Oakland County
Water Resources Commissioner's Office
2024 State Revolving Fund Project Plan

Date: April 13, 2023

WRC
WATER RESOURCES COMMISSIONER

1 Public Works Drive
Waterford, MI 48328

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Prepared by:

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

P.O. Box 824 • 555 Hulet Drive
Bloomfield Hills, Michigan 48302-0360

HRC JOB NO. 20220218

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Response to EGLE Comments

N/A – To be updated

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Section I - Introduction

The Oakland County Water Resources Commissioner's Office (OCWRC) submitted an Intent to Apply for a Nonpoint Source (NPS) Project Plan for SRF funding on January 26, 2023. This Project Plan is intended to identify projects within Oakland County, obtain funding, and work toward meeting the goals and objectives identified in the approved Watershed Management Plans across the County.

OCWRC has chosen to sponsor local drainage district water quality improvements within four (4) of the five (5) watersheds, Clinton River, Huron River, Rouge River, Shiawassee River, and Flint River, located within the County. The projects are located on various county drains throughout Oakland County. The Clinton River watershed projects include Nelson Drain, Pontiac Creek Extension, Red Oaks Water Park, Lane Drain Restoration, Sylvan Glen Habitat Restoration, Perry Park Green Infrastructure Improvements, Oakland Park Green Infrastructure Improvements, and Green Infrastructure Improvements – City of Pleasant Ridge. Rouge River watershed projects include Minnow Pond Drain, Hamlin Drain, Pebble Creek Drain, Sprague Drain, and Catalpa Park. Huron River watershed projects include Lower Straits Lake. Shiawassee River watershed projects include the Patterson Holly Drain.

The purpose of this Project Plan is to help reduce nonpoint source stormwater pollutants and manage flow in county drains by detention and treatment or retention and infiltration of stormwater runoff.

Focusing on the NPS pollutant removal within these watersheds will help the County achieve the Michigan Department of Environmental, Great Lakes, and Energy's (EGLE) enforced Total Maximum Daily Load (TMDL) for phosphorous, *Escherichia coli* (E. coli), dissolved oxygen (D.O.) and biota.

The locations and projects presented in this Project Plan were individually evaluated to determine the quantity of stormwater runoff and/or pollutants that could be captured and mitigated. Best Management Practices (BMPs) were then selected based on watershed storage or streambank protection needs and individual site conditions and constraints. The data were then used to preliminarily design each BMP to maximize the pollutant removal, emphasizing total suspended solids (TSS), total phosphorous (TP), and *E. coli* removal while promoting onsite infiltration. Projects were partially selected based on the goals identified in the respective WMPs.

Infiltration will be used to the extent practicable based on soil conditions. While some soil conditions are known, additional infiltration may be able to be proposed during design based on more comprehensive soil information. Additionally, wetland creation, streambank stabilization, oversized pipes for extended detention, including sumps for maintenance, or stone reservoirs with underdrains, will be used to promote stormwater quality.

1. Perry Park – Green Infrastructure Improvements

Watershed: Clinton River
Location: City of Pontiac
Scope: This proposed project will construct a basin to collect stormwater runoff and reduce nonpoint source pollution.

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2. Oakland Park – Green Infrastructure Improvements

Watershed: Clinton River
Location: City of Pontiac
Scope: This proposed project will construct a basin to collect stormwater runoff and reduce nonpoint source pollution.

3. Red Oaks Water Park– Green Infrastructure Improvements

Watershed: Clinton River
Location: City of Madison Heights
Scope: This proposed project will include the construction of a rain garden that will collect and treat stormwater runoff from a curb cut along Thirteen Mile Road, which will reduce nonpoint source pollution and localized runoff from the park property. A natural grow zone will be created from the spoils of the newly constructed rain garden.

4. Lower Straits Lake – County Drain Establishment & Restoration

Watershed: Huron River
Location: Commerce Township
Scope: The restoration of approximately 2,700 linear feet of streambank between Lower Straits Lake and S. Commerce Road. The restoration will include establishing a bankfull bench and creating meanders, riffles, and pools to stabilize the channel and reduce sedimentation.

5. Hamlin Drain – Regional Stormwater Detention Facility

Watershed: Rouge River
Location: Bloomfield Township
Scope: Create an above-ground regional stormwater detention basin located inline in the existing portion of the Hamlin Drain. The detention basin will include a sedimentation forebay and outlet control structure to improve water quality by decreasing sediment and pollutant loads.

6. Patterson Holly Drain Restoration

Watershed: Shiawassee River
Location: Holly Township, Village of Holly
Scope: Restoration of approximately 7,000 linear feet of streambank to remove sediment and improve water quality. The improvements include sizing the drain for the appropriate low flow event and creating a natural, meandering channel with a bankfull bench.

7. Nelson Drain – Bank Stabilization & Sediment Trap

Watershed: Clinton River
Location: City of Troy
Scope: Streambank stabilization and habitat restoration to reduce sedimentation. The drain will be sized for the appropriate flow events with natural meandering channels and the creation of bankfull benches. Channel restoration, including re-meandering the stream and reducing the width-to-depth ratio, is proposed.

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8. Pontiac Creek Extension – Wetland & Stream Restoration

Watershed: Clinton River
Location: City of Pontiac, Waterford Township
Scope: Construct a stable stream channel with natural features such as low-moderate sinuosity, bedform diversity (riffles/pools), roughness, and floodplain connectivity. Invasive vegetation will be removed and replaced with native vegetation that will promote stormwater infiltration, streambank stabilization, and additional habitat. Water control and in-stream structures will help control flow and protect the banks from erosion, reducing annual sediment loads.

9. Minnow Pond Drain – Flood Control Basin Conversion

Watershed: Rouge River
Location: City of Farmington Hills
Scope: Improve water quality through decreased sedimentation in the Minnow Pond Drain. An existing offline flood control basin will be converted to the primary path of the drain. Meanders, pools, and riffles will be constructed to improve peak flow management and decrease sedimentation.

10. Pebble Creek Drain Restoration

Watershed: Rouge River
Location: City of Farmington Hills
Scope: This project proposed the restoration of approximately 6,300 linear feet of streambank in the Pebble Creek Drain to remove sediment and improve the water quality in the drain. The drain will be appropriately sized for flow events and the creation of bankfull benches.

11. Sprague Drain – Pond & Stream Restoration

Watershed: Rouge River
Location: City of Troy
Scope: This project will utilize streambank restoration BMPs to reduce nonpoint source pollution. An existing inline pond will be converted to an offline pond with streambed stabilization BMPs such as pools, riffles, and meanders. Rock vanes will be constructed to stabilize the streambank.

12. Catalpa Park – Green Infrastructure Improvements

Watershed: Clinton River
Location: City of Southfield
Scope: Remove two underutilized baseball fields and convert them into natural landscapes with native shade trees and grow zones. The project proposes replacing the dirt parking lot with an accessible porous surface and adding several areas for bioretention that will reduce pollutant and sediment loads.

13. Lane Drain Restoration – Phase II

Watershed: Clinton River
Location: City of Troy
Scope: This proposed project will utilize streambank and streambed stabilization BMPs to reduce nonpoint source pollution, particularly sediment loading. The restoration of the natural channel will include the creation of riffles, pools, and meanders.

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14. Sylvan Glen Habitat Restoration – Phase III

Watershed: Clinton River
Location: City of Troy
Scope: This project proposed the restoration of approximately 575 feet of streambank, improvements of aquatic habitat, improvement of riparian habitat, and a reduction of sediment loading along the downstream portion of the lower Gibson-Renshaw Drain and West Gibson Branches of the Clinton River by utilizing natural channel design and incorporating geomorphic features.

15. WaterTowns – Green Infrastructure Improvements

Watershed: Clinton River
Location: City of Pleasant Ridge
Scope: This project involves the construction of four different green infrastructure projects in Pleasant Ridge to modify existing public facilities. All proposed projects seek to increase infiltration, improve water quality, reduce the volume of stormwater runoff, and increase native vegetation and habitats.

a. Oxford Park Intersection Pavement Reduction & Bioretention
b. Poplar Park Boulevard Bioretention & Bioretention End Caps
c. Elm Boulevard Entrance Bioretention & Native Plantings
d. Police Department Permeable Paver Parking Area

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Section II - Project Background

A. Study Area Characteristics

1. Delineation of the Study Area

The study area is defined as Oakland County contributing flow in five (5) watersheds: Huron, Clinton, Rouge, Flint, and Shiawassee, as shown in Figure II-1. Oakland County subwatershed groups are shown in Figure II-2.

The projects proposed within this Project Plan are located in numerous communities throughout Oakland County: City of Madison Heights, City of Pontiac, Waterford Township, Commerce Township, Bloomfield Township, Village of Holly, Township of Holly, City of Troy, City of Southfield, City of Pleasant Ridge, and the City of Farmington Hills. See Figure II-3 for a general overview of the anticipated locations for stormwater improvements that will improve overall water quality. The projects are located in four (4) of the five (5) Oakland County tributary watersheds: Huron, Clinton, Rouge, and Shiawassee River Watersheds.

Huron River Watershed: The Huron River Watershed has 1,200 miles of creeks and streams flowing into the Huron River. The watershed has a drainage area of roughly 908 square miles. Land use includes remote natural preserves, farmland, urban and industrial centers, and suburban sprawl. Subwatersheds that make up the Huron River Watershed within Oakland County are the Kent Lake/Upper Huron and the Chain of Lakes. One (1) project is within the Kent Lake/Upper Huron subwatershed, whose land use consists of residential, commercial, rural residential, agriculture, and undeveloped land.

Clinton River Watershed: The Clinton River Watershed drainage area is roughly 760 square miles. The land use within the watershed includes residential, natural areas, industrial/commercial, active agricultural, woodland/wetland, and recreational/conservation land. Subwatersheds that make up the Clinton River Watershed within Oakland County include the Clinton River Main, the North Branch, the Red Run, the Stony Creek, the Paint Creek, and the Upper Clinton. There are fourteen (14) projects within the Clinton River Watershed, and the land use surrounding the project locations is heavily built out, consisting predominantly of residential, industrial, and commercial land use.

Rouge River Watershed: The Rouge River Watershed drains 467 square miles (127 river miles) into the Detroit River. There are over 400 lakes, impoundments, and ponds within the watershed, and over 50% of the entire watershed is developed, while 25% is undeveloped. Subwatersheds that make up the Rouge River Watershed within Oakland County are the Main 1, the Main 2, the Upper 1, the Upper 2, and the Middle 1. There are four (4) projects within the Main 1 and Upper 1 subwatersheds. Both subwatersheds are heavily urbanized with industry and residential housing.

Shiawassee Watershed: The Shiawassee River Watershed is roughly 1,200 square miles, with a total watercourse length of 118 miles. Land use within the watershed includes residential, commercial, rural residential, agriculture, and undeveloped land. Subwatersheds that make up Shiawassee River Watershed within Oakland County are the Shiawassee and the South Branch Shiawassee. There is one (1) project within the Shiawassee subwatershed; the land use surrounding the project area is predominantly residential, rural, and some agricultural.

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a. Lakes, Rivers, Ponds, and Wetlands

The general locations of wetlands are shown in relation to the proposed project locations according to data from the National Wetlands Inventory (NWI) (Figure II-4). A more detailed review would be performed during the design of each of the projects to identify any potential wetland areas regulated under Part 303 of Public Act 451.

b. Existing Treatment Facilities

Not applicable to NPS stormwater improvement projects.

c. Effluent Disposal Locations

Not applicable to NPS stormwater improvement projects.

d. Sludge Disposal Sites

Not applicable to NPS stormwater improvement projects.

e. Existing Interceptors, Collectors, Pumping Stations, and Force Mains

Not applicable to NPS stormwater improvement projects.

f. Population Distribution

Not applicable to NPS stormwater improvement projects.

g. Parks and Recreation Areas

See Figure II-5 for locations of park and recreation areas owned by cities, townships, and Oakland County. There are over 1,400 inland lakes within Oakland County, many of which are publicly accessible, so public properties where visitors have access to open surface water within the study area are too numerous to count. Activities such as canoeing, kayaking, hiking, swimming, and bird watching, are among the amenities supported by these surface water features.

2. Land Use in the Study Area

a. Land Use in the Study Area

Table II-1, on the next page, summarizes the land use and land coverage within Oakland County.

b. Summary of Land Cover within the Study Area

The land cover within the southeastern area of the study area is a nearly built-out, densely urbanized environment containing single-family residential, multi-family residential, retail, office, and industrial land use. The land cover within the northwestern area of the study area is less urbanized, utilized for single-family, multi-family residential, recreation/open space, agriculture, and water.

c. Future Land Use

The majority of the study area watersheds are built-out. There is relatively little available land for new development in the southeastern portion, which is heavily urbanized. However, redevelopment of areas from one land use to another is possible. Land towards the northwest is less developed, predominantly rural suburbs and agriculture, and has potential for development. According to Oakland County's Composite Master Plan, most future land use in the northwest

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region of the study area will be built out for single-family residential dwellings. Most of the land currently used for agriculture is predicted to decrease and become developed.

Table II-1: Oakland County 2020 Land Use/Land Cover (acres/%)

2020 SEMCOG Land Use	Area (acres)	Percentage (%)
Single-Family Residential	145,990	28.9%
Multi-Family Residential	8,160	1.6%
Retail	8,493	1.7%
Office	7,750	1.5%
Hospitality	1,814	0.4%
Medical	2,865	0.6%
Institutional	15,368	3.0%
Industrial	14,389	2.9%
Agricultural	129,631	25.7%
Recreation / Open Space	61,352	12.2%
Cemetery	2,530	0.5%
Parking	1,183	0.2%
Extractive	5,787	1.1%
Transportation, Communication, and Utility	8,508	1.7%
Vacant	61,762	12.2%
Water	28,851	5.7%
Total	507,433	100%

Source: SEMCOG Community Profiles, Oakland County, Environment. Community Profiles (semcog.org)

3. Surface and Ground Waters

a. Contributing Watersheds

Pollutants from the contributing areas significantly impact the Clinton, Huron, Rouge, and Shiawassee Rivers and their tributaries. The landscape is highly impervious in the southeastern portion of Oakland County, allowing little opportunity for stormwater infiltration and natural pollutant removal. Currently, two (2) of the five (5) watersheds in the study area have established TMDLs requiring the community to achieve a reduction in NPS pollutants to improve overall water, habitat, and biotic quality. See Appendix E for copies of the EGLE-established TMDLs. Michigan has a statewide TMDL for *E. coli*. The TMDLs for the study area are as follows:

Table II-2: Study Area Established TMDLs per Watershed and Watercourse

Watershed	Water Course	TMDLs
Clinton River	Lower Clinton River	*E. coli*
Clinton River	Red Run Drain & Bear Creek	*E. coli*
Rouge River	Rouge River	Biota (sediment) & *E. coli*
Rouge River	Johnson Creek	Dissolved Oxygen (DO)
Huron River	Kent Lake	Phosphorus
Huron River	Norton Creek	Dissolved Oxygen (DO)
Huron River	Strawberry Lake	Phosphorus

b. Lakes, Rivers, Ponds, Wetlands, and Floodplains

There are over 1,400 lakes and impoundments located within Oakland County. Some of the most prominent is Cass Lake, Kent Lake, and Orchard Lake, all larger than 780 acres. In addition, there are numerous open-channel waterways, inline detention basins, potentially regulated wetlands, and floodplains within the study area. The stormwater improvement projects are located at various points along the surface waterways and throughout the contributing subwatersheds. See Figure II-4 for the locations of the wetlands within the study area and Figure II-6 for the locations of the floodplains and floodways. There are many waterways within the study area between the five (5) watersheds that make up Oakland County.

c. Drinking Water

Oakland County's water supply is drawn from both surface and groundwater. Most of Oakland County's public drinking water is from the Great Lakes Water Authority (GLWA) (Figure II-7), which draws water from Lake Huron and the Detroit River. The following communities get their water from either private wells or well water provided by their city, village, or township's DPW: Holly, Groveland, Brandon, Oxford, Addison, Rose, Springfield, Independence, Oakland, Wolverine Lake, Waterford, White Lake, Highland, Milford, Lyon, South Lyon, Franklin, and Lake Angelus.

d. NPDES Permits

Entities discharging or proposing to discharge storm or wastewater into the surface waters of the State are required by law to obtain a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit is intended to control discharge into the surface waters of the State by imposing effluent limits and other conditions necessary to meet the State and Federal requirements. See Appendix D for a copy of the County's current NPDES permit.

B. Economic Characteristics

1. Major Employers

The major employers within Oakland County are primarily within the medical/health services field. The following table lists the Top Ten Largest Employers by the number of employees in Oakland County.

2. Household Income

The median annual household income in Oakland County is $81,190 (per Data USA, accessed March 2022).

3. Economic Climate

Oakland County saw a decline of 9.8% in employment in 2020 but is projected to have overall net gains in the private sector. Increased residential development is predicted for land use, which could increase contaminants to the water bodies within Oakland County.

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Table II-3: Top Ten Largest Employers in Oakland County and Number of Staff

Organization	Number of Staff
Beaumont Health	17,071
Stellantis NV	13,156
General Motors Co.	7,604
United Wholesale Mortgage	6,241
Ascension Michigan	5,699
Henry Ford Health System	5,454
U.S. Postal Service	4,880
Oakland County	3,583
Magna International of America	2,389
Trinity Health Michigan	2,357

Source: Oakland County Government: Largest Employers 2020.

C. Existing Facilities

The Oakland County Water Resources Commissioner's Office (OCWRC) is responsible for the design, construction, operation, and maintenance of over 500 stormwater management systems and flood control systems within Oakland County. This includes approximately 500 miles of drains. These range from open channel flow to enclosed systems and lake level controls. Additionally, Oakland County has storm sewer conveyance systems with numerous inlets and catch basins.

All developments discharging to a county-owned system must follow Oakland County's Stormwater Engineering Design Standards. Most communities have also adopted the County's Design Standards, and both new developments and redevelopments are subjected to these standards. If construction exceeds one acre of land, then channel protection rate control, channel protection volume control, water quality control, and detention and flood control storage are to be provided.

Discussion of the existing municipal sewage conveyance, treatment, and disposal facilities are not applicable to the proposed NPS stormwater improvement projects.

D. Need for the Project

An extensive review of the Clinton River, Rouge River, Huron River, Shiawassee River, and their many contributing waterways within Oakland County by EGLE has led to the establishment of several TMDLs in the County. The measures were taken to put limits on pollutant discharge to the watershed, thereby improving water, habitat, and biotic quality. The following locations and established TMDLs are directly impacted by stormwater improvements within the study area are listed in Table II-2 above.

Oakland County, along with its internal municipalities, has engaged in a multi-year effort to achieve the requirements of the established TMDLs via multiple watershed management plans; including the Clinton Main Subwatershed Management Plan (2010), Red Run Subwatershed Management Plan (2006), Middle Flint Watershed Management Plan (2005), Watershed Management Plan for the Kent Lake Subwatershed (2002), Kent Lake/Upper Huron Watershed Management Plan (2006), Huron Chain of Lakes Watershed (2005), Rouge River Watershed Management Plan (2012), and the Shiawassee River Watershed Management Plan (2008). Associated volume reductions will improve hydrologic conditions throughout the study area and limit downstream hydraulic impacts.

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These initiatives rely on a variety of NPS pollution reduction goals outlined as part of the 319 approved WMPs:

- Improve water quality and reduce sources of pollution that threaten public health,
- Reduce runoff impacts through sustainable stormwater management strategies and programs,
- Increase the public's understanding of their role in protecting, restoring, and enhancing water quality,
- Appropriately manage suitable habitats for aquatic life, wildlife, and fisheries in the subwatershed,
- Promote and enhance recreational opportunities in the subwatershed,
- Protect, restore and enhance natural features to maintain/improve river and watershed ecosystems,
- Maximize community assets related to the watershed, and
- Support regional partnerships for the implementation of the watershed management plan.

Most of the projects within this Project Plan are located within the Clinton River and Rouge River watersheds which target *E. coli* and biota pollutants. Projects that focus on total suspended solids (TSS) reduction and infiltration will be beneficial to work towards the existing *E. coli* TMDL. EGLE does not issue TMDLs for TSS. However, TSS is a surrogate for the biota TMDL. The Patterson Holly Drain is located within the Shiawassee River Watershed, which will help achieve the TMDL goal associated with Strawberry Lake.

Oakland County has conducted various projects and initiatives to help achieve TMDL compliance from nonpoint sources. Recent projects include stormwater improvements on the Lane Drain in Troy, the Gibson Renshaw on the Sylvan Glen Golf Course, Red Run streambanks projects, Nelson Drain cleanout, and green infrastructure (GI) work in the George W. Kuhn (GWK) retention basin.

Taken holistically, all of the alternative locations work toward the common goal of NPS pollutant removal while simultaneously striving to meet the requirements of the local TMDLs.

1. Compliance Status

a. Point Source

Discussion of the compliance status with an existing point source or groundwater discharge permit is not considered applicable for NPS stormwater improvement projects.

b. NPDES Permit

Most stormwater outfalls into the Red Run Drain, Clinton River, Rouge River, and contributing waterways within Oakland County are permitted Municipal Separate Storm Sewer Systems (MS4) under the jurisdiction of Oakland County and each individual Community's permit. The permits have six minimum requirements that must be maintained for compliance. The projects presented in this Project Plan are not MS4 Permit required and are an additional effort over and above the six minimum control measures.

A copy of the current NPDES stormwater permit for the County is included in Appendix D. Other NPDES permits can be provided as necessary.

c. Discharge Data

The discharge data form is not applicable for NPS stormwater improvement projects.

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2. Orders

This section is not applicable to this Project Plan. There have been no water quality orders of any kind. Some municipalities within the County have Administrative Consent Orders related to sanitary sewer and/or combined sewer overflows, but they do not apply to NPS projects.

3. Water Quality Problems

a. Point and Nonpoint Sources of Pollution

The priority of Oakland County and its communities is to improve stormwater quality, increase onsite infiltration, and strive to meet the goals of the watershed management plans as previously stated.

Implementation of the stormwater management practices proposed in this Plan will help achieve those goals identified in the WMPs. The proposed projects incorporate natural feature enhancements, including the use of vegetation to increase infiltration and stabilization, provide buffers, and reduce the amount of untreated impervious runoff. The reduction of direct stormwater runoff will decrease the amount of pollution and flow variability, thereby helping to restore the natural flow regime by reducing peak wet weather flows. The proposed flow attenuation practices via BMPs will help mitigate streambank erosion and ensure the success of the future/proposed stabilization projects.

Public involvement will be an integral part of the project implementation. Involving the public in the Project Plan development process and increasing the public awareness of the improvements that result from the projects will elevate public understanding of their role in protecting and enhancing watershed resources.

The target pollutants associated with stormwater runoff that will be reduced due to the proposed projects identified in this Plan are *E. coli*, phosphorus, dissolved oxygen (DO), and biota.

E. coli, a bacterium that can enter the watershed from animal waste and other sources, is a significant pollutant in the State of Michigan, specifically Oakland County. This is evident in Michigan's Statewide established TMDL for *E. coli* (2019) as well as the Lower Clinton River's TMDL (2010). The sources have been attributed, in part, to stormwater runoff caused by urban development. For additional details, see Appendix E regarding the *E. coli* TMDLs.

Phosphorous is a nutrient commonly found in water affected by eroded soils and attributed to erosion, lawn fertilizers, animal waste, and plant debris. High concentrations of phosphorous can harm aquatic life and deplete dissolved oxygen in water bodies. Sediments and nutrients are introduced from landscape runoff and are transported to waterways by heavy rains. This condition is especially problematic in highly impervious urban landscapes. These pollutants can be washed overland into storm drains, ultimately contributing to the Clinton River, Rouge River, Huron River, Shiawassee River, and the connected waterways. Strawberry Lake and Kent Lake have established TMDLs for phosphorous to control algae blooms and periodic fish kills. See Appendix E for the established TMDLs regarding phosphorus.

The water quality standards of Michigan require that all waters of the state be protected for warmwater fish and other indigenous aquatic life and wildlife in addition to other uses. Low dissolved oxygen (DO) may result in fish kills since there must be sufficient available oxygen to fulfill minimum metabolic demands. Norton Creek, located in the Huron River Watershed,

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established a TMDL for DO in 2008 after experiencing DO standard nonattainment issues. This issue posed a threat to the warmwater fish and other indigenous aquatic life and wildlife. Low DO in water bodies is primarily caused by excessive algae growth. Norton Creek sustained relatively stagnant conditions, which can contribute to algae growth and a decrease in DO. The Rouge Watershed also has a TMDL for DO. See Appendix E for the established TMDL regarding DO.

Biota is the indigenous aquatic life and wildlife associated with a particular region or habitat. The biota TMDL for the Rouge River Watershed aims to reduce sediment loadings in order to achieve the fish and macroinvertebrate community targets and established water quality standards. Human activities that increase soil erosion or alter rates of sediment transport in waterways (e.g., forestry, mining, urban development, industrial activities, agriculture, dredging, channel alteration, and dam construction) are among the most pervasive causes of sediment imbalance in aquatic systems (Waters, 1995; Nietch et al., 2005; USEPA, 2006). The TMDL's target is to reestablish macroinvertebrate communities that result in a consistently acceptable or excellent rating when monitored using Procedure 51 (e.g., a score of -4 to +9). Macroinvertebrate communities are evaluated based on a minimum of two (2) Procedure 51 biological assessments conducted in successive years, following the implementation of efforts such as Best Management Practices (BMPs) to stabilize runoff discharges and extremes in streamflow conditions and minimize sediment loadings to the watershed.

Sedimentation is when particulates settle out of the water. When large amounts of sediment start to settle out, they can reduce water depth, and alter the direction of ; sedimentation is made worse from forestry, mining, urban development, industrial activities, agriculture, dredging, channel alterations, and dam construction. The purpose of the TMDL created for sedimentation is to restore water quality to improve habitat, macroinvertebrates, and fish populations.

The proposed improvement projects within this plan are intended to promote treatment, detention, and onsite stormwater infiltration or increase stabilization. These practices will filter many pollutants and mitigate the potential for erosion. Increasing onsite infiltration will also reduce and delay the volume of direct runoff entering streams, which will help reduce any impacts on the natural flow regime of the Clinton River, Huron River, Rouge River, Shiawassee River, and the connected waterways and improve base flows.

b. Unsewered Areas

Municipal sanitary and county interceptor sewer systems generally serve the project areas. Some of the northern properties remain unsewered and served by private on-site systems. Therefore, actions taken upon private systems are not applicable to this Plan.

c. Septage Disposal

There are no identified septage disposal problems near the proposed improvement project locations.

4. Future Project Needs for the Next 20 Years

a. Nonpoint Source Needs

The County has identified possible NPS stormwater treatment projects that will be needed within the 20-yr planning period in addition to those described in this plan. They are the following:

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Table II-4: NPS Stormwater Treatment Projects List

Project	Type
Brandon Oxford Drain	Streambank stabilization
Brown Drain	Streambank stabilization
Caddell Drain	Streambank stabilization
Clinton Oakland Sanitary Interceptor	Water quality improvement
Dutton Drain	Streambank stabilization
Hampton Drain	Streambank stabilization & Overflow basin repairs
Hazel Drain and Clarenceville Drain	Create a regional basin, Water quality improvement, & Green infrastructure
Honeywell Drain	Streambank stabilization
Kensington Metropark	Streambank stabilization & Green infrastructure
Novi-Lyon Drain Culvert Replacement	Streambank stabilization
Otter Drain	Create a regional basin, Water quality improvement, & Green infrastructure
Reid and Branch Drain	Streambank stabilization
Rufe Collier Drain	Streambank stabilization
Sinking Bridge Drain	Streambank stabilization & Wetland enhancement
Stony Creek Metropark	Streambank stabilization & Green infrastructure
Sturgis Drain	Streambank Stabilization
Detention Basin Updates	Water quality improvement & Green Infrastructure
GWK Drainage District	Green Infrastructure

b. Future Sanitary Flows

Documentation and projection of future sanitary flows are not considered applicable for NPS stormwater improvement projects.

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5. Future Environment without the Proposed Project

Suppose the proposed work within this Plan is not undertaken. In that case, there is the likelihood that the environmental conditions will not improve and potentially worsen within Oakland County and along the connecting waterways. There must be reductions in sediment, nutrient, and bacteria inputs to achieve the established TMDLs. Otherwise, these pollutants will continue to have severe consequences on the environment.

Failure to substantially reduce *E. coli* colonies will likely result in continued Beneficial Use Impairments (BUI) for recreational activities downstream of the project areas. Without the proposed improvements, the existing problems associated with the lack of adequate stormwater management practices will continue to worsen. High frequency and large volume peak flows will increase, leading to more issues from nutrient loading, flooding, downstream thermal changes, and loss of aquatic habitat associated with sedimentation. As a result, recreational opportunities provided by the Clinton River, Rouge River, Huron River, and Shiawassee River waterways will continue to diminish, and property owners may experience increased flooding conditions and property impacts. The County and municipalities are being proactive in implementing highly visible BMPs on their properties and are setting an example and encouraging developers and property owners to incorporate BMPs into their plans for development and redevelopment.

E. Population Data

1. Existing and Projected Study Area Population

The following table provides the actual population from the 2020 Census, along with future projected populations provided by SEMCOG:

Table II-5: Existing and Projected Population in Oakland County

Year	Population
2020 (actual Census)	1,274,395
2030	1,286,750
2040	1,314,016
2045	1,319,089

Source: Census Data for Oakland County, SEMCOG website, accessed March 2022. U.S. Census Bureau and SEMCOG 2045 Forecast

2. Current population served by existing facilities

Discussion of this item is not applicable to an NPS Project Plan.

3. Current and future population served by the proposed improvements

Discussion of this item is not applicable to an NPS Project Plan.

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F. Environmental Setting

1. Cultural Resources

The County is committed to preserving and protecting historical sites. The Michigan State Historic Preservation provides local governments, non-profits, and property owners with historic preservation services and training. The National Register of Historic Places noted key historic sites: Cranbrook, Brooks Farm, Clarkston Village Historic District, Detroit Zoological Park, Eastern Michigan Asylum Historic District, Meadow Brook Farms, and Royal Aldrich House. Communication will be established with appropriate Tribal Historic Preservation Officers to ensure all necessary permissions are granted before projects begin.

2. The Natural Environment

a. Climate

The climate will not be affected by the improvements recommended in this Plan. Designs will be evaluated for continuous function across a range of climate factors to ensure resiliency.

b. Air Quality

There are no significant factors affecting air quality by the improvements recommended in this Plan.

c. Wetlands

There are wetlands within the study area and at several of the project locations, according to the Nation Wetland Inventory (NWI) (Figure II-4). Impacts may be necessary as part of the stormwater improvements. However, any proposed impacts will be considered during the respective project design. An EGLE Joint Permit and local wetland permit, when applicable, will be submitted for all improvement projects fulfilling the requirements as identified in the regulations.

d. Coastal Zone

There are no coastal zones within the study area.

e. Floodplains

There are designated FEMA floodplains and floodways (Figure II-6) at several proposed improvement project locations. Any work within the 100-year floodplains and floodways will be performed in accordance with applicable regulations and per any specific conditions of the applicable EGLE Joint Permit, if necessary. Compensatory site modifications will be components of all the improvement projects where a mapped floodplain/floodway is present.

f. Natural or Scenic Rivers

There are no natural or wild scenic rivers in the study area.

g. Major Surface Waters

Several named watercourses and numerous connecting drains have been selected as project sites in this plan; details of these specific project locations are included in Section III. The proposed streambank stabilization improvements will all be within the existing channel. All the proposed improvements intend to improve water, habitat, and biotic quality and will be performed in

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accordance with applicable regulations and per any specific conditions of the applicable EGLE Joint Permit. No modifications will have an adverse effect on water quality or impede flow.

h. Recreational Facilities

There are numerous parks and open spaces located throughout the study area. Several project locations are within publicly owned parks such as Catalpa Oaks County Park, Red Oaks Water Park, and Waterford Oaks County Park, all owned by Oakland County, the City of Troy Nature Center, and Sylvan Glen Golf Course. Existing recreational areas do not have planned expansions.

i. Topography

The topography varies throughout the study area, from gentle and flat to reasonably steep along some watercourses. None of the proposed improvements will be affected by the topography. However, access to some streambank stabilization sites will require additional review during the design phase to protect the surrounding property due to steep slopes.

j. Geology

The geology of the study area will not affect the choice of alternatives. The surficial geology of Oakland County is associated with deglaciation and deposition within the proglacial lake environment during the Wisconsinan Stage of the Pleistocene Series glacial episode. Subsurface glacial drift materials are expected to consist primarily of sands, gravels, and silts underlain by unsorted clayey till. Groundwater within the glacial drift reportedly occurs under unconfined conditions at shallow depths and under confined conditions at greater depths.

k. Soils

The soils within the study area vary significantly but can generally be classified ranging from well-drained sandy to loamy texture glacial till which exhibits moderate to moderately slow permeability. Before any formal design and construction, soil samples will be taken at each site where infiltration BMPs are proposed.

l. Agricultural Resources

There is agricultural land in the northern portion of the County. Agricultural lands benefit from quality drainage. Any project through or adjacent to existing agricultural uses will be evaluated during the design to avoid and minimize any impacts on these properties.

m. Fauna and Flora

Work within the study area will be limited to publicly owned land or easements, land within the public right-of-way, or utility easements. There are no known impacts that will occur to any biotic species. In areas where improvements will be located within wetland or stream habitats, the project will incorporate the reestablishment of the native species. Prior to any formal design and construction, there will be a field investigation at each site to ensure there is no impact on the existing biota.

n. Unique Features

There are no unique features identified within the study area that the proposed improvement project activities will impact.

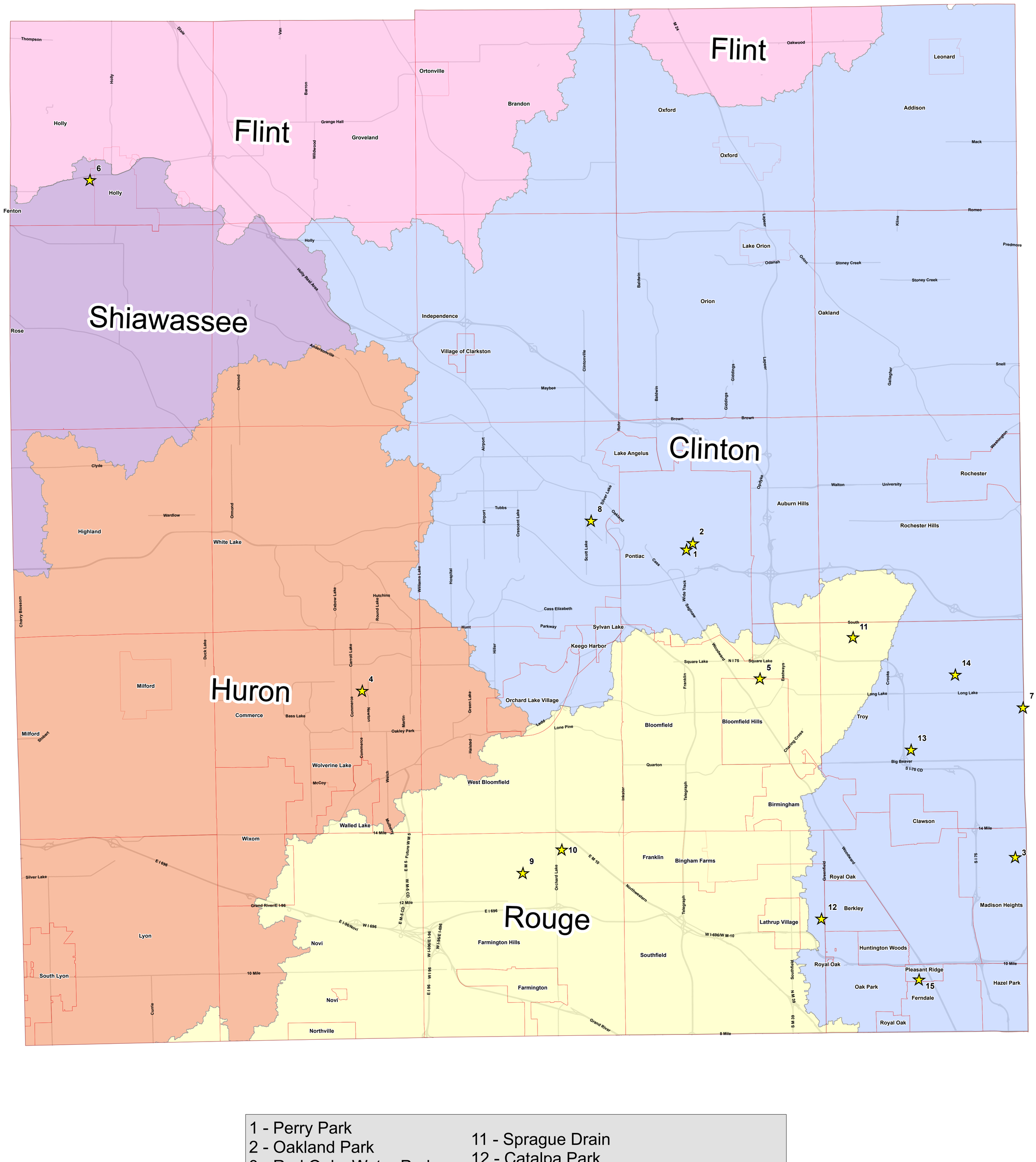
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o. Existing Plant and Animal Communities:

The existing plant and animal species are typical of urbanized areas. No habitat for animals of economic or sport value is within the area. The U.S. Fish and Wildlife Service (USFWS) was contacted in March 2022. Endangered and threatened species listed as having a presence in Oakland County include the Indiana Bat, the Northern Long-eared Bat, Piping Plover, Red Knot, Whooping Crane, Eastern Massasauga, Northern Riffleshell, Rayed Bean, Snuffbox Mussel, Mitchell's Satyr Butterfly, Monarch Butterfly, Poweshiek Skipperling, and the Eastern Prairie Fringed Orchid (https://ecos.fws.gov/ipac/). Best management practices will be implemented to minimize and avoid impacts on threatened and endangered species (Appendix I).

Hubbell, Roth and Clark, Inc. reviewed this information and found that the proposed projects would have no long-term, negative impacts on any species. Since the proposed projects are designed to improve water quality and reduce impervious surfaces, the long-term effects should enhance the habitat for any species present. Refer to the correspondence included in Appendix F for additional information.

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1 - Perry Park
2 - Oakland Park
3 - Red Oaks Water Park
4 - Lower Straits Lake
5 - Hamlin Drain
6 - Patterson Holly Drain
7 - Nelson Drain
8 - Pontiac Creek Extension
9 - Minnow Pond Drain
10 - Pebble Creek Drain
11 - Sprague Drain
12 - Catalpa Park
13 - Lane Drain Phase II
14 - Sylvan Glen Phase III

<u>15 - Water Towns - Green Infrastructure</u>
15a - Oxford Intersection
15b - Endcap Bioretention / Rain Garden
15c - Elm Blvd Entrance
15d - City Hall Police Station Parking Lot

Legend

- Project Sites
- Municipal Boundary

Watersheds

- Clinton
- Flint
- Huron
- Rouge
- Shiawassee

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Figure II-1

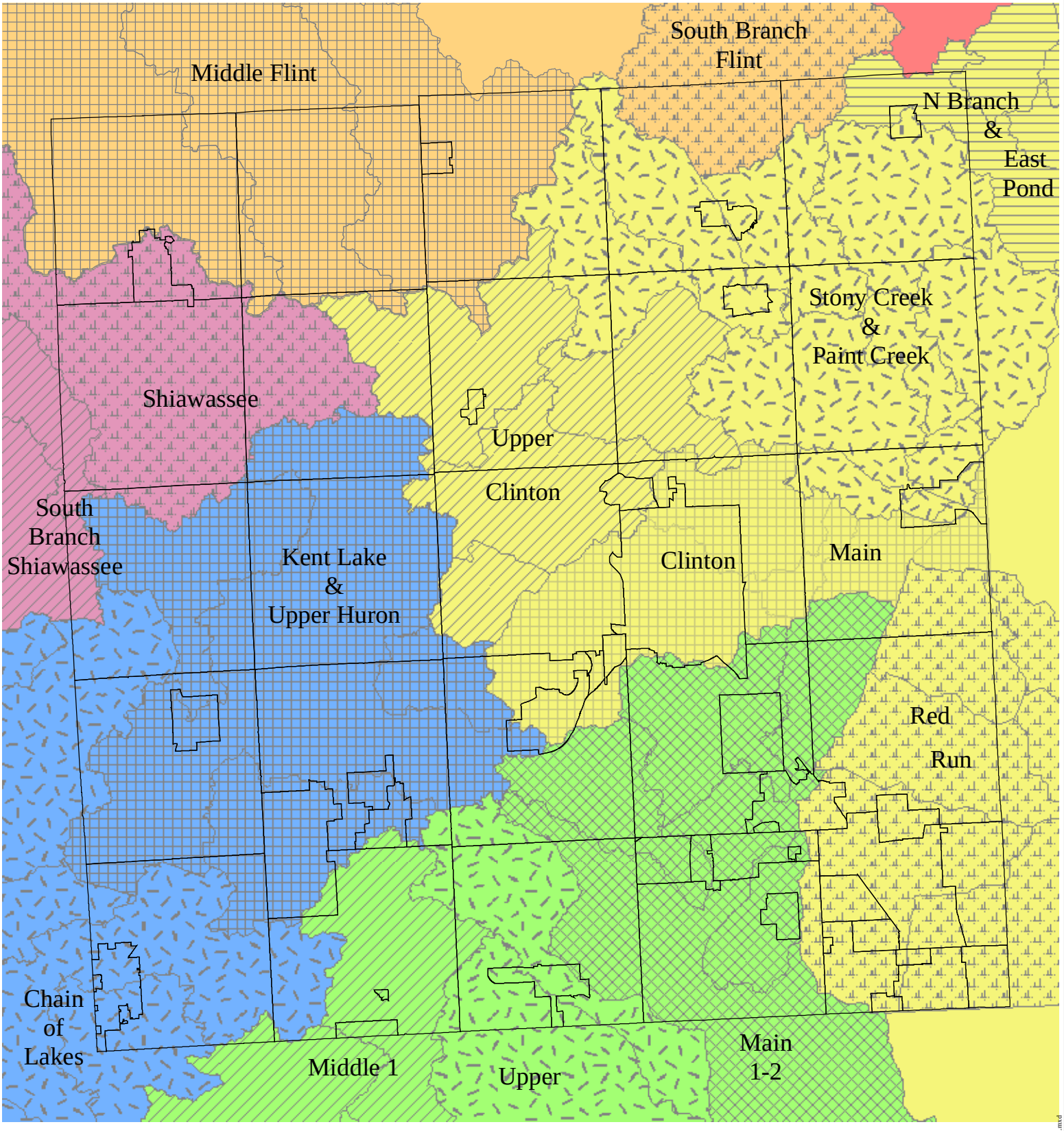
Watersheds in Oakland County SRF Project Plan 2024

N W E S

0 2.5 5 10 Miles

WRC WATER RESOURCES COMMISSIONER Jim Nash

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915



Oakland County Subwatersheds

Figure II-2

Oakland County Municipal Boundaries

WRC WATER RESOURCES COMMISSIONER Jim Nash

- Belle River Watershed
- Clinton River Watershed
- Flint River Watershed
- Huron River Watershed
- Rouge River Watershed
- Shiawassee River Watershed

0 15,000 30,000 Feet

0 3 6 Miles

Date: 7-7-03 TLP
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1 - Perry Park
2 - Oakland Park
3 - Red Oaks Water Park
4 - Lower Straits Lake
5 - Hamlin Drain
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15 - Water Towns - Green Infrastructure
15a - Oxford Intersection
15b - Endcap Bioretention / Rain Garden
15c - Elm Blvd Entrance
15d - City Hall Police Station Parking Lot

Legend
- Project Sites
- Municipal Boundary
- Watersheds
- Hydrology
- Lakes

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Figure 2

County Wide Project Locations
SRF Project Plan 2024

N W E S

0 2.5 5 10 Miles

WRC WATER RESOURCES COMMISSIONER Jim Nash

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915



1 - Perry Park
2 - Oakland Park
3 - Red Oaks Water Park
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<u>15 - Water Towns - Green Infrastructure</u>
15a - Oxford Intersection
15b - Endcap Bioretention / Rain Garden
15c - Elm Blvd Entrance
15d - City Hall Police Station Parking Lot

Legend

- Project Sites
- Watersheds
- Municipal Boundary

Wetlands

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

*National Wetland Inventory & MIRIS

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Figure 3

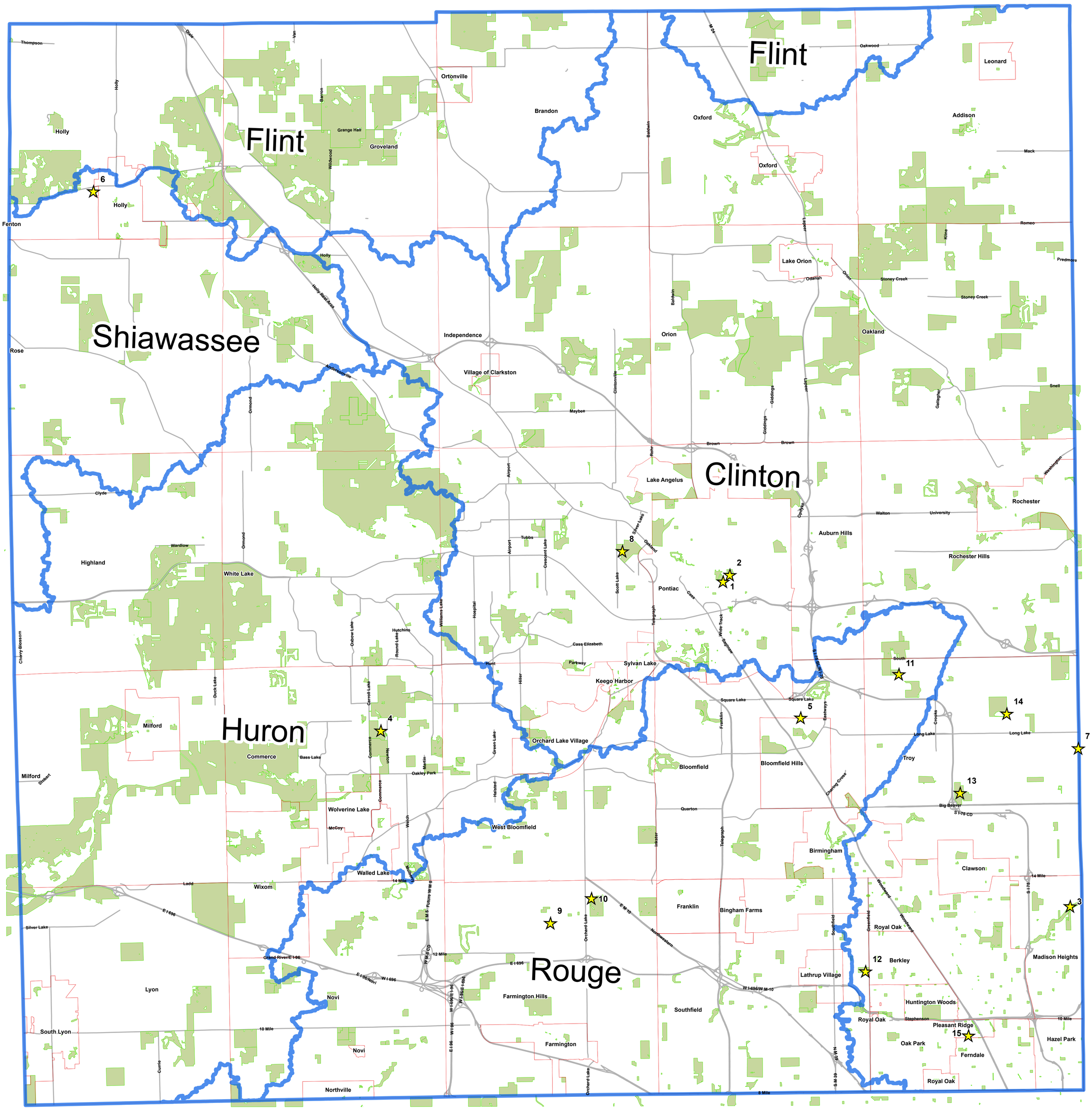
Wetlands in Oakland County SRF Project Plan 2024

N W E S

0 2.5 5 10 Miles

WRC WATER RESOURCES COMMISSIONER Jim Nash

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915



1 - Perry Park
2 - Oakland Park
3 - Red Oaks Water Park
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15 - Water Towns - Green Infrastructure
15a - Oxford Intersection
15b - Endcap Bioretention / Rain Garden
15c - Elm Blvd Entrance
15d - City Hall Police Station Parking Lot

Legend

- Project Sites
- Watersheds
- Municipal Boundary
- Parks Locations

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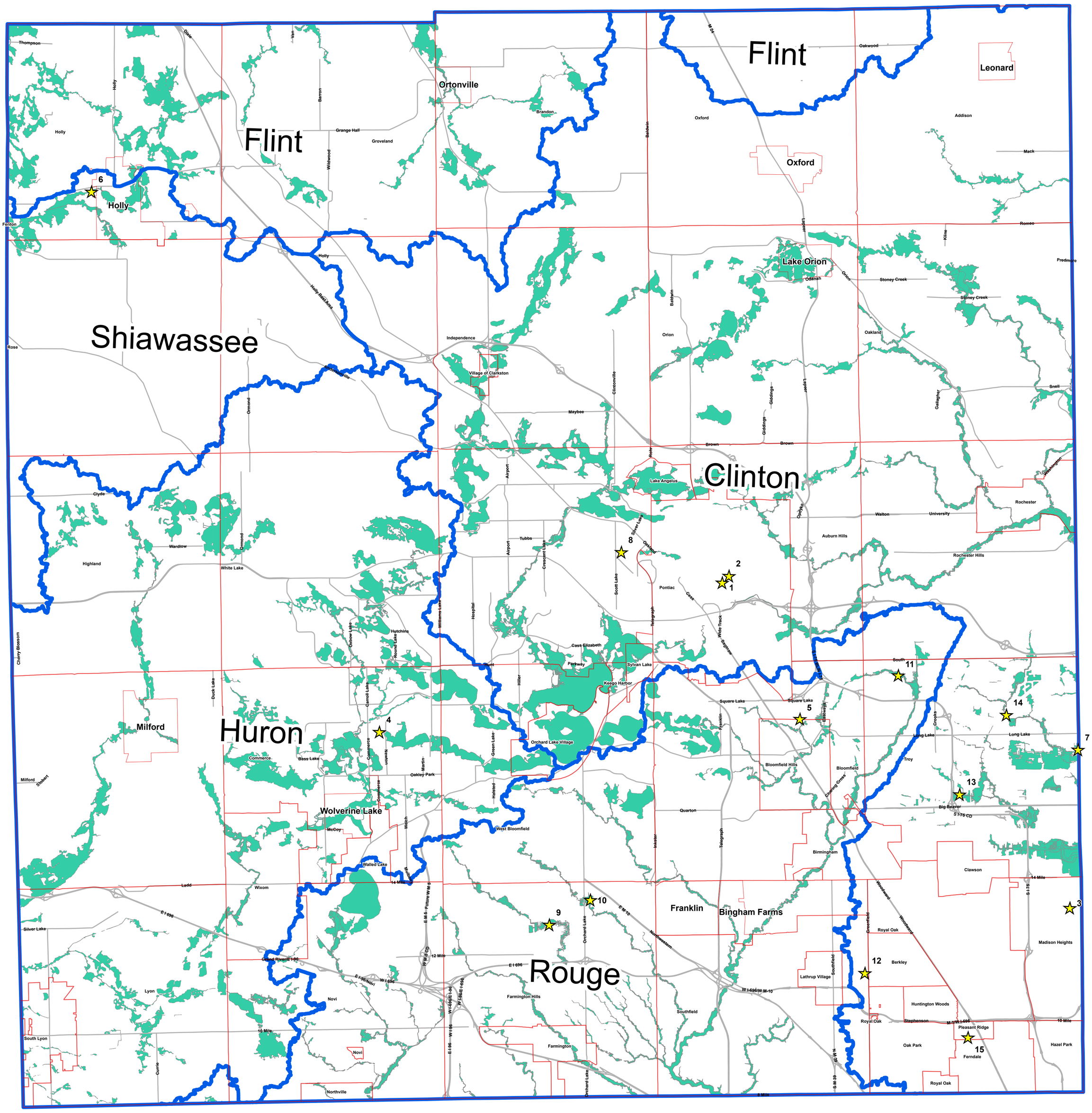
0 2.5 5 10 Miles

Parks in Oakland County SRF Project Plan 2024

Figure 4

WRC WATER RESOURCES COMMISSIONER Jim Nash

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915



1 - Perry Park
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Legend

- Project Sites
- Municipal Boundary
- Watersheds
- FEMA Floodplains*

*FEMA 100-yr Floodplain Designations

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Figure 5

Floodplains in Oakland County SRF Project Plan 2024

N W E S

0 2.5 5 10 Miles

WRC WATER RESOURCES COMMISSIONER Jim Nash

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915

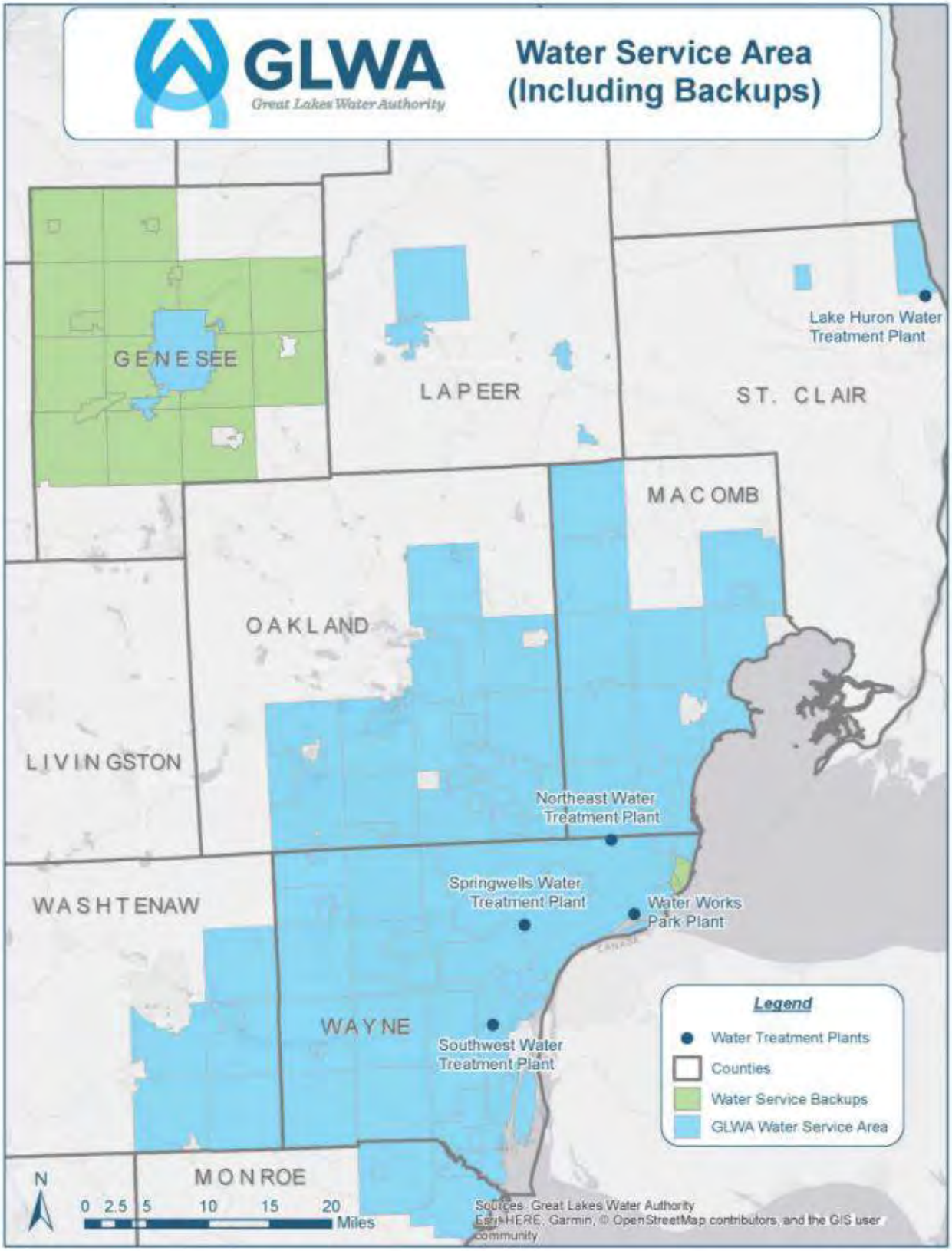


Figure II-7 GLWA Service Area

Section III - Analysis of Alternatives

The BMP alternatives presented in this Plan were reviewed on a qualitative and quantitative basis. When applicable, the projects were compared against water quality benefits, infiltration capacity, land availability, compatibility with surrounding land uses, capital expenditures and operations, maintenance, and repair (OM&R) costs, ease of implementation, and public educational opportunities. BMP load and removal efficiencies were calculated as the cost associated with the removal of each pound of pollution or cubic foot of runoff of volume reduction over the lifespan of the BMP. Projects were based on opportunities previously outlined in local management plans or originally planned as County capital improvements. Removal efficiencies were quantified for TSS, TP, *E. coli*, and stormwater volume.

During the site evaluation analysis, each location was considered for stormwater infiltration where feasible. This type of mitigation, when conditions are suitable, is highly successful at removing TSS, TP, and *E. coli*. Each BMP location was evaluated against the Natural Resources Conservation Service (NRCS) soil data. The NRCS has categorized each soil class based on its capacity to infiltrate water as a function of the hydrologic and physical properties of the material. The classes are Type A, B, C, or D, where the properties range from loose unconsolidated sands and gravels to heavy dense clay. Sites with Type A and B soils are most favorable for infiltration BMPs, whereas locations with Type C and D soils may be less favorable for infiltration. Additional design and engineering must be considered for proper BMP functionality and success when Type C and D soils are present. In addition, soil borings are available at or nearby some project areas.

A. General Alternatives Considered

Each site was analyzed for water quality improvement alternatives, optimization of existing facilities, and no action depending on the site-specific conditions. The subwatersheds addressed in this Plan are primarily contained within the Clinton River Watershed. However, projects are also proposed in the Rouge River, Huron River, and Shiawassee River watersheds. This plan evaluates possible alternatives to improve runoff and stormwater quality for specific locations within the study area. Therefore, all other options are site-specific and regional solutions are not applicable. Conceptual figures of the proposed BMPs are included in this section. Refer to Appendix G for the existing conditions site photos. Currently, there are five established TMDLs within the study area, all to improve water quality by reducing volume, sediment, nutrient, and bacteria inputs. The water quality issues have been explained to the public, and they have spoken through the planning process with the watershed management plans (WMP). Within each document are action items to address the water quality concerns. This plan is intended to serve as a conduit to help achieve those goals utilizing low-interest funding, ultimately working to improve the health of Oakland County and its connecting waterways. This section has been broken down based on individual projects, with a project description, alternatives considered per project, pollutant removal, and cost analysis. The basis of the cost analysis is included following the project descriptions.

1. Alternative 1 – No Action

If the County is to take no action and does not implement innovative stormwater improvements, then the existing water quality problems will not improve. Therefore, this is not a Principal Alternative.

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2. Alternative 2 – Water Quality BMPs

As an alternative to "No action," water quality improvements as described below can be made on various project sites. This includes Water Quality BMPs, Optimization of Existing Facilities, and Streambank Stabilization. Water quality BMPs are being proposed at eight (8) locations within the study area. These sites provide an opportunity for retrofits to improve stormwater quality. Each site is listed with specific details on the proposed BMPs in Section III-B. Generally, the BMPs considered in this Project Plan are:

a. Porous Pavement

Porous pavement is an infiltration technique that combines stormwater infiltration, storage, and structural pavement consisting of a porous surface underlain by a storage reservoir. Porous pavement helps reduce the amount of impervious land area within the watershed, which is critical to infiltrating stormwater runoff, improving water quality, and reducing streamflow variability. Porous pavement has been considered in areas with existing impervious surfaces where soil conditions are conducive to infiltration.

b. Underground Pollutant Separation Structures

Pollutant separation structures are mechanical stormwater management devices used to reduce NPS pollution. They are designed as flow-through structures with a settling or separation unit to remove sediment, and other pollutants from the storm flow before moving downstream to the outfall. Periodic maintenance is needed to remove accumulated sediment.

c. Stormwater Retention/Infiltration Basins

Stormwater infiltration basins are any stormwater device or system that causes some amount of runoff from small storms to infiltrate into the ground rather than be discharged to a stream. Most infiltration devices also remove waterborne pollutants by filtering water through the soil. Stormwater infiltration can provide a means of maintaining the hydrologic balance by reducing impervious areas. Infiltration devices can include any of the following: basins, trenches, porous pavement, modular pavement, or other systems that collect runoff and discharge it into the ground. Infiltration devices should only be used on locations with gentle slopes, permeable soils, and relatively deep-water tables and bedrock levels. New developments located in areas of sandy soils would be ideal candidates for these types of practices.

d. Grassed Swales

Grassed swales are open channel management practices designed to treat and attenuate stormwater runoff. As stormwater runoff flows through these channels, it is filtered first by the vegetation in the channel, then through a subsoil matrix, and finally infiltrates into the underlying soils. Grassed swales are improvements on the traditional drainage ditch and are well suited for treating highway or residential road runoff. Grassed channels are most similar to a conventional drainage ditch. The major differences are flatter side and longitudinal slopes and a slower design velocity for water quality treatment of small storm events. The type and coverage of vegetation grown in the swales will influence pollutant treatment. Native plantings may provide more significant pollutant reduction, but they may also alter conveyance hydraulics. Using vegetation in these applications is important to filter contaminants that may enter the median from the surrounding pavement. Drainage swales are applicable on virtually all developed sites.

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e. Rain Gardens (Bio infiltration)

The term "rain garden" refers to a constructed depressional area used as a small landscape tool, usually located in residential yards or roadway ditches, to improve water quality. Rain gardens are sometimes also referred to as biofiltration systems on a larger scale. Rain gardens should be placed strategically to intercept water runoff and typically are placed beside impervious surfaces such as driveways, sidewalks, or below downspouts. Rain gardens are designed to allow for ponding "first flush" and increased infiltration. Nutrient removal occurs as the water comes in contact with the soil and the roots of the trees, shrubs, or other vegetation planted in the depression. Plant choices should center on native wildflowers and grasses adapted to local conditions to enhance nutrient removal. Suitable applications for biofiltration systems, or rain gardens, are parking lot islands, residential developments utilizing swale drainage for pre-treatment, and commercial developments utilizing filter strips adjacent to parking lots. Rain gardens are not ponds and should be designed to drain within 48 hours. Engineered soil mixes should be incorporated into the design to facilitate drainage in areas with less suitable soil conditions (such as clay or clay loam). Under-drainage is also typically installed to facilitate drainage.

f. Infiltration Sewers

Infiltration sewers are perforated storm sewers that allow for infiltration. Manholes located on the infiltration sewers are fitted with a weir plate to allow time for the stormwater to infiltrate into the surrounding soils. All catch basins and manholes along the infiltration storm sewer will have sumps to capture accumulated sediment.

g. Oversized Storm Sewer/First Flush Storm Sewers

Oversized storm sewers are identical to infiltration sewers, except they are not perforated. These sewers are utilized in areas with soils not conducive to infiltration.

h. Tree Planting

Strategically placed, healthy trees can effectively reduce the amount of runoff and pollutant loading in receiving waters. Trees protect water quality by substantially reducing runoff during small rainfall events, which consist primarily of the first flush runoff. The intercept amount depends on the size and canopy of each tree. On average, there is a 15-20% reduction in rainfall overtime under tree cover compared to open environments (Teague and Kuehler, 2016).

i. Tree Pits

Trees planted in urban areas have additional concerns due to the proximity of other infrastructure. There are limited areas for root growth and potential complications with surrounding underground infrastructure. However, engineered tree pits can provide an option to manage root growth and drainage (GreenBlue, 2019) if suitable soils and underground space can be provided. The benefits tree pits provide include natural uptake and more infiltration. Additionally, they are easier to design and install during road reconstruction projects.

3. Alternative 3 – Optimization of Existing Facilities

Three (3) of the project locations within the study area are good candidates for the optimization of existing facilities to improve water quality. Due to the unique existing conditions of these sites, they have an opportunity for modifications to their existing function that would improve water

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quality while preserving their intended use. Each site is listed with the specific details of the proposed modifications in Section III-B.

4. Alternative 4 – Streambank Restoration

Streambank stabilization projects are being proposed at nine (9) locations within the study area. These project sites provide an opportunity to stabilize, restore, re-route, enhance, and/or otherwise improve the streambanks and beds to improve stormwater quality. Each site is listed with specific details of the streambank stabilization methods proposed at each site in Section III-B.

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B. Specific Alternatives Considered

1. Perry Park – Green Infrastructure (Figure III-1)

Perry Park, located in the City of Pontiac, regularly accumulates standing water after rainfall events from the surrounding lots. Currently at this site, water carrying nonpoint source pollution is pumped into the local storm sewer system. These conditions forgo the water quality benefits of the stormwater being retained in a engineered wetland to remove particulate and chemical pollutants before being discharged downstream. This proposed project will include the construction of a basin that will reduce nonpoint source pollution in the storm sewer system by collecting stormwater and improve water quality by facilitating infiltration of runoff. A boardwalk and proper signage will be installed along the basin to improve the accessibility of the park. Based on future site analysis, it will be determined if the soil conditions are suitable for infiltration. If they are, then the design will proceed as a retention basin to promote infiltration. If the conditions are not supportive of infiltration, then the design will proceed as a detention basin to maximize the water quality benefits before stormwater outlets from the site. The new basin would handle surface drainage from approximately 12 acres. By collecting and treating stormwater in the basin and allowing it to filter through native vegetation, there will be considerable reduction nitrogen (N), total phosphorus (TP), and total suspended solids (TSS). The increase in storage time and volume will increase infiltration and decrease excess peak discharge flows.

Perry Park falls within the Joseph Jones Drainage District. This is a Chapter 20 Drain that is funded entirely by the City of Pontiac, a significantly overburdened community.

Total Preliminary Costs	$853,600
Present Worth of Analysis	$397,000

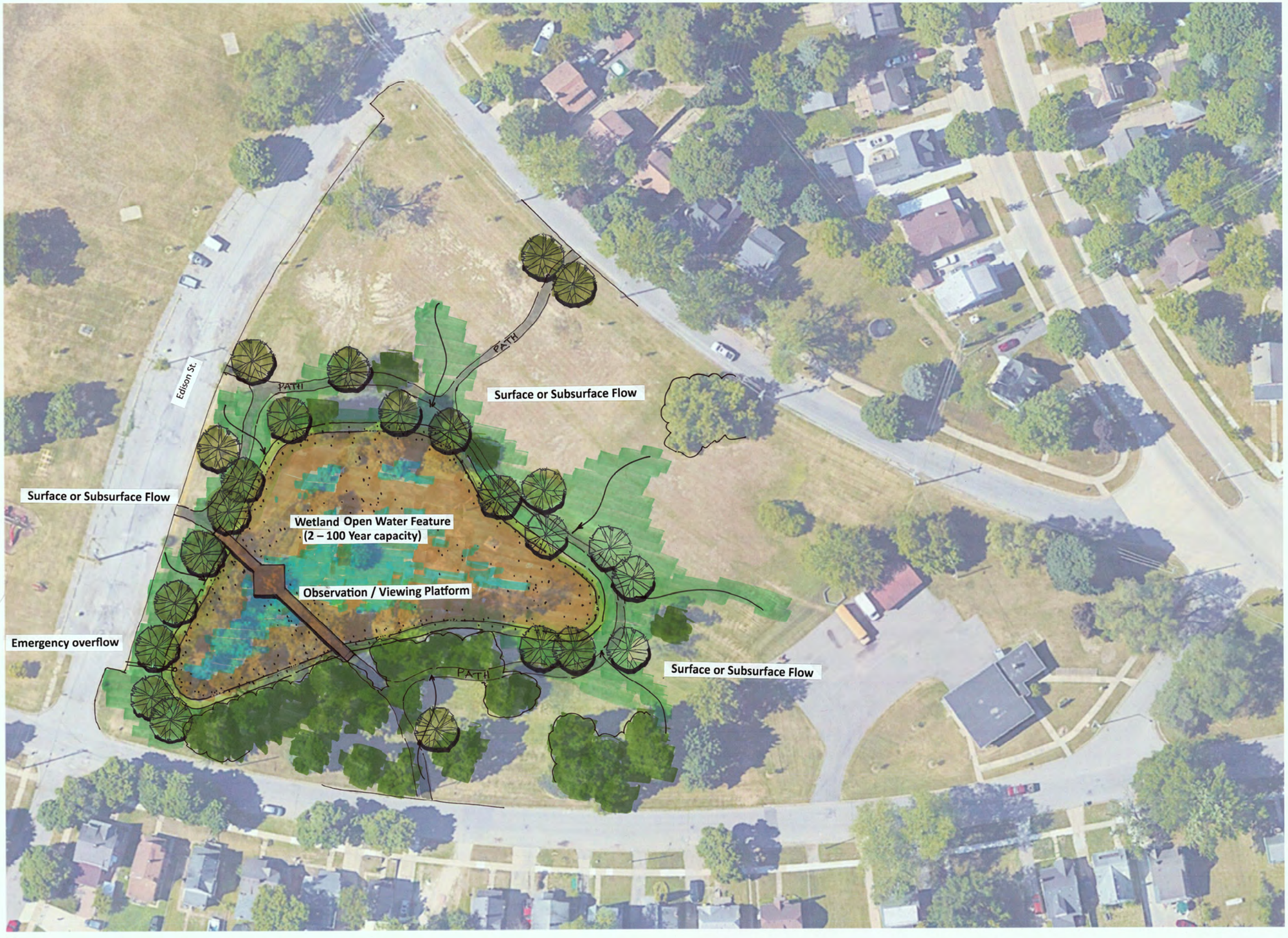
Direct, Indirect, and Irreversible Impacts

This project will provide stormwater management retrofits and a storage basin in Perry Park. The project scope includes a bioretention cell and native plantings. Project goals include increased infiltration, reduced flooding, the reduction of stormwater entering the county drainage infrastructure, and reduced pollutant and sediment loads. Ideally, if existing soils permit adequate infiltration, the existing pump station would be used as an overflow in the case of extreme rainfall events and the majority of stormwater would be treated locally.

This project does not occur within the floodway. During design, all necessary permits will be secured prior to beginning construction. There is a potential for limited tree removal. Easements may be required, and if they are, they will be secured prior to construction. Adverse impacts on any historic resources or endangered species are not anticipated. There may also be disruptions to traffic or parking on Rundell Street, Edison Street, Nelson Street, and Marquette Street during construction. These disruptions will be temporary and will be communicated through proper signage.

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WRC
WATER RESOURCES COMMISSIONER



PERRY PARK
RETENTION CONCEPT

PONTIAC
The HEART of Oakland County



*Wetland data from EGLE's Wetlands Map Viewer

Figure III-1

Floodplain - Perry Park
SRF Project Plan 2024

N W E S

0 0.01 0.03 0.05 Miles

WRC WATER RESOURCES COMMISSIONER Jim Nash

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915



*Wetland data from EGLE's Wetlands Map Viewer

Figure III-1

Wetlands - Perry Park
SRF Project Plan 2024

N W E S

0 0.03 0.05 Miles

WRC WATER RESOURCES COMMISSIONER Jim Nash

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915

2. Oakland Park – Green Infrastructure (Figure III-2)

Oakland Park, located in the City of Pontiac, regularly accumulates standing water after rainfall events from the surrounding lots. Currently at this site, water carrying nonpoint source is pumped into the local storm sewer system. These conditions forgo the water quality benefits of the stormwater being retained in an engineered wetland to remove particulate and chemical pollutants before being discharged downstream. This proposed project will include the construction of a basin that will reduce nonpoint source pollution in the storm sewer system by collecting stormwater and improve water quality by facilitating infiltration of runoff. Based on future site analysis, it will be determined if the soil conditions are suitable for infiltration. If they are, then the design will proceed as a retention basin to promote infiltration. If the conditions are not supportive of infiltration, then the design will proceed as a detention basin to maximize the water quality benefits before stormwater outlets from the site. The new basin would handle surface drainage from approximately 12 acres. By collecting and treating stormwater in the basin and allowing it to filter through native vegetation, there will be considerable reduction nitrogen (N), total phosphorus (TP), and total suspended solids (TSS). The increase in storage time and volume will increase infiltration and decrease excess peak discharge flows.

Oakland Park falls within the Joseph Jones Drainage District. This is a Chapter 20 Drain that is funded entirely by the City of Pontiac, a significantly overburdened community.

Total Preliminary Costs	$491,100
Present Worth of Analysis	$233,000

Direct, Indirect, and Irreversible Impacts

This project will provide stormwater management retrofits and a storage basin in Oakland Park. The project scope includes a bioretention cell and native plantings. Project goals include increased infiltration, reduced flooding, the reduction of stormwater entering the county drainage infrastructure, and reduced pollutant and sediment loads. Ideally, if existing soils permit adequate infiltration, the existing pump station would be used as an overflow in the case of extreme rainfall events and the majority of stormwater would be treated locally.

This project does not occur within the floodway. During design, all necessary permits will be secured prior to beginning construction. There is a potential for limited tree removal. Easements may be required, and if they are, they will be secured prior to construction. Adverse impacts on any historic resources or endangered species are not anticipated. There may also be disruptions to traffic or parking on E Montcalm Street, Ivy Street, Nelson Street, and Hammond Street during construction. These disruptions will be temporary and will be communicated through proper signage.

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OAKLAND PARK RETENTION CONCEPT

PONTIAC
The HEART of Oakland County



*Wetland data from EGLE's Wetlands Map Viewer

Figure III-2

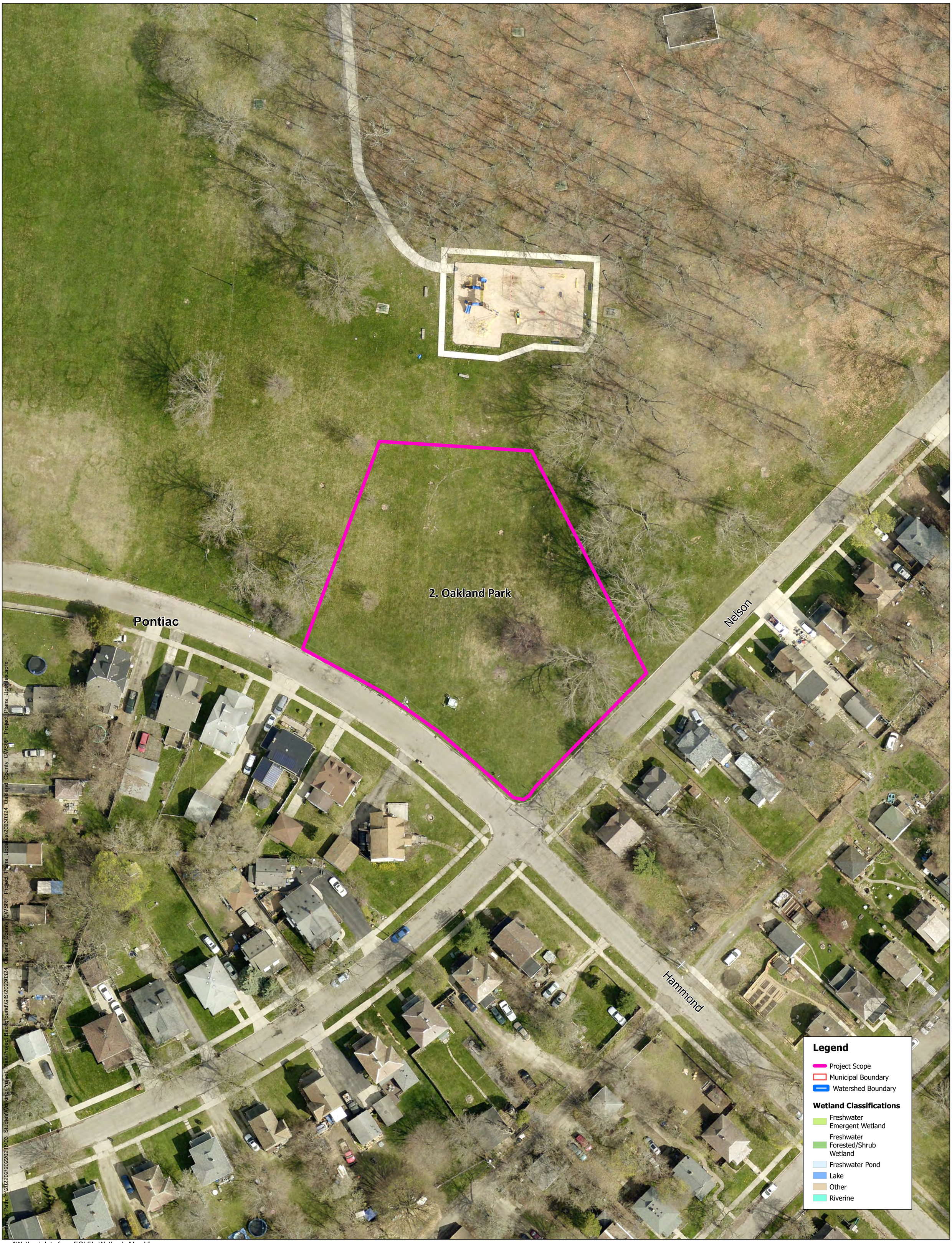
Floodplain - Oakland Park
SRF Project Plan 2024

N W E S

0 0.01 0.03 0.05 Miles

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-2

Wetlands - Oakland Park
SRF Project Plan 2024

N
W E
S

0 0.03 0.05 Miles

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3. Red Oaks Water Park– Green Infrastructure Improvements (Figure III-3)

The Red Oaks Water Park, located on East Thirteen Mile Road between John R Road and Dequindre Road, is a highly visible area and open to all residents of Oakland County. The Water Park's separate storm sewer directly discharges sediment, *E. coli*, and phosphorus into the Red Run Drain, a subwatershed of the Clinton River. The project will install a rain garden to collect and treat stormwater runoff from a curb cut along Thirteen Mile Road and localized runoff from the park. The rain garden will be constructed with an underdrain to connect to an existing catch basin, and soils will be amended to promote infiltration. The spoils created from the rain garden construction will remain onsite to eliminate standing water and make a natural grow zone.

BMPs will be designed to capture the channel protection volume and provide water quality control for a 1-inch rainfall event and extended detention for a 1.9-inch rainfall event. A maintenance path with appropriate signage will be added on-site to provide contractors with clear guidance.

Alternative water quality BMPs such as underground storage and pollutant separation structures were considered for this site; however, this option using bioretention and infiltration is the most cost-effective.

The Red Oaks Water Park falls within the separated north storm drain of the George W. Kuhn Drainage District. Therefore, the majority (94.48%) of this project will be funded by the City of Madison Heights, an overburdened community.

Total Preliminary Costs	$292,200
Present Worth of Analysis	$142,000

Direct, Indirect, and Irreversible Impacts

This project proposes the construction of a bioretention cell that is roughly 10,000 square feet, a curb cut on Thirteen Mile Road, sidewalk modification, energy dissipation structures, a regraded natural grow zone, and a new walking path to allow residents to view the rain garden. It is expected that roughly 60 lbs. of TSS, 5 lbs. of total phosphorus, and 5 lbs. of total nitrogen will be removed annually. Approximately 800,000 gallons of stormwater runoff will be processed annually.

Proposed improvements include increased infiltration and the reduction of stormwater entering the sewer system, increased native vegetation and habitat, and other water quality measures. This proposed project will provide stormwater management retrofits and additional storage in a portion of the Red Run Drain subwatershed of the Clinton River.

This project does not occur within the floodway or floodplain and does not impact any wetlands. During design, all necessary permits will be secured prior to beginning construction. There is unlikely to be any tree removal. Adverse impacts on any historic resources or endangered species are not anticipated. There may also be disruptions to traffic or parking on Thirteen Mile Road during construction of the curb cut and minor disruption to the Water Park entrance driveway. These disruptions will be temporary and will be communicated through proper signage.

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Red Oaks Water Park
Proposed Green Infrastructure

Wright Ave

Legend

- Proposed Bioretention w/ Amended Soils
- Proposed Regrade & Grow Zone
- Proposed Path
- Proposed Energy Dissipation
- Proposed Curb Cut
- Proposed Pipe Underneath Sidewalk
- Sheet Flow
- Modify Existing Catch Basin
- Access Point
- Lift Station
- Catch Basin
- Standard Inlet
- Pipe Outlet
- Storm Manhole
- Junction Chamber
- Storm Sewer
- Combined Interceptor
- Combined Lateral Main
- Oakland County Detention Basin

Proposed Curb Cut

E 13 Mile Rd

Sheet Flow

Hales St

N
W E
S

0 25 50 100
Feet

WRC
WATER RESOURCES COMMISSIONER

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14 - Red Oaks Water Park

Madison Heights

Legend

- Project Area
- Municipal Boundary
- Watersheds

Wetlands*

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

Flood Susceptibility

- Floodway
- Floodplain

Document Path: Y:\2022021\2022021803_StudiesWorking\Project_Plan\Project Background\GIS\20220414_Projects.mxd

*Wetland data from EGLE's Wetlands Map Viewer

Figure III-3

Floodplain/Wetlands - Red Oaks Water Park
SRF Project Plan 2024

N W E S

0 0.025 0.05 0.1 Miles

WRC WATER RESOURCES COMMISSIONER *Jim Nash*

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4. Lower Straits Lake – County Drain Establishment & Restoration (Figure III-4)

This project includes the restoration of approximately 2,700 linear feet of streambank, between Lower Straits Lake and S. Commerce Road, in the Upper Huron River subwatershed of the Huron River Watershed.

A reduction in nonpoint source pollution will be achieved by this project through streambank and streambed stabilization BMPs. The streambed BMPs proposed include pools, riffles, and meandering the stream by creating a two-stage channel (or bankfull bench) which will include bank stabilization of toe wood and stone toe. The natural channel design improvements and BMPs will reduce nonpoint source pollutant loads, especially sedimentation, and improve water quality while reducing erosive flows. The stream will be established as a county drain. This will minimize erosion and lead to permanent improvements in water quality while better managing peak stormflows through the drain.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. The action that provides the most benefit is maximizing the stream's use and functionality. Other design approaches were considered to improve the water quality at this site, but they were determined not to be as cost-effective or impactful as this project.

Total Preliminary Costs	$2,477,700
Present Worth of Analysis	$1,124,000

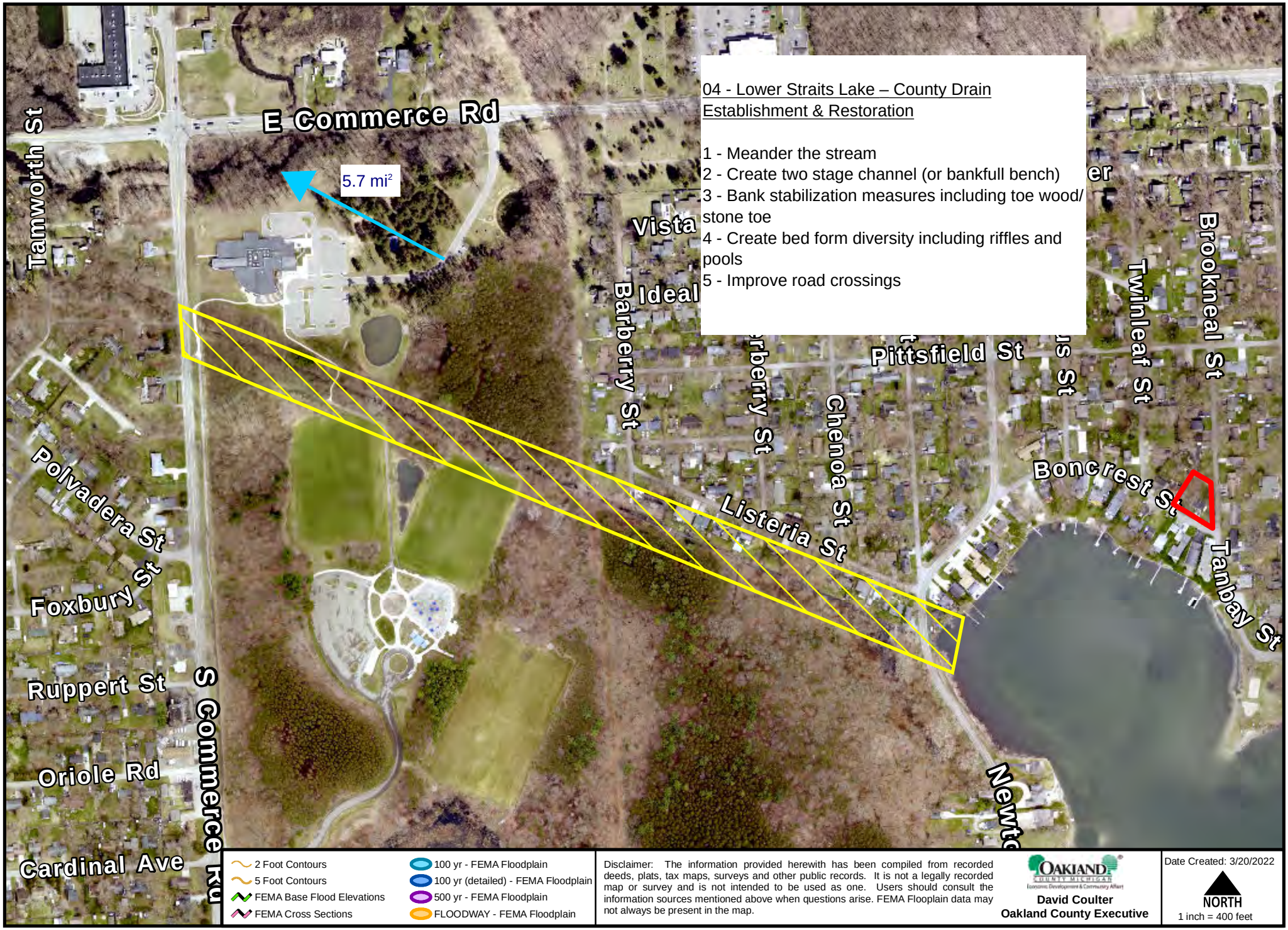
Direct, Indirect, and Irreversible Impacts

Channel restoration measures consist of meander restoration, pool and riffle structures construction, bankfull bench establishment, and riparian buffer zone planting. Benefits from the proposed improvements include decreased sediment loads, improved water quality, improved peak flow management, and mitigation of peak flow impacts on surrounding septic systems. This proposed project will provide critical improvements within the Huron River watershed.

This project occurs within the floodway, and a hydraulic analysis will be performed to verify that the improvements will not impact the 100-year flood elevation and base flood elevation. As this is not within an established Drainage District, any project completed along this stretch of the stream will include establishing a drainage district to assess the proposed project and to keep it properly maintained. During design, all necessary permits will be secured prior to construction. Tree removal may be necessary to access the stream and install the stabilization measures. Tree removal will occur at times indicated in the permits to cause no impacts on endangered species.

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Lower Straits Lake



2 Foot Contours
5 Foot Contours
FEMA Base Flood Elevations
FEMA Cross Sections
100 yr - FEMA Floodplain
100 yr (detailed) - FEMA Floodplain
500 yr - FEMA Floodplain
FLOODWAY - FEMA Floodplain

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OAKLAND COUNTY MICHIGAN
Economic Development & Community Affairs

David Coulter
Oakland County Executive

Date Created: 3/20/2022

NORTH

1 inch = 400 feet

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Figure III-4

Floodplain - Lower Straits Lake
SRF Project Plan 2024

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CONSULTING ENGINEERS SINCE 1915

Carroll Lake

Commerce

Commerce

3 - Lower Straits Lake

Legend

- Project Area
- Municipal Boundary
- Watersheds

Wetlands*

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

N

W E

S

Miles

0 0.025 0.05 0.1

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-4

Wetlands - Lower Straits Lake
SRF Project Plan 2024

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5. Hamlin Drain – Regional Stormwater Detention Facility (Figure III-5)

This project includes the restoration of approximately 2,700 linear feet of streambank, between Lower Straits Lake and S. Commerce Road, in the Upper Huron River subwatershed of the Huron River Watershed. The project will consist of the design and construction of a regional stormwater detention basin with a sedimentation forebay and outlet control structure. The inline basin will be located within the existing portion of Hamlin Drain. It will provide both stormwater quantity and quality benefits for the Rouge River watershed. The increase in storage time will lead to infiltration and a decrease in the excess flow downstream to Stoneycroft Hills Golf Course. The accumulated sediment, as a result of increased storage time in the basin, will be contained in the basin and will thereby reduce the amount of TSS reaching the Rouge River. The inline basin will provide maintenance access for routine sediment removal.

Depending on the soil conditions encountered in the field, the basin may be able to connect to a sand seam, which would allow for some infiltration to further improve water quality and reduce stormwater runoff volumes.

Potential alternatives include underground storage and mechanical water quality enhancements units; however, this alternative would incur a significantly greater cost for the same amount of tangible benefits and was considered impractical.

Total Preliminary Costs	$895,900
Present Worth of Analysis	$601,000

Direct, Indirect, and Irreversible Impacts

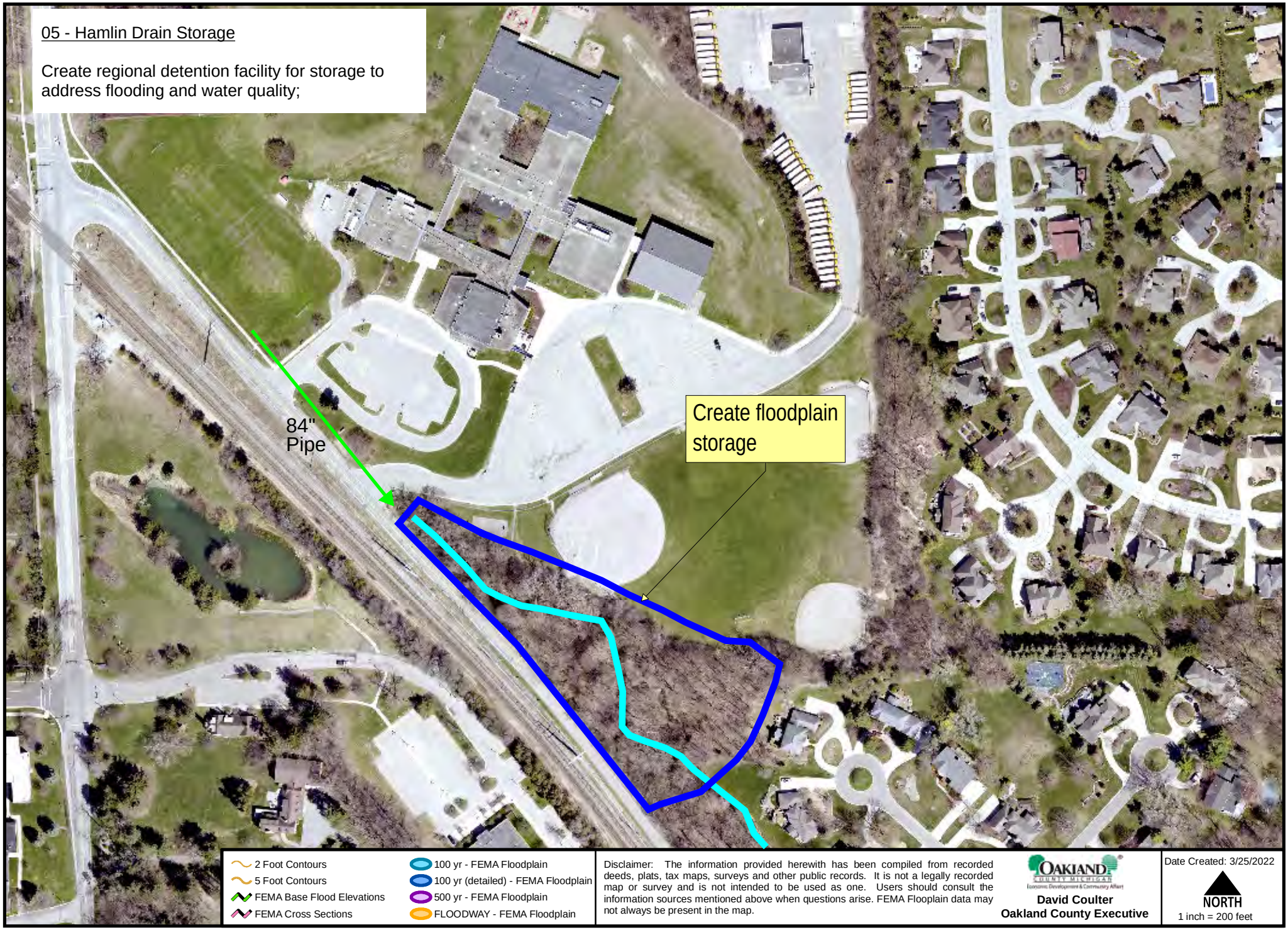
This proposed project will improve stormwater quantity and quality management by creating additional storage in a portion of the Main Rouge River subwatershed. Adverse environmental impacts are expected to be minimal. All construction activities will occur on publicly owned property or in publicly held easements for drainage.

This project occurs within the floodway, floodplain, and upland areas. A hydraulic analysis will be performed to verify that the improvements will not adversely impact the 100-year flood and base flood elevations. Appropriate easements, if necessary, will be secured prior to construction. During design, all the required permits for work not under the Drain Commissioner's purview will be secured prior to beginning construction. Tree removal may be necessary to access the stream and install the stabilization measures. Tree removal will occur at times indicated in the permits to cause no impacts on endangered species.

There will be traffic disruptions and inconveniences for people living in the area during construction. These disruptions will be temporary and communicated through project signage. Construction may affect the nearby school property and will be timed in a manner that will minimize conflicts. There may be interruptions to the use of the baseball fields adjacent to the project area during the project's construction. Once the construction is complete, activities in these fields will be able to resume.

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Hamlin Drain



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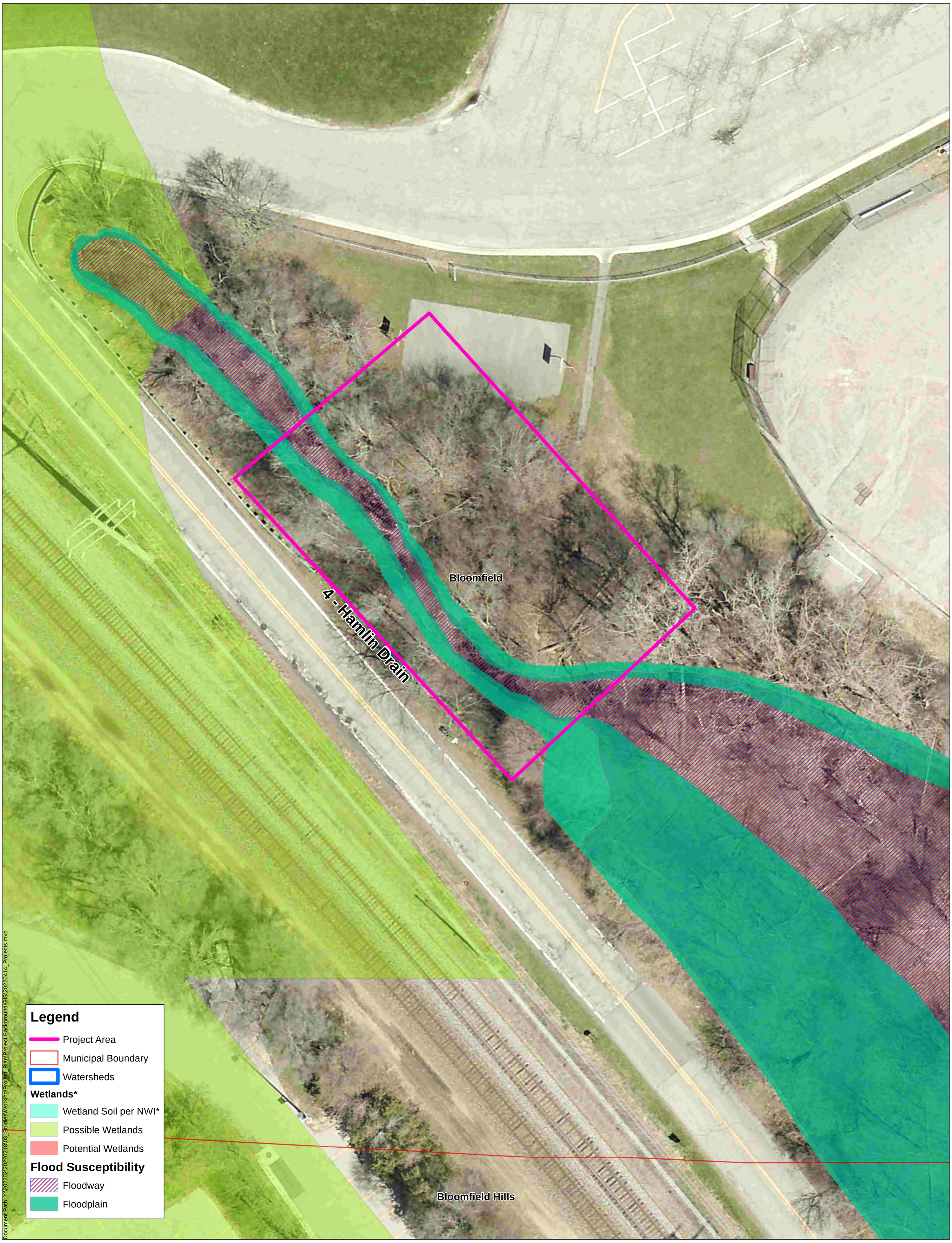
David Coulter
Oakland County Executive

Date Created: 3/25/2022

NORTH

1 inch = 200 feet

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-5

Floodplain/Wetlands - Hamlin Drain
SRF Project Plan 2024

N W E S

0 0.0025 0.005 0.01 Miles

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6. Patterson Holly Drain Restoration (Figure III-6)

This project includes the restoration of approximately 7,000 linear feet of streambank in the Patterson Holly Drain, between Bevins Lake and the Shiawassee River, to remove sediment and improve water quality in the drain. The drain will be sized for appropriate flow events with natural meandering channels and bankfull benches. This will minimize erosion and lead to permanent improvements in water quality while better managing peak stormflows through the drain. The natural channel will feature riffles, pools, and native plantings to restore habitats. Additionally, the four (4) existing culverts over the drain will be evaluated to determine if they are appropriately sized to meet current EGLE design criteria.

This project is considered a Principal Alternative. It is an opportunity to optimize the performance of an existing facility. The action that provides the most benefit is maximizing the stream's use and functionality. Other design approaches were considered to improve the water quality at this site, but they were determined not to be as cost-effective or impactful as this project.

Total Preliminary Costs	$3,763,600
Present Worth of Analysis	$1,708,000

Direct, Indirect, and Irreversible Impacts

This project proposes streambank stabilization on roughly 7,000 linear feet of the drain. Benefits from the proposed improvements include decreased sediment loads, improved water quality, and improved peak flow management. This proposed project will provide necessary stream restoration efforts within the Shiawassee River watershed.

This project occurs within the floodplain and possible wetlands. A hydraulic analysis will be performed to verify that the improvements will not impact the 100-year flood elevation and base flood elevation. During design, all necessary permits for work not under the Drain Commissioner's purview will be secured prior to beginning construction. Tree removal may be required to access the drain and install the stabilization measures. Tree removal will occur at times indicated in the permits to cause no impacts on endangered species. There will be traffic disruptions and inconveniences for people living in the area during construction. These disruptions will be temporary and communicated through project signage.

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Patterson Holly Drain



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5 - Patterson Holly Drain

Holly

Holly

Legend

Project Area

Municipal Boundary

Watersheds

Flood Susceptibility

Floodway

Floodplain

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Figure III-6

Floodplain - Patterson Holly Drain
SRF Project Plan 2024

N W E S

0 0.05 0.1 0.2 Miles

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5 - Patterson Holly Drain

Holly

Holly

Legend

- Project Area
- Municipal Boundary
- Watersheds

Wetlands*

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-6

Wetlands - Patterson Holly Drain
SRF Project Plan 2024

N W E S

0 0.05 0.1 0.2 Miles

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7. Nelson Drain – Bank Stabilization & Sediment Trap (Figure III-7)

This portion of Nelson Drain is in poor condition and in need of streambank stabilization and habitat restoration. Streambank erosion is occurring in stretches of the existing channel and is being deposited further downstream in the drain. Channel straightening and a lack of floodplain connectivity have increased erosive flow velocities resulting in an increase in sedimentation and diminished water quality.

A decrease in nonpoint source pollutants, especially sediment loading, is a main priority of this project. The drain will be sized for appropriate flow events with natural meandering channels and bankfull benches. This will minimize erosion and lead to permanent improvements in water quality while better managing peak stormflows through the drain. Proposed streambed and streambank BMPs, including riffles, pools, and native plantings, aim to decrease nonpoint source pollutant loads. Channel restoration (re-meandering and reduction of the width-to-depth ratio) will be implemented to mitigate the potential for future erosion and subsequent sedimentation.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. The action that provides the most benefit is maximizing the stream's use and functionality. Other design approaches were considered to improve the water quality at this site, but they were determined not to be as cost-effective or impactful as this project.

Total Preliminary Costs	$2,502,400
Present Worth of Analysis	$1,135,000

Direct, Indirect, and Irreversible Impacts

This project proposes streambank stabilization on roughly 4000 linear feet of the drain. Benefits from the proposed improvements include decreased sediment loads, improved water quality, and improved peak flow management. This proposed project will provide necessary stream restoration efforts within the Clinton River watershed.

This project occurs within the floodway and floodplain. A hydraulic analysis will be performed to verify that the improvements will not impact the 100-year flood elevation and base flood elevation. During design, all necessary permits for work not under the Drain Commissioner's purview will be secured prior to beginning construction. Tree removal may be necessary to access the drain and install the stabilization measures. Tree removal will occur at times indicated in the permits to cause no impacts on endangered species. There will be traffic disruptions and inconveniences for people living in the area during construction. These disruptions will be temporary and communicated through project signage.

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Nelson Drain



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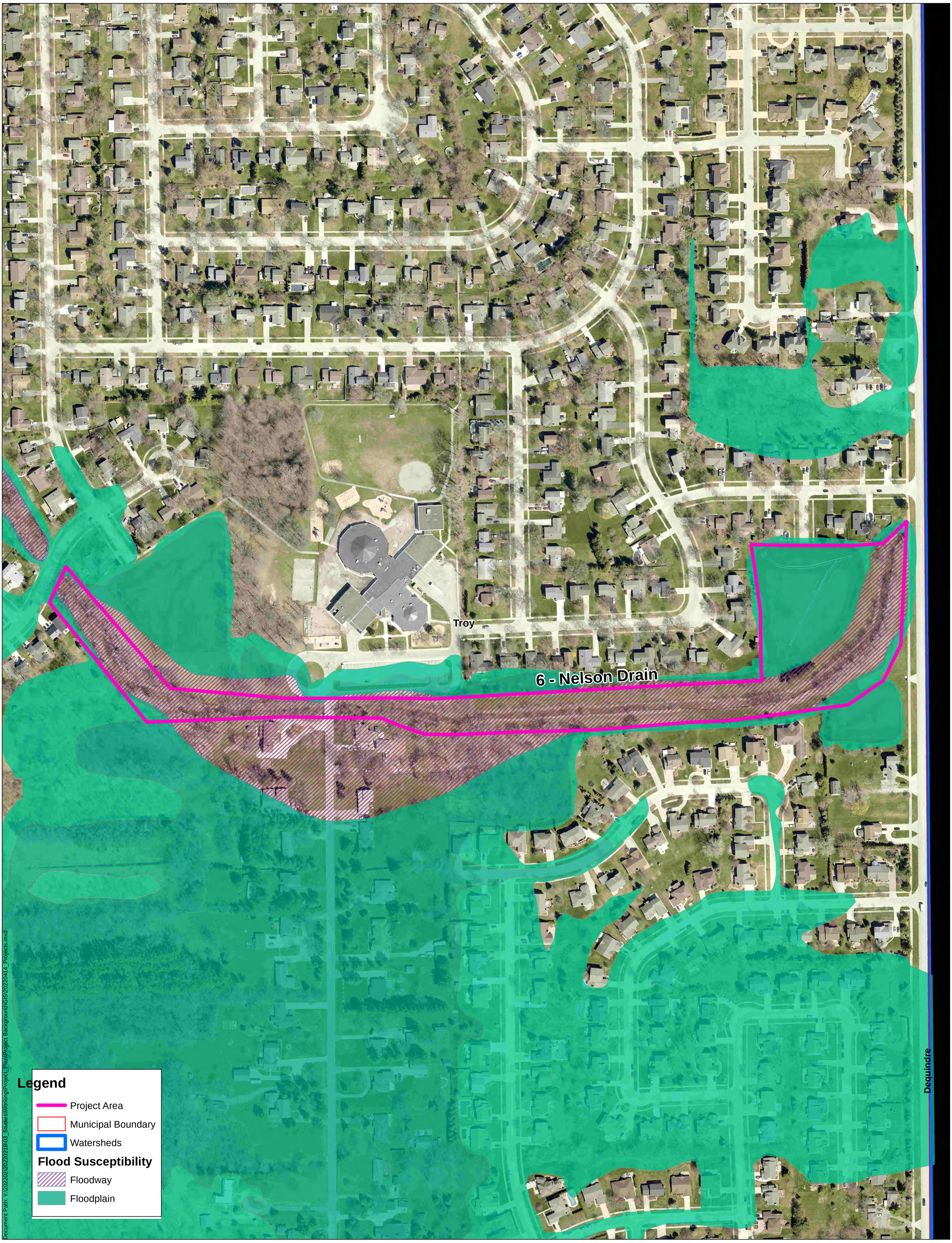


Figure III-7

Floodplain - Nelson Drain
SRF Project Plan 2024

N
W E
S

0 0.025 0.05 0.1 Miles

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-7

Wetlands - Nelson Drain
SRF Project Plan 2024

N
W E
S

0 0.025 0.05 0.1 Miles

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8. Pontiac Creek Extension – Wetland & Stream Restoration (Figure III-8)

Located on the Oakland County Campus, the Pontiac Creek Extension Drain is an open channel that includes portions of Waterford Township and the City of Pontiac. The Pontiac Creek Extension is currently subject to poor water quality and a high sedimentation rate. These result from backups within the drain as it experiences localized flooding, flashy erosive hydrology, streambank erosion, and habitat loss due to sediment deposition. As more frequent and intense rain events continue to occur, the Pontiac Creek Extension endures more sedimentation and an increase in other pollutant loads without any remediation.

This project seeks to decrease nonpoint source pollutant loads through stream and outfall stabilization. The BMPs installed will reduce excessive sedimentation and improve infiltration, in addition to providing stabilization to the creek. This project will directly increase the storage capacity of the creek and contiguous wetland system and allow it to be more resilient to changes in the climate, both within the specific project location and throughout the drainage district, using sustainable, nature-based design solutions. The wetland enhancement and stream restoration will reduce nonpoint source pollutants.

A stable stream channel will be constructed with natural features such as low-moderate sinuosity, bedform diversity (riffles/pools), roughness, and floodplain connectivity. The constructed in-stream features will include stone-grade controls and vegetated banks. These constructed stream features will decrease sedimentation and improve water quality. The outfalls and over-bank wetland areas will be stabilized to reduce excessive sedimentation and improve infiltration. Dense invasive vegetation (phragmites) that hinders stormwater conveyance will be removed from the stream and wetlands. The restored areas will be planted with native vegetation to promote stormwater infiltration, streambank stabilization, and additional habitat. Diversion and water control structures will be installed to help control the movement and detainment of water during peak flow events.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. Other water quality and quantity enhancement design approaches are not feasible at this site due to the limited amount of undeveloped area available.

Total Preliminary Costs	$2,206,100
Present Worth of Analysis	$1,000,000

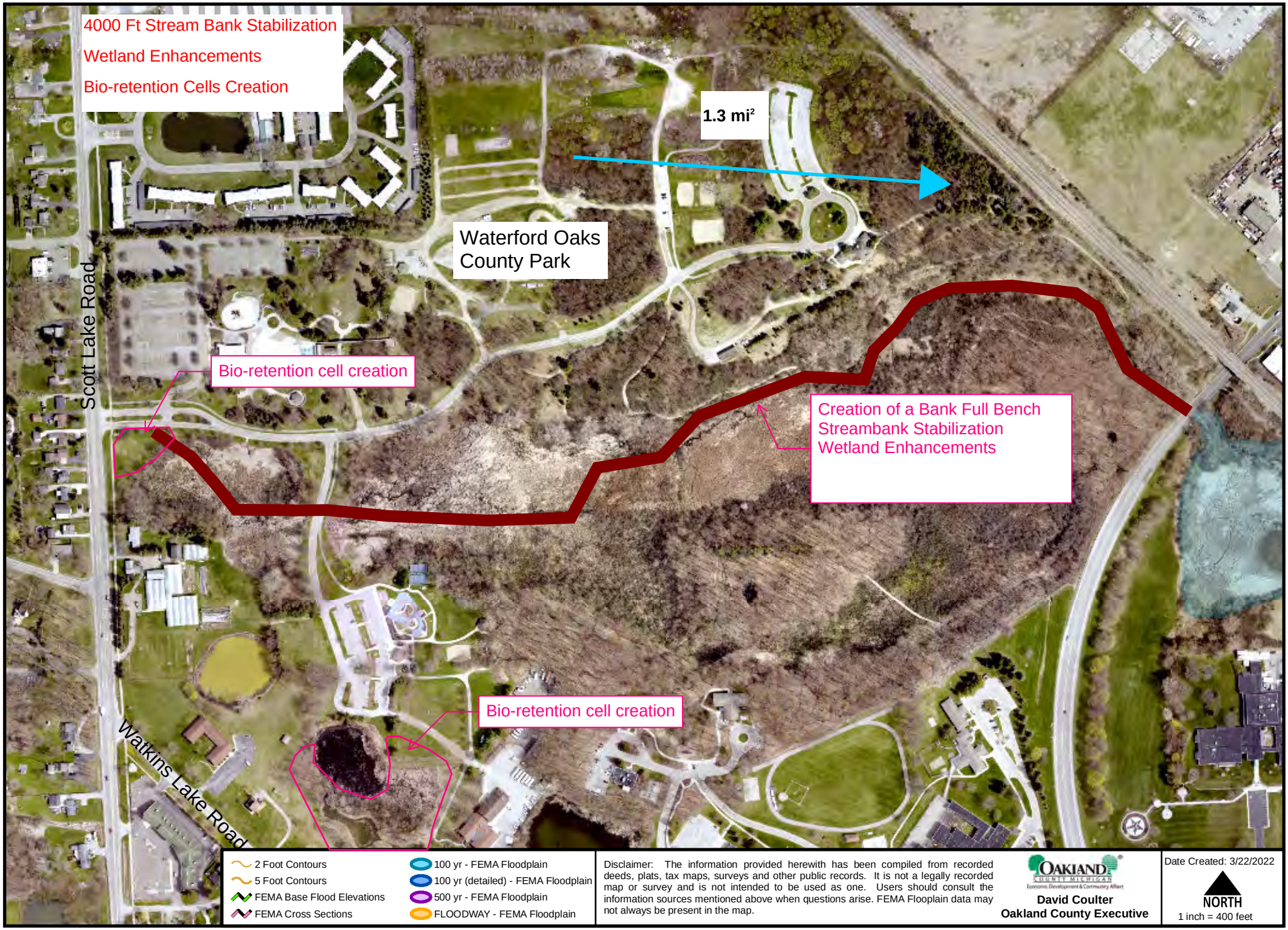
Direct, Indirect, and Irreversible Impacts

This project proposes streambank stabilization on roughly 2000 linear feet of the creek. Benefits from the proposed improvements include decreased sediment loads, improved water quality, and improved peak flow management. This proposed project will provide necessary stream restoration efforts within the Clinton River watershed.

This project does not occur within the floodplain but will impact possible wetlands. During design, all necessary permits for work not under the Drain Commissioner's purview will be secured prior to beginning construction. There is a potential for limited tree removal. Easements may be required, and if they are, they will be secured prior to construction. Adverse impacts on any historic resources or endangered species are not anticipated. There may be disruptions to traffic or parking during construction. These disruptions will be temporary and will be communicated through proper signage.

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Pontiac Creek Extension



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OAKLAND COUNTY MICHIGAN
Economic Development & Community Affairs

David Coulter
Oakland County Executive

Date Created: 3/22/2022

NORTH

1 inch = 400 feet

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7 - Silvercrest Drain
Silver Lake
Dixie
Dixie
Oakland
8 - Pontaic Creek
Waterford
Scott Lake
Pontiac
2 - Mainland Drain
Telegraph
Watkins Lake

Legend

- Project Area
- Municipal Boundary
- Watersheds

Wetlands*

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

Flood Susceptibility

- Floodway
- Floodplain

Document Path: Y:\2022\20220218\03_Studies\Working\Project_Plan\Project Background\GIS\20220414_Projects.mxd

*Wetland data from EGLE's Wetlands Map Viewer

Figure III-8

Floodplain/Wetlands - Pontiac Creek
SRF Project Plan 2024

N W E S

0 0.075 0.15 0.3 Miles

WRC WATER RESOURCES COMMISSIONER *Jim Nash*

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9. Minnow Pond Drain – Flood Control Basin Conversion (Figure III-9)

The Minnow Pond Drain in Farmington Hills has an offline flood control basin that was added to the drain to manage peak stormwater flows. As a result of its intended function, the basin does not generally have water flowing through or detained within itself unless there has been enough flow in the enclosed section of the drain to overflow into the pond. This project will convert the flood control basin into the primary path of the drain and utilize the enclosed portion for flood control overflows.

The conversion will be accomplished by modifying the three existing junction structures to invert their use, and divert the expected flows through the basin. Only high flows will be permitted to pass through the enclosed drain. The basin will be modified to incorporate a natural channel with bends, meanders, pools, and riffles to decrease the velocity of the flow. This will improve water quality while not adversely impacting the peak stormwater runoff capacity of the drain.

Depending on the soil conditions encountered in the field, the basin may be able to connect to a sand seam, which would allow for some infiltration to further improve water quality and reduce stormwater runoff volumes out letting back into the drain.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. Other water quality and quantity enhancement design approaches are not feasible at this site due to the limited amount of undeveloped area available.

Total Preliminary Costs	$2,526,800
Present Worth of Analysis	$1,146,000

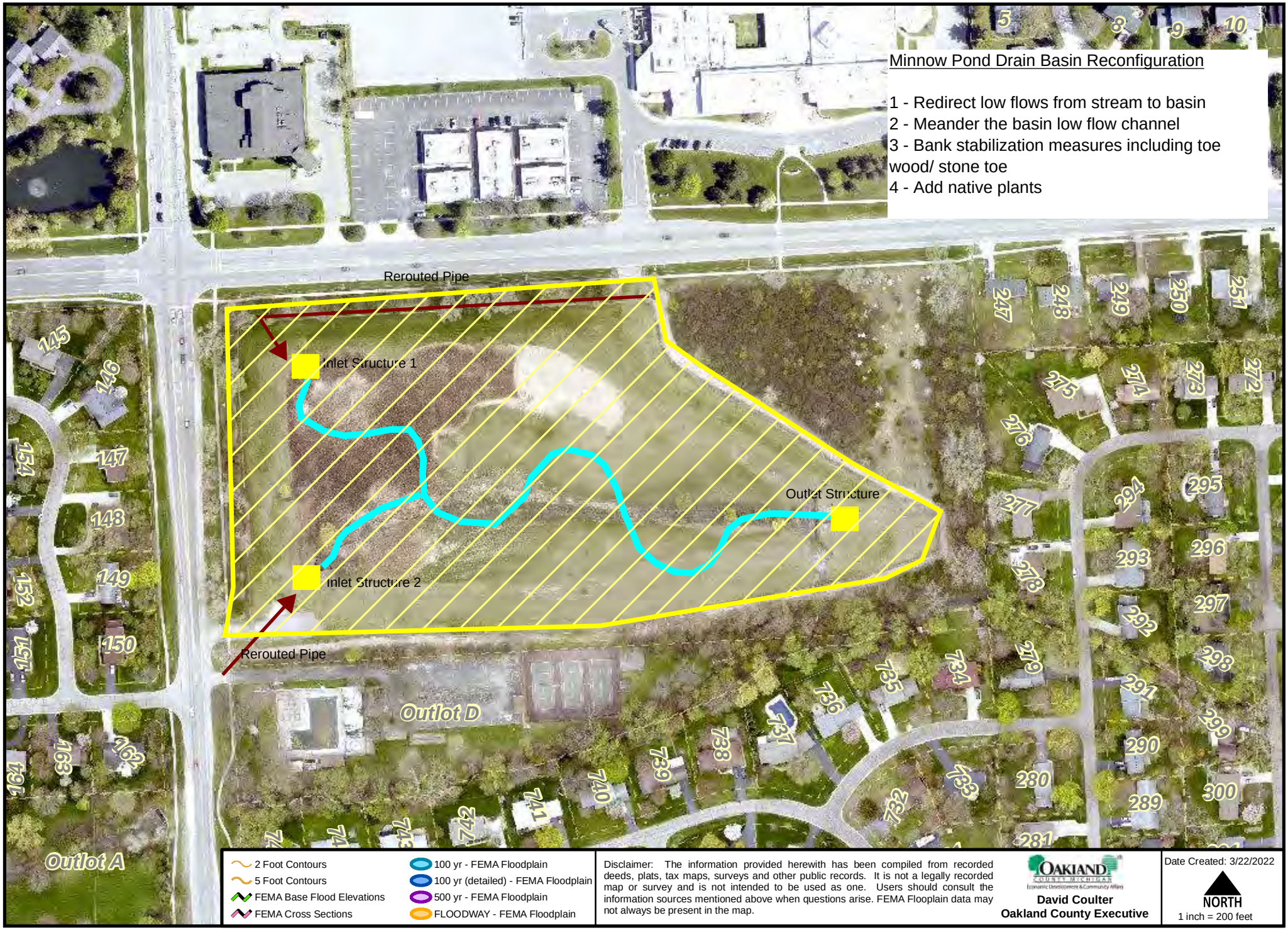
Direct, Indirect, and Irreversible Impacts

Benefits from the proposed improvements include decreased sediment loads, improved water quality, and improved peak flow management. This proposed project will provide tangible benefits to the Rouge River watershed.

This project occurs within the floodplain, and a hydraulic analysis will be performed to verify that the improvements will not adversely impact the 100-year flood and base flood elevations. During design, all necessary permits for work not under the Drain Commissioner's purview will be secured prior to beginning construction. There is a potential for limited tree removal. Easements may be required, and if they are, they will be secured prior to construction. Adverse impacts on any historic resources or endangered species are not anticipated. There may be disruptions to traffic or parking during construction. These disruptions will be temporary and will be communicated through proper signage.

DRAFT

Minnow Pond Drain



Disclaimer: The information provided herewith has been compiled from recorded deeds, plats, tax maps, surveys and other public records. It is not a legally recorded map or survey and is not intended to be used as one. Users should consult the information sources mentioned above when questions arise. FEMA Flooplain data may not always be present in the map.

OAKLAND COUNTY MICHIGAN
Economic Development & Community Affairs

David Coulter
Oakland County Executive

Date Created: 3/22/2022

NORTH

1 inch = 200 feet

Oakland County One Stop Shop 2100 Pontiac Lake Road Bldg. 41 West Waterford, MI 48328 Phone: 248-858-0721 Web: www.advantageoakland.com

9 - Minnow Pond

Farmington Hills

Legend

- Project Area
- Municipal Boundary
- Watersheds

Wetlands*

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

Flood Susceptibility

- Floodway
- Floodplain

Document Path: Y:\2022\2022021\Project_Plan\Project Background\GIS\20220414_Projects.mxd

*Wetland data from EGLE's Wetlands Map Viewer

Figure III-9

Floodplain/Wetlands - Minnow Pond Drain
SRF Project Plan 2024

N W E S

0 0.025 0.05 0.1 Miles

WRC WATER RESOURCES COMMISSIONER Jim Nash

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915

10. Pebble Creek Drain Restoration (Figure III-10)

This project includes the restoration of approximately 6,300 linear feet of streambank in the Pebble Creek Drain, where it flows through the Glen Oaks Golf Course, to remove sediment and improve water quality. The drain will be sized for the appropriate flow events and natural meandering channels with bankfull benches will be created. This will minimize erosion and lead to permanent improvements in water quality while better managing peak stormflows through the drain. The natural channel will feature stone toes, riffles, pools, and native plantings to restore habitats.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. The action that provides the most benefit is maximizing the facility's use and functionality. Other design approaches were considered to improve the water quality at this site, but they were determined not to be as cost-effective or impactful as this project.

Total Preliminary Costs	$4,415,700
Present Worth of Analysis	$2,003,000

Direct, Indirect, and Irreversible Impacts

This project proposes streambank stabilization on roughly 6,300 linear feet of the drain. Benefits from the proposed improvements include decreased sediment loads, improved water quality, and improved peak flow management. This proposed project will provide necessary stream restoration efforts within the Rouge River watershed.

This project occurs within the floodplain and floodway, and a hydraulic analysis will be performed to verify that the improvements will not impact the 100-year flood elevation and base flood elevation. During design, all necessary permits for work not under the Drain Commissioner's purview will be secured prior to beginning construction. Tree removal may be necessary to access the drain and install the stabilization measures. Tree removal will occur at times indicated in the permits to cause no impacts on endangered species. There will be traffic disruptions and inconveniences for people living in the area during construction. These disruptions will be temporary and communicated through project signage.

DRAFT

Pebble Creek Drain



Disclaimer: The information provided herewith has been compiled from recorded deeds, plats, tax maps, surveys and other public records. It is not a legally recorded map or survey and is not intended to be used as one. Users should consult the information sources mentioned above when questions arise. FEMA Flooplain data may not always be present in the map.

OAKLAND COUNTY MICHIGAN
Economic Development & Community Affairs

David Coulter
Oakland County Executive

Date Created: 3/22/2022

NORTH

1 inch = 800 feet

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Figure III-10

Floodplain - Pebble Creek Drain
SRF Project Plan 2024

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-10

Wetlands - Pebble Creek Drain
SRF Project Plan 2024

N W E S

0 0.05 0.1 0.2 Miles

WRC WATER RESOURCES COMMISSIONER *Jim Nash*

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11. Sprague Drain – Pond & Stream Restoration (Figure III-11)

The Stage Nature Center, located off Coolidge Highway in the City of Troy, abuts the Sprague Drain, an upstream section of the Rouge River. The drain meanders through the Nature Center's forested property and has, over time, formed an inline pond near the back of the building. This pond has accumulated sediment and caused the drain to erode in other areas.

A reduction in nonpoint source pollution will be achieved by this project through streambank and streambed stabilization BMPs. The streambed BMPs proposed include pools, riffle, and meanders streambed and the streambank will be stabilized with rock vanes. These BMPs will reduce nonpoint source pollutant loads, especially sedimentation. The natural channel design improvements will improve sediment transport and water quality while reducing erosive flows.

This project proposes to restore the streambank to convert the inline pond to an offline pond. The pond will remain hydraulically connected to the drain during high flows. The drain will be reshaped and reinforced with streambed and streambank stabilization BMPs.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. Other water quality and quantity enhancement design approaches are not feasible at this site due to the limited amount of undeveloped area available.

