

Mean wet and dry weather TSS concentrations in the Middle Branch (all sites) were 34 and 15 mg/L, respectively, in 2017. Wet weather concentrations fell approximately 64% when compared to data collected between 1994 and 2001 as reported in the Biota TMDL. TSS concentrations across the stations sampled within the Middle Branch in 2017 exhibit considerable spread (Figure A2-7). One station had TSS concentrations above 400 mg/L (Figure 18). Nonetheless, the mean wet weather TSS concentrations at all but two of the stations fell below 80 mg/L and several sites were at or below 20 mg/L (Table 16). The sites that exceeded the criteria were D06 – Middle Branch confluence with the Main Branch and MD03 – Tonquish Creek confluence with the Middle Branch.

Based on analysis of the available monitoring data for the POR from 2015 through 2017, concentrations of TSS in this subwatershed have decreased significantly over this time ($p = 0.036$), with a decrease in monthly concentrations during the period of May through September of approximately 8.6 mg/L per month. The mean TSS value for all weather conditions during 2017 (18 mg/L) fell at the low end of the range of historical mean values for TSS at D06 from 1994 to 2007 (Catalfio et al., 2007). Mean wet weather TSS for 2017 (34 mg/L) is much lower than that reported for wet weather events in 2007 at D06 (66.4 mg/L) (Catalfio et al., 2007).

Figure 18. Total Suspended Solids Distribution Rouge River Middle Branch



3.2.1.4 DO and TSS Upper Branch

The mean DO concentrations in the Upper Branch were 7.5 mg/L (Table 20). Compared to other Rouge River subwatersheds, mean DO concentrations are somewhat lower in the Upper Branch. Nonetheless, only 0.5% of the observations were less than the WQS. Mean DO concentrations appear to be fairly consistent since 2003. However, these values are 0.5 to 1.6 mg/L higher than the means reported between 1994 and 2002 (Catalfio, 2007).

Table 21. Summary of DO Data from the Upper Branch

Year	Number of observations (n)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Percent > 5 mg/L
U05/04166470 Upper Branch at Telegraph Road in Detroit					
1994	15,355	2.9	12.7	6.9	94
1995	10,072	0.0	10.7	6.7	91
1996	13,220	1.9	12.9	5.9	72
1997	13,650	1.2	12.2	6.8	79
1998	12,510	1.6	10.5	6.5	90
1999	15,189	1.2	11.5	5.9	71
2000	12,548	0.5	11.2	6.5	93
2001	17,301	0.1	12.4	6.9	87
2002	15,519	1.3	13.0	7.0	84
2003	14,636	3.8	13.0	7.7	96
2004	15,854	1.1	13.3	7.7	100
2005	15,385	0.3	15.2	7.3	91
2008	14,953	3.80	14.0	8.0	99
2010	17,402	4.3	10.5	7.5	99
2017	17,655	3.2	11.8	7.5	99

DO concentrations fell during the month of June, with occasional rebounds in August (Figures A1-35). Statistical testing for temporal trends in minimum DO concentrations cannot confirm a trend in the data. This indicates that concentrations have stayed relatively steady since 2010. However, there has been marked improvements in the portion of values meeting the WQS at D06 when looking at data collected between 1994 and 2002.

Mean wet and dry weather TSS concentrations in the Upper Branch (all sites) were 26 and 20, respectively, in 2017. Wet weather concentrations fell approximately 83% when compared to data collected between 1994 and 2001 as reported in the Biota TMDL. Across the stations sampled within the Upper Branch in 2017, TSS concentrations were consistently within the 80-400 mg/L range outside of station U05 (Figure 19, Figure A2-8). Wet weather mean TSS concentrations at all but two of the stations fell below 80 mg/L with many below 20 mg/L (Table 16). The stations that exceeded the criteria were U05 – Upper Branch confluence with the Main Branch and UP04 – Bell Branch at Beech Daly Rd. in Redford Township.,

An adequate POR with raw data for statistical testing for temporal trends in TSS concentrations was not available for the Upper Branch. However, the mean TSS value for all weather conditions during 2017 (15 mg/L) falls within the lower range of historical mean values for TSS at other monitoring locations in the Upper Branch from 1994 to 2007 (Catalfio et al., 2007). Mean wet weather TSS for 2017 (26 mg/L) is much lower than that reported for wet weather events in 2007 at U05 (111.4 mg/L) (Catalfio et al., 2007).

3.2.2 DO and TSS Regression Analysis

Nonparametric regression was used to evaluate association between DO and flow using USGS data from continuous monitoring gages for varying periods of record (Table 21). Additionally, nonparametric regression was used to evaluate association between DO and TSS using 2017 data from USGS gages co-located with TSS sample locations well as TSS and flow by subwatershed using 2017 data sample locations under all weather conditions.

Table 22. Summary of DO and TSS regression analysis results

Analysis	Significant Trend			
	Lower Branch (L05D)	Main Branch	Middle Branch	Upper Branch
DO and flow	Yes, weak positive	US7: Yes, weak positive US5: No	D03: Yes positive US2: No	U05: No
TSS and flow all weather	No	US7: Yes, positive	US2: No	US3: No
TSS and DO	No	US 7: No	US2: No	U05: No

3.2.2.1 <u>DO and TSS Regressions Lower Branch</u>

In the Lower Branch subwatershed, DO appears to have a weak positive relationship with flow based on measurements obtained from that station at S. Military Street (L05D) (Figure 20). This suggests that DO is not naturally controlled by hydrologic conditions but may be driven by the biochemical oxygen demand (BOD) of these waters. Similarly, data collected from 2017 do not

Figure 19. Total Suspended Solids Distribution Rouge River Upper Branch

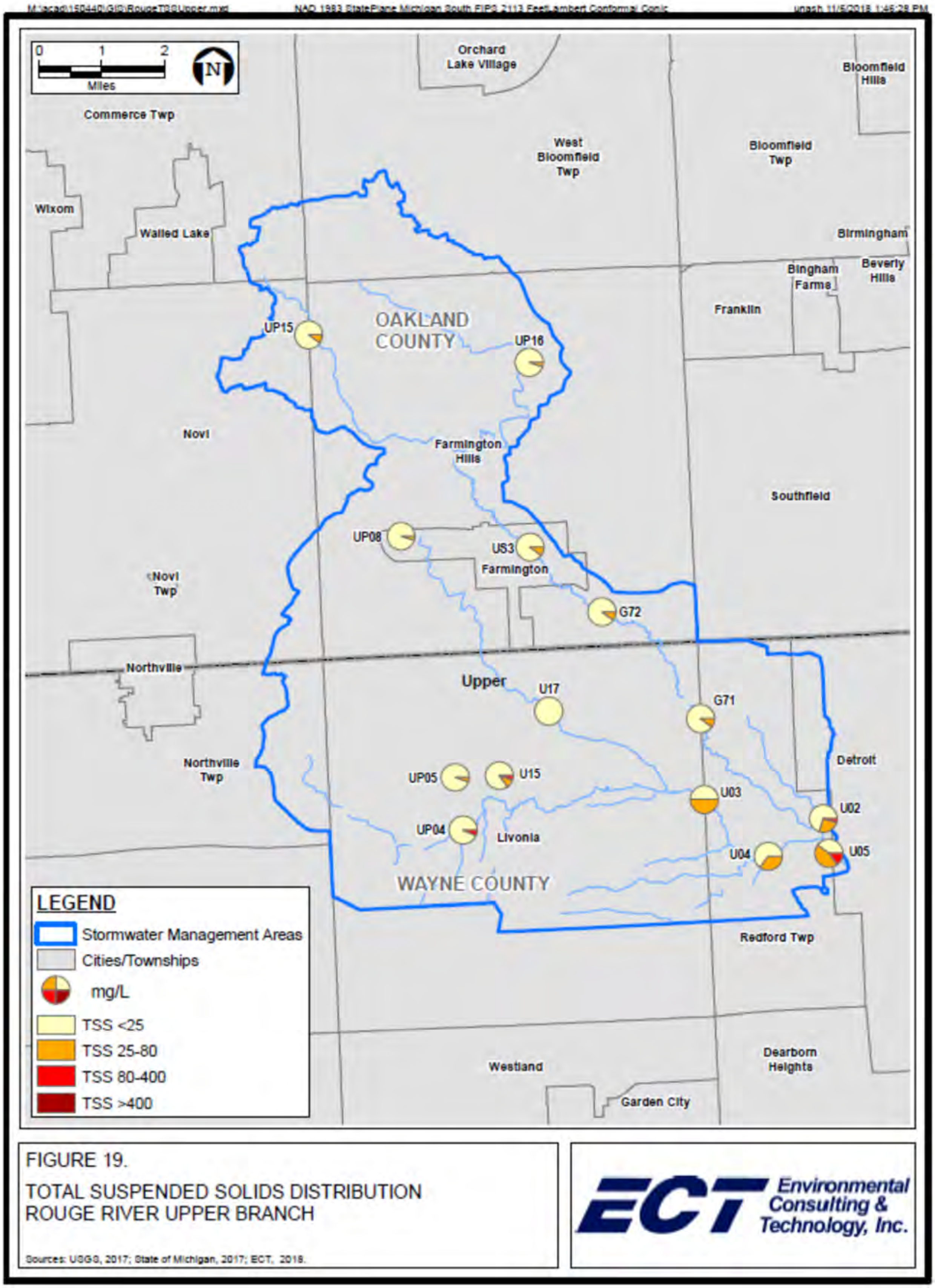
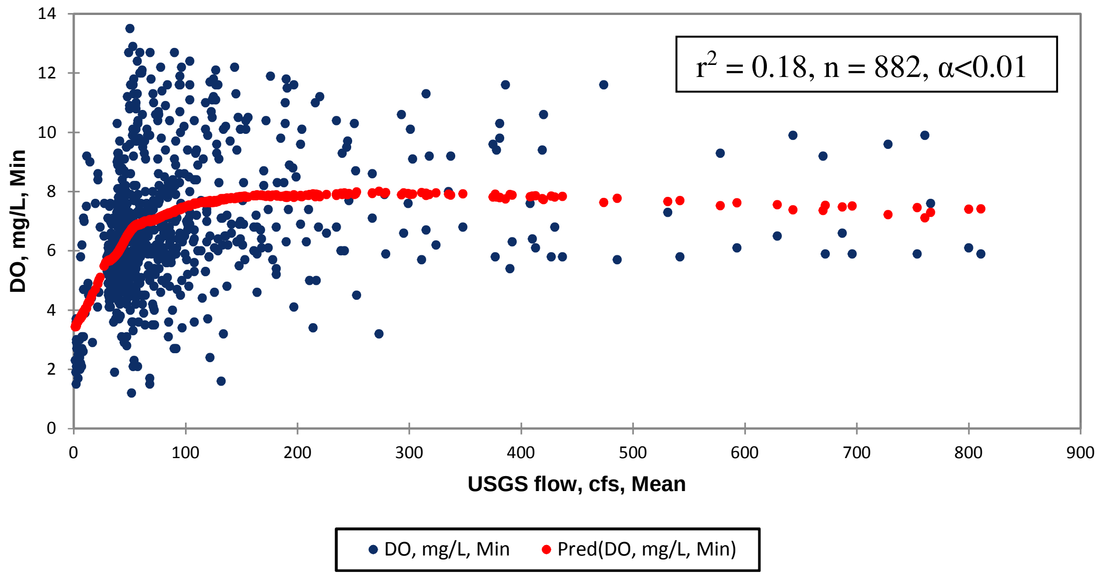


exhibit a statistically significant relationship between TSS and flow during all weather conditions. In addition, the lack of a significant relationship between TSS and DO indicates that TSS does not drive DO. It is possible that BOD and organic matter content of the waters in the Lower Branch subwatershed control DO concentrations, but that these parameters are not related to or captured in TSS concentrations.

Figure 20. Lower Branch (L05D/04168400): Relationship between DO and Flow



3.2.2.2 DO and TSS Regressions Main Branch

In the Main Branch subwatershed, DO appears to have a weak positive relationship with flow based on measurements obtained from the station at Plymouth Road in Detroit (US7) (Figure 21). This suggests that DO is not naturally controlled by hydrologic conditions but may be driven by the BOD of these waters. Measurements obtained from the station at Beech Rd. in Southfield (US5) do not demonstrate any significant trend.

TSS concentrations and flow at US7 exhibit a stronger positive relationship, during all weather conditions (Figure 22). As discussed in Section 3.1.2.2, *E. coli* in the Main Branch has a significant positive relationship with flow, with TSS and *E. coli* exhibiting a strong positive relationship, as well. As such, the significant positive relationship between TSS and flow further suggests that TSS, *E. coli*, and flow are positively related, especially during wet weather events.

The lack of a significant relationship between TSS and DO indicate that TSS concentrations do not drive DO concentrations. Similar to the Lower Branch subwatershed, it is possible that BOD and organic matter content of the waters in the Main Branch subwatershed control DO concentrations, but that these parameters are not related to or captured in TSS concentrations.

Figure 21. Main Branch (US7/04166500): Relationship between DO and Flow

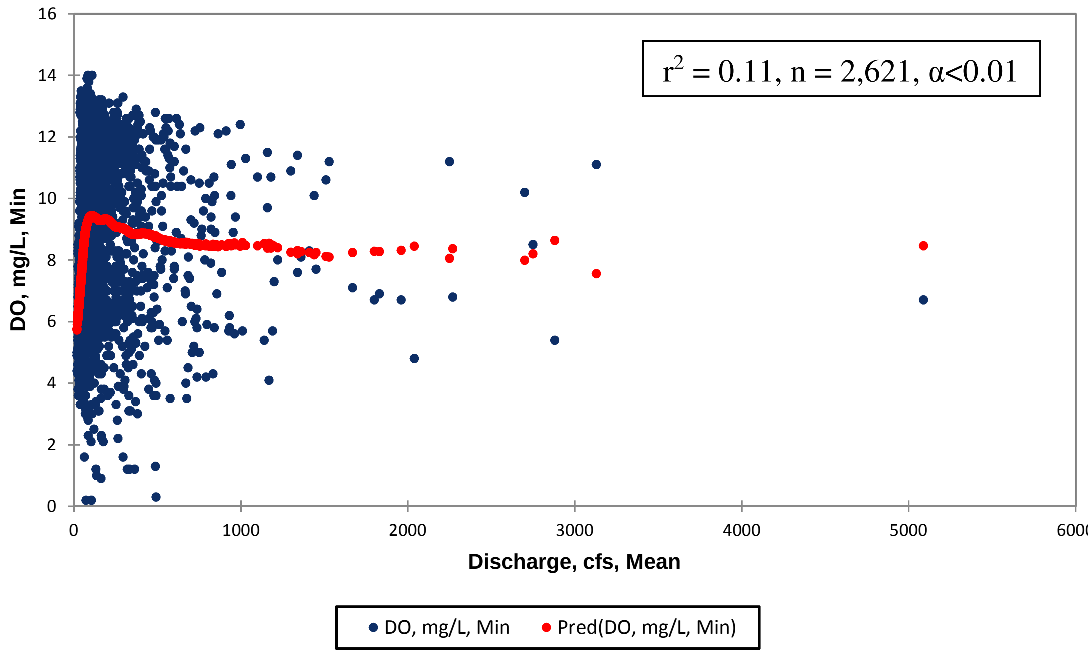
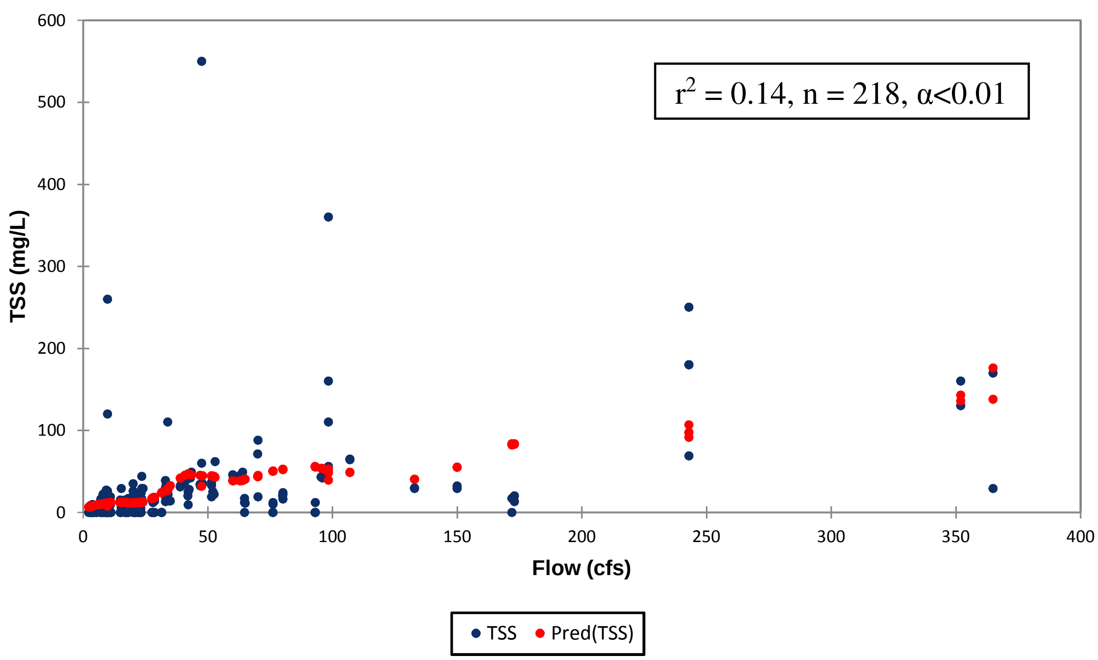


Figure 22. Main Branch (US7/04166500): Relationship between TSS and Flow during all weather conditions

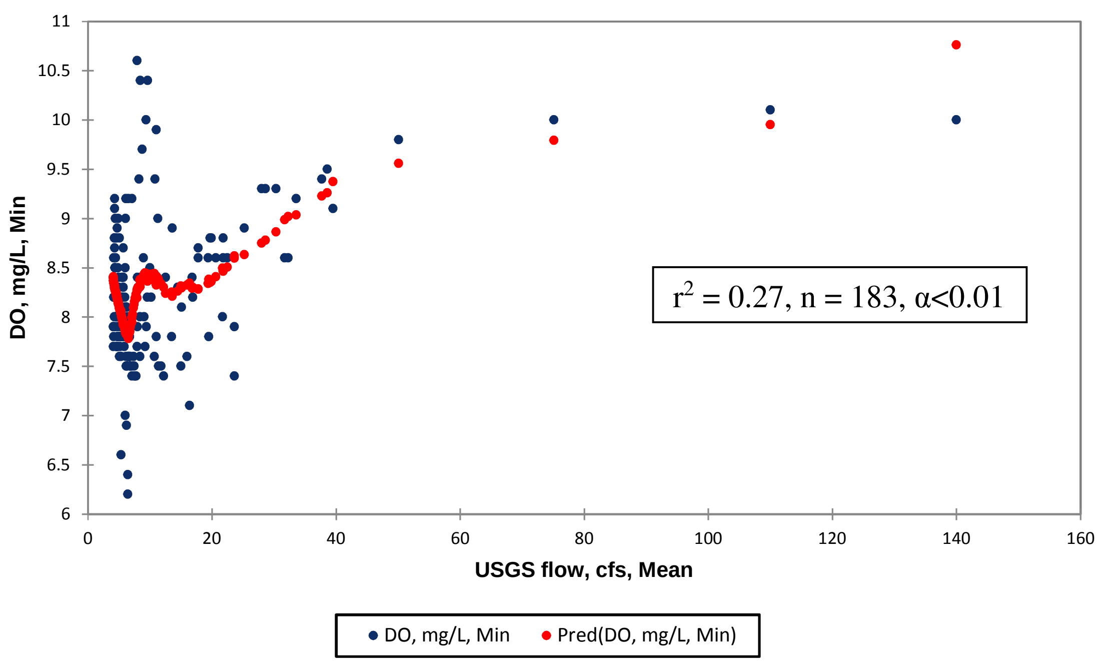


3.2.2.3 DO and TSS Regressions Middle Branch

While there are two DO monitoring stations in the Middle Rouge subwatershed, only data from the station on Johnson Creek (D03) exhibits a positive relationship with flow (Figure 23). This suggests that in the Johnson Creek portion of the subwatershed, DO is naturally controlled in part by hydrologic conditions. This finding suggests that the hydrology and geomorphology of Johnson Creek are supporting DO concentrations and variation that is found in healthy, natural systems.

For the greater Middle Rouge subwatershed (US2), there is not a statistically significant relationship between TSS concentrations and flow during all weather conditions. This further suggests that the Middle Branch exhibits a more natural hydrologic regime, with peak runoffs contributing minimally to TSS concentrations. This finding is also supported by the lack of a significant relationship between TSS and DO.

Figure 23. Johnson Creek (D03/04166700): Relationship between DO and Flow



3.2.2.4 Upper Branch

In the Upper Rouge subwatershed, DO does not exhibit a statistically significant relationship with flow based on measurements obtained from U05, Telegraph Rd. & River Circle for data collected during 2010. In addition, TSS and DO data from U05 do not demonstrate a significant relationship. Continuous flow monitoring at this location was discontinued after 2010. As such, TSS and flow data from US3 (USGS gage 04166300) were evaluated.

TSS concentrations and flow at US3 do not exhibit a significant relationship under all weather conditions. This lack of a significant relationship between TSS and DO indicate that TSS concentrations do not drive DO concentrations. Similar to other subwatersheds, it is possible that BOD and organic matter content of the waters in the Upper Rouge subwatershed control DO concentrations, but that these parameters are not related to or captured in TSS concentrations.

3.3 Macroinvertebrates

The result of the Fall and Spring macroinvertebrate monitoring indicate a Fair water quality rating for each SWMA except Johnson Creek which received a Good rating. Long-term trends (2001-2017) were assessed for each SWMA and improving trends were found in Johnson Creek and the Middle 3 SWMA (Spring and Fall) and Middle 1 (Spring only). However, negative trends were found for the Main 1-2 and Upper SWMAs (Fall only).

The Winter sampling events found stoneflies at 33%, 17%, 26% and 58% of sample sites in 2014, 2015, 2016 and 2017, respectively.

Additional information on the macroinvertebrate conditions, including individual site scores and trends, can be found in the individual event reports contained in Appendix F.

4.0 Discussion

Overall WQS outcomes in the Rouge River Watershed as of 2017 are provided in Table 22. The evaluations provided are based on attainment of WQS within each subwatershed, as well as temporal patterns in concentrations. This section discusses potential controls, points of interest for further study, and management actions related to these WQS outcomes.

Table 23. Summary of 2017 WQS outcomes in the Rouge River Watershed

Subwatershed	*E. coli*	DO	TSS
Lower Branch	Poor	Poor	Good
Main Branch	Moderate	Good	Moderate to Good
Middle Branch	Moderate	Good	Good
Upper Branch	Poor to moderate	Good	Good

4.1 Lower Branch

In general, little improvement was observed in attaining TMDL numeric criteria for *E. coli* for the stations sampled in the 2017 monitoring when compared to the concentrations reported in the 2007 TMDL in the Lower Branch. Statistical analysis indicates that *E. coli* concentrations in this subwatershed have not decreased significantly over time, and the monitoring data observations pinpoint the locations that contribute to this lack of trend (e.g. L05D, G64). Overall, the Lower Branch exhibited some of the lowest compliance for *E. coli* numeric criteria in the watershed, in addition to the Upper Branch.

Based on analysis of the 2017 monitoring data, concentrations of *E. coli* in the Lower Branch do not have a significant relationship with flow. Marked increases in *E. coli* concentrations are observed where the Lower Branch meets the Main Branch in the City of Dearborn (L05D). This is likely due to the illicit discharges previously discussed, but CSOs could also be contributing to this issue. The similar temporal pattern of *E. coli* peak concentrations seen at L05D and upstream stations (LW03, US1, G97, L06, G64) suggest that wet weather events results in increased *E. coli* concentrations throughout the region.

The western portion of the Lower Branch also regularly exhibits elevated *E. coli* concentrations; however, the cause here is less clear. There are no CSOs and limited septic systems located in this area (ARC, 2012). It is possible that the *E. coli* concentrations may be associated with human waste from underperforming or failing septic systems, illicit connections or nonpoint sources including agricultural activities which occur upstream to the west. Certain locations in this area, such as L51 (McKinstry Drain in Canton Township), exhibit a decrease in *E. coli* concentrations from 2005 that suggest sources have been removed. Other locations, such as LW13 (Fellows Creek in Canton Township) and LW14 (North Branch Fellows Creek in Canton Township), have improved with lower *E. coli* concentrations during wet weather, but increases during dry weather conditions. It is possible that illicit connections or aging sanitary sewer infrastructure may be contributing to elevated *E. coli* concentrations in this area.

The Lower Branch has exhibited a marked decrease in TSS concentrations when compared to concentrations in the Biota TMDL. This has resulted in TSS concentrations that are within the acceptable range for biota throughout most of the subwatershed.

Mean minimum DO concentrations are the lowest in the Lower Branch compared to other Rouge River subwatersheds. Statistical analysis did not suggest a temporal trend in DO or TSS concentrations over the POR, which suggests that concentrations of both parameters have remained static in the subwatershed. Issues with the sanitary sewer system in this region (blockages, etc.) and illicit connections are likely contributing to increased nutrients which result in increased BOD and decreased DO in these waters. Additionally, agricultural activities in the western Lower Branch may be contributing to increased nutrient loads. If improvements in DO concentrations are sought in the Lower Branch, a reduction in nutrient sources is expected to play a critical role. However, it should be noted that the decrease in DO concentrations during 2017 is likely associated with illicit discharges that have since been addressed.

Flows do not appear to be related to TSS concentrations in the Lower Branch. This suggests that increased runoff during storm events is not likely to be the primary contributor to TSS concentrations in the subwatershed, as is commonly assumed. While TSS concentrations are favorable throughout most of the subwatershed, DO concentrations are still outside of the desired range almost 20% of the time during 2017. Since TSS does not control DO concentrations in this subwatershed, it is possible that BOD and organic matter content of the waters in the Lower Branch subwatershed control DO concentrations, but that these parameters are not related to or captured in TSS concentrations.

Nutrient concentrations are typically better indicators of biogeochemical cycles that contribute to DO concentrations, as opposed to organic matter/carbon concentrations that are captured to some extent in TSS concentrations. If DO concentrations continue to be below the WQS once *E. coli* sources are addressed, then nutrient monitoring may prove beneficial.

4.2 Main Branch

Based on the results in the 2007 TMDL, the Main Branch historically exhibited some of the highest *E. coli* concentrations. While some overall improvement has been observed in reducing *E. coli* concentrations in this subwatershed, concentrations in this area still commonly exceed the WQS. This is evidenced in the results of statistical analysis, which indicates a decrease in *E. coli* over the past 5 years. While this decrease has not yet reached the ultimate goal of numeric criteria compliance, it does show progress has been made in reaching this goal.

It appears that concentrations of *E. coli* increase as water moves from north to south, from low intensity residential development to medium and high intensity residential development. In the Main Branch, an increase in residential density is commonly associated with an increase in septic tank density in areas outside the highly urbanized City of Detroit. While the upper Main Branch exhibits much improved compliance with the numeric criteria, portions of the lower Main Branch continue to exhibit high *E. coli* concentrations. Based on the significant positive relationships between *E. coli* and flow as well as *E. coli* and TSS, it is reasonable to infer that failing sewage infrastructure, septic systems, and illicit connections may be contributing to high *E. coli* concentrations in this region. In the upper Main Branch, where there are fewer septic systems, lower intensity of development and newer sanitary sewer infrastructure as compared to other parts of the subwatershed, *E. coli* concentrations are comparatively low (e.g. MN29, MN31, and MN33 in Bloomfield Hills; and MN35 in Troy). Focusing on illicit connection identification, sanitary sewer maintenance/rehabilitation and septic system improvements (e.g. G461 in Bloomfield Township; MN08, MN09, MN10, MN12, MN14, MN15, MN17, G46, G59A, and MN13 and US5 in Southfield; MN16 in Farmington Hills; and MN18 in Franklin) could improve water quality by reducing *E. coli* concentrations.

The decrease in *E. coli* concentrations in the lower Main Branch in the City of Detroit (G42, M12, MN01, US7, and US8) when compared to 2007 TMDL concentrations are likely associated with decreased CSO discharge volumes (Appendix E). However, concentrations in this area are still often above the numeric criteria.

The Main Branch has exhibited a decrease in TSS concentrations when compared to the Biota TMDL; however, this decrease is not as dramatic as that observed in other subwatersheds. Nonetheless, this decrease has resulted in mean TSS concentrations that are very near the acceptable range for biota throughout the subwatershed.

Compared to other subwatersheds, mean minimum DO concentrations are highest in the Main Branch. In fact, the Main Branch reaches target DO concentrations for almost the entire POR. Statistical analysis did not suggest a temporal trend in DO or TSS concentrations over the POR, which suggests that concentrations of both parameters have remained static in the subwatershed. The lack of a significant relationship between TSS and DO indicate that TSS concentrations do not drive DO concentrations. Since the Main Branch exhibits good water quality with regards to DO concentrations, nutrient concentrations in this subwatershed may be compared with others to determine causative relationships and implement improvements in other subwatersheds with low DO. Furthermore, the weak positive relationship between DO and flow suggests that at least portions of the Main Branch exhibit natural geomorphological conditions that support DO concentrations.

Flows and TSS concentrations have a positive relationship in the Main Branch during all weather conditions. This finding, coupled with the significant positive relationship between TSS and *E. coli* under all conditions, again suggests that *E. coli*, TSS, and flows are intrinsically linked. Spatially, TSS concentrations increase where *E. coli* concentrations increase in the Main Branch.

4.3 Middle Branch

The Middle Branch demonstrates some improvement in attaining WQS for *E. coli* when compared to the concentrations reported in the 2007 TMDL. While watershed-wide compliance was approximately 40%, several stations that were not compliant exhibited lower *E. coli* concentrations when compared to 2007 values. However, statistical analysis indicates that *E. coli* concentrations in this subwatershed have not decreased significantly over time. This lack of trend can be attributed to several stations within the watershed that have not exhibited a significant decrease in *E. coli* concentrations, such as D62, D06, MD16, MD17, MD18, and MD19.

Due to the variable waste management systems in the Middle Branch, potential sources of *E. coli* vary widely by specific location within the subwatershed. As such, the variety of sources contributing to elevated *E. coli* concentrations in the Middle Branch likely contributes to the difficulty in establishing significant relationships between parameters. In areas in the Middle Rouge Parkway (e.g. MD09 and US10, upstream of Newburgh Lake), *E. coli* concentrations are uniformly low. This is likely due to the distance from highly developed areas. Other regions with older infrastructure, such as the City of Plymouth (e.g. MD06 and D62) have much higher *E. coli* values. This is likely due to illicit connections (which are currently being investigated by the City, Wayne County and the ARC) and aging sanitary sewer infrastructure.

Areas that are known to contain a larger number of septic systems, such as the City of Novi (e.g. MD16, MD17, and MD18), may contribute to uniformly elevated *E. coli* concentrations in the Middle Branch through poorly sited or maintained systems that are not functioning optimally. These locations listed above have not shown much improvement in water quality since the 2007 TMDL.

Other potential sources of *E. coli* in the Middle Branch include CSO discharges and agriculture. At D06, peak *E. coli* concentrations align with CSO occurrences within the vicinity (Appendix E). Concentrations of *E. coli* at this location have remained consistently high when compared to the TMDL. To address this source of contamination, CSOs in the vicinity should be separated/improved by treatment facilities. At MD19, *E. coli* concentrations increase during wet weather conditions. However, peaks at this location do not align with those from other stations in the vicinity (MD16 and MD18). It is likely that a source unique to this area (e.g. nonpoint sources such as birds, wildlife) contribute to elevated concentrations.

Statistical analysis suggest that minimum DO concentrations have remained static in the Middle Branch; however, they are the highest in the watershed compared to other Rouge River subwatersheds. This is evident because they were above the WQS 100% and 98% of time at Johnson Creek and the outlet of the subwatershed (D06), respectively. As such, efforts to protect DO concentrations in the Middle Branch have proven to be effective. Gage data from Johnson Creek indicate a positive relationship between DO concentrations and flow, suggesting that DO in this portion of the watershed is naturally controlled in part by hydrologic conditions. This finding suggests that the hydrology and geomorphology of Johnson Creek and the greater Middle Branch are supporting DO concentrations and variation that is found in healthy, natural systems.

The Middle Branch has exhibited a marked decrease in TSS concentrations, as seen in other regions of the watershed. This has resulted in mean TSS concentrations that are within the acceptable range for biota throughout the subwatershed. This decrease in TSS as well as a lack of significant relationship with flow and TSS as well as TSS and DO suggests that a more natural hydrologic regime has been obtained in this subwatershed.

4.4 Upper Branch

In general, some improvement was observed in attaining WQS for *E. coli* for the stations in the Upper Branch when compared to the 2007 TMDL. Statistical analysis indicates that *E. coli* concentrations in this subwatershed have decreased significantly over time; however, they rarely meet the WQS with the exception of station UP15 (Seeley Drain at Haggerty Rd.). Overall, the Upper Branch along with the Lower Branch exhibited the lowest attainment for *E. coli* numeric criteria in the watershed.

In the lower portion of the Upper Branch, several stations exhibit the same temporal patterns in peak *E. coli* concentrations (U02, U03, U04, and U05), consistent with CSO discharges or similar discharges to waters. However, records for CSOs in Redford/Livonia do not indicate that discharges took place within the 2017 sampling period (Appendix E). As such, illicit discharges and/or operation of CSOs in the vicinity should be further investigated.

Based on the similar temporal patters of peak *E. coli* concentrations in other portions of the watershed, it appears that illicit connections and/or failing sewage infrastructure and septic systems may be a major contributor. The significant positive relationships between *E. coli* and flow as well as *E. coli* and TSS further suggest that these sources may be contributing to high *E. coli* concentrations in this region. This relationship is strongest during wet weather conditions, which could indicate that subsurface and surface flows during wet weather are contaminated with *E. coli* from these systems. The Rouge River Watershed Management Plan indicates that the most septic systems are located within the Main and Upper Rouge subwatersheds. It appears that focusing on sewage infrastructure, septic system improvement, as well as addressing illicit connections in this subwatershed may benefit water quality by reducing *E. coli* concentrations.

The Upper Branch has exhibited a marked decrease in TSS concentrations when compared to the Biota TMDL. This has resulted in mean TSS concentrations that are within the acceptable range for biota throughout the subwatershed.

Mean DO concentrations are high in the Upper Branch compared to several of the other Rouge River subwatersheds, and they consistently achieve target concentrations. Statistical analysis did not suggest a temporal trend in DO or TSS concentrations over the POR, which suggests that concentrations of both parameters have remained static in the subwatershed.

In the Upper Branch subwatershed, DO does not exhibit a statistically significant relationship with flow. The lack of a significant relationship between TSS and DO indicate that TSS concentrations do not drive DO concentrations. Therefore, it is possible that BOD and organic matter content of the waters in the Upper Rouge subwatershed control DO concentrations, but that these parameters are not related to or captured in TSS concentrations.

5.0 Recommendations

Based on the data collected in 2017, several recommendations are made for where to focus watershed restoration efforts.

Given that suspended sediment concentrations were found to be at acceptable levels, the biological impairments noted in the Biota TMDL do not appear to be caused by excessive suspended sediment in the river. Rather a lack of appropriate substrate, flashy stream flows, a lack of connectivity and poor riparian zone management may be more of a concern.

Periodic monitoring of fish and macroinvertebrate communities should continue with a focus on causative factors. It is possible that as stormwater is better managed through improved post-construction stormwater standards, flashiness will decrease, base flows will increase and stream temperatures will increase. Other actions that should improve biological communities to acceptable levels are as follows: addressing connectivity issues to allow for better fish passage, establishment of riparian management ordinances, and addressing *E. coli* pollution sources.

Except for the Lower Branch, DO conditions in the watershed were very good with all stations exceeding WQSs 98% of the time. As such, the MDEQ should be petitioned to remove portions of the Main, Middle and Upper branches from the impaired waters list (for DO impairments).

The recommendations to improve *E. coli* throughout the watershed and DO conditions in the Lower Branch focus on CSO control, illicit discharge surveys, sanitary sewer maintenance and septic system maintenance.

Based on the data presented in this report, recommendations by subwatershed are as follows:

Lower Branch

1. Address CSO discharges in the Lower 2 SWMA to reduce *E. coli* concentrations.
2. Address issues with sewer infrastructure in the Lower 2 SWMA to increase DO concentrations and reduce BOD and *E. coli*.

3. Conduct/continue sanitary sewer maintenance programs in the Lower 2 SWMA to address potential exfiltration of sewage.
4. Investigate illicit discharges or other alternative sources of *E. coli* in targeted areas (L02).
5. Implement BMPs in agricultural areas in the upstream portions of the Lower 1 SWMA to reduce runoff contaminated with *E. coli* and nutrients.
6. Reevaluate *E. coli* and DO conditions once sewage sources are better controlled.
7. Consider nutrient monitoring in waters to evaluate DO causative factors, if improvements are not seen once *E. coli* sources are addressed.

Main Branch

1. Address CSO discharges in the Main 3-4 SWMA to reduce *E. coli* concentrations.
2. Evaluate septic systems in the Main 1-2 SWMA and implement improvements and/or sewer connections where necessary to lower *E. coli* concentrations.
3. Conduct/continue sanitary sewer maintenance programs to address potential exfiltration of sewage.
4. Consider delisting this subwatershed as impaired for DO concentrations. Over the 2017 monitoring period, the WQS was exceeded 98% of the time.

Middle Branch

1. Evaluate septic systems through much of the subwatershed and implement improvements and/or sewer connections where necessary to lower *E. coli* concentrations.
2. CSOs should be separated/improved by treatment facilities to decrease *E. coli* concentrations.
3. Conduct/continue sanitary sewer maintenance programs to address potential exfiltration of sewage.
4. Investigate illicit discharges or other alternative sources of *E. coli* in targeted areas (MD06, D62, MD07).
5. Consider delisting this subwatershed as impaired for DO concentrations. Over the 2017 monitoring period, the DO WQS was exceeded approximately 98% of the time.
6. Consider storm event-focused TSS monitoring in areas where suspended was periodically elevated to determine peak flow/peak TSS relationships and evaluate engineering solutions.

Upper Branch

1. Evaluate septic systems in the northern portion of the subwatershed and implement improvements and/or sewer connections where necessary to lower *E. coli* concentrations.
2. Investigate illicit discharges and/or operation of CSOs in the vicinity to determine sources of elevated *E. coli* concentrations.
3. Conduct/continue sanitary sewer maintenance programs to address potential exfiltration of sewage.
4. Consider delisting this subwatershed as impaired for DO concentrations. Over the 2017 monitoring period, the DO WQS was exceeded 99.5% of the time.
5. Consider storm event-focused TSS monitoring in areas where suspended was periodically elevated to determine peak flow/peak TSS relationships and evaluate engineering solutions.

6.0 References

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MDEQ – Water Bureau. 2007b. Total Maximum Daily Load for Dissolved Oxygen for Johnson Creek, Washtenaw and Wayne Counties.

MDEQ – Water Bureau. 2007c. Total Maximum Daily Load for Biota for the River Rouge Watershed, including Bishop and Tonquish Creeks, Washtenaw, Wayne and Oakland Counties.

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Appendix A

Graphical Depictions of *E. coli* Results and DO Minimums

APPENDIX A: LOWER ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-1: Lower Branch, Confluence of Sines Drain and Fowler Creek upstream (US) of G92

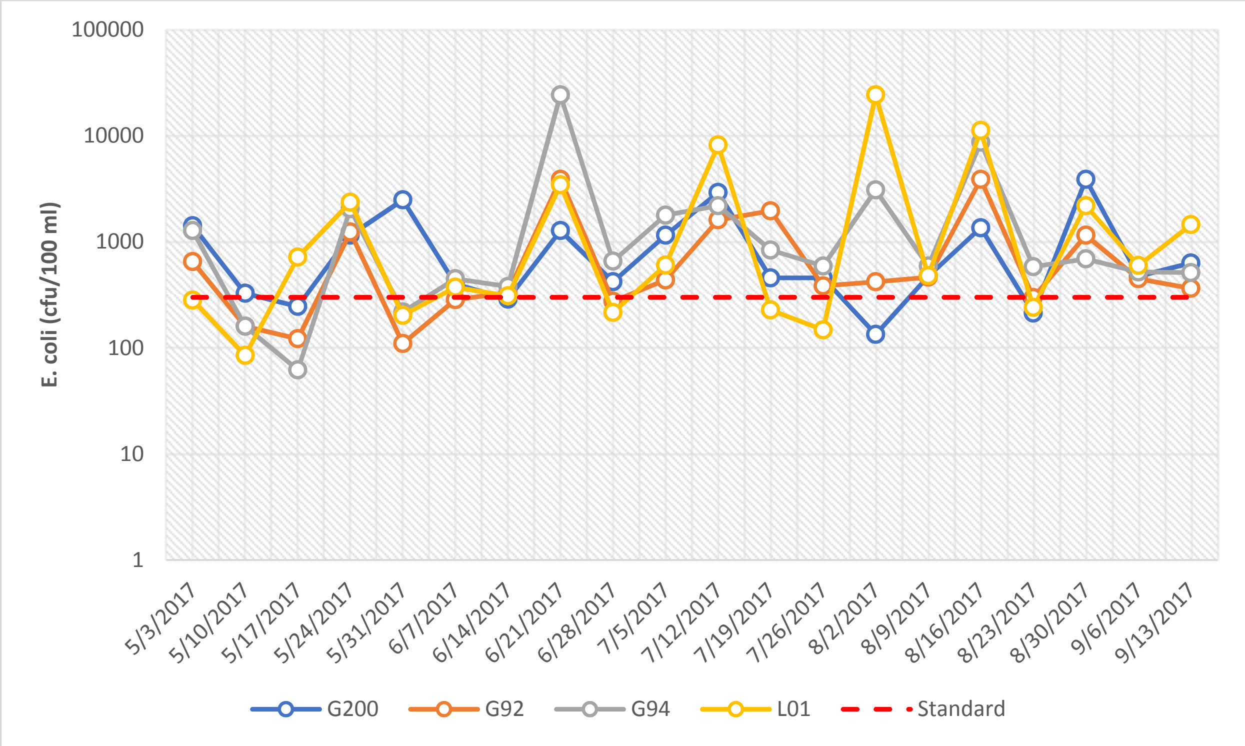
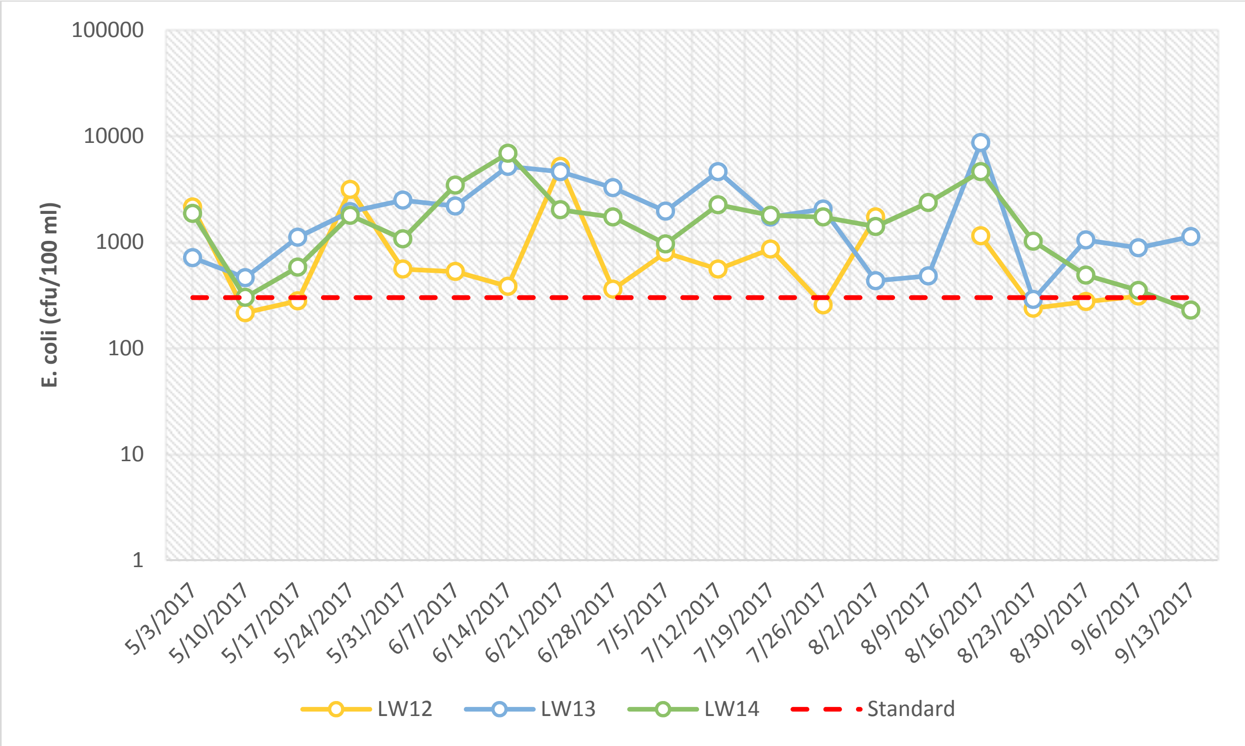


Figure A1-2: Confluence of Truesdell Drain, Fellows Creek, North Branch Fellows Creek and Lower Rouge US of L02



APPENDIX A: LOWER ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-3: Confluence of Fellows Creek (downstream (DS) of G92, US of L07), McClaughrey Drain (DS of L07, US of L06) and Lower Rouge

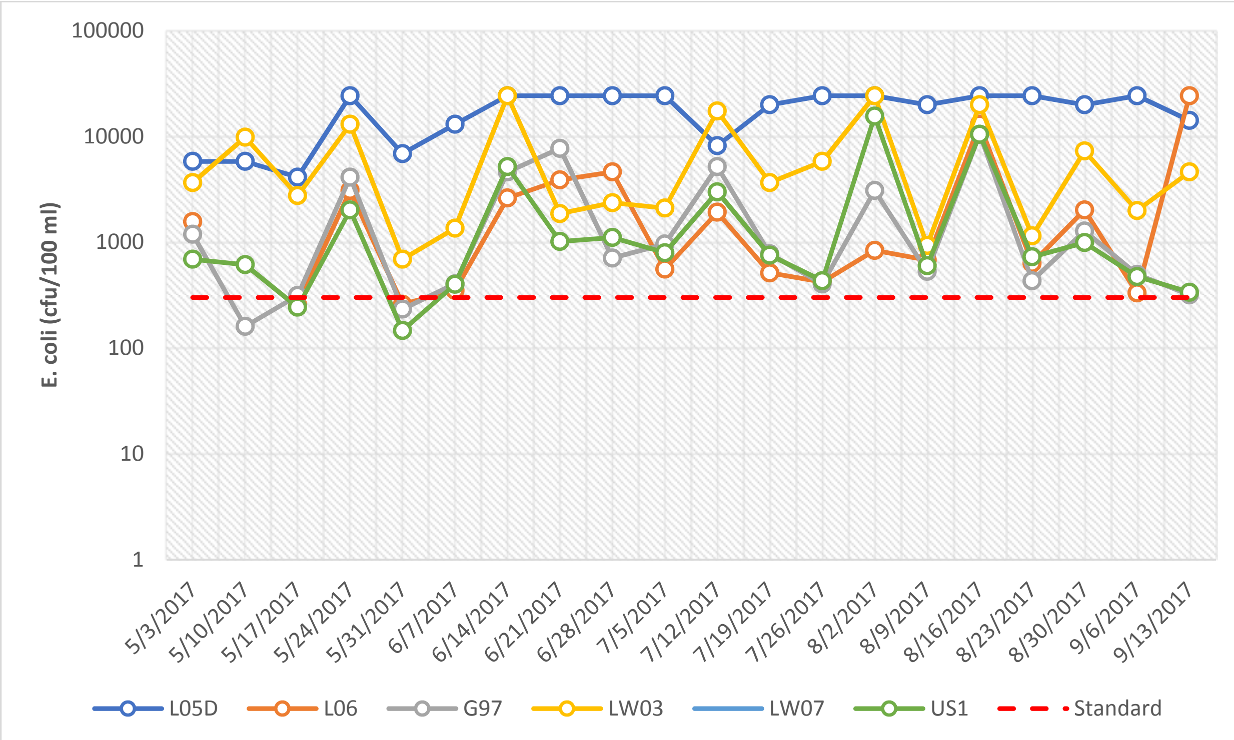
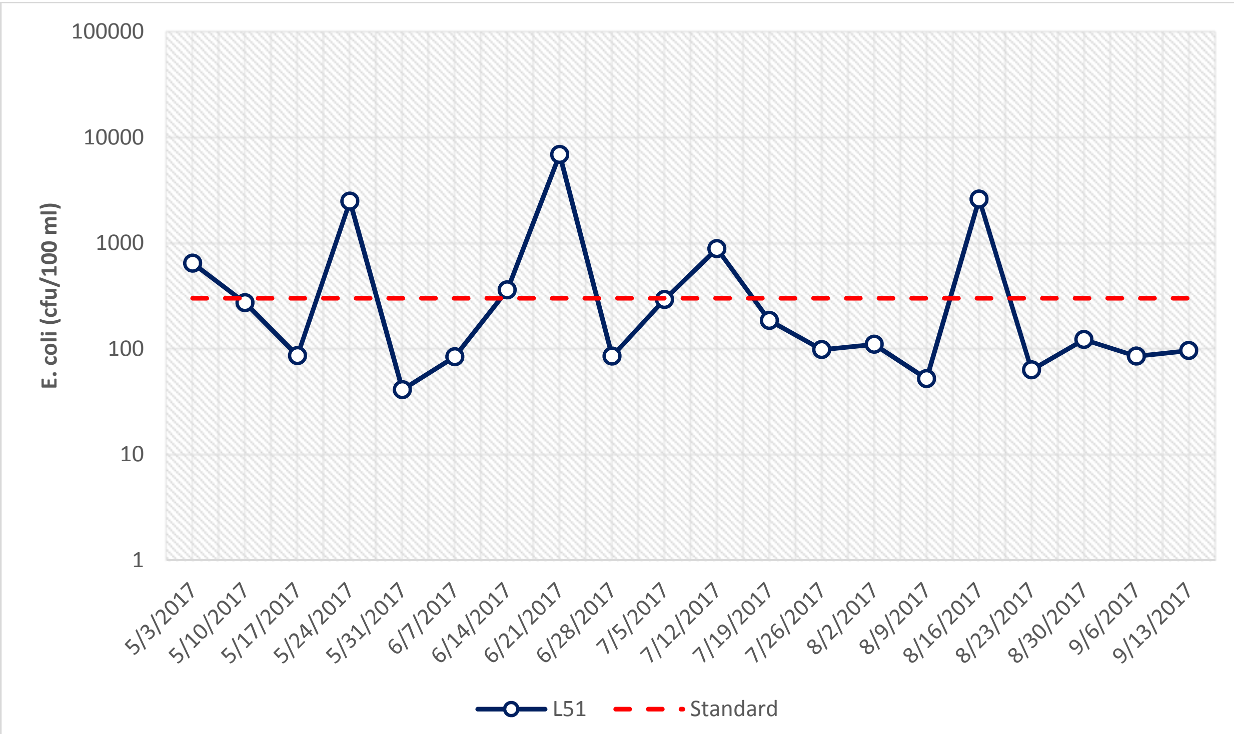


Figure A1-4: Confluence of McKinstry Drain and Lower Rouge DS of G94, US of G92



APPENDIX A: LOWER ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-5: Lower Rouge DS of G92 and L02, US of L06