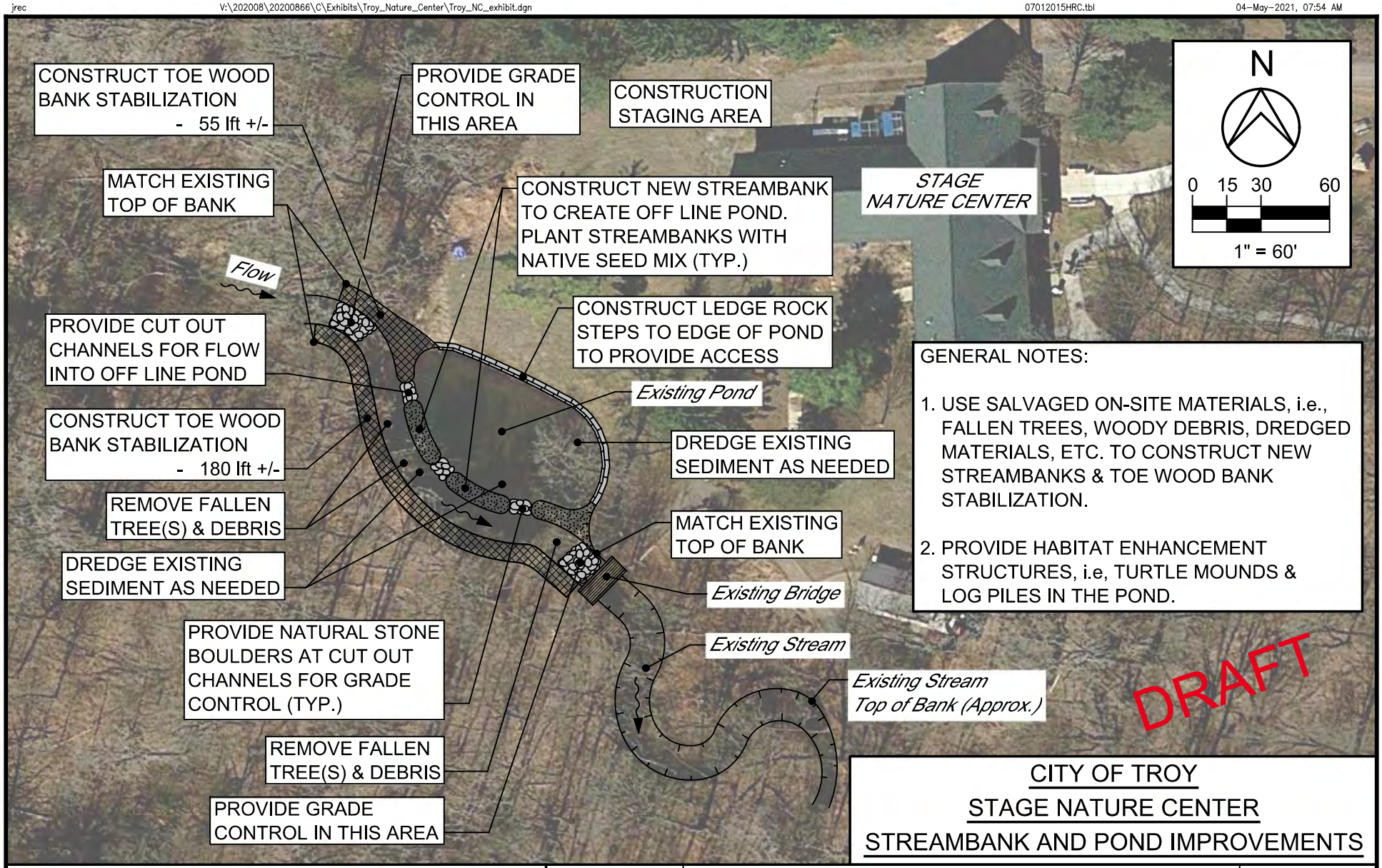
Total Preliminary Costs	$531,500
Present Worth of Analysis	$241,000

Direct, Indirect, and Irreversible Impacts

This project proposes streambank stabilization on roughly 200 feet and converting an inline pond to an offline storage pond feature. Benefits from the proposed improvements include decreased sediment loads, improved sediment transport, and improved water quality. This proposed project will provide a valuable reduction in nonpoint sources pollutants entering the upper Rogue River.

This project occurs within the floodplain, floodway, and possible wetlands. A hydraulic analysis will be performed to verify that the improvements will not impact the 100-year flood elevation and base flood elevation. During design, all necessary permits for work not under the Drain Commissioner's purview will be secured prior to beginning construction. Tree removal may be necessary to access the drain and install the stabilization measures. Tree removal will occur at times indicated in the permits to cause no impacts on endangered species. Adverse effects on any historic resources or endangered species are not anticipated. During construction, there may also be disruptions to traffic or parking within the Nature Center property. These disruptions will be temporary and will be communicated through proper signage.

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GENERAL NOTES:

1. USE SALVAGED ON-SITE MATERIALS, i.e., FALLEN TREES, WOODY DEBRIS, DREDGED MATERIALS, ETC. TO CONSTRUCT NEW STREAMBANKS & TOE WOOD BANK STABILIZATION.

2. PROVIDE HABITAT ENHANCEMENT STRUCTURES, i.e, TURTLE MOUNDS & LOG PILES IN THE POND.

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CITY OF TROY
STAGE NATURE CENTER
STREAMBANK AND POND IMPROVEMENTS

Stage NATURE CENTER

TROY MICHIGAN

JOB NO. 20210364

DATE APR. 2021

HRC HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

555 HULET DRIVE P.O. BOX 824
BLOOMFIELD HILLS, MICH. 48303 - 0824

PHONE: (248) 454-6300
FAX (1st. Floor): (248) 454-6312
FAX (2nd. Floor):
WEB SITE: http: / / www.hrcengr.com

FIGURE A

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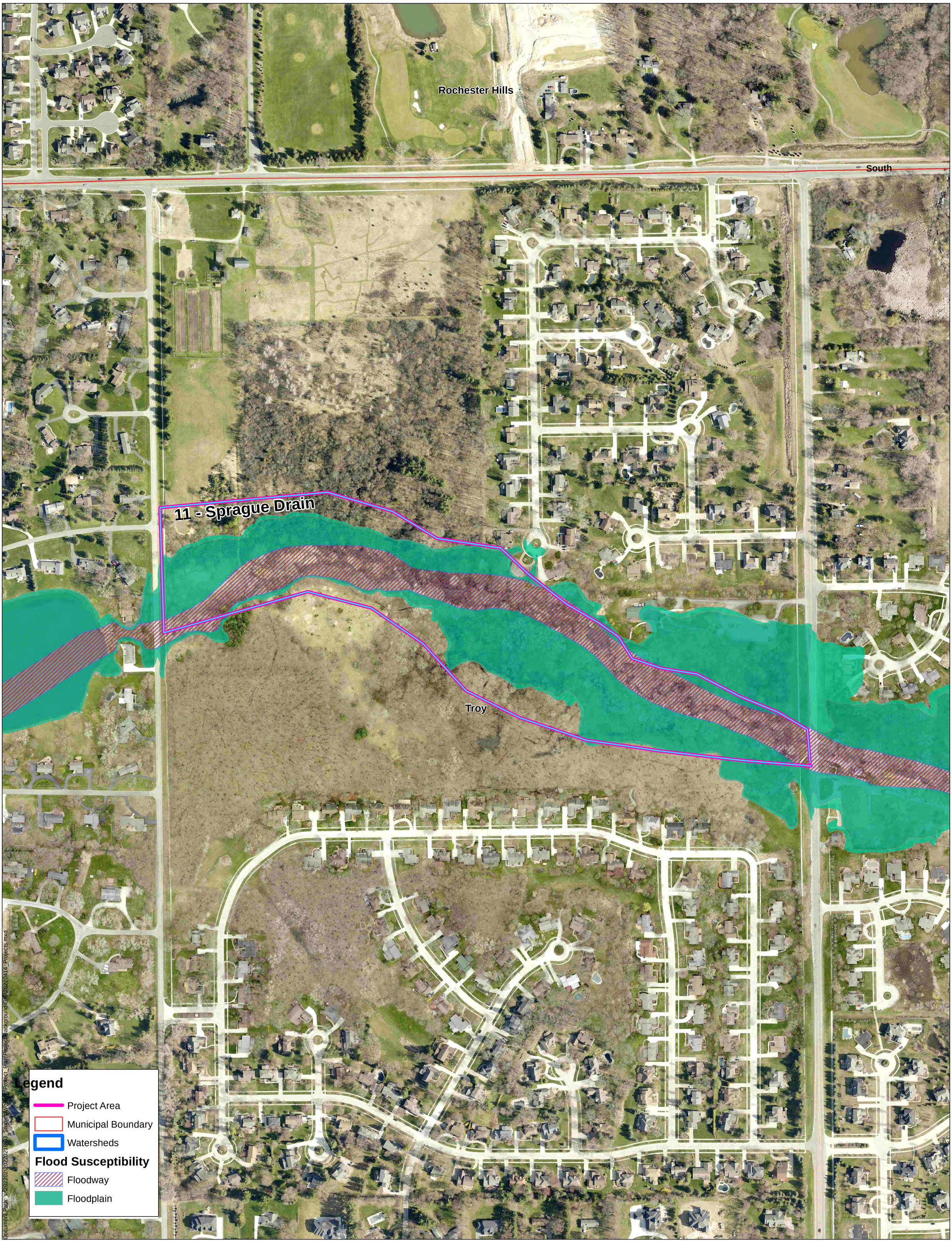


Figure III-11

Floodplain - Sprague Drain
SRF Project Plan 2024

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CONSULTING ENGINEERS SINCE 1915

Rochester Hills

South

11 - Sprague Drain

Troy

Legend

- Project Area
- Municipal Boundary
- Watersheds

Wetlands*

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

Document Path: X:\2022\2022018\03_Studies\Working\Project_Plan\Project_Background\GIS\20220414_Projects.mxd

*Wetland data from EGLE's Wetlands Map Viewer

Figure III-11

Wetlands - Sprague Drain
SRF Project Plan 2024

N W E S

0 0.05 0.1 0.2 Miles

WRC WATER RESOURCES COMMISSIONER *Jim Nash*

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12. Catalpa Oaks Park – Green Infrastructure Improvements (Figure III-12)

Catalpa Oaks Park, owned and operated by Oakland County Parks and Recreation (OCPR), encompasses 24 acres of green space in Southfield, Michigan. Located at Catalpa Drive and Greenfield Road, the park is primarily utilized for its soccer fields. However, large parts of the park remain under-utilized and provide a significant opportunity to improve green infrastructure and stormwater management. Stormwater from the park property enters a combined sewer that transports sediment, phosphorus, nitrogen, and *E. coli* into the GWK Retention Treatment Basin.

The project will remove two (2) baseball fields on the east side of the property and restore the area to a natural landscape with seating areas, trails, shade trees, and stormwater management such as rain gardens and bioswales. The existing parking lot will also be replaced to improve traffic flow, provide more accessible surfacing such as porous pavement or permeable pavers, and establish bioswales with additional native pollinator habitats. In its current form, the parking lot contributes a large amount of sediment to the sewer system. The project will maximize the amount, size, and area available for water quality BMPs to be implemented while also converting underutilized turf grass into a more natural landscape. Bioretention and other stormwater management will help reduce the amount of sediment, nitrogen, *E. coli*, and phosphorus runoff entering the GWK combined sewer system. This will reduce both the pathogen loads and the total volume of water entering the retention treatment basin.

Alternative water quality BMPs were considered for this site; however, they were determined to be less cost-effective.

Total Preliminary Costs	$1,475,100
Present Worth of Analysis	$767,000

Direct, Indirect, and Irreversible Impacts

This project proposes roughly 8,500 square feet of bioretention, 7,000 square feet of porous pavement, and 28,000 square feet of converted naturalized landscape. It is expected that roughly 350 lbs. of TSS, 35 lbs. of total phosphorus, and 35 lbs. of total nitrogen will be removed annually. Approximately six (6 Mgal) million gallons of stormwater runoff will be processed annually. Proposed improvements include increased infiltration, reduced pollutant and sediment loads, and other water quality measures. This proposed project will provide stormwater management retrofits and additional storage in the GWK Drainage District, a subwatershed of the Clinton River.

This project does not occur within the floodway. During design, all necessary permits will be secured prior to beginning construction. There may be limited tree removal, but the project will provide a net increase in both trees and shade provided. Adverse impacts on any historic resources or endangered species are not anticipated. There may be disruptions to traffic and the visitor parking lot during construction. These disruptions will be temporary and will be communicated through proper signage.

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Catalpa Oaks Proposed Projects

Improved Parking/Bioswales/Stormwater Mgmt.

Proposed Splash Pad or Playground Fit Gym

Existing Restrooms & Pavilion

Existing Playgrounds

Existing Pavilion

Garden/Rain Garden/Stormwater

Seating/Benches/Signage

Landscaping/Trees/Restoration













13 - Catalpa Park

Southfield

Berkley

Greenfield

Legend

- Project Area
- Municipal Boundary
- Watersheds

Wetlands*

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

Flood Susceptibility

- Floodway
- Floodplain

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-12

Floodplain/Wetlands - Catalpa Park
SRF Project Plan 2024

N W E S

0 0.05 0.1 0.2 Miles

WRC WATER RESOURCES COMMISSIONER Jim Nash

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13. Lane Drain Restoration – Phase II (Figure III-13)

This proposed project will utilize streambank and streambed stabilization BMPs to reduce nonpoint source pollution, particularly sediment loading, to improve water quality in downstream waterways. Additional benefits include improving conditions for aquatic life, such as benthic macroinvertebrates and fish communities, and establishing floodplain benches with native plantings to infiltrate stormwater from nearby impervious surface areas to decrease peak stormflows. The restoration of the natural channel with riffles, pools, and meanders will reduce erosive flows.

Restoration projects have been completed directly upstream and downstream of the proposed project reach. Upstream, the City of Troy completed a project in 2014 on Lane Drain with NOAA Habitat Restoration funding. This project removed an inline detention pond and low-head concrete dam, replaced undersized and perched culverts, and created a stable channel with diverse aquatic habitats. The project restored 450 feet of riparian shoreline and 82,616 square feet of the floodplain. Downstream, the City completed a project in conjunction with the Clinton River Watershed Council's (CRWC) River Day in 2007. This project created a floodplain bench on one side of the channel and a riparian buffer zone with native plantings. The proposed project is a continuation of the efforts to restore the Lane Drain.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. The action that provides the most benefit is maximizing the stream's use and functionality. Other design approaches were considered to improve the water quality at this site, but they were determined not to be as cost-effective or impactful as this project.

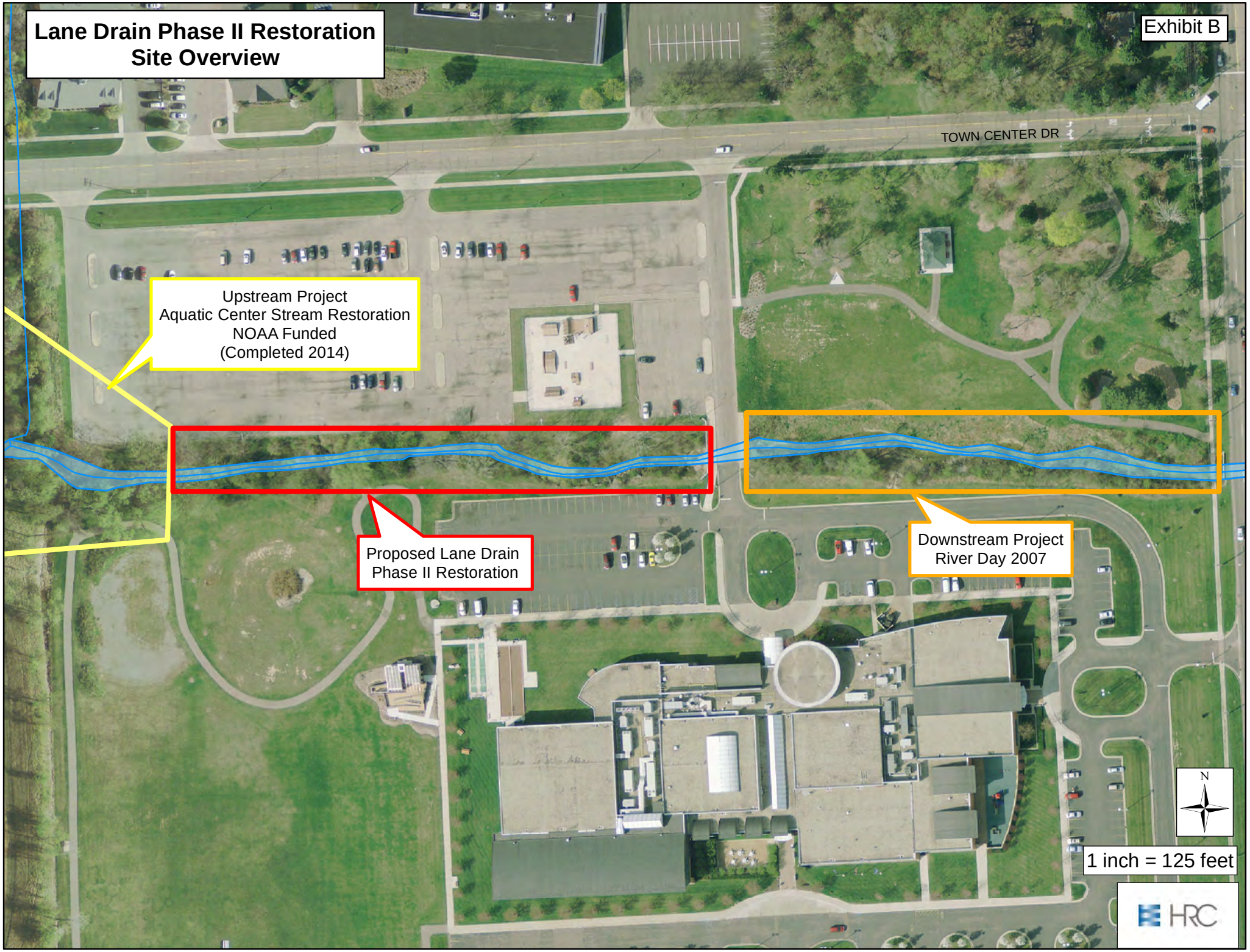
Total Preliminary Costs	$572,100
Present Worth of Analysis	$260,000

Direct, Indirect, and Irreversible Impacts

The proposed project will restore 650 linear feet of the Lane Drain stream channel by stabilizing both the streambanks and streambed, improving floodplain condition and connectivity while decreasing pollutant loads. The project will establish up to one acre of native riparian buffer vegetation and no-mow areas. It is anticipated that 80% of the current sediment load from this section of the drain will be reduced, an estimated 35 tons per year of sediment.

This project occurs within the floodplain and floodway. A hydraulic analysis will be performed to verify that the improvements will not impact the 100-year flood elevation and base flood elevation. During design, all necessary permits for work not under the Drain Commissioner's purview will be secured prior to beginning construction. Tree removal may be necessary to access the drain and install the stabilization measures. Tree removal will occur at times indicated in the permits to cause no impacts on endangered species. Adverse impacts on any historic resources or endangered species are not anticipated. There will likely be disruptions to traffic or parking on the City's Community Center property during construction. These disruptions will be temporary and will be communicated through proper signage.

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Lane Drain Phase II Restoration
Site Overview
Exhibit B
TOWN CENTER DR
Upstream Project
Aquatic Center Stream Restoration
NOAA Funded
(Completed 2014)
Proposed Lane Drain
Phase II Restoration
Downstream Project
River Day 2007
N
1 inch = 125 feet
HRC



LOCATION MAP

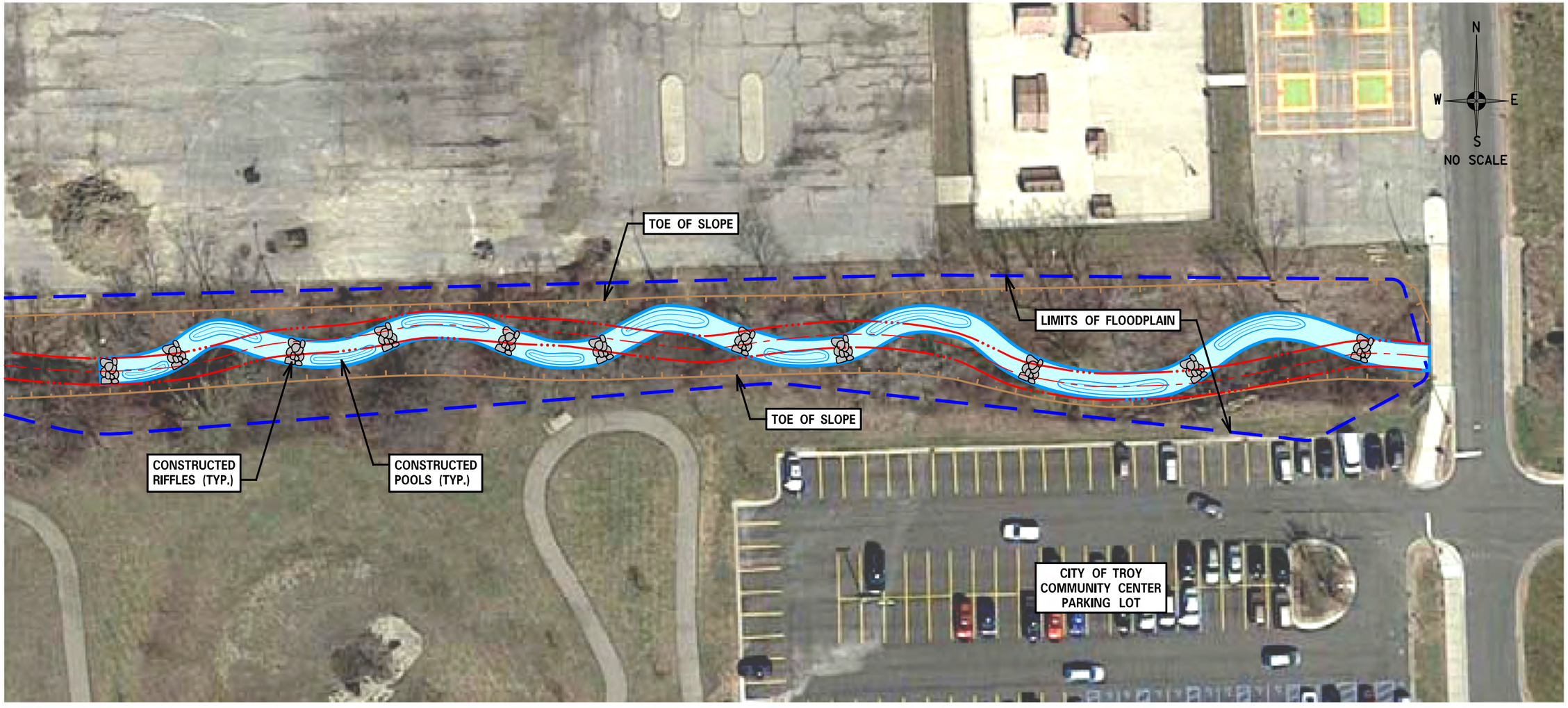


PROJECT AREA

CITY OF TROY - LANE DRAIN PHASE II

City of Troy	HRC JOB NO. 20150624 DATE OCTOBER, 2015	HRC 100 YEARS CONSULTING ENGINEERS SINCE 1915	555 HULET DRIVE BLOOMFIELD HILLS, MICH. P.O. BOX 824 48303-0824	FIGURE A

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LEGEND:

EXISTING DRAIN		PROPOSED DRAIN	
EXISTING DRAIN ℄		PROPOSED RIFFLES	
TOE OF SLOPE		PROPOSED POOLS	
FLOODPLAIN LIMITS			

CITY OF TROY – LANE DRAIN PHASE II

PROPOSED IMPROVEMENTS

City of Troy

HRC JOB NO. 20150624

DATE OCTOBER, 2015

HRC 100 YEARS
CONSULTING ENGINEERS SINCE 1915

555 HULET DRIVE
BLOOMFIELD HILLS, MICH.
P.O. BOX 824
48303–0824

FIGURE
B

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Troy

15 - Lane Drain

Legend

Project Area

Municipal Boundary

Watersheds

Flood Susceptibility

Floodway

Floodplain

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N

W E

S

0 0.0125 0.025 0.05 Miles

Figure III-13

Floodplain - Lane Drain
SRF Project Plan 2024

WRC WATER RESOURCES COMMISSIONER *Jim Nash*

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915

Troy

15 - Lane Drain

Legend

- Project Area
- Municipal Boundary
- Watersheds

Wetlands*

- Wetland Soil per NWI*
- Possible Wetlands
- Potential Wetlands

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-13

Wetlands - Lane Drain
SRF Project Plan 2024

N W E S

0 0.0125 0.025 0.05 Miles

WRC WATER RESOURCES COMMISSIONER *Jim Nash*

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915

14. Sylvan Glen Habitat Restoration – Phase III (Figure III-14)

The Sylvan Glen Phase III project located on the Sylvan Glen Golf Course property in the City of Troy, will restore approximately 575 feet of streambank, improve aquatic and riparian habitats, and reduce sediment loading along the downstream portion of the lower Gibson-Renshaw Drain and West Gibson Branches of the Clinton River. This will be accomplished by utilizing natural channel design and incorporating geomorphic features.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. The action that provides the most benefit is maximizing the stream's use and functionality. Thus, no other alternatives were considered for this project.

Total Preliminary Costs	$991,300
Present Worth of Analysis	$450,000

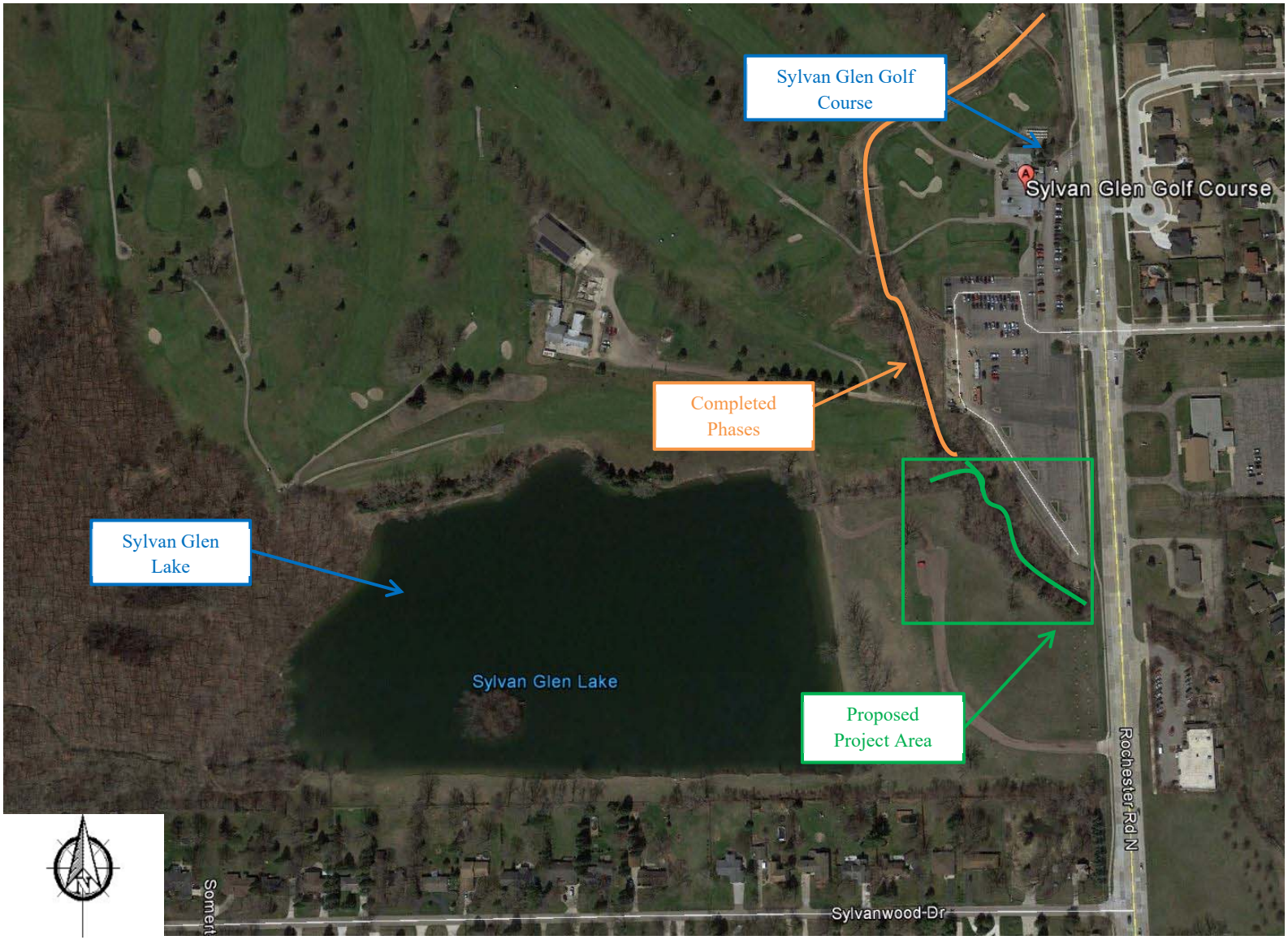
Direct, Indirect, and Irreversible Impacts

This project will significantly reduce sedimentation, which will also improve aquatic habitats. Channel restoration measures will consist of meander restoration, construction of pool and riffle structures, and planting of riparian buffer zones. Anticipated outcomes include a self-sustaining channel with various benthic macroinvertebrates and fish species that thrive in a stream with improved water quality.

This project occurs within the floodway, and a hydraulic analysis will be performed to verify that the improvements will not impact the 100-year flood elevation and base flood elevation. During design, all necessary permits for work not under the Drain Commissioner's purview and easements will be secured prior to beginning construction. There is a potential for limited tree removal. Adverse impacts on any historic resources are not anticipated. There are not expected to be any disruptions to traffic or golf course operations during construction.

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Sylvan Glen Phase III Habitat Restoration
Project Location Map
Troy, Michigan



Troy MICHIGAN

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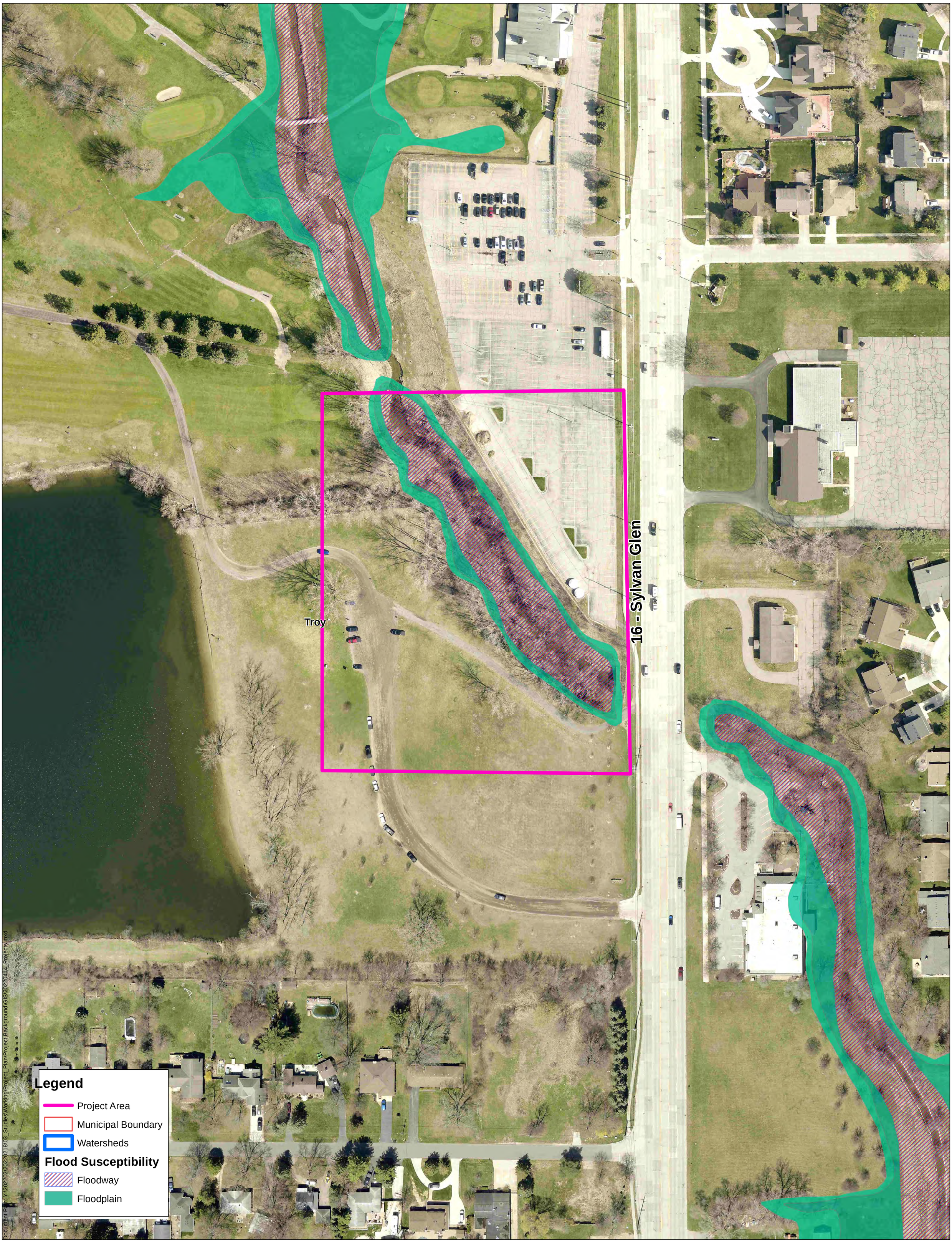


Figure III-14

Floodplain - Sylvan Glen
SRF Project Plan 2024

N
W E
S

0 0.025 0.05 0.1 Miles

WRC
WATER RESOURCES COMMISSIONER
Jim Nash

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15. WaterTowns – Green Infrastructure Improvements (Figure III-15)

WaterTowns involves the construction of four different green infrastructure projects in the City of Pleasant Ridge to augment existing public facilities.

a. Oxford Park Intersection Pavement Reduction & Bioretention

This project is located at the intersection of Oxford and Cambridge Boulevards, adjacent to Hessel Park. The pavement at the intersection will be reduced to shorten pedestrian crossing distance and create space to incorporate three (3) bioretention cells to treat stormwater runoff from the roadway. The design adds 2,800 cubic feet of stormwater storage volume in 1,950 square feet of bioretention.

b. Poplar Park Boulevard Bioretention & Bioretention End Caps

Poplar Park Boulevard has the opportunity for treating stormwater within the right-of-way by utilizing some of the existing boulevard median and converting 1,650 square feet into a bioswale. The adjacent roadway is crowned with half of the drainage directed towards the center median (approximately 6,400 square feet of impervious). Many other median segments have large mature trees, but the selected segment has younger trees and presents an opportunity for a retrofit to store and treat stormwater from the road. New catch basin inlets would direct runoff into the bioretention swale.

In a different section of Poplar Park Boulevard, catch basins near the end of the median provide a retrofit opportunity for bioretention. Two (2) bioretention cells located at the end of this median could receive runoff from 6,400 square feet of impervious surface area from the roadway via these catch basins. The new bioretention cells would overflow into the existing storm sewer when their capacity is exceeded.

c. Elm Boulevard Entrance Bioretention & Native Plantings

Near the intersection of Elm Boulevard and Woodward Avenue, there is an opportunity for two (2) bioretention cells and native plantings. The bioretention cells total 2,050 square feet and would treat runoff from a drainage area of approximately 21,000 square feet. The bioretention practices are located on parkland on the north and south sides of the road near existing catch basins. The center median in this area compliments the bioretention on the sides of the road with native plants that reduce runoff and create wildlife habitat.

d. Police Department Permeable Paver Parking Area

The Police Department parking lot at the Pleasant Ridge Civic Center is a candidate for replacement. The existing parking area would be replaced with permeable pavers or equivalent porous surface material. In conjunction with the porous surface, underground storage will be added utilizing gravel infiltration beds to capture and treat approximately 8,900 gallons of stormwater beneath the parking lot. The additional stormwater runoff would be diverted into the underground storage system via an insert in the existing catch basin.

This project is considered a Principal Alternative. It is a path to optimize the performance of an existing facility. The action that provides the most benefit is maximizing the facility's use and functionality. Other design approaches were considered to improve the water quality at this site, but they were determined not to be as cost-effective or impactful as this project.

DRAFT

Total Preliminary Costs	$1,352,800
Present Worth of Analysis	$710,000

Direct, Indirect, and Irreversible Impacts

These proposed improvements would increase infiltration, improve water quality, reduce the volume of stormwater runoff, and increase native vegetation and habitats. This proposed project will provide stormwater management retrofits and additional storage in a portion of the Red Run Drain, a subwatershed of the Clinton River.

This project does not occur within the floodplain, floodway, or wetlands. During design, all necessary permits will be secured prior to beginning construction. There is unlikely to be any tree removal. Adverse impacts on any historic resources or endangered species are not anticipated. There will likely be temporary disruptions to traffic and parking during the construction of these improvements. These disruptions will be temporary and will be communicated through proper signage.

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17b - Popular Park Boulevard Bioretention / Endcap

Project 17b - Popular Park Boulevard Bioretention / Endcap

•Convert boulevard to a bioswale
•Add catch basins to direct flow to bioswale
•Retrofit boulevard to store and treat stormwater
•Retrofit catch basins and add 2 bioretention cells to endcap

E M-1 Service Drive

17c - Elm Boulevard Entrance

Project 17c - Elm Boulevard Bioretention and Native Plantings

•Add 2 bioretention cells to either side of Elm Boulevard
•Add native plants to center median to reduce runoff
•Create wildlife habitat

Pleasant Ridge

Project 17d - Police Department Permeable Paver Parking

•Add permeable pavers on surface of treatment
•Add insert into existing catch basin to direct flow to underground storage

17d - Police Station Parking Lot

17a - Oxford Park Intersection

Project 17a - Oxford Park Intersection

•Pavement reduction
•Shorten pedestrian crossing distance
•Incorporate 3 bioretention cells for reduction and treatement of sotrmwater

Ferndale

Legend

Project Scope

Municipal Boundary

Watershed Boundary

Watershed Boundary

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Figure III-15

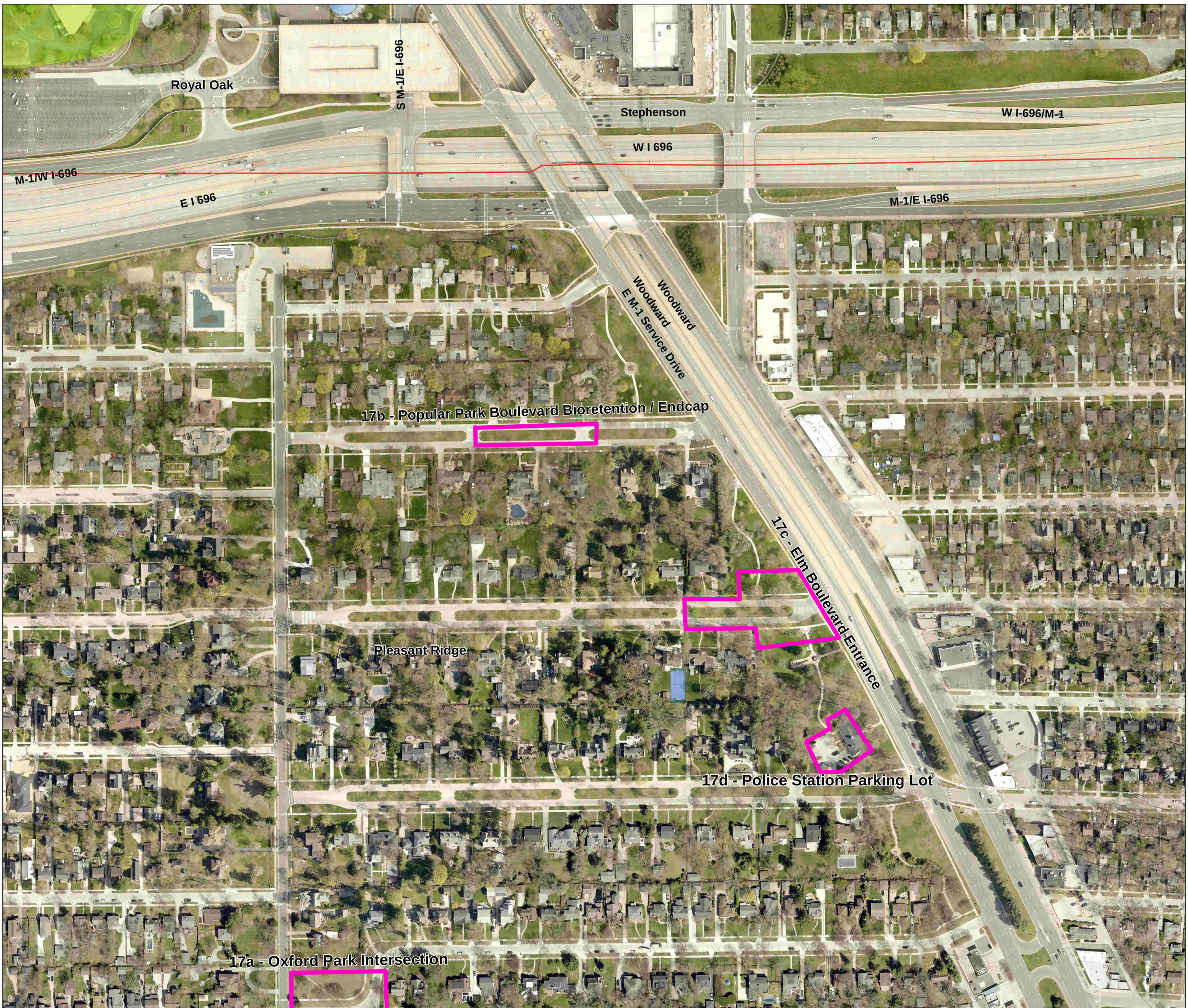
Water Towns
SRF Project Plan 2024

N
W E
S

0 0.025 0.05 0.1 Miles

WRC
WATER RESOURCES COMMISSIONER
Jim Nash

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*Wetland data from EGLE's Wetlands Map Viewer

Figure III-15

Floodplain/Wetlands - WaterTowns
SRF Project Plan 2024

N W E S

0 0.05 0.1 0.2 Miles

WRC WATER RESOURCES COMMISSIONER *Jim Nash*

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915

C. Analysis of Principal Alternatives

For each of the project alternatives discussed previously, the Principal Alternatives were selected based on the site analysis, feasibility of conceptual design, and stakeholder input. When selecting the alternatives, technical feasibility, maintenance, and pollutant removal efficiency were the defining factors. The "no action" alternative was not considered a feasible option to improve the conditions of the watershed. It is imperative that the community continue to address the need for improved water quality. Taking a "no action" approach would not address that need. The selected potential alternatives identified for the sites are considered Principal Alternatives and will be subject to the following evaluations:

1. The Monetary Evaluation

a. Sunk Costs

Sunk costs are any investment or financial commitments made before or during Planning. There are no sunk costs associated with the projects proposed in this Plan.

b. Present Worth

Present worth calculations for the alternatives have been included in the sections above for each site. Each alternative includes capital costs for construction, engineering, financial, legal, administration, contingency, and annual operations and maintenance performed by the City or County. See Appendix A for the complete present worth analysis for all the alternatives.

c. Salvage Value

There is a salvage value associated with certain equipment and structures. Salvage value was calculated using straight-line depreciation and is included in the monetary evaluation for items that have a remaining value at the end of the 20-year planning period. Salvage value is considered for the following items: all underground concrete infrastructure and detention basins.

d. Escalation

Energy costs and land value may be escalated, if appropriate. This is most applicable if different alternatives use different fuel supplies or an alternative land application and others do not. For the projects proposed in this Plan, any increase will apply equally to all alternatives. Therefore, costs were not escalated.

e. Interest During Construction

If interest during construction is significant and may influence the choice of alternatives, it may be included in the monetary evaluation. The construction period for the project alternatives is anticipated to be on the order of months, with no projects taking more than a year. Any interest during the construction of the projects proposed in this Plan is not anticipated to affect the choice of alternatives; however, a year's worth of interest was included in the financial analysis for each project.

f. Mitigation Cost

There will be no mitigation required to construct the proposed alternatives. Therefore, mitigation costs were not included as part of the monetary evaluation. The mitigation costs described herein are part of general construction costs.

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g. User Costs

Another aspect of the monetary evaluation is the computation of the project's total cost to users. Total cost in this context includes capital and financing costs, OM&R costs, and end-of-life salvage value. The alternative analysis consists of evaluating projects with different capital costs, life expectancies, and annual costs using a present worth analysis, which provides the estimated annual and quarterly costs of each selected alternative to the users in the study area. This information is included in this Plan and will be included in the public participation in the planning process. A summary of the capital present worth values for all projects is incorporated herein, along with the individual values in the descriptions above:

Table III-1: Present Worth Values – All Projects

No.	Proposed Alternative Projects	Present Worth
1	Perry Park – Green Infrastructure Improvements	$ 397,000
2	Oakland Park – Green Infrastructure Improvements	$ 233,000
3	Red Oaks Water Lot – Green Infrastructure Improvements	$ 142,000
4	Lower Straits Lake – County Drain Establishment & Restoration	$ 1,124,000
5	Hamlin Drain – Regional Stormwater Detention Facility	$ 601,000
6	Patterson Holly Drain Restoration	$ 1,708,000
7	Nelson Drain – Bank Stabilization & Sediment Trap	$ 1,135,000
8	Pontiac Creek Extension – Wetland & Stream Restoration	$ 1,000,000
9	Minnow Pond Drain – Flood Control Basin Conversion	$ 1,146,000
10	Pebble Creek Drain Restoration	$ 2,003,000
11	Sprague Drain – Pond & Stream Restoration	$ 241,000
12	Catalpa Park – Green Infrastructure Improvements	$ 767,000
13	Lane Drain Restoration – Phase II	$ 260,000
14	Sylvan Glen Habitat Restoration – Phase III	$ 450,000
15	WaterTowns – Green Infrastructure Improvements	$ 710,000

2. Staging Construction

The monetary evaluation was performed using a 20-year planning period. For all alternatives identified in this Plan, the design life is anticipated to be sustainable. There is no growth associated with the individual sites. Therefore, there are no effects on staging construction to consider.

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3. Partitioning the Project

Under certain circumstances, partitioning of a project is allowed. A partitioned Project Plan may be prepared when the construction of a discrete component of the project must occur before the completion of the entire Project Plan to remedy severe public health, water quality, or other environmental concerns. For the proposed projects, there are no components that need to be completed prior to the Project Plan. Therefore, there is no need to partition any of the proposed projects.

4. The Environmental Evaluation

Each of the proposed Principal Alternatives provides a positive impact on the environment. The alternatives help reduce NPS pollution by reducing erosive runoff velocities, stabilizing eroded streambanks, providing runoff infiltration, filtering pollutants, facilitating needed maintenance (such as providing access or sedimentation traps for future maintenance), and reducing peak runoff flows.

5. Implementation and Public Participation

All the proposed project locations presented in this plan are identified in the respective WMPs. During the planning process for those plans, the public was involved and had the opportunity to comment and help prioritize the improvements.

The locations of the majority of the projects proposed in this Plan are within established drain easements, public rights of way, or County-owned properties. There are a couple of drains in which the County is working on obtaining easements and jurisdictions to perform these improvements as noted herein. These will be procured prior to the implementation of any project. The overall scale of these proposed projects is well within their abilities to manage. Additionally, OCWRC and the Municipalities in the County have strong relationships and are able to implement and coordinate multiple design and construction projects simultaneously.

6. Technical and Other Considerations

The following considerations are outlined in the SRF Project Plan development guidance. The majority of the considerations are related to sanitary analyses and are not applicable to NPS Project Plan developments, and they are included only to ensure completeness of the Project Plan development process.

a. Infiltration and Inflow (I/I) Removal

I/I removal is an issue related to sanitary sewers and is therefore not applicable to this NPS Project Plan.

b. Sludge and Residuals

Sludge and residuals are related to wastewater treatment processes and are therefore not applicable to this NPS Project Plan.

c. Structural Integrity

I/I removal is an issue related to sanitary sewers and is therefore not applicable to this NPS Project Plan.

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d. Industrial Pretreatment

This section is not applicable to this NPS Project Plan

e. Growth Capacity

The land cover of the drainage areas is nearly built-out. Future stormwater increases are not anticipated for the study area, particularly as new development is required to implement current OCWRC stormwater management standards.

f. Areas Currently without Sewers

The area of the Lower Straits Lake project has onsite sewage disposal systems (OSDS) near the proposed project area. The other project sites are not near any OSDS. The proposed BMPs are not considered to adversely affect any OSDS.

g. Reliability

It is anticipated that all the sites will need soil erosion and sedimentation permits. Areas where work is proposed within or near an inland waterway, wetland, or 100-year floodplain, will require an EGLE Joint Permit unless completed under the Drain Code. It is anticipated that to maintain BMP reliability, all sites will be inspected on a regular frequency. Any improvement sites with water quality BMPs, such as pollutant separation or offline first flush storm sewer, will need to be regularly maintained by the OCWRC.

h. Alternative Sites and Routings

All BMPs will be constructed onsite. Therefore, no routing considerations are needed.

i. Combined Sewer Overflows

This section is not applicable to this NPS Project Plan.

j. Contamination at the Project Site

There are no known contamination sites that will affect or be affected by the proposed BMPs.

k. Green Project Reserve (GPR)

As seen in the table below, several projects will qualify for the Green Project Reserve (GPR).

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Table III-2: Proposed GPR Projects

No.	Project	Description	Amount
1	Perry Park – Green Infrastructure Improvements	Bioretention	$ 352,100.00
		Trees	$ 25,500.00
		Sustainable landscaping and site design	$ 30,400.00
		Total:	$ 408,000.00
2	Oakland Park – Green Infrastructure Improvements	Bioretention	$ 259,700.00
		Trees	$ 22,800.00
		Sustainable landscaping and site design	$ 12,400.00
		Total:	$ 294,900.00
3	Red Oaks Water Park – Green Infrastructure Improvements	Sustainable landscaping and site design	$ 50,000.00
		Bioretention	$ 104,100.00
		Total:	$ 292,200.00
4	Lower Straits Lake – County Drain Establishment & Restoration	Bioengineered streambank	$ 884,000.00
		Riparian buffers	$ 36,400.00
		Total:	$ 920,400.00
6	Patterson Holly Drain Restoration	Bioengineered streambank	$ 1,976,000.00
		Sustainable landscaping and site design	$ 20,800.00
		Riparian buffers	$ 41,600.00
		Total:	$ 2,038,400.00
7	Nelson Drain – Bank Stabilization & Sediment Trap	Bioengineered streambank	$ 925,600.00
		Sustainable landscaping and site design	$ 20,800.00
		Riparian buffers	$ 26,000.00
		Total:	$ 972,400.00
8	Pontiac Creek Extension – Wetland & Stream Restoration	Riparian buffers	$ 135,700.00
		Bioengineered streambank	$ 416,000.00
		Stream Restoration	$ 237,100.00
		Constructed wetlands	$ 357,000.00
		Total:	$ 1,145,800.00
9	Minnow Pond Drain – Flood Control Basin Conversion	Other practices that mimic natural hydrology to prevent wet weather flows	$ 894,400.00
		Bioengineered streambank	$ 447,200.00
		Riparian buffers	$ 62,400.00
		Total:	$ 1,404,000.00
10	Pebble Creek Drain Restoration	Bioengineered streambank	$ 1,466,200.00
		Bioretention	$ 176,800.00
		Total:	$ 1,643,000.00

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11	Sprague Drain – Pond & Stream Restoration	Bioengineered streambank	$	178,000.00
		Bioretention	$	72,000.00
		Riparian buffers	$	8,800.00
		Total:	$	258,800.00
12	Catalpa Park – Green Infrastructure Improvements	Bioretention	$	41,600.00
		Porous Pavement	$	572,000.00
		Sustainable landscaping and site design	$	52,000.00
		Total:	$	665,600.00
13	Lane Drain Restoration – Phase II	Sustainable landscaping and site design	$	16,600.00
		Riparian buffers	$	47,000.00
		Constructed wetlands	$	57,000.00
		Bioengineered streambank	$	164,800.00
		Total:	$	285,400.00
14	Sylvan Glen Habitat Restoration – Phase III	Sustainable landscaping and site design	$	23,000.00
		Riparian buffers	$	93,400.00
		Bioengineered streambank	$	228,200.00
		Aquatic Habitat Improvements	$	42,100.00
		Total:	$	386,700.00
15	Water Towns – Green Infrastructure Improvements	Sustainable landscaping and site design	$	20,800.00
		Bioretention	$	124,800.00
		Permeable pavement	$	26,000.00
		Total:	$	171,600.00

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Section IV - Selected Alternative

A. Description of the Selected Alternative

As described in Section III, the Principal Alternatives were evaluated for each proposed project location, emphasizing removing NPS pollutants from the study area. The proposed BMPs were categorized as Water Quality BMPs, Optimization of Existing Facilities, and Streambank Stabilization. When considering the opportunities, each BMP was maximized to mitigate NPS pollutants most closely associated with first flush components. Corrective options for facility optimization and streambank stabilization projects were much more limited; however, the impacts of the projects are still expected to reduce NPS pollutants significantly.

The water quality BMP locations were evaluated as suites. Several options could be implemented on each site to maximize the removal of NPS pollutants and allow for substitution/replacement options if a specific BMP must be removed from the formal design. In addition, utilizing several options at a given site will yield a greater reduction in TSS, TP, and *E. coli*. A summary of all the sites and respective selected alternatives are presented below in Table IV-1.

Table IV-1: Proposed Projects

No.	Project	Selected Alternatives		
		Water Quality BMPs	Optimization of Existing Facilities	Streambank Stabilization
1	Perry Park – Green Infrastructure Improvements	✓		
2	Oakland Park – Green Infrastructure Improvements	✓		
3	Red Oaks Water Park – Green Infrastructure Improvements	✓		
4	Lower Straits Lake – County Drain Establishment & Restoration		✓	✓
5	Hamlin Drain – Regional Stormwater Detention Facility		✓	
6	Patterson Holly Drain Restoration			✓
7	Nelson Drain – Bank Stabilization & Sediment Trap			✓
8	Pontiac Creek Extension – Wetland & Stream Restoration	✓		✓
9	Minnow Pond Drain – Flood Control Basin Conversion		✓	
10	Pebble Creek Drain Restoration			✓
11	Sprague Drain – Pond & Stream Restoration			✓
12	Catalpa Park – Green Infrastructure Improvements	✓		
13	Lane Drain Restoration – Phase II			✓
14	Sylvan Glen Habitat Restoration – Phase III			✓
15	Water Towns – Green Infrastructure Improvements	✓		

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1. Relevant Design Parameters

a. Proposed Projects

The major proposed projects are listed on the previous page in Table IV-1. The pollutant loads and BMP reductions for each site are outlined in Appendix E.

b. Unit Processes and Sizes as Related to Service Area Needs

The BMPs for each site have only been conceptually sized – more extensive and rigorous calculations will be performed during the design phase for each selected project. The concepts for each project are presented graphically in the Figures of Section III.

c. Schematic flow diagram(s) of the treatment process(es)

This is not applicable to the proposed stormwater treatment projects.

d. Design Criteria (detention times, overflow rates, process loadings, and design flows)

In all cases where BMPs were considered, site improvements were selected based on the objective of first flush rainfall mitigation. Events of this size account for the majority (approximately 85%) of the total rain events that occur in a year. All water quality BMPs, in accordance with the OCWRC design standards, will be constructed to dewater within 24-48 hours. Soil amendments and under draining are also considerations for bio-infiltration, bio-swales, and porous surface BMPs.

Porous surfaces (comprised of porous pavement and an open-graded aggregate subbase) will be designed to the thickness and depth necessary to mitigate the entire first flush runoff volume. The porous surface is anticipated to maintain a 40% void space for stormwater infiltration and detention. However, per OCWRC design standards' requirement/recommendation that a safety factor is used for porous surfaces, a 30% design void space has been used for the stormwater calculations. In addition, underdrain will be placed below the aggregate subbase to capture any stormwater volume beyond the soil and BMP's capacity and convey it to a stormwater system.

Several mechanical pollutant separators are proposed for some of the projects in the study area, primarily at the Hamlin Drain. Each unit has been sized for a first flush flow capacity based on the upstream land cover, time of concentration, and contributing area.

Proposed bio-infiltration and infiltration swales will be designed to dewater within 24-48 hours. Locations and limits are only conceptual; additional testing will be performed during the design stage. An overflow system will also be considered for all proposed BMPs as a means of emergency conveyance during large, infrequent storm events.

Streambank stabilization work will be designed on a site-specific basis – impacts and options such as stream/drain bank grading, toe protection, flow dissipation, erosion minimization, and habitat improvements for native species are considered for and tailored for the unique limitations and opportunities of each site. The final design will also reflect the expectation for these improvements to have the ability to withstand high velocities.

e. Residuals Management

It is anticipated that regular vactoring, dredging, or clearing of sediment, debris, and invasive vegetation from the rain gardens, bioswales, detention basins, and other integrated BMPs will be

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performed to maintain their optional functionality. It is recommended that the County initially perform maintenance twice annually. All removed sediment and debris will be transported and disposed of at a licensed disposal facility chosen at the contractor's discretion. This O&M task will be needed every five years with a duration of two weeks each time. The noise and air emissions impact to the local area of the basin impacts less than ambient highway impacts.

f. Sewer Length and Sizes

Unless otherwise noted, the drains proposed for this project plan are associated with the first flush or more significant storm drain upgrades. All improvements will be performed as an enhancement and upsize to the existing infrastructure to mitigate the flow and volume associated with the first flush. Specific streets and locations can be found in Section III. The final sizing and length of the storm drain will be determined as part of the project design.

For the bio infiltration basins, infiltration swales, and porous road surfaces, it may be necessary for an underdrain below the BMPs if the in-situ soils are poorly drained. This will be determined as part of the design phase.

g. Pump Station Types and Sizes (including provisions for standby power and odor control)

There are no pump stations to be constructed as part of this Project Plan.

h. Proposed Schedule for Design and Construction

From the project plan's submittal to the project closeout, it is anticipated that the entire timeline will occur from September 2023 to July 2026. There are six major tasks identified for the completion of the selected alternative. These tasks include:

- Submittal of the Project Plan to EGLE – June 01, 2022
- Project Plan review and approval – EGLE will have the opportunity to review the plan. Approval will be needed prior to the design and construction of the selected alternatives.
- Plan development and design – Design of the selected alternatives will be performed, and construction plans will be developed.
- Permits and easements – All required permits will be obtained. All easement acquisitions will be handled prior to the project.
- Project construction – The selected alternatives will be constructed per each project milestone schedule.
- Administration and closeout – Administration of the improvements will be necessary throughout the length of the project. Closeout will be performed at the end of the project.

2. Controlling Factors

The typical controlling factors listed in CWSRF Project Plan development guidelines are not applicable to this NPS Project Plan. These include items such as service area population; characteristics of influent wastewater and treatment residuals; discharge permit requirements; stipulations in court orders, federal or state enforcement orders, or administrative consent orders; proposed effluent limits; local health department findings and directives; and mitigation of environmental impacts with regard to collection and transport via sewers or force mains.

However, additional controlling factors applicable to this NPS Project Plan include:

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a. Pedestrian or Traffic Impact

The location of BMPs must be carefully chosen to balance high visibility and/or accessibility with the needs of pedestrian and vehicular traffic at each specific project site. Bio infiltration areas adjacent to high foot traffic zones will be marked with signs to educate the public on their purpose and need for protection. All underground BMPs within the right-of-way may pose a traffic hazard during maintenance procedures. County staff will utilize proper traffic signage and signaling during maintenance activities. The sites potentially affected by this control are primarily the Perry Park, Oakland Park, Catalpa Park, and WaterTowns.

b. Maintenance

Proper BMP maintenance is crucial for long-term success. Street sweeping on the porous surfaces, vactoring pollutant separation units and first flush storm sewers, and biannual freshening of the bio infiltration and bioswale planted beds will help sustain their storm runoff mitigation capacity. Furthermore, cleaning out oversized pipes, storm structure sumps, and detention basins annually will help maintain stormwater treatment capacity. The sites with the need for regular maintenance include Perry Park, Oakland Park, WaterTowns, Minnow Pond, Hamlin Drain, Red Run Waterpark, and Catalpa Oaks Park.

c. Topographic Constraints

Steep topography can limit the accessibility for construction and maintenance of the proposed BMPs. Additional analysis during design and construction may be required.

d. Accessibility

Several BMP locations are located in remote locations on drain reaches. These areas are all within designated public right-of-ways and/or drainage easements. However, temporary signage and markers will be necessary along the roadways and possibly temporary construction easements for equipment to access the sites. The sites potentially affected by this control are Patterson Holly Drain, Nelson Drain, Pontiac Creek, Pebble Creek Drain, Sprague Drain, Lane Drain, and Sylvan Drain.

3. Project Maps

The categories identified in the guidance document were not applicable to this Project Plan. However, maps have been created to illustrate the proposed projects and convey the proposed improvements. These figures illustrate aerial views of the sites, existing storm sewers, and the locations or footprints of the proposed BMPs. These are all shown in the figures included in the previous section.

4. Sensitive Features

The proposed projects will not impact sensitive features, such as agricultural lands and archeological sites. Threatened and endangered species habitat has been evaluated and will be further evaluated during the design phase. Additional information can be found in Appendix F. All protocols will be mitigated in accordance with State and Federal Law. Figure 2.3 provides the location of the existing wetlands that are near several of the proposed projects. Additional sensitive features are included in the figures included in the previous section.

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Established FEMA floodplain/floodways are present at numerous locations, and mitigation may be necessary due to the nature of the proposed improvements. All work within regulatory floodplains not under the purview of the Drain Code will be permitted through the EGLE Joint Permit Application process. See Figure 2.5 for locations of the Floodways and Floodplains in Oakland County.

5. Mitigation of Environmental Impacts

All proposed improvements not under the purview of the Drain Code that may impact existing wetlands and/or floodplains will be performed in accordance with all regulations and any specific conditions of the EGLE Joint Permits. The improvements are intended to improve habitat quality while enhancing its functionality as a stormwater quality feature. At no point is it the intention of this Project Plan to destroy, remove, or impact a sensitive habitat/feature without proper mitigation or restoration. Such measures would be counterintuitive to enhancing water quality within the study area.

6. Special Assessment District Projects

There are no Special Assessment District (SAD) projects within the scope of the proposed study area, except for previously determined county drainage districts.

7. Schedule for Design and Construction

The Schedule is tentative, pending the approval of the SRF Project Plan. Below is a tentative proposed schedule.

Advertise Public Hearing	April 14, 2022
Draft Project Plan on Display	April 14, 2022
Public Hearing	May 16, 2022
Adoption of Project Plan by the Statutory Drain Board	May 24, 2022
Final Project Plan Submittal to EGLE	June 01, 2023

Dates for Design, Financing, Bidding, Permit Procurement, Seasonal Restrictions, and Mitigation of Environmental Impacts will vary for each project.

Table IV-2 below outlines the proposed fiscal year(s) of the improvement projects for each site.

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Table IV-2: Proposed Project Schedule

No.	Project	Year
1	Perry Park – Green Infrastructure Improvements	2024
2	Oakland Park – Green Infrastructure Improvements	2024
3	Red Oaks Water Lot – Green Infrastructure Improvements	2024
4	Lower Straits Lake – County Drain Establishment & Restoration	2027
5	Hamlin Drain – Regional Stormwater Detention Facility	2027
6	Patterson Holly Drain Restoration	2026
7	Nelson Drain – Bank Stabilization & Sediment Trap	2026
8	Pontiac Creek Extension – Wetland & Stream Restoration	2027
9	Minnow Pond Drain – Flood Control Basin Conversion	2026
10	Pebble Creek Drain Restoration	2025
11	Sprague Drain – Pond & Stream Restoration	2026
12	Catalpa Park – Green Infrastructure Improvements	2025
13	Lane Drain Restoration – Phase II	2026
14	Sylvan Glen Habitat Restoration – Phase III	2026
15	Water Towns – Green Infrastructure Improvements	2025

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8. Cost Summary

The cost summary provided in Table IV-3 is the total cost for all selected alternatives, including engineering, construction, contingency fees, administration, financial and legal services, land acquisition, mitigation, and other project-related activities. As the summary indicates, the total cost for all selected alternatives is approximately $25,347,900. See Appendix A for a detailed cost breakdown of each site.

Table IV-3: Total Project Costs

No.	Project	Preliminary Construction Cost
1	Perry Park – Green Infrastructure Improvements	$ 853,600
2	Oakland Park – Green Infrastructure Improvements	$ 491,100
3	Red Oaks Water Lot – Green Infrastructure Improvements	$ 269,800
4	Lower Straits Lake – County Drain Establishment & Restoration	$ 2,477,700
5	Hamlin Drain – Regional Stormwater Detention Facility	$ 895,900
6	Patterson Holly Drain Restoration	$ 3,763,600
7	Nelson Drain – Bank Stabilization & Sediment Trap	$ 2,502,400
8	Pontiac Creek Extension – Wetland & Stream Restoration	$ 2,206,100
9	Minnow Pond Drain – Flood Control Basin Conversion	$ 2,526,800
10	Pebble Creek Drain Restoration	$ 4,415,700
11	Sprague Drain – Pond & Stream Restoration	$ 531,500
12	Catalpa Park – Green Infrastructure Improvements	$ 1,475,100
13	Lane Drain Restoration – Phase II	$ 572,100
14	Sylvan Glen Habitat Restoration – Phase III	$ 991,300
15	WaterTowns – Green Infrastructure Improvements	$ 1,352,800

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B. Authority to Implement the Selected Alternative

The Oakland County Water Resources Commissioner is chair of the Statutory Drain Board, which oversees all activities within the various drainage districts. Planning will take place under the authority of Oakland County. Project implementation will take place under the authority of the individual districts. Financing will be backed with the Full Faith and Credit of Oakland County. All site locations within Oakland County are either publicly owned or within a public ROW or easement.

C. Users Costs

The Oakland County Study Area comprises several entities based on jurisdictional authority. The proposed projects fit into three drain categories:

Chapter 4 of the 1956 Michigan Drain Code: Chapter 4 County Drains must be initiated by a petition and reviewed by the Statutory Drainage Board with comments received and taken into consideration. Costs of improvements of Chapter 4 Drains are assessed to the benefiting landowners (users) in the drainage districts. Please note that the public corporations such as Road Commissions, MDOT, Cities, Villages or Townships (CVT's) are also assessed. The apportionments for the benefiting public corporations have not been determined at this time but generally equated to 20-40% of project costs. Due to the lengthy apportionment calculations, the users' costs were calculated using the number of households within each Chapter 4 Drain Drainage District. The fifteen (15) project sites have a combined estimated construction cost of $28,096,000. This equates to $300 or less per annually for households located within Chapter 4 drainage districts. The proposed Chapter 20 projects must be presented and approved at a Board of Determination and apportioned entities offered a chance to review their assessments and object if necessary, at a Public Day of Review. Aggrieved parties have an appeal process as specified in the Drain Code. In general, project costs will be assessed based on previously determined apportionment percentages within the appropriate drainage districts.

Chapter 20 of the 1956 Michigan Drain Code: Chapter 20 County Drains must be initiated by a petition and reviewed by the Statutory Drainage Board with comments received and taken into consideration. Costs of improvements of Chapter 4 Drains are assessed to only public corporations such as Road Commissions, MDOT, Cities, Villages, or Townships (CVT's), so households (users) will not receive an assessment and thus there is no user charge system for these projects.

General Community-at-Large: Community at Large are projects requested by the jurisdictional authority. For some Community-at-Large projects, communities will be assessed based on the number of parcels within their communities. This equates to $100.00 or less per annually for households with the Community-at-Large category.

These projects will be funded through loans from Michigan's State Revolving Fund. We have indicated specifically which project will be funded through which mechanism herein.

D. Disadvantaged Community

The proposed projects that qualify for Disadvantaged Community Status are Perry Park, Oakland Park, and Red Oaks. Pontiac is considered a significantly overburdened community, while Madison Heights is overburdened. Aside from those three (3) projects, the other projects and municipalities do not qualify as currently defined by the State of Michigan. Overburdened calculation forms provided by E.G.L.E. can be found in Appendix J.

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E. Useful Life

The useful life calculations are part of the present worth analysis costs presented in Section III and Appendix A.

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Section V - Evaluation of Environmental Impacts

A. General

Construction of the selected plan is expected to have beneficial and adverse, short-term and long-term, and non-recoverable and irreversible impacts on the environment. This section evaluates the environmental impacts identified in the selected alternatives.

1. Beneficial and Adverse Impacts

Construction activities associated with this Project Plan will be located primarily within the limits of existing rights-of-way and/or easements. Local and state economies would be positively impacted by generating construction and manufacturing-related jobs. Local contractors would have an equal opportunity to bid on the construction contracts, thereby offering an opportunity for an improved quality of life for residents.

Construction activities associated with the Project Plan would also create temporary disruptions, such as noise and dust, possible delays to vehicular and pedestrian traffic, reduced/limited use of public spaces (such as parks), and an increased risk of soil erosion from excavation spoils and stockpiles. The alternatives of this Project Plan were also selected based on avoiding adverse impacts on important historical and/or environmental resources.

2. Short and Long-Term Impacts

The short-term adverse impacts associated with construction activities are minimal, and will be appropriately mitigated, compared to the resulting long-term beneficial impacts. Short-term adverse impacts are expected to include temporary disruptions, such as noise and dust, possible delays to vehicular and pedestrian traffic, reduced/limited use of public spaces (such as parks) and accessibility, the prospect of temporary blight for adjacent/neighboring properties, and an increased risk of soil erosion from excavation spoils and stockpiles. However, no long-term adverse impacts are anticipated due to the proposed Project Plan. Ultimately, the long-term impacts will be beneficial, improving water quality for watersheds located partially or completely within Oakland County.

3. Non-Recoverable and Irreversible Impacts

Implementation of the Project Plan will require a commitment to investing in non-recoverable resources in exchange for improved facility performance over the system's life. Such an investment would include public capital, energy, labor, and unsalvageable materials – non-recoverable resources that would be foregone to provide for the proposed improvements.

This Project Plan ultimately seeks to improve the quality of life for all species living within and/or connected to Oakland County by improving the water quality within various watersheds. However, these improvements will be implemented through construction activities and operations – a possible impact of which is accidental, irreversible bodily injury and accidental damage/destruction of property. Contractors selected to perform the proposed work will be required to appoint safety managers and prepare and implement safety plans and any applicable OSHA requirements.

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B. Analysis of Impacts

1. Direct Impacts

The direct impacts of each individually proposed project are identified under the project descriptions and costs in Section III of the Project Plan. Across all of the proposed alternatives, the most prevalent direct impact will be a disruption to local vehicular and pedestrian traffic in the form of temporary closures and limited accessibility. However, these direct adverse impacts are considered minimal in scale and short-term in duration, especially when considering the long-term beneficial results of the projects.

2. Indirect Impacts

The individually proposed projects are not expected to produce any adverse, long-term, indirect impacts – land use will remain unchanged; recreational areas will not be reduced; there will be no decline in water and/or air quality; and environmentally, culturally, and historically significant areas and resources will remain protected by law.

3. Cumulative Impacts

Implementing the Project Plan's selected alternatives will positively impact the environment, and those impacts will be cumulative. The proposed methods for improving water quality are primarily based on the control and treatment of stormwater runoff, which will benefit both the natural environment and public infrastructure.

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Section VI - Mitigation

A. Mitigation of Short-Term Impacts

1. Direct Short-Term Impacts

The direct, short-term adverse impacts of the selected alternatives are expected to be construction-related issues such as, but not limited to, traffic disruptions, limited/reduced vehicular and pedestrian accessibility, the generation of noise and dust, and soil erosion. Traffic control will be necessary for proposed work located near areas with vehicular traffic (streets, roads, parking lots, etc.). Proper signage, barricades, and lighting will be furnished, placed, and maintained for the duration of a given construction project, in accordance with applicable Federal, State, County, and local requirements. A soil erosion and sedimentation control (SESC) permit will be obtained as required per Part 91 from the appropriate agency (city, village, township, county, etc.). Permits to work within existing rights-of-way (ROW) will be required from appropriate owners/agencies/municipalities. An EGLE/Army Corps Joint Permit will be required for all work not under the purview of the Drain Code within, adjacent to, or near any inland lake, stream, wetland, or floodplain/floodway.

2. Indirect Short-Term Impacts

The selected alternatives outlined in this Project Plan are not expected to result in any indirect, short-term adverse impacts on the natural and designed environments.

B. Mitigation of Long-Term Impacts

1. Direct Long-Term Impacts

The selected alternatives set forth in this Project Plan are not expected to result in any adverse, direct long-term impacts. Where work may extend into or be located within a sensitive, regulated habitat, such as a wetland, stream, or floodplain, there will be mitigation as part of the design and permitting process, per the requirements of Act 451 of 1995, as amended.

To comply with the Michigan Natural Features Inventory (MNFI) requirements, Oakland County will adhere to both State and Federal legislation related to the protection of endangered and threatened species. To comply with the requirements of the US Fish and Wildlife Service (USFWS), best management practices (BMPs) will be implemented to minimize and avoid impacts on eastern massasauga rattlesnakes (EMR). The removal of trees will be restricted to between April 1 and September 30 of a given year to avoid disturbing seasonal bat breeding/roosting activities.

2. Indirect Long-Term Impacts

The selected alternatives set forth in this Project Plan are not expected to result in indirect, long-term adverse impacts on the natural and designed environments.

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Section VII - Public Participation

A. Public Meetings on Project Alternatives

Most of the project's alternatives were developed from recommendations presented in the watershed management plans (WMP). The public went through traditional means to receive input at public meetings and workshops. The findings, directives, and recommendations outlined in the WMPs were utilized to develop this SRF Project Plan. The project areas are significantly affected by stormwater runoff or are a source of NPS pollutants. The proposed improvements take into consideration the objectives of the WMPs and will help the county achieve a reduction in contaminants as directed in the local TMDLs.

B. The Formal Public Hearing

A formal public hearing was held on May 16, 2022, at the Oakland County Water Resources Commissioner's Office and via Zoom Videoconference. An advertisement was posted in the Oakland Press on April 15, 2022. The Project Plan was made available to the public for review on April 16, 2022, at the OCWRC Office, One Public Works Drive, Waterford, MI 48328-7598 and online at https://www.oakgov.com/water, for 30 days. Electronic copies were available via email. A verbatim transcript of the hearing has been included in the final Project Plan, along with comments raised by the public. See Appendix B for the presentation, transcript, and attendee list.

C. Adoption of the Project Plan

Resolutions adopting the Project Plan have been executed and are included in this submission. See Appendix C.

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Section VIII - References

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APPENDIX A

PROJECT COST ANALYSIS

2024 CWSRF PROJECT PLAN
ENGINEERS PRELIMINARY OPINION OF COSTS

No.	Project	Preliminary Cost
1	Perry Park - Green Infrastructure Improvements	$ 853,600
2	Oakland Park - Green Infrastructure Improvements	$ 491,100
3	Red Oaks Water Lot – Green Infrastructure Improvements	$ 292,200
4	Lower Straits Lake – County Drain Establishment & Restoration	$ 2,477,700
5	Hamlin Drain – Regional Stormwater Detention Facility	$ 895,900
6	Patterson Holly Drain Restoration	$ 3,763,600
7	Nelson Drain – Bank Stabilization & Sediment Trap	$ 2,502,400
8	Pontiac Creek Extension – Wetland & Stream Restoration	$ 2,206,100
9	Minnow Pond Drain – Flood Control Basin Conversion	$ 2,526,800
10	Pebble Creek Drain Restoration	$ 4,415,700
11	Sprague Drain – Pond & Stream Restoration	$ 531,500
12	Catalpa Park – Green Infrastructure Improvements	$ 1,475,100
13	Lane Drain Restoration – Phase II	$ 572,100
14	Sylvan Glen Habitat Restoration – Phase III	$ 991,300
15	WaterTowns – Green Infrastructure Improvements	$ 1,352,800
	Total:	$ 25,347,900

2024 CWSRF PROJECT PLAN
PRESENT WORTH CALCULATIONS

No.	Project	Present Worth
1	Perry Park – Green Infrastructure Improvements	$ 397,000
2	Oakland Park – Green Infrastructure Improvements	$ 233,000
3	Red Oaks Water Lot – Green Infrastructure Improvements	$ 142,000
4	Lower Straits Lake – County Drain Establishment & Restoration	$ 1,124,000
5	Hamlin Drain – Regional Stormwater Detention Facility	$ 601,000
6	Patterson Holly Drain Restoration	$ 1,708,000
7	Nelson Drain – Bank Stabilization & Sediment Trap	$ 1,135,000
8	Pontiac Creek Extension – Wetland & Stream Restoration	$ 1,000,000
9	Minnow Pond Drain – Flood Control Basin Conversion	$ 1,146,000
10	Pebble Creek Drain Restoration	$ 2,003,000
11	Sprague Drain – Pond & Stream Restoration	$ 241,000
12	Catalpa Park – Green Infrastructure Improvements	$ 767,000
13	Lane Drain Restoration – Phase II	$ 260,000
14	Sylvan Glen Habitat Restoration – Phase III	$ 450,000
15	WaterTowns – Green Infrastructure Improvements	$ 710,000
	Total:	$ 11,917,000

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PROJECT NO. 1: PERRY PARK – GREEN INFRASTRUCTURE IMPROVEMENTS

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Pontiac, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NM**
WORK: Green infrastructure installation				CHECKED BY:	**RJK**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 48,000.00	$ 48,000.00
2	Clearing and Grubbing	1	Lsum	$ 7,500.00	$ 7,500.00
3	Traffic Control	1	Lsum	$ 2,500.00	$ 2,500.00
4	Erosion Control	1	Lsum	$ 1,800.00	$ 1,800.00
5	Earthwork	5,000	Cyd	$ 30.00	$ 150,000.00
6	Trees	24	Ea	$ 600.00	$ 14,400.00
7	Shrubs plantings	100	Ea	$ 45.00	$ 4,500.00
8	Turf - Restoration	1,000	Syd	$ 3.45	$ 3,450.00
9	Native Wetland Basin Planting Mix	2	Ac	$ 4,000.00	$ 6,000.00
10	Topsoil	150	Cyd	$ 30.00	$ 4,500.00
11	Pathway Planting Mix	100	Cyd	$ 31.00	$ 3,100.00
12	Boardwalk Platform	1	Ea	$ 280,000.00	$ 280,000.00
13	Permanent Signage	1	Ea	$ 2,000.00	$ 2,000.00
14	Plant Plugs	250	Ea	$ 3.50	$ 875.00
15	Basin Outflow Structure	1	Ea	$ 4,800.00	$ 4,800.00
				Sub Total:	**$ 533,400.00**
Contingency - 30%					**$ 160,100.00**
Engineering and Administration - 30%					**$ 160,100.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 853,600.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Perry Park – Green Infrastructure Improvements
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Perry Park – Green Infrastructure Improvements	$	853,600.00	50	$	371,000.00
TOTAL CAPITAL COST	**$**	**853,600.00**		$	371,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	16,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	500.00			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	10,000.00
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**397,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**20,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 2: OAKLAND PARK – GREEN INFRASTRUCTURE IMPROVEMENTS

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Pontiac, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NM**
WORK: Green infrastructure installation				CHECKED BY:	**RJK**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 27,000.00	$ 27,000.00
2	Clearing and Grubbing	1	Lsum	$ 4,500.00	$ 4,500.00
3	Traffic Control	1	Lsum	$ 2,500.00	$ 2,500.00
4	Erosion Control	1	Lsum	$ 1,500.00	$ 1,500.00
5	Earthwork	4,000	Cyd	$ 30.00	$ 120,000.00
6	Trees	20	Ea	$ 600.00	$ 12,000.00
7	Shrubs plantings	50	Ea	$ 45.00	$ 2,250.00
8	Turf - Restoration	750	Syd	$ 3.45	$ 2,600.00
9	Native Wetland Basin Planting Mix	1	Ac	$ 4,000.00	$ 4,000.00
10	Topsoil	50	Cyd	$ 30.00	$ 1,500.00
11	Pathway Planting Mix	50	Cyd	$ 31.00	$ 1,550.00
12	Boardwalk Platform	1	Ea	$ 120,000.00	$ 120,000.00
13	Permanent Signage	1	Ea	$ 2,000.00	$ 2,000.00
14	Plant Plugs	200	Ea	$ 3.50	$ 700.00
15	Basin Outflow Structure	1	Ea	$ 4,800.00	$ 4,800.00
				Sub Total:	**$ 306,900.00**
Contingency - 30%					**$ 92,100.00**
Engineering and Administration - 30%					**$ 92,100.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 491,100.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Oakland Park – Green Infrastructure Improvements
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Oakland Park – Green Infrastructure Improvements	$	491,100.00	50	$	214,000.00
TOTAL CAPITAL COST	**$**	**491,100.00**		$	214,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	9,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	500.00			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	10,000.00
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**233,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**12,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 3: RED OAKS WATER PARK – GREEN INFRASTRUCTURE IMPROVEMENTS

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Madison Heights, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**BHT**
WORK: Green infrastructure installation				CHECKED BY:	**NJK**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 16,000.00	$ 16,000.00
2	Curb and Gutter, Rem	10	Ft	$ 10.40	$ 104.00
3	Energy Dissipator	1	Lsum	$ 4,165.00	$ 4,165.00
4	Rip Rap	4	Cyd	$ 125.00	$ 500.00
5	Culvert, 12" CMP	10	Ft	$ 100.00	$ 1,000.00
6	Dr Structure Modification	1	Ea	$ 4,685.00	$ 4,685.00
7	Fine Grading and Topsoil	1,700	Syd	$ 10.40	$ 17,680.00
8	Grow Zone	1	Lsum	$ 26,000.00	$ 26,000.00
9	Bioretention	1	Lsum	$ 104,100.00	$ 104,100.00
10	SESC Measures	1	Lsum	$ 3,125.00	$ 3,125.00
11	Restoration	1	Lsum	$ 5,200.00	$ 5,200.00
				Sub Total:	**$ 182,600.00**
Contingency - 30%					**$ 54,800.00**
Engineering and Administration - 30%					**$ 54,800.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 292,200.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Red Oaks Water Park – Green Infrastructure Improvements
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Red Oaks Water Park – Green Infrastructure Improvements	$	292,200.00	50	$	127,000.00
TOTAL CAPITAL COST	**$**	**292,200.00**		$	127,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	5,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	500.00			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	10,000.00
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**142,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**7,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 4: LOWER STRAIGHTS LAKE – COUNTRY DRAIN ESTABLISHMENT & RESTORATION

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Commerce Township, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Optimization of existing facilities and streambank stabilization				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (Max 10%)	1	Lsum	$ 140,000.00	$ 140,000.00
2	Access Route and Staging	1	Lsum	$ 10,400.00	$ 10,400.00
3	Create Two Stage Channel	4,000	Lft	$ 52.00	$ 208,000.00
4	Riffles	800	Lft	$ 104.00	$ 83,200.00
5	Disposal of Dredged Material	4,000	Cyd	$ 42.00	$ 168,000.00
6	Prepare Spoil Area	1	Ac	$ 4,200.00	$ 4,200.00
7	Remove Fallen Trees	1	Lsum	$ 10,400.00	$ 10,400.00
8	Toe Protection (toe wood or stone toe)	2,000	Lft	$ 208.00	$ 416,000.00
9	Grade Control at the Inlet and Outlet and Side Drain Confluence	3	Ea	$ 8,300.00	$ 24,900.00
10	Native Seeding on Banks and Buffer on Both Sides	3	Ac	$ 10,400.00	$ 31,200.00
11	Road Crossings	8	Ea	$ 52,000.00	$ 416,000.00
12	Utilities Crossings Improvement	1	Lsum	$ 20,800.00	$ 20,800.00
13	Soil Erosion and Sediment Control	1	Lsum	$ 10,400.00	$ 10,400.00
14	EGLE Permit Conditions	1	Lsum	$ 5,000.00	$ 5,000.00
				Sub Total:	**$ 1,548,500.00**
Contingency - 30%					**$ 464,600.00**
Engineering and Administration - 30%					**$ 464,600.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 2,477,700.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Lower Straits Lake – County Drain Establishment & Restoration
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Lower Straits Lake – County Drain Establishment & Restoration	$	2,477,700.00	50	$	1,078,000.00
TOTAL CAPITAL COST	**$**	**2,477,700.00**		$	1,078,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	46,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**1,124,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**58,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 5: HAMLIN DRAIN – REGIONAL STORMWATER DETENTION FACILITY

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Bloomfield Township, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Optimization of existing facilities				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (Max 10%)	1	Lsum	$ 50,000.00	$ 50,000.00
2	Access Route and Staging	1	Lsum	$ 5,200.00	$ 5,200.00
3	Drain Structures	2	Ea	$ 26,000.00	$ 52,000.00
4	Earth Excavation	8,500	Cyd	$ 16.00	$ 136,000.00
5	Storm Sewer Network (84" Dia.)	500	Lft	$ 575.00	$ 287,500.00
6	Native Seeding on Banks and Buffer on Both Sides	1	Ac	$ 10,400.00	$ 10,400.00
7	Soil Erosion and Sediment Control	1	Lsum	$ 7,800.00	$ 7,800.00
8	EGLE Permit Conditions	1	Lsum	$ 5,000.00	$ 5,000.00
9	Permit Fees	1	Lsum	$ 6,000.00	$ 6,000.00
				Sub Total:	**$ 559,900.00**
Contingency - 30%					**$ 168,000.00**
Engineering and Administration - 30%					**$ 168,000.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 895,900.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Hamlin Drain – Regional Stormwater Detention Facility
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Hamlin Drain – Regional Stormwater Detention Facility	$	895,900.00	50	$	390,000.00
TOTAL CAPITAL COST	**$**	**895,900.00**		$	390,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	17,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	10,000.00			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	194,000.00
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**601,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**31,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 6: PATTERSON HOLLY DRAIN RESTORATION

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Village of Holly & Holly Township, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Streambank stabilization				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (Max 10%)	1	Lsum	$ 213,000.00	$ 213,000.00
2	Access Route and Staging	1	Lsum	$ 41,650.00	$ 41,650.00
3	Create Meandered Two Stage Channel within Wetland	7,000	Lft	$ 52.00	$ 364,000.00
4	Riffles	1,800	Lft	$ 104.00	$ 187,200.00
5	Excess Sediment Removal	1	Lsum	$ 52,100.00	$ 52,100.00
6	Disposal of Dredged Material	10,000	Cyd	$ 31.25	$ 312,500.00
7	Prepare Spoil Area	3	Ac	$ 4,200.00	$ 12,600.00
8	Remove Fallen Trees	1	Lsum	$ 31,200.00	$ 31,200.00
9	Toe Protection (Toe Wood or Stone Toe)	3,500	Lft	$ 208.00	$ 728,000.00
10	Grade Control at Dam and Outfall and Side Drain Confluence	3	Ea	$ 20,800.00	$ 62,400.00
11	Native Seeding on Banks and Buffer on Both Sides	4	Ea	$ 10,400.00	$ 41,600.00
12	Stream Improvement U/S and D/S Crossings	6	Ea	$ 41,600.00	$ 249,600.00
13	Soil Erosion and Sediment Control	1	Lsum	$ 31,300.00	$ 31,300.00
14	EGLE Permit Conditions	1	Lsum	$ 5,000.00	$ 5,000.00
15	Impacted Wetland Restoration	1	Lsum	$ 20,000.00	$ 20,000.00
				Sub Total:	**$ 2,352,200.00**
Contingency - 30%					**$ 705,700.00**
Engineering and Administration - 30%					**$ 705,700.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 3,763,600.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Patterson Holly Drain Restoration
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Patterson Holly Drain Restoration	$	3,763,600.00	50	$	1,637,000.00
TOTAL CAPITAL COST	**$**	**3,763,600.00**		$	1,637,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	71,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**1,708,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**88,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 7: NELSON DRAIN – BANK STABILIZATION & SEDIMENT TRAP

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Troy, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Streambank stabilization				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (Max 10%)	1	Lsum	$ 142,000.00	$ 142,000.00
2	Access Route and Staging	1	Lsum	$ 20,800.00	$ 20,800.00
3	Create Meandered Two Stage Channel	4,000	Lft	$ 52.00	$ 208,000.00
4	Riffles	800	Lft	$ 104.00	$ 83,200.00
5	Excess Sediment Removal	1	Lsum	$ 52,100.00	$ 52,100.00
6	Disposal of Dredged Material	5,000	Cyd	$ 42.00	$ 210,000.00
7	Prepare Spoil Area	5	Ac	$ 4,200.00	$ 21,000.00
8	Remove Fallen Trees	1	Lsum	$ 10,400.00	$ 10,400.00
9	Toe Protection (toe wood or stone toe)	2,000	Lft	$ 312.00	$ 624,000.00
10	Native Seeding on Banks and Buffer on Both Sides	2	Ac	$ 10,400.00	$ 20,800.00
11	Stream improvement U/S and D/S crossings	3	Ea	$ 52,100.00	$ 156,300.00
12	Soil Erosion and Sediment Control	1	Lsum	$ 10,400.00	$ 10,400.00
13	EGLE Permit Conditions	1	Lsum	$ 5,000.00	$ 5,000.00
				Sub Total:	**$ 1,564,000.00**
Contingency - 30%					**$ 469,200.00**
Engineering and Administration - 30%					**$ 469,200.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 2,502,400.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Nelson Drain – Bank Stabilization & Sediment Trap
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Nelson Drain – Bank Stabilization & Sediment Trap	$	2,502,400.00	50	$	1,088,000.00
TOTAL CAPITAL COST	**$**	**2,502,400.00**		$	1,088,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	47,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**1,135,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**59,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 8: PONTIAC CREEK EXTENSION – WETLAND & STREAM RESTORATION

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Pontiac & Waterford Township, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Green infrastructure installation and streambank stabilization				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (Max 10%)	1	Lsum	$ 124,000.00	$ 124,000.00
2	Project Signage	1	Lsum	$ 1,250.00	$ 1,250.00
3	Maintaining Traffic (includes haul route prepartion and restoration and temp stream crossing)	1	Lsum	$ 15,600.00	$ 15,600.00
4	Prevent Spreading of Invasive Species	1	Lsum	$ 10,500.00	$ 10,500.00
5	Clearing, Grubbing, and Tree Removal	2	Ac	$ 20,800.00	$ 41,600.00
6	Earth Excavation	8,000	Cyd	$ 17.00	$ 136,000.00
7	Plant Plugs	1,000	Ea	$ 6.25	$ 6,246.68
8	Plantings, Shrubs	100	Lsum	$ 12.50	$ 1,250.00
9	Trees 1" Cal B&B Cont. or BR	10	Ea	$ 680.00	$ 6,800.00
10	Riffles	1,000	Lft	$ 104.00	$ 104,000.00
11	Toe Wood Structure	2,000	Lft	$ 208.00	$ 416,000.00
12	Erosion Control Blanket (C125)	5,000	Syd	$ 2.25	$ 11,250.00
13	Fine Grading and Topsoil	11,000	Syd	$ 8.50	$ 93,500.00
14	Culvert 15 Inch, CMP	100	Lft	$ 120.00	$ 12,000.00
15	Outlet Structure	2	Ea	$ 3,100.00	$ 6,200.00
16	Seed Mix "A" - Flood Plain Shelf	1	Ac	$ 16,700.00	$ 16,700.00
17	Seed Mix "B" - Rough Mix	2	Ac	$ 10,400.00	$ 20,800.00
18	Wetland Enhancements	8	Ac	$ 41,600.00	$ 332,800.00
19	Staging Area Prep and Restoration	1	Lsum	$ 7,800.00	$ 7,800.00
20	Soil Erosion Control Measures	1	Lsum	$ 8,400.00	$ 8,400.00
21	Permit Fees	1	Lsum	$ 6,000.00	$ 6,000.00
				Sub Total:	**$ 1,378,700.00**
Contingency - 30%					**$ 413,700.00**
Engineering and Administration - 30%					**$ 413,700.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 2,206,100.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Pontiac Creek Extension – Wetland & Stream Restoration
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Pontiac Creek Extension – Wetland & Stream Restoration	$	2,206,100.00	50	$	959,000.00
TOTAL CAPITAL COST	**$**	**2,206,100.00**		$	959,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	41,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**1,000,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**52,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

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(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 9: MINNOW POND DRAIN – FLOOD CONTROL BASIN CONVERSION

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Farmington Hills, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Optimization of existing facilities				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (Max 10%)	1	Lsum	$ 143,000.00	$ 143,000.00
2	Access Route and Staging	1	Lsum	$ 10,400.00	$ 10,400.00
3	Create Two Stage Channel	2,000	Lft	$ 104.00	$ 208,000.00
4	Riffles	600	Lft	$ 104.00	$ 62,400.00
5	Toe Protection (toe wood or stone toe)	2,000	Lft	$ 210.00	$ 420,000.00
6	Storm Sewer Network, 96" Dia. Pipes/Structures	1,200	Lft	$ 315.00	$ 378,000.00
7	Inlet and outlet stuctures modification	3	Ea	$ 104,000.00	$ 312,000.00
8	Native Seeding on Banks and Buffer on Both Sides	3	Ac	$ 10,400.00	$ 31,200.00
9	Soil Erosion and Sediment Control	1	Lsum	$ 5,200.00	$ 5,200.00
10	EGLE Permit Conditions	1	Lsum	$ 5,000.00	$ 5,000.00
11	Permit Fees	1	Lsum	$ 4,000.00	$ 4,000.00
				Sub Total:	**$ 1,579,200.00**
Contingency - 30%					**$ 473,800.00**
Engineering and Administration - 30%					**$ 473,800.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 2,526,800.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Minnow Pond Drain – Flood Control Basin Conversion
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Minnow Pond Drain – Flood Control Basin Conversion	$	2,526,800.00	50	$	1,099,000.00
TOTAL CAPITAL COST	**$**	**2,526,800.00**		$	1,099,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	47,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**1,146,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**59,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

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(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 10: PEBBLE CREEK DRAIN RESTORATION

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Farmington Hills, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Streambank stabilization				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (Max 10%)	1	Lsum	$ 250,000.00	$ 250,000.00
2	Access Route and Staging	1	Lsum	$ 20,800.00	$ 20,800.00
3	Create Meandered Two Stage Channel	7,000	Lft	$ 52.00	$ 364,000.00
4	Riffles	1,400	Lft	$ 104.00	$ 145,600.00
5	Excess Sediment Removal	1	Lsum	$ 20,800.00	$ 20,800.00
6	Disposal of Dredged Material	9,000	Cyd	$ 42.00	$ 378,000.00
7	Prepare Spoil Area	2	Ac	$ 4,200.00	$ 8,400.00
8	Remove Fallen Trees	1	Lsum	$ 10,400.00	$ 10,400.00
9	Toe Protection (toe wood or stone toe)	3,500	Lft	$ 315.00	$ 1,102,500.00
10	Native Seeding on Banks and Buffer on Both Sides	3	Ac	$ 14,600.00	$ 43,800.00
11	Soil Erosion and Sediment Control	1	Lsum	$ 10,400.00	$ 10,400.00
12	EGLE Permit Conditions	1	Lsum	$ 5,000.00	$ 5,000.00
13	Road Crossings	8	Ea	$ 50,000.00	$ 400,000.00
				Sub Total:	**$ 2,759,700.00**
Contingency - 30%					**$ 828,000.00**
Engineering and Administration - 30%					**$ 828,000.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 4,415,700.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Pebble Creek Drain Restoration
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Pebble Creek Drain Restoration	$	4,415,700.00	50	$	1,920,000.00
TOTAL CAPITAL COST	**$**	**4,415,700.00**		$	1,920,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	83,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)			$ -		
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)			$ -		
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**2,003,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**103,000.00**

Notes:

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Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 11: SPRAGUE DRAIN – POND & STREAM RESTORATION

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Troy, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Streambank stabilization				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (Max 10%)	1	Lsum	$ 30,000.00	$ 30,000.00
2	Access Route and Staging	1	Lsum	$ 8,300.00	$ 8,300.00
3	Dredging and Dewatering	1,000	Cyd	$ 21.00	$ 21,000.00
4	Disposal of Dredged Material	800	Cyd	$ 36.50	$ 29,200.00
5	Prepare Spoil Area	1	Ac	$ 4,200.00	$ 2,100.00
6	Remove Fallen Trees	1	Lsum	$ 4,200.00	$ 4,200.00
7	Toe Protection (toe wood or stone toe)	240	Lft	$ 208.00	$ 49,920.00
8	Ledge Rock on the East Bank of the Pond	100	Face Sqft	$ 208.00	$ 20,800.00
9	Grade Control at the Inlet and Outlet	2	Ea	$ 8,400.00	$ 16,800.00
10	Native Seeding on Banks and Buffer on Both Sides	1	Ac	$ 7,300.00	$ 3,650.00
11	Native Trees on the West Bank	5	Ea	$ 833.00	$ 4,165.00
12	Native Shrubs on Off-Line Pond Bank	25	Ea	$ 21.00	$ 525.00
13	Stream Bank Construction to Create Off-Line Pond	150	Lft	$ 833.00	$ 124,950.00
14	Off-Line Pond Habitat Enhancement (turtle mounds and log piles)	1	Lsum	$ 5,200.00	$ 5,200.00
15	Soil Erosion and Sediment Control	1	Lsum	$ 6,300.00	$ 6,300.00
16	EGLE Permit Conditions	1	Lsum	$ 5,000.00	$ 5,000.00
				Sub Total:	**$ 332,100.00**
Contingency - 30%					**$ 99,700.00**
Engineering and Administration - 30%					**$ 99,700.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 531,500.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Sprague Drain – Pond & Stream Restoration
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Sprague Drain – Pond & Stream Restoration	$	531,500.00	50	$	231,000.00
TOTAL CAPITAL COST	**$**	**531,500.00**		$	231,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	10,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**241,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**12,000.00**

Notes:

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Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 12: CATALPA PARK – GREEN INFRASTRUCTURE IMPROVEMENTS

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Southfield, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**BHT**
WORK: Green infrastructure installation				CHECKED BY:	**NJK**

	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 83,000.00	$ 83,000.00
2	Pavt Rem	250	Syd	$ 14.00	$ 3,500.00
3	Storm Sewer Pipe R&R	1	Lsum	$ 52,000.00	$ 52,000.00
4	Ditch Cleanout	8	Sta	$ 400.00	$ 3,200.00
5	Porous Pavement	7,000	Sft	$ 31.30	$ 219,100.00
6	HMA, 13A	1,400	Ton	$ 130.00	$ 182,000.00
7	Pavement Markings	1	Lsum	$ 23,000.00	$ 23,000.00
8	Fine Grading and Topsoil	11,000	Syd	$ 10.50	$ 115,500.00
9	Seeding	2	Ac	$ 6,300.00	$ 14,301.00
10	Plantings (trees and shrubs)	1	Lsum	$ 47,000.00	$ 47,000.00
11	Bioretention	1	Lsum	$ 146,000.00	$ 146,000.00
12	Outlet Control Structures	3	Ea	$ 5,200.00	$ 15,600.00
13	Traffic Controls	1	Lsum	$ 10,400.00	$ 10,400.00
14	SESC Measures	1	Lsum	$ 7,300.00	$ 7,300.00
				Sub Total:	**$ 921,900.00**
Contingency - 30%					**$ 276,600.00**
Engineering and Administration - 30%					**$ 276,600.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 1,475,100.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Catalpa Park – Green Infrastructure Improvements
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Catalpa Park – Green Infrastructure Improvements	$	1,475,100.00	50	$	642,000.00
TOTAL CAPITAL COST	**$**	**1,475,100.00**		$	642,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	28,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	5,000.00			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	97,000.00
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**767,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**40,000.00**

Notes:

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Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 13: LANE DRAIN RESTORATION – PHASE II

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Troy, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Streambank stabilization				CHECKED BY:	**JFB**
	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 32,000.00	$ 32,000.00
2	Rip Rap	40	Cyd	$ 125.00	$ 5,000.00
3	Earthwork	1,000	Cyd	$ 26.00	$ 26,000.00
4	Fine Grading and Topsoil	1,000	Syd	$ 10.50	$ 10,500.00
5	Seeding	1	Ac	$ 6,300.00	$ 6,300.00
6	Plantings (trees and shrubs)	1	Lsum	$ 47,400.00	$ 47,400.00
7	Cell Water Control Structures	10	Ea	$ 5,700.00	$ 57,000.00
8	Toe Protection	600	Lft	$ 208.00	$ 124,800.00
9	Riffles	11	Ea	$ 3,700.00	$ 40,700.00
10	SESC Measures	1	Lsum	$ 7,800.00	$ 7,800.00
				Sub Total:	**$ 357,500.00**
Contingency - 30%					**$ 107,300.00**
Engineering and Administration - 30%					**$ 107,300.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 572,100.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Lane Drain Restoration – Phase II
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Lane Drain Restoration – Phase II	$	572,100.00	50	$	249,000.00
TOTAL CAPITAL COST	**$**	**572,100.00**		$	249,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	11,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**260,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**13,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

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(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 14: SYLVAN GLEN HABITAT RESTORATION – PHASE III

ENGINEER'S OPINION OF PROBABLE PROJECT COST				DATE:	**3/28/2023**
LOCATION: Troy, Michigan				PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL				ESTIMATOR:	**NJK**
WORK: Streambank stabilization				CHECKED BY:	**JFB**

	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 55,000.00	$ 55,000.00
2	Project Signage	1	Lsum	$ 875.00	$ 875.00
3	Maintaining Traffic (includes haul route prepartion and restoration and temp stream crossing)	1	Lsum	$ 15,600.00	$ 15,600.00
4	Prevent Spreading of Invasive Species	1	Lsum	$ 6,250.00	$ 6,250.00
5	Construction Fence	575	Lft	$ 2.25	$ 1,293.75
6	Clearing & Grubbing and Tree Removal	1	Ac	$ 20,800.00	$ 19,760.00
7	Earth Excavation and Embankment	7,263	Cyd	$ 18.00	$ 130,734.00
8	Remove Pavement	661	Syd	$ 19.00	$ 12,559.00
9	Remove Curb and Gutter	386	Lft	$ 26.00	$ 10,036.00
10	Reset Storm Sewer	1	Ea	$ 3,650.00	$ 3,650.00
11	Reset End Section	1	Ea	$ 1,040.00	$ 1,040.00
12	Plant Plugs	2,000	Ea	$ 6.25	$ 12,493.36
13	Vegetated Reinforced Soil Slope (VRSS)	93	Lft	$ 160.00	$ 14,880.00
14	Log Vane	3	Ea	$ 3,100.00	$ 9,300.00
15	Toe Wood Structure	126	Lft	$ 208.00	$ 26,208.00
16	Rock W-Weir Vane	1	Ea	$ 38,500.00	$ 38,500.00
17	Erosion Control Blanket (C125)	7,454	Syd	$ 2.50	$ 18,635.00
18	6A Natural Round Gravel	20	Ton	$ 110.00	$ 2,200.00
19	4"-10" Field Stone	30	Ton	$ 135.00	$ 4,050.00
20	12"-18" Field Stone	25	Ton	$ 160.00	$ 4,000.00
21	40/60 Sharp Sand and Gravel Mix	5	Ton	$ 52.00	$ 260.00
22	Step Pool Structure, Less Than 50 Feet	2	Ea	$ 5,200.00	$ 10,400.00
23	Step Pool Structure, Greater Than 50 Feet	1	Ea	$ 8,300.00	$ 8,300.00
24	Seed Mix "A" - Flood Plain Shelf	1	Ac	$ 16,700.00	$ 12,692.00
25	Seed Mix "B" - Rough Mix	1	Ac	$ 10,400.00	$ 10,712.00
26	Trees 1" Cal B&B Cont. or BR	150	Ea	$ 470.00	$ 70,500.00
27	Staging Area Prep and Restoration	1	Lsum	$ 7,800.00	$ 7,800.00
28	Riffle Structures	3	Ea	$ 9,400.00	$ 28,200.00
29	Rock Cutoff Sill	3	Ea	$ 4,700.00	$ 14,100.00
30	Soil Erosion Control Measures	1	Lsum	$ 8,300.00	$ 8,300.00
31	6' Chain Link Fence, Match Existing	480	Lft	$ 104.00	$ 49,920.00
32	Post, Match Existing	60	Ea	$ 52.00	$ 3,120.00
33	Permit Fees	1	L Sum	$ 6,000.00	$ 6,000.00
34	Project Monitoring and Public Education	1	L Sum	$ 2,100.00	$ 2,100.00
				Sub Total:	**$ 619,500.00**
Contingency - 30%					**$ 185,900.00**

HUBBELL, ROTH & CLARK, INC
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ph. (248) 454-6300

PROJECT NO. 14: SYLVAN GLEN HABITAT RESTORATION – PHASE III

ENGINEER'S OPINION OF PROBABLE PROJECT COST	DATE:	**3/28/2023**
LOCATION: Troy, Michigan	PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL	ESTIMATOR:	**NJK**
WORK: Streambank stabilization	CHECKED BY:	**JFB**
Engineering and Administration - 30%		**$ 185,900.00**
TOTAL ESTIMATED CONSTRUCTION COST		**$ 991,300.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Sylvan Glen Habitat Restoration – Phase III
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Sylvan Glen Habitat Restoration – Phase III	$	991,300.00	50	$	431,000.00
TOTAL CAPITAL COST	**$**	**991,300.00**		$	431,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	19,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	-
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**450,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**23,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

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PROJECT NO. 15: WATERTOWNS – GREEN INFRASTRUCTURE IMPROVEMENTS

ENGINEER'S OPINION OF PROBABLE PROJECT COST	DATE:	**3/28/2023**
LOCATION: Pleasant Ridge, Michigan	PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL	ESTIMATOR:	**BHT**
WORK: Green infrastructure installation	CHECKED BY:	**NJK**

Sub-Section A: Oxford Park Intersection Pavement Reduction & Bioretention

	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 17,000.00	$ 17,000.00
2	Pavt, Rem	950	Syd	$ 14.00	$ 13,300.00
3	Curb, Rem	375	Ft	$ 16.00	$ 6,000.00
4	Curb and Gutter, Rem	125	Ft	$ 30.00	$ 3,750.00
5	Sidewalk, Rem	80	Syd	$ 17.00	$ 1,360.00
6	Excavation, Earth	110	Cyd	$ 52.00	$ 5,720.00
7	Soil Erosion and Sedimentation Control	1	LS	$ 5,200.00	$ 5,200.00
8	Aggregate Base	150	Ton	$ 27.00	$ 4,050.00
9	Sewer, Cl E, 12 inch, Tr Det B	120	Ft	$ 76.00	$ 9,120.15
10	Dr Structure Tap, 12 inch	3	Ea	$ 542.00	$ 1,626.00
11	Outlet Control Structure	3	Ea	$ 5,200.00	$ 15,600.00
12	HMA, 5E1	250	Ton	$ 115.00	$ 28,750.00
13	HMA Surface, Rem	230	Syd	$ 21.00	$ 4,830.00
14	Curb and Gutter, Conc, Det F2	520	Ft	$ 28.00	$ 14,560.00
15	Sidewalk, Conc, 4 inch	900	Sft	$ 6.25	$ 5,622.01
16	Curb Ramp, Conc, 6 inch	475	Sft	$ 8.50	$ 4,037.50
17	Detectable Warning Surface	30	Ft	$ 36.50	$ 1,095.00
18	Curb Ramp Opening, Conc	36	Ft	$ 33.50	$ 1,206.00
19	Post, Steel, 3 lb	144	Ft	$ 8.50	$ 1,224.00
20	Sign, Type IIA	40	Sft	$ 17.00	$ 680.00
21	Sign, Type II, Erect, Salv	3	Ea	$ 47.00	$ 141.00
22	Pavt Mrkg, Ovly Cold Plastic, 12 inch, Crosswalk	205	Ft	$ 6.25	$ 1,280.57
23	Pavt Mrkg, Ovly Cold Plastic, 24 inch, Stop Bar	36	Ft	$ 9.00	$ 324.00
24	Traffic Control	1	LS	$ 10,400.00	$ 10,400.00
25	Rain Gardens	3	Ea	$ 8,650.00	$ 25,950.00
26	Site Restoration	1	LS	$ 5,200.00	$ 5,200.00
27	Staging Area Prep and Restoration	1	Lsum	$ 7,800.00	$ 7,800.00
28	Permit Fees	1	L Sum	$ 5,000.00	$ 5,000.00
				Sub Total Sub-Section A:	**$ 200,800.00**

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PROJECT NO. 15: WATERTOWNS – GREEN INFRASTRUCTURE IMPROVEMENTS

ENGINEER'S OPINION OF PROBABLE PROJECT COST	DATE:	**3/28/2023**
LOCATION: Pleasant Ridge, Michigan	PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL	ESTIMATOR:	**BHT**
WORK: Green infrastructure installation	CHECKED BY:	**NJK**

Sub-Section B: Poplar Park Boulevard Bioretention & Bioretention End Caps

	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 9,000.00	$ 9,000.00
2	Pavt, Rem	15	Syd	$ 185.00	$ 2,775.00
3	Curb, Rem	30	Ft	$ 25.00	$ 750.00
4	Excavation, Earth	60	Cyd	$ 52.00	$ 3,120.00
5	Soil Erosion and Sedimentation Controls	1	LS	$ 2,600.00	$ 2,600.00
6	Sewer, Cl E, 12 inch, Tr Det B	150	Ft	$ 76.00	$ 11,400.19
7	Dr Structure Tap, 12 inch	2	Ea	$ 540.00	$ 1,080.00
8	Inlet Control Structure	6	Ea	$ 5,200.00	$ 31,200.00
9	Outlet Control Structure	2	Ea	$ 5,200.00	$ 10,400.00
10	Conc Pavt with Integral Curb, Nonreinf, 8 inch	20	Syd	$ 130.00	$ 2,600.00
11	Traffic Control	1	LS	$ 10,400.00	$ 10,400.00
12	Bioretention Swale	1	LS	$ 15,400.00	$ 15,400.00
13	Site Restoration	1	LS	$ 5,200.00	$ 5,200.00
14	Permit Fees	1	L Sum	$ 2,500.00	$ 2,500.00
				Sub Total Sub-Section B:	**$ 108,400.00**

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ph. (248) 454-6300

PROJECT NO. 15: WATERTOWNS – GREEN INFRASTRUCTURE IMPROVEMENTS

ENGINEER'S OPINION OF PROBABLE PROJECT COST	DATE:	**3/28/2023**
LOCATION: Pleasant Ridge, Michigan	PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL	ESTIMATOR:	**BHT**
WORK: Green infrastructure installation	CHECKED BY:	**NJK**

Sub-Section C: Elm Boulevard Entrance Bioretention & Native Plantings

	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 14,000.00	$ 14,000.00
2	Tree, Rem, 6 inch to 18 inch	1	Syd	$ 360.00	$ 360.00
3	Pavt, Rem	16	Syd	$ 185.00	$ 2,960.00
4	Curb, Rem	20	Ft	$ 25.00	$ 500.00
5	Sidewalk, Rem	30	Syd	$ 34.50	$ 1,035.00
6	Excavation, Earth	210	Cyd	$ 52.00	$ 10,920.00
7	Landscaping, Rem	1	LS	$ 1,040.00	$ 1,040.00
8	Soil Erosion and Sedimentation Controls	1	LS	$ 5,200.00	$ 5,200.00
9	Sewer, Cl E, 12 inch, Tr Det B	130	Ft	$ 76.00	$ 9,880.17
10	Dr Structure Tap, 12 inch	4	Ea	$ 540.00	$ 2,160.00
11	Inlet Control Structure	4	Ea	$ 5,200.00	$ 20,800.00
12	Outlet Control Structure	4	Ea	$ 5,200.00	$ 20,800.00
13	Conc Pavt with Integral Curb, Nonreinf, 8 inch	20	Syd	$ 130.00	$ 2,600.00
14	Sidewalk, Conc, 4 inch	250	Sft	$ 8.50	$ 2,125.00
15	Traffic Control	1	LS	$ 20,800.00	$ 20,800.00
16	Sign, Type II, Erect, Salv	1	Ea	$ 47.00	$ 47.00
17	Bioretention Cells	4	Ea	$ 9,200.00	$ 36,800.00
18	Native Plantings	1	LS	$ 730.00	$ 730.00
19	Site Restoration	1	LS	$ 10,400.00	$ 10,400.00
20	Permit Fees	1	L Sum	$ 5,000.00	$ 5,000.00
				Sub Total Sub-Section C:	**$ 168,200.00**

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555 Hulet Dr., Bloomfield Hills, MI 48302
ph. (248) 454-6300

PROJECT NO. 15: WATERTOWNS – GREEN INFRASTRUCTURE IMPROVEMENTS

ENGINEER'S OPINION OF PROBABLE PROJECT COST	DATE:	**3/28/2023**
LOCATION: Pleasant Ridge, Michigan	PROJECT NO.	**20220218**
BASIS FOR ESTIMATE: **[X] CONCEPTUAL** [ ] PRELIMINARY [ ] FINAL	ESTIMATOR:	**BHT**
WORK: Green infrastructure installation	CHECKED BY:	**NJK**

Sub-Section D: Police Department Permeable Paver Parking Area

	Description	Quantity	Unit	Unit Price	Total Cost
1	Mobilization (10%)	1	Lsum	$ 33,000.00	$ 33,000.00
2	Pavt, Rem	775	Syd	$ 14.00	$ 10,850.00
3	Excavation, Earth	180	Cyd	$ 52.00	$ 9,360.00
4	Soil Erosion and Sedimentation Controls	1	LS	$ 2,600.00	$ 2,600.00
5	Aggregate Base	125	Ton	$ 27.00	$ 3,375.00
6	Sewer, Cl E, 12 inch, Tr Det B	20	Ft	$ 76.00	$ 1,520.03
7	Dr Structure Tap, 12 inch	1	Ea	$ 542.00	$ 542.00
8	Underground Reservoir	4,800	Cft	$ 52.00	$ 249,600.00
9	Outlet Control Structure	1	Ea	$ 5,200.00	$ 5,200.00
10	HMA, 5E1	185	Ton	$ 115.00	$ 21,275.00
11	Permeable Pavers	670	Sft	$ 15.00	$ 10,050.00
12	Pavt Mrkg, Polyurea, 4 inch, Yellow	280	Ft	$ 5.25	$ 1,470.00
13	Pavt Mrkg, Polyurea, 4 inch, Blue	78	Ft	$ 5.25	$ 409.50
14	Pavt Mrkg, Polyurea, 4 inch, Cross Hatching, Blue	87	Ft	$ 5.25	$ 456.75
15	Pavt Mrkg, Polyurea, Accessible Sym	1	Ea	$ 220.00	$ 220.00
16	Minor Traf Devices	1	LS	$ 5,200.00	$ 5,200.00
17	Site Restoration	1	LS	$ 10,400.00	$ 10,400.00
18	Permit Fees	1	L Sum	$ 2,500.00	$ 2,500.00
				Sub Total Sub-Section D:	**$ 368,000.00**
				Sub Total Sub-Sections A-D:	**$ 845,400.00**
Contingency - 30%					**$ 253,700.00**
Engineering and Administration - 30%					**$ 253,700.00**
TOTAL ESTIMATED CONSTRUCTION COST					**$ 1,352,800.00**

Oakland County Water Resources Commissioner
2024 CWSRF Project Plan
Non Point Source Projects

Water Towns – Green Infrastructure Improvements
Present Worth Calculation

CAPITAL COST		CAPITAL COST[1]	SERVICE LIFE[2] (YEARS)		PRESENT WORTH[3]
Water Towns – Green Infrastructure Improvements	$	1,352,800.00	50	$	588,000.00
TOTAL CAPITAL COST	**$**	**1,352,800.00**		$	588,000.00
INTEREST DURING CONSTRUCTION Assumes 1 year interest at 1.875%				$	25,000.00
ANNUAL OPERATION AND MAINTENANCE COST					
ANNUAL O, M & R COST (NON-ENERGY)	$	5,000.00			
PRESENT WORTH OF OM&R COST (NON ENERGY)				$	97,000.00
ANNUAL O, M & R COST (ENERGY)	$	-			
PRESENT WORTH OF OM&R COST (ENERGY)					
PRESENT WORTH				**$**	**710,000.00**
AVERAGE ANNUAL EQUIVALENT COST				**$**	**37,000.00**

Notes:

(1) March 2023 ENR CCI for Detroit = 13,801

(2) BMPs expected to last 50 years if properly maintained.

(3) Cost is based on a study period of 20 years and a discount rate of 0.3%.
Present Worth Costs are based on straight line depreciation and no inflation.

APPENDIX B

PUBLIC HEARING PRESENTATION & TRANSCRIPT

APPENDIX C

RESOLUTION

APPENDIX D

OAKLAND COUNTY WATER RESOURCES COMMISSIONER OFFICE - MS4 PERMIT

PERMIT NO. MI0060089

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act (33 U.S.C. 1251 *et seq*., as amended; the "Federal Act"); Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA); Part 41, Sewerage Systems, of the NREPA; and Michigan Executive Order 2019-06,

Oakland County
Water Resources Commissioner's Office
One Public Works Drive, Building 95 West
Waterford, MI 48328

is authorized to discharge from the Municipal Separate Storm Sewer System (MS4)

designated as **Oakland CDC MS4**

to surface waters of the state of Michigan in accordance with effluent limitations, monitoring requirements, and other conditions set forth in this permit.

This permit takes effect on January 1, 2021. This permit is based on a complete application submitted on March 24, 2008, as amended through July 16, 2020.

The provisions of this permit are severable. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term in accordance with applicable laws and rules. On its effective date this permit shall supersede Certificate of Coverage No. MIG610042, issued on December 16, 2003, which is hereby revoked upon the effective date of this permit.

This permit and the authorization to discharge shall expire at midnight, **October 1, 2023**. In order to receive authorization to discharge beyond the date of expiration, the permittee shall submit an application which contains such information, forms, and fees as are required by the Department of Environment, Great Lakes, and Energy (Department) by **April 4, 2023**.

Issued: November 12, 2020.

Original signed by Christine Alexander
Christine Alexander, Manager
Permits Section
Water Resources Division

PERMIT FEE REQUIREMENTS

In accordance with Section 324.3118 of the NREPA, the permittee shall make payment of an annual storm water fee to the Department for each January 1 the permit is in effect regardless of occurrence of discharge. The permittee shall submit the fee in response to the Department's annual notice. Payment may be made electronically via the Department's MiWaters system. The MiWaters website is located at https://miwaters.deq.state.mi.us. Payment shall be submitted or postmarked by March 15 for notices mailed by February 1. Payment shall be submitted or postmarked no later than 45 days after receiving the notice for notices mailed after February 1.

Annual Permit Fee Classification: Municipal Storm Water – County

CONTACT INFORMATION

Unless specified otherwise, all contact with the Department required by this permit shall be made to the Warren District Office of the Water Resources Division. The Warren District Office is located at 27700 Donald Court, Warren, MI 48092-2793, Telephone: 586-753-3700, Fax: 586-751-4690.

CONTESTED CASE INFORMATION

Any person who is aggrieved by this permit may file a sworn petition with the Michigan Administrative Hearing System within the Michigan Department of Licensing and Regulatory Affairs, c/o the Michigan Department of Environment, Great Lakes, and Energy, setting forth the conditions of the permit which are being challenged and specifying the grounds for the challenge. The Department of Licensing and Regulatory Affairs may reject any petition filed more than 60 days after issuance as being untimely.

PART I

Section A. Limitations and Monitoring Requirements

1. Authorized Discharges

a. Authorized Outfalls and Points of Discharge
This permit authorizes the discharge of storm water from the permittee's MS4 to the surface waters of the state via the outfalls and points of discharge identified in the permittee's application and as modified in accordance with this permit. Such discharges shall be controlled and monitored by the permittee in accordance with this permit.

b. Nested MS4 Discharges
This permit authorizes the discharge of storm water to surface waters of the state from a nested MS4 owned or operated by public bodies that include, but are not limited to, public school districts; public universities; airports; or county, state, or federal agencies. The permittee may request to modify permit coverage to add or remove a nested MS4 by submitting a request to the Department for approval. Modifications to the permit coverage may result in a permit modification, after opportunity for public comment.

c. Discharges Authorized Under Other National Pollutant Discharge Elimination System (NPDES) Permits
This permit does not prohibit the use of an MS4 for other discharges authorized under other NPDES permits, or equivalent Department approval under the NREPA or the Federal Act.

d. Water Quality Requirements
Discharges from the permittee's MS4 shall not cause or contribute to an exceedance of water quality standards in the receiving waters. This includes, but is not limited to, the requirement set forth in R 323.1050 of the Water Quality Standards stating that the receiving waters shall not have any of the following unnatural physical properties as a result of the discharge, in quantities which are or may become injurious to any designated use: turbidity, color, oil films, floating solids, foams, settleable solids, suspended solids, or deposits.

2. Outfall or Point of Discharge Identified, Constructed, or Installed After Permit Issuance

a. Outfall or Point of Discharge Within the Permittee's Regulated Area
Authorization from the Department is required to discharge storm water to a surface water of the state from a permittee owned or operated outfall or point of discharge identified, constructed, or installed after issuance but during the term of this permit and located within the permittee's regulated area as identified in the application. For each outfall or point of discharge identified, constructed, or installed after issuance but during the term of this permit, the permittee shall request authorization to discharge storm water by providing the following to the Department in a written request:

1) whether the discharge is from an outfall or point of discharge;

2) the outfall or point of discharge identification number assigned by the permittee;

3) the surface water of the state receiving the discharge from the outfall or point of discharge;

4) a certification statement that the outfall or point of discharge is within the permittee's regulated area as identified in the application;

5) a certification statement that the previously approved Storm Water Management Program (Part I.A.3. of this permit) includes best management practices (BMPs) to comply with the minimum requirements of the permit for the outfall or point of discharge; and

PART I

Section A. Limitations and Monitoring Requirements

6) a certification statement that the previously approved Storm Water Management Program (Part I.A.3. of this permit) is being implemented in the regulated area served by the outfall or point of discharge, including having available an up-to-date storm sewer system map required in Part I.A.3.d.1) of this permit.

b. Outfall or Point of Discharge Outside the Permittee's Regulated Area
Authorization from the Department is required to discharge storm water to a surface water of the state from a permittee owned or operated outfall or point of discharge identified, constructed, or installed after issuance but during the term of this permit and located outside the permittee's regulated area as identified in the application (e.g., area served by an expanded MS4 or area previously served by a combined sewer system that is now separated). For each outfall or point of discharge identified, constructed, or installed after issuance but during the term of this permit, the permittee shall request authorization to discharge storm water by providing the following to the Department in a written request:

1) whether the discharge is from an outfall or point of discharge;

2) the outfall or point of discharge identification number assigned by the permittee;

3) the surface water of the state receiving the discharge from the outfall or point of discharge;

4) a map identifying the expanded regulated area served by the permittee's MS4;

5) a certification statement that the previously approved Storm Water Management Program (Part I.A.3. of this permit) includes BMPs to comply with the minimum requirements of the permit for the outfall or point of discharge and expanded regulated area; and

6) a certification statement that the previously approved Storm Water Management Program (Part I.A.3. of this permit) is being implemented in the expanded regulated area served by the outfall or point of discharge, including having available an up-to-date storm sewer system map as required in Part I.A.3.d.1) of this permit.

c. Upon review of the request to authorize the discharge from an outfall or point of discharge identified, constructed, or installed after issuance but during the term of this permit in accordance with Part I.A.2.a. or Part I.A.2.b. of this permit, the Department may determine that a permit modification is required, after opportunity for public comment. The Department will notify the permittee if a modification is required.

3. Storm Water Management Program (SWMP)

The permittee submitted a SWMP with its application for an NPDES permit. The SWMP is approved as submitted. The permittee shall implement the approved SWMP to comply with the minimum requirements identified in this permit. The SWMP shall cover the regulated area served by, or otherwise contributing to discharges from, the MS4 owned or operated by the permittee identified in the application. The permittee shall implement and enforce the SWMP to reduce the discharge of pollutants from the MS4 to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the NREPA and the Federal Act. The approved SWMP is an enforceable part of this permit and any Department approved modifications made to the SWMP shall also become enforceable parts of this permit.

a. Enforcement Response Procedure (ERP)
The permittee shall implement the ERP for violations of the permittee's ordinances or regulatory mechanisms identified in the SWMP to the maximum extent practicable. The ERP shall be implemented to compel compliance with the permittee's ordinances and/or regulatory mechanisms and to deter continuing violations.

PART I

Section A. Limitations and Monitoring Requirements

The permittee shall track and document all enforcement conducted pursuant to the permittee's ERP. At a minimum, the permittee shall track and document the following: the name of the person responsible for violating the permittee's ordinance or regulatory mechanism; the date and location of the violation; a description of the violation; a description of the enforcement response used; a schedule for returning to compliance; and the date the violation was resolved.

b. Public Participation/Involvement Program (PPP)
The permittee shall implement the PPP to encourage public participation/involvement in the implementation and periodic review of the SWMP to the maximum extent practicable. The permittee shall implement the PPP as part of the SWMP. The permittee has chosen to work collaboratively with watershed or regional partners to implement the PPP or part of the PPP, therefore each permittee working collaboratively is responsible for complying with the PPP as described in the SWMP.

The PPP requires implementation of the following minimum requirements:

1) The procedure for making the SWMP available for public inspection and comment, including complying with local public notice requirements, as appropriate; and

2) The procedure for inviting public participation and involvement in the implementation and periodic review of the SWMP.

c. Public Education Program (PEP)
The permittee shall implement the PEP as part of the SWMP to the maximum extent practicable. At the minimum, the PEP shall promote, publicize, and facilitate education for the purpose of encouraging the public to reduce the discharge of pollutants in storm water runoff. The PEP shall be implemented to achieve measurable improvements in the public's understanding of storm water pollution and efforts to reduce the impacts of storm water pollution.

The PEP requires implementation of the following minimum requirements:

1) BMPs to address the following PEP topics:

(a) Promote public responsibility and stewardship in the permittee's watershed.

(b) Inform and educate the public about the connection of the MS4 to area waterbodies and the potential impacts discharges can have on surface waters of the state.

(c) Educate the public on illicit discharges and promote public reporting on illicit discharges and improper disposal of materials into the MS4.

(d) Promote preferred cleaning materials and procedures for car, pavement, and power washing.

(e) Inform and educate the public on proper application and disposal of pesticides, herbicides, and fertilizers.

(f) Promote proper disposal practices for grass clippings, leaf litter, and animal wastes that may enter into the MS4.

(g) Identify and promote the availability, location, and requirements of facilities for collection or disposal of household hazardous wastes, travel trailer sanitary wastes, chemicals, and motor vehicle fluids.

(h) Inform and educate the public on proper septic system care and maintenance, and how to recognize system failure.

PART I

Section A. Limitations and Monitoring Requirements

(i) Educate the public on, and promote the benefits of, green infrastructure and Low Impact Development.

(j) Identify and educate commercial, industrial, and institutional entities likely to contribute pollutants to storm water runoff.

2) The procedure for determining the overall effectiveness of implementation and the process for modifying the PEP to address ineffective implementation. The Department may determine that a permit modification is required, after opportunity for public comment, based on modifications to the PEP. The Department will notify the permittee if a modification is required.

d. Illicit Discharge Elimination Program (IDEP)

The permittee shall implement and enforce the IDEP to detect and eliminate illicit discharges and connections to the permittee's MS4. The permittee shall implement the IDEP as part of the SWMP to the maximum extent practicable. The permittee has chosen to work collaboratively with watershed or regional partners to implement the IDEP or part of the IDEP, therefore each permittee working collaboratively is responsible for complying with the IDEP as described in the SWMP.

The IDEP requires implementation of the following minimum requirements:

1) An available, up-to-date storm sewer system map identifying the following: the storm sewer system, location of all outfalls and points of discharge the permittee owns or operates in the regulated area, and the names and location of all surface waters of the state that receive discharges from the permittee's MS4. The map shall be retained by the permittee and made available to the Department upon request. The map shall be maintained and updated as outfalls and points of discharge are identified, constructed, and installed in accordance with Part I.A.2. of this permit.

2) The plan to detect and eliminate non-storm water discharges to the permittee's MS4, including illegal dumping/spills. The plan includes the following:

a) A procedure for identifying priority areas for field observations. The permittee shall conduct field observations in accordance with the procedure identifying the priority area(s) developed as part of the IDEP.

b) A procedure for conducting field observations, field screening, and source investigations. The permittee shall conduct a field observation in accordance with the procedure during dry-weather at least once during the term of the permit. Field screening and source investigation shall be conducted in accordance with the schedule in the procedure.

Field observations, field screening, and source investigations shall include the following:

(1) Field Observation – The permittee shall observe the outfall or point of discharge for the following during dry-weather in accordance with the procedure: presence/absence of flow, water clarity, color, odor, floatable materials, deposits/stains on the discharge structure and bank, vegetation condition, structural condition, and biology (e.g. bacterial sheens, algae, and slimes).

(2) Field Screening – If flow is observed at an outfall or point of discharge, the permittee shall analyze the flow for the indicator parameters identified in the procedure. If the source of an illicit discharge is identified during the field observation, field screening may not be necessary.

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Section A. Limitations and Monitoring Requirements

(3) Source Investigation – If the source of the illicit discharge was not identified by the field screening, the permittee shall conduct an investigation to identify the source in accordance with the procedure. If the permittee opts to use tracer dyes, the discharge of the dyes shall be authorized in accordance with Part I.A.6. of this permit.

If the permittee is made aware of non-storm water discharges outside the priority areas, illegal dumping/spills, or complaints received, the permittee shall conduct field observations and follow-up field screening and source investigations as appropriate in accordance with the procedure, including the schedule, in the IDEP. The permittee shall immediately report any release of any polluting material which occurs to the surface waters or groundwaters of the state in accordance with Part II.C.7. of this permit.

c) A procedure for responding to illicit discharges and pursuing enforcement action. The permittee shall implement the procedure to respond and pursue enforcement action once the source of the illicit discharge is identified, including the corrective action required to eliminate the illicit discharge. The permittee shall also implement the procedure to respond to illegal spills/dumping. For each illicit discharge not eliminated within 90 days of its discovery, the permittee shall provide, with the next progress report due, a written certification that the illicit discharge was eliminated or a description of how the illicit discharge will be eliminated.

3) The employee training program, which includes the following:

a) Training on techniques for identifying illicit discharges and connections, including field observations, field screening, and source investigations;

b) Training on procedures for reporting, responding to, and eliminating an illicit discharge or connection and the proper enforcement response; and

c) A schedule and requirement for training at least once during the term of the permit for existing staff and within the first year of hire for new staff.

4) The procedure for IDEP evaluation and determining the overall effectiveness of the IDEP.

e. Construction Storm Water Runoff Control Program

The permittee shall implement the construction storm water runoff control program to address areas of construction activity that disturb one (1) or more acres, including projects less than one (1) acre that are part of a larger common plan of development or sale. The permittee shall implement the construction storm water runoff control program as part of the SWMP to the maximum extent practicable.

The construction storm water runoff control program requires implementation of the following minimum requirements:

1) The procedure to notify the Part 91 Agency, or appropriate staff (if the permittee is a Part 91 Agency), when soil or sediment is discharged to the permittee's MS4 from a construction activity.

2) The procedure to notify the Department when soil, sediment, or other pollutants are discharged to the permittee's MS4 from a construction activity.

3) The procedure for ensuring that construction activity one (1) acre or greater in total earth disturbance with the potential to discharge to the permittee's MS4 obtains a Part 91 permit or is conducted by an approved Authorized Public Agency, as appropriate.

4) The procedure to advise the landowner or recorded easement holder of the State of Michigan Permit by Rule (R 323.2190 of the Part 21 Rules promulgated pursuant to Part 31 of the NREPA).

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f. Post-Construction Storm Water Runoff Program

The permittee shall implement and enforce the program to address post-construction storm water runoff from new development and redevelopment projects that disturb one (1) or more acres, including projects less than one (1) acre that are part of a larger common plan of development or sale, and that discharge into the permittee's MS4. The permittee shall implement and enforce the post-construction storm water control program as part of the SWMP, to the maximum extent practicable and in accordance with the approved ordinance or regulatory mechanism.

1) On or before March 1, 2021, the permittee shall submit to the Department for approval an in-effect Post-Construction Storm Water Control regulatory mechanism to achieve the post-construction storm water runoff performance standards set forth in a) and b) below at the project site (including projects where the permittee is the project developer). Upon Department approval of the in-effect regulatory mechanism, the permittee shall implement and enforce the regulatory mechanism requiring implementation of BMPs by the project developer (including the permittee if the permittee is the project developer) to achieve the post-construction storm water runoff performance standards at the project site to the maximum extent practicable.

a) Water Quality Control Performance Standard

Treat the post-development runoff volume generated from a 1.0-inch rainfall event. BMPs shall be designed on a site-specific basis to achieve a minimum of 80 percent removal of total suspended solids (TSS) as compared with uncontrolled runoff or a discharge concentration of TSS not to exceed 80 milligrams per liter (mg/l).

b) Channel Protection Control Performance Standard (CPC)

The CPC shall be implemented to limit the surface runoff rate and volume at the project site to maintain or restore stable hydrology in receiving waters. An alternative CPC was approved as part of the SWMP. The alternative CPC requires implementation of the following at the project site to the maximum extent practicable:

(1) Channel Protection Volume Control (CPVC): Retain onsite the post-development runoff volume from a 1.3-inch rainfall event, and

(2) Channel Protection Rate Control (CPRC): Provide extended detention for the post-development runoff volume from a 1.9-inch rainfall event.

On or before April 1, 2022 and on or before April 1 of each year following, as part of the approved alternative, the permittee shall submit an annual report to the Department for the previous calendar year documenting the results of implementing the alternative CPC within the regulated area. The annual report shall tabulate the following for each development or redevelopment project subject to the permittee's alternative CPC (including projects where the permittee is the project developer) and provide an overall summary for each reporting line:

(1) Change in impervious area, pervious area by cover type, and total area by site.

(2) CPVC volume provided at the site.

(3) Difference between required and provided CPVC volume by site.

(4) Percent of site in each Hydrologic Soil Group (Type A, B, C. D).

(5) Site location in geographic information system (GIS) polygon format.

(6) Site outfalls and points of discharge in GIS point format.

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Section A. Limitations and Monitoring Requirements

(7) Site MS4 outfall drainage area in GIS polygon format, including any offsite drainage that passes through the outfall or points of discharge.

(8) CPRC volume provided at the site.

(9) Difference between required and provided CPRC volume by site.

The Department will provide a written determination to the permittee based on the review of each progress report. The permittee shall submit available documentation to support implementation of the alternative CPC, such as approved project plans, upon request. The permittee may submit information to support implementation of the alternative CPC in addition to the reporting requirements above as part of the progress report.

The alternative CPC approval is limited to the permit term. The results from the annual reports will be evaluated as part of permit reissuance using methods agreed to by the permittee and the Department, which may result in an updated alternative CPC. A modification to the alternative CPC during the permit term will result in a permit modification after opportunity for public comment.

2) The permittee shall implement and enforce the following site-specific requirements as part of meeting the post-construction storm water runoff performance standards set forth in a) and b), above:

a) The procedure for reviewing the use of infiltration BMPs to achieve the performance standards in areas of soil or groundwater contamination in a manner that does not exacerbate existing conditions.

b) The ordinance or regulatory mechanism requiring BMPs to address the associated pollutants in potential hot spots as part of meeting the performance standards. Hot spots include areas with the potential for significant pollutant loading including, but not limited to, the following: gas stations; vehicle maintenance and repair; auto recyclers; recycling centers and scrap yards; landfills; solid waste facilities; and railroads. Hot spots also include areas with the potential for contaminating public water supply intakes.

3) All structural and vegetative BMPs installed and implemented to meet the performance standards shall be operated and maintained in perpetuity by the BMP owner/operator. The permittee shall implement and enforce the ordinance or regulatory mechanism program to ensure long-term operation and maintenance of BMPs.

4) The ordinance or regulatory mechanism and procedures for site plan review and approval for projects that disturb one (1) or more acres, including projects less than one (1) acre that are part of a larger common plan of development or sale, and discharge to the permittee's MS4, including projects where the permittee is the developer. The site plan review and approval shall demonstrate compliance with the performance standards and long-term operation and maintenance requirements of this permit.

g. Pollution Prevention and Good Housekeeping Activities for Municipal Operations

The permittee shall implement the pollution prevention and good housekeeping program with the goal of preventing or reducing pollutant runoff from municipal facilities and operations that discharge storm water to surface waters of the state. The permittee shall implement the program as part of the SWMP to the maximum extent practicable.

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Section A. Limitations and Monitoring Requirements

1) Municipal Facility and Structural Storm Water Control Inventory

The permittee shall make available to the Department upon request an up-to-date map or maps of the facilities and structural storm water controls owned or operated by the permittee with a discharge to surface waters of the state in the regulated area. In accordance with the procedure for updating and revising the permittee's facility inventory and map(s), the permittee shall submit to the Department the type and location for any new facility obtained or constructed during this permit term with a discharge of storm water to surface waters of the state and the information requested in Part I.A.2. of the permit.

2) Facility-Specific Storm Water Management

The permittee shall implement the facility-specific standard operating procedure (SOP) for each facility the permittee identified as having the high potential to discharge pollutants to surface waters of the state. The permittee shall implement the BMPs identified in the procedure to prevent or reduce pollutant runoff at each facility the permittee identified as having the medium or low potential to discharge pollutants to surface waters of the state. The permittee shall assess new facilities for the potential to discharge pollutants to surface waters of the state in accordance with the procedure to determine a priority level. High-priority facilities shall include permittee-owned or operated fleet maintenance and storage yards unless a demonstration is submitted and approved by the Department demonstrating how the permittee's fleet maintenance or storage yard has the low potential to discharge pollutants to surface waters of the state. The assessment shall be submitted in writing to the Department for approval within 30 days of ownership or operation of the new facility. The permittee shall certify in writing to the Department that a facility-specific SOP is being implemented within 90 days of ownership or operation of a new high-priority facility. Within 90 days of ownership or operation, the permittee shall certify in writing to the Department that BMPs are being implemented in accordance with the procedure developed to prevent or reduce pollutant runoff at each new medium- or low-priority facility. For new facilities, the Department may determine that a permit modification is required, after opportunity for public comment. The Department will notify the permittee if a modification is required. The permittee shall document all other changes to the facility assessment as part of the progress report and as an update to the procedure.

The facility-specific SOP shall be kept at the site described in the SOP and made available upon request by the Department. The facility-specific SOP for each high-priority facility shall include implementation of the following.

a) Structural and non-structural storm water controls to prevent or reduce the discharge of pollutants to surface waters of the state.

b) Up-to-date list of significant materials stored on-site that could pollute storm water with a description of the handling and storage requirements and potential to discharge for each significant material.

c) Good housekeeping practices including, but not limited to, maintaining a clean and orderly facility, properly storing and covering materials, and minimizing pollutant sources to prevent or reduce pollutant runoff.

d) Routine maintenance and inspections of storm water management and control devices to ensure materials and equipment are clean and orderly and prevent or reduce pollutant runoff. The written report of the inspection and corrective actions shall be retained in accordance with Part II.B.5. of this permit.

e) Comprehensive site inspections at least once every six (6) months. The comprehensive site inspection shall include an inspection of all structural storm water controls and a review of non-structural storm water controls to prevent or reduce pollutant runoff. A written report of the inspection and corrective actions shall be retained in accordance with Part II.B.5. of this permit.

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Section A. Limitations and Monitoring Requirements

3) Structural Storm Water Control Operation and Maintenance Activities

a) The permittee shall implement the procedures for inspecting, cleaning, and maintaining permittee-owned or operated catch basins in the regulated area using the priority level assigned to each catch basin. The permittee shall document changes to the priority level for a catch basin as part of the progress report and as an update to the procedure.

The permittee shall also implement the procedure for dewatering and disposal of materials extracted from the catch basins in accordance with Part 111 (Hazardous Waste), Part 115 (Solid Waste), and Part 121 (Liquid Industrial Waste) of the NREPA.

b) The permittee shall implement the procedure for inspecting and maintaining permittee-owned or operated structural storm water controls other than catch basins in the regulated area. The permittee shall document changes to the procedure as part of the progress report and as an update to the procedure.

c) The permittee shall implement the procedure requiring that new permittee-owned or operated facilities or structural storm water controls to address water quantity be designed and implemented in accordance with the post-construction storm water runoff performance standards and long-term operation and maintenance requirements in Part I.A.3.f. of this permit.

4) Municipal Operations and Maintenance Activities

a) The permittee shall implement the procedure, including the BMPs identified, to prevent or reduce pollutant runoff from the permittee's operation and maintenance activities identified in the SWMP. The permittee shall document changes to the assessment of operation and maintenance activities for the potential to discharge pollutants to surface waters of the state as part of the progress report and as an update to the procedure.

b) The permittee shall implement the procedure for the street sweeping program for permittee-owned or operated streets, parking lots, or other impervious infrastructure in the regulated area using the sweeping methods and assigned priority levels identified in the procedure. The permittee shall document changes to the priority level for a street, parking lot, or other impervious infrastructure as part of the progress report and as an update to the procedure.

The permittee shall also implement the procedure for dewatering and disposal of street sweeper waste material.

5) Managing Vegetated Properties

The permittee shall implement the procedure requiring the permittee's pesticide applicator to be certified by the State of Michigan as an applicator in the applicable category, to prevent or reduce pollutant runoff from vegetated land.

6) Employee Training

The permittee shall implement the employee training program to train employees involved in implementing pollution prevention and good housekeeping activities. At a minimum, existing staff shall be trained once during the permit cycle and new hire employees within the first year of their hire date.

7) Contractor Requirements and Oversight

The permittee shall implement the procedure requiring contractors hired by the permittee to perform municipal operation and maintenance activities that comply with the permittee's pollution prevention and good housekeeping program and contractor oversight to ensure compliance.

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Section A. Limitations and Monitoring Requirements

h. Total Maximum Daily Load (TMDL) Implementation Plan
The permittee shall implement the TMDL Implementation Plan to reduce the discharge of pollutants from the permittee's MS4 to make progress in meeting Water Quality Standards. The permittee shall implement the TMDL Implementation Plan as part of the SWMP.

The following TMDLs are applicable to the discharge from the permittee's MS4:

Name of TMDL	Pollutant of Concern
Clinton River	*E.coli*
Red Run Drain and Bear Creek	*E.coli*
Rouge River	Biota (sediment) and *E.coli*
Johnson Creek	Dissolved oxygen
Kent Lake	Phosphorus
Norton Creek	Dissolved oxygen
Strawberry Lake	Phosphorus

The permittee shall implement the prioritized BMPs included in the TMDL Implementation Plan during the permit cycle to make progress in achieving the pollutant load reduction requirement in the TMDL. The permittee shall review, update, and revise the list of BMPs implemented as part of the TMDL Implementation Plan in accordance with the procedure included in the SWMP. The Department may determine that a permit modification is required, after opportunity for public comment, based on modifications to the TMDL Implementation Plan. The Department will notify the permittee if a modification is required.

The permittee shall implement the monitoring plan included in the TMDL Implementation Plan for assessing the effectiveness of the BMPs implemented in making progress toward achieving the TMDL pollutant load reduction. Available monitoring data shall be submitted with each progress report.

4. SWMP Modifications

a. SWMP Modifications Requested by the Permittee
Modifications to the previously approved SWMP may be requested by the permittee as follows:

1) Modifications adding BMPs (but not replacing, subtracting, or affecting the level of implementation of any other BMP) to the previously approved SWMP may be made by the permittee at any time upon written notification to the Department. Notification shall include a description of the modification, which may include a description of a new BMP with a corresponding measurable goal. Upon notification to the Department, the modification is considered an enforceable part of the approved SWMP.

2) Modifications replacing an ineffective or unfeasible BMP identified in the previously approved SWMP with an alternative BMP may be requested at any time by written notification to the Department. The ineffective or unfeasible BMP identified shall not be replaced in the previously approved SWMP unless the replacement is approved by the Department. Modifications to the previously approved SWMP may result in a permit modification after opportunity for public comment. Such requests shall include the following:

a) an analysis of why the BMP is ineffective or unfeasible (including cost-prohibitive);

b) a measurable goal for the replacement BMP; and

c) an analysis of why the replacement BMP is expected to achieve the intent of the BMP to be replaced.

PART I

Section A. Limitations and Monitoring Requirements

3) Modifications subtracting an ineffective or unfeasible BMP identified in the previously approved SWMP may be requested by written notification to the Department. The identified BMP shall not be subtracted from the previously approved SWMP unless the subtraction is approved by the Department. Modifications to the previously approved SWMP may result in a permit modification after opportunity for public comment. Such requests shall include the following:

a) an analysis of why the BMP is ineffective or unfeasible (including cost prohibitive); and

b) a determination of why the removal of the BMP will not change the permittee's ability to comply with the permit requirements.

b. Modifications Required by the Department
The Department may require the permittee to modify the SWMP as needed to:

1) address contributions from the permittee's MS4 discharge that impair receiving water quality;

2) include more stringent requirements necessary to comply with new state or federal statutory or regulatory requirements; and/or

3) include such other conditions deemed necessary by the Department to comply with the goals and requirements of the Federal Act or the NREPA, including the requirement to reduce the discharge of pollutants from the MS4 to the maximum extent practicable.

5. Request for Approval to Use Water Treatment Additives

This permit does not authorize the use of any water treatment additive without prior written approval from the Department. Such approval is authorized under separate correspondence. Water treatment additives include any materials that are added to water used at the facility, or to wastewater generated by the facility, to condition or treat the water. Permittees proposing to use water treatment additives, including a proposed increased concentration of a previously approved water treatment additive, shall submit a request for approval via the Department's MiWaters system. The MiWaters website is located at https://miwaters.deq.state.mi.us. Instructions for submitting such a request may be obtained at http://www.michigan.gov/npdes (near the bottom of that page, click on one or both of the links located under the Water Treatment Additives banner). Additional monitoring and reporting may be required as a condition of approval to use the water treatment additive.

A request for approval to use water treatment additives shall include all of the following usage and discharge information for each water treatment additive proposed to be used:

a. The Safety Data Sheet (SDS);

b. Ingredient information, including the name of each ingredient, CAS number for each ingredient, and fractional content by weight for each ingredient;

c. The proposed water treatment additive discharge concentration with supporting calculations;

d. The discharge frequency (i.e., number of hours per day and number of days per year);

e. The outfall(s) and monitoring point(s) from which the water treatment additive is to be discharged;

f. The type of removal treatment, if any, that the water treatment additive receives prior to discharge;

g. The water treatment additive's function (i.e., microbiocide, flocculant, etc.);

h. The SDS shall include a 48-hour LC50 or EC50 for a North American freshwater planktonic crustacean (either *Ceriodaphnia* sp., *Daphnia* sp., or *Simocephalus* sp.); The results shall be based on the whole water treatment additive, shall not be results based on a similar product, and shall not be estimated; and

PART I

Section A. Limitations and Monitoring Requirements

i. The SDS shall include the results of a toxicity test for one (1) other North American freshwater aquatic species (other than a planktonic crustacean) that meets a minimum requirement of R 323.1057(2) of the Water Quality Standards. The results shall be based on the whole water treatment additive, shall not be results based on a similar product, and shall not be estimated. Examples of tests that would meet this requirement include a 96-hour LC50 for rainbow trout, bluegill, or fathead minnow.

6. Tracer Dye Discharges

This permit does not authorize the discharge of tracer dyes without approval from the Department. Requests to discharge tracer dyes shall be submitted to the Department in accordance with Rule 1097 (R 323.1097 of the Michigan Administrative Code).

7. Storm Water Program Manager (Facility Contact)

The "Facility Contact" was specified in the application. The permittee may replace the facility contact at any time, and shall notify the Department in writing within 10 days after replacement (including the name, address and telephone number of the new facility contact).

a. The facility contact shall be (or a duly authorized representative of this person):
- for a corporation, a principal executive officer of at least the level of vice president; or a designated representative if the representative is responsible for the overall operation of the facility from which the discharge originates, as described in the permit application or other NPDES form,
- for a partnership, a general partner,
- for a sole proprietorship, the proprietor, or
- for a municipal, state, or other public facility, either a principal executive officer, the mayor, village president, city or village manager or other duly authorized employee.

b. A person is a duly authorized representative only if:
- the authorization is made in writing to the Department by a person described in paragraph a. of this section; and
- the authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the facility (a duly authorized representative may thus be either a named individual or any individual occupying a named position).

Nothing in this section obviates the permittee from properly submitting reports and forms as required by law.

PART I

Section B. Program Assessment and Reporting

1. Progress Reports

Progress reports shall be submitted on or before April 1, 2022 and on or before April 1 every two (2) years following. The Department may approve alternate dates for progress report submittal if requested and adequately justified by the permittee. Each progress report shall contain the following information for the entire period that has elapsed since the last progress report submittal (i.e., the reporting cycle):

a. Compliance Assessment
The permittee shall describe the status of compliance with the approved SWMP identified in Part I.A.3 of this permit. The permittee shall assess and describe the appropriateness of the BMPs identified in the SWMP. The report shall describe the progress made towards achieving the identified measurable goals for each of the BMPs, and specific evaluation criteria as follows:

1) For the PEP, provide a summary of the evaluation of the overall effectiveness of the PEP, using the evaluation methods described in the PEP.

2) For the IDEP, provide a summary of the evaluation and determination of the overall effectiveness of the IDEP, using the evaluation methods described in the IDEP. For each illicit discharge that was not eliminated within 90 days of its discovery the permittee shall provide a written certification that the illicit discharge was eliminated or a description of how the illicit discharge will be eliminated.

3) If applicable, the permittee shall submit to the Department any new outfall or point of discharge information as required in Part I.A.2. of this permit.

4) For the TMDL Implementation Plan, if monitoring data is available in accordance with the monitoring plan, provide an assessment of progress made toward achieving the TMDL pollutant load reduction requirement.

b. Data and Results
The permittee shall provide a summary of all of the information collected and analyzed, including monitoring data, if any, during the reporting cycle.

c. Upcoming Activities
The permittee shall provide a summary of the BMPs to be implemented during the next reporting cycle.

d. Changes to BMPs and Measurable Goals
The permittee shall describe any changes to BMPs or measurable goals in the approved SWMP. In accordance with the permit, these changes will be reviewed to determine if a permit modification is necessary. The Department will notify the permittee if a permit modification is required.

e. Notice of Changes in Nested Jurisdiction Agreements
The permittee shall identify any nested jurisdictions that enter into or terminate permit agreements with the permittee which were not identified in the SWMP. The permittee may request to modify the permit coverage to add or remove a nested MS4 by submitting a request to the Department for approval in accordance with Part I.A.1.b. of this permit. Modifications to the permit coverage may result in a permit modification, after opportunity for public comment.

f. Required Signatures
All reports required by this permit, and other information requested by the Department, shall be signed by either a principal executive officer or ranking elected official, or by a duly authorized representative of that person in accordance with 40 CFR 122.22(b).

PART II

Part II may include terms and /or conditions not applicable to discharges covered under this permit.

Section A. Definitions

Acute toxic unit (TU_A) means $100/LC_{50}$ where the LC_{50} is determined from a whole effluent toxicity (WET) test which produces a result that is statistically or graphically estimated to be lethal to 50% of the test organisms.

Annual monitoring frequency refers to a calendar year beginning on January 1 and ending on December 31. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Authorized public agency means a state, local, or county agency that is designated pursuant to the provisions of Section 9110 of Part 91, Soil and Sedimentation Control, of the NREPA, to implement soil erosion and sedimentation control requirements with regard to construction activities undertaken by that agency.

Best management practices (BMPs) means structural devices or nonstructural practices that are designed to prevent pollutants from entering into storm water, to direct the flow of storm water, or to treat polluted storm water.

Bioaccumulative chemical of concern (BCC) means a chemical which, upon entering the surface waters, by itself or as its toxic transformation product, accumulates in aquatic organisms by a human health bioaccumulation factor of more than 1000 after considering metabolism and other physiochemical properties that might enhance or inhibit bioaccumulation. The human health bioaccumulation factor shall be derived according to R 323.1057(5). Chemicals with half-lives of less than 8 weeks in the water column, sediment, and biota are not BCCs. The minimum bioaccumulation concentration factor (BAF) information needed to define an organic chemical as a BCC is either a field-measured BAF or a BAF derived using the biota-sediment accumulation factor (BSAF) methodology. The minimum BAF information needed to define an inorganic chemical as a BCC, including an organometal, is either a field-measured BAF or a laboratory-measured bioconcentration factor (BCF). The BCCs to which these rules apply are identified in Table 5 of R 323.1057 of the Water Quality Standards.

Biosolids are the solid, semisolid, or liquid residues generated during the treatment of sanitary sewage or domestic sewage in a treatment works. This includes, but is not limited to, scum or solids removed in primary, secondary, or advanced wastewater treatment processes and a derivative of the removed scum or solids.

Bulk biosolids means biosolids that are not sold or given away in a bag or other container for application to a lawn or home garden.

Certificate of Coverage (COC) is a document, issued by the Department, which authorizes a discharge under a general permit.

Chronic toxic unit (TU_C) means 100/MATC or $100/IC_{25}$, where the maximum acceptable toxicant concentration (MATC) and IC_{25} are expressed as a percent effluent in the test medium.

Class B biosolids refers to material that has met the Class B pathogen reduction requirements or equivalent treatment by a Process to Significantly Reduce Pathogens (PSRP) in accordance with the Part 24 Rules, Land Application of Biosolids, promulgated under Part 31 of the NREPA. Processes include aerobic digestion, composting, anaerobic digestion, lime stabilization and air drying.

Combined sewer system is a sewer system in which storm water runoff is combined with sanitary wastes.

Continuous monitoring refers to sampling/readings that occur at regular and consistent intervals throughout a 24-hour period and at a frequency sufficient to capture data that are representative of the discharge. The maximum acceptable interval between samples/readings shall be one (1) hour.

PART II

Section A. Definitions

Daily concentration
FOR PARAMETERS OTHER THAN pH, DISSOLVED OXYGEN, TEMPERATURE, AND CONDUCTIVITY – Daily concentration is the sum of the concentrations of the individual samples of a parameter taken within a calendar day divided by the number of samples taken within that calendar day. The daily concentration will be used to determine compliance with any maximum and minimum daily concentration limitations. For guidance and examples showing how to perform calculations using results below quantification levels, see the document entitled "Reporting Results Below Quantification," available at https://www.michigan.gov/documents/deq/wrd-npdes-results-quantification_620791_7.pdf.

FOR pH, DISSOLVED OXYGEN, TEMPERATURE, AND CONDUCTIVITY – The daily concentration used to determine compliance with maximum daily pH, temperature, and conductivity limitations is the highest pH, temperature, and conductivity readings obtained within a calendar day. The daily concentration used to determine compliance with minimum daily pH and dissolved oxygen limitations is the lowest pH and dissolved oxygen readings obtained within a calendar day.

Daily loading is the total discharge by weight of a parameter discharged during any calendar day. This value is calculated by multiplying the daily concentration by the total daily flow and by the appropriate conversion factor. The daily loading will be used to determine compliance with any maximum daily loading limitations. When required by the permit, report the maximum calculated daily loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMRs.

Daily monitoring frequency refers to a 24-hour day. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Department means the Michigan Department of Environment, Great Lakes, and Energy.

Detection level means the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability.

Discharge means the addition of any waste, waste effluent, wastewater, pollutant, or any combination thereof to any surface water of the state.

EC_{50} means a statistically or graphically estimated concentration that is expected to cause 1 or more specified effects in 50% of a group of organisms under specified conditions.

Fecal coliform bacteria monthly
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – Fecal coliform bacteria monthly is the geometric mean of all daily concentrations determined during a discharge event. Days on which no daily concentration is determined shall not be used to determine the calculated monthly value. The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR. If the period in which the discharge event occurred was partially in each of two months, the calculated monthly value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – Fecal coliform bacteria monthly is the geometric mean of all daily concentrations determined during a reporting month. Days on which no daily concentration is determined shall not be used to determine the calculated monthly value. The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR.

PART II

Section A. Definitions

Fecal coliform bacteria 7-day
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – Fecal coliform bacteria 7-day is the geometric mean of the daily concentrations determined during any 7 consecutive days of discharge during a discharge event. If the number of daily concentrations determined during the discharge event is less than 7 days, the number of actual daily concentrations determined shall be used for the calculation. Days on which no daily concentration is determined shall not be used to determine the value. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day geometric mean value for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. If the 7-day period was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – Fecal coliform bacteria 7-day is the geometric mean of the daily concentrations determined during any 7 consecutive days in a reporting month. If the number of daily concentrations determined is less than 7, the actual number of daily concentrations determined shall be used for the calculation. Days on which no daily concentration is determined shall not be used to determine the value. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day geometric mean for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs. The first calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

Flow-proportioned composite sample – See definition of **24-hour composite sample**.

General permit means an NPDES permit authorizing a category of similar discharges.

Geometric mean is the average of the logarithmic values of a base 10 data set, converted back to a base 10 number.

Grab sample is a single sample taken at neither a set time nor flow.

IC_{25} means the toxicant concentration that would cause a 25% reduction in a nonquantal biological measurement for the test population.

Illicit connection means a physical connection to a municipal separate storm sewer system that primarily conveys non-storm water discharges other than uncontaminated groundwater into the storm sewer; or a physical connection not authorized or permitted by the local authority, where a local authority requires authorization or a permit for physical connections.

Illicit discharge means any discharge to, or seepage into, a municipal separate storm sewer system that is not composed entirely of storm water or uncontaminated groundwater. Illicit discharges include non-storm water discharges through pipes or other physical connections; dumping of motor vehicle fluids, household hazardous wastes, domestic animal wastes, or litter; collection and intentional dumping of grass clippings or leaf litter; or unauthorized discharges of sewage, industrial waste, restaurant wastes, or any other non-storm water waste directly into a separate storm sewer.

Individual permit means a site-specific NPDES permit.

Inlet means a catch basin, roof drain, conduit, drain tile, retention pond riser pipe, sump pump, or other point where storm water or wastewater enters into a closed conveyance system prior to discharge off site or into waters of the state.

PART II

Section A. Definitions

Interference is a discharge which, alone or in conjunction with a discharge or discharges from other sources, both: 1) inhibits or disrupts a POTW, its treatment processes or operations, or its sludge processes, use or disposal; and 2) therefore, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or, of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including Title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including state regulations contained in any state sludge management plan prepared pursuant to Subtitle D of the SWDA), the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act. [This definition does not apply to sample matrix interference].

Land application means spraying or spreading biosolids or a biosolids derivative onto the land surface, injecting below the land surface, or incorporating into the soil so that the biosolids or biosolids derivative can either condition the soil or fertilize crops or vegetation grown in the soil.

LC_{50} means a statistically or graphically estimated concentration that is expected to be lethal to 50% of a group of organisms under specified conditions.

Maximum acceptable toxicant concentration (MATC) means the concentration obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test. A lower chronic limit is the highest tested concentration that did not cause the occurrence of a specific adverse effect. An upper chronic limit is the lowest tested concentration which did cause the occurrence of a specific adverse effect and above which all tested concentrations caused such an occurrence.

Maximum extent practicable means implementation of best management practices by a public body to comply with an approved storm water management program as required by a national permit for a municipal separate storm sewer system, in a manner that is environmentally beneficial, technically feasible, and within the public body's legal authority.

MBTU/hr means million British Thermal Units per hour.

MGD means million gallons per day.

Monthly concentration is the sum of the daily concentrations determined during a reporting period divided by the number of daily concentrations determined. The calculated monthly concentration will be used to determine compliance with any maximum monthly concentration limitations. Days with no discharge shall not be used to determine the value. When required by the permit, report the calculated monthly concentration in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMR.

For minimum percent removal requirements, the monthly influent concentration and the monthly effluent concentration shall be determined. The calculated monthly percent removal, which is equal to 100 times the quantity [1 minus the quantity (monthly effluent concentration divided by the monthly influent concentration)], shall be reported in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Monthly loading is the sum of the daily loadings of a parameter divided by the number of daily loadings determined during a reporting period. The calculated monthly loading will be used to determine compliance with any maximum monthly loading limitations. Days with no discharge shall not be used to determine the value. When required by the permit, report the calculated monthly loading in the "AVERAGE" column under "QUANTITY OR LOADING" on the DMR.

Monthly monitoring frequency refers to a calendar month. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Municipal separate storm sewer means a conveyance or system of conveyances designed or used for collecting or conveying storm water which is not a combined sewer and which is not part of a POTW as defined in the Code of Federal Regulations at 40 CFR 122.2.

PART II

Section A. Definitions

Municipal separate storm sewer system (MS4) means all separate storm sewers that are owned or operated by the United States, a state, city, village, township, county, district, association, or other public body created by or pursuant to state law, having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under state law, such as a sewer district, flood control district, or drainage district, or similar entity, or a designated or approved management agency under Section 208 of the Clean Water Act that discharges to the waters of the state. This term includes systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewers in very discrete areas, such as individual buildings.

National Pretreatment Standards are the regulations promulgated by or to be promulgated by the Federal Environmental Protection Agency pursuant to Section 307(b) and (c) of the Clean Water Act. The standards establish nationwide limits for specific industrial categories for discharge to a POTW.

No observed adverse effect level (NOAEL) means the highest tested dose or concentration of a substance which results in no observed adverse effect in exposed test organisms where higher doses or concentrations result in an adverse effect.

Noncontact cooling water is water used for cooling which does not come into direct contact with any raw material, intermediate product, by-product, waste product or finished product.

Nondomestic user is any discharger to a POTW that discharges wastes other than or in addition to water-carried wastes from toilet, kitchen, laundry, bathing or other facilities used for household purposes.

Nonstructural controls are practices or procedures implemented by employees at a facility to manage storm water or to prevent contamination of storm water.

NPDES means National Pollutant Discharge Elimination System.

Outfall is the location at which a point source discharge first enters a surface water of the state.

Part 91 agency means an agency that is designated by a county board of commissioners pursuant to the provisions of Section 9105 of Part 91 of the NREPA; an agency that is designated by a city, village, or township in accordance with the provisions of Section 9106 of Part 91 of the NREPA; or the Department for soil erosion and sedimentation control activities under Part 615, Supervisor of Wells; Part 631, Reclamation of Mining Lands; or Part 632, Nonferrous Metallic Mineral Mining, of the NREPA, pursuant to the provisions of Section 9115 of Part 91 of the NREPA.

Part 91 permit means a soil erosion and sedimentation control permit issued by a Part 91 agency pursuant to the provisions of Part 91 of the NREPA.

Partially treated sewage is any sewage, sewage and storm water, or sewage and wastewater, from domestic or industrial sources that is treated to a level less than that required by the permittee's NPDES permit, or that is not treated to national secondary treatment standards for wastewater, including discharges to surface waters from retention treatment facilities.

Point of discharge is the location of a point source discharge where storm water is discharged directly into a separate storm sewer system.

Point source discharge means a discharge from any discernible, confined, discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, or rolling stock. Changing the surface of land or establishing grading patterns on land will result in a point source discharge where the runoff from the site is ultimately discharged to waters of the state.

PART II

Section A. Definitions

Polluting material means any material, in solid or liquid form, identified as a polluting material under the Part 5 Rules, Spillage of Oil and Polluting Materials, promulgated under Part 31 of the NREPA (R 324.2001 through R 324.2009 of the Michigan Administrative Code).

POTW is a publicly owned treatment work.

Predevelopment is the last land use prior to the planned new development or redevelopment.

Pretreatment is reducing the amount of pollutants, eliminating pollutants, or altering the nature of pollutant properties to a less harmful state prior to discharge into a public sewer. The reduction or alteration can be by physical, chemical, or biological processes, process changes, or by other means. Dilution is not considered pretreatment unless expressly authorized by an applicable National Pretreatment Standard for a particular industrial category.

Public (as used in the MS4 individual permit) means all persons who potentially could affect the authorized storm water discharges, including, but not limited to, residents, visitors to the area, public employees, businesses, industries, and construction contractors and developers.

Public body means the United States; the state of Michigan; a city, village, township, county, school district, public college or university, or single-purpose governmental agency; or any other body which is created by federal or state statute or law.

Qualified Personnel means an individual who meets qualifications acceptable to the Department and who is authorized by an Industrial Storm Water Certified Operator to collect the storm water sample.

Qualifying storm event means a storm event causing greater than 0.1 inch of rainfall and occurring at least 72 hours after the previous measurable storm event that also caused greater than 0.1 inch of rainfall. Upon request, the Department may approve an alternate definition meeting the condition of a qualifying storm event.

Quantification level means the measurement of the concentration of a contaminant obtained by using a specified laboratory procedure calculated at a specified concentration above the detection level. It is considered the lowest concentration at which a particular contaminant can be quantitatively measured using a specified laboratory procedure for monitoring of the contaminant.

Quarterly monitoring frequency refers to a three month period, defined as January through March, April through June, July through September, and October through December. When required by this permit, an analytical result, reading, value or observation shall be reported for that period if a discharge occurs during that period.

Regional Administrator is the Region 5 Administrator, U.S. EPA, located at R-19J, 77 W. Jackson Blvd., Chicago, Illinois 60604.

Regulated area means the permittee's urbanized area, where urbanized area is defined as a place and its adjacent densely-populated territory that together have a minimum population of 50,000 people as defined by the United States Bureau of the Census and as determined by the latest available decennial census.

Secondary containment structure means a unit, other than the primary container, in which significant materials are packaged or held, which is required by state or federal law to prevent the escape of significant materials by gravity into sewers, drains, or otherwise directly or indirectly into any sewer system or to the surface waters or groundwaters of the state.

Separate storm sewer system means a system of drainage, including, but not limited to, roads, catch basins, curbs, gutters, parking lots, ditches, conduits, pumping devices, or man-made channels, which is not a combined sewer where storm water mixes with sanitary wastes, and is not part of a POTW.

PART II

Section A. Definitions

Significant industrial user is a nondomestic user that: 1) is subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; or 2) discharges an average of 25,000 gallons per day or more of process wastewater to a POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process waste stream which makes up five (5) percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the permittee as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's treatment plant operation or violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

Significant materials means any material which could degrade or impair water quality, including but not limited to: raw materials; fuels; solvents, detergents, and plastic pellets; finished materials such as metallic products; hazardous substances designated under Section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (see 40 CFR 372.65); any chemical the facility is required to report pursuant to Section 313 of Emergency Planning and Community Right-to-Know Act (EPCRA); polluting materials as identified under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code); Hazardous Wastes as defined in Part 111, Hazardous Waste Management, of the NREPA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges.

Significant spills and significant leaks means any release of a polluting material reportable under the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code).

Special-use area means storm water discharges for which the Department has determined that additional monitoring is needed from: secondary containment structures required by state or federal law; lands on Michigan's List of Sites of Environmental Contamination pursuant to Part 201, Environmental Remediation, of the NREPA; and/or areas with other activities that may contribute pollutants to the storm water.

Stoichiometric means the quantity of a reagent calculated to be necessary and sufficient for a given chemical reaction.

Storm water means storm water runoff, snow melt runoff, surface runoff and drainage, and non-storm water included under the conditions of this permit.

Storm water discharge point is the location where the point source discharge of storm water is directed to surface waters of the state or to a separate storm sewer. It includes the location of all point source discharges where storm water exits the facility, including *outfalls* which discharge directly to surface waters of the state, and *points of discharge* which discharge directly into separate storm sewer systems.

Structural controls are physical features or structures used at a facility to manage or treat storm water.

SWPPP means the Storm Water Pollution Prevention Plan prepared in accordance with this permit.

Tier I value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier I toxicity database.

Tier II value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier II toxicity database.

Total maximum daily loads (TMDLs) are required by the Clean Water Act for waterbodies that do not meet water quality standards. TMDLs represent the maximum daily load of a pollutant that a waterbody can assimilate and meet water quality standards, and an allocation of that load among point sources, nonpoint sources, and a margin of safety.

Toxicity reduction evaluation (TRE) means a site-specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

PART II

Section A. Definitions

Water Quality Standards means the Part 4 Water Quality Standards promulgated pursuant to Part 31 of the NREPA, being R 323.1041 through R 323.1117 of the Michigan Administrative Code.

Weekly monitoring frequency refers to a calendar week which begins on Sunday and ends on Saturday. For a calendar week that falls entirely within a single calendar month, then when required by this permit, an analytical result, reading, value, or observation shall be reported for that week if a discharge occurs during that week. For a calendar week split across two (2) calendar months, a separate analytical result, reading, value, or observation shall be reported for each part of that week/month in which a discharge occurs.

WWSL is a wastewater stabilization lagoon.

WWSL discharge event is a discrete occurrence during which effluent is discharged to the surface water up to 10 days of a consecutive 14 day period.

3-portion composite sample is a sample consisting of three equal-volume grab samples collected at equal intervals over an 8-hour period.

7-day concentration
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – The 7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days of discharge during a WWSL discharge event divided by the number of daily concentrations determined. If the number of daily concentrations determined during the WWSL discharge event is less than 7 days, the number of actual daily concentrations determined shall be used for the calculation. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations. When required by the permit, report the maximum calculated 7-day concentration for the WWSL discharge event in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMR. If the WWSL discharge event was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – The 7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days in a reporting month divided by the number of daily concentrations determined. If the number of daily concentrations determined is less than 7, the actual number of daily concentrations determined shall be used for the calculation. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations in the reporting month. When required by the permit, report the maximum calculated 7-day concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMR. The first 7-day calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

PART II

Section A. Definitions

7-day loading
FOR WWSLs THAT COLLECT AND STORE WASTEWATER AND ARE AUTHORIZED TO DISCHARGE ONLY IN THE SPRING AND/OR FALL ON AN INTERMITTENT BASIS – The 7-day loading is the sum of the daily loadings determined during any 7 consecutive days of discharge during a WWSL discharge event divided by the number of daily loadings determined. If the number of daily loadings determined during the WWSL discharge event is less than 7 days, the number of actual daily loadings determined shall be used for the calculation. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations. When required by the permit, report the maximum calculated 7-day loading for the WWSL discharge event in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMR. If the WWSL discharge event was partially in each of two months, the value shall be reported on the DMR of the month in which the last day of discharge occurred.

FOR ALL OTHER DISCHARGES – The 7-day loading is the sum of the daily loadings determined during any 7 consecutive days in a reporting month divided by the number of daily loadings determined. If the number of daily loadings determined is less than 7, the actual number of daily loadings determined shall be used for the calculation. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations in the reporting month. When required by the permit, report the maximum calculated 7-day loading for the month in the "MAXIMUM" column under "QUANTITY OR LOADING" on the DMR. The first 7-day calculation shall be made on day 7 of the reporting month, and the last calculation shall be made on the last day of the reporting month.

24-hour composite sample is a flow-proportioned composite sample consisting of hourly or more frequent portions that are taken over a 24-hour period and in which the volume of each portion is proportional to the discharge flow rate at the time that portion is taken. A time-proportioned composite sample may be used upon approval from the Department if the permittee demonstrates it is representative of the discharge.

PART II

Section B. Monitoring Procedures

1. Representative Samples

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations promulgated pursuant to Section 304(h) of the Clean Water Act (40 CFR Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants), unless specified otherwise in this permit. **Test procedures used shall be sufficiently sensitive to determine compliance with applicable effluent limitations**. Requests to use test procedures not promulgated under 40 CFR Part 136 for pollutant monitoring required by this permit shall be made in accordance with the Alternate Test Procedures regulations specified in 40 CFR 136.4. These requests shall be submitted to the Manager of the Permits Section, Water Resources Division, Michigan Department of Environment, Great Lakes, and Energy, P.O. Box 30458, Lansing, Michigan, 48909-7958. The permittee may use such procedures upon approval.

The permittee shall periodically calibrate and perform maintenance procedures on all analytical instrumentation at intervals to ensure accuracy of measurements. The calibration and maintenance shall be performed as part of the permittee's laboratory Quality Assurance/Quality Control program.

3. Instrumentation

The permittee shall periodically calibrate and perform maintenance procedures on all monitoring instrumentation at intervals to ensure accuracy of measurements.

4. Recording Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information: 1) the exact place, date, and time of measurement or sampling; 2) the person(s) who performed the measurement or sample collection; 3) the dates the analyses were performed; 4) the person(s) who performed the analyses; 5) the analytical techniques or methods used; 6) the date of and person responsible for equipment calibration; and 7) the results of all required analyses.

5. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the Department.

PART II

Section C. Reporting Requirements

1. Start-Up Notification

If the permittee will not discharge during the first 60 days following the effective date of this permit, the permittee shall notify the Department within 14 days following the effective date of this permit, and then 60 days prior to the commencement of the discharge.

2. Submittal Requirements for Self-Monitoring Data

Part 31 of the NREPA (specifically Section 324.3110(7)); and R 323.2155(2) of Part 21, Wastewater Discharge Permits, promulgated under Part 31 of the NREPA, allow the Department to specify the forms to be utilized for reporting the required self-monitoring data. Unless instructed on the effluent limitations page to conduct "Retained Self-Monitoring," the permittee shall submit self-monitoring data via the Department's MiWaters system.

The permittee shall utilize the information provided on the MiWaters website, located at https://miwaters.deq.state.mi.us, to access and submit the electronic forms. Both monthly summary and daily data shall be submitted to the Department no later than the 20th day of the month following each month of the authorized discharge period(s). The permittee may be allowed to submit the electronic forms after this date if the Department has granted an extension to the submittal date.

3. Retained Self-Monitoring Requirements

If instructed on the effluent limits page (or otherwise authorized by the Department in accordance with the provisions of this permit) to conduct retained self-monitoring, the permittee shall maintain a year-to-date log of retained self-monitoring results and, upon request, provide such log for inspection to the staff of the Department. Retained self-monitoring results are public information and shall be promptly provided to the public upon request.

The permittee shall certify, in writing, to the Department, on or before January 10th (April 1st for animal feeding operation facilities) of each year, that: 1) all retained self-monitoring requirements have been complied with and a year-to-date log has been maintained; and 2) the application on which this permit is based still accurately describes the discharge. With this annual certification, the permittee shall submit a summary of the previous year's monitoring data. The summary shall include maximum values for samples to be reported as daily maximums and/or monthly maximums and minimum values for any daily minimum samples.

Retained self-monitoring may be denied to a permittee by notification in writing from the Department. In such cases, the permittee shall submit self-monitoring data in accordance with Part II.C.2., above. Such a denial may be rescinded by the Department upon written notification to the permittee. Reissuance or modification of this permit or reissuance or modification of an individual permittee's authorization to discharge shall not affect previous approval or denial for retained self-monitoring unless the Department provides notification in writing to the permittee.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

Monitoring required pursuant to Part 41 of the NREPA or Rule 35 of the Mobile Home Park Commission Act, 1987 PA 96, as amended, for assurance of proper facility operation, shall be submitted as required by the Department.

PART II

Section C. Reporting Requirements

5. Compliance Dates Notification

Within 14 days of every compliance date specified in this permit, the permittee shall submit a *written* notification to the Department indicating whether or not the particular requirement was accomplished. If the requirement was not accomplished, the notification shall include an explanation of the failure to accomplish the requirement, actions taken or planned by the permittee to correct the situation, and an estimate of when the requirement will be accomplished. If a written report is required to be submitted by a specified date and the permittee accomplishes this, a separate written notification is not required.

6. Noncompliance Notification

Compliance with all applicable requirements set forth in the Clean Water Act, Parts 31 and 41 of the NREPA, and related regulations and rules is required. All instances of noncompliance shall be reported as follows:

a. 24-Hour Reporting
Any noncompliance which may endanger health or the environment (including maximum and/or minimum daily concentration discharge limitation exceedances) shall be reported, verbally, within 24 hours from the time the permittee becomes aware of the noncompliance. A written submission shall also be provided within five (5) days.

b. Other Reporting
The permittee shall report, in writing, all other instances of noncompliance not described in a. above at the time monitoring reports are submitted; or, in the case of retained self-monitoring, within five (5) days from the time the permittee becomes aware of the noncompliance.

Written reporting shall include: 1) a description of the discharge and cause of noncompliance; and 2) the period of noncompliance, including exact dates and times, or, if not yet corrected, the anticipated time the noncompliance is expected to continue, and the steps taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

7. Spill Notification

The permittee shall immediately report any release of any polluting material which occurs to the surface waters or groundwaters of the state, unless the permittee has determined that the release is not in excess of the threshold reporting quantities specified in the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code), by calling the Department at the number indicated on the second page of this permit (or, if this is a general permit, on the COC); or, if the notice is provided after regular working hours, call the Department's 24-hour Pollution Emergency Alerting System telephone number, 1-800-292-4706 (calls from **out-of-state** call 1-517-373-7660).

Within ten (10) days of the release, the permittee shall submit to the Department a full written explanation as to the cause of the release, the discovery of the release, response (clean-up and/or recovery) measures taken, and preventive measures taken or a schedule for completion of measures to be taken to prevent reoccurrence of similar releases.

PART II

Section C. Reporting Requirements

8. Upset Noncompliance Notification

If a process "upset" (defined as an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee) has occurred, the permittee who wishes to establish the affirmative defense of upset shall notify the Department by telephone within 24 hours of becoming aware of such conditions; and within five (5) days, provide in writing, the following information:

a. that an upset occurred and that the permittee can identify the specific cause(s) of the upset;

b. that the permitted wastewater treatment facility was, at the time, being properly operated and maintained (note that an upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation); and

c. that the permittee has specified and taken action on all responsible steps to minimize or correct any adverse impact in the environment resulting from noncompliance with this permit.

No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

In any enforcement proceedings, the permittee, seeking to establish the occurrence of an upset, has the burden of proof.

9. Bypass Prohibition and Notification

a. Bypass Prohibition
Bypass is prohibited, and the Department may take an enforcement action, unless:

1) bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

2) there were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass; and

3) the permittee submitted notices as required under 9.b. or 9.c. below.

b. Notice of Anticipated Bypass
If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Department, if possible at least ten (10) days before the date of the bypass, and provide information about the anticipated bypass as required by the Department. The Department may approve an anticipated bypass, after considering its adverse effects, if it will meet the three (3) conditions listed in 9.a. above.

c. Notice of Unanticipated Bypass
The permittee shall submit notice to the Department of an unanticipated bypass by calling the Department at the number indicated on the second page of this permit (if the notice is provided after regular working hours, call: 1-800-292-4706) as soon as possible, but no later than 24 hours from the time the permittee becomes aware of the circumstances.

PART II

Section C. Reporting Requirements

d. Written Report of Bypass
A written submission shall be provided within five (5) working days of commencing any bypass to the Department, and at additional times as directed by the Department. The written submission shall contain a description of the bypass and its cause; the period of bypass, including exact dates and times, and if the bypass has not been corrected, the anticipated time it is expected to continue; steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass; and other information as required by the Department.

e. Bypass Not Exceeding Limitations
The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to ensure efficient operation. These bypasses are not subject to the provisions of 9.a., 9.b., 9.c., and 9.d., above. This provision does not relieve the permittee of any notification responsibilities under Part II.C.11. of this permit.

f. Definitions

1) Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

2) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

10. Bioaccumulative Chemicals of Concern (BCC)

Consistent with the requirements of R 323.1098 and R 323.1215 of the Michigan Administrative Code, the permittee is prohibited from undertaking any action that would result in a lowering of water quality from an increased loading of a BCC unless an increased use request and antidegradation demonstration have been submitted and approved by the Department.

11. Notification of Changes in Discharge

The permittee shall notify the Department, in writing, as soon as possible but no later than 10 days of knowing, or having reason to believe, that any activity or change has occurred or will occur which would result in the discharge of: 1) detectable levels of chemicals on the current Michigan Critical Materials Register, priority pollutants or hazardous substances set forth in 40 CFR 122.21, Appendix D, or the Pollutants of Initial Focus in the Great Lakes Water Quality Initiative specified in 40 CFR 132.6, Table 6, which were not acknowledged in the application or listed in the application at less than detectable levels; 2) detectable levels of any other chemical not listed in the application or listed at less than detection, for which the application specifically requested information; or 3) any chemical at levels greater than five times the average level reported in the complete application (see the first page of this permit, for the date(s) the complete application was submitted). Any other monitoring results obtained as a requirement of this permit shall be reported in accordance with the compliance schedules.

PART II

Section C. Reporting Requirements

12. Changes in Facility Operations

Any anticipated action or activity, including but not limited to facility expansion, production increases, or process modification, which will result in new or increased loadings of pollutants to the receiving waters must be reported to the Department by a) submission of an increased use request (application) and all information required under R 323.1098 (Antidegradation) of the Water Quality Standards or b) by notice if the following conditions are met: 1) the action or activity will not result in a change in the types of wastewater discharged or result in a greater quantity of wastewater than currently authorized by this permit; 2) the action or activity will not result in violations of the effluent limitations specified in this permit; 3) the action or activity is not prohibited by the requirements of Part II.C.10.; and 4) the action or activity will not require notification pursuant to Part II.C.11. Following such notice, the permit or, if applicable, the facility's COC may be modified according to applicable laws and rules to specify and limit any pollutant not previously limited.

13. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharge emanates, the permittee shall submit to the Department 30 days prior to the actual transfer of ownership or control a written agreement between the current permittee and the new permittee containing: 1) the legal name and address of the new owner; 2) a specific date for the effective transfer of permit responsibility, coverage and liability; and 3) a certification of the continuity of or any changes in operations, wastewater discharge, or wastewater treatment.

If the new permittee is proposing changes in operations, wastewater discharge, or wastewater treatment, the Department may propose modification of this permit in accordance with applicable laws and rules.

14. Operations and Maintenance Manual

For wastewater treatment facilities that serve the public (and are thus subject to Part 41 of the NREPA), Section 4104 of Part 41 and associated Rule 2957 of the Michigan Administrative Code allow the Department to require an Operations and Maintenance (O&M) Manual from the facility. An up-to-date copy of the O&M Manual shall be kept at the facility and shall be provided to the Department upon request. The Department may review the O&M Manual in whole or in part at its discretion and require modifications to it if portions are determined to be inadequate.

At a minimum, the O&M Manual shall include the following information: permit standards; descriptions and operation information for all equipment; staffing information; laboratory requirements; record keeping requirements; a maintenance plan for equipment; an emergency operating plan; safety program information; and copies of all pertinent forms, as-built plans, and manufacturer's manuals.

Certification of the existence and accuracy of the O&M Manual shall be submitted to the Department at least sixty days prior to start-up of a new wastewater treatment facility. Recertification shall be submitted sixty days prior to start-up of any substantial improvements or modifications made to an existing wastewater treatment facility.

PART II

Section C. Reporting Requirements

15. Signatory Requirements

All applications, reports, or information submitted to the Department in accordance with the conditions of this permit and that require a signature shall be signed and certified as described in the Clean Water Act and the NREPA.

The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

The NREPA (Section 3115(2)) provides that a person who at the time of the violation knew or should have known that he or she discharged a substance contrary to this part, or contrary to a permit, COC, or order issued or rule promulgated under this part, or who intentionally makes a false statement, representation, or certification in an application for or form pertaining to a permit or COC or in a notice or report required by the terms and conditions of an issued permit or COC, or who intentionally renders inaccurate a monitoring device or record required to be maintained by the Department, is guilty of a felony and shall be fined not less than $2,500.00 or more than $25,000.00 for each violation. The court may impose an additional fine of not more than $25,000.00 for each day during which the unlawful discharge occurred. If the conviction is for a violation committed after a first conviction of the person under this subsection, the court shall impose a fine of not less than $25,000.00 per day and not more than $50,000.00 per day of violation. Upon conviction, in addition to a fine, the court in its discretion may sentence the defendant to imprisonment for not more than 2 years or impose probation upon a person for a violation of this part. With the exception of the issuance of criminal complaints, issuance of warrants, and the holding of an arraignment, the circuit court for the county in which the violation occurred has exclusive jurisdiction. However, the person shall not be subject to the penalties of this subsection if the discharge of the effluent is in conformance with and obedient to a rule, order, permit, or COC of the Department. In addition to a fine, the attorney general may file a civil suit in a court of competent jurisdiction to recover the full value of the injuries done to the natural resources of the state and the costs of surveillance and enforcement by the state resulting from the violation.

16. Electronic Reporting

Upon notice by the Department that electronic reporting tools are available for specific reports or notifications, the permittee shall submit electronically all such reports or notifications as required by this permit, on forms provided by the Department.

PART II

Section D. Management Responsibilities

1. Duty to Comply

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit, more frequently than, or at a level in excess of, that authorized, shall constitute a violation of the permit.

It is the duty of the permittee to comply with all the terms and conditions of this permit. Any noncompliance with the Effluent Limitations, Special Conditions, or terms of this permit constitutes a violation of the NREPA and/or the Clean Water Act and constitutes grounds for enforcement action; for permit or Certificate of Coverage (COC) termination, revocation and reissuance, or modification; or denial of an application for permit or COC renewal.

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

2. Operator Certification

The permittee shall have the waste treatment facilities under direct supervision of an operator certified at the appropriate level for the facility certification by the Department, as required by Sections 3110 and 4104 of the NREPA. Permittees authorized to discharge storm water shall have the storm water treatment and/or control measures under direct supervision of a storm water operator certified by the Department, as required by Section 3110 of the NREPA.

3. Facilities Operation

The permittee shall, at all times, properly operate and maintain all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes adequate laboratory controls and appropriate quality assurance procedures.

4. Power Failures

In order to maintain compliance with the effluent limitations of this permit and prevent unauthorized discharges, the permittee shall either:

a. provide an alternative power source sufficient to operate facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit; or

b. upon the reduction, loss, or failure of one or more of the primary sources of power to facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit, the permittee shall halt, reduce or otherwise control production and/or all discharge in order to maintain compliance with the effluent limitations and conditions of this permit.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize or prevent any adverse impact to the surface waters or groundwaters of the state resulting from noncompliance with any effluent limitation specified in this permit including, but not limited to, such accelerated or additional monitoring as necessary to determine the nature and impact of the discharge in noncompliance.

PART II

Section D. Management Responsibilities

6. Containment Facilities

The permittee shall provide facilities for containment of any accidental losses of polluting materials in accordance with the requirements of the Part 5 Rules (R 324.2001 through R 324.2009 of the Michigan Administrative Code). For a POTW, these facilities shall be approved under Part 41 of the NREPA.

7. Waste Treatment Residues

Residuals (i.e. solids, sludges, biosolids, filter backwash, scrubber water, ash, grit, or other pollutants or wastes) removed from or resulting from treatment or control of wastewaters, including those that are generated during treatment or left over after treatment or control has ceased, shall be disposed of in an environmentally compatible manner and according to applicable laws and rules. These laws may include, but are not limited to, the NREPA, Part 31 for protection of water resources, Part 55 for air pollution control, Part 111 for hazardous waste management, Part 115 for solid waste management, Part 121 for liquid industrial wastes, Part 301 for protection of inland lakes and streams, and Part 303 for wetlands protection. Such disposal shall not result in any unlawful pollution of the air, surface waters or groundwaters of the state.

8. Right of Entry

The permittee shall allow the Department, any agent appointed by the Department, or the Regional Administrator, upon the presentation of credentials and, for animal feeding operation facilities, following appropriate biosecurity protocols:

a. to enter upon the permittee's premises where an effluent source is located or any place in which records are required to be kept under the terms and conditions of this permit; and

b. at reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect process facilities, treatment works, monitoring methods and equipment regulated or required under this permit; and to sample any discharge of pollutants.

9. Availability of Reports

Except for data determined to be confidential under Section 308 of the Clean Water Act and Rule 2128 (R 323.2128 of the Michigan Administrative Code), all reports prepared in accordance with the terms of this permit, shall be available for public inspection at the offices of the Department and the Regional Administrator. As required by the Clean Water Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Clean Water Act and Sections 3112, 3115, 4106 and 4110 of the NREPA.

10. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or the facility's COC, or to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

PART II

Section E. Activities Not Authorized by This Permit

1. Discharge to the Groundwaters

This permit does not authorize any discharge to the groundwaters. Such discharge may be authorized by a groundwater discharge permit issued pursuant to the NREPA.

2. POTW Construction

This permit does not authorize or approve the construction or modification of any physical structures or facilities at a POTW. Approval for the construction or modification of any physical structures or facilities at a POTW shall be by permit issued under Part 41 of the NREPA.

3. Civil and Criminal Liability

Except as provided in permit conditions on "Bypass" (Part II.C.9. pursuant to 40 CFR 122.41(m)), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance, whether or not such noncompliance is due to factors beyond the permittee's control, such as accidents, equipment breakdowns, or labor disputes.

4. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee may be subject under Section 311 of the Clean Water Act except as are exempted by federal regulations.

5. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Clean Water Act.

6. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other Department of Environment, Great Lakes, and Energy permits, or approvals from other units of government as may be required by law.

APPENDIX E

TMDL's

Michigan Department of Environmental Quality
Water Bureau
August 2007

Total Maximum Daily Load for Dissolved Oxygen for Johnson Creek Wayne and Washtenaw Counties

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of oxygen demanding pollutants so that the coldwater dissolved oxygen (D.O.) standard of 7 milligrams per liter (mg/l) as a minimum can be met in Johnson Creek.

Johnson Creek is the only designated trout stream in the Rouge River watershed and in Wayne County. The watershed is a mix of agricultural, low and medium density residential, industrial, and commercial land use. The channel has historically been highly modified through past drainage projects. Dredge spoils can be seen along the banks at numerous locations along the watercourse. In most cases the banks are now wooded indicating that the most recent dredging was decades ago. A map of the watershed is presented in Figure 1.

Based on miscellaneous flow measurements and long-term stream flow records on area gages, the low flow statistics have been estimated for several locations on the stream and are presented in Appendix A. These statistics indicate that the lower part of the watershed starting at Salem Road (drainage area of 11 square miles) has a much higher base flow than the upper watershed.

PROBLEM STATEMENT

The TMDL reach for Johnson Creek appears on the Section 303(d) list as:

Johnson Creek WBID#: 061304I
County: Wayne/ Washtenaw Size: 7 Miles
Location: From the confluence with the Walled Lake Branch upstream to 5 Mile Rd. West of Currie Rd.
NHD Reach Code: 04090004000067
Problem Summary: Dissolved Oxygen
TMDL YEAR(s): 2007

Johnson Creek was placed on the 2006 Section 303(d) list (Edly and Wuycheck, 2006) due to measured D.O. values at multiple locations on multiple days that are less than the standard of 7 mg/l as a minimum. During initial analysis of this reach it became apparent that the level of pollutant reduction needed to meet the 7 mg/l D.O. standard throughout the stream reach was unachievable due to extremely low stream flow characteristics under drought conditions. Therefore, this reach of river will be divided into two reaches. The first reach will be two miles

long and extends from the confluence with the Walled Lake Branch of the Rouge River upstream to 6 Mile Road. This TMDL will prescribe loads to meet the D.O. standard in this reach. The second reach will be 9.4 miles long and extend from 6 Mile Road upstream to the 5 Mile Road crossing upstream of Currie Road. Note that while this TMDL addresses only the lower reach of Johnson Creek, loadings of oxygen demanding substances from the upper reach must also be considered in the TMDL development and are further discussed in the Data Discussion section.

The upper part of the watershed (upstream of Napier Road), although designated for the protection of coldwater fish, has a flow yield of only 0.01 cubic feet per second (cfs) per square mile at the lowest monthly 95 percent exceedance flow (Appendix A). Southeastern Michigan trout streams typically have low flow yields of 0.03 to 0.16 cfs at the lowest monthly 95 percent exceedance flow. The extremely low flow yields upstream of Napier Road contribute to the D.O. problem by reducing stream flow velocity and reaeration in the reach. The resulting wide and shallow characteristics at low flow, further contributes to the D.O. demand from the suspended solids on the stream bottom. The lack of flow is not an issue that can be addressed by a TMDL.

When the Section 303(d) list is updated in 2008, the Johnson Drain listing will be split as described above with the upstream reach rescheduled for a TMDL at a future date. This will allow sufficient time to evaluate flow conditions and model assumptions in more detail and to determine whether portions of the upstream reach of river are appropriately designated for coldwater fish protection.

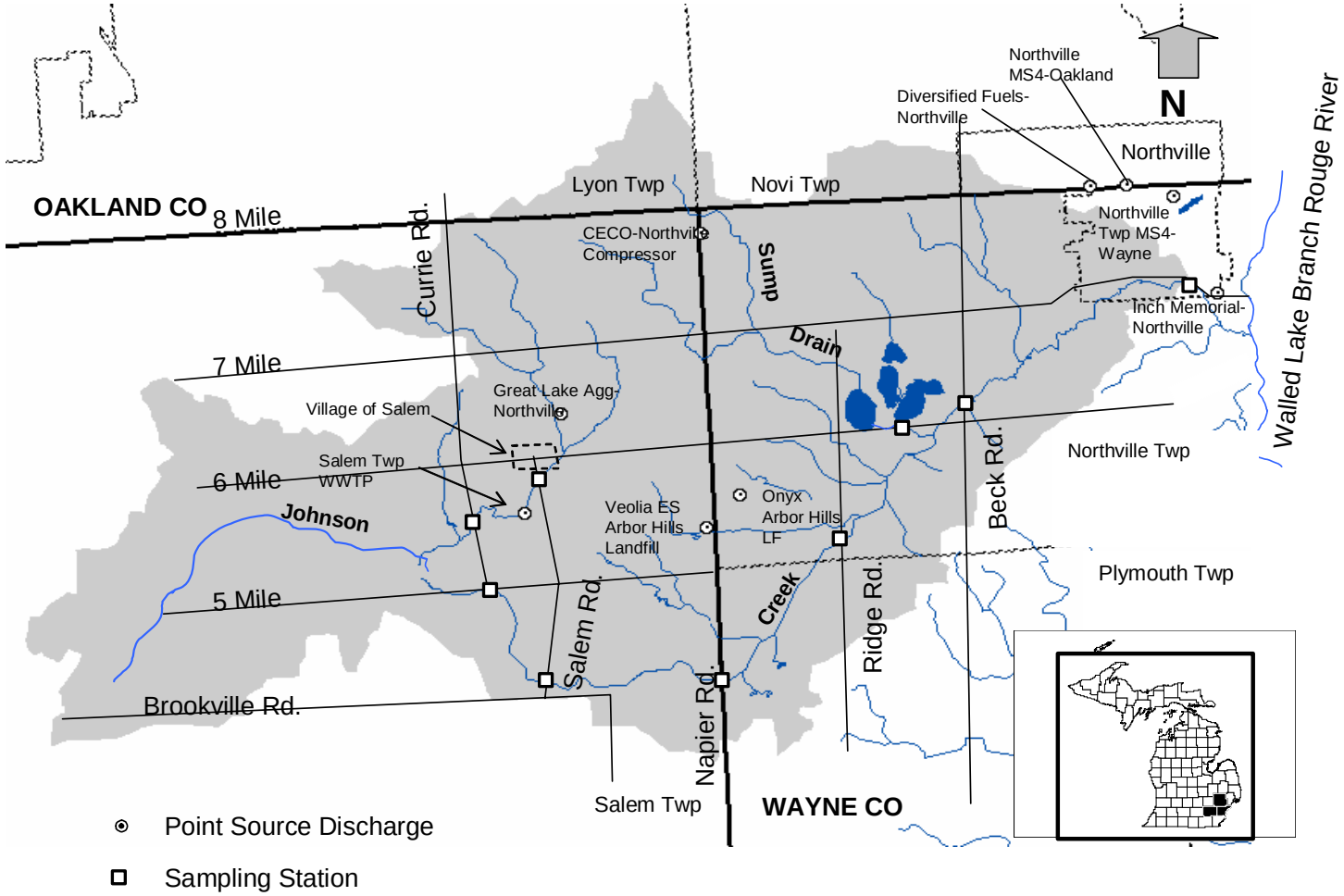


Figure1. Johnson Creek Watershed, Oakland, Washtenaw, and Wayne Counties.

NUMERIC TARGET

The D.O. rule (R 323.1064 (1) 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 (NREPA)) states, in part, that "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." Johnson Creek and all of its tributaries are protected for coldwater fish because it appears on the designated trout stream list established by the Department of Natural Resources, Director's Order No. DFI-101.97. However, as stated in the Problem Statement section of this document, this TMDL will determine pollutant loads needed to meet the coldwater stream D.O. standard only in the lower reach of river downstream from 6 Mile Road.

The D.O. WQS is defined as follows:

> R 323.1064 Dissolved oxygen in Great Lakes, connecting waters, and inland streams.
> Rule 64. (1) A minimum of 7 milligrams per liter of dissolved oxygen in all Great Lakes and connecting waterways shall be maintained, and, except for inland lakes as prescribed in R 323.1065, a minimum of 7 milligrams per liter 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 milligrams per liter of dissolved oxygen shall be maintained. These standards do not apply for a limited warmwater fishery use subcategory or limited coldwater fishery use subcategory established pursuant to R 323.1100(11) or during those periods when the standards specified in subrule (2) of this rule apply.
> (2) Surface waters of the state which do not meet the standards set forth in subrule (1) of this rule shall be upgraded to meet those standards. The department may issue permits pursuant to R 323.2145 which establish schedules to achieve the standards set forth in subrule (1) of this rule for point source discharges to surface waters which do not meet the standards set forth in subrule (1) of this rule and which commenced discharge before December 2, 1986. For point source discharges which commenced before December 2, 1986, the dischargers may demonstrate to the department that the dissolved oxygen standards specified in subrule (1) of this rule are not attainable through further feasible and prudent reductions in their discharges or that the diurnal variation between the daily average and daily minimum dissolved oxygen concentrations in those waters exceeds 1 milligram per liter, further reductions in oxygen consuming substances from such discharges will not be required, except as necessary to meet the interim standards specified in this subrule, until comprehensive plans to upgrade these waters to the standards specified in subrule (1) of this rule have been approved by the department and orders, permits, or other actions necessary to implement the approved plans have been issued by the department. In the interim, all of the following standards apply:
> (a) For surface waters of the state designated for use for coldwater fish, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 6 milligrams per liter at the design flow during the warm weather season in accordance with R 323.1090(2) and (3). At the design flows during other seasonal periods, as provided in R 323.1090(3), a minimum of 7 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.
> (b) For surface waters of the state designated for use for warmwater fish and other aquatic life, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season in accordance with
> R 323.1090(3) and (4). At the design flows during other seasonal periods as provided in

R 323.1090(3), a minimum of 5 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.

(c) For surface waters of the state designated for use for warmwater fish and other aquatic life, but also designated as principal migratory routes for anadromous salmonids, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below 5 milligrams per liter as a minimum during periods of migration.

(3) The department may cause a comprehensive plan to be prepared to upgrade waters to the standards specified in subrule (1) of this rule taking into consideration all factors affecting dissolved oxygen in these waters and the cost effectiveness of control measures to upgrade these waters and, after notice and hearing, approve the plan. After notice and hearing, the department may amend a comprehensive plan for cause. In undertaking the comprehensive planning effort the department shall provide for and encourage participation by interested and impacted persons in the affected area. Persons directly or indirectly discharging substances which contribute towards these waters not meeting the standards specified in subrule (1) of this rule may be required after notice and order to provide necessary information to assist in the development or amendment of the comprehensive plan. Upon notice and order, permit, or other action of the department, persons directly or indirectly discharging substances which contribute toward these waters not meeting the standards specified in subrule (1) of this rule shall take the necessary actions consistent with the approved comprehensive plan to control these discharges to upgrade these waters to the standards specified in subrule (1) of this rule.

This TMDL will be considered the comprehensive plan for this reach.

DATA DISCUSSION

Available D.O. data for Johnson Creek include a summer 2000 study by the Michigan Department of Environmental Quality (MDEQ) (Trapp, 2002) and data from the Rouge River National Wet Weather Demonstration Project (RRNWWDP), which is available on the Web at http://www.waynecounty.com/doe/rouge-river-project.htm. Both data sources demonstrate D.O. values less than the standard of 7 mg/l at multiple locations and on multiple days in the watershed. The available D.O. data for Johnson Creek and tributaries to Johnson Creek are summarized in Table 1.

In July 2000, the MDEQ monitored D.O. and temperature continuously at Salem Road for 13 days. For all but 1 day, the minimum D.O. was less than 7 mg/l. The period monitored included wet and dry weather although weather did not appear to substantially affect D.O. except for a possible tendency for the D.O. to be higher after a heavy rain, which substantially increased flow in the stream. The lowest D.O. recorded was 5.1 mg/l. Twelve grab samples were also collected at 4 additional locations both upstream and downstream of Salem Road on 4 different days and analyzed for D.O. Six of the 12 samples were less than 7 mg/l with the minimum being 5.6 mg/l, which was recorded at the most upstream station in the watershed (in the unnamed creek flowing from the village of Salem). This station is upstream of all point sources and upstream from the village of Salem.

The RRNWWDP has collected D.O. data on Johnson Creek including continuously monitored stations at Salem Road and at 7 Mile Road near the mouth of Johnson Creek with over 43,000 hourly observations recorded at 7 Mile Road from 1994-2001 (although all but 42 values were collected from 1994 to 1996). An additional 50 grab samples were collected at 7 different locations from 1998 through 2001.

The continuous data at 7 Mile Road demonstrated compliance with the 7 mg/l standard for all but 1 observation in 1994 and 1996. In 1995, 93 percent of the hourly observations were

greater than 7 mg/l with the minimum observed D.O. at 7 Mile Road being 6 mg/l. From 1997 to 2001, 2 of the 42 values were less than 7 mg/l. Even though the data spanned an 8-year period, no trends could be discerned because of the uneven distribution of data in time and because exceedances of the 7 mg/l standard occurred throughout this time period indicating no apparent change. In addition, although the D.O. values observed were strongly correlated to temperature because of saturation values being influenced by temperature, there was no apparent influence from wet weather on the observed values less than 7 mg/l.

Table 1. Summary of D.O. Data from Johnson Creek and its Tributaries.

Collecting Agency	Location	Period of Record (mm/yr – mm/yr)	Number of Observations	Minimum (mg/l)	Average (mg/l)	% less than 7 mg/l
DEQ	Tributary at Salem Rd.	07/00 – 08/00	3	5.6	6.6	66%
RRNWWDP	Tributary at Currie Rd.	06/01 – 10/01	4	5.5	6.4	50%
RRNWWDP	Currie Rd.	09/98 – 09/98	1	2.6	2.6	100%
DEQ	Salem Rd.	07/00 – 08/00	838	5.1	6.7	56%
RRNWWDP	Salem Rd.	06/98 – 09/98	2	8.5	8.8	0%
RRNWWDP	Napier Rd.	06/01 – 10/01	5	5.0	6.0	100%
DEQ	Ridge Rd.	07/00 – 07/00	2	6.8	6.9	100%
RRNWWDP	Ridge Rd.	06/98 – 11/01	34	4	7.3	41%
DEQ	6 Mile Rd.	07/00 – 08/00	3	6.2	6.8	33%
RRNWWDP	6 Mile Rd.	06/98 – 09/98	2	8.3	8.9	0%
DEQ	Beck Rd.	07/00 – 08/00	4	6.5	7.7	25%
RRNWWDP	Sump Drain at 6 Mile Rd.	08/01 – 10/01	2	5.4	6.9	50%
RRNWWDP	7 Mile Rd.	04/94 – 11/01	43,895	6.0	9	3%

Of 50 grab samples collected by the RRNWWDP from 1998 to 2001, 22 were less than 7 mg/l of D.O., 10 were less than 6 mg/l of D.O., and 3 were less than 5 mg/l of D.O. with the minimum observed being 2.6 mg/l at Currie Road in the upper part of the watershed.

Collectively these data show a pattern of intermittent but persistently recurring periods of D.O. less than the standard of 7 mg/l with a tendency for the lowest values being in the upper part of the watershed where stream flows and flow yields (flow per unit area) are lowest. Based on a comparison between wet and dry weather D.O. measurements at the 7 mile Road station and at the Salem Road station, there appear to be no wet weather D.O. sags occurring in the watershed following rainfall events. These two stations were the locations where data were collected hourly over multiple days. Values less than 7 mg/l were recorded at both stations, but these low D.O. values occurred during both wet and dry weather.

The diurnal variation in D.O. concentration gives an indication of the density of aquatic plants in Johnson Creek and can be an important consideration in D.O. models. The diurnal D.O. variation in Johnson Creek can be evaluated at two stations (Salem Road and 7 Mile Road) where continuous measurements (hourly) were made. The diurnal variation in this analysis is defined as the daily average minus daily minimum concentration. At Salem Road the diurnal variation during the monitoring period (July-August 2000) varied between 0.4 and 0.9 mg/l and averaged 0.6 mg/l. At 7 Mile Road the diurnal variation during the summer low flow period (June-August of 1994-1996) varied between 0.2 and 1.4 mg/l with an average of 0.6 mg/l.

Other water chemistry data were also collected during the MDEQ survey of 2000 and the RRNWWDP sampling. These data will be useful for determining nonpoint source loads of carbonaceous biochemical oxygen demand (CBOD) and ammonia.

LINKAGE BETWEEN D.O. AND POLLUTANTS

Factors, which deplete oxygen in Johnson Creek include the following:

1. CBOD, which is a measure of the amount of oxidizable organic matter in a sample of water.
2. Nitrogenous Oxygen Demand is a measure of nitrogenous material, which is oxidizable and is primarily in the form of ammonia.
3. Sediment oxygen demand (SOD), which is the oxidation of organic material on the stream bottom.
4. Plant respiration, which is the oxidative process by which energy-rich molecules such as glucose are converted into the energy needed to sustain the life of a plant.

CBOD and ammonia from point sources directly exert a D.O. demand on Johnson Creek. SOD and plant respiration are D.O. demands that are created indirectly by loads of suspended solids and nutrients respectively. SOD is created by loads of oxygen demanding suspended solids that are usually delivered to the stream during runoff after which they settle and concentrate on the stream bottom and exert their oxygen demand at a more or less steady rate, which is dependent primarily on temperature and sediment depth (USEPA, 1978). Plant respiration is an oxygen demand, which is created by a standing crop of aquatic plants. If nutrient discharges to the stream are excessive then the nutrients become pollutants of concern for a D.O. TMDL when they stimulate excessive plant growths, which contribute significantly to a D.O. problem by their respiration.

The relative importance of these multiple pollutants to the oxygen budget of a stream can be evaluated with a D.O. model that quantifies each oxygen demand present. For Johnson Creek, the oxygen budget of the stream was evaluated with a multi reach Streeter-Phelps model that incorporates SOD on an aerial basis in each reach and plant respiration by subtracting the observed difference between daily average and daily minimum D.O. from the simulated daily average D.O. values (Thomann and Mueller, 1987).

The available D.O. data indicate that the D.O. standard exceedances in Johnson Creek are not related to storm water sags. The only indication that runoff has an immediate affect on D.O. in the stream is that D.O. may be higher as the stream flow increases from runoff (Trapp, 2002). Therefore, for purposes of modeling the stream, two categories of pollutants will be considered: 1) point source discharges of CBOD and ammonia that are not storm water related, which would have an immediate effect on the D.O. of the stream; and 2) suspended solids, which are primarily discharged during runoff events but have their adverse oxygen consuming effect after they have settled and the stream flow has decreased. CBOD and ammonia are already controlled by National Pollutant Discharge Elimination System (NPDES) permits to the maximum extent possible and therefore are considered in the oxygen balance but not pollutants to be addressed by this TMDL.

Since the diurnal variation in stream D.O. was not excessive, plant nutrients including phosphorus will not be pollutants of concern for this TMDL. However, the diurnal variation in D.O. will still be considered in the model.

The D.O. concentration in permitted discharges is also relevant to the D.O. TMDL and will be addressed along with the other pollutants because of its importance to the overall oxygen balance in the stream.

TMDL DEVELOPMENT

D.O. levels in a stream typically reach their minimum level seasonally during warm weather, low flow conditions in the stream. The available D.O. data for Johnson Creek confirm that low D.O. occurs primarily during low flow non-runoff conditions. Therefore, the acceptable levels of oxygen demand in the stream were determined with the D.O. model at drought flow as defined in the Michigan WQS. The drought flow is the lowest of the 12-monthly 95 percent exceedance flows and was determined to be 0.03 cfs at the upstream end of Johnson Creek and 1.42 cfs at the downstream end of the creek (Appendix A).

The D.O. model was first calibrated to conditions observed on July 24, 2000 (Trapp, 2002). This date was chosen for calibration because of the availability of stream chemistry data at multiple locations and point source loading data; and because of the presence of steady low flow conditions in the stream. Calibration involved setting stream flow, temperature, point source water quality and upstream water quality to levels actually observed on that day and then adjusting the SOD rate to a level that would best predict observed D.O. throughout the stream. The SOD rate that best predicted D.O. in the stream was 1 gram per square meter (gm/square meter) per day. The median relative error in predicted D.O. was 0.05 mg/l.

Next, the model was verified by predicting D.O. at conditions of stream flow, temperature, point source loads, and background loads that occurred on July 27, 2000. This date was chosen for verification because of the availability of stream chemistry data at multiple locations and point source loading data; and because of the presence of steady low flow conditions in the stream. The SOD rate was kept at 1 gm/square meter per day. The median relative error in predicted D.O. was 0.4 mg/l, which is less than 6 percent. Median relative errors of 10 percent for D.O. modeling are typical and levels below that are considered acceptable (Thomann, 1982).

The calibrated and verified model was then used to predict D.O. under a design scenario, which included drought flow, 90 percent occurrence stream temperature as determined from the three years of continuous temperature data collected by the RRNWWDP, 1 gm/square meter per day of SOD, and the presently permitted point source discharge levels of CBOD, ammonia, and D.O. The result for this simulation indicated that the D.O. standard would not be met.

The relative importance of each oxygen demand (SOD, CBOD, and ammonia) was evaluated in the model for 15 different locations throughout the length of Johnson Creek. The results did not vary appreciably from location to location. The model indicated that SOD was by far the greatest oxygen demand in the stream followed by CBOD and then ammonia as shown in Table 2.

Table 2. Relative Importance of Factors that Deplete Oxygen in Johnson Creek.

Oxygen Demand	As a % of Total D.O. Deficit	
	Minimum	Maximum
SOD	80%	94%
CBOD	5%	12%
Ammonia	1%	8%

The model analysis continued by decreasing the SOD incrementally in the model until the D.O. standard was met in the lower two miles of Johnson Creek from 6 Mile Road down to the confluence with the Walled Lake Branch of the Rouge River. This required reducing SOD by 85 percent. Point source discharges of CBOD and ammonia with individual NPDES permits were not reduced beyond currently permitted levels because the currently permitted levels are already at the maximum treatment level achievable (10 mg/l of $CBOD_5$ and 2 mg/l ammonia as a maximum). This was the scenario from which the TMDL was developed.

The rate of SOD per unit area is dependent upon sediment depth when depth is less than a critical value of 10 to 20 centimeters (USEPA, 1978). The amount of D.O. consumed in a reach from SOD is also dependent upon the surface area that is covered by oxygen demanding sediment. Both of these parameters (sediment depth and areal coverage) can be expected to decrease as suspended solids loads are decreased to a stream. Modeling the fate of suspended solids discharged to Johnson Creek is well beyond the scope of this TMDL and is not necessary since the magnitude of the reduction needed is so large. To achieve an 85 percent reduction in SOD in Johnson Creek, a proportionate reduction in the suspended solids discharges is therefore needed.

SOURCE ASSESSMENT

The pollutant of concern for D.O. in Johnson Creek is suspended solids. For suspended solids, the effect on D.O. is a secondary effect. Suspended solids discharged primarily during high flow conditions settle on the stream bottom and have the greatest adverse effect under low flow conditions. Therefore, suspended solids should be regulated as a monthly average.

Sources of suspended solids to the stream include:

- Point sources with individual NPDES permits.
- Permitted storm water sources, which include facilities and land uses covered by general permits and construction sites covered by Permits-by-Rule.
- Runoff from agricultural, wetlands and forest land.

Collectively, the existing suspended solids load from these sources must be reduced by 85 percent to achieve the D.O. standard from 6 Mile Road downstream to the confluence with the Walled Lake Branch of the Rouge River. A list of individual and general NPDES permits is contained in Appendix B. A list of all 171 construction sites covered by a Permit-by-Rule that occur in the five townships encompassing Johnson Creek is shown in Appendix C. We estimate that approximately 21 of these sites are located in the Johnson Creek watershed. The suspended solids loads from point sources with individual permits were estimated from monitoring data and are presented in Table 3. The loads for $CBOD_5$, ammonia, and D.O. in Table 3 are based on permit limitations.

The suspended solids loads from all sources except those point sources described in the previous paragraph were estimated from 2000 land use data available from the Southeast Michigan Council of Governments and the USEPA's Simple Method model (USEPA, 2001). These loads are presented in Table 3. The Simple Method is an empirical approach for estimating pollutant loadings, using the following equation:

$$L_P = \Sigma_u(P*P_J*R_{VU}*C_U*A_U*2.7/12)$$

Where:

L_P = Pollutant load, lbs.
u = Land use type
P = Precipitation, inches/year
P_J = Ratio of storms producing runoff (default = 0.9)
R_{VU} = Runoff Coefficient for land use type u, $inches_{run}/inches_{rain}$, = 0.05 + (0.9 *$I_U$)
I_U = Percent Imperviousness
C_U = Event Mean Concentration for land use type u, mg/L
A_U = Area of land use type u, acres

Table 3. Johnson Creek Estimated Loads for all Pollutant Sources Covered in the TMDL.

Permit Type or Source		Daily Composite Maximum $CBOD_5$ lb/day	Daily Composite Maximum Ammonia (lbs/day)	Dissolved Oxygen Minimum (mg/l)	Daily Average Suspended Solids (lbs/day)
Individual	Salem Twp	5.8	1.2	8	2.4
Individual	Onyx Arbor Hills	8.3	1.7	7	7.9
General Permit	Diversified Fuels - Northville	Load of oxygen consuming materials not expected			
Industrial		N.A.	N.A.	N.A.	1592
Transportation					10
Commercial		N.A.	N.A.	N.A.	217
Urban Open		N.A.	N.A.	N.A.	108
Residential high density		N.A.	N.A.	N.A.	49
Residential medium density		N.A.	N.A.	N.A.	1577
Agriculture		N.A.	N.A.	N.A.	711
Forest		N.A.	N.A.	N.A.	294
Water and Wetland		N.A.	N.A.	N.A.	111
Total		14.1	2.9	N.A	4680

N.A. = Not applicable because these sources only contribute flow during runoff conditions and the TMDL is based on meeting the D.O. standard under a worst-case scenario of low flow, non-runoff conditions.

ALLOCATIONS

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

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

The term LC represents the maximum loading that can be assimilated by the receiving water while still achieving WQS.

WLAs

There are three individual NPDES permitted point source discharges to Johnson Creek. These are the Salem Township Wastewater Treatment Plant (WWTP) (MI0054798), the Onyx Arbor Hills Landfill discharge (MI0045713), and the Michigan Department of Transportation (MDOT) MS4 (MI0057364). The WLAs for these permits are shown in Table 4 (note that the MDOT permit is addressed by the transportation land use category). The WLAs for Salem Township and Onyx Arbor Hills are based on their existing loads.

With the exception of the Diversified Fuels NPDES permitted discharge, the other entities in the WLA are storm water sources covered under NPDES permits under the following land use categories: residential, commercial, industrial, transportation, and urban open. The Diversified Fuels discharge originates from a petroleum cleanup and is not expected to be a source of suspended solids.

LAs

The LAs are shown in Table 4 for agricultural and forest land, and water/wetland. The LAs are 15 percent of the estimated existing loads of suspended solids from these sources.

Table 4 summarizes the existing loads and numeric targets for all sources and all pollutants of concern to the D.O. TMDL.

Table 4. Existing Loads of and Numeric Targets for Suspended Solids for the Johnson Creek D.O. TMDL.

Source Category	Existing Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Numeric Target (lbs/day)
Salem Twp. Individual Permit	2.4	2.4		2.4
Onyx Arbor Hills Individual Permit	7.9	7.9		7.9
Diversified Fuels – Northville general permit	0	0		0
Industrial	1592	235.9		235.9
Transportation	10	1.4		1.4
Commercial	217	32.2		32.2
Urban Open	108	16.1		16.1
Residential high density	49	7.3		7.3
Residential medium density	1577	233.6		233.6
Agriculture	711		105.3	105.3
Forest	294		43.5	43.5
Water and Wetland	111		16.5	16.5
Total	**4679.3**	**536.8**	**165.3**	**702.1**

MOS

The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. This TMDL uses an implicit MOS due to very conservative assumptions incorporated in D.O. modeling. Background flows and tributary inflows are represented at the 95 percent exceedance summer low flow as determined by the MDEQ, Land and Water Management Division. The summer 95 percent exceedance flow is a stream flow that would be expected only during periods of severe drought. Stream flows would be expected to be this low for only five percent or less of the time during the driest summer month. Michigan WQS (R 323.1090), specify that WQS apply at all flows equal to or exceeding the lowest monthly 95 percent exceedance flow. Similarly, river temperatures are represented at the highest monthly 90 percent occurrence temperature for the summer season. This temperature would be expected to be exceeded only ten percent of the time during the summer months. Such high temperatures result in lower D.O. saturation concentrations and increased rates of in-stream oxygen utilization. The conservative assumptions regarding stream flow and water temperature are the same as those employed in the determination of water quality-based effluent limits in NPDES WLAs at critical design conditions. For design condition TMDL modeling, the Salem Township WWTP and the Onyx Arbor Hills Landfill discharge were represented as discharging their maximum design flows, which would not normally occur. This is an extremely unlikely scenario and further lends to the conservative assumptions of the

modeling. A large degree of uncertainty in the D.O. modeling is also removed, as the models used, were calibrated to observed data and verified with an independent set of data.

SEASONALITY

The reduction in suspended solids loads recommended in this TMDL must apply year-round since suspended solids discharged at any time of the year could settle to the stream bottom and exert an oxygen demand during the summer low flow, high temperature period. Consequently, the reduced SOD will also occur year-round. Monitoring and modeling indicates that the summer season represents the most critical conditions for D.O. standard attainment in Johnson Creek. Since this TMDL was developed to meet the D.O. standard in the summer, the D.O. standard will also be met in other seasons without any further reductions of pollutants other than the suspended solids reductions recommended and the existing NPDES permit loads for $CBOD_5$ and ammonia.

MONITORING

Future monitoring will be conducted to assess whether activities implemented under the TMDL result in water quality improvements. This monitoring will be conducted as resources allow. Typically, the MDEQ monitors watersheds in accordance with the five-year NPDES permit review process. D.O. standard attainment will result in the water bodies being removed from the Section 303(d) list, while continued nonattainment will result in further evaluation under the TMDL process.

REASONABLE ASSURANCE ACTIVITIES

Under the NPDES permit program, the Salem Township WWTP and the Onyx Arbor Hill's discharges are required to meet limitations for CBOD, ammonia, and D.O. To ensure meeting these limitations at all times, the facilities typically achieve a much better effluent quality than required by their permits. Any violations of the permit limits are dealt with by a well established compliance and enforcement program administered by the MDEQ's Southeast Michigan and Jackson District Offices.

Erosion from construction sites is regulated under the Soil Erosion and Sedimentation Control (SESC) Program (Part 91, SESC, of the NREPA), by Wayne and Washtenaw Counties. This program aims to reduce sedimentation in rivers, lakes, and streams by controlling sediments in runoff from construction sites greater than one acre in area, or those located within 500 feet of a water of the state. Temporary (silt fences) and permanent control measures (such as vegetated buffer strips) are employed. The MDEQ, Water Bureau, oversees the counties' programs to ensure that they are effectively enforcing SESC regulations.

Johnson Creek is part of the Rouge River watershed, which is the site of a national demonstration project that seeks to restore and protect the Rouge River watershed through pollution control activities that are guided by a watershed management process (RRNWWDP, 2007). Johnson Creek has unusually high water quality for the Rouge River watershed; however, many of the initiatives of the Rouge River project such as identification of illicit connections, erosion control programs, and storm water runoff management will benefit Johnson Creek also.

In an effort to improve the water quality of Johnson Creek and the Rouge River, Northville Township, with help from several other organizations, facilitated the creation of the Johnson Creek Protection Group. In this organization, residents, businesses, and local officials can work together to identify actions in which the community can partake to preserve and restore water quality as well as educate the public regarding their role in this ongoing endeavor. The group

mobilizes the public to protect Johnson Creek through hosting educational events and supporting volunteer inventory, restoration, and advocacy work.

The Washtenaw Conservation District serves farmers and landowners in the Johnson Creek watershed, which includes both Washtenaw and Wayne Counties, with conservation planning and erosion control through various programs by providing assistance and educational information related to conservation.

Federal regulations require certain industries to apply for an NPDES permit if storm water associated with industrial activity at the facility discharges into a separate storm sewer system or directly into a surface water. There are three industrial facilities with storm water discharge authorization within the Johnson Creek watershed. Prior to obtaining permit coverage, applicants must certify that they do not have any unauthorized discharges. MDEQ staff conduct inspections of a percentage of permitted, and all regulated, industrial facilities annually. Inspections are utilized to ensure that facilities comply with the regulations, and result in a further reduction in unauthorized discharges and illicit connections. Additionally, as additional facilities obtain industrial storm water permits, more illicit discharges will be eliminated. There are other industrial facilities that have not yet obtained storm water permit authorization.

Within Johnson Creek there are two local jurisdictions that have obtained Phase II municipal separate storm sewer (MS4) permit coverage (see Appendix B). Long-term watershed management plans were developed in 2001 under these permits and implementation of BMPs and other pollution prevention activities are under way. Among other things, these permits require:

1. Watershed planning that specifically addresses any TMDLs in the watershed, including identification of priority problems and opportunities (including any TMDL established for a parameter within the watershed that may be affected by storm water).

2. Development of a Storm Water Pollution Prevention Initiative that contains long-term goals for the watershed (which shall include both the protection of designated uses of the receiving waters as defined in Michigan's WQS, and attaining compliance with any TMDL established for a parameter within the watershed).

Prepared by: John Suppnick, Environmental Quality Analyst
Surface Water Assessment Section
Water Bureau
Michigan Department of Environmental Quality
August 22, 2007

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Appendix A

Low Flow Statistics for Johnson Creek.

			Flows in cubic feet per second											
Location	**Drainage Area (Sq. Mi.)**	**% Exceedance**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Trib to Johnson Creek at Salem Rd Center of section 14 T 1S, R 7E	3.2	95 %	0.07	0.10	0.14	0.12	0.16	0.54	0.86	0.31	0.10	0.03	0.04	0.06
		50 %	0.42	0.84	1.12	1.05	1.19	3.66	3.54	1.71	0.75	0.35	0.24	0.26
Johnson Creek Downstream of confluence with trib from Salem NW ¼, SE ¼ Sec 15 T 1S, R 7E	8.0	95 %	0.18	0.26	0.36	0.31	0.41	1.36	2.15	0.77	0.24	0.08	0.09	0.14
		50 %	1.05	2.09	2.81	2.64	2.97	9.14	8.86	4.28	1.88	0.87	0.61	0.64
Johnson Creek Downstream of confluence with trb from west SW ¼, SE ¼ Sec 15 T 1S, R 7E	10.1	95 %	0.22	0.33	0.45	0.39	0.52	1.71	2.72	0.97	0.30	0.10	0.11	0.18
		50 %	1.32	2.64	3.54	3.33	3.74	11.54	11.19	5.41	2.37	1.10	0.77	0.81
Johnson Creek Salem Rd SW ¼ 23 T 1S, R 7E	11	95 %	0.24	0.36	0.49	0.42	0.56	1.86	2.96	1.05	0.33	0.11	0.12	0.19
		50 %	1.44	2.88	3.86	3.62	4.08	12.57	12.18	5.89	2.58	1.19	0.84	0.88
Johnson Creek Ridge Rd SE ¼ 18 T1S, R 8E	15	95 %	0.69	0.90	1.12	1.01	1.24	3.03	4.37	1.96	0.85	0.41	0.43	0.59
		50 %	2.48	4.28	5.42	5.15	5.67	14.68	14.29	7.68	3.92	2.15	1.65	1.71
Johnson Creek Beck Rd. SE ¼ 8 T1S, R 8E	22.1	95 %	1.64	2.05	2.45	2.25	2.65	5.33	7.03	3.81	1.95	1.05	1.11	1.44
		50 %	4.58	6.92	8.26	7.95	8.54	17.31	16.97	10.71	6.47	4.10	3.33	3.43
Johnson Creek At confluence with Walled Lk. Branch SE ¼ 3 T1S, R 8E	26.1	95 %	2.19	2.70	3.21	2.96	3.45	6.64	8.54	4.86	2.58	1.42	1.49	1.92
		50 %	5.77	8.42	9.88	9.55	10.18	18.81	18.50	12.44	7.93	5.21	4.29	4.40

Note: These statistics were derived by the MDEQ Land and Water Management Division hydrologists from flow yields observed during 1958 through 2004 at the United States Geological Survey stream flow gage on the Upper Rouge River at Farmington using correlations derived from 11 flow measurements on Johnson Creek at Napier Road and 34 flow measurements on Johnson Creek at Hines Drive.

Appendix B

List of Facilities in Johnson Creek Watershed that have Individual or General Permits.

NAME	Design Flow (MGD)	PERMIT NO.	COUNTY	TOWNSHIP	RECEIVING WATER
Diversified Fuels-Northville	no data	MIG081077	Oakland	Novi	Unnamed tributary of Rouge River
Great Lakes Agg-Northville	NA	MIS210732	Washtenaw	Salem	Johnson Creek
Inch Memorials-Northville	NA	MIS210685	Wayne	Plymouth	Johnson Creek
Oakland Co. Watershed wide Storm water (MS4)	NA	MIG610042	Oakland	--	Johnson Creek
Wayne Co. Watershed wide Storm water (MS4)	NA	MIG610040	Wayne	--	Johnson Creek
Washtenaw Co. Rd. Comm. Watershed wide Storm water (MS4)	NA	MIG610314	Washtenaw	--	Johnson Creek
Washtenaw Co. Drain Comm. Watershed wide Storm water (MS4)	NA	MIG610039	Washtenaw	--	Johnson Creek
MDOT Statewide Storm water (MS4)	NA	MI0057364	Multple	--	Johnson Creek
Northville Schools Jurisdictional Storm water (MS4)	NA	MIS040078	Wayne	Northville	Johnson Creek
Plymouth Twp. Watershed wide Storm water (MS4)	NA	MIG610038	Wayne	Plymouth	Johnson Creek
Salem Twp. Jurisdictional Storm water (MS4)	NA	MIS040068	Washtenaw	Salem	Johnson Creek
Novi Watershed wide Storm water (MS4)	NA	MIG610030	Oakland	Novi	Johnson Creek
Lyon Twp. Watershed wide Storm water (MS4)	NA	MIG610034	Oakland	Lyon	Johnson Creek
Northville MS4-Oakland	NA	MIG610024	Oakland	Novi	Rouge River, Johnson Drain and others
Northville Twp MS4-Wayne	NA	MIG610025	Oakland	Novi	Rouge River, Johnson Drain and others
Onyx Arbor Hills LF	0.10	MI0045713	Wayne	Plymouth	Unnamed tributary to Johnson Creek
Salem Twp WWTP	0.07	MI0054798	Washtenaw	Salem	Unnamed tributary to Johnson Creek
Veolia ES Arbor Hills Landfill	NA	MIS210766	Washtenaw	Salem	Unnamed tributary to Johnson Creek

Appendix C

List of Permit-by-Rule Construction Sites in the Townships Encompassing Johnson Creek.

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
Lyon Center Drive	Unknown	0	Oakland	Lyon
Nine Mile Road	Northville	48167	Oakland	Lyon
Pontiac Trail, north of 11 Mile Road	Unknown	0	Oakland	Lyon
10 Mile Road	South Lyon	48178	Oakland	Lyon
31001 Lahser Road	Beverly Hills	48025	Oakland	Lyon
5201 Knobby Hill Drive	Highland	48357	Oakland	Lyon
10 Mile Road	South Lyon	48178	Oakland	Lyon
49397 Shafer Avenue	Wixom	48393	Oakland	Lyon
26740 Pontiac Trail	South Lyon	48178	Oakland	Lyon
51830 Grand River	Wixom	48393	Oakland	Lyon
345 South Warren Street	South Lyon	48178	Oakland	Lyon
51490 Pontiac Trail	Wixom	48393	Oakland	Lyon
345 South Warren	South Lyon	48178	Oakland	Lyon
31731 Northwestern Highway	Farmington Hills	48334	Oakland	Lyon
403b East Grand River Avenue	Brighton	48116	Oakland	Lyon
Napier & 9 Mile Road	Novi	48374	Oakland	Lyon
345 South Warren Street	South Lyon	48178	Oakland	Lyon
Martindale Road & 11 Mile Road	South Lyon	48178	Oakland	Lyon
Lake Street (10 Mile Road)	West Bloomfield	48325	Oakland	Lyon
Beck Road	Wixom	48393	Oakland	Lyon
Eleven Mile Road West of Milford Road	New Hudson	48165	Oakland	Lyon
11 Mile and Martindale Road	South Lyon	48178	Oakland	Lyon
Ten Mile Road at Johns Road	Unknown	0	Oakland	Lyon
Ten Mile and Johns Road	South Lyon	48178	Oakland	Lyon
Ten Mile Road and Currie Road	South Lyon	48178	Oakland	Lyon
Martindale Street	New Hudson	48165	Oakland	Lyon
Pontiac Trail and Nine Mile Road	South Lyon	48178	Oakland	Lyon
Dixboro Road	South Lyon	48178	Oakland	Lyon
Between Spaulding Road and Milford Road	New Hudson	48165	Oakland	Lyon
Eleven Mile Road	New Hudson	48165	Oakland	Lyon
William K Smith Drive	New Hudson	48165	Oakland	Lyon
28140 Lakeview Drive	Wixom	48393	Oakland	Lyon
Milford Road	South Lyon	48178	Oakland	Lyon
South side of Ten Mile Road, East of Currie Road	Unknown	0	Oakland	Lyon
Nine Mile Road (vacant property)	South Lyon	48178	Oakland	Lyon
Ten Mile Road and Matindale Road	New Hudson	48165	Oakland	Lyon

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
Coach House Lane	Southfield	48034	Oakland	Lyon
30729 Lyon Center Drive East	New Hudson	48165	Oakland	Lyon
22727 Griswold Road	Unknown	0	Oakland	Lyon
Northwest corner of 10 Mile Road and Milford Road	New Hudson	48165	Oakland	Lyon
Haggerty Road	Novi	48375	Oakland	Lyon
10 Mile Road and Martindale Road	Unknown	0	Oakland	Lyon
55500 Grand River Avenue	New Hudson	48165	Oakland	Lyon
32400 Telegraph Road, Suite 100	Bingham Farms	48025	Wayne	Northville
3005 University Drive, Suite 100	Auburn Hills	48326	Wayne	Northville
30100 Telegraph Road, Suite 366	Bingham Farms	48025	Wayne	Northville
740 Salem Road	Northville	48167	Wayne	Northville
6024 West Maple Road, Suite 106	West Bloomfield	48322	Wayne	Northville
34018 Beacon Street	Livonia	48150	Wayne	Northville
46680 West Seven Mile Road	Northville	48167	Wayne	Northville
1330 Goldsmith	Plymouth	48170	Wayne	Northville
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Wayne	Northville
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Wayne	Northville
Southeast corner of Ridge Road & Six Mile Road	Northville	48167	Wayne	Northville
Southeast corner of Ridge Road and Six Mile Road	Northville	48167	Wayne	Northville
46670 Six Mile Road	Northville	48167	Wayne	Northville
Northwest corner of 12 Mile and Dixon Road	Novi	48375	Oakland	Novi
Northwest corner of 12 Mile Road & Dixon Road	Novi	48375	Oakland	Novi
32070 Lahser Road	Beverly Hills	48025	Oakland	Novi
1330 Goldsmith	Plymouth	48170	Oakland	Novi
31731 Northwestern Highway, Suite 250	Farmington Hills	48334	Oakland	Novi
26699 West 12 Mile Road, Suite 200	Southfield	48034	Oakland	Novi
31000 Northwestern Highway, Suite 220	Farmington Hills	48334	Oakland	Novi
Unknown	Farmington Hills	48333	Oakland	Novi
41200 Bridge Street	Novi	48375	Oakland	Novi
45175 West 10 Mile Road	Novi	48375	Oakland	Novi
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Oakland	Novi
32400 Telegraph Road	Bingham Farms	48025	Oakland	Novi
32400 Telegraph Road	Bingham Farms	48025	Oakland	Novi
1330 Goldsmith	Plymouth	48170	Oakland	Novi

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
111 South Telegraph Road	Pontiac	48341	Oakland	Novi
45175 West 10 Mile Road	Novi	48375	Oakland	Novi
39000 Country Club Drive	Farmington Hills	48331	Oakland	Novi
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Oakland	Novi
7125 Orchard Lake Road, Suite 200	West Bloomfield	48322	Oakland	Novi
31300 Orchard Lake Road, Suite 100	Farmington Hills	48334	Oakland	Novi
41115 Jo Drive	Novi	48375	Oakland	Novi
45380 West 10 Mile Road, Suite 135	Novi	48375	Oakland	Novi
45175 West Ten Mile Road	Novi	48375	Oakland	Novi
39575 Thirteen Mile Road	Novi	48377	Oakland	Novi
30100 Telegraph Road, Suite 220	Bingham Farms	48025	Oakland	Novi
45380 West 10 Mile Road, Suite 135	Novi	48375	Oakland	Novi
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Oakland	Novi
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Oakland	Novi
30100 Telegraph Road, Suite 220	Bingham Farms	48025	Oakland	Novi
2617 Beacon Hill Drive	Auburn Hills	48326	Oakland	Novi
39000 Country Club Drive	Farmington Hills	48331	Oakland	Novi
42355 Grand River	Novi	48375	Oakland	Novi
Unknown	West Bloomfield	48325	Oakland	Novi
14200 Breakfast Drive	Redford	48239	Oakland	Novi
30078 Schoenherr, Suite 300	Warren	48088	Oakland	Novi
31300 Orchard Lake Road	Farmington Hills	48334	Oakland	Novi
43700 Expo Drive	Novi	48375	Oakland	Novi
39000 Country Club Drive	Farmington Hills	48331	Oakland	Novi
30500 Northwestern Highway	Farmington Hills	48334	Oakland	Novi
45175 West Ten Mile Road	Novi	48375	Oakland	Novi
45175 West Ten Mile Road	Novi	48375	Oakland	Novi
49232 Hunt Club Court	Plymouth	48170	Oakland	Novi
Unknown	Lansing	48909	<UNKNOWN>	Novi
31550 Northwestern Highway, Suite 200	Farmington Hills	48334	Oakland	Novi
41115 Jo Drive	Novi	48375	Oakland	Novi
Meadowbrook Road	Novi	48375	Oakland	Novi
Northwest corner of 12 Mile Road and Dixon Road	Novi	48375	Oakland	Novi
Meadowbrook Road	Novi	48374	Oakland	Novi
Haggerty Road	Novi	48375	Oakland	Novi
Eight Mile Road and Garfield	Novi	48374	Oakland	Novi
Napier and 12 Mile Roads	Novi	48374	Oakland	Novi
10 Mile Road	Novi	48375	Oakland	Novi

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
Grand River Avenue and Wixom Road	Novi	48376	Oakland	Novi
27875 Cabot Drive	Novi	48377	Oakland	Novi
North of Eight Mile Road, Between Garfield Road & Beck Road	Novi	48374	Oakland	Novi
12 1/2 Mile Road	Novi	48375	Oakland	Novi
12 Mile Road	Novi	48375	Oakland	Novi
South of Chattman Road, West of Meadowbrook Road	Novi	48375	Oakland	Novi
Saybrook Court	Novi	48375	Oakland	Novi
Nine Mile Road	Novi	48375	Oakland	Novi
50200 Ten Mile Road	Novi	48374	Oakland	Novi
39450 12 Mile Road	Novi	48377	Oakland	Novi
25500 Meadowbrook Road	Novi	48375	Oakland	Novi
Southwest corner of Grand River and Beck Road	Wixom	48393	Oakland	Novi
Northwest corner of Twelve Mile and Dixon Roads	Novi	48375	Oakland	Novi
Northwest corner of Twelve Mile and Dixon Roads	Novi	48375	Oakland	Novi
Ten Mile Road	Novi	48374	Oakland	Novi
Various	Novi	48375	Oakland	Novi
Southwest corner of Grand River and Beck Road	Novi	48374	Oakland	Novi
Northeast corner of 12 Mile and West Park Drive	Novi	48374	Oakland	Novi
45625 Grand River Avenue	Novi	48375	Oakland	Novi
Northwest corner of 12 Mile Road and Dixon Road	Novi	48375	Oakland	Novi
27500 Novi Road	Novi	48377	Oakland	Novi
Taft Road	Novi	48375	Oakland	Novi
44150 12 Mile Road	Novi	48375	Oakland	Novi
Unknown	Novi	48374	Oakland	Novi
Ten Mile Road and Wixom Road	Novi	48375	Oakland	Novi
51000 Grand River Avenue	Wixom	48393	Oakland	Novi
41787 Grand River Avenue	Novi	48375	Oakland	Novi
41720 and 41750 8 Mile Road	Novi	48375	Oakland	Novi
48201 Grand River Avenue	Novi	48374	Oakland	Novi
Southwest corner of Grand River and Beck Road	Unknown	0	Oakland	Novi
32535 Schoolcraft	Livonia	48150	Oakland	Novi
Nine Mile Road	Novi	48374	Oakland	Novi
North side of Grand River, East of Novi Road	Novi	48374	Oakland	Novi
243 West Grand River	East Lansing	48823	Wayne	Plymouth
243 West Grand River	East Lansing	48823	Wayne	Plymouth
McClumpha Road and Ann	Plymouth	48170	Wayne	Plymouth

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
Arbor Road				
Haggerty Road	Plymouth	48170	Wayne	Plymouth
M-14 from Napier Road to Haggerty Road	Plymouth	48170	Wayne	Plymouth
North Territorial Road	Plymouth	48170	Wayne	Plymouth
220 North Smith Street, Suite 300	Palatine	60067	Wayne	Plymouth
45501 Helm Street	Plymouth	48170	Wayne	Plymouth
14270 Livonia Crescent	Livonia	48154	Wayne	Plymouth
15075 Beck Road	Plymouth	48170	Wayne	Plymouth
15000 Haggerty Road	Plymouth	48170	Wayne	Plymouth
Napier Road to Haggerty Road	Plymouth	48170	Wayne	Plymouth
15726 Penderbrook Lane	Northville	48168	Wayne	Plymouth
Five Mile and Sheldon Roads	Northville	48167	Wayne	Plymouth
5 Mile Road and Sheldon Road	Unknown	0	Wayne	Plymouth
East of Sheldon, north of 5 Mile Road	Northville	48167	Wayne	Plymouth
Ridge Road	Northville	48167	Wayne	Plymouth
Ridge Road and 7 Mile Road	Northville	48167	Wayne	Plymouth
Ridge Road, 5 Mile Road, Sheldon Road	Northville	48167	Wayne	Plymouth
40440 Palmer Road	Canton	48188	Wayne	Plymouth
34333 Michigan Avenue	Wayne	48184	Wayne	Plymouth
From Meyers Road to Greenfield Road	Unknown	0	Wayne	Plymouth
Pontiac Trail	South Lyon	48178	Washtenaw	Salem
7 Mile & Chubb Roads	Unknown	0	Washtenaw	Salem
55815 8 Mile Road	Northville	48167	Washtenaw	Salem
5755 Vorhies Road	Ann Arbor	48105	Washtenaw	Salem

Michigan Department of Environmental Quality
Surface Water Quality Division
October 1999

Total Maximum Daily Load (TMDL) for Phosphorus in Kent Lake

Location: Kent Lake is a 1,000 acre (405 ha) impoundment of the Huron River located in Oakland County (Figure 1). This lake is entirely public-owned and receives over two million visitors annually, making it one of the most intensively used recreational lakes in the state.

Pollutant: Total Phosphorus.

Phosphorus Data and Goal:

Year	Total Phosphorus Concentration (mg/L)	Total Load to lake (pounds/year)	Actual Point Source contribution (pounds/year)	Nonpoint Source contribution (pounds/year)
1978	**0.044**	**12,400**	**7,400**	**5,000**
1994	**0.030**	7,600	**1,100**	6,500
1997	**0.023**	5,800	**1,400**	4,400
1998	**0.030**	7,600	**1,300**	6,300
1999	**0.025**	**7,000**	**1,400**	**5,600**
Average 1994-99	0.027	7,000	1,300	5,700

	Total Phosphorus Concentration (mg/L)	Loading Capacity (pounds/year)	Waste Load Allocation (pounds/year)	Load Allocation (pounds/year)	Margin of Safety (pounds/year)
TMDL Goal	0.030	7,600	2,700	4,700	200

Bold numbers indicate actual measured values.

Background: In the late 1970's, Kent Lake was classified as a highly eutrophic to hypereutrophic lake with periodic fish kills and frequent nuisance algae blooms (Wandell and Jackson, 1979). Phosphorus was identified as the limiting nutrient for algae growth in this lake. In 1978, the in-lake phosphorus concentrations averaged 0.044 mg/L with a range of 0.027 mg/L to 0.09 mg/L and a total load of 12,400 pounds/year to Kent Lake (Wandell and Jackson, 1979). Of the 12,400 pounds of phosphorus, approximately 60 percent were from point source contributions and 40 percent were from nonpoint source contributions. In 1980, a point source phosphorus allocation of 2,700 pounds/year was approved by the Water Resource Commission for Kent Lake, which included Ford Motor Company-Wixom, Milford Publicly Owned Treatment Works (POTW), and Wixom POTW. In August 1991, the Ford Motor Company-Wixom diverted its effluent from the Huron River to the Wixom POTW.

Subsequent to the implementation of the 1980 allocation, overall water quality in Kent Lake has improved (Alexander, 1999). This improved water quality can be attributed to significant reductions in total phosphorus loading to Kent Lake. No reported nuisance algae blooms or fish kills have been reported within the past few years. In 1994, the spring turnover phosphorus concentration was 0.030 mg/L (Kosek, 1996). Using the Walker Model (Reckhow, 1978), total phosphorus loading in 1994 was estimated to be 7,600 pounds/year. Of the total loading for

1994, 15 percent was from point source contributions and 85 percent was from nonpoint source contributions. In 1997, spring turnover phosphorus concentration was 0.023 mg/L (Alexander, 1998). Using the Walker Model, total phosphorus loading in 1997 was estimated to be 5,800 pounds/year with point source contributions making up 24 percent of the total and nonpoint source contributing 76 percent. Also, in 1998, the spring turnover phosphorus concentration was 0.030 mg/L (Alexander, 1999). Using the Walker Model, total phosphorus loading in 1998 was estimated to be 7,600 pounds/year with a point source contribution of 17 percent and nonpoint contributions making up the remaining 83 percent.

Kent Lake was listed as a threatened waterbody on Michigan's 1998 Section 303(d) list (Creal and Wuycheck, 1998) of waterbodies needing TMDLs. The primary issue identified as threatening Kent Lake was nutrient enrichment (phosphorus).

In April 1998, a 12-month phosphorus loading analysis was begun to confirm the appropriateness of the Walker Model as a phosphorus predictive tool for Kent Lake (Alexander, 1999). This phosphorus analysis showed a total phosphorus load to Kent Lake of 6,700 pounds from April 1998 to March 1999. The April 1999 spring turnover phosphorus concentration was 0.025 mg/L and the predicted in-lake phosphorus concentration using the Walker Model was 0.026 mg/L. Based on comparison of the actual in-lake phosphorus concentration and the predicted, the Walker Model was determined to be a good predictor for phosphorus, for both loading and in-lake concentration.

The goal for phosphorus concentration in Kent Lake is 0.030 mg/L. This concentration is generally accepted in the majority of available literature as the cutoff point between eutrophic and hypereutrophic. This goal was recommended in the draft TMDL for phosphorus in Kent Lake, which was public noticed from January 18, 1999 to February 19, 1999, in which no public comments opposing this goal were received. Additionally, this goal will meet the requirements of the Water Quality Standards R 323.1060(2) for plant nutrients. This rule states "nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the waters of the state."

Waste Load Allocation: The waste load allocation was established at 2,700 pounds/year, using current National Pollutant Discharge Elimination System permit limits for the Milford POTW and the Wixom POTW (Table 1). Phosphorus loading from the two point source discharges averaged 1,300 pounds/year during 1994, 1997, 1998, and 1999 (Table 2), significantly less than the 7,400 pounds/year in 1978.

Load Allocation: The estimated total nonpoint source contribution during 1994, 1997, 1998, and 1999 averaged 5,600 pounds/year with a range of 4,400 pounds/year to 6,500 pounds/year, slightly more than the 5,000 pounds/year in 1979. Based on this information, it can be assumed that there is some variability in nonpoint source contributions and that there may be some increases in nonpoint source loading since 1978. Therefore, a load allocation of 4,700 pounds/year of phosphorus was established for nonpoint source contributions to Kent Lake. This load allocation equates to an average phosphorus reduction of 16 percent (900 pounds/year) in nonpoint source contributions. This will likely occur over the time period that point sources are increasing. Therefore, it is anticipated that Kent Lake will meet the goal of 0.030 mg/L during this period. The total nonpoint source phosphorus load includes contributions from atmospheric deposition, ground water contribution, and immediate drainage area runoff (Alexander, 1999).

Margin of Safety: There are 200 pounds/year of phosphorus loading allocated to a margin of safety. This equates to about 3 percent of the loading capacity of this lake. This is appropriate due to the good predictions found with the model used in the TMDL development process.

Summary: The TMDL for Kent Lake allocates 4,700 pounds of phosphorus to nonpoint source loads, 2,700 pounds of phosphorus to point source loads, and 200 pounds/year to a margin of safety. These loads are established on an annual basis to meet the goal of 7,600 pounds per year and an in-lake total phosphorus concentration of 0.030 mg/L.

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Prepared by: Michael Alexander, Aquatic Biologist
Great Lakes and Environmental Assessment Section
Surface Water Quality Division
Michigan Department of Environmental Quality

Table 1. Current permit limits and waste load allocation recommendations for facilities discharging upstream of Kent Lake.

Facility	Current Limits (pounds/year)	Waste Load Allocation (pounds/year)
Milford POTW	900	900
Wixom POTW	1,800	1,800

Table 2. Phosphorus loading data for facilities discharging upstream of Kent Lake.

Facility	Year	Design Flow (MGD)	Avg. Flow (MGD)	Actual Total Load (pounds/year)
Milford POTW	1994	1.04	0.83	451
	1997		0.44	178
	1998		0.74	187
	1999		0.59	261
Wixom POTW	1994	2.8	2.13	665
	1997		2.34	1177
	1998		2.34	1132
	1999		2.41	1112

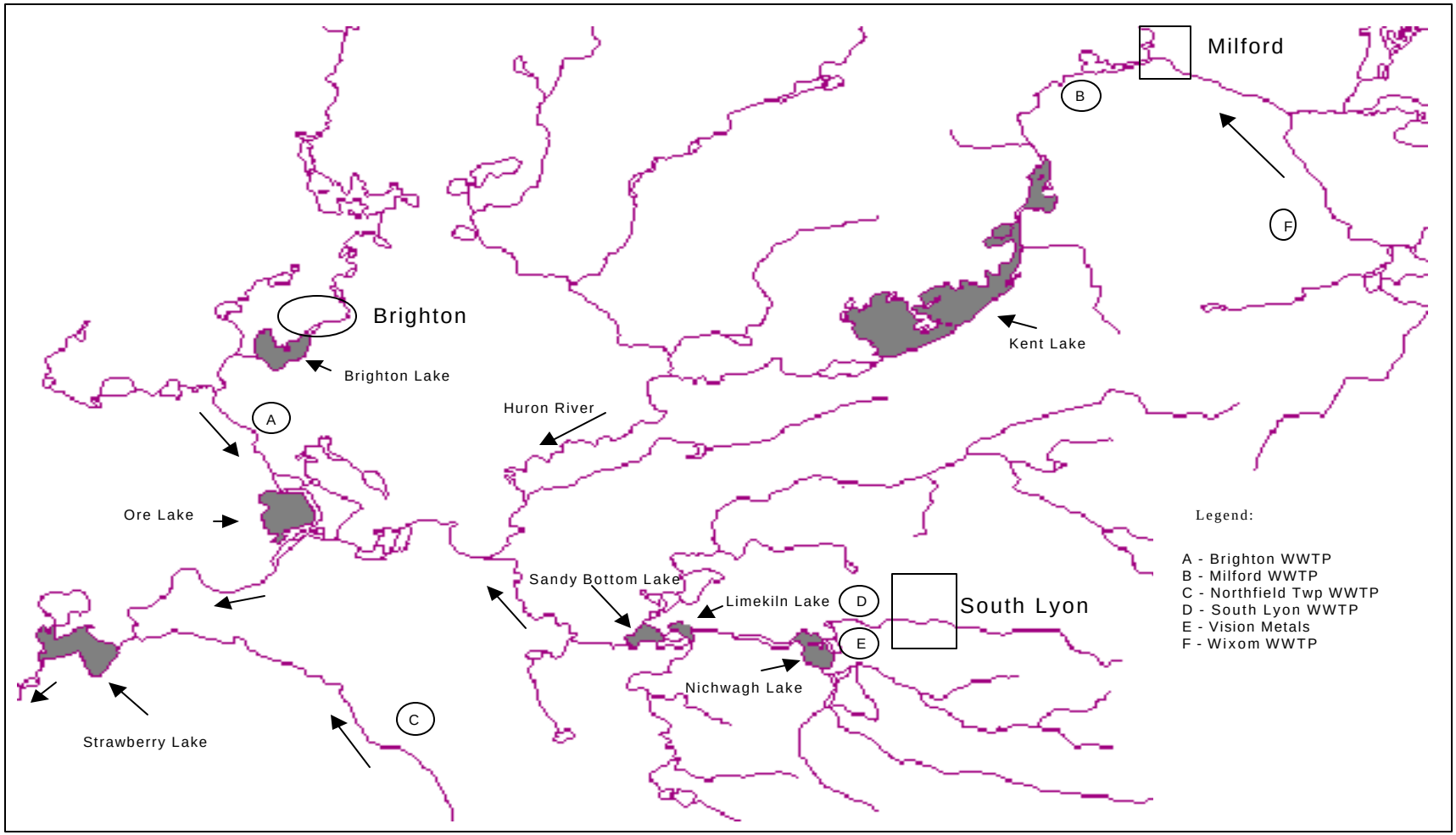


Figure 1. Upper Huron River and the Kent Lake watershed showing the current point source discharges.