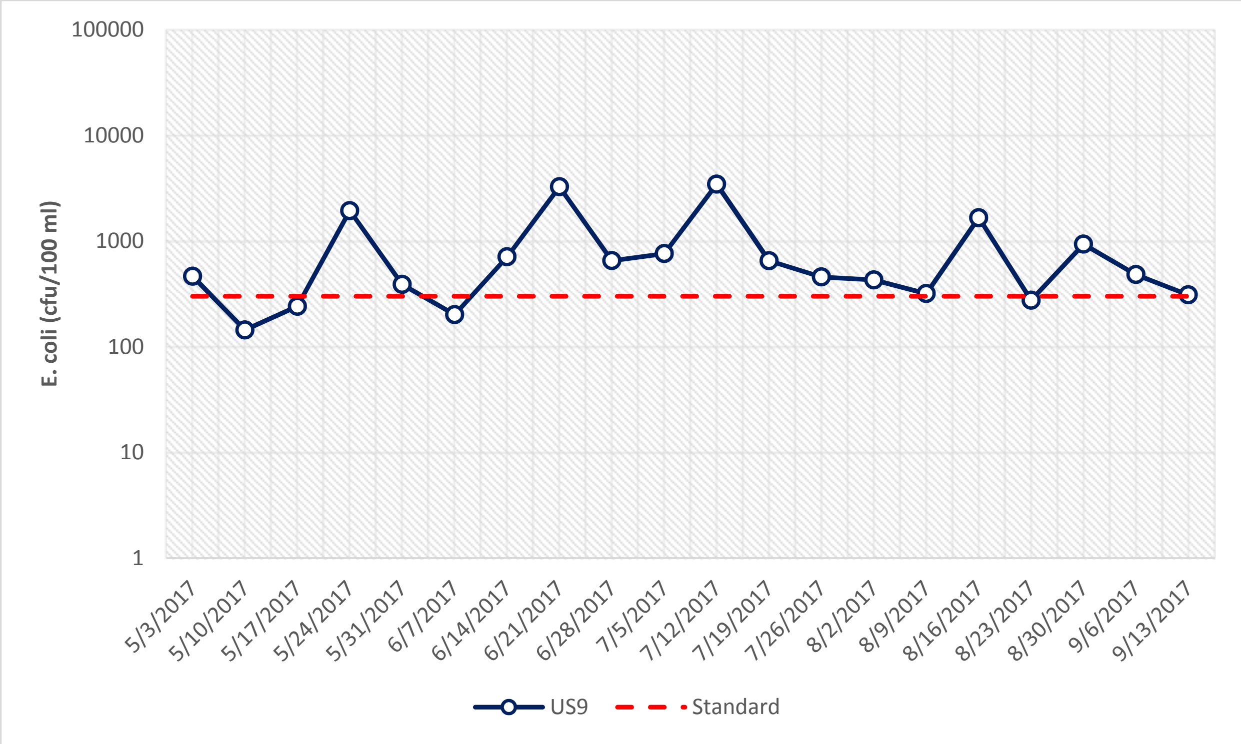
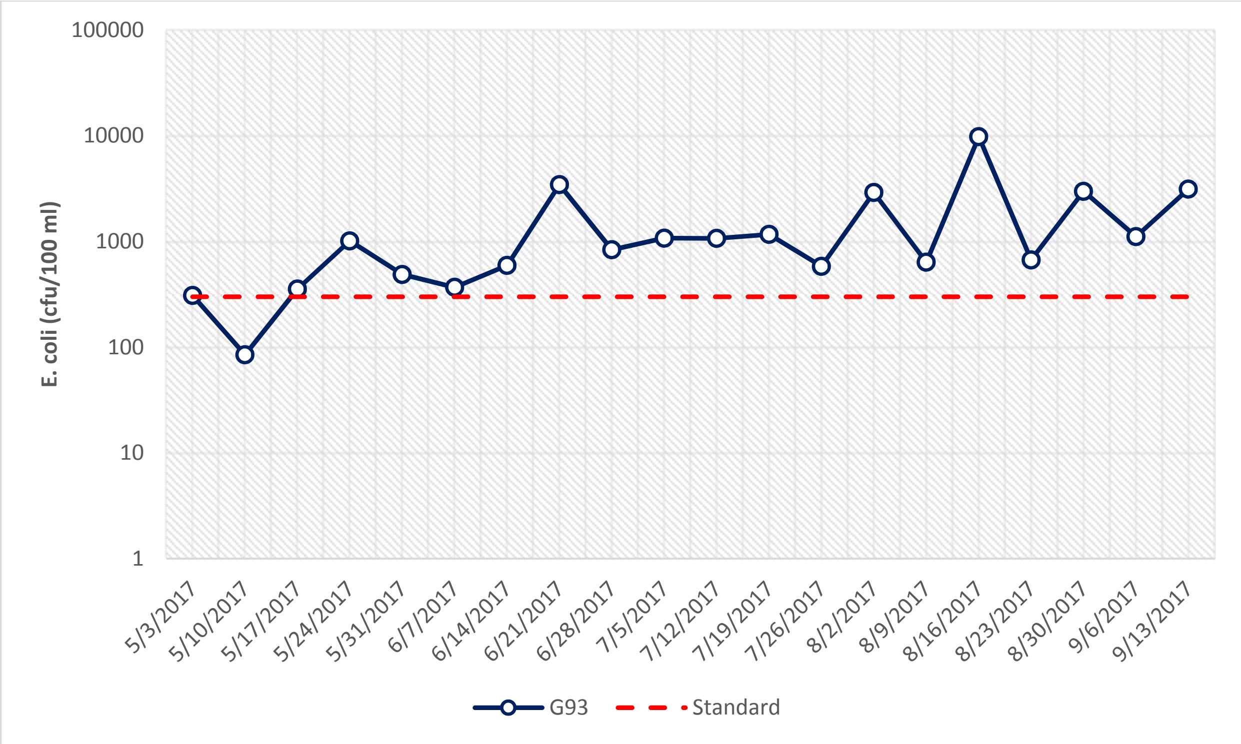


Figure A1-6: Confluence of Fowler Creek and Lower Rouge DS of L01, US of G65



APPENDIX A: LOWER ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-7: Confluence of McClaughrey Drain and Lower Rouge DS of L07, US of L06

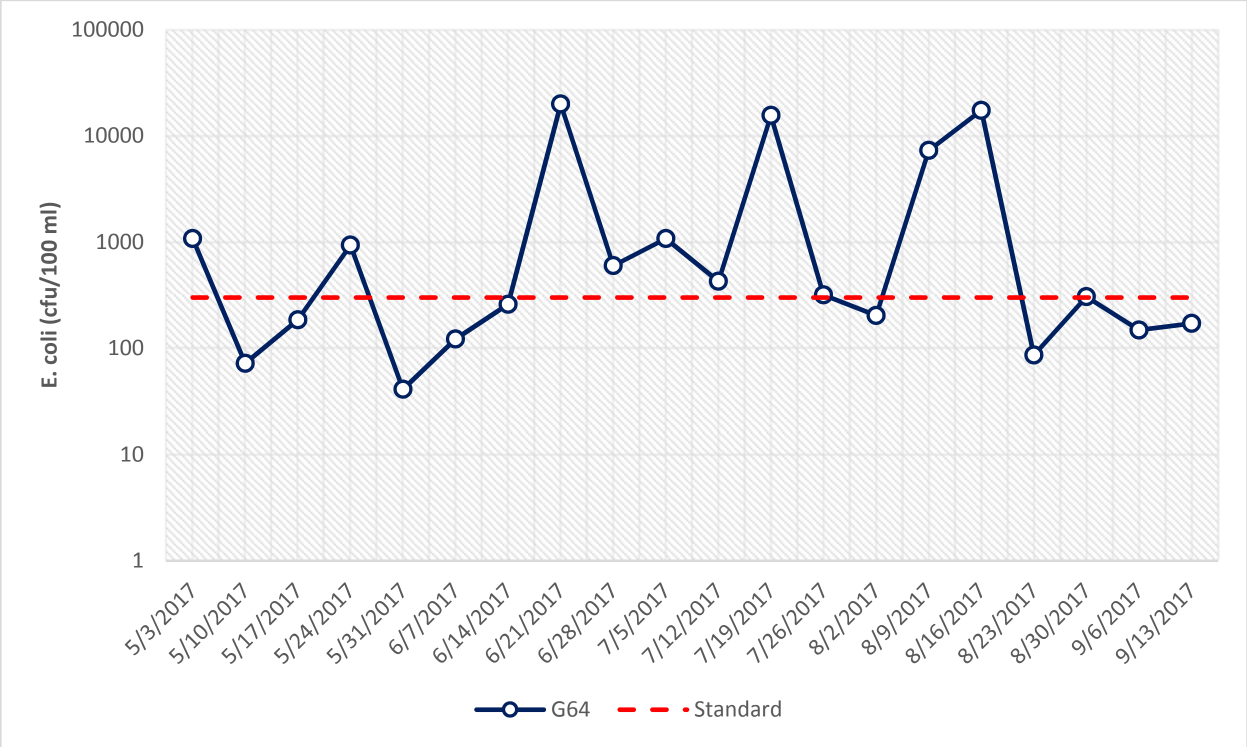
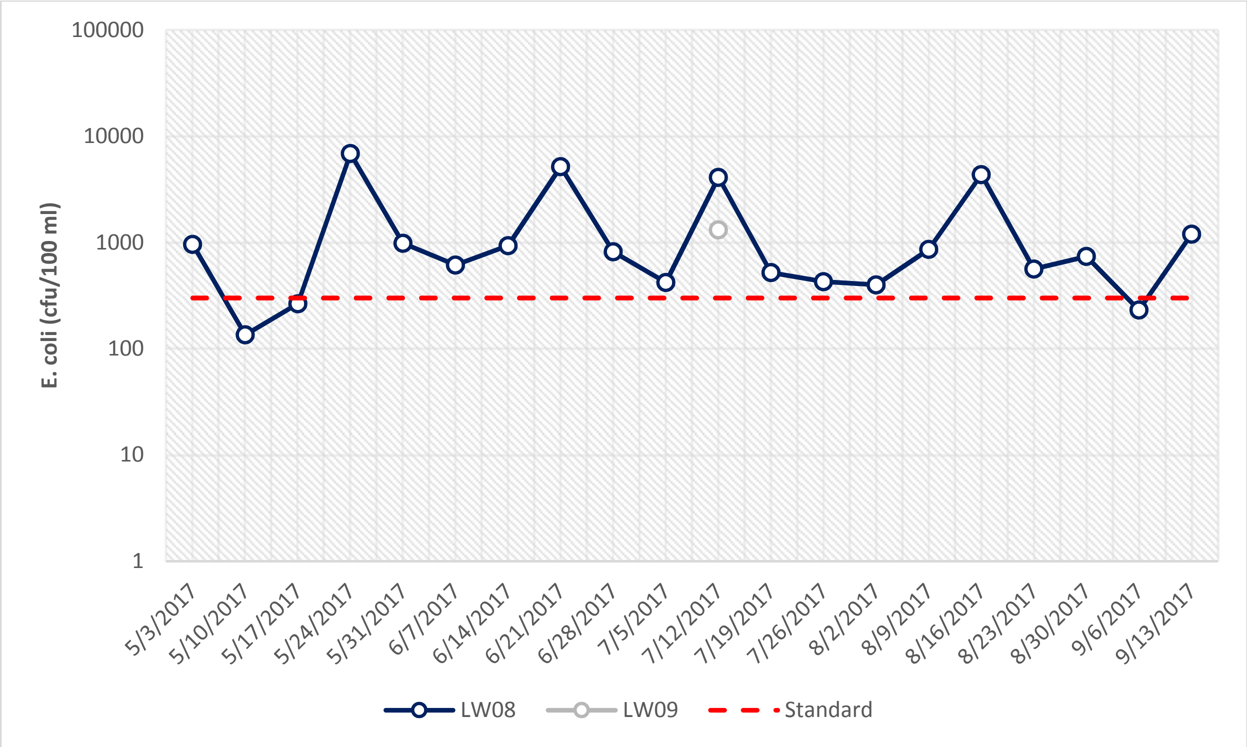
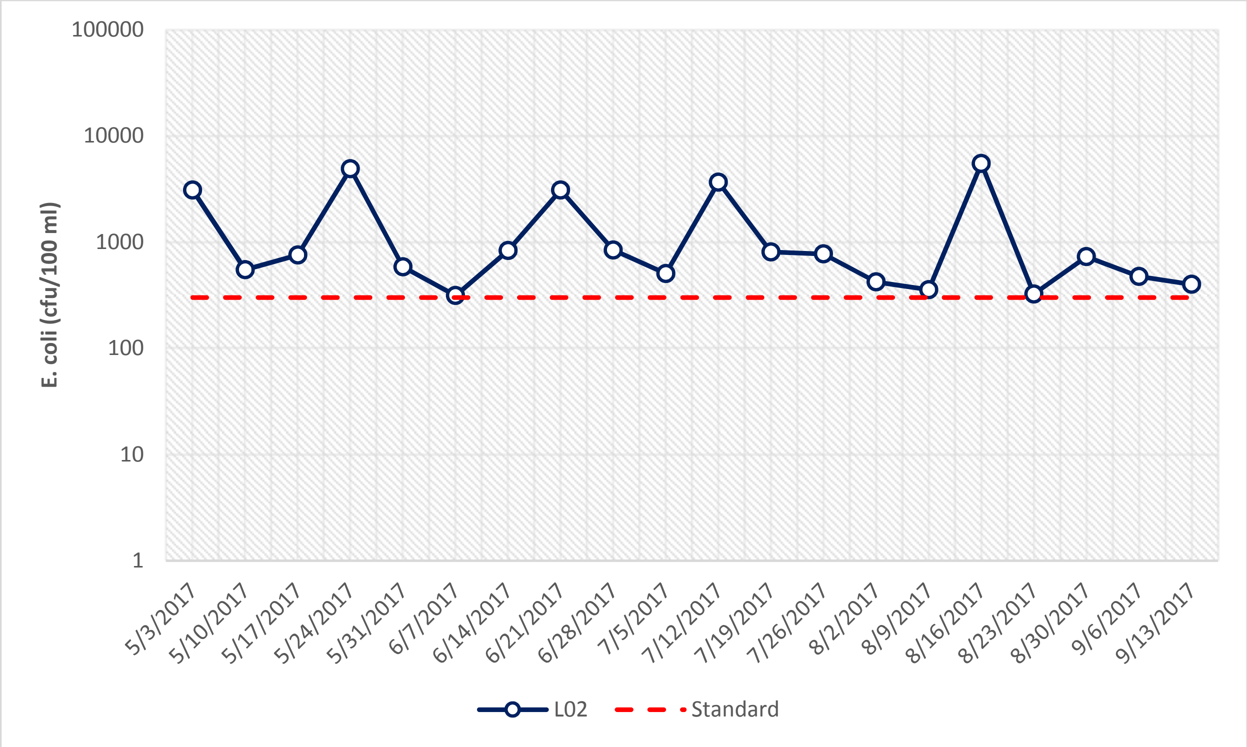


Figure A1-8: Confluence of Bingell Drain and Lower Rouge DS of US9, US of L06



APPENDIX A: LOWER ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-9: Confluence of Fellows Creek and Lower Rouge DS of G92, US of L07



APPENDIX A: MAIN ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-10: Confluence of Franklin Branch and Main Rouge DS of M03, US of G59

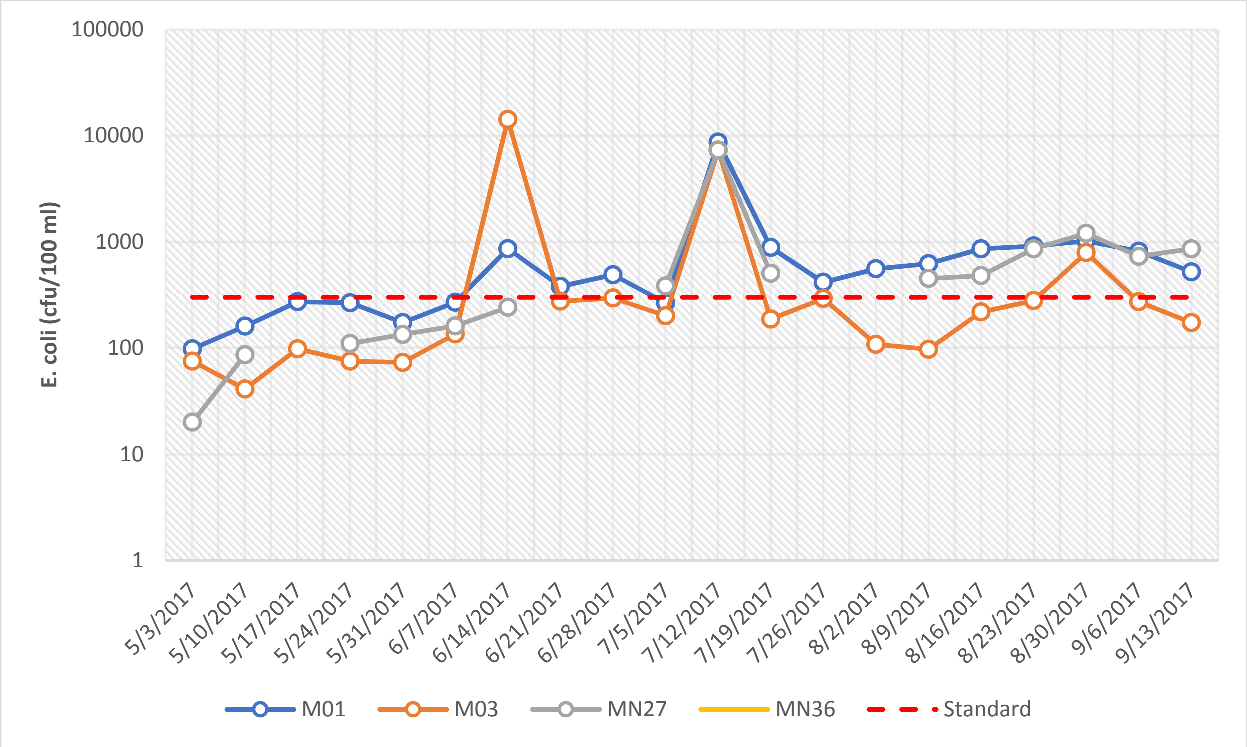
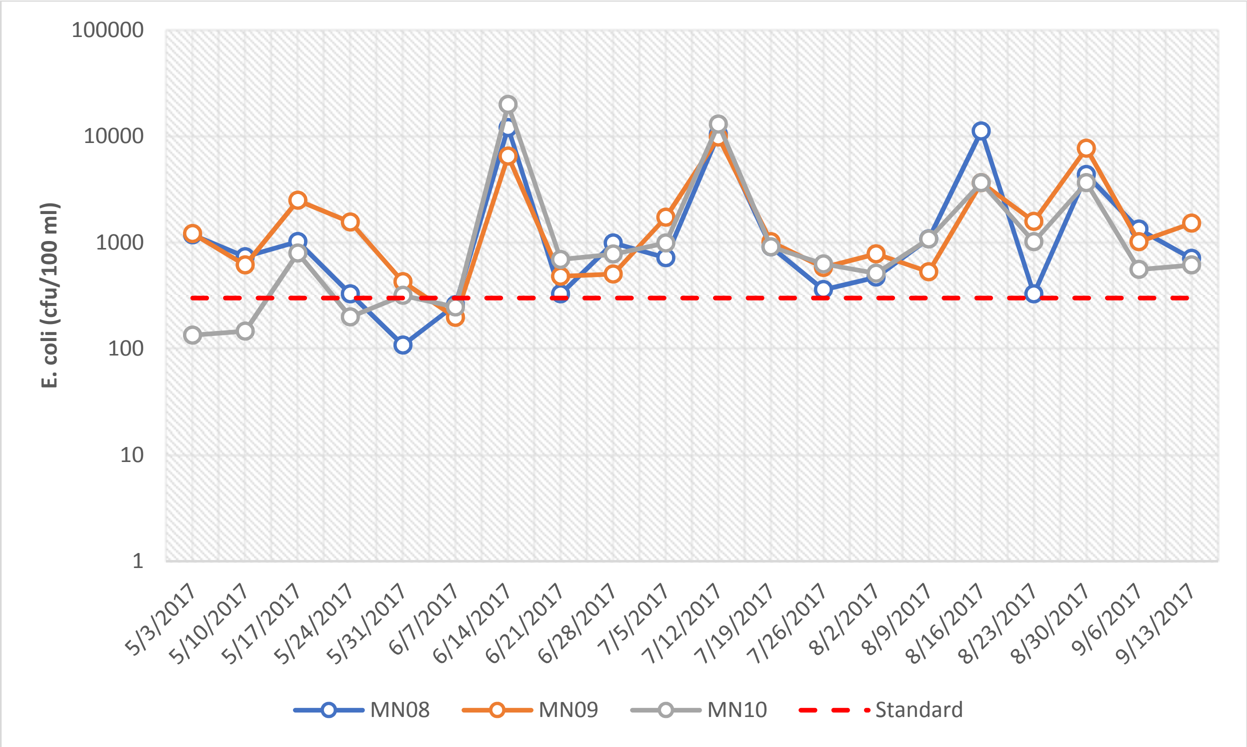


Figure A1-11: Confluence of Evans Ditch, Tamarack Creek, and Main Rouge DS of US5, US of M15



APPENDIX A: MAIN ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-12: Confluence Franklin Branch (DS of M03, US G59A), Pebble Creek (DS of G59A, US of US5), and Evans Ditch (DS of US5, US of M15) and Main Rouge

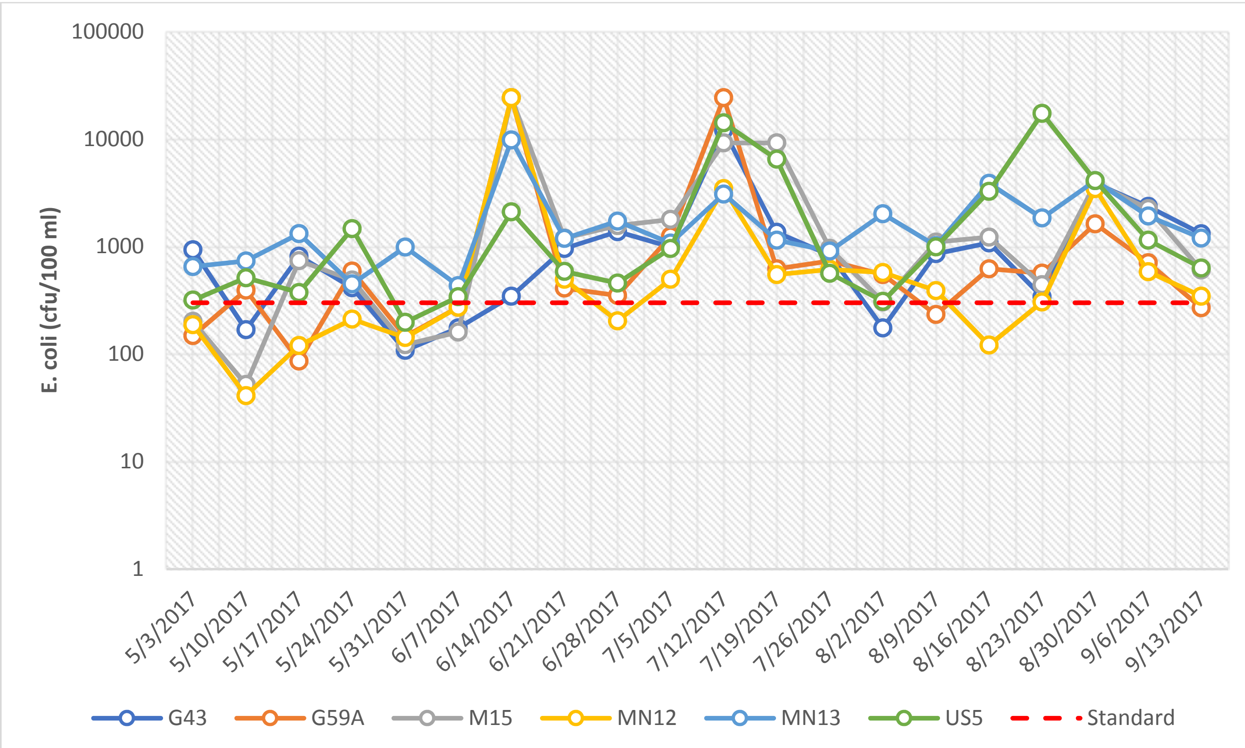
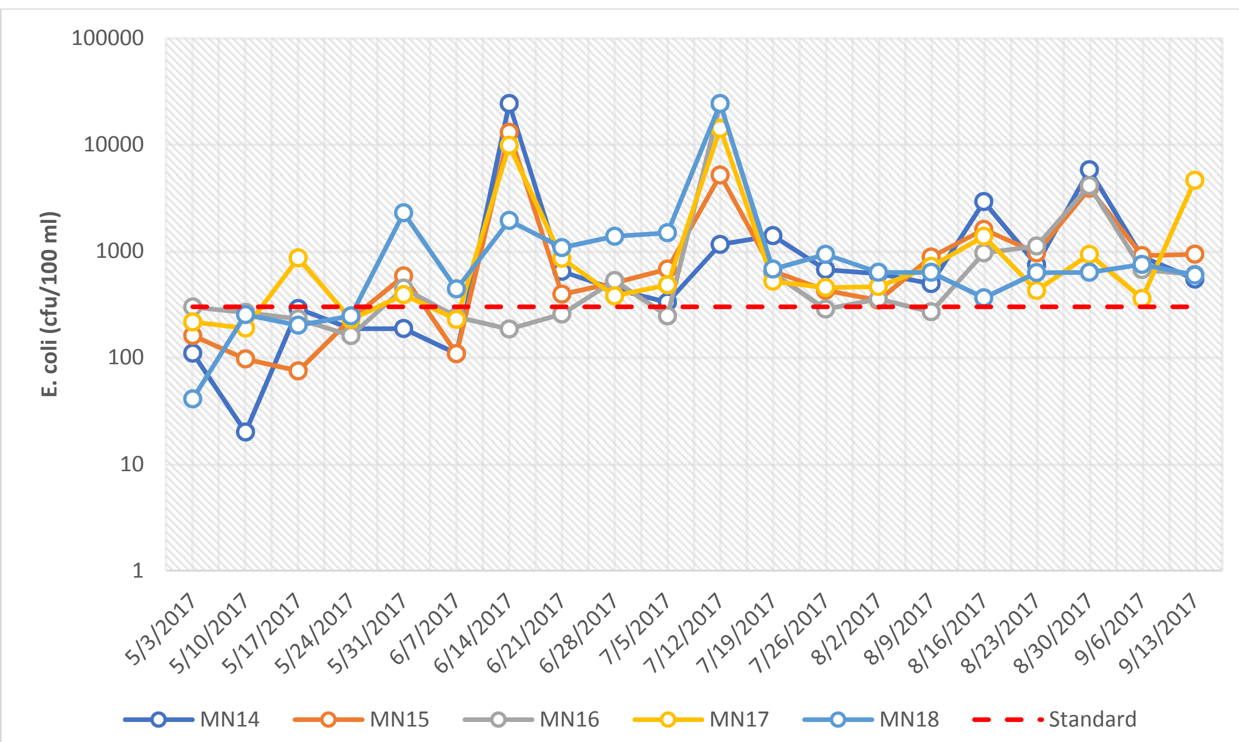


Figure A1-13: Confluence of Pebble Creek and Main Rouge DS of MN12, US of US5



APPENDIX A: MAIN ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-14: Main Branch of Main Rouge

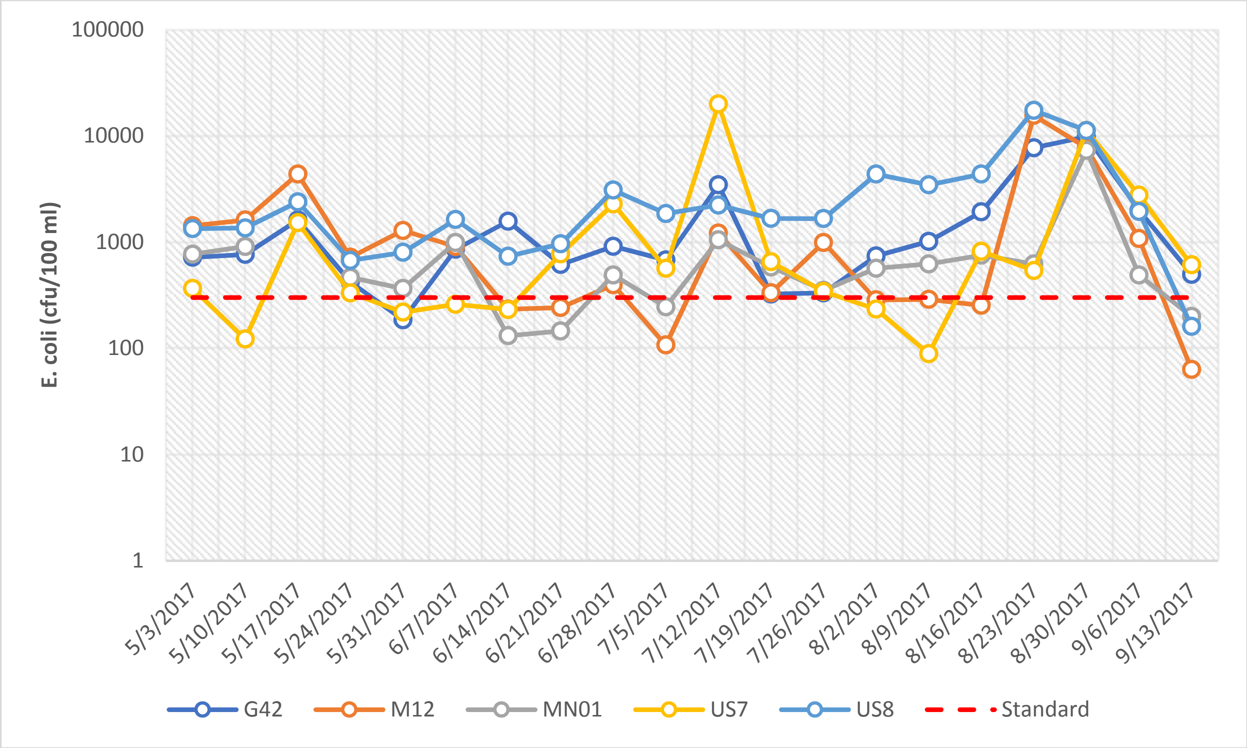
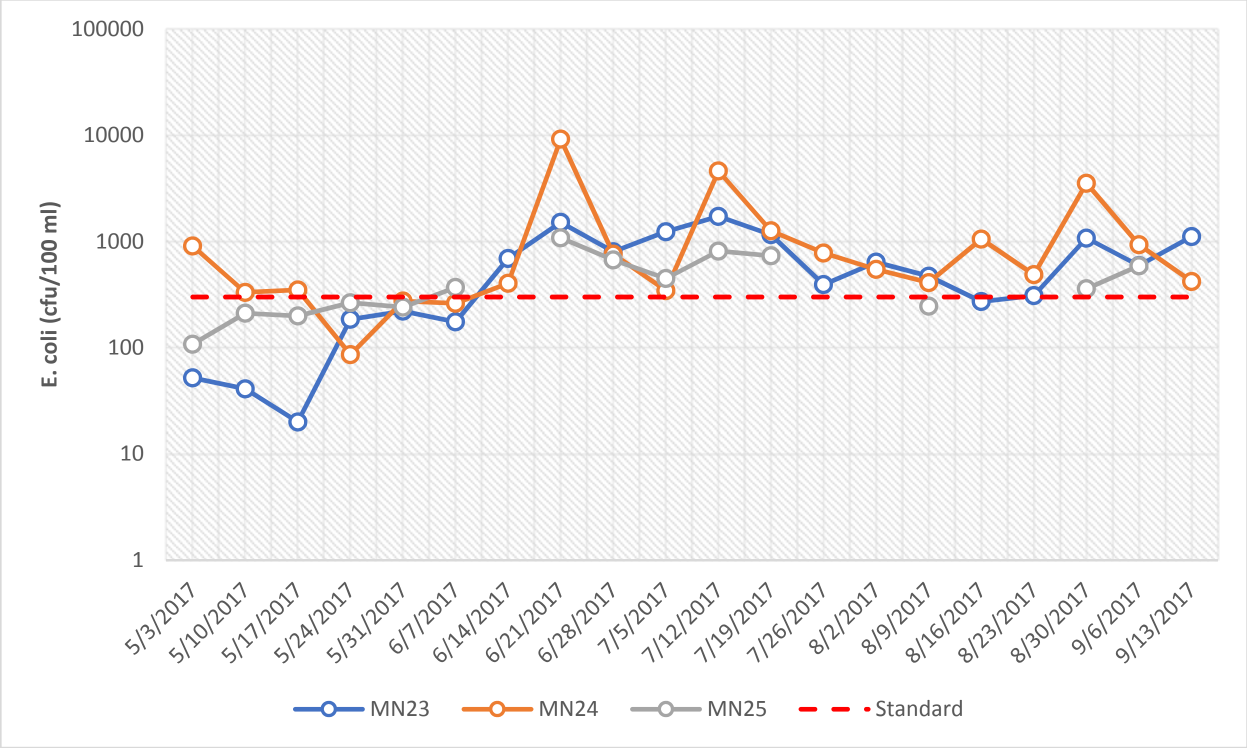


Figure A1-15: Confluence of Franklin Branch and Main Rouge US of G461



APPENDIX A: MAIN ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-16: Confluence of Franklin Branch and Main Rouge DS of M03, US of G59

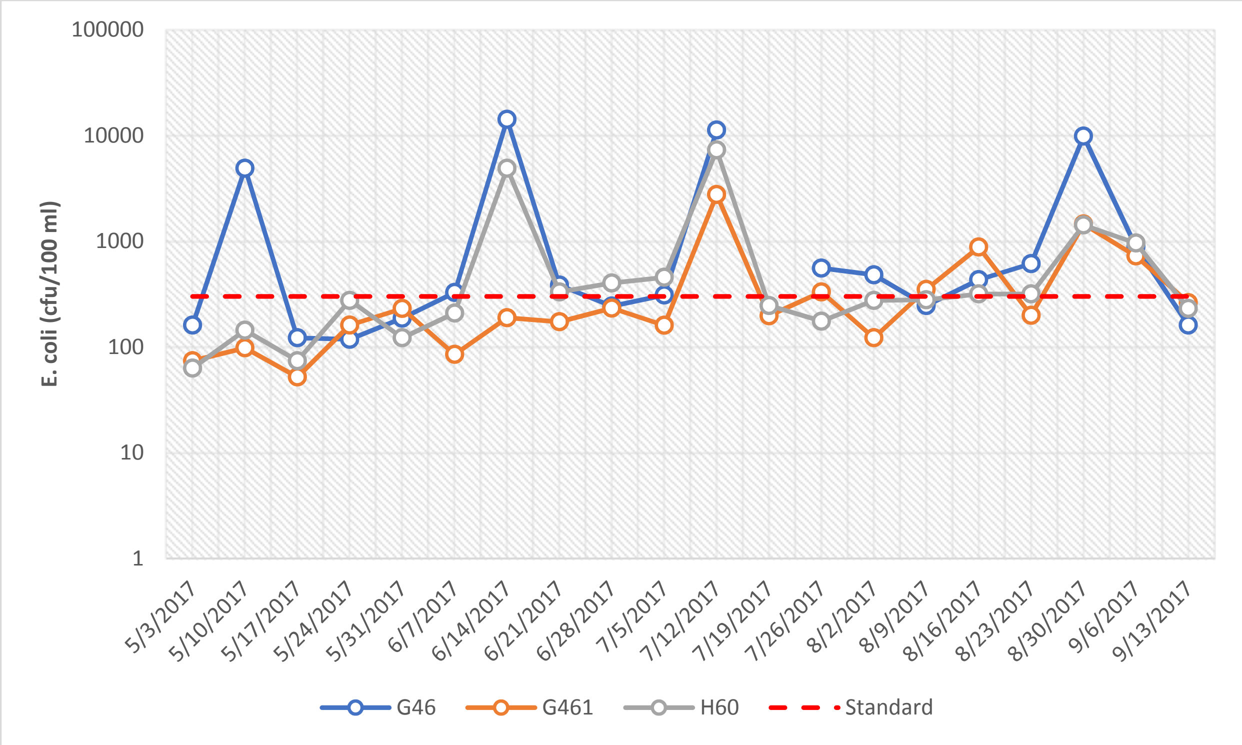
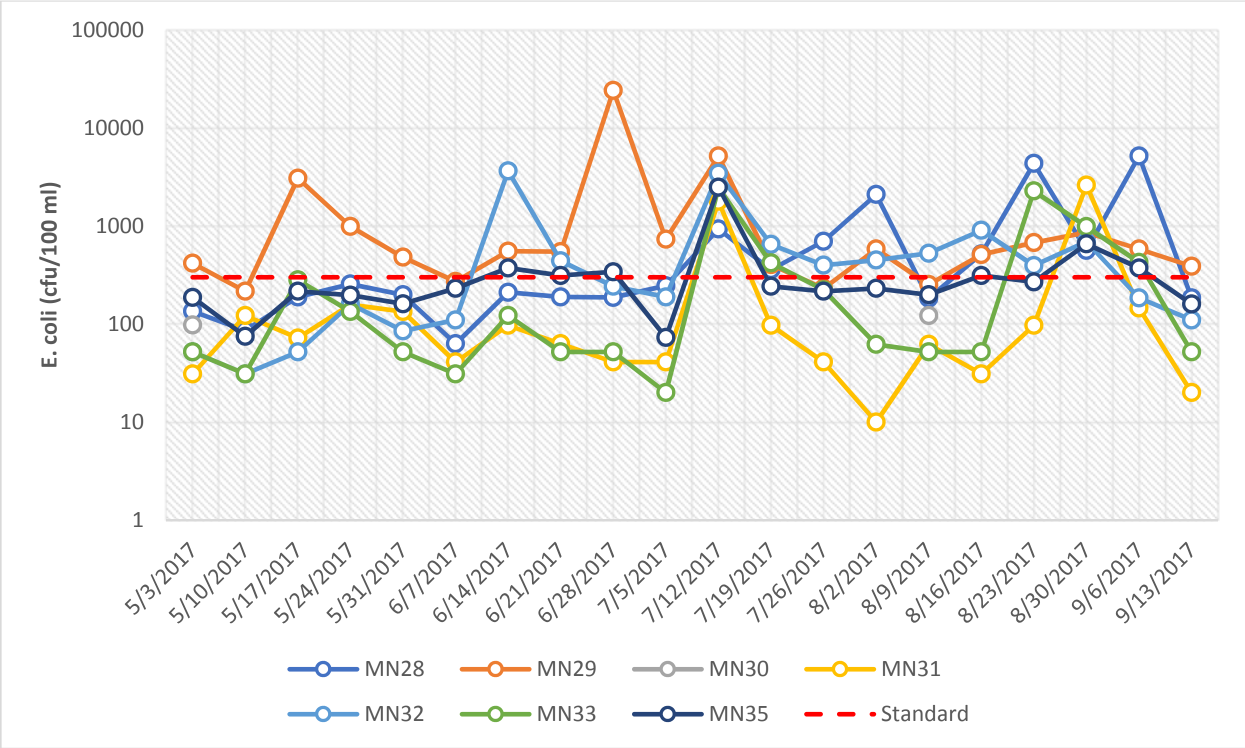


Figure A1-17: Confluence of Main Branch, Sunken Bridge Drain and Main Rouge US of MN27 and M01



APPENDIX A: MIDDLE ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-18: Confluence of Tonquish Creek and Middle Rouge DS of G13, US of D33

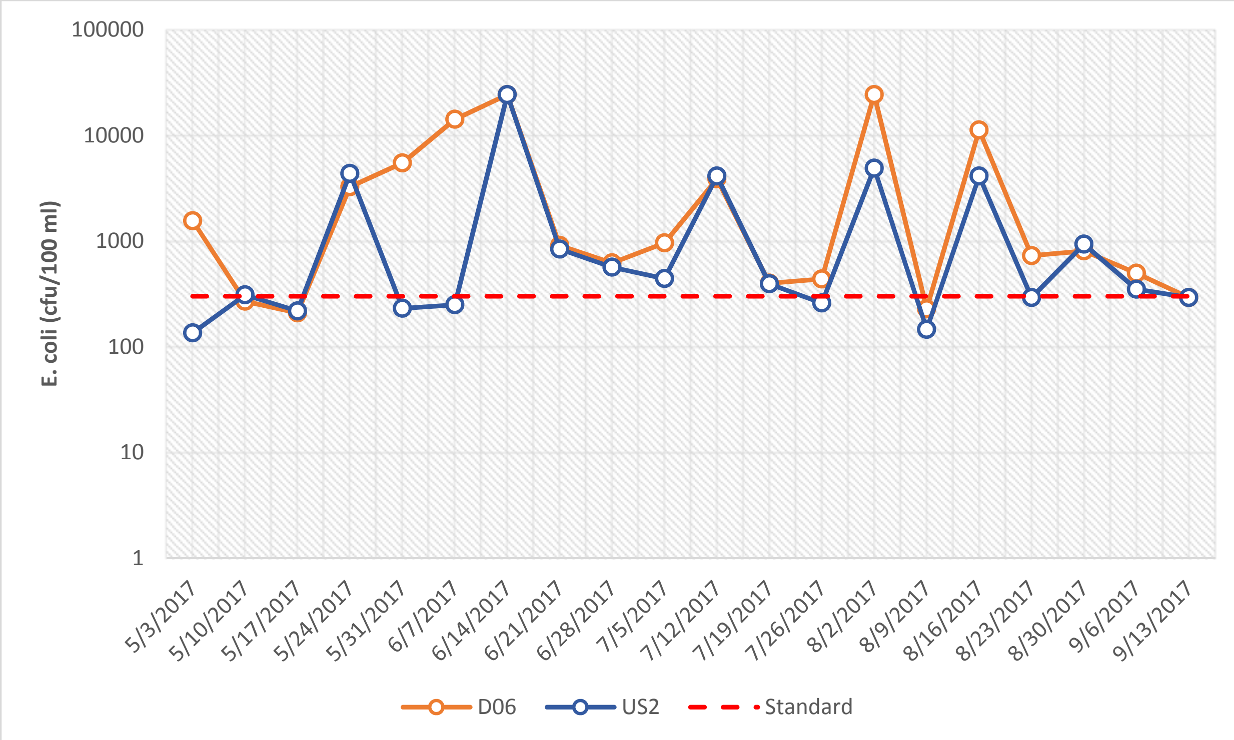
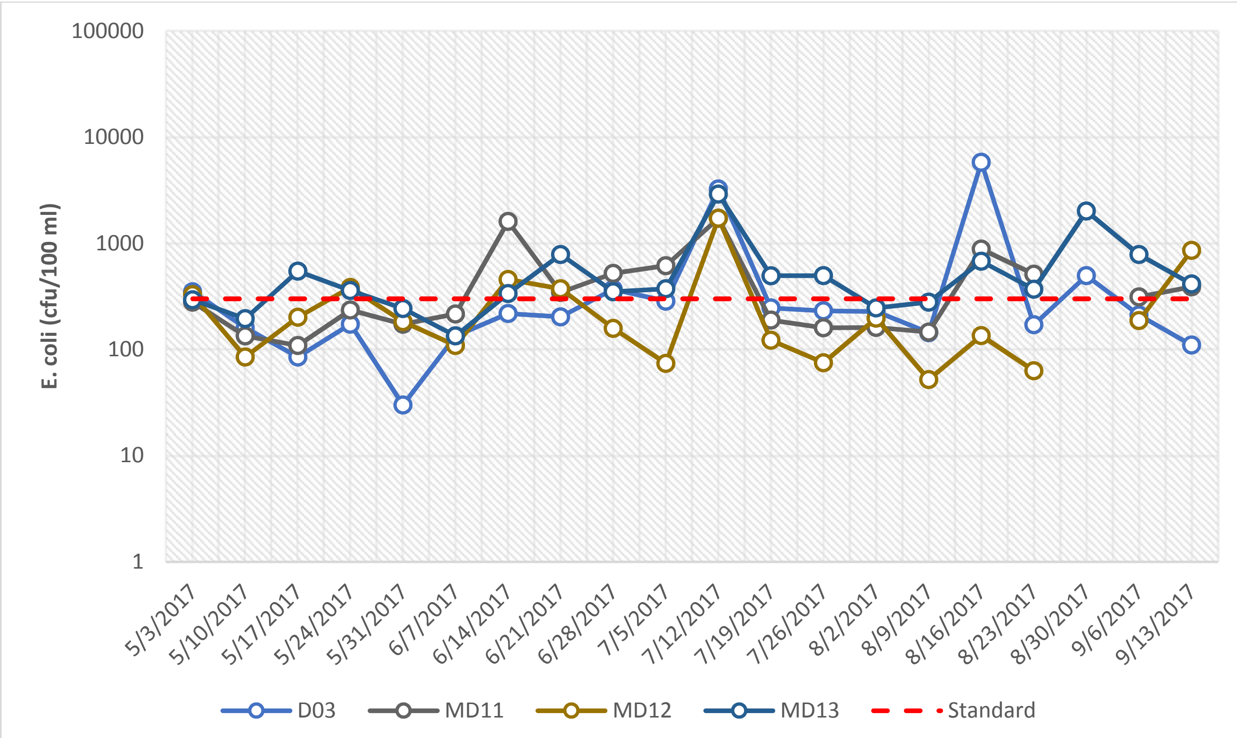


Figure A1-19: Confluence of Johnson Creek and Middle Rouge DS of G03, US of G04



APPENDIX A: MIDDLE ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-20: Confluence of Tonquish Creek and Middle Rouge DS of G13, US of D33

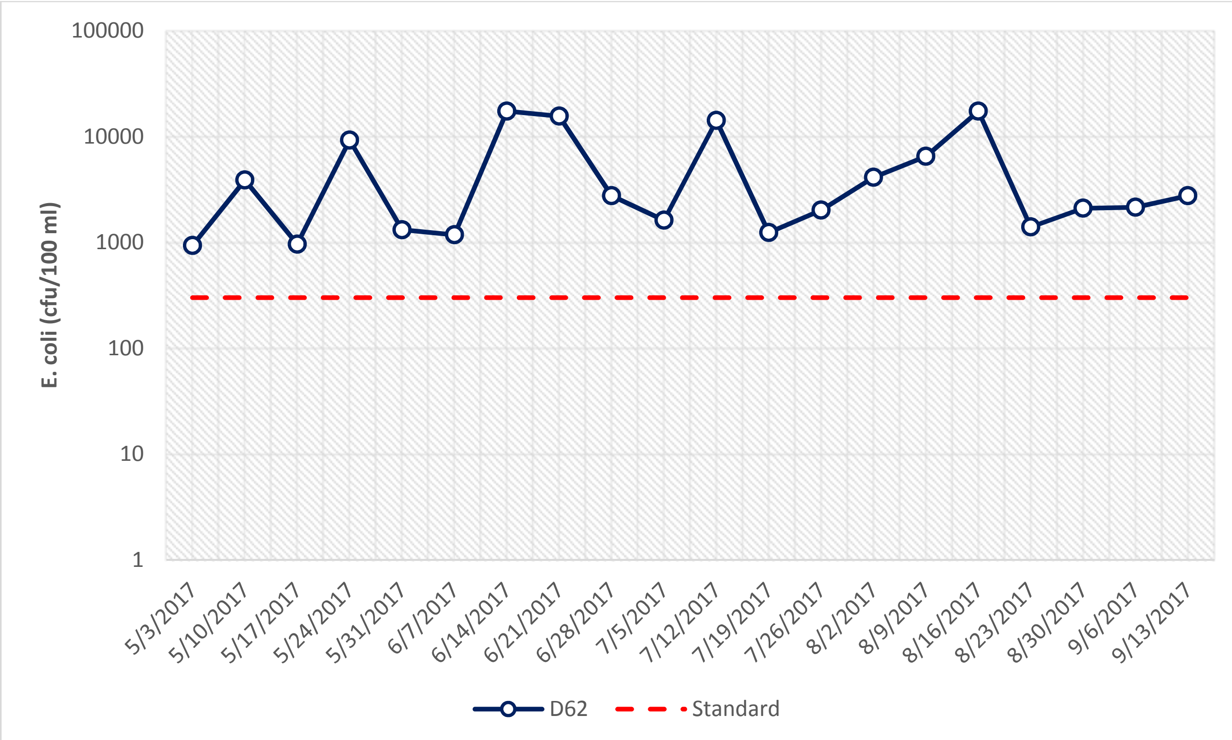
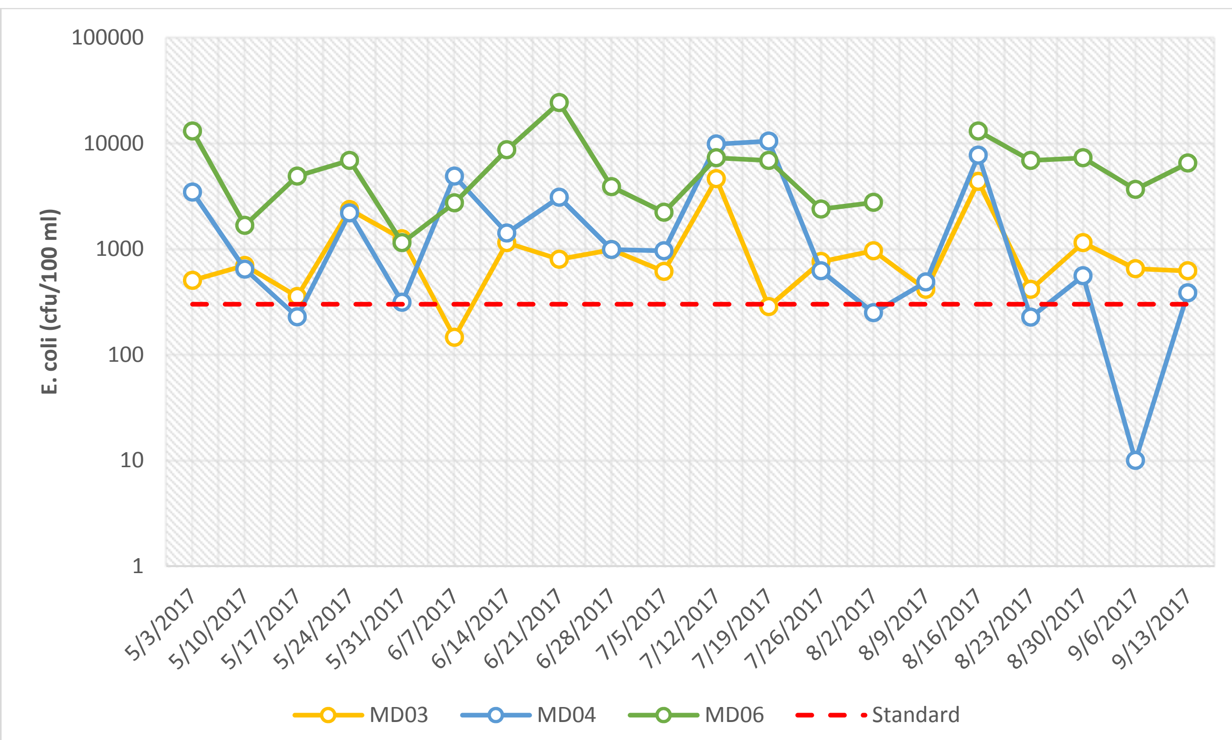


Figure A1-21: Confluence of Tonquish Creek, Willow Creek, South Branch Tonquish Creek and Middle Rouge DS of US10 and US of US2



APPENDIX A: MIDDLE ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-22: Confluence of Walled Lake Branch, Thornton Creek and Middle Rouge DS of MD18, US of MD09

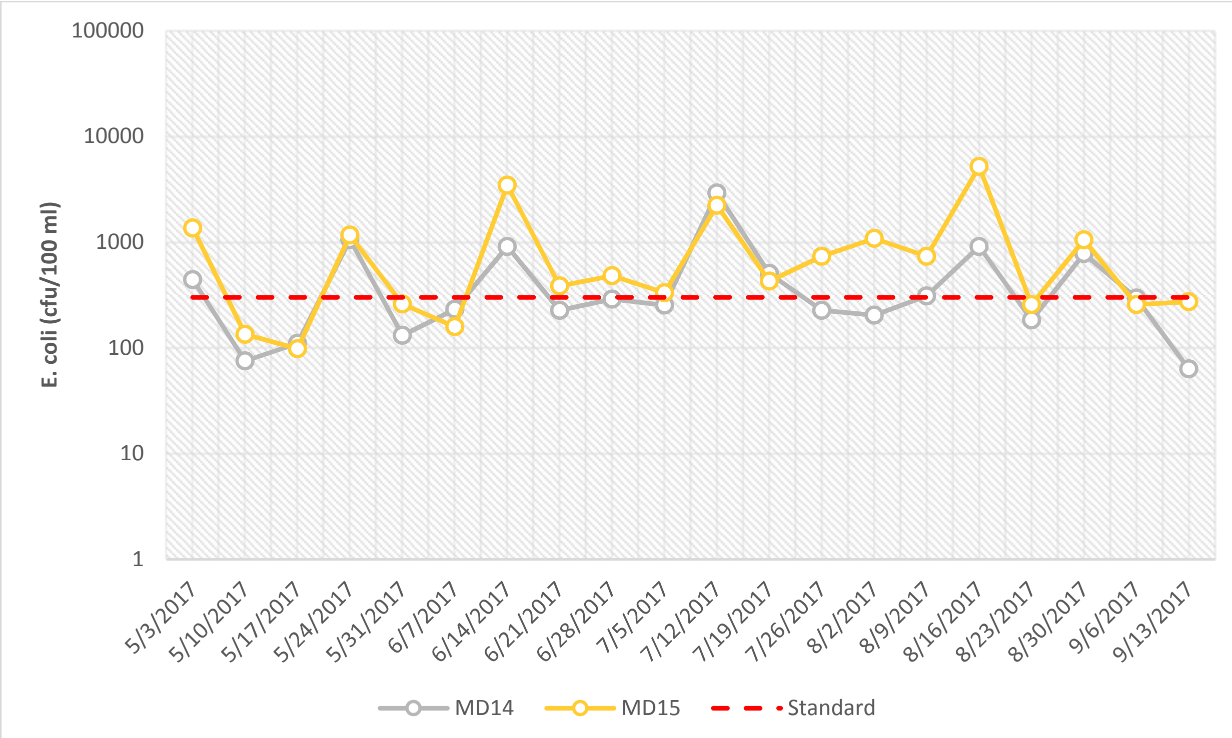
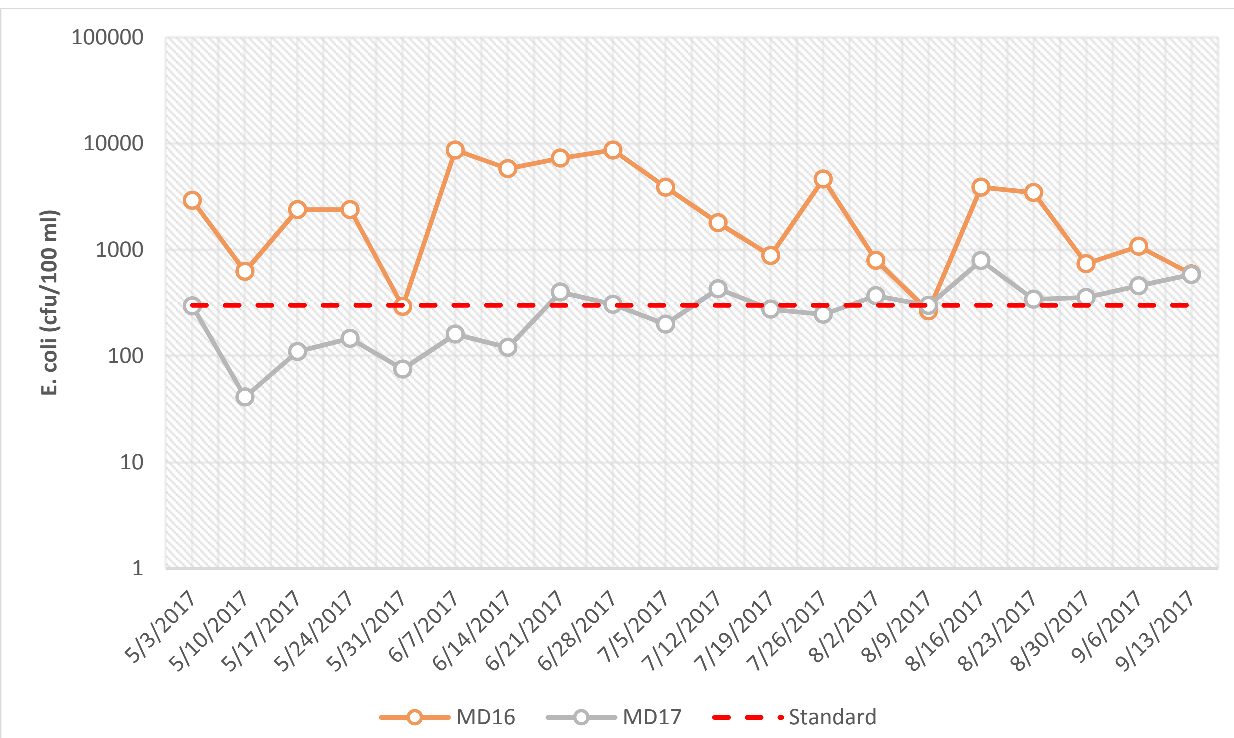
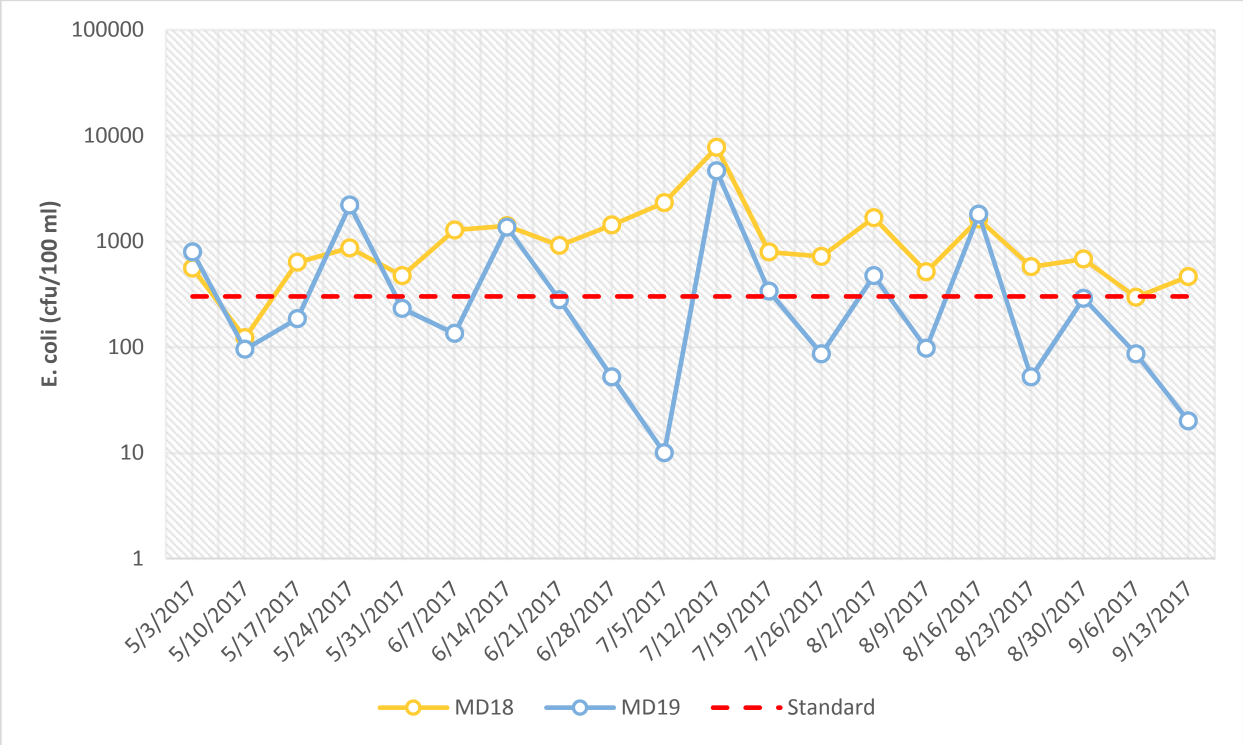


Figure A1-23: Confluence of Walled Lake Branch and Middle Rouge DS of MD18, US of MD09



APPENDIX A: MIDDLE ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-24: Confluence of Ingersol Creek, Bishop Creek, and Middle Rouge US of MD09



APPENDIX A: UPPER ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-25: Confluence of Bell Branch and Upper Rouge DS of U02, US of U05

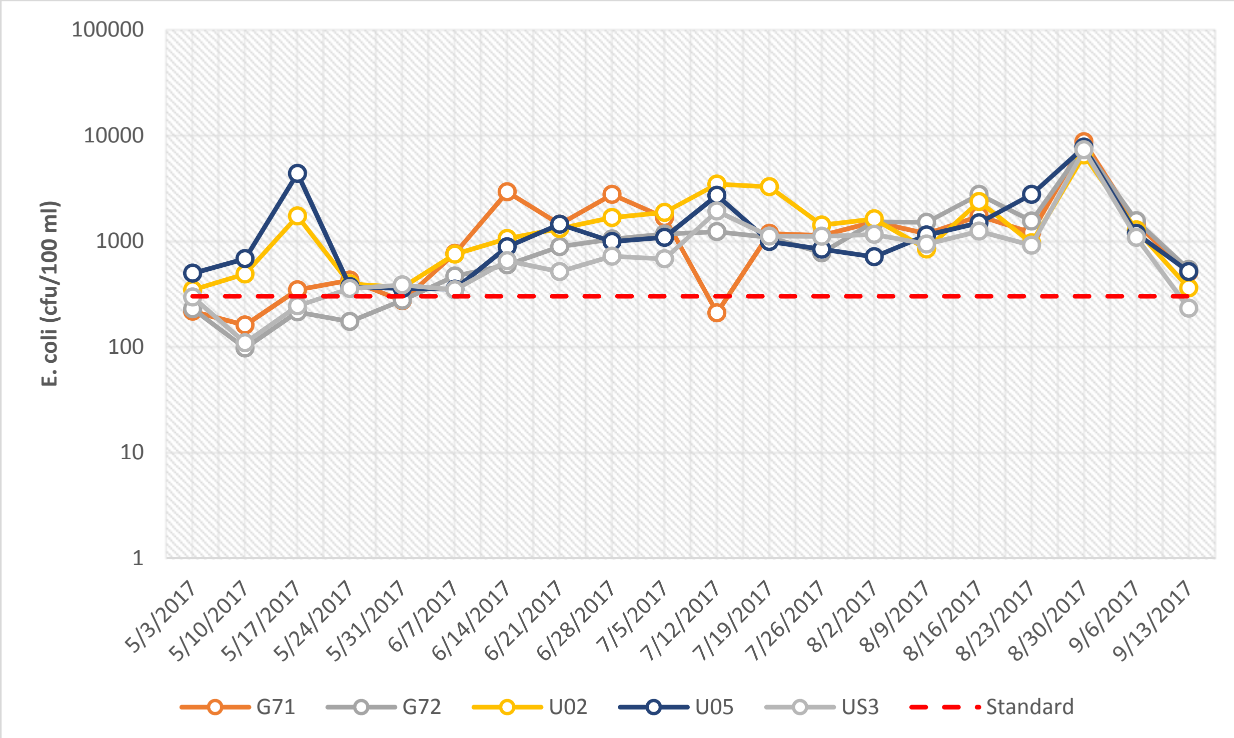
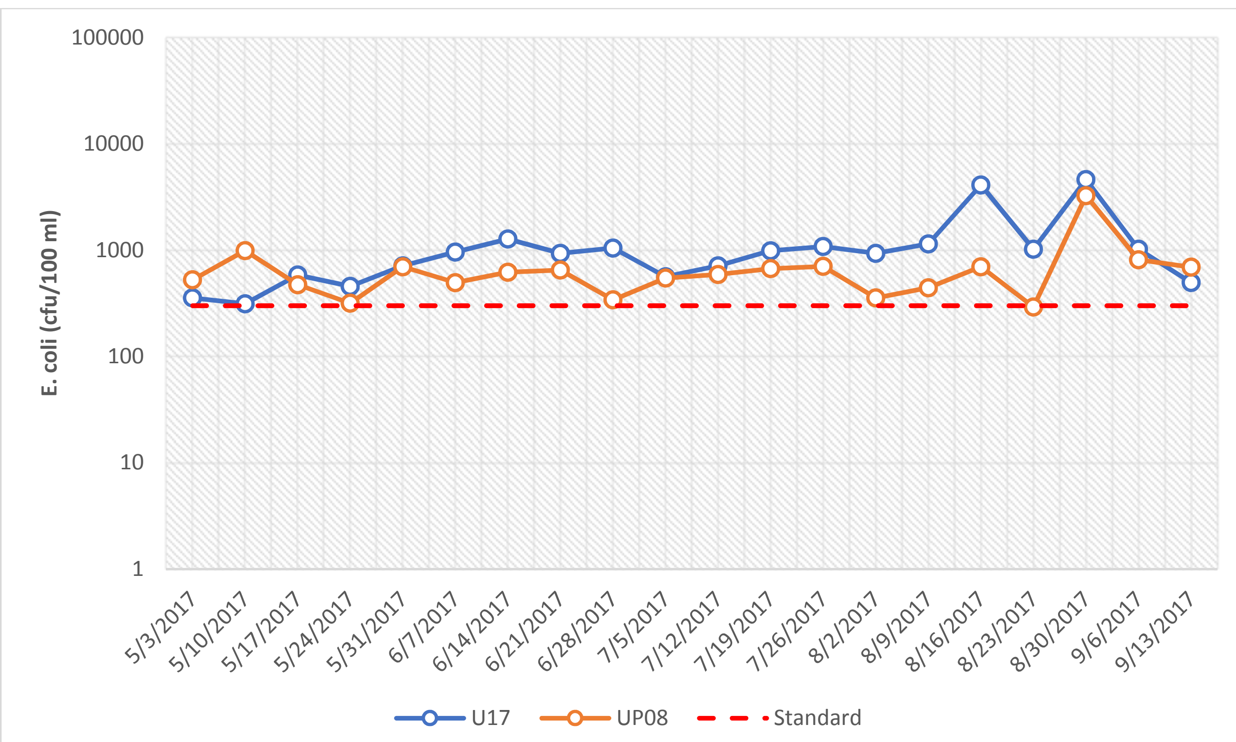


Figure A1-26: Confluence of Tarabusi Creek and Bell Branch DS of U14, US of U03



APPENDIX A: UPPER ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-27: Confluence of Tarabusi and Bell Branch DS of U14 and U15, US of U03

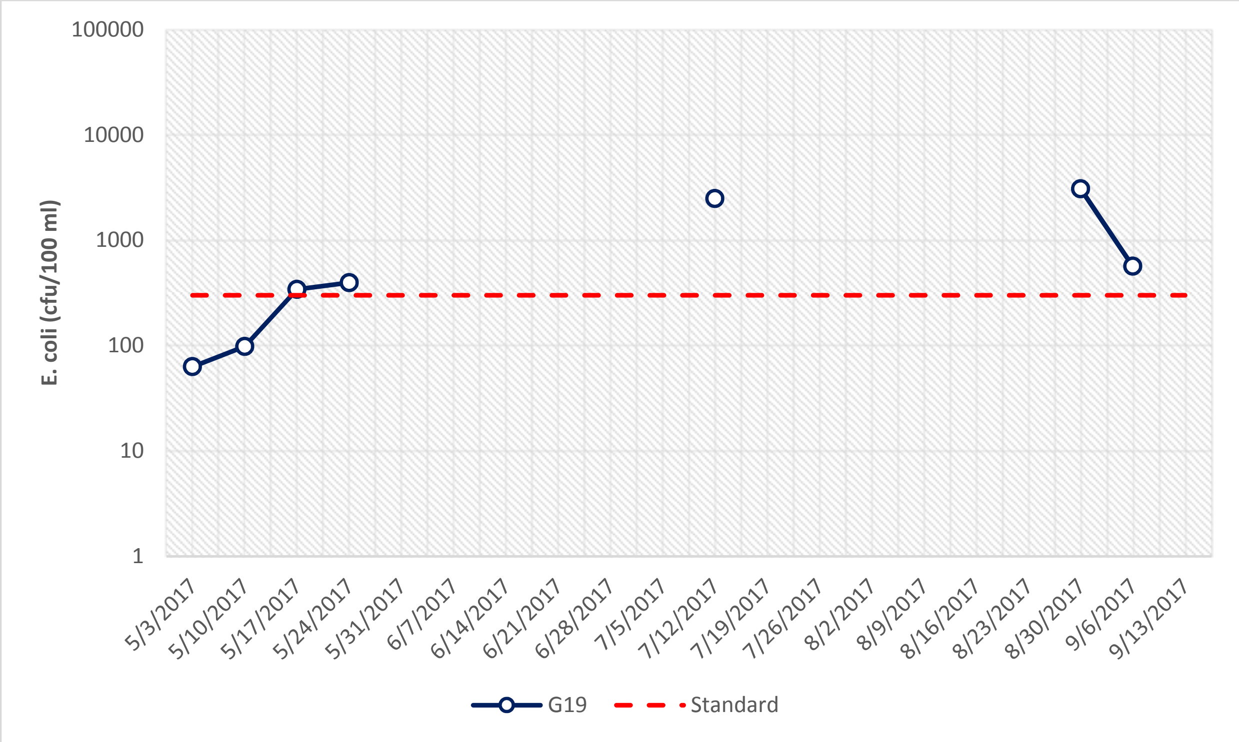
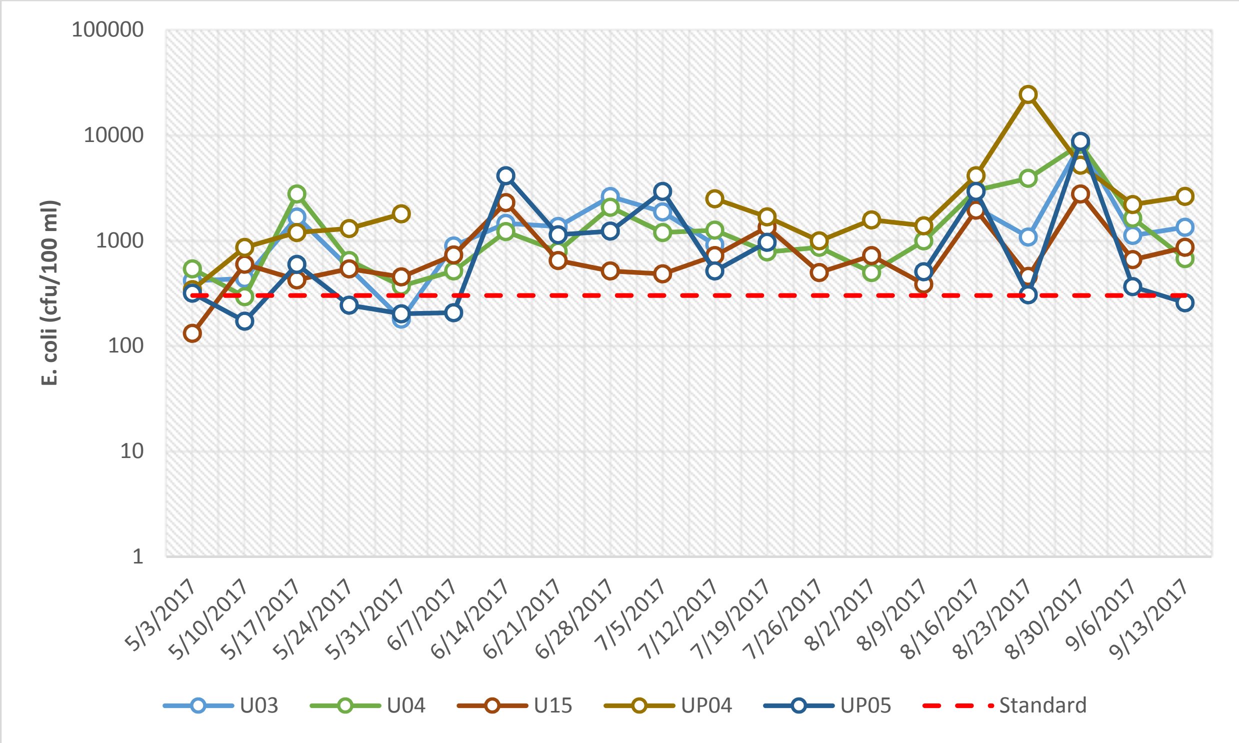
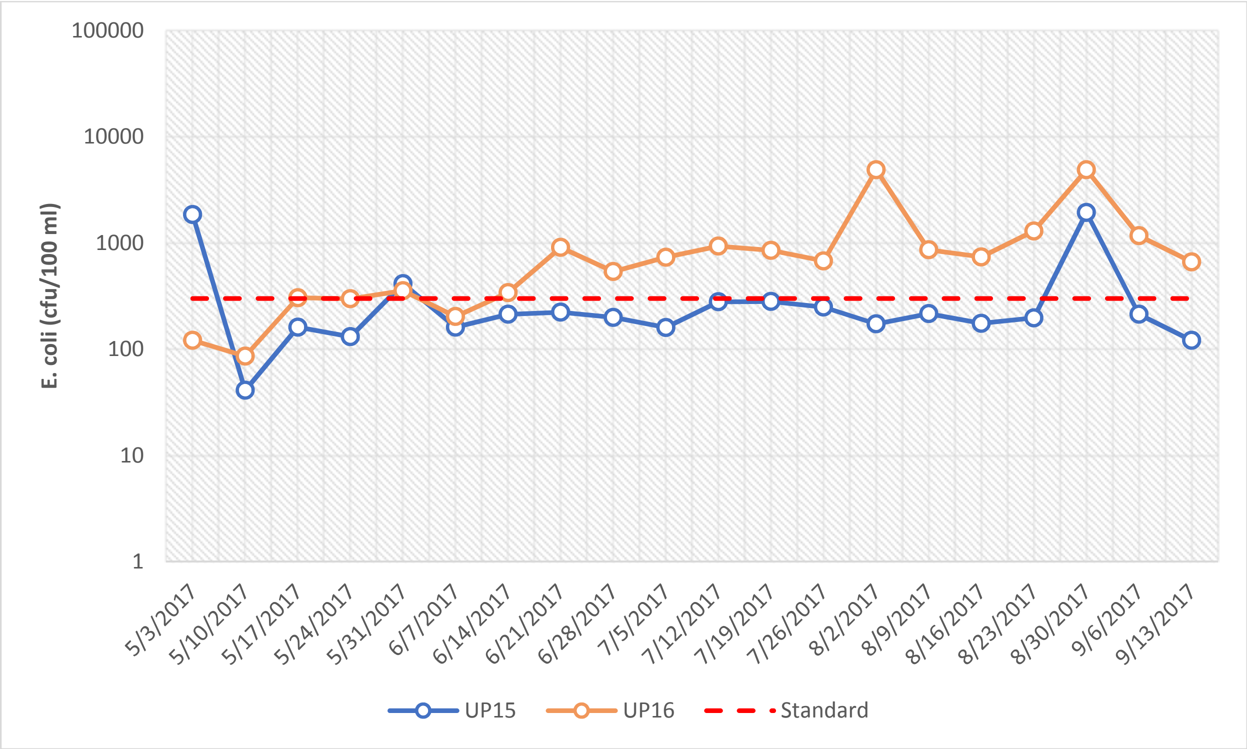


Figure A1-28: Confluence of Tarabusi Creek and Bell Branch DS of U14 and U15, US of U03



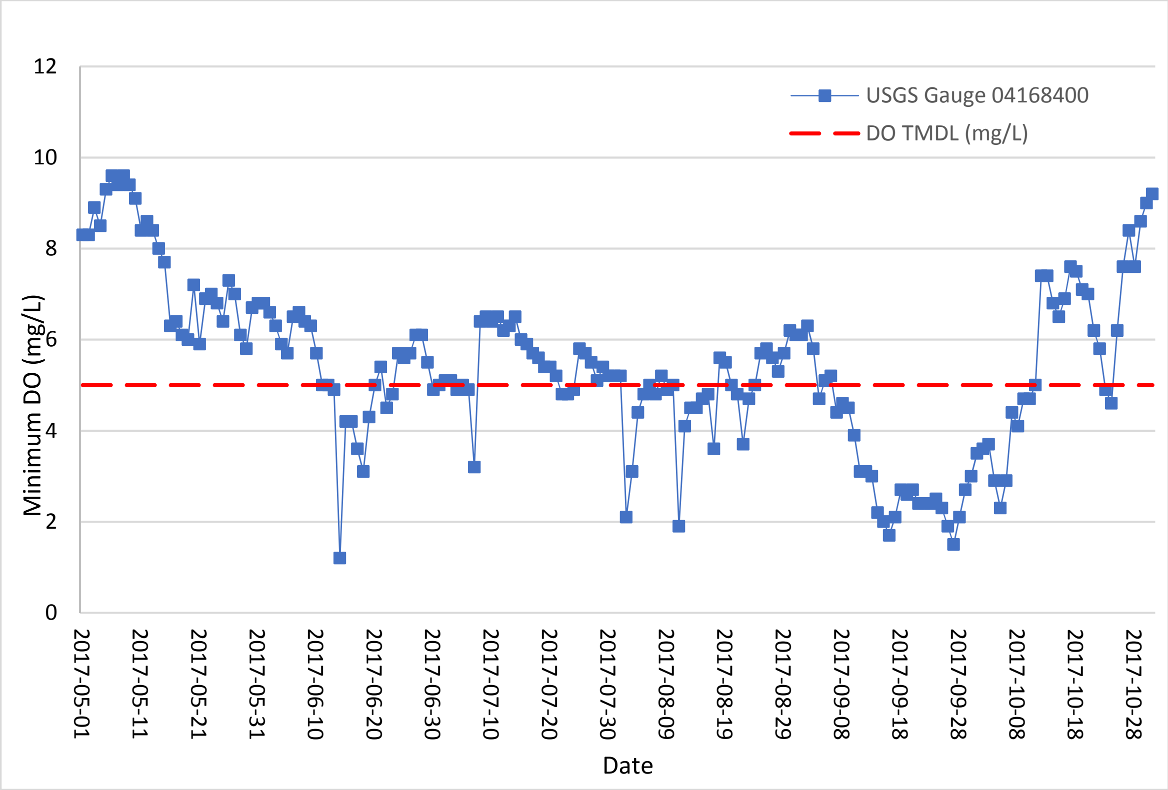
APPENDIX A: UPPER ROUGE SUBWATERSHED (DATA SOURCE: ECT 2017)

Figure A1-29: Confluence of Minnow Pond Drain (US of US3), Seeley Drain (US of UP08), and Upper Rouge



APPENDIX A: LOWER ROUGE SUBWATERSHED (DATA SOURCE: USGS)

Figure A1-30: Lower Rouge at Dearborn, MI, Station L05D



APPENDIX A: MAIN ROUGE SUBWATERSHED (DATA SOURCE: USGS)

Figure A1-31: Main Rouge at Southfield, MI, Station US5

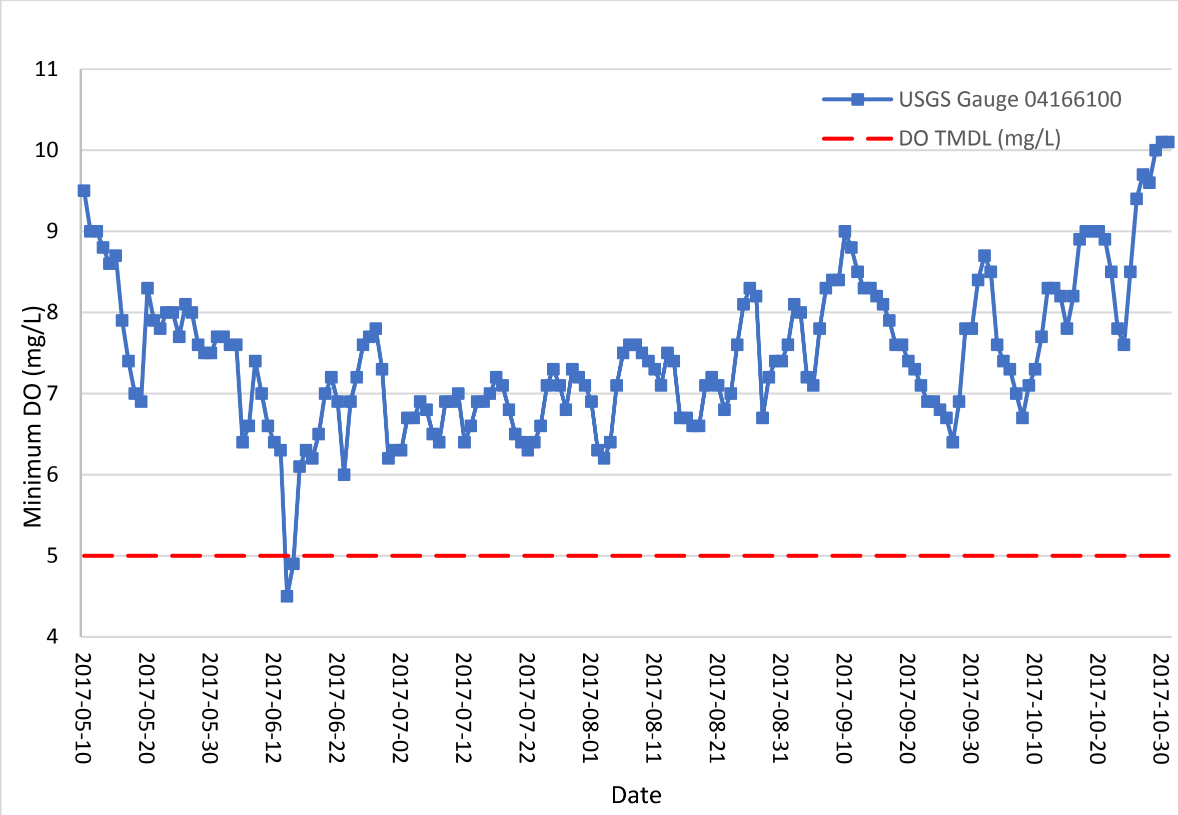
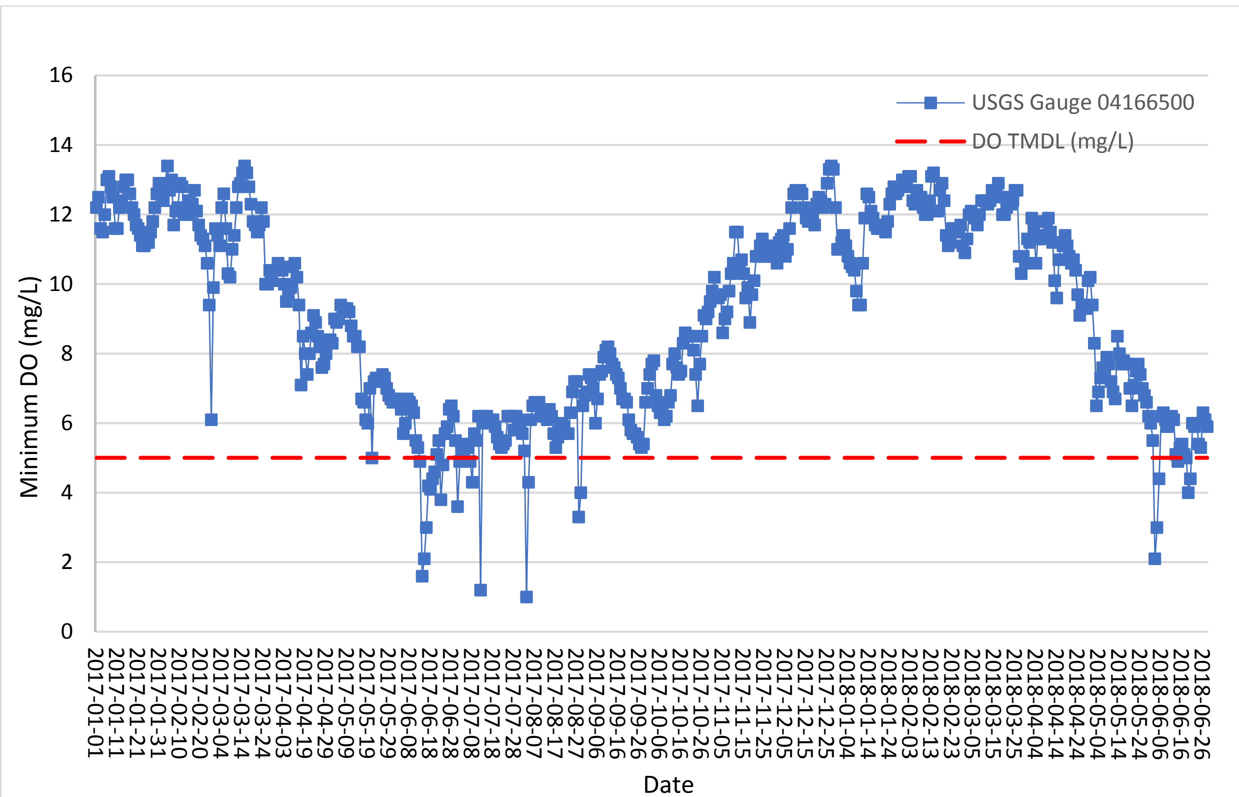


Figure A1-32: Main Rouge at Detroit, MI, Station US7



APPENDIX A: MIDDLE ROUGE SUBWATERSHED (DATA SOURCE: USGS)

Figure A1-33: Middle Rouge at Detroit, MI, Station D06

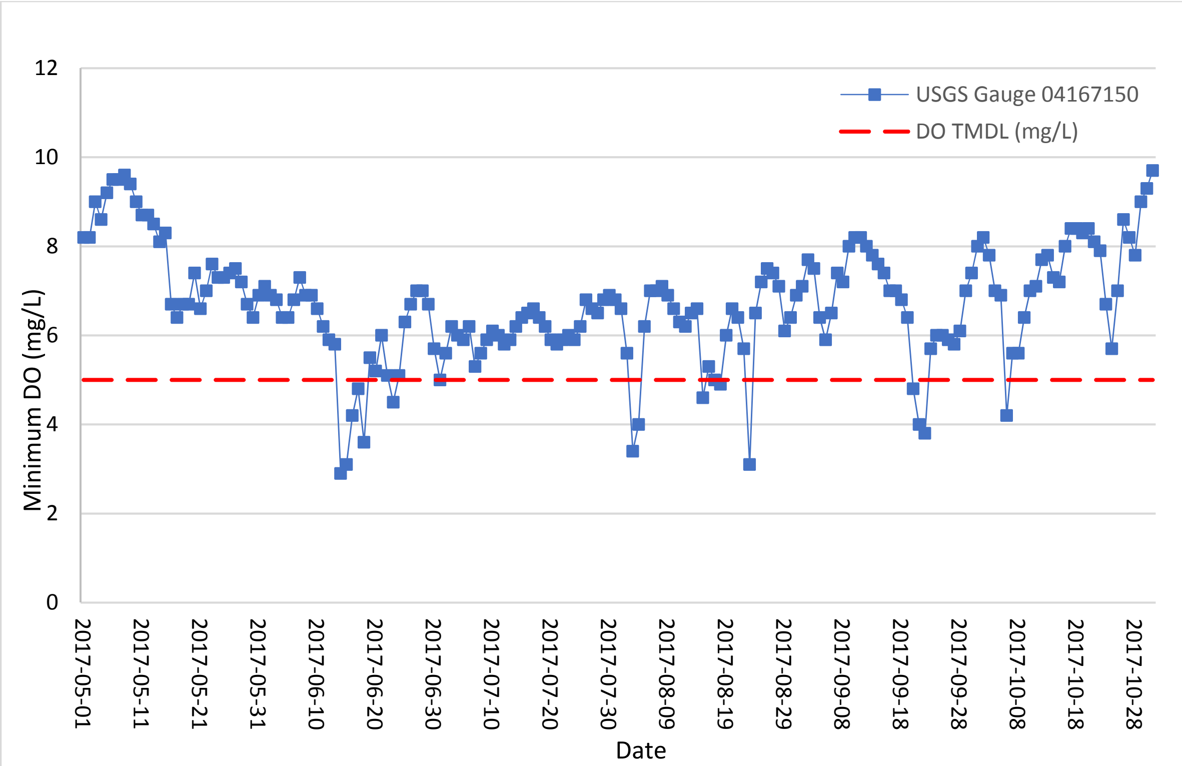
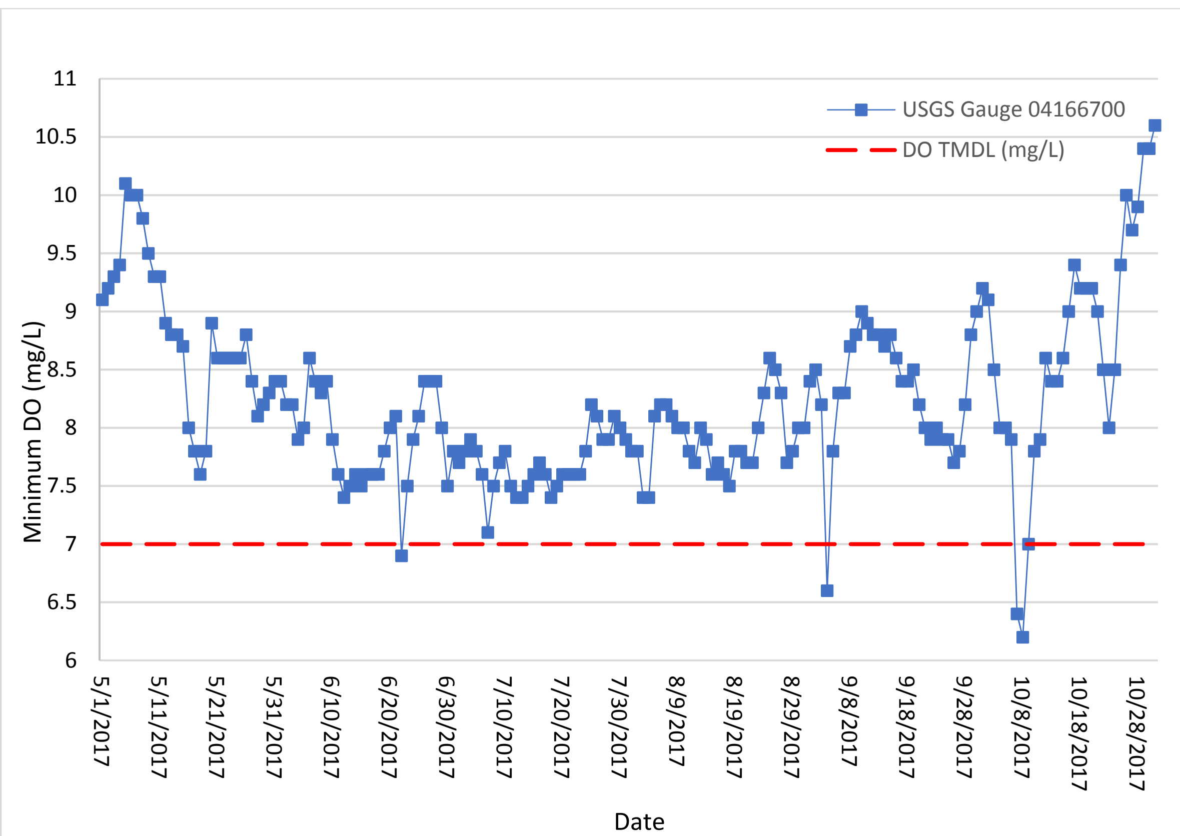
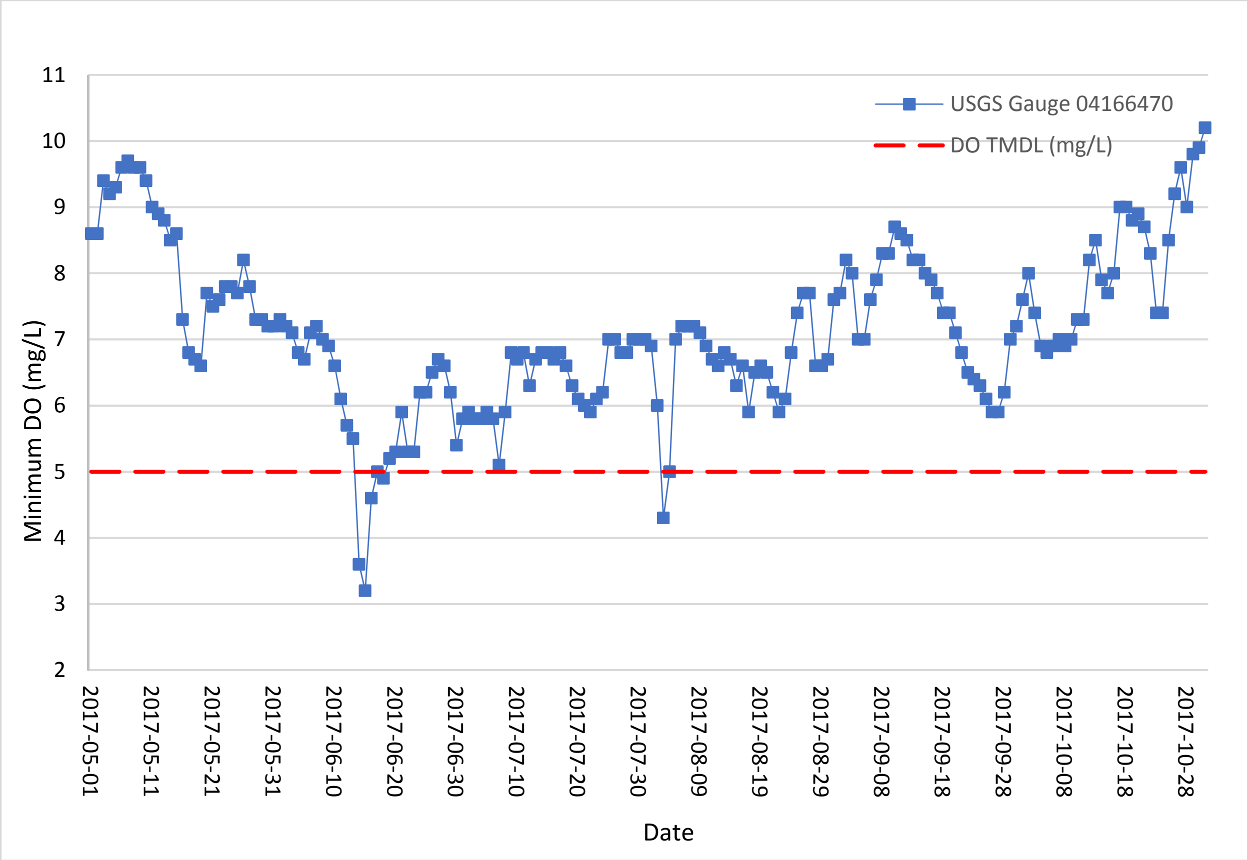


Figure A1-34: Middle Rouge at Johnson Creek, Station D03



APPENDIX A: UPPER ROUGE SUBWATERSHED (DATA SOURCE: USGS)

Figure A1-35: Upper Rouge at Detroit, MI, Station U05



Appendix B

Graphical Depictions of Distribution and Spread of *E. coli* and TSS Concentrations

APPENDIX B: DISTRIBUTION & SPREAD OF LEVELS

Figure A2-1: Distribution and spread of *E. coli* concentrations across the Lower Rouge for 2017 sampling period (Data Source: ECT 2017).

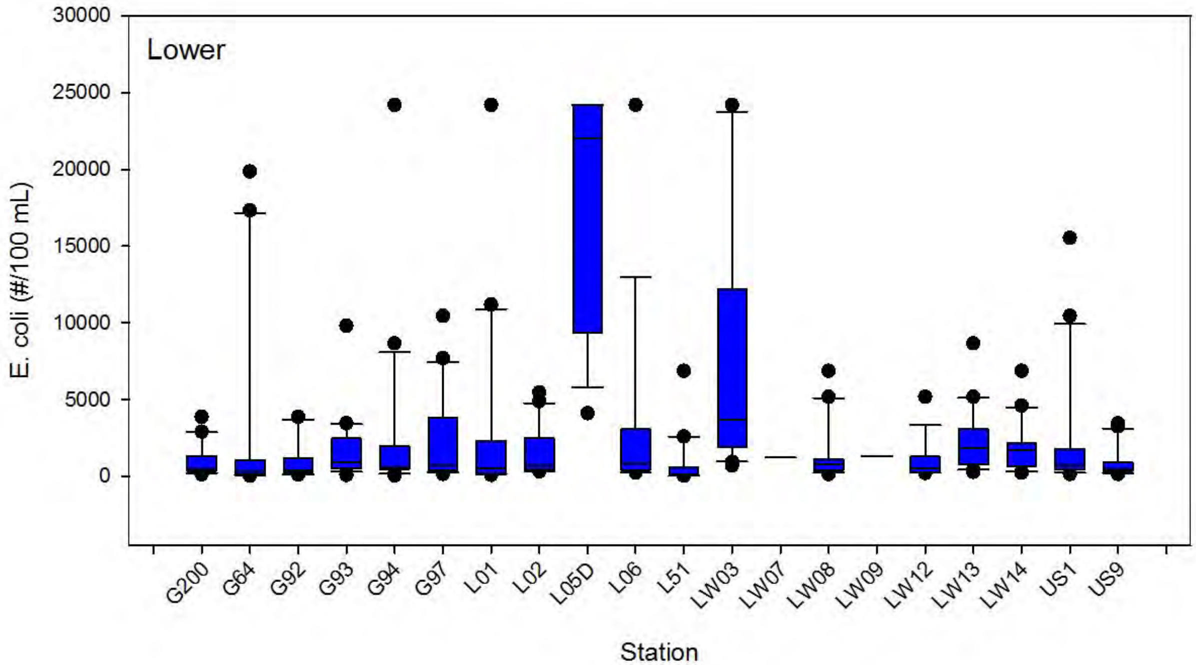


Figure A2-2: Distribution and spread of *E. coli* concentrations across the Main Rouge for 2017 sampling period (Data Source: ECT 2017).

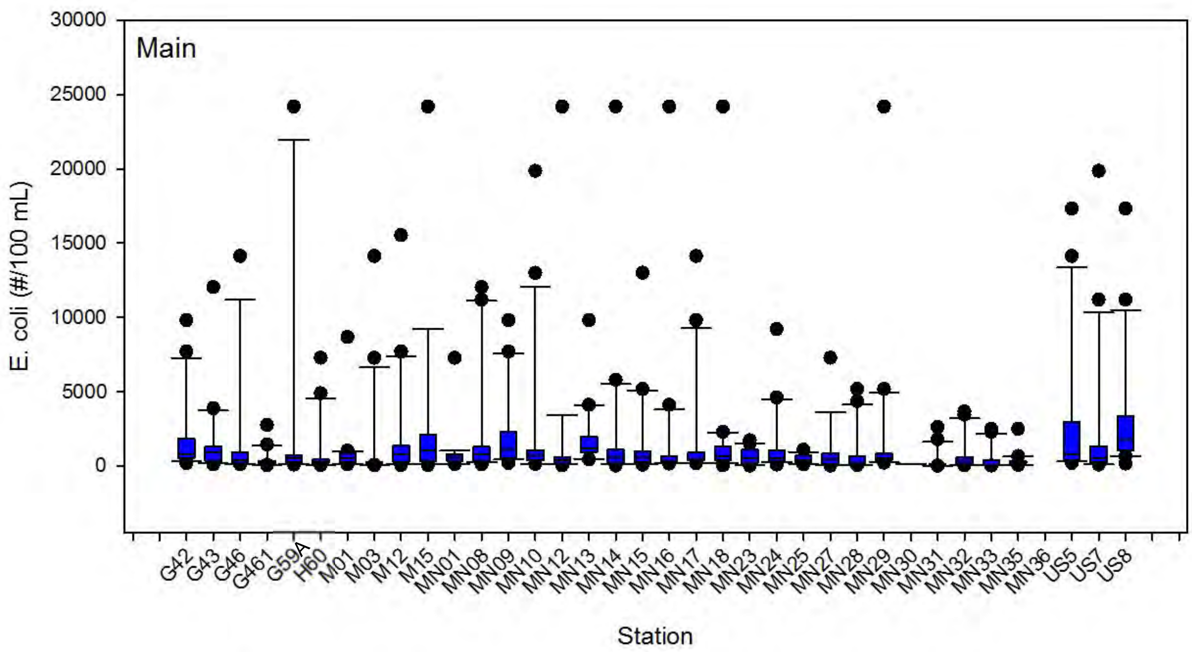


Figure A2-3: Distribution and spread of *E. coli* concentrations across the Middle Rouge for 2017 sampling period (Data Source: ECT 2017).