DRAFT

Total Maximum Daily Load for *E. coli* in the Lower Clinton River

Macomb, Oakland, and St. Clair Counties

Michigan Department of Natural Resources and Environment

April 2010

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Figure 6. Thirty-day geometric mean *E. coli* sampling results from North Branch Clinton River (Stations NB1-NB8).

Michigan Department of Natural Resources and Environment
May 2010

Total Maximum Daily Load for *E. coli* for the Lower Clinton River Macomb, Oakland, and St. Clair Counties

INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of *Escherichia coli* (*E. coli)* that will result in the attainment of the applicable WQS in the Clinton River, located in Macomb, Oakland, and St. Clair Counties, Michigan (Figure 1).

PROBLEM STATEMENT

This TMDL addresses the assessment units (AUIDs) and listings that appear on the 2008 Section 303(d) list (LeSage and Smith, 2008) as:

CLINTON RIVER **AUID**: 040900030402-01
County: Macomb SIZE: 43.3 M
Location: Clinton River and Unnamed Tributaries to Clinton River.
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Combined Sewer Overflows from Pontiac.
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030402-02
County: Macomb SIZE: 10.3 M
Location: Clinton River from Gratiot Avenue downstream to the mouth.
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Combined Sewer Overflows from Pontiac.
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030402-03
County: Macomb SIZE: 27.8 M
Location: Clinton River
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Combined Sewer Overflows from Pontiac.
TMDL Year(s): 2010

This TMDL also addresses the AUIDs described in Appendix 1 proposed for inclusion on the Department of Natural Resources and Environment's (DNRE's) 2010 Section 303(d) list. The Main Branch Clinton River, downstream of Yates Dam near Rochester, was first placed on the Section 303(d) list in 1998 due to impairment of recreational uses by *E. coli* (Creal and Wuycheck, 1998). Monitoring data collected by the DNRE in 2008 for the Main, North, and Middle Branch Clinton River and tributaries documented multiple exceedances of the daily maximum and 30-day geometric mean WQS for *E. coli* during the total body contact (TBC) recreational season of May 1 through October 31, and periodic exceedances of the partial body contact (PBC) WQS (Table 1-4; Figures 4-6). This TMDL addresses the entirety of the Middle Branch, Main Branch downstream of Rochester (including Harrington Drain), and the North Branch Clinton River from 33-Mile Road downstream to the confluence with the Main Branch (including tributaries) (Figure 1). Monitoring data collected by the DNRE in 2008 on Paint Creek and the Main Branch Clinton River upstream of the TMDL reach (Figure 1) indicate that these waters are also not attaining the TBS and PBC recreation designated use, and will be included on the 2012 Section 303(d) list and a TMDL scheduled. There are several water bodies with approved *E. coli* TMDLs adjacent to the water bodies addressed by this TMDL: these are, Red Run Drain and Bear Creek, East Coon Creek, Deer Creek, and East Pond Creek (Figure 1).

The TMDL reach is located in the Clinton River watershed (Hydrologic Unit Code 4090003), which flows into Lake St. Clair (Figure 1). The Clinton River TMDL watershed covers 127,200 acres (about 198 square miles) of Macomb, Oakland, and St. Clair Counties and is composed of 17 minor civil divisions (Table 6). The infrastructure for the city of Detroit alters the hydrology of the Clinton River watershed such that discharges to the municipal system within the Clinton River watershed area are routed to the Detroit River watershed. Therefore, sources of *E. coli* from the Detroit municipal boundaries are not addressed in this TMDL. The Clinton River watershed was home to a population of about 334,200 people in 2008, based on data in the 2000 census (U.S. Census Bureau, 2000) and an estimated 5.4 percent increase in population from 2000-2008 (SEMCOG, 2008).

The Clinton River TMDL watershed is located within the Maumee Lake Plain ecosystem type (Subsubsection VI.1.1), which is characterized by flat, clay lake plain with loamy and somewhat poorly drained soils, ideal for agriculture when artificial drainage is used (Albert, 1995). Areas of well-drained, sand-dominated soils bisect the clay plains formed by glacial drainage ways. Prior to European colonization, extensive marshes occurred along the shores of Lake St. Clair and extended upstream for several miles on major rivers such as the Clinton River. Upslope of the marshes were deciduous swamps followed by beech-sugar maple forests on the upland areas (Albert, 1995). Land cover data (2006) was used to calculate the land cover types of the entire TMDL watershed, as well as a breakdown of land cover in the Main, Middle, and North Branches (Table 5) (NOAA, 2008b). The portion of the North Branch Clinton River within the TMDL watershed (Figure 1) is largely agricultural with 37 percent of the land area used for cultivated row crops, and an additional 17 percent as pasture or hay. The Middle Branch Clinton River, which is entirely within the TMDL watershed, is 47 percent low, medium, and high intensity developed land, which was mainly single family residential according to land use data from 2000 (SEMCOG, 2009). Agriculture in the Middle Branch Clinton River occupies 16 percent of the land area (cultivated cropland and pasture/hay combined). Land cover in the Main Branch Clinton River area of the TMDL watershed is dominated by low, medium, and high intensity development, which together occupy 73 percent of the land area. No land area within the Main Branch Clinton River TMDL boundary is used for agriculture; however, this does not exclude agricultural sources to the sites located directly on the Main Branch Clinton River

(Stations CR1-3, 5, 7-11, and 13), because some of the land upstream of the TMDL reach is used for agriculture, but was not included in the analysis in Table 5.

NUMERIC TARGET

The impaired designated uses addressed by this TMDL are TBC and PBC recreation. The designated use rule (Rule 100 [R 323.1100] of the Part 4 rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended) states that this water body be protected for TBC recreation from May 1 through October 31 and PBC recreation year-round. The target levels for these designated uses are the ambient *E. coli* standards established in Rule 62 of the WQS as follows:

> R 323.1062 Microorganisms.
> Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *E. coli* per 100 milliliters (mL), as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during five or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of three 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 three or more samples taken during the same sampling event at representative locations within a defined sampling area.
>
> (2) All surface waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 *E. coli* per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples, taken during the same sampling event, at representative locations within a defined sampling area.

For this TMDL, the WQS of 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum to protect the TBC use are the target levels for the TMDL reach from May 1 through October 31, and 1000 *E. coli* per 100 ml as a daily maximum year-round to protect the PBC use. The 2008 monitoring data indicated daily maximum and 30-day geometric mean exceedances at all stations. The PBC WQS was exceeded at least once at all stations.

A sanitary wastewater discharge is considered in compliance with the WQS of 130 *E. coli* per 100 mL if the National Pollutant Discharge Elimination System (NPDES) permit limit of 200 fecal coliform per 100 mL as a monthly average is met. This is assumed because *E. coli* are a subset of fecal coliform (American Public Health Association, 1995). Fecal coliform concentrations are substantially higher than *E. coli* concentrations when the wastewater of concern is sewage (Whitman, 2001). Therefore, typically it can be assumed that there are less than 130 *E. coli* per 100 mL in the effluent when the point source discharge is meeting its limit of 200 fecal coliform per 100 mL.

DATA DISCUSSION

Weekly *E. coli* data were collected by the DNRE from 25 sites from June 4-October 1, 2008, (Tables 1-3). Stations NB1-NB8 are located on the North Branch, CR1-CR13 are located on the Main Branch (and tributaries to the Main Branch), and MB1-MB4 are located on the Middle Branch Clinton River (Figure 1). The daily maximum TBC standard (300 *E. coli* per 100 mL)

and PBC recreation daily maximum standard (1000 *E. coli* per 100 mL) were exceeded at all stations and the daily maximum TBC standard was exceeded on all sample dates at three of the stations (CR3, CR6, and MB4).

Station geometric means were calculated using all weekly data collected at each station throughout the sampling period (Table 4). *E. coli* daily maximum and 30-day geometric mean data for 2008 are shown in Tables 1-3 and Figures 4-6. Based on the station geometric means of all 25 sites sampled within the TMDL reach, CR3 on Harrington Drain had the highest concentrations of *E. coli* (1,778 *E. coli* per 100 mL) followed by CR6 on Red Run Drain (1,686 *E. coli* per 100 mL) (Table 4). CR1 on the Clinton River Spillway had the lowest overall station geometric mean (249 *E. coli* per 100 mL). The highest daily maximum *E. coli* concentration of 32,166 *E. coli* per 100 mL was recorded at Station CR5 on July 8, 2008, following a minor rainfall of 0.09 inches. Station CR3, located on Harrington Drain, had the highest station geometric mean of all stations and also the greatest number of PBC WQS exceedances of all stations in the entire TMDL watershed. Results from the three branches of the Clinton River will each be discussed separately.

Precipitation data for the two days prior to each DNRE sampling event were obtained from a weather station at Romeo, Michigan (MAWN, 2008) for the North Branch and Middle Branch Clinton River (Tables 1 and 3), and the Pontiac Wastewater Treatment Plant (WWTP) (NOAA, 2008a) for the Main Branch (Table 2). Overall, precipitation at the Romeo-based weather station showed near average amounts of precipitation in June and July 2008. Below average precipitation was observed in August 2008 (observed=1.82 inches, average=3.0 inches), and precipitation observed in September 2008 was more than 3 times the average amount (observed=6.81 inches, average=2.2) based on 25 years of precipitation data (NOAA, 2008a). The Clinton River United States Geological Survey (USGS) gauge (4165500) located at Moravian Road shows that flows responded accordingly to the increased rainfall in September. The Main Branch Clinton River was at a near record low flow of 74 cubic feet per second (cfs) on September 1, 2008. The discharge from the Clinton River increased dramatically, from 295 cfs on September 9, 2008 (near the historic monthly mean) to 1,280 cfs on September 10, 2008. A series of storms from September 7-9, 2008, resulted in the hydrograph peaking at a maximum flow of 7,910 cfs on September 15, 2008.

In addition to weekly *E. coli* samples, samples for bacterial source tracking analysis to determine sources of fecal contamination were also collected from CR3 (Harrington Drain), CR12 (Paint Creek), MB3 (Gloede Drain), NB2 (Coon Creek), and NB7 (McBride Drain). Samples from CR3, NB2, and NB7 were collected on September 3, 2008. Samples from CR12 were collected on September 24, 2008. Samples were collected from MB3 and NB2 for a second time on October 1, 2008. Each sample was analyzed for fecal *Bacteriodetes* human and bovine (cattle) gene biomarkers by polymerase chain reaction; these results are shown in Table 4. Since *Bacteriodetes* are strict anaerobes, and cannot survive long outside their host, the detection of this biomarker indicates recent or nearby human or bovine fecal pollution. Positive human *Bacteroidetes* results were found at Stations CR3, CR12, MB3, NB2, and NB7. Positive bovine Bacteroidetes results were found at Stations NB2 and NB7.

Main Branch Clinton River

Of the nine stations located directly on the Main Branch Clinton River, the *E. coli* concentrations tended to increase from upstream to downstream (Table 2). These results can be interpreted to mean that additional sources of *E. coli* were entering the Main Branch Clinton River as it flowed downstream, rather than a single upstream source, which would have been

gradually diluted by any uncontaminated tributaries or storm water. A notable increase in *E. coli* concentration occurred downstream of the Red Run Drain confluence with the main stem river (between stations CR5 and CR7). With the exception of Station CR1 (located on the emergency spillway), the *E. coli* data from stations downstream of the Red Run Drain confluence with the Main Branch Clinton River (CR2-CR6) all followed similar trends in *E. coli* concentrations over time (Figure 4). *E. coli* concentrations at sites downstream of Red Run Drain (CR2-CR6) tended to be more variable over time and reached maximum concentrations in late July, decreased through August, and increased dramatically through late September; whereas, *E. coli* concentrations upstream of Red Run Drain (CR7-CR13) reached their maximum at the beginning of the sampling season in late June, decreased and remained fairly stable from August through the end of September (Figure 4).

Of the 18 sampling events, 10 events were preceded by rainfall according to records kept by the Pontiac WWTP. *E. coli* concentrations at Stations CR2-CR6 (those downstream of Red Run Drain including Harrington Drain), and CR8 tended to be elevated following precipitation. All stations in the Main Branch Clinton River, except CR1 on the spillway, exceeded the PBC WQS on the June 25, 2008 sampling event, which were collected the day following a rainfall of 0.21 inches. The human *Bacteroidetes* biomarker was detected at Station CR3 on September 3, 2008, and CR12 on September 24, 2008. Bovine *Bacteroidetes* was not detected at either CR3 or CR12.

Middle Branch Clinton River

Each of the four stations located on the Middle Branch Clinton River study area exceeded the daily maximum TBC WQS for most, if not all, of the sampling season. The daily maximum TBC WQS was exceeded on 100 percent of sampling events at MB4, 94 percent at Stations MB1 and MB3, and 89 percent of events at Station MB2. The 30-day geometric mean TBC WQS was exceeded throughout the sampling season at all four of the Middle Branch Clinton River stations. The number of PBC WQS exceedances at each station increased at the further downstream locations, as did the station geometric means (Table 4). Station MB3, on Gloede Drain, had the highest station geometric mean of the four Middle Branch Clinton River stations. The 30-day geometric mean of Stations MB3 and MB4 increased gradually toward the end of the sampling season (Figure 5), and Station MB4 consistently exceeded the daily maximum PBC WQS for the last 4 weeks of sampling, beginning with the September 10, 2008, sample (Table 3). Exceedances of the PBC WQS at Middle Branch Clinton River stations occurred in both wet and dry weather. The two largest rain events captured by the sampling (June 11 and September 10, 2008) resulted in exceedances of the WQS at Stations MB2, MB3, and MB4 (Table 3). Human *Bacteroidetes* was detected in a sample from MB3, from Gloede Drain, on October 1, 2008. Bovine *Bacteroidetes* was not detected at MB3.

North Branch Clinton River

Of the eight stations in the North Branch Clinton River study area, results at Station NB2 on Coon Creek were consistently the highest, resulting in exceedances of the PBC WQS on 44 percent of sampling events (Table 1). McBride Drain, Station NB7, had a notably higher station geometric mean when compared with the four stations on the North Branch Clinton River (NB1, NB5, NB6, and NB8) (Table 4). Station NB1, the station located furthest upstream in the watershed, had the lowest station geometric mean (279 *E. coli* per 100 mL) of all stations in the North Branch Clinton River. This station exceeded the PBC WQS on 4 of the 18 sampling dates. *E. coli* concentrations at Stations NB1, NB2, and NB7 were notably affected by wet weather. Of the 7 rain events, which occurred within 2 days prior to sampling, Station NB2

(Coon Creek) exceeded the PBC WQS on 6 events, and Stations NB1 (North Branch Clinton River at 29-Mile) and NB7 (McBride Drain) exceeded the PBC WQS on 4 events. Bovine *Bacteroidetes* biomarkers were detected on September 3, 2008, at Stations NB2 and NB7. Positive human *Bacteroidetes* results were found at NB2 (Coon Creek) on October 1, 2008, and NB7 (McBride Drain) on September 2, 2008.

SOURCE ASSESSMENT

Potential sources to all three branches of the TMDL watershed include illicit connections, failing on-site sewage disposal systems (OSDS), agricultural operations, wildlife and pet waste, dumping of trash, contaminated groundwater, NPDES permitted discharges of storm water, as well as urban runoff. General sources are discussed here, while sources specific to each of the three branches (Main Branch, Middle Branch, and North Branch Clinton River) are discussed separately below.

To assist in determining potential sources to TMDL water bodies, the DNRE conducted a load duration curve analysis for each sampling station as outlined by Cleland (2002). A load duration curve considers how flow conditions relate to a variety of pollutant sources (point and nonpoint sources). The load duration curves for each station show the flow conditions that occurred during sampling, and can be used to make rough determinations as to which conditions result in exceedances of the WQS. The load duration curves for each station sampled in the Clinton River TMDL watershed are included in Appendices 3-5. The USGS gauges which were used to determine the load duration curves for this TMDL are listed and described in Table 9. A ratio of the drainage area of the station locations to the drainage area of the gauged watersheds (defined as the drainage area ratio) was calculated for each of the 25 stations for this TMDL. The curves were generated by applying these drainage area ratios to gauged flows for the period of record (Table 9).

Exceedances that occur during high flows are generally linked with rainfall events, such as surface runoff contaminated with fecal material, a flush of accumulated wildlife feces, or trash from the storm sewers or septic tank failures involving failing drainage fields that no longer percolate properly (surface failures). Exceedances that occur during low flows or dry conditions can generally be attributed to a constant source that is independent of the weather. Examples of constant sources include illicit connections (either directly to surface waters or to storm sewers), some types of OSDS failures, groundwater contamination, and pasture animals with direct stream access. Groundwater contamination of surface water with *E. coli* can occur in areas where septic tanks are too close to surface waters or in areas where livestock or animal waste is allowed to accumulate in close proximity to surface waters.

OSDS are a common method of treatment where sanitary sewers are not available, including, Armada, Chesterfield, Clinton, Harrison, Macomb, Ray, Shelby, Sterling Heights, and Washington Townships. These systems become a potential source of *E. coli* to surface waters when they fail or are poorly designed. Failures occur at varying degrees, resulting in a range of contamination severity, with major failures such as sewage on the ground surface and tanks connected directly to surface waters (also considered illicit discharges) at one end of the scale, and minor failures such as laundry or sinks bypassing the treatment systems at the other end of the scale. The Macomb County Health Department (MCHD) maintains a Point of Sale inspection for OSDS to enforce their Property Transfer Ordinance. The overall rate of OSDS failure for Macomb County was 12 percent during 2008 (this figure does not include laundry and sink violations) (personal communication with MCHD). Oakland County has over 80,000 OSDS in its jurisdiction, but does not have a Point of Sale Ordinance and therefore the precise

failure rate is unknown. However, it is estimated that the OSDS failure rate, including laundry and sink violations) is about 10 percent across Michigan based on an average of existing Point of Sale programs throughout the state (*E. coli* Work Group, 2008).

Of the entire TMDL watershed, 41 percent of the land coverage is a combination of high, low, and medium intensity development, with an additional 10 percent developed open space (NOAA, 2008b). Residences and industrial and commercial buildings within this area are largely connected to the sanitary sewers and are served by storm sewers. The sewers in the TMDL watershed are all separated, meaning that sanitary waste and storm water are transported in separate systems. Sanitary waste is transported to a WWTP, where the effluent is subject to fecal coliform limits (as described in the Reasonable Assurance section). The USEPA's Storm Water Phase II Rules require that all public entities operating Municipal Separate Storm Sewers (MS4s) within urbanized areas obtain municipal storm water permits, unless this requirement is waived by the NPDES permitting authority. The State of Michigan's Phase II Watershed-Based Storm Water General Permit (MIG610000) and the Phase II Jurisdictional-Based Storm Water General Permit (MIS040000) have been developed to meet the federal requirement. The TMDL watershed receives MS4 permitted storm water from 15 minor civil divisions (townships, villages, and cities), 2 counties, and the Selfridge Air National Guard base (Table 8). Macomb County is responsible for approximately 5,895 surface water discharge points according to their 2008 MS4 permit application. Oakland County's permit application states that they have 1,499 known outfalls, though few of these are located within the TMDL watershed. While portions of St. Clair County are within the boundary of this TMDL watershed, the land area makes up less than 1 percent of the TMDL watershed and no MS4 oufalls from St. Clair County discharge to the watershed; therefore, the St. Clair County MS4 has not been included in Table 8. In addition to MS4 permitted discharges within the TMDL watershed, there are four individual NPDES permits, 182 Certificates of Coverage (COCs) under the industrial storm water general permit (MIS110000), 1 COC for petroleum groundwater cleanup (MIG080000), 1 COC for noncontact cooling water (MIS110000), and 1 COC for storm water discharge with required monitoring (MIS120000) (Figure 2, Table 8, and Appendix 2).

The large percentage of area with impervious surface within the Clinton River watershed causes a flush of storm water following precipitation, which can cause storm water to become contaminated with *E. coli* from human litter (such as diapers) and pet and wildlife fecal waste. In addition to pet and wildlife fecal waste on the ground surface, wildlife, including raccoons, opossums, rats, and mice are residents of the storm sewers. Bacteria from these warm-blooded mammals are a certain contributor to the WQS exceedances observed in the urban subwatersheds.

Main Branch Clinton River

Sanitary Sewer Overflows (SSOs) are illegal events that occur when a sanitary sewer discharges raw or inadequately treated sewage to the ground surface or waters of the state rather than being transported to a WWTP. Chronic SSOs usually occur in a predictable location on a somewhat regular basis and can be caused by infiltration or inflow of groundwater into sewers during precipitation events, which in turn causes the system to overload. Three municipalities are responsible for chronic SSOs in the TMDL watershed. These are: Fraser (1 outfall), Center Line (1 outfall), and Clinton Township (7 outfalls) (Figure 3). The municipality of Fraser was responsible for 10 SSO events in 2008 and 12 in 2009. These chronic SSOs all occurred at the Beacon Lift Station and resulted in raw sewage entering Sweeney Drain, a tributary to Harrington Drain, upstream of Station CR3. As an example of the potential impact

of this SSO, the MCHD sampling on Harrington Drain after a June 10, 2008, Fraser SSO event had a result of 54,750 *E. coli* per 100 mL (MCHD, 2008). The DNRE sampling event at the same location (Station CR3) on the day following this Fraser SSO event showed an elevated result (3,806 *E. coli* per 100 mL) and may reflect residual contamination from the SSO event. Clinton Township was responsible for 4 SSO events in 2008 and 2 SSO events in 2009, which resulted in raw sewage entering the Clinton River and Harrington Drain. Center Line was responsible for 2 SSO events in 2008 and 2 SSO events in 2009, resulting in raw sewage entering a tributary to Bear Creek (Red Run Drain), upstream of Station CR6. Due to timing of the events and sampling, DNRE data would not have captured potentially elevated *E. coli* levels from the 2008 events from the Clinton Township or Center Line SSOs. Sampling by MCHD targeted the September 13, 2008, Center Line event, which occurred after 3.72 inches of rain. Macomb County collected a sample just downstream of the Center Line SSO location and found an *E. coli* concentration of 34,480 *E. coli* per 100 mL (MCHD, 2008).

OSDS are not a prevalent method of sanitary waste disposal in the Main Branch Clinton River TMDL watershed, because the majority of this area is sewered; but, there are local areas where OSDS are common, including Shelby, Sterling Heights, and Clinton Townships. In Clinton Township, the OSDS from 347 were determined by the MCHD to be either failing or too close in proximity to the Clinton River. As of November 2008, the OSDS for 54 out of 347 problem homes had been corrected by connecting the homes to a newly constructed sanitary sewer (Clinton Township, 2008). Similar situations may exist in other townships.

Seventy-three percent of the Main Branch Clinton River TMDL watershed is a combination of high, medium, and low intensity developed land, plus an additional 10 percent is categorized as developed open space. This developed land area is largely drained by storm sewers. MS4 permitted discharges for the Main Branch Clinton River include Shelby, Clinton, Macomb, and Chesterfield Townships, Macomb and Oakland Counties, and the cities of Fraser, Utica, Mount Clemens, Center Line, Rochester, and Rochester Hills. Other point sources include the Mount Clemens WWTP (MI0023647) and an additional 161 NPDES permitted discharges to the Main Branch Clinton River and its tributaries (Figure 2). Illicit connections to the storm sewers regulated under MS4 permits are a potential source of *E. coli* to the Main Branch Clinton River.

Positive detections of human *Bacteroidetes* were found in Paint Creek (CR12, upstream of the TMDL reach) and Harrington Drain. No SSOs occurred prior to the collection of these samples, suggesting that illicit connections or failing OSDS are a source of the pathogens.

As mentioned in the Data Discussion of this TMDL, sources of *E. coli* within the Red Run Drain subwatershed are apparently contributing to the impairment of the lower Clinton River downstream of the confluence. This is evident by the pattern of fluctuating *E. coli* concentrations from Main Branch Clinton River stations upstream of the Red Run Drain confluence (CR7-CR13), which responded differently than stations downstream of Red Run Drain (CR1-CR6); a pattern which can be seen in Figure 4 and is described in the Data Discussion of the Main Branch Clinton River stations on Pages 6 and 7. Detailed sampling of the Red Run Drain watershed was conducted for the *E. coli* TMDL approved in 2006 (Lipsey, 2006). Analysis of these data lead the DNRE to conclude that wet weather sources within the Red Run Drain and Bear Creek watersheds were having a significant influence over *E. coli* exceedances and the downstream stations on the Main Branch Clinton River. The data collected in 2008 at Station CR6 for this TMDL support this conclusion.

Based on the 2008 DNRE data, wet weather sources appear to be having a bigger impact on Station CR8 than nearby, upstream Station CR9. Exceedances of the PBC WQS occurred at

Station CR8 after the majority of the recorded rain events (Table 2), while few wet weather exceedances occurred at Station CR9, which is located a few miles upstream of Station CR8. The station geometric mean of CR8 was also higher than the station mean for CR9 (Table 4). Tributaries or outfalls located between Stations CR8 and CR9 should be scrutinized for potential wet weather sources.

According to the load duration curves, low flow conditions were well represented in the sampling for most Main Branch Clinton River stations (Appendix 3). According to the load duration analysis, exceedances of the daily maximum TBC WQS did not occur under low flow conditions at Station CR1, which is likely because the spillway is an artificially constructed overflow designed as a bypass during high flows, and therefore, was not flowing under low flow conditions. At the upstream end of the watershed (Station CR13), only two samples were collected during high flow conditions and both attained the TBC WQS. With the noted exception of Stations CR1 and CR13, exceedances occurred under all flow conditions sampled, at all sites in the Main Branch Clinton River. The dry and mid-range flow *E. coli* exceedances suggest that constant sources, often referred to as "dry weather" sources (e.g., illicit connections), are having a strong influence on the *E. coli* concentrations at the Main Branch Clinton River stations during these flow conditions. Across all stations, very few samples were collected during high flows or moist conditions, although sampling during these conditions generally revealed exceedances of the daily maximum TBC WQS.

Middle Branch Clinton River

High, medium, and low density developed land occupies 47 percent of the Middle Branch Clinton River, which is largely single family residential land use (SEMCOG, 2009). This land area is generally drained by storm sewers. MS4 permitted discharges that discharge to the Middle Branch Clinton River include Shelby, Macomb, Washington, Romeo, and Clinton Townships, and Macomb County. Illicit connections to the storm sewers are a potential source of *E. coli* to the Middle Branch Clinton River. In addition to the MS4s, there are 23 NPDES permitted discharges to the Middle Branch Clinton River, none of which are WWTPs (Figure 2). A positive detection of human *Bacteroidetes* was found in a sample collected from Gloede Drain (MB3) during dry conditions. No SSOs have been reported in the Middle Branch Clinton River, suggesting that illicit connections or failing OSDS are a likely source of the pathogens.

Based upon the number of repair permits issued by the MCHD in 2008, Shelby Township has a high concentration of malfunctioning OSDS. OSDS repair permits issued within Shelby Township are consistently higher than other townships in Macomb County (personal communication with MCHD). Communities in northern Shelby Township were constructed in the 1970s with on-site systems rather than being connected to a sanitary sewer. In 2008 alone, 104 repair permits were issued in Shelby Township. To put that into context, the next highest number of permits issued within the county was 16, issued in neighboring Macomb Township in 2008 (MCHD, personal communication). Although the soils in Shelby Township are well drained and are appropriate for these systems to function well, even on the small sized lots in these neighborhoods, the aging systems fail at high rates, resulting in varying degrees of groundwater and surface water contamination by sewage. It should be noted that the issuance of a repair permit does not assure that the repair was actually completed. The high number of repair permits issued is a positive sign that potential sources of fecal contamination are being remedied, but is also an indicator that a significant problem may exist in older neighborhoods of Shelby Township.

Upstream portions of the Middle Branch Clinton River are agricultural. Approximately

ten percent of the land cover in the Middle Branch Clinton River is categorized as row crops and an additional six percent is pasture or hay. This land is mainly upstream of Station MB1 at 25-Mile Road (Figures 1 and 2). No bovine *Bacteroidetes* biomarker was found in the MB3 sample from October 1, 2008; however, these negative results do not exclude cattle as a source to the Middle Branch Clinton River.

Overall for the Middle Branch Clinton River, 7 sampling dates occurred during dry conditions, 7 during mid-range conditions, 3 in moist conditions, and 1 in high conditions. No samples were collected during low flow conditions. Load duration curves for Middle Branch Clinton River stations (MB1-MB4) indicate that exceedances of the daily maximum TBC WQS occurred under all flow conditions that were sampled, from high flows to dry conditions (Appendix 4).

North Branch Clinton River

Nine percent of the land area in the North Branch Clinton River TMDL watershed is a combination of high, medium, and low density developed land, with an additional 5 percent as developed open space. This urbanized area is considerably less than in the Main or Middle Branches, but storm sewers are used in these areas. MS4s that discharge to the North Branch Clinton River include Macomb, Clinton, Romeo, and Chesterfield Townships, Macomb County, and the city of Mount Clemens. Illicit connections to the storm sewers regulated under MS4 permits are a potential source to the North Branch Clinton River. In addition to the MS4 discharges, there are 4 NPDES permitted discharges to the North Branch Clinton River (Figure 2). New Haven Schools – Ray Township is the only WWTP that discharges to the North Branch Clinton River. The majority of the land area is not served by sanitary or storm sewers. In these areas OSDS are the only method for sanitary waste disposal. Positive detections of human *Bacteroidetes* suggest that illicit connections or failing on-site treatment systems are a source of pathogens to Coon Creek (NB2) and McBride Drain (NB7).

In the North Branch Clinton River, livestock and manure spreading are a potential source of *E. coli*. The bovine *Bacteroidetes* biomarker was detected on Coon Creek (NB2) and McBride Drain (NB7). Thirty-seven percent of the North Branch Clinton River land area is cultivated for row crops and another 17 percent are used for pasture or hay, and therefore, are potentially available for manure land application. While there are no permitted Concentrated Animal Feeding Operations (CAFOs) in the TMDL watershed, there is a CAFO upstream of the TMDL watershed near Romeo, Michigan. This CAFO (Ingleside – MIG010157) manifests (sells or gives away) its manure to other farmers. It is therefore not possible to know where, when, or if the manure from this operation is land applied within the TMDL watershed. According to the 2007 Census of Agriculture, there are 4,271 cattle, 1,356 horses, and 301 swine living in Macomb County (United States Department of Agriculture, 2007).

Station NB1, the furthest upstream station on the North Branch Clinton River, had four exceedances of the PBC WQS, and all of those samples were collected immediately following rainfall events. Between these PBC WQS exceedances, the daily maximum TBC and PBC WQS were generally met. These wet weather PBC exceedances indicate that contaminated storm runoff is a likely source of *E. coli* contamination at Station NB1. Three miles further downstream, at Station NB5, additional exceedances of the WQS were observed; but, these exceedances of the TBC WQS occur at lower concentrations than at NB1 and occur across all weather conditions. One major tributary (Camp Brook Drain) enters the North Branch Clinton River between Stations NB1 and NB5. Additional constant sources of either human or animal nature in this subwatershed or directly to the North Branch Clinton River between NB1 and NB5 may be contributing to the persistent daily maximum TBC WQS exceedances at the NB5.

According to the DNRE load duration analysis of the North Branch Clinton River stations, seven sampling dates occurred during dry conditions, seven during mid-range conditions, three in moist conditions, and 1 in high conditions (Appendix 5). No samples were collected during low flow conditions. Load duration curves for most North Branch Clinton River stations (NB1, NB2, and NB5-NB8) indicate that exceedances of the daily maximum TBC WQS occurred under all flow conditions that were sampled, from high flows to dry conditions. Exceedances during all flow conditions indicate that there are multiple sources of *E. coli* contamination to the North Branch Clinton River, e.g., storm runoff contaminated by manure applications, illicit connections, and failing OSDS. This pattern of exceedances at all flow conditions varied only at Station NB3 on the East Branch Coon Creek and Station NB4, immediately downstream of the confluence with the East Branch Coon Creek. At Stations NB3 and NB4, the majority of exceedances occurred during mid-range flows and dry conditions indicating a constant source originating on the East Branch Coon Creek and affecting Coon Creek. The East Branch Coon Creek sources were assessed as part of an *E. coli* TMDL approved by the USEPA in 2006. Agricultural runoff, illicit connections, failing or poorly operating OSDS, and urban runoff were all listed as possible sources of *E. coli* to the East Branch Coon Creek watershed (Cooper and Alexander, 2006).

LOADING CAPACITY (LC) DEVELOPMENT

The LC represents the maximum loading that can be assimilated by the water body while still achieving WQS. As indicated in the Numeric Target section, the targets for this pathogen TMDL are the TBC 30-day geometric mean WQS of 130 *E. coli* per 100 mL, daily maximum of 300 *E. coli* per 100 mL, and the PBC daily maximum WQS of 1000 *E. coli* per 100 ml. Concurrent with the selection of a numeric concentration endpoint, development of the LC requires identification of the critical condition. The “critical condition” is defined as the set of environmental conditions (e.g., flow) used in development of the TMDL that results in attaining WQS and has an acceptably low frequency of occurrence.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For *E. coli*, however, mass is not an appropriate measure, and the USEPA allows pathogen TMDLs to be expressed in terms of organism counts (or resulting concentration). Therefore, this pathogen TMDL is concentration-based, consistent with R 323.1062, and the TMDL is equal to the TBC target concentrations of 130 *E. coli* per 100 mL as a 30-day geometric mean and daily maximum of 300 *E. coli* per 100 mL in all portions of the TMDL reach for each month of the recreational season (May through October) and PBC target concentration of 1000 *E. coli* per 100 mL as a daily maximum year-round. Expressing the TMDL as a concentration equal to the WQS ensures that the WQS will be met under all flow and loading conditions; therefore, a critical condition is not applicable for this TMDL.

LC

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

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

The LC represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. Because this TMDL is concentration-based, the total loading for this TMDL is equal to the TBC WQS of 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum during the recreation season and PBC WQS of 1000 *E. coli* per 100 mL as a daily maximum year-round.

WLAs

The WLA for the facilities listed in Table 8 and Appendix 2 are equal to 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum during the recreational season between May 1 and October 31, and 1000 *E. coli* per 100 mL as a daily maximum the remainder of the year. There are 4 individual NPDES permits included in the WLA. COCs under general NPDES permits include: 182 storm water from industrial activities (MIS110000), 15 watershed-based MS4 (MIG610000), 3 jurisdictional-based MS4 (MIS040000), 1 petroleum groundwater cleanup (MIG080000), 1 noncontact cooling water (MIS110000), and 1 storm water discharge with required monitoring (MIS120000).

LAs

Because this TMDL is concentration-based, the LA is also equal to 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum during the recreational season and 1000 *E. coli* per 100 mL as a daily maximum year-round. This LA is based on the assumption that all land, regardless of use, will be required to meet the WQS. Therefore, the relative responsibility for achieving the necessary reductions of bacteria and maintaining acceptable conditions will be determined by the amount of land under the jurisdiction of the local unit of government in the watershed (Tables 6 and 7). Seventeen municipalities have land area within the Clinton River TMDL watershed.

MOS

This section addresses the incorporation of an MOS in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality, including the pollutant decay rate, if applicable. The MOS can be either implicit (i.e., incorporated into the WLA or LA through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS because no rate of decay was used. Pathogen organisms ordinarily have a limited capability of surviving outside of their hosts and a rate of decay could be developed. However, applying a rate of decay could result in an allocation that would be greater than the WQS, thus no rate of decay is applied to provide for greater protection of water quality. The DNRE has determined that the use of the TBC WQS of 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum during the recreational season, and the PBC WQS of 1000 *E. coli* per 100 mL as a daily maximum year-round for the WLA and LA is a more conservative approach than developing an explicit MOS. This accounts for the uncertainty in the relationship between pollutant loading and water quality, based on available data and the assumption to not use a rate of decay. Applying the WQS to be met under all flow conditions also adds to the assurance that an explicit MOS is unnecessary.

SEASONALITY

The WQS for *E. coli* are expressed in terms of seasons, e.g., TBC from May 1 through October 31 and PBC year-round. Allocations and controls developed for the more protective

TBC season are also expected to assure attainment of the daily maximum PBC WQS of 1000 *E. coli* per 100 mL, year-round. Because this is a concentration-based TMDL, WQS must be met regardless of flow conditions in the applicable season.

REASONABLE ASSURANCE ACTIVITIES

Point Source Discharges

The permittees listed in Table 8 and Appendix 2 are responsible for meeting their NPDES permit limits. Permits for the NPDES permitted facilities that may be a source of fecal contamination contain measures to reduce or eliminate the potential for fecal contamination of the Clinton River. Michigan regulates discharges containing treated or untreated human waste (i.e., sanitary wastewater) using fecal coliform. Sanitary wastewater discharges are required to meet 200 fecal coliform per 100 mL as a monthly average and 400 fecal coliform per 100 mL as a maximum. The sanitary discharges are expected to be in compliance with the ambient PBC and TBC WQS if their NPDES permit limits for fecal coliform are met. The *E. coli* criteria contained in the USEPA's criteria document (1986) were derived to approximate the degree of protection, e.g., no more than 8 illnesses per 1000 swimmers, provided by the fecal coliform indicator level of 200 *E. coli* per 100 mL recommended by the USEPA prior to the adoption of the 1986 criteria. All WWTPs provide year-round disinfection, providing another level of confidence that the WQS for *E. coli* will be met. The individual permittees identified in Table 8 with treated human waste discharges are Mount Clemens WWTP and New Haven Schools-Ray Township. They are responsible for maintaining compliance listed with their NPDES permit limitations for fecal coliform, and to monitor their effluent according to their permit requirements.

The COCs for the general industrial storm water permit (MIS310000) listed in Appendix 2, specifies that if a TMDL is established by the Department for the receiving water that restricts the discharge of any of the identified significant materials or constituents of those materials, then the Storm Water Pollution Prevention Plan shall identify the level of control for those materials necessary to comply with the TMDL, and an estimate of the current annual load of those materials via storm water discharges to the receiving stream.

The TMDL watershed receives storm water discharges from Phase I communities, Phase II communities, and other regulated MS4s (a complete list of the regulated MS4s within the TMDL watershed is included in Table 8). These regulated MS4s are required to obtain permit coverage under Michigan's NPDES MS4 Jurisdictional-Based or Watershed-Based Storm Water General Permits. However, the Michigan Department of Transportation has a statewide NPDES Individual Storm Water Permit (MI0057364) to cover storm water discharges from their regulated MS4. Under the Jurisdictional, Watershed, and Individual MS4 permits, permittees are required to reduce the discharge of pollutants (including *E. coli*) from their MS4 to the maximum extent practicable through the development and implementation of a Public Involvement and Participation Process, a storm water-related Public Education Plan, an Illicit Discharge Elimination Program (IDEP), a post-construction Storm Water Control Program for new development and redevelopment project, a Construction Storm Water Runoff Control Program, and a Pollution Prevention/Good Housekeeping Program for municipal operations.

In particular, the IDEP and TMDL requirements of the permits have the greatest potential to contribute to the reduction of *E. coli* levels in the Clinton River. The IDEP requirements of the MS4 storm water permits require permittees to develop a program to find and eliminate illicit connections and discharges to their MS4. This includes a plan to conduct dry-weather

screening of each MS4 discharge point at least once every five years (unless an alternative schedule or approach is approved by the DNRE or the permittee opts to pursue the elective option). Dry-weather screening does not require *E. coli* sampling; however, if a permittee observes evidence of any illicit connection or discharge they are required to investigate and eliminate them. As for the TMDL requirements, permittees are required to identify and prioritize actions to be consistent with the requirements and assumptions of the TMDL. Through prioritizing TMDL actions, permittees are able to focus their efforts, which will help to make progress towards meeting Michigan's WQS.

The MS4 permit for Macomb County (MIG610052) covers all county-owned outfalls and outfalls under the nested jurisdiction of the county, including county road, county drain, and school district outfalls. The IDEP Plan for Macomb County uses a watershed approach, and coordinates the efforts of the Macomb County departments (MCHD, Public Works Office, and Road Commission), nested jurisdictions within Macomb County, watershed partner communities, and the Clinton River Watershed Council. Macomb County has been conducting IDEP activities from 2001 through 2010. Macomb County estimates that approximately 42 million gallons per year of wastewater have been excluded from the Clinton River and Lake St. Clair due to their efforts since 2003 (Macomb County, 2008). During the reporting period from October 2007 to September 2008, 163 illicit discharge investigations were conducted by Macomb County and resulted in the identification of 20 illicit discharges (14 of these were corrected during the reporting period) (Macomb County, 2008). From September 2008 through the end of 2009, the MCHD has identified an additional 20 illicit discharges of sewage (includes septic failures), 11 of which have been corrected. The MCHD also found that trash compactor leachate had been leaking into a surface water tributary (Schroeder Drain) to the Clinton River. This situation was remedied in July 2009. Trash compactor leachate can have very high *E. coli* concentrations, and therefore, eliminating this persistent source is a particularly notable accomplishment.

Each of the MS4 communities in the TMDL watershed are required to maintain their own IDEP and submit annual reports identifying actions taken to find and eliminate illicit connections, as well as identify improvements to the sanitary and storm sewers, which may indicate progress to eliminate the contamination of storm water. The minor civil divisions within Macomb County that are covered under the watershed MS4 permit (MIG61000), work together and build from the Macomb County IDEP described above; therefore, some of the information described below, from the municipality IDEPs, may be duplicate information from the Macomb County IDEP. The following IDEP information was collected from the individual IDEP progress reports from each permittee, encompassing the period from November 1, 2007, through October 31, 2008.

- Macomb, Washington, and Shelby Townships and the village of Romeo reported no suspected illicit discharges within their jurisdiction (Macomb Township, 2008; Washington Township, 2008; Shelby Township, 2008; and Village of Romeo, 2008).
- No information from this reporting period was available for Harrison Township, and the previous reporting cycle did not provide enough details to report on IDEP progress.
- Clinton Township tested outfalls in 2003 and no illicit connections were found at that time (Clinton Township, 2008).
- The city of Utica identified and corrected 1 illicit connection (laundry/sink violation) and reported that 95 percent of the city system has been inspected by the reporting date (City of Utica, 2008).

- The city of Fraser completed 70 residential, commercial, and industrial inspections, including dye testing, which resulted in the identification and correction of 2 illicit sewage discharges and numerous floor drains connected to the storm sewer (City of Fraser, 2008).
- The city of Mount Clemens identified two outfalls with evidence of illicit connections (*E. coli* concentrations in the 1000-3000 range) (City of Mount Clemens, 2008). Both of these outfall investigations are still unresolved due to difficulties in source identification.
- Chesterfield Township reported no illicit connections. In 2007/2008, the township cleaned and examined 36,000 feet of storm sewer (Chesterfield Township, 2008). Portions were replaced, and Chesterfield Township is making plans to line sections of the sanitary sewer to reduce infiltration and leaking.
- The city of Center Line initiated residential dye testing and outfall inspections with *E. coli* screening in February 2008, which resulted in the elimination of 1 illicit connection (City of Center Line, 2008). Center Line also inspected their entire storm sewer in 2005-2007, and no contamination by seepage from the sanitary sewer was noted.
- The city of Sterling Heights reported finding and correcting 1 illicit discharge and 1 OSDS violation in 2008 (City of Sterling Heights, 2008).
- The city of Warren found and corrected 9 illicit connections to the storm sewers (City of Warren, 2008).

The MS4 permit for Oakland County (MIG610042) covers all county-owned outfalls and outfalls under the nested jurisdiction of the county, including county road, county drain, and school district outfalls. Similar to the Macomb County IDEP, the IDEP Plan for Oakland County uses a watershed approach, which coordinates the efforts of the Oakland County departments, nested jurisdictions within Oakland County, and watershed partner communities via a committee called the Oakland County Stormwater Committee. Oakland County has been conducting IDEP activities from 2003 through 2010. During the reporting period of October 2007 to September 2008, dry weather IDEP surveys were conducted at 790 discharge points in 18 communities including: 144 discharge points on 105 county drains in the Rouge River and Clinton River watersheds, 193 discharge points on road commission drains in 67 subdivisions in the Clinton River watershed, and 126 discharge points at 43 county facilities (Oakland County, 2008). Oakland County eliminated 2 failed OSDS, 7 illicit connections to the storm sewer, and 3 broken sanitary lines during the 2008 reporting period, resulting in the exclusion of an estimated 7 million gallons per year of untreated sanitary waste to the Clinton River (Oakland County, 2008). None of these illicit discharges were located in the TMDL watershed, but the elimination of illicit discharges within the Clinton River, upstream of the TMDL reach, directly benefits the TMDL reach. The following IDEP information was collected from the individual IDEP progress reports from each permittee, encompassing the period from November 1, 2007 through October 31, 2008:

- The city of Rochester replaced approximately 17,000 linear feet of sanitary sewer and 92 storm sewer structures in order to minimize infiltration (City of Rochester, 2008). The city of Rochester did not find any suspicious outfalls during a dry weather survey of outfalls in 2007.
- The city of Rochester Hills reported no suspected illicit discharges within their jurisdiction (City of Rochester Hills, 2008).

At the time of the Section 303(d) listing of the Clinton River in 1998, the city of Pontiac (upstream of the listed reach) was discharging untreated sewage to the Clinton River through

combined sewer overflows (CSOs). Pontiac has completely separated their storm and sanitary sewers, and therefore, no longer has CSOs. While the CSOs have been eliminated, the Pontiac WWTP is prone to chronic SSOs and is under a consent order to eliminate these by 2020. There are no uncontrolled CSOs in the TMDL watershed. Chronic SSOs represent a significant source of fecal contamination, and therefore, *E. coli* to the Clinton River TMDL watershed. The three municipalities that are responsible for SSOs in the TMDL watershed (Clinton Township and the cities of Center Line and Fraser) are all under Administrative Consent Order to fix the discharges. The city of Centerline's SSO remedy is under construction and the SSO will be eliminated by the end of 2011. Clinton Township is required to correct their SSOs by the end of 2011, leaving only one emergency SSO outfall, which can only be used during storms above specified magnitude (approved by the DNRE). The city of Fraser will have eliminated their chronic SSO by June of 2010. The elimination of chronic SSOs that affect the Clinton River TMDL area will help to attain the TBC and PBC WQS.

Nonpoint Source Activities

The MCHD has a Point of Sale Ordinance, which requires the inspection of OSDS prior to property transfer, and requires the remediation of failing systems. Owners of systems that are found to be failing have 180 days to correct the problem after the submission of a corrective action plan to the MCHD. The MCHD responded to 77 complaints resulting in the correction of 19 violations in 2008, and issued 195 OSDS repair permits in 2008 (Macomb County, 2008). Oakland County does not have a Point of Sale Ordinance, but the Oakland County Health Department responded to 129 complaints of failing systems and issued 449 permits for the installation of new or replacement systems during 2008 (Oakland County, 2008). Failing OSDS have the potential to contaminate ground and surface water; therefore, the repair of failing systems is critical to reducing *E. coli* in the Clinton River TMDL watershed.

Watershed Management Plans (WMPs) have been developed for Clinton River East, Stony Creek, and Red Run Drain subwatersheds. These plans were a joint effort between Macomb County, its nested jurisdictions, cities, and townships and the Clinton River Watershed Council. The Watershed Management Plans identify a plan of action to meet all WQS within the watershed to remediate threatened and impaired water bodies, while improving water quality in all water bodies. Reducing pathogens and meeting the *E. coli* WQS in Clinton River are listed as goals in these Watershed Management Plans. In 2008, the Macomb County Public Works Office was awarded a Federal CWA Section 319 grant to develop a Watershed Management Plan for the North Branch Clinton River. This Watershed Management Plan is currently being developed with a target completion date of July 31, 2010. A major aspect of this project involves modeling different land management scenarios to predict future pollutant loadings in the watershed.

The MCHD has been awarded a Clean Michigan Initiative-Clean Water Fund grant titled, "Facility Dye Testing Project – Phase III." The grant was awarded in 2009 and work is scheduled to be completed in 2011. This project will improve the quality of storm water by eliminating illicit connections that have been identified during dye testing of industrial, commercial, and institutional facilities located in Sterling Heights and Clinton Township. Another Clean Michigan Initiative grant titled, "IDEP City of Mount Clemens," was awarded to the city of Mount Clemens WWTP. The goal of this project was to lower bacterial contamination in the Clinton River through identification and elimination of illicit connections within the city of Mount Clemens. This project was completed in December 2009, and resulted in the elimination of two illicit connections to the storm system, and the identification of an additional illicit connection, which is in the enforcement phase. Also, as part of this project, five

additional outfalls were cleaned and resampled. The total estimated dry weather daily reduction in fecal coliform from this IDEP project is 655,559,996 counts per 100 mL, or a 77 percent estimated reduction.

Other Reasonable Assurance Activities

The entire Clinton River watershed is designated as a Great Lakes Area of Concern. The lower section of the river was first designated by the International Joint Commission in 1985 and was then expanded to the entire basin in 1995. Part of the reason for the Area of Concern designation was the concern for high bacterial counts entering Lake St. Clair from CSOs in the watershed. In 1985, the Remedial Action Plan was developed by the DNRE listing beach closings as a beneficial use impairment. The goal of the Remedial Action Plan is to identify environmental problems, establish water use goals, and provide cleanup solutions that will restore the Area of Concern's beneficial uses. In 1998, the Remedial Action Plan was updated and identified fecal contamination due to failing septic tanks and illicit connections to storm sewers, and the contamination of storm water surface runoff as pollution concerns that remained for the Area of Concern. The 1998 Remedial Action Plan also acknowledged pollution cleanup efforts, specifically, the elimination of uncontrolled CSOs in Mount Clemens and the reduction in the number of SSOs. The Public Advisory Committee set restoration goals for the beach closing impairment in 2007. The designation of the Clinton River as an Area of Concern gives priority to planning and implementation projects in the watershed for funding through sources such as the Great Lakes Restoration Initiative and Section 319 federal funds.

The Clinton River is part of the Adopt-A-Stream Program, implemented by The Clinton River Watershed Council. The Adopt-A-Stream Program monitors water quality throughout the Clinton River watershed. This program does not specifically monitor for *E. coli*, but distributes educational materials and promotes a sense of public and personal responsibility to maintain water quality. Other volunteer actions include promoting proper lawn care, pet waste cleanup, investigating pollution sources, education, and land use planning.

The Blue Ribbon Commission on Lake St. Clair was established in 1997 by Macomb County. This commission determined four key elements that are required to manage water quality issues affecting Lake St. Clair. These include monitoring, education, voluntary action, and regulation and enforcement. The commission also recommended various actions at watershed, local, state, national, and international levels that should be taken to support the four key elements (MCHD, 1997). The recommendations of the commission resulted in the creation of the Lake St. Clair Regional Monitoring Project (Project). The Project was a joint effort between county governments in southeast Michigan (Macomb, Oakland, Wayne, and St. Clair Counties), the DNRE, and the USGS. Water quality data, including *E. coli*, were collected during 2004 and 2005 at 75 previously unsampled locations (including 20 sites on the Clinton River) and is available on the Internet to aid in source assessment and the improvement of water quality. The Project includes a Web site (www.lakestclairdata.net) and the embedded database, which is intended to be "used for making decisions on prevention strategies and on priorities for remediation and for the protection of public health." The final report, which contains information on sediment and pollutant loads and identifies data gaps for Lake St. Clair tributaries, was published online in September 2007 (Fogarty, 2007). Data and conclusions from the Project have guided, and will continue to guide, community leaders in targeting improvements in the Clinton River watershed to meet the goal of WQS attainment. Also, following the recommendations of the Blue Ribbon Committee, the MCHD has led a monitoring effort, beginning in 1998, where samples are collected once per week and tested for

E. coli at 50 sites throughout the Macomb County portion of the Clinton River watershed. Samples are also collected at selected sites in response to rainfall events, especially in areas where SSOs have occurred or are anticipated. The data collected is entered into a database and is reviewed closely for trends that might indicate problems requiring further investigation and for reductions in pollution levels that result from corrective efforts.

MONITORING

Future monitoring by the DNRE will take place as part of the five-year rotating basin monitoring, as resources allow, once actions have occurred to address sources of *E. coli.* When these results indicate that the water body may be meeting WQS, sampling will be conducted at the appropriate frequency to determine if the 30-day geometric mean value of 130 *E. coli* per 100 ml and daily maximum values of 300 *E. coli* per 100 ml and 1000 *E. coli* per 100 ml are being met.

The MCHD plans to continue their weekly and wet weather targeted surface water *E. coli* monitoring as their resources allow.

Prepared by: Molly Rippke, Aquatic Biologist
Surface Water Assessment Section
Water Bureau
Michigan Department of Natural Resources and Environment
May 11, 2010

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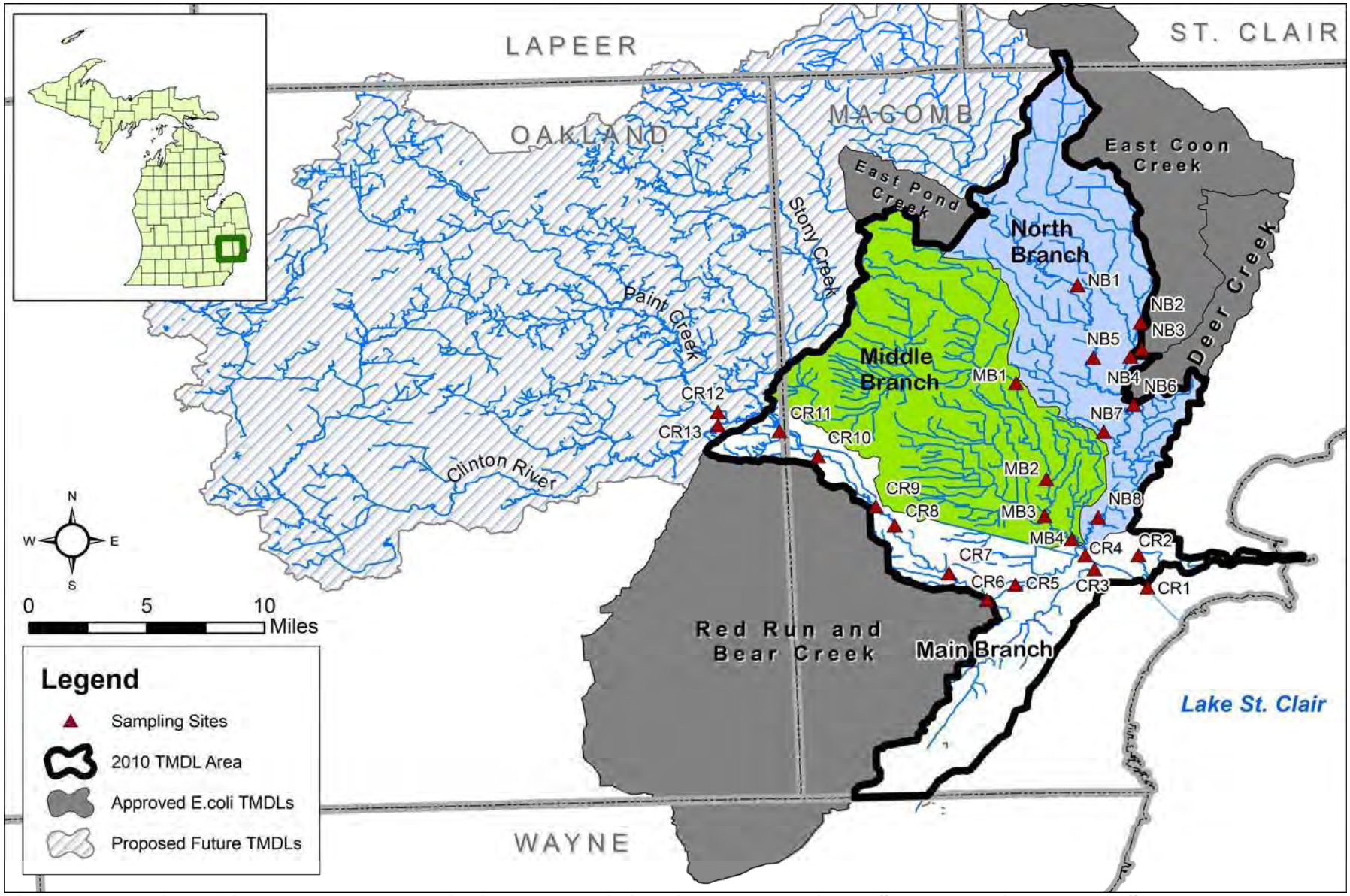


Figure 1. Overview of the 2010 TMDL watershed, 2008 sample locations, approved *E. coli* TMDLs and future *E. coli* TMDL areas.

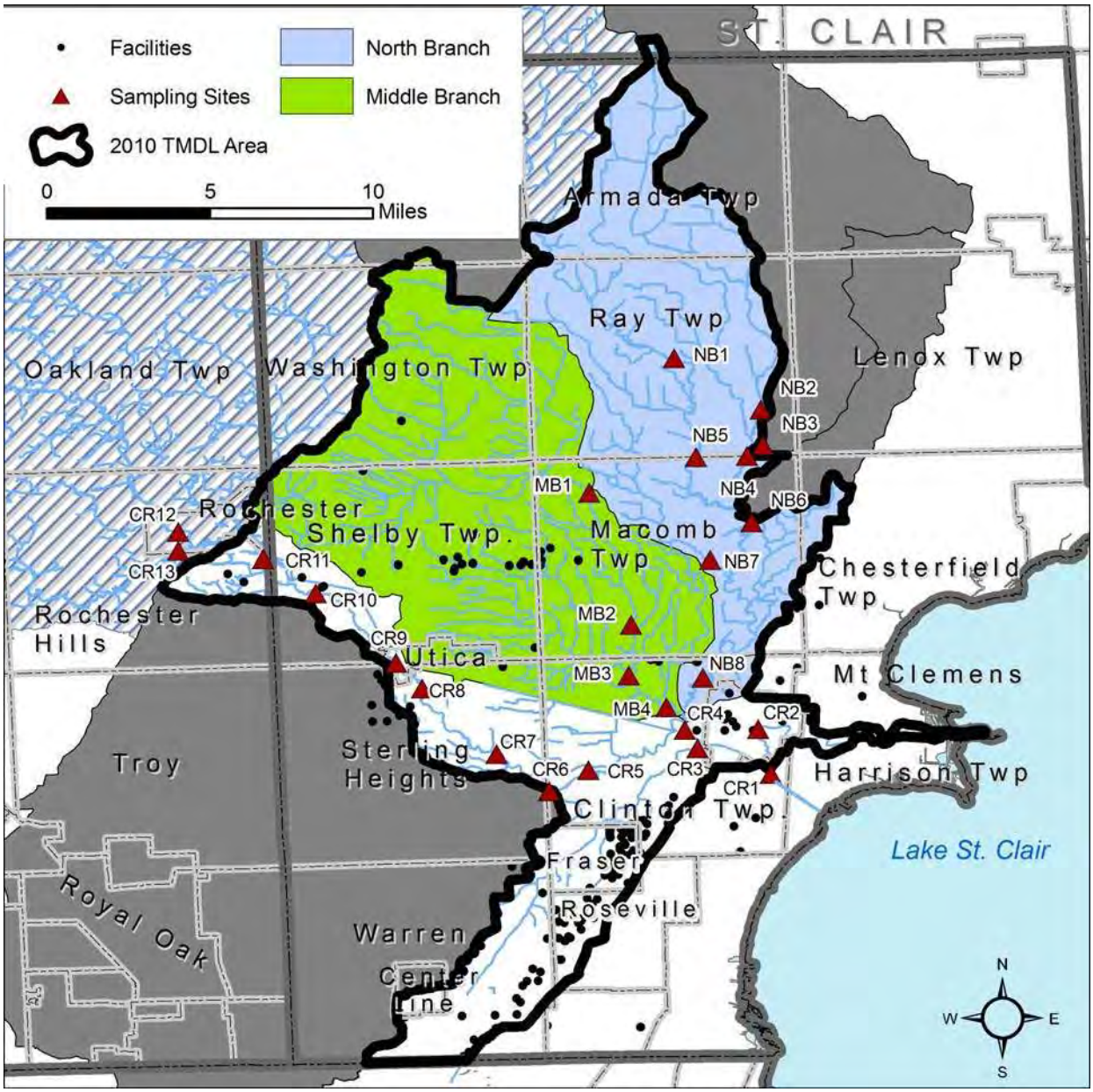


Figure 2. Locations of sampling stations, NPDES permitted discharges, and municipalities within the TMDL watershed.

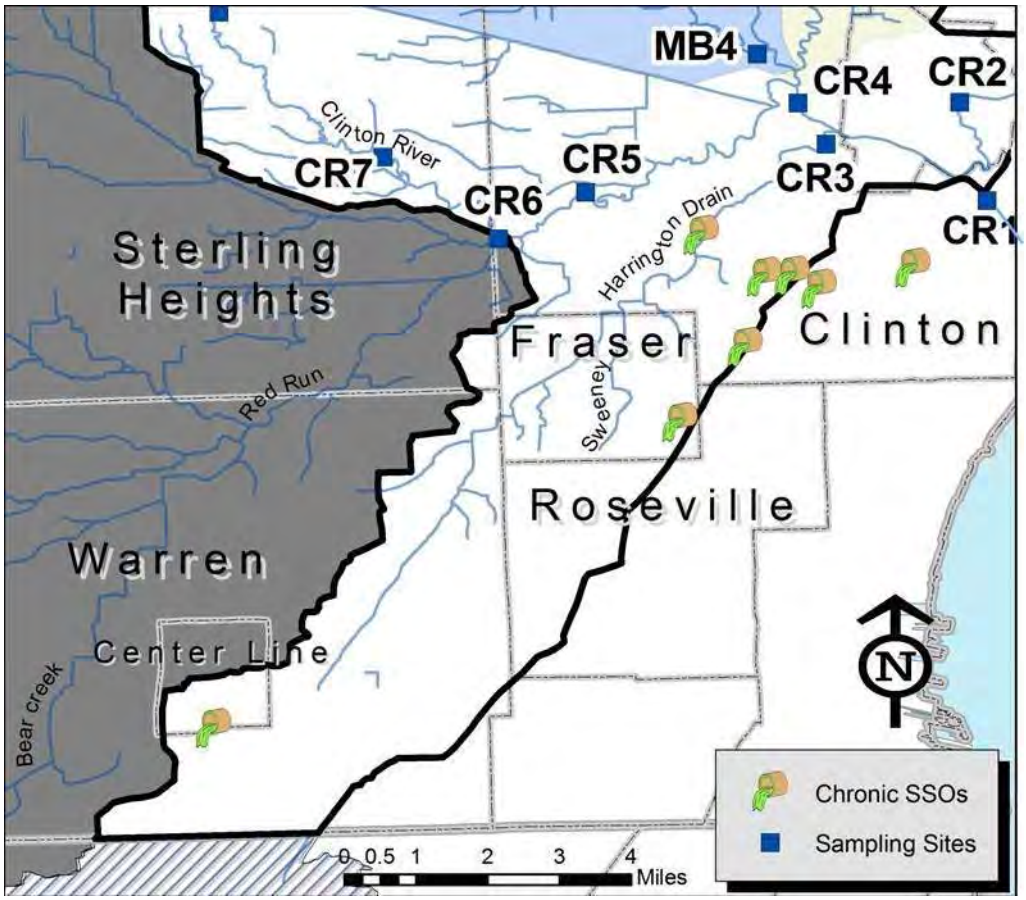
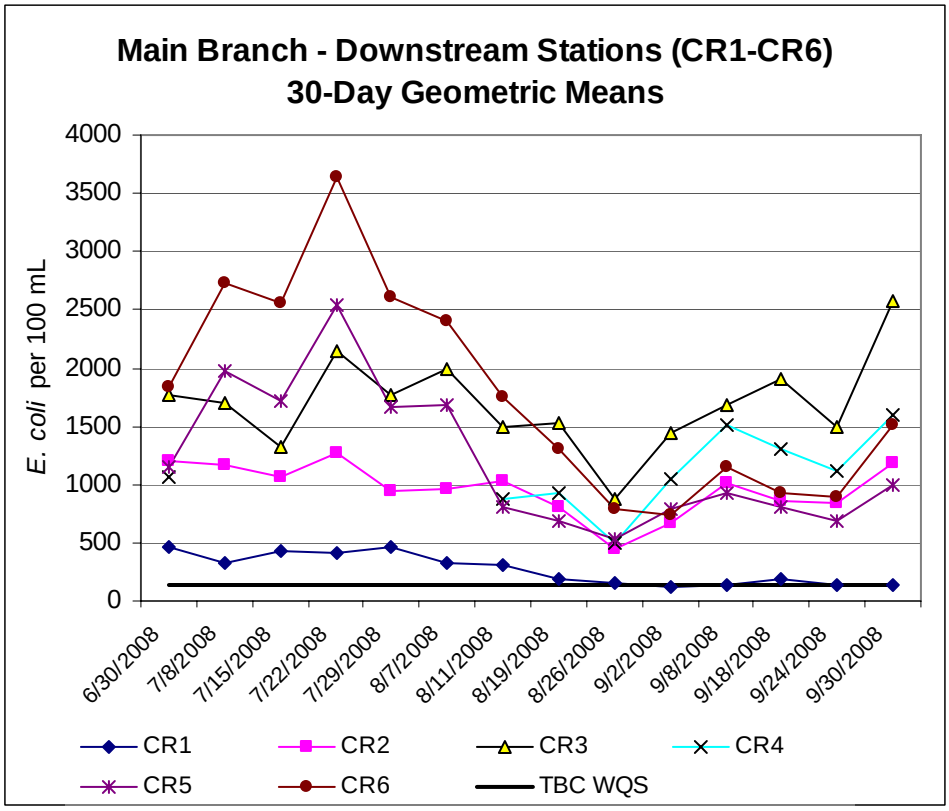


Figure 3. Map of chronic SSOs (under the jurisdictions of Center Line, Fraser, and Clinton Townships) in relation to DNRE sampling stations.



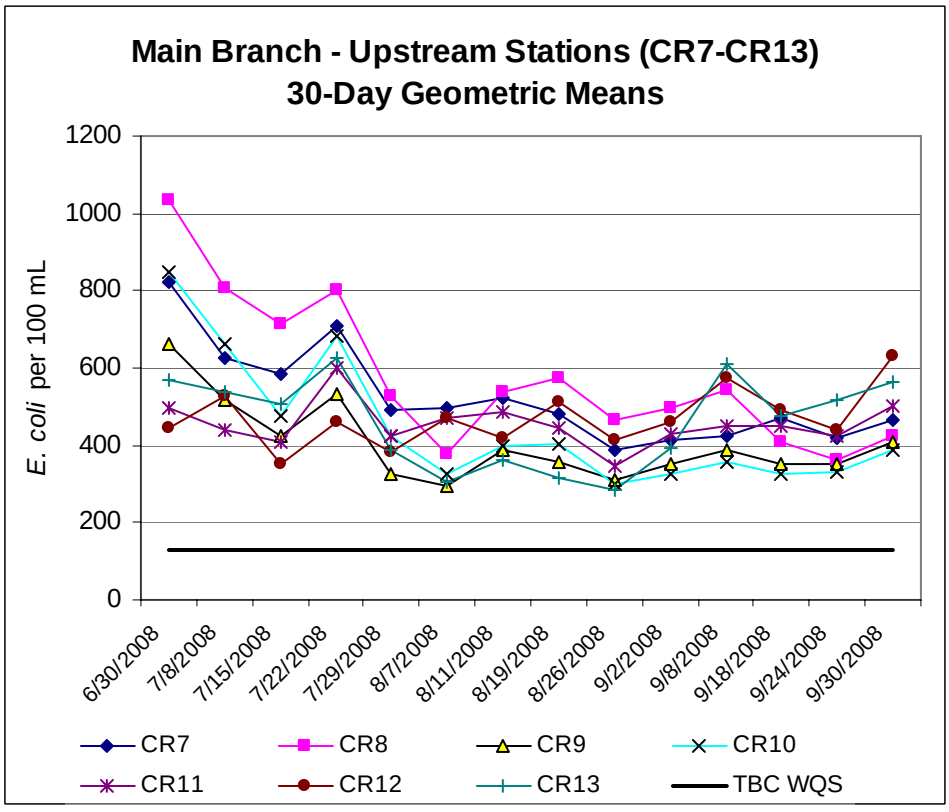


Figure 4. Thirty-day geometric mean *E. coli* sampling results from the Main Branch Clinton River (Stations CR1-CR13) in relation to the TBC WQS of 130 *E. coli* per 100 mL as a 30-day geometric mean.

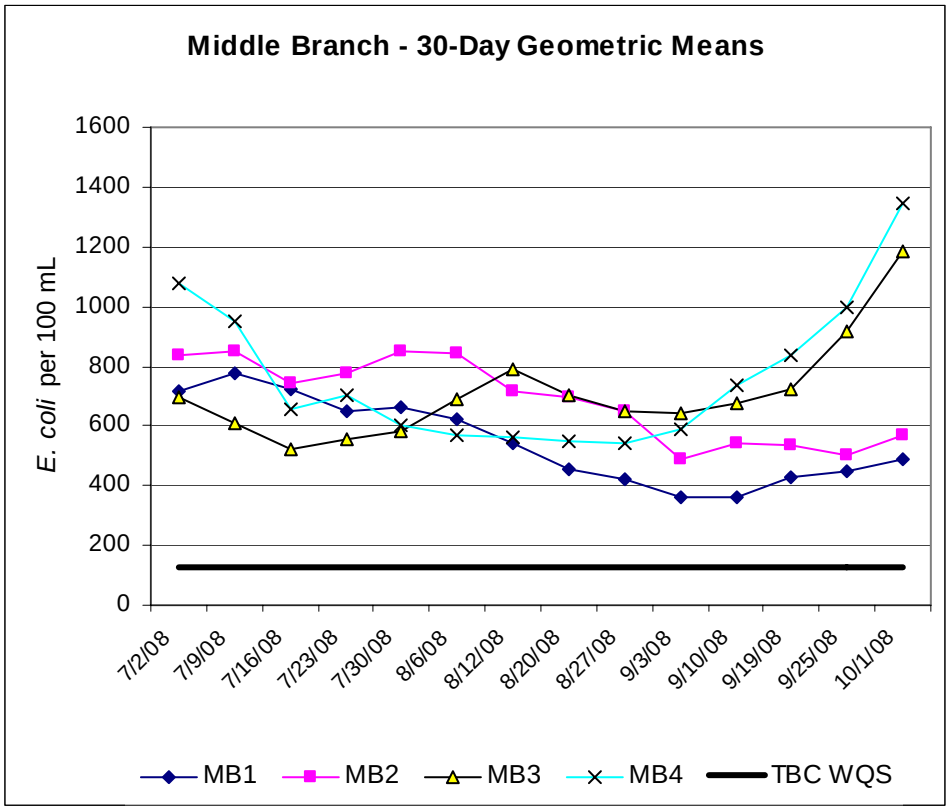


Figure 5. Thirty-day geometric mean *E. coli* sampling results from the Middle Branch Clinton River (Stations MB1-MB4) in relation to the TBC WQS of 130 *E. coli* per 100 mL as a 30-day geometric mean.

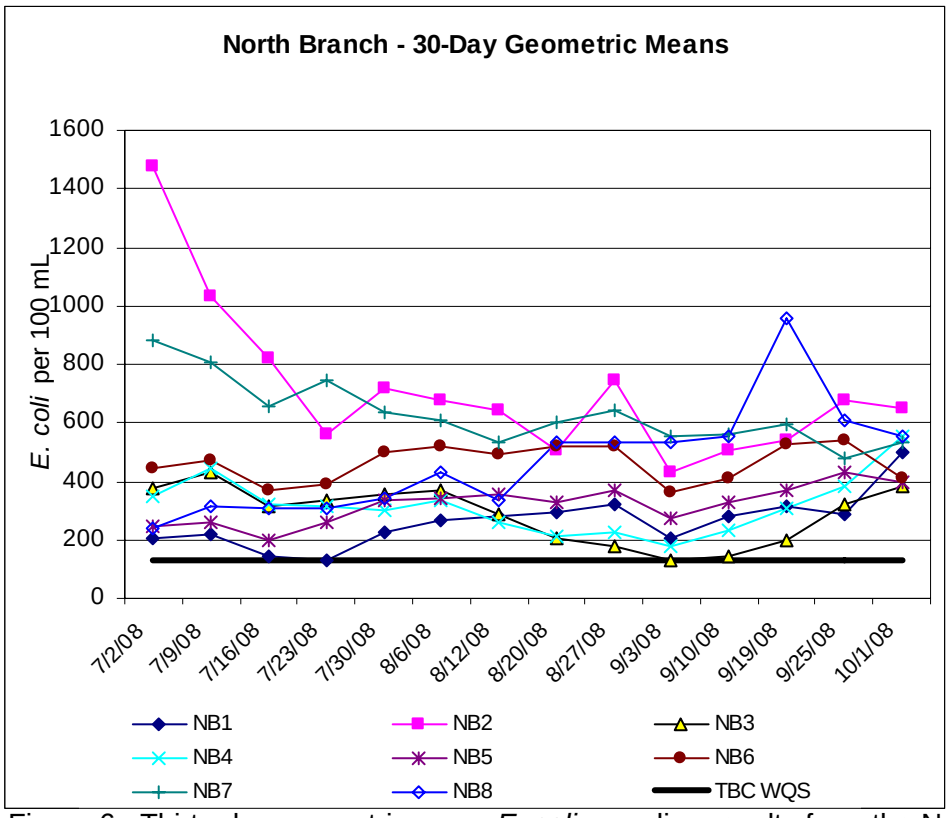


Figure 6. Thirty-day geometric mean *E. coli* sampling results from the North Branch Clinton River (Stations NB1-NB8) in relation to the TBC WQS of 130 *E. coli* per 100 mL as a 30-day geometric mean.

Table 1. Weekly *E. coli* sampling results (counts per 100 mL) from the North Branch Clinton River (Stations NB1-NB8); June 5-October 1, 2008. Exceedances of the TBC WQS are shaded gray and PBC exceedances are outlined in bold.

	NB1					NB2					NB3					NB4					
	N. Br. Clinton at 29-Mile					Coon creek at North Rd.					E. Br. Coon Creek at 29-Mile					Coon creek at 26-Mile					
Sample Date	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	2-day prior precip. (Romeo, MI)
6/5/2008	60	160	160	115		1000	4000	1940	1980		240	200	60	142		140	180	120	145		0.24
6/11/2008	1580	1200	1600	1448		2800	3200	2200	2701		1520	3200	1600	1982		1600	1600	1400	1530		0.65
6/19/2008	300	100	140	161		560	1000	2600	1133		240	260	100	184		180	160	100	142		0.07
6/25/2008	100	60	140	94		1000	1280	1200	1154		480	900	300	506		640	600	560	599		0.15
7/2/2008	200	200	60	134	202	700	1200	1200	1003	1476	600	200	200	288	377	200	240	400	268	347	0
7/9/2008	220	140	180	177	221	200	400	440	328	1030	800	80	340	279	431	360	520	660	498	445	0
7/16/2008	200	240	120	179	145	260	1400	1800	869	821	280	480	500	407	314	320	380	240	308	323	0
7/23/2008	120	100	60	90	129	220	200	100	164	558	300	300	200	262	337	160	140	100	131	317	0
7/30/2008	2200	1400	1200	1546	226	7800	2200	4000	4094	719	600	820	520	635	353	300	460	800	480	304	0.29
8/6/2008	400	400	160	295	265	560	1200	600	739	676	460	500	200	358	368	600	260	600	454	337	0
8/12/2008	300	260	180	241	281	160	300	340	254	642	80	60	120	83	289	140	120	140	133	259	0
8/20/2008	220	140	320	214	292	120	600	240	259	504	60	<20	80	69	203	120	100	120	113	212	0
8/27/2008	140	120	200	150	323	320	2600	1800	1144	743	140	140	140	140	179	180	160	200	179	226	0
9/3/2008	180	200	140	171	208	240	380	220	272	432	120	120	140	126	130	200	140	100	141	177	0
9/10/2008	1000	1800	1400	1361	283	1800	1200	2000	1629	506	580	740	600	636	145	2000	1400	1800	1715	230	1.1
9/19/2008	380	160	1000	393	312	140	560	600	361	543	760	480	200	418	201	1000	400	400	543	305	0
9/25/2008	200	140	100	141	287	1200	1000	380	770	676	400	1600	600	727	321	480	260	320	342	381	0
10/1/2008	2000	1600	4400	2415	500	800	1000	1000	928	648	260	480	320	342	384	2400	820	780	1154	553	0.14

Table 1 (continued). Weekly *E. coli* sampling results (counts per 100 mL) from the North Branch Clinton River (Stations NB1-NB8); June 5-October 1, 2008. Exceedances of the TBC WQS are shaded gray and PBC exceedances are outlined in bold.

	NB5					NMB6					NB7					NB8					
	N. Br. Clinton at 26-Mile					N. Br. Clinton at 24-Mile					Mcbride Drain at Card Rd.					N. Br. Clinton at end of Dunham					
Sample Date	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	2-day prior precip. (Romeo, MI)
6/5/2008	280	200	240	237		280	400	200	335		1140	1020	980	1078		80	120	200	98		0.24
6/11/2008	1200	1200	1200	1200		600	3000	1200	1342		1400	2200	2400	1755		380	360	1200	370		0.65
6/19/2008	40	60	60	49		120	340	200	202		60	400	400	155		420	360	100	389		0.07
6/25/2008	180	400	240	268		560	400	460	473		3200	5000	2800	4000		260	200	300	228		0.15
7/2/2008	240	200	220	255	249	240	380	460	402	444	1000	220	2000	461	884	140	140	160	254	241	0
7/9/2008	580	100	280	295	260	540	200	400	438	469	800	820	1020	675	805	160	400	160	378	316	0
7/16/2008	240	420	240	319	200	260	320	80	392	366	1200	600	1200	641	658	160	280	220	322	307	0
7/23/2008	180	100	160	179	259	180	180	140	276	390	200	300	200	286	744	220	320	140	379	306	0
7/30/2008	1600	2000	1800	990	336	3000	2000	2400	1585	496	3400	3800	4000	1858	638	100	800	800	408	344	0.29
8/6/2008	360	200	160	290	344	500	440	800	515	521	240	400	400	369	610	1000	620	580	805	433	0
8/12/2008	420	400	280	352	356	240	280	260	332	493	240	360	420	349	535	40	40	140	105	335	0
8/20/2008	160	240	560	201	325	520	500	300	492	516	1600	1800	1000	1141	600	8200	6600	7200	3349	535	0
8/27/2008	600	280	220	336	369	260	220	240	288	521	600	220	200	410	645	260	340	400	385	536	0
9/3/2008	280	240	600	228	275	300	160	200	258	362	1400	1200	1000	848	552	200	600	180	389	531	0
9/10/2008	1800	860	340	709	329	1800	1400	1000	968	411	740	200	1600	393	559	1200	1400	1600	970	551	1.1
9/19/2008	1500	540	720	628	369	1500	2500	2500	1174	530	1600	120	200	467	592	3500	2400	3000	1648	957	0
9/25/2008	800	260	280	430	430	600	600	300	544	540	340	340	400	397	479	560	160	600	356	611	0
10/1/2008	160	140	200	231	399	20	40	200	73	410	1000	800	860	690	532	160	140	60	233	553	0.14

Table 2. Weekly *E. coli* sampling results (counts per 100 mL) from the Main Branch Clinton River (Stations CR1-CR13); June 3-September 30, 2008. Exceedances of the TBC WQS are shaded gray and PBC exceedances are outlined in bold.

	CR1					CR2					CR3					CR4					
	Clinton River Spillway at Harper Rd.					Main Br. Clinton at Crocker Blvd.					Harrington Drain at Harrington Rd.					Main Br. Clinton at Moravian Rd.					
Sample Date	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	2-day prior precip. (Pontiac WWTP, MI)
6/4/2008	1200	1040	1000	1077		1600	1800	3800	2220		3200	4400	4800	4073		800	600	1000	783		0.48
6/9/2008	600	200	400	363		3000	1200	1000	1533		4500	3500	3500	3806		1600	2400	3200	2308		0.63
6/18/2008	1000	760	1400	1021		2400	860	1200	1353		1200	380	1000	770		1800	440	1000	925		0.04
6/24/2008	160	120	120	132		440	1800	2200	1203		1200	1600	2000	1566		1800	1800	600	1248		0.21
6/30/2008	480	400	440	439	471	540	400	440	456	1204	780	760	1400	940	1774	800	520	600	630	1056	0.06
7/8/2008	220	120	180	168	325	560	2600	4800	1912	1168	2000	8800	2000	3277	1698	ns	ns	ns	ns	na	0.09
7/15/2008	280	1400	10200	1587	436	1000	1000	860	951	1062	1400	1200	800	1104	1326	400	320	520	405	na	0
7/22/2008	580	540	1320	745	410	3200	1400	8400	3351	1273	12200	7200	6800	8422	2139	5600	8200	7400	6978	na	0.73
7/29/2008	160	280	400	262	470	240	180	400	259	936	800	480	560	599	1765	300	300	800	416	na	0
8/7/2008	180	100	20	71	326	500	800	360	524	962	3600	1000	1400	1715	1991	80	580	380	260	na	0
8/11/2008	40	210	200	119	304	2400	2400	3800	2797	1039	760	840	700	765	1488	1000	2000	2200	1639	*871*	0.34
8/19/2008	180	200	160	179	197	200	220	380	256	799	1060	1200	1600	1267	1530	600	560	460	537	921	0
8/26/2008	180	200	140	171	147	200	200	180	193	451	500	400	740	529	880	440	220	280	300	491	0
9/2/2008	140	40	140	92	119	960	380	17400	1852	669	12600	2800	9400	6922	1435	20600	18200	17000	18541	1050	0
9/8/2008	260	80	140	143	137	4800	4600	3000	4046	1007	3000	3800	4800	3796	1682	1000	1600	2600	1608	1511	0.26
9/18/2008	800	200	800	504	183	420	<20	3500	1212	852	2000	1400	1000	1409	1901	1400	560	600	778	1302	0
9/24/2008	20	60	100	49	141	180	340	200	230	834	560	200	500	383	1496	180	260	360	256	1123	0
9/30/2008	60	200	180	129	133	1020	1460	980	1134	1189	1800	17400	15800	7910	2570	1000	1600	3200	1724	1593	0.07

Table 2 (continued). Weekly *E. coli* sampling results (counts per 100 mL) from the Main Branch Clinton River (Stations CR1-CR13); June 4-September 30, 2008. Exceedances of the TBC WQS are shaded gray and PBC exceedances are outlined in bold.

	CR5					CR6					CR7					CR8					
	Main Br. Clinton at Garfield Rd.					Red Run Drain at Utica Rd.					Main Br. Clinton at Schoenner Rd.					Main Br. Clinton at Riverland Rd.					
Sample Date	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	2-day prior precip. (Pontiac WWTP, MI)
6/4/2008	1000	3000	3400	2169		1200	1400	1400	1330		1400	1400	1600	1464		800	800	1600	1008		0.48
6/9/2008	3500	1800	1600	2160		4500	3400	1200	2638		800	600	400	577		600	200	600	416		0.63
6/18/2008	420	400	500	438		2000	2000	2400	2125		600	860	480	628		2400	780	1000	1232		0.04
6/24/2008	2200	4200	2000	2644		3200	2600	3400	3047		1600	2200	1000	1521		2200	2000	1200	1741		0.21
6/30/2008	400	300	460	381	1156	1000	1000	820	936	1843	500	500	400	464	822	1200	1200	1600	1321	1035	0.06
7/8/2008	10000	52000	64000	32166	1983	10500	11800	6600	9351	2722	400	420	300	369	624	320	220	360	294	809	0.09
7/15/2008	1000	1500	740	1035	1711	4000	2800	660	1948	2562	360	340	600	419	585	600	100	180	221	713	0
7/22/2008	1000	4200	7800	3200	2547	13400	14800	9600	12394	3646	1800	1000	2400	1629	708	1640	3200	2040	2204	801	0.73
7/29/2008	220	400	360	316	1666	580	500	640	570	2608	220	320	220	249	493	260	200	200	218	529	0
8/7/2008	360	440	400	399	1681	1200	500	400	621	2402	360	800	400	487	498	360	220	200	251	379	0
8/11/2008	800	800	940	844	812	2800	2000	1200	1887	1744	300	600	600	476	524	1000	1600	2800	1649	535	0.34
8/19/2008	500	600	360	476	695	480	460	400	445	1299	180	380	320	280	483	500	240	240	307	572	0
8/26/2008	600	1200	1000	896	539	1600	1000	800	1086	798	360	600	740	543	388	800	1600	400	800	467	0
9/2/2008	3000	9400	380	2205	795	280	440	440	378	735	240	460	380	347	414	180	400	340	290	494	0
9/8/2008	660	780	1400	897	934	7400	6200	4600	5954	1155	620	560	500	558	426	560	440	280	410	545	0.26
9/18/2008	1500	200	200	391	801	1200	480	400	613	922	400	1200	1000	783	470	220	460	540	379	406	0
9/24/2008	160	260	260	221	687	480	440	240	370	889	180	120	180	157	419	200	140	180	171	362	0
9/30/2008	8800	10600	2000	5714	996	13600	14200	18400	15260	1508	860	600	1600	938	468	3000	2400	820	1807	426	0.07

Table 2 (continued). Weekly *E. coli* sampling results (counts per 100 mL) from the Main Branch Clinton River (Stations CR1-CR13); June 4-September 30, 2008. Exceedances of the TBC WQS are shaded gray and PBC exceedances are outlined in bold.

	CR9					CR10					CR11					CR12					CR13					
	Main Br. Clinton at Auburn Rd.					Main Br. Clinton at Ryan Rd.					Main Br. Clinton at Dequidre Rd					Paint Creek at Rochester Rd.					Main Br. Clinton at Diversion St.					
Sample Date	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	2-day prior precip. (Pontiac WWTP, MI)
6/4/2008	600	1200	800	832		1200	800	600	832		800	1200	840	931		400	500	400	431		600	400	660	541		0.48
6/9/2008	400	1200	600	660		2500	200	1000	794		400	1200	400	577		800	2000	600	986		1000	400	400	543		0.63
6/18/2008	240	400	360	326		540	400	180	339		160	180	400	226		140	120	400	189		120	200	820	270		0.04
6/24/2008	1800	3200	800	1664		2400	800	6200	2283		1200	1600	1400	1390		1040	1200	1000	1077		1600	1400	1400	1464		0.21
6/30/2008	200	1000	400	431	663	400	1000	1600	862	849	160	200	180	179	497	200	220	180	199	444	520	460	600	524	571	0.06
7/8/2008	280	80	600	238	516	400	600	60	243	664	600	540	380	497	438	860	1340	880	1005	526	240	600	420	393	536	0.09
7/15/2008	120	600	220	251	425	160	220	100	152	477	260	800	320	405	408	160	100	160	137	354	360	360	580	422	509	0
7/22/2008	1000	1200	800	986	531	3800	1800	1200	2017	681	1000	3000	1200	1533	599	660	740	740	712	462	600	600	1200	756	626	0.73
7/29/2008	120	200	140	150	328	400	160	140	208	422	240	220	280	245	423	560	420	320	422	383	220	140	80	135	389	0
8/7/2008	180	220	380	247	294	200	240	300	243	328	440	180	380	311	473	780	540	440	570	473	140	180	160	159	306	0
8/11/2008	1800	600	780	944	387	1400	520	360	640	397	700	600	420	561	484	520	600	560	559	420	1200	880	740	921	363	0.34
8/19/2008	120	260	160	171	358	120	140	240	159	401	500	160	240	268	446	380	460	280	366	512	200	180	260	211	316	0
8/26/2008	300	1000	400	493	312	300	460	800	480	301	340	400	600	434	346	240	260	220	239	411	400	440	480	439	283	0
9/2/2008	340	280	220	276	352	180	360	500	319	328	740	400	1200	708	428	900	780	600	750	461	2400	280	480	686	392	0
9/8/2008	400	400	420	407	389	340	400	400	379	358	340	500	380	401	450	1200	1800	2200	1681	573	1600	2400	800	1454	611	0.26
9/18/2008	580	800	420	580	353	360	280	600	393	325	560	480	600	544	448	260	200	340	261	492	800	120	200	268	477	0
9/24/2008	140	160	200	165	350	140	200	180	171	330	180	220	200	199	422	240	200	180	205	438	240	560	220	309	515	0
9/30/2008	540	1200	1800	1053	408	2200	1200	500	1097	389	1100	1060	880	1009	500	680	2200	2200	1487	631	1000	400	800	684	563	0.07

Table 3. Weekly *E. coli* sampling results (counts per 100 mL) from the Middle Branch Clinton River (Stations MB1-MB4); June 5-October 1, 2008. Exceedances of the TBC WQS are shaded gray and PBC exceedances are outlined in bold.

	MB1					MB2					MB3					MB4					
	Middle Br. Clinton at 25-Mile					Middle Br. Clinton at 21-Mile					Gloede Dr. at Romeo Plank rd.					Middle Br. Clinton at Heydenreich					
	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	Left	Center	Right	Daily Max	30-Day Geomean	2-day prior precip. (Romeo, MI)
6/5/2008	460	380	60	418		860	440	600	615		1200	600	1000	849		1400	1400	1000	1400		0.24
6/11/2008	960	920	1000	940		2200	1600	2400	**1876**		600	2400	2000	1200		3200	2800	2400	2993		0.65
6/19/2008	800	1000	360	894		520	500	340	510		720	820	400	768		500	540	720	520		0.07
6/25/2008	1000	800	800	894		700	880	800	785		800	240	560	438		660	1000	500	812		0.15
7/2/2008	1400	600	800	593	715	600	1300	680	883	836	600	740	1000	475	696	800	1000	700	823	1078	0
7/9/2008	800	1200	1080	630	776	400	880	860	657	847	460	620	600	448	612	940	720	620	746	950	0
7/16/2008	1400	1000	600	654	721	1000	1400	800	973	743	1400	340	1000	527	519	400	520	640	476	658	0
7/23/2008	900	600	600	519	647	700	480	600	630	775	2000	2200	1400	**1104**	558	640	1000	1600	710	700	0
7/30/2008	2800	1120	1280	**1017**	664	2800	1120	1280	**1260**	852	600	800	820	548	584	380	240	340	376	600	0.29
8/6/2008	1000	220	340	423	620	960	1000	1200	837	843	1600	2000	1800	**1115**	693	600	600	780	629	569	0
8/12/2008	360	260	520	322	543	200	220	400	287	714	1600	1200	2600	863	790	400	1200	1000	724	566	0
8/20/2008	220	300	380	278	457	220	4600	4000	847	694	300	160	380	295	703	300	340	280	415	550	0
8/27/2008	260	400	160	337	419	220	600	600	440	646	780	920	800	727	647	800	580	440	670	544	0
9/3/2008	680	560	200	471	360	200	300	340	321	492	500	600	600	542	645	580	440	440	548	587	0
9/10/2008	600	380	560	422	359	3000	1600	2000	**1389**	544	2000	2400	2600	**1383**	674	3000	3600	2400	**1938**	735	1.1
9/19/2008	1400	1000	800	803	431	180	160	3000	257	532	2000	1000	1400	**1242**	725	2500	1400	1200	**1364**	834	0
9/25/2008	300	280	480	330	447	840	640	100	636	503	1400	1000	1600	949	915	1000	1200	900	**1032**	1000	0
10/1/2008	560	600	680	512	486	1600	600	580	799	567	5200	6400	5400	**2640**	1185	4200	5200	5400	**2958**	1346	0.14

Table 4. Summary of data for all stations, including station geometric means, the number of PBC and daily maximum TBC WQS exceedances, and the results of bacterial source tracking at selected stations (+ indicates that the biomarker was detected; - indicates that no biomarker was detected). Station NB2 was sampled for Bacterial Source Tracking on two dates with mixed results.

Station ID	Sample Location	Number of PBC WQS exceedances	Number of TBC WQS exceedances	Station geometric mean	Cattle bacteroidetes biomarker	Human bacteroidetes biomarker
CR1	Clinton River Spillway at Harper Road	3	7	249		
CR2	Main Br. Clinton River at Crocker Blvd.	11	14	975		
CR3	Harrington Drain at Harrington Rd.	11	18	1778	-	+
CR4	Main Br. Clinton River at Moravian Rd	7	15	1005		
CR5	Main Br. Clinton River at Garfield Rd	8	17	1135		
CR6	Red Run Drain at Utica Rd.	11	18	1686		
CR7	Main Br. Clinton River at Schoenner Rd.	3	15	546		
CR8	Main Br. Clinton River at Riverland Rd.	7	12	579		
CR9	Main Br. Clinton River at Auburn Rd.	2	11	430		
CR10	Main Br. Clinton River at Ryan Rd.	3	12	456		
CR11	Main Br. Clinton River at Dequindre Rd.	3	5	474		
CR12	Paint Creek at Rochester Rd.	4	6	482	-	+
CR13	Main Br. Clinton River at Diversion St.	2	5	458		
MB1	Middle Br. Clinton River at 25 Mile	1	17	582		
MB2	Middle Br. Clinton River at 21 Mile	3	16	729		
MB3	Gloede Drain at Romeo Plank Rd..	6	17	1024	-	+
MB4	Middle Br. Clinton River at Heydenreich Rd.	6	18	900		
NB1	North Br. Clinton River at 29 Mile	4	5	279		
NB2	Coon Creek at North Rd.	8	14	767	+-	-+
NB3	East Br. Coon Creek at 26 Mile Rd.	1	8	306		
NB4	Coon Creek at 26 Mile Rd.	3	10	337		
NB5	North Br. Clinton River at 26 Mile	1	8	326		
NB6	North Br. Clinton River at 24 Mile.	2	13	402		
NB7	McBride Drain at Card Rd.	5	16	725	+	+
NB8	North Br. Clinton River at end of Dunham Rd	2	13	363		

Table 5. 2006 Land Cover Classification of the entire TMDL watershed and the Main Branch, Middle Branch, and North Branch Clinton River (separately) as a percent of total land area.

2006 Land Cover Classification	Entire TMDL Watershed	Main Branch	Middle Branch	North Branch
Developed, High Intensity	5%	12%	4%	1%
Developed, Medium Intensity	17%	34%	18%	2%
Developed, Low Intensity	19%	27%	25%	6%
Developed, Open Space	10%	11%	14%	5%
Cultivated Crops	16%	0%	10%	37%
Pasture/Hay	8%	0%	6%	17%
Grassland/Herbaceous	1%	0%	1%	2%
Deciduous Forest	13%	7%	14%	17%
Evergreen Forest	1%	1%	1%	1%
Mixed Forest	1%	1%	1%	1%
Scrub/Shrub	1%	0%	1%	2%
Palustrine Forested Wetland	5%	4%	3%	7%
Palustrine Scrub/Shrub Wetland	1%	0%	1%	2%
Palustrine Emergent Wetland	1%	1%	1%	1%
Bare Land	1%	0%	1%	1%

Table 6. Percent of land area in the Lower Clinton River TMDL watershed located within each municipality. Municipalities that hold an MS4 permit are marked with an “X.”

Municipality Name	County	Percent of TMDL Watershed	MS4 community
Armada Twp	Macomb	8%	
Center Line	Macomb	<1%	X
Chesterfield Twp	Macomb	<1%	X
Clinton Twp	Macomb	10%	X
Fraser	Macomb	2%	X
Harrison Twp	Macomb	<1%	X
Macomb Twp	Macomb	17%	X
Mt Clemens	Macomb	2%	X
Ray Twp	Macomb	17%	
Rochester	Oakland	<1%	X
Rochester Hills	Oakland	2%	X
Roseville	Macomb	1%	X
Shelby Twp	Macomb	16%	X
Sterling Heights	Macomb	5%	X
Utica	Macomb	<1%	X
Warren	Macomb	6%	X
Washington Twp	Macomb	11%	X

Table 7. Percent of land area in the Lower Clinton River TMDL watershed located within each county. Counties that hold an MS4 permit are marked with an ”X.”

County	Percent of TMDL Watershed	MS4 community
Macomb	91%	X
Oakland	1%	X
St. Clair	<1%	X

Table 8. NPDES facilities discharging to the Clinton River watershed. COCs under the General Storm Water Permit are listed in Appendix 2.

Facility Name	Permit Details		Permit No.	Latitude	Longitude
Individual Permits					
Mt Clemens WWTP			MI0023647	42.6000	-82.8661
Selfridge ANGB			MI0055328	42.6111	-82.8306
MDOT - Statewide MS4			MI0057364	na	na
New Haven Schools-Ray Twp			MI0058039	42.7203	-82.8794
Regulated Municipal Separate Storm Sewers					
Oakland Co MS4	Phase II	Watershed Permit	MIG610042	na	na
Macomb Co MS4	Phase II	Watershed Permit	MIG610052	na	na
Shelby Twp MS4-Macomb	Phase II	Watershed Permit	MIG610115	na	na
Rochester MS4-Oakland	Phase II	Watershed Permit	MIG610219	na	na
Rochester Hills MS4-Oakland	Phase II	Watershed Permit	MIG610283	na	na
Clinton Twp MS4-Macomb	Phase II	Watershed Permit	MIG610299	na	na
Center Line MS4-Macomb	Phase II	Watershed Permit	MIG610304	na	na
Washington Twp MS4-Macomb	Phase II	Watershed Permit	MIG610305	na	na
Utica MS4-Macomb	Phase II	Watershed Permit	MIG610306	na	na
Romeo MS4-Macomb	Phase II	Watershed Permit	MIG610309	na	na
Mount Clemens MS4-Macomb	Phase II	Watershed Permit	MIG610311	na	na
Macomb Twp MS4-Macomb	Phase II	Watershed Permit	MIG610312	na	na
Chesterfield Twp MS4-Macomb	Phase II	Watershed Permit	MIG610310	na	na
Fraser MS4-Macomb	Phase II	Watershed Permit	MIG610308	na	na
Harrison Twp MS4-Macomb	Phase II	Watershed Permit	MIG610313	na	na
Selfridge ANGB MS4 - Macomb	Phase II	Jurisdictional Permit	MIS040043	na	na
Sterling Heights MS4	Phase I	Jurisdictional Permit	MIS040085	na	na
Warren MS4	Phase I	Jurisdictional Permit	MIS040088	na	na
Cleanup of Water Contaminated by Petroleum Products, General Permit: MIG080000					
Speedway SuperAmerica 2254			MIG081076	42.6716	-83.0166
Non Contact Cooling Water, General Permit: MIG250000					
International Paper Co-Warren			MIG250009	42.4633	-82.9933
Storm Water from Industrial Activities, General Permit: MIS110000					
See Appendix 1					
Storm Water Discharges With Required Monitoring, General Permit: MIS120000					
DuPont-Mt Clemens			MIS120007	42.6125	-82.8897

Table 9. USGS gage locations for each station and the period of record for each gage used in load duration curve development.

Gage Number	Location	Stations	Period of Record
4165500	Clinton River at Moravian Dr.	CR1-CR2	Oct 1968 to current year
4164500	N. Br. Clinton at Mt. Clemens	CR4, NB1, NB5-NB8 and MB1-MB4	May 1947 to current year.
4164000	Clinton near Fraser	CR5	May 1947 to current year.
4164300	East Branch Coon Creek at Armada	CR6, NB2-NB4	October 1958 to current year.
4161820	Clinton at Sterling Heights	CR7-CR11	October 1978 to December 1982, March 1996 to May 1998, July 2001 to current year.
4161540	Paint Cr. At Rochester	CR12	October 1959 to current year.
4161000	Clinton at Auburn Hills	CR13	May 1935 to June 1939 and February to September 1940 , October 1956 to September 1982 , water years 1983-91 (operated as a crest-stage partial-record station), July 2001 to September 2002, water year 2003 (operated as a crest-stage partial-record station), April 2004 to current year.

Appendix 1. Assessment units proposed to be listed as nonattaining for the PBC and TBC designated uses in the 2010 Section 303(d) list and addressed in this TMDL.

CLINTON RIVER **AUID**: 040900030306-01
County: Macomb SIZE: 51.9 M
Location: Armada and Ray Drain, Coon Creek, Priest Drain, Tupper Brook, Unnamed Tributaries to Coon Creek, and Unnamed Tributary to Priest Drain
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture and Sewage Discharges in Unsewered Areas
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030307-01
County: Macomb SIZE: 32.4 M
Location: Middle Branch Clinton River and Unnamed Tributaries to Middle Branch Clinton River
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Sewage discharges in unsewered areas and illicit connections to storm sewers
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030307-02
County: Macomb SIZE: 17.1 M
Location: Unnamed Tributaries to Yates Drain and Yates Drain
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture and Sewage Discharges in Unsewered Areas
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030308-01
County: Macomb SIZE: 32.8 M
Location: Healy Drain, Heide Drain, Miller Drain, Price Brook, Unnamed Tributaries to Healy Drain, and Unnamed Tributary to Price Brook
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture and Sewage Discharges in Unsewered Areas
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030309-01
County: Macomb SIZE: 57.7 M
Location: Bannister Drain, Crittenden Drain, Decker Drain, Dunn Drain, Harris Drain, Kenner Drain, Lewis Drain, Longstaff Drain, Longstaff Drain Number Two, Shoemaker Drain, Unnamed Tributary to Middle Branch Clinton River, and Utica Drain
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Sewage discharges in unsewered areas and illicit connections to storm sewers
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030310-01
County: Macomb SIZE: 3.8 M
Location: North Branch Clinton River
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture and Sewage Discharges in Unsewered Areas
TMDL Year(s): 2010

Appendix 1 cont.

CLINTON RIVER **AUID**: 040900030310-02
County: Macomb SIZE: 9.7 M
Location: North Branch Clinton River and Wyman Drain
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture and Sewage Discharges in Unsewered Areas
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030310-04
County: Macomb SIZE: 19.6 M
Location: North Branch Clinton River
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture and Sewage Discharges in Unsewered Areas
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030310-05
County: Macomb SIZE: 10 M
Location: CAMP BROOK DRAIN
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture and Sewage Discharges in Unsewered Areas
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030311-01
County: Macomb SIZE: 47.9 M
Location: Heydenreich Drain, Howard Drain, Middle Branch Clinton River, Miller Drain, Nicol Drain, Pingle Drain, Preston Drain, Unnamed Tributaries to Middle Branch Clinton River, and Zander Drain
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture, sewage discharges in unsewered areas and illicit connections to storm sewers
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030312-01
County: Macomb SIZE: 47.8 M
Location: Conklin Drain, Hammon Drain, Hart Drain, McBride Drain, North Branch Clinton River, Thoel Drain, Unnamed Tributary to Hart Drain, and Unnamed Tributary to McBride Drain
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Agriculture and Sewage Discharges in Unsewered Areas
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030401-01
County: Macomb SIZE: 20.2 M
Location: SWEENEY DRAIN AND HARRINGTON DRAIN
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Sanitary Sewer Overflows and illicit connections to storm sewer
TMDL Year(s): 2010

CLINTON RIVER **AUID**: 040900030402-04
County: Macomb SIZE: 14.8 M
Location: Clinton River, Cranberry Marsh Drain, Faulman Drain, Hildebrandt Drain, Kukuk Drain, and Unnamed Tributaries to Clinton River
Use impairments: Total and partial body contact recreation.
Cause: *E. coli*
Source: Combined Sewer Overflows from Pontiac
TMDL Year(s): 2010

Appendix 2. List of facilities holding Certificates of Coverage under the Industrial Stormwater Permit (MIS11000) within the TMDL watershed.

Storm Water from Industrial Activities, General Permit: MIS110000			
Facility	Permit No.	Latitude	Longitude
Continental Plastics	MIS110061	42.5425	-82.9322
Blue Water Fabricators	MIS110067	42.6264	-82.9039
Lincoln Die Casting-Roseville	MIS110069	42.4939	-82.9661
CBS Boring & Machining-Fraser	MIS110073	42.5442	-82.9383
Joint Production Technology	MIS110074	42.6753	-82.9733
Auto-Con Corp-Clinton Twp	MIS110080	42.5559	-82.9278
Jolico-JB Tool Inc	MIS110083	42.6600	-83.0697
Westgood Mfg-15211 11 Mile	MIS110084	42.4939	-82.9644
DieTech North America LLC	MIS110085	42.5125	-82.9500
A & M Industries	MIS110087	42.5583	-82.9167
Triumph Gear Sys-Macomb Inc	MIS110091	42.6714	-82.9731
H & M Machining Inc-Roseville	MIS110094	42.5136	-82.9497
Thread-Craft-Sterling Hgts	MIS110096	42.6169	-83.0372
Howard Finishing LLC	MIS110105	42.5144	-82.9600
Barcoa Manufacturing	MIS110122	42.6019	-82.8519
Selfridge Plating-Mt Clemens	MIS110123	42.6031	-82.8519
Par-Kut International	MIS110124	42.6000	-82.8539
Northern Industrial Mfg	MIS110125	42.6014	-82.8553
Yates Cider Mill LLC	MIS110213	42.6728	-83.0933
Johnson Controls-Mt Clemens	MIS110224	42.6044	-82.8983
Mini Mix Supply-Clinton Twp	MIS110233	42.5486	-82.9275
Sur-Flo Plastics-Warren	MIS110235	42.4750	-82.9825
Arlington Transit Mix	MIS110243	42.6694	-83.0367
Profile Mfg-Chesterfield	MIS110250	42.6722	-82.8494
Ernies Auto Parts	MIS110253	42.6050	-82.8517
Barrett Paving-Mt Clemens	MIS110256	42.6008	-82.8917
Don & Hanks Highway Auto Parts	MIS110259	42.5103	-82.9567
Harry & Sons Auto Parts-Warren	MIS110260	42.4897	-82.9769
Waste Management-East	MIS110263	42.5419	-82.8847
Visteon Corp-Utica Fac	MIS110276	42.6661	-83.0531
Lunar Industries-Clinton Twp	MIS110280	42.5500	-82.9267
Hydra-Fab-Eastpointe	MIS110304	42.4644	-82.9706
Burkard Industries Inc	MIS110307	42.5558	-82.9300
M & W Manufacturing Co	MIS110308	42.4636	-82.9844
Superior Heat Treat LLC	MIS110333	42.5625	-82.9167
A-1 Stampings-Fraser	MIS110334	42.5417	-82.9292
Aero Grinding Inc-Roseville	MIS110338	42.5042	-82.9611
Great Lakes Paper Stock Corp	MIS110340	42.5208	-82.9483
Tonys Die & Machine-Warren	MIS110342	42.4695	-82.9839
TBL Trailer Inc-Fraser	MIS110354	42.5303	-82.9417
Wolverine Bronze Co-Roseville	MIS110358	42.5047	-82.9681
Middleton Auto Parts-Fraser	MIS110361	42.5406	-82.9339
Venture Ind-Masonic Plt	MIS110369	42.5314	-82.9450
Moon Roof Corp of America	MIS110371	42.5022	-82.9625
TM Smith Tool Intl Corp	MIS110374	42.6039	-82.8972
Fori Automation-Shelby Twp	MIS110381	42.6706	-82.9811
Norgren Automotive-Clinton Twp	MIS110382	42.6292	-82.8758
Warhoops Auto & Truck Parts	MIS110387	42.6000	-83.0417
Van Loon Ind-Clinton Twp	MIS110400	42.5661	-82.9144

Appendix 2 cont.

Storm Water from Industrial Activities, General Permit: MIS110000			
Facility	Permit No.	Latitude	Longitude
Radar Industries-Roseville	MIS110401	42.5022	-82.9628
Inter-Lakes Bases-Fraser	MIS110404	42.5497	-82.9428
Ultimate Hydroforming Inc	MIS110406	42.6025	-83.0361
Global Rollforming Systems LLC	MIS110411	42.5074	-82.9555
Regal Prototypes Inc	MIS110412	42.6208	-83.0458
A-V-R Mfg-Fraser	MIS110447	42.5485	-82.9325
Advance Precision Grinding	MIS110448	42.5125	-82.9547
Grippe Machining & Mfg Co	MIS110510	42.5158	-82.9631
US Mfg Corp-Fraser	MIS110766	42.5317	-82.9389
SND Steel Fabrication Inc	MIS110770	42.6667	-83.0119
John Carlo-Rex Model S 2017	MIS110788	42.6272	-82.9244
Phalanx Inc-Roseville	MIS110790	42.5139	-82.9589
Edrich Products-Fraser	MIS110809	42.5410	-82.9423
A-1 Roll Co-Mt Clemens	MIS110876	42.5958	-82.8917
G & F Prototype Plasters	MIS110877	42.5431	-82.9383
Austemper-Clinton Twp	MIS110891	42.5542	-82.9333
Automated Production-Fraser	MIS110895	42.5458	-82.9364
Avon Broach & Production Co	MIS110898	42.6656	-83.1125
Electroplating Ind-Clinton Twp	MIS110914	42.6264	-82.9042
Diversified Fabricators-Fraser	MIS110916	42.5521	-82.9377
MW Gilco LLC	MIS110923	42.5161	-82.9667
Nat Asphalt Products Inc	MIS110930	42.6697	-83.0083
Discount Auto Salvage LLC	MIS110932	42.6031	-82.8903
Motor City Stamping	MIS110933	42.6517	-82.8497
Prototype Tooling & Mfg-Fraser	MIS110935	42.5500	-82.9333
Oakland Tool & Mfg-Fraser	MIS110936	42.5517	-82.9425
MNP Corporation-Utica	MIS110950	42.6219	-83.0386
Piper Industries-Roseville	MIS110952	42.5161	-82.9597
Technical Rotary Services	MIS110956	42.4822	-82.9814
RCO Engineering Inc-Roseville	MIS110957	42.5103	-82.9631
Sterling Concrete-Washington	MIS110961	42.7333	-83.0353
Wolverine Plating-Roseville	MIS110969	42.5111	-82.9556
Specialty Steel-Fraser	MIS110977	42.5506	-82.9428
FormTech Industries	MIS111019	42.5503	-82.9364
John Carlo Inc-Johnson Plt 225	MIS111036	42.6272	-82.9244
John Carlo Inc-Plt 2721	MIS111038	42.6272	-82.9244
UPS-Roseville	MIS111054	42.5131	-82.9636
Michigan Production Machining	MIS111069	42.6714	-82.9567
Concord Tool & Mfg-Mt Clemens	MIS111083	42.6031	-82.8992
Utica-Craft Industries	MIS111114	42.6700	-83.0036
Utica Transit Mix & Supply Co	MIS111147	42.6064	-83.0314
Press-Way-Clinton Twp	MIS111154	42.5542	-82.9261
CBS Boring & Machine Co Plt 3	MIS111155	42.5514	-82.9364
CBS Boring & Machine Co Plt 2	MIS111156	42.5522	-82.9428
Roberts & Sons-Roseville	MIS111158	42.5211	-82.9528
Hydra-Lock-Mt Clemens	MIS111163	42.5958	-82.8792
Midwest Brake	MIS111174	42.4883	-82.9736

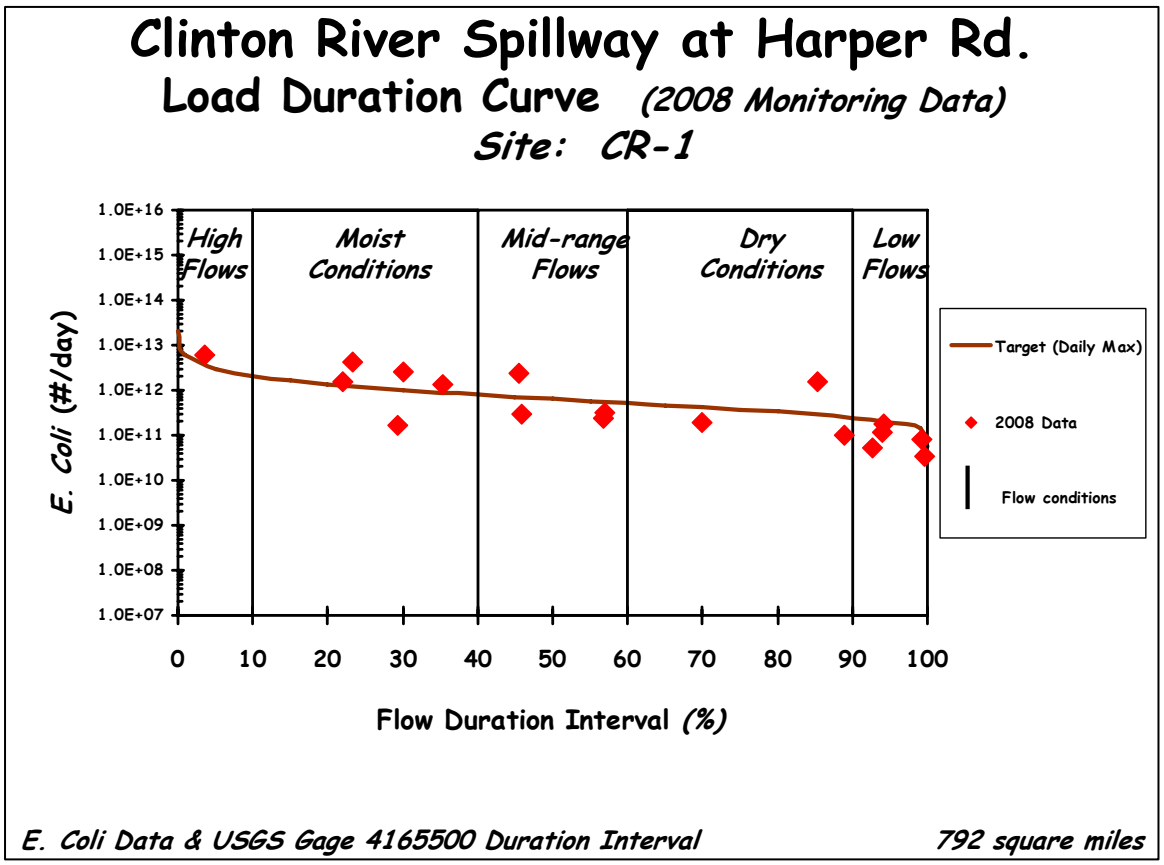
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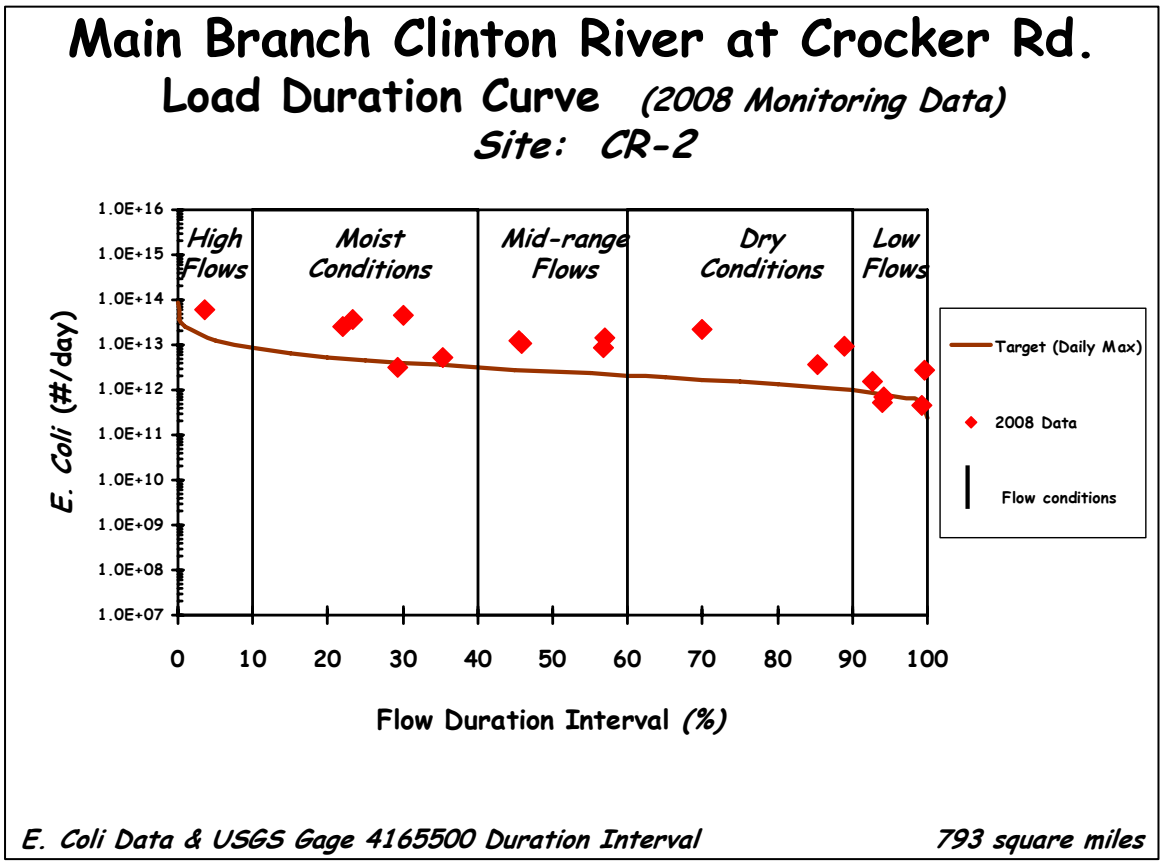
Storm Water from Industrial Activities, General Permit: MIS110000			
Facility	Permit No.	Latitude	Longitude
John Carlo Inc-2828 Rex	MIS111179	42.6272	-82.9244
John Carlo-Johnson Plt 2841	MIS111195	42.6265	-82.9211
Fairlane Tool Co-Groesbeck Hwy	MIS111207	42.5303	-82.9417
National Precast Structural	MIS111223	42.6708	-82.9811
Fairlane Products-Fraser	MIS111227	42.5450	-82.9358
Vac-Met Inc-Fraser	MIS111235	42.5281	-82.9347
JAC Products Inc Rollform	MIS111237	42.6728	-83.0103
Casadei Structural Steel Inc	MIS111245	42.6158	-83.0425
Sur-Flo Plastics-Fraser	MIS111247	42.5503	-82.9342
Radar Industries Inc-Warren	MIS111251	42.5032	-82.9705
Warren Industries Inc-Clinton	MIS111264	42.5532	-82.8876
AZ Automotive-Centerline	MIS111270	42.4683	-83.0338
AZ Automotive-Roseville	MIS111271	42.5158	-82.9675
Tower Automotive-Clinton Twp	MIS111276	42.6275	-82.8762
Lakeside Building Products	MIS111279	42.5975	-82.8865
US Farathane-Utica	MIS111281	42.6681	-83.0116
Hamlin Tool & Machine Co	MIS111283	42.6619	-83.1054
Lapeer Metal Stamping Co Inc	MIS111284	42.6044	-82.8986
Oakley Plt 4	MIS111290	42.5483	-82.9426
Oakley Plt 6	MIS111291	42.5522	-82.9327
R J Plt 3-Fraser	MIS111293	42.5520	-82.9428
Oakley Plt 2	MIS111294	42.5570	-82.8778
Oakley Plt 3	MIS111295	42.5570	-82.8778
Oakley Plt 1-Clinton Township	MIS111296	42.5570	-82.8778
Oakley Plt 7	MIS111299	42.5522	-82.9327
Plast-O-Foam	MIS111300	42.6236	-82.8594
Advanced Accessory Systems	MIS111310	42.6690	-82.9873
Atlas Tool Inc-Roseville	MIS111321	42.5185	-82.9512
Logghe Stamping Co-Fraser	MIS111361	42.6328	-82.9760
First Student Inc 20197	MIS111370	42.5997	-82.8881
Special Tool & Engineering Inc	MIS111377	42.5481	-82.9331
Rivas Inc	MIS111379	42.6693	-82.9824
Century Plastics Inc	MIS111389	42.6694	-82.9736
Century Plastics Inc	MIS111389	42.6694	-82.9736
La Fata Cabinets	MIS111402	42.6696	-82.9774
Diversified Industries	MIS111403	42.5125	-82.7583
Powder Cote II	MIS111406	42.6031	-82.8956
Positive Ind-American Laser	MIS111414	42.4638	-82.9290
Positive Ind-American Laser	MIS111414	42.4638	-82.9290
Positive Ind-American Laser	MIS111414	42.4638	-82.9290
Duggan Manufacturing	MIS111416	42.6595	-83.0707
Pamar Ent Portable Crusher	MIS111437	42.5958	-82.9042
Faurecia Automotive Seating	MIS111443	42.7112	-83.0524
Anderson Cook Inc	MIS111452	42.5520	-82.9428
Mica-Tec	MIS111456	42.4528	-83.0053
Acument Global Technologies	MIS111457	42.4508	-83.0077
Sterling Die and Engineering	MIS111462	42.6768	-82.9692

Appendix 2 cont.

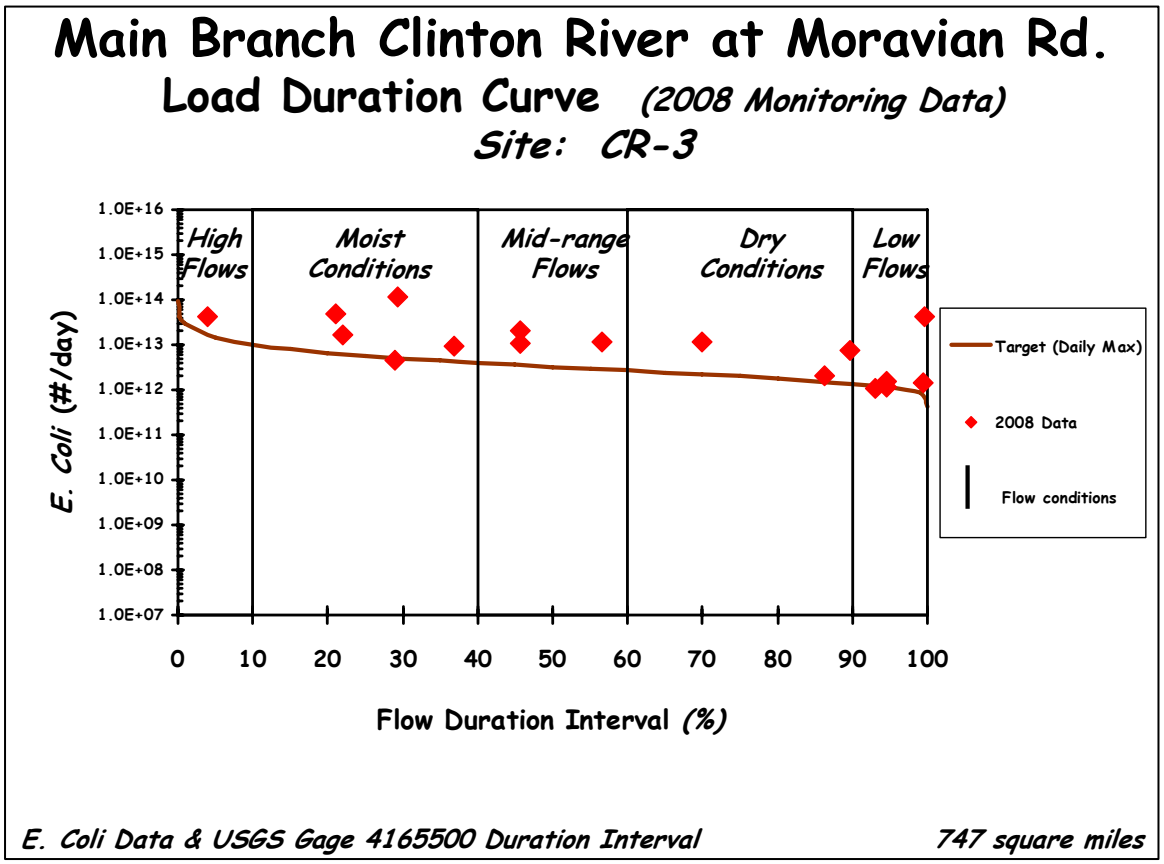
Storm Water from Industrial Activities, General Permit: MIS110000			
Facility	Permit No.	Latitude	Longitude
M & W Manufacturing Company	MIS111481	42.5186	-82.9506
Deluxe Technologies LLC-Fraser	MIS111487	42.5521	-82.9377
Accurate Boring Co	MIS111489	42.5483	-82.9426
Faurecia - Fraser	MIS111490	42.5411	-82.9373
Roush Industries-Levan Road	MIS111499	42.3729	-83.4043
Avon Gear Co	MIS111500	42.6828	-83.0025
Marten Models and Molds	MIS111502	42.5485	-82.9325
Fraser Grinding Co - Riviera	MIS111503	42.5484	-82.9376
Fraser Grinding Co - Groesbeck	MIS111504	42.5412	-82.9322
Fraser Grinding Co - James J P	MIS111505	42.5485	-82.9325
Visioneering	MIS111506	42.5332	-82.9419
US Machine Co Inc	MIS111508	42.5371	-82.9421
PCS Co	MIS111510	42.5521	-82.9377
Eifel Mold and Engineering	MIS111512	42.5258	-82.9515
Firestone Metal Products	MIS111513	42.5354	-82.9862
Supreme Gear Co	MIS111516	42.5483	-82.9426
Midwest Gear & Tool-Roseville	MIS111518	42.5158	-82.9625
Dominion Tech & Viking	MIS111519	42.5146	-82.9607
Husky LLC	MIS111520	42.5034	-82.9654
Hercules Machine Tool & Die	MIS111522	42.4767	-82.9842
Hercules Machine Tool & Die	MIS111522	42.4767	-82.9842
L & M Machining & Mfg	MIS111528	42.4767	-82.9842
Magna-Ryan Road Facility	MIS111530	42.5354	-82.9862
Troy Design & Manufacturing	MIS111532	42.4688	-83.0085
Mariah Industries Inc	MIS111534	42.4497	-82.9844
Emtech	MIS111536	42.6071	-83.0485
US Farathane-Merrill Rd	MIS111538	42.5999	-83.0481
Mid-Michigan Recycling-Macomb	MIS111543	42.6504	-82.8594
Hi-Craft Engineering	MIS111548	42.5412	-82.9322
American Metal Processing	MIS111549	42.4582	-83.0030
Iroquois Ind - Groesbeck Hwy	MIS111553	42.4842	-82.9796
Trynex Inc	MIS111554	42.4692	-82.9937
Detroit Edge Tool Co	MIS111557	42.5035	-82.9602
Florence Cement Co	MIS111570	42.6700	83.0029
Florence Cement Co Plt 701	MIS111572	42.6241	-82.9903
LTC Roll & Eng-Clinton Twp	MIS111574	42.6181	-82.8672
Iroquois Ind-Hoover	MIS111576	42.4846	-82.9747
Arin Inc	MIS111580	42.5108	-82.9657
Carroll Products	MIS111586	42.6181	-83.0442

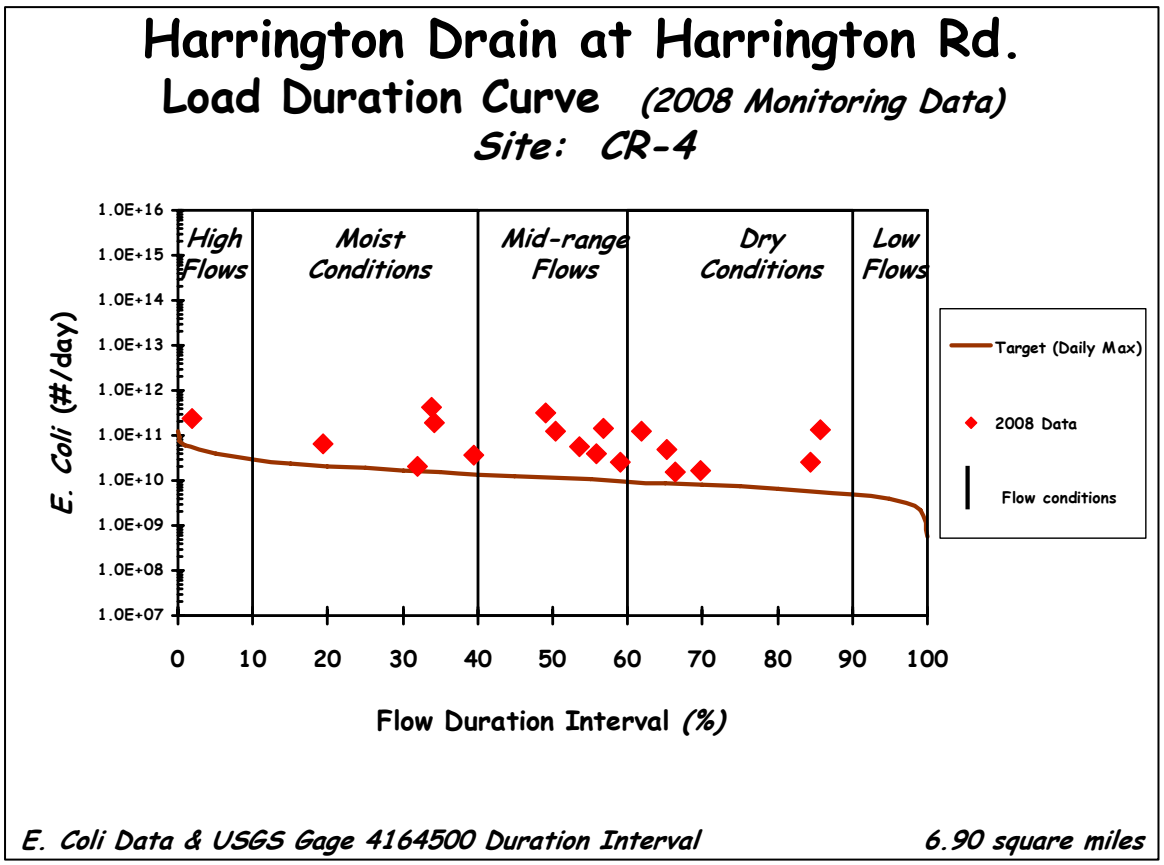
Appendix 3. Load duration curves for the Main Branch Clinton River Stations CR1-CR13. The gage used for the correlation and the drainage area size for each drainage area ratio calculation is indicated on the bottom of each chart.



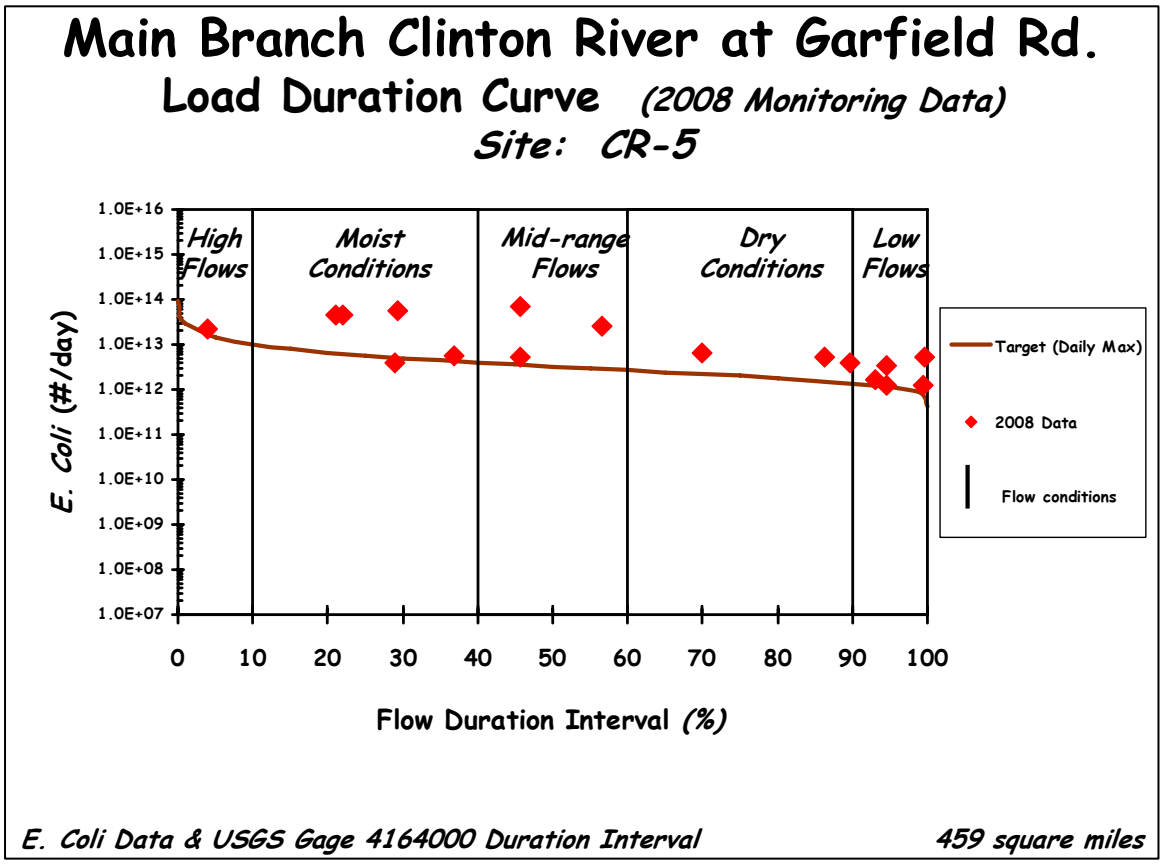


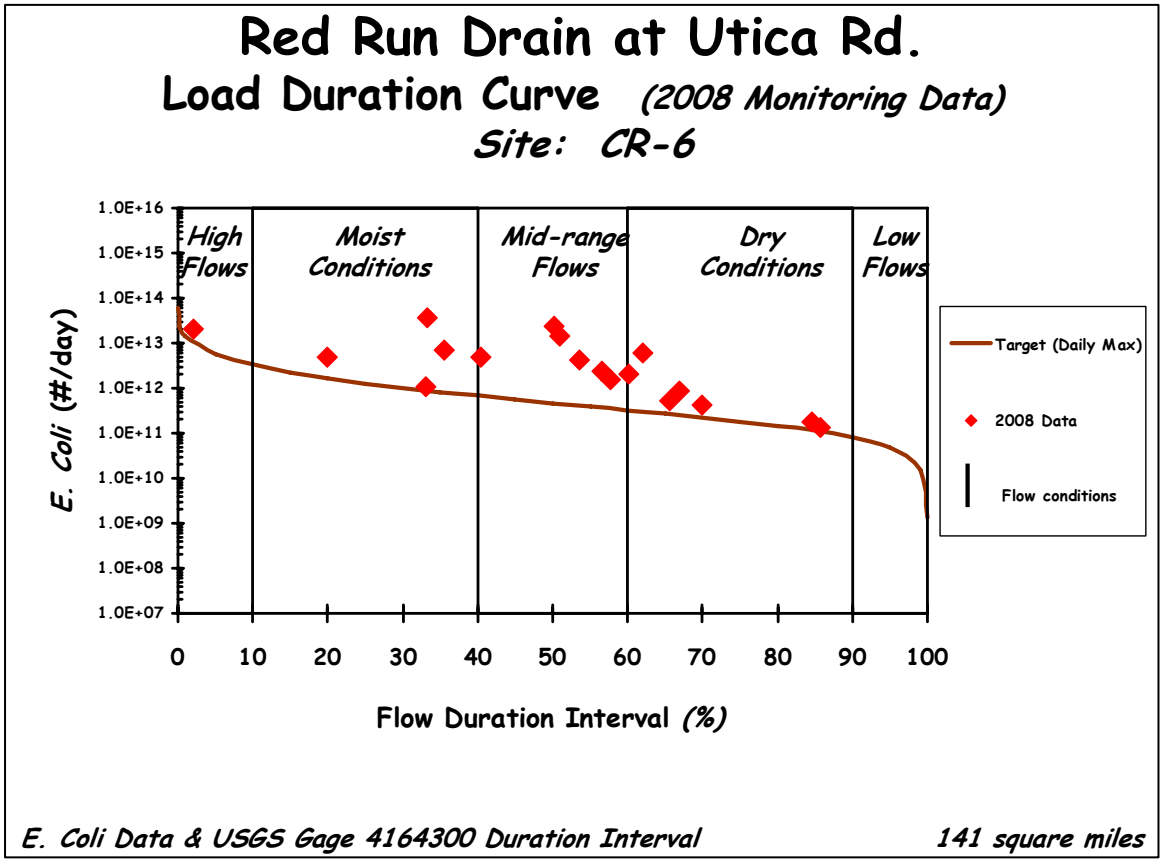
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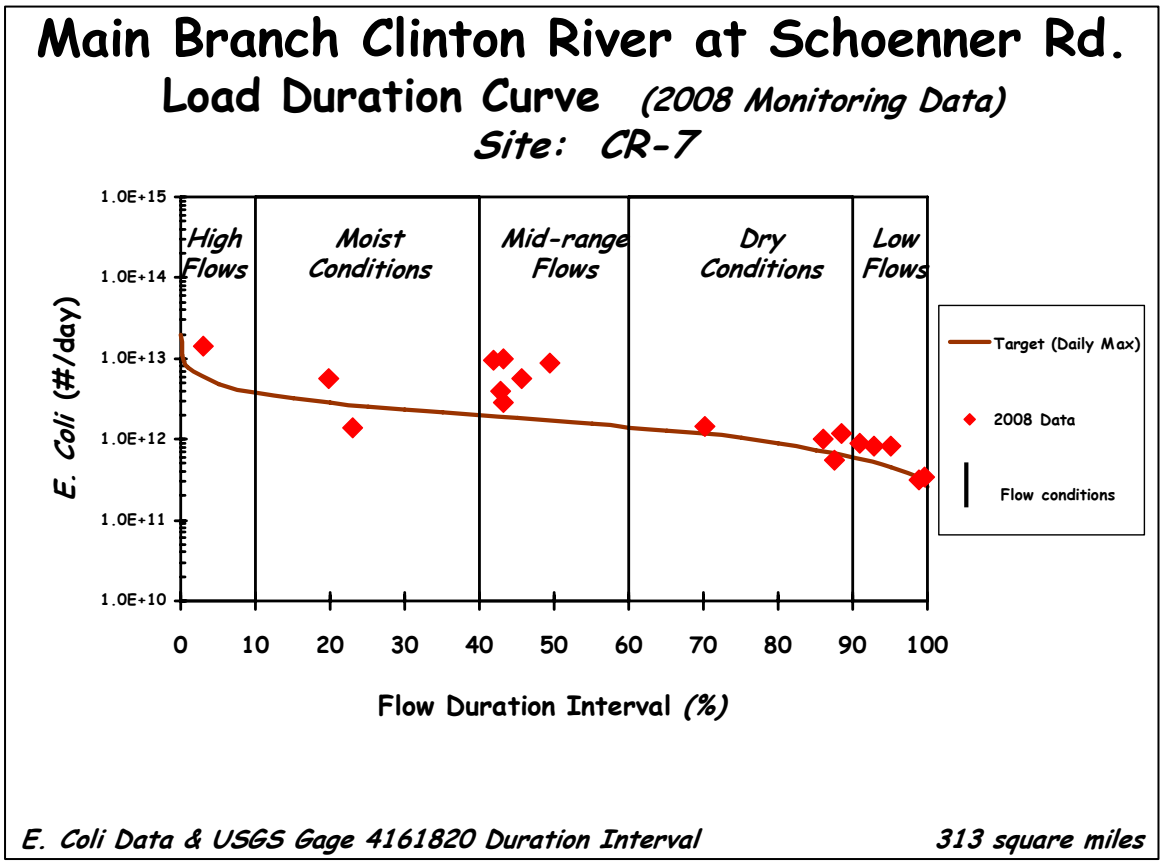


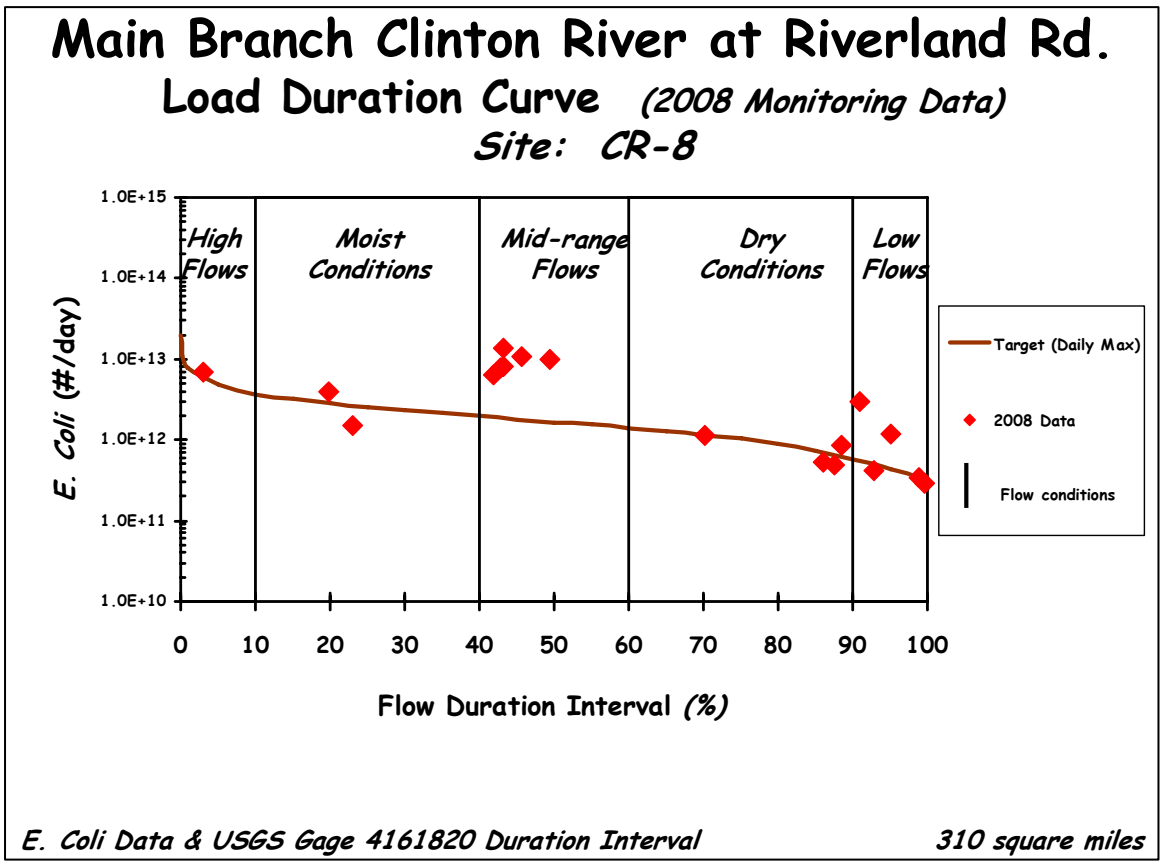
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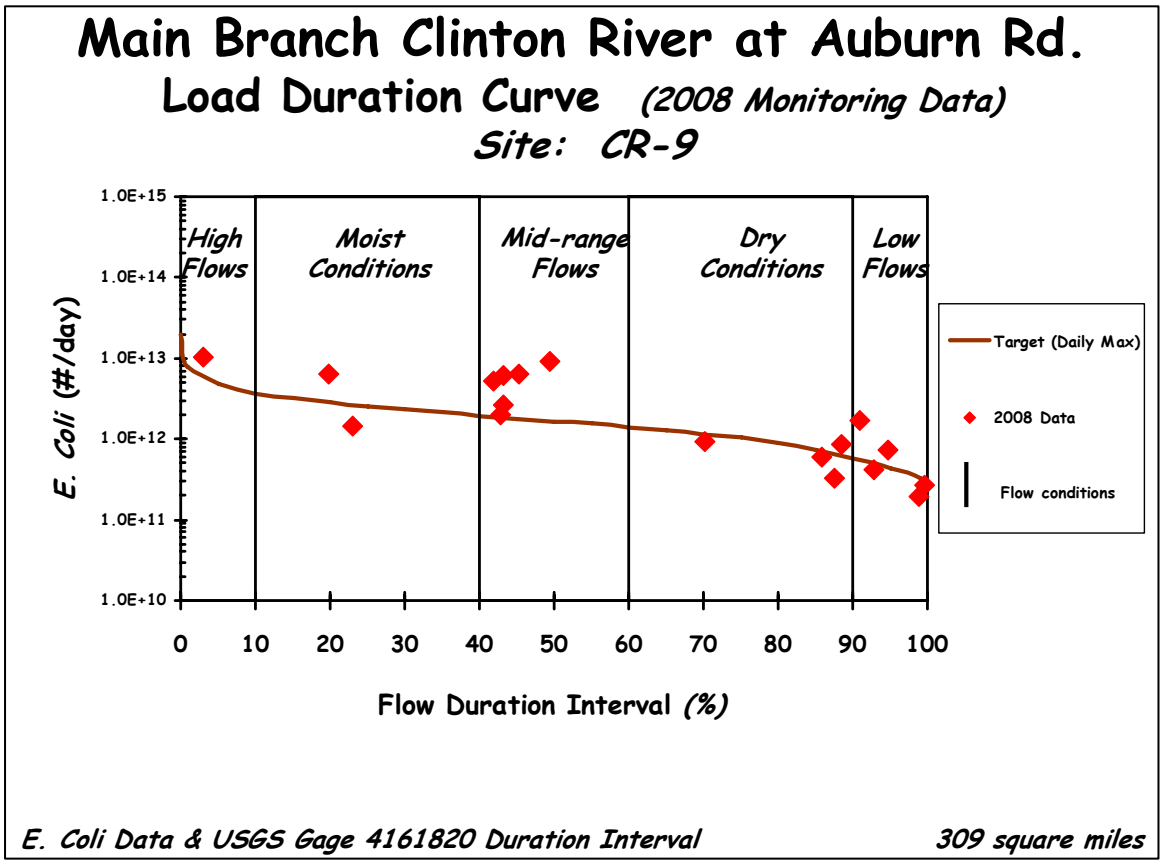


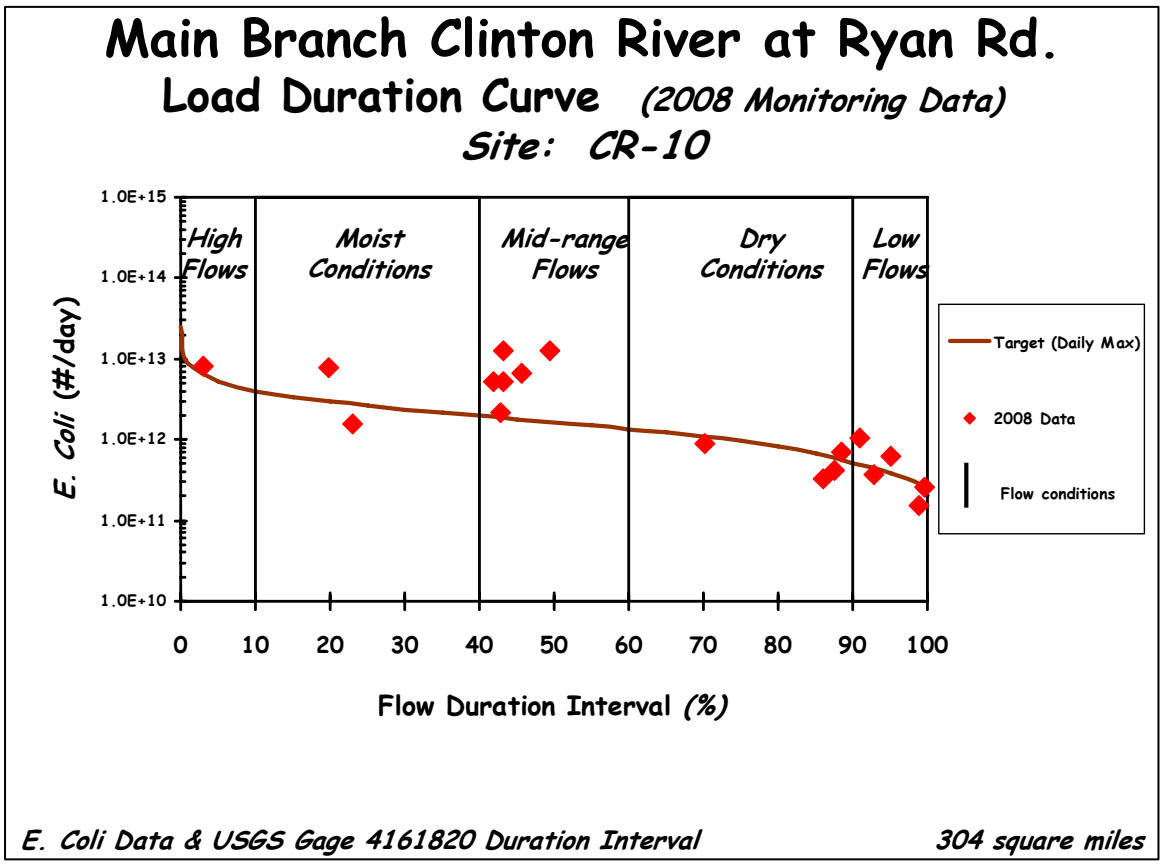
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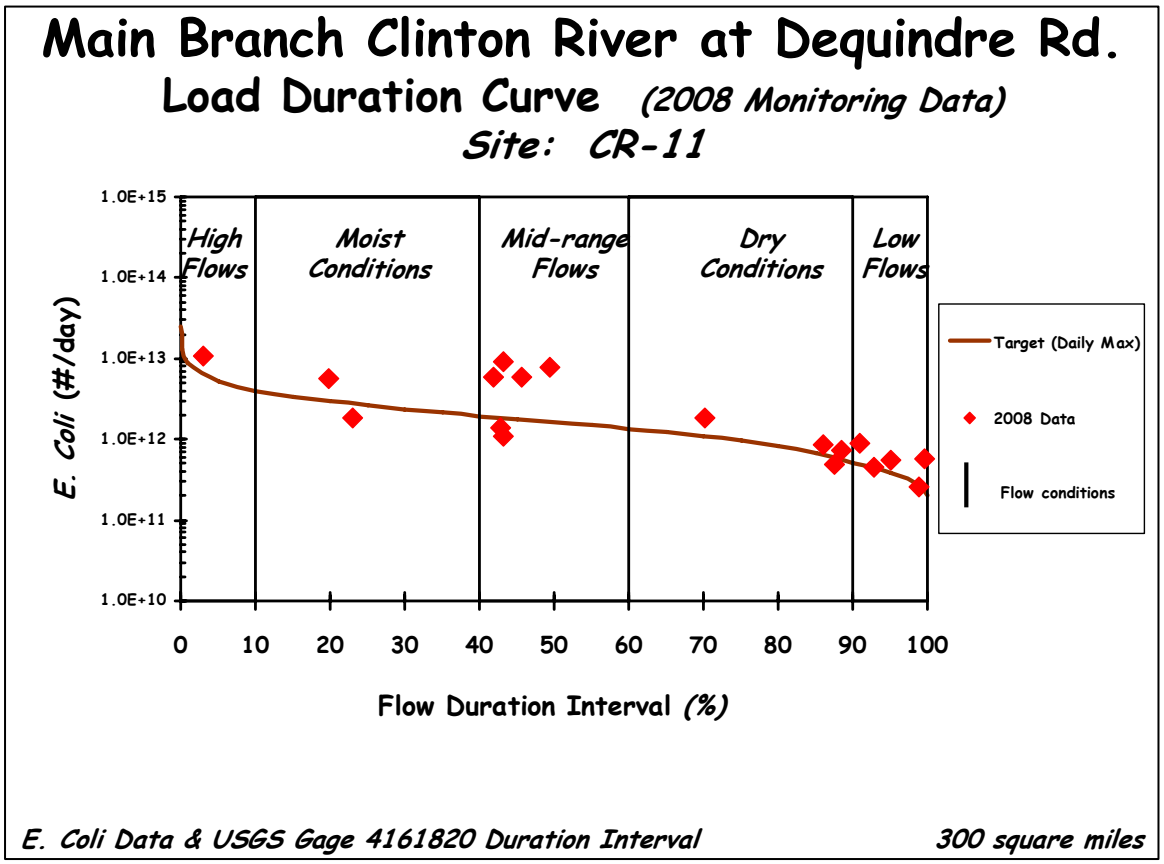


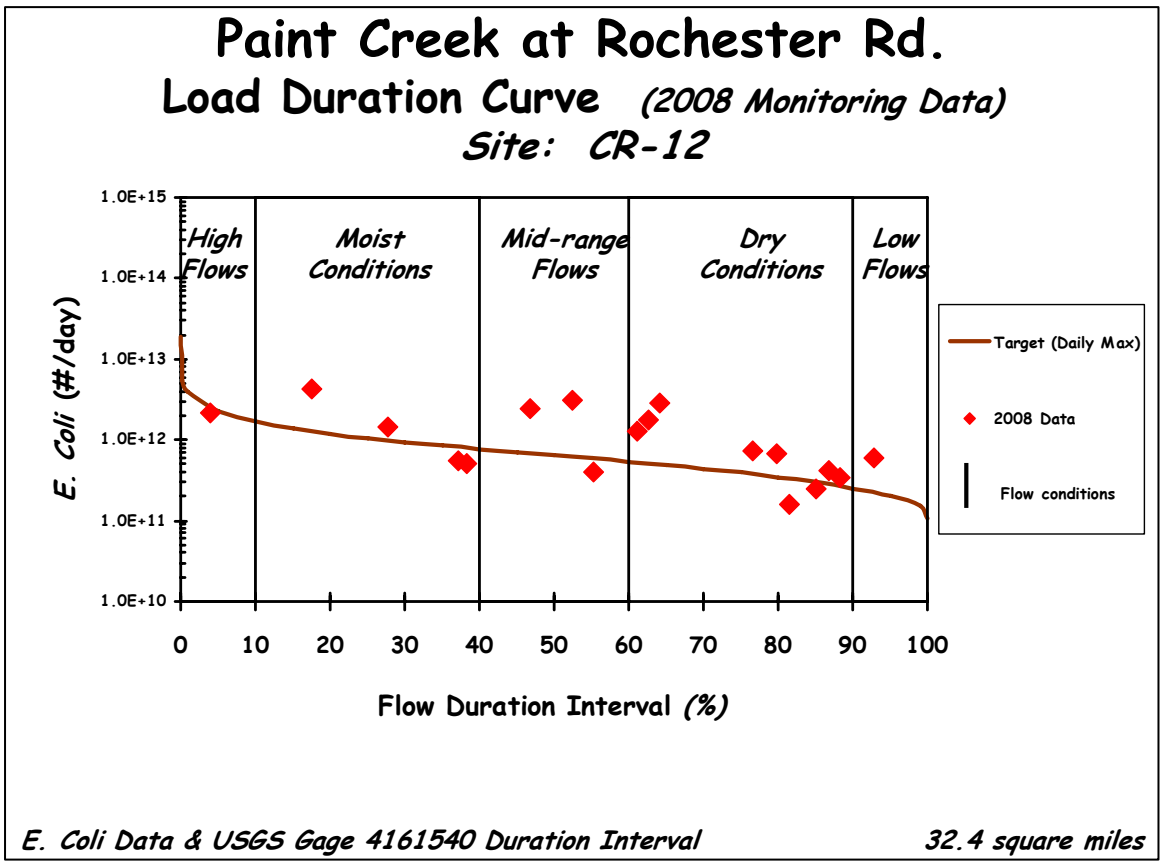
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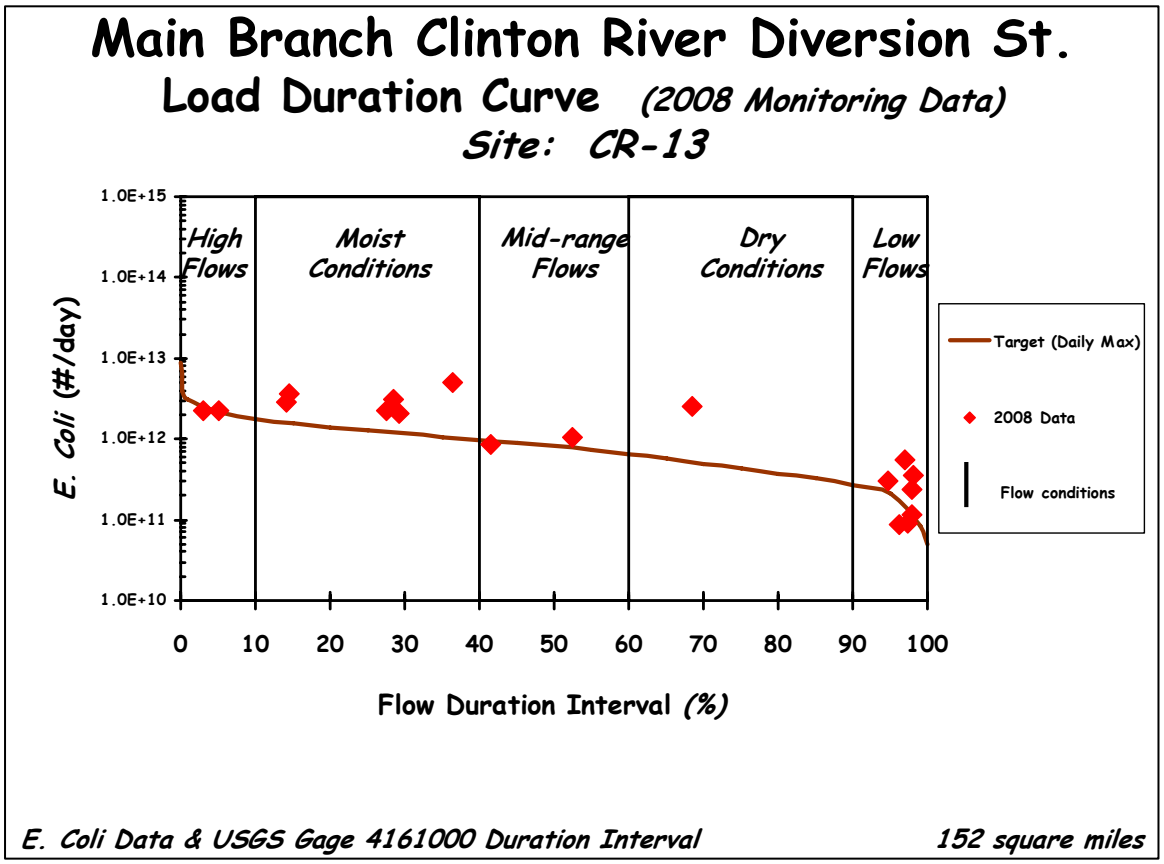


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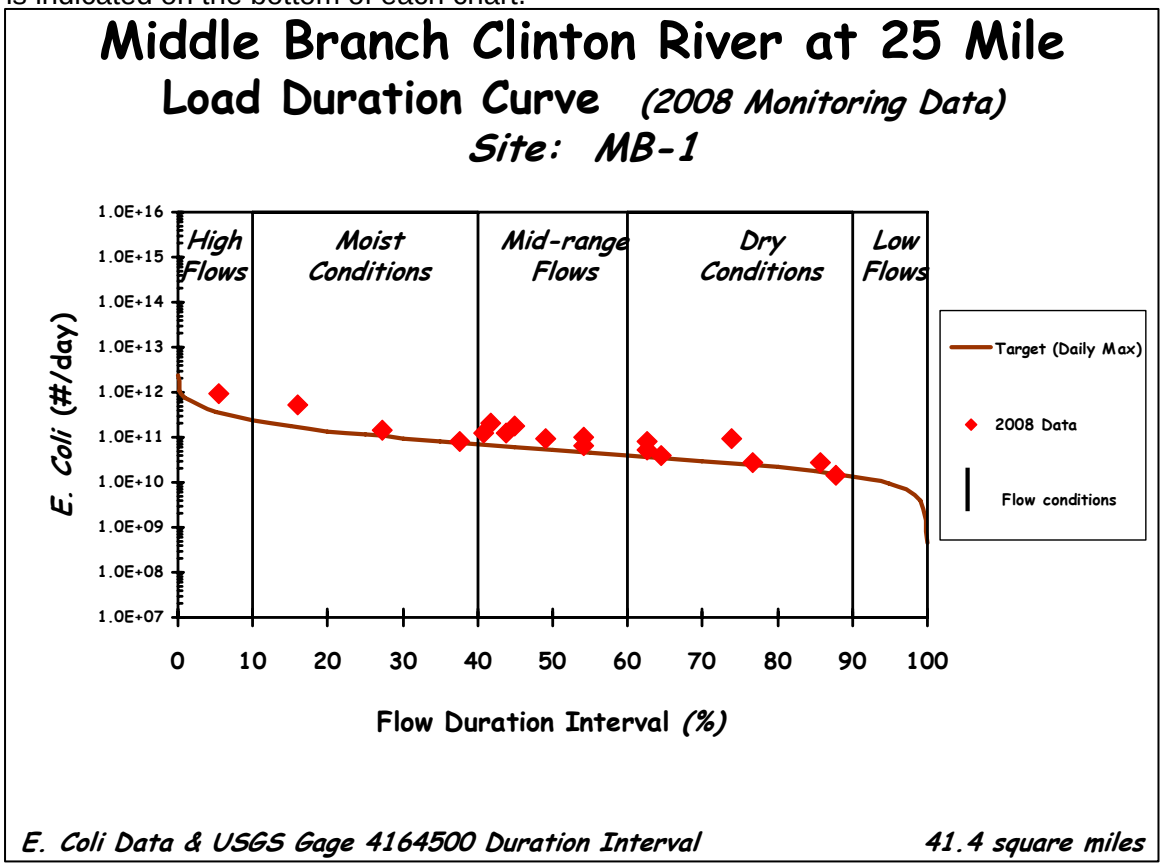


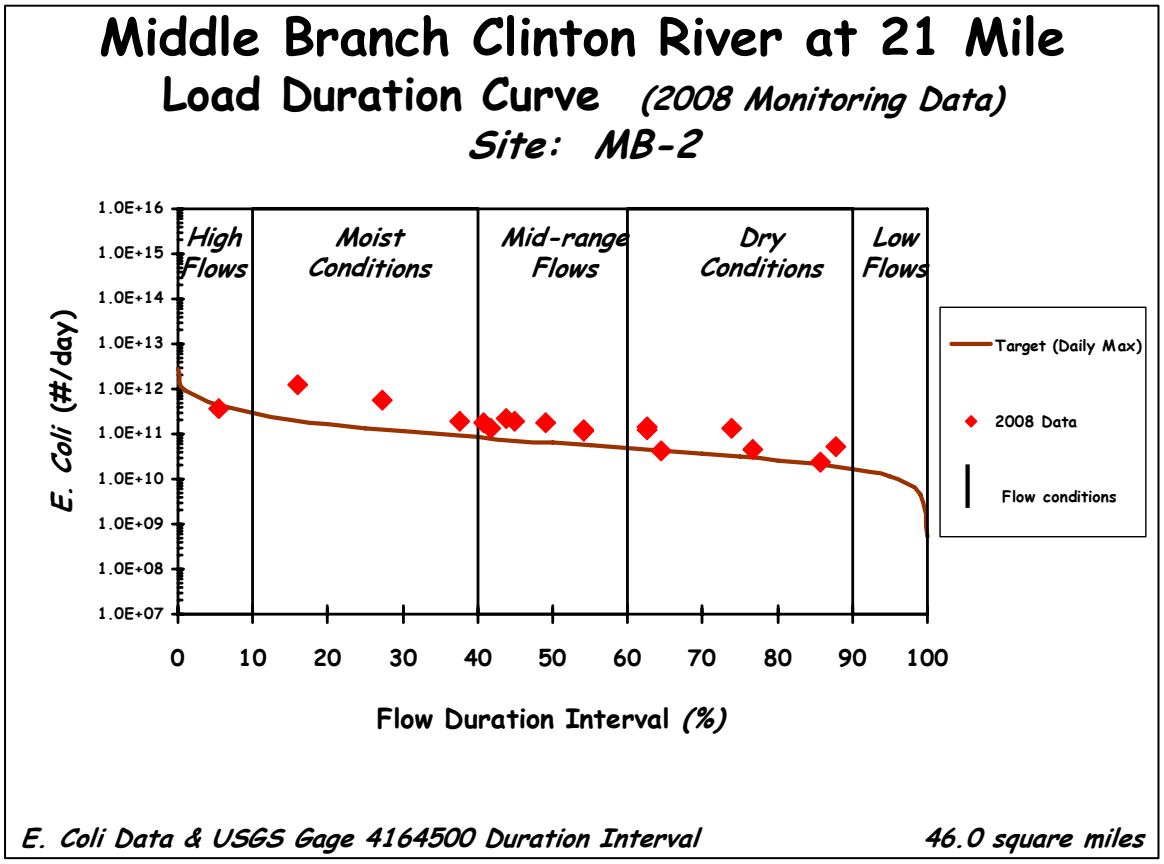


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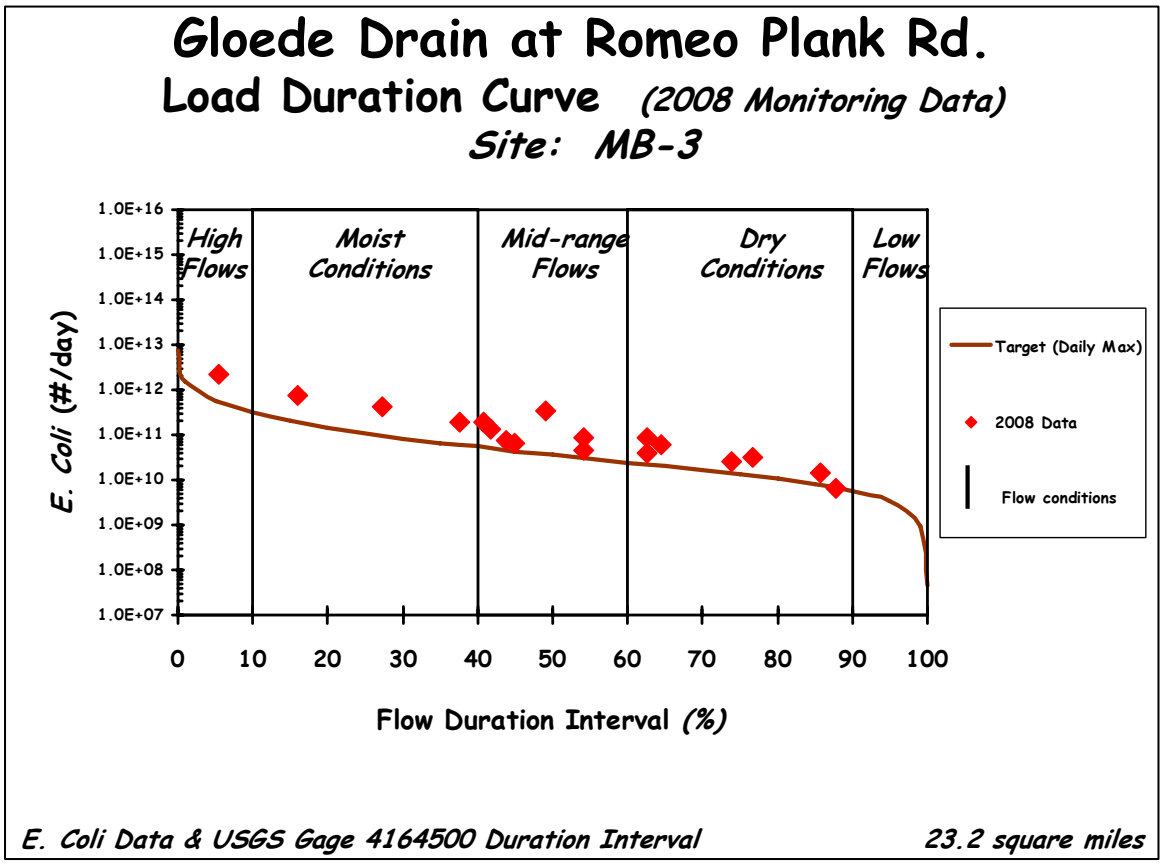


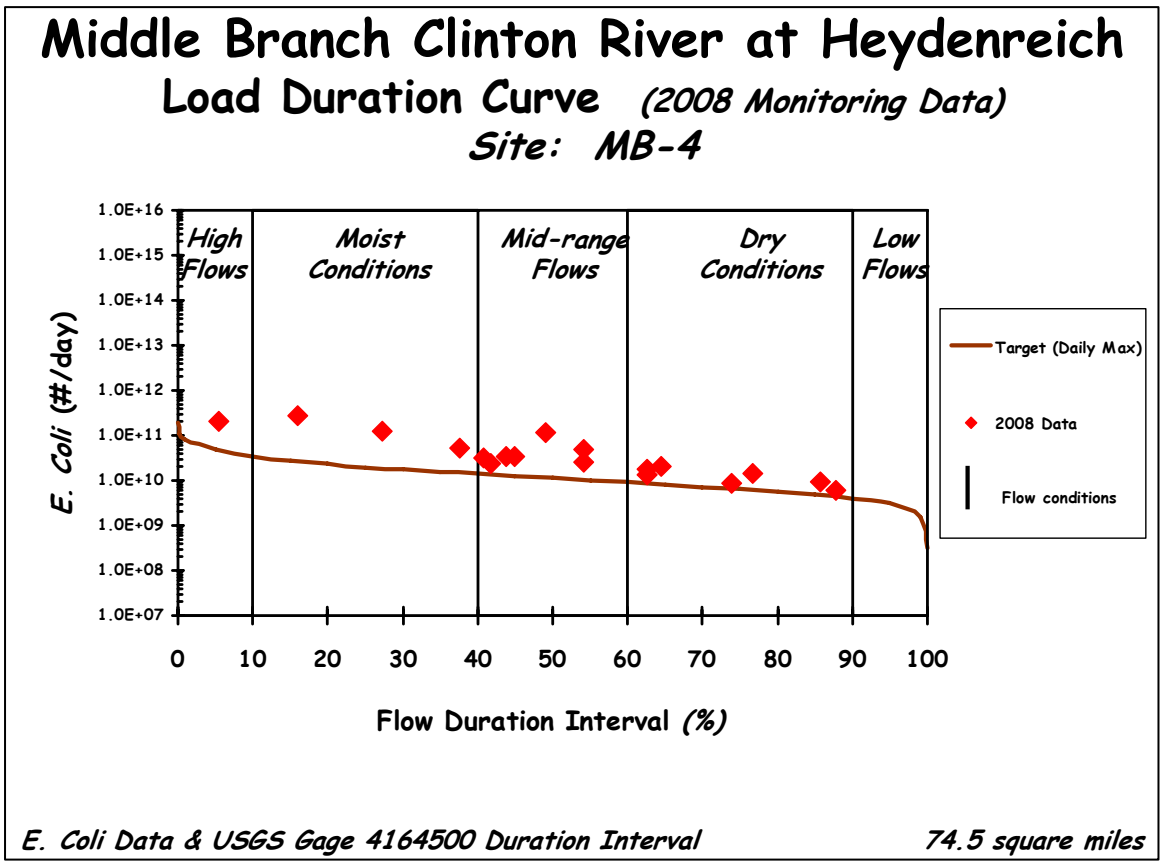
Appendix 4. Load duration curves for the Middle Branch Clinton River Stations MB1-MB4. The gage used for the correlation and the drainage area size for each drainage area ratio calculation is indicated on the bottom of each chart.



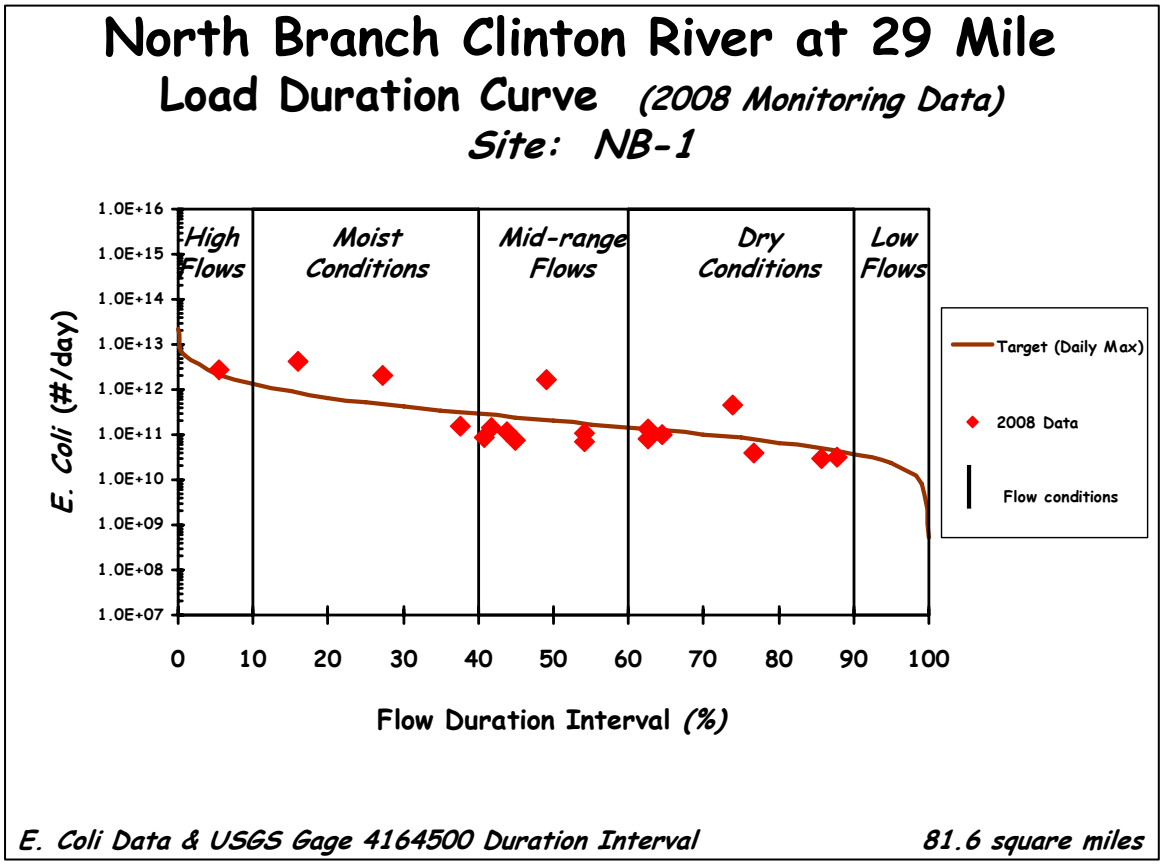


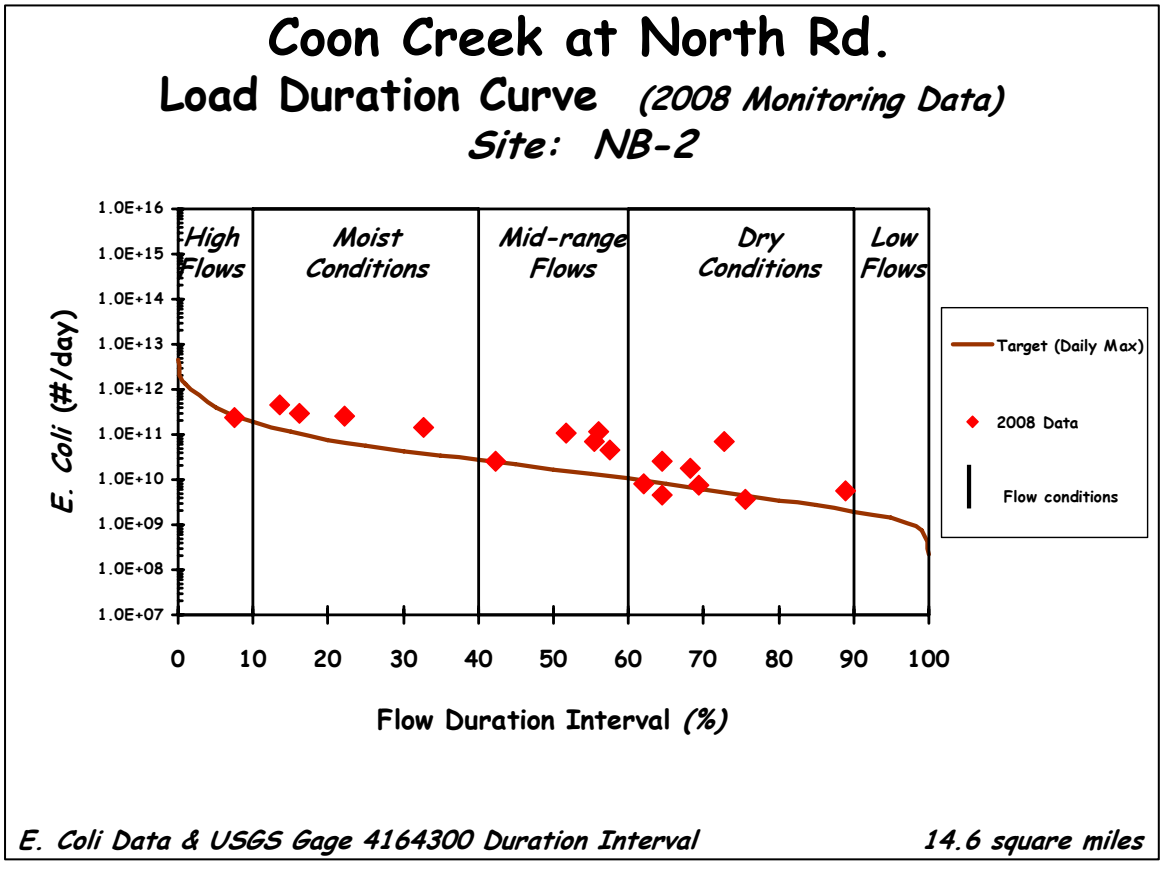
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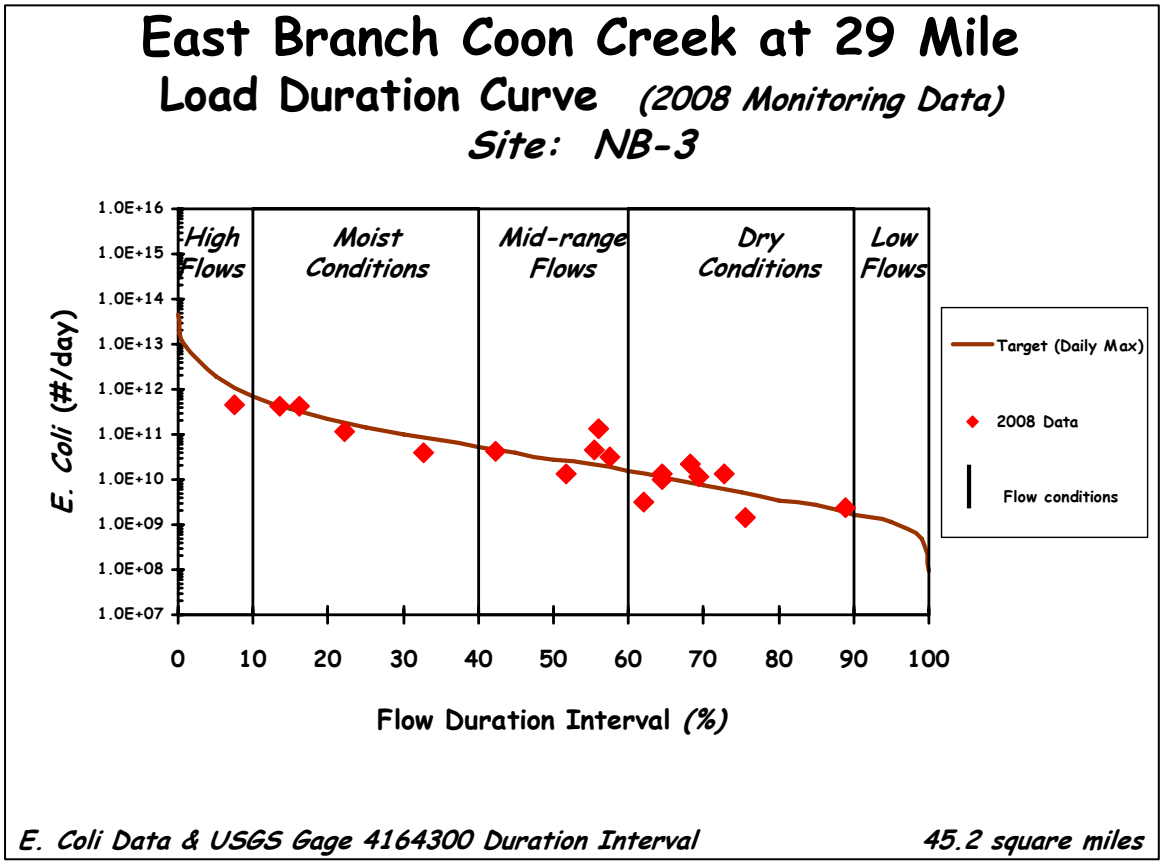


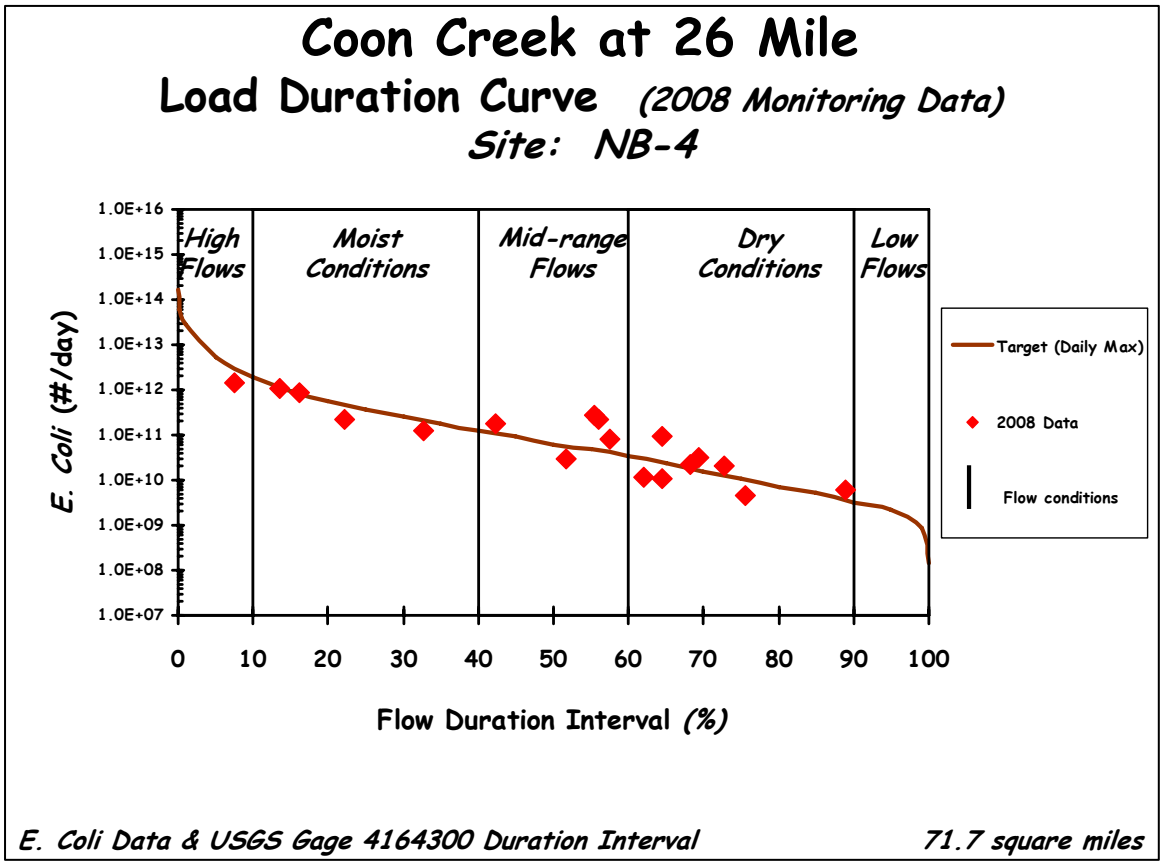
Appendix 5. Load duration curves for the North Branch Clinton River Stations NB1-NB8. The gage used for the correlation and the drainage area size for each drainage area ratio calculation is indicated on the bottom of each chart.



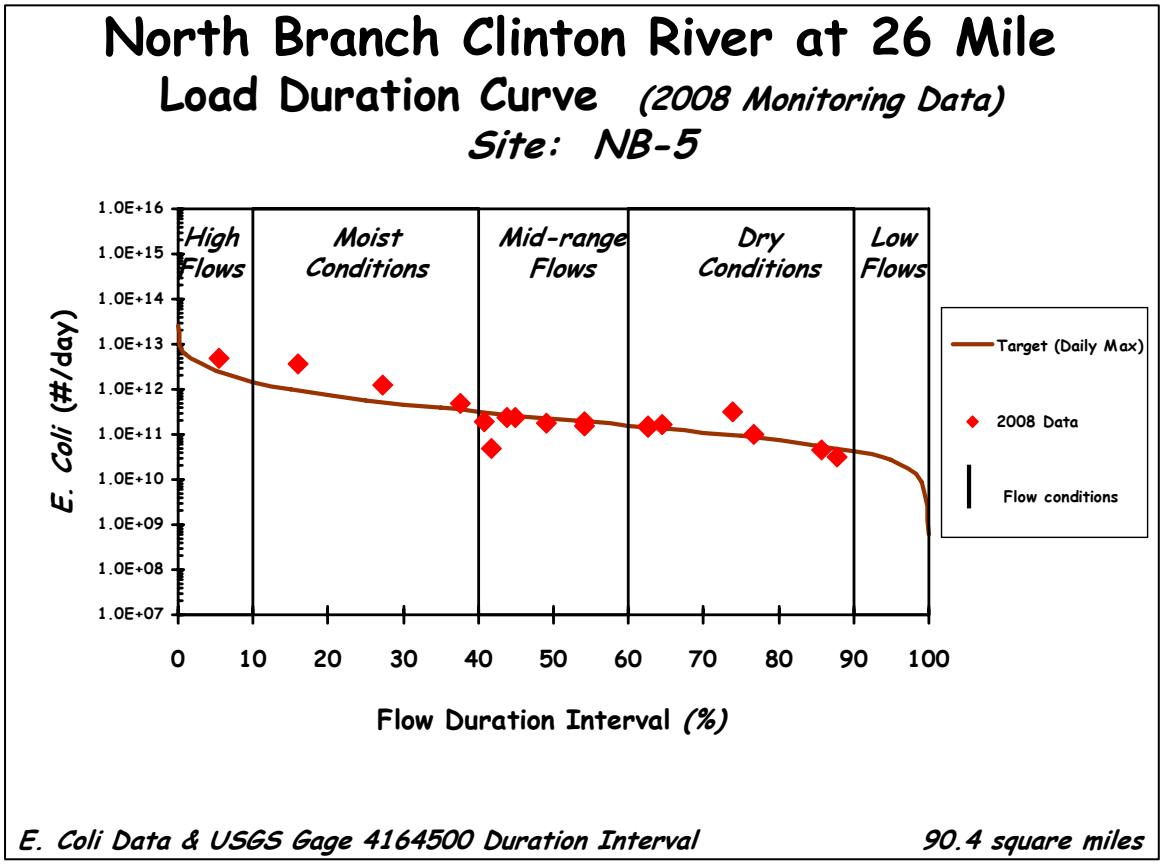


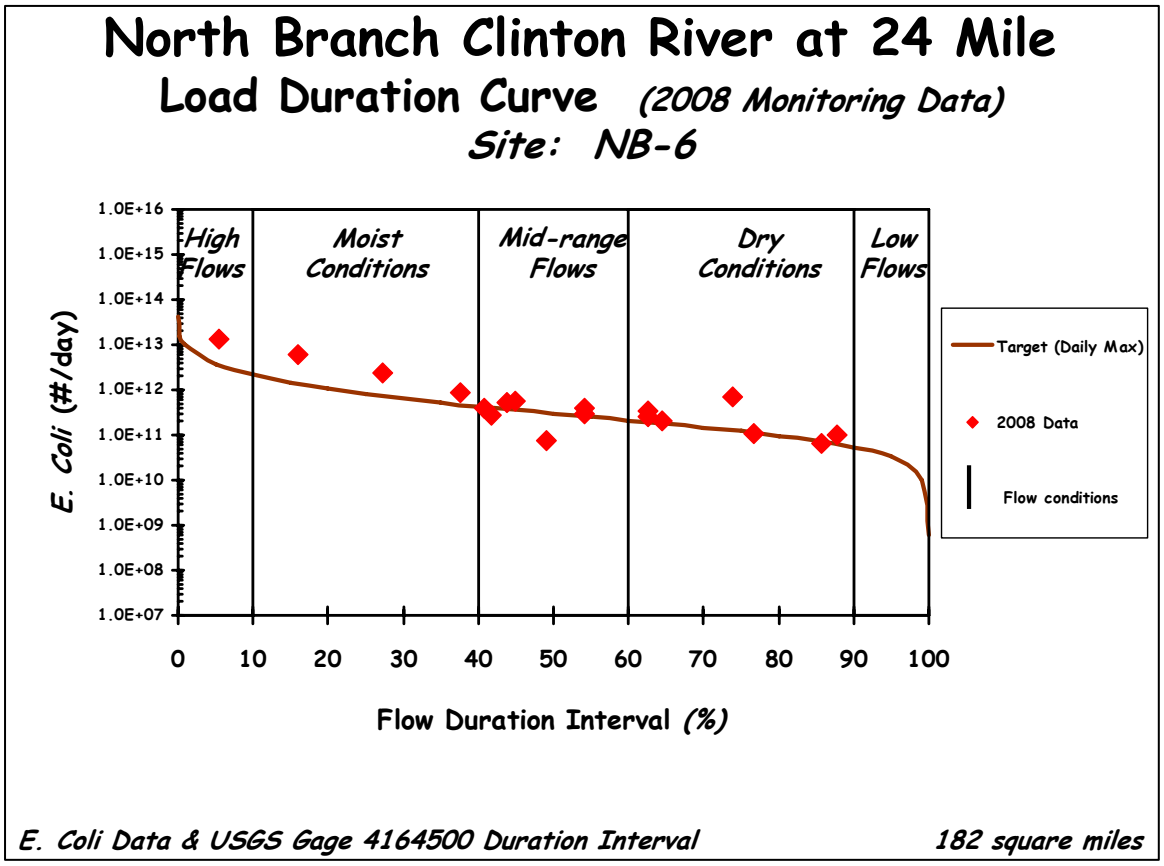
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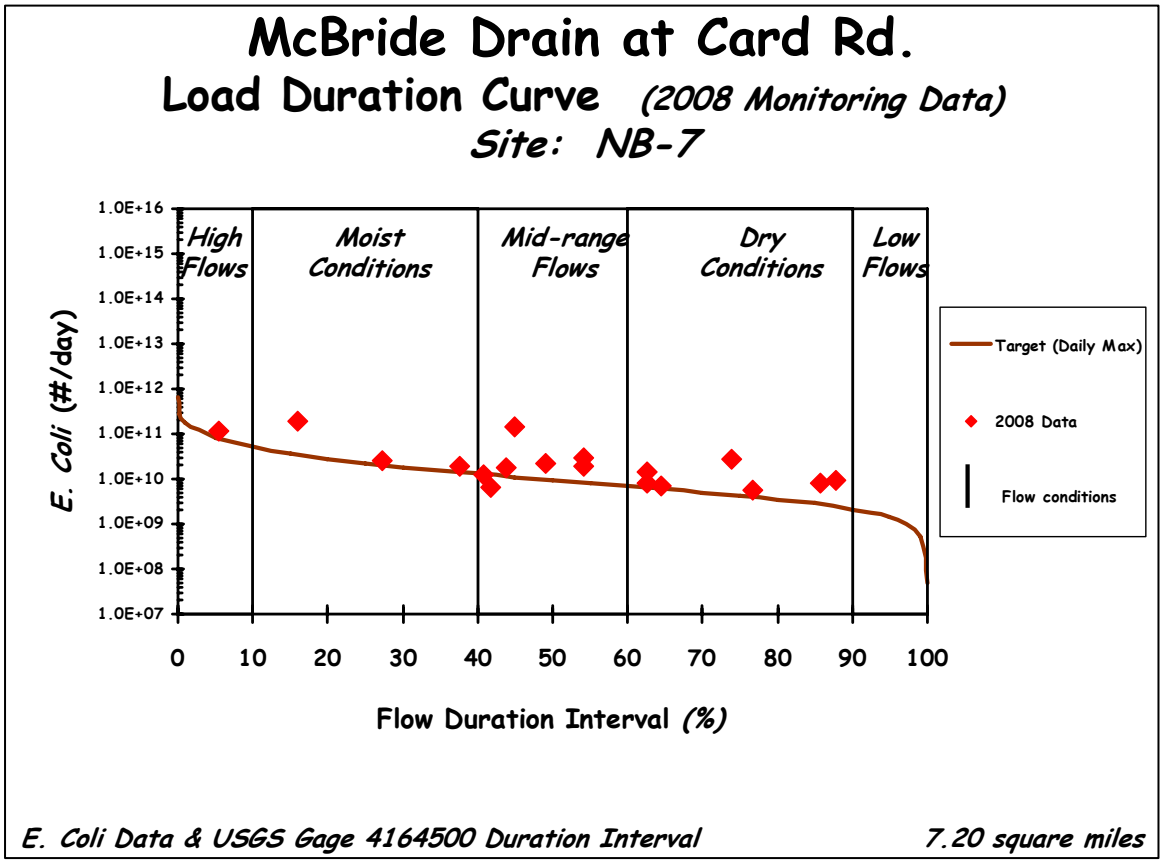


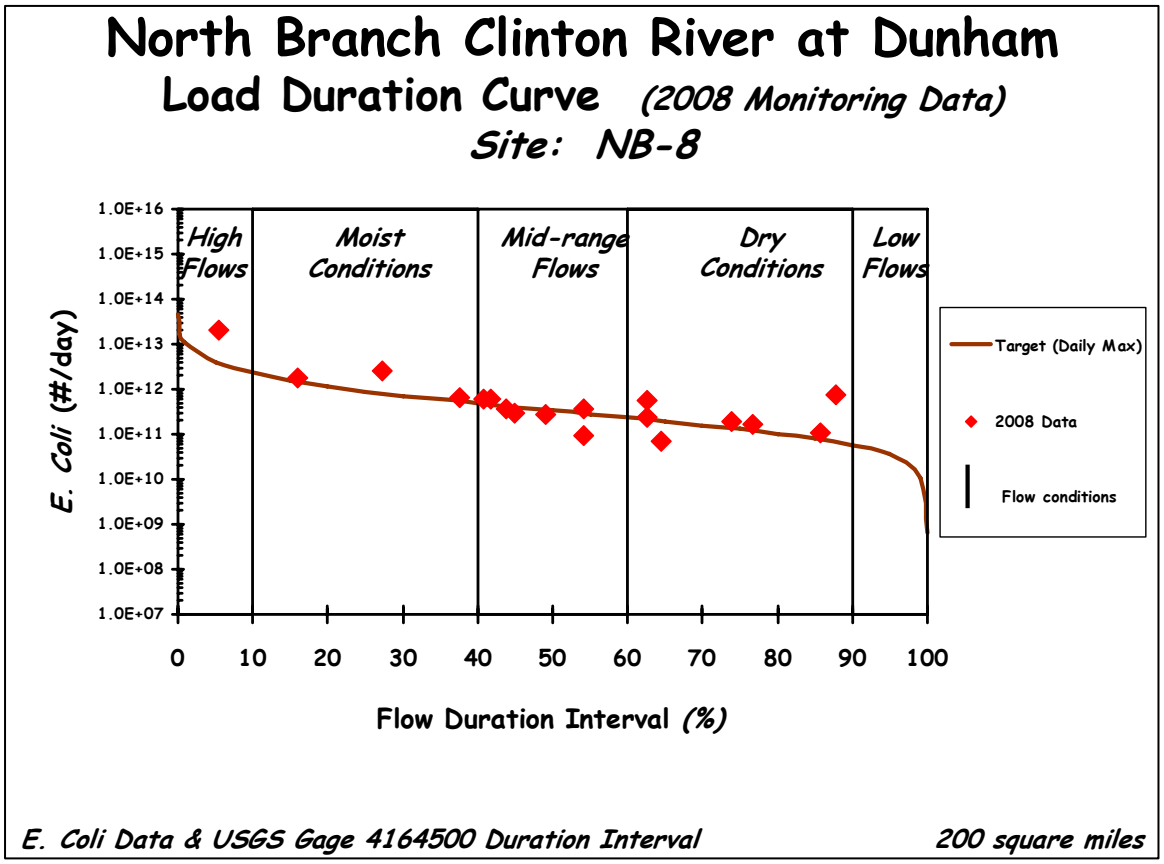
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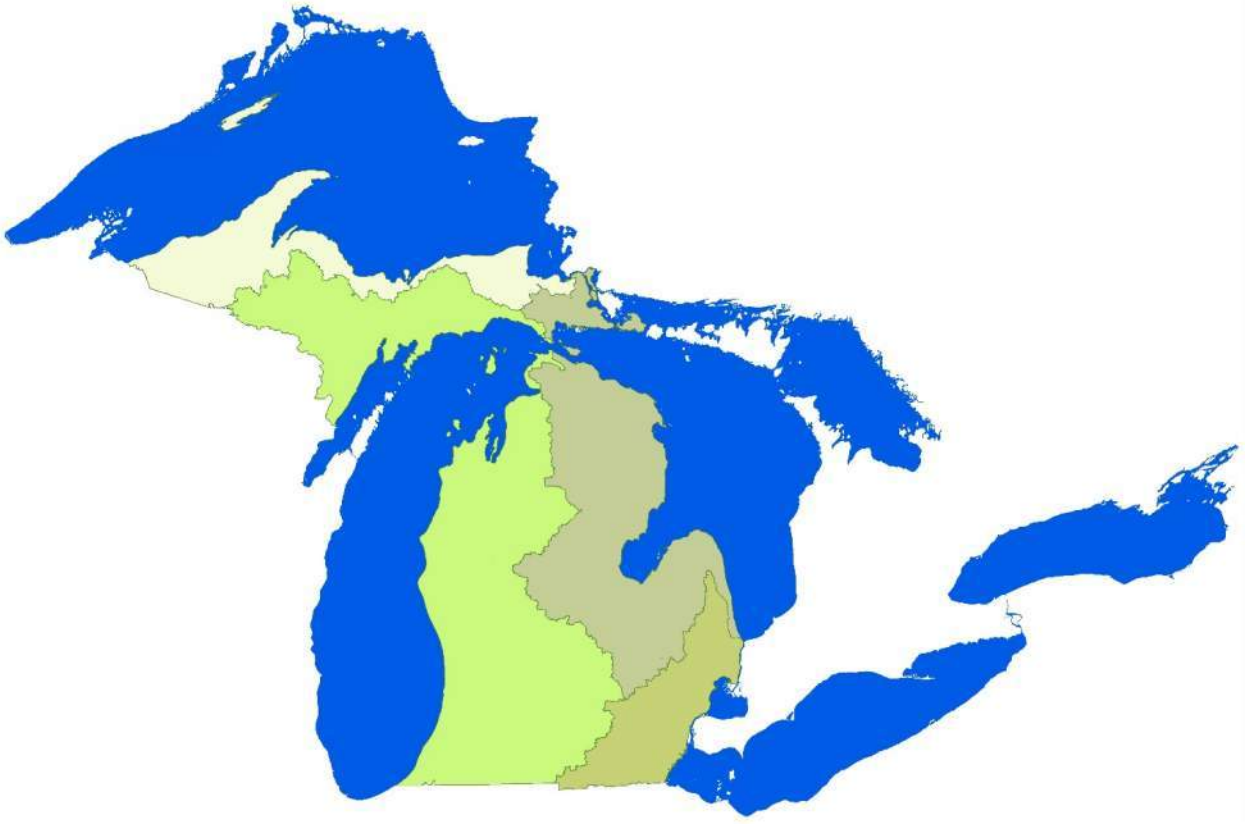


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Michigan's Statewide *E. coli* Total Maximum Daily Load



Michigan Department of Environment, Great Lakes, and Energy
Prepared By: Molly Rippke
Water Resources Division
July 2019
Michigan.gov/EGLE
Environmental Assistance Center 800-662-9278

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ACRONYMS

AFO	Animal Feeding Operation
ANOVA	Analysis of Variance
AUID	Assessment Unit Identification Number
BMP	Best Management Practices
CAFO	Concentrated Animal Feeding Operation
CFR	Code of Federal Regulations
CNMP	Comprehensive Nutrient Management Plan
COC	Certificate of Coverage
CSO	Combined Sewer Overflow
CWA	Clean Water Act
EGLE	Department of Environment, Great Lakes, and Energy
GAAMP	Generally Accepted Agricultural and Management Practices
GLISA	Great Lakes Integrated Science and Assessments
HSD	Honest Significant Difference
HUC	Hydrologic Unit Code
IDEP	Illicit Discharge Elimination Program
LA	Load Allocation
LC	Loading Capacity
MAEAP	Michigan Agriculture Environmental Assurance Program
MDARD	Michigan Department of Agriculture and Rural Development
MDEQ	Michigan Department of Environmental Quality (currently EGLE)
MDNR	Michigan Department of Natural Resources
MOS	Margin of Safety
mL	Milliliters
MS4	Municipal Separate Storm Sewer System
MSU	Michigan State University
NOAA	National Oceanic and Atmospheric Administration
NOC	Notice of Coverage
NPDES	National Pollutant Discharge Elimination System
NREPA	Natural Resources and Environmental Protection Act
PBC	Partial Body Contact
RA	Reasonable Assurance
SA	Source Assessment
SAW	Stormwater, Asset Management, and Wastewater Program
SSO	Sanitary Sewer Overflow
SWMP	Storm Water Management Program
SWPPP	Storm Water Pollution Prevention Plan
TBC	Total Body Contact
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WCMP	Water Chemistry Monitoring Program
WLA	Waste Load Allocation
WQS	Water Quality Standards
WRD	Water Resources Division
WWSL	Wastewater Stabilization Lagoon
WWTP	Wastewater Treatment Plant

Michigan's Statewide *E. coli* Total Maximum Daily Load

1. INTRODUCTION

Keeping our residents and visitors safe while recreating in Michigan's waters is an EGLE priority. To help attain the goal of enhancing recreational waters and tie together the efforts that Michigan continues to expend on reducing *E. coli* contamination of surface waters, EGLE has made it a priority to develop this *E. coli* TMDL.

This Total Maximum Daily Load (TMDL) addresses all surface waters (inland lakes, Great Lakes, streams, rivers, wetlands, and beaches) in the state of Michigan that are impaired by *E. coli.* The goal of the TMDL is to identify problem areas, address sources of *E. coli* statewide, and provide guidance to restore these waters.

The targets in this TMDL are concentrations of *E. coli* per 100 milliliters (mL) of water, set equal to Michigan's Water Quality Standard (WQS) for recreation (described in Section 3). This target is easier to understand and communicate than a load-based target, which would vary by water body, and is also easier to measure with limited resources.

This TMDL also references an array of tools (to be used by EGLE, watershed groups, interested stakeholders, and other state and local agencies) that have been created to help locate and address sources of bacterial contamination, and supplement and guide implementation of this TMDL.

1.1 LEGAL BACKGROUND

Section 303(d) of the federal Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) require states to develop TMDLs for water bodies that are not meeting WQS. The water bodies that are not meeting their designated uses are listed on Michigan's 303(d) list, which is included in the Sections 303(d), 305(b), and 314 Integrated Report (Michigan Department of Environmental Quality [MDEQ], 2016a]). The Integrated Report fulfills the state's requirement to assess the designated uses of its waters. Michigan's Integrated Report is published every two years, and in addition to containing a list of impaired water bodies, it also contains the causes of impairment and a schedule for TMDL development.

A TMDL establishes the allowable levels of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of water resources. The purpose of this TMDL is to identify the allowable levels of *E. coli* that will result in attainment of the applicable WQS in Michigan's surface waters.

Water bodies are evaluated for the Total Body Contact (TBC) and Partial Body Contact (PBC) recreation designated uses using *E. coli* bacteria as an indicator for other harmful pathogens. This is consistent with USEPA recommendations for fresh water recreational water quality criteria for protecting human health (USEPA, 2012).

1.2 FUTURE TMDL APPLICABILITY

1.2.A Adding or Removing Impaired Waters

Once approved, this TMDL document will be routinely revised only to add additional impaired water bodies, and to indicate waters that have been restored. Proposed impaired water bodies that are identified by future monitoring will be added via an addendum to the TMDL released with EGLE's biennial submittal of the Integrated Report (hereafter referred to as the Statewide *E. coli* TMDL Addendum). Minimum water quality monitoring data requirements for determining if a water body is impaired by a pollutant are described in the assessment methodology section of EGLE's Integrated Report. This assessment methodology is updated with each biennial submittal. Beginning with the 2020 version of the Integrated Report, the Statewide *E. coli* TMDL Addendum will clearly and concisely present proposed new impaired water bodies to the public and the USEPA, along with a cumulative list of all water bodies that are included in this TMDL, and water bodies that have been restored and are no longer impaired due to *E. coli* (assessment category 2). Proposed impaired water bodies will be placed in the "Impaired, TMDL completed" Integrated Report assessment category (category 4a) for the TBC or PBC designated uses, as applicable. Once the USEPA approves the Statewide *E. coli* TMDL Addendum, the newly proposed water bodies will be part of this statewide TMDL. It is EGLE's intent that no new water bodies will be added to the Integrated Report assessment category "Impaired-TMDL needed" (category 5) for the TBC or PBC designated uses.

Water bodies that have been restored to meet the TBC and PBC designated uses, and are part of this statewide TMDL, will be listed as attaining (category 2) in the next applicable 305(b) list. In order to be considered fully restored, data must fall below the exceedance thresholds described in the Integrated Report assessment methodology as demonstrated by a study that is comparable in scope to the study that was used to list it as nonattaining. The approximate flow and weather conditions that were sampled in the study used for impairment assessment decision must be captured in the monitoring designed to demonstrate the restoration of the water body. Data submitted by outside agencies is acceptable for determining designated use attainment but must meet quality assurance/quality control requirements of EGLE. For water bodies that are monitored each summer (e.g., beaches), this will be a minimum of two years of data collected in successive years to demonstrate restoration. The exact number of samples in the pre- and post-studies need not be the same. Minimum data requirements identified in the Integrated Report assessment methodology must be met. In addition, for all water bodies, if a significant source of *E. coli* (e.g. an illegal discharge, violation of permitted activity, or a source known to cause WQS violations) was identified and documented by EGLE or other responsible agency during the initial assessment, that source must have been remedied for the water body to be listed as attaining.

The Integrated Report is available on EGLE's Web site and the 30-day public notice for the biennial submittal shall serve as the required public notice for the proposed addition of impaired water bodies in the TMDL addendum.

If the Michigan bacterial WQS changes in the future, this TMDL will be revised to reflect those changes. Further details on the revision of this TMDL can be found in Appendix 2.

1.2.B Updating Previously Approved *E. coli* TMDLs

The state of Michigan has previously submitted 57 watershed-based *E. coli* TMDL documents to the USEPA. Of these, 53 were approved by the USEPA with concentration-based TMDL targets (Appendix 2). The remaining four TMDLs (Rouge River, Detroit River, Ecorse Creek, and the Black River) contain load-based allocations designed to meet the water quality standard. Due to the significant changes that have been made to Combined Sewer Overflow (CSO) long-term control plans in the Rouge River watershed, the load-based TMDL allocations are in need of updating; however, redeveloping the allocations would be time-consuming and yield no environmental benefit since the target of any *E. coli* TMDL is to meet the water quality standard. Therefore, EGLE proposes to revoke the River Rouge *E. coli* TMDL and replace (reissue) it with coverage by the statewide *E. coli* TMDL. This transition process will occur upon approval of the statewide *E. coli* TMDL by the USEPA and as a result there will be no time gap in coverage by an *E. coli* TMDL. Because the target of any TMDL is to meet the water quality standard, this transition will not affect environmental outcomes or ongoing corrective actions in the Rouge River, but will be more consistent with EGLE's approach to *E. coli* TMDLs throughout the rest of the state.

EGLE intends to leave the remaining watershed-based *E. coli* TMDLs intact at this time because the allocations are still appropriate, and the documents contain valuable information on the sources at the time they were approved. In the future these TMDLs may be revoked and replaced with coverage by the statewide TMDL through the TMDL addendum and Integrated Report processes if warranted (on a case-by-case basis). Because changes in point source regulation have occurred, and continue to occur, the process described in Appendix 2 may also be used, as needed, to update the point source facility lists (Waste Load Allocation [WLA]) and source assessment portions of all previously approved concentration-based *E. coli* TMDLs. This will allow stakeholders to use updated and current information on the point sources and nonpoint sources in these watersheds, as well as view updated water quality data, to improve implementation of previously approved TMDLs.

1.3 PROBLEM STATEMENT

All surface waters identified in the 2016 303(d) list due to TBC or PBC impairments caused by *E. coli*, and the Rouge River, are addressed by this TMDL. Michigan uses the National Hydrography Dataset to organize and identify water bodies for the TMDL and Sections 303(d) and 305(b) lists. A base assessment unit is a 12-digit hydrologic unit code (HUC), which may be split further into smaller assessment units depending on information such as land use, known areas of contamination, specific fish consumption advisories, physical barriers such as dams, etc. Each assessment unit is assigned an assessment unit identification (AUID) number and may consist of all water bodies in a 12-digit HUC (as a maximum) or specific stream segments, shorelines, or lakes located in that HUC. AUIDs may also be points, such as in the case of clearly defined and monitored bathing beaches or public water supply intakes.

The data requirements to list an AUID as impaired for a designated use are included in each biennial submittal of the Integrated Report. Both the USEPA and public have an opportunity to comment on the impairment assessment methodology and changes to the segments listed as impaired or meeting designated uses.

Rather than focus on the number of AUIDs that are impaired, it is more meaningful to discuss the length of stream miles and shorelines, lake acres and number of beaches (individual AUIDs vary greatly in size for reasons mainly unrelated to bacterial pollution). The number of stream miles with the TBC and PBC designated uses impaired by *E. coli* have increased dramatically since 2008 (Figure 1 [MDEQ, 2008; 2010a; 2012; 2014; and 2016a]). As far as EGLE is aware,

this is not due to a decline in water quality; rather, it is due to an increase in targeted *E. coli* monitoring.

EGLE has received many comments from the public expressing concern with bacteria in surface water and has directed more resources to monitoring in order to detect areas with problems. In addition to targeted monitoring of water bodies, EGLE has monitored rivers and streams for *E. coli* as part of its Water Chemistry Monitoring Program (WCMP). This monitoring program was designed to report on Michigan's water quality status, which includes monitoring 250 randomly located sites throughout the state over a span of five years (50 sites per year). Each site is monitored four times in its designated year. *E. coli* was part of the WCMP in 2009, 2011, 2012, and 2013, resulting in about 200 sites being monitored for *E. coli*. Extrapolating from these data, EGLE estimated that 48 percent of the rivers and streams exceeded the TBC designated use in 2013. Additionally, 22 percent of monitored beaches had closures due to bacterial pollution in 2014 (MDEQ, 2015a).

While currently there are almost 9,000 miles of streams with the TBC designated use impaired, as more monitoring is conducted, we expect that the number of impaired stream miles will grow to be about half of Michigan's stream miles (around 37,000 miles). As of 2016, 89 percent of Michigan's stream miles had not been fully assessed for attainment of the TBC and PBC WQS.

Appendix 1 contains a list of all impaired water bodies (AUIDs) that are addressed by this TMDL. An Addendum will be published with each issuance of the biennial update of the Integrated Report as summarized in Section 1.2, and described in more detail in Appendix 2.

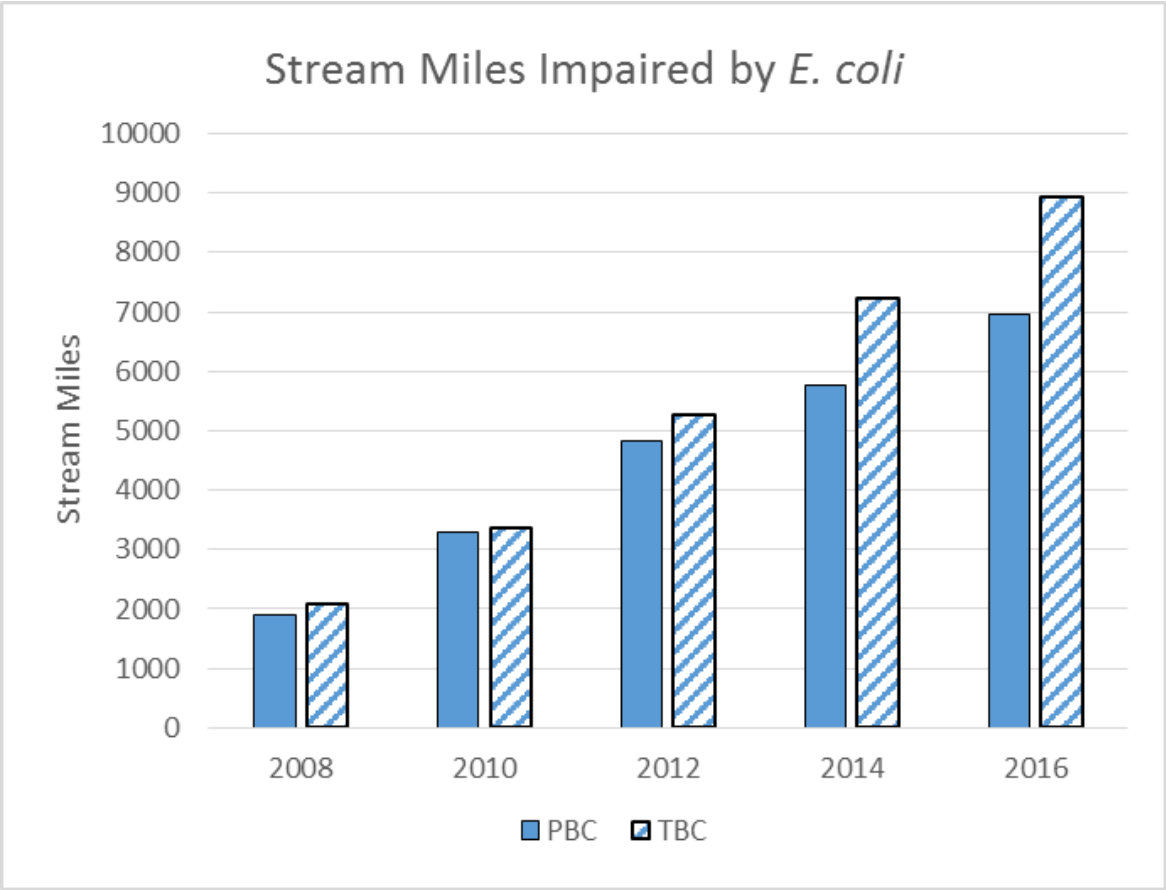


Figure 1. Changes in the number of stream miles that are category 5 (Impaired - TMDL needed) or category 4a (Impaired – TMDL completed) in successive Integrated Reports. The increase in impaired stream miles is due to increased EGLE monitoring efforts and increased use of data collected by other organizations.

2. GEOGRAPHY AND BACKGROUND INFORMATION

2.1 WATERSHEDS AND SUBWATERSHEDS (HUCS)

Watersheds are defined as the area of land (and water) that drains into a river, lake, or wetland. Watersheds are separated by a line of higher elevation land, such as a ridge or hills. HUCs are numeric watershed identifiers that were developed by the United States Geologic Survey (USGS) in order to standardize nomenclature across the nation. Larger watersheds are identified by HUCs with fewer digits in their identifier, and as watersheds are nested within larger watersheds, more digits are added. For example, Stony Creek (HUC 040500050406) is a tributary to the Maple River (HUC 04050005), which is a tributary to the Grand River (part of HUC 040500). For the purposes of this document, 8-digit HUCs will be called watersheds, and 12-digit HUCs will be called subwatersheds. In Michigan, there are 60 watersheds and approximately 1,846 subwatersheds with significant land area in the state (Figure 2). To further simplify, this TMDL groups watersheds by the region and Great Lake they drain to, hereafter called drainage units (these are modified 6-digit HUCs). All but two of Michigan's subwatersheds drain to the Great Lakes. Michigan has a relatively small amount of land that drains to the Mississippi River via the Upper Wisconsin River (in the western Upper Peninsula), and the Kankakee River (near Michigan's border with Indiana).

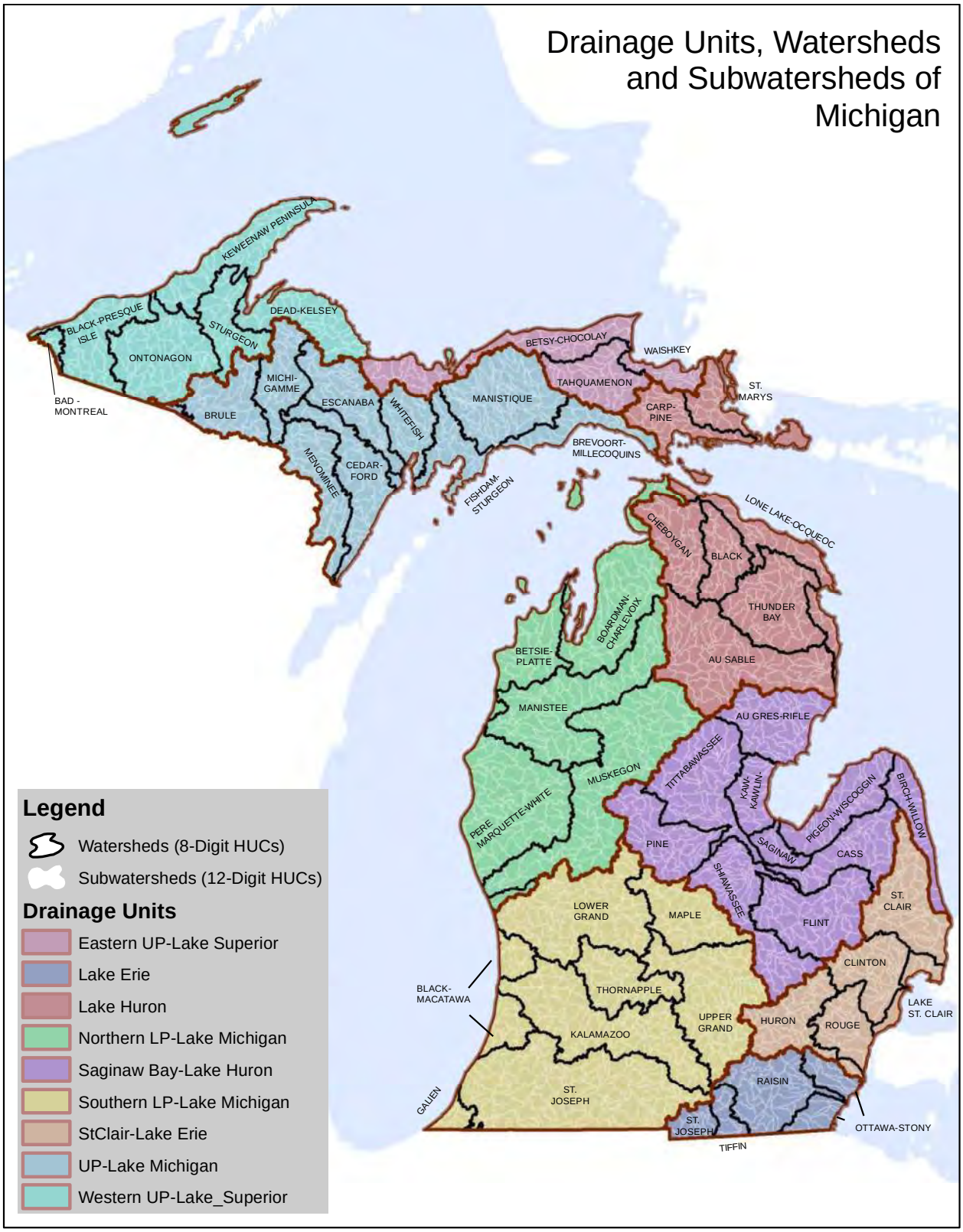


Figure 2. Drainage units, watersheds (8-digit HUCs), and subwatersheds (12-digit HUCs) of Michigan.

2.2 LAND COVER

Land cover types (defined as the physical land type, such as forest or open water) each possess their own set of challenges in terms of *E. coli* sources, and can give a cursory indication of the potential sources in a subwatershed. Watersheds in Michigan that have more agricultural land cover types tend to have higher *E. coli*, for a variety of possible reasons; correspondingly, watersheds that have more forested land cover generally have lower *E. coli* (Section 5 – Data Discussion). The modification of more natural land cover types, such as forest and wetland, for human development or agriculture does impact water quality by introducing new sources (such as septic systems and manure land-application). In addition to new sources, the hydrology of rivers may also be modified by channelization and wetland destruction. Tile-drainage in agricultural areas and increased impervious surfaces in developed areas may result in increased flow flashiness and a decrease in the ability of soils to remove *E. coli* through filtration. Flashiness is a measure of the frequency and speed of changes in stream flow following precipitation. A flashy stream will rise and fall very quickly after a rain event, while a less flashy stream will rise less and more slowly.

In the state as a whole, there is more land in natural cover types (forest and wetland) than in cultivated, pastured, or developed land combined (Figure 3). Michigan is 19 percent cultivated land, 5 percent hay/pasture, 11 percent developed, 37 percent forested, and 22 percent wetland (NOAA, 2011); however, viewing the land cover of the state as a whole can be misleading. In areas where human development is the norm, such as the southern half of the Lower Peninsula, natural cover types are much less prevalent than modified land covers such as agriculture and developed land (Figure 4). Regional variation is considerable; for example, total agricultural land cover types (includes cultivated and hay/pasture) varies from only 2 percent of land area in the Eastern Upper Peninsula – Lake Superior drainage unit, to 64 percent of land area in the Lake Erie drainage unit (Table 1). Some subwatersheds were as much as 95 percent cultivated land in 2011 (National Oceanic and Atmospheric Administration [NOAA], 2011).

An increase in cultivated land between 2001 and 2011 is occurring in some subwatersheds; the farming of row crops is growing, and this is particularly true in the Northern Lower Peninsula – Lake Michigan, Saginaw Bay, and Lake Huron drainage units (Figure 5). Other areas have seen land converted to developed land cover types, particularly the Southern Lower Peninsula–Lake Michigan and St. Clair–Lake Erie drainage units (Figure 5). Although these trends are not obvious on the drainage unit scale, some urban areas are being converted into open land and even being put to agricultural uses. While these changes are small and at the local level, they can have effects on the local water quality.

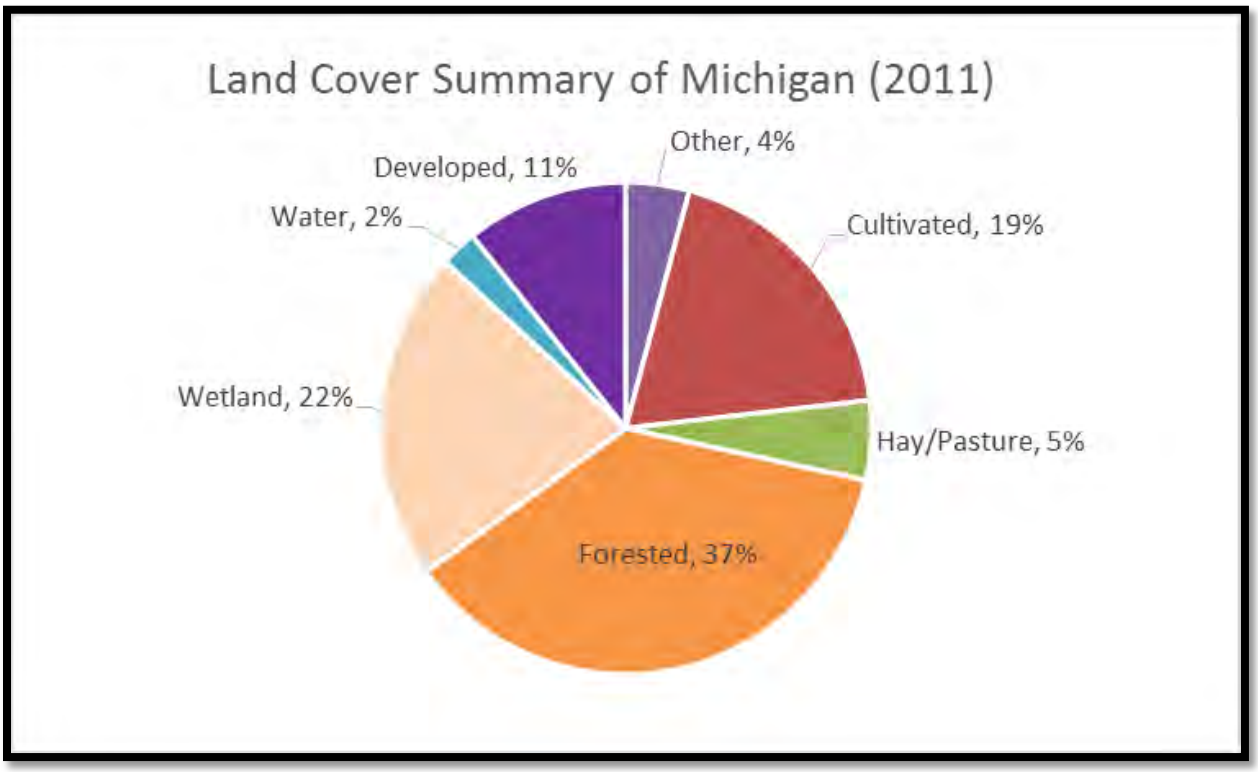


Figure 3. Generalized 2011-era land cover types in the state of Michigan (the Great Lakes are not included).

Table 1. Simplified land cover types as a percent of each drainage unit. Darker color shading indicates a higher value. High amounts of modified land covers are related to lower water quality, while higher amounts of natural land cover have positive effects on water quality (See Section 5.2).

		Highly Modified Land Covers (%)		Natural Land Covers (%)	
Drainage Unit	Area (sq. mi.)	Total Developed Land	Total Agriculture	Total Wetland	Total Forest
Lake Erie	2057	13	64	7	12
St. Clair-Lake Erie	3713	40	31	8	16
Lake Huron	6965	7	7	22	46
Saginaw Bay-Lake Huron	9160	11	47	12	22
Northern LP-Lake Michigan	9335	8	15	13	46
Southern LP-Lake Michigan	11390	14	53	12	17
UP-Lake Michigan	7768	4	4	37	44
Western UP-Lake_Superior	5399	3	3	15	71
Eastern UP-Lake Superior	2270	3	2	34	49

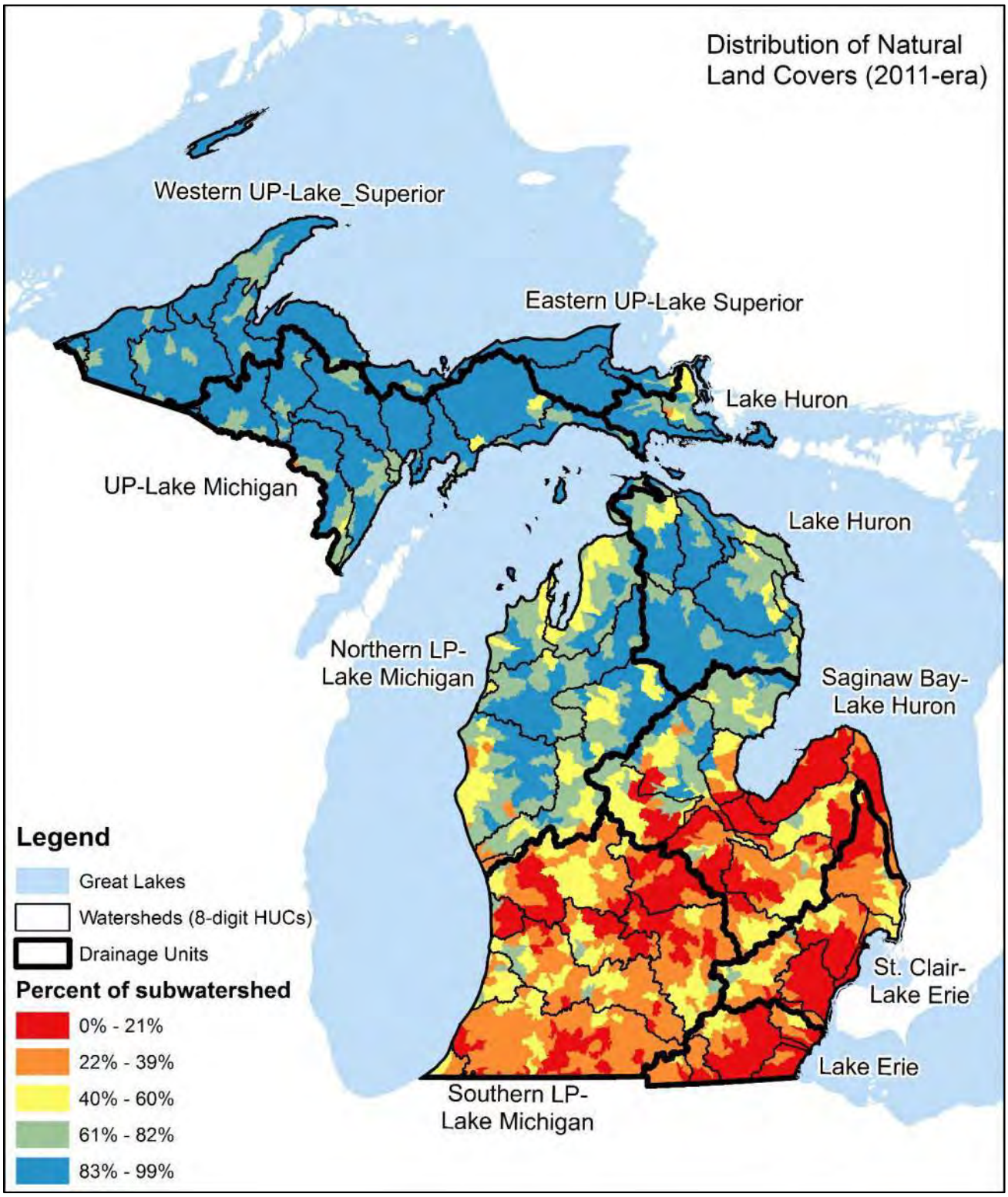


Figure 4. Natural land cover distribution (2011-era) as a percent of each subwatershed (NOAA, 2011). All forested, scrub, grassland, and wetland land cover types are included.

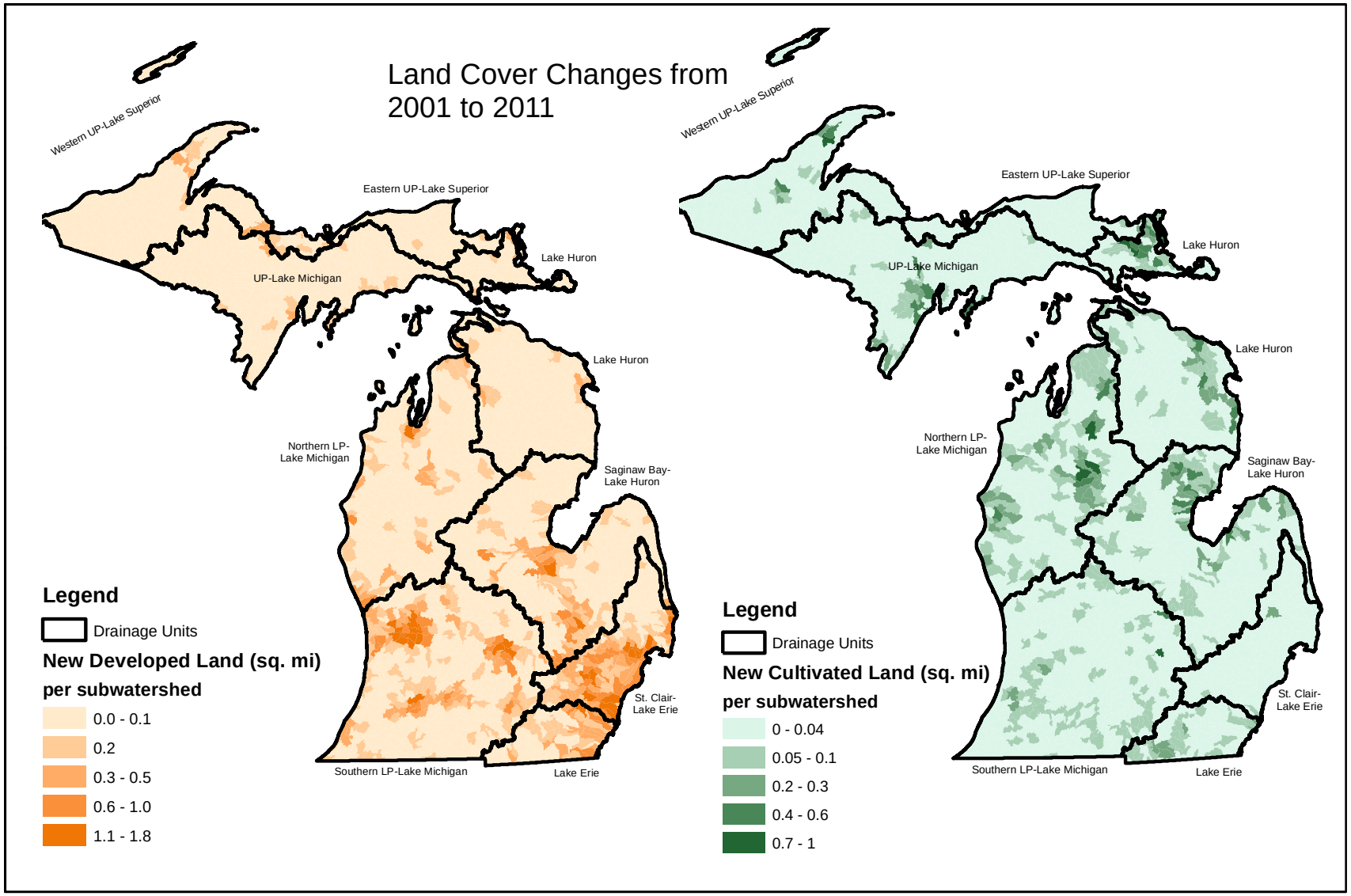


Figure 5. Changes in cultivated and developed land cover, in square miles per subwatershed, from 2001 to 2011 (NOAA, 2014). The changes are relatively small compared with the average area of a subwatershed (31 square miles).

2.3 HUMAN POPULATION

Watersheds in Michigan with higher population density generally have higher *E. coli* in surface waters, likely due to a variety of human activities (Section 5 – Data Discussion). In 2010, Michigan's population was estimated to be 9,884,000 (U.S. Census Bureau, 2012). Population density ranges from between less than one person per square mile in subwatersheds dominated by natural areas, to subwatersheds with more than 5,100 people per square mile (Figure 6). Between the years of 2000 and 2010, the overall population of Michigan fell by about 55,000 individuals (U.S. Census Bureau, 2002 and 2012), then rebounded slightly by about 5,000 individuals (U.S. Census Bureau, 2015). This hardly tells the full story. The falling population was most dramatic in the Lake St. Clair drainage unit, where the population fell by around 167,000 (Table 2). The population decrease was also notable in the Saginaw Bay – Lake Huron drainage unit (decrease of about 26,000). Between 2000 and 2014, the estimated population increased by around 112,000 in the Southern Lower Peninsula – Lake Michigan drainage unit, the area with the largest growth in human population.

Table 2. Total population and population change between 2000 and 2014 in Michigan drainage units. Data estimated from census tract level data to the nearest thousand, adapted from the 2000 and 2010 U.S. Census Bureau Decennial Census and 2014 Population Estimates (U.S. Census Bureau, 2002, 2010b, and 2015).

Drainage Unit	Census 2000	Census 2010	Estimates - 2014	Estimated Population Change
St. Clair-Lake Erie	4,511,000	4,344,000	4,344,000	-167,000
Saginaw Bay-Lake Huron	1,392,000	1,378,000	1,366,000	-26,000
UP-Lake Michigan	140,000	132,000	131,000	-9,000
Lake Huron	210,000	207,000	205,000	-6,000
Eastern UP-Lake Superior	24,000	23,000	23,000	-1,000
Western UP-Lake Superior	110,000	112,000	111,000	1,000
Northern LP-Lake Michigan	366,000	388,000	388,000	22,000
Lake Erie	637,000	660,000	661,000	24,000
Southern LP-Lake Michigan	2,548,000	2,639,000	2,660,000	112,000
Totals	9,938,000	9,883,000	9,889,000	-50,000

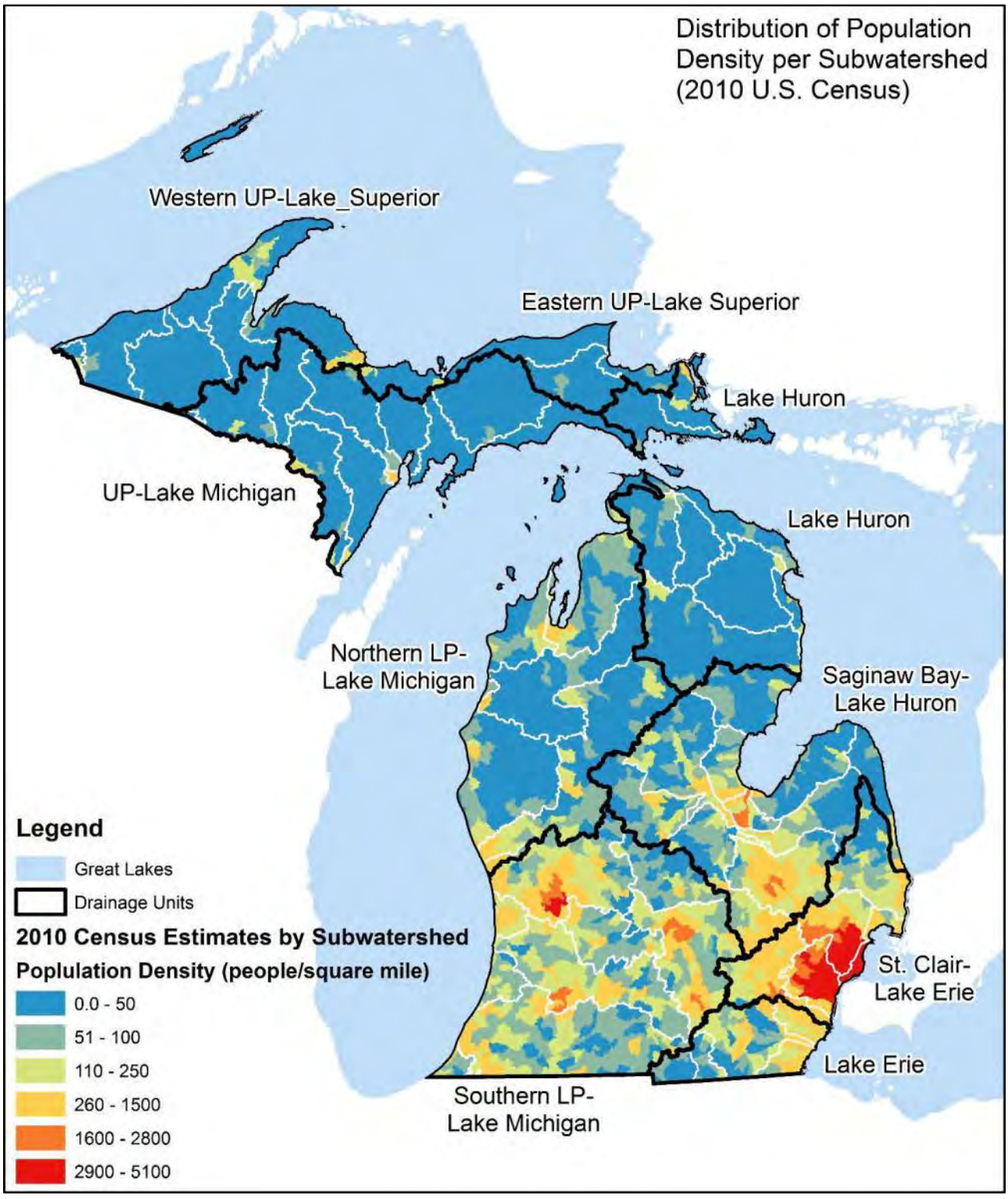


Figure 6. Population density (persons per square mile) estimates by subwatershed (Estimated from U.S. Census Bureau (2010a and 2010b).

3. NUMERIC TARGET

The impaired designated uses addressed by this TMDL are TBC and PBC recreation. The designated use rule (Rule 100 [R 323.1100] of the Part 4 Rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended) states that all water bodies be protected for TBC recreation from May 1 through October 31 and PBC recreation year-round. The target levels for these designated uses are the ambient *E. coli* WQS established in Rule 62 as follows:

R 323.1062 Microorganisms.

> Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *E. coli* per 100 milliliters (mL), as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during five or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of three 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 three or more samples taken during the same sampling event at representative locations within a defined sampling area.
>
> (2) All surface waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 *E. coli* per 100 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.

Sanitary wastewater discharges have an additional target:

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

For this TMDL, the WQS of 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum to protect the TBC use are the target levels for the TMDL reaches from May 1 through October 31, and 1,000 *E. coli* per 100 mL as a daily maximum year-round to protect the PBC use. Appendix 3 provides guidance to convert the concentration-based targets to load-based targets.

Sanitary wastewater discharges are required to meet 200 fecal coliform per 100 mL as a monthly average and 400 fecal coliform per 100 mL as a maximum. Michigan's WQS for *E. coli* are based upon criteria in the USEPA's 1986 criteria document (USEPA, 1986). Specifically, the USEPA criterion of 126 *E. coli* per 100 mL is the basis for Michigan's TBC WQS of 130 *E. coli* per 100 mL. This criterion is intended to provide a level of protection of producing no more than eight illnesses per 1,000 swimmers and approximates the degree of protection provided by the 200 fecal coliform per 100 mL bacteria standard recommended by the USEPA prior to the adoption of the 1986 criteria. *E. coli* is a subset of fecal coliform. Accordingly, the sanitary discharges are expected to be in compliance with the ambient PBC and TBC *E. coli* WQS if their National Pollutant Discharge Elimination System (NPDES) permit limits for fecal coliform are met.

4. TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by the water body while still achieving WQS. As indicated in the Numeric Target section, the targets for this TMDL are the TBC 30-day geometric mean WQS of 130 *E. coli* per 100 mL and daily maximum of 300 *E. coli* per 100 mL, and the PBC daily maximum WQS of 1,000 *E. coli* per 100 mL.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For *E. coli*, however, mass is not an appropriate measure, and the USEPA allows pathogen TMDLs to be expressed in terms of daily maximum allowable organism counts (or resulting concentration). Therefore, this TMDL is concentration-based, with a daily target consistent with R 323.1062. For the convenience of stakeholders and to meet all federal requirements, this bacterial TMDL is presented in two formats: concentrations of bacteria (*E. coli* per 100 mL), and calculations to convert the concentrations found in rivers, lakes, wetlands, and beaches into loads of bacteria.

While both formats express targets designed to attain the TBC and PBC designated uses, EGLE prefers the concentration-based TMDL format because it is more readily understandable, easier to communicate, does not rely on having good flow data or the use of models, and is universal to all water bodies. Appendix 3 describes the process of converting this concentration-based TMDL to load-based targets (*E. coli* colonies per day).

Concurrent with the selection of a numeric concentration endpoint, development of the Loading Capacity (LC) requires identification of the critical condition. The “critical condition” is defined as the set of environmental conditions (e.g., flow, loading, and other water quality parameters) that result in violation of the WQS. The existence of multiple sources of *E. coli* to a water body result in a variety of critical conditions (e.g., high flow is the critical condition for storm water-related sources and low flow is the critical condition for dry weather sources such as illicit discharges); therefore, no single critical condition is applicable for this TMDL. Expressing the TMDL as a concentration equal to the WQS, which applies during all conditions, ensures that the WQS will be met under all critical flow and loading conditions.

Load Duration Curves can assist stakeholders and EGLE in determining which critical condition applies to their water body at the time samples were collected and will be a critical part of the implementation of this TMDL. Section 6 provides stakeholders with the necessary tools to interpret Load Duration Curves during the implementation phase of this TMDL. EGLE may also assist stakeholders with this task upon request. Examples from previously approved *E. coli* TMDLs are used in Section 6 to illustrate the interpretation of WQS exceedances under various flow conditions.

4.1 LOADING CAPACITY (LC) DEVELOPMENT

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

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

The LC represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. Because this TMDL is concentration-based, the total loading for this TMDL is equal to the TBC WQS of 130 *E. coli* per 100 mL as a 30-day geometric mean, 300 *E. coli* per

100 mL as a daily maximum during the recreation season, and PBC WQS of 1,000 *E. coli* per 100 mL as a daily maximum year-round. Appendix 3 describes the process of converting this concentration-based TMDL to a load-based target (*E. coli* colonies per day). Sources that are not allowable receive an allocation (WLA or LA) of zero (e.g. sanitary sewer overflows (SSOs), leaking sewer collection systems, and illicit discharges). Federal and state regulations (not this TMDL) determine whether sources are point or nonpoint (WLA or LA); therefore, sources listed may be shifted from LA to WLA, or from WLA to LA, in the future.

4.2 WLA

WLA refers to the point source portion of the TMDL. All point sources (including NPDES permitted facilities or discharges) discharging to the TMDL area are subject to the WLA. The WLA for facilities is equal to 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum during the recreational season between May 1 and October 31, and 1,000 *E. coli* per 100 mL as a daily maximum the remainder of the year.

4.3 LA

LA refers to the nonpoint source portion of the TMDL. Because this TMDL is concentration-based, the LA for allowable sources is set equal to 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum during the recreational season, and 1,000 *E. coli* per 100 mL as a daily maximum the remainder of the year. This LA is based on the assumption that all sources, regardless of the land use, will be required to meet the WQS.

4.4 MARGIN OF SAFETY (MOS)

This section addresses the incorporation of a MOS in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality, including the pollutant decay rate if applicable. The MOS can be either implicit (i.e., incorporated into the WLA or LA through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings) (USEPA, 2001). This concentration-based TMDL uses an implicit MOS because no rate of pollutant decay was used. Pathogen organisms ordinarily have a limited capability of surviving outside of their hosts; they die and settle out of the water column, and therefore, a rate of pollutant decay could be developed; however, applying a rate of pollutant decay could result in an allocation that would be greater than the WQS, thus no rate of decay is applied to provide for a greater protection of water quality. The use of the TBC (130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL during the recreational season) and PBC (1,000 *E. coli* per 100 mL as a daily maximum the remainder of the year) WQS as a WLA and LA is a more conservative approach than developing an explicit MOS and accounts for the uncertainty in the relationship between pollutant loading and water quality.

4.5 UPSTREAM WATERS

Thirteen of Michigan's 60 watersheds originate or pass through neighboring states (Ohio, Indiana, and Wisconsin). Minnesota and Illinois also contribute drainage to Lakes Superior and Michigan, respectively. Additionally, Michigan has 12 federally recognized tribes. Flow from Canada enters Lakes Superior, Huron, Erie, and St. Clair, as well as the connecting channels (St. Marys, St. Clair, and Detroit Rivers). Appendix 1 contains a list of impaired water bodies included in this TMDL and identifies the impaired waters that directly flow across state boundaries. Permitted point sources of *E. coli* originating in other states and jurisdictions are

the responsibility of the respective authorized regulatory entities. This statewide TMDL applies only to waters of the state of Michigan.

5. DATA DISCUSSION

5.1 STATEWIDE PROBABILISTIC *E. COLI* SAMPLE COLLECTION AND ANALYSIS METHODS

EGLE's WCMP includes 250 sites, randomly selected by the USEPA, with a target population of all perennial rivers and streams within Michigan and a goal of evaluating spatial and temporal trends (Roush, 2013). These sites are sampled over a period of 5 years with approximately 50 sites sampled each year on a rotating basis. A complete description of each site can be found in EGLE report (Roush, 2013). *E. coli* was monitored as part of this program in 2009, 2011, 2012, and 2013 at 200 sites (plus 5 replicates). Three samples (left channel, center of channel, and right channel) were collected at each site once in each of the following months: May, July, September, and November. *E. coli* colonies were measured using the Colilert Quanti-Tray® 2000 method (Idexx Laboratories). This method had a minimum quantification level of 1 colony per 100 ml and a maximum quantification level of 2,419 colonies per 100 ml.

To make statements about watershed characteristics that may affect *E. coli* concentrations, a spatial analysis was conducted for each of the 200 sites (plus 5 replicates) and their watersheds (Figure 7). Spatial variables analyzed in each WCMP site watershed include human population, land cover types, livestock populations and agricultural practices (Table 3 and Appendix 4.3).

The following statistical analyses were run on the WCMP *E. coli* and watershed spatial data:

- Appendix 4.1 - Analysis of Variance (ANOVA) and Tukey Honest Significant Different (HSD) test of all *E. coli* results by sampling year.
- Appendix 4.2 - ANOVA and Tukey HSD test for all *E. coli* results by sampling month (May, July, September, and November).
- Appendix 4.3 - Correlation of site-specific *E. coli* data to watershed spatial variables (Table 3). For this analysis, several scenarios were explored. Correlations were performed using:
  - *E. coli* data vs. spatial data from each sampling month separately.
  - Pooled *E. coli* data from all months vs. spatial data.
  - Pooled *E. coli* data from TBC season sampling (May, July, and September) vs. spatial data.
- Appendix 4.4 - Correlation of *E. coli* with Prior Precipitation (24 and 48 hours).