APPENDIX B: DISTRIBUTION & SPREAD OF LEVELS

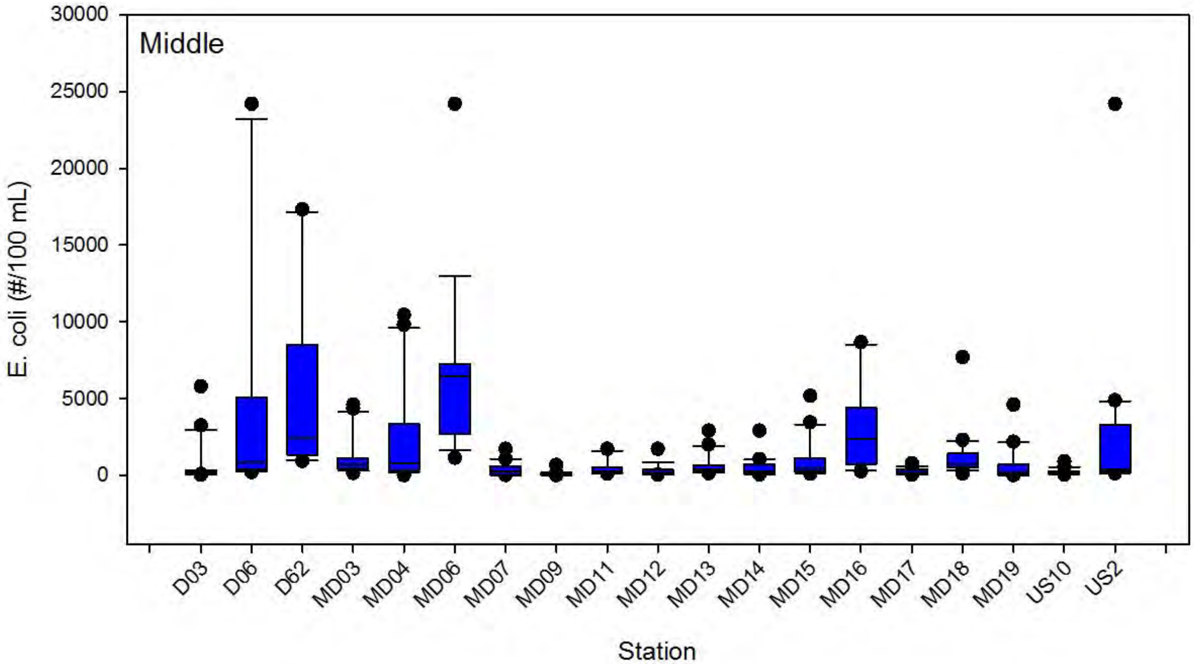
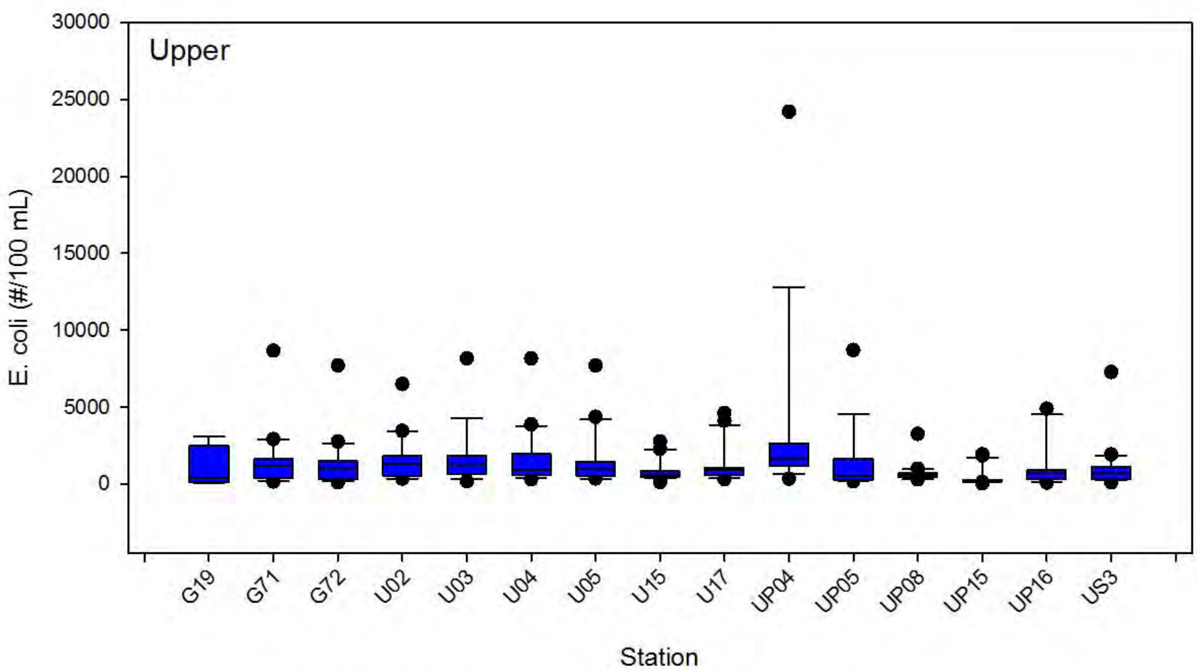


Figure A2-4: Distribution and spread of *E. coli* concentrations across the Upper Rouge for 2017 sampling period (Data Source: ECT 2017).



APPENDIX B: DISTRIBUTION & SPREAD OF LEVELS

Figure A2-5: Distribution and spread of Total Suspended Solids (TSS) concentrations across the Lower Rouge for 2017 sampling period (Data Source: ECT 2017).

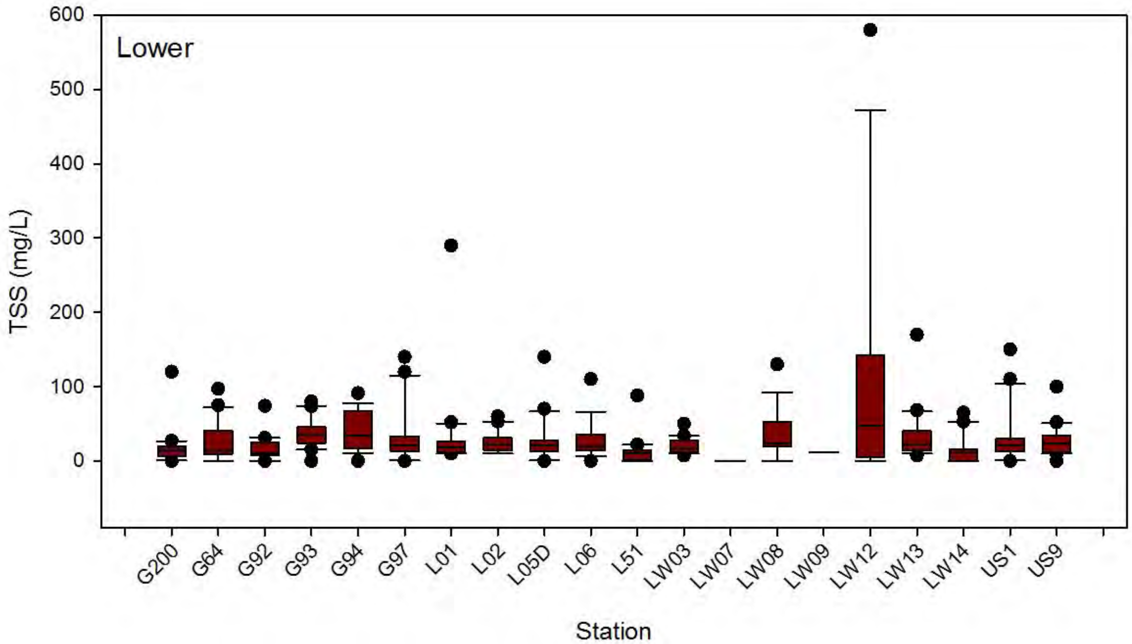
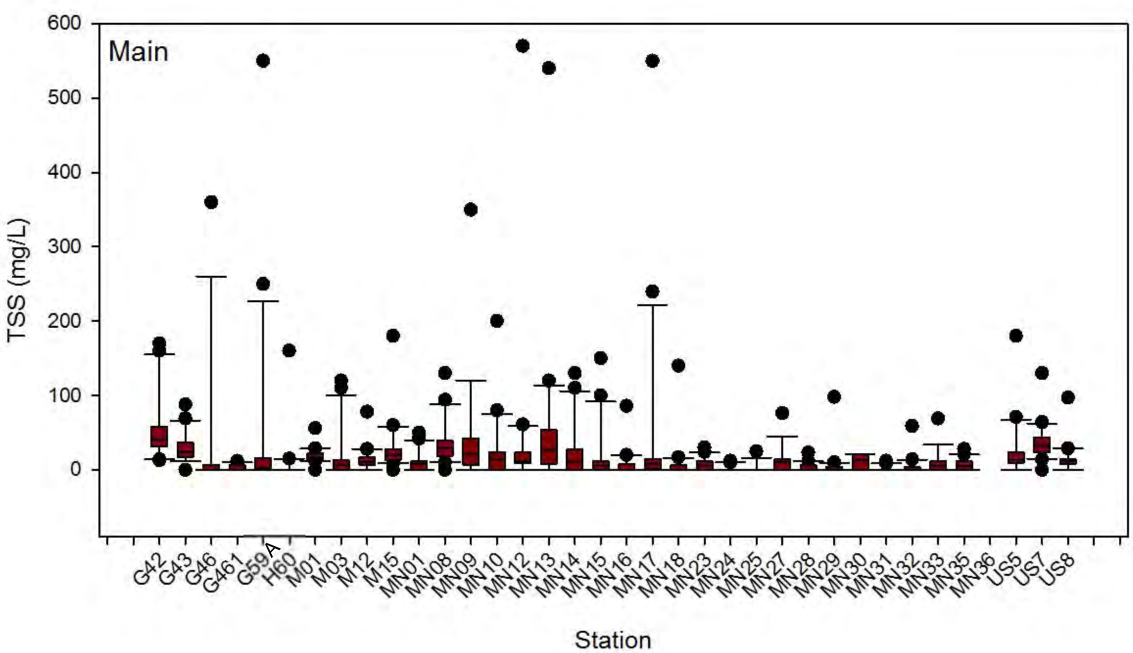


Figure A2-6: Distribution and spread of Total Suspended Solids (TSS) concentrations across the Main Rouge for 2017 sampling period (Data Source: ECT 2017).



APPENDIX B: DISTRIBUTION & SPREAD OF LEVELS

Figure A2-7: Distribution and spread of Total Suspended Solids (TSS) concentrations across the Middle Rouge for 2017 sampling period (Data Source: ECT 2017).

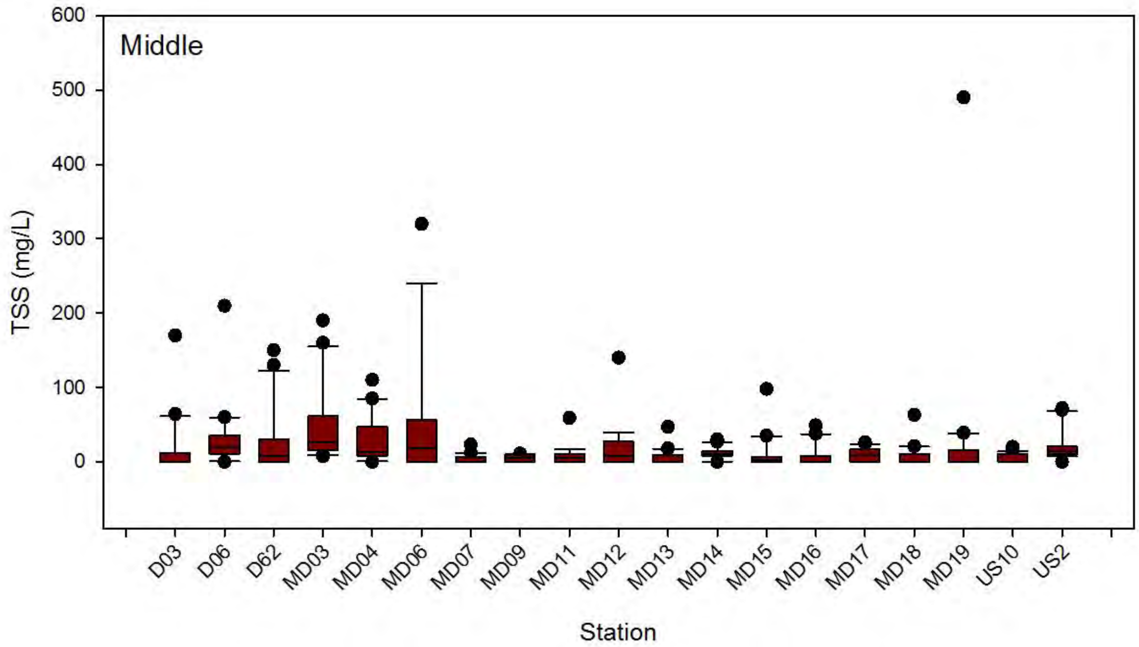
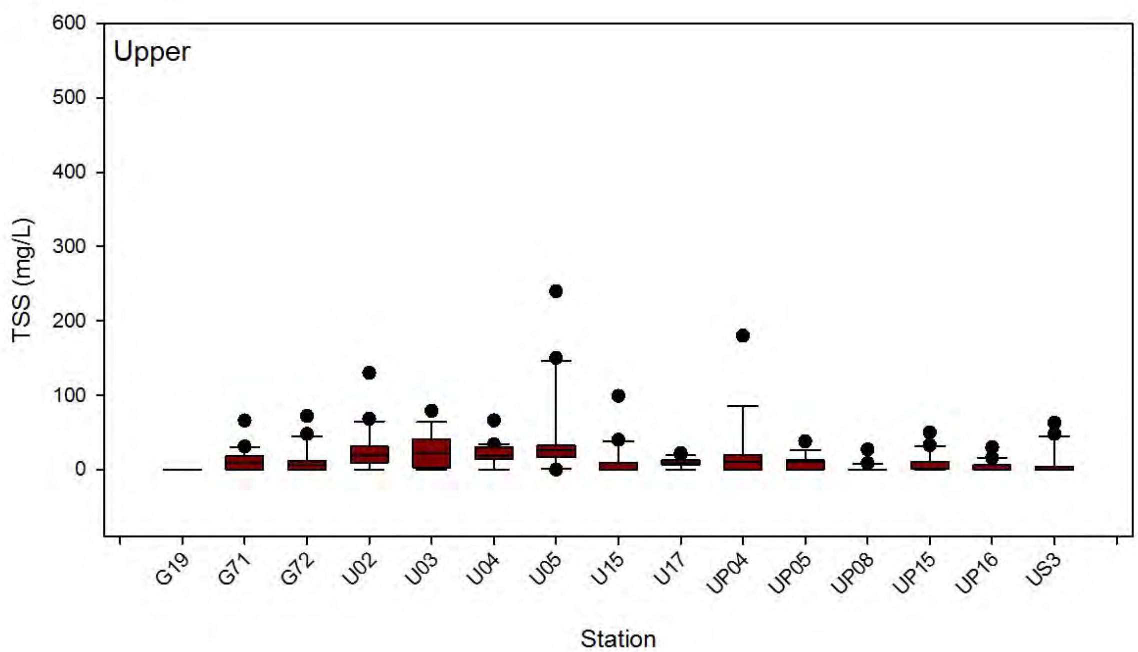


Figure A2-8: Distribution and spread of Total Suspended Solids (TSS) concentrations across the Upper Rouge for 2017 sampling period (Data Source: ECT 2017).



APPENDIX B: DISTRIBUTION & SPREAD OF LEVELS

Figure A2-9: Average *E. coli* concentrations across the Lower Rouge for 2005/2006 sampling period (Data Source: MDEQ 2007).

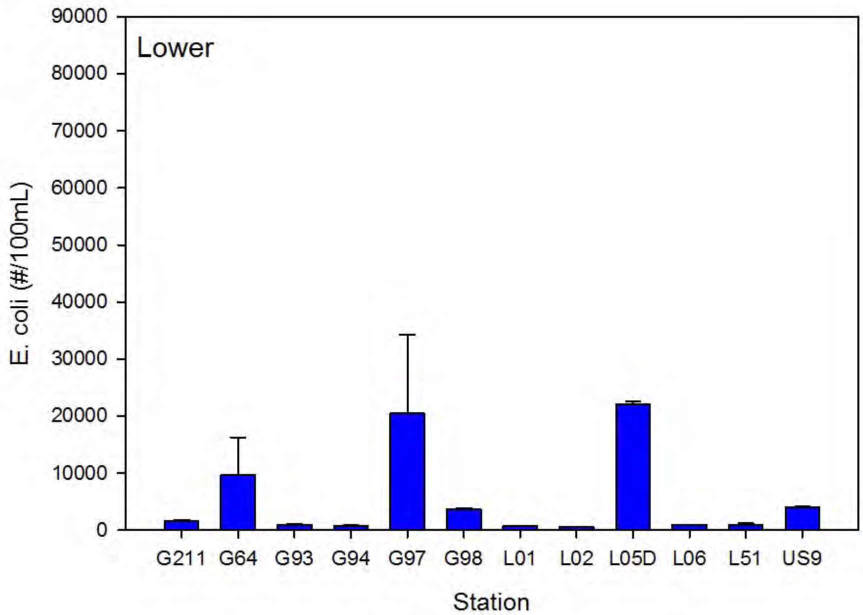
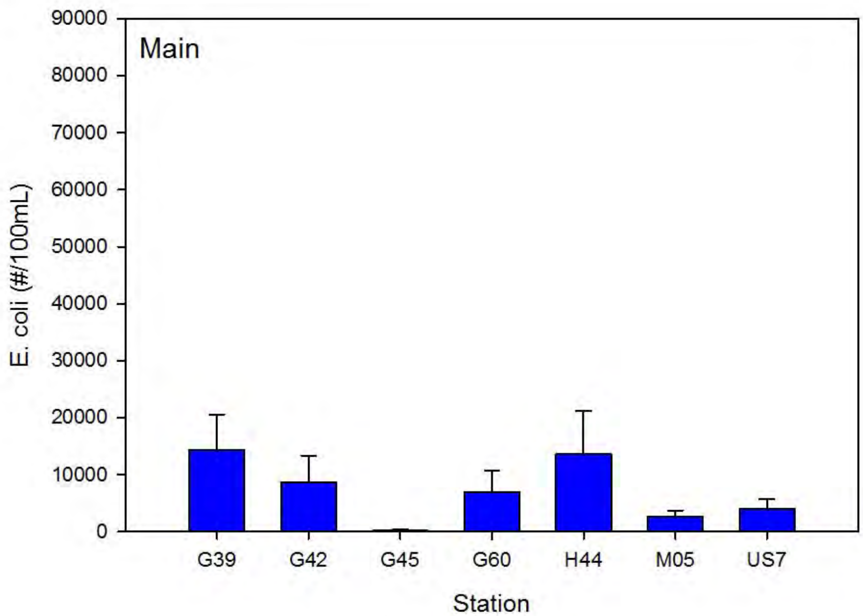


Figure A2-10: Average *E. coli* concentrations across the Main Rouge for 2005/2006 sampling period (Data Source: MDEQ 2007).



APPENDIX B: DISTRIBUTION & SPREAD OF LEVELS

Figure A2-11: Average *E. coli* concentrations across the Middle Rouge for 2005/2006 sampling period (Data Source: MDEQ 2007).

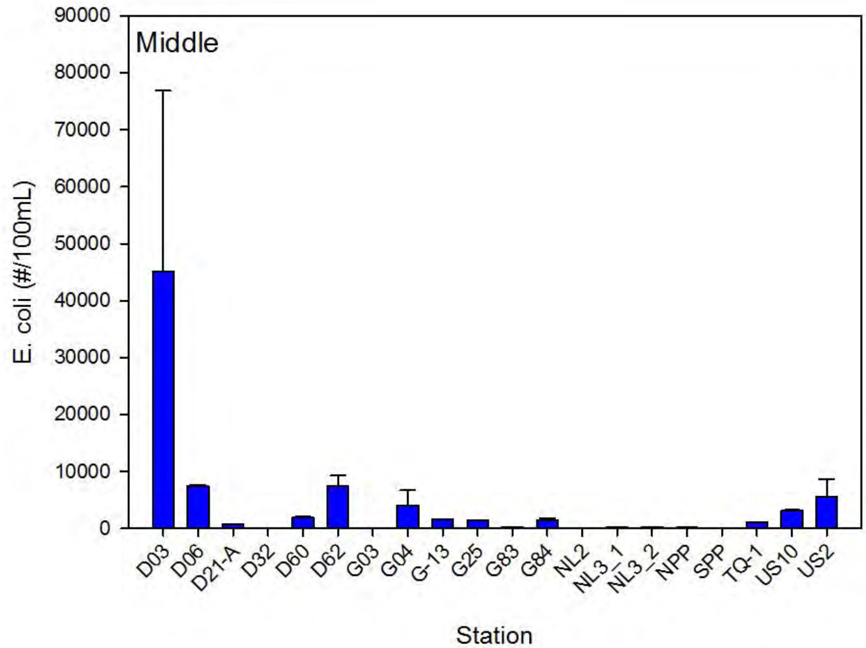
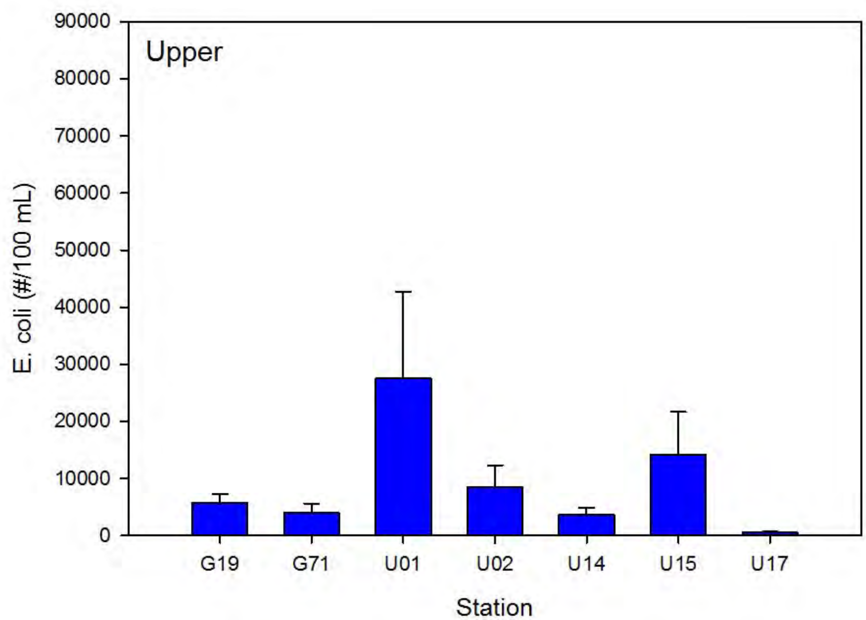


Figure A2-12: Average *E. coli* concentrations across the Upper Rouge for 2005/2006 sampling period (Data Source: MDEQ 2007).



APPENDIX B: DISTRIBUTION & SPREAD OF LEVELS

Figure A2-13: Average Total Suspended Solids (TSS) concentrations across the Lower Rouge for 2005/2006 sampling period (Data Source: MDEQ 2007).

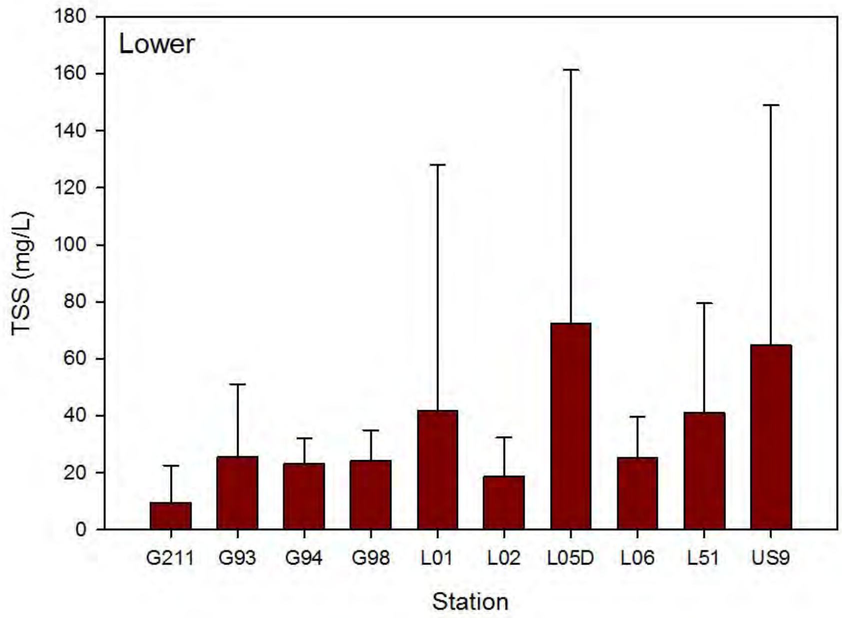
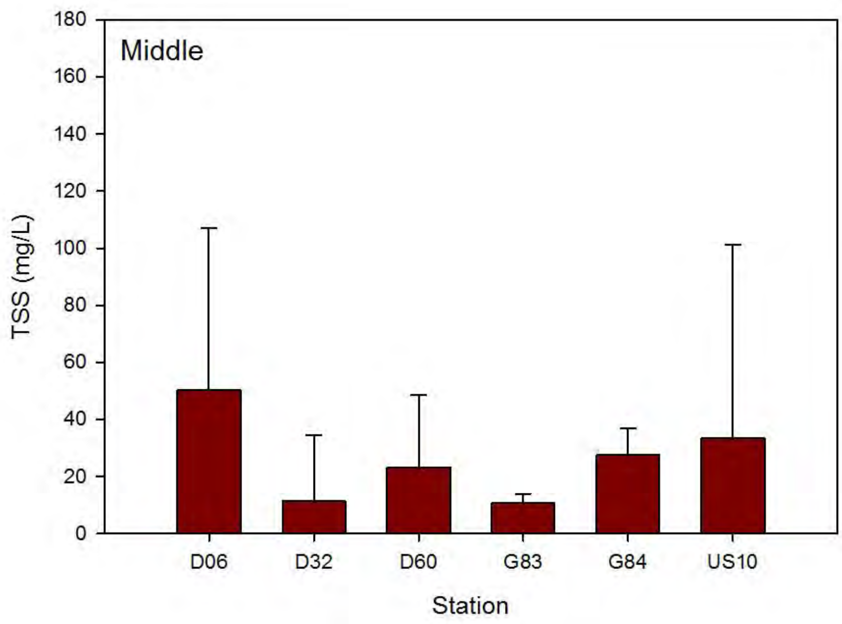


Figure A2-14: Average Total Suspended Solids (TSS) concentrations across the Middle Rouge for 2005/2006 sampling period (Data Source: MDEQ 2007).



Appendix C

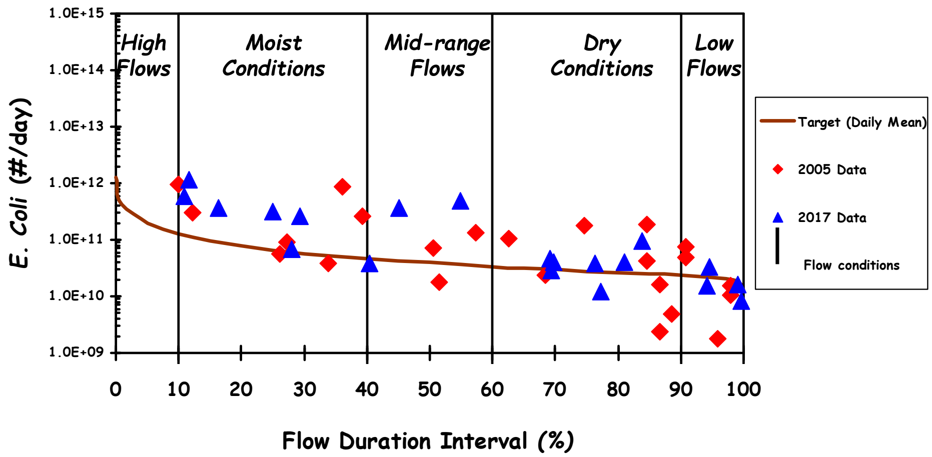
Load Duration Curves for *E. coli* concentrations in Lower, Main, and Middle Rouge Subwatersheds

Lower Rouge

Lower Rouge at Denton Rd

Load Duration Curve *(2005+2017 Monitoring Data)*

Site: G200

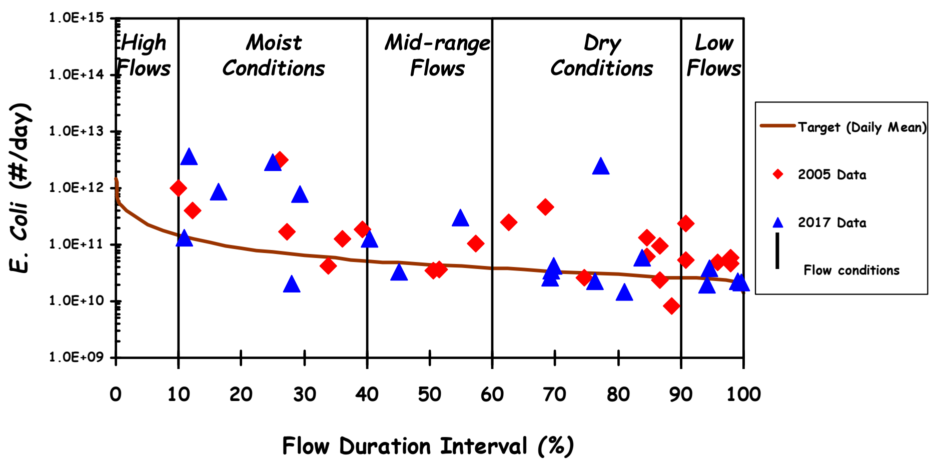


E. Coli Data & USGS Gage 04168400 Duration Interval *7.86 square miles*

Lower Rouge at Beck Rd

Load Duration Curve *(2005+2017 Monitoring Data)*

Site: L01

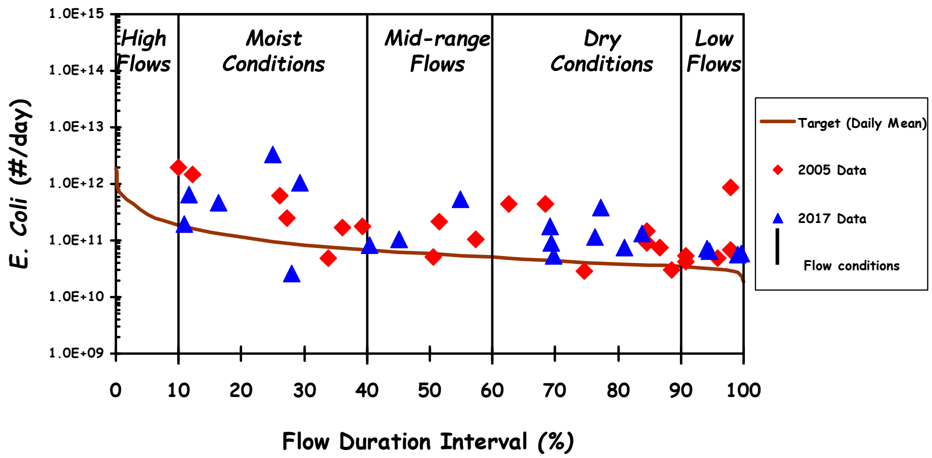


E. Coli Data & USGS Gage 04168400 Duration Interval *8.97 square miles*

Fowler Creek at Beck Rd

Load Duration Curve *(2005+2017 Monitoring Data)*

Site: G93

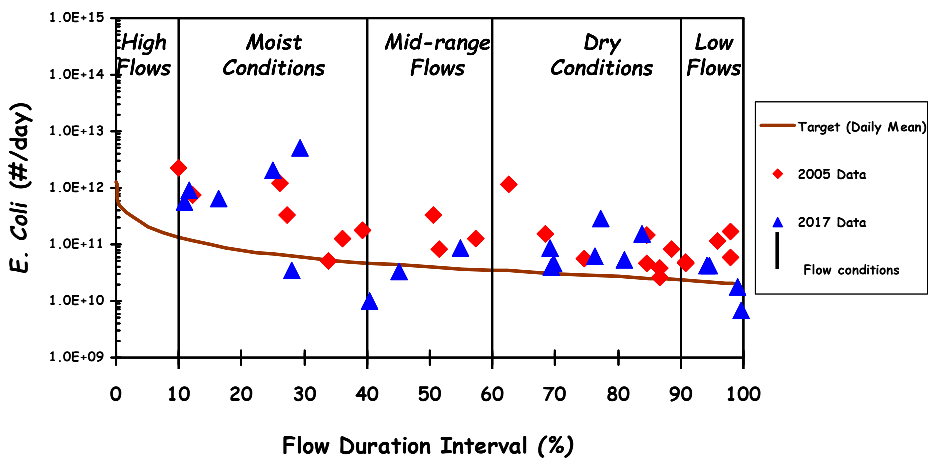


E. Coli Data & USGS Gage 04168400 Duration Interval *11.64 square miles*

Sines Drain at Sheldon Rd

Load Duration Curve *(2005+2017 Monitoring Data)*

Site: G94

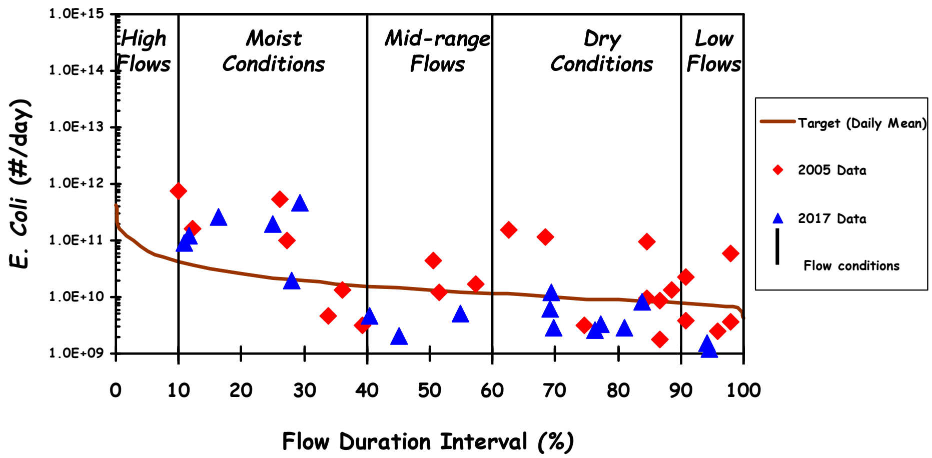


E. Coli Data & USGS Gage 04168400 Duration Interval *8.09 square miles*

McKinstry Drain at Michigan Ave

Load Duration Curve *(2005+2017 Monitoring Data)*

Site: L51

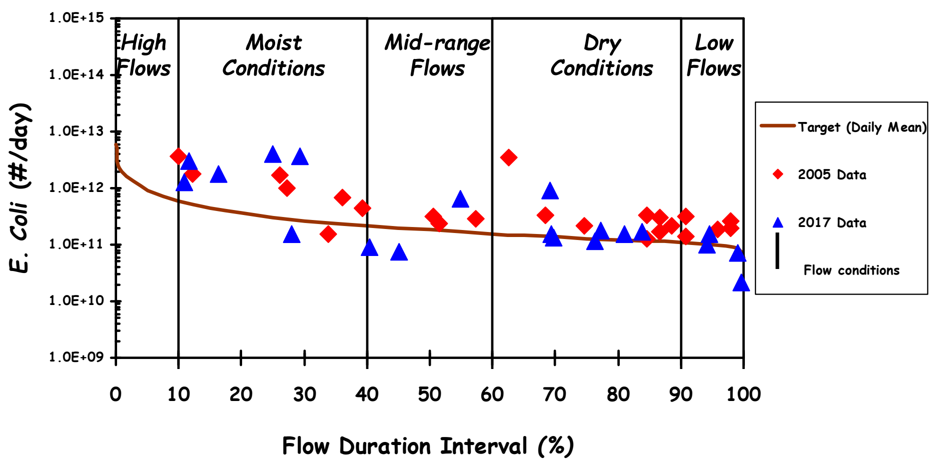


E. Coli Data & USGS Gage 04168400 Duration Interval *2.65 square miles*

Lower Rouge at Haggerty Rd

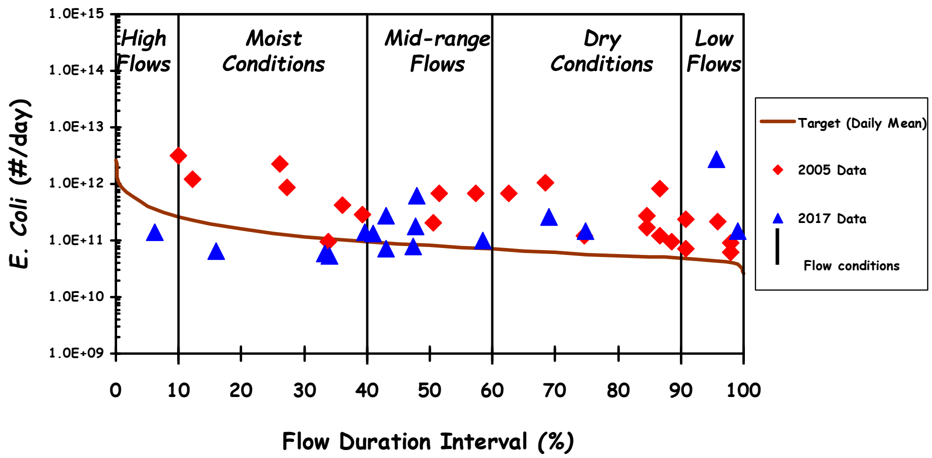
Load Duration Curve *(2005+2017 Monitoring Data)*

Site: G92



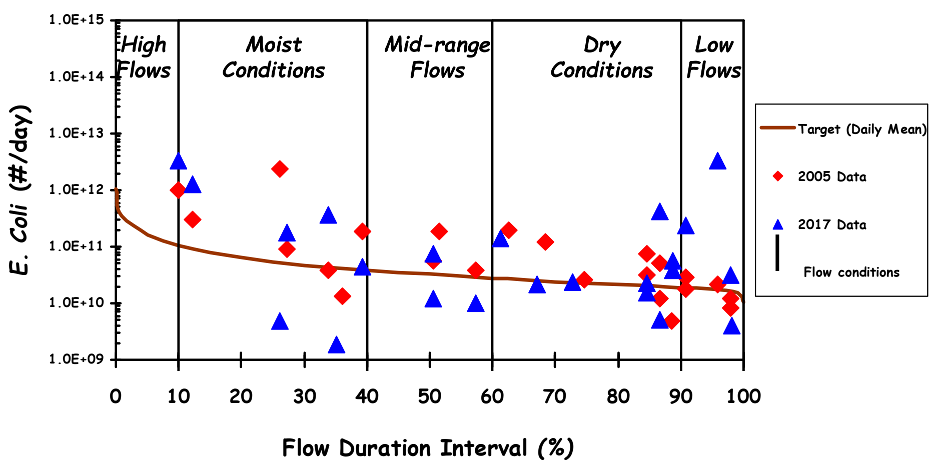
E. Coli Data & USGS Gage 04168400 Duration Interval *36.5 square miles*

Fellows Creek at Palmer Rd
Load Duration Curve *(2005+2017 Monitoring Data)*
Site: L02



E. Coli Data & USGS Gage 04168400 Duration Interval *16.2 square miles*

McClaughrey Drain at Annapolis
Load Duration Curve *(2005+2017 Monitoring Data)*
Site: G64

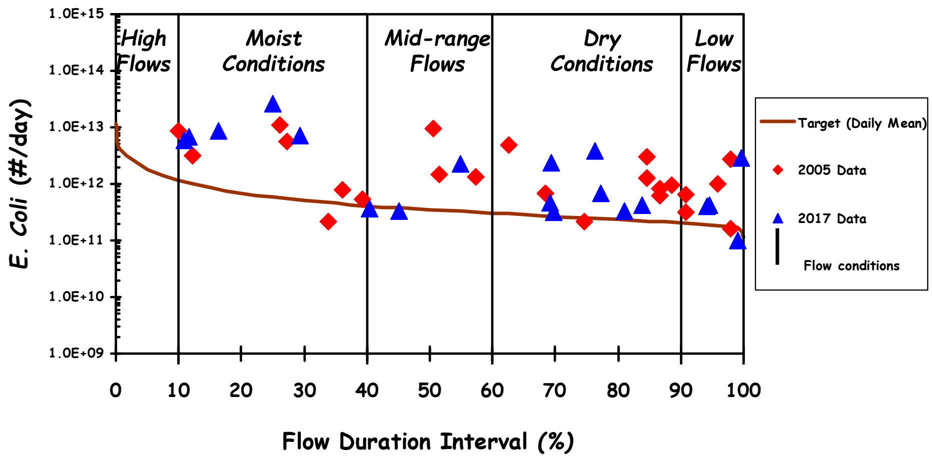


E. Coli Data & USGS Gage 04168400 Duration Interval *6.46 square miles*

Lower Rouge at Wayne Rd

Load Duration Curve *(2005+2017 Monitoring Data)*

Site: LO6

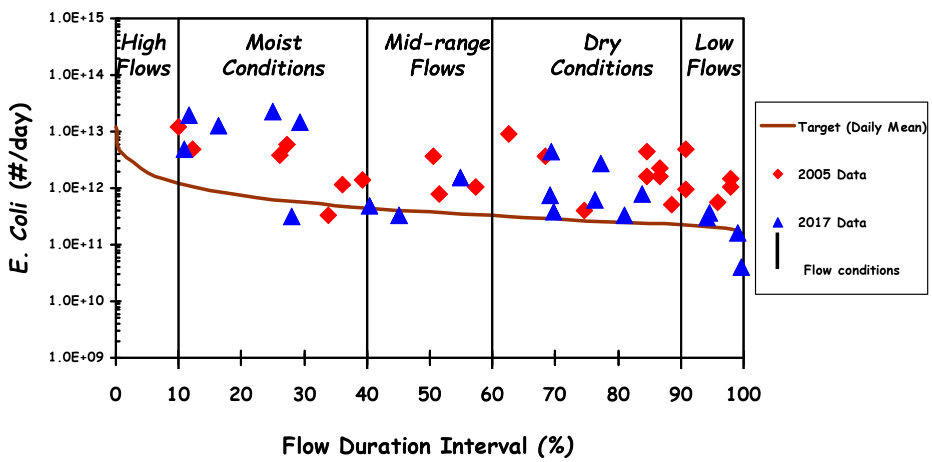


E. Coli Data & USGS Gage 04168400 Duration Interval *70.5 square miles*

Lower Rouge at Henry Ruff Rd

Load Duration Curve *(2005+2017 Monitoring Data)*

Site: G97

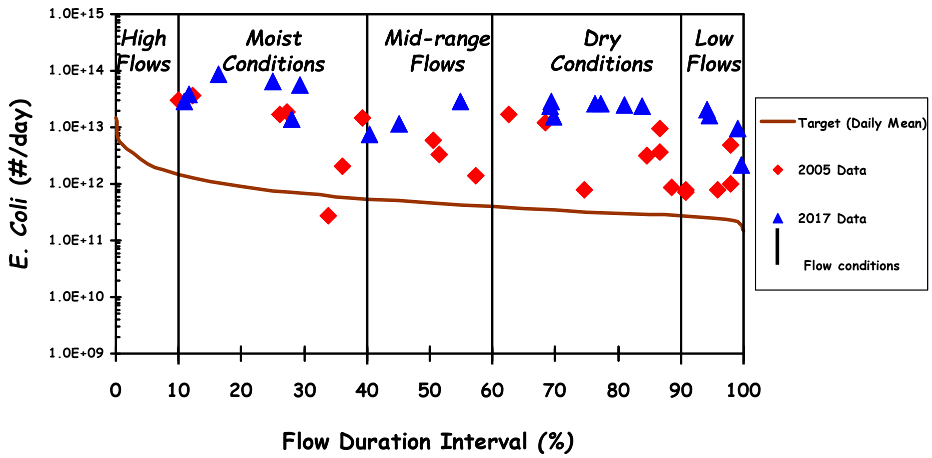


E. Coli Data & USGS Gage 04168400 Duration Interval *75.7 square miles*

Lower Rouge at Military Rd

Load Duration Curve *(2005+2017 Monitoring Data)*

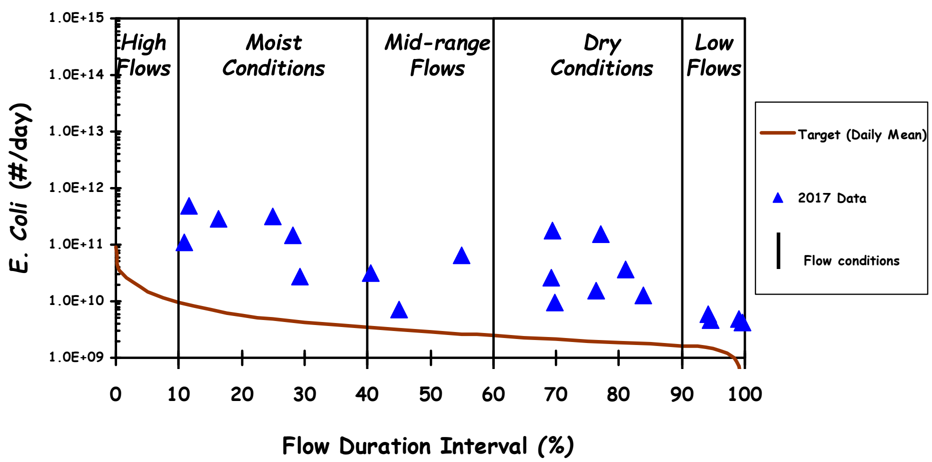
Site: L05D



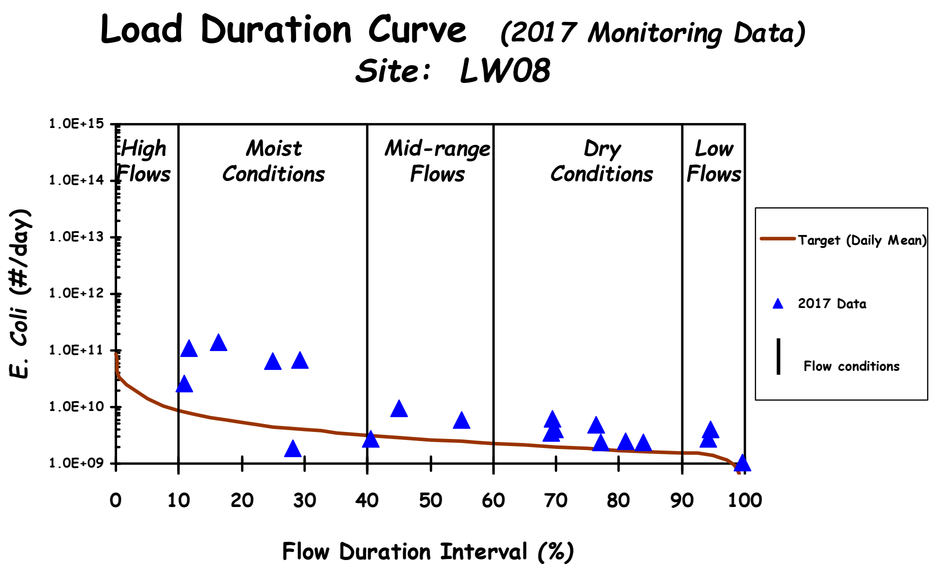
E. Coli Data & USGS Gage 04168400 Duration Interval *91.2 square miles*

Load Duration Curve *(2017 Monitoring Data)*

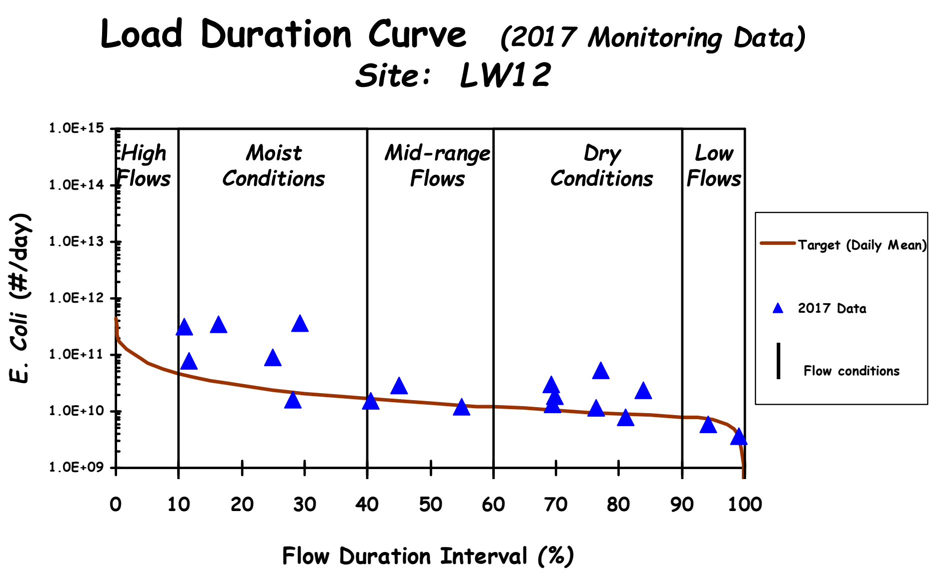
Site: LW03



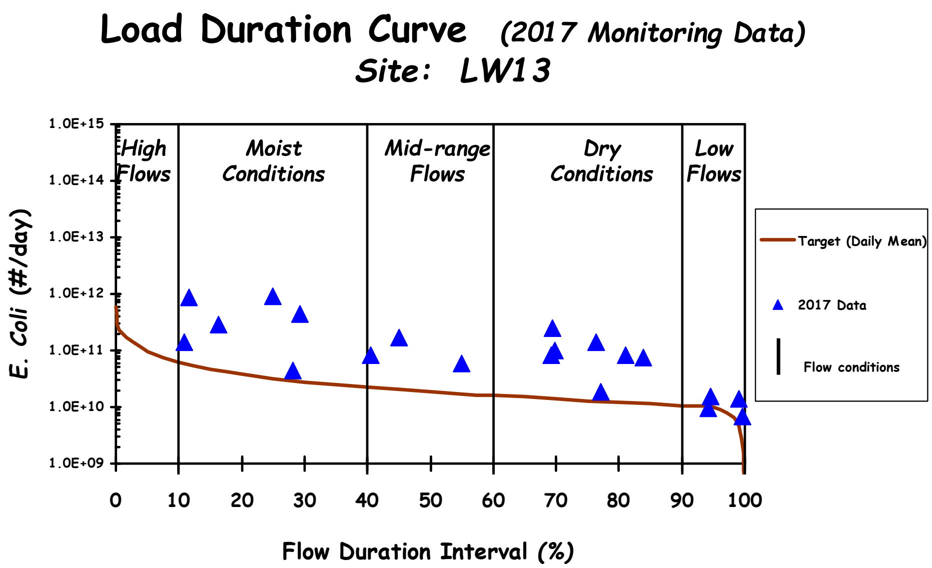
E. Coli Data & USGS Gage 04168400 Duration Interval *0.56 square miles*



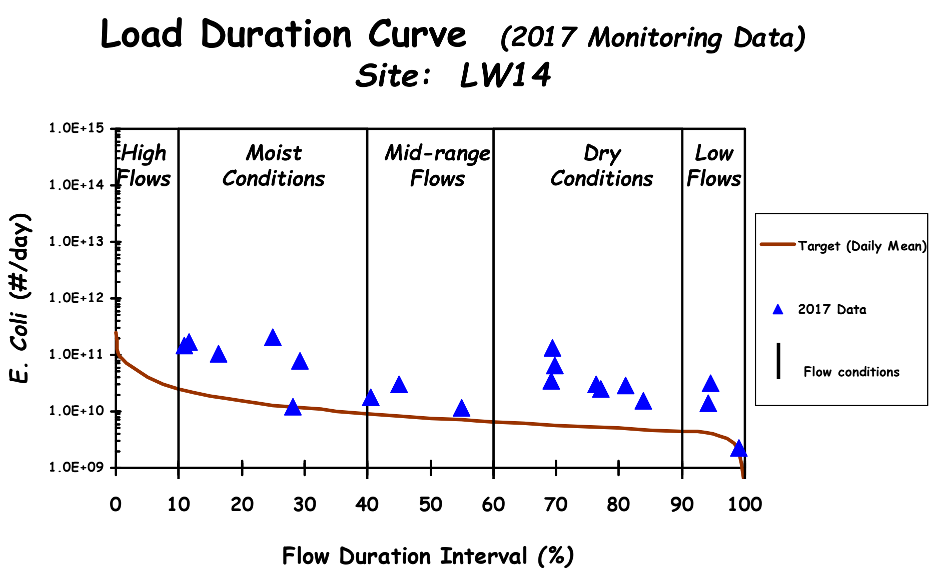
E. Coli Data & USGS Gage 04168400 Duration Interval 0.52 square miles