5.2 CONCLUSIONS

- *E. coli* concentrations varied widely by year of sampling, and 2011 had the highest mean *E. coli*. (Appendix 4.1).
- *E. coli* varied significantly by the month of sampling (May, July, September, and November). July had the highest *E. coli* concentrations (Appendix 4.2). One hypothesis on why July *E. coli* concentrations are the highest statewide may be due to low flows during what is typically the hottest and driest part of the summer. In the two days prior to each sampling event, the July sampling events had the lowest precipitation. Potential sources of *E. coli* that are prominent during low flow include illicit discharges, failing septic systems, and livestock with direct access to water bodies.
- Site latitude had a strong negative correlation with *E. coli* (*E. coli* decreased to the north); however, latitude itself is not a potential source or cause of *E. coli* and thus is not used to assess sources in this TMDL. Water temperatures at the time of sampling were

negatively correlated with latitude (colder water temperatures in the north, Appendix 4.3), but the relationship between water temperature and *E. coli* was weak (Table 4).

- A strong positive correlation between *E. coli* and agricultural land covers (cultivated land and pasture/hay land cover) was found; as agricultural land covers increased, generally *E. coli* increased (Appendix 4.3); however, this correlation does not indicate that agriculture is the primary cause of the relationship. Other commonly noted attributes of agricultural rural areas that may contribute *E. coli* to surface waters include: aging/failing septic systems, illicit sanitary discharges to tile drains or direct discharges to surface water, and nuisance wildlife populations.
- Statistically, this study found that the amount of agriculture in a watershed has a stronger correlation with *E. coli* than the amount of total developed land (Table 4, Appendix 4.3). In correlations between *E. coli* and each of the subsets of developed land (open, low density, medium density, and high density), low density development had a stronger correlation with *E. coli* than medium and high density types of development (Table 4, Appendix 4.3).
- In this analysis, a strong negative correlation between *E. coli* and forested land was found; the more forested land, the lower the *E. coli*. This relationship was also examined using forested land in a 30-meter buffer surrounding surface waters, but the relationship of *E. coli* to forested buffers was weaker than the relationship found using the overall amount of forested land in the watershed (Table 4, Appendix 4.3).
- While precipitation prior to a sampling event likely causes a local increase in the *E. coli* concentration in many cases, our dataset did not show a strong relationship statewide. This is likely because this study was not designed to test precipitation-related hypotheses (a maximum reporting limit of 2,419 *E. coli per* 100 mL was used, and relative to the large sample size, few rain events were captured by chance (Appendix 4.4).

Table 3. Summary of land cover (percent of watershed) and other watershed characteristics (spatial variables) in *E. coli* WCMP watersheds (n=202, interstate waters removed).

Variable	Units	Mean	Min.	Max.
Natural Riparian Buffers	% of 30-meter buffer area	62.5	0.8	99
Agricultural Land (All types)	% of watershed area	34.5	0.0	89
Forested Land (All types)	% of watershed area	32.2	1.4	99
Developed Land (All types)	% of watershed area	10.0	0.2	92
Developed Land - High Density	% of watershed area	0.3	0.0	9
Developed Land - Med Density	% of watershed area	1.0	0.0	21
Developed Land - Low Density	% of watershed area	3.3	0.0	37
Developed Land - Open	% of watershed area	5.4	0.2	32
Wetland (All Types)	% of watershed area	17.5	0.0	77
Lost Wetlands (Since Presettlement)	% of Presettlement Wetland Area	24.3	0.0	98
Population Density	People/square mile	141	0.0	2704
Septic System Density	Systems/square mile	24.2	0.3	187
Tiled Agricultural Land	% of watershed area	8.6	0.0	82
Agriculture Land with Manure Applied	% of watershed area	2.8	0.0	14
Watershed size	Square Miles	62.0	0.4	1364

Table 4. Results of Pearson's Correlations between normalized *E. coli* WCMP results by site and spatial variables for each sites' watershed. The higher the absolute value of the Pearson's Correlation, the stronger the linear relationship between variables. All P-values were <0.01.

Variables (Normalized)	Units	Pearson's
Natural Riparian Buffer (30 M)	% of 30-meter buffer area	-0.52
Agricultural Landcover (all types)	% of watershed area	0.58
Forested Landcover (all types)	% of watershed area	-0.63
Developed Landcover (all types)	% of watershed area	0.29
Developed Land - High Density	% of watershed area	0.24
Developed Land - Med Density	% of watershed area	0.25
Developed Land - Low Density	% of watershed area	0.41
Wetland (all types)	% of watershed area	-0.18
Lost Wetland	% of Presettlement Wetland Area	0.31
Population Density	People/square mile	0.53
Septic System Density	Systems/square mile	0.46
Tiled Agricultural Land	% of watershed area	0.52
Agriculture Land with Manure Applied	% of watershed area	0.51
Site latitude	Latitude (decimal degrees)	-0.64
Water Temperature	Celcius	0.30

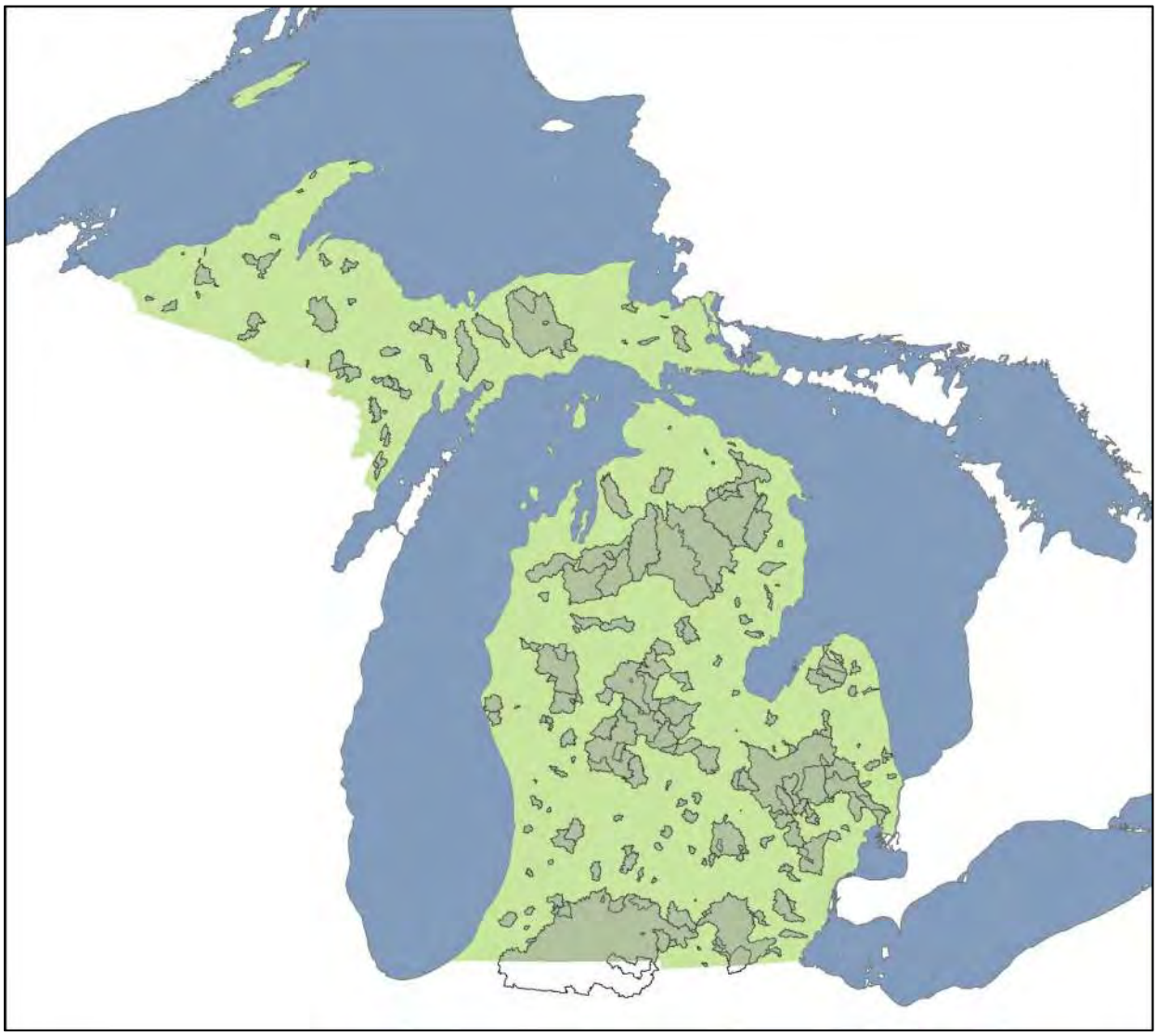


Figure 7. Watersheds for spatial analysis of probabilistic WCMP sites where *E. coli* was monitored.

6. INTERPRETING *E. COLI* DATA

6.1 USING PRECIPITATION DATA

Noting precipitation prior to *E. coli* sample collection can help to determine the critical conditions that cause *E. coli* to exceed the WQS in a particular water body; e.g., if a water body is contaminated under all conditions, or just under certain conditions such as after heavy rain. Collecting precipitation totals from the day, or days, prior to the sampling event is as easy as finding a local weather data-collection station such as those used by airports, media outlets, universities, and agricultural extension agencies. Small tributaries, or tributaries that are highly modified by channelization, storm sewer inputs, impervious surfaces, or agricultural drainage may only reflect high *E. coli* for a short time after the runoff precipitation event occurs. The pulse of surface runoff immediately following a rain event is called the 'first flush,' and typically contains high levels of *E. coli.* Depending on the hydrology of the stream and watershed characteristics (such as artificial drainage and soil type), the *E. coli* in surface water could remain elevated for hours or even days after the first flush. In a small or flashy stream, the *E. coli* could rapidly decrease to levels typical of that measured in baseflow conditions.

In the following examples, *E. coli* monitoring was conducted for 16 weeks in tributaries to the Flint River (Rippke, 2011). The stream sites were analyzed separately due to significant differences in the size of the watersheds and resulting flow, which would have an effect on the timing of the first flush of *E. coli* following a rain event. Figure 8 shows larger tributaries, while Figure 9 shows smaller ones. The larger tributaries to the Flint River exceed the WQS frequently, but a massive rain event of 3 inches in the prior 24 hours had a dramatic effect on the *E. coli* at all sites (Figure 8). The same storm event caused a similar increase in *E. coli* at the small tributaries, but Site FR2 (represented by the pink line on Figure 9) was elevated during the dry periods between rain events, indicating a dry weather source. An illicit connection from a group housing facility was later identified by the local health department, and the issue has been resolved.

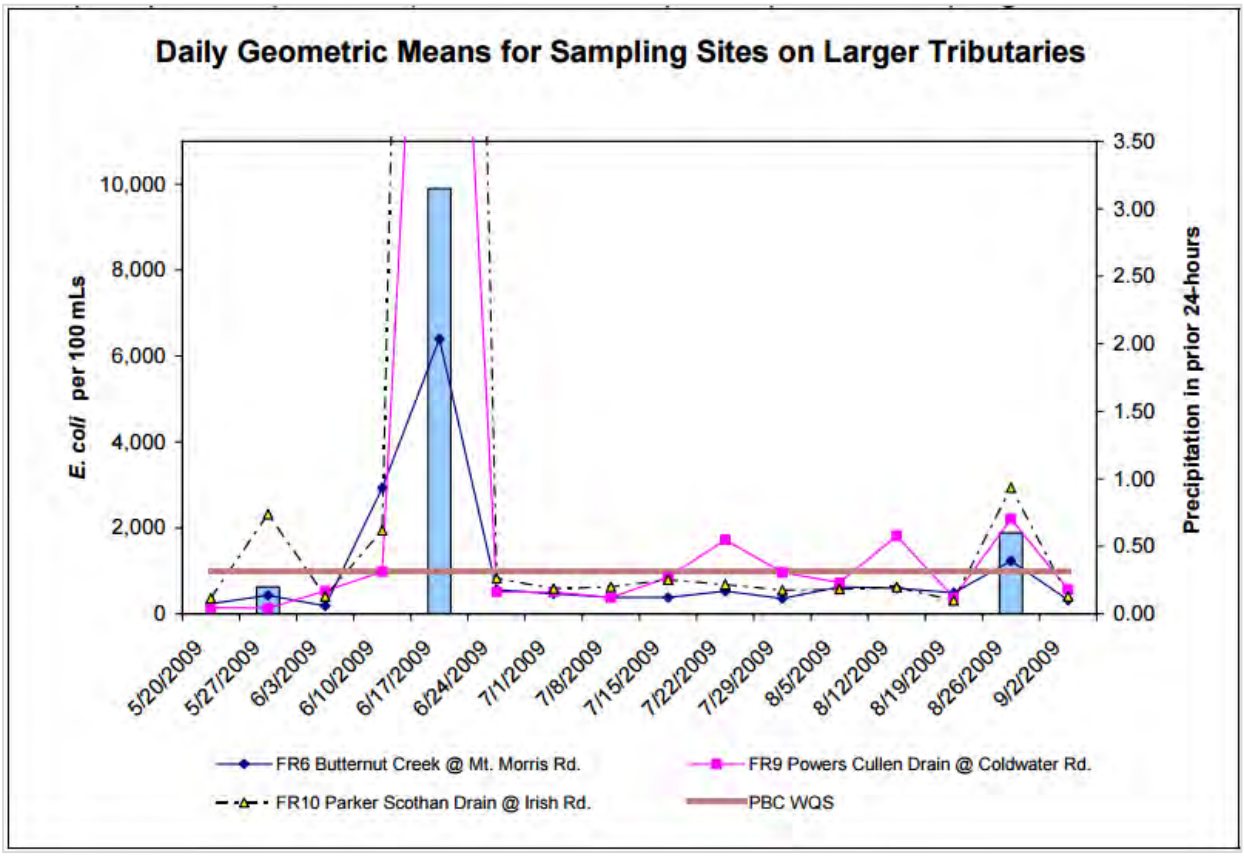


Figure 8. Rainfall data prior to sample collection (blue bars) is useful to help interpret large spikes in *E. coli* concentrations, as seen here in tributaries to the Flint River.

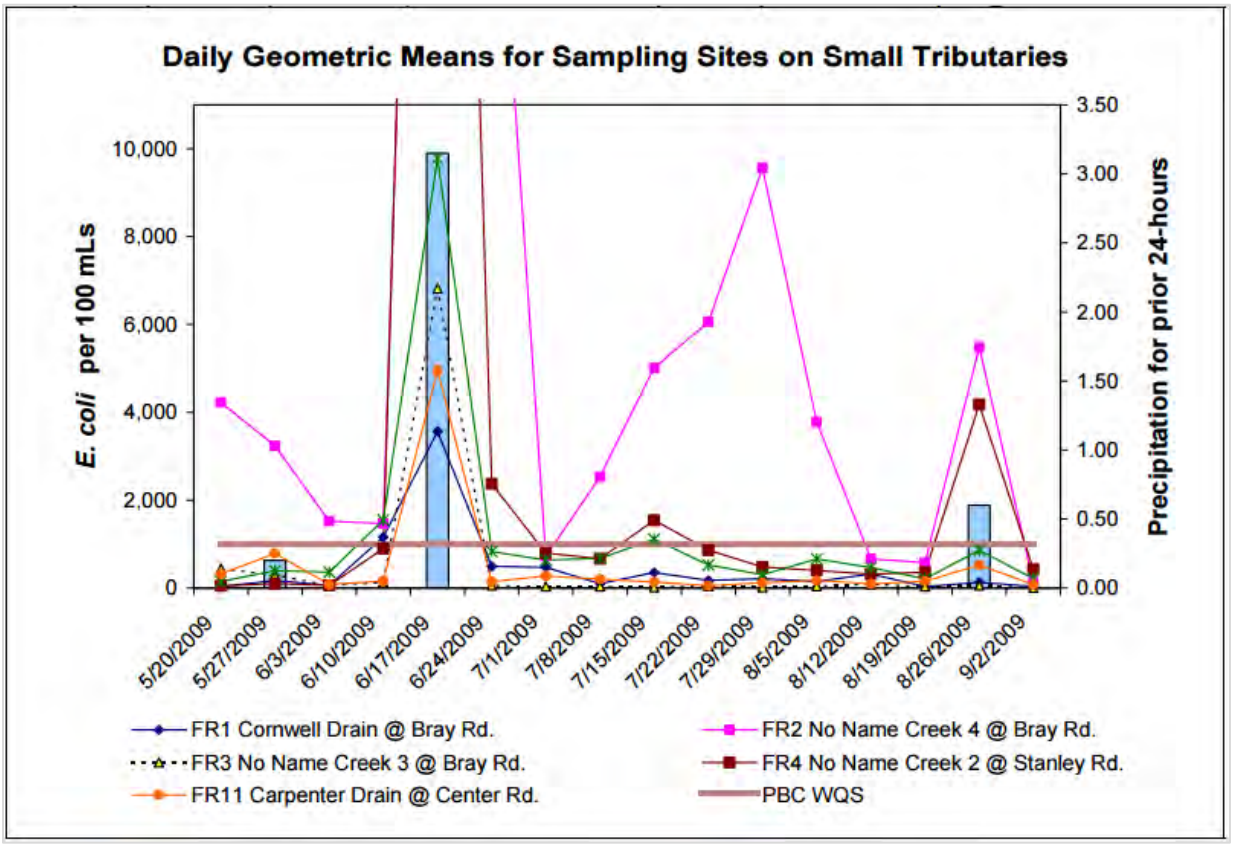


Figure 9. Precipitation falling in 24 hours prior to sample collection (blue bars) in smaller tributaries to the Flint River shows that while most sites are exceptionally high after rainfall, one site (FR2) is high even during dry weather.

6.2 LOAD DURATION CURVE ANALYSIS WITH EXAMPLES FROM PREVIOUS TMDLS

To assist in determining potential sources to TMDL water bodies for previous watershed-based TMDLs approved by the USEPA, EGLE conducted a load duration curve analysis for all TMDL water bodies between the years 2006-2013. For the purposes of this TMDL, covering all *E. coli* impaired water bodies in Michigan, load duration curve development was not practical, and the large amount of data needed to produce a quality product was not available. In the future, EGLE will continue developing load duration curves in areas determined to be a priority (as resources allow) and will assist stakeholders in their efforts upon request.

6.2.A What is a Load Duration Curve?

A load duration curve considers how stream flow conditions relate to a variety of pollutant sources (point and nonpoint sources). The load duration curves for each site show the flow conditions that occurred during sampling and can be used to make rough determinations of the critical flow conditions that result in exceedances of the WQS. On each load duration curve, flows associated with exceedances of the daily maximum TBC and PBC WQS are indicated where data points are above the red and blue curved lines, which represent the water quality load targets. Complete details on the development of load duration curves can be found in "TMDL Development from the "Bottom Up" – Part II: Using Duration Curves to Connect the Pieces (Cleland, 2002).

Two components are needed to create a load duration curve: concentrations of the pollutant (*E. coli*), and flows recorded on the sampling dates when the pollutant was measured. Details and recommendations for each component are discussed below:

E. coli Component: For the *E. coli* data component, ideally, the data for each event would be the geometric mean of three grab samples collected at the same site. The use of single sample data, or composite samples collected during an event could also be used by stakeholders to get a sense of data patterns but could not be compared to the WQS according to Rule 62. Each load duration curve shows data from only one site or location. Data pooling from different sites is generally not recommended because the flow at different sites, even along the same stream, may vary. Data could span the entire length of the study, and multiple years. More data points result in more powerful load duration curves. As few as ten data points can tell a story, but more data points are easier to interpret, and lend more confidence to the results. With fewer than ten data points, the response of *E. coli* to flow changes may be difficult to interpret. Using precipitation data (instead of flow) may be preferable.

Flow Component: USGS gauges provide the best and most reliable source of flow data. These gages have a long period of record for flow measurements to use as a basis for determining relative flow conditions, also known as flow duration intervals (low flow, high flow, dry conditions, etc.). Flow duration data are daily mean flow values measured over a specified time interval that have been exceeded various percentages of the time. For example, a 5 percent exceedance probability represents a high flow that has been exceeded only 5 percent of all days of the flow record. Conversely, a 95 percent exceedance probability would characterize low flow conditions in a stream, because 95 percent of all daily mean flows in the record are greater than that amount.

For tributaries without a USGS gauge, correlations and models are available to estimate the flow in the tributary using data from the nearby gauge using drainage area ratios and local watershed and hydrology characteristics. When monitoring data are collected, it may be beneficial to collect water level elevation data on each sampling event for later interpretation. Relative water level elevation is a measure of water depth in the channel, determined by measuring the distance from a fixed point (such as a culvert edge) to the water's surface using a weighted tape. Staff gauges can also be used to record relative water levels.

6.2.B Interpreting Load Duration Curves

A load duration curve helps to identify flow conditions that cause an increase in *E. coli* pollution (critical conditions). Exceedances of the *E. coli* WQS that occur during high flows are generally linked with rainfall events, such as surface runoff contaminated with fecal material, a flush of accumulated wildlife feces in runoff or storm sewers (regulated and unregulated), trash from the storm sewers or septic tank failures involving failing drainage fields that no longer percolate properly (surface failures). Exceedances that occur during low flows or dry conditions can generally be attributed to a constant source that is independent of the weather. Examples of constant sources include illicit discharges (either directly to surface waters or to storm sewers), some types of on-site septic system failures, continuous NPDES discharges, groundwater contamination, and pasture animals with direct stream access. Groundwater contamination of surface water with *E. coli* can occur in areas where a high groundwater table overlaps with septic systems, or in areas where livestock or animal waste is allowed to accumulate in groundwater recharge areas. Load duration curves are most informative in a water body that does not exceed the WQS consistently.

6.2.B.i Wet Weather Problems: Examples from Real Streams

The following example from the Red Run Drain *E. coli* TMDL shows a tributary area with a clear wet weather problem (Figure 10) (Lipsey, 2006). This is a more common occurrence on large rivers, such as in the Grand River (Figure 11), which almost always meets the daily maximum TBC, except following rainfall and resulting higher flows (Rippke, 2012).

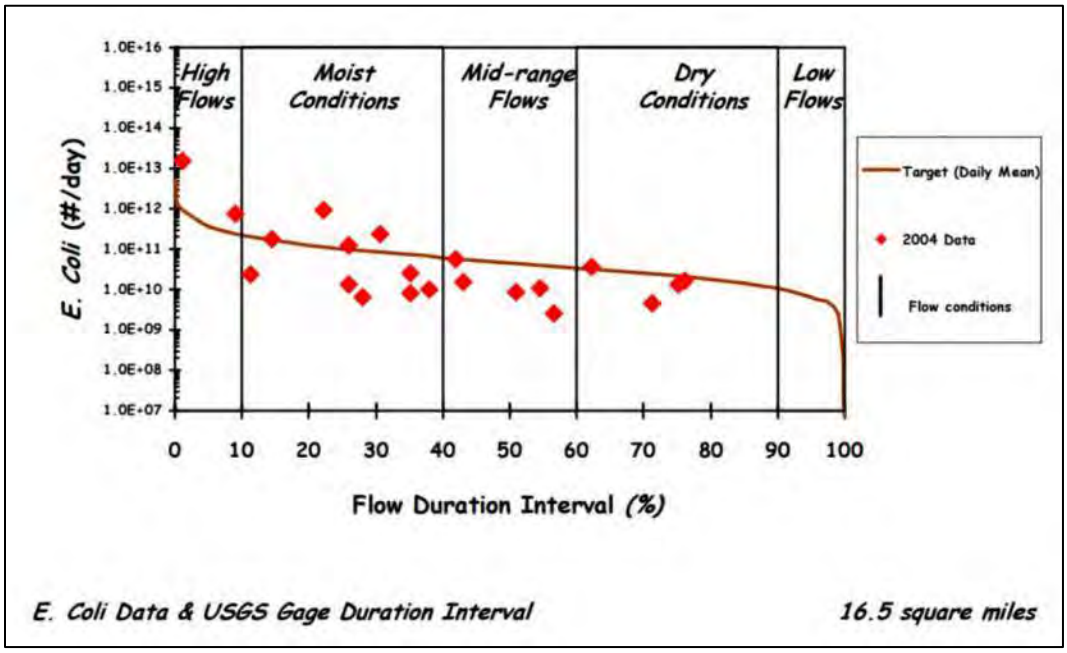


Figure 10. Load duration curve from the Red Run Drain, showing pattern of exceedances generally occurring at higher flows, indicating wet weather sources (Lipsey, 2006).

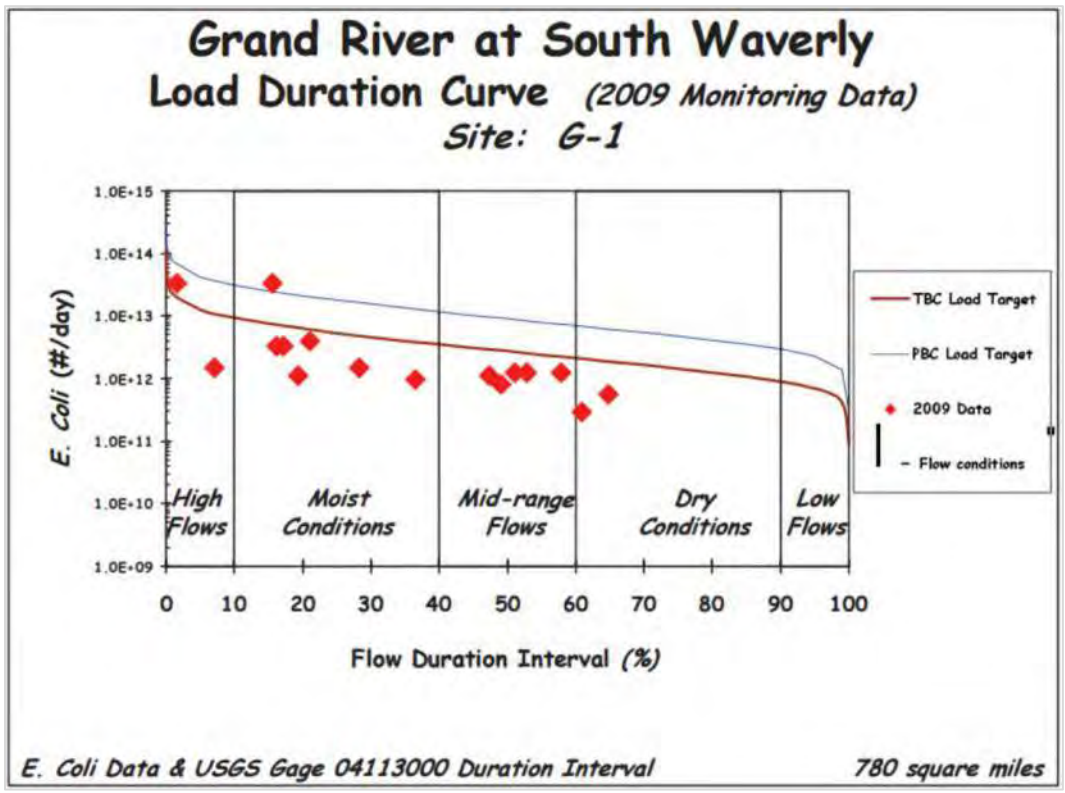


Figure 11. This load duration curve using 16 sampling events from the Grand River shows exceedance of the TBC and PBC designated uses only occur at higher flows (Rippke, 2012).

6.2.B.ii Dry Weather Problems: Examples from Real Streams

Water bodies with only a low flow or dry condition *E. coli* problem are rare in the experience of EGLE. During a particularly dry year, a full summer of weekly sampling may not capture high flows at all, as is the case in Figure 12. In this case, the *E. coli* concentrations and loads were the highest at the lowest flows. In Figure 12, the low flow exceedances were determined to be caused by a dry weather source; failing septic systems from an unsewered village and associated illicit discharges near Smiths Creek (Rippke, 2009). Knowing the conditions during which exceedances occur can help to direct efforts and resources appropriately. In this case, EGLE had evidence of failing septic systems apart from this data. If that evidence were lacking, an additional year of data where higher flow conditions are captured may provide a more complete picture of the dynamics between flow and *E. coli.* A sanitary sewer has recently been extended to serve the Smith's Creek area.

In another example of lower flow exceedances (Figure 13), sampling events spanned most of the possible flow duration interval categories with the exception of the 'low flow' (90-100 percent exceedance flows). The *E. coli* exceedances occurred during dry conditions (60-90 percent exceedance flows), and generally met the WQS at high flows and moist conditions. This is a rare pattern, where the source of *E. coli* is likely being diluted during higher flows. It is important to note that in a particularly dry period of sampling, the flows may still be relatively low even after a significant rain event. In this case, precipitation data are invaluable to provide a complete understanding of *E. coli* sources under different conditions.

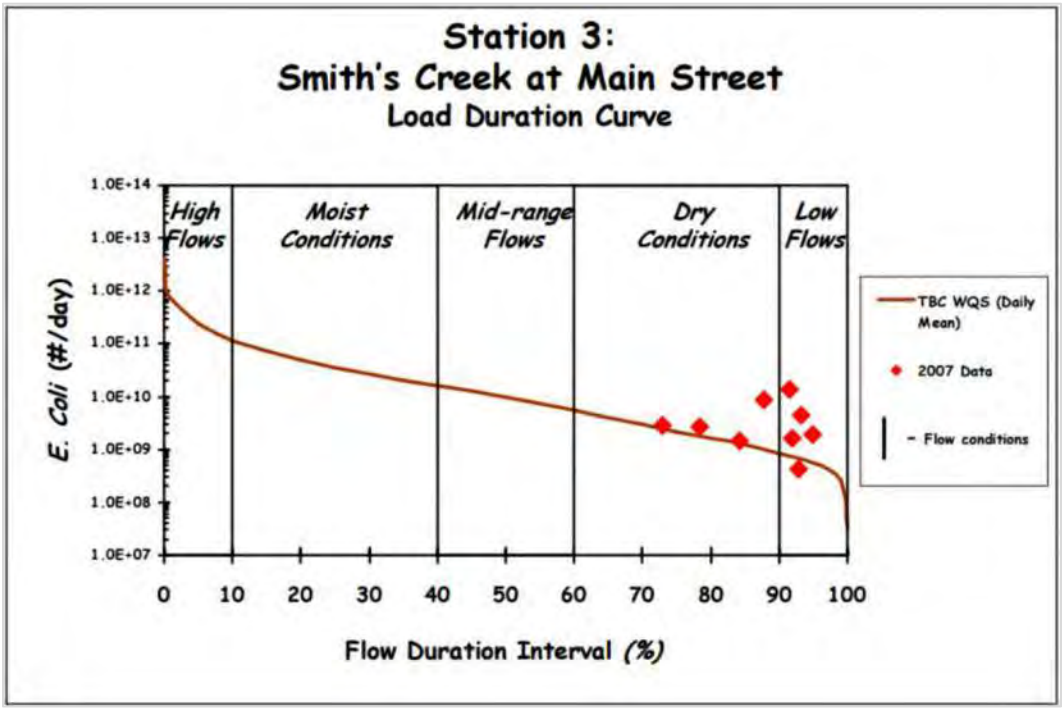


Figure 12. Load duration curve for a TMDL area with exceedances at low flows, but no higher flow events were sampled due to dry weather. Despite this, *E. coli* was generally higher at the lowest flows sampled. Sources were determined to be illicit discharges and failing septic systems.

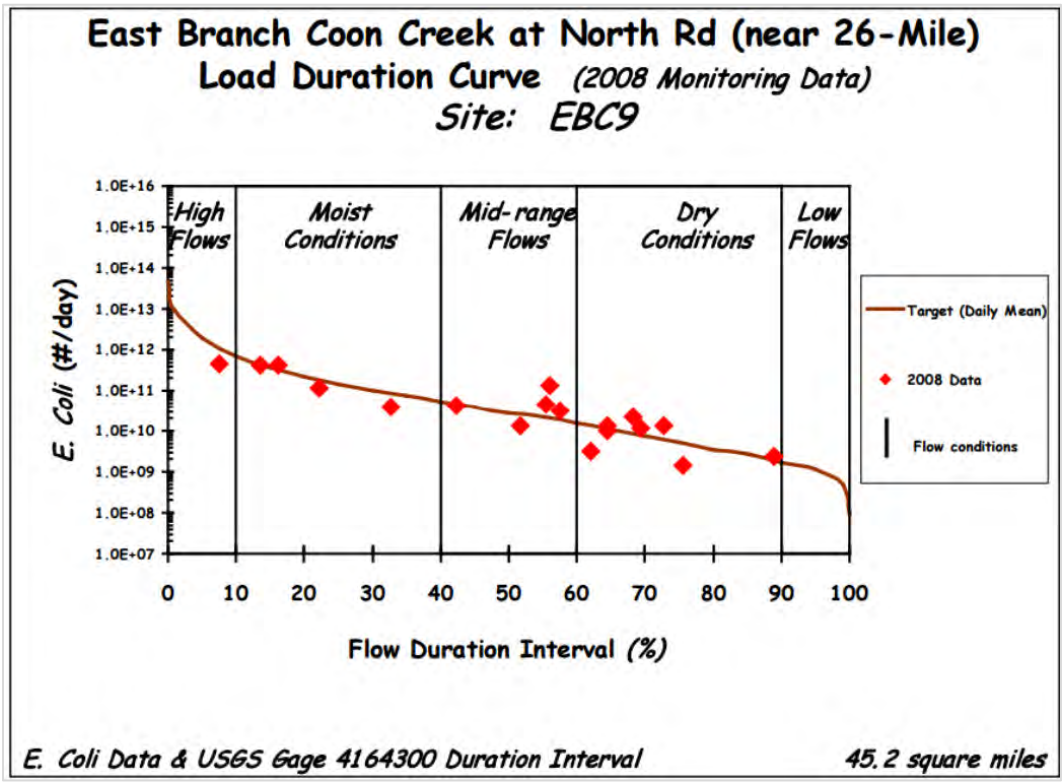


Figure 13. Sampling for this water body occurred during most flow conditions, and most exceedances occurred in the dry conditions range, indicating a constant source that is likely diluted during higher flows.

6.2.B.iii Problems under All Flow Conditions: Examples from Real Streams

A third scenario for a load duration curve interpretation is a water body that has high *E. coli* under all conditions sampled, and always exceeds the WQS, as in Figure 14 and 15. This generally indicates that the watershed has wet weather sources, such as livestock-related runoff, and dry weather sources, such as illicit discharges or failing septic systems. This is a commonly seen pattern throughout smaller tributaries in parts of rural agrarian Michigan. In Albrow Creek (Figure 15), a small tributary in a rural area of Jackson County, a community with multiple failing septic systems was identified as a source and was later corrected (Lipsey, 2007). More recent microbial source tracking results showed that horses were also a source and may be a cause of the wet weather issues (EGLE data, unpublished).

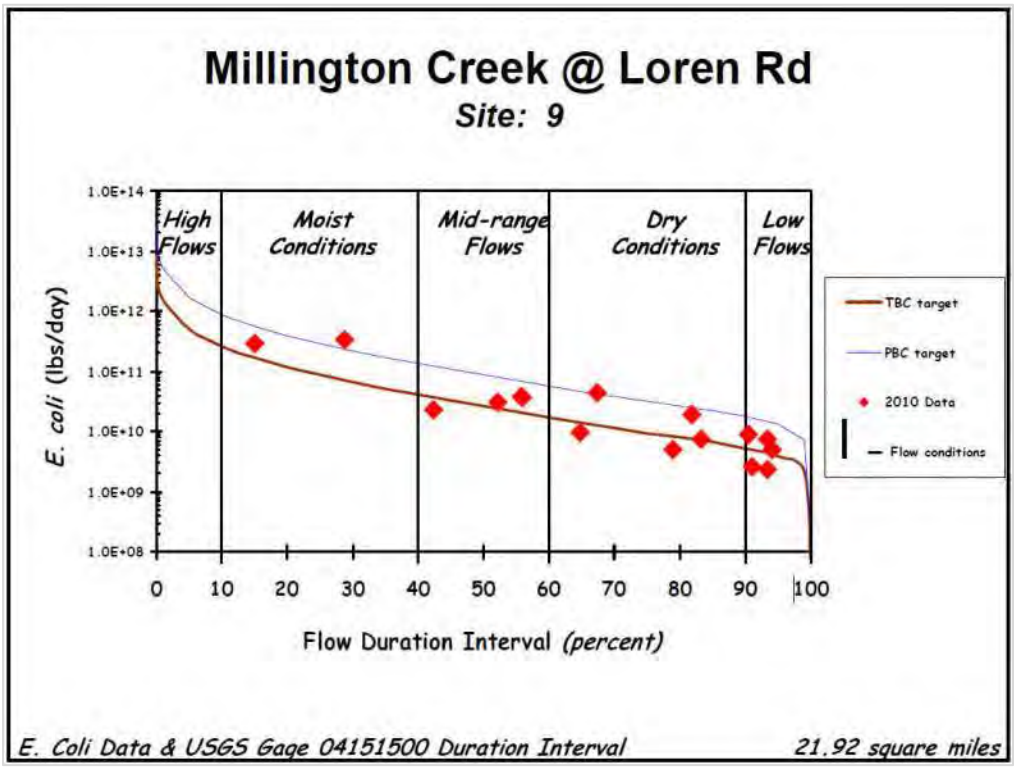


Figure 14. Load duration curve showing exceedances of the TBC WQS under all flow conditions that were sampled (Rippke, 2013).

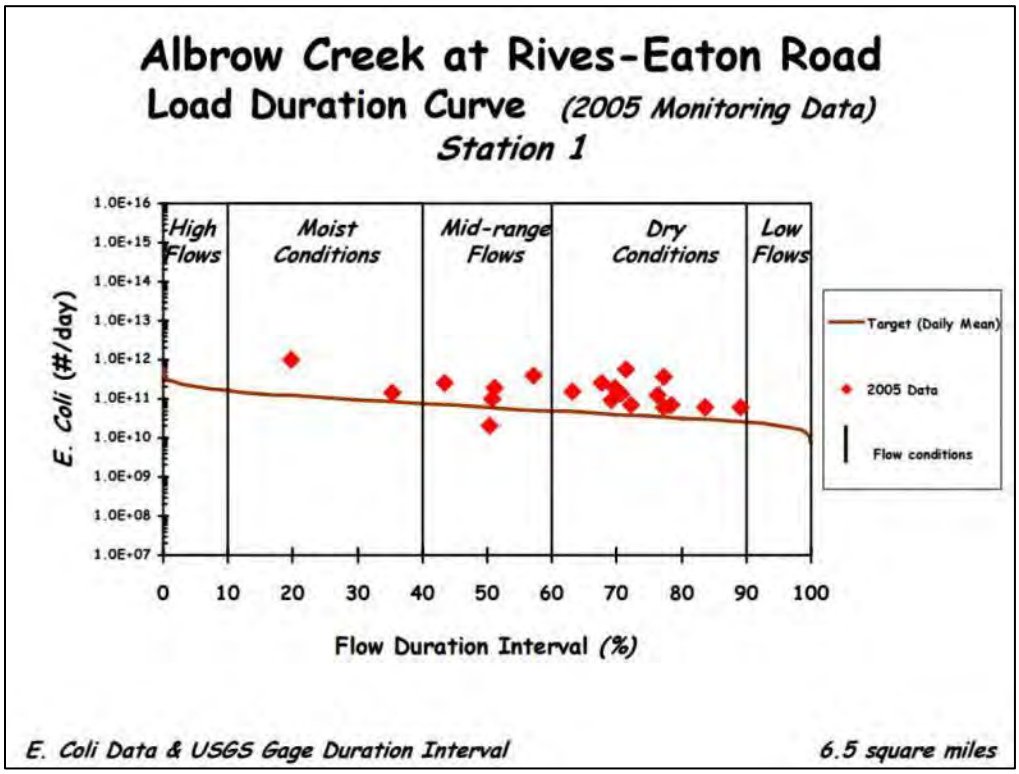


Figure 15. Load duration curve showing exceedances of the TBC WQS under all flow conditions sampled (Lipsey, 2007).

7. SOURCE ASSESSMENT (SA) AND REASONABLE ASSURANCE (RA)

This section of the TMDL describes the potential sources of *E. coli* throughout the state and Reasonable Assurance (RA) activities for each one. RA activities are ongoing or potential actions that can be or are being implemented to address the problem; these include local and state regulations, voluntary efforts, and best management practices (BMP). In the point and nonpoint source sections of this TMDL (7.3 and 7.4), the Source Assessment (SA) discussion is called 'Potential Sources' and the RA discussion is called 'Potential Solutions.' Additionally, in this section, you will find statistics and maps that show the distribution of these potential sources and implementation of the solutions across the state. For a more local view of sources, see Section 7.1 (Knowing your Watershed).

In general, there are three types of sources: point, nonpoint, and illegal. Illegal sources are not subject to NPDES permits. This TMDL does not make a final or official determination of whether a source is regulated as a point source; this determination is made using state and federal regulations. Point sources, for the purpose of discussion in this TMDL, are sources that are regulated by NPDES permits. Pollutants discharged directly or indirectly into waterways from wastewater sources are regulated by NPDES permits. Some types of storm water are also regulated by NPDES permits. Potential point sources of *E. coli* include: municipal separate storm sewer systems (MS4), industrial storm water, wastewater treatment facilities, concentrated animal feeding operations (CAFO), CSOs, and biosolids land-application.

Nonpoint sources of *E. coli* contamination include any source that is not regulated by an NPDES permit, and not contributing to a discharge regulated by an NPDES permit, including: failing septic systems, septage land application, sanitary groundwater discharges, manure land applications to agricultural fields, and pet and wildlife waste. Additionally, certain types of storm water and livestock operations below a certain size (non-CAFO) may not be regulated by NPDES permit, and are therefore potential nonpoint sources of *E. coli*. Eliminating nonpoint source pollution is a critical task for EGLE given that most of the remaining water quality impacts in Michigan are caused, at least in part, by these sources. Permits to discharge pollutants from nonpoint sources are not issued by EGLE, but this does not mean they are unregulated nor does it give anyone the right to cause a water quality problem or exceedance of the WQS. Septic systems serving individual residences, for example, are primarily regulated by the county health departments (see Section 7.4.B), and livestock issues that affect surface water can be reported to EGLE or Michigan Department of Agriculture and Rural Development (MDARD) through the Right to Farm process (see Section 7.4.A).

Illicit discharges are also potential sources, but are considered separately from point and nonpoint sources in this TMDL. Illicit discharges, including illicit sanitary discharges, barn wash water, and SSOs are prohibited and must be eliminated by the responsible agency, individual, or municipality. Illicit discharges are not part of the WLA or LA of this TMDL.

Each potential source is discussed separately, in Section 7.3 (NPDES Discharges), Section 7.4 (Nonpoint Sources), and Section 7.5 (Illegal Sources), along with RA activities that are specific to that source. These discussions and maps summarize the issues for the whole state. To get a closer view of a specific watershed, an online mapping interface will provide a subwatershed perspective of sources (see Section 7.1).

As a supplement to this TMDL and as implementation guidance, EGLE is providing success stories related to *E. coli* TMDLs (available on Michigan.gov/EcoliTMDL). Success stories include instances of complete remediation of the *E. coli* impairment by the elimination of sources, but also examples of gradual progress shown through data and installation of best management practices (BMP) for nonpoint sources.

7.1 KNOWING YOUR WATERSHED

Some nonpoint sources of *E. coli* are fairly universal across areas that humans have developed for agriculture, commercial, or residential use though they can vary significantly in magnitude depending on local watershed characteristics. Knowing your watershed characteristics is vitally important to understanding and fixing an *E. coli* water quality problem. Sections 7.3 and 7.4 provide an overall statewide summary of each point and nonpoint source of *E. coli*. To assist stakeholders with locating sources in subwatersheds upstream of their homes, paddling destinations, fishing spots, and beaches, EGLE is providing online TMDL supplemental resources, including an interactive mapping interface and guidance on conducting watershed inventories. The mapping interface will allow stakeholders to interact with maps of point sources and indicators of nonpoint sources (such as census population information, land cover types, and hydric soils). All of these resources are available from EGLE *E. coli* TMDL Web site (Michigan.gov/EcoliTMDL).

The mapping interface includes many of the spatial datasets used to create maps for this TMDL, including:

- Locations of NPDES permitted facilities, including industrial storm water dischargers, CAFOs, biosolids land application sites, and wastewater treatment facilities. This information is updated annually in the interface. More detailed information, such as discharge monitoring reports and compliance history, can be found on the MiWaters Site Explorer.
- Land cover information, updated when new data are released.
- Water bodies that are impaired by *E. coli*, updated every two years to reflect changes in the 303(d) (impaired waters) list.
- USEPA approved *E. coli* TMDL watersheds (individual and statewide).
- Waters directly affected by uncontrolled CSOs.
- U.S. Census population information, updated every 10 years.
- Lost wetland area (areas with high wetland restoration potential).
- Municipalities and counties with time-of-sale septic inspection ordinances.
- Septage land-application areas and municipalities where septage land-application is prohibited by local ordinance.
- Urbanized areas that are subject to MS4 regulation according to state and federal regulations.
- Approximate number of on-site septic systems in the subwatershed.
- Local watershed councils and environmental organizations (that EGLE is aware of).
- Section 319 approved Watershed Management Plans.

Information on NPDES permit compliance by site, results of discharge monitoring, permit limitations and requirements, and enforcement actions may be found on the MiWaters Site Explorer. MiWaters Site Explorer is an interactive mapping interface designed to display information about permitted facilities and 'sites.' Sites in MiWaters Site Explorer can be entities (such as a municipality or business) without an NPDES permit, where EGLE actions are occurring to address an issue, or a permit application has been received but not yet issued. Some of these issues may be related to *E. coli* sources such as administrative actions taken to address SSOs or other illicit raw sewage discharges.

7.2 INFORMATION FOR NPDES PERMITTEES

This TMDL does not include a list of specific NPDES permitted facilities included in the WLA (see Section 4.2). The determination of whether a discharge is included in a TMDL is completed by EGLE staff at the time of permit issuance or reissuance. For planning purposes, NPDES permittees may use the MiWaters Site Explorer or the interactive mapping interface

available on Michigan.gov/EcoliTMDL, to assist in determining if they discharge to an impaired waterbody or are included in a USEPA approved TMDL watershed.

7.3 NPDES DISCHARGES

NPDES permitted discharges are point sources regulated by EGLE to maintain the quality of surface water. There are three types of NPDES permits: individual permits, general permits and permit by rule. Staff of EGLE, Water Resources Division (WRD), determine the appropriate permit type for each surface water discharge.

- An individual NPDES permit is site specific. The limitations and requirements in an individual permit are based on the permittee's discharge type, the amount of discharge, facility operations (if applicable), and receiving stream characteristics.
- A general permit is designed to cover permittees with similar operations and/or type of discharge. Locations or situations where more stringent requirements are necessary require an individual permit. Facilities that are eligible to be covered under a general permit receive a Certificate of Coverage (COC).
- "Permit by rule" denotes that permit requirements are stated in a formally promulgated administrative rule. A facility requiring coverage under a permit by rule must abide by the provisions written in the rule. Instead of applying for an NPDES permit, the facility submits a form called a Notice of Coverage (NOC).

NPDES individual permits, and COCs are reissued every five years on a rotating schedule, and the requirements within the permits (outlined below) may also change at reissuance. Pursuant to R 323.1207(1)(b)(ii) of the Part 8 Rules, Water Quality-Based Effluent Limit Development for Toxic Substances, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), and 40 CFR, Part 130.7, NPDES permits issued or reissued to facilities discharging to impaired waters after the approval of this TMDL are required to be consistent with the goals of this TMDL (described in the WLA Section [4.2]).

EGLE staff inspect or audit NPDES-permitted facilities approximately once every five years. At the time of these audits, EGLE staff review permits, permittee actions, submittals, and records to ensure that each permittee is fulfilling the requirements of its permit. Consistency of the permit with the TMDL, and any potential deficiencies of the facility, are reviewed and addressed as part of the audit and permit reissuance processes.

Potential point sources of *E. coli* include: MS4s, CSOs, industrial storm water, wastewater treatment facilities, CAFOs, and biosolids land-application. It is not expected that the General Permits for the discharges of municipal potable water supply, mining, noncontact cooling water, swimming pool wastewater, or hydrostatic pressure test water would be sources of *E. coli* due to the nature of the discharges and because the discharge of *E. coli* is not authorized by the permits.

Online Resources:

- Michigan's general NPDES permits, contact staff, or general information may be found at: Michigan.gov/EGLENPDES.
- Michigan's MiWaters portal will allow you to view details associated with a particular COC, NPDES permit, or CSO/SSO discharge and may be found at: miwaters.deq.state.mi.us.
- EGLE's Storm Water Program staff and information may be found at: Michigan.gov/EGLEStormwater.

7.3.A MS4s

7.3.A.i Potential Sources (SA):

Storm water is runoff from rain or snow-melt. In urban communities, storm water often enters into pipes and roadside ditches or flows directly across roads and parking lots before entering surface water. An urban landscape prevents much of the storm water runoff from soaking into the ground due to impervious surfaces like building roofs and pavement, leaving pollutants to be carried untreated to surface waters. As storm water flows across the developed landscape and through pipes and drains, it becomes contaminated by pet and wildlife waste, trash, and other pollutants. Sometimes sewage from homes and businesses comes into contact with the storm water because the plumbing is improperly connected to the storm sewer, rather than entering the sanitary sewer. This situation is called an illicit connection to storm sewers, and they are illegal under all circumstances (Section 7.5).

Municipalities with a regulated MS4 (e.g., separated storm sewer pipes, parking lots, public roads, and roadside ditches) located within an urbanized area with a discharge to surface waters are required to have the MS4 permit. These permits are generally issued to counties, cities, townships, universities, public school systems, airports with public areas, and state agencies. Urbanized areas are defined by the U.S. Census Bureau and updated after each major population census, every ten years (Figure 16). When new census results are released, the new urbanized areas may be added to the previous area. This means that as urbanized areas grow over time, new MS4 permittees are identified and issued permits in accordance with EGLE regulations, but the regulated areas never shrink. Some areas within the MS4 permitted municipality may not be subject to permit requirements; for example, townships often own or operate a regulated MS4 on small parcels of property (e.g., township hall or library), and are only regulated if that property is part of the urbanized area. If a municipality is located in an urbanized area, but is found to have no storm sewer outfalls that enter surface water, a permit may not be required.

Cities, villages, and townships are required to have their own MS4 permit. Other municipal entities may have their own MS4 permit, or they may be included (“nested”) in the MS4 permit of another municipal entity (such as a school district that is nested within an MS4 permitted city).

Like other types of storm water, potential sources of *E. coli* from these MS4s include illicit sanitary discharges to storm sewers, and contaminated runoff during storm events. Contamination of runoff can be from pets, feral animals, nuisance wildlife (especially those that are attracted to human habitation, such as raccoons), improper garbage disposal (such as diapers or cat litter), and failing septic systems (such as failures that result in seepage to the storm sewer).

7.3.A.ii Potential Solutions (RA):

EGLE issues individual permits to authorize discharges of storm water from a regulated MS4 to surface waters of the state. The application format guides the development of a Storm Water Management Program (SWMP) by requiring BMPs be identified that will be implemented during the permit term. The application and SWMP is reviewed by EGLE and the proposed decision is public noticed for 30 days in the form of a draft permit. Once these documents are approved by EGLE as part of permit issuance, the MS4 permittee is required to implement and enforce the SWMP during the permit term to the maximum extent practicable and protect water quality in accordance with appropriate requirements.

Under the MS4 individual permit, all permittees are required to reduce the discharge of pollutants (including *E. coli*) from their MS4 to the maximum extent practicable through the development and implementation of a Public Involvement and Participation Program, a

storm water-related Public Education Program, an Illicit Discharge Elimination Program (IDEP), a post-construction Storm Water Control Program for new development and redevelopment projects, a Construction Storm Water Runoff Control Program, and a Pollution Prevention/Good Housekeeping Program for municipal operations.

The IDEP requirements of the permits have great potential to reduce *E. coli* levels in impaired water bodies. The IDEP requires permittees to develop a program to find and eliminate illicit connections and discharges to their MS4. This includes a plan to conduct dry-weather screening of each MS4 outfall and point of discharge at least once every five years (unless an alternative schedule or approach is approved by EGLE). If an *E. coli* TMDL is identified in the notice letter to apply for permit coverage, the applicant must submit a TMDL Implementation Plan as part of the application. Upon issuance of an MS4 individual permit, the permittee is required to implement the approved TMDL Implementation Plan with the goal of reducing the discharge of *E. coli*. The permittee is required to demonstrate that they are making progress in meeting WQS as part of the TMDL Implementation Plan. EGLE will evaluate the implementation status of the permittee's approved TMDL Implementation Plan and progress towards meeting the water quality standard (TMDL goal) as part of the approved SWMP. Requirements in future MS4 permit revisions may be different, but must be consistent with the goals of this TMDL.

The individual MS4 permits discharging to a USEPA-approved *E. coli* TMDL area are required to implement prioritized BMPs to be consistent with the requirements and assumptions of the TMDL and TMDL Implementation Plan. By prioritizing BMPs, permittees are able to focus their efforts, which will help to make progress towards meeting Michigan's WQS. To demonstrate progress, permittees are required to monitor the effectiveness of the BMPs during the permit term. MS4 permittees may choose to work collaboratively on the TMDL Implementation Plan to address an *E. coli* impairment. Collaborative efforts may provide an opportunity to work with watershed or regional partners in a cost-effective manner.

The Michigan Department of Transportation (MDOT) statewide MS4 permit requires the reduction of the discharge of pollutants to the maximum extent practicable and employment of BMPs to protect water quality. In their current permit (as of 2017), the MDOT has electively chosen to apply their MS4 permit requirements to their MS4 statewide (including state roads, rights of way, and facilities), regardless of the urbanized area delineation.

The individual MS4 permits, EGLE approved TMDL Implementation Plans, and compliance information may be found on the MiWaters Site Explorer (see 'online resources' in Section 7.3).



Figure 16. Urbanized area according to the combined 2000 and 2010 United States Census. Municipalities in these areas may be subject to applicable MS4 regulations. The extent of the area is updated with every decennial census. This layer can be viewed using the interactive map, found at Michigan.gov/EcoliTMDL.

7.3.B Industrial Storm Water

7.3.B.i Potential Sources (SA):

Federal regulation (40 CFR, Part 122.26) requires that facilities apply for industrial storm water permit coverage if the storm water runoff discharges to surface waters of the state after being exposed to industrial materials or areas of industrial activity. This requirement also includes facilities that discharge storm water runoff indirectly to surface waters of the state via a private or municipal storm sewer system, which conveys storm water. Industrial Storm Water permit coverage is issued to regulate storm water originating from regulated industrial sites, including: factories, food processors, transportation facilities that conduct maintenance on their equipment, airports, and landfills. The decision on which facilities must be regulated is based on the primary industrial activity conducted at the facility and federal regulation. The 11 categories described in the regulations are identified by Standard Industrial Classification codes, or by narrative description of the industrial activity.

The authorization to discharge storm water from areas of industrial activity in Michigan is granted through: a general permit, a general permit with special use areas, or a site-specific individual permit. General permits with special use areas and site-specific individual permits are issued in special cases depending upon the type of industrial materials and industrial activities the storm water has been exposed to, or the contaminants that are expected to be present in the storm water.

Like other types of storm water, potential sources of *E. coli* from Industrial Storm Water facilities include illicit sanitary connections and contaminated runoff during storm events. Contamination of runoff can be from feral animals, wildlife attracted to the industrial activity (such as raccoons and seagulls), or improper garbage disposal (such as open, overflowing, or leaking dumpsters). Contamination can also come from industrial byproducts associated with food processing and wood.

There are about 2,900 Industrial Storm Water permitted discharges in Michigan (personal communication with Jeffrey Jones, MDEQ, March 5, 2015). Around 85 percent of these are covered by the general permits, and the remaining are individual permits that have industrial storm water discharges (Table 5). These numbers are expected to fluctuate considerably as industries come and go. Industrial storm water facilities tend to be clustered in urban areas, but some are located in a more rural setting (Figure 17). Most of these facilities have minimal risk of discharging *E. coli* in quantities that exceed the WQS. But because of the nature of some industries, some storm water systems are particularly at risk for *E. coli* contamination, including; landfills, trash incinerators, and parking lots for recycling and garbage hauling trucks. The open land and food opportunities at landfills may attract nuisance wildlife, such as large flocks of seagulls, and refuse hauling facilities occasionally have issues with leaking storage. Michigan currently has about 53 active landfills or refuse handling systems under the industrial storm water general permit, and more included under the individual permits.

Table 5. Approximate distribution of facilities covered by the industrial storm water general permit and facilities with industrial storm water discharges permitted under an individual NPDES permit (estimates include pending, in effect, and extended permits. Source: MiWaters database, 2015).

Drainage Unit	Industrial Stormwater COCs	Other Permits with Stormwater Coverage
Western UP-Lake Superior	50	8
Eastern UP-Lake Superior	7	2
UP-Lake Michigan	60	8
Southern LP-Lake Michigan	700	62
Lake Huron	60	7
Saginaw Bay-Lake Huron	490	44
St. Clair-Lake Erie	1140	54
Lake Erie	90	18
Northern LP-Lake Michigan	100	14

7.3.B.ii Potential Solutions (RA):

Once a TMDL is established, facilities with a discharge of storm water that contains *E. coli* in quantities that exceed the WQS are required by their permit to implement control measures so that the discharge is reduced to meet the targets set by the TMDL (Section 4.2). The general permit for industrial storm water or individual permits issued for industrial storm water specify that facilities need to obtain an Industrial Storm Water Certified Operator who will have supervision over the facility's storm water treatment and control measures included in the Storm Water Pollution Prevention Plan (SWPPP). The facility is also required to eliminate any unauthorized non-storm water discharges, and develop and implement the SWPPP for the facility. When the USEPA approves a TMDL for the receiving water, the COC issued immediately following the TMDL approval will identify the applicable approved TMDL(s). The permittee shall assess whether the TMDL requirements for the facility's discharge are being met through the existing SWPPP controls or whether additional control measures are necessary. Appropriate control measures to reduce *E. coli* are specific to the identified source of the contamination; for example, if leaking trash bins are identified as a problem, the control could include a proposal to replace the leaking bins or collect, treat, or properly dispose of the contaminated leachate. EGLE's assessment of whether the TMDL requirements are being met shall focus on the effectiveness, adequacy, and implementation of the permittee's SWPPP controls.

Information on NPDES general industrial storm water permits may be found on the MiWaters Site Explorer (see 'online resources' in Section 7.3).

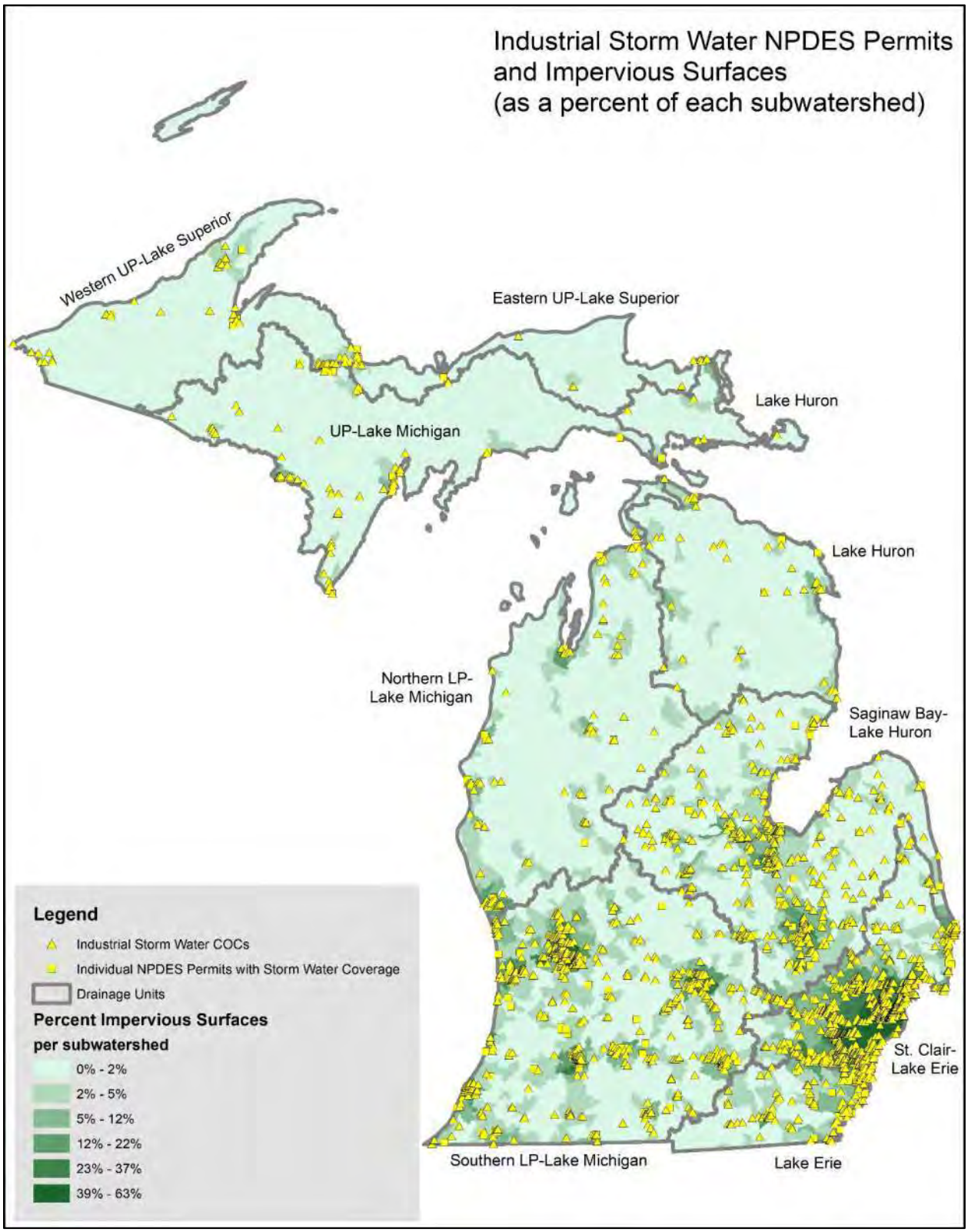


Figure 17. Industrial storm water COCs, individual NPDES permits with storm water coverage, and percent imperviousness of each subwatershed. These facilities tend to be clustered in urban areas where impervious surfaces are common.

7.3.C Wastewater Treatment Plants (WWTPs) and Wastewater Stabilization Lagoons (WWSLs)

7.3.C.i Potential Sources (SA):

Treated sanitary surface water discharges from WWTPs are not expected to contribute to exceedances of the WQS because they are subject to permit limitations consistent with the ambient WQS; however, older infrastructure (such as the collection system) may be a source of *E. coli* (see Section 7.5.A).

In 2015 there were 542 NPDES permitted WWTPs, WWSLs, and other sanitary discharges in Michigan discharging to surface water (MiWaters database, access date: November 19, 2015). Thirteen percent of the total number of wastewater treatment facilities serve small private mobile home communities, subdivisions, or condominiums. These numbers will fluctuate as previously unsewered towns build their own treatment facilities, and some communities abandon their own in favor of contributing to a nearby facility. The distribution of these permits (by type) is in Table 6.

Table 6. Treated sanitary wastewater NPDES discharges by permit type (MiWaters database, access date: November 19, 2015).

Permit Types		Number of Permits or COCs
General Permit for Wastewater Stabilization Lagoon (MIG580000)		232
General Permit for Secondary Wastewater Treatment (MIG570000)		22
Individual (Standard or Non-Industrial Sanitary Wastewater)	Combined Sewer Overflow and Retention Basin	20
	Wastewater Stabilization Lagoon	18
	Wastewater Treatment Plants	250
	Total Individual	288

7.3.C.ii Potential Solutions (RA):

Michigan regulates discharges containing treated or untreated human waste (i.e., sanitary wastewater) using fecal coliform as the indicator. Sanitary wastewater discharges are required to meet 200 fecal coliform per 100 mL as a monthly average and 400 fecal coliform per 100 mL as a maximum. As discussed in the Numeric Target section (Section 3), the sanitary discharges are expected to be in compliance with the ambient PBC and TBC *E. coli* WQS if their NPDES permit limits for fecal coliform are met. All WWTPs provide year-round disinfection, providing another level of confidence that the WQS for *E. coli* will be met.

WWSLs are not required to provide active disinfection of their effluent; however, all WWSL discharges under general permit MIG589000 must monitor their effluent for bacteria (typically fecal coliform is used as an indicator) and receive EGLE approval prior to beginning a discharge. WWTP and WWSLs may elect to use an indicator other than fecal coliform, such as *E. coli*, if the alternate indicator is protective of water quality and EGLE approves the change. During discharge, monitoring for fecal coliform occurs the first day and every other day after the first day of discharge. Discharge is generally prohibited between January 1 and

February 28/29, and from June 1 through September 30. This summer discharge prohibition corresponds with the bulk of the total body contact season (May 1-October 31). EGLE's statewide probabilistic *E. coli* study found that the highest *E. coli* concentrations generally occur in July, during the period when WWSLs are prohibited from discharging (Section 5.2 and Appendix 4.2), providing further assurance that WWSLs are not a significant source of impairments.

Additionally, under the authority of Part 41, Sewerage Systems, of the NREPA, Michigan has regulatory oversight for the planning, construction, and operation of public wastewater facilities (Michigan.gov/Part41). This includes design review of proposed treatment components, including disinfection systems, for adequacy to meet established permit limits and design standards. Upon determination that proposed facilities are adequate, issuance of a construction permit follows. This part also covers WWTP classification and operator certification requirements, along with requirements for the proper operation and maintenance of wastewater facilities.

Information on NPDES and groundwater discharge general and individual permits may be found on the MiWaters Site Explorer (see 'online resources' in section 7.3).

7.3.D Concentrated Animal Feeding Operations (CAFO)

7.3.D.i Potential Sources (SA):

CAFOs are animal production facilities (farms) that raise large numbers of animals for meat, dairy products, eggs, or even companion animals (horses). Pursuant to Michigan Administrative Code, R 323.2196, CAFOs are point sources that require NPDES permits for discharges or potential discharges unless a No Potential to Discharge Determination is issued by EGLE. These No Potential to Discharge Determination facilities may be a potential source of *E. coli* in the future because the determination status can be revoked if a discharge should occur.

CAFOs are defined by Michigan Administrative Code, Part 21, R 323.2102. Rule 2196(3) provides that EGLE may designate animal feeding operations (AFOs) as CAFOs upon determination that the AFO is a significant contributor of pollutants to waters of the state. Some factors that EGLE may consider in designating an AFO as a CAFO include size of the operation, amount of wastes and wastewaters discharging into waters of the state, means of conveyance of the waste, and other factors affecting likelihood or frequency of discharges into waters of the state.

There are 263 active or pending CAFO permits in Michigan as of 2015 (personal communication with Mike Bitondo, Permits Section, MDEQ, March 4, 2015). About 88 percent of the in-effect permits are covered under an NPDES general permit (221 facilities). Of those remaining, about 11 percent have individual NPDES permits (28 facilities), and less than 1 percent have "No Potential to Discharge Determination" status (14 facilities). Below is a breakdown of the number of facilities, by animal type (effective March 4, 2015):

CAFO Type	Number of CAFO Facilities
Dairy	118
Swine	106
Beef	15
Chickens	20
Turkey	11
Heifers	4
Mixed	1
Veal	1

These facilities produce and manage large amounts of manure that must be used or disposed. Waste that is land-applied as fertilizer by the CAFO operator is subject to regulation by the NPDES permit. Waste that is manifested (sold or given away) to another entity is no longer regulated by the CAFO permit. Manure with a high commercial value, such as that originating from poultry, is most often sold and generally not land-applied in the vicinity of the CAFO facility. Manures with lower commercial value, such as cattle and sometimes hog manure, are more often manifested or land-applied by the CAFO in the vicinity of the originating facility to minimize fuel costs involved in moving the manure.

At this time, all CAFOs are located in the Lower Peninsula, and south of Grand Traverse County (Figure 18). If current climate and economic trends continue, CAFOs may extend farther northward with the spread of cultivated land (see Section 8.2).

7.3.D.ii Potential Solutions (RA):

The NPDES CAFO permits (individual and general) contain several measures designed to prevent *E. coli* from entering surface waters from the production area, waste (manure) storage sites, and manure land application sites. At production facilities and associated manure storage sites, the permit requires properly designed, constructed, and maintained manure storage structures in order to prevent discharges. To minimize the occurrence of precipitation-related overflows, these structures must be designed to store at least six months of generated production area waste, with additional reserve capacity for normal and design-storm precipitation, and the required freeboard amount. Discharges from such overflows at properly designed, maintained, and operated structures are not allowable if they cause or contribute to a violation of WQS. All discharges due to overflows from storage structures at new swine, poultry, or veal facilities are prohibited. All manure storage structures must be inspected once per week by the CAFO operator, providing assurance against overflow and potential structural damage. The CAFO permit states that direct contact of animals with the surface waters of the state is prohibited at the production area, and the disposal of dead animals shall not contaminate surface waters.

The CAFO permit requires the development of a Comprehensive Nutrient Management Plan (CNMP) as well as annual reviews and reports. As of 2015, CNMPs do not specifically address *E. coli*, but by addressing nutrients contained in manure, these plans indirectly assist in controlling the amount of *E. coli* entering surface water. The CNMP is designed to prevent over-application of manure by requiring CAFO operators to plan and record manure applications on an ongoing basis. The CNMP requires the submission of maps to identify land application areas and reports on the quantities and types of manure applied. The permit requires an assessment of land application areas prior to land application, including the condition of all tile outlets, observations of soil cracking, moisture holding capacity of the soil, crop maturity, and the condition of designated conservation practices (i.e., grassed waterways, buffers, diversions). During land application of waste, a set-back surrounding waterways and other sensitive areas is required to minimize potential contamination of waterways with manure. The set-back may be replaced with a managed vegetated buffer where no land application can occur. After any land application of manure, tile outlets must be inspected. If an inspection reveals a discharge with color, odor, or other characteristics indicative of an unauthorized discharge of CAFO waste, the permit instructs the permittee to immediately notify EGLE. CAFO waste may not be land applied if the field is flooded or saturated, it is raining, or if rain above a set amount is predicted with a set probability of occurrence. To help minimize contaminated runoff, CAFO waste on tillable fields must be injected or incorporated into the ground within 24 hours of application. The land application of CAFO waste where it cannot be incorporated due to no-till practices and may enter surface waters of the state, is prohibited. The application of CAFO waste to frozen or snow-covered fields without incorporation is only allowed after a specific field-by-field demonstration is completed, and only on fields or portions of fields where the runoff will not flow

to surface waters. The CAFO permit requirements summarized above are designed to minimize the contamination of surface water by CAFO-generated waste by providing record keeping, inspection, and land-application requirements and guidance.

EGLE is currently developing further guidance for CAFO facilities that are located, or that land-apply, in *E. coli* TMDL areas.

The CAFO permit requirements discussed in the preceding paragraphs are applicable to facilities operating under the 2010 general permit (March 2010 to April 2015) and the current 2015 general permit (March 2015 to April 2020). Future versions of this permit, and provisions specific to individual CAFO facilities and permits can be found on the MiWaters (see 'online resources' in Section 7.3). EGLE CAFO Web site contains staff contact information, rules, and guidance for CAFO operators, and is accessible through Michigan.gov/EGLEnpdes.

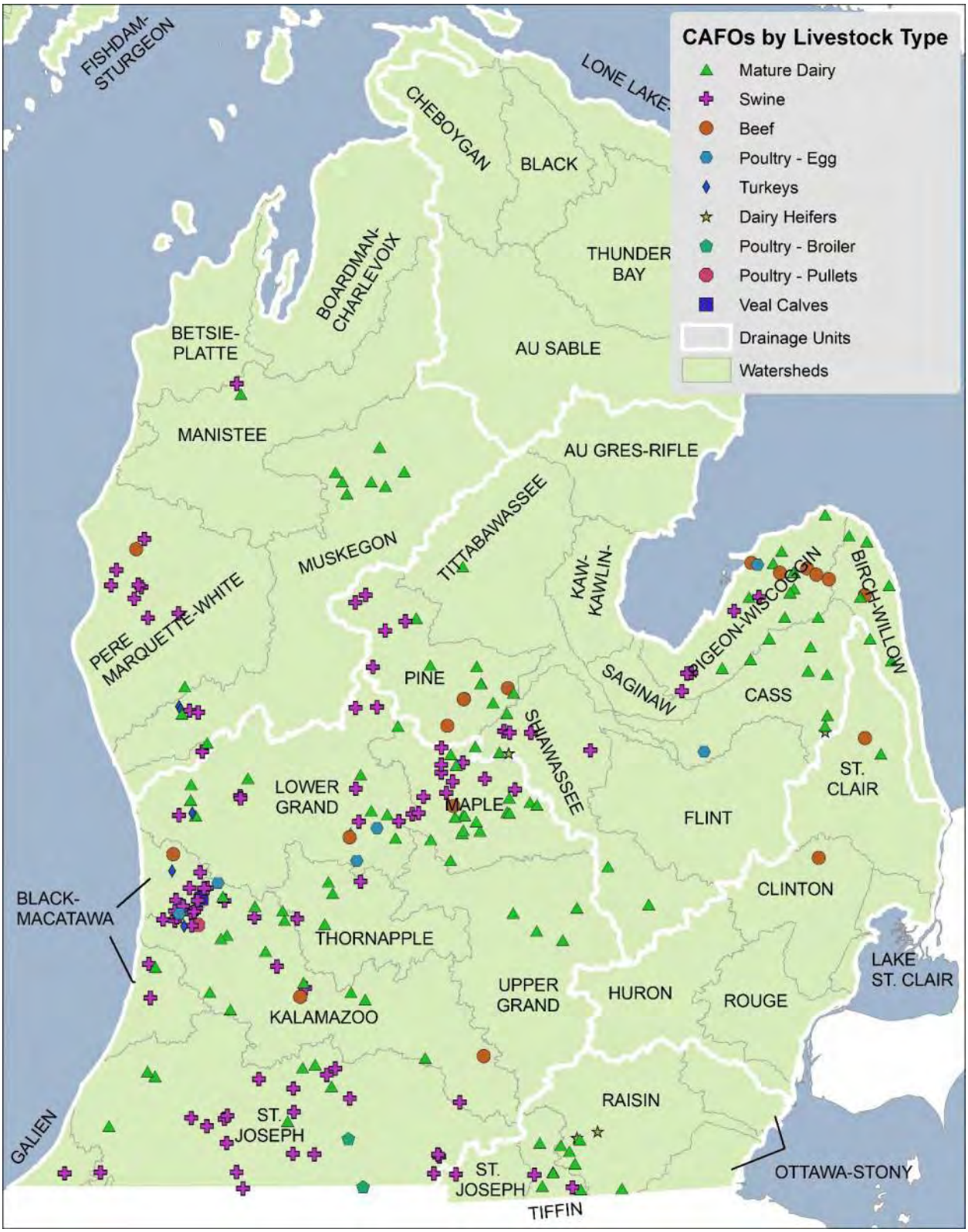


Figure 18. Locations of CAFOs in the Lower Peninsula of Michigan in 2015, by type of livestock. As of 2015, there were no permitted CAFOs in the Upper Peninsula.

7.3.E Combined Sewer Overflows (CSOs)

7.3.E.i Potential Sources (SA):

A combined sewer is a conveyance that is designed to carry both sanitary sewage and storm water runoff. Combined sewer systems are generally older sewer systems that are sized to carry all the water and waste to a WWTP during dry weather and smaller storms. Generally, combined sewer systems were designed with overflow points in the sewer system and/or at the WWTP. This is because the systems cannot handle all the volume of water that is associated with some larger storm events.

A discharge from a combined sewer system, referred to as a CSO, occurs in response to heavier rainfall and/or snowmelt because the carrying capacity of the combined sewer system or WWTP is exceeded. Under normal conditions the wastewater is transported to a wastewater treatment facility and receives appropriate treatment prior to discharge. CSO discharges do not receive all treatment that is available and utilized under ordinary dry weather or small storm conditions.

The history of combined sewers in Michigan dates back to the 1700s when existing natural streams were utilized to carry sewage and storm water away from the newly formed city of Detroit. These waterways often already existed, or had been modified or constructed, for the purpose of flood control in areas with flat and swampy terrain. Surface ditches gradually became enclosed, and were replaced with brick lined channels, wood, clay or metal pipes. At that time, throughout urban areas in the United States and Europe, sewage was collected in 'cesspools' (or pits) below homes. At one point, it was estimated that some large cities in the eastern United States had upwards of 70,000 cesspools (Billings, 1885). By the mid-1800s, the storage of raw sewage under houses had been linked to increased rates of diseases such as cholera, creating urgency to wash away sewage (Waring, 1867). In many cases, cities decided that if the existing storm water ditches and pipes were large enough to accommodate sewage in addition to storm water, then combining the sewers would be a cost-effective solution. If the storm sewers were not large enough to accommodate sewage, then often a separate system for sewage would be constructed (Schladwieler, 2016). This matter of economics resulted in most sewer collection systems in Michigan, at the time, transporting both sewage and storm water, thus accomplishing two very important tasks of sanitation and flood control simultaneously. Where once these systems discharged directly to surface waters, the passage of federal and state legislation led to the construction of wastewater treatment plants. In the 1960s, combined system construction stopped in Michigan, and new additions to older sewers began keeping storm water separate from sewage (MDEQ, 2007).

CSOs can be categorized as uncontrolled or controlled. Retention treatment basin discharges that are settled, skimmed, and disinfected before discharge are controlled CSOs and not likely a source of *E. coli*. Partially treated sewage not disinfected before release are uncontrolled CSOs and a source of *E. coli*.

Uncontrolled CSOs are required to be controlled by either elimination (via sewer separation projects) or adequate treatment, as in the case of retention treatment basins. Currently all remaining untreated CSOs in Michigan are under schedules to be controlled. These schedules are included in permits, orders, or other enforceable documents issued by EGLE or by court action. Waters that are still impacted by uncontrolled CSOs originating in Michigan, as of 2016, are in Figure 19.



Figure 19. Waters that are impacted by uncontrolled CSOs, as of February 2016 (personal communication with Charles Hill, P.E., MDEQ, February 9, 2016). All CSO facilities in Michigan already have an EGLE-approved control plan in place, and progress will continue to occur according to those plans.

7.3.E.ii Potential Solutions (RA)

When Michigan began its CSO elimination more than 30 years ago, there were over 600 uncontrolled CSO outfalls throughout the state. Progress in CSO elimination or control has no perfect measure of success. The number of CSO outfalls that still exist provides one measure, but some outfalls discharge huge amounts per year, while others discharge only rarely and in small amounts, if at all (Figure 20). The number of gallons of raw sewage discharged is another measure, but this may be greatly influenced by the amount of rainfall received and the intensity of rain events that weather patterns bring to each local area. As of 2017, 80 percent of the 613 CSO outfalls that existed in 1988 have been eliminated by Michigan communities, and the remaining 20 percent are scheduled for elimination through implementation of long-term control plans associated with their NPDES permit. On average, since 2003, there have been approximately five CSO outfalls eliminated or redirected to retention treatment basins per year (MDEQ, 2017a). Many of Michigan's large communities, such as the cities of Saginaw and Grand Rapids, have completely eliminated uncontrolled CSOs. EGLE and local communities continue to work toward eliminating all uncontrolled CSO discharges. Currently, 100 percent of our permittees have approved long-term control plans, but permittees will continue to implement the plans for decades.

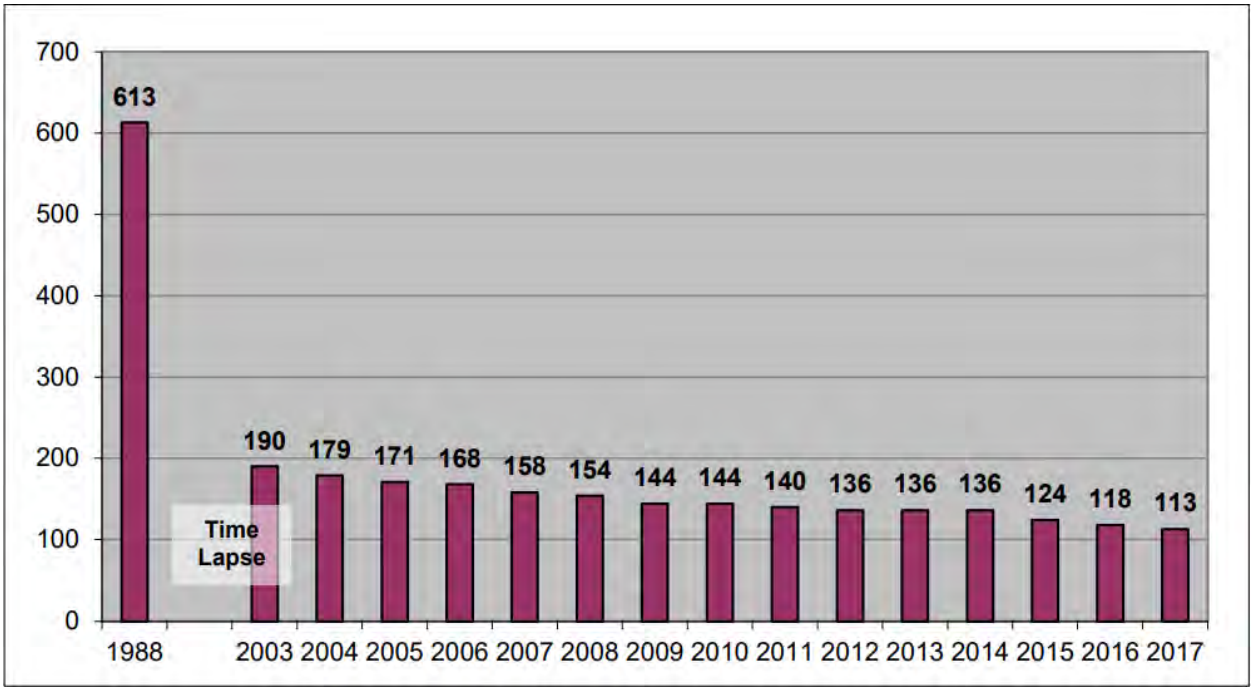


Figure 20. Number of CSO outfalls by year (MDEQ, 2017a).

Section 324.3112(a) requires responsible parties to report releases of untreated or partially treated sanitary sewage. Section 324.3112(c) requires an annual reporting of these releases. This section was added in July 2000. EGLE has produced an annual report and database as a means of providing the public with information regarding known discharges of untreated and partially treated sewage to land and waters of the state. Although discharges from retention treatment basins are required to be reported as a "partially treated" discharge, these discharges are designed to be fully compliant with permit requirements, and protect water quality and public health. Prior to 2004, only releases from municipalities were required to be reported; however, in 2004, Section 324.3112(a) was amended to include reporting of treated and partially treated sewage releases from private systems (system serving more than a duplex).

When raw or partially treated sewage is released into a river, lake, or stream, the responsible party is required to notify the local health department and others as specified in the law. The

local health department may sample, or may require the responsible party to sample, the water body that received the sewage discharge. If the discharge poses a public health threat, then the local health department is responsible for issuing a public health advisory to notify people of the dangers associated with river or lake water contact. More information about water quality monitoring related to health aspects of water pollution, including a list of local health departments with phone numbers, may be found on the Michigan Department of Health and Human Services' Web site at Michigan.gov/MDHHS (search for "local health department map").

All discharge events that are reported to EGLE, as required by law, are documented in the MiWaters database. The database is searchable by water body or responsible facility and will give users information such as volume of discharge, condition of the discharge (treated, partially treated, untreated, etc.), response by the discharger, and corrective actions being taken by EGLE.

The CSO/SSO annual reports, contact information for CSO/SSO expert EGLE staff, the searchable online CSO/SSO database, and relevant legislation may be found at: Michigan.gov/SewageDischarge.

7.3.F Biosolids

7.3.F.i Potential Sources (SA):

While human sewage is generally thought of as waste that should be treated and disposed of, it does contain nutrients that are beneficial to producing agricultural crops that feed the world's growing population. Treated sewage can be a valuable fertilizer. In 1842, an intrepid factory owner and farmer found that adding sewage to his croplands increased his yield (Billings, 1885). As early as the 1860s, the city of London, England, proposed to design its sewerage systems so that farmers along the sewers exiting the city could use the sewage as agricultural fertilizer (Waring, 1867). Today, the use of human sewage as fertilizer continues, but is highly regulated by the federal and state government to ensure public safety and reduce environmental risks.

Biosolids are defined as the residuals settled out of NPDES permitted municipal and commercial sanitary sewage treatment facilities during the treatment process and are also known as sewage sludge. Biosolids are treated and land applied to agricultural land throughout Michigan. EGLE encourages the use of biosolids to enhance agricultural and silvicultural production in Michigan.

There are 263 NPDES facilities (MiWaters Database, accessed August 13, 2015) permitted to land-apply biosolids on approximately 5,690 sites (Figure 21) throughout Michigan. This equates to more than 200,000 acres of Michigan's agricultural land that is being fertilized by regulated biosolids.

7.3.F.ii Potential Solutions (RA):

Biosolids applications are regulated by Residuals Management Programs that are required by the provisions of the originating facility's NPDES discharge permit for wastewater treatment or by a general permit (MIG960000). Michigan's administrative rules require that pathogens in biosolids be significantly reduced through a composting process, prior to land application (R 323.2418, Part 24. Land Application of Biosolids, NREPA, 1994 PA 451).

There are different rules for different classes of biosolids. Class A biosolids contain no detectible levels of pathogens, and therefore, are not a potential source of *E. coli* to surface waters. Class A biosolids that meet the strict requirements pose little threat to water quality, and therefore, have fewer limitations when land-applied to fields. Class B biosolids are treated but still contain detectible levels of pathogens. There are buffer requirements, public access,

and crop harvesting restrictions for virtually all forms of Class B biosolids. Provisions contained in Part 24 that protect surface and groundwaters from contamination by bulk land-applied Class A and Class B biosolids include: isolation distances from surface water (50 feet for subsurface injection or surface application with incorporation or 150 feet for surface application without incorporation within 48 hours), sampling to ensure that pathogen density requirements in R 323.2414 are met, and restrictions (but not prohibition) of land application to frozen, saturated, or highly sloped land.

Biosolids are categorized here as a potential point source, because they are regulated by an NPDES permit. Discharge of biosolids to surface waters of the state is prohibited; but if a spill should occur in violation of the permit, the permit holder (generator of the biosolids) is generally held accountable. Information, applicable rules/laws, and EGLE Biosolids Program staff contacts may be found at Michigan.gov/Biosolids.

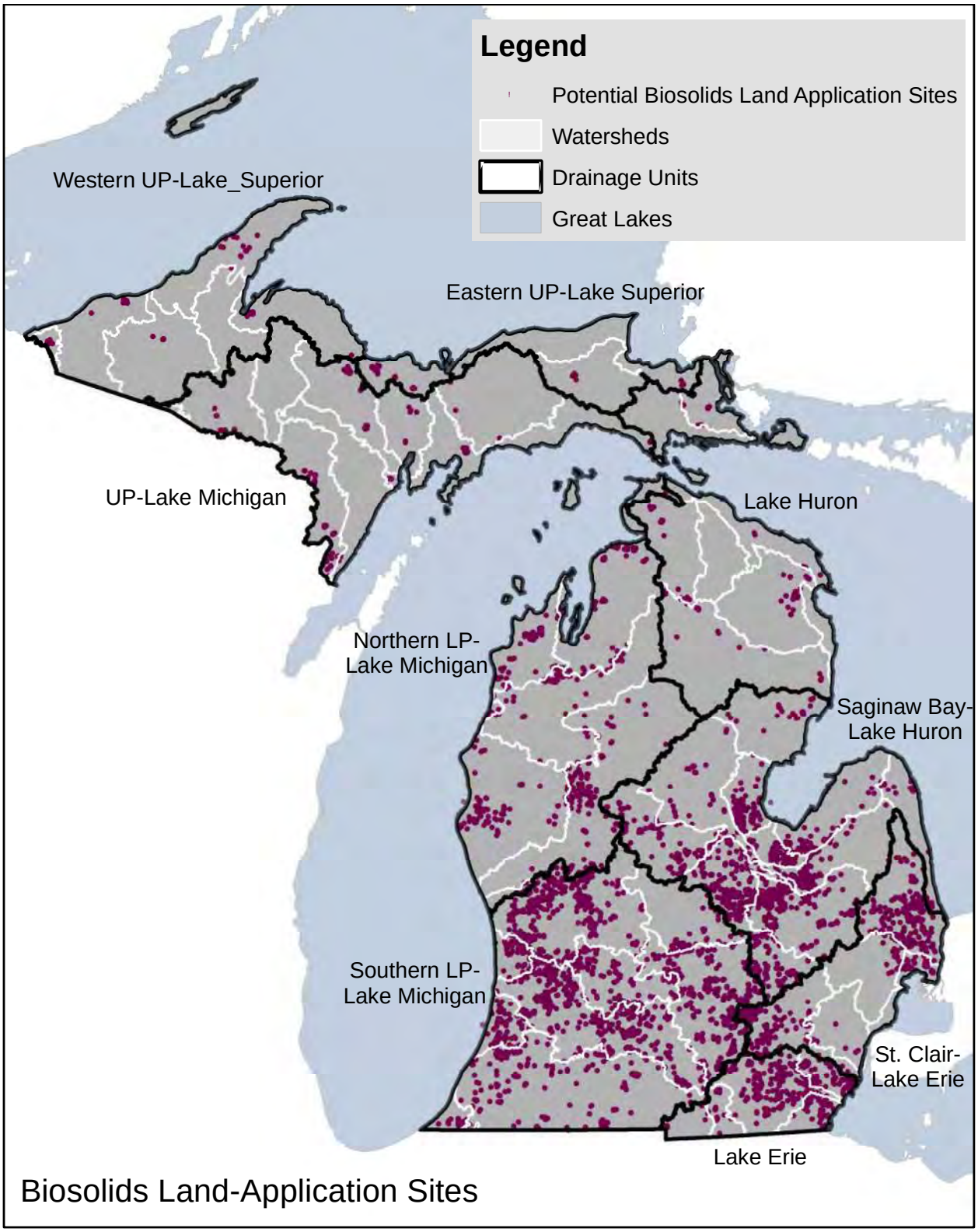


Figure 21. Statewide distribution of Biosolids land-application sites (MiWaters Database, accessed August 13, 2015).

7.4 NONPOINT SOURCES

Nonpoint sources of *E. coli* contamination include any source that is not a discharge regulated by an NPDES permit, including: some types of storm water, failing septic systems, regulated septage land application, sanitary groundwater discharges, non-CAFO livestock operations, manure land applications to agricultural fields not covered by a CAFO permit, and pet and wildlife waste.

Some types of nonpoint sources typically contaminate surface water under specific weather conditions (Table 7). Wet weather nonpoint sources are caused when rain or snowmelt carry pollutants off the land or out of drains and storm sewers that are not covered by NPDES permits, and into surface water. Impervious surfaces play a major role in delivering precipitation-driven *E. coli* to surface waters. Impervious surfaces are hard surfaces that water cannot readily penetrate, such as concrete parking lots and typical roofing materials of buildings. Some of Michigan's highly developed subwatersheds have up to 63 percent impervious area (Figure 17). Dry weather nonpoint sources, such as failing septic systems or livestock with any direct contact with surface water, could contaminate surface water at any time but may be most noticeably expressed in surface water *E. coli* data during dry weather. Illicit sanitary discharges are illegal sources (not part of the TMDL LA) may be wet or dry weather sources (see Section 7.5 - Illegal Sources).

Table 7. Various potential sources of *E. coli* and weather conditions under which they are most likely to reflect in ambient surface water samples.

Potential Sources	Dry Weather	Wet Weather
Septage Land-Applications		X
Illicit discharges directly to surface water #	X	X
Illicit discharges to ground surface or dry roadside ditches #		X
Illicit discharges to field tiles #	X	X
Failing Septic Systems	X	X
Manure Land-Application entering surface water		X
Livestock pasture run-off entering surface water		X
Livestock with Direct Access to Surface Water	X	X
Pets	*	X
Wildlife	*	X

* Could occur, but would be uncommon

\# Illegal source, see Section 7.5

Nonpoint source reductions are often done voluntarily, and funding is available under certain circumstances to help implement these reductions. To facilitate this, EGLE has a Nonpoint Source Program that focuses primarily on the voluntary aspects of pollution reduction. The basis of the Program is watershed management planning and working with local stakeholders to solve problems. The purpose of a watershed management plan is to identify stakeholders' concerns, find problems, assign responsibility for and prioritize actions to achieve water quality goals. The USEPA requires that watershed management plans contain nine major elements and be approved by EGLE, in order for work described in the plan to be funded by CWA Section 319 funding. Determining responsibility for priority actions identified in the watershed management plan (i.e., who does what) is key to the success of the plan. This TMDL does not

assign responsibility for many of the recommended actions for nonpoint sources where no state regulations or laws are in place (such as ambient wildlife in a normally nonregulated municipality). This is because the local situations are unique and variable from place to place, including differences in organization and agency missions, local ordinances, and regulations. Assigning responsibility is most meaningful when done by the stakeholders at the local level. EGLE recognizes that watershed management planning, at some level, is imperative to restoration success in areas that are included in this TMDL.

The Nonpoint Source Program Web site (Michigan.gov/NPS) contains helpful links for grant opportunities, watershed management planning, and technical guidance for implementation of nonpoint pollution reduction activities.

The following sections (7.4.A through 7.4.F) discuss the types of nonpoint sources that are common in Michigan, and provide the following recommendations or actions that may help to remedy them. In general, any action to reduce imperviousness (thereby decreasing runoff and stream flashiness) will reduce pollutants reaching surface water due to filtration provided by movement through soil. EGLE recommends these BMPs that could help solve many of these potential problems:

- Wetland Restoration: Michigan has lost 20 percent of its presettlement wetland area (about 4.2 million acres) (Fizzell, 2015). Wetland restoration has the potential to decrease *E. coli* concentrations in contaminated runoff by increasing the filtration provided by sediment and vegetation (Knox et al., 2008). Wetlands have been shown to have the capability to retain contaminated water long enough to cause increased bacterial mortality, and create conditions that increase mortality (such as high levels of sunlight and competition with natural bacterial communities) (Knox et al., 2008). This would also result in the reduction of nutrients and help mitigate dramatic fluctuations in flow of rivers. EGLE endorses the use of its Landscape Level Wetland Functional Assessment tool as a means to prioritize areas for wetland restoration and protection. Michigan's Landscape Level Wetland Functional Assessment methodology identifies historically lost wetlands, determines the functions they once provided, and helps to prioritize wetlands for restoration to obtain the most significant water quality improvements. Riparian wetlands (located between uplands and lakes/streams) with high amounts of emergent vegetation (such as wet meadows and emergent marsh) have the most potential to decrease *E. coli* in runoff, and also would not attract large amounts of waterfowl. It is important to note the TBC and PBC WQS apply in wetlands. More information on potential wetland restoration areas in Michigan may be found at Michigan.gov/Wetlands. Additional information on wetland restoration in watershed management planning may be found in the USEPA's Wetland Supplement (USEPA, 2013).
- Vegetated Riparian Buffers: Vegetated riparian buffers can improve water quality and reduce *E. coli* by increasing infiltration (which reduces storm water runoff volume and improves the quality by removing pollutants) (Coyne et al, 1998; Lim et al., 1998). Buffers of dense and tall vegetation can also discourage geese (Section 7.4.F) and dog-walking near the surface water (Section 7.4.E). In urban or residential areas, buffers can take the form of gardens to make them more appealing. Recommendations on the width of buffers for effective filtration and plant communities for buffers may be found at Michigan.gov/NPS, then click on "NPS BMP Manual, Other BMP Design References, and Pollutants Controlled," then click on the link to the "Riparian Buffer" document listed under "Individual BMPs."

7.4.A Livestock and Land-Application of Manure

7.4.A.i Potential Sources (SA):

Agriculture, including hay/pasture, accounts for approximately 24 percent of the land cover in the state and as much as 95 percent of the land area in some subwatersheds (NOAA, 2011). Farming operations can be potential nonpoint sources of *E. coli* through barnyard runoff, direct animal access to surface waters, spills, lagoon seepage, pasture runoff, inappropriately stockpiled manure, and manure land-application. Illicit discharges of animal waste (such as barn wash-water) or human waste from a farmstead are not considered a nonpoint source, and are discussed in Section 7.5 – Illegal Sources.

Among all the land-application waste sources in the state of Michigan (biosolids, CAFOs, septage, and nonpoint sources), the largest percentage of waste applied to land originates from farming operations that are not CAFOs, and therefore are not regulated by the NPDES Program (unless a discharge to surface water is reported) (MDEQ, 2010b).

The best estimates of livestock, manure use, and farm numbers EGLE can obtain are at the county level, from the United States Department of Agriculture's (USDA) census of agriculture (USDA, 2014). The census of agriculture is performed every five years by surveying commercial agricultural producers. These survey results have several limitations. In order to protect the confidentiality of farmers, some survey information may not be present; such as when a farm could be specifically identified (e.g. when there is only one poultry farm in a county and revealing the inventory numbers would be a breach of confidence). Additionally, the farm size classes are not divided such that we can separate regulated CAFOs from other larger farms. The information presented in this summary is intended to give readers a general idea of farming trends in Michigan.

For the purposes of this TMDL, all livestock within the source area are considered potential sources of *E. coli*. Livestock are animals that are bred and raised for human use, and include cattle, swine (hogs), poultry, horses, and more uncommon types (such as llamas, sheep, goats). Livestock with access to surface waters, polluted runoff from livestock production area, pasture runoff, and discharges from artificial drainage, such as tiles, and the land application of manure are all potential sources of *E. coli* to surface waters. Many factors affect the amount of *E. coli* transported from fields when manure is land-applied or deposited by grazing animals; chief among them is the amount of *E. coli* present in the manure at the time of application. Liquid cattle manure, swine manure, and dairy slurry have been shown to contain *E. coli* concentrations of up to 1,500,000 *E. coli* per mL.(Unc and Goss, 2004).

Livestock farms in close proximity, or adjacent, to water bodies are more likely to contaminate surface waters from barnyard or pasture runoff, particularly if animal pasture areas slope towards the water bodies without buffer vegetation or embankments to contain runoff. Larger farms generate more waste that requires storage, disposal, or dispersal (land application). Smaller farms, such as hobby horse farms and small farms, can also contaminate surface water if the pastures slope into adjacent water bodies, animals have direct access, or if manure is stockpiled upslope of a water body.

Large to medium livestock operations will generally land-apply manure in the early spring and late fall on fields available to them for land application as near as possible to their operations. Knowing the locations of all livestock operations in the source area, ranging in size from a single animal up to larger dairy and meat operations, would be beneficial for determining nonpoint sources of *E. coli* in rural areas. For guidance in locating animal feeding operations in your watershed, see EGLE's online TMDL supplemental resources (Michigan.gov/EcoliTMDL).

Summary of Livestock Operations in Michigan

Overall, Michigan farmers reported fertilizing about 761,000 acres of farmland with manure in 2012 (USDA, 2014). Nearly one quarter of farm facilities with cropland (9,149 out of 44,668) used manure as fertilizer (USDA, 2014). The top five watersheds with the highest percent of land with applied manure are the Pigeon-Wiscogin and Birch-Willow (in the Saginaw Bay drainage unit), and the Maple, Thornapple, and Lower Grand (in the Southern Lower Peninsula-Lake Michigan drainage unit) (Figure 22).

In 2017, there were approximately 12,000 cattle farms (beef and dairy) in Michigan, which is a decrease from the 1997 census, when Michigan contained about 18,000 cattle farms (USDA, 2019). The total number of cattle (beef and dairy), including calves, has remained generally the same between those years (around 1 million), illustrating the trend of fewer, but larger farming operations. The number of cattle on farms with more than 500 head has increased steadily between the 1997 and 2017 surveys (Figure 23), while the number of cattle in small farms has decreased (Figure 24). Having fewer, but larger farms, has the effect of concentrating the application of manure in areas where the farms are located. In 2017, 57 percent of cattle were kept in farms larger than 500 head in 2017, up from only 21 percent in 1997 (USDA, 2019). The number of hogs in Michigan remained fairly steady at around 1 million from 1997 through 2012, until it increased to 1.2 million in the 2017 agriculture census. The increase in hogs occurred mainly due to an increase of hogs kept in very large farms (greater than 5,000 head). By 2017 the number of hogs kept in large farms (over 1,000 head) had increased dramatically to 96 percent of the inventory, up from 75 percent in 1997 (USDA, 2019). Cattle and hog populations (according to the 2012 census) by county are shown in Figure 25.

Between 1997 and 2017, the number of broiler chickens in Michigan increased dramatically, from approximately 0.1 to 1.6 million (USDA, 2019). Likewise, between 1997 and 2017, the number of layer chickens has tripled, from 4.9 to 15.1 million, and the number of farms has gone from about 2,700 to 7,000. Most of these chickens (14.7 million) are kept in large farms (more than 100,000 head). In Michigan, the number of chickens kept in flocks has increased among all sizes of flocks and farms. For example, the number of layer chickens in farms that keep more than 100,000 head has increased steadily since 1997 (Figure 26) and the same can be said of the number of chickens kept in small flocks (Figure 27); however, the 14.7 million layer chickens in these large AFOs/CAFOs clearly towers above the 104,000 kept in small flocks. In fact, beginning sometime between the 2007 and 2012 agricultural census, there were more layer chickens in Michigan than people (9.9 million). In addition to chickens, there are 2.3 million turkeys in Michigan farms in 2017. The USDA agriculture census does not account for the recent increase in backyard poultry keeping, which is not commercial farming and is discussed further in Section 7.4.E (Pets).

According to the USDA 2017 Census of Agriculture, there are about 89,000 sheep and lambs, 29,000 goats, and 64,000 horses in commercial operations in Michigan. This census does not include animals kept as pets at non-commercial farms (Section 7.4.E). The numbers of sheep, goats, and horses are much smaller than the overall numbers of cattle or hogs, and poultry, but they can be locally significant sources of *E. coli* to surface waters.

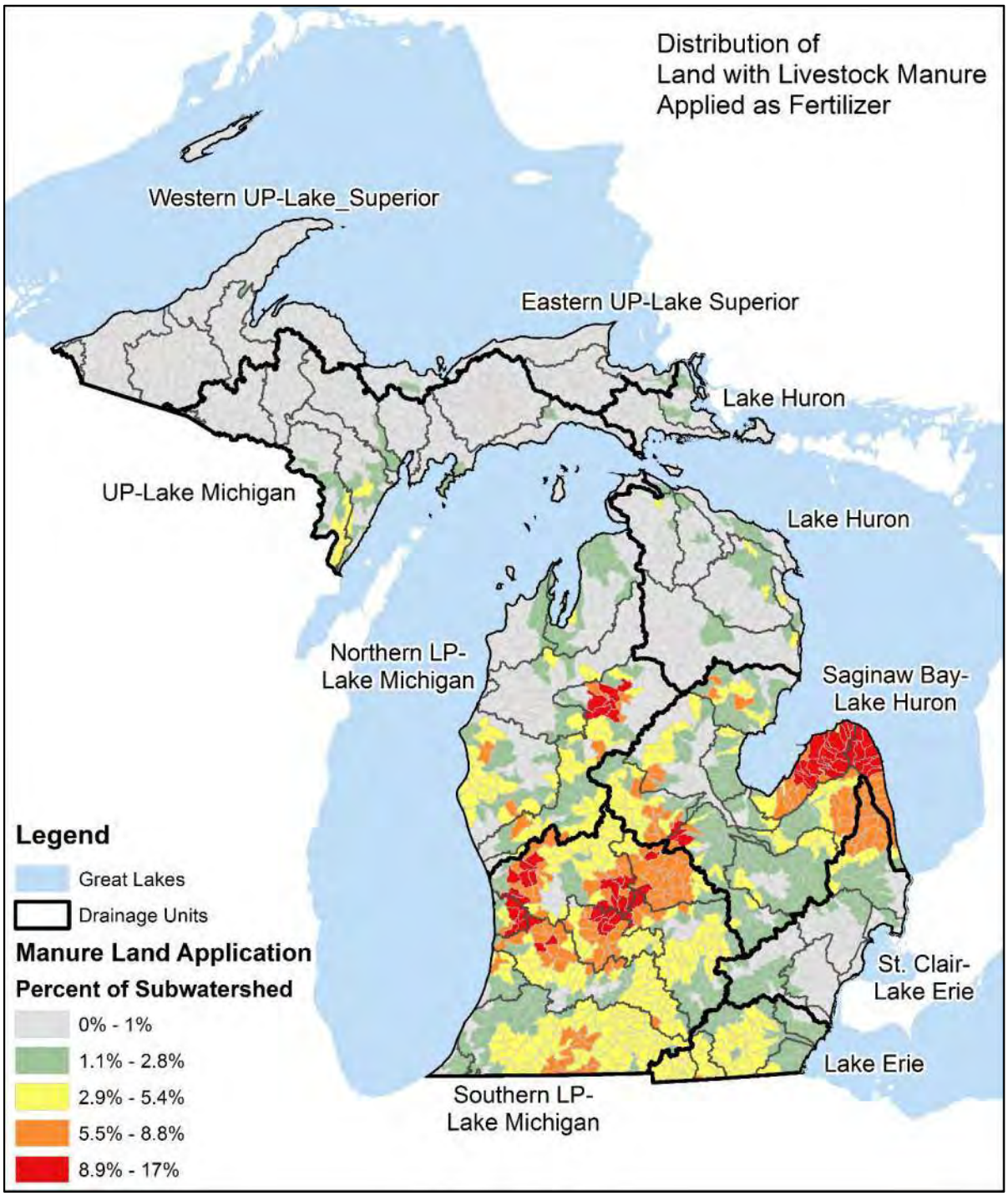


Figure 22. Estimated manure applied to agricultural lands in Michigan as a percent of subwatershed area, extrapolated from 2012 USDA Agricultural Census County Level Data (USDA, 2014). This estimation includes manure from permitted CAFOs and unpermitted small and medium farms.

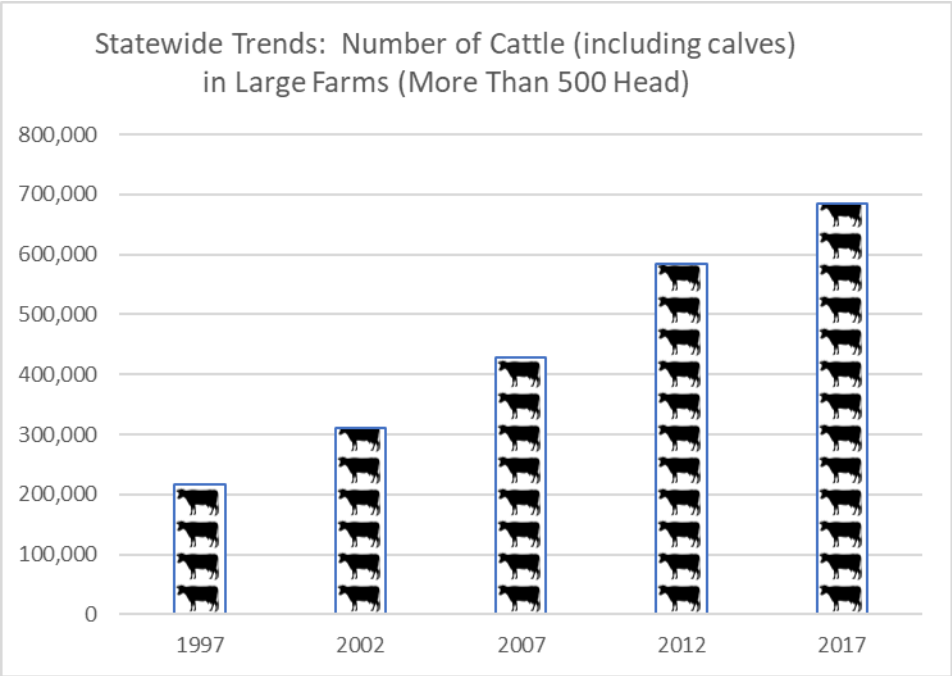


Figure 23. Number of head of cattle (including calves) in farms that are in the size class of greater than 500 head (USDA, 2019).

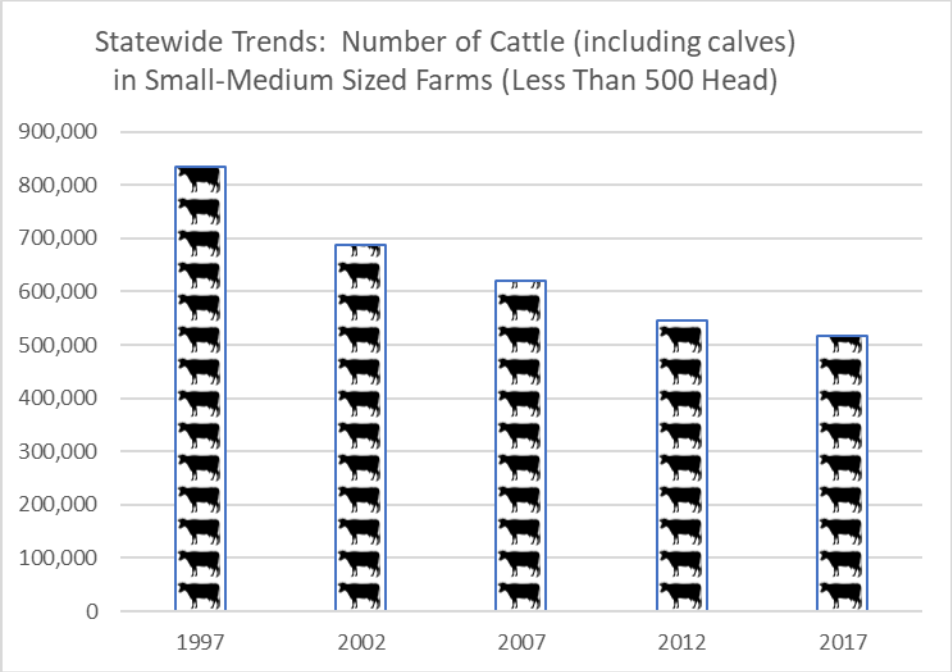


Figure 24. Number of head of cattle (including calves) in farms that are in the size class of less than 500 head (USDA, 2019).

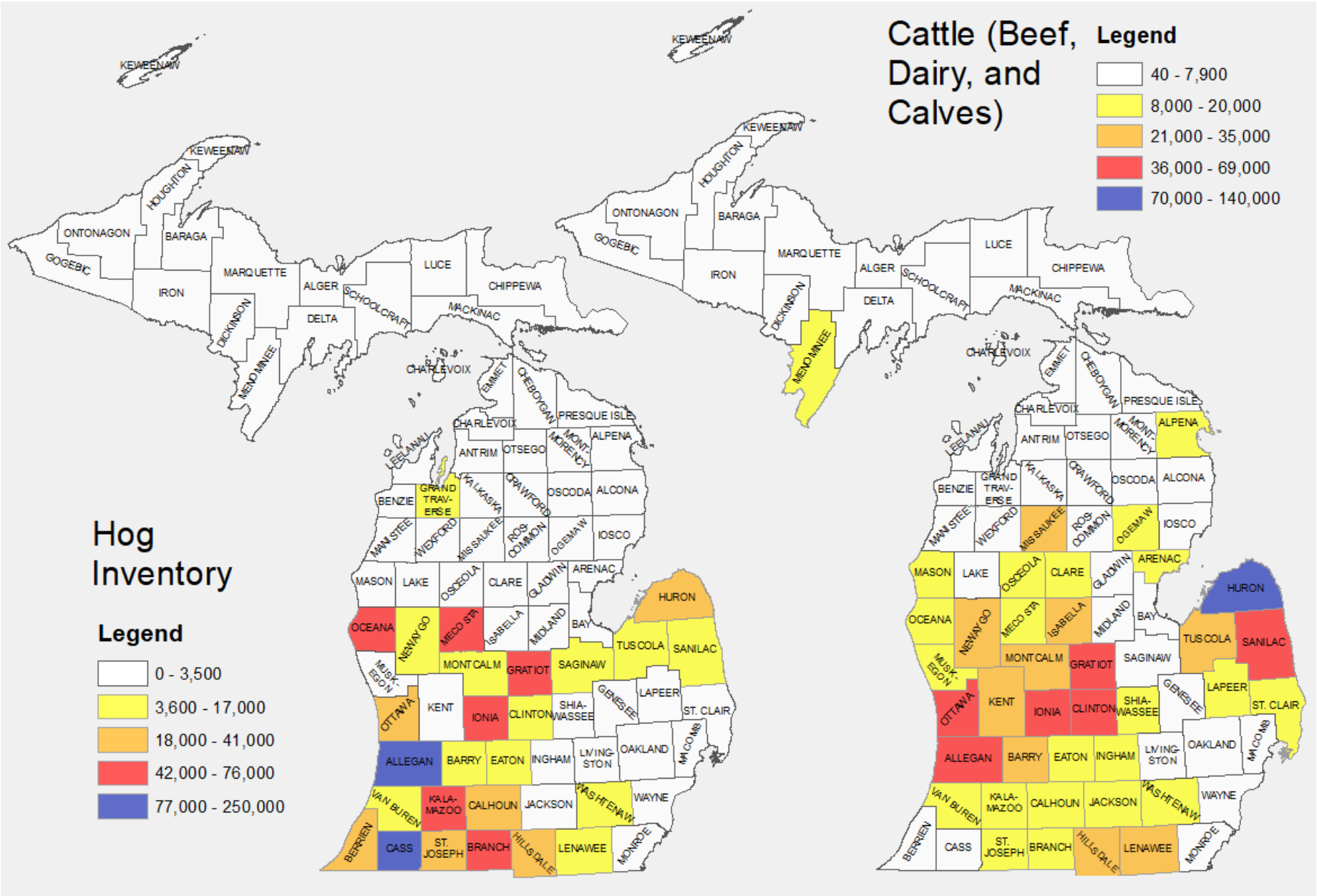


Figure 25. 2012 Inventory of cattle and hogs in Michigan, by county (USDA, 2014).

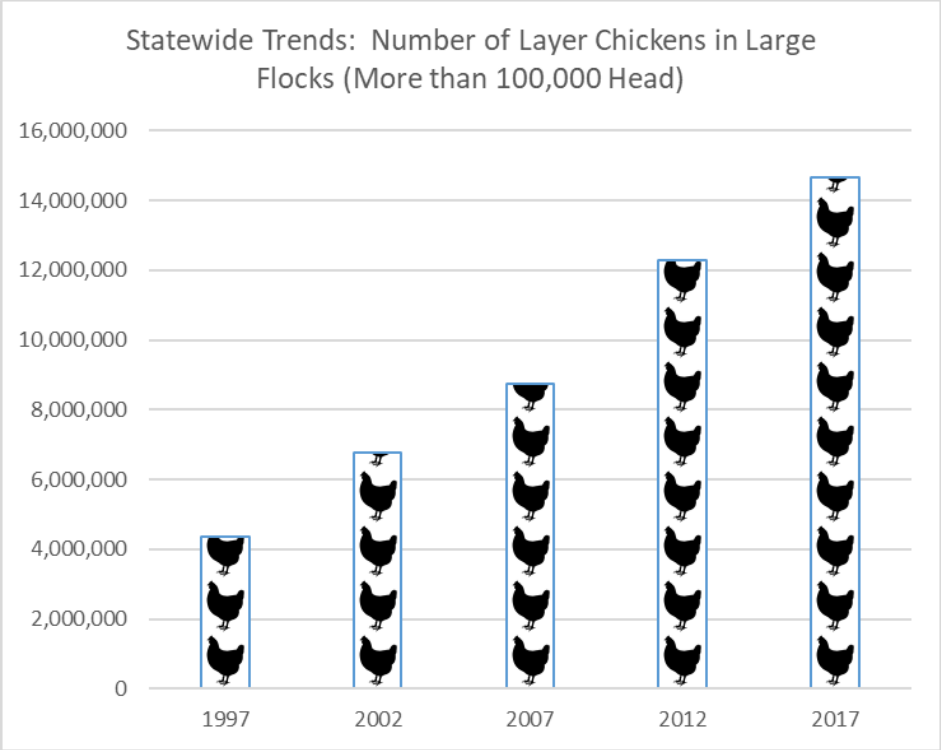


Figure 26. Number of laying chickens in farms that are in the size class of greater than 100,000 head (USDA, 2019). The number of poultry in these large sized farms has increased steadily since 1997.

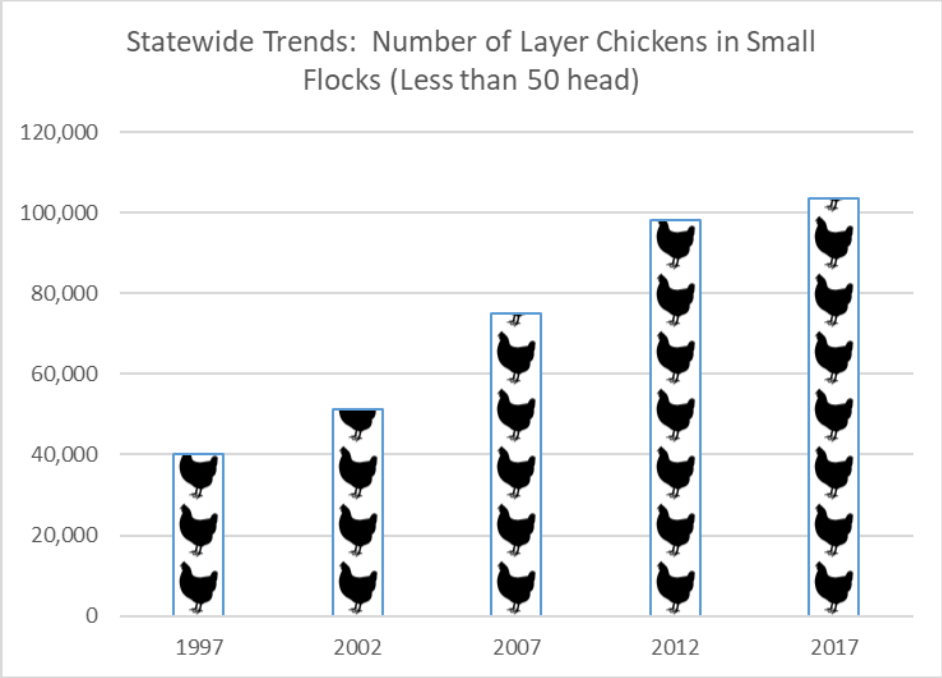


Figure 27. Number of laying chickens in farms that are in the size class of less than 50 head (USDA, 2019). The number of poultry in these small sized farms has increased steadily since 1997.

Summary of Environmentally Risky Practices

The following agricultural practices may be especially risky from an environmental perspective:

- Manure land application on frozen ground is known to be an environmentally risky practice for surface water quality (Thompson et al., 1979; Stratton et al., 2004; Srinivasan et al., 2006; and Frame 2012). The manure cannot be readily incorporated into the soil, and thus remains exposed to the forces of rain, sun, air, and snowmelt. Aside from causing bacterial contamination of nearby surface waters, this also causes nitrogen to be lost by volatilization (Atta, 2008), and high dissolved phosphorus losses in runoff (Frame, 2012). According to a five-year study of a Wisconsin beef farm, where manure was applied routinely on frozen and unfrozen ground, the months of February and March had the highest rates of field runoff (as much as 39 percent of monthly precipitation became runoff) and dissolved phosphorus losses peaked during these months at more than 0.8 pounds per acre; the study points out that it is not these months that were particularly hazardous for surface water pollution, but that the manure land application coincidentally occurred during or immediately prior to snow pack melting and led to increased losses (Frame, 2012). Frozen soil has a low infiltration capacity, causing high rates of runoff during snowmelt or rain (Fleming and Fraser, 2000). In a Wisconsin study of several fields with slopes less than 5 percent, it was found that 50 percent of all agricultural runoff occurred during snow melt (Stuntebeck et al., 2011). Land application of manure on frozen ground is particularly risky on sloped land, land with swales, or on land adjacent to surface waters.
- Livestock with direct access to surface water: Animals with access to surface waters can transport manure from pastures to the water on their hooves and via direct defecation into the water (MDARD, 2016). While controlled or restricted access sites, such as concrete crossing pads, can eliminate soil erosion issues, they may act as a hydrologic path for pasture runoff to flow into surface water and do not prevent direct defecation in the water; and therefore, do not alleviate pathogen contamination.
- Pastures sloped towards water bodies: Pasture runoff can be an issue even when livestock are excluded from directly accessing surface water. Pastures that slope towards water bodies, or have swales running through them, are likely to contaminate surface water.
- Stockpiling manure in fields: Stockpiling manure in fields or open areas is a risky practice if done improperly. This practice involves concentrating manure in piles that are exposed to rainfall, thus increasing the risk of bacteria and nutrients entering surface or groundwater. From a water quality perspective, it is preferable to land apply and till under the manure. Occasionally, farms may not have the ability to land apply due to frozen or muddy ground, and view stockpiling as the best or only option.
- Manure applications on tile drained fields may pose an especially high risk of surface water contamination by *E. coli*, given that fissures in the natural soil structure can provide a relatively unimpeded pathway for contaminated water to reach tiles, then surface water, without the benefits of filtration through soil or riparian buffer strips (Shipitalo and Gibbs, 2000; Cook and Baker, 2001; Haack and Duris, 2008). In Michigan, approximately 26 percent of all agricultural lands are artificially drained, which equates to about 7 percent of the land area in the state (USDA, 2014) (Figure 28). Subsurface drainage tiles reduce the amount of surface runoff by up to 45 percent (Busman and Sands, 2002), but reroute precipitation through the soil vadose zone (3- to 5-foot depth) and into a permeable tile, which then routes directly to surface water bypassing buffer strips. The end result is an increased risk of contaminated storm water to a surface water body if manure is applied prior to rainfall.
- Manure applications just prior to heavy rainfall tend to have a higher risk of runoff if not fully incorporated or injected before the rainfall. Many studies have shown that time

spent outside the host body, exposed to cold and the drying effects of the sun, can reduce pathogens over time, resulting in less risk of contaminating surface water (Crane et al., 1980; Jiang et al., 2002; Saini et al., 2003, Unc and Goss, 2004). Applying manure just prior to rainfall, or during snowmelt, would not allow time for pathogens to naturally die off.

- Manure applications on saturated ground. In fields where water infiltration rates are slow due to already saturated conditions or poorly drained soil types (including areas that are frequently flooded), runoff and ponding can be enhanced, causing sheet-flow of contaminated runoff if manure has been applied (MDARD, 2016).

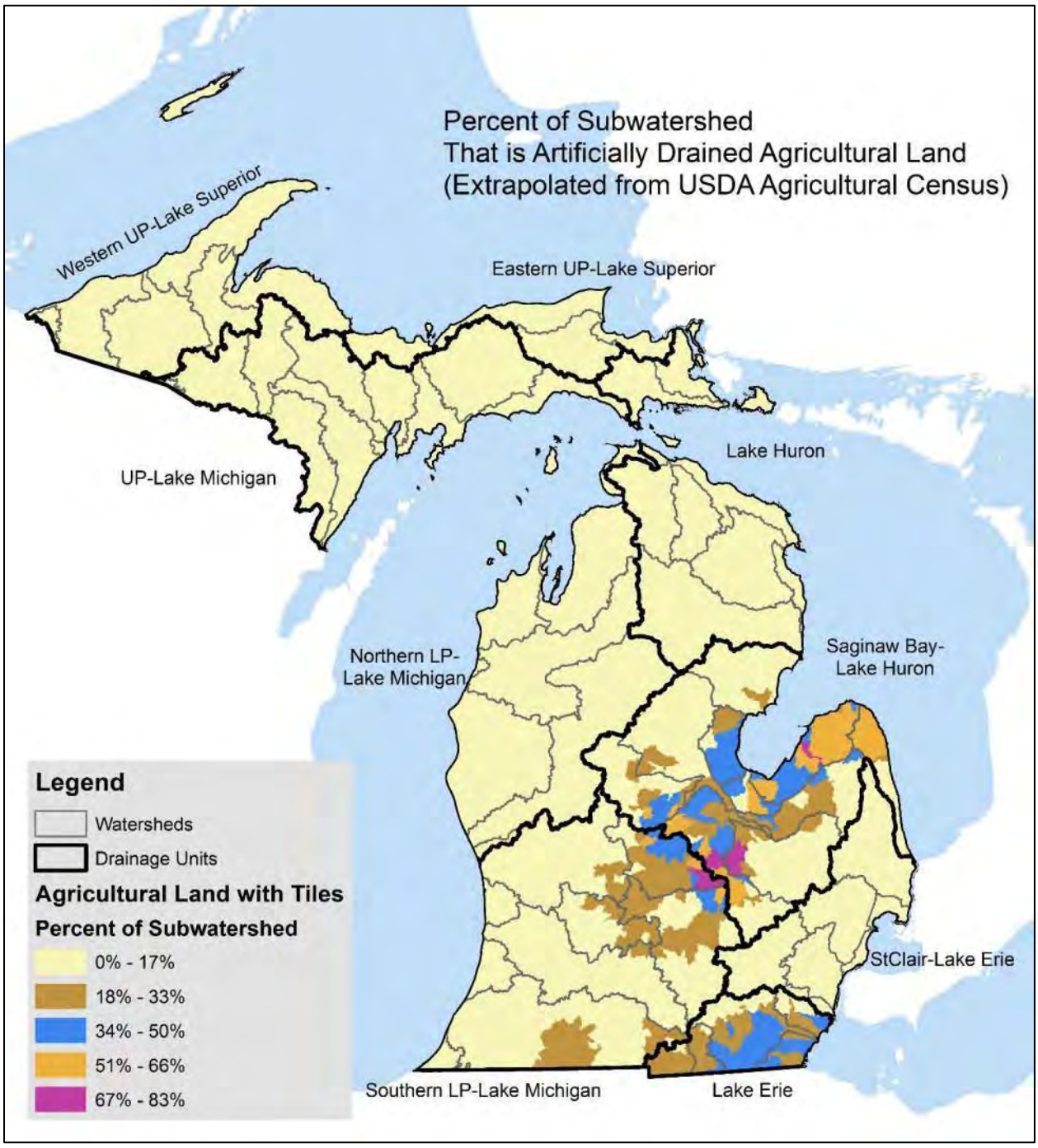


Figure 28. Estimated artificial drainage of agricultural land as a percent of each subwatershed area. Data extrapolated from 2012 USDA Agricultural Census County Level Data (USDA, 2014).

7.4.A.ii Potential Solutions (RA):

Nonpoint source pollution from unpermitted agricultural operations are generally addressed through voluntary actions funded under the Clean Michigan Initiative, federal CWA Section 319 funded grants for Watershed Management Plan development and implementation, Farm Bill programs, and other federal, state, local, and private funding sources.

The Michigan Right to Farm Act, PA 93 of 1981, as amended, authorizes the Michigan Commission of Agriculture and Rural Development to develop and adopt Generally Accepted Agricultural and Management Practices (GAAMPs) for farms and farm operations in Michigan. These GAAMPs are based on science and are reviewed annually and revised as necessary. GAAMPs promote environmental stewardship, and when the MDARD determines that a farm conforms to GAAMPs, then that farmer may use the Right to Farm Act as an affirmative defense in a nuisance lawsuit. If a farm is alleged to be causing a water quality problem, an environmental complaint may be filed by anyone, and an investigation will be conducted by the MDARD and/or EGLE, WRD. If the management practices on a farm are causing a violation of Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), then enforcement action may be taken by EGLE to address the complaint and compel the farmer to correct the water pollution problem and abate the violation.

Livestock operations may be required to apply for an NPDES permit in accordance with the circumstances set forth in Rule 2196 (R 323.2196) of Part 21 of the NREPA. This authority allows EGLE to impose pollution controls and conduct inspections, thereby reducing pollutant contamination (i.e., *E. coli* from agricultural operations that have been determined to be significant contributors of pollutants).

The Michigan Agriculture Environmental Assurance Program (MAEAP) is a voluntary program to minimize the environmental risk of farms, ensure conformance with applicable state and federal laws and standards, and promote the adherence to Right to Farm GAAMPs, established by Michigan law (Section 324.3109d of NREPA). Any farm (CAFO or otherwise) may become MAEAP-verified. For a farm to earn MAEAP verification, the operator must demonstrate that they are meeting the requirements geared toward reducing contamination of ground and surface water, as well as the air. Farmstead, cropping, and livestock portions of the MAEAP verification process hold promise for protecting waters of the state from contamination by *E. coli*, including: steps to promote the separation of contaminated storm water from clean storm water at the farm site; the completion of a CNMP or Manure Management System Plan, similar to that required by NPDES-permitted CAFOs; runoff control at feedlots and the identification of environmentally sensitive areas; the prevention of manure reaching tile lines; septic system management; and controlling contamination of runoff through incorporation on land application fields. In 2016, there were about 600 livestock MAEAP verifications (Figure 29). In 2019, the 5,000th MAEAP verification was celebrated (personal communication with Meredith Smith, MDARD, November 11, 2018). According to Section 324.3109d of the NREPA, if a MAEAP-verified farm is in compliance with all MAEAP standards applicable to the farming operation, the farm is considered to be implementing conservation and management practices needed to meet TMDL implementation for impaired waters pursuant to 33 USC 1313. If an NPDES-permitted CAFO receives MAEAP verification, they must also comply with their NPDES permit requirements. A MAEAP verification does not limit the obligation to apply for an NPDES permit if required pursuant to Rule 2196 (R 323.2196) of Part 21 of NREPA.

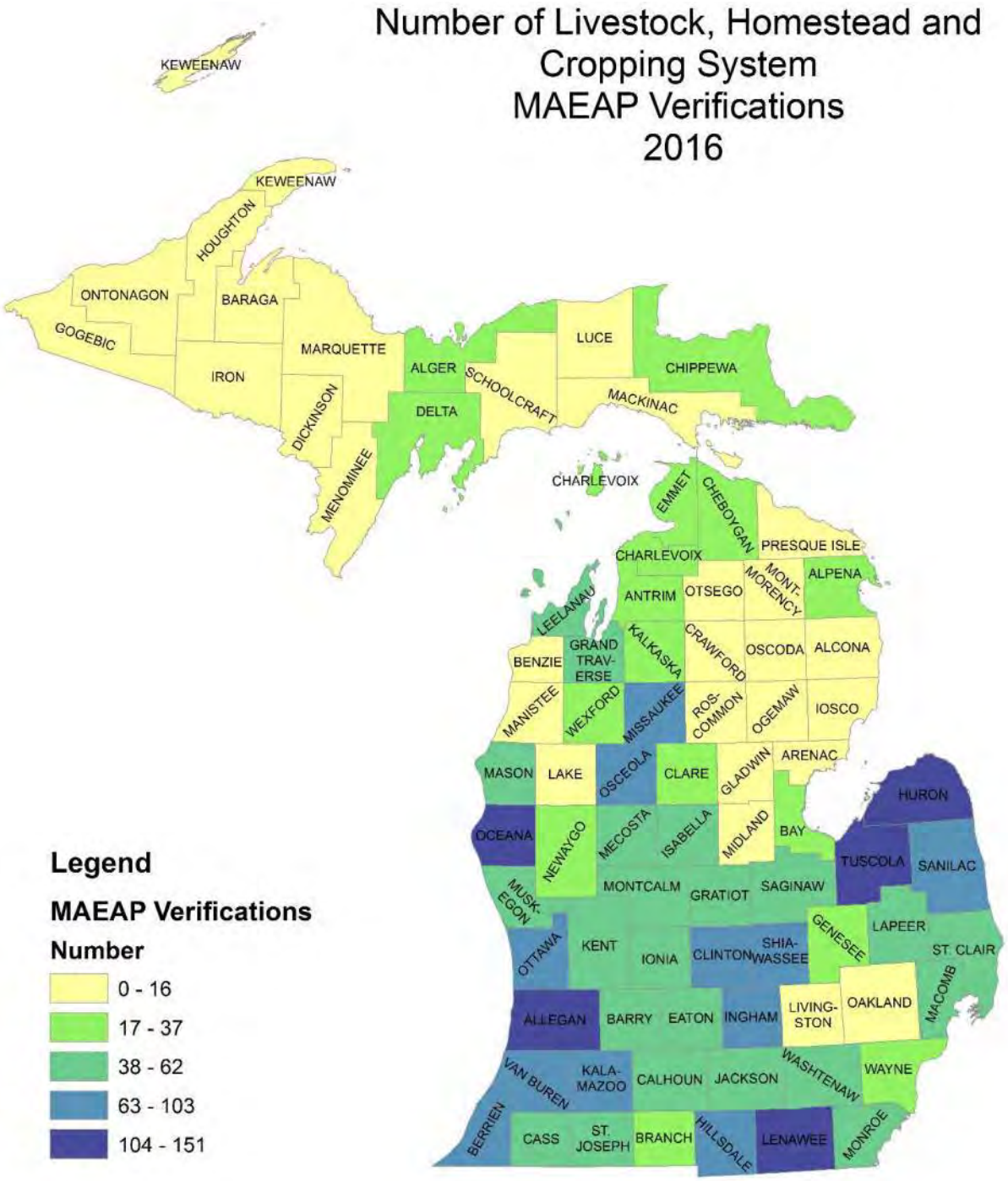


Figure 29. Number of MAEAP verifications by county (personal communication with Thomas Young, MDARD, July 25, 2016).

Summary of Recommended BMPs

EGLE recommends outreach to farmers and producers to connect them with existing voluntary conservation programs through organizations such as those found in the "Online and Funding Resources" section below. EGLE recommends that all livestock producers in *E. coli*-impaired watersheds (the LA of this TMDL) work with these local and state agencies to develop **CNMPs or Manure Management System** Plans that address manure management and storage practices. The following BMPs are voluntary, unless a direct discharge has occurred, an NPDES permit is issued, or EGLE has found that the farm is contributing significantly to a water quality impairment in any surface water of the state (as described in Section 7.4.A). The following BMPs are recommended to reduce the potential for *E. coli* contamination of surface waters by a farm:

- **Avoid manure land application on frozen ground**: To avoid this, store manure in appropriately designed storage areas until ground is thawed and no longer saturated. Michigan's GAAMPs for manure include a specification to control runoff with conservation practices, and if manure application on frozen ground is necessary, it should only be done on slopes less than six percent for solid manure, and three percent for liquid manure (MDARD, 2016). If manure must be applied on frozen ground, EGLE and MDARD recommend calculating a Manure Application Risk Index score for each field to determine if the field is high risk (Gangwer, 2008). Research has shown that land-applying manure on frozen ground immediately prior to spring snow melt is especially risky in terms of contaminated runoff volume, therefore EGLE recommends avoiding that period of time (varies by climate and locality) (Stuntebeck et al., 2001).
- **Injection or Incorporation of Manure:** EGLE recommends injecting or incorporating all manure after land application. In addition to reducing bacterial contamination of surface waters, incorporation and injection are also recommended practices to keep nutrients on the field and reduce volatilization of valuable fertilizer (Atta, 2008). If manure cannot be incorporated, conservation practices (residue management, cover crops, perennial crops, etc.) should be used to protect against runoff and erosion losses to surface waters.
- **Tile Line Control Structures:** When manure is applied on tile-drained fields, water-level management through a tile outlet control is advised to minimize the contamination of surface water; however, these structures require active management and are not suitable for all soil types and fields. Tile line control structures can also be effective at containing manure discharges in case of misapplication of manure, thus minimizing environmental impacts.
- **Avoid Livestock Access to Streams:** EGLE recommends that livestock be excluded from surface waters. To aid in this, an alternate watering source could be provided to eliminate the need for livestock access to surface water as a drinking source. In the event that livestock need to cross a water body, EGLE recommends the construction of crossings that either prevent livestock access to surface waters or crossings that are designed to limit livestock access to the time it takes to move from one side of the surface water to the other. Controlled livestock crossings may not be sufficient to reduce or prevent *E. coli* contamination because they still allow animals to contact the water. Michigan GAAMPs state that livestock producers do have a right to utilize surface water, but only to the extent that it does not result in water quality degradation (MDARD, 2016).
- **Runoff Management:** To minimize or eliminate contaminated pasture or barnyard runoff, EGLE recommends practices to eliminate runoff from directly entering surface water. Planting and maintaining long-term vegetation (including wetland construction and restoration) will promote infiltration. Diversion of clean storm water away from manure storage and production areas is a very effective way to reduce polluted runoff.

- **Treatment of manure to reduce pathogen concentration.** Successful pathogen reduction (through methods such as composting, retention basins, or anaerobic digestion) will result in less potential for pathogens entering ground and surface waters (Unc and Goss, 2002).
- **Avoid manure applications on saturated ground** (MDARD, 2016).
- **Adequate Cover and/or Storage of Manure:** To avoid stockpiling manure in fields and the need to apply manure to saturated or frozen ground, it is recommended that all livestock farmers have a minimum of six months of covered or contained storage available to guard against this risk. This is not always feasible; alternatively, EGLE recommends not stockpiling on slopes or swales, near surface waters or groundwater recharge areas, and near drinking water wells.
- **Riparian Buffers:** Vegetated riparian buffers and grassed waterways (swales) can increase infiltration, and thereby reduce *E. coli*, pathogens, and other pollutants (Coyne et al., 1998; Lim et al., 1998). Manure should not be applied to grassed waterways, and having a buffer zone with no manure applied around surface water and grassed waterways is recommended. In no-till situations, a cover crop can be valuable to increase infiltration and reduce runoff where manure cannot be incorporated. In no-till situations where tiles are also present, drainage water management (through tile line control structures) is important to reduce contamination of surface water.

Online and Funding Resources:

- Michigan's Resource Conservation and Development Councils and the USDA Natural Resource Conservation Service (nrcs.usda.gov/)
- Michigan's County Conservation Districts (macd.org/)
- Michigan State University (MSU) Extension Specialists (msue.anr.msu.edu/experts)
- MAEAP Program (MAEAP.org)
- MDARD (Michigan.gov/MDARD) can provide you with more information on Michigan's GAAMPs and Right to Farm complaints and law, and MDARD staff contacts.
- Information on funding available for nonpoint source control, and guidance on BMP selection and installation may be found at Michigan.gov/NPS

7.4.B Failing, Aging, and Poorly-Designed On-Site Septic Systems

7.4.B.i Potential Sources (SA):

Failing or poorly-designed on-site septic systems are likely a significant source of *E. coli* to unsewered areas. Recent studies have found that between 40 to 80 percent of sampled sites in several Mid-Michigan rivers have had positive detections of human sewage, in areas that rely primarily on septic systems for sewage treatment (unpublished data from the Shiawassee and Clinton County Conservation Districts). Michigan has approximately 1.4 million septic systems, which serve about half of our state's population. The majority of the population using septic systems live in primarily rural areas, but there are many small towns in Michigan that do not have sanitary sewer service, and there are also neighborhoods in very urban areas that continue to rely on septic systems (Figure 30).

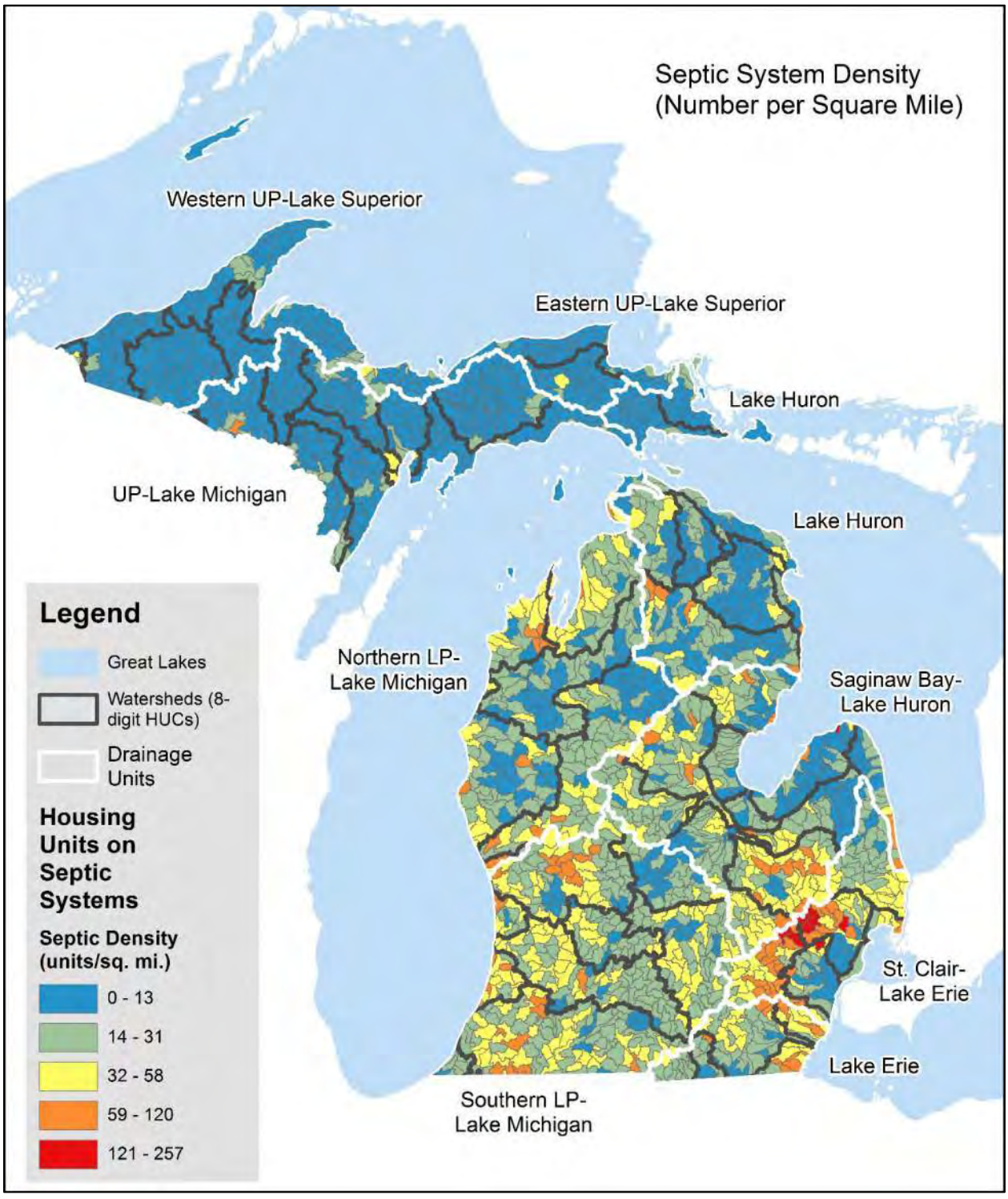


Figure 30. Estimated septic system density, in number per square mile. The number of septic systems was estimated by subtracting the number of housing units in known areas served by sanitary sewers, from the total number of housing units in each subwatershed.

A fully functioning, well designed, and maintained septic system is an acceptable way to treat and dispose of sanitary wastewater. Traditional septic systems are generally composed of several parts: tank(s) to contain liquid and solid waste and allow settling of solids, a drainage (adsorption) field where liquid wastewater infiltrates the ground, and a filter to keep solids from entering the drainage field. All three of these parts must be in good order for a septic system to function properly. The removal of bacteria occurs mainly in the adsorption field by filtration, which begins in the drainage field and continues down through the soil column, and mortality by exposure to an inhospitable environment and the time it takes for the wastewater to reach, and pass through, groundwater.

Local agencies report the probable causes of septic system failures to EGLE annually. Factors that may make septic systems ineffective include:

- Age – Older tanks and pipes may develop cracks, while filters and pores in drainage fields may get clogged with solids. System age is likely the ultimate cause of many of the failure types reported to EGLE by local agencies in 2014, including; soil clogging (17 percent of failures), tank failure (6 percent of failures), and damages to filter and piping systems (11 percent of failures) (MDEQ, 2015a). Housing built before the passage of environmental regulations (1970s) are more at risk for having old septic systems, tanks with no fields, or no systems at all. Septic systems installed in the 1970s are now at the end of their effective lifespans, and should be updated or replaced. Two-thirds of the housing units in Michigan were built before 1979 (Figure 31), and of the septic failures reported to EGLE in 2014, 45 percent were systems that were older than 25 years (24 percent were older than 40 years) (MDEQ, 2015a).

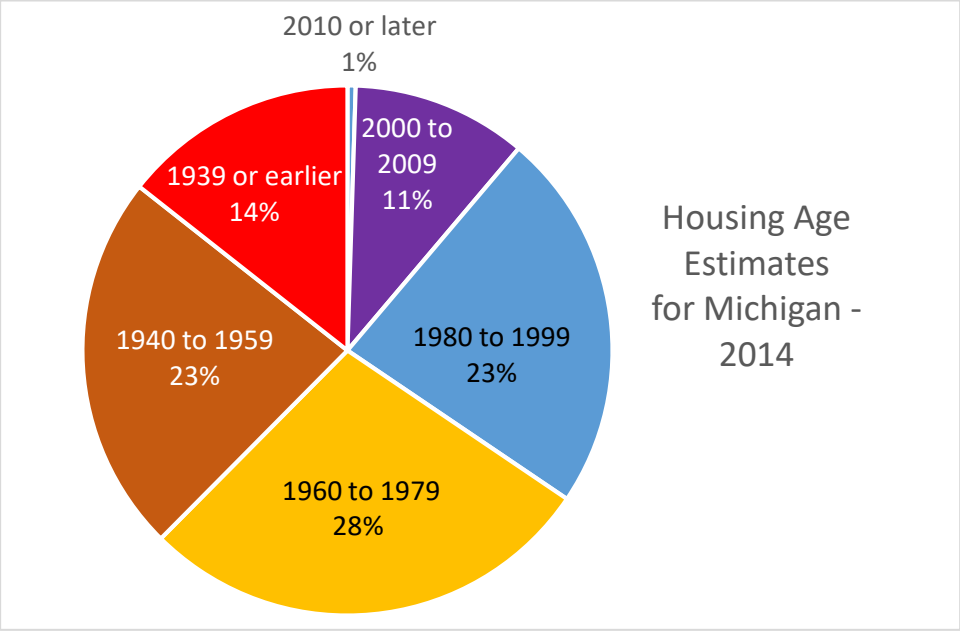


Figure 31. Estimates of the distribution of housing unit age for the state of Michigan (U.S. Census Bureau, 2014).

Factors that may make septic systems ineffective include (continued):

- *Land area is too small* – Some residential and commercial land parcels are too small to support an adequately-sized drainage field while maintaining required setbacks from surface water, drinking water wells, roads, parking areas and buildings.
- *Poor soils for drainage* – Soils beneath the drainage field may either drain too fast (allowing contamination of the shallow groundwater), or too slow (resulting in a failure of drainage and sewage on the surface of the ground). The drainage field may also be compacted over time by driving vehicles over it, or disturbed by tree roots growing through it. Approximately 87 percent of the land in Michigan is made up of soils that are poorly suited for on-site septic system adsorption fields (NRCS-USDA). Much of this area is undeveloped and is either natural or used for agriculture; however, about 4 percent of the low, medium, and high density developed land covers in Michigan are located on these types of soils. From a statewide perspective, this seems like a trivial amount, but on a local basis as much as 72 percent of the land area in a subwatershed has been developed and is located on these poorly suited soils.
- *Water table is too high*: The depth to water table (the depth at which you hit groundwater when digging), may be zero (at the surface) in some areas, especially in a wet season and areas that were formerly wetland or are floodplains. If wastewater cannot percolate down, the system is not performing the removal of pathogens. Insufficient isolation from the water table is reported to cause about 8 percent of septic system failures in Michigan (MDEQ, 2015a).
- *Maintenance:* Like system age, lack of maintenance is often a main cause of failure identified by local agencies.
    - Pumping: Septic tanks must be pumped in order to keep functioning. If a tank becomes too full of solids, the waste may be forced into the filter and drainage field without a chance to settle, resulting in the failure of the field. Pumping every two to five years is suggested (based on the size of the tanks, water usage, and number of people in the home), and at the time of pumping a cursory inspection can be done to look for some possible problems with the system, such as a clogged or dislodged filter (USEPA, 2005).
    - Vegetation: Trees, shrubs, or other deep-rooted plants may cause root intrusion into the field or tank, or may dislodge filters. Root intrusion is reported as a cause of failure in 9 percent of Michigan inspections (MDEQ, 2015a).
- *Hydraulic overload and undersized systems:* Hydraulic overload (too much water passing through the system) and undersized systems (systems too small for the number of people using the system), when considered together accounted for 25 percent of reported system failures in Michigan in 2014 (MDEQ, 2015a). The end result of both of these issues is too much waste for a system to function properly. Hydraulic overload on a properly designed system can be caused by leaking faucets, running toilets, or other problems that cause excessive water to enter the system.

7.4.B.ii Potential Solutions (RA):

Michigan does not have a unified statewide sanitary code with centralized regulatory authority over on-site septic systems (Sacks and Falardeau, 2004). Instead, Michigan regulatory code (Section 2435 of the Public Health Code, 1978 PA 368, as amended) gives local district health departments the authority to “adopt regulations to properly safeguard the public health and to prevent the spread of diseases and sources of contamination.” The state of Michigan does issue design criteria for on-site septic systems that are utilized by more than two homes and discharge 1,000 to 10,000 gallons per day (Michigan Department of Public Health, 1994). For systems that discharge less than 1,000 gallons per day, the system must be approved by the local health department in accordance with local sanitary code (R 323.2210 of the Part 22

rules). Local health departments must be accredited by the state in a process that involves evaluation every three years. More information on the accreditation process and minimum program requirements may be found at accreditation.localhealth.net. In general, there are five components to the accreditation process: maintain and enforce local sanitary code and applicable laws; inspect parcels (including size, setbacks, soil suitability, and seasonally high water table) prior to issuing/denying permits for new or replacement systems; inspect systems during or after construction prior to covering to ensure compliance with permit and applicable laws/codes; respond to and keep records of complaints; and collect data on the number of system failures and reasons for failure when replacement/repair permits are issued (Michigan Department of Public Health, 2016). EGLE summarizes the failure data into annual statewide reports, which may be found at Michigan.gov/EGLE, then search for "onsite wastewater."

In most areas of Michigan, septic systems for single residences are only inspected when new systems are constructed, or local permits are issued for repair or replacement. As of 2018, time-of-sale ordinances have been adopted at the local level by 10 counties, 8 townships and 1 village (Figure 32). These ordinances go above and beyond the normal requirements by ensuring that septic systems are in working order at the time of property sale or transfer. Not only is this beneficial to the new homeowner, who will have some assurance that their sewage treatment is working, it is beneficial to surface and groundwater quality because it prevents pollution that would otherwise go unnoticed. As an example, 602 sewage system failures were identified in the first three years of the Barry-Eaton District Health Department time-of-sale program (Pessell and Young, 2011). After 10 years with the program, the Heath Department identified 2,241 systems with serious issues (leaking tanks, unrecognizable systems, no system, sewage on the ground or illicit discharges) (Barry-Eaton District Health Department, 2017). A statewide sanitary code that included a time-of-sale program, or another mechanism for periodic inspection of septic systems, would help to minimize the impact of failing septics on water quality over time by finding problems and requiring repair or replacement.

The federal CWA Section 319 funding may provide additional septic system repair or replacement opportunities where eligibility requirements are met. Michigan's Nonpoint Source Program Plan can be found at Michigan.gov/NPS. The Program Plan establishes the criteria used by EGLE to determine project eligibility and priority and is updated every five years (including 2019). The 2019 draft Program Plan places emphasis on the responsible county or municipality having a comprehensive approach to finding and fixing failing on-site septic systems (e.g. time-of-sale ordinance). In addition to other requirements, the approved watershed management plans must cover an area that includes waters that are impaired by *E. coli*, must identify failing septic systems as a cause of the impairment, and identify priority locations for septic repairs or replacements.

The following voluntary activities are recommended as possible actions to be completed by local responsible agencies and organizations:

- Modify ordinances to include a periodic inspection mechanism for existing and new septics (such as time-of-sale).
- If applicable, modify existing on-site septic system isolation distances in local ordinances to treat open county drains as conservatively as other surface waters. Open county drains are waters of the state, and the same WQS apply.
- Educate residents on the importance of clean water to human health and the dangers of surface water contamination by raw sewage.
- Investigate on-site septic systems (with assistance from the local responsible agency), prioritizing in areas that are considered high risk; for instance, older housing or housing that is located on poor soils, or densely populated/small lots. Particular attention should be paid to small rural communities in unsewered areas, and unsewered cabins or homes

around lakes. Effort directed at aging or densely populated housing areas may be the most productive use of resources. Community-wide problems with failing septic systems may best be resolved through a comprehensive solution such as centralized or cluster wastewater treatment systems. Please see "Locating Priority Areas for Septic System Investigations" in Online Resources, below.

- Outreach to educate residents on the routine maintenance of a septic system and signs that their residence may have a failure.

Online Resources:

- TMDL Supplemental Resources: "Locating Priority Areas for Septic System Investigations" may be found at Michigan.gov/EcoliTMDL,
- Michigan's Onsite Wastewater Web site may be found at Michigan.gov/EGLE then search for "Onsite wastewater."
- Contact information for the local health departments may be found on the Michigan Department of Health and Human Services' Web site at Michigan.gov/MDHHS (search for "local health department map").
- USEPA Guide to Septic Systems may be found at epa.gov/septic.

Funding Resources:

- Federal funding and low interest loans may be available for small communities with wastewater issues through the USEPA, USDA Rural Development, and United States Department of Housing and Urban Development. These programs include State Revolving Funds (epa.gov/cwsrf), Water & Waste Disposal Loan and Grant Program, Hardship Grant Program for Rural Communities, and CWA Indian Set-Aside Program (for Tribes only). To search for opportunities that meet requirements and eligibility, please visit grants.gov.
- USEPA Guide to Funding Septic System Repair and Replacement may be found at epa.gov/septic/funding-septic-systems.
- Michigan Community Action agencies (https://mcac.memberclicks.net/) may be able to assist homeowners in need.
- The State of Michigan's Stormwater, Asset Management, and Wastewater (SAW) Program offers funding for municipalities and Tribes to manage, design, and implement their stormwater and wastewater assets. Visit Michigan.gov (search for "SAW Program"). Funding for this program varies annually, and may not be available in the future.
- EGLE Nonpoint Source Program Web site (Michigan.gov/NPS) contains helpful links for grant opportunities, watershed management planning, and technical guidance in implementation of nonpoint pollution reduction activities.



Figure 32. Counties and townships that have a time-of-sale ordinances, effective April 2018.

7.4.C Septage

7.4.C.i Potential Sources (SA):

Domestic septage is defined as the solids that settle out in an on-site septic system tank, which must be pumped and hauled away. Septage can be hauled to a licensed septage waste receiving facility for disposal and treatment, or land-applied at a site permitted by EGLE and utilized by crops as a fertilizer. Given the limited number and small size of these land application areas, and regulation of septage by EGLE, contamination of surface water is expected to be minimal, but could be locally important. As of 2017, there were 127 septage land-application sites that were approved (Figure 33) (MDEQ, 2017b).

The Septage Hauler Directory (https://www.egle.state.mi.us/shr/) is an online searchable database that allows users to locate approved land-application sites and search for information on specific licensed haulers and facilities that accept septage.

7.4.C.ii Potential Solutions (RA):

The licensing and handling of domestic septage is regulated under 2004 Public Act 381, which amended Part 117, Septage Waste Servicers, of the NREPA (1994 PA 451, as amended). EGLE's Drinking Water and Environmental Health Division administers the Septage Program with the assistance of participating county health departments. Provisions contained in Part 117 that protect surface and groundwaters from contamination by land-applied septage include: a prohibition of the application of septage on frozen ground and highly sloped land, isolation distances from surface water (150 feet from surface water for sub-surface injection or 500 feet for surface application), and a requirement for incorporation within 6 hours where possible. Stabilization or disinfection by lime is encouraged and is required if septage is applied to the land surface and cannot be incorporated within 6 hours. Land application sites are annually inspected by EGLE staff for indications of runoff or other issues that may pose a risk to surface waters or human health. All the above provisions will minimize or eliminate the potential for contamination of surface waters by septage land-application.

Several counties and townships have elected to ban the land-application of septage within their boundaries. EGLE is not always notified when this occurs, but to our knowledge, at the time this document was written, the following counties and townships had banned the practice: Barry, Grand Traverse, Jackson, Livingston, and Muskegon Counties, and Ash (Monroe County), Centerville (Leelanau County), Locke (Ingham County), and Milton Townships (Cass County) (personal communication with Matthew Campbell, Drinking Water and Environmental Health Division, Environmental Health Section, June 11, 2015).

Information on the Michigan Septage Program (including staff contacts, laws and rules, and the Septage Hauler Directory) may be found at https://www.egle.state.mi.us/shr/

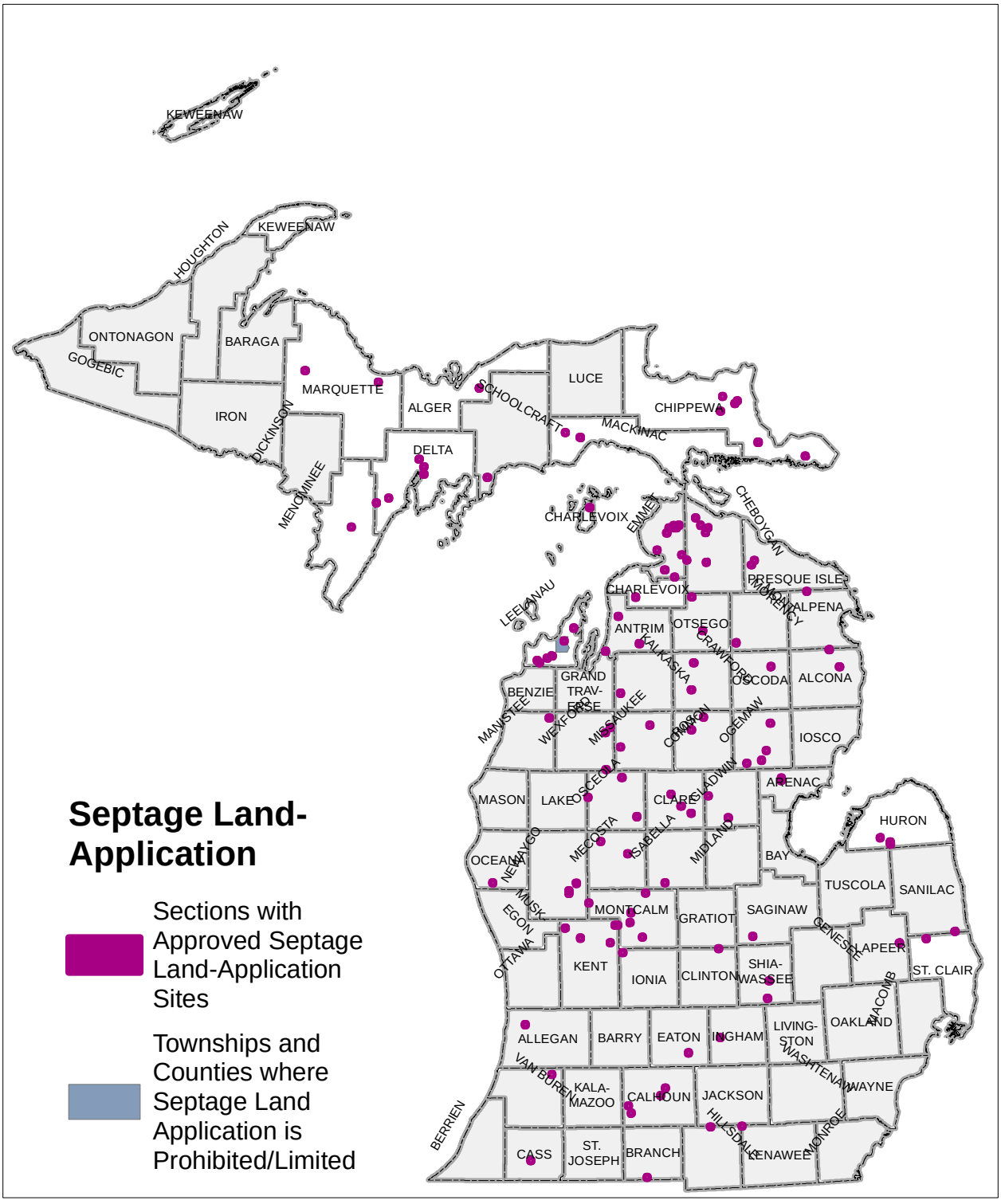


Figure 33. Areas where land-application of septage had been approved in 2017, and counties and townships where EGLE is aware of local ordinances that prohibit or limit septage land applications.

7.4.D Groundwater Discharges

7.4.D.i Potential Sources (SA):

In addition to the NPDES wastewater treatment facilities that discharge to surface water, groundwater discharges are common in Michigan. EGLE Groundwater Program regulates the discharge of wastewater to groundwater under Part 31. In 2015 there were about 252 facilities that discharged sanitary wastewater to the groundwater, including municipalities, parks, schools, commercially operated mobile home parks and subdivisions, and groups of homes (MiWaters database, access date: November 19, 2015). Groundwater discharges are a popular option for mobile home communities, subdivisions, and condominiums (110 facilities present in 2015), but publicly owned and operated systems exist too. Approximately 132 of these are publicly owned municipal wastewater treatment facilities, some of them serving large populations.

7.4.D.ii Potential Solutions (RA):

The purpose of groundwater discharge permits is to ensure that groundwater quality is maintained for all of the protected uses of groundwater pursuant to Section 3109 of Part 31. Properly designed and operated sanitary groundwater treatment systems provide treatment of bacteria and other contaminants by filtration through the ground and cause bacterial mortality through the long travel time between the discharge and groundwater. Therefore, these groundwater discharges are not expected to be a source of *E. coli* to surface water. Occasionally, older or poorly designed groundwater treatment systems may fail, causing surface water to become contaminated. Thus, they remain a potential (although uncommon) source of *E. coli* to surface water.

7.4.E Pets

7.4.E.i Potential Sources (SA):

Pet waste left in yards, parks, or streets is a potential source of *E. coli*. If runoff carrying pet waste enters a regulated municipal or industrial storm sewer, it then contributes to a point source discharge. But if the waste enters surface waters of the state without passing through a regulated system, it is considered a nonpoint source.

Dogs: According to the American Veterinary Medical Association, an average of 37.2 percent of households own dogs, and households with dogs have an average of 1.7 dogs (American Veterinary Medical Association, 2007). Using these statistics, EGLE estimates that there are 2.4 million dogs in Michigan, using occupied housing units from the 2010 Census. Dog parks are outdoor areas designated for walking dogs, and are frequently located near surface water. Storm sewers serving dog parks, parks where people frequently walk dogs, boarding or veterinary kennels, and residences that are near surface water are also of special concern.

Cats: Feral and outdoor cats are a potential source and that should be considered in any effort to reduce contamination by encouraging people to clean up after their pets and reduce populations of feral animals. Another possible way for cat feces to become a surface water issue is if an owner of an indoor cat were to dump used cat litter outside, rather than sending it to a landfill. A study of storm water discharging to the Huron River (in Michigan) found that cats can significantly contribute to *E. coli* in storm water, and therefore surface water (Ram et al., 2007).

Poultry, horses, goats, and other livestock kept as pets: As summarized in the nonpoint source livestock section (Section 7.4.A), backyard poultry are allowed in an increasing number of Michigan cities, and are often considered to be pets in residential areas because the eggs are not sold commercially. Frequently a household may have a few horses, goats, or pigs that are kept as pets. Increasingly, as with poultry, this is being allowed in more urban areas. These animals should be considered a potential source of *E. coli* especially when bacterial source tracking results in urban areas indicate the presence of livestock waste in surface water.

7.4.E.ii Potential Solutions (RA):

EGLE requires MS4 permittees to detect and eliminate sources of pet waste to the regulated MS4 as part of its IDEP as well as promote proper disposal practices for animal waste as part of its PEP. For areas that are not regulated MS4s, EGLE recommends outreach by local agencies and watershed groups to educate residents on proper pet waste management, and discouraging the congregation of feral animals. Some situations could be addressed with BMPs (such as rain gardens) to divert contaminated run-off away from surface waters and provide treatment by storage, infiltration or settling.

Dogs: EGLE encourages local units of government to adopt pet waste ("pooper scooper") ordinances where none exist, and enforcement and education where ordinances are in place. Ordinances may be developed to ensure that both public and private property do not accumulate pet feces. For an example of a pet waste ordinance, see the city of Plymouth, Michigan's ordinance number 2002-02, Sections 14-26 and 14-27. For parks and residential areas, EGLE recommends tall vegetation to discourage dogs from getting close to surface water or storm retention ponds. Dense and shrubby vegetation may help to discourage dogs from entering riparian areas, and any vegetation with well-established roots will provide some filtration and will also help reduce stream bank erosion. EGLE recommends pet waste stations to provide access to pet waste disposal options.

Cats: Discouraging the congregation of feral cats can be done by reducing their accessibility to food by local enforcement of proper garbage disposal, and creating and enforcing local ordinances regarding pet waste cleanup. If it is found that feral animals are contributing to *E. coli* issues, then reducing numbers of feral cats through humane capture, shelters, voluntary spay/neuter programs, and re-homing may be a potential solution.

Poultry, horses, goats, and other livestock kept as pets: Many local municipalities are developing and modifying existing ordinances to allow small backyard livestock holdings in residentially zoned areas, such as four or fewer laying hens. Backyard chicken-keeping is a growing trend in Michigan (personal communication with Dr. Darrin Karcher, MSU Extension, April 28, 2015), and at least 31 cities have adopted or modified existing ordinances to allow chicken-keeping in residentially zoned areas, including (but not limited to) large cities such as Ann Arbor, Pontiac, Holland, Lansing, and East Lansing (Backyard Chicken Keepers of Michigan, 2012). To protect municipal regulated and unregulated storm water, and surface waters of the state from fecal contamination, ordinances should take into account waste management and prohibit the improper disposal of animal waste. MSU Extension has published a bulletin providing guidance on ordinance development, which is available through their Web site (Karcher et al., 2010) (msue.anr.msu.edu).

7.4.F Wildlife

7.4.F.i Potential Sources (SA):

All wildlife may potentially contribute to an *E. coli* problem. In watersheds dominated by forested land and wetlands, *E. coli* is typically low, demonstrating that ambient wildlife at non-nuisance populations are unlikely to cause an *E. coli* problem (see Section 5.2); however, humans can modify landscapes in several ways that can potentially encourage wildlife to congregate at nuisance levels. Examples include planting crops that inadvertently attract, shelter, and feed wildlife, mowing riparian areas, installing storm sewers without animal-exclusion devices, or leaving trash exposed. Below is some specific information on common animals that have been known to cause issues when they congregate at or near surface water:

Raccoons: Raccoons prefer wooded areas near surface water, but are highly adaptable creatures that have taken advantage of urban and suburban sources of food and shelter (Baldwin, 2014). A study of storm water discharges to the Huron River found that raccoons can contribute significantly to *E. coli* in storm water, and therefore surface water (Ram et al., 2007). In this case, the most likely scenario is that raccoons were inhabiting the storm sewer pipes. Urban blight removal, or urban renewal projects, may also have a positive impact by reducing available habitat for nuisance raccoons.

Geese: Canada geese demonstrate a preference for riparian areas that have been mowed, or cleared, so that they can have a clear view of predators. Because of this tendency, they can significantly contribute to local *E. coli* issues at or downstream of parks, cemeteries, golf courses, or residential areas. Geese and other waterfowl may also congregate directly on beaches, defecating directly into the water or on the beach. The goose population in Michigan generally has increased from 1991 to 2014, but for practical purposes, given the large fluctuations in the estimates, it has been stable from around 1996-2014 (Figure 34).

Seagulls: Seagulls by nature are scavengers that congregate near water where food is abundant. This is especially true at beaches, but also in commercial parking lots and parks. Scraps from human food are particularly inviting.

Deer: Deer, like geese and raccoons, have taken advantage of human modification of the landscape. A correlation of the amount of agricultural land and the estimated number of deer in the deer management units (r^2=0.53) found that in Michigan, generally, the highest numbers of deer occur in the areas with the highest amount of agricultural land cover. Calhoun County is estimated to have the most deer in Michigan in the south central Lower Peninsula, with approximately 44,000 deer in 2010 (Figure 35). In Calhoun County, deer are still outnumbered by humans (population of 136,008), and cattle and hogs, of which there are about 46,600 (U.S. Census Bureau, 2012 and USDA, 2014). In the state as a whole, the Michigan Department of Natural Resources (MDNR) estimates that there were approximately 1.7 million deer in 2010 (MDNR, 2016). Deer may congregate in urban parks, residential areas, and farm fields (especially with edible crop residues, such as sugar beets and corn).

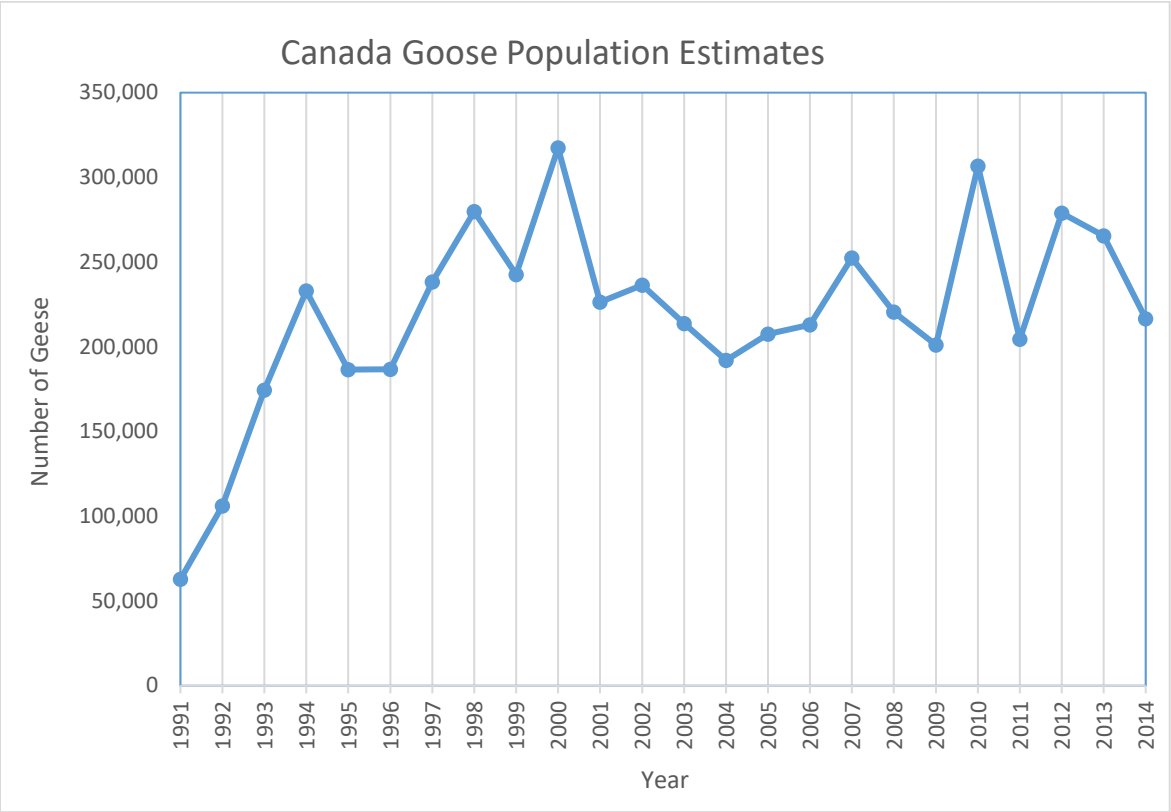


Figure 34. Canada goose population estimates for the State of Michigan from 1991-2014 (Luukkonen, 2014).

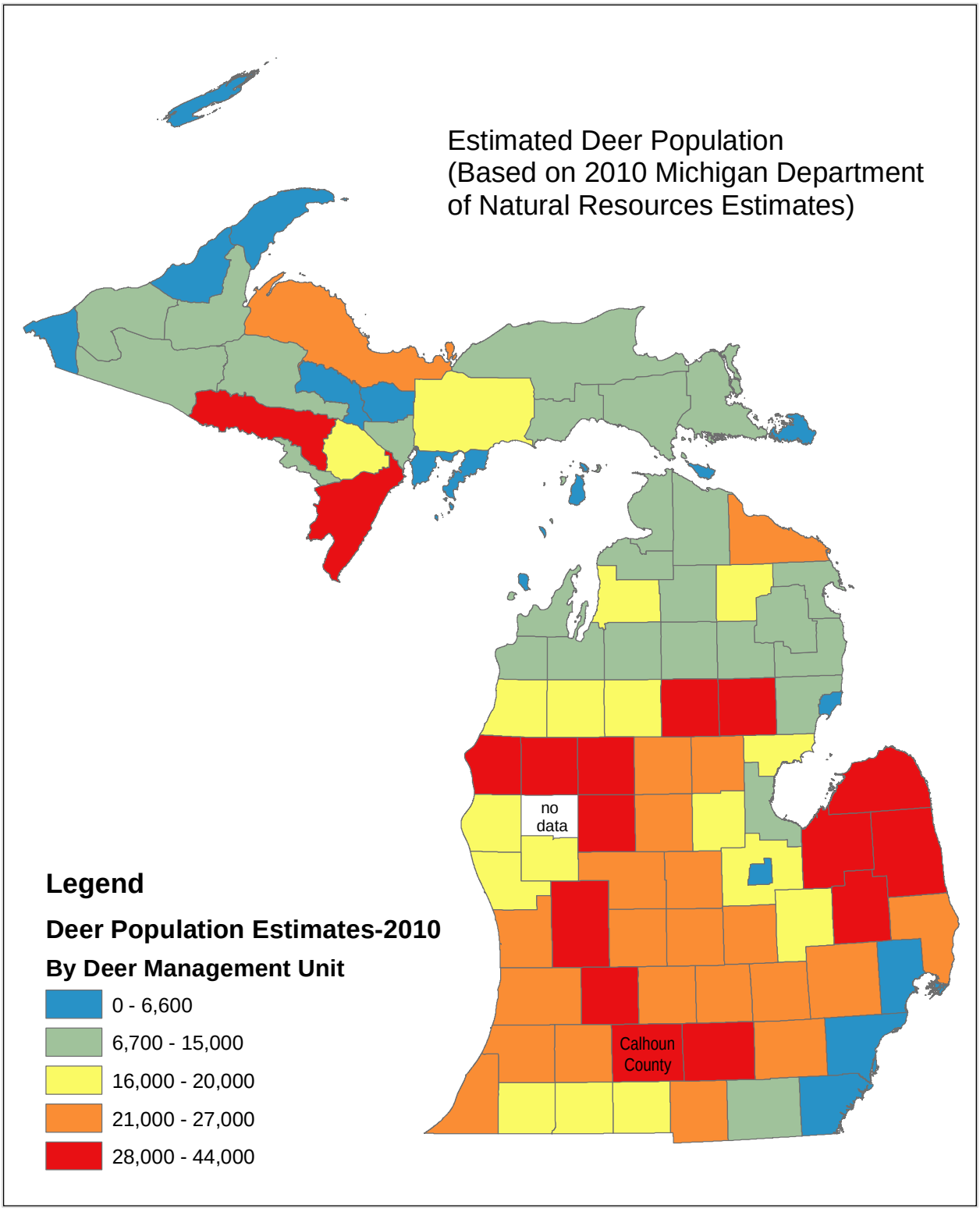


Figure 35. Estimated deer population in 2010 by deer management unit (source: unpublished data provided by the MDNR, Wildlife Division, March 2016). Deer management units are often

individual counties, but may also be defined in other ways including following the boundaries of state or federal managed land.

7.4.F.ii Potential Solutions (RA):

EGLE recommends that local agencies and watershed groups reach out to educate residents, businesses, and farmers on proper waste management to eliminate food sources for nuisance wildlife, projects that promote infiltration (reducing pollutants in contaminated runoff), and discouragement of congregating nuisance animals. Below are some specific recommendations for discouragement and management of deer, raccoons, and geese:

Raccoons:

- Educate residents on reducing food and shelter opportunities for raccoons. Trash can lids can be secured by tying them down; staking receptacles upright also can prevent them from being tipped over and spilling. Unkempt woodpiles and outbuildings that are not sealed provide shelter for raccoons.

- Raccoons in urban areas can be a nuisance, and in addition to pathogen contamination of surface waters, they may be a health hazard to humans as disease carriers (e.g., rabies). Therefore, municipalities may wish to consider trapping and removing animals to control populations.

- Some field tiles and storm sewers may be capped with grates to exclude larger wildlife from inhabiting the pipes.

Deer:

- Avoid attracting deer to riparian areas by not feeding or baiting deliberately, or leaving excessive deer-friendly crop residue (such as sugar beets after harvest) near waterways. Natural riparian vegetation in riparian areas sometimes attracts deer, but the importance of this habitat for pollutant filtration, deterring geese (see below), and as habitat for other native animals, outweighs the slight risk of attracting animals.

Geese:

- Discourage the congregation of geese in riparian areas (such as parks, cemeteries, and golf courses) using tall and dense vegetation where possible. This diminishes short (mowed) green grass cover, which geese prefer for foraging because it provides an unobstructed view. The goal is to displace foraging geese by creating an unfavorable environment, while creating a favorable environment for people to enjoy as well, such as a garden. Shoreline buffers can be incorporated into municipal landscaping plans for public lands and adopted on private lands voluntarily or through zoning code requirements.

- Trained canines can be hired to scare off geese in areas where open space needs to be maintained, such as a beach. One prominent example is the National Park Service hiring dogs to scare geese off of the National Mall in Washington, D.C (Sherwood, 2015).

- Swan and dog decoys are hypothesized to frighten geese away before they land.

Seagulls:

- Reducing seagulls on the beach should focus on not attracting the animals with human food scraps or natural beach debris. Beach managers should evaluate their waste management to ensure that ample trash cans are present, receptacles are covered, and emptied frequently. Removing natural debris and trash that could attract seagulls may be helpful. Similar to geese, trained canines may help to deter seagulls (McGrath, 2014). Policies against feeding wildlife, or signage on the implications of feeding wildlife, might also be effective in minimizing the impact of seagulls.

7.5 ILLEGAL SOURCES

Illegal sources exist without a permit, and have not necessarily been discovered. Illegal sources include SSOs, illicit sanitary discharges, and barn wash-water. Issues that have been documented and are being acted upon by EGLE can be obtained from MiWaters Site Explorer (miwaters.deq.state.mi.us).

7.5.A Sanitary Sewer Overflows (SSOs) and Failing Collection Systems

7.5.A.i Potential Sources (SA):

Separate sanitary sewers are designed to carry only sanitary sewage to a WWTP; storm water is directed to a nearby river, wetland, lake, or stream via storm sewers. Edwin Chadwick is credited as the first engineer to advocate the complete separation of storm water from sewage systems, as early as 1842 (Metcalf and Eddy, 1913). His reasoning, that the frequency, intensity, and spacing of rainstorms is too unpredictable to allow cost effective planning in designing sewage systems, still stands today. New combined sewer construction in Michigan came to a halt in the 1960s, and separate sanitary sewers became the norm for new construction at that time (MDEQ, 2007).

Collection systems are often composed of an extensive series of pipes and pumping stations, both above and below ground that collect untreated sewage and gray water for transport to the treatment facility. This infrastructure does have a finite lifetime, and much like aging septic systems, all infrastructure eventually fails. As an example of how the sewer systems of Michigan are aging, 25 percent of the 18,000 miles of sewer lines in southeast Michigan were built before 1940, and 38 percent were built between 1941 and 1969 (SEMCOG, 2001). In the 1870s the Michigan Pipe Company in Bay City, Michigan, began the mass manufacture of wooden sewer pipes of pine and tamarack logs that were used throughout Michigan and the rest of the mid-west (Schladwieler, 2016). During infrastructure improvement projects, these wooden pipes are occasionally still found to be in use throughout Michigan.

SSOs are discharges of raw or inadequately treated sewage from sanitary sewer systems that are designed to carry domestic sanitary sewage only. These overflows may also contain industrial wastewater that is present in the sewer system. During 2017, there were 287 SSO events reported for a total SSO volume of approximately 394 million gallons (MDEQ, 2017a).

There are two types of SSOs; chronic and isolated. Isolated SSOs occur occasionally due to mechanical or electrical equipment failure. Chronic or recurring SSOs are usually related to large precipitation events but may occur due to one of several issues:

- Capacity and Design: A community can outgrow its sewer system, and due to expansion and population growth, there can be too much sewage going into the sewer system. Or, alternatively, a sewer system may have been designed improperly. Occasionally, gutters from buildings or sump drains are also connected to the sanitary sewer, creating capacity issues.
- Condition: Old sanitary collection systems can be cracked or broken, and even damaged by tree roots. Deterioration of sanitary sewers can be due to age. This leakiness can allow groundwater and storm water to infiltrate the sanitary sewer lines. The influx of water into the system can cause it to overflow when capacity is exceeded. Sanitary lines can be blocked by sediment or material building up, causing backups.

All SSO discharge events that are reported to EGLE, as required by law, are documented in MiWaters. The database is searchable by water body or responsible entity and will give users information such as volume and condition of the discharge (treated, partially treated, untreated, etc).

7.5.A.ii Potential Solutions (RA):

SSOs are illegal and often constitute a serious environmental and public health threat. In recent years, there has been much effort by municipalities across the state and EGLE to identify chronic SSO facilities and correct the issues that lead to the SSO discharges. Similar to CSOs, there is no perfect measure of progress statewide. The number of gallons discharged per year is one measure, but since SSOs occur mainly due to wet weather events, this can be misleading during years where precipitation is higher than average. Additionally, the sewer systems that were installed decades ago are reaching the end of their design life. So, unlike CSOs, new problems will emerge as other problems are remedied. Figure 36 shows the number of SSO events by year, illustrating the lack of a clear trend in these incidents.

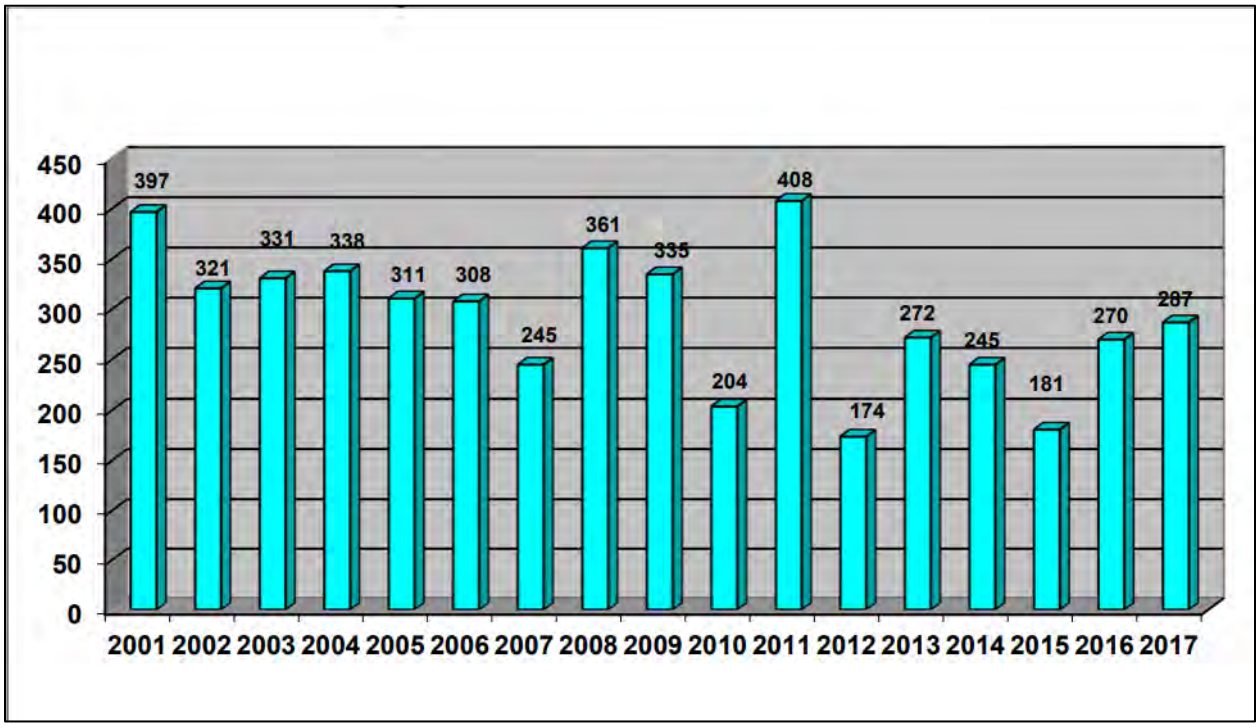


Figure 36. Number of SSO events by year (MDEQ, 2017a). SSOs are often related to wet weather (for example, 2012 was a dry year and few events were reported).

EGLE has broad statutory and regulatory authority to deal with SSOs and leaking sanitary sewage collection systems under Part 31. Municipalities are responsible for the control of the all sewage generated within the municipality, according to Part 31: 323.6(2) "The discharge of any raw sewage of human origin, directly or indirectly into any of the waters of the state shall be considered prima facie evidence of a violation of this act by the municipality in which the discharge originated unless the discharge shall have been permitted by an order or rule of the commission."

The construction and planning for sewerage systems is regulated in Part 41 (Michigan.gov/Part41). Additionally, Part 41, Rule 55, requires proper operation and maintenance of wastewater systems in a manner that will minimize upsets and discharges of excessive pollutants.

EGLE has developed an SSO policy and clarification statement to address SSOs. The policy states that sewer systems should be able to function properly during a 24-hour storm of an intensity that occurs once every 25 years (under growth conditions, normal soil moisture, and specified distribution), without having an SSO. When SSOs are a chronic problem in a community, EGLE will require the responsible entity to implement corrective action programs within a defined "schedule of compliance." The corrective action program outlines how the SSOs will be eliminated or treated, and the schedule of compliance will be embodied in a compliance document. Frequently, EGLE works to achieve a voluntary settlement. These settlements are often embodied in permits or Administrative Consent Orders. If a voluntary settlement is not achieved, then a schedule of compliance will often be sought through litigation resulting in a court order or court judgment. Many communities with known chronic SSOs are currently under corrective action programs in accordance with the SSO Policy and Clarification Statement, to meet state and federal SSO correction requirements. EGLE continues to work with municipalities across the state to correct SSOs as they are identified.

The identification of the causes of SSOs and the cost of the remedy (often replacing old pipes) can be very burdensome on municipalities. In fact, a USEPA report concluded that Michigan has $3.7 billion in wastewater infrastructure needs over the next 20 years (USEPA, 2008a). Therefore, EGLE makes every attempt to balance the human health and environmental concerns with flexibility of the schedule of the corrective program taking into account the financial burden, environmental gain from the SSO elimination project, and funding available to the municipality.

To ensure that municipalities are planning for their future infrastructure needs, and aid them in the care of their sanitary collection systems and facilities, Michigan includes asset management program language in all major municipal WWTP NPDES permits. The requirements of an asset management program function to achieve the goals of effective system performance, adequate funding, and adequate operator staffing and training. Asset management is a planning process for ensuring that financial resources are available to rehabilitate and replace infrastructure when necessary. Additionally, EGLE awards grants and loans for storm water and wastewater asset management plan development, storm water management plan development, sewage collection and treatment plan development, and state-funded loans to construct projects identified in an asset management plan or storm water management plan. These grants are referred to as SAW grants and more information may be found on EGLE Web site (Michigan.gov) by searching for “SAW Program.”

Funding for infrastructure upgrades has been identified as a gap that must be filled, and the urgency is increasing. Finalized in 2016, the Water Strategy is a 30-year plan to protect, manage, and enhance Michigan's water resources for current and future generations. According to the Water Strategy, “the state needs to implement a long-term strategy to sustain state water programs, including funding to maintain critical regulatory oversight programs, water quality monitoring, and provide assistance to communities for local water infrastructure” (MDEQ, Office of the Great Lakes, 2016).

When an SSO involves raw or partially treated sewage being released into a river, lake, or stream, the responsible party is required to notify the local health department and others as specified in the law. The local health department may sample, or may require the responsible party to sample, the water body that received the sewage discharge. If the discharge poses a public health threat, then the local health department is responsible for issuing a public health advisory to notify people of the dangers associated with river or lake water contact.

In 2010, an EGLE workgroup issued recommendations to improve the implementation of our programs (MDEQ, 2010b). One recommendation was to enact a permitting system for sewage collection systems that do not operate a WWTP but contribute to another municipality that does operate a WWTP. As a result of this effort, WWTP facilities with NPDES permits now must identify the municipalities that contribute to their sanitary sewer collection systems.

The searchable database, MiWaters, documents the specific response by the SSO discharger, and corrective actions being taken by EGLE. The CSO/SSO annual reports, contact information for CSO/SSO expert EGLE staff, SSO policy statement, and relevant legislation can be found on Michigan.gov/SewageDischarge.

7.5.B Illicit Discharges of Raw or Partially Treated Sewage from Private Residences and Buildings

7.5.B.i Potential Sources (SA):

Discharges of raw sewage, while illegal, do occur to storm sewer systems, roadside ditches, the ground surface, field drainage tiles, or directly to surface waters of the state. The topic of illicit

connections to regulated municipal storm sewers is addressed in Section 7.3.A (MS4 Permits). In rural areas, illicit discharges are often referred to as “cheater pipes” because instead of routing sewage from the household plumbing to a septic system with a filter and adsorption field, a pipe takes sewage and wastewater directly to ditches, hillsides, or surface water. Illicit discharges of raw sewage can occur anywhere, so the location is difficult to predict; therefore, this TMDL does not provide a map of this potential source. Illicit discharges may occur more commonly in areas where soils are unsuitable for septic system adsorption fields, or where the property size is too small for a septic system, and a more expensive engineered system would be necessary. Raw sewage is an acute health hazard to those who come into contact with it, and all illicit discharges should be reported to EGLE or local health department.

Small communities with no centralized sanitary wastewater treatment system are a significant issue in rural Michigan. Downtown business districts often have no room for septic systems and were constructed with sanitary waste connected to storm sewers, ditches, or underground tanks. These tanks may have been constructed with frequent pumping in mind, to dispose of the waste properly (referred to as “pump and haul” systems); however, given that the average three-bedroom home for a family of four produces 400 gallons per day of waste, pumping may need to occur almost daily (USEPA, 2008b). This is not a practical option and may lead to laundry and sink wastewater being illegally rerouted away from the tank, and to the ground surface or nearby surface water to save on pumping fees. Residences in these small communities may not have room for septic systems either, given the small lot sizes and the legally required setbacks from property lines, drinking water wells, roads, and buildings. Pump and haul systems are considered appropriate as a temporary option only, when there are no on-site options or public sewer available, but a long-term solution is in progress (such as, a sewer is being installed).

Some types of illicit discharges are particularly difficult to find; these include connections to agricultural drainage field tiles which can be located very far from surface water (a half-mile or more). A discharge to a field tile or underground drain may only enter surface water during times of high water tables or after a rainfall large enough to make the tile flow. Therefore, these illicit discharges could be wet-weather sources but their effect on ambient *E. coli* may be diluted making them difficult to identify. Alternatively, if the field tile flows all the time, they could also be a dry weather source of *E. coli.* Due to water usage variations over time, these discharges may be intermittent and may appear as a nonflowing pipe at times. Discharges directly to surface water (rather than to ditches or tiles) would be considered dry and wet-weather sources and would be a likely cause of consistently high *E. coli* concentrations (Table 7).

Although exact numbers are difficult to estimate, occupancy of housing units without running water is another potential source of *E. coli*. This risk may be especially prevalent in urban areas with high concentrations of vacant and abandoned housing that are being illegally occupied. Occupancy of vacant houses or encampments without running water may lead to improper disposal of waste products to land or storm drains.

7.5.B.ii Potential Solutions (RA):

Illicit discharges to MS4s are the responsibility of the permittee, and as described in Section 7.3.A, the IDEP requires permittees to develop a program to find and eliminate illicit connections and discharges to their MS4. Unpermitted discharges of pollutants to waters of the state (illicit discharges), whether direct or indirect, are illegal in the State of Michigan. Section 3109(1) of Part 31 states that a person shall not directly or indirectly discharge into the waters of the state a substance that is or may become injurious to public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other uses that may be made of such waters. Section 3109(2) specifically prohibits the discharge of raw sewage of human origin, directly or indirectly, into any of the waters of the state. The municipality in which that

discharge originates is responsible for the violation when it originates from four or more on-site wastewater treatment systems, unless the discharge is regulated by an NPDES permit issued to another party. The elimination of illicit discharges of raw human sewage to the waters of Michigan will remove a public health threat.

EGLE is committed to the elimination of illicit discharges to uphold our mission of protecting public health, by working with local municipalities and health departments to find economically feasible solutions in a timely fashion. These solutions are expensive for small communities with few residents or businesses to share the cost. It also takes considerable time to implement the solutions due to engineering of the proposed new treatment systems, raising funds to pay for the projects, and negotiating with local politics and public opinion. Rural loans may be available to help small communities plan and construct wastewater treatment systems (see "Funding Resources" in Section 7.4.A0). CWA Section 319 funding (or matching funds in Section 319 grant) cannot be used to fix illicit discharges.

Time-of-sale septic, or other periodic inspection programs, are useful for locating illicit discharges, in addition to finding other types of sewage system failures that are a threat to public health. For example, of the 602 sewage system failures that were identified in the first three years of the Barry-Eaton District Health Department time-of-sale program, 136 were illicit discharges or tanks without adsorption fields (Pessell and Young, 2011). By the 10th year of the program, the Health Department had identified 455 illicit discharges and an additional 222 residences/businesses without a sewage system (Barry-Eaton District Health Department, 2017).

The following voluntary activities are recommended for local agencies:

- Adopt a periodic inspection program, such as time-of-sale.
- Outreach to educate residents on the signs that their residence may have improper connections to a sanitary or storm sewer or a surface water body.
- Educate residents on the importance of clean water to human health and the dangers of surface water contamination by raw sewage.

Raw sewage is an acute health hazard to those who come into contact with it, and all illicit discharges should be reported to EGLE or the local health department.

To report an illicit discharge of sewage:

- Contact your local health department. Contact information may be found at Michigan.gov/MDHHS, then search for "local health department map."
- Alternatively, EGLE accepts anonymous complaints through MiWaters: miwaters.deq.state.mi.us.

7.5.C Other Illegal Discharges

7.5.C.i Potential Sources (SA):

During occasional inspections of farms, a commonly found issue is contaminated water from milk house parlors or livestock washing barns, discharging to storm drains, ditches, tile drainage or surface water. These discharges are illegal and when found by MDARD staff, they are reported to EGLE and promptly addressed. Other scenarios include, but are not limited to; washing stations at livestock showing areas (fairs), wash-water or runoff from livestock auction houses or manure hauling equipment, and waste from kennels.

7.5.C.ii Potential Solutions (RA):

All unpermitted discharges of pollutants to waters of the state (illicit discharges), whether direct or indirect, are illegal in the State of Michigan. Section 3109(1) of Part 31 states that a person shall not directly or indirectly discharge into the waters of the state a substance that is or may become injurious to public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other uses that may be made of such waters.

There is no regulatory mechanism to justify the MDARD or EGLE routinely inspecting unpermitted farms or other livestock areas. Inspections are generally the result of complaints or a farm facility applying for MAEAP verification.

Illegal discharges from facilities that have an NPDES permit will be handled by EGLE through the compliance and enforcement processes. Complaints may be submitted through MiWaters (miwaters.deq.state.mi.us).

8. FUTURE

8.1 FUTURE MONITORING

EGLE will continue to perform several types of *E. coli* monitoring, as follows:

1. Continue assessing waters that are unassessed for the TBC and PBC designated uses. EGLE will continue to make progress on assessing unassessed waters at a pace that is reasonable given our available resources and extensive river miles and lake acres. Our current pace is approximately two percent of our river miles every two years, but much of this progress is reliant on funding that is diminishing (such as Beaches Environmental Assessment and Coastal Health Act and Clean Michigan Initiative funding). EGLE assessment progress also relies on data submitted by external partners (local health departments, conservation districts, watershed organizations, other state, local, or federal agencies, and Tribes). If local partners are interested in submitting data to assist in this effort, the data should be collected using EGLE or USEPA-approved methods; for more information on data collection you may contact EGLE, WRD (Michigan.gov/EcoliTMDL). Waters that are found to be not attaining the TBC and PBC designated uses, pursuant the most recently approved assessment methodology, will be added to this TMDL as described in Section 1.2.
2. Post-TMDL implementation monitoring to guide restoration activities. EGLE recognizes that minimal datasets exist for many of the water bodies included in this TMDL. The existing amount of *E. coli* data are enough to establish that the water body is impaired, and needed a TMDL, but are not likely enough to determine with confidence the locations of needed BMPs for nonpoint source implementation. Following the approval of this TMDL, EGLE will focus existing monitoring resources in one or more of the TMDL water bodies each year (as resources allow). In these priority areas, monitoring may be

directed toward identifying sources of *E. coli* using microbial DNA techniques, obtaining more *E. coli* concentrations over a longer period of time and over various conditions (such as dry or wet weather), conducting watershed source inventories, or establishing flow patterns for the development of load duration curves. The WRD intends to give priority to areas of the state that are used most heavily for recreation, and where local governments and agencies show a commitment to solving problems through action. EGLE will consider factors such as public access to water bodies, established water trails, and areas used heavily for swimming, fishing, wading or paddling. In addition, surface waters with drinking water intakes will be given priority status. Because documenting success is important to EGLE, the restoration potential of a water body will also be considered. This includes considering the size of the upstream area, the complexity of sources, and severity of the problem.

3. Demonstration of restoration success or progress. Future monitoring to document restoration success will take place as resources allow, once actions have occurred to address sources of *E. coli.* When the results of these actions indicate that the water body may have improved, sampling will be conducted at the appropriate frequency to determine if the WQS are being met.

The WRD will continue to consider other factors to determine where to monitor, restore and implement efforts, including the Michigan Surface Water Monitoring Strategy (Roush, 2017), and stakeholder input. One way to provide this input is to submit a targeted monitoring request through EGLE's Web site at: Michigan.gov/WaterQuality. The monitoring requests may be submitted by anyone, and are evaluated based on available funding, sampling rationale, and the State of Michigan's priorities for assessment and restoration.

Any future data collected by EGLE will be accessible to the public via the *E. coli* mapping system (Michigan.gov/EcoliTMDL) and by request.

8.2 PLANNING FOR FUTURE CHANGE

It is important to recognize that land cover, land uses, and human population in Michigan are constantly changing, while our related geographic datasets are only updated every five to ten years.

Between the United States decennial census of 2000 and 2010, the population of Michigan fell, but the population is projected to grow slightly in the future and 2014 estimates indicate that population is rebounding (Section 2.3). As *E. coli* concentrations are related to human population density (Section 5.2), areas with population growth may experience some declines in water quality related to increased human habitation.

Likewise, agricultural land covers have a statistically significant positive relationship to *E. coli* concentrations in Michigan watersheds (Section 5.2). Agricultural land covers are increasing in some areas of Michigan (Section 2.2 and Figure 5), resulting in an increase of nonpoint sources such as livestock and manure spreading, and wildlife attracted to cultivated areas. In areas where the increases are notable, such as Northern Lower Peninsula - Lake Michigan, Saginaw Bay, and Lake Huron drainage units, some local declines in water quality can be expected but can be minimized with land planning (such as requiring unfarmed vegetated riparian buffers through a local ordinance).

Climate change is also expected to affect the delivery of *E. coli* to Michigan waters. Great Lakes Integrated Science and Assessments (GLISA) examined and summarized available climate data from long-term weather records throughout Michigan, as well as available predictive climate models for the future (Great Lakes Integrated Science and Assessments, 2014). Between the years 1900 and 2012, GLISA found that actual observed changes include

an average increase in temperature by 2 degrees Fahrenheit (F), an increase in annual precipitation by 11 percent, and an increase in the frequency and intensity of high magnitude precipitation events.

Current climate models predict several changes that may affect contamination of surface water by *E. coli* in the future. Climate models vary, but generally predict a further 1.8 degree F increase in temperature by 2050 (GLISA, 2014). The amount of precipitation falling in high magnitude precipitation events increased by 37 percent from 1958-2012. These large and intense storm events can cause an increase in wet weather *E. coli* concentrations by allowing contamination to accumulate on the land during a dry period, then flushing the pollution from the land and storm sewers into surface water. The intensity of these storms, sometimes on the magnitude of six inches in several hours, does not allow time for rainwater to infiltrate into the soil, resulting in more runoff and high peak flows in rivers. Additionally, SSOs and CSOs have a tendency to occur during heavy and intense storms due to excessive amounts of water entering the systems either by the storm sewers in combined systems, or through infiltration in separated sewer systems.

The exact changes we may see in the flows of Michigan rivers are unknown, but possible scenarios include lower base flows during the summer due to increased evaporation and transpiration (evaporation through plants) from warmer temperatures, interspersed with extremely high flows following the increased magnitude storm events (GLISA, 2014). Lower base flows may have the effect of increasing the *E. coli* concentrations in areas where dry weather, or constant sources (such as failing septic systems or illicit discharges), are present. Surface waters may also be warmer with the increasing air temperatures and lower base flows. Once *E. coli* is in the ambient surface water, the effects of water temperature on the survival of *E. coli* are unknown; some studies have shown that *E. coli* in nonsterile river water can survive six days at 37° C (98.6° F), eight days at 20° C (68° F), and longer in lower temperatures (Bogosian et al., 1996). EGLE's WCMP *E. coli* study (described in Section 5.1) found that *E. coli* is highest in the July sampling event (typically the warmest month of the year). Additionally, a slight positive relationship was found between *E. coli* concentration and water temperature statewide ($r = 0.30$, P value < 0.001); however, in this study the watershed land cover (the amount of agricultural land, forested land, etc.) appeared to have a much more significant influence over *E. coli* concentration than water temperature (Appendix 4.3). Low flow conditions occurring simultaneously with the warmer temperatures of mid-summer make the effects impossible to separate.

Perhaps more important than the direct effect of temperature on *E. coli* in water, increased air temperatures are predicted to increase the length of the agricultural growing season (GLISA, 2014). This may contribute to agricultural activity moving further north, into areas that were previously not suitable or profitable. Preserving the integrity of vegetated riparian buffers in these areas can help to ensure water quality does not degrade.

Regardless of the causes for the changes in weather patterns, trends toward larger intense storms and warmer temperatures have been observed and are expected to continue. Planning for change now can minimize issues and costs in the future. Several Michigan cities are leaders in reevaluating their infrastructure in response to anticipated changes in weather patterns. EGLE acknowledges the increase in high intensity storm events, and stresses the importance of holistic watershed-based approaches to preserve our water resources. This may be accomplished by increasing capacity to infiltrate storm water, reduce untreated sewer overflows, and reduce runoff and pollutants in runoff (MDEQ, Office of the Great Lakes, 2016).

EGLE's Nonpoint Source Program's vision is to restore impaired waters and protect high quality waters threatened by nonpoint source pollution and causes of impairment. The Nonpoint Source Program Plan outlines a series of goals, objectives, strategies and short-term action

necessary to achieve this vision (MDEQ, 2015a). The plan is updated every two to three years, and the most recent version can be found on Michigan.gov/NPS. The 2015 plan addressed the potential impacts of climate change on water quality and plant hardiness zone changes on BMPs to reduce nonpoint source pollution. The plan notes that between 1990 and 2006, plant hardiness zones shifted about half a zone northward. This shift means that plants and trees that once did well in an area may no longer flourish, indicating that the plant composition of vegetated BMPs should be modified as the climate warms to include more heat tolerant, and fewer cold adapted species; for example, using red maple instead of sugar maple. Also, because of the documented increase in storm intensity, the design criteria for storm events in BMP design should also be reevaluated periodically (MDEQ, 2015a).

9. IMPLEMENTATION PROCESS

NPDES permit-related point source discharges are regulated as determined by the language contained within each permit, and they must be consistent with the goals and assumptions of this TMDL (see Section 7.3). The implementation of nonpoint source activities to reach the goal of attaining the WQS is largely voluntary, unless the source is found to be contributing significantly to a water quality impairment, or is illegal (Sections 7.4 and 7.5). TMDL implementation may include additional monitoring and source identification work, which can be conducted by EGLE or other interested persons or organizations (see Section 8.1). Funding for nonpoint source TMDL implementation activities may be available on a competitive basis through federal CWA Section 319 grants for TMDL implementation and watershed planning and management activities (Section 7.4). To illustrate ongoing progress in addressing *E. coli* impairments, EGLE is providing success stories related to *E. coli* TMDLs, including examples of complete remediation of the *E. coli* impairment and also examples of gradual progress measured by the installation of best management practices (BMPs) for nonpoint sources. EGLE is also providing implementation guidance documents, including suggestions on conducting watershed-based source surveys and remote sensing techniques. All implementation guidance documents and success stories are available on Michigan.gov/EcoliTMDL.

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Appendix 1. Impaired Water Bodies and Percent Reductions

This appendix contains a list of water bodies that are covered by the Statewide *E. coli* TMDL. Future biennial updates of the Sections 303(d), 305(b), and 314 Integrated Report will include an addendum intended to update this appendix, as summarized in Section 1.2 of the Statewide *E. coli* TMDL, and described in more detail in Appendix 2.

For each water body in the attached list, the ultimate water quality goal is to meet the requirements for removal contained in the Assessment Methodology Section of the most recently approved Integrated Report. The data summarized for each water body segment includes all sample results that are readily available, and may not contain the exact dataset that was used in making the initial impairment decision (pursuant the assessment methodology at the time the decision was made). The information in columns 3-12 of this appendix is provided for informational purposes only, to assist stakeholders in determining the magnitude of the problem in their water body.

In order to give stakeholders an overview of the water quality in the impaired waters, the attached table provides the following:

Column 1 - AUID - Michigan uses the National Hydrography Dataset to organize and identify water bodies for the Section 303(d) and 305(b) lists. A base assessment unit is a 12-digit HUC, which may be split further into smaller assessment units depending on information such as land use, known areas of contamination, specific fish consumption advisories, physical barriers such as dams, etc. Each assessment unit is assigned a numeric identifier (AUID) and may consist of all water bodies in a 12-digit HUC (as a maximum) or specific stream segments or lakes located in that HUC. AUIDs may also be lakes or points, such as in the case of clearly defined and monitored bathing beaches or public water supply intakes.

Column 2 - Water Body Type - AUIDs can be beaches, rivers/streams, lakes, public water supply intakes, or shorelines.

Column 3 - n (number) - Number of daily geometric means that were used in the calculation of Column 4 (geometric mean of all data in each AUID). The data for all sites in an AUID are combined for the total number of daily geometric means.

Column 4 - Geometric mean of all *E. coli* data in each AUID (river segment, lake or beach). Geometric mean of all available data within the AUID. This value is used for calculating column 5 (percent reduction) for informational purposes only, but is not used in evaluating attainment status for assessment purposes. This number cannot be compared to the daily or 30-day WQS, since it contains data from more than one day and potentially more than one 30-day period. Data are only included if they meet the criteria of three or more individual samples during the same sampling event.

Column 5 - Percent Reduction - This value, provided for informational purposes, represents the amount of reduction that would be necessary for the geometric mean of all data (Column 4) to reach the 300 *E. coli* per 100 mL daily threshold. Attaining this reduction does not necessarily mean that the water body will be removed from the TMDL. The assessment methodology contained in the most recently approved Integrated Report determines the criteria for removal of a water body from the impairment status. In some cases, the percent reduction is not provided because the geometric mean in Column 4 was less than the 300 *E. coli* per 100 mL daily threshold. In all cases, the water quality goal is to meet the threshold for removal of the

impairment using the assessment methodology in the most recently approved Integrated Report.

Column 6 - Number of 30-Day Geometric Means - Number of 30-day geometric means that were calculated, and used in the calculation of Column 7 (Percent 30-Day Exceedance). If 30-day geometric means were not calculated when the data were submitted to EGLE, then this value may be 0.

Column 7 - Percent 30-Day TBC Exceedance - Percent of available 30-day geometric means (Column 6) that are exceeding the threshold of 130 *E. coli* per 100 mL. If only one 30-day geometric mean is available, this value will be 0 or 100%.

Column 8 - Percent Daily TBC Exceedances - Percent of daily geometric means ("n", Column 3) that exceed the 300 *E. coli* per 100 mL threshold.

Column 9 - Percent PBC Exceedance - Percent of daily geometric means ("n", Column 3), that exceed the 1,000 *E. coli* per 100 mL threshold.

Column 10 - Interstate Waters - Inland waters that flow directly in or out of Michigan, from other states, are flagged with the direction of flow and the state involved; for example, waters marked "From Indiana" leave Indiana and enter Michigan. Waters are only flagged if EGLE has evidence of an impairment that extends to our border.

Column 11 - Code - This column contains notes that are unique to the water body:

> Data: The summary for this water body is based on a small dataset ($n < 5$) but is supported by a larger dataset ($n > 5$) from a nearby contiguous and comparable AUID.
>
> Declining WQ (Water Quality): These water bodies, typically beaches, have large datasets where older data show few exceedances of the WQS, but newer data show an impairment according to the most current Assessment Methodology in the Integrated Report.
>
> Raw Sewage: Water bodies are listed as impaired based on the presence of raw sewage in surface water.
>
> Reissue: This water body is already in a USEPA approved *E. coli* TMDL, and that TMDL is being revoked and reissued. Once this TMDL or Addenda is approved by the USEPA, this water body will be part of the statewide TMDL.

Column 12 – Cycle First Listed - This column contains the Integrated Reporting cycle year where the waterbody was first listed as not attaining the TBC designated use. Each biennial submittal of the Integrated Report contains a description and guidance on data requirements to list an AUID as impaired.

Appendix 1. Assessment Units Impaired by E. coli and included in this TMDL

Column 1: Assessment Unit	Column 2: Type	Column 3: n	Column 4: Geometric Mean (E. coli)	Column 5: % Reduction	Column 6: # of 30-Day Geometric Means	Column 7: % 30-day TBC Exceedance	Column 8: % Daily TBC Exceedance	Column 9: % Daily PBC Exceedance	Column 10: Interstate Waters	Column 11: Code	Column 12: Year 1st Listed
Watershed	04020203	Waiska									
Subwatershed	040202030105	Waiska Creek-Frontal Lake Superior									
040202030105-02	Beach/Launch	168	51		148	26%	17%	4%	No		2014
Watershed	04040001	Little Calumet-Galien									
Subwatershed	040400010101	Painterville Drain-Frontal Lake Michigan									
040400010101-05	River	3	1,244,542	100.0%	0		100%	100%	No	Raw Sewage	2016
040400010101-09	River	6	575	47.8%	2	100%	67%	17%	No		2014
Subwatershed	040400010102	White Ditch-Frontal Lake Michigan									
040400010102-01	River	5	1,002	70.1%	1	100%	100%	40%	Yes		2016
Subwatershed	040400010206	South Branch Galien River									
040400010206-02	River	102	586	48.8%	78	100%	86%	20%	Yes		2014
Watershed	04050001	St. Joseph									
Subwatershed	040500010111	Coldwater River									
040500010111-06	Beach/Launch	18	52		14	21%	22%	0%	No		2008
Subwatershed	040500010305	Bear Creek									
040500010305-01	River	91	274		0		48%	15%	No		2010
Subwatershed	040500010505	Indian Lake-Portage River									
040500010505-03	River	27	1,075	72.1%	1	100%	89%	63%	No		2008
Subwatershed	040500012508	Blue Creek-Paw Paw River									
040500012508-01	River	13	451	33.5%	2	100%	69%	8%	No		2008

Column 1: Assessment Unit	Column 2: Type	Column 3: n	Column 4: Geometric Mean (E. coli)	Column 5: % Reduction	Column 6: # of 30-Day Geometric Means	Column 7: % 30-day TBC Exceedance	Column 8: % Daily TBC Exceedance	Column 9: % Daily PBC Exceedance	Column 10: Interstate Waters	Column 11: Code	Column 12: Year 1st Listed
Watershed	04050002	Black-Macatawa									
Subwatershed	040500020405	Bosch and Hulst Drain									
040500020405-02	Beach/Launch	17	147		11	45%	18%	0%	No		2008
Subwatershed	040500020408	Macatawa Bay									
040500020408-02	Beach/Launch	186	120		134	39%	28%	10%	No		2006
Watershed	04050003	Kalamazoo									
Subwatershed	040500030405	Rice Creek									
040500030402-01	River	5	511	41.3%	1	100%	100%	0%	No		2016
040500030405-01	River	5	511	41.3%	1	100%	100%	0%	No		2016
040500030405-02	River	4	588	49.0%	0		75%	50%	No	Data	2016
Subwatershed	040500030505	Headwaters Augusta Creek									
040500030505-01	River	48	129		0		25%	2%	No		2012
Subwatershed	040500030506	Augusta Creek									
040500030506-01	River	64	136		0		19%	0%	No		2012
Subwatershed	040500030603	Portage Creek									
040500030603-05	River	6	1,849	83.8%	0		100%	100%	No		2010
Subwatershed	040500030604	Davis Creek-Kalamazoo River									
040500030604-02	River	10	1,534	80.4%	0		100%	80%	No		2008
040500030604-03	River	10	1,534	80.4%	0		100%	80%	No		2008
Subwatershed	040500030606	Averill Lake-Kalamazoo River									
040500030606-04	River	12	1,106	72.9%	0		100%	58%	No		2010
Subwatershed	040500030701	Gun Lake-Gun River									
040500030701-06	Beach/Launch	152	26		104	13%	9%	2%	No		2014
040500030701-13	River	35	737	59.3%	7	100%	89%	31%	No		2016

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Watershed	04050004	Upper Grand									
Subwatershed	040500040705	Sandstone Creek-Grand River									
040500040705-03	River	21	369	18.7%	13	100%	62%	10%	No		2016
Subwatershed	040500040706	Frayer Creek-Grand River									
040500040706-03	River	30	601	50.1%	18	100%	67%	23%	No		2016
Subwatershed	040500040707	Winchell and Union Drain-Sebewa Creek									
040500040707-01	River	20	352	14.9%	12	100%	60%	20%	No		2016
Subwatershed	040500040708	Sebewa Creek									
040500040708-01	River	50	220		30	80%	58%	4%	No		2016
Subwatershed	040500040709	Cryderman Lake Drain-Grand River									
040500040709-02	River	30	791	62.1%	18	100%	87%	40%	No		2016
Watershed	04050005	Maple									
Subwatershed	040500050101	Spring Brook-Maple River									
040500050101-01	River	10	605	50.4%	2	100%	100%	10%	No		2014
Subwatershed	040500050102	Coon Creek-Bear Creek									
040500050102-01	River	6	677	55.7%	0		100%	0%	No		2014
Subwatershed	040500050104	Little Maple River									
040500050104-01	River	10	383	21.7%	0		70%	20%	No		2014
Subwatershed	040500050105	Ovid-Maple River									
040500050103-01	River	12	411	27.1%	1	100%	83%	0%	No		2014
040500050103-02	River	12	411	27.1%	1	100%	83%	0%	No		2014
040500050104-02	River	12	411	27.1%	1	100%	83%	0%	No		2014
040500050105-01	River	12	411	27.1%	1	100%	83%	0%	No		2014
040500050105-02	River	12	411	27.1%	1	100%	83%	0%	No		2014
040500050105-03	River	12	411	27.1%	1	100%	83%	0%	No		2014

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Subwatershed	040500050207	Pine Creek									
040500050205-01	River	5	416	27.9%	1	100%	60%	20%	No		2014
040500050205-02	River	5	416	27.9%	1	100%	60%	20%	No		2014
040500050205-03	River	5	416	27.9%	1	100%	60%	20%	No		2014
040500050205-04	River	5	416	27.9%	1	100%	60%	20%	No		2014
040500050206-01	River	5	416	27.9%	1	100%	60%	20%	No		2014
040500050207-01	River	11	1,406	78.7%	1	100%	82%	55%	No		2014
040500050207-02	River	6	6,636	95.5%	0		100%	83%	No		2014
Subwatershed	040500050303	County Ditch No 131									
040500050303-01	River	5	706	57.5%	1	100%	100%	20%	No		2014
Subwatershed	040500050305	Middle Fish Creek									
040500050305-03	River	5	626	52.1%	1	100%	100%	0%	No		2014
Subwatershed	040500050306	Lower Fish Creek									
040500050301-01	River	5	490	38.8%	1	100%	100%	20%	No		2014
040500050301-04	River	5	490	38.8%	1	100%	100%	20%	No		2014
040500050302-01	River	5	490	38.8%	1	100%	100%	20%	No		2014
040500050304-01	River	5	490	38.8%	1	100%	100%	20%	No		2014
040500050305-02	River	5	490	38.8%	1	100%	100%	20%	No		2014
040500050306-02	River	5	490	38.8%	1	100%	100%	20%	No		2014
Subwatershed	040500050401	Spaulding Drain									
040500050401-01	River	5	731	58.9%	1	100%	100%	20%	No		2014
Subwatershed	040500050402	Bad Creek									
040500050402-01	River	5	538	44.2%	1	100%	100%	0%	No		2014
Subwatershed	040500050403	Holden Drain-Stony Creek									
040500050403-01	River	15	293		2	100%	47%	33%	No	Data	2014

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Subwatershed	040500050404	Muskrat Creek									
040500050404-01	River	5	657	54.3%	1	100%	100%	0%	No		2014
Subwatershed	040500050405	Kloeckner and Fuller Creek-Stony Creek									
040500050401-02	River	5	211		1	100%	40%	0%	No		2014
040500050405-01	River	10	449	33.2%	2	100%	70%	20%	No		2014
040500050406-01	River	5	211		1	100%	40%	0%	No		2014
040500050406-02	River	5	211		1	100%	40%	0%	No		2014
040500050406-03	River	5	211		1	100%	40%	0%	No		2014
Subwatershed	040500050501	South Fork Hayworth Creek									
040500050501-02	River	6	718	58.2%	0		67%	33%	No		2010
Subwatershed	040500050503	Hayworth Creek									
040500050202-03	River	5	512	41.4%	1	100%	80%	0%	No		2014
040500050501-01	River	5	512	41.4%	1	100%	80%	0%	No		2014
040500050502-01	River	5	512	41.4%	1	100%	80%	0%	No		2014
040500050502-02	River	5	512	41.4%	1	100%	80%	0%	No		2014
040500050502-03	River	5	512	41.4%	1	100%	80%	0%	No		2014
040500050503-01	River	8	354	15.2%	1	100%	50%	0%	No		2014
040500050503-02	River	6	808	62.9%	0		100%	33%	No		2014
040500050503-03	River	6	997	69.9%	0		100%	50%	No		2014
Subwatershed	040500050505	Maple River									
040500050207-03	River	5	451	33.5%	1	100%	60%	20%	No		2014
040500050504-01	River	5	451	33.5%	1	100%	60%	20%	No		2014
040500050505-01	River	5	451	33.5%	1	100%	60%	20%	No		2014

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Watershed	04050006	Lower Grand									
Subwatershed	040500060101	Clear Lake-Black Creek									
040500060101-01	River	5	542	44.7%	1	100%	80%	20%	No		2016
Subwatershed	040500060103	Townline Creek-Flat River									
040500060103-01	River	5	125		1	0%	0%	0%	No		2016
Subwatershed	040500060104	Mud Lake-Flat River									
040500060104-01	River	10	263		2	100%	50%	0%	No		2016
Subwatershed	040500060105	Hunter Lake-Flat River									
040500060105-02	River	10	174		2	50%	30%	0%	No		2016
Subwatershed	040500060106	Alder Creek Drain-Black Creek									
040500060106-01	River	23	576	47.9%	4	100%	74%	43%	No		2016
Subwatershed	040500060107	Clear Creek									
040500060107-01	River	26	566	47.0%	18	100%	69%	31%	No		2016
Subwatershed	040500060108	Coopers Creek									
040500060108-03	River	5	934	67.9%	1	100%	100%	60%	No		2016
Subwatershed	040500060201	Wabasis Creek									
040500060201-01	River	7	100		1	100%	14%	0%	No		2016
Subwatershed	040500060202	County Farm Pond-Dickerson Creek									
040500060202-05	River	9	219		1	100%	22%	11%	No		2016
Subwatershed	040500060204	Long Lake									
040500060204-01	River	5	471	36.3%	1	100%	60%	40%	No		2016
Subwatershed	040500060205	Dickerson Creek									
040500060205-01	River	5	689	56.5%	1	100%	100%	40%	No		2016
Subwatershed	040500060206	Sanderson Lake-Flat River									
040500060108-01	River	5	370	18.8%	1	100%	60%	0%	No		2016

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040500060109-01	River	5	370	18.8%	1	100%	60%	0%	No		2016
040500060206-01	River	5	370	18.8%	1	100%	60%	0%	No		2016
040500060206-02	River	5	200		1	100%	0%	0%	No		2016
Subwatershed	040500060207	Seely Creek									
040500060207-04	River	5	801	62.5%	1	100%	80%	60%	No		2016
Subwatershed	040500060209	Flat River									
040500060208-01	River	5	150		1	100%	20%	0%	No		2016
040500060209-01	River	23	106		4	75%	17%	0%	No		2016
040500060209-02	River	5	579	48.2%	1	100%	80%	20%	No		2016
Subwatershed	040500060503	Mill Creek									
040500060503-03	River	12	466	35.7%	4	100%	75%	17%	No		2016
Subwatershed	040500060511	Rush Creek									
040500060511-02	River	18	597	49.8%	3	100%	83%	11%	No		2016
Subwatershed	040500060705	Ottawa Creek-Grand River									
040500060705-02	Beach/Launch	163	98		103	38%	22%	7%	No		2008
Subwatershed	040500060712	Grand River									
040500060712-01	River	16	104		12	33%	13%	0%	No		2008
Watershed	04050007	Thornapple									
Subwatershed	040500070101	Butternut Creek									
040500070101-01	River	4	419	28.4%	0		75%	50%	No	Data	2016
Subwatershed	040500070104	Fish Creek-Little Thornapple River									
040500070104-01	River	21	954	68.6%	13	100%	95%	38%	No		2016
Subwatershed	040500070105	Hayes Drain-Thornapple River									
040500070102-01	River	16	776	61.3%	12	100%	94%	38%	No		2016
040500070105-01	River	20	733	59.0%	12	100%	90%	35%	No		2016

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Subwatershed	040500070206	Scipio Creek-Thornapple River									
040500070201-01	River	16	658	54.4%	12	100%	94%	19%	No		2016
040500070203-01	River	16	658	54.4%	12	100%	94%	19%	No		2016
040500070206-02	River	16	658	54.4%	12	100%	94%	19%	No		2016
Subwatershed	040500070208	Mud Creek									
040500070208-01	River	21	224		13	100%	24%	5%	No		2016
Subwatershed	040500070209	High Bank Creek									
040500070209-03	River	16	600	50.0%	12	100%	88%	19%	No		2016
Subwatershed	040500070211	Thornapple Lake-Thornapple River									
040500070211-03	River	32	89		24	46%	13%	3%	No		2016
Subwatershed	040500070405	Duncan Creek									
040500070405-03	River	16	473	36.6%	12	100%	69%	13%	No		2016
Watershed	04060101	Pere Marquette-White									
Subwatershed	040601010201	North Branch Lincoln River									
040601010201-01	River	8	296		1	100%	50%	0%	No		2016
Watershed	04060102	Muskegon									
Subwatershed	040601020104	Houghton Lake									
040601020104-03	Beach/Launch	123	33		71	1%	7%	1%	No		2008
040601020104-04	Beach/Launch	22	50		13	23%	9%	5%	No	Declining WQ	2006
040601020104-05	Beach/Launch	88	23		48	0%	8%	1%	No	Declining WQ	2008
Watershed	04060104	Betsie-Platte									
Subwatershed	040601040305	Crystal Lake Outlet									
040601040305-02	River	18	316	5.0%	3	100%	56%	0%	No		2016
040601040305-05	Beach/Launch	33	13		22	0%	9%	0%	No		2016
040601040305-06	River	3	634	52.7%	0		67%	67%	No	Data	2016

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Watershed	04060105	Boardman Charlevoix									
Subwatershed	040601050305	Torch Lake									
040601050305-02	River	5	200		1	100%	20%	0%	No		2016
040601050305-03	River	5	108		1	0%	20%	0%	No		2016
Subwatershed	040601050702	Birch Lake-Frontal Grand Traverse Bay									
040601050702-04	River	26	582	48.4%	4	100%	69%	23%	No		2008
Watershed	04080101	Au Gres-Rifle									
Subwatershed	040801010307	Au Gres River									
040801010307-01	River	13	175		1	100%	31%	0%	No		2016
Subwatershed	040801010501	Plains Creek-Big Creek									
040801010501-01	River	9	674	55.5%	1	100%	89%	22%	No		2016
Subwatershed	040801010503	Schnitzelbank Creek-Frontal Lake Huron									
040801010503-01	Beach/Launch	138	16		94	12%	7%	2%	No		2014
040801010503-02	Beach/Launch	178	23		117	11%	8%	1%	No		2016
040801010504-02	Beach/Launch	226	82		142	41%	20%	2%	No		2008
Subwatershed	040801010504	Mason Creek-Frontal Lake Huron									
040801010504-04	Beach/Launch	135	26		69	3%	7%	1%	No	Declining WQ	2014
Watershed	04080102	Kawkawlin-Pine									
Subwatershed	040801020105	Saganing River									
040801020105-01	River	46	143		30	60%	37%	11%	No		2016
Subwatershed	040801020201	Kawkawlin Creek-North Branch Kawkawlin River									
040801020201-01	River	4	317	5.5%	0		75%	0%	No	Data	2016
Subwatershed	040801020203	Dingman Drain-Kawkawlin River									
040801020203-01	River	11	169		7	57%	27%	9%	No		2016

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Subwatershed	040801020204	Culver Creek-Kawkawlin River									
040801020204-01	River	29	119		20	30%	14%	3%	No		2016
Subwatershed	040801020205	North Branch Kawkawlin River									
040500030401-01	River	14	263		10	100%	43%	0%	No		2016
040801020205-01	River	14	263		10	100%	43%	0%	No		2016
040801020205-02	River	84	125		51	53%	25%	5%	No		2016
Subwatershed	040801020206	Kawkawlin River									
040801020206-02	River	15	66		10	20%	20%	0%	No		2016
040801020206-03	River	48	82		28	29%	19%	6%	No		2016
Watershed	04080103	Pigeon-Wiscoggin									
Subwatershed	040801030304	Pinnebog River									
040801030304-01	River	48	300		2	100%	52%	23%	No		2010
Watershed	04080104	Birch-Willow									
Subwatershed	040801040205	Mill Creek-Frontal Lake Huron									
040803000001-26	Beach/Launch	25	43		12	0%	32%	28%	No	Raw Sewage	2008
Subwatershed	040801040207	Milwaukee Creek-Frontal Lake Huron									
040801040207-01	Beach/Launch	239	22		179	1%	6%	0%	No	Declining WQ	2014
040801040207-02	Beach/Launch	244	14		174	1%	7%	1%	No	Declining WQ	2014
040801040207-11	Beach/Launch	228	17		160	3%	7%	1%	No	Declining WQ	2014
040801040207-12	Beach/Launch	238	21		161	4%	7%	1%	No	Declining WQ	2014
Watershed	04080201	Tittabawassee									
Subwatershed	040802010201	Middle Branch Cedar River-Cedar River									
040802010201-01	River	10	144		6	33%	10%	10%	No		2016
Subwatershed	040802010203	Wiggins Lake-Cedar River									
040802010203-01	River	10	174		6	100%	10%	0%	No		2016

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040802010203-07	River	10	174		6	100%	10%	0%	No		2016
Watershed	04080202	Pine									
Subwatershed	040802020202	Lake Issabella-Chippewa River									
040802020202-01	River	20	132		16	75%	5%	0%	No		2014
Subwatershed	040802020206	Hogg Creek-North Branch Chippewa River									
040802020205-02	River	14	924	67.5%	10	100%	71%	43%	No		2014
040802020205-03	River	14	924	67.5%	10	100%	71%	43%	No		2014
040802020206-01	River	16	763	60.7%	10	100%	69%	38%	No	Raw Sewage	2014
040802020206-03	River	14	924	67.5%	10	100%	71%	43%	No		2014
Subwatershed	040802020207	Johnson Creek-Chippewa River									
040802020204-01	River	15	118		11	73%	7%	0%	No		2014
040802020207-02	River	19	88		11	73%	5%	0%	No		2014
Subwatershed	040802020310	Coles Creek									
040802020310-01	River	5	479	37.4%	1	100%	80%	0%	No		2016
Subwatershed	040802020311	Honeryoey Creek									
040802020311-01	River	28	491	38.9%	16	100%	89%	11%	No		2016
Subwatershed	040802020312	Newark and Arcadia Drain-Pine River									
040802020309-01	River	23	329	8.8%	16	100%	61%	0%	No		2016
040802020312-01	River	64	187		42	67%	34%	0%	No		2016
Subwatershed	040802020501	Mission Creek-Chippewa River									
040802020501-01	River	12	417	28.1%	6	100%	50%	33%	No		2014
Watershed	04080203	Shiawassee									
Subwatershed	040802030108	Lake Ponemah-Shiawasee River									
040802030108-01	Beach/Launch	141	11		102	4%	1%	1%	No	Declining WQ	2012

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Subwatershed	040802030209	Deer Creek-Shiawassee River									
040802030209-02	River	54	102		37	41%	13%	0%	No		2008
Watershed	04080205	Cass									
Subwatershed	040802050103	Gerstenberger Drain-South Branch Cass River									
040802050103-01	River	32	339	11.4%	24	100%	50%	9%	No		2014
Subwatershed	040802050106	Stony Creek-South Branch Cass River									
040802050106-02	River	5	3,394	91.2%	1	100%	80%	80%	No	Raw Sewage	2008
Subwatershed	040802050302	Perry Creek									
040802050302-01	River	47	387	22.5%	27	100%	68%	6%	No		2012
040802050302-03	River	5	544	44.9%	1	100%	100%	20%	No		2012
Subwatershed	040802050303	Millington Creek-Cass River									
040802050303-01	River	14	447	32.9%	2	100%	64%	21%	No		2014
Subwatershed	040802050304	Dead Creek									
040802050304-01	River	30	645	53.5%	18	100%	90%	30%	No		2012
040802050304-02	River	5	480	37.5%	1	100%	100%	0%	No		2014
Subwatershed	040802050305	Cole Creek-Cass River									
040802050305-01	River	16	105		12	17%	0%	0%	No		2012
040802050305-02	River	10	669	55.2%	6	100%	70%	50%	No		2008
040802050305-03	Beach/Launch	54	43		37	5%	13%	2%	No	Declining WQ	2012
040802050305-03	River	16	61		12	8%	6%	0%	No	Declining WQ	2012
040802050305-04	River	10	669	55.2%	6	100%	70%	50%	No		2012
040802050305-05	River	26	535	43.9%	14	100%	65%	23%	No		2012
Subwatershed	040802050306	Cass River									
040802050306-01	River	32	108		24	38%	6%	0%	No		2012
040802050306-02	River	47	54		18	6%	6%	0%	No		2008

Column 1: Assessment Unit	Column 2: Type	Column 3: n	Column 4: Geometric Mean (E. coli)	Column 5: % Reduction	Column 6: # of 30-Day Geometric Means	Column 7: % 30-day TBC Exceedance	Column 8: % Daily TBC Exceedance	Column 9: % Daily PBC Exceedance	Column 10: Interstate Waters	Column 11: Code	Column 12: Year 1st Listed
Watershed	04080206	Saginaw									
Subwatershed	040802060204	Saginaw River									
040802060204-02	Beach/Launch	57	30		39	0%	7%	2%	No	Declining WQ	2010
Watershed	04090001	St. Clair									
Subwatershed	040900010307	Bunce Creek-Frontal St. Clair River									
040900010307-03	Beach/Launch	239	46		165	18%	10%	2%	No		2010
Watershed	04090003	Clinton									
Subwatershed	040900030103	Loon Lake-Clinton River									
040900030103-05	Lake	21	55		12	50%	14%	0%	No		2008
040900030103-12	Beach/Launch	68	96		24	42%	28%	9%	No		2008
Subwatershed	040900030104	Paint Creek Drain									
040900030104-01	River	4	165		0		25%	25%	No	Data	2012
Subwatershed	040900030106	Krohn Drain-Stony Creek									
040900030106-01	River	8	9		4	0%	0%	0%	No		2012
Subwatershed	040900030109	Stony Creek									
040900030107-01	River	69	273		0		42%	9%	No		2012
040900030109-01	River	71	317	5.5%	0		49%	11%	No		2012
040900030109-03	River	140	295		0		46%	10%	No		2012
Subwatershed	040900030110	Paint Creek									
040900030105-01	River	21	475	36.8%	14	100%	67%	19%	No		2012
040900030110-01	River	21	475	36.8%	14	100%	67%	19%	No		2012
040900030110-02	River	21	475	36.8%	14	100%	67%	19%	No		2012
040900030110-05	River	8	143		0		25%	13%	No		2012
Subwatershed	040900030111	Galloway Creek-Clinton River									
040900030108-01	River	18	458	34.5%	14	100%	72%	11%	No		2012

Column 1: Assessment Unit	Column 2: Type	Column 3: n	Column 4: Geometric Mean (E. coli)	Column 5: % Reduction	Column 6: # of 30-Day Geometric Means	Column 7: % 30-day TBC Exceedance	Column 8: % Daily TBC Exceedance	Column 9: % Daily PBC Exceedance	Column 10: Interstate Waters	Column 11: Code	Column 12: Year 1st Listed
040900030108-34	River	18	458	34.5%	14	100%	72%	11%	No		2012
040900030111-01	River	18	458	34.5%	14	100%	72%	11%	No		2012
040900030111-02	River	18	458	34.5%	14	100%	72%	11%	No		2012
Subwatershed	040900030305	East Pond Creek									
040900030305-01	River	4	124		0		50%	25%	No		2012
Subwatershed	040900030310	Deer Creek-North Branch Clinton River									
040900030301-01	River	18	279		14	93%	28%	22%	No		2012
040900030301-02	River	18	279		14	93%	28%	22%	No		2012
040900030304-01	River	18	279		14	93%	28%	22%	No		2012
Watershed	04090004	Detroit									
Subwatershed	040900040101	Wolfrom Drain-Bell Branch									
040900040101-01	River	40	2,280	86.8%	31	100%	98%	78%	No	Reissue	2006
Subwatershed	040900040102	Bell Branch									
040900040102-01	River	64	2,310	87.0%	49	100%	100%	80%	No	Reissue	2006
040900040102-02	River	21	2,639	88.6%	15	100%	100%	86%	No	Reissue	1998
Subwatershed	040900040103	Upper River Rouge									
040900040103-01	River	88	1,754	82.9%	66	100%	93%	72%	No	Reissue	2006
040900040103-02	River	21	1,417	78.8%	17	100%	95%	62%	No	Reissue	2006
040900040103-03	River	21	1,417	78.8%	17	100%	95%	62%	No	Reissue	2006
040900040103-04	River	46	1,394	78.5%	32	100%	91%	65%	No	Reissue	1998
Subwatershed	040900040201	Johnson Drain									
040900040201-01	River	28	355	15.6%	20	90%	43%	29%	No	Reissue	2006
040900040201-02	River	5	586	48.8%	1	100%	80%	40%	No	Reissue	2006
040900040201-03	River	9	371	19.2%	1	100%	67%	22%	No	Reissue	2006

Column 1: Assessment Unit	Column 2: Type	Column 3: n	Column 4: Geometric Mean (E. coli)	Column 5: % Reduction	Column 6: # of 30-Day Geometric Means	Column 7: % 30-day TBC Exceedance	Column 8: % Daily TBC Exceedance	Column 9: % Daily PBC Exceedance	Column 10: Interstate Waters	Column 11: Code	Column 12: Year 1st Listed
Subwatershed	040900040202	Tonquish Creek									
040900040202-01	River	46	1,948	84.6%	38	100%	93%	78%	No	Reissue	2006
040900040202-02	River	23	1,423	78.9%	19	100%	91%	65%	No	Reissue	2006
Subwatershed	040900040203	Newburgh Lake-Middle River Rouge									
040900040203-01	River	372	124		275	46%	30%	9%	No	Reissue	2006
040900040203-02	River	23	589	49.1%	19	100%	70%	35%	No	Reissue	1998
040900040203-03	Beach/Launch	114	140		86	51%	31%	6%	No	Reissue	2008
040900040203-07	River	111	93		68	35%	22%	3%	No	Reissue	2008
040900040203-08	River	23	589	49.1%	19	100%	70%	35%	No	Reissue	2006
040900040203-09	Beach/Launch	97	35		53	34%	18%	2%	No	Reissue	2012
040900040203-09	River	193	90		150	31%	21%	8%	No	Reissue	2012
040900040203-10	River	23	850	64.7%	19	100%	74%	48%	No	Reissue	2012
040900040203-12	Beach/Launch	97	35		53	34%	18%	2%	No	Reissue	1998
Subwatershed	040900040204	Middle River Rouge									
040900040204-01	River	86	1,482	79.8%	66	100%	93%	56%	No	Reissue	2006
040900040204-02	River	19	594	49.5%	15	100%	74%	21%	No	Reissue	1998
Subwatershed	040900040301	Fellows Creek									
040900040301-01	River	50	1,157	74.1%	38	100%	94%	52%	No	Reissue	2006
Subwatershed	040900040302	Molt Drain-Lower River Rouge									
040900040302-01	River	95	522	42.6%	81	98%	67%	25%	No	Reissue	2006
040900040302-02	River	23	1,189	74.8%	19	100%	96%	52%	No	Reissue	2006
040900040302-03	River	46	576	47.9%	38	95%	65%	33%	No	Reissue	2006
Subwatershed	040900040303	Lower River Rouge									
040900040303-01	River	67	1,741	82.8%	55	100%	93%	67%	No	Reissue	2006
040900040303-02	River	70	915	67.2%	58	100%	84%	44%	No	Reissue	1998

Column 1: Assessment Unit	Column 2: Type	Column 3: n	Column 4: Geometric Mean (E. coli)	Column 5: % Reduction	Column 6: # of 30-Day Geometric Means	Column 7: % 30-day TBC Exceedance	Column 8: % Daily TBC Exceedance	Column 9: % Daily PBC Exceedance	Column 10: Interstate Waters	Column 11: Code	Column 12: Year 1st Listed
Subwatershed	040900040402	Franklin Branch									
040900040402-01	River	105	424	29.2%	85	92%	70%	17%	No	Reissue	2006
Subwatershed	040900040403	Headwaters River Rouge									
040900040401-01	River	21	797	62.3%	17	100%	90%	38%	No	Reissue	2006
040900040403-01	River	85	574	47.8%	69	100%	78%	26%	No	Reissue	2006
Subwatershed	040900040404	Pebble Creek-River Rouge									
040900040404-01	River	21	896	66.5%	17	100%	86%	43%	No	Reissue	2006
040900040404-02	River	85	674	55.5%	69	100%	79%	32%	No	Reissue	2006
Subwatershed	040900040405	Eliza Howell Park-River Rouge									
040900040405-01	River	137	1,104	72.8%	113	100%	86%	47%	No	Reissue	2006
Subwatershed	040900040406	Ashcroft Sherwood Drain-River Rouge									
040900040406-01	River	66	1,403	78.6%	48	100%	85%	58%	No	Reissue	2006
Subwatershed	040900040407	River Rouge									
040900040407-01	River	43	1,022	70.7%	35	100%	77%	47%	No	Reissue	2006
Watershed	04090005	Huron									
Subwatershed	040900050203	North Fork									
040900050203-01	River	10	778	61.4%	1	100%	90%	40%	No		2016
Subwatershed	040900050204	Mill Creek									
040900050204-02	River	19	462	35.1%	6	100%	79%	11%	No		2016
Subwatershed	040900050304	Upper Portage Creek									
040900050304-01	River	46	498	39.7%	36	100%	70%	20%	No		2014
040900050304-03	River	22	420	28.6%	18	100%	68%	14%	No		2014
Watershed	04100002	Raisin									
Subwatershed	041000020410	Willow Run at mouth									
041000020410-01	River	7	285		3	100%	14%	14%	No		2010

Column 1: Assessment Unit	Column 2: Type	Column 3: n	Column 4: Geometric Mean (E. coli)	Column 5: % Reduction	Column 6: # of 30-Day Geometric Means	Column 7: % 30-day TBC Exceedance	Column 8: % Daily TBC Exceedance	Column 9: % Daily PBC Exceedance	Column 10: Interstate Waters	Column 11: Code	Column 12: Year 1st Listed
Watershed	04100006	Tiffin									
Subwatershed	041000060106	Covell Drain-Bean Creek									
041000060106-03	River	10	156		2	100%	30%	10%	No		2004

Appendix 2. TMDL Update Process

The WLA of this TMDL applies only to facilities that discharge to waters currently listed as impaired for the TBC or PBC designated uses in the most recent USEPA-approved Section 303(d) list, or are impacting those waters by discharging upstream. The number of TBC/PBC designated use impairments is expected to grow with each biennial update of the Sections 303(d) and 305(b) list, as more monitoring is conducted. In addition to including new impaired waters every two years, and the addition of facilities to the WLA that will accompany that expansion, it is expected that the affected NPDES facilities will change frequently due to many factors, including the opening and closing of facilities and changes in regulations. The WLA is a concentration-based numeric target, equal to the ambient WQS; thus, adding and removing facilities to the WLA has no effect on the allocations of the remaining facilities. The following steps provide guidance on the procedures to be used by EGLE to update the WLA of the statewide *E. coli* TMDL with changes to facilities, in order to provide sufficient public notice and opportunities for facilities to comment on their inclusion in the statewide *E. coli* TMDL.

Public notice for expanding the area covered by the TMDL will include the following steps:

- Newly proposed impaired AUIDs will be listed as Category 4a (impaired, with TMDL complete) in the Section 305(b) list contained in the Integrated Report, and in an addendum to this TMDL, hereafter called Statewide *E. coli* TMDL Addendum.
- The Statewide *E. coli* TMDL Addendum will be public noticed biennially along with the Integrated Report, and will include a brief description of each AUID, and needed pollutant reductions in each AUID or group of AUIDs.
- EGLE will determine the contributing land area (watershed) to each impaired AUID segment (lake, stream, wetland, or beach). This watershed is hereafter referred to as the "Statewide *E. coli* TMDL Area," and will be in the shapefile format for viewing in Geographic Information System platforms. The extent of the TMDL area upstream of an impaired AUID will be determined by available data and using best professional judgment. The shapefile will be available for public review and comment via the TMDL interactive mapping system (Michigan.gov/EcoliTMDL) and on MiWaters Site Explorer (miwaters.deq.state.mi.us) during the biennial update of the Section 305(b) list. For impaired beaches where the rest of the water body (river or lake where the beach is located) is not listed as impaired, the Statewide *E. coli* TMDL Area will be established as the immediate surrounding subwatershed (12-digit HUC), as a minimum. The Statewide *E. coli* TMDL Area will be considered final when the Addendum and Integrated Report are approved by the USEPA, after public comments have been addressed.
- Any facility discharging to the impaired waters included pursuant to the most recent approved Section 305(b) list, are considered to be included in the WLA of this TMDL. To help determine which facilities are in the WLA, the Statewide *E. coli* TMDL Area shapefile will be overlaid on top of the facility locations to generate a list of facilities included in the WLA.
- Facilities discharging to the proposed impaired AUIDs and TMDL Area will be notified of their proposed inclusion in the TMDL, upon issuance of the public notice of the Integrated Report, and given a chance to review the addendum and comment on the expanded area and their inclusion, accordingly. Comments on the main TMDL document will not be accepted after the approval by the USEPA, unless it is determined that a revision is necessary and the revised TMDL is public noticed.
- Per existing EGLE policy, implementation of the TMDL in the newly added permits/facilities will take place during the permit reissuance following the approval of the update of the TMDL addendum by the USEPA.

New facilities entering the approved TMDL area:

- New permits or COCs for facilities moving into an already approved TMDL area, will be written and issued consistent with the TMDL per federal and state regulation. This process will be ongoing. Staff of EGLE, WRD, Permit Section, will have access to the most up-to-date approved Statewide *E. coli* TMDL Area shapefile via the MiWaters Site Explorer (an online mapping interface that is available to the general public), or other means.
- Public notices of all draft permit actions are placed on the MiWaters Web site by EGLE Permit Section staff, according to EGLE policies and pursuant applicable regulations. The public notice description directs interested persons to read the draft permit either online or at their local district office. The USEPA is informed of public notices for new permits of major facilities. MiWaters Site Explorer will be kept up-to-date when new facilities are added or removed from our permitting programs, and with the TMDL area shapefile, allowing stakeholders to view current permittees in the WLA of the TMDL. This method of public notice will be sufficient to inform the general public and the USEPA of the inclusion of a new NPDES permitted discharge in the WLA of the approved TMDL and approved TMDL Area.
- At any time, should an interested person or organization wish to determine if a particular facility is included in the TMDL, they may estimate this by utilizing the approved TMDL area shapefile located as part MiWaters Site Explorer, the interactive mapping system at Michigan.gov/EcoliTMDL, or requesting the information from EGLE, WRD. Interested parties can be also be placed on the public notice list for a specific facility. Contact information is located at Michigan.gov/EGLENPDES.

Updating previously approved concentration-based *E. coli* TMDLs

The State of Michigan has previously submitted 57 watershed-based *E. coli* TMDL documents to the USEPA. Of these, 53 were approved by the USEPA with concentration-based TMDL targets (Table 8). The facility lists included as part of the WLA for these TMDLs become outdated due to the construction of new facilities, expansion of existing facilities, facility name changes, and changes in the scope of EGLE regulation. The approved TMDL shapefiles for each of the TMDLs listed in Table 8 will be used to update the facilities that fall within the WLA of all concentration-based *E. coli* TMDLs. This information will be available to the public, USEPA, and affected facilities via the MiWaters Site Explorer, or by other means. EGLE intends to leave the remainder of these documents intact because they contain valuable information on the sources at the time they were approved. In the future these TMDLs may be revoked and replaced with coverage by the statewide TMDL through the TMDL addendum and Integrated Report processes if warranted (on a case-by-case basis).

Table 8. List of USEPA approved concentration-based *E. coli* TMDLs.

TMDL Name	Counties	Approval Year
Albrow Creek	Jackson	2005
Bad Axe Drain	Huron	2016
Bass River	Ottawa	2005
Bean Creek	Hillsdale/Lenawee	2003
Buck Creek	Kent	2006
Burdick Drain and Potters Lake	Lapeer	2004
C.S. Mott Lake - Bluebell Beach	Genesee and Lapeer	2011
Cedar River	Gladwin	2004
Clinton River	Macomb, Oakland, and St. Clair	2010
Coldwater River and Bear Creek (Tyler Creek)	Kent	2005
Coon Creek (East Branch) - revised in 2011	Macomb	2002 and 2011
Crapaud Creek	Macomb	2002
Deer Creek	Berrien	2002
Deer Creek	Macomb	2006
Deer, Little Deer, and Beaver Creeks	Ottawa and Muskegon	2012
Duff Creek	Sanilac	2004
East Pond Creek	Macomb	2006
Eau Claire Village Drain and Farmers Creek	Berrien	2008
Galien River	Berrien	2002
Geddes Pond (Huron River)	Washtenaw	2001
Grand River	Kent	2006
Grand River - *E. coli* - Jackson Co	Jackson	2003
Honey Creek	Washtenaw	2009
Kintz Creek and Hunter's Creek (Metamora)	Lapeer	2004
Lake Erie/Luna Pier Beach	Monroe	2007
Lake St. Clair Metropolitan and Memorial Beaches	Macomb	2007
Lenawee County Drain No. 70	Lenawee	2002
Lincoln Lake	Kent	2006
Little Portage Creek	Kalamazoo, St. Joseph, and Calhoun	2012
Mickles Creek (Shiawassee River)	Saginaw	2003
Mill Creek	St. Clair	2004
Paint Creek	Washtenaw	2005
Pine and Mill Creeks	Berrien and Van Buren	2009
Planter Creek	Gogebic	2011
Plaster Creek	Kent	2002
Prattville Drain and Lime Lake	Hillsdale/Lenawee	2003
Red Cedar River and Grand River	Ingham, Eaton, Clinton, Jackson, and Livingston	2012
Red Run Drain and Bear Creek	Macomb	2006
Rio Grande Creek	Ottawa	2003

Statewide *E. coli* TMDL

TMDL Name	Counties	Approval Year
River Raisin	Lenawee	2002
River Raisin	Monroe	2005
River Raisin (South Branch)	Lenawee	2008
Ruddiman Creek	Muskegon	2010
Saline River	Washtenaw	2002
Salt River	Macomb	2005
Sault Ste. Marie Area Tributaries	Chippewa	2012
Small Creek and Hunter's Lake	Alcona	2004
Smiths Creek	St. Clair	2009
St. Joseph River	Berrien	2004
Three Mile Creek and Holly Drain	Shiawassee	2011
Tittabawasee River	Midland	2009
Wagner-Pink Drain	Monroe	2003

Appendix 3. Converting Concentrations to Loads

This *E. coli* TMDL for Michigan's waters is a concentration-based TMDL, with a concentration-based target for point and nonpoint sources, as described in Section 4 of this document. Providing a simple target that is equivalent to the WQS and applies to all water bodies is easier to implement and communicate to permittees and stakeholders; however, to comply with federal guidance, this appendix provides the means to translate the concentration-based TMDL target into a load for rivers, wetlands, beaches, and lakes. A traditional load is presented in pounds per day; but, for bacteria, mass in pounds is not practical or useful. The equations found in this appendix convert *E. coli* organisms per 100 mL into organisms per day, based upon the flow of the river or the replacement rate of the lake, wetland, or beach.