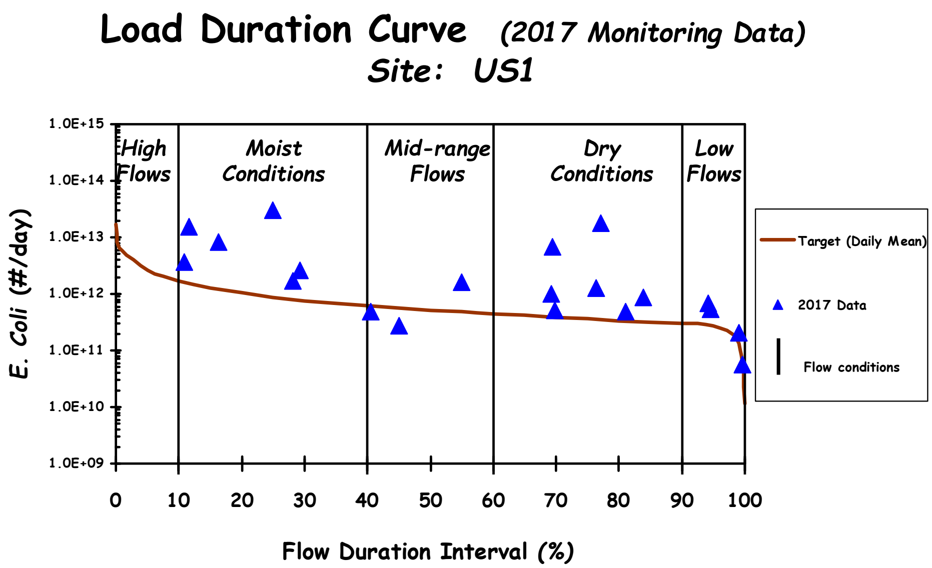
E. Coli Data & USGS Gage 04168400 Duration Interval 2.75 square miles



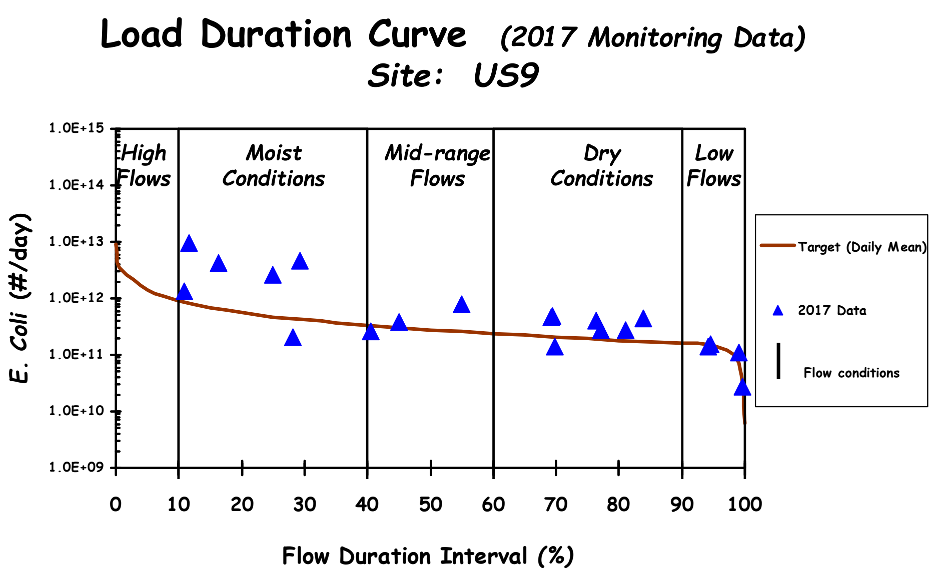
E. Coli Data & USGS Gage 04168400 Duration Interval *3.67 square miles*



E. Coli Data & USGS Gage 04168400 Duration Interval *1.50 square miles*



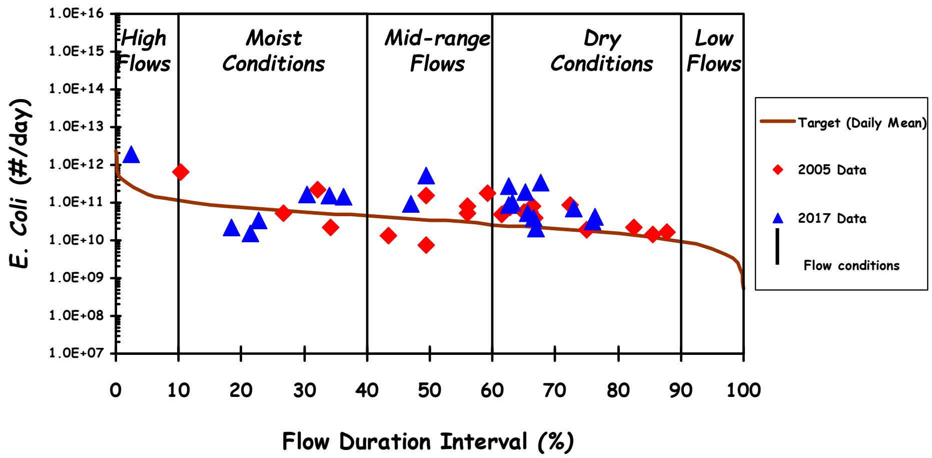
E. Coli Data & USGS Gage 04168400 Duration Interval 101.5 square miles



E. Coli Data & USGS Gage 04168400 Duration Interval 54.5 square miles

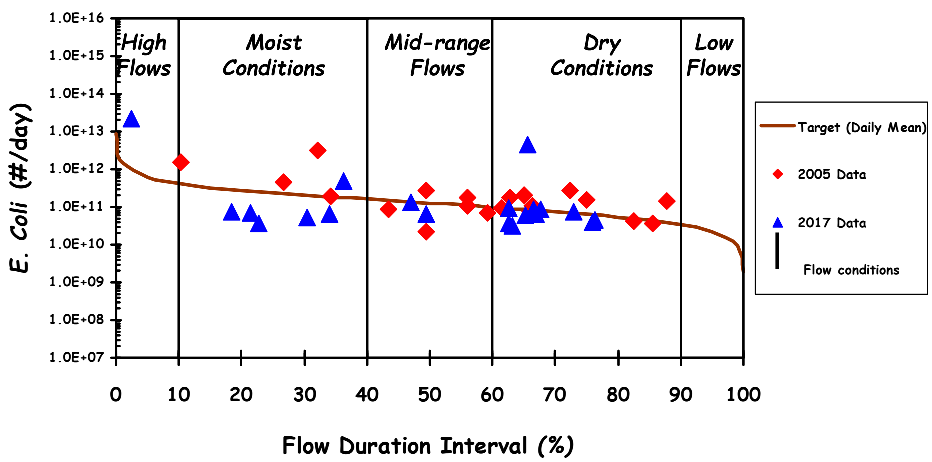
Main Rouge

Main Rouge at Adams Rd
Load Duration Curve *(2005 Monitoring Data)*
Site: M01



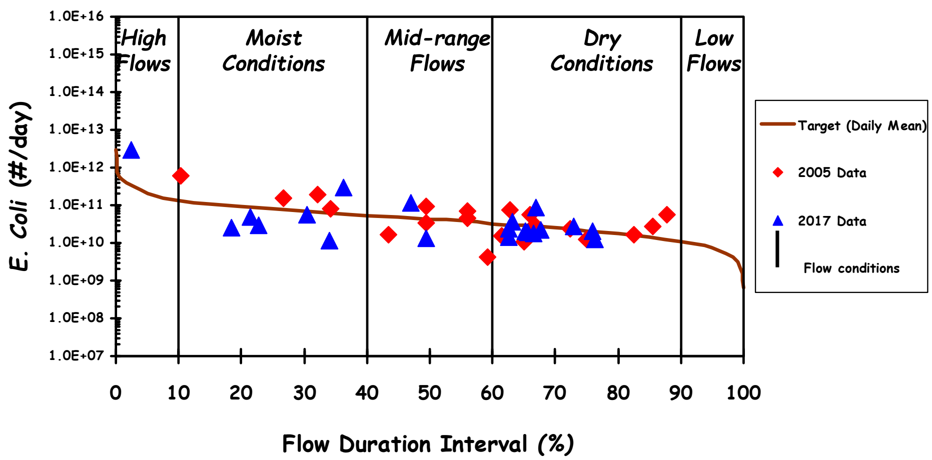
E. Coli Data & USGS Gage Duration Interval 04166000 *11.89 square miles*

Main Rouge at Lahser Rd
Load Duration Curve *(2005 Monitoring Data)*
Site: M03



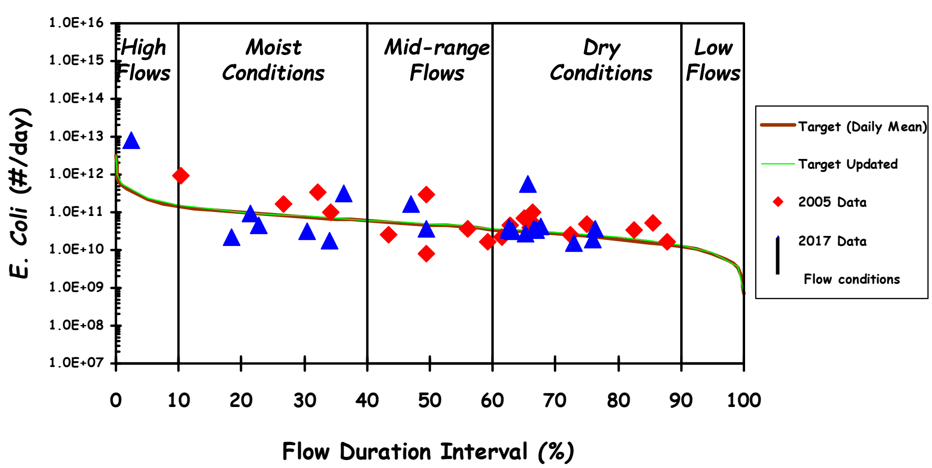
E. Coli Data & USGS Gage Duration Interval 04166000 *43.13 square miles*

Franklin Branch at Franklin Rd
Load Duration Curve *(2005 Monitoring Data)*
Site: G461



E. Coli Data & USGS Gage Duration Interval 04166000 *14.34 square miles*

Franklin Branch at 13 Mile Rd
Load Duration Curve *(2005 Monitoring Data)*
Site: H60

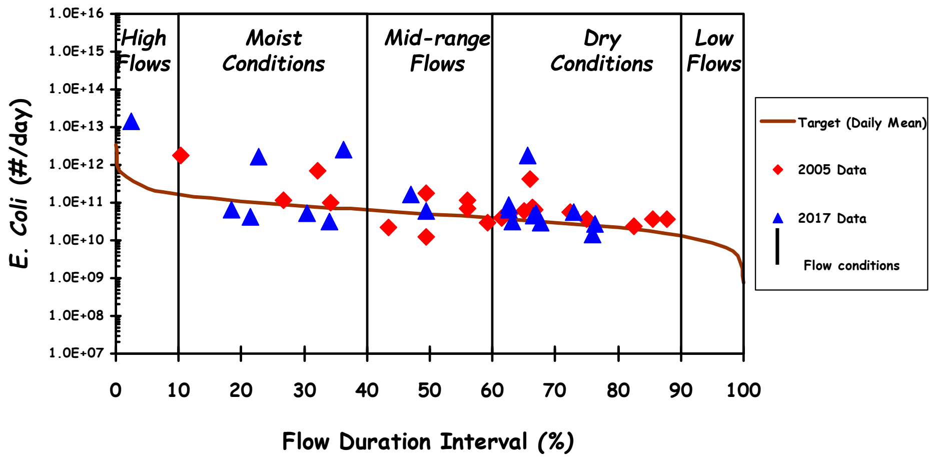


E. Coli Data & USGS Gage Duration Interval 04166000 *15.6 square miles*

Franklin Branch at 12 Mile Rd

Load Duration Curve *(2005 Monitoring Data)*

Site: G46

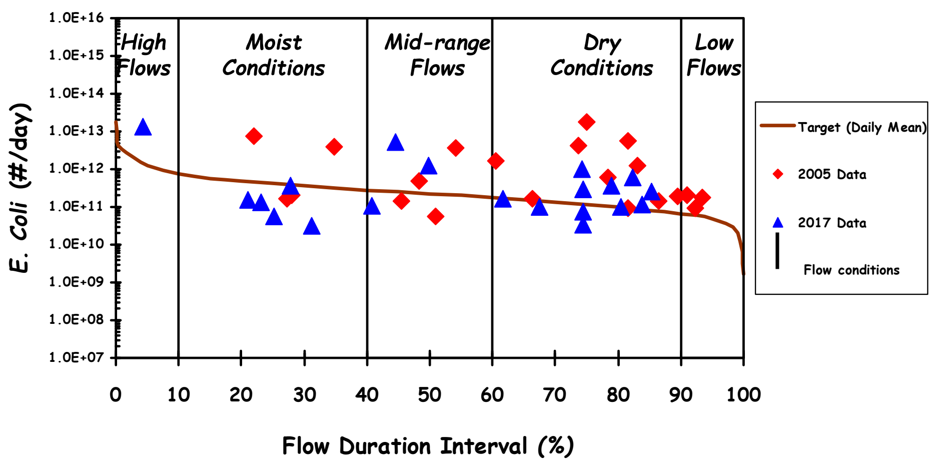


E. Coli Data & USGS Gage Duration Interval 04166000 *17.20 square miles*

Main Rouge at 10 mile west of Telegraph

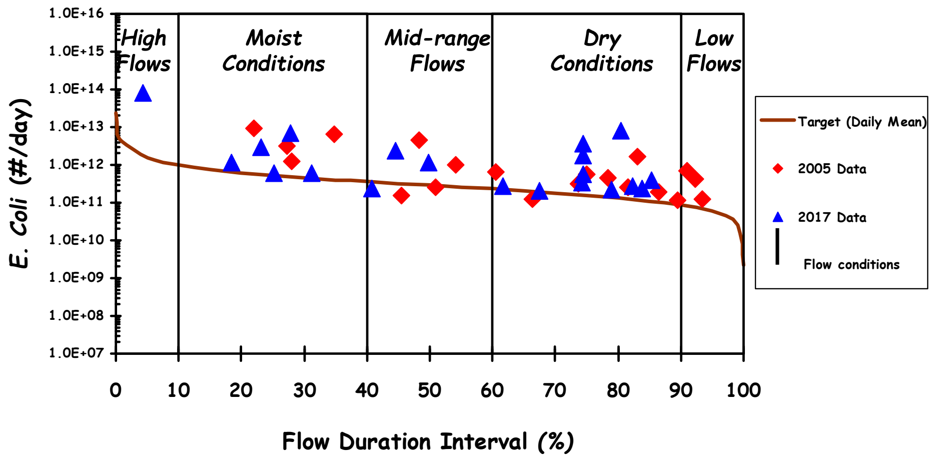
Load Duration Curve *(2005 Monitoring Data)*

Site: G59A



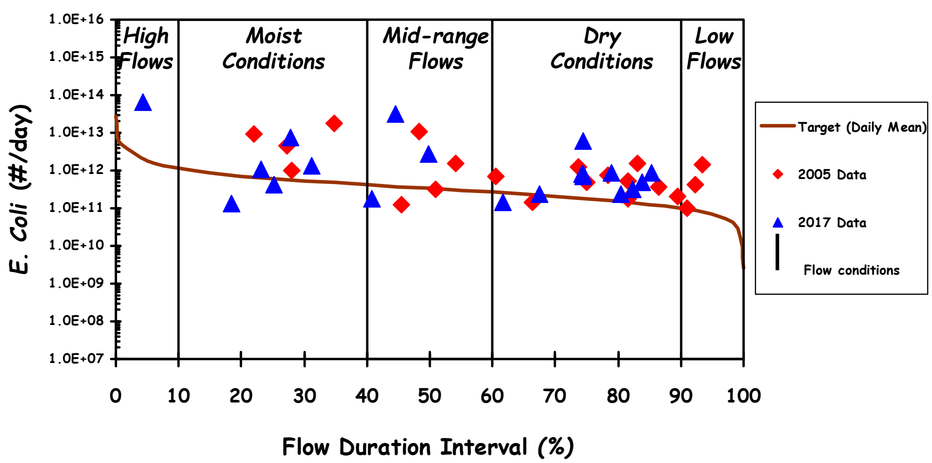
E. Coli Data & USGS Gage Duration Interval 04166100 *66.14 square miles*

Main Rouge at Beech Road
Load Duration Curve *(2005 Monitoring Data)*
Site: US5

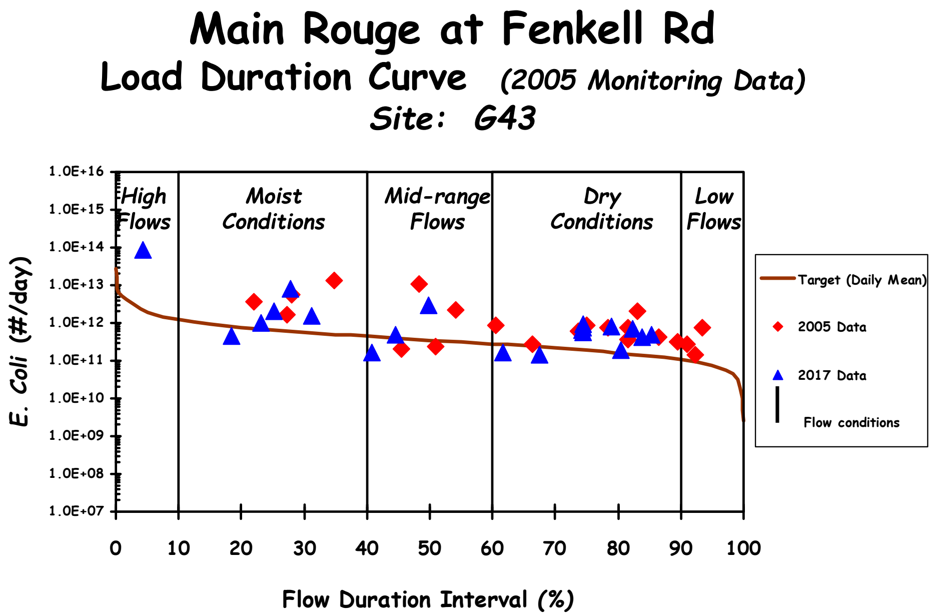


E. Coli Data & USGS Gage Duration Interval 04166100 *86.89 square miles*

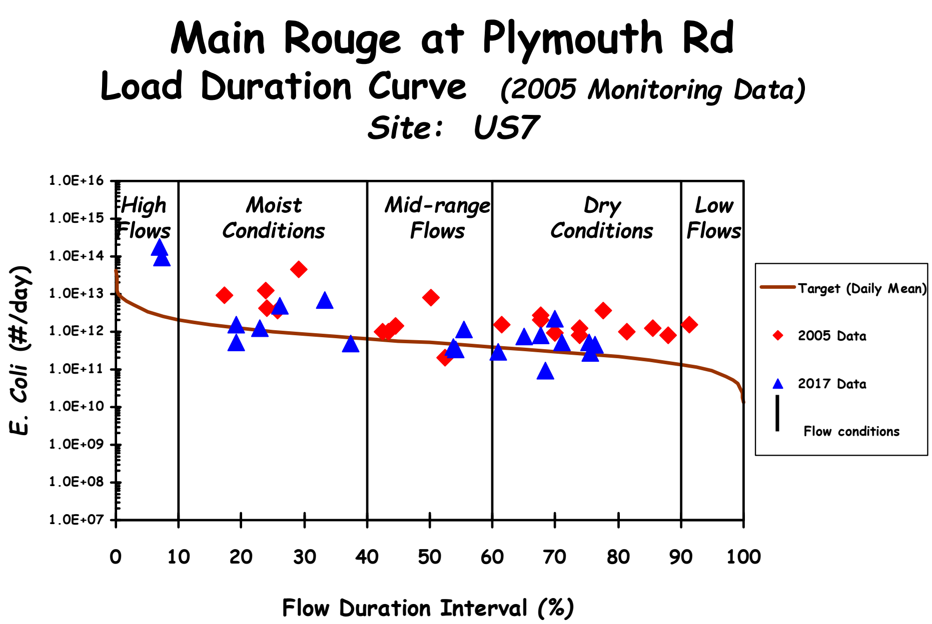
Main Rouge north of 7 Mile Rd at Bonnie Brook Golf Course
Load Duration Curve *(2005 Monitoring Data)*
Site: M15



E. Coli Data & USGS Gage Duration Interval 04166100 *100.74 square miles*



E. Coli Data & USGS Gage Duration Interval 04166100 — 105.36 square miles

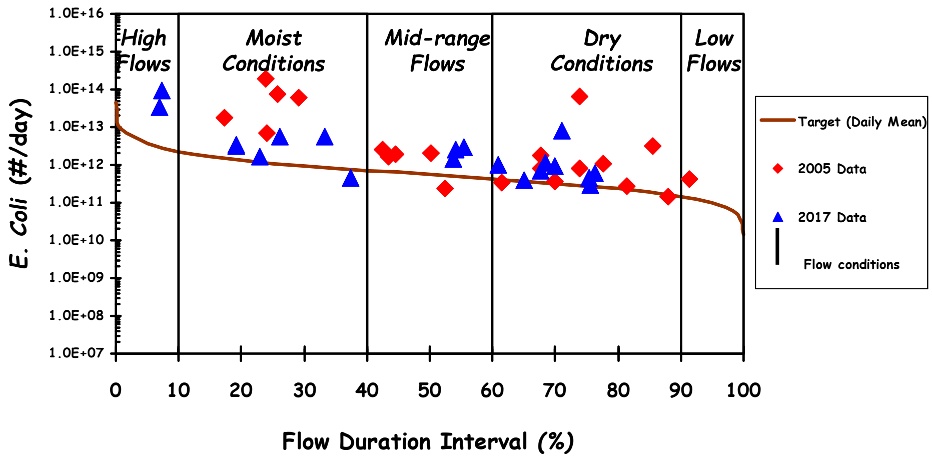


E. Coli Data & USGS Gage Duration Interval 04166500 — 184.26 square miles

Main Rouge at Ann Arbor Trail

Load Duration Curve *(2005 Monitoring Data)*

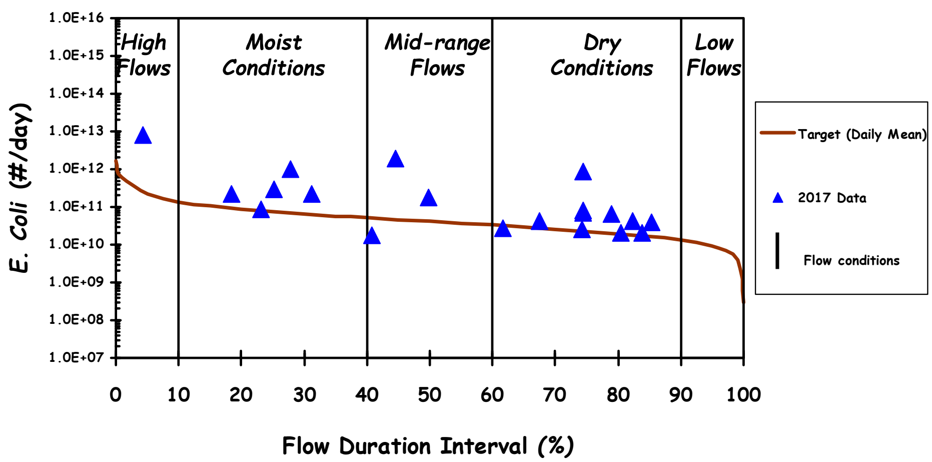
Site: G42



E. Coli Data & USGS Gage Duration Interval 04166500 *199.74 square miles*

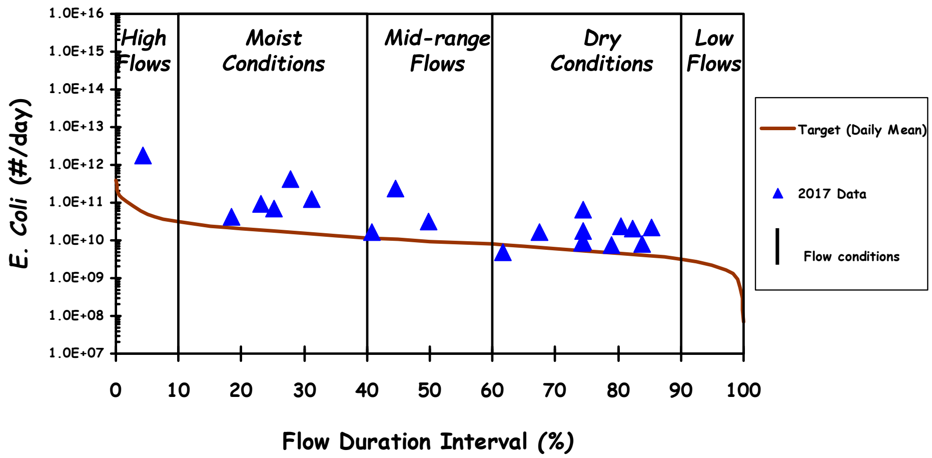
Load Duration Curve *(2017 Monitoring Data)*

Site: MN08



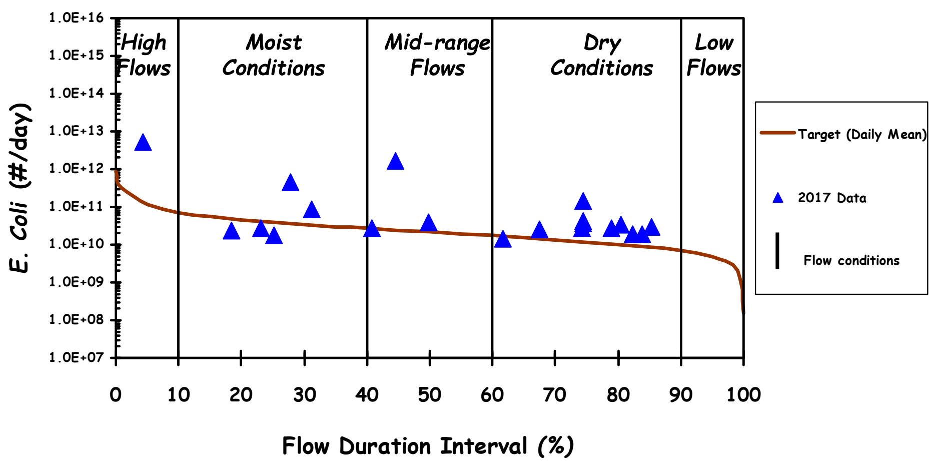
E. Coli Data & USGS Gage Duration Interval 04166100 *11.74 square miles*

Load Duration Curve *(2017 Monitoring Data)*
Site: MN09



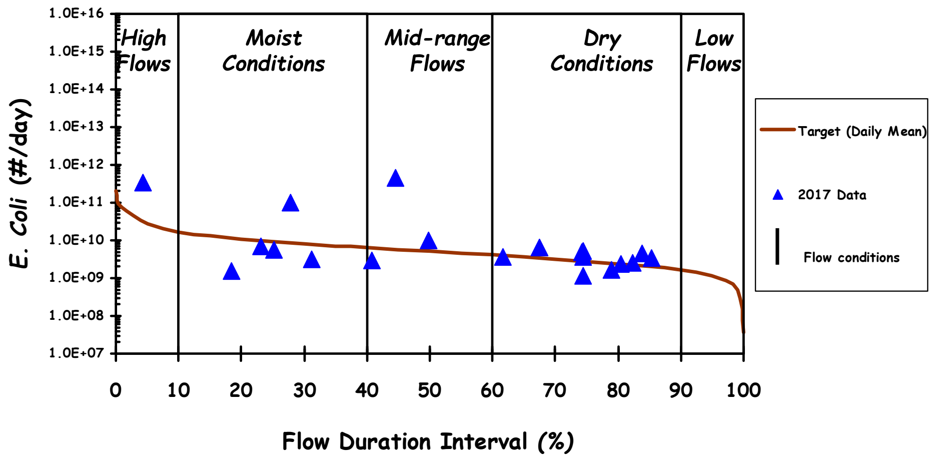
E. Coli Data & USGS Gage Duration Interval 04166100 *2.75 square miles*

Load Duration Curve *(2017 Monitoring Data)*
Site: MN10



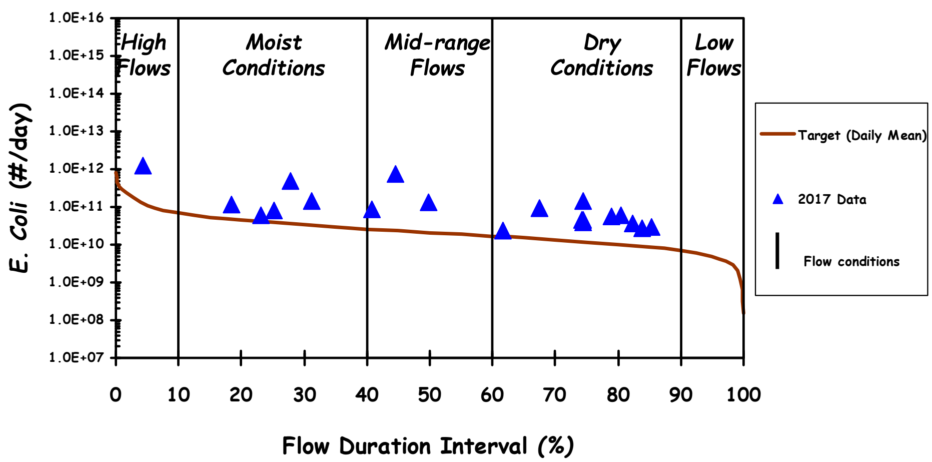
E. Coli Data & USGS Gage Duration Interval 04166100 *6.16 square miles*

Load Duration Curve *(2017 Monitoring Data)*
Site: MN12



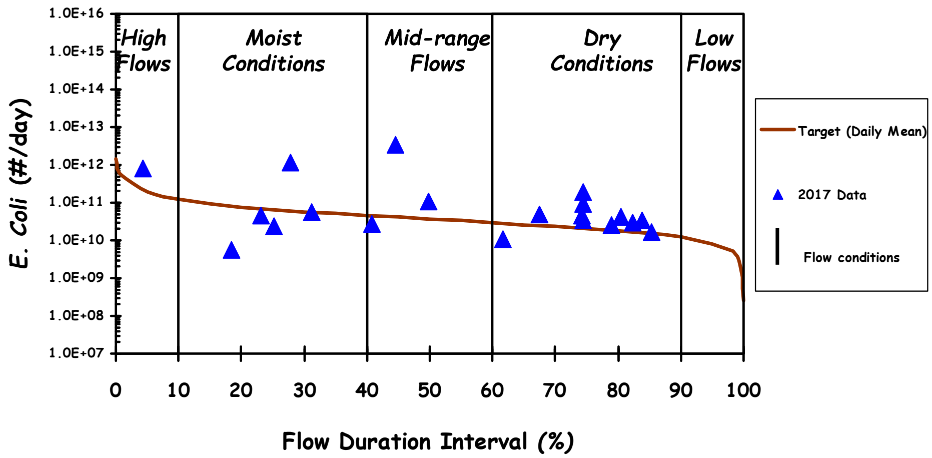
E. Coli Data & USGS Gage Duration Interval 04166100 *1.46 square miles*

Load Duration Curve *(2017 Monitoring Data)*
Site: MN13



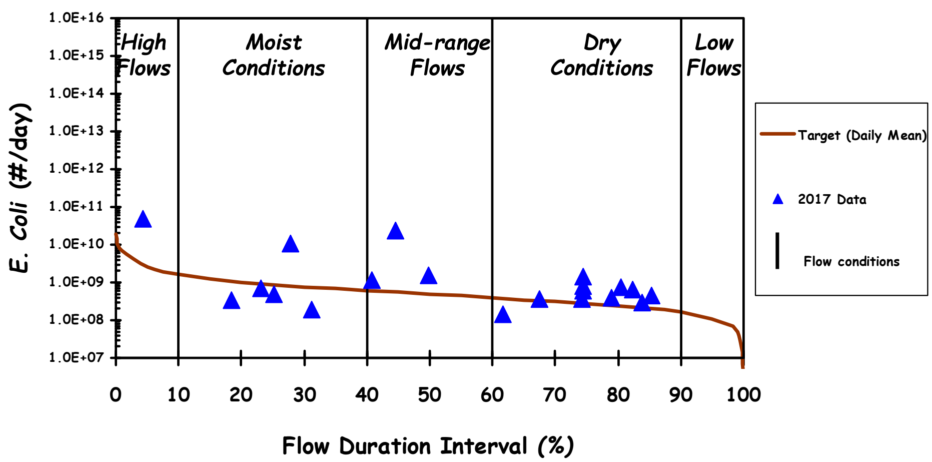
E. Coli Data & USGS Gage Duration Interval 04166100 *5.96 square miles*

Load Duration Curve *(2017 Monitoring Data)*
Site: MN14

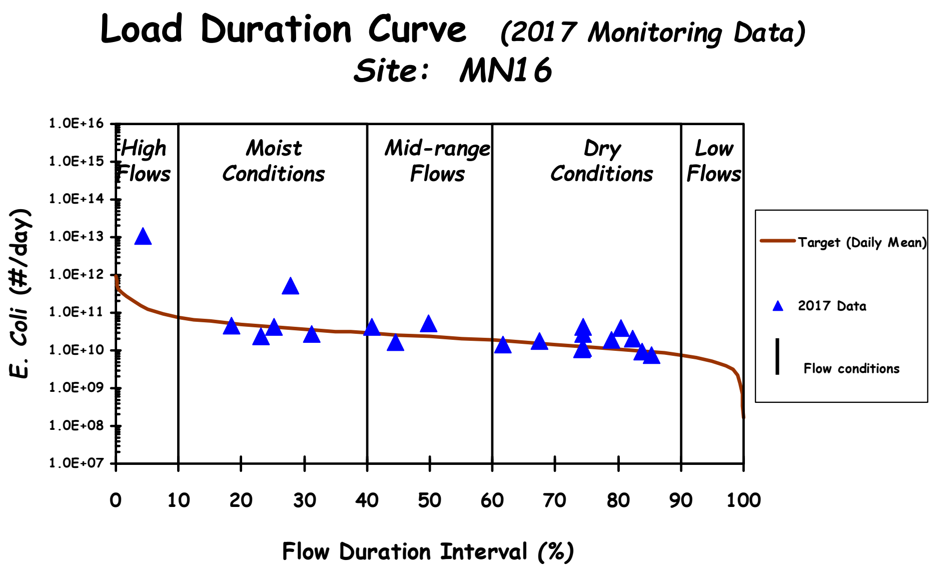


E. Coli Data & USGS Gage Duration Interval 04166100 *10.5 square miles*

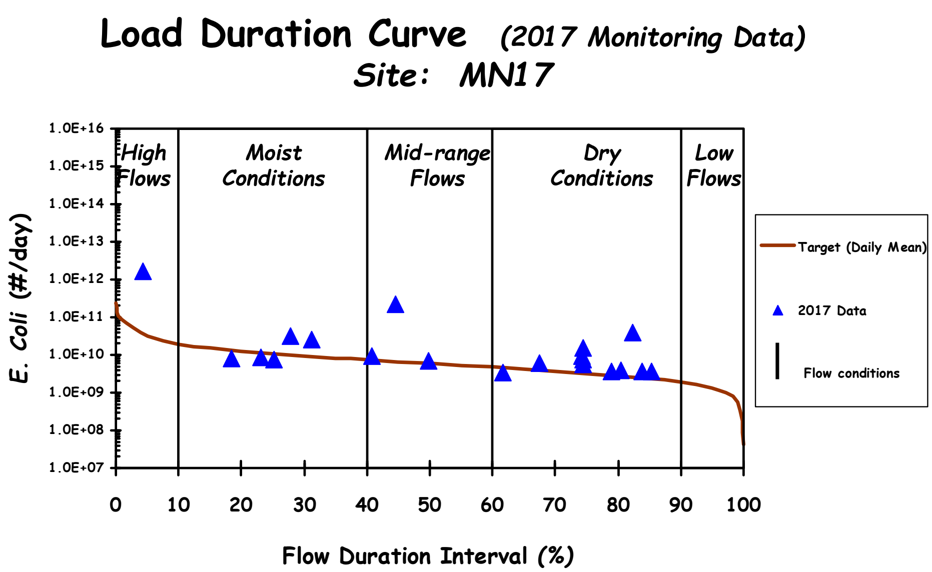
Load Duration Curve *(2017 Monitoring Data)*
Site: MN15



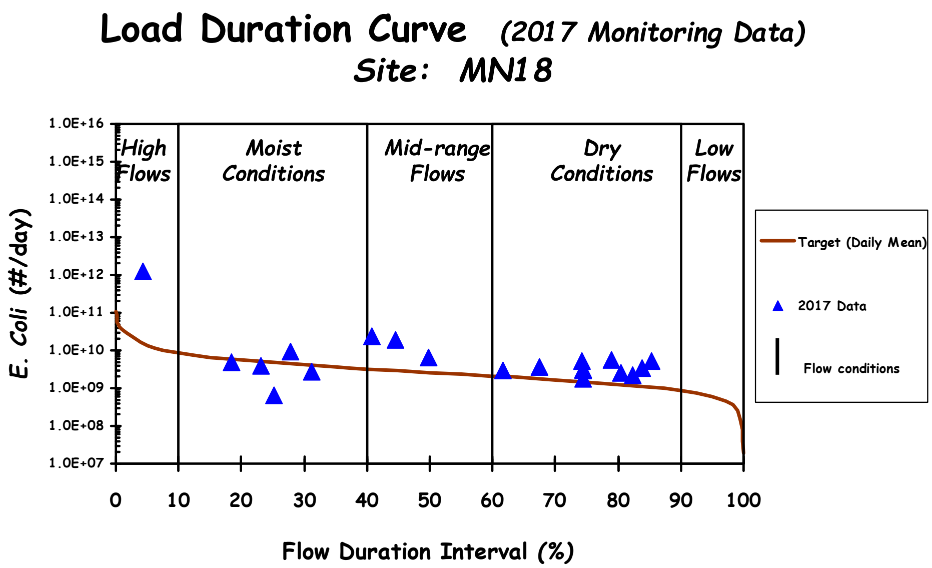
E. Coli Data & USGS Gage Duration Interval 04166100 *0.14 square miles*



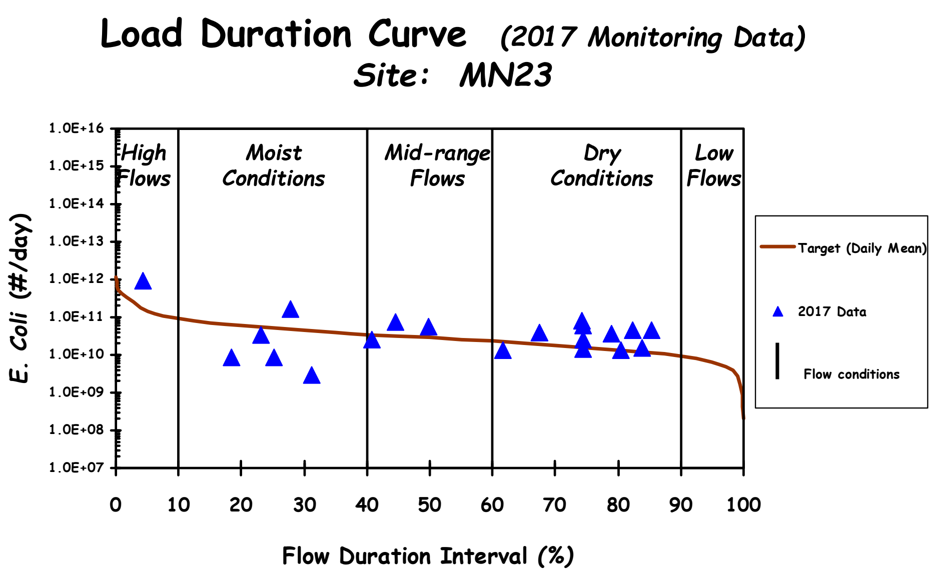
E. Coli Data & USGS Gage Duration Interval 04166100 6.60 square miles



E. Coli Data & USGS Gage Duration Interval 04166100 1.68 square miles

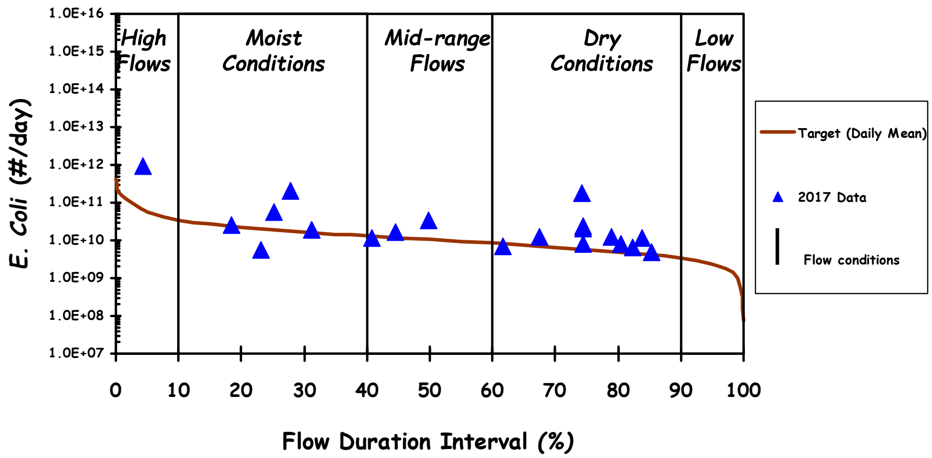


E. Coli Data & USGS Gage Duration Interval 04166100 *0.74 square miles*



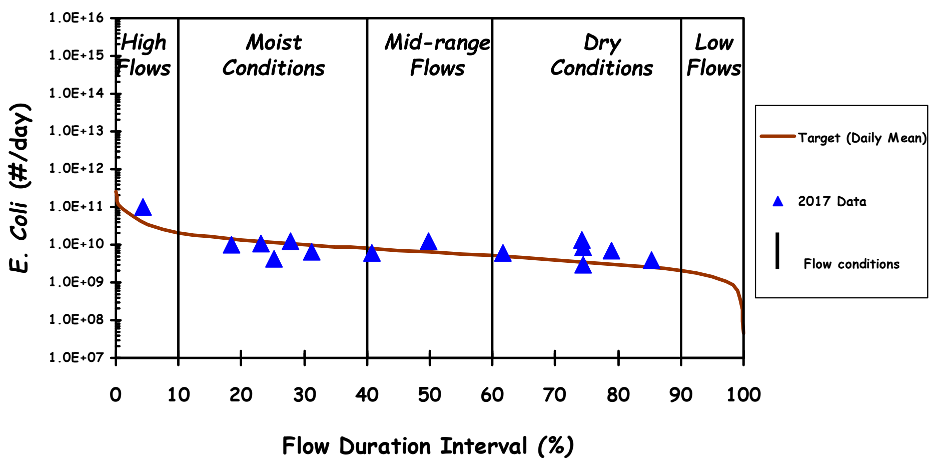
E. Coli Data & USGS Gage Duration Interval 04166100 *8.11 square miles*

Load Duration Curve (2017 Monitoring Data)
Site: MN24

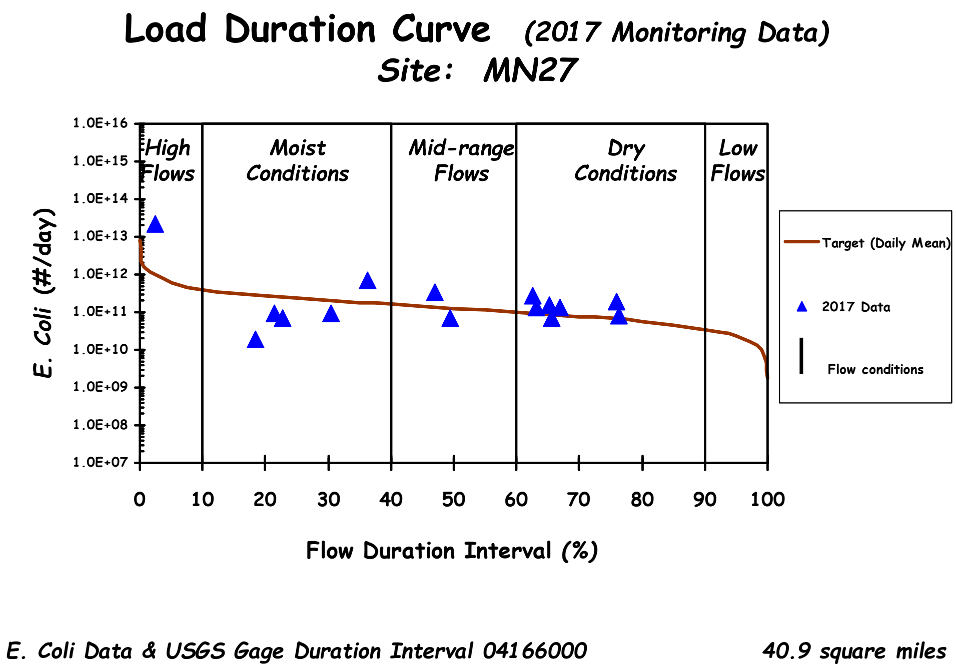


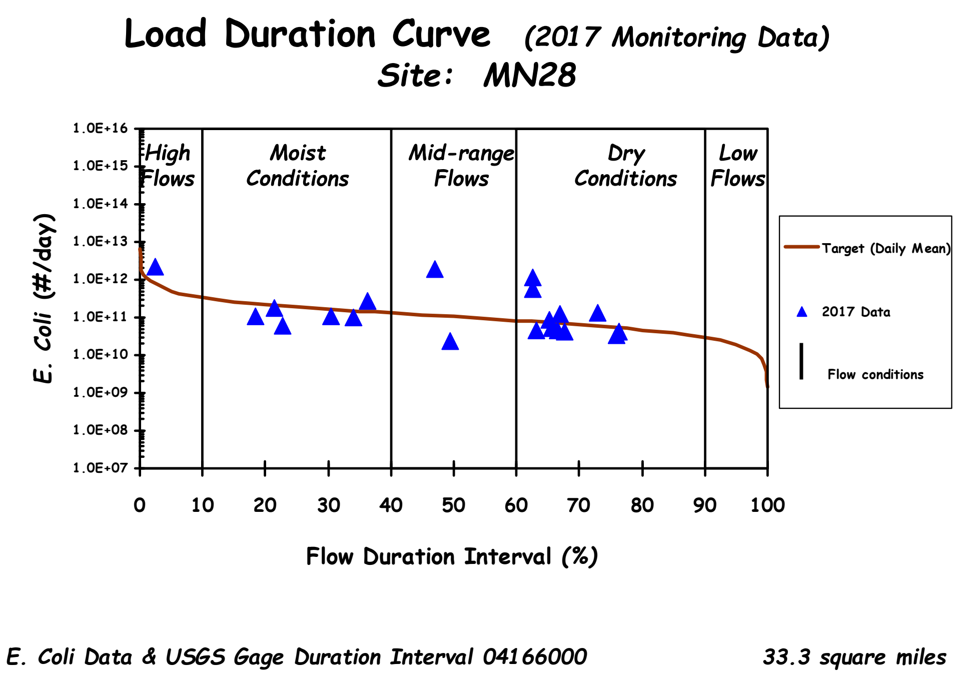
E. Coli Data & USGS Gage Duration Interval 04166100 *3.00 square miles*

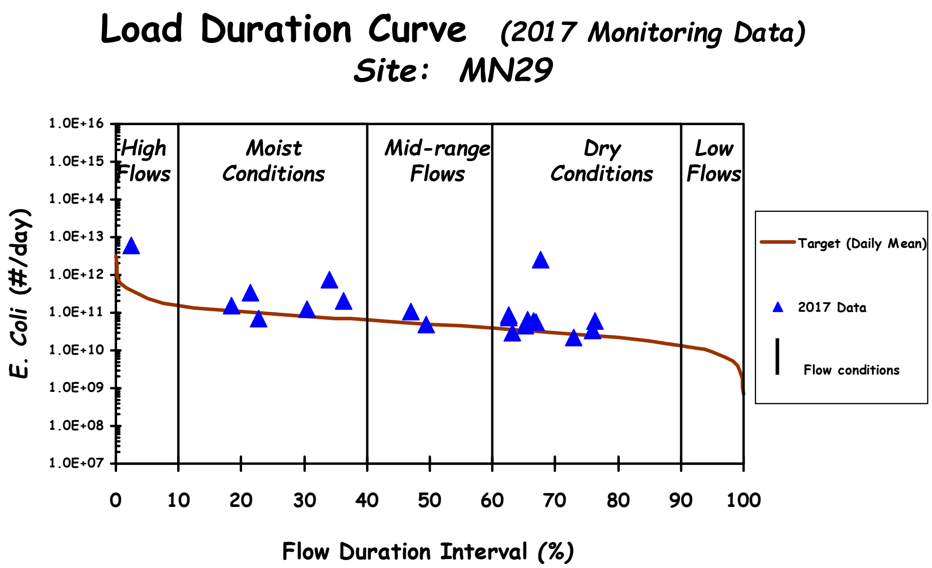
Load Duration Curve (2017 Monitoring Data)
Site: MN25



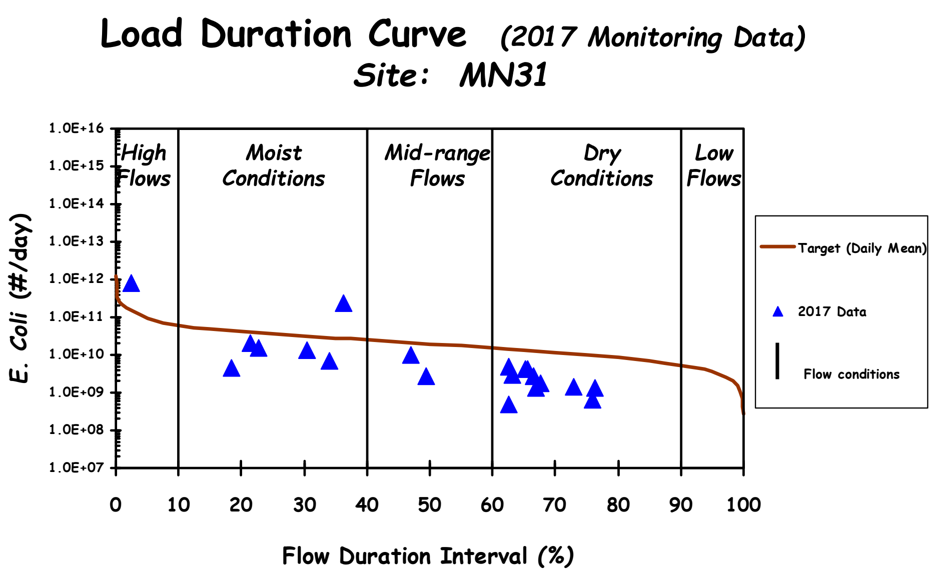
E. Coli Data & USGS Gage Duration Interval 04166100 *1.81 square miles*


Load Duration Curve (2017 Monitoring Data)
Site: MN27
1.0E+16
1.0E+15
1.0E+14
1.0E+13
1.0E+12
1.0E+11
1.0E+10
1.0E+09
1.0E+08
1.0E+07
E. Coli (#/day)
High Flows
Moist Conditions
Mid-range Flows
Dry Conditions
Low Flows
Target (Daily Mean)
2017 Data
Flow conditions
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
E. Coli Data & USGS Gage Duration Interval 04166000
40.9 square miles


Load Duration Curve (2017 Monitoring Data)
Site: MN28
1.0E+16
1.0E+15
1.0E+14
1.0E+13
1.0E+12
1.0E+11
1.0E+10
1.0E+09
1.0E+08
1.0E+07
E. Coli (#/day)
High Flows
Moist Conditions
Mid-range Flows
Dry Conditions
Low Flows
Target (Daily Mean)
2017 Data
Flow conditions
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
E. Coli Data & USGS Gage Duration Interval 04166000
33.3 square miles

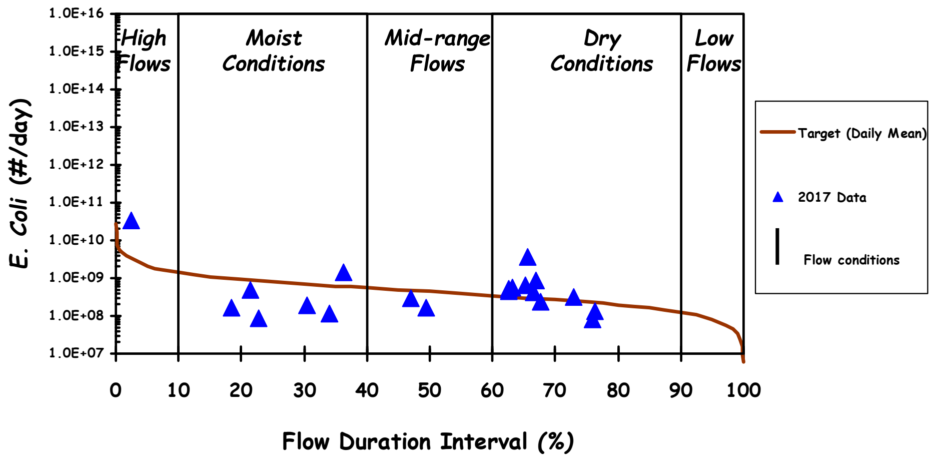


E. Coli Data & USGS Gage Duration Interval 04166000 15.8 square miles



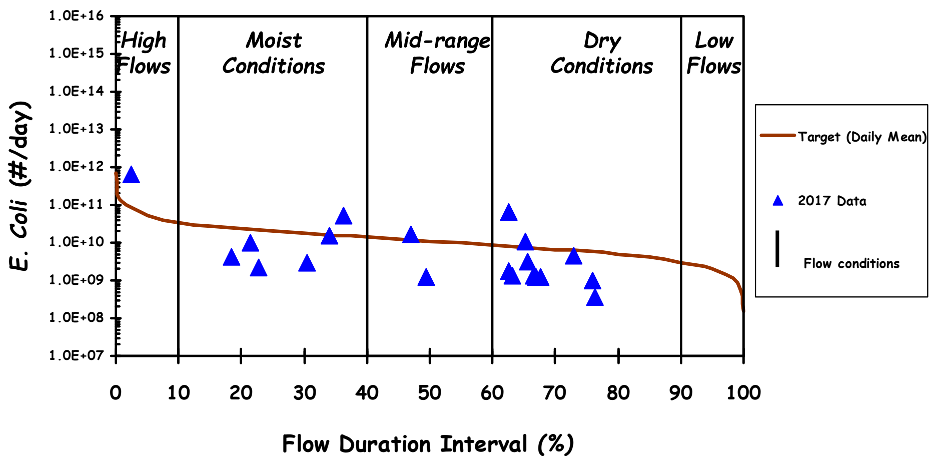
E. Coli Data & USGS Gage Duration Interval 04166000 6.20 square miles

Load Duration Curve (2017 Monitoring Data)
Site: MN32

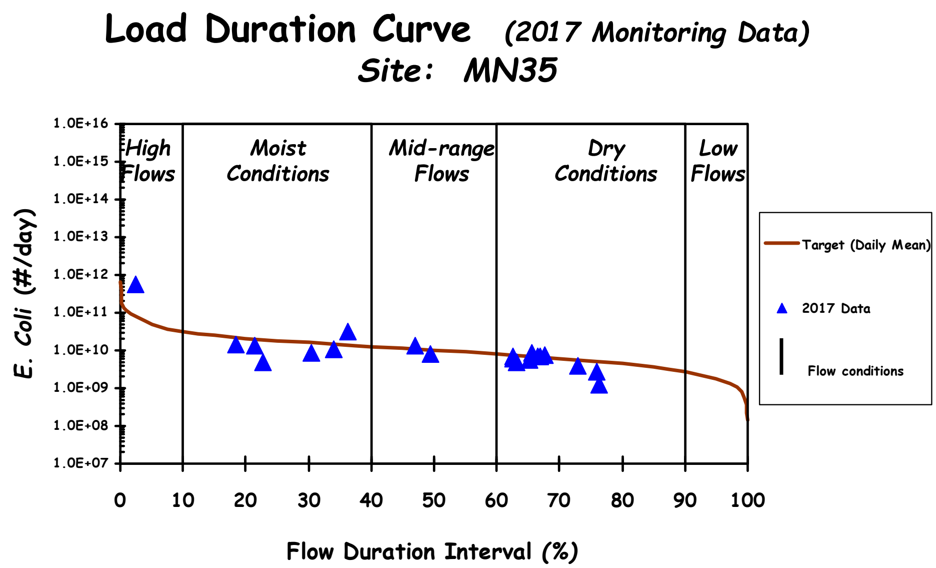


E. Coli Data & USGS Gage Duration Interval 04166000 0.14 square miles

Load Duration Curve (2017 Monitoring Data)
Site: MN33



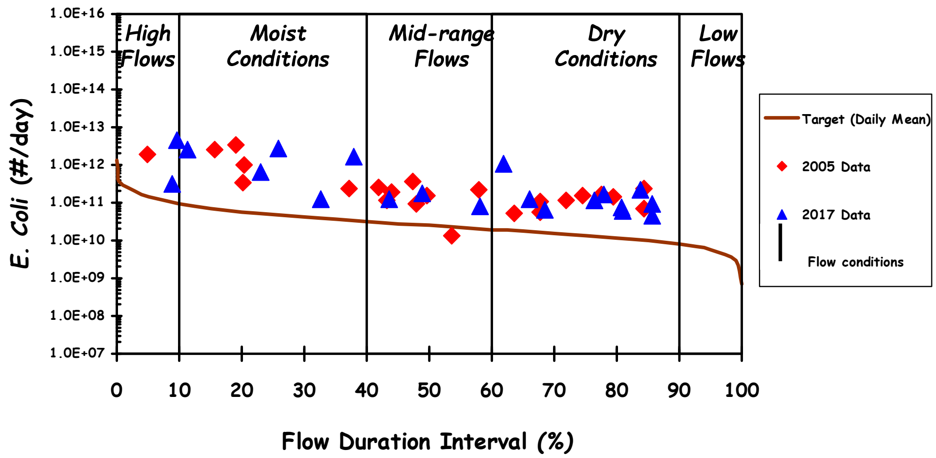
E. Coli Data & USGS Gage Duration Interval 04166000 3.55 square miles



E. Coli Data & USGS Gage Duration Interval 04166000 *3.21 square miles*

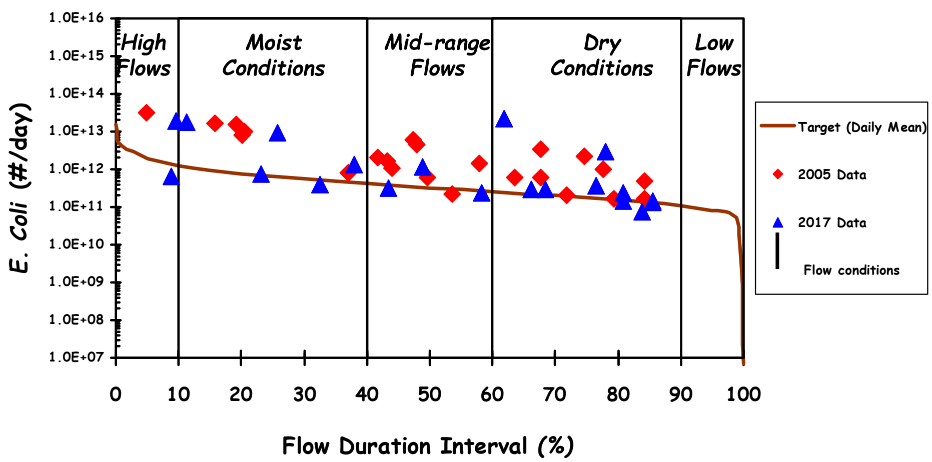
Middle Rouge

Tonquish Creek at Joy Rd
Load Duration Curve *(2005 Monitoring Data)*
Site: D62

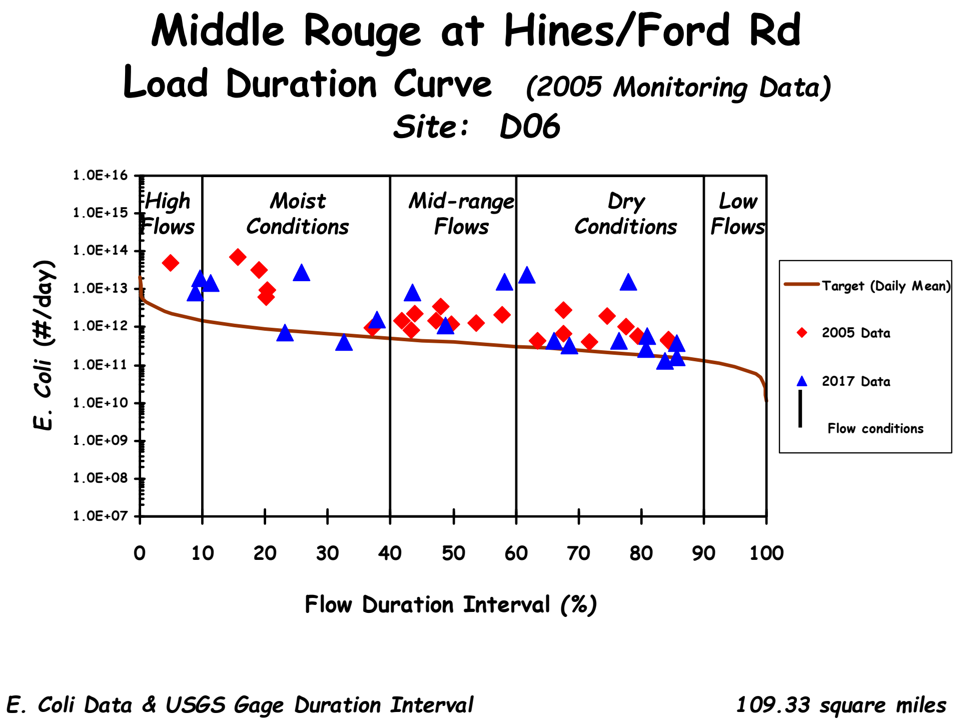


E. Coli Data & USGS Gage Duration Interval *6.83 square miles*

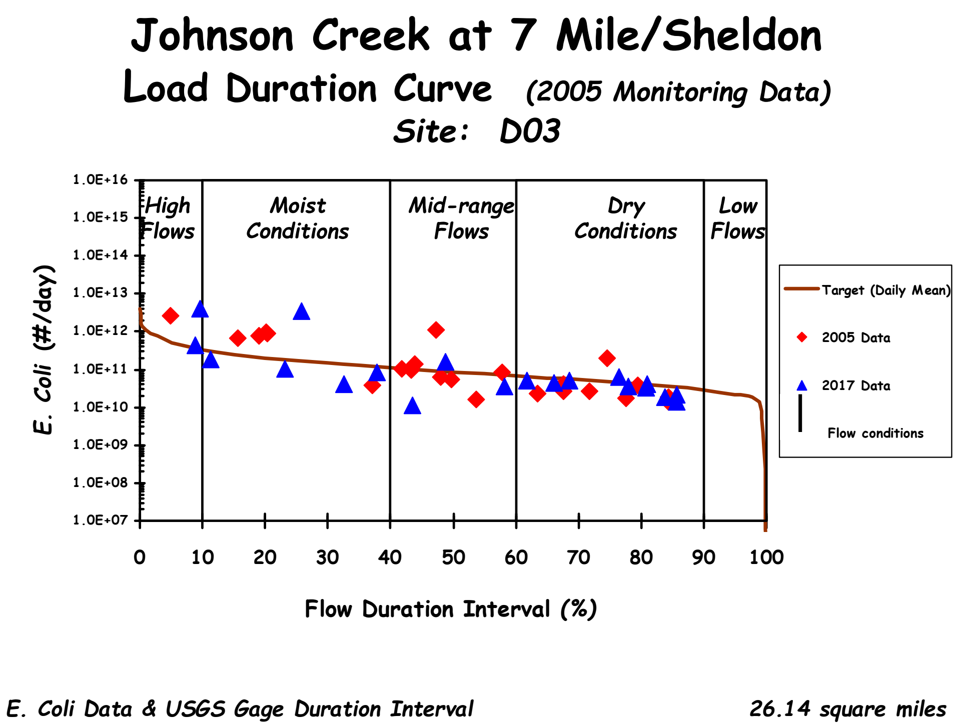
Middle Rouge at Inkster Rd
Load Duration Curve *(2005 Monitoring Data)*
Site: US2



E. Coli Data & USGS Gage Duration Interval *98.39 square miles*

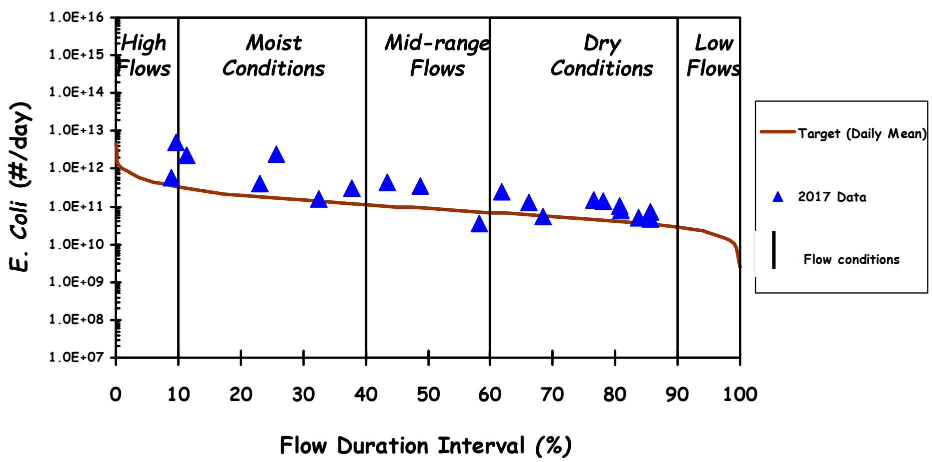


Middle Rouge at Hines/Ford Rd
Load Duration Curve (2005 Monitoring Data)
Site: D06
High Flows
Moist Conditions
Mid-range Flows
Dry Conditions
Low Flows
E. Coli (#/day)
1.0E+16
1.0E+15
1.0E+14
1.0E+13
1.0E+12
1.0E+11
1.0E+10
1.0E+09
1.0E+08
1.0E+07
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Target (Daily Mean)
2005 Data
2017 Data
Flow conditions
E. Coli Data & USGS Gage Duration Interval
109.33 square miles



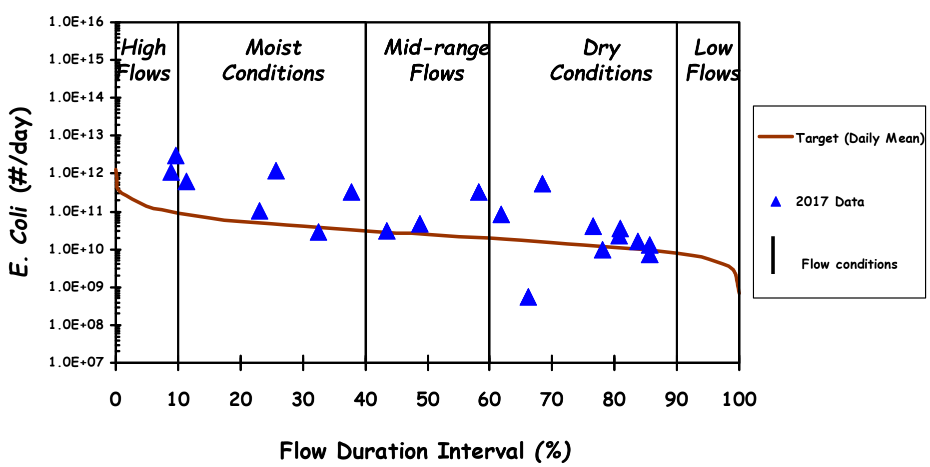
Johnson Creek at 7 Mile/Sheldon
Load Duration Curve (2005 Monitoring Data)
Site: D03
High Flows
Moist Conditions
Mid-range Flows
Dry Conditions
Low Flows
E. Coli (#/day)
1.0E+16
1.0E+15
1.0E+14
1.0E+13
1.0E+12
1.0E+11
1.0E+10
1.0E+09
1.0E+08
1.0E+07
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Target (Daily Mean)
2005 Data
2017 Data
Flow conditions
E. Coli Data & USGS Gage Duration Interval
26.14 square miles

Load Duration Curve *(2017 Monitoring Data)*
Site: MD03

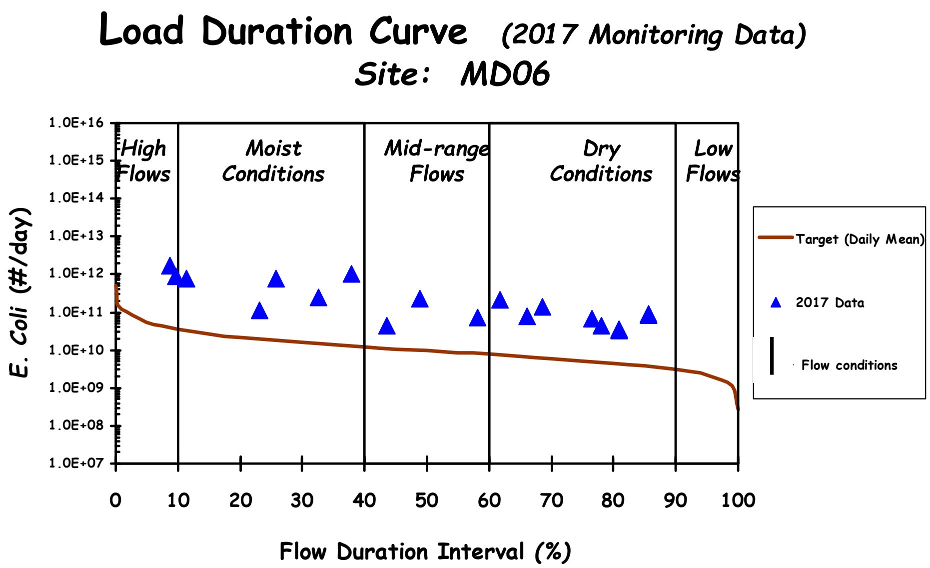


E. Coli Data & USGS Gage 04167000 Duration Interval *24.2 square miles*

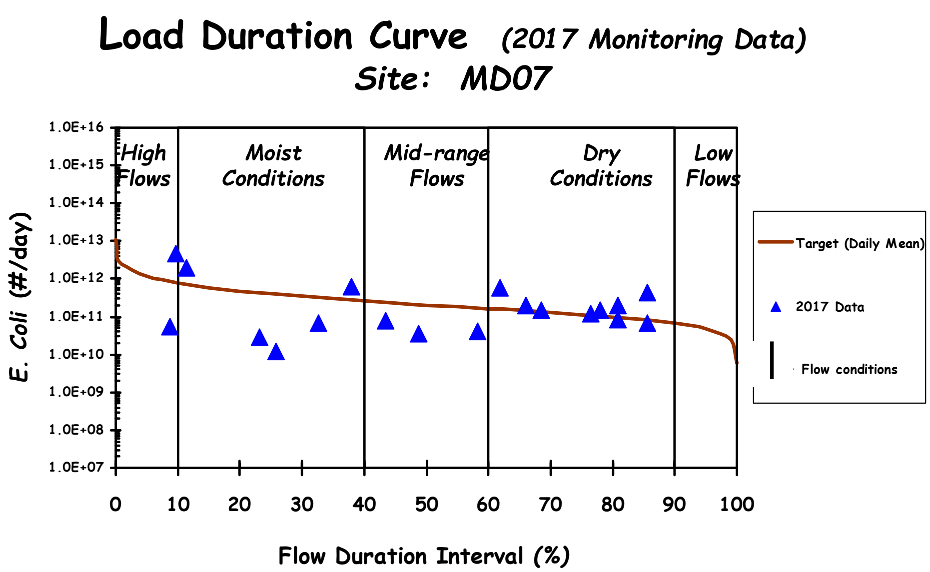
Load Duration Curve *(2017 Monitoring Data)*
Site: MD04



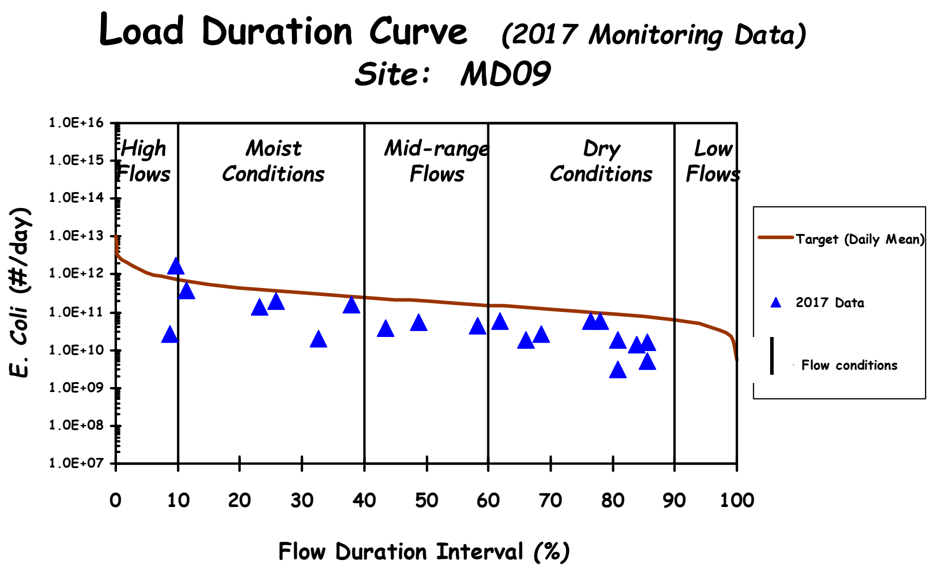
E. Coli Data & USGS Gage 04167000 Duration Interval *6.74 square miles*



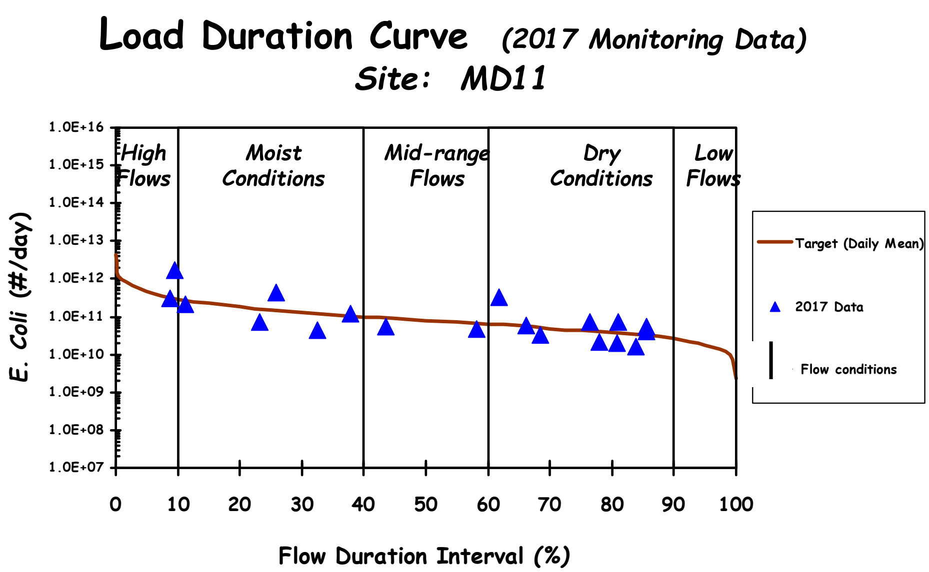
E. Coli Data & USGS Gage 04167000 Duration Interval 2.66 square miles



E. Coli Data & USGS Gage 04167000 Duration Interval 57.0 square miles

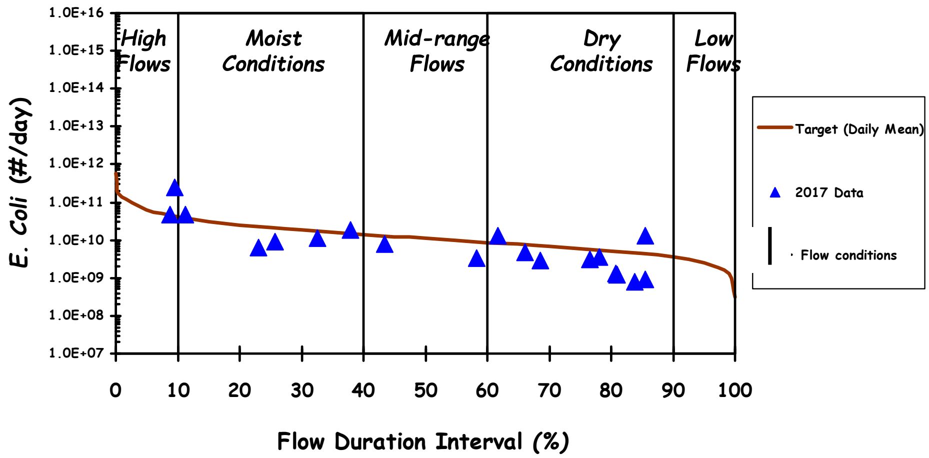


E. Coli Data & USGS Gage 04167000 Duration Interval 53.5 square miles



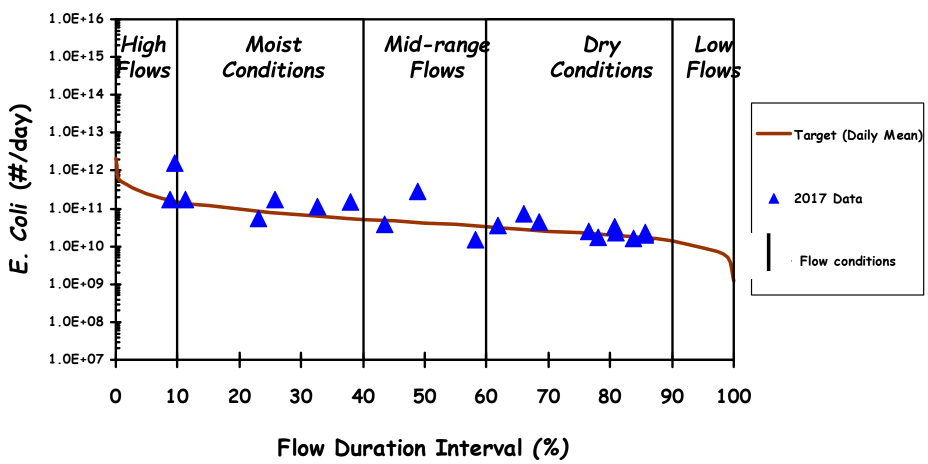
E. Coli Data & USGS Gage 04167000 Duration Interval 22.0 square miles

Load Duration Curve *(2017 Monitoring Data)*
Site: MD12

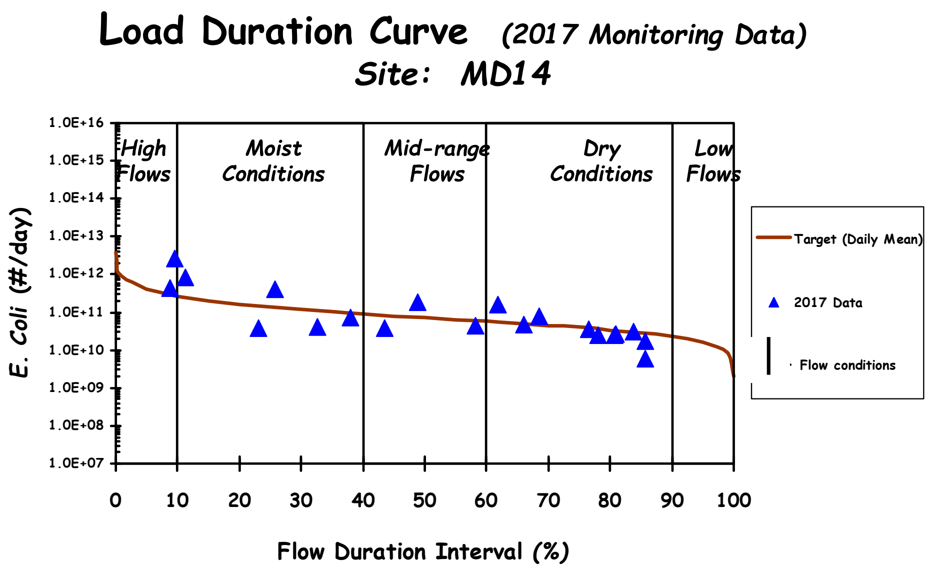


E. Coli Data & USGS Gage 04167000 Duration Interval *3.05 square miles*

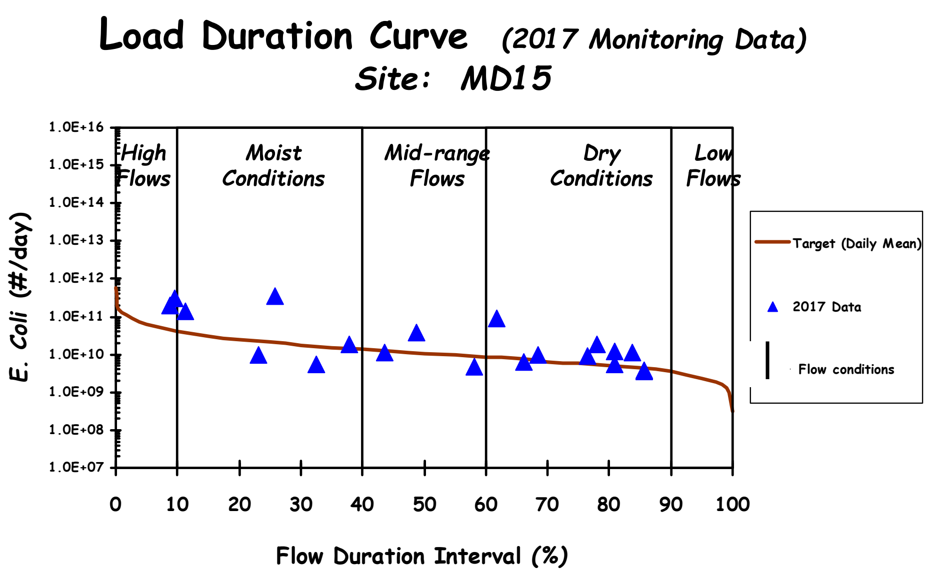
Load Duration Curve *(2017 Monitoring Data)*
Site: MD13



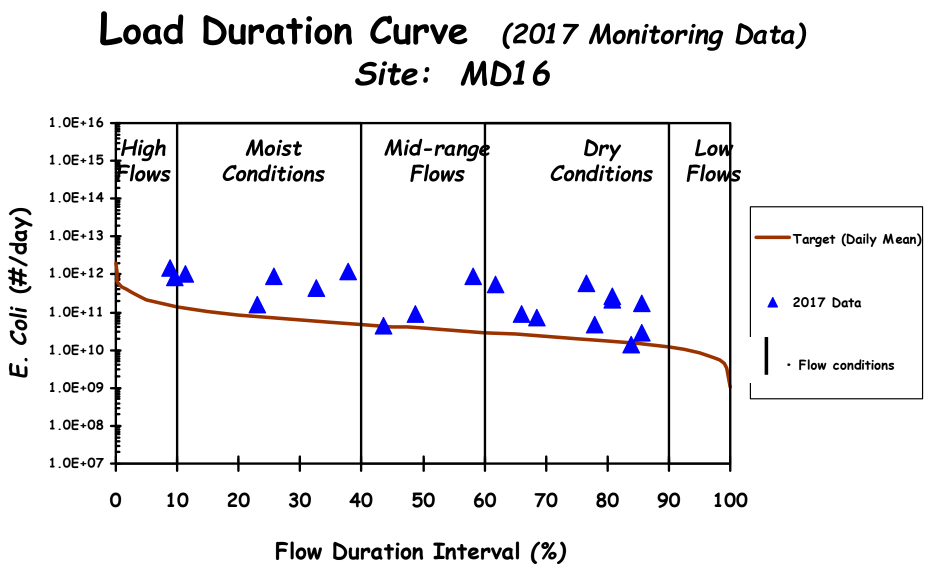
E. Coli Data & USGS Gage 04167000 Duration Interval *11.5 square miles*



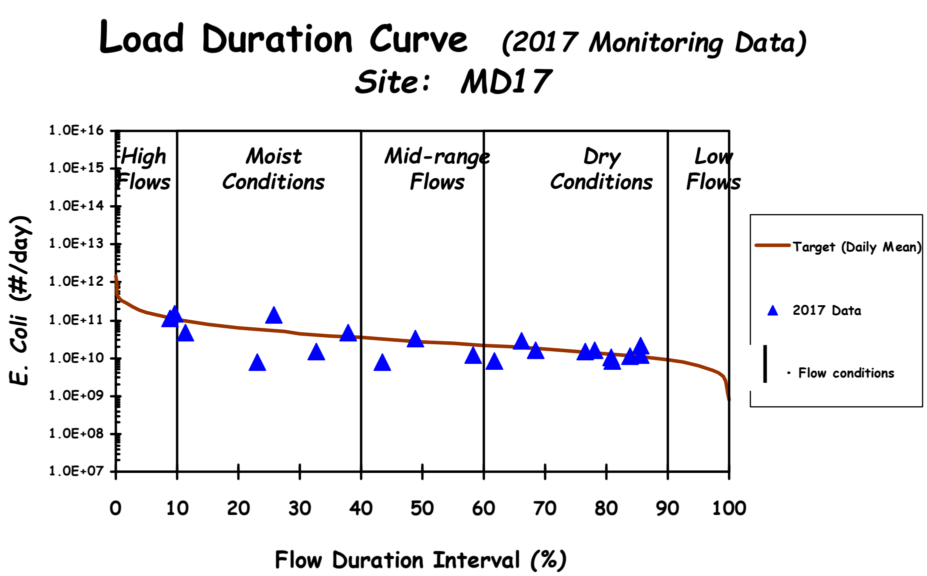
E. Coli Data & USGS Gage 04167000 Duration Interval 20.0 square miles



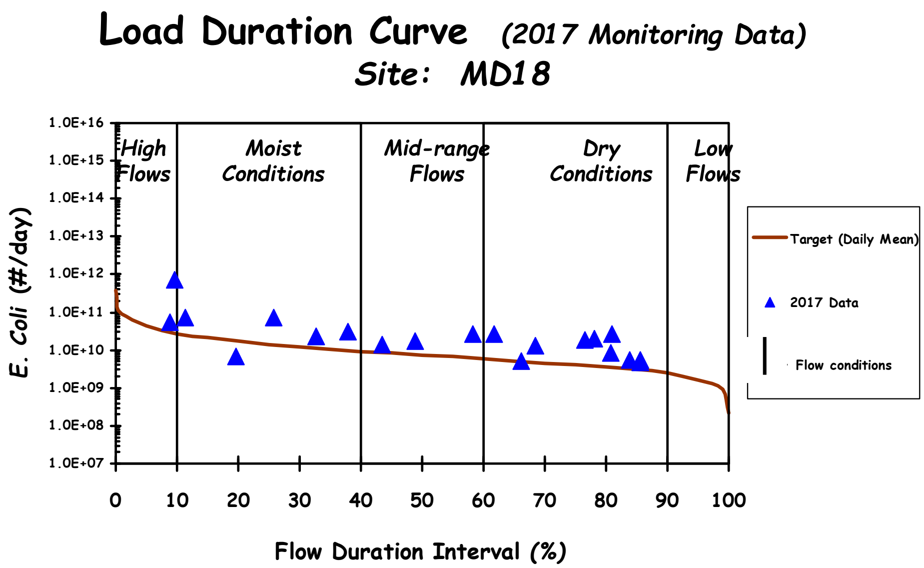
E. Coli Data & USGS Gage 04167000 Duration Interval 2.98 square miles



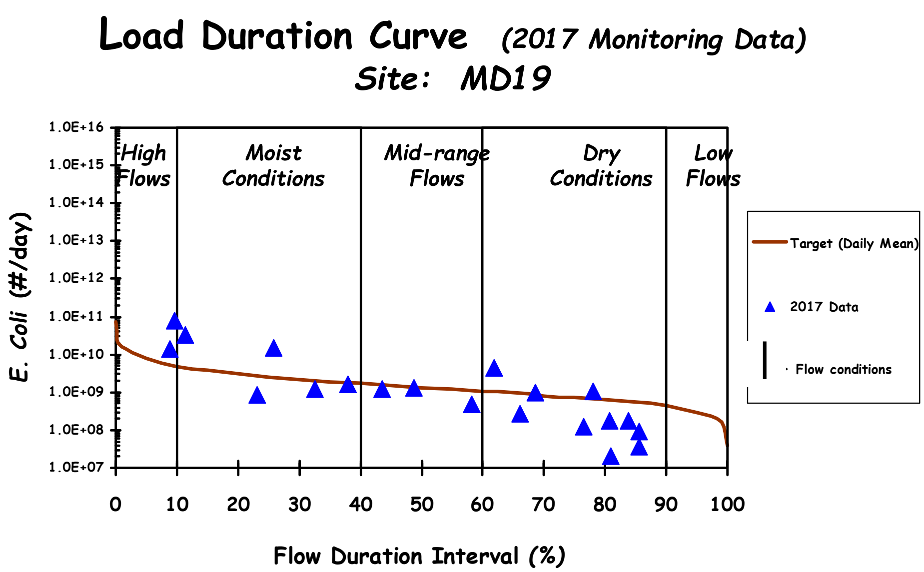
E. Coli Data & USGS Gage 04167000 Duration Interval 10.3 square miles



E. Coli Data & USGS Gage 04167000 Duration Interval 7.60 square miles



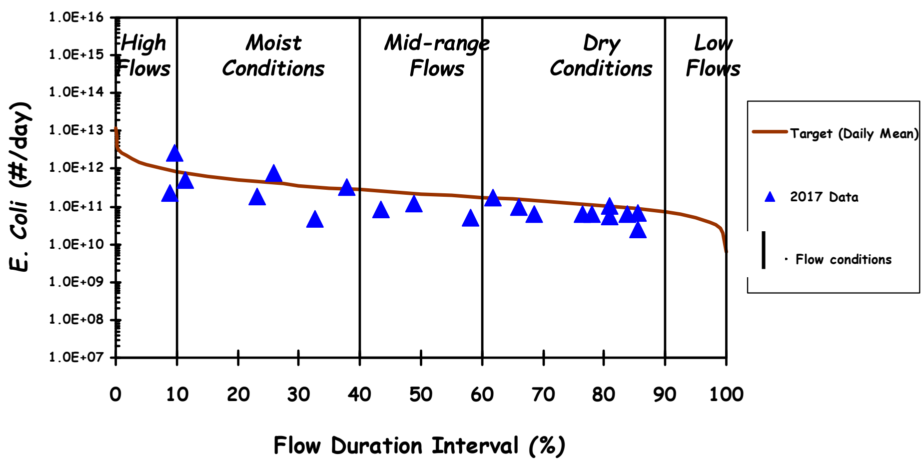
E. Coli Data & USGS Gage 04167000 Duration Interval 2.06 square miles



E. Coli Data & USGS Gage 04167000 Duration Interval 0.37 square miles

Load Duration Curve *(2017 Monitoring Data)*

Site: US10



E. Coli Data & USGS Gage 04167000 Duration Interval *60.7 square miles*

Appendix D

Field Notes

GROUP A ROUTE (FLOW):

https://goo.gl/maps/H7yb6vXmcG22 https://goo.gl/maps/CQHN8Kpu3q52

A1. UP05 [Flow location] [Coordinates: 42.411342, -83.392855]
Sample site located on 6Mile Rd, east of Wayne Rd.

Parking: Park on Wayne Rd Grab samples to be collected: *E. coli* and TSS

Accessibility: Sample at bridge on 6mile Rd. Upstream side of bridge.

A2. G72 [Flow location] - [Coordinates: 42.449199, -83.346448]
Site is located on *upper branch river rouge* at Tuck Rd south of Folsom Rd. [Between Folsom & Archwood Cir]
Parking: Park on Tuck Rd north of the bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Tuck Rd. Upstream.

A3. G461 [Flow location] - [Coordinates: 42.529993, -83.305529]
Site is located on franklin branch at Franklin Rd, North of 14Mile Rd. [Franklin Cider Mill]
Parking: Park at Franklin cider mill parking lot. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from bridge. Second footbridge from Franklin Rd. Upstream.

A4. MN28 [Coordinates: 42.545379, -83.224816]
Site is located on Main Rouge River branch at W.Maple Rd, west of Southfield Rd.
Parking: Park on Baldwin Rd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from footbridge on Maple Rd. Upstream.

A5. M01 [Coordinates: 42.560498, -83.214754]
Sample site is located on Main Rouge River branch at W. Big Beaver Rd, 1mile East of Woodward Ave. [Landmark- Springdale Park]
Parking: Park West side of bridge on beaver Rd near Springdale park. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Big Beaver Rd. Upstream. **Watch out for traffic**

POSSIBLE TIMING OF BREAK— AND Meet with Lab Courier, LUNCH

A6. MN35 [Flow location] - [Coordinates: 42.609323, -83.179803]
Sample site is located on Main Rouge River branch at Firefighter's Park east of Coolidge Hwy and W Square Lake Rd intersection.
Parking: Park at parking lot. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge inside the park, beside back parking lot. Upstream.

A7. MN36 [Coordinates: 42.603743, -83.222664]
Sample site is located on Sprague branch at Squirrel Rd, South of E.Square Lake Rd.
Parking: Park on side of Squirrel Rd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Squirrel Rd. Upstream.

A8. MN33 [Coordinates: 42.585684, -83.237233]
Sample site is located on Main Rouge River branch at E Long Lake Rd, West of Stonycroft Ln, Bloomfield hills
Parking: Park on side of road at bridge [or Stonycroft Ln]. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from culvert on E. Long lake Rd. Upstream.

A9. MN29 [Coordinates: 42.57466, -83.24546]
Sample site is located on Sunken bridge drain at bridge on Tamarack way, west of Woodward Ave.
Parking: Park on the side of Tamarack way near bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from footbridge on Tamarack way. Upstream.

A10. MN31 [Coordinates: 42.573552, -83.258730]
Sample at Vaughan Rd.
Parking: Park by the side of Orchard ridge rd. Grab samples to be collected: *E. coli* and TSS
Accessibility: 0.5 Miles east of Lahser Rd &Vaughan intersection [Residential area]. Sample from Vaughan Rd. Upstream

A11. MN30 [Coordinates: 42.56703, -83.26164]
Sample site is located on Sunken bridge drain at culvert on Lone pine Rd. 0.2 mile east of Lahser Rd.
Parking: Park on Lone Pine Rd. [Residential area. Grab samples to be collected: *E. coli* and TSS
Accessibility: Small creek flowing into a culvert at Lone pine rd. Sample from the culvert. Upstream.

A12. MN32 [Coordinates: 42.589847, -83.278999]
Sample at Devon Brook Rd, 1 mile North of W. Long Lake rd.
Parking: Park on shoulder Devon Brook Rd at the culvert. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from side of culvert on Devon Brook Dr. Upstream

GROUP B ROUTE:

https://goo.gl/maps/szUyJChQ7Z92 AND https://goo.gl/maps/kPRRqWHrmjF2 AND https://goo.gl/maps/VCxHv1MDf6y

B1. MN01 [Coordinates: 42.290580, -83.167527]
Sample site is located on Main Rouge River branch at Schaeffer Hwy, North of Intersection Melon St & Schaeffer Hwy.
Parking: Park East of bridge at gas station. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Schaeffer Rd. **Upstream** side

B2. M12 [Coordinates: 42.294618, -83.179241]
Sample site is located on Main Rouge River branch at Greenfield Rd, South of intersection Greenfield & Butler Rd.
Parking: Park near City Park at Dearborn St. and Allen Rd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Greenfield Rd. **Upstream** side

B3. US8 [Coordinates: 42.301095, -83.199398]
Sample site is located on Main Rouge River branch at Rotunda Dr, East of intersection Rotunda Dr. & Republic Dr.
Parking: Park in driveway just west of bridge on upstream side Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Rotunda Dr. Upstream.

B4. G42 [Coordinates: 42.336059, -83.247163]
Sample site is located on Main Rouge River branch at Ann Arbor trail, East of Walter Cassidy dr.
Parking: Park on Walter cassidy Dr. or side of Ann Arbor trail Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Ann Arbor trail. Upstream side

B5. US7 [Coordinates: 42.371776, -83.255556]
Sample site is located on Main Rouge River branch at Plymouth Rd, East of Rouge Park Dr.
Parking: Park on driveway near bridge. [golf course sign] Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Plymouth Rd. Upstream side.

B6. U05 [Coordinates: 42.392683, -83.276665]
Sample site is located on Telegraph Rd, North of River Circle.
Parking: Park on Telegraph Rd on bridge shoulder [safety reasons] or park at "Simple self-storage" parking lot, south of bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Telegraph Rd. Upstream.

B7. G43 [Coordinates: 42.400043, -83.271583]
Sample site is located on Main Rouge River branch at Fenkell Ave, west of Virgil st.
Parking: Park on Virgil St. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Fenkell Ave. **Upstream side.**

B8. U02 [Coordinates: 42.398208, -83.278385]
Sample site located on Graham Rd west of telegraph Rd.
Parking: Park on side of Graham Road beside the bridge. Grab samples to be collected: *E. coli* and TSS

Accessibility: Sample at bridge on Graham Rd. Upstream

B9. U04 [Coordinates: 42.392142, -83.295563]
Sample site located on Beech Daly rd, North of Ross dr.
Parking: Park at Ross Dr. Sidewalk access to bridge sample site. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Beech Daly Rd. Upstream [faces golf course bridge].

B10. U03 [Coordinates: 42.405507, -83.315252]
Sample site located on N. Inkster Rd, North of 5mile Rd.
Parking: Park on Meadowbrook Rd cross to sample at Upstream side of bridge Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on N. Inkster Rd.

B11. G71 [Coordinates: 42.42433, -83.31618]
Sample site located on Inkster Rd, south of W. 7Mile Rd
Parking: Park at Margareta St. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on N. Inkster Rd. Upstream [side is facing Margareta st].

POSSIBLE TIMING OF BREAK— AND Meet with Lab Courier, LUNCH

B12. MN13 [Coordinates: 42.457364, -83.317543]
Sample site is located on Main Rouge River branch at Inkster Road, Between 9mile and Spring valley dr.
Parking: Park near outfall site by the bridge Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Inkster. Upstream.

B13. MN12 [Coordinates: 42.456262, -83.313634]
Sample site is located on Main Rouge River branch at 2nd stream crossing on 9Mile Rd, east of Inkster.
Parking: Park on N. side of road. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from bank on 9Mile. Upstream.

B14. US5 [Coordinates: 42.447867, -83.297672]
Sample site is located on Main Rouge River branch at Beech Road, North of Beech and Shiawassee St intersection.
Parking: Park by the bridge Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Beech Rd. Upstream.

B15. MN14 [Coordinates: 42.471354, -83.303989]
Sample site is located on Pebble creek at 10 mile Rd East of Inkster.
Parking: Park at Samoset trail. Grab samples to be collected: *E. coli* and TSS
Accessibility: Downstream.

B16. MN15 [Coordinates: 42.485820, -83.308736]
Sample site is located on Pebble creek at 11Mile Rd about 0.5 mile East of Inkster Rd.
Parking: Park at Carnegie Park Apartments. Grab samples to be collected: *E. coli* and TSS
Accessibility: Upstream.

B17. MN17 [Coordinates: 42.484291, -83.288878]
Sample site is located on Main Rouge River branch at Franklin Rd west of Telegraph Rd.
Parking: Park at Lakeland center parking lot Grab samples to be collected: *E. coli* and TSS
Accessibility: When dry sample from bank. When wet sample from bridge. Upstream.

B18. G59 [Coordinates: 42.479135, -83.284474]
Sample site is located on Main Rouge River branch at Civic center drive, East of Telegraph Rd.
Parking: Park in parking lot near the bridge at civic center drive. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from Bridge. Upstream.

B19. MN10 [Coordinates: 42.471861, -83.253591]
Sample site is located on Main Rouge River branch at first stream crossing on Tamarack Trail, South of 10Mile Rd.
Parking: Park by the bridge Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Tamarack Trail. Upstream.

B20. MN09 [Coordinates: 42.466552, -83.252434]
Sample site is located on Main Rouge River branch at second stream crossing on Tamarack Trail, South of 10Mile Rd.
Parking: Park by the bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Tamarack Trail. Upstream.

B21. MN08 [Coordinates: 42.444062, -83.268736]
Sample site is located on Main Rouge River branch at Berg Rd. North of W.8 mile Rd on Berg.
Parking: Park on Berg road. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Berg Rd. Upstream.

B22. M15 [Coordinates: 42.429135, -83.269132]
Sample site is located on Main Rouge River branch at W. Seven Mile Rd west of Seven mile and Berg Rd intersection.
Parking: Park at parking lot on Berg at North West corner of intersection. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on W. Seven Mile Rd. Upstream.

GROUP C ROUTE:

https://goo.gl/maps/L3zEEYVesg52 https://goo.gl/maps/9dZkLrqj8su
https://goo.gl/maps/FY4bwTVHCVH2

C1. UP04 [Coordinates: 42.39909, -83.39064] **Sub watershed**: Upper
Sample site is located on Bell drain branch at Ellen Dr. North of 5Mile Rd.
Parking: Park on Ellen Dr near bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Ellen Dr. (fenced off). Upstream.

C2. U15 [Coordinates: 42.411430, -83.379121]
Sample site located on 6Mile Rd, west of Farmington Rd. [between Whitby St & Polyanna St]
Parking: Park at Pollyanna St. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on 6mile Rd. ***Downstream*** [Upstream not accessible. Site inside woods].

C3. U17 [Coordinates: 42.426543, -83.363432]
Sample site located on Tarabusi creek at 7Mile Rd, West of Merriman Rd.
Parking: Park at Jehova Witness, Osmus St, 7mile Rd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on 7mile Rd. Upstream.

C4. G19 [Coordinates: 42.441280, -83.348802]
Sample site is located on 8Mile Rd, East of Orchard Lake Rd.
Parking: Park at nearby parking lot. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on 8Mile Rd. **Downstream side** [Upstream not accessible].

C5. G46 [Coordinates: 42.501224, -83.278604]
Site is located on Franklin branch at 12 mile Rd, East of Telegraph. First stream crossing from telegraph.
Parking: Park on side of 12Mile. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from Bridge. Upstream.

C6. MN27 [Coordinates: 42.527673, -83.241951]
Sample site is located on Main Rouge River branch at Riverside Dr, East of Evergreen Rd.
Parking: Park on Riverside by the bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from bridge on Riverside. Upstream.

C7. M03 [Coordinates: 42.510152, -83.262320]
Sample site is located on Main Rouge River branch at Lahser road 0.5-mile North of 12 Mile.
Parking: Park at Lahser Rd near outfall site. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from bridge. Upstream.

C8. H60 [Coordinates: 42.515456, -83.279595]
Site is located on Franklin branch at 13 mile Rd 0.3 miles East of Telegraph.
Parking: Park at Bingham Rd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from bridge. Upstream.

C9. MN18 [Coordinates: 42.509759, -83.299754]
Site is located on Cheviot Hills Ct. [west of Telegraph and 13Mile]
Parking: Residential Area; Park by the side of road. Grab samples to be collected: *E. coli* and TSS

Accessibility: Sample from road. Upstream.

POSSIBLE TIMING OF BREAK— AND Meet with Lab Courier, LUNCH

C10. MN16 [Coordinates: 42.514373, -83.342322]
Sample site is located on Pebble creek branch at 13 mile Rd, West of Middlebelt Rd.
Parking: Park on Adat shalom Synagouge Driveway. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from footbridge. Upstream.

C11. MN24 [Coordinates: 42.531156, -83.334984]
Sample site is located on Franklin branch at Brookridge Dr. [East of 14mile & Middlebelt Rd intersection]
Parking: Park on Brookridge Dr. [Residential area] Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from bridge. Upstream

C12. MN23 [Coordinates: 42.535364, -83.329512]
Sample site is located on Main Rouge River branch at second stream crossing [**North** stream crossing] on 10 hill Dr., North of Old Ct.
Parking: Park on 10hill Dr. [Residential area] Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from bridge. Upstream.

C13. MN25 [Coordinates: 42.559470, -83.357840]
Sample site is located on Main Rouge River branch at Doherty St, East of Orchard Lake Rd & Walnut Lake Rd intersection.
Parking: Park on Doherty St [residential area] Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample from bridge. Upstream

C14. UP16 [Coordinates: 42.507190, -83.368318]
Sample site is located on Minnow pond drain at Nottingwood St, East of Ravenwood st. [Intersection: Ravenwood St & Nottingwood St]
Parking: Park on side of the road @Nottingwood St. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Nottingwood St. Upstream.

C15. UP15 [Coordinates: 42.514159, -83.436991]
Sample site is located on Seely drain at Haggerty Rd, First stream crossing North of 13Mile Rd. [Between 13Mile and Lancaster Dr].
Parking: Park at Seely creel signboard before Lancaster & Haggerty Rd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Haggerty Rd. Downstream.

C16. UP08 [Coordinates: 42.467327, -83.408941]
Sample site is located on Tarabusi creek at Brittany Hill Dr, East of Halsted Rd & grand River ave intersection.
Parking: Park by bridge on Brittany Hill Dr. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Brittany Hill Dr. Upstream.

C17. US3 [Coordinates: 42.464526, -83.368670]
Sample site is located on Upper Rouge River branch inside Shiawasee Park at Power Rd, Farmington
Parking: Park at parking lot. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge at the east end of the park. Upstream.

GROUP D ROUTE (FLOW):

https://goo.gl/maps/UPQNxhaHkcH2 and https://goo.gl/maps/U8Fv4Ju29ds

D1. D62 [Flow location] [Coordinates: 42.351646, -83.462714]
Sample site located on Joy Rd, east of Main St.
Parking: Park on road E. of bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Joy Rd. Upstream.

D2. US9 [Flow location] [Coordinates: 42.28439, -83.42732]
Sample site located at first stream crossing on Hannan Rd, North of Michigan ave
Parking: Parking on side of road, little south of the bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge crossing on Hannan Rd. Upstream.

D3. G93 [flow location] [Coordinates: 42.282302, -83.505405]
Sample site located on S. Beck Rd, South of Lindenhurst blvd.
Parking: Park at Lindenhurst blvd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge crossing on Beck Rd. Upstream.

D4. L01 [Coordinates: 42.283485, -83.505433]
Sample site located on S.Beck Rd, North of Lindenhurst blvd.
Parking: Park at Lindenhurst blvd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge crossing on Beck Rd. Upstream. sidewalk bridge access also available.

D5. G200 [Coordinates: 42.297201, -83.525834]
Sample site located on Denton Rd, between Hudson Dr & Proctor Rd.
Parking: Pull off on E. side of bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge crossing on Denton Rd. Upstream.

D6. MD13 [flow location] [Coordinates: 42.381706, -83.555045]
Sample site located on Napier Rd, 0.5 Miles North of Territorial Rd.
Parking: Park N of bridge on Napier road. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge on Napier Rd. Upstream.

D7. MD18 [flow location] [Coordinates: 42.458972, -83.454809]
Sample site is located on Meadowbrook Rd, 0.5 Mile South of 10 Mile Rd.
Parking: Park at Chattman St. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge located on Meadowbrook Rd, just south of Chattman st. Upstream.

D8. MD19 [Coordinates: 42.49526, -83.46953]
Sample site is located on 12 Mile Rd, East of Novi Rd. [Twelve oak mall drive]

Parking: Park at twelve oaks mall parking Lot at McDonald's. Walk to the culvert by 12mile Rd. Grab samples to be collected: *E. coli* and TSS
Accessibility: Creek east of McDonalds. Sample at the creek by 12mile Rd. Downstream.

D9. MD17 [Coordinates: 42.495079, -83.495920]
Sample site located on 12Mile Rd, 0.5 Mile west of Novi Rd. [nearby intersection: 12mile & Taft Rd]
Parking: Park by the side of 12 Mile Rd at the bridge. Grab samples to be collected: *E. coli* and TSS
Accessibility: Sample at bridge located on 12Mile Rd, east of the railroad. Upstream.

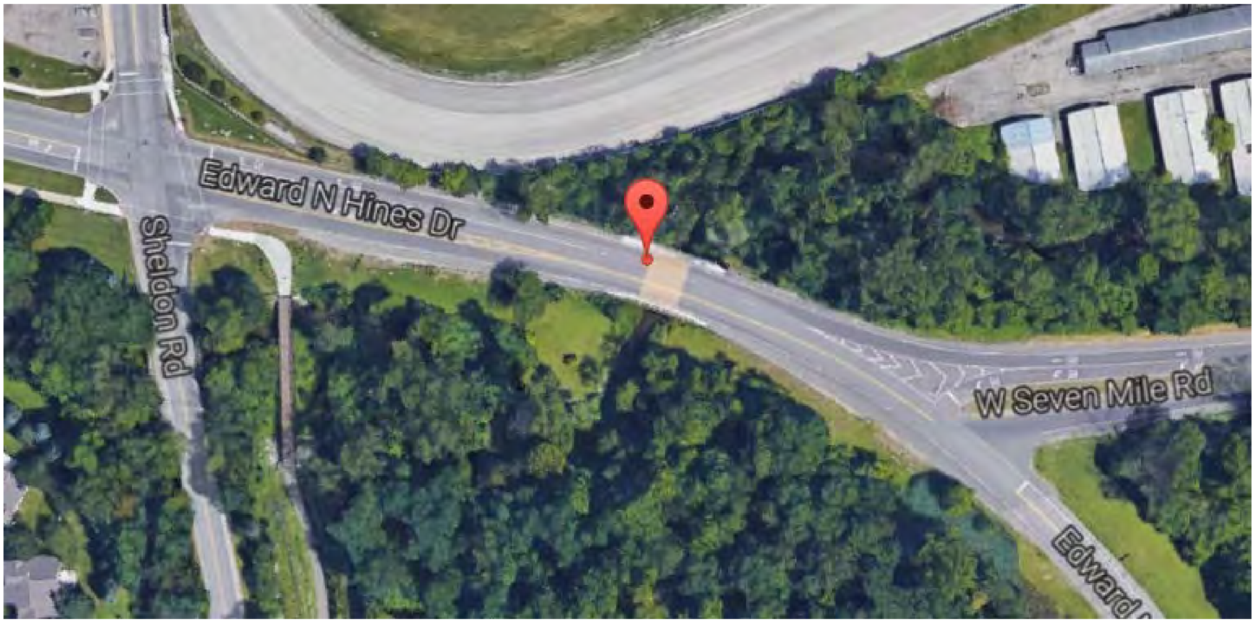
D10. MD16 [Coordinates: 42.467125, -83.466189]
Sample site located on W 10Mile Rd. 0.5 Mile east of Novi Rd.
Parking: Park by side of 10 Mile Rd at the outfall site gates. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample site is located on W 10Mile Rd west of Myrtle Ct [Between Novi Rd and Myrtle Ct]. Upstream.

D11. MD15 [Coordinates: 42.44776, -83.46918]
Sample site located on Ashbury Dr, Novi
Parking: Park on side of road by the bridge. [Residential area] Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on **Ashbury drive, North of Windmill ct**. [northern stream crossing]. Upstream.

D12. MD14 [Coordinates: 42.428915, -83.478230]
Sample site located on Beal St 0.1 miles West of Northvile Rd.
Parking: Park on River St, East of bridge. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Beal St. Upstream.

D13. D03 [Johnson creek gauge] [Coordinates: 42.425697, -83.481137]

Sample site located on Edward Hines Dr, East of Sheldon Rd.



Parking: Park on Edward Hines Dr west of bridge. OR in parking lot on NW corner of Sheldon Rd and Hines Drive. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Edward Hines Dr. ***Downstream.***

D14. MD11 [Coordinates: 42.411955, -83.511146]
Sample site located at second stream crossing on Beck road, north of 6Mile rd. [Between Maplebrook Dr and Pine creek ct]
Parking: Park south of bridge at Maplebrook Dr. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Beck Rd. It is the second stream crossing from 6mile to beck. Upstream.

D15. MD12 [Coordinates: 42.408327, -83.519558]
Sample site located on 6Mile Rd, West of Lake view circle Rd
Parking: Park on side of the road by the bridge. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on 6 Mile Rd. Sample at footbridge. Upstream.

GROUP E ROUTE:

https://goo.gl/maps/rubXoiSJEp22 and https://goo.gl/maps/imB7udmDSuo and https://goo.gl/maps/wyhEYkgJ6A12

E1. MD09 [Coordinates: 42.376143, -83.454400]
Sample site located on Plymouth Rd, East of Edward Hines Dr.
Parking: Park by courthouse grille east of the sample site. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Plymouth Rd. Upstream.

E2. MD06 [Coordinates: 42.359590, -83.469624]
Sample site located on S. Main St, North of Ann Arbor Rd. [Between Ann arbor Rd and Byron St]
Parking: Park at Rite aid pharmacy parking lot. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on S.Main St. Upstream.

E3. US10 [Coordinates: 42.371621, -83.445615]
Sample site located on Haggerty Rd, North of Edward Hines Dr. [Between Plymouth and Edward Hines Dr.]. Landmark: Heartland Health care center, Plymouth.
Parking: Park at Breakfast Dr south of sample site. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Haggerty Rd. Upstream.

E4. MD07 [Coordinates: 42.358457, -83.386461]
Sample site located on Wayne Rd, South of Edward Hines Dr [Between Hines Dr & Ann Arbor Trail]
Parking: Park at Parkway heights apartment parking lot, South of sample site on Wayne Rd. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Wayne Rd. Upstream.

E5. MD03 [Coordinates: 42.351892, -83.386037]
Sample site located on Wayne Rd, South of Joy Rd.
Parking: Park at 7 Eleven North of the sample site [near Joy Rd & Wayne Rd intersection] Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Wayne Rd. Upstream.

E6. US2 [Coordinates: 42.348262, -83.312538]
Sample site located on N. Inkster Rd, South of Edward Hines Dr.
Parking: Park on Clairview and cross street for Upstream. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Inkster. Upstream.

E7. D06 [USGS flow location] [Coordinates: 42.330724, -83.248019]
Sample site located on Edward N Hines Dr, North of Ford Rd.
Parking: Park on side of the road near bridge. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Edward N Hines Dr. Upstream.

E8. L05D [USGS flow location] [Coordinates: 42.308582, -83.252712]
Sample site located on Military St, North of Michigan ave.
Parking: Park in circle drive. Residential drive. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge South of City of Dearborn Office. Upstream.

E9. US1 [Coordinates: 42.300629, -83.300559]
Site located on John Daly St, 0.5 miles north of Michigan Ave.
Parking: Park by the side of road near the bridge. [Residential area] Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on John Daly St. Upstream.

E10. LW03 [Coordinates: 42.30283, -83.30533]
Site located near Lucerne Dr, East of Inkster. [Intersection nearby: Inkster Rd & Avondale st]
Parking: Park at Lucerne Dr. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample site is at bridge between Lucerne Dr & Elm circle Dr. Access through woods east of Lucerne Dr. Upstream.

E11. G97 [Coordinates: 42.29003, -83.33915]
Site located on Henry Ruff Rd, North of Michigan Ave
Parking: Driveway south of bridge just by sherrif's dept. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Henry Ruff Rd. Upstream.

E12. L06 [Coordinates: 42.284866 , -83.383787]
Sample site located on Wayne Rd, north of Michigan Ave.
Parking: Park at Wayne city hall south of bridge. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Wayne Rd. Upstream.

E13. LW07 [Coordinates: 42.285603, -83.407092]
Sample site located on S. Newburgh Rd, south of Glenwood Rd.
Parking: Park on Whitney Dr. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge crossing on Newburgh Rd, South of Glenwood and North of hillcrest Dr. Upstream.

E14. G64 [Coordinates: 42.27361, -83.40084]
Sample site located on Annapolis St, south of Michigan Ave. [Intersection: Annapolis and Treadwell St]
Parking: Park by side of road on Annapolis St. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge crossing on Annapolis st, East of Treadwell St. Bridge is fenced off sample from banks. Upstream.

E15. LW09 [Coordinates: 42.265233, -83.429126]
Sample site located on Van Born Rd, west of Hannan Rd.
Parking: Park on the side of Van born Rd adjacent to bridge. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge crossing on Van born Rd. Upstream.

E16. LW08 [Coordinates: 42.278471, -83.423708]
Sample site located on Michigan Ave, east of Hannan Rd. [Between Hannan Rd and Grace ave]
Parking: Park on Grace Ave. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge crossing on Michigan Ave. Access near sidewalk. Upstream.

[If upstream is not accessible cross road and sample; Park at Pro fireworks]

E17. G92 [Coordinates: 42.279900, -83.446952]
Parking: South of bridge park at western township authority building on the East side. Sample site located on Haggerty Rd, North of Michigan Ave.
Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Haggerty Rd. Upstream.

E18. L51 [Coordinates: 42.276348, -83.465606]
Sample site located on Michigan Ave west of Lilley Rd. [adjacent to S. Morton Taylor Rd]
Parking: Park on Morton Taylor Rd. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge crossing on Michigan Ave, next to S.Morton Taylor Rd. Access via culvert.
Sample Downstream [historic sample site].

E19. G94 [Coordinates: 42.281770, -83.476143]
Sample site located on S. Sheldon Rd, first stream crossing North of Michigan Ave.
Parking: Park on side of the road by the bridge. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge crossing on Sheldon Rd [south of Dionne st.] Upstream.

E20. LW14 [Coordinates: 42.323142, -83.488192]
Site located on N. Canton center Rd, north of Ford Rd.
Parking: Park on Maben Rd. Sidewalk available for site. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on N. Canton Rd. Upstream.

E21. LW12 [Coordinates: 42.300940, -83.453644]
Sample site located East of S. Lilley Rd on chase Dr. [intersection: S.lilley Rd & Trent Dr]
Parking: Park on Chase Ct. Grab samples to be collected: *E. coli* & TSS
Accessibility: Access to sample site is on chase drive. Private bridge access. Upstream.

E22. L02 [Coordinates: 42.294140, -83.436054]
Sample site located at Palmer Rd, East of S. Lotz Rd
Parking: Park on side of road, east of bridge. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge crossing on Palmer Rd. Upstream.

E23. LW13 [30ft] [Coordinates: 42.308552, -83.443875]
Sample site is located on Cherry hill Dr, East of Haggerty Rd.
Parking: Park on shoulder of bridge on cherry hill. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Cherry Hill Dr. 30ft deep. Upstream.

E24. MD04 [Coordinates: 42.333045, -83.412775]
Sample site located on Warren Rd, 0.2 miles west of Newburgh Rd. [Landmark nearby Joe Randazzo's Fruit Market].
Parking: Park West of bridge. Grab samples to be collected: *E. coli* & TSS
Accessibility: Sample at bridge on Warren Rd. Upstream.

Sample No.	Subwatershed	Sample ID	Intersection	Coordinates	Height to water	Flow conditions	Accessibility	Parking [nearest possible]	Sample pole reaches?	Sample side	
			Main Rouge								
1	Main Rouge	MN01	Melon & Schaeffer Rd.	42.290580, -83.167527	19'	>100' width	Bridge on highway, industrial area.	Park east of the bridge at gas station.	No	Upstream	
2	Main Rouge	M12	Greenfield & Butler Rd.	42.294618, -83.179241	17.5'	Near high flow	Industrial area.	Park at Dearborn St. and Allen Rd. City Park.		Downstream	
3	Main Rouge	US8	Rotunda Dr. & Republic Dr.	42.301095, -83.199398	20'	Near high flow, concrete channel	Sample from bridge	Park in driveway just after bridge on upstream side	No	Upstream	
4	main	G42	Ann arbor trail and walter cassidy dr	42.336059, -83.247163	17	100 ft W. Logs	Park on walter cassidy Dr. or side of Ann Arbor trail			Upstream	
5	main	US7	Plymouth rd and Rouge park drive	42.371776, -83.255556	16	Tons of log debris	Park on driveway near bridge. [golf course sign]			Upstream	USGS flow location
6	Main	G43	Fenkell ave and virgil st	42.400043, -83.271583	22	good	Park on Virgil st. Sample at bridge on Fenkell Ave			Upstream	
7	Main	M15	W 7 mile and Berg Rd	42.429135, -83.269132	25	good	Park at parking lot on 7 mile and berg			Upstream	
8	Main	MN08	Berg and 8mile	42.444080, -83.268760	18	Good. Log debris. >50ft W	Sample at bridge on Berg	Park on Berg road	no	Upstream	
9	Main	MN09	Tamarack trail and haiawatha trail	42.466608, -83.252509							
10	Main	MN10	Tamarack Trail & 10 mile	42.471861, -83.253591	Banks	good	Park by the bridge on Tamarack trail			Upstream	
11	Main	US5	Beech rd and shiawassee st	42.447867, -83.297672	14	good	Park on W.Shoulder next to bridge. Check if gauge is active			Upstream	
12	Main	MN12	N inkster rd and 9 mile	42.456262, -83.313634	Banks		Sample at 2nd crossing east of Inkster on 9 mile. Park on N. side of road. No access to bridge but can walk down and sample from bank			Upstream	
13	Main	MN13	N Inkster and Spring valley Dr	42.457364, -83.317543				Park near outfall site by the bridge			
14	Main	MN14	W 10mile and samoset trail	42.471354, -83.303989	Banks	good	Sample from banks on samoset trail	park at outfall site on samoset		Downstream	
15	Main	MN15	11 mile & Mel Bauman Blvd.	42.485820, -83.308736	Banks	good	Park at outfall site nearby			Upstream	
16	Main	MN16	13 mile and Middlebelt	42.514245, -83.342398	12	near high flow	Accessible at 13Mile Rd. Park at Adat Shalom Synagouge Driveway . Sample at bridge on 13Mile			Upstream	Go from site 6 to site 8 and then to site 7 . Easier
17	Main	MN17	Franklin rd and 11mile rd	42.484291, -83.288878	Banks	good	Access to franklin from Telegraph is closed. Take swanson to franklin.	Park at lakeland parking lot			
18	Main	MN18	13mile and cheviot hills ct	42.509759, -83.299754	5	very small stream	at cheviot hills ct	Park by side of road. [residential area]		upstream	
19	Main	G59	Civic Center & Telegraph	42.479135, -83.284474	Banks	>75ft wide	No access at Telegraph [given map location]. Access at civic centre dr. Brige to high to sample > 35ft. Starirs to banks upstream. Bridge present upstream.	Park on civic centre dr		upstream	
20	Main	G46	12 mile rd and wildbrook dr.	42.501224, -83.278604	5	good	Access on first stream crossing E. of wildbrook dr . Sample on 12 mile Rd	Park on side of road on 12 Mile		upstream	
21	Main	H60	13mile and Bingham rd	42.515456, -83.279595	>30	Good	Sample from banks. Bridge on 13mile is too high to sample.	Park at bingham rd		upstream	
22	Main	G461	Franklin rd and 14mile rd	42.529993, -83.305529	8	turbulent stream	Cider mill on 14 mile N of intersection	Park at cider mill		upstream	

23	Main	MN23	West Maple& Middlebelt rd [Site at 7056 10 Hill Drive, West Bloomfield Township, MI]	42.535364, -83.329512	8	small creek; 15ft W	Site on North end of 10hill Dr; Sample from bridge	Park on 10hill Dr. [Residential area]	yes	Upstream	
24	Main	MN24	Site North of Brookridge Dr and Cold spring Ln	42.531156, -83.334984	3	very shallow; 3ft W; <1 ft deep [**May not have enough water to sample during dry conditions**]	Sample from crossing at Brookridge	Park on Brookridge Dr	yes	Upstream	
25	main	MN25	Walnut lake Rd and Doherty ST	42.559470, -83.357840		Good. Small stream.	Sample from culvert on Doherty st	Park on road			
26	Main	M03	12mile and Lahser rd	42.510152, -83.262320	20		Sample at bridge on Lahser rd	Park at lahser rd near outfall site		Upstream	
27	Main	MN27	evergreen and riverside	42.527673, -83.241951	11		sample at bridge on riverside. Parking space on riverside			upstream	
28	Main	MN28	west maple and baldwin rd	42.545581, -83.224560	9		Bridge on Baldwin St. Park on Baldwin st			Upstream	
29	Main	MN29	Tamarack Way & Kingswood Campus Dr.	42.574731, -83.245461	12		Accesible at Tamarack way. Sample at bridge.			Upstream	
30	Main	MN30	Accesible at Lone pine & Thetford Ln	42.564881, -83.264538	3		sample on Lone pine Rd			Upstream	
31	Main	MN31	vaughan rd & orchard ridge rd	42.575033, -83.260828	6		Park at parking lot [at 1011 orchard ridge Rd]			Downstream	
32	Main	MN32	Telegraph Rd & W. Long Lake Rd		4		Accessible at Devon brook st			Upstream	
33	Main	MN33	stonycroft ln and E long lake rd	42.585555, -83.237172	8		Park on stonycroft Ln			Upstream	
34	Main	M01	W.Big beaver rd and Adams Rd [sample at Big beaver Rd]	42.560498, -83.214754	8	small dam upstream	sample from side of the bridge on Beaver rd. **Watch out for traffic**	Park by side of bridge on beaver rd near springdale park	yes	Upstream	
35	Main	MN35	Firefighters Park	42.609323, -83.179803	14		Park at back parking lot. Bridge beside parking lot			Upstream	
36	Main	MN36	Squirrel Rd and E Square Lake rd	42.603743, -83.222664	5		Park at side of Squirrel Rd			Upstream	
		Lower Rouge									
1	Lower Rouge	L05D	S. Military Rd. & Morley Ave.	42.308582, -83.252712	17.5'	75' wide, vegetated channel, near high flow	Bridge near City of Dearborn Office.	Park in circle drive. Residential drive.	no	Upstream	
2	Lower Rouge	US1	John Daly St. & Lower Rouge Pkwy Dr.	42.300629, -83.300559	17'	50' wide, near high flow	sample at bridge on John Daly st	Inkster Park driveway south of bridge. Residential area.	No	Upstream	
3		LW03	Inkster& avondale	42.302771, -83.305465		turbid water	sample at bridge east of Lucerne Dr[connects Lucerne Dr & Elm circle Dr]	Park on Lucerne Dr. walk east into woods.			
4	Lower Rouge	g97	Michigan Ave. & Hendry Ruff St.	42.290030, -83.339159	13'	50' wide, near high flow	Sample at bridge on Henry Ruff Rd	Driveway south of bridge just by sherrif's dept.	Yes	Upstream	
5	Lower Rouge	L06	S. Wayne Rd. & Michigan Ave.	42.284978, -83.383583	19'	75' wide, near high flow	sample at bridge on S Wayne Rd	Park at Ash st across the fire dept.		Upstream	
6	Lower Rouge	G64	Annapolis St. & Treadwell St.	42.273615, -83.400887	6'	15' wide, normal flow	Sample from bank--bridge is fenced off.	Can pull over on the side of the road.	Yes	Downstream	
7	Lower Rouge	LW07	Newburg & hillcrest dr	42.285603, -83.407092			Sample at bridge crossing on Newburgh Rd, South of glenwood and North of hillcrest Dr.Upstream	Park on Whitney Dr			
8	Lower Rouge	LW08	Michigan Ave and hannan rd	42.278955, -83.423370							
9	Lower Rouge	LW09	van born & hannan rd	42.265233, -83.429126			Access at Van born Rd				
10	Lower Rouge	US9	Hannan Rd. & Michigan Ave.	42.28439, -83.42732	20	75ft W , near high flow	sample at bridge on hannan rd N. of Michigan Ave	Pullover side of Rd North of bridge @park	No	Upstream	sample at bridge- No side walk; church nearby
11	Lower Rouge	G92	Michigan ave and Haggetry rd.	42.279900, -83.446952	17	75 ft W, near high flow	Sample at bridge on haggetry rd	South of bridge park at western twonship authority bulding on the East side	No	Upstream	
12	Lower Rouge	L51	Michigan Ave. & South Taylor Rd	42.276348, -83.465606	10	small stream Semi turbulent bend in river	smaple from side of Michigan ave	Park at S. Morton Taylor Rd just by Michigan Ave.	yes	Downstream	
13	Lower Rouge	G94	Michigan Ave. & Sheldon Rd	42.281770, -83.476143	11	Fast and turbulent ; Bends present	Park @Dionne Rd; Sample at bridge; No sidewalks		No	Upstream	
14	Lower Rouge	L01	S. Beck Rd. and Lindenhurst Blvd. - northern crossing	42.283485, -83.505433	11.5	25ft W; Normal flow conditions	Sample at bridge on S.beck road	Park at Linderhurst blvd [charing cross apts]		Upstream	

15	Lower Rouge	G93	S. Beck Rd. and Lindenhurst Blvd. - southern crossing	42.282302, -83.505405	12	25ft W; Normal flow conditions	Sample at bridge on S.beck road	Park at Linderhurst blvd [charing cross apts]		Upstream	
16	Lower Rouge	G200	Denton & Hudson Dr.	42.297201, -83.525834	12	Very shallow ;low flow	Pull off on E. side of road S of the bridge			Upstream	sample @steel bridge
17	Lower Rouge	L02	Palmer and Lotz	42.294140, -83.436054	12	20ft W, wider at bridge	Park at Lotz Rd opposite to Links @fellow creek	Park at Lotz Rd opposite to Links @fellow creek		upstream	sample from bridge; No sidewalks
18	Lower Rouge	LW12	site North of S. Haggetry rd and Palmer rd [Truesdell drain]	42.300940, -83.453644			Access at chase and trent dr.[Bridge access inside Covington Square apartments]	Park on chase Dr	Did not visit	did not visit	
19	Lower Rouge	LW13	Cherry hill rd & N. Haggetry Rd	42.308552, -83.443875	30	near high flow	Park on shoulder of bridge on cherry wall		No	Upstream	
20	Lower Rouge	LW14	N. Canton Rd & Ford rd	42.323079, -83.487962	12	15ft W ; Low flow ; Shallow	sample north of speedway gas station	Park at speedway cross st @ Bridge	No	Upstream	

Upper Rouge

1	Upper	U05	Telegraph rd and river circle	42.392683, -83.276665	22		Pull over on shoulder on W. side of telegraph near "Simply storage"		-	Upstream	
2	Upper	U04	Beech daly rd & ross dr	42.392142, -83.295563	14		Park on Ross Dr. Sample from bridge.			Upstream	
3	Upper	U03	Inkster Rd & Meadowbrook	42.405507, -83.315252	12	near high flow	Park on Meadowbrook's. Cross road			Upstream	
4	Upper	UP04	5mile & Ellen rd	42.396943, -83.390460	9	near high flow	Adjacent to Idle hills estates. Park at Ellen dr			Upstream	
5	Upper	UP05	6mile & Wayne Dr	42.411201, -83.392861	11		Sample from bringe at 6 mile Rd.	Park @ wayne Rd		Upstream	
6	Upper	U15	Farmington & Pollyanna	42.411557, -83.379109	20	30ft W.	Park at Pollyanna Rd. Sample from				
7	Upper	U17	7 Mile & Osmus st	42.426445, -83.363430	16	Shallow flow	sample at bridge on 7mile	Park at Jehova Witness, 7mile rd			
8	Upper	UP08	Brittany Hill Dr & Grand River Ave	42.467299, -83.408839	11	small creek	Sample at bridge on Brittany hill dr	Park by bridge @chatham hill apts			
9	Upper	U02	Graham rd and Telegraph rd	42.398208, -83.278385	16	good	Park on Graham Rd. sample at bridge			Upstream	
10	Upper	G71	Inkster & Margareta	42.424304, -83.316061	10	near high flow	Park on Margareta			Upstream & Downstream [2locations]	
9	Upper	G19	8 Mile & Milburn Rd	42.441280, -83.348802	10	Shallow flow	sample at bridge on 8mile	Park at nearby parking lot		Downstream	Upstream not accesible
11	Upper	G72	Folsom & Tuck Rd	42.449199, -83.346448	9	10ft wide	Sample at bridge on Tuck Rd	Park off the bridge		Upstream	
13	Upper	UP16	Ravenwood & Nottingwood	42.507190, -83.368318	7		bridge on Nottingwood st. Park on side of Nottingwood			Upstream	
14	upper	UP15	13mile & N. Haggetery Rd	42.514159, -83.436991	Banks		sample near bridge[banks mostly] on haggetery rd	Park at Seely creel signboard before Lacanster & Haggetery Rd	yes	upstream	
15	upper	UP14	Halsted Rd & Howard Rd	42.489254, -83.416798	No access	No access	Pull over near bridge	Bridge on Halsted		upstream	
16	Upper	US3	Shiawassee st & Farmington Rd.	42.464520, -83.368684	10		Sample from bridge inside shiawassee park near USGS flow location	Park at Shiawassee parking lot Btwn Riphael& Farmington Rd.		Upstream	

Middle Rouge

1	Middle	D06	Ford rd and Edward hines Dr	42.330724, -83.248019	Did not visit	N/A	Sample at bridge on edward hines dr				
2	Middle	US2	Inkster and Edward N hines dr	42.348262, -83.312538	21	Good	Park on clairview and cross street for Upstream			Upstream	
3	Middle	MD03	wayne and joy road	42.351892, -83.386037							
4	Middle	MD04	Warren Rd & N Newburgh Rd	42.333045, -83.412775							
5	Middle	D62	Joy Rd. & Manton Ave.	42.351646, -83.462714	11	20ft wide; low flow; shallow	Sample from bridge on Joy Rd	Park on road E. of bridge		Upstream	
6	Middle	MD06	Ann Arbor Rd and S Main St	42.359590, -83.469624			sample from bridge on S main St	Park at Rite aid pharmacy parking lot.			
7	Middle	MD07	Wayne and Edward hines dr	42.358514, -83.386578		Added later by Meghan					
8	Middle	US10	Edward hines dr & Haggerty Rd [W. of I-275]	42.371621, -83.445615						Upstream	

9	Middle	MD09	Plymouth and Edward Hines dr	42.376143, -83.454400	did not visit		Sample from bridge	Park by courthouse grille near		Upstream	15ft height from bankls on Gunsolly Dr.
10	Middle	**Johnson creek gauge**	**7mile rd W. of Edward hines dr**	**42.425697, -83.481137**	**N/A**		**sample at bridge on Edward hines dr**	**Park west of bridge**		**Upstream**	
11	Middle	MD11	Beck Rd and 6 mile	42.411955, -83.511146				Site North of intersection on Beck Rd			
12	Middle	MD12	W. 6mile and lake view circle	42.408146, -83.519346	8	Good	Sample from sidewalk bridge.	Park on side of road near bridge on 6mile	yes	Upstream	
13	Middle	MD13	Napier Rd & last Dr	42.381706, -83.555045	12.5	Good. Shallow at sides	Park N of bridge on Napier road		yes	Upstream	
14	Middle	MD14	S.Main st and Beal St	42.428915, -83.478230	15	Good.Dam upstream; 40ft W	sample from bridge on Beal st	Park on River st	-	Upstream	
15	Middle	MD15	Ashbury dr & chase Dr	42.447750, -83.469200	16	20 ft	Park at bridge. Residential area			Upstream	
16	Middle	MD16	W 10mile Rd & Myrtle Ct	42.461387, -83.464450		12 ft shallow	Walk behind the apt playground into the woods		yes		sample from side
17	Middle	MD17	12Mile Rd & Taft rd	42.495015, -83.495897							
18	Middle	MD18	Meadowbrook & chattman St	42.458972, -83.454809		small creek	Sample at bridge on edward hines dr	park at chattman St			
19	Middle	MD19	12 Mile and Novi	42.495584, -83.469970	12 mile road and Novie Rd		Access from twelve oaks mall. Creek east of Mc.Donalds	Park at twelve oak mall parking Lot. Walk to the culvert by 12mile road			

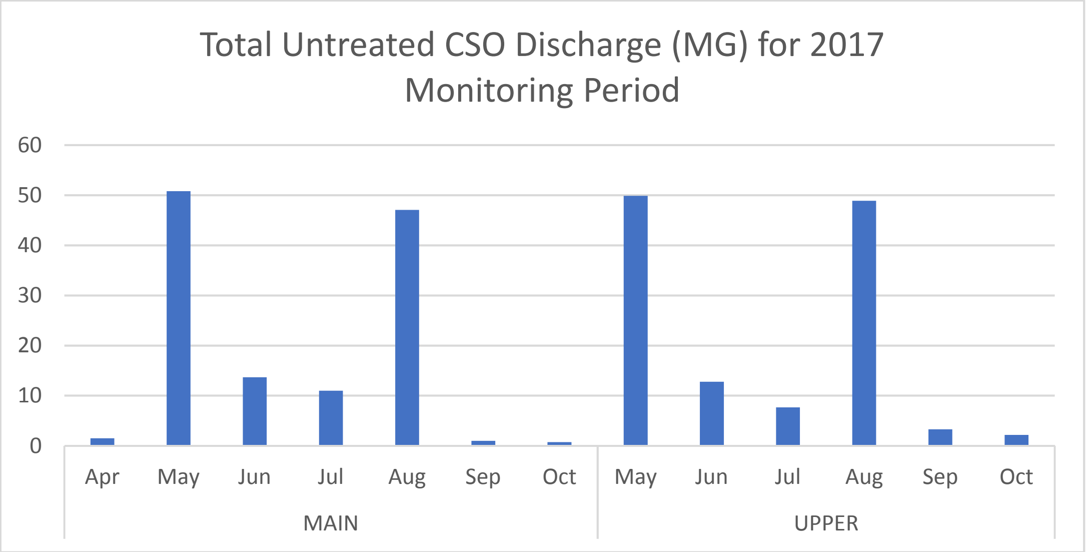
Appendix E

2005 and 2017 CSO Discharges

Total Uncontrolled CSO Discharge for 2017 Monitoring Period

Row Labels	Sum of Volume (MG)*
MAIN	**125.6627**
Apr	1.47
May	50.81
Jun	13.65
Jul	10.9727
Aug	47.07
Sep	0.97
Oct	0.72
UPPER	**124.58**
May	49.87
Jun	12.75
Jul	7.65
Aug	48.89
Sep	3.26
Oct	2.16
Grand Total	**250.2427**

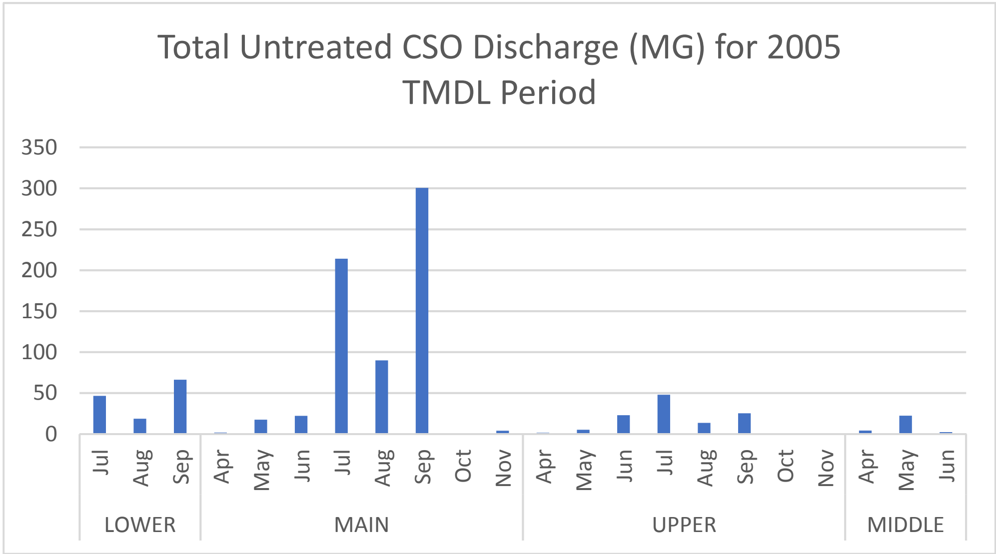
*Excludes flows from RTBs.



Source: MDEQ CSO/SSO Database accessed August 2018
http://www.deq.state.mi.us/csosso/find_event.asp

Total Uncontrolled CSO Discharge for 2005 TMDL Period

Row Labels	Sum of Volume (MG)
LOWER	131.5
Jul	46.6
Aug	18.7
Sep	66.2
MAIN	649.49332
Apr	1.58
May	17.503
Jun	22.08732
Jul	213.95
Aug	89.795
Sep	300.548
Oct	0.01
Nov	4.02
UPPER	116.321
Apr	1.403
May	5.124
Jun	22.954
Jul	47.82
Aug	13.45
Sep	25.31
Oct	0.09
Nov	0.17
MIDDLE	28.644
Apr	4.17
May	22.28
Jun	2.194
Grand Total	925.95832



Source: MDEQ CSO/SSO Database accessed August 2018

http://www.deq.state.mi.us/csosso/find_event.asp

Uncontrolled CSO Discharge Events for 2017 Monitoring Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
18744	1	MAIN	Telegraph & Silvery	4/30/2017 2:32	5/1/2017 13:37	0.78	CSO	0.45	Rouge River, Lower Branch
18759	1	MAIN	Telegraph & Silvery	5/4/2017 9:10	5/5/2017 19:53	1.87	CSO	1.94	Rouge River, Lower Branch
18781	1	MAIN	Telegraph & Silvery	5/16/2017 6:49	5/16/2017 8:22	0.39	CSO	0.13	Rouge River, Lower Branch
18791	1	MAIN	Telegraph & Silvery	5/21/2017 2:16	5/21/2017 17:23	1.08	CSO	0.77	Rouge River, Lower Branch
18807	1	MAIN	Telegraph & Silvery	5/24/2017 23:59	5/25/2017 16:34	0.87	CSO	0.54	Rouge River, Lower Branch
18808	1	MAIN	Telegraph & Silvery	5/28/2017 22:01	5/28/2017 23:55	0.3	CSO	0.08	Rouge River, Lower Branch
18844	1	MAIN	Telegraph & Silvery	6/14/2017 12:10	6/14/2017 13:25	0.5	CSO	0.21	Rouge River, Lower Branch
18845	1	MAIN	Telegraph & Silvery	6/22/2017 19:59	6/22/2017 22:11	0.99	CSO	0.66	Rouge River, Lower Branch
18896	1	MAIN	Telegraph & Silvery	6/30/2017 3:45	6/30/2017 6:04	0.22	CSO	0.03	Rouge River, Lower Branch
18897	1	MAIN	Telegraph & Silvery	6/30/2017 17:38	6/30/2017 21:42	0.33	CSO	0.1	Rouge River, Lower Branch
18744	2	MAIN	Telegraph & Silvery	4/30/2017 2:32	5/1/2017 13:37	0.78	CSO	0.01	Rouge River, Lower Branch
18759	2	MAIN	Telegraph & Silvery	5/4/2017 9:10	5/5/2017 19:53	1.87	CSO	0.13	Rouge River, Lower Branch
18791	2	MAIN	Telegraph & Silvery	5/21/2017 2:16	5/21/2017 17:23	1.08	CSO	0.02	Rouge River, Lower Branch
18807	2	MAIN	Telegraph & Silvery	5/24/2017 23:59	5/25/2017 16:34	0.87	CSO	0.01	Rouge River, Lower Branch
18845	2	MAIN	Telegraph & Silvery	6/22/2017 19:59	6/22/2017 22:11	0.99	CSO	0.01	Rouge River, Lower Branch
18899	2	MAIN	Telegraph & Silvery	7/7/2017 5:36	7/7/2017 8:00	0.52	CSO	0.01	Rouge River, Lower Branch
18907	2	MAIN	Telegraph & Silvery	7/7/2017 20:04	7/7/2017 21:52	1.1	CSO	0.02	Rouge River, Lower Branch
19006	2	MAIN	Telegraph & Silvery	8/17/2017 7:26	8/17/2017 16:06	1.18	CSO	0.03	Rouge River, Lower Branch
19036	2	MAIN	Telegraph & Silvery	8/28/2017 18:10	8/29/2017 1:47	1.93	CSO	0.14	Rouge River, Lower Branch
18759	3	MAIN	west of Telegraph & Michigan Ave.	5/4/2017 9:10	5/5/2017 19:53	1.87	CSO	6.11	Rouge River, Lower Branch
18781	3	MAIN	west of Telegraph & Michigan Ave.	5/16/2017 6:49	5/16/2017 8:22	0.39	CSO	0.78	Rouge River, Lower Branch
18791	3	MAIN	west of Telegraph & Michigan Ave.	5/21/2017 2:16	5/21/2017 17:23	1.08	CSO	3.16	Rouge River, Lower Branch
18807	3	MAIN	west of Telegraph & Michigan Ave.	5/24/2017 23:59	5/25/2017 16:34	0.87	CSO	2.41	Rouge River, Lower Branch
18808	3	MAIN	west of Telegraph & Michigan Ave.	5/28/2017 22:01	5/28/2017 23:55	0.3	CSO	0.49	Rouge River, Lower Branch
18844	3	MAIN	west of Telegraph & Michigan Ave.	6/14/2017 12:10	6/14/2017 13:25	0.5	CSO	1.15	Rouge River, Lower Branch
18845	3	MAIN	west of Telegraph & Michigan Ave.	6/22/2017 19:59	6/22/2017 22:11	0.99	CSO	2.84	Rouge River, Lower Branch
18896	3	MAIN	west of Telegraph & Michigan Ave.	6/30/2017 3:45	6/30/2017 6:04	0.22	CSO	0.23	Rouge River, Lower Branch
18897	3	MAIN	west of Telegraph & Michigan Ave.	6/30/2017 17:38	6/30/2017 21:42	0.33	CSO	0.58	Rouge River, Lower Branch
18899	3	MAIN	west of Telegraph & Michigan Ave.	7/7/2017 5:36	7/7/2017 8:00	0.52	CSO	1.21	Rouge River, Lower Branch
18907	3	MAIN	west of Telegraph & Michigan Ave.	7/7/2017 20:04	7/7/2017 21:52	1.1	CSO	3.23	Rouge River, Lower Branch
18908	3	MAIN	west of Telegraph & Michigan Ave.	7/10/2017 11:03	7/10/2017 15:14	0.4	CSO	0.81	Rouge River, Lower Branch
18922	3	MAIN	west of Telegraph & Michigan Ave.	7/12/2017 13:02	7/12/2017 15:41	0.17	CSO	0.06	Rouge River, Lower Branch
18926	3	MAIN	west of Telegraph & Michigan Ave.	7/13/2017 5:56	7/13/2017 7:54	0.25	CSO	0.32	Rouge River, Lower Branch
18950	3	MAIN	west of Telegraph & Michigan Ave.	8/2/2017 17:06	8/2/2017 18:17	0.36	CSO	0.68	Rouge River, Lower Branch
19006	3	MAIN	west of Telegraph & Michigan Ave.	8/17/2017 7:26	8/17/2017 16:06	1.18	CSO	3.52	Rouge River, Lower Branch
19007	3	MAIN	west of Telegraph & Michigan Ave.	8/22/2017 15:03	8/22/2017 16:04	0.17	CSO	0.06	Rouge River, Lower Branch
19036	3	MAIN	west of Telegraph & Michigan Ave.	8/28/2017 18:10	8/29/2017 1:47	1.93	CSO	6.34	Rouge River, Lower Branch
19037	3	MAIN	west of Telegraph & Michigan Ave.	8/29/2017 15:02	8/29/2017 19:05	0.3	CSO	0.49	Rouge River, Lower Branch
19038	3	MAIN	west of Telegraph & Michigan Ave.	9/4/2017 18:29	9/4/2017 20:28	0.34	CSO	0.62	Rouge River, Lower Branch
19085	3	MAIN	west of Telegraph & Michigan Ave.	9/19/2017 14:59	9/19/2017 16:55	0.39	CSO	0.23	Rouge River, Lower Branch
18744	4	MAIN	east of Telegraph (north)	4/30/2017 2:32	5/1/2017 13:37	0.78	CSO	1	Rouge River, Lower Branch
18759	4	MAIN	east of Telegraph (north)	5/4/2017 9:10	5/5/2017 19:53	1.87	CSO	4.75	Rouge River, Lower Branch
18791	4	MAIN	east of Telegraph (north)	5/21/2017 2:16	5/21/2017 17:23	1.08	CSO	1.9	Rouge River, Lower Branch
18807	4	MAIN	east of Telegraph (north)	5/24/2017 23:59	5/25/2017 16:34	0.87	CSO	1.26	Rouge River, Lower Branch
18844	4	MAIN	east of Telegraph (north)	6/14/2017 12:10	6/14/2017 13:25	0.5	CSO	0.25	Rouge River, Lower Branch
18845	4	MAIN	east of Telegraph (north)	6/22/2017 19:59	6/22/2017 22:11	0.99	CSO	1.62	Rouge River, Lower Branch
18899	4	MAIN	east of Telegraph (north)	7/7/2017 5:36	7/7/2017 8:00	0.52	CSO	0.3	Rouge River, Lower Branch
18907	4	MAIN	east of Telegraph (north)	7/7/2017 20:04	7/7/2017 21:52	1.1	CSO	1.96	Rouge River, Lower Branch
19006	4	MAIN	east of Telegraph (north)	8/17/2017 7:26	8/17/2017 16:06	1.18	CSO	2.22	Rouge River, Lower Branch

Uncontrolled CSO Discharge Events for 2017 Monitoring Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
19036	4	MAIN	east of Telegraph (north)	8/28/2017 18:10	8/29/2017 1:47	1.93	CSO	4.99	Rouge River, Lower Branch
18744	5	MAIN	east of Telegraph (south)	4/30/2017 2:32	5/1/2017 13:37	0.78	CSO	0.01	Rouge River, Lower Branch
18759	5	MAIN	east of Telegraph (south)	5/4/2017 9:10	5/5/2017 19:53	1.87	CSO	0.53	Rouge River, Lower Branch
18791	5	MAIN	east of Telegraph (south)	5/21/2017 2:16	5/21/2017 17:23	1.08	CSO	0.08	Rouge River, Lower Branch
18807	5	MAIN	east of Telegraph (south)	5/24/2017 23:59	5/25/2017 16:34	0.87	CSO	0.02	Rouge River, Lower Branch
18845	5	MAIN	east of Telegraph (south)	6/22/2017 19:59	6/22/2017 22:11	0.99	CSO	0.05	Rouge River, Lower Branch
18907	5	MAIN	east of Telegraph (south)	7/7/2017 20:04	7/7/2017 21:52	1.1	CSO	0.09	Rouge River, Lower Branch
19006	5	MAIN	east of Telegraph (south)	8/17/2017 7:26	8/17/2017 16:06	1.18	CSO	0.12	Rouge River, Lower Branch
18898	9	MAIN	east of Middlebelt	7/7/2017 20:35	7/8/2017 0:30	1.27	CSO	0.0027	Rouge River, Lower Branch
18759	13	UPPER	Greenfield Village	5/4/2017 9:10	5/5/2017 19:53	1.87	CSO	14.39	Rouge River
18781	13	UPPER	Greenfield Village	5/16/2017 6:49	5/16/2017 8:22	0.39	CSO	1.49	Rouge River
18791	13	UPPER	Greenfield Village	5/21/2017 2:16	5/21/2017 17:23	1.08	CSO	6.71	Rouge River
18807	13	UPPER	Greenfield Village	5/24/2017 23:59	5/25/2017 16:34	0.87	CSO	4.98	Rouge River
18808	13	UPPER	Greenfield Village	5/28/2017 22:01	5/28/2017 23:55	0.3	CSO	0.91	Rouge River
18844	13	UPPER	Greenfield Village	6/14/2017 12:10	6/14/2017 13:25	0.5	CSO	2.23	Rouge River
18845	13	UPPER	Greenfield Village	6/22/2017 19:59	6/22/2017 22:11	0.99	CSO	5.95	Rouge River
18908	13	UPPER	Greenfield Village	7/10/2017 11:03	7/10/2017 15:14	0.4	CSO	1.56	Rouge River
18922	13	UPPER	Greenfield Village	7/12/2017 13:02	7/12/2017 15:41	0.17	CSO	0.12	Rouge River
18926	13	UPPER	Greenfield Village	7/13/2017 5:56	7/13/2017 7:54	0.25	CSO	0.6	Rouge River
18950	13	UPPER	Greenfield Village	8/2/2017 17:06	8/2/2017 18:17	0.36	CSO	1.3	Rouge River
19006	13	UPPER	Greenfield Village	8/17/2017 7:26	8/17/2017 16:06	1.18	CSO	7.59	Rouge River
19007	13	UPPER	Greenfield Village	8/22/2017 15:03	8/22/2017 16:04	0.17	CSO	0.12	Rouge River
19036	13	UPPER	Greenfield Village	8/28/2017 18:10	8/29/2017 1:47	1.93	CSO	15.05	Rouge River
19037	13	UPPER	Greenfield Village	8/29/2017 15:02	8/29/2017 19:05	0.3	CSO	0.91	Rouge River
19038	13	UPPER	Greenfield Village	9/4/2017 18:29	9/4/2017 20:28	0.34	CSO	1.17	Rouge River
19038	13	UPPER	Greenfield Village	9/4/2017 18:29	9/4/2017 20:28	0.34	CSO	1.17	Rouge River
19085	13	UPPER	Greenfield Village	9/19/2017 14:59	9/19/2017 16:55	0.39	CSO	0.42	Rouge River
19128	13	UPPER	Greenfield Village	10/6/2017 7:25	10/6/2017 21:51	0.43	CSO	1.76	Rouge River
19129	13	UPPER	Greenfield Village	10/7/2017 23:14	10/8/2017 1:54	0.2	CSO	0.3	Rouge River
18759	14	UPPER	1625 ft. north of Rotunda	5/4/2017 9:10	5/5/2017 19:53	1.87	CSO	15.45	Rouge River
18791	14	UPPER	1625 ft. north of Rotunda	5/21/2017 2:16	5/21/2017 17:23	1.08	CSO	3.73	Rouge River
18807	14	UPPER	1625 ft. north of Rotunda	5/24/2017 23:59	5/25/2017 16:34	0.87	CSO	1.95	Rouge River
18844	14	UPPER	1625 ft. north of Rotunda	6/14/2017 12:10	6/14/2017 13:25	0.5	CSO	0.18	Rouge River
18845	14	UPPER	1625 ft. north of Rotunda	6/22/2017 19:59	6/22/2017 22:11	0.99	CSO	2.9	Rouge River
18907	14	UPPER	1625 ft. north of Rotunda	7/7/2017 20:04	7/7/2017 21:52	1.1	CSO	3.93	Rouge River
19006	14	UPPER	1625 ft. north of Rotunda	8/17/2017 7:26	8/17/2017 16:06	1.18	CSO	4.77	Rouge River
19036	14	UPPER	1625 ft. north of Rotunda	8/28/2017 18:10	8/29/2017 1:47	1.93	CSO	16.66	Rouge River
19128	14	UPPER	1625 ft. north of Rotunda	10/6/2017 7:25	10/6/2017 21:51	0.43	CSO	0.04	Rouge River
18787	59	UPPER	W. Warren @ Detroit River	5/21/2017 1:41	5/21/2017 3:04	0.95	CSO	0.26	Rouge River
18927	59	UPPER	W. Warren @ Detroit River	6/14/2017 11:04	6/14/2017 11:44	0.12	CSO	0.88	Rouge River
18840	59	UPPER	W. Warren @ Detroit River	6/22/2017 19:17	6/22/2017 21:27	1.01	CSO	0.61	Rouge River
18904	59	UPPER	W. Warren @ Detroit River	7/10/2017 9:52	7/10/2017 10:57	0.96	CSO	1.44	Rouge River
18949	59	UPPER	W. Warren @ Detroit River	8/2/2017 15:58	8/2/2017 17:13	0.26	CSO	0.09	Rouge River
18984	59	UPPER	W. Warren @ Detroit River	8/17/2017 6:48	8/17/2017 14:33	1.19	CSO	1.5	Rouge River
18999	59	UPPER	W. Warren @ Detroit River	8/22/2017 13:52	8/22/2017 14:27	0.01	CSO	0.79	Rouge River
19021	59	UPPER	W. Warren @ Detroit River	8/28/2017 17:44	8/28/2017 20:29	1.96	CSO	0.11	Rouge River
19029	59	UPPER	W. Warren @ Detroit River	9/4/2017 17:58	9/4/2017 19:14	0.52	CSO	0.25	Rouge River
19029	59	UPPER	W. Warren @ Detroit River	9/4/2017 17:58	9/4/2017 19:14	0.52	CSO	0.25	Rouge River
19115	59	UPPER	W. Warren @ Detroit River	10/11/2017 6:30	10/11/2017 6:50	0.86	CSO	0.06	Rouge River

Uncontrolled CSO Discharge Events for 2017 Monitoring Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
18787	61	MAIN	W. Chicago @ Detroit River	5/21/2017 2:54	5/21/2017 3:40	0.95	CSO	1.32	Rouge River
19021	61	MAIN	W. Chicago @ Detroit River	8/28/2017 18:19	8/28/2017 19:29	1.96	CSO	0.6	Rouge River
18787	64	MAIN	Rouge Park	5/21/2017 2:40	5/21/2017 3:40	0.95	CSO	1.67	Rouge River
18829	64	MAIN	Rouge Park	6/15/2017 15:29	6/15/2017 16:10	0.29	CSO	1.39	Rouge River
18840	64	MAIN	Rouge Park	6/22/2017 19:36	6/22/2017 23:07	1.01	CSO	3.61	Rouge River
18904	64	MAIN	Rouge Park	7/10/2017 10:04	7/12/2017 13:29	0.96	CSO	2.48	Rouge River
19021	64	MAIN	Rouge Park	8/28/2017 17:49	8/28/2017 20:19	1.96	CSO	11.72	Rouge River
18751	67	MAIN	I-96 @ Detroit River	5/4/2017 15:46	5/5/2017 16:58	1.71	CSO	1.05	Rouge River
18787	67	MAIN	I-96 @ Detroit River	5/21/2017 1:35	5/21/2017 2:49	0.95	CSO	0.6	Rouge River
18800	67	MAIN	I-96 @ Detroit River	5/25/2017 6:27	5/25/2017 10:45	0.62	CSO	0.81	Rouge River
18829	67	MAIN	I-96 @ Detroit River	6/15/2017 14:28	6/15/2017 15:15	0.29	CSO	0.38	Rouge River
18840	67	MAIN	I-96 @ Detroit River	6/22/2017 19:22	6/22/2017 21:08	1.01	CSO	0.54	Rouge River
18904	67	MAIN	I-96 @ Detroit River	7/10/2017 9:42	7/12/2017 12:52	0.96	CSO	0.48	Rouge River
18949	67	MAIN	I-96 @ Detroit River	8/2/2017 16:03	8/2/2017 16:33	0.26	CSO	0.32	Rouge River
18984	67	MAIN	I-96 @ Detroit River	8/17/2017 7:08	8/17/2017 14:28	1.19	CSO	0.38	Rouge River
19021	67	MAIN	I-96 @ Detroit River	8/28/2017 18:04	8/28/2017 20:24	1.96	CSO	0.13	Rouge River
19029	67	MAIN	I-96 @ Detroit River	9/4/2017 18:18	9/4/2017 18:43	0.52	CSO	0.06	Rouge River
19029	67	MAIN	I-96 @ Detroit River	9/4/2017 18:18	9/4/2017 18:43	0.52	CSO	0.06	Rouge River
19115	67	MAIN	I-96 @ Detroit River	10/11/2017 6:25	10/11/2017 13:15	0.86	CSO	0.72	Rouge River
18751	74	MAIN	McNichols @ Detroit River	5/4/2017 17:00	5/4/2017 18:59	1.71	CSO	9.97	Rouge River
18787	74	MAIN	McNichols @ Detroit River	5/21/2017 2:32	5/21/2017 3:52	0.95	CSO	10.28	Rouge River
18949	74	MAIN	McNichols @ Detroit River	8/2/2017 16:38	8/2/2017 17:58	0.26	CSO	12.92	Rouge River
18949	79	MAIN	Frisbee (east)	8/2/2017 16:02	8/2/2017 16:08	0.26	CSO	2.41	Rouge River
Total								**250.2427**	

Source: MDEQ CSO/SSO Database accessed August 2018
http://www.deq.state.mi.us/csosso/find_event.asp

Retention and Treatment Basin (RTB) Discharge Events for 2017 Monitoring Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
19004	103	MIDDLE	Evergreen & Beverly	8/28/2017 18:42	8/28/2017 23:55	1.31	RTB	3.54	Rouge River
18758	117	MIDDLE	former outfall 017	5/5/2017 17:57	5/5/2017 23:07	1.64	RTB	8.66	Rouge River
18851	117	MIDDLE	former outfall 017	6/22/2017 20:57	6/23/2017 12:04	0.62	RTB	13.49	Rouge River
18905	117	MIDDLE	former outfall 017	7/7/2017 20:42	7/7/2017 23:05	1.29	RTB	11.97	Rouge River
19005	117	MIDDLE	former outfall 017	8/17/2017 8:25	8/17/2017 18:15	1.47	RTB	11.89	Rouge River
19035	117	MIDDLE	former outfall 017	8/28/2017 19:25	8/29/2017 2:00	1.27	RTB	19.41	Rouge River
18748	101A	LOWER	east of Southfield Freeway, south of Michigan Ave., discharges to north bank of Rouge River	5/4/2017 19:55	5/6/2017 7:50	1.71	RTB	189.1	Rouge River
18785	101A	LOWER	east of Southfield Freeway, south of Michigan Ave., discharges to north bank of Rouge River	5/21/2017 6:00	5/21/2017 17:05	0.95	RTB	3.5	Rouge River
18838	101A	LOWER	east of Southfield Freeway, south of Michigan Ave., discharges to north bank of Rouge River	6/23/2017	6/23/2017 7:55	1.01	RTB	8.5	Rouge River
19020	101A	LOWER	east of Southfield Freeway, south of Michigan Ave., discharges to north bank of Rouge River	8/28/2017 20:30	8/29/2017 5:20	1.96	RTB	79.7	Rouge River
18748	107A	MAIN	Baby Creek Screening & Disinfection Facility	5/4/2017 20:30	5/8/2017 6:00	1.71	RTB	178.9	Rouge River
18785	107A	MAIN	Baby Creek Screening & Disinfection Facility	5/21/2017 8:30	5/22/2017 6:00	0.95	RTB	101.7	Rouge River
18798	107A	MAIN	Baby Creek Screening & Disinfection Facility	5/25/2017 14:35	5/25/2017 23:55	0.62	RTB	5.5	Rouge River
18828	107A	MAIN	Baby Creek Screening & Disinfection Facility	6/15/2017 15:30	6/16/2017 0:20	0.29	RTB	16	Rouge River
18902	107A	MAIN	Baby Creek Screening & Disinfection Facility	7/12/2017 6:15	7/13/2017 19:45	0.96	RTB	62.6	Rouge River
18982	107A	MAIN	Baby Creek Screening & Disinfection Facility	8/17/2017 19:45	8/18/2017 2:00	1.19	RTB	20.8	Rouge River
19020	107A	MAIN	Baby Creek Screening & Disinfection Facility	8/28/2017 21:50	8/29/2017 22:30	1.96	RTB	41.4	Rouge River
18748	109A	MAIN	Oakwood RTB	5/5/2017 1:15	5/7/2017 10:30	1.71	RTB	24.5	Rouge River
18785	109A	MAIN	Oakwood RTB	5/21/2017 16:45	5/22/2017 6:10	0.95	RTB	7.8	Rouge River
18798	109A	MAIN	Oakwood RTB	5/25/2017 22:00	5/26/2017 6:10	0.62	RTB	2.1	Rouge River
18902	109A	MAIN	Oakwood RTB	7/13/2017 8:10	7/13/2017 21:40	0.96	RTB	6	Rouge River
Total								**817.06**	

Source: MDEQ CSO/SSO Database accessed August 2018
http://www.deq.state.mi.us/csosso/find_event.asp

Uncontrolled CSO Discharge Events for 2005 TMDL Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
6578	1	MAIN	100 ft. west of Jefferson	6/21/2005 23:00	6/21/2005 23:45		CSO	0.04032	Rouge River
6707	1	MAIN	100 ft. west of Jefferson	7/16/2005 10:45	7/16/2005 13:00		CSO	0.86	Rouge River
6759	1	MAIN	100 ft. west of Jefferson	7/25/2005 2:30	7/27/2005 9:00	1	CSO	4.8	Rouge River
6845	1	MAIN	100 ft. west of Jefferson	8/27/2005 13:30	8/27/2005 14:30		CSO	0.785	Rouge River
6939	1	MAIN	100 ft. west of Jefferson	9/22/2005 20:15	9/23/2005 0:09		CSO	1.818	Rouge River
6812	1	MAIN	Telegraph & Silvery	5/13/2005 21:25	5/14/2005 4:45		CSO	0.37	Rouge River, Lower Branch
6828	1	MAIN	Telegraph & Silvery	5/20/2005 0:15	5/20/2005 2:19		CSO	0.04	Rouge River, Lower Branch
6831	1	MAIN	Telegraph & Silvery	5/22/2005 17:56	5/22/2005 19:00		CSO	0.01	Rouge River, Lower Branch
6832	1	MAIN	Telegraph & Silvery	6/4/2005 12:55	6/4/2005 13:40		CSO	0.01	Rouge River, Lower Branch
6833	1	MAIN	Telegraph & Silvery	6/8/2005 22:04	6/10/2005 1:25		CSO	0.54	Rouge River, Lower Branch
6847	1	MAIN	Telegraph & Silvery	6/11/2005 16:40	6/11/2005 19:55		CSO	0.16	Rouge River, Lower Branch
6862	1	MAIN	Telegraph & Silvery	6/15/2005 12:55	6/15/2005 14:00		CSO	0.01	Rouge River, Lower Branch
6863	1	MAIN	Telegraph & Silvery	6/21/2005 20:49	6/22/2005 0:45		CSO	0.38	Rouge River, Lower Branch
6889	1	MAIN	Telegraph & Silvery	6/30/2005 13:55	6/30/2005 18:04		CSO	0.28	Rouge River, Lower Branch
7137	1	MAIN	Telegraph & Silvery	7/4/2005 22:25	7/5/2005 0:30		CSO	0.05	Rouge River, Lower Branch
6708	1	MAIN	Telegraph & Silvery	7/16/2005 12:15	7/16/2005 19:10		CSO	0.68	Rouge River, Lower Branch
6709	1	MAIN	Telegraph & Silvery	7/18/2005 20:55	7/19/2005 0:04		CSO	0.21	Rouge River, Lower Branch
6718	1	MAIN	Telegraph & Silvery	7/21/2005 2:15	7/21/2005 5:49		CSO	0.2	Rouge River, Lower Branch
6751	1	MAIN	Telegraph & Silvery	7/24/2005 9:25	7/24/2005 14:45		CSO	0.35	Rouge River, Lower Branch
6752	1	MAIN	Telegraph & Silvery	7/26/2005 15:45	7/27/2005 10:19		CSO	1.39	Rouge River, Lower Branch
6861	1	MAIN	Telegraph & Silvery	8/13/2005 6:55	6/13/2005 8:00		CSO	0.01	Rouge River, Lower Branch
7203	1	MAIN	Telegraph & Silvery	8/14/2005 1:49	8/14/2005 9:55		CSO	0.15	Rouge River, Lower Branch
7208	1	MAIN	Telegraph & Silvery	8/21/2005 12:45	8/21/2005 15:25		CSO	0.07	Rouge River, Lower Branch
6875	1	MAIN	Telegraph & Silvery	8/27/2005 14:40	8/27/2005 18:30		CSO	0.59	Rouge River, Lower Branch
7229	1	MAIN	Telegraph & Silvery	9/16/2005 17:19	9/16/2005 12:19		CSO	0.22	Rouge River, Lower Branch
7240	1	MAIN	Telegraph & Silvery	9/22/2005 20:45	9/23/2005 2:10		CSO	0.63	Rouge River, Lower Branch
6947	1	MAIN	Telegraph & Silvery	9/25/2005 19:55	9/26/2005 10:15		CSO	0.18	Rouge River, Lower Branch
7262	1	MAIN	Telegraph & Silvery	9/29/2005 2:34	9/29/2005 7:19		CSO	0.2	Rouge River, Lower Branch
7642	1	MAIN	Telegraph & Silvery	10/2/2005 9:30	10/2/2005 9:19		CSO	0.01	Rouge River, Lower Branch
7645	1	MAIN	Telegraph & Silvery	11/1/2005 8:10	11/1/2005 11:19		CSO	0.1	Rouge River, Lower Branch
7667	1	MAIN	Telegraph & Silvery	11/5/2005 3:10	11/16/2005 4:49		CSO	2.07	Rouge River, Lower Branch
7651	1	MAIN	Telegraph & Silvery	11/9/2005 5:19	11/9/2005 9:15		CSO	0.37	Rouge River, Lower Branch
6813	2	MAIN	Telegraph & Silvery	5/13/2005 22:25	5/13/2005 23:10		CSO	0.01	Rouge River, Lower Branch
6834	2	MAIN	Telegraph & Silvery	6/9/2005 22:10	6/9/2005 23:25		CSO	0.04	Rouge River, Lower Branch
6864	2	MAIN	Telegraph & Silvery	6/21/2005 21:25	6/21/2005 22:40		CSO	0.02	Rouge River, Lower Branch
6890	2	MAIN	Telegraph & Silvery	6/30/2005 14:34	6/30/2005 15:15		CSO	0.01	Rouge River, Lower Branch
7141	2	MAIN	Telegraph & Silvery	7/16/2005 15:00	7/6/2005 16:25		CSO	0.06	Rouge River, Lower Branch
7174	2	MAIN	Telegraph & Silvery	7/24/2005 10:49	7/24/2005 11:00		CSO	0.01	Rouge River, Lower Branch
7187	2	MAIN	Telegraph & Silvery	7/26/2005 16:10	7/27/2005 7:49		CSO	0.12	Rouge River, Lower Branch
7212	2	MAIN	Telegraph & Silvery	8/27/2005 14:55	8/27/2005 16:30		CSO	0.09	Rouge River, Lower Branch
7241	2	MAIN	Telegraph & Silvery	9/22/2005 21:15	9/23/2005 0:10		CSO	0.06	Rouge River, Lower Branch
7523	3	MAIN	west of Telegraph & Michigan Ave.	4/26/2005 18:45	4/27/2005 1:00		CSO	0.66	Rouge River, Lower Branch
6814	3	MAIN	west of Telegraph & Michigan Ave.	5/13/2005 21:55	5/14/2005 7:25		CSO	1.44	Rouge River, Lower Branch
6835	3	MAIN	west of Telegraph & Michigan Ave.	6/8/2005 22:40	6/10/2005 4:04		CSO	1.86	Rouge River, Lower Branch
6848	3	MAIN	west of Telegraph & Michigan Ave.	6/11/2005 17:15	6/11/2005 22:34		CSO	0.51	Rouge River, Lower Branch
6865	3	MAIN	west of Telegraph & Michigan Ave.	6/21/2005 21:15	6/22/2005 3:25		CSO	1.24	Rouge River, Lower Branch
6891	3	MAIN	west of Telegraph & Michigan Ave.	6/30/2005 14:19	6/30/2005 20:49		CSO	0.91	Rouge River, Lower Branch
7138	3	MAIN	west of Telegraph & Michigan Ave.	7/5/2005 4:00	7/5/2005 5:04		CSO	0.01	Rouge River, Lower Branch
7142	3	MAIN	west of Telegraph & Michigan Ave.	7/16/2005 12:55	7/16/2005 21:49		CSO	2.65	Rouge River, Lower Branch
7155	3	MAIN	west of Telegraph & Michigan Ave.	7/18/2005 21:19	7/19/2005 2:45		CSO	0.63	Rouge River, Lower Branch

Uncontrolled CSO Discharge Events for 2005 TMDL Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
7165	3	MAIN	west of Telegraph & Michigan Ave.	7/21/2005 2:45	7/21/2005 8:30		CSO	0.68	Rouge River, Lower Branch
7175	3	MAIN	west of Telegraph & Michigan Ave.	7/24/2005 9:55	7/24/2005 17:25		CSO	1.34	Rouge River, Lower Branch
7188	3	MAIN	west of Telegraph & Michigan Ave.	7/26/2005 16:04	7/27/2005 13:00		CSO	5.35	Rouge River, Lower Branch
7204	3	MAIN	west of Telegraph & Michigan Ave.	8/14/2005 5:19	8/14/2005 12:34		CSO	0.5	Rouge River, Lower Branch
7209	3	MAIN	west of Telegraph & Michigan Ave.	8/21/2005 14:04	8/21/2004 18:04		CSO	0.09	Rouge River, Lower Branch
7213	3	MAIN	west of Telegraph & Michigan Ave.	8/27/2005 14:55	8/27/2005 21:10		CSO	2.44	Rouge River, Lower Branch
7230	3	MAIN	west of Telegraph & Michigan Ave.	9/16/2005 8:30	9/16/2005 15:00		CSO	0.77	Rouge River, Lower Branch
7242	3	MAIN	west of Telegraph & Michigan Ave.	9/22/2005 21:04	9/23/2005 4:45		CSO	2.39	Rouge River, Lower Branch
7257	3	MAIN	west of Telegraph & Michigan Ave.	9/25/2005 23:49	9/26/2005 13:45		CSO	0.72	Rouge River, Lower Branch
7263	3	MAIN	west of Telegraph & Michigan Ave.	9/29/2005 3:49	9/29/2005 10:00		CSO	0.67	Rouge River, Lower Branch
7648	3	MAIN	west of Telegraph & Michigan Ave.	11/1/2005 9:10	11/1/2005 14:00		CSO	0.23	Rouge River, Lower Branch
7656	3	MAIN	west of Telegraph & Michigan Ave.	11/9/2005 5:55	11/9/2005 11:55		CSO	1.22	Rouge River, Lower Branch
7524	4	MAIN	east of Telegraph (north)	4/26/2005 20:19	4/26/2005 23:34		CSO	0.09	Rouge River, Lower Branch
6815	4	MAIN	east of Telegraph (north)	5/13/2005 22:25	5/14/2005 3:45		CSO	0.86	Rouge River, Lower Branch
6836	4	MAIN	east of Telegraph (north)	6/9/2005 0:04	6/10/2005 2:45		CSO	1.24	Rouge River, Lower Branch
6849	4	MAIN	east of Telegraph (north)	6/11/2005 18:04	6/11/2004 21:19		CSO	0.13	Rouge River, Lower Branch
6866	4	MAIN	east of Telegraph (north)	6/21/2005 21:30	6/22/2005 2:10		CSO	1.09	Rouge River, Lower Branch
6892	4	MAIN	east of Telegraph (north)	6/30/2005 14:40	6/30/2005 19:19		CSO	0.63	Rouge River, Lower Branch
7143	4	MAIN	east of Telegraph (north)	7/16/2005 14:45	7/16/2005 20:25		CSO	1.95	Rouge River, Lower Branch
7156	4	MAIN	east of Telegraph (north)	7/18/2005 21:49	7/19/2005 1:34		CSO	0.38	Rouge River, Lower Branch
7166	4	MAIN	east of Telegraph (north)	7/21/2005 3:30	7/21/2005 7:15		CSO	0.3	Rouge River, Lower Branch
7176	4	MAIN	east of Telegraph (north)	7/24/2005 10:30	7/24/2005 16:10		CSO	0.79	Rouge River, Lower Branch
7189	4	MAIN	east of Telegraph (north)	7/26/2005 16:19	7/27/2005 11:45		CSO	4.29	Rouge River, Lower Branch
7214	4	MAIN	east of Telegraph (north)	8/27/2005 15:10	8/27/2005 19:55		CSO	1.82	Rouge River, Lower Branch
7231	4	MAIN	east of Telegraph (north)	9/16/2005 9:45	9/16/2005 13:34		CSO	0.2	Rouge River, Lower Branch
7243	4	MAIN	east of Telegraph (north)	9/22/2005 21:25	9/23/2005 3:34		CSO	2.08	Rouge River, Lower Branch
7264	4	MAIN	east of Telegraph (north)	9/29/2005 5:15	9/29/2005 8:40		CSO	0.13	Rouge River, Lower Branch
7144	5	MAIN	east of Telegraph (south)	7/16/2005 15:40	7/16/2005 20:25		CSO	1.95	Rouge River, Lower Branch
7190	5	MAIN	east of Telegraph (south)	7/27/2005 3:04	7/27/2005 9:30		CSO	0.49	Rouge River, Lower Branch
7244	5	MAIN	east of Telegraph (south)	9/22/2005 23:19	9/23/2005 1:04		CSO	0.06	Rouge River, Lower Branch
7145	6	MAIN	east of Outer Dr. (north)	7/16/2005 15:30	7/16/2005 17:19		CSO	0.04	Rouge River, Lower Branch
7191	6	MAIN	east of Outer Dr. (north)	7/27/2005 3:25	7/27/2005 8:49		CSO	0.08	Rouge River, Lower Branch
7215	6	MAIN	east of Outer Dr. (north)	8/27/2005 15:34	8/27/2005 17:30		CSO	0.04	Rouge River, Lower Branch
7245	6	MAIN	east of Outer Dr. (north)	9/22/2005 23:04	9/23/2004 1:04		CSO	0.05	Rouge River, Lower Branch
7525	7	MAIN	west of Outer Dr. (south)	4/26/2005 20:10	4/26/2005 0:15		CSO	0.23	Rouge River, Lower Branch
6816	7	MAIN	west of Outer Dr. (south)	5/13/2005 22:19	5/14/2005 6:30		CSO	1.59	Rouge River, Lower Branch
6837	7	MAIN	west of Outer Dr. (south)	6/9/2005 22:15	6/10/2005 3:19		CSO	2.12	Rouge River, Lower Branch
6850	7	MAIN	west of Outer Dr. (south)	6/11/2005 18:19	6/11/2005 21:34		CSO	0.06	Rouge River, Lower Branch
6877	7	MAIN	west of Outer Dr. (south)	6/21/2005 21:30	6/22/2005 2:45		CSO	1.59	Rouge River, Lower Branch
6893	7	MAIN	west of Outer Dr. (south)	6/30/2005 14:40	6/30/2005 20:10		CSO	0.85	Rouge River, Lower Branch
7167	7	MAIN	west of Outer Dr. (south)	7/12/2005 3:34	7/21/2005 7:45		CSO	0.35	Rouge River, Lower Branch
7146	7	MAIN	west of Outer Dr. (south)	7/16/2005 14:45	7/16/2005 21:15		CSO	4	Rouge River, Lower Branch
7157	7	MAIN	west of Outer Dr. (south)	7/18/2005 21:49	7/19/2005 2:00		CSO	0.33	Rouge River, Lower Branch
7177	7	MAIN	west of Outer Dr. (south)	7/24/2005 10:30	7/24/2005 16:45		CSO	1.52	Rouge River, Lower Branch
7192	7	MAIN	west of Outer Dr. (south)	7/26/2005 16:19	7/27/2005 12:25		CSO	8.93	Rouge River, Lower Branch
7216	7	MAIN	west of Outer Dr. (south)	8/27/2005 15:10	8/27/2005 20:19		CSO	3.47	Rouge River, Lower Branch
7232	7	MAIN	west of Outer Dr. (south)	9/16/2005 9:40	9/16/2005 14:19		CSO	0.46	Rouge River, Lower Branch
7246	7	MAIN	west of Outer Dr. (south)	9/22/2005 21:19	9/23/2005 4:00		CSO	3.64	Rouge River, Lower Branch
6948	7	MAIN	west of Outer Dr. (south)	9/26/2005 8:30	9/26/2005 11:40		CSO	0.05	Rouge River, Lower Branch
7265	7	MAIN	west of Outer Dr. (south)	9/29/2005 5:10	9/29/2005 9:25		CSO	0.29	Rouge River, Lower Branch

Uncontrolled CSO Discharge Events for 2005 TMDL Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
7526	8	MAIN	Alexandriene @ Reginald extended, north bank	4/26/2005 19:49	4/26/2005 23:25		CSO	0.41	Rouge River, Lower Branch
6818	8	MAIN	Alexandriene @ Reginald extended, north bank	5/13/2005 22:30	5/14/2005 5:40		CSO	1.27	Rouge River, Lower Branch
6838	8	MAIN	Alexandriene @ Reginald extended, north bank	6/9/2005 22:19	6/10/2005 3:19		CSO	2.12	Rouge River, Lower Branch
6851	8	MAIN	Alexandriene @ Reginald extended, north bank	6/11/2005 18:19	6/11/2005 20:55		CSO	0.13	Rouge River, Lower Branch
6878	8	MAIN	Alexandriene @ Reginald extended, north bank	6/21/2005 21:40	6/22/2005 1:49		CSO	1.21	Rouge River, Lower Branch
6894	8	MAIN	Alexandriene @ Reginald extended, north bank	6/30/2005 14:40	6/30/2005 19:10		CSO	0.75	Rouge River, Lower Branch
7147	8	MAIN	Alexandriene @ Reginald extended, north bank	7/16/2005 14:40	7/16/2005 20:15		CSO	3.18	Rouge River, Lower Branch
7158	8	MAIN	Alexandriene @ Reginald extended, north bank	7/18/2005 22:00	7/19/2005 1:00		CSO	0.31	Rouge River, Lower Branch
7168	8	MAIN	Alexandriene @ Reginald extended, north bank	7/21/2005 3:34	7/21/2005 6:55		CSO	0.37	Rouge River, Lower Branch
7178	8	MAIN	Alexandriene @ Reginald extended, north bank	7/24/2005 10:34	7/24/2005 15:49		CSO	1.31	Rouge River, Lower Branch
7193	8	MAIN	Alexandriene @ Reginald extended, north bank	7/26/2005 16:19	7/27/2005 11:34		CSO	7.02	Rouge River, Lower Branch
7205	8	MAIN	Alexandriene @ Reginald extended, north bank	8/14/2005 8:40	8/14/2005 10:55		CSO	0.04	Rouge River, Lower Branch
7217	8	MAIN	Alexandriene @ Reginald extended, north bank	8/27/2005 15:10	8/27/2005 19:30		CSO	2.86	Rouge River, Lower Branch
7233	8	MAIN	Alexandriene @ Reginald extended, north bank	9/16/2005 9:30	9/16/2005 13:34		CSO	0.62	Rouge River, Lower Branch
7247	8	MAIN	Alexandriene @ Reginald extended, north bank	9/22/2005 21:25	9/23/2005 3:15		CSO	2.76	Rouge River, Lower Branch
7258	8	MAIN	Alexandriene @ Reginald extended, north bank	9/26/2005 7:40	9/26/2005 11:34		CSO	0.3	Rouge River, Lower Branch
7266	8	MAIN	Alexandriene @ Reginald extended, north bank	9/29/2005 4:55	9/29/2005 8:34		CSO	0.46	Rouge River, Lower Branch
7527	9	MAIN	east of Military (south)	4/26/2005 19:25	4/26/2005 22:04		CSO	0.12	Rouge River, Lower Branch
6817	9	MAIN	east of Military (south)	5/13/2005 22:00	5/14/2005 2:15		CSO	0.45	Rouge River, Lower Branch
6839	9	MAIN	east of Military (south)	6/8/2005 23:30	6/10/2005 0:45		CSO	0.53	Rouge River, Lower Branch
6852	9	MAIN	east of Military (south)	6/11/2005 17:34	6/11/2005 19:25		CSO	0.07	Rouge River, Lower Branch
6879	9	MAIN	east of Military (south)	6/22/2005 21:19	6/22/2005 0:19		CSO	0.42	Rouge River, Lower Branch
6895	9	MAIN	east of Military (south)	6/30/2005 14:25	6/30/2005 17:49		CSO	0.25	Rouge River, Lower Branch
7148	9	MAIN	east of Military (south)	7/16/2005 14:25	7/16/2005 19:00		CSO	1.03	Rouge River, Lower Branch
7159	9	MAIN	east of Military (south)	7/18/2005 21:34	7/18/2005 23:34		CSO	0.11	Rouge River, Lower Branch
7169	9	MAIN	east of Military (south)	7/21/2005 3:04	7/21/2005 5:19		CSO	0.14	Rouge River, Lower Branch
7179	9	MAIN	east of Military (south)	7/24/2005 10:04	7/24/2005 14:19		CSO	1.31	Rouge River, Lower Branch
7194	9	MAIN	east of Military (south)	7/26/2005 16:04	7/27/2005 10:10		CSO	2.18	Rouge River, Lower Branch
7218	9	MAIN	east of Military (south)	8/27/2005 14:55	8/27/2005 17:55		CSO	0.97	Rouge River, Lower Branch
7219	9	MAIN	east of Military (south)	8/27/2005 14:55	8/27/2005 17:55		CSO	0.97	Rouge River, Lower Branch
7234	9	MAIN	east of Military (south)	9/16/2005 9:10	9/16/2005 12:00		CSO	0.16	Rouge River, Lower Branch
7248	9	MAIN	east of Military (south)	9/22/2005 21:10	9/23/2005 1:40		CSO	0.9	Rouge River, Lower Branch
7259	9	MAIN	east of Military (south)	9/26/2005 8:00	9/26/2005 9:45		CSO	0.03	Rouge River, Lower Branch
7270	9	MAIN	east of Military (south)	9/29/2005 4:34	9/29/2005 7:04		CSO	0.12	Rouge River, Lower Branch
6819	10	MAIN	Brentwood	5/13/2005 22:15	5/13/2005 22:40		CSO	0.01	Rouge River, Lower Branch
6840	10	MAIN	Brentwood	6/9/2005 22:10	6/9/2005 23:04		CSO	0.01	Rouge River, Lower Branch
6880	10	MAIN	Brentwood	6/21/2005 21:19	6/21/2005 22:15		CSO	0.01	Rouge River, Lower Branch
6896	10	MAIN	Brentwood	6/30/2005 14:34	6/30/2005 14:45		CSO	0.01	Rouge River, Lower Branch
7149	10	MAIN	Brentwood	7/16/2005 14:49	7/16/2005 16:55		CSO	0.03	Rouge River, Lower Branch
7180	10	MAIN	Brentwood	7/24/2005 12:49	7/24/2005 13:45		CSO	0.01	Rouge River, Lower Branch
7195	10	MAIN	Brentwood	7/26/2005 16:10	7/27/2005 8:00		CSO	0.06	Rouge River, Lower Branch
7206	10	MAIN	Brentwood	8/14/2005 7:19	8/14/2005 7:45		CSO	0.01	Rouge River, Lower Branch
7220	10	MAIN	Brentwood	8/27/2005 14:55	8/27/2005 18:25		CSO	0.02	Rouge River, Lower Branch
7235	10	MAIN	Brentwood	9/16/2005 11:25	9/16/2005 11:45		CSO	0.01	Rouge River, Lower Branch
7249	10	MAIN	Brentwood	9/22/2005 21:15	9/23/2005 0:45		CSO	0.02	Rouge River, Lower Branch
7528	11	MAIN	500 ft. northeast of Cherry Hill	4/26/2005 18:10	4/26/2005 22:10		CSO	0.07	Rouge River
6820	11	MAIN	500 ft. northeast of Cherry Hill	5/13/2005 21:30	5/14/2005 4:04		CSO	0.15	Rouge River
6829	11	MAIN	500 ft. northeast of Cherry Hill	5/20/2005 0:34	5/20/2005 2:00		CSO	0.01	Rouge River
6841	11	MAIN	500 ft. northeast of Cherry Hill	6/8/2005 22:10	6/10/2005 1:40		CSO	0.22	Rouge River
6853	11	MAIN	500 ft. northeast of Cherry Hill	6/11/2005 16:55	6/11/2005 19:49		CSO	0.06	Rouge River

Uncontrolled CSO Discharge Events for 2005 TMDL Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
6881	11	MAIN	500 ft. northeast of Cherry Hill	6/21/2005 20:49	6/22/2005 0:55		CSO	0.15	Rouge River
6673	11	MAIN	500 ft. northeast of Cherry Hill	6/30/2005 13:55	6/30/2005 18:04		CSO	0.11	Rouge River
7150	11	MAIN	500 ft. northeast of Cherry Hill	7/16/2005 12:19	7/16/2005 18:55		CSO	0.28	Rouge River
7160	11	MAIN	500 ft. northeast of Cherry Hill	7/18/2005 21:00	7/19/2005 0:10		CSO	0.08	Rouge River
7170	11	MAIN	500 ft. northeast of Cherry Hill	7/21/2005 2:19	7/21/2005 5:49		CSO	0.07	Rouge River
7181	11	MAIN	500 ft. northeast of Cherry Hill	7/24/2005 9:30	7/24/2005 14:25		CSO	0.14	Rouge River
7196	11	MAIN	500 ft. northeast of Cherry Hill	7/26/2005 15:45	7/27/2005 10:10		CSO	0.59	Rouge River
7207	11	MAIN	500 ft. northeast of Cherry Hill	8/14/2005 2:15	8/14/2005 9:15		CSO	0.05	Rouge River
7210	11	MAIN	500 ft. northeast of Cherry Hill	8/21/2005 13:00	8/21/2005 15:04		CSO	0.02	Rouge River
7221	11	MAIN	500 ft. northeast of Cherry Hill	8/27/2005 14:34	8/27/2005 18:30		CSO	0.25	Rouge River
7237	11	MAIN	500 ft. northeast of Cherry Hill	9/16/2005 7:40	9/16/2005 11:25		CSO	0.08	Rouge River
7250	11	MAIN	500 ft. northeast of Cherry Hill	9/22/2005 22:04	9/23/2005 1:55		CSO	0.26	Rouge River
7260	11	MAIN	500 ft. northeast of Cherry Hill	9/25/2005 22:34	9/26/2005 10:10		CSO	0.06	Rouge River
7271	11	MAIN	500 ft. northeast of Cherry Hill	9/29/2005 3:10	9/29/2005 7:15		CSO	0.07	Rouge River
7529	12	UPPER	east of Garrison (south)	4/26/2005 19:30	4/26/2005 20:49		CSO	0.03	Rouge River, Lower Branch
6821	12	UPPER	east of Garrison (south)	5/13/2005 21:49	5/14/2005 1:04		CSO	0.17	Rouge River, Lower Branch
6842	12	UPPER	east of Garrison (south)	6/8/2005 22:40	6/9/2005 23:34		CSO	0.22	Rouge River, Lower Branch
6854	12	UPPER	east of Garrison (south)	6/11/2005 17:19	6/11/2005 18:19		CSO	0.04	Rouge River, Lower Branch
6882	12	UPPER	east of Garrison (south)	6/21/2005 21:10	6/21/2005 23:10		CSO	0.19	Rouge River, Lower Branch
7134	12	UPPER	east of Garrison (south)	6/30/2005 14:15	6/30/2005 16:40		CSO	0.08	Rouge River, Lower Branch
7151	12	UPPER	east of Garrison (south)	7/16/2005 13:30	7/16/2005 17:40		CSO	0.39	Rouge River, Lower Branch
7161	12	UPPER	east of Garrison (south)	7/18/2005 21:19	7/18/2005 22:25		CSO	0.07	Rouge River, Lower Branch
7171	12	UPPER	east of Garrison (south)	7/21/2005 2:49	7/21/2005 4:15		CSO	0.07	Rouge River, Lower Branch
7182	12	UPPER	east of Garrison (south)	7/24/2005 9:55	7/24/2005 13:15		CSO	0.17	Rouge River, Lower Branch
7197	12	UPPER	east of Garrison (south)	7/26/2005 16:04	7/27/2005 8:49		CSO	0.77	Rouge River, Lower Branch
7223	12	UPPER	east of Garrison (south)	8/27/2005 14:49	8/27/2005 16:34		CSO	0.05	Rouge River, Lower Branch
7238	12	UPPER	east of Garrison (south)	9/16/2005 9:04	9/16/2005 10:49		CSO	0.05	Rouge River, Lower Branch
7251	12	UPPER	east of Garrison (south)	9/22/2005 21:10	9/23/2005 0:25		CSO	0.36	Rouge River, Lower Branch
7272	12	UPPER	east of Garrison (south)	9/29/2005 4:30	9/29/2005 5:55		CSO	0.04	Rouge River, Lower Branch
7663	12	UPPER	east of Garrison (south)	11/9/2005 5:55	11/9/2005 7:30		CSO	0.17	Rouge River, Lower Branch
7530	13	UPPER	Greenfield Village	4/26/2005 18:10	4/26/2005 21:40		CSO	1.33	Rouge River
6823	13	UPPER	Greenfield Village	5/13/2005 21:40	5/14/2005 4:40		CSO	3.17	Rouge River
6830	13	UPPER	Greenfield Village	5/20/2005 0:49	5/20/2005 3:10		CSO	0.05	Rouge River
6844	13	UPPER	Greenfield Village	6/8/2005 22:19	6/10/2005 0:19		CSO	3.14	Rouge River
6856	13	UPPER	Greenfield Village	6/11/2005 17:00	6/11/2005 19:00		CSO	0.8	Rouge River
6885	13	UPPER	Greenfield Village	6/21/2005 20:55	6/22/2005		CSO	3.69	Rouge River
7136	13	UPPER	Greenfield Village	6/30/2005 14:04	6/30/2005 17:34		CSO	1.95	Rouge River
7140	13	UPPER	Greenfield Village	7/4/2005 22:49	7/5/2005 4:30		CSO	0.06	Rouge River
7153	13	UPPER	Greenfield Village	7/16/2005 12:25	7/16/2005 18:30		CSO	5.4	Rouge River
7163	13	UPPER	Greenfield Village	7/18/2005 20:55	7/18/2005 23:19		CSO	1.64	Rouge River
7173	13	UPPER	Greenfield Village	7/21/2005 2:19	7/21/2005 5:04		CSO	1.63	Rouge River
7185	13	UPPER	Greenfield Village	7/24/2005 9:34	7/24/2005 14:25		CSO	3.01	Rouge River
7199	13	UPPER	Greenfield Village	7/26/2005 15:55	7/27/2005 10:00		CSO	11.76	Rouge River
7211	13	UPPER	Greenfield Village	8/21/2005 13:00	8/21/2005 14:25		CSO	0.28	Rouge River
7225	13	UPPER	Greenfield Village	8/27/2005 14:45	8/27/2005 17:34		CSO	5.64	Rouge River
7239	13	UPPER	Greenfield Village	9/16/2005 7:45	9/16/2005 12:45		CSO	1.66	Rouge River
7253	13	UPPER	Greenfield Village	9/22/2005 20:49	9/22/2005 1:45		CSO	5.81	Rouge River
7261	13	UPPER	Greenfield Village	9/25/2005 21:55	9/26/2005 10:49		CSO	1.22	Rouge River
7273	13	UPPER	Greenfield Village	9/29/2005 3:04	9/29/2005 6:55		CSO	1.59	Rouge River
7644	13	UPPER	Greenfield Village	10/2/2005 8:10	10/2/2005 9:55		CSO	0.09	Rouge River

Uncontrolled CSO Discharge Events for 2005 TMDL Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
6824	14	UPPER	1625 ft. north of Rotunda	5/13/2005 23:15	5/14/2005 2:45		CSO	0.89	Rouge River
6886	14	UPPER	1625 ft. north of Rotunda	6/21/2005 21:40	6/22/2005 0:49		CSO	3.1	Rouge River
7154	14	UPPER	1625 ft. north of Rotunda	7/16/2005 15:19	7/16/2005 18:40		CSO	2.43	Rouge River
7186	14	UPPER	1625 ft. north of Rotunda	7/24/2005 12:30	7/24/2005 15:10		CSO	0.56	Rouge River
7200	14	UPPER	1625 ft. north of Rotunda	7/26/2005 16:55	7/27/2005 10:45		CSO	9.35	Rouge River
7226	14	UPPER	1625 ft. north of Rotunda	8/27/2005 15:25	8/27/2005 18:30		CSO	3.85	Rouge River
7254	14	UPPER	1625 ft. north of Rotunda	9/22/2005 21:45	9/22/2005 2:45		CSO	4.93	Rouge River
6887	15	MAIN	south of Rotunda	6/21/2005 21:30	6/22/2005 1:00		CSO	0.44	Rouge River
7201	15	MAIN	south of Rotunda	7/26/2005 3:25	7/27/2005 11:10		CSO	0.68	Rouge River
7227	15	MAIN	south of Rotunda	8/27/2005 15:34	8/27/2005 18:30		CSO	0.25	Rouge River
7255	15	MAIN	south of Rotunda	9/22/2005 21:40	9/23/2005 3:15		CSO	0.51	Rouge River
6888	17	UPPER	Ford Motor Co. turning basin	6/21/2005 21:30	6/21/2005 23:49		CSO	7.65	Rouge River
7202	17	UPPER	Ford Motor Co. turning basin	7/27/2005 4:55	7/27/2005 10:10		CSO	10.51	Rouge River
7228	17	UPPER	Ford Motor Co. turning basin	8/27/2005 15:34	8/27/2005 17:19		CSO	3.63	Rouge River
7256	17	UPPER	Ford Motor Co. turning basin	9/22/2005 21:40	9/23/2005 2:15		CSO	9.65	Rouge River
6822	20	MAIN	east of Morley	5/13/2005 21:34	5/13/2005 22:49		CSO	0.02	Rouge River, Lower Branch
6843	20	MAIN	east of Morley	6/8/2005 22:10	6/9/2005 23:04		CSO	0.05	Rouge River, Lower Branch
6855	20	MAIN	east of Morley	6/11/2005 16:55	6/11/2005 17:30		CSO	0.01	Rouge River, Lower Branch
6884	20	MAIN	east of Morley	6/21/2005 20:45	6/21/2005 22:25		CSO	0.04	Rouge River, Lower Branch
7135	20	MAIN	east of Morley	6/30/2005 13:49	6/30/2005 14:55		CSO	0.02	Rouge River, Lower Branch
7152	20	MAIN	east of Morley	7/16/2005 14:30	7/16/2005 16:10		CSO	0.08	Rouge River, Lower Branch
7162	20	MAIN	east of Morley	7/18/2005 20:55	7/18/2005 21:45		CSO	0.01	Rouge River, Lower Branch
7172	20	MAIN	east of Morley	7/21/2005 2:30	7/21/2005 3:25		CSO	0.01	Rouge River, Lower Branch
7184	20	MAIN	east of Morley	7/24/2005 9:34	7/24/2005 10:40		CSO	0.01	Rouge River, Lower Branch
7198	20	MAIN	east of Morley	7/26/2005 15:40	7/26/2005 7:34		CSO	0.15	Rouge River, Lower Branch
7224	20	MAIN	east of Morley	8/27/2005 14:30	8/27/2005 16:15		CSO	0.1	Rouge River, Lower Branch
7252	20	MAIN	east of Morley	9/22/2005 20:40	9/22/2005 23:49		CSO	0.07	Rouge River, Lower Branch
7664	20	MAIN	east of Morley	11/9/2005 5:30	11/9/2005 6:55		CSO	0.03	Rouge River, Lower Branch
7860	57	MIDDLE	Miller & W. Fort	4/26/2005 21:00	4/27/2005 0:30		CSO	4.099	Rouge River
7901	57	MIDDLE	Miller & W. Fort	5/13/2005 23:00	5/14/2005 5:30		CSO	21.821	Rouge River
7861	59	UPPER	W. Warren @ Detroit River	4/26/2005 16:00	4/26/2005 17:48		CSO	0.04	Rouge River
7902	59	UPPER	W. Warren @ Detroit River	5/13/2005 19:00	5/13/2005 21:00		CSO	0.405	Rouge River
7918	59	UPPER	W. Warren @ Detroit River	6/8/2005 20:00	6/9/2005 21:30		CSO	0.852	Rouge River
7919	59	UPPER	W. Warren @ Detroit River	6/11/2005 14:00	6/11/2005 15:48		CSO	0.219	Rouge River
7920	59	UPPER	W. Warren @ Detroit River	6/21/2005 18:00	6/21/2005 20:00		CSO	0.504	Rouge River
7921	59	UPPER	W. Warren @ Detroit River	6/30/2005 12:00	6/30/2005 13:48		CSO	0.336	Rouge River
7903	60	MAIN	Tireman @ Detroit River	5/13/2005 22:00	5/14/2005 4:00		CSO	9.979	Rouge River
7865	62	UPPER	W. Chicago @ Detroit River	4/29/2005 4:00	4/29/2005 4:18		CSO	0.003	Rouge River
7904	62	UPPER	W. Chicago @ Detroit River	5/12/2005 14:00	5/12/2005 14:18		CSO	0.003	Rouge River
7905	62	UPPER	W. Chicago @ Detroit River	5/13/2005 20:00	5/13/2005 23:48		CSO	0.346	Rouge River
7906	62	UPPER	W. Chicago @ Detroit River	5/19/2005 13:00	5/20/2005		CSO	0.077	Rouge River
7907	62	UPPER	W. Chicago @ Detroit River	5/22/2005 15:00	5/22/2005 16:00		CSO	0.01	Rouge River
7908	62	UPPER	W. Chicago @ Detroit River	5/27/2005 6:00	5/27/2005 6:18		CSO	0.003	Rouge River
7922	62	UPPER	W. Chicago @ Detroit River	6/7/2005 19:00	6/7/2005 19:18		CSO	0.003	Rouge River
7923	62	UPPER	W. Chicago @ Detroit River	6/14/2005 13:00	6/14/2005 13:18		CSO	0.003	Rouge River
7924	62	UPPER	W. Chicago @ Detroit River	6/21/2005 19:00	6/21/2005 21:00		CSO	0.126	Rouge River
7925	62	UPPER	W. Chicago @ Detroit River	6/29/2005 17:00	9/29/2005 18:30		CSO	0.051	Rouge River
7909	64	MAIN	Rouge Park	5/13/2005 20:00	5/14/2005 16:48		CSO	0.807	Rouge River
7910	65	MIDDLE	Lasher @ Detroit River	5/13/2005 23:00	5/13/2005 23:30		CSO	0.066	Rouge River
7867	66	MIDDLE	I-96 @ Detroit River	4/26/2005 16:00	4/26/2005 18:18		CSO	0.071	Rouge River

Uncontrolled CSO Discharge Events for 2005 TMDL Period

Event ID	Outfall Number	Subwatershed	Outfall Location	Discharge Begin Date	Discharge End Date	Precip. Inches	Event Type	Volume (MG)*	Receiving Water
7911	66	MIDDLE	I-96 @ Detroit River	5/13/2005 19:00	5/13/2005 22:18		CSO	0.393	Rouge River
7926	66	MIDDLE	I-96 @ Detroit River	6/8/2005 20:00	6/9/2005 21:30		CSO	0.811	Rouge River
7927	66	MIDDLE	I-96 @ Detroit River	6/11/2005 14:00	6/11/2005 16:00		CSO	0.231	Rouge River
7928	66	MIDDLE	I-96 @ Detroit River	6/21/2005 18:00	6/21/2005 20:00		CSO	0.406	Rouge River
8705	66	MIDDLE	I-96 @ Detroit River	6/26/2005 14:00	6/27/2006 16:45		CSO	0.43	Rouge River
7929	66	MIDDLE	I-96 @ Detroit River	6/30/2005 12:00	6/30/2005 13:48		CSO	0.316	Rouge River
7912	72	MAIN	Puritan (east)	5/13/2005 20:00	5/14/2005 8:00		CSO	0.37	Rouge River
7913	72	MAIN	Puritan (east)	5/22/2005 16:00	5/22/2005 18:18		CSO	0.048	Rouge River
7930	72	MAIN	Puritan (east)	6/5/2005 23:00	6/6/2005 0:18		CSO	0.025	Rouge River
7935	72	MAIN	Puritan (east)	6/8/2005 18:00	6/9/2005 21:00		CSO	0.129	Rouge River
7931	72	MAIN	Puritan (east)	6/8/2005 21:00	6/10/2005 5:18		CSO	0.55	Rouge River
7932	72	MAIN	Puritan (east)	6/11/2005 15:00	6/11/2005 23:48		CSO	0.212	Rouge River
7933	72	MAIN	Puritan (east)	6/21/2005 20:00	6/22/2005		CSO	0.182	Rouge River
7934	72	MAIN	Puritan (east)	6/30/2005 12:00	6/30/2005 16:18		CSO	0.155	Rouge River
7914	75	MAIN	Glenhurst @ Detroit River	5/13/2005 19:00	5/13/2005 20:48		CSO	0.053	Rouge River
7915	75	MAIN	Glenhurst @ Detroit River	5/15/2005 10:00	5/15/2005 10:18		CSO	0.008	Rouge River
7916	75	MAIN	Glenhurst @ Detroit River	5/21/2005 20:00	5/21/2005 20:18		CSO	0.008	Rouge River
7936	75	MAIN	Glenhurst @ Detroit River	6/11/2005 14:00	6/11/2005 15:30		CSO	0.028	Rouge River
7937	75	MAIN	Glenhurst @ Detroit River	6/15/2005 5:00	6/15/2005 22:18		CSO	0.015	Rouge River
7938	75	MAIN	Glenhurst @ Detroit River	6/21/2005 18:00	6/21/2005 20:00		CSO	0.078	Rouge River
7939	75	MAIN	Glenhurst @ Detroit River	6/30/2005 12:00	6/30/2005 13:30		CSO	0.058	Rouge River
7940	77	MAIN	Seven Mile @ Detroit River	6/11/2005 16:00	6/11/2005 16:18		CSO	0.019	Rouge River
7941	79	MAIN	Frisbee (east)	6/8/2005 21:00	6/8/2005 21:30		CSO	0.071	Rouge River
7942	79	MAIN	Frisbee (east)	6/11/2005 16:00	6/11/2005 17:00		CSO	0.235	Rouge River
6738	050A	MAIN	@ the WWTP	7/16/2005 14:34	7/17/2005 5:00	0.63	CSO	150	Rouge River
6860	050A	MAIN	@ the WWTP	8/27/2005 16:44	8/28/2005 5:41	0.67	CSO	74.2	Rouge River
6925	050A	MAIN	@ the WWTP	9/16/2005 13:15	9/16/2005 19:18		CSO	48.3	Rouge River
6946	050A	MAIN	@ the WWTP	9/22/2005 20:43	9/23/2005 13:00	0.48	CSO	216	Rouge River
6955	050A	MAIN	@ the WWTP	9/26/2005 8:10	9/26/2005 10:11		CSO	15.2	Rouge River
6736	101A	LOWER	east of Southfield Freeway, south of Michigan Ave., discharges to north bank of Rouge River	7/16/2005 14:15	7/16/2005 21:00		CSO	16.8	Rouge River
6755	101A	LOWER	east of Southfield Freeway, south of Michigan Ave., discharges to north bank of Rouge River	7/27/2005 5:55	7/27/2005 12:25	0.58	CSO	29.8	Rouge River
6858	101A	LOWER	east of Southfield Freeway, south of Michigan Ave., discharges to north bank of Rouge River	8/27/2005 15:10	8/27/2005 22:00	0.67	CSO	18.7	Rouge River
6944	101A	LOWER	east of Southfield Freeway, south of Michigan Ave., discharges to north bank of Rouge River	9/22/2005 21:00	9/23/2005 5:36	0.48	CSO	66.2	Rouge River
Total								**925.95832**	

Source: MDEQ CSO/SSO Database accessed August 2018
http://www.deq.state.mi.us/csosso/find_event.asp