In a concentration-based TMDL, the MOS is implicit, as described in Section 2.1.c. The LC is calculated by adding the ∑WLA and ∑LA and MOS, as in Equation 1. We do not recommend calculating a load for lakes with no outlet, or beaches on lakes with no outlet, because there is no flow or replacement rate dilution that occurs.

Equation 1: LC calculation for all water bodies. The MOS is zero because a number is needed for the formula, while in reality the MOS is implicit as described in Section 2.1.c.

$$LC \text{ (or TMDL)} = (\sum WLA + \sum LA) + MOS$$

$$MOS = 0$$

To calculate an LC for rivers, multiply the WQS (daily maximum geometric mean or the 30-day geometric mean) by the flow of the river at any given time (Equation 2). River flows for translating concentrations into loads can be measured on site through a hydrologic study, or calculated from nearby gaging stations using drainage area ratios and models. The USGS offers a range of flow, or discharge, data in rivers throughout Michigan (waterwatch.usgs.gov/). Table 9 and Figure 37 show example calculations of the ∑WLA and ∑LA, or LC, for rivers.

$$\sum WLA + \sum LA = \text{Criteria} * \text{Flow} * \text{Unit Conversion Factor}$$

$$\sum WLA + \sum LA = \frac{X\ E.coli}{100\ mL} * \frac{Y\ \text{cubic feet}}{\text{second}} * \frac{28{,}317\ mL}{1\ \text{cubic foot}} * \frac{86{,}400\ \text{seconds}}{1\ \text{day}}$$

Where:

X = 130 (30-day geometric mean WQS), 300 (daily maximum TBC WQS), or 1,000 (daily maximum PBC WQS) in *E. coli* per 100 mL.

Y = discharge of river in cubic feet per second

Equation 2. LC calculation for rivers.

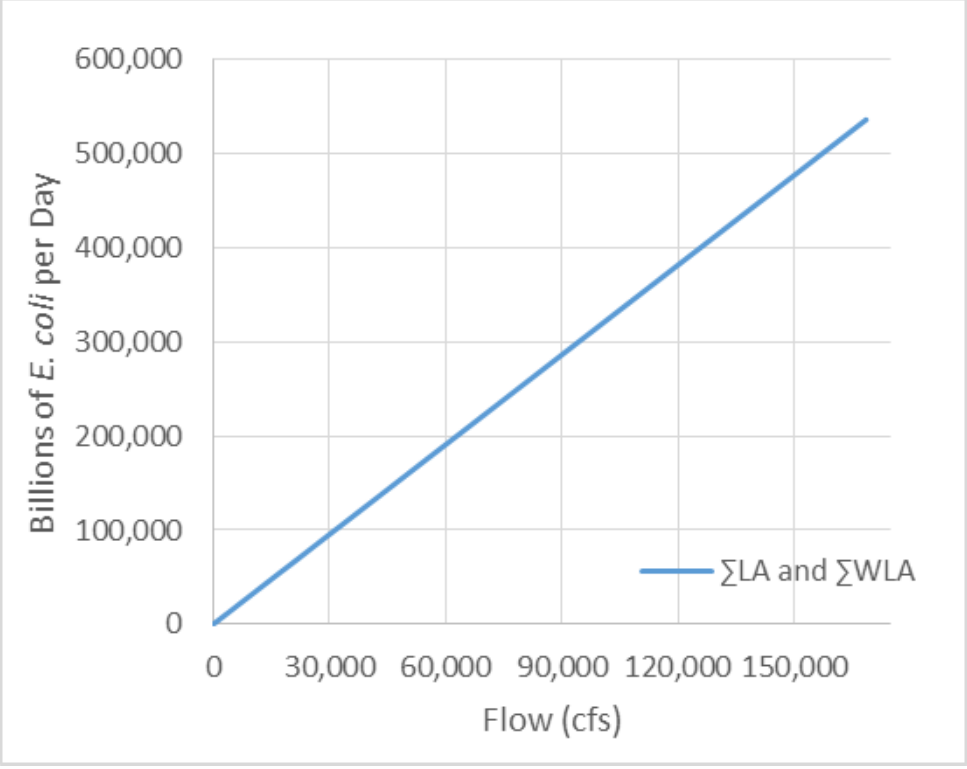


Figure 37. *E. coli* daily loads for rivers and streams based on 30-day geometric mean WQS.

Table 9. Example *E. coli* daily loads for rivers and streams.

Flow	∑LA and ∑WLA
cubic feet per second	Billions of *E. coli*/Day
0.01	0.03
0.05	0.16
0.25	0.80
0.5	1.59
1	3.18
5	15.9
10	31.8
50	159
100	318
500	1,590
1,000	3,180
2,000	6,360
3,000	9,541
4,705*	14,963
168,600**	536,187

*2013 annual average discharge of the Grand River in Grand Rapids (USGS Gage 04119000) (USGS 2015).
**2013 annual average discharge of the St. Clair River connecting channel (USGS Gage 04153190) (USGS 2015).

Appendix 3.2 Lakes, Wetlands, and Ponds with an Outlet Flow

For lakes, ponds, and wetlands that have an outlet, the load-based TMDL is calculated by multiplying the WQS by the replacement rate of the water body and converting to *E. coli* colonies per day (Equation 3). The replacement rate is calculated by multiplying the annual exchange rate (number of times per year the volume of the water body is exchanged) by the volume of the water body and converting years to seconds (Equation 4). To calculate the annual exchange rate of a lake, the flows of inlets and outlets and volume of the water body must be estimated and used in a model, such as the bathtub model. Table 10 and Figure 38 show example calculations of ∑WLA and ∑LA (LC) for lakes, wetlands, and ponds with outlets.

$$\sum WLA + \sum LA = (\text{Criteria} * \text{Lake Replacement Rate} * \text{Unit Conversion Factor})$$

$$\sum WLA + \sum LA = \frac{X\ E.coli}{100\ mL} * \frac{Y\ \text{cubic feet}}{\text{day}} * \frac{28{,}317\ mL}{1\ \text{cubic foot}}$$

Where:

X = 130 (30-day geometric mean WQS), 300 (daily maximum TBC WQS), or 1000 (daily maximum PBC WQS) in *E. coli* per 100 mL.

Y = Replacement Rate, in cubic feet per second

Equation 3. WLA and LA calculation for lakes.

$$\text{Replacement Rate} = \text{Annual Exchange Rate} * \text{Lake Volume} * \text{Unit Conversion Factor}$$

$$\text{Replacement Rate} = \frac{A}{\text{year}} * B\ \text{cubic feet} * \frac{1\ \text{year}}{365.25\ \text{days}}$$

Where:

A = Annual Exchange Rate in times per year

B = Volume of the water body in cubic feet

Equation 4. Calculation of the replacement rate for lake LC calculations.

Table 10. Example *E. coli* daily loads (in billions of *E. coli* per day) for Michigan lakes using the 30-day geometric mean WQS of 130 *E. coli* per 100 mL.

	Annual Exchange Rate	Volume of Lake	Replacement Rate	∑LA and ∑WLA
Name	Times exchanged per year	millions of cubic feet	millions of cubic feet per day	Billions of *E. coli*/Day
Limekiln Lake[1]	24.39	28	2	70
Strawberry Lake[1]	25.00	247	17	623
Goose Lake	1.54	225	1	35
Crystal Lake	0.02	30,047	2	67
Lake Huron*	0.05	125,118,259	15,571	573,190
Lake Michigan*	0.01	173,693,583	4,804	176,827
Lake Superior*	0.01	426,874,061	6,119	225,251

[1] – Detention time of Livingston County Lakes (Alexander 2000).
* Detention time of Great Lakes (MSU Extension 1985).

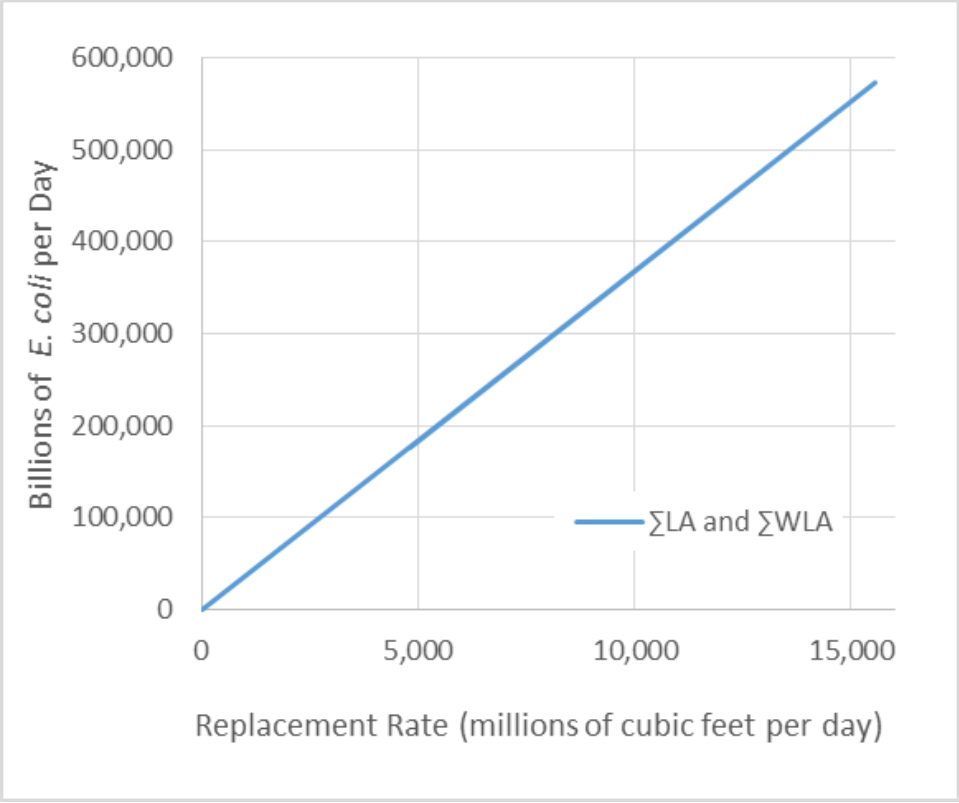


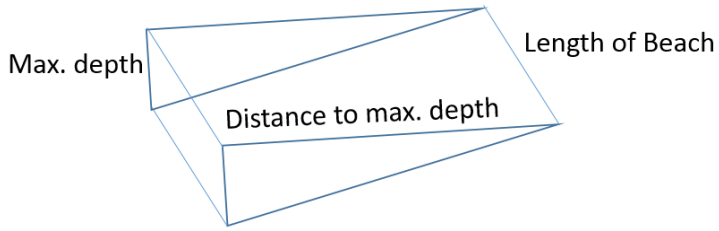
Figure 38. *E. coli* daily loads for lakes and wetlands based on 30-day geometric mean WQS of 130 *E. coli* per 100 mL.

For beaches on lakes with outlets, an appropriate conservative approach is to calculate the volume of the beach, using Equation 5, and use this volume instead of the lake or water body volume in calculating the replacement rate (Equation 4). This approach is extremely conservative because it assumes that the replacement rate, expressed in cubic feet per second, is the only mixing that occurs between the beach and the rest of the lake. In other words, the lake where the beach is located is not mixing due to wind, waves, or human or animal activity. Equation 6 describes the calculation of WLAs and LAs for beaches.

Table 11 and Figure 39 show examples of WLA and LA calculations for beaches on lakes with outlets. Load calculations are not recommended for beaches on lakes with no outlets.

Equation 5. Calculation of beach area (all units in feet). Maximum depth may be defined by site characteristics, such as the depth where “no swimming beyond this point” buoys are placed.

Area of Beach = ½ * Length (or frontage) of Beach * Max. Depth * Distance from Shore to Max. Depth



Equation 6. Formula for calculation of WLA and LA for beaches.

$$LC \text{ (or TMDL)} = (\sum WLA + \sum LA) + MOS$$

$$MOS = 0$$

$$\sum WLA + \sum LA = (\text{Criteria} * \text{Beach Replacement Rate} * \text{Unit Conversion Factor})$$

$$\sum WLA + \sum LA = \frac{X \text{ } E.coli}{100 \text{ mL}} * \frac{Y \text{ cubic feet}}{\text{day}} * \frac{28{,}317 \text{ mL}}{1 \text{ cubic foot}}$$

Where:

X = 130 (30-day geometric mean WQS), 300 (daily maximum TBC WQS), or 1,000 (daily maximum PBC WQS) in *E. coli* per 100 mL.

Y = Beach Replacement Rate (derived from lake replacement rate) in cubic feet per day.

Table 11. Example *E. coli* daily loads (in millions of *E. coli* per day) for imaginary beaches on Michigan lakes using the 30-day geometric mean WQS of 130 *E. coli* per 100 mL.

	Hydraulic Detention Time of Lake	Annual Exchange Rate	Volume of Beach	Replacement Rate of Beach	∑LA and ∑WLA
Name	Years	Times exchanged per year	cubic feet	cubic feet per day	Millions of *E. coli*/Day
Limekiln Lake[1]	0.041	24.39	5,273	352	13.0
Strawberry Lake[1]	0.04	25.00	12,825	878	32.3
Crystal Lake	45	0.02	2,475	0.15	0.006
Lake Huron*	22	0.05	3,750	0.47	0.017
Lake Michigan*	99	0.01	13,125	0.36	0.013
Lake Superior*	191	0.01	45,000	0.65	0.024

[1] – Detention time of Livingston County Lakes (Alexander 2000).
* Detention time of Great Lakes (Extension 1985).

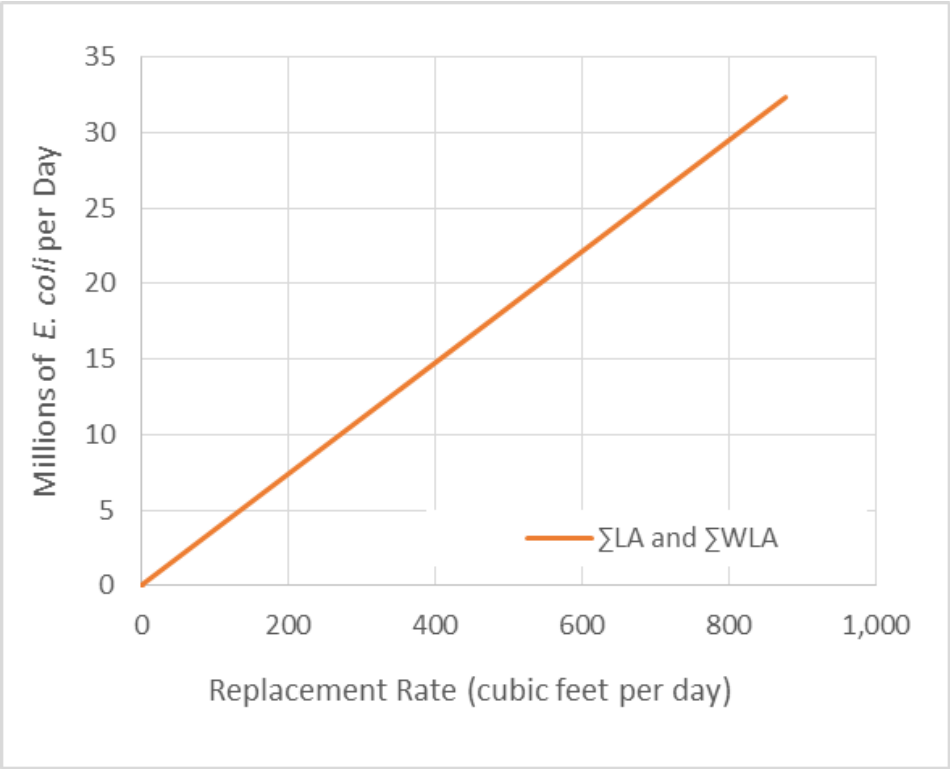


Figure 39. *E. coli* daily loads for beaches based on 30-day geometric mean WQS of 130 *E. coli* per 100 mL.

Appendix 4. Data Analysis - Results of Statistical Analysis of WCMP Data

Appendix 4.1 ANOVA and Tukey HSD test of all results by sampling year.

The *E. coli* component of the WCMP included 200 sites (plus 5 replicates) sampled over four years (2009, 2011, 2012, and 2013), yielding about 50 sites per year of sampling. The distribution of WCMP *E. coli* data was skewed; to normalize the data the natural log transformation was used (Figure 40). ANOVA of all *E. coli* results in each sampling year found that the results did vary significantly by year. The Tukey HSD test compares the mean of every treatment to the mean of every other treatment; that is, it identifies any difference between two means that is greater than the expected standard error. In conducting pairwise comparisons, this method is considered the best available when sample sizes are not equal. The results of the Tukey HSD test (Table 13) show that the results from 2009 and 2012 are not significantly different, and likewise, 2012 and 2013 are not significantly different. The highest annual mean *E. coli* (382 *E. coli* per 100mL) was in 2011 and was significantly different than all other years; however, because the site pool monitored each year was different, characteristics such as land cover, agricultural practices, and human population were different in each year of sampling. In addition to the watershed selection and characteristics being different, the climate also varied by year, so further investigation was needed to determine if the pool of sites and associated watershed parameters were causing the differences, or if the climate in the given year may have been the cause. To evaluate the variation in the pool of sites and watersheds each year, ANOVA of each watershed characteristic (such as major land cover types, human population, etc.) among the watersheds in the sample pools of each year (2009, 2011, 2012, and 2013) was conducted. No significant differences (P-values <.05) were found in the watershed characteristics of the yearly sample pools. Based on this, it is likely that the differences in *E. coli* results from year to year were the result of another factor, possibly climate effects on flow or soil saturation with moisture, rather than the differences between the watersheds selected in the sampling pool. In terms of climate variation among the sampling years, there were annual variations in precipitation as well as regional variation throughout the state. The Lower Peninsula had a fairly wet sampling season in 2011 (Table 14). In 2012, the southern Lower Peninsula had a dry season, but in the Upper Peninsula, the precipitation was fairly normal. In the Upper Peninsula, 2013 was the wettest season sampled.

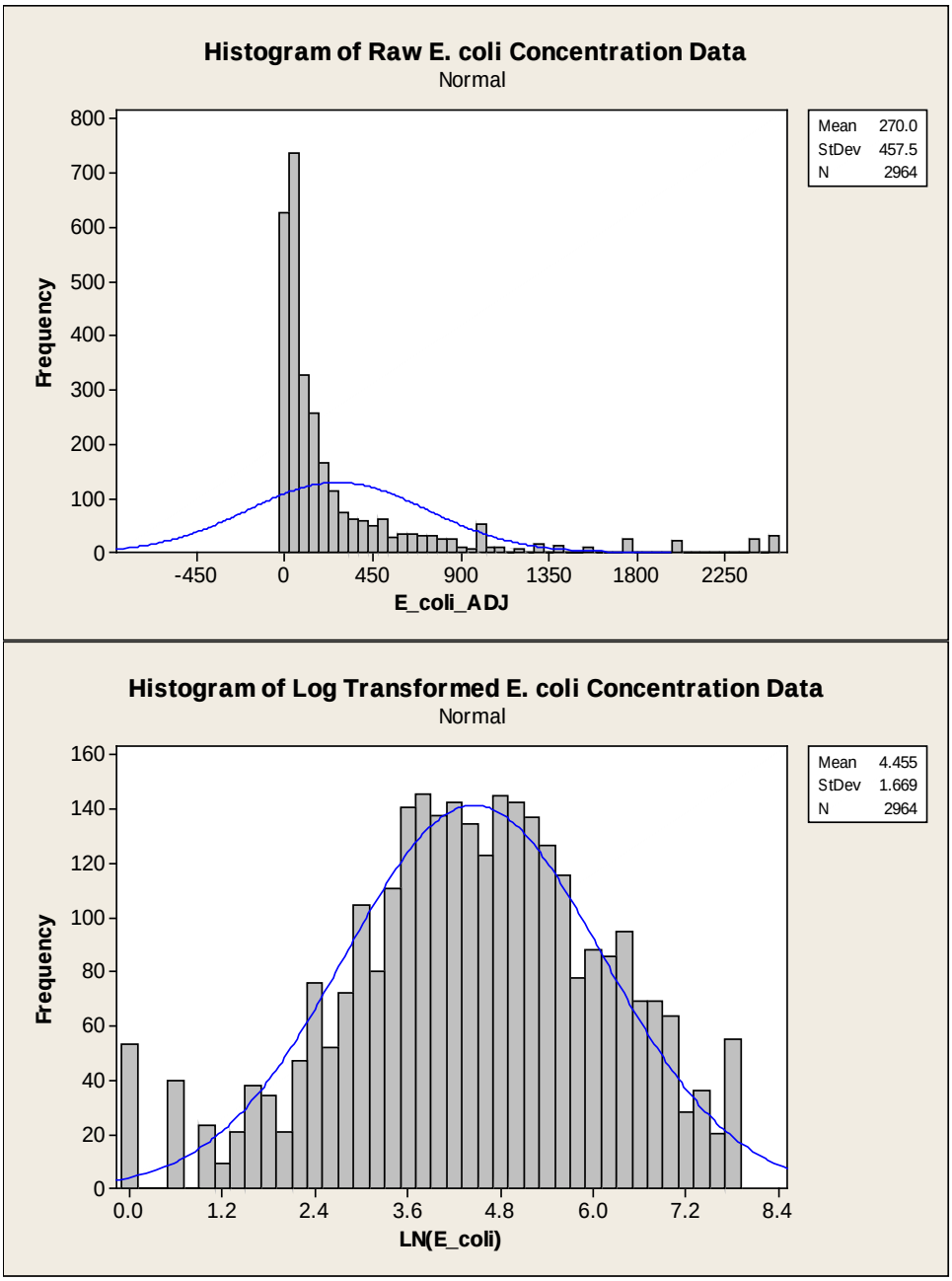


Figure 40. Histogram of raw *E. coli* concentration data showing skewed distribution, and the same data after transformation using natural log.

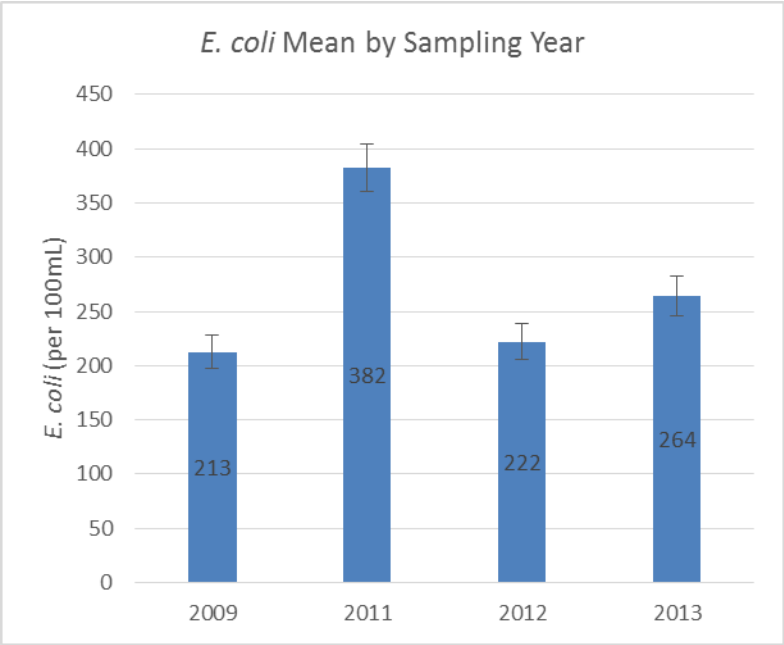


Figure 41. Mean of WCMP *E. coli* (per 100 mL) data, pooled by sampling year, with all sampling events included.

Table 12. *E. coli* WCMP data summary by sampling year (number of samples includes left, center, and right individual results).

Year	Number of Analyses	Number of Samples	Number of Replicates	*E. coli* Mean	Standard Deviation	Standard Error
2009	717	646	71	213	395	16
2011	760	628	132	382	547	22
2012	752	637	115	222	409	16
2013	735	651	84	264	475	19

Table 13. Matrix of pairwise comparison probabilities (P-values) from Tukey HSD test. Underlined values are significantly different pairs (P-Value ≤ 0.05).

Year	2009	2011	2012	2013
2009	1			
2011	0.00	1		
2012	0.75	0.00	1	
2013	0.04	0.00	0.37	1

Table 14. Average regional precipitation (in inches) during the sampling period (May-November). Data obtained from MSU Extension Enviro-Weather (2015). Note that 2012 was a dry season for most regions, and 2011 was a wet season in the Lower Peninsula.

Average of Weather Stations in Region	Average Precipitation in Inches (May 1-Nov 30)			
	2009	2011	2012	2013
Upper Peninsula (4 stations)	19.05	17.17	19.17	22.17
North Central Lower (2 stations)	17.66	21.2	21.5	21.22
Northwest Lower (8 stations)	18.75	23.4	18.94	23.3
Southeast Lower (4 stations)	18.28	26.37	14.2	18.74
South Central Lower (9 stations)	20.48	27.03	13.87	22.96

Appendix 4.2 ANOVA and Tukey HSD test for all results by sampling event (1-4).

As part of the WCMP, *E. coli* was monitored at 50 sites per year (plus replicate sites), at four events in the year of sampling; May, July, September, and November. ANOVA of all results in each sampling event (across all years) found that the results vary significantly by event, or month, sampled (P-value=0.00). Event 2, sampled in July, had the highest mean *E. coli* (420 *E. coli* per 100 mL) (Table 15). According to the Tukey HSD test, which compares each month's results, all months were significantly different from each other (Table 16).

Table 15. *E. coli* WCMP data summary by sampling event (month).

Sampling Event	n	Mean (*E. coli* per 100mL)	Standard Deviation	Standard Error
Event1 (May)	726	221	457	21
Event2 (July)	759	421	553	24
Event3 (September)	730	326	453	21
Event4 (November)	749	111	252	16

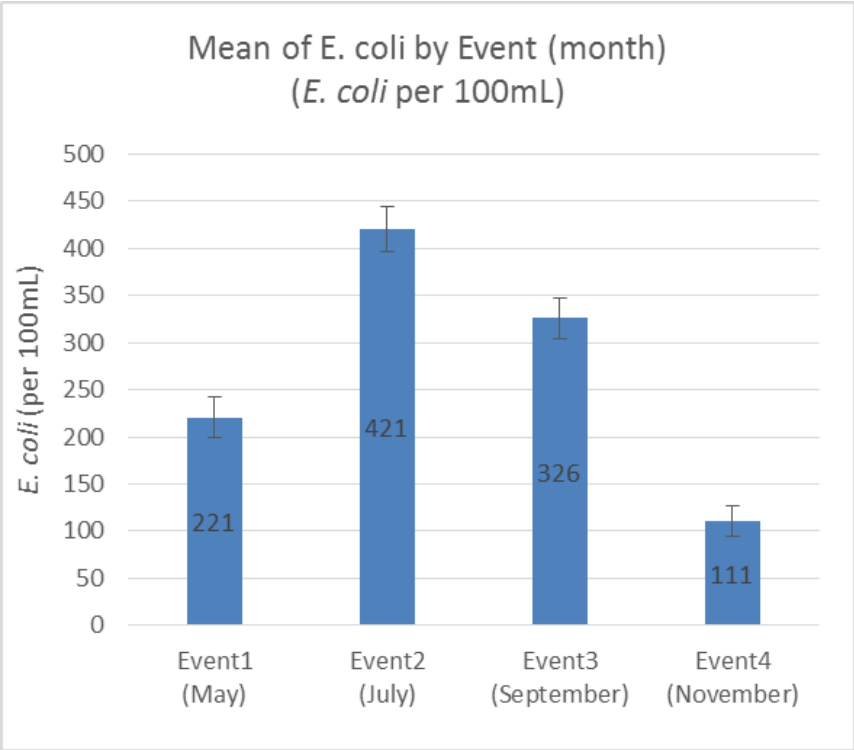


Figure 42. Mean of WCMP *E. coli* data pooled by event across all years (2009, 2011, 2012, and 2013).

Table 16. Matrix of pairwise comparison probabilities from Tukey HSD test for sampling event/month. All pairs are significantly different (P-Value ≤ 0.05).

Year	1-May	2-Jul	3-Sep	4-Nov
1-May	1			
2-Jul	0.00	1		
3-Sep	0.00	0.001	1	
4-Nov	0.00	0.00	0.00	1

Appendix 4.3 Correlation of site-specific *E. coli* data to spatial variables for each site.

The Spatial Analyst Watershed Tool (which uses National Hydrography Dataset Flow Direction, Flow Accumulation, and Digital Elevation Models) was used to delineate the entire watersheds upstream of each site. Five watersheds were missing data required for this model, and these were delineated manually using topography and road layers, and aerial imagery. The validity of statistical analysis depends upon the normality of the data and the random selection of sites. Data from nature are typically skewed, and not normal. To correct for this, the pool of *E. coli* data and spatial data derived from the United States Census was normalized using the logarithmic transformation method. Arcsine-square root transformation was used to normalize the spatial land cover percentages for the watersheds.

Spatial data analysis included population density (U.S. Census Bureau, 2010 and U.S. Census Bureau, 2012), 2011-era land cover types (NOAA, 2014), 2011-era land cover types in a 30-meter riparian buffer, lost wetland area (Fizzell, 2015), extrapolated manure application and tile drainage acreage (USDA, 2014), site latitude, and watershed size. County level manure application and tile drainage acreage was extrapolated to watersheds by assuming that within each county, the affected acreages were evenly distributed across the extent of 2011-era agricultural land (cultivated and hay/pasture). Buffers (30 meter and 15 meter) were constructed around Michigan's hydrography line shapefile (rivers). To calculate intact riparian buffers, all natural land covers were combined (all forest, wetland, and herbaceous types). Only watersheds that were completely contained in the state of Michigan were included in the spatial analysis of watershed characteristics, due to the difficulty in obtaining certain datasets across the state boundaries (watersheds removed due to interstate watersheds are Sites 75, 126, and 395). A summary of important WCMP watershed characteristics is found in Table 3.

For this analysis, several scenarios were explored. Correlations were performed using: *E. coli* data from each sampling event separately (1-4), pooled *E. coli* data from all events (1-4), and pooled *E. coli* data from sampling events during the TBC season (1-3). The strongest correlations with watershed characteristics were found by pooling all *E. coli* data from all events (1-4) for each site. The ANOVA of the sampling events suggested that the *E. coli* results from each sampling event were different from all the others. Examining correlations of *E. coli* and watershed characteristics for the sampling events separately found that the relationships were similar to the analysis of the pooled sampling event results, but had a lower correlation (lower r).

All individual *E. coli* results from all years were pooled for each site to analyze for correlations with the watershed spatial variables (Table 4). According to EGLE's analysis of correlation between each sites' spatial characteristics and *E. coli* results, the amount of forested land (combined mixed, deciduous and coniferous types) had the strongest relationship with *E. coli*. More forested land generally meant less *E. coli* ($r = -0.63$). Among the land cover types that are anthropogenically modified for agriculture and development, higher amounts of agriculture in the watershed had a significant and strongly correlated relationship with higher *E. coli* levels ($r = 0.58$). Examining the developed land types separately (high density, medium density, low density, and open developed land), found that the low density-developed land type had the highest correlation with *E. coli* ($r = 0.40$). Increases in the amount of developed land (all types grouped together) did not have a strongly correlated relationship with *E. coli* and were only slightly correlated ($r = 0.29$). Human population density did correlate well with *E. coli* ($r = 0.52$). This may indicate that humans have a more direct impact on *E. coli* than just our modification of land covers and associated hydrological changes. Results suggest that it is the number of septic systems that may drive this correlation. Other recent studies have made similar conclusions using *Bacteroides thetaiotaomicron* rather than *E. coli* (Verhougstraete, 2015). In this study, watershed size had no relationship with *E. coli.*

In order to understand these relationships better, correlations were run between all watershed characteristics (Table 17). Through this, it was found that agriculture had a high negative

correlation with the natural riparian buffers (r = -0.80), while the negative correlation between all developed land types combined and the presence of natural riparian buffers was much weaker (r = -0.37).

Within land cover data, it is uncommon to find a variable that is independent since land not used for agriculture is used for another purpose, such as forest. A relationship typically exists between the major land cover types and as seen in Table 17, this generality was true for this study.

Table 17. Matrix of Pearson's correlation coefficients for major WCMP watershed characteristics. Correlation coefficients with P-values less than 0.05 are listed as NS (not significant).

WCMP Watershed Variables and Characteristics	*E. coli* (geomean)	Agricultural (Ag.) Landcover (all)	Forest Landcover (all)	Developed Landcover (all)	Natural Riparian Buffer	Wetland Landcover (all)	Lost Wetland (% of original)	Septic System Density	Population Density	Housing Unit Density	Site Latitude
Agricultural (Ag.) Landcover (all)	0.58										
Forest Landcover (all)	-0.63	-0.78									
Developed Landcover (all)	0.29	NS	-0.38								
Natural Riparian Buffer	-0.52	-0.80	0.78	-0.37							
Wetland Landcover (all)	-0.18	-0.40	NS	-0.22	0.54						
Lost Wetland (% of original)	0.31	0.54	-0.50	0.15	-0.65	-0.29					
Septic System Density	0.46	0.49	-0.50	0.42	-0.42	-0.18	0.18				
Population Density	0.53	0.46	-0.62	0.76	-0.56	-0.29	0.29	0.83			
Housing Unit Density	0.46	0.33	-0.55	0.81	-0.48	-0.24	0.22	0.82	0.98		
Site Latitude	-0.64	-0.69	0.68	-0.42	0.67	0.41	-0.33	-0.75	-0.76	-0.69	
Water Temperature (mean)	0.30	0.31	-0.27	0.22	-0.29	-0.24	NS	0.36	0.34	0.32	-0.42

Appendix 4.4 Correlation of *E. coli* with Prior Precipitation (24 and 48 hours)

Precipitation data prior to each WCMP sampling event was estimated using gridded 1-day precipitation shapefiles obtained from the National Weather Service's Advanced Hydrologic Prediction Service (NOAA, 2015). The gridded shapefiles were intersected with the WCMP watersheds and the precipitation values were summed. To account for storms that occurred in portions of the watersheds and for differences in watershed sizes, the precipitation grid sum was divided by the watershed area. Both the day before sampling (1 day prior), and the sum of the 2 days prior to sampling were analyzed. The National Weather Service's Advanced Hydrologic Prediction Service does not allow the user to specify a start time, so rain may have occurred on the day of sampling between midnight and the sampling time (this situation was rare). The precipitation data did not have a normal frequency distribution, with a large amount of sample days occurring on dry days where zero precipitation had occurred. Out of 852 sampling events, 549 had zero precipitation, leaving 36 percent of the sampling events with some precipitation estimated. Summary statistics on the precipitation dataset are in Table 18. Spearman's correlations (nonparametric counterpart of the Pearson's correlation) were chosen because of the non-normality issues. Although significant (P-value < 0.001), the resulting Spearman's correlation of log transformed *E. coli* and precipitation prior to sample collection was very weak (r = 0.13). The correlation was also run excluding all dry weather events, and the results were no longer significant. There are several factors, each unaccounted for in this study, that could contribute to the lack of a relationship:

- Regardless of precipitation, a large number of sampling events had high *E. coli,* exceeding the TBC WQS.
- Timing between the rainfall event and the sampling event differs, where the critical time period of the arrival of the first flush (initial pulse of contaminated storm water) would also vary by watershed.
- The amount of rainfall that would be required to produce runoff in each watershed is unknown, and would vary by soil type, level of development, rainfall intensity, and overall climate (soil saturation condition).
- The maximum quantification limit of 2500 *E. coli* per 100 mL may have interfered with capturing very high *E. coli* responding to rainfall.

Flow estimates relative to baseflow for each sampling event may be a better predictor of *E. coli* given the differences in hydrology and land cover characteristics for our WCMP watersheds (this information is not practical to obtain for a study of this scale).

Table 18. Summary statistics for precipitation per square mile prior to each sampling event.

Statistic	Inches/sq. mi.
Mean	0.027
Minimum	0
First Quartile	0
Second Quartile (median)	0
Third Quartile	0.02
Maximum	1.64
Mode	0
N for Mode	549

Michigan Department of Environmental Quality
Water Bureau
August 2009

Total Maximum Daily Loads for Dissolved Oxygen and Sedimentation/Siltation for Norton Creek Oakland County

INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources (NPS) to restore and maintain the quality of their water resources. The purpose of these TMDLs is to identify the sources of dissolved oxygen (D.O.) standard nonattainment and sedimentation/siltation problems in Norton Creek near Wixom, and to quantify reductions in these sources necessary for attainment of WQS. Norton Creek and its tributaries in the vicinity of Wixom are designated as warmwater streams with a D.O. standard of 5 milligrams per liter (mg/l) as a minimum [Rule 64 (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 (NREPA)]. These TMDLs seek to achieve D.O. standard attainment and eliminate sedimentation/siltation issues through the reduction of total suspended solids (TSS) loads to Norton Creek.

Norton Creek is part of the Huron River watershed as illustrated in Figure 1, and is located in portions of Commerce, Lyon, and Milford Townships, and the cities of Novi, Walled Lake, Wixom, and the village of Wolverine Lake in Oakland County. Figure 2 describes the Norton Creek watershed and location of the TMDL reach. The majority of the population in the Norton Creek watershed resides in Wixom, which had 13,263 residents as of the 2000 census. Table 1 defines the extent and length of the reach. A total of approximately 3.1 river miles are addressed by these TMDLs.

Table 1. Norton Creek D.O. and Sedimentation/Siltation TMDL Reach.

Water Body	Reach Start	Reach End	Distance
Norton Creek	Buno Road (T2N, R7E, Section 25 of Oakland County)	Durr Drive (T2N, R8E, Section 30 of Oakland County)	3.1 miles

Norton Creek has a drainage area of approximately 24.2 square miles at its confluence with the Huron River in Section 13, T2N, R7E of Oakland County. Estimated summer season 50 percent (%) and 95% exceedance flows (cubic feet per second [cfs]) for Norton Creek at this location are 2.5 cfs and 0.7 cfs, respectively. Norton Creek low flows were computed from historic data collected at a United States Geological Survey gage, Upper River Rouge at Farmington, Michigan (Gage Number 04166300). Much of the Norton Creek drainage basin is dominated by wetlands. Since the 1980s, a significant portion of the Norton Creek watershed has been dredged as straight-cut channels to facilitate drainage.

PROBLEM STATEMENT

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

Water Body Name: Norton Creek **AUID:** 040900050103-04
Impaired Designated Use: Warmwater Fishery, Other indigenous aquatic life and wildlife
Cause: Dissolved Oxygen, Sedimentation/Siltation **Size: 18.8** miles
Location: Norton Creek from its confluence with the Huron River, upstream to its headwaters and including all tributaries
TMDL Year: 2009

Assessment units are prioritized for TMDL development considering the existing TMDL schedule (i.e., the number of TMDLs currently scheduled for each year), Michigan's five-year rotating watershed cycle, available resources to complete TMDLs, data and supporting information quality and quantity, complexity of the problem and severity of the pollution, and the USEPA's recommendation to develop TMDLs within 13 years of listing. Based on these considerations, the Norton Creek TMDLs, first listed in 1998 (sedimentation/siltation) and 2004 (D.O.), were scheduled for TMDL development in 2009.

The designated use rule (Rule 100 [R 323.1100]) requires the protection of, among other uses and specific to these TMDLs, other indigenous aquatic life and wildlife (R 323.1100(1)(e)) and warmwater fish (R323.1100(1)(d)) uses.

These TMDLs address D.O. standard nonattainment and sedimentation/siltation issues in Norton Creek near Wixom. The D.O. standard nonattainment is associated both with impairment of the warmwater fishery and the other indigenous aquatic life and wildlife designated uses. The excess sedimentation/siltation is associated with impairment of the other indigenous aquatic life and wildlife designated use. These TMDLs do not address WQS nonattainment or associated use impairments due to total dissolved solids or polychlorinated biphenyls in the water column, for which portions of Norton Creek are also listed on the 2008 Section 303(d) list. Those parameters and use impairments will be addressed in separate TMDLs. The listing location for the D.O. and sedimentation/siltation TMDLs will be modified in the 2010 Integrated Report to more explicitly define the impaired reaches for the impaired designated uses. The reach length of 18.8 miles will be reduced to 3.1 miles for the updated D.O. and sedimentation/siltation impairment listings. The upper and lower limits of that modified reach will be as follows:

> The upstream limit is at Durr Drive (Latitude 42.5187; Longitude -83.5448) with the downstream limit at Buno Road (Latitude 42.5527; Longitude -83.5622).

DATA DISCUSSION

D.O.

<u>1980 Water Quality Survey</u>

A 24-hour water quality study was performed on Norton Creek at Wixom in the summer of 1980 (Suppnick, 1981) in order to determine the capacity of the creek to assimilate oxygen-consuming wastes discharged by the Wixom Wastewater Treatment Plant (WWTP) (MI0024384) discharging to Norton Creek, and the Ford-Wixom Assembly Plant (MI0028151) discharging process and noncontact cooling waters to Norton Creek via Congdon Drain in Section 7, T1N, R8E of Oakland County. The 1980 study measured D.O. at seven locations in Norton Creek and Congdon Drain above and below the Wixom WWTP and the Ford-Wixom Assembly Plant discharges.

The 1980 study found minimum D.O. levels less than the current warmwater D.O. standard of 5 mg/l as a daily minimum at several monitoring locations in Norton Creek. Large diurnal D.O. variations (daily average concentration minus daily minimum concentration) were documented throughout the study reach during the 1980 study. A diurnal of approximately 4.5 mg/l was measured at the Durr Drive location (Section 6, T1N, R8E of Oakland County, upstream of the Wixom WWTP), while a diurnal of 3.5 mg/l was recorded at Buno Road (Section 25, T2N, R7E of Oakland County, downstream of the Wixom WWTP). Aquatic plant growth below Congdon Drain was described as "extremely abundant."

A calibrated and verified D.O. model of Norton Creek was created based on the 1980 study. Modeling results concluded that respiration of aquatic plants would prevent attainment of the D.O. standard during drought flow conditions. The modeling concluded that advanced waste treatment (AWT) limits for the summer and fall seasons at the Ford-Wixom Assembly Plant and Wixom WWTP would greatly improve water quality in Norton Creek. Note that the Ford-Wixom Assembly Plant redirected its process and noncontact cooling water discharge to the Wixom WWTP in 1991. Today, this facility has only an industrial stormwater permit (MIS410193) for surface water discharges. The Wixom WWTP upgraded to AWT in 1991.

2002 Water Quality Survey

Dissolved oxygen was monitored continuously in Norton Creek at Wixom, Michigan, from August 7-20, 2002, at Durr Drive and at Buno Road (Sunday, 2003). See Figure 2. The purpose of the study was to determine Norton Creek's compliance with the warmwater D.O. standard and to document changes in stream D.O. dynamics since the 1980 D.O. study.

Significant periods of warmwater D.O. standard nonattainment were documented in Norton Creek at the Durr Drive monitoring location. D.O. concentrations ranged from 2.6 to 6.9 mg/l, with an average study period concentration of 4.7 mg/l. An overall average diurnal D.O. variation of 0.8 mg/l was measured. Norton Creek at the Durr Drive location was in nonattainment of the 5 mg/l minimum warmwater D.O. standard for the majority of the study period. Approximately 62% of the continuously logged data points at the Durr Drive location were less than 5.0 mg/l. D.O. standard nonattainment occurred during both wet and dry weather. During the study period, Norton Creek at the Durr Drive monitoring location had little flow during dry weather. It is possible that relatively stagnant conditions due to low stream flows contributed to the relatively low levels of D.O. observed at this location.

A brief period (less than 12 hours) of D.O. standard nonattainment was documented at the Buno Road location. D.O. concentrations ranged from 4.7 to 8.0 mg/l, with an average concentration of 6.1 mg/l. An overall average diurnal D.O. variation of 0.7 mg/l was recorded at Buno Road. Norton Creek at Buno Road was largely in attainment of the warmwater D.O. standard. Approximately 3.6% of the continuously logged data points at the Buno Road location were less than 5.0 mg/l. The brief period of D.O. standard nonattainment that occurred on August 17, 2002, took place within 12 hours of the start of a wet weather event on August 16. It is possible that NPS pollutants contributed to this standard nonattainment at the Buno Road monitoring location.

The summer 2002 study documented much smaller diurnal variations at Durr Drive and Buno Road than those documented in the 24-hour study of Norton Creek conducted in 1980. The lower diurnals may be due, in part, to the reduction of combined nutrient loads from the Ford-Wixom Assembly Plant and Wixom WWTP since 1980.

Sedimentation/Siltation

The Michigan Department of Environmental Quality (MDEQ) has conducted several biosurveys in Norton Creek since 1971. Biological assessments in 1971, 1972, 1976, 1988, and 1997

indicated the presence of degraded macroinvertebrate communities at Durr, West Maple, and Buno Roads, variously attributed to excess sedimentation/siltation, excessive nutrient levels, and/or low D.O. levels (Figure 2) (Jackson, 1971; Jackson, 1972; Grant, 1976; Evans, 1990; Rippke, 2005).

Additional biosurveys were conducted in 2007 and 2008 using MDEQ Procedure 51 to evaluate benthic macroinvertebrate communities and habitat (MDEQ, 1990). Macroinvertebrate community scores are rated on a scale of -9 to 9, with scores of -4 to 4 considered acceptable, scores -5 or less poor, and 5 or greater, excellent. Negative ratings that are acceptable are indicative of water bodies that are strongly tending toward poor, while positive ratings that are acceptable indicate slight impairment. Fourteen metrics representing stream habitat were qualitatively evaluated at each station, with a range of total possible scores for all metrics of 0 (poor) to 200 (excellent). Macroinvertebrates and habitat were evaluated at four sites: Buno Road (2007 and 2008), upstream of the Wixom WWTP access road (2008), West Maple Road (2007 and 2008) and Durr Drive (2008) (Figure 2).

The 2007 macroinvertebrate results at Buno and West Maple Roads were acceptable (-3) and poor (-6) respectively, with the Buno Road score at the low end of acceptable. The 2008 sampling results at Buno and West Maple Roads were both poor (-5 and -6, respectively), and while the results upstream of the WWTP and the Durr stations were acceptable, both were at the low end of acceptable (-2 and -4, respectively). The 1997 macroinvertebrate sampling results at Buno and West Maple Roads scored poor at both stations (-5 at each station). These results indicate a persistently degraded system over the past 10 years of sampling using the current Procedure 51 methodology. Sample results prior to 1996 cannot be compared to current results due to different scoring methodologies used in the earlier studies.

A notable observation in the macroinvertebrate community survey results in both 2007 and 2008 is the paucity of sensitive organisms at all stations (e.g., certain families of caddiflies, mayflies, and stoneflies), which can be indicative of D.O. and/or sedimentation/siltation concerns.

The habitat evaluations at all stations in 2007 and 2008 rated towards the lower end of good (possible range of scores in the good category 114-154), with scores ranging from 114 (West Maple Road – 2007) to 135 (upstream of the WWTP – 2008). The habitat metric, Epifaunal Substrate/Available Cover, is a measure of the amount of stream channel in the sample reach that contains substrates that are free from sedimentation/siltation impacts and therefore, favorable for epifaunal colonization. Out of a total score of 20 for this metric, the highest score was found at West Maple Road (11 - the low end of good) and lowest at Buno Road (5 – high end of poor). A poor score is indicative of a stream substrate with less than 20% stable habitat, while the low end of good is indicative of 40% stable habitat. All stations sampled in 2007 and 2008 were found to have some degree of siltation.

NUMERIC TARGETS

D.O.

Rule 100 (R 323.1100) requires that all waters of the state are to be protected for warmwater fish, other indigenous aquatic life and wildlife, agriculture, navigation, industrial water supply, public water supply at the point of intake, partial body contact recreation, fish consumption, and total body contact recreation from May 1 to October 31. Regarding D.O., the impaired designated uses for Norton Creek addressed by these TMDLs are the warmwater fish and the other indigenous aquatic life and wildlife uses. The D.O. standard was developed to provide protection of these designated use. Attainment of the warmwater D.O. standard of 5 mg/l as a daily minimum is the target of these TMDLs. The D.O. WQS is defined as follows:

R 323.1064 Dissolved oxygen in Great Lakes, connecting waters, and inland streams.

Rule 64. (1) A minimum of 7 milligrams per liter of dissolved oxygen in all Great Lakes and connecting waterways shall be maintained, and, except for inland lakes as prescribed in R 323.1065, a minimum of 7 milligrams per liter 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 milligrams per liter of dissolved oxygen shall be maintained. These standards do not apply for a limited warmwater fishery use subcategory or limited coldwater fishery use subcategory established pursuant to R 323.1100(11) or during those periods when the standards specified in subrule (2) of this rule apply.

(2) Surface waters of the state which do not meet the standards set forth in subrule (1) of this rule shall be upgraded to meet those standards. The department may issue permits pursuant to R 323.2145 which establish schedules to achieve the standards set forth in subrule (1) of this rule for point source discharges to surface waters which do not meet the standards set forth in subrule (1) of this rule and which commenced discharge before December 2, 1986. For point source discharges which commenced before December 2, 1986, the dischargers may demonstrate to the department that the dissolved oxygen standards specified in subrule (1) of this rule are not attainable through further feasible and prudent reductions in their discharges or that the diurnal variation between the daily average and daily minimum dissolved oxygen concentrations in those waters exceeds 1 milligrams per liter, further reductions in oxygen-consuming substances from such discharges will not be required, except as necessary to meet the interim standards specified in this subrule, until comprehensive plans to upgrade these waters to the standards specified in subrule (1) of this rule have been approved by the department and orders, permits, or other actions necessary to implement the approved plans have been issued by the department. In the interim, all of the following standards apply:

…(b) For surface waters of the state designated for use for warmwater fish and other aquatic life, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season in accordance with R 323.1090(3) and (4). At the design flows during other seasonal periods as provided in R 323.1090(3), a minimum of 5 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.

…(3) The department may cause a comprehensive plan to be prepared to upgrade waters to the standards specified in subrule (1) of this rule taking into consideration all factors affecting dissolved oxygen in these waters and the cost effectiveness of control measures to upgrade these waters and, after notice and hearing, approve the plan. After notice and hearing, the department may amend a comprehensive plan for cause. In undertaking the comprehensive planning effort the department shall provide for and encourage participation by interested and impacted persons in the affected area. Persons directly or indirectly discharging substances which contribute towards these waters not meeting the standards specified in subrule (1) of this rule may be required after notice and order to provide necessary information to assist in the development or amendment of the comprehensive plan. Upon notice and order, permit, or other action of the department, persons directly or indirectly discharging substances which contribute toward these waters not meeting the standards specified in subrule (1) of this rule shall take the necessary actions consistent with the approved comprehensive plan to control these discharges to upgrade these waters to the standards specified in subrule (1) of this rule.

Sedimentation/Siltation

The second impaired designated use addressed by these TMDLs is the other indigenous aquatic life and wildlife use associated with the sedimentation/siltation-related impairments to the macroinvertebrate communities found in the TMDL reach.

The TMDL target is the reestablishment of macroinvertebrate communities that, when monitored using Procedure 51, result in a consistent acceptable or excellent rating (e.g., a score of -4 to +9). Macroinvertebrate communities will be evaluated based on a minimum of two Procedure 51 biological assessments conducted in successive years, following the implementation of efforts such as Best Management Practices (BMPs) to stabilize runoff discharges and extremes in stream flow conditions, and minimize sediment loadings to the watershed.

LINKAGE ANALYSIS

D.O.

Factors that can deplete oxygen in Norton Creek include the following:

Biochemical Oxygen Demand (BOD): BOD is the amount of D.O. that a given organic material will consume when it is oxidized by aerobic microorganisms in a water body. BOD has units of mg/l of D.O. consumed in the decomposition process. Potential sources of BOD in Norton Creek include the point source Wixom WWTP and NPS sources such as pet wastes and other organic materials present in surface runoff. When carbon-based compounds are oxidized, the oxygen demand is referred to as carbonaceous BOD, or CBOD. When nitrogen-based compounds are oxidized, it is called nitrogenous BOD, or NBOD. NBOD is exerted when ammonia is oxidized into nitrates and nitrites through nitrification. Organic nitrogen can be converted into ammonia, which can then be oxidized into nitrates and nitrites.

BOD can exist in a solubilized form (such as sugars), as well as in the form of organic solids (particulate matter such as leaf litter). In general, soluble BOD is more readily degraded in the environment than particulate BOD (USEPA, 1985). A portion of the solids in the water column present as TSS may be aerobically biodegradable and exerted as BOD, while a portion of the solids may be biologically unreactive or inert due to a low organic and high mineral content. Particulate BOD may settle out in a water body and contribute to sediment oxygen demand.

Sediment Oxygen Demand (SOD): Solids from NPS and point sources present in the water column of a flowing water body can settle to the stream bed, forming layers of sediments with variable depths and compositions. Organic solids on the surface layer of the bottom in direct contact with the water can undergo aerobic decomposition, causing diffusion of D.O. from the water column into the sediment layer and depleting D.O. levels in the overlying river water. NPS solids contributing to SOD most often enter a water body during runoff events. For point sources, the discharge of sediments, their rate of deposition, and the associated SOD all decrease with increased levels of wastewater treatment (Thomann & Mueller, 1987). SOD and sediment deposits are typically highly variable spatially and temporally due to varying flow regimes affecting deposition and scour (USEPA, 1985).

During the 2002 D.O. monitoring, stream substrates at the Durr Drive and Buno Road monitoring locations were observed to be silty, mucky, and organic in nature. Sediment depths greater than one foot were observed at Buno Road, and evidence of channel dredging was present. At both locations, stream velocities were low and flow conditions were quiescent. These conditions encourage the settling of sediments out of the water column and exacerbate SOD.

Plant Respiration: The presence of aquatic plants in a water body can have a significant effect on levels of D.O. Plants such as rooted macrophytes and algae use photosynthesis during daylight hours to convert carbon dioxide and water into glucose, a process that releases oxygen. The oxygen is released to the surrounding water increasing levels of D.O. Throughout the day and night, plants also respire aerobically. This process removes D.O. from the water column. D.O. concentrations vary throughout the day in response to photosynthesis and respiration. Since the photosynthetic contribution of D.O. occurs only with sunlight, and respiration is relatively constant, levels of D.O. are most often lowest just before sunrise. Plant growth can be encouraged by the addition of nutrients, such as phosphorus, to a water body. This increased growth causes increases in photosynthesis and respiration rates, resulting in exaggerated daytime D.O. concentration peaks and potentially problematic early morning lows.

Norton Creek diurnal D.O. variations measured during the 2002 study were not considered to be excessive as they were less than 1 mg/l (MDEQ, 1995). Observed plant growths were not considered to be at levels of overabundance. Therefore, excessive plant growths are not considered to be problematic for D.O. standard attainment in Norton Creek, consistent with observations during the 2007 and 2008 biological surveys. Plant nutrients (phosphorus) are not pollutants of concern for these TMDLs.

The relative importance of the multiple D.O. sinks to the oxygen budget of a stream can be evaluated with a D.O. model that quantifies each oxygen demand present. For Norton Creek, the oxygen budget of the stream was evaluated with a multiple reach Streeter-Phelps D.O. model based on the modified Streeter-Phelps equation. The multiple reach Streeter-Phelps D.O. model is considered appropriate for use in the TMDL as it can represent the system without being unnecessarily complex or overly data-intensive. Model inputs include background and inflow water quality chemistry, CBOD and NBOD decay and deoxygenation rates, reaeration rates, and stream velocity. The model calculates an average daily D.O. concentration at the end of each defined reach. A minimum daily D.O. concentration can be calculated by applying D.O. diurnal variations measured during D.O. studies. The model incorporates stream D.O. contributions from photosynthesis, and D.O. consumption due to plant and algal respiration and SOD in each reach (Thomann and Mueller, 1987).

The TMDL model is based on the calibrated and verified D.O. model of Norton Creek, which was first developed using data from the 1980 Water Bureau (WB) D.O. study and which has been used to develop water quality-based effluent limits (WQBELs) for the Wixom WWTP's NPDES permit. The D.O. model used study-measured values for stream velocity, channel slope, background and inflow water chemistry, and CBOD and NBOD decay rates. Modeled daily maximum, minimum, and average D.O. concentrations were made to match observed D.O. concentrations (model calibration) by adjusting the models inputs for photosynthesis and respiration. For the TMDL analysis, the model was re-calibrated to match D.O. concentration data collected during the 2002 D.O. study.

The recalibrated model was used to calculate the Loading Capacity for these TMDLs. The modeling was consistent with Great Lakes and Environmental Assessment Section (GLEAS) Procedure 80, Guidance on Water Quality-Based Effluent Limit Recommendations for Oxygen Demanding Substances (MDEQ, 1995), which prescribes the selection of model input values. Model inputs which were not measured during DO studies of Norton Creek, such as stream reaeration rates, were calculated as per Procedure 80. Conservative design conditions were incorporated to determine necessary loading reductions also as per Procedure 80. Such modeled conditions included 95% exceedance drought flows and 10% exceedance stream temperatures. The Wixom WWTP was modeled as discharging at its maximum permitted flow rate and at its maximum limits of CBOD and ammonia.

The relative importance of the multiple D.O. sinks to the oxygen budget of a stream can be evaluated with a D.O. model that quantifies each oxygen demand present. For Norton Creek,

the oxygen budget of the stream was evaluated with a multiple reach Streeter-Phelps D.O. model that incorporates stream D.O. contributions from photosynthesis, and D.O. consumption due to plant and algal respiration and SOD in each reach (Thomann and Mueller, 1987). Modeling was conducted in accordance with guidance described in the GLEAS Procedure 80 (MDEQ, 1995). The modeling analysis was used to develop the Norton Creek D.O. TMDLs' pollutant Loading Capacity (LC).

Sedimentation/Siltation

Excessive sedimentation/siltation has repeatedly been identified as the leading cause of impairment of the nation's waters. In 1998, approximately 40% of assessed river miles in the United States were impaired or threatened from an imbalanced sediment supply (USEPA, 2000). In appropriate amounts, sediments (both suspended and bedded) are essential to aquatic ecosystems. Natural levels transport nutrients, detritus, and other essential organic matter throughout aquatic environments and replenish intermittently mobile bottom sediments and create valuable micro-habitats, such as pools and sand bars (USEPA, 2006). The effects of excessive sediments on aquatic biota can range in severity from no effects to behavioral effects (e.g., invertebrate drift, fish relocation, and impaired ingestion rates in mussels) to lethal effects (USEPA, 2006). Further, sedimentation/siltation of benthic substrates has been shown to decrease substrate heterogeneity, increase embeddedness, and alter benthic community structure and species diversity (Waters, 1995). Sediments may also have associated stressors such as nutrients, pesticides, and other bound toxins that further stress aquatic organisms.

Human activities that increase soil erosion or alter rates of sediment transport in waterways (e.g., forestry, mining, urban development, industrial activities, agriculture, dredging, channel alteration, and dam construction) are among the most pervasive causes of sediment imbalance in aquatic systems (Waters, 1995; Nietch et al., 2005; USEPA, 2006). Altered hydrology, or more specifically, increased flashiness due to increased runoff rates and volume, in the Norton Creek watershed has been identified as a cause for the lack of stable in-stream habitat, increased in-stream erosion, channel aggradation, and heavy siltation of stable in-stream habitats (Wuycheck, 2009).

Reducing TSS loads in the Norton Creek watershed as prescribed by the D.O. portion of these TMDLs, along with the commensurate decrease in flow volume and rate, should increase macroinvertebrate community diversity and abundance. As sedimentation/siltation are reduced, the negative effects of sedimentation/siltation described above are expected to diminish, with the goal of meeting the other indigenous aquatic life and wildlife designated use.

LC DEVELOPMENT

The LC represents the maximum loading of oxygen demanding substances (BOD) or other parameters that can indirectly cause oxygen demand (sediments, nutrients) that can be assimilated by the water body while still achieving WQS. As indicated in the Numeric Target section, the targets for these TMDLs are the D.O. WQS of 5 mg/l minimum and the reestablishment of macroinvertebrate communities that are rated consistently as acceptable or excellent under Procedure 51.

The LC development defines the environmental conditions that will be used when defining allowable pollutant loads. The "critical condition" is defined as the set of environmental conditions that result in the attainment of WQS and have an acceptably low frequency of occurrence. The critical conditions for the applicability of WQS in Michigan surface waters are given in Rule 90 (R 323.1090), applicability of WQS. Rule 90 requires that the WQS apply at all flows equal to or exceeding the water body design flow. In general, the lowest monthly 95% exceedance flow and 90% occurrence temperature for streams are used as design conditions for oxygen-demanding pollutant loads (CBOD, ammonia nitrogen, and TSS). For these TMDLs,

the critical condition for D.O. is the summer season when high temperatures and low stream flows reduce the assimilative capacity of streams for D.O. consuming pollutants.

In order to quantify reductions in river D.O. demands necessary to attain the D.O. standard at critical conditions, the calibrated and verified D.O. model originally developed with data collected during the 1980 stream survey was updated with and recalibrated to data collected during the 2002 D.O. study. The recalibration involved adjustment of simulated D.O. contributions from photosynthesis, and D.O. sinks from plant respiration and SOD. Since the 2002 survey found much smaller D.O. diurnal variations than those measured during the 1980 survey and at values typical of streams unaffected by excessive plant growth, aquatic plant and algal photosynthesis and respiration were represented in the model simply by subtracting the diurnal variation value from the modeled average D.O. concentration. The D.O. modeling indicates that SOD is the leading cause of D.O. depletion in Norton Creek. Plant respiration and BOD from the Wixom WWTP and NPS play smaller roles in the D.O. problem in the TMDL reach.

The calibrated model was used to predict D.O. under a design scenario, which included drought flow, 90 percent occurrence stream temperature, SOD at the value determined during model calibration, and the presently permitted point source discharge levels of CBOD, ammonia, and D.O. The result for this simulation indicated that the D.O. standard would not be met.
The relative importance of each oxygen demand (SOD, CBOD, and ammonia) was evaluated in the model at the end of each of twenty stream reaches. The model indicated that SOD was by a large margin the greatest overall oxygen demand in the stream followed by CBOD as shown in Table 2. NBOD due to ammonia oxidation is not a factor as the 1980 water quality survey and model calibration have shown nitrification rates to be zero throughout all modeled reaches.

Table 2. Relative Importance of Factors that Deplete Oxygen in Norton Creek.

Oxygen Demand	As a % of Total D.O. Deficit for Each Model Reach	
	Minimum	Maximum
SOD	92	98
CBOD	2	8
Ammonia	0	0

The model analysis continued by decreasing the SOD incrementally in the model until the D.O. standard was met throughout Norton Creek. This required reducing SOD by 84%. The Wixom WWTP's discharge of CBOD and ammonia was not reduced beyond currently permitted levels in the modeling analysis because the currently permitted levels are already at the maximum treatment level achievable (AWT limits of 10 mg/l $CBOD_5$ and 2 mg/l ammonia as daily maxima). This was the scenario from which these TMDLs were developed.

The rate of SOD per unit area is dependent upon sediment depth when depth is less than a critical value of 10 to 20 centimeters (USEPA, 1985). The amount of D.O. consumed in a reach from SOD is also dependent upon the surface area that is covered by oxygen demanding sediment. Both of these parameters (sediment depth and areal coverage) can be expected to decrease as suspended solids loads are decreased to a stream. Modeling the fate of suspended solids discharged to Norton Creek is beyond the scope of these TMDLs and is not necessary since the magnitude of the reduction needed is relatively large. To achieve an 84% reduction in SOD in Norton Creek, a proportionate reduction in the suspended solids discharges is therefore needed.

The sediment load reductions prescribed to meet the warmwater fishery and the other indigenous aquatic life and wildlife designated uses through the attainment of the 5 mg/l minimum D.O. standard are expected to result in achievement of the target of the

reestablishment of macroinvertebrate communities that are rated consistently as acceptable or excellent. TSS load reductions will primarily result from less sediment entering the TMDL reach during wet weather events. This will result in reductions in sedimentation/siltation rates, which will be evident under both wet and dry conditions. This in turn will allow the establishment of desired macroinvertebrate communities to an acceptable level as determined by Procedure 51. If biological assessments conducted after TMDL implementation show that such biocommunities have not been established, reassessment of the sediment load reductions called for under the D.O. TMDL may be necessary.

SOURCE ASSESSMENT

The pollutant of concern for D.O. and sedimentation/siltation in Norton Creek is suspended solids. The effect of suspended solids on D.O. is a secondary effect exerted mostly through SOD. Suspended solids discharged primarily during high flow conditions settle on the stream bottom and have the greatest adverse effect under low flow conditions. Sources of suspended solids to the stream include:

- Point sources with individual National Pollutant Discharge Elimination System (NPDES) permits.
- Permitted storm water sources, which include facilities and land uses covered by general permits and construction sites covered by Permit-by-Rule.
- Runoff from land uses not covered by NPDES permits (e.g., agricultural, forest lands).

Point Sources

There are 40 NPDES permitted point source discharges in the Norton Creek watershed. These include facilities covered under 2 individual NPDES permits, 28 industrial stormwater permits, 2 construction sites covered under Permit-by-Rule Notices of Coverage (NOCs) (construction sites greater than 5 acres in area), and 8 municipal separate sanitary stormwater system (MS4) general permits.

The two individual permits are the Wixom WWTP and Michigan Department of Transportation's (MDOT's) statewide MS4 permit (MI0057364) covering storm water runoff from state-managed roads in the basin (portions of I-96 and M-5). The eight general municipal MS4 permittees include seven under the Storm Water Discharges from Separate Storm Water Drainage Systems general permit (MIG619000), and one covered by the Storm Water Discharges from Municipal Separate Storm Sewer Systems (MS4s) with Controls Based on Six Minimum Measures permit (MIG040000). The MDEQ, WB, has issued ten No Exposure Certifications to facilities whose standard industrial classifications would have otherwise made them subject to industrial stormwater permit coverage. No Norton Creek watershed surface water discharges are covered under any general NPDES permit aside from those mentioned here. There are no known Concentrated Animal Feeding Operations in the watershed. See Appendix A for a listing of all NPDES permitted outfalls discharging to the Norton Creek watershed.

Runoff from the lands covered under the MDOT statewide MS4 permit is considered insignificant in relation to runoff from other land uses. State roads cover approximately 21 acres in the Norton Creek watershed, accounting for less than 0.2% of the total area.

Wixom WWTP

The Wixom WWTP, with a design flow of 2.8 million gallons per day (MGD), is permitted to continuously discharge treated sanitary wastewater from outfall 001 to Norton Creek in Section 30, T2N, R8E of Oakland County. See Appendix B for Wixom WWTP current NPDES permit conventional parameter effluent limits based on the current 2.8 MGD design flow. The Wixom WWTP's current NPDES permit was issued on December 1, 2004, with an expiration

date of October 1, 2008. The permit has been extended until it is formally reissued, which is expected to occur before September 30, 2009. The current permit includes effluent limits based on a design flow of 4.02 MGD from an expanded treatment facility. There is no timetable for facility expansion as such upgrades are dependent on local development. The NPDES permit to be reissued in 2009 will include limits based on the current and increased design flows of 2.8 and 4.02 MGD, respectively.

The facility's current NPDES permit requires AWT limits in the summer and fall seasons (May through November) for both the 2.8 and 4.02 MGD design flows. AWT limits are treatment technology-based effluent limits and are the most restrictive conventional pollutant limits imposed on sanitary wastewater facilities employing biological treatment. Such effluent is assumed to exert no in-stream D.O. demand and is often referred to as "stable effluent" due to very low BOD decay rates and high ultimate BOD to BOD_5 ratios (Chapra, 1997; MDEQ, 1995). The city of Wixom has no known combined sewer or sanitary sewer overflows, and none have been known to exist in the past.

A summary of monthly average data from Wixom WWTP Discharge Monitoring Reports (DMRs) from May 2006 through April 2008 is presented in Table 3. The facility was in compliance with all limits for the listed parameters during the monitoring period. The Wixom WWTP's tertiary treatment system employs enhanced coagulation, flocculation, and sand filters to produce a high quality final effluent with low concentrations of TSS and total BOD. Such effluents contain a low ratio of particulate-to-soluble BOD, such that the rate of settling of any volatile (oxygen-demanding) solids becomes insignificant (Thomann & Mueller, 1987). In addition, any remaining effluent particulate BOD is more resistant to biodegradation in the environment than the soluble portion (USEPA, 1985). Any solids settling from such a highly treated effluent are therefore expected to contribute significantly less SOD than more readily degraded, untreated settled solids from NPS such as pet waste, detritus, or rich organic soils.

Based on the current annual permitted TSS loading averaged over the year, the facility is permitted to discharge 565 pounds per day (lbs/day) TSS. However DMR data show that an average of about 60 lbs/day TSS is actually discharged. The Wixom WWTP produces a very clear effluent, such that ultraviolet disinfection is highly effective and is preferred over chemical disinfection.

Table 3. Wixom WWTP Monthly Average DMR Data from May 2006 through April 2008.

Parameter	Wixom WWTP
Flow (MGD)	2.05
Ammonia (mg N/l)	0.13
$CBOD_5$ (mg/l)	2.03
CBOD % removal	98.7
D.O. (mg/l)	8.9
Total phosphorus (mg P/l)	0.21
TSS (mg/l)	3.19
TSS % removal	97.3

Table 4 contains permitted daily conventional pollutant loads for the Wixom WWTP point source discharge. Facility loads are calculated from the facility's monthly NPDES permit load limits. Note that the facility may, in fact, be discharging significantly lower loads of these pollutants than is permitted to discharge.

Table 4. Norton Creek Permitted Point Source Conventional Pollutant Loadings - Wixom WWTP.

	Wixom WWTP	
Load (lbs/day)	Total Annual Load	Average Daily Load
BOD_5 *	83,000	227
TSS	206,280	565
Total phosphorus	1,800	4.9
Ammonia nitrogen	35,320	97

* - $CBOD_5$ is limited in the Wixom WWTP NPDES permit

Estimates of all land use-related (NPDES permitted and non-NPDES permitted land use) loads of BOD, TSS, total phosphorus, and total nitrogen to the Norton Creek TMDL reach were estimated using the Long-Term Hydrologic Impact Assessment (L-THIA) Web-based software created and maintained by Purdue University and the USEPA (Purdue University and USEPA, 2001). This geographic information system-based application uses the event mean concentration and curve number procedures to calculate annual pollutant loads based on land use, soil type, and meteorological data. The L-THIA application is supported by staff of the USEPA, Region 5.

The L-THIA has been developed as a straightforward analysis tool that provides estimates of changes in runoff, recharge, and NPS pollution resulting from past or proposed land use changes. It gives long-term average annual runoff for a land use configuration, based on actual long-term climate data for that area. By using many years of climate data in the analysis, L-THIA focuses on the average impact, rather than an extreme year or storm. L-THIA results do not predict what will happen in a specific year. As a quick and easy approach, L-THIA results are intended to provide insight into the relative hydrologic impacts of different land use scenarios. The results can be used to generate community awareness of potential long-term problems and to support physical planning aimed at minimizing disturbance of critical areas. It is an ideal tool to assist in the evaluation of potential effects of land use change and to identify the best location of a particular land use for minimum impact on the natural environment of the area. Concern over urban sprawl has focused on several land use change issues, including the failure to account for hydrologic aspects of land use change that can result in flooding, stream degradation, erosion, and loss of groundwater supply. The L-THIA was developed to provide a quick, accessible tool to use in assessing the long-term impacts of land use change. This site suitability analysis tool makes use only of information that is readily available from municipal databases (Purdue University and USEPA, 2001).

Land use areas in the Norton Creek watershed were based on aerial photography taken by the Southeast Michigan Council of Governments (SEMCOG) in 2000 (SEMCOG, 2003). These land uses and their percentage of the total TMDL watershed area are outlined in Table 5.

Table 5. Norton Creek Basin Land Use Categories as Percentages at the Confluence with The Huron River.

Land Use Category	Percent Land Use Category
Single family residential	26.3
Multiple family residential	4.0
Under development	2.3
Commercial, office, institutional	2.2
Industrial	14.6
Transportation, communications, utilities	5.1
Vacant land in nonresidential areas	1.7
Cultural, outdoor recreation, cemetery	3.8
Active agriculture	4.6
Grassland and shrub	10.9
Woodland and wetland	20.3
Water	4.1

Estimates of pollutant loads from NPDES-permitted land uses, considered to be point sources in these TMDLs, appear in Table 6. These land uses include those covered under the NPDES stormwater permits and those covered under municipal and MDOT statewide MS4 permits. All commercial and industrial land uses were considered to be covered by stormwater permits for load calculations with the L-THIA application, while all residential, transportation, utilities, communications, and mixed urban land uses were considered to be covered under MS4 permits. Loads outlined in Table 6 represent point source pollutant loads to the TMDL reach in addition to those generated by the Wixom WWTP listed in Table 4. Calculated loadings are based on event mean concentration data collected by the Rouge River National Wet Weather Demonstration Project (Cave et al., 1994).

Table 6. Norton Creek Permitted Point Source Conventional Pollutant Loadings – NPDES Land Use Sources.

	Industrial Stormwater Permits		Municipal and MDOT MS4 Permits	
Load (lbs/day) **	Total Annual Load	Average Daily Load	Total Annual Load	Average Daily Load
BOD_5	38,488	105	72,694	199
TSS	220,750	605	208,381	571
Total Phosphorus	529	1.5	1,064	2.9
Total Nitrogen	2,886	7.9	4,582	12.6

** - Facilities' NPDES permits contain no limits for the listed parameters. Loads are estimated from land use data.

NPS

Land uses that are not covered under NPDES permits are considered to be NPS in nature in these TMDLs. For pollutant loads calculations, these land uses were considered to include cropland and pasture, shrub and brush, forest, lakes, streams, and wetlands. Loads from these land uses appear in Table 7.

Table 7. Estimated Daily Non-NPDES Land Use-Related Conventional Pollutant Loads to Norton Creek at its Confluence with the Huron River.

Pollutant	Total Annual Load (lbs/year)	Daily Load (lbs/day)
BOD	12,705	35
TSS	56,895	156
Total Phosphorus	232	0.6
Total Nitrogen	1,402	3.8

ALLOCATIONS

The LC is comprised of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for NPS and natural background levels. In addition, the LC must include a MOS, either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

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

The LC represents the maximum loading of pollutants that can be assimilated by the receiving water while still achieving WQS. The LC is allocated into WLAs for point sources, LAs for NPS, and the MOS. The LC calculated through D.O. modeling of Norton Creek calls for SOD and TSS loads to the TMDL reach to be reduced by 84% for WQS attainment. This reduction of TSS loads to Norton Creek will also result in elimination of the documented sedimentation/siltation problems to the extent that designated uses are impaired.

As detailed in the Source Assessment portion of these TMDLs, loads of TSS from the Wixom WWTP are not expected to contribute significantly towards levels of SOD in Norton Creek. Therefore, TSS reductions from this facility will not be sought. To achieve an 84% TSS load reduction to Norton Creek from the remaining sources, which are land-use related sources, NPDES and non-NPDES land use-related TSS loads will be reduced by 84%. The land-use TSS load reduction calculation is illustrated below using existing TSS loading data from Tables 4, 6, and 7. The TSS load reduction equals a target LC for the non-WWTP TSS fraction of 213 lbs/day TSS, an 84% reduction from the existing land-use TSS load of 1,332 lbs/day. The total LC including the WWTP allocation of 565 pounds is 778 pounds.

$$\text{Overall reduction} = \frac{\text{Existing load - Target load}}{\text{Existing load}}$$

$$= \frac{[(605 + 571) + 156] - [(97 + 91) + 25]\ \text{lbs/d}}{(605 + 571) + 156\ \text{lbs/d}}$$

= 84%

To summarize, D.O. modeling indicates that an overall 84% TSS load reduction from all non-WWTP sources will result in D.O. standard attainment in the TMDL reach. Sedimentation/siltation issues in the Norton Creek watershed will also be addressed through this TSS load reduction. See Table 8 below for a summary of existing and target TSS loads according to the TMDL WLA and LA.

Table 8. Daily TSS WLAs, LAs, and Numeric Targets - Norton Creek at the Mouth of the Huron River.

Water Body	Current Daily TSS Load (lbs)	Daily TSS Loading Capacity (lbs)	WLA Daily TSS Load (lbs)	LA Daily TSS Load (lbs)
NORTON CREEK:				
Wixom WWTP	565	565 *	565 *	-
Industrial Stormwater Permitted Outfalls	605	97	97	-
MS4 Stormwater Permitted Outfalls	571	91	91	-
Non-NPDES Land Use-Related Sources[%]	156	25	-	25
Totals:	1,897			
Daily TSS Load Numeric Target To TMDL Reach		778*	753**	25

% - Attributed to land uses in the townships of Commerce, Lyon, Milford, and Novi, and the cities of Novi, Walled Lake, Wixom, and the village of Wolverine Lake.
* Note the loading capacity for TSS, excluding the Wixom WWTP TSS load for reasons described above, is 213 pounds, an 84% reduction from the current load.
** Note the target WLA for TSS, excluding the Wixom WWTP TSS load for reasons described above, is 188 pounds.

WLAs

WLAs were assigned to sanitary wastewater, industrial storm water, and municipal storm water discharges permitted by an individual NPDES permit or general NPDES permit as described in the sections below. A complete list of NPDES permits addressed in these TMDLs is included in Appendix A.

The D.O. standard nonattainment in Norton Creek has been documented during the summer months only. During the summer months (May through September), the most potentially significant single point source of oxygen demanding substances to nonattaining reaches, the Wixom WWTP, is currently required by its NPDES permit to meet AWT (stable effluent) permit limits for $CBOD_5$ and ammonia. Further reductions in conventional pollutants (CBOD, ammonia nitrogen, and TSS) from this facility are not expected to impact Norton Creek D.O. levels in the critical summer months.

TSS inputs resulting from land use-related sediment loads will be the primary targets for TSS reductions in these TMDLs. Existing TSS loads from all NPDES-permitted land use-related sources have been reduced by 84% in the WLA as described in Table 8. Lands contributing WLA TSS loads to Norton Creek are located in Commerce, Lyon, and Milford Townships and the cities of Novi, Walled Lake, Wixom, and the village of Wolverine Lake in Oakland County.

No specific TSS load reduction is targeted for the statewide MDOT statewide MS4 permit (NPDES land use), as only a very small fraction of the overall transportation land use in the watershed consists of state-maintained roads as described in the Source Assessment section of these TMDLs. Existing and target loads from the MDOT statewide MS4 permit are included in the MS4 Permittees category in Table 8.

LAs

Existing TSS loads from all non-NPDES permitted land use-related sources have been reduced by 84% in the LA as described in Table 8. Lands contributing LA TSS loads to Norton Creek are located in the same jurisdictions as the WLA land-use sources.

MOS

The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings).

These TMDLs use an implicit MOS due to very conservative assumptions incorporated in D.O. modeling used to determine appropriate load reductions for TSS. Background flows and tributary inflows are represented at the 95% exceedance summer low flow as determined by the MDEQ, Land and Water Management Division. The summer 95% exceedance flow is a stream flow that would be expected only during periods of severe drought. Stream flows would be expected to be this low for only 5% or less of the time during the summer season. Michigan WQS (R 323.1090) specify that WQS apply at all flows equal to or exceeding the 12-month 95% exceedance low flow. This is the stream flow employed in the modeling of the critical summer season, the minimum flow at which WQS are to be applied. Similarly, river temperatures are represented at the highest monthly 90% occurrence temperature for the summer season as defined in the Effluent Limit Coordination Procedure No. 15 (Buda, 1980). This temperature would be expected to be exceeded only 10% of the time during the summer months. This design temperature is derived from R 323.1075 of the WQS. Such high temperatures result in lower D.O. saturation concentrations and increased rates of in-stream oxygen utilization. The conservative assumptions regarding stream flow and water temperature are the same as those employed in the determination of WQBELs in NPDES WLAs at critical design conditions. For design condition TMDL modeling, the Wixom WWTP was represented as discharging its maximum design flow and maximum permitted concentrations of oxygen demanding substances. This is an extremely unlikely scenario and further lends to the conservative assumptions of the modeling. A large degree of uncertainty in the D.O. modeling is also removed as the models used were calibrated to observed data.

SEASONALITY

Monitoring and modeling indicates that design conditions occurring during the summer season represents the most critical conditions for D.O. standard attainment in Norton Creek. Modeling of Norton Creek in other seasons using appropriate 95% exceedance low flows and 90% occurrence temperatures shows predicted D.O. standard nonattainment occurring in the fall season. The reduction in TSS loads recommended in these TMDLs should result in decreased SOD and sedimentation/siltation in Norton Creek during all seasons. The Wixom WWTP's NPDES permit contains AWT permit limits in the summer and fall as a result of the D.O. standard nonattainment predicted by modeling in those seasons.

MONITORING

Future monitoring will be conducted once activities have occurred to reduce TSS loadings to assess whether these activities have resulted in water quality improvements. This monitoring will be conducted as resources allow. Typically, the WB monitors watersheds in accordance with the five-year NPDES permit review process. D.O. standard attainment will result in the water bodies being removed from the Section 303(d) list, while continued nonattainment will result in further evaluation under the TMDL process. Wet weather pollutant load sampling may

aid in directing future efforts toward specific areas contributing significant NPS loads. Norton Creek is next scheduled for monitoring in 2012.

REASONABLE ASSURANCE ACTIVITIES

The Reasonable Assurance section discusses various activities and regulatory controls that are in place or are expected to be in place that will aid in achieveing the pollutant load reductions prescribed by these TMDLs.

Under the NPDES permit program, the Wixom WWTP is required to meet limitations for TSS, CBOD, ammonia, and D.O. To ensure these limitations are met at all times, the facility typically achieves a much better effluent quality than required by its permit. Any violations of the permit limits are dealt with by a well established compliance and enforcement program administered by the MDEQ's Southeast Michigan District Office.

The Huron River Watershed Council (HRWC) works with residents, businesses, and local governments to protect water quality in the watershed, including Norton Creek (HRWC, 2009). The Council coordinates efforts involving public awareness and outreach, land use and conservation, and data collection and analysis. The HRWC has been very instrumental in establishing an effective citizen monitoring network, passing environmental protection ordinances, and disseminating guidance for the preservation and restoration of streams and lakes in the Huron Watershed.

Norton Creek is a tributary of Kent Lake, a recreational impoundment on the Huron River located approximately 5 miles downstream of Norton Creek's confluence with the Huron River. Many entities, including the HRWC, are involved with the implementation of the Kent Lake Subwatershed Management Plan (KLSMP) prepared by the Kent Lake Subwatershed Workgroup (KLSW) with funding from the MDEQ under the CWA Section 319 Program (KLSW, 2002). The KLSMP was approved in August 2002 by the MDEQ. The main goal of the KLSMP is to attain the requirements of the Kent Lake Total Phosphorus TMDL written by MDEQ and approved by USEPA in March 2000. Since many of the actions designed to prevent loadings of nutrients to the watershed will also reduce loadings of TSS, the KLSMP can be a great aid in implementation of the Norton Creek D.O. and sedimentation/siltation TMDLs. The KLSMP also aims to establish a protocol to help subwatershed communities obtain coverage under Phase II stormwater permits by meeting program requirements. The KLSMP employs comprehensive, long-term efforts geared towards control of stormwater runoff through BMPs, conservation planning and standards adoption, and education and stewardship. Such efforts will be conducted within each subwatershed of the Kent Lake drainage basin, including the Norton Creek watershed.

Oakland County administers the Part 91, Soil Erosion and Sedimentation Control (SESC), Program of the NREPA. This program aims to reduce sedimentation/siltation in rivers, lakes, and streams by controlling sediments in runoff from construction sites greater than 1 acre in area, or those located within 500 feet of a water of the state. Temporary (silt fences) and permanent control measures (such as fully vegetation buffer strips) are employed. The MDEQ, WB, oversees the counties' programs to ensure that they are effectively enforcing SESC regulations.

The Norton Creek TMDL reach is designated as a county drain, managed by the Oakland County Drain Commission. The Oakland County Drain Commissioner and the Michigan Department of Agriculture manage Norton Creek for water quantity and, to a limited extent, for water quality issues.

The Oakland Conservation District serves farmers and landowners in the Norton Creek watershed with conservation planning and erosion control through various programs by providing assistance and educational information related to conservation.

Federal regulations require certain industries to apply for an NPDES permit if storm water associated with industrial activity at the facility discharges into a separate storm sewer system or directly into a surface water. There are 28 industrial facilities with storm water discharge authorization within the Norton Creek watershed. Prior to obtaining permit coverage, applicants must certify that they do not have any unauthorized discharges. MDEQ staff conduct inspections of a percentage of permitted, and all regulated, industrial facilities annually. Inspections are utilized to ensure that facilities comply with the regulations, and result in a further reduction in unauthorized discharges and illicit connections. Additionally, as more facilities obtain industrial storm water permits, more illicit discharges will be eliminated. Within Norton Creek there are eight local jurisdictions that have obtained Phase II MS4 permit coverage (Appendix A). Long-term watershed management plans have been or will be developed under these permits, and implementation of BMPs and other pollution prevention activities are underway.

Among other things, these stormwater permits require:

1. Watershed planning that specifically addresses any TMDLs in the watershed, including identification of priority problems and opportunities (including any TMDL established for a parameter within the watershed that may be affected by storm water).

2. Development of a Storm Water Pollution Prevention Initiative that contains short-term and long-term goals for the watershed (which shall include both the protection of designated uses of the receiving waters as defined in Michigan's WQS, and attaining compliance with any TMDL established for a parameter within the watershed).

Prepared by: Erik Sunday
John Wuycheck
Surface Water Assessment Section
Water Bureau
Michigan Department of Environmental Quality
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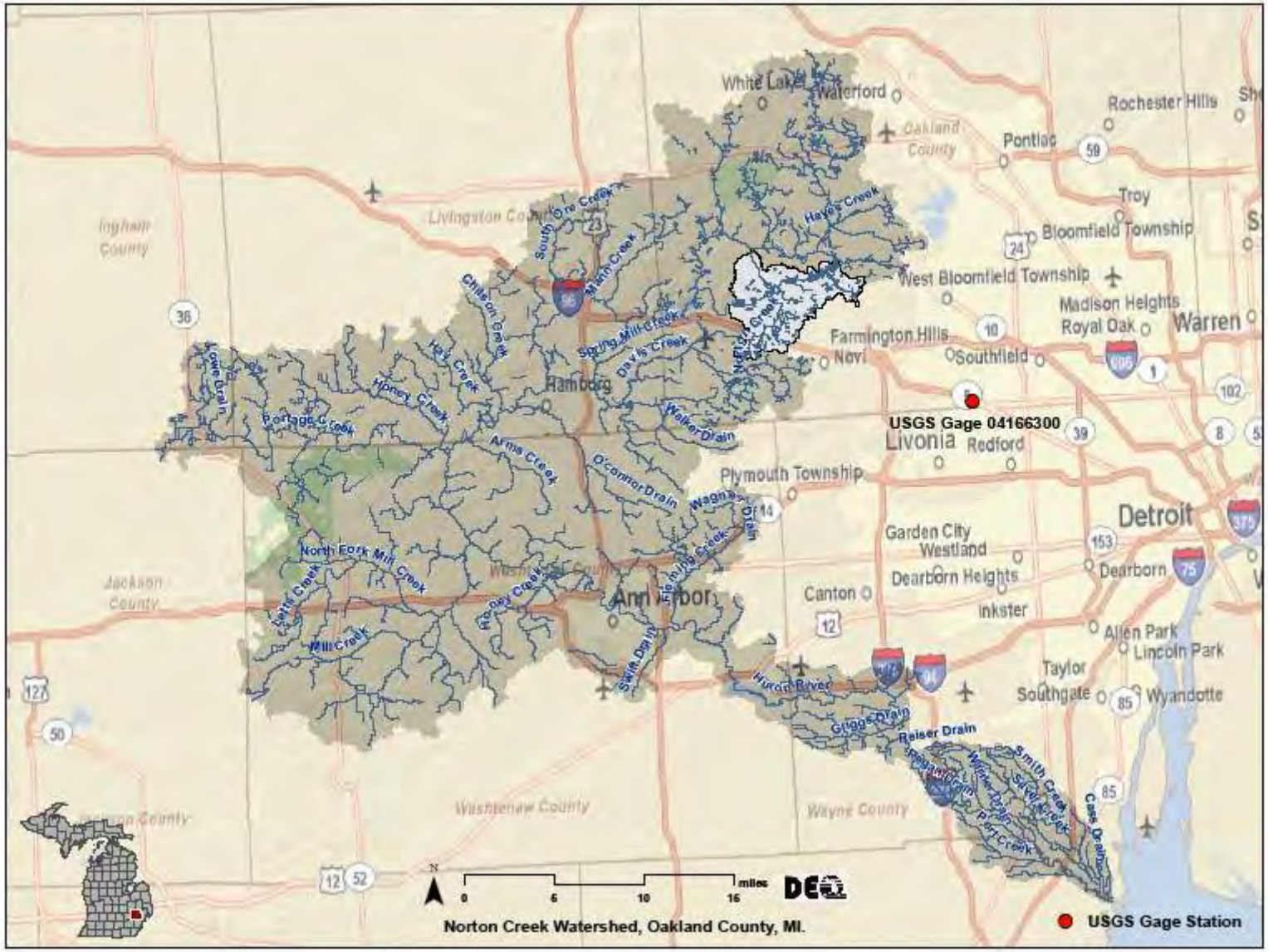


Figure 1. Norton Creek Watershed within Huron River Watershed.

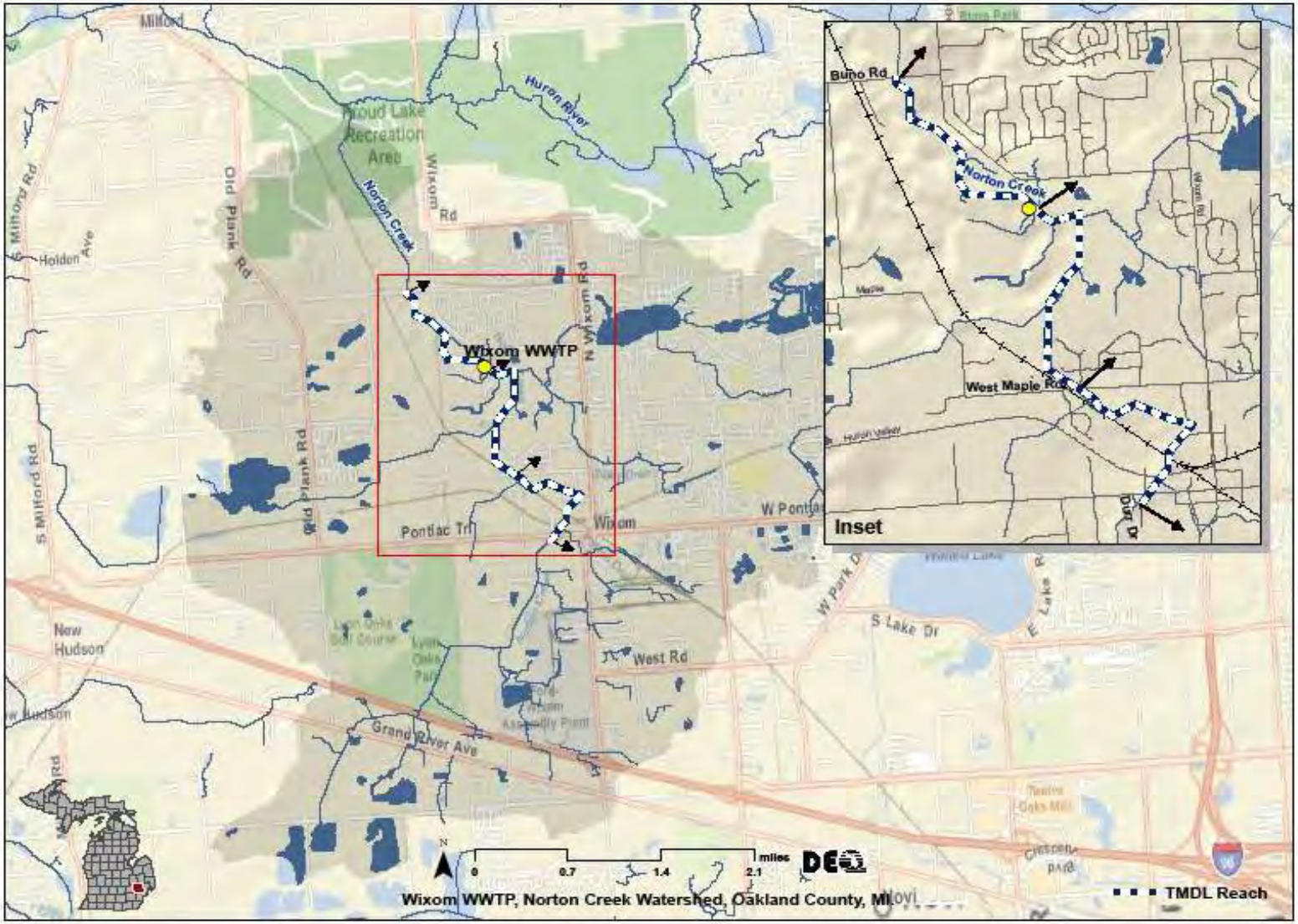


Figure 2. Norton Creek Watershed with TMDL Reach Indicated.

Appendix A. NPDES-Permitted Facilities discharging in the Norton Creek Watershed.

DESIGNATED FACILITY NAME	PERMIT TYPE	PERMIT NO.	CITY OR TWP	REC. WATER
Individual Permits				
Wixom WWTP	Individual	MI0024384	Wixom	Norton Creek
MDOT Statewide MS4	Individual	MI0057364	-	-
Industrial Stormwater				
2V Industries-Wixom	INDSW	MIS410373	Wixom	Norton Crk
American Plastic-Walled Lake	INDSW	MIS410215	Walled Lake	Huron
Atmosphere Heat Treat-Wixom	INDSW	MIS410469	Wixom	Norton Crk
Cadillac Asphalt-Plt 3A-Wixom	INDSW	MIS210392	Wixom	Novi Lyon Drain
Capital Stamping & Machine	INDSW	MIS410443	Wixom	Norton Crk
Chase Nedrow Manufacturing I	INDSW	MIS410667	Wixom	Norton Crk
CSM Manufacturing-Plt 2-Wixom	INDSW	MIS410444	Wixom	Norton Crk
CSX Transportation-Wixom	INDSW	MIS410435	Wixom	Norton Crk
Durr Automation-Wixom	INDSW	MIS410214	Wixom	Norton Crk
Exatec LLC	INDSW	MIS410669	Wixom	Norton Creek
Ford-Wixom Assembly Plt	INDSW	MIS410193	Wixom	Norton Crk
FRIMO Inc	INDSW	MIS410647	Wixom	Norton Crk
Glass & Mirror Craft-Wixom	INDSW	MIS410641	Wixom	Norton Creek
Hawk Tool & Machine-Wixom	INDSW	MIS410474	Wixom	Huron River
Jervis B Webb Co-Wixom	INDSW	MIS210598	Wixom	Norton Crk
Korex Corp-Wixom	INDSW	MIS410190	Wixom	Norton Crk
Mac Valves Inc-Wixom	INDSW	MIS410192	Wixom	Huron River
Matrix Sys Auto-Walled Lake	INDSW	MIS410612	Walled Lake	Mud Lake
Moeller Manufacturing Co Inc	INDSW	MIS410645	Wixom	Walled Lake
NLB Corp	INDSW	MIS410642	Wixom	Huron River
Oaks Concrete Products-Wixom	INDSW	MIS410181	Wixom	Holden Drain
Pascucci Marble & Granite	INDSW	MIS410648	Wixom	Kent Lake
Schupan Recycling-Wixom	INDSW	MIS410630	Wixom	Huron River
Superior Materials LLC	INDSW	MIS210353	Wixom	Novi Lyon Drain
Tiodize/Michigan Inc	INDSW	MIS410629	Wixom	Huron River
TTSI-Wixom	INDSW	MIS410522	Wixom	Norton Crk
UPS-Wixom	INDSW	MIS410194	Wixom	Huron River
Wendt Diacraft	INDSW	MIS410639	Wixom	Norton Crk
General Municipal MS4				
Walled Lake PS MS4-Oakland	MS4	MIS040080	Various	-
Lyon Twp MS4-Oakland	MS4	MIG610034	Various	-
Commerce Twp MS4-Oakland	MS4	MIG610033	Various	-
Walled Lake MS4-Oakland	MS4	MIG610028	Various	-
Wixom MS4-Oakland	MS4	MIG610035	Various	-
Wolverine Lake-Oakland	MS4	MIG610280	Various	-
Oakland Co	MS4	MIG610042	Various	-
Novi-Oakland	MS4	MIG610030	Various	-
Construction Site NOC				
East 20 Ent-Schupan/Tomra/Ubur	CONST	MIR109438	Milford Twp	Huron
MDOT-I-96 at Wixom Rd	CONST	MIR110523	Novi Twp	Norton Crk

Appendix B. Wixom WWTP (MI0024384) Conventional NPDES Permit Limits.

Parameter	Period	Maximum Loading (lbs/day)		Maximum Concentration (mg/l)		
		Monthly	7-day	Monthly	7-day	Daily
$CBOD_5$ (mg/l)	May – Nov.	90	230	4	-	10
	Dec. – March	440	680	19	-	29
	April	350	540	15	-	23
$CBOD_5$ % Removal (minimum)	Year-round	-	-	(report)	-	-
TSS (mg/l)	May – Nov.	470	700	20	30	-
	Dec. – April	700	1100	30	45	-
TSS % Removal (minimum)	May – Nov.	-	-	(report)	-	-
	Dec. – April	-	-	85	-	-
Ammonia Nitrogen (mg/l)	May – Nov.	12	47	0.5	-	2.0
	Dec. – March	(report)	230	(report)	-	10
	April	150	160	6.6	-	7.0
TP (mg/l)	Year-round	1800	-	0.4	-	-
D.O. (min., mg/l)	Year-round	-	-	-	-	6.0

Indicated permit limits apply at current facility design flow of 2.8 MGD.

Michigan Department of Environmental Quality
Water Bureau
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Total Maximum Daily Load for *E. coli* for Red Run Drain and Bear Creek Macomb and Oakland Counties

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations [CFR], Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of *Escherichia coli (E. coli*) that will result in the attainment of the applicable WQS in Red Run Drain and Bear Creek. Bear Creek is a tributary to Red Run Drain and both are tributaries of the Clinton River, located in Oakland and Macomb Counties, Michigan (Figure 1). A list of acronyms used within this document is provided in Appendix B.

PROBLEM STATEMENT

This TMDL addresses two listings: Red Run Drain and Bear Creek. The TMDL reaches for Red Run Drain and Bear Creek appear on the Section 303(d) list as:

RED RUN DRAIN WBID#: 061402A
County: MACOMB Size: 6 M
Location: Clinton River confluence upstream including all tributaries to Warren, Center Line, Madison Heights, Troy, and Clawson.
HUC: 4090003 RF3RchID: 4090003 0.00
Problem: CSO, pathogens (Rule 100).
TMDL YEAR(s): 2006

BEAR CREEK WBID#: 061402B
County: MACOMB Size: 3 M
Location: Red Run Drain confluence u/s to Mound Road in the vicinity of Warren.
HUC: 4090003 RF3RchID: 4090003 525 0.00
Problem: CSO, pathogens (Rule 100).
TMDL Year(s): 2005

Red Run Drain and Bear Creek were placed on the Section 303(d) list due to impairment of recreational uses as indicated by the presence of elevated levels of *E. coli* (Wolf and Wuycheck, 2004). Monitoring data collected by the Michigan Department of Environmental Quality (MDEQ) in 2004, documented exceedances of the WQS for *E. coli* at all but one sampling location during the total body contact recreational season of May 1 through October 31 (Tables 1-3).

NUMERIC TARGET

The impaired designated use addressed by this TMDL is total body contact recreation. The designated use rule (Rule 100 of the Part 4 rules, WQS, promulgated under Part 31, Water

Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended) states that this water body be protected for total body contact recreation from May 1 to October 31. The target levels for this designated use are the ambient *E. coli* standards established in Rule 62 of the WQS as follows:

> R 323.1062 Microorganisms.
> Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *E. coli* per 100 ml, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during five or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of three 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 three or more samples taken during the same sampling event at representative locations within a defined sampling area.

The target for sanitary wastewater discharges is:

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

Sanitary wastewater discharges are considered in compliance with the WQS of 130 *E. coli* per 100 milliliters (ml) if their National Pollutant Discharge Elimination System (NPDES) permit limit of 200 fecal coliform per 100 ml as a monthly average is met. Therefore, typically it can be assumed that there are less than 130 *E. coli* per 100 ml in the effluent when the point source discharge is meeting its limit of 200 fecal coliform per 100 ml.

For this TMDL, the WQS of 130 *E. coli* per 100 ml as a 30-day geometric mean and 300 *E. coli* per 100 ml as a daily geometric mean are the target levels for the TMDL reach from May 1 to October 31. As previously stated, the 2004 monitoring data indicated exceedances of both WQS at all locations sampled, with the exception of Plum Brook always meeting the 30-day geometric mean.

DATA DISCUSSION

Red Run Drain, Bear Creek, and two additional tributaries (Big Beaver Creek and Plum Brook) were sampled at a total of ten locations in the vicinity of Warren to address this TMDL listing (Figures 1 and 2). Plum Brook was the only location that did not have an exceedance of the 30-day geometric mean (Tables 1-3). All other stations exceeded the 30-day geometric mean WQS on multiple occasions. In Red Run Drain, 30-day geometric mean *E. coli* concentrations ranged from 43 *E. coli* per 100 ml in June at Ryan and Mound Roads to 988 *E. coli* per 100 ml in September at Van Dyke Avenue (Figure 3, Table 1). In Bear Creek, 30-day geometric mean *E. coli* concentrations ranged from 77 *E. coli* per 100 ml in July at Old 13-Mile Road to 1046 *E. coli* per 100 ml in August at Mound Road (Figure 4, Table 2). The 30-day geometric mean was exceeded 15 times in Bear Creek at 12-Mile Road (Figure 4, Table 2). In Big Beaver Creek at Van Dyke Avenue, 30-day geometric mean *E. coli* concentrations ranged from 39 *E. coli* per 100 ml in September to 211 *E. coli* per 100 ml in August (Figure 5, Table 3). In Plum Brook at Schoenherr Road, 30-day geometric mean *E. coli* concentrations ranged from 47 *E. coli* per 100 ml in August to 126 *E. coli* per 100 ml in June (Figure 6, Table 3).

The daily geometric mean was exceeded at all sampling locations. In Red Run Drain, daily geometric mean *E. coli* concentrations ranged from 20 *E. coli* per 100 ml at several locations to 4898 *E. coli* per 100 ml in August at Schoenherr Road (Figure 7, Table 1). In Bear Creek, daily geometric mean *E. coli* concentrations ranged from 20 *E. coli* per 100 ml in July at Old 13-Mile Road to 4252 *E. coli* per 100 ml in July at 12-Mile Road (Figure 8, Table 2). The daily geometric mean was exceeded 12 times in Bear Creek at 12-Mile Road (Figure 8, Table 2). In Big Beaver Creek at Van Dyke Avenue, daily geometric mean *E. coli* concentrations ranged from 20 *E. coli* per 100 ml in August and September to 1657 *E. coli* per 100 ml in August (Figure 9, Table 3). In Plum Brook at Schoenherr Road, daily geometric mean *E. coli* concentrations ranged from 20 *E. coli* per 100 ml in June and July to 526 *E. coli* per 100 ml in June (Figure 10, Table 3).

The Macomb County Health Department (MCHD) conducts weekly monitoring at 11 stations in the Red Run Drain watershed. MCHD data collected at these stations in 2004, 2005, and 2006 indicates that *E. coli* levels exceeded WQS (MCHD, 2004; 2005; 2006).

SOURCE ASSESSMENT

The official listed reach for the Red Run Drain watershed is the entire watershed beginning at the confluence with the Clinton River. Bear Creek is included in this listing but is also separately listed as the confluence with Red Run Drain upstream approximately three miles to Mound Road. There are several municipalities making up the TMDL watershed including the cities of Warren, Troy, Sterling Heights, Royal Oak, Madison Heights, Rochester Hills, Oak Park, Ferndale, Hazel Park, Southfield, Berkley, Clawson, Birmingham, Center Line, Huntington Woods, and Pleasant Ridge, the Village of Beverly Hills, and the Charter Townships of Shelby, Royal Oak, and Clinton (Table 4). The watershed lies in Macomb and Oakland counties. The municipalities in the TMDL watershed are represented by the shaded area in Figure 2. The watershed area is approximately 142 square miles and contains approximately 54 miles of open channel. Land use is primarily residential, commercial, or industrial (Clinton River Watershed Council, 2006; Red Run Drain Subwatershed Group, 2006). Possible sources of *E. coli* include illicit connections to storm sewers, wildlife and/or pet waste, leaking septic or sanitary sewers, Combined Sewer Overflows (CSOs), Sanitary Sewer Overflows (SSOs), the Warren Wastewater Treatment Plant (WWTP), and nonpoint source runoff.

There are 475 NPDES permitted discharges to Red Run Drain or its tributaries in the TMDL reach (Tables 5 and 6, Figure 11), including 5 individual permits, 219 certificates of coverage (COCs) under 3 general permits, and 251 notices of coverage under 1 permit-by-rule. Table 7 contains information on each of the general permits and the permit-by-rule.

The Red Run Drain watershed has one permitted CSO discharge named the Oakland County George W. Kuhn Retention Basin, under Permit #MI0026115. Five overflows occurred during the 2004 recreational season due to rain events (MDEQ, 2006). Approximately 370 million gallons of partially treated sewage (partial treatment consists of primary settling, screening, and disinfection) was released to Red Run Drain. Sampling stations 1, 2, 3, 4, and 5 are downstream of the CSO discharge location (Figure 11). The exceedances of the *E. coli* WQS noted on August 4, 2004, at sampling stations 1-5 (Figure 2) could be attributed in part to CSO discharges that occurred August 3 and 4 (Figures 12 and 13). Although the facility was in compliance with their NPDES permit limits (200 fecal coliform per 100 ml as a monthly geometric mean, and 400 fecal coliform per 100 ml as a 7-day geometric mean), fecal coliform numbers in the CSO discharge were as high as 14,600 per 100 ml on August 3, 2004 (Figure 12). As noted above, *E. coli* are a subset of fecal coliform (American Public Health Association, 1995). Fecal coliform concentrations are substantially higher than *E. coli* concentrations when the wastewater of concern is sewage (Whitman, 2001). However, a study by the United States Geological Survey (USGS) Kansas Water Center indicates that more than 60 percent of fecal coliform was *E. coli* in several Kansas streams (Rasmussen and Ziegler,

2003). Therefore, if fecal coliform levels are elevated as high as 14,600 per 100 ml, it may be assumed that *E. coli* levels are elevated and exceeding the WQS as well.

The Red Run Drain watershed has one permitted WWTP discharge under Permit #MI0024295, the Warren WWTP, which is a blending facility. A flow equalization retention basin holds any water that can not be processed by the facility due to rain events that cause influent rates to exceed the hydraulic capacity of the WWTP. Following primary treatment (settling), the retention basin water is mixed or blended with the treated effluent and chlorinated when the basin overflows its capacity. The facility was in compliance with their NPDES permit limits for fecal coliform (200 fecal coliform per 100 ml as a monthly geometric mean, and 400 fecal coliform per 100 ml as a 7-day geometric mean at the point of final discharge) for January 2004 through April 2006, with the exception of January 2005, when the 7-day geometric mean was exceeded (474 fecal coliform per 100 ml). Although the 7-day geometric mean and the 30-day geometric mean WQS were almost always met, individual single sample fecal coliform measurements exceeded 200 fecal coliform per 100 ml several times (e.g., fecal coliform numbers were reported to be 1300 per 100 ml on August 4, 2004). The exceedances of the *E. coli* WQS at stations 3, 4, and 5 in Red Run Drain (Figure 11) could be attributed in part to the Warren WWTP discharges in that same time period (Figure 13).

The Municipal Separate Storm Sewer System (MS4) permittees (MIG61900), and the three individual stormwater permits (city of Sterling Heights, city of Warren, and Michigan Department of Transportation (MDOT) - statewide permit) are prohibited from having discharges that may cause or contribute to a violation of WQS. The general storm water permittees (MIS110000) must develop a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP requires the permittee to complete an evaluation of the reasonable potential for contribution of significant materials to runoff, such as pollutants from areas where animals are known to congregate. If a source of pollutant (including *E. coli*) is found, the permittee is required to address the pollutant in their SWPPP. This information is used by the permittee to estimate the annual load of pollutants to the water body and identify the level of control necessary to comply with any established TMDL. The noncontact cooling water permits (MIG250000) allow for the discharge of only uncontaminated water and are not expected to be a source of *E. coli*. The permits-by-rule (MIR100000) involve earthwork in the TMDL watershed and are not considered a significant source of *E. coli*. There are no Concentrated Animal Feeding Operations in the Red Run Drain and Bear Creek TMDL watersheds.

The city of Center Line has had 11 SSOs to Lorraine Drain, a tributary of Bear Creek, since July 2000. These SSOs are a source of *E. coli* to the watershed. Center Line entered into an Administrative Consent Order with the MDEQ in August 2001, that requires the elimination of the SSO by September 30, 2009. This order was amended in August 2002 and October 2004. There has been only one SSO since January 2004. On July 16, 2005, 1.6 million gallons of raw sewage entered into Lorraine Drain from a lift station. This overflow was due to a heavy rain event and an electrical storm that damaged a pump. Center Line Department of Public Works personnel manually operated the station until the pump was on line. Previous overflows were primarily due to heavy rain events and wet weather inflow and infiltration.

Illicit discharges are most likely a significant source of *E. coli* in the Red Run Drain watershed. Illicit connections can be a source of *E. coli* during both wet and dry weather. The watershed is entirely within a highly populated urban area. Several illicit connections, including those that drain subdivisions, business parks, public schools, an industrial building, and an apartment complex have been identified in the Schoenherr Relief Drain. In May and June 2005, Lincoln High School, the stadium and maintenance buildings; Lincoln Middle School; and Lincoln Elementary School were dye tested by the MCHD to search for illicit connections. A section of the high school and elementary school sanitary systems were found to be connected to the storm drainage system and the problem is being corrected (MCHD, 2005). In the winter of 2005, the MCHD conducted 855 investigations of illicit discharges in Warren and Center Line

through the facility dye testing program. Sixty-six problems were found and were corrected or are in the process of being corrected (MCHD, 2005).

Several illicit discharges have also been found in the Bear Creek watershed and are under correction. The Bear Creek subwatershed is approximately 19 square miles and consists of 29 tributaries, which drain a concentrated urban area (MCPWO, 2006). One example of an illicit discharge was found in Lorraine Drain at Stephens and Hoover Roads where there was a direct sanitary connection to the storm drain from over 230 homes (MCHD, 2005). The Bear Creek Clean Water Initiative (BCCWI) was formed to improve water quality in Bear Creek. Water quality data collected by the BCCWI noted exceedances of the *E. coli* WQS at several stations in Bear Creek and its tributaries between 1998 and 2000 (MCPWO, 2006). Data collected by the MCHD has also documented exceedances of the *E. coli* WQS in Bear Creek. The Lorraine Drain, an enclosed tributary of Bear Creek, contains particularly high concentrations of *E. coli*; often orders of magnitude above WQS (MCHD, 2006).

LINKAGE ANALYSIS

Determining the link between the *E. coli* concentrations in the Red Run Drain watershed and the potential sources is necessary to develop the TMDL. This link provides the basis for estimating the total assimilative capacity of the water body and any needed load reductions. For this TMDL, the loading of pathogens appears to enter the Red Run Drain watershed during all weather conditions (i.e., wet and dry weather events), but the largest exceedances occur primarily during or soon after wet weather events (Tables 1-3, Figures 7-10). Precipitation data for the two days prior to each MDEQ sampling event were obtained from a weather station in Hazel Park, Michigan (Weather Underground, 2006).

To further investigate the potential sources mentioned in the Source Assessment section above, a load duration curve analysis was developed for each sampling station as outlined in a paper by Cleland (2002). A load duration curve is a relatively new method utilized in TMDL development and considers how flow conditions relate to a variety of pollutant sources (point and nonpoint sources).

The load duration curves for each station sampled on Red Run Drain, Bear Creek, Big Beaver Creek, and Plum Brook are included in Appendix A. The USGS gage used to determine the load duration curves discussed here is located on Plum Brook, in the vicinity of Utica (Gage #04163400). The other streams did not have gages with the period of record necessary to calculate average flows. Therefore, the flows of Plum Brook were used to develop load duration curves for Red Run Drain and Bear Creek. The data indicate that exceedances of the WQS are observed during wet and dry weather events. Note that dots above the curve on the left side of the figure are indicative of WQS exceedances during wet weather conditions (higher flows) and dots above the curve to the right side of the figure indicate *E. coli* WQS exceedances during dry weather conditions (lower flows). The *E. coli* WQS exceedances at the most upstream station of Bear Creek [Mound Road (Station 0, Figure 1)] appear to be influenced by mid to higher flow events (A-1). The more downstream stations at 12-Mile Road and Old 13-Mile Road (Stations 1A and 2A, Figure 1) experience WQS exceedances during all flow conditions (Appendices A-2 and A-3). With the exceptions of Station 6 on Big Beaver Creek and Stations 5 on Red Run Drain (Figure 1), *E. coli* WQS exceedances in Red Run Drain and Plum Brook occurred most often under moist to high flow events (Appendices A-4 through A-10). In Figures 7-10 the prior two-day precipitation total is graphed along with the daily geometric mean for *E.coli* at the MDEQ 2004 sampling stations. As noted in the Source Assessment section, exceedances of the *E. coli* WQS during wet weather (and thus high flow), could be partially attributed to discharges from the G.W. Kuhn Retention basin CSO and discharges from the Warren WWTP. Illicit discharges could occur during any range of flows.

The guiding water quality management principle used to develop the TMDL was that compliance with the numeric pathogen target in the Red Run Drain and Bear Creek watersheds depends on the control of *E. coli* from wet and dry weather sources. If the *E. coli* inputs can be controlled to meet the numeric standards, then total body contact recreation in these watersheds will be restored and protected.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by the water body while still achieving WQS. As indicated in the Numeric Target section, the targets for this pathogen TMDL are the 30-day geometric mean WQS of 130 *E. coli* per 100 ml and daily geometric mean of 300 *E. coli* per 100 ml. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the environmental conditions that will be used when defining allowable levels. Many TMDLs are designed around the concept of a "critical condition." The "critical condition" is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical conditions for the control of point sources in Michigan are given in R 323.1082 (Mixing Zones) and R 323.1090 (Applicability of WQS). In general, the lowest monthly 95 percent exceedance flow for streams is used as a design condition for point source discharges. However, for pathogens in point source discharges of treated or untreated human sewage, levels are restricted to a monthly average limit of 200 fecal coliform per 100 ml regardless of stream flow. Therefore, the design stream flow is not a critical condition for determining the allowable loading of pathogen for WWTPs. In addition, sources of pathogens to the Red Run Drain watershed arise from a mixture of wet and dry weather-driven sources. For these sources, there are a number of different allowable loads that will ensure compliance, as long as they are distributed properly throughout the watershed.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For *E. coli*, however, mass is not an appropriate measure, and the USEPA allows pathogen TMDLs to be expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). Therefore, this pathogen TMDL is concentration based, consistent with R 323.1062, and the TMDL is equal to the target concentration of 130 *E. coli* per 100 ml as a 30-day geometric mean and daily geometric mean of 300 *E. coli* per 100 ml in all portions of the TMDL reach for each month of the recreational season (May through October). Expressing the TMDL as a concentration equal to the WQS ensures that the WQS will be met under all flow and loading conditions; therefore, a critical condition is not applicable for this TMDL.

ALLOCATIONS

TMDLs are comprised of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly within the WLA or LA, or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

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

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. Because this TMDL is concentration based, the total loading for this TMDL is equal to the WQS of 130 *E. coli* per 100 ml as a 30-day geometric mean and 300 *E. coli* per 100 ml as a daily geometric mean during the recreation season. This pathogen TMDL will not be expressed on a mass loading basis and is concentration based, consistent with USEPA regulations in 40 CFR, Section 130.2(i).

WLAs

Tables 5 and 6 outline the 475 permitted point source discharges to the Red Run Drain watershed. The discharges include 5 individual permits, 219 COCs under 3 general permits, and 251 notices of coverage under 1 permit-by-rule. The WWTP discharge contains treated human waste and although the discharge is in compliance with the NPDES fecal coliform limit, the single sample fecal coliform numbers suggest that the discharge could be a possible source of *E. coli* to Red Run Drain at levels that exceed WQS (Figure 12). The individual permit for the Goerge W. Kuhn CSO authorizes the discharge of sanitary waste via a retention basin during wet weather events. Again, although the discharge is in compliance with the NPDES fecal coliform limit, single sample fecal coliform numbers suggest that the discharges could be a possible source of *E. coli* to Red Run Drain at levels that exceed WQS. The general permitted discharges are not considered significant sources of *E. coli* to the Red Run Drain due to Best Management Practices (BMPs) required in the permit. The remaining permits-by-rule involve earthwork in the watershed and, due to the nature of the permit, are not considered a significant source of *E. coli* to the TMDL watershed. The WLA for the above mentioned permits is equal to 130 *E. coli* per 100 ml as a 30-day average and 300 *E. coli* per 100 ml as a daily average during the recreational season between May 1 and October 31.

LAs

Because this TMDL is concentration based, the LA is also equal to 130 *E. coli* per 100 ml as a monthly geometric mean and 300 *E. coli* per 100 ml as a daily geometric mean. This LA is based on the assumption that all land, regardless of use, will be required to meet the WQS. Therefore, the relative responsibility for achieving the necessary reductions of bacteria and maintaining acceptable conditions will be determined by the amount of land under the jurisdiction of the local unit of government in the watershed. This TMDL reach is located in 20 municipalities and 2 counties (Table 4). The municipalities making up the largest portion of the watershed are the cities of Warren (24.2 percent), Troy (19.5 percent), and Sterling Heights (18.2 percent).

MOS

This section addresses the incorporation of an MOS in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality, including the pollutant decay rate if applicable. The MOS can be either implicit (i.e., incorporated into the WLA or LA through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS because no rate of decay was used. Pathogen organisms ordinarily have a limited capability of surviving outside of their hosts and a rate of decay could be developed. However, applying a rate of decay could result in an allocation that would be greater than the WQS, thus no rate of decay is applied to provide for a greater protection of water quality. The MDEQ has determined that the use of the WQS of 130 *E. coli* per 100 ml as a monthly geometric mean and 300 *E. coli* per 100 ml as a daily geometric mean for the WLA and LA is a more conservative approach than developing an explicit MOS and accounts for the uncertainty in the relationship between pollutant loading and water quality, based on available data and the assumption to not use a rate of decay. Applying the WQS to be met under all flow conditions also adds to the assurance that an explicit MOS is unnecessary.

SEASONALITY

Seasonality in the TMDL is addressed by expressing the TMDL in terms of a total body contact recreation season that is defined as May 1 through October 31 by R 323.1100 of the WQS. It is expected that there is no total body contact during the remainder of the year due to cold weather; however, there is a separate WQS of a maximum of 1000 *E. coli*/100 ml for the partial

body contact season. Because this is a concentration-based TMDL, WQS will be met regardless of flow conditions in the applicable season.

MONITORING

Pathogens were monitored weekly at five stations on Red Run Drain, three stations on Bear Creek, and one station each on Big Beaver Creek and Plum Brook, which are tributaries to Red Run Drain. Monitoring occurred from May through September 2004. Future monitoring will take place as resources allow, as part of the five-year rotating basin monitoring. When these results indicate that the water body may be meeting WQS, sampling will be conducted at the appropriate frequency to determine if the 30-day geometric mean value of 130 *E. coli* per 100 ml and 300 *E. coli* per 100 ml as a daily maximum are being met.

REASONABLE ASSURANCE ACTIVITIES

The Warren WWTP is responsible for meeting their NPDES permit limits for fecal coliform. Compliance is determined based on review of Discharge Monitoring Report data by the MDEQ. The WWTP is presently meeting their permit limits for fecal coliform; however, as noted above, during rain events single sample fecal coliform data collected by the WWTP indicates that the WWTP may be a possible source of *E. coli* at levels that exceed WQS (Figure 12). It is during the rain events that the facility experiences influent flow amounts that exceed the capacity of the WWTP. The WWTP is working on reducing the excess inflow and infiltration to their collection system within approximately ten years. The goal of the plan is to decrease the amount of excess water to the wastewater system, ultimately eliminating the need for overflows of sewage from the retention basin that is blended with the effluent before discharging to Red Run Drain. A reduction in overflows may lead to a reduction in fecal coliform and *E. coli* levels present in the final discharge.

The Oakland County George W. Kuhn Retention Basin is currently implementing a Long-Term CSO Control Program. As part of the control program the permittee constructed a new inlet weir structure to provide 30 million gallons of additional storage, which will result in fewer overflows to Red Run Drain. The chlorination system has also been upgraded to allow for more contact time to provide improved disinfection. The city of Madison Heights has also separated parts of their storm sewers that originally were directed to the retention basin. This will reduce the amount of storm water that the retention basin needs to hold, freeing up hydraulic capacity for sanitary inputs, and thus leading to fewer instances of overflow of partially treated sewage to Red Run Drain. The facility is also starting an upgrade of the flushing system in the retention basin so that the basin can be cleaned more efficiently after an overflow. The flushed water along with the settled solids from the bottom of the retention pond are treated by the Detroit WWTP and thus would not enter Red Run Drain.

The city of Center Line and the MDEQ have signed an Administrative Consent Order dated August 24, 2001, and most recently amended October 29, 2004, to resolve the SSOs to Lorraine Drain. This agreement contains activities for flow monitoring, negotiations for obtaining additional treatment capacity from the Detroit Water and Sewerage Department, and structural improvements to the sewer system that shall be completed by September 30, 2008. Since signing of the agreement, the number of SSOs has been significantly reduced. The main goal of the agreement is a plan that includes the closure of the SSO by September 30, 2009.

The industrial storm water permits identified in Table 6 require that if there is a TMDL established by the MDEQ for the receiving water that restricts a material that could impair or degrade water quality, then the required storm water pollution prevention plan shall identify the level of control for those materials necessary to comply with the TMDL and an estimate of the current annual load of those materials via storm water discharges to the receiving stream.

The cities of Warren and Sterling Heights are under a Phase I storm water permit. A Phase I storm water permit is issued when an individual community's MS4 serves a population greater than 100,000. This permit contains multiple requirements that have a positive impact on water quality, such as education and outreach programs regarding storm water impacts, the development and implementation of an illicit discharge elimination program, the development and implementation of a program to address storm water from new and redevelopment projects, and the development of good housekeeping practices at municipal facilities. The MDOT is also under a Phase I storm water permit. This is a statewide permit that requires the permittee to reduce the discharge of pollutants to the maximum extent practicable and employ BMPs to comply with TMDL requirements.

The municipalities including the cities of Troy, Hazel Park, Rochester Hills, Madison Heights, and Center Line, townships of Shelby and Clinton, and counties of Macomb and Oakland are under NPDES Phase 2 MS4 storm water permits. These permits also require activities that reduce pollutant inputs (including *E. coli*) to surface waters through public education, a storm water management plan, and illicit connection identification and elimination requirements.

Macomb County is in the fourth year of required MS4 permit activities. A partnership between Macomb County and individual municipalities (several are listed above) has resulted in countywide efforts to identify all outfalls within county boundaries that discharge to waters of the state. Part of the identification process includes taking one time samples for *E. coli* to identify illicit connections. Each municipality will assure that there are no illicit connections to the municipal storm water system from township- and city-owned and operated properties and facilities. The MCHD conducts weekly *E. coli* monitoring at 11 locations within the Red Run Drain watershed. This data is entered into a database and is available to the public at the following link: htttp://macombcountymi.gov/publichealth/surfacesamples.asp. The MDEQ works with the MCHD to identify *E. coli* sampling locations and share data. The MCPWO is also required to sample outfalls to legally established county drains to locate illicit discharges. Numerous outfalls in the Red Run and Bear Creek watershed were sampled in 2005. Follow-up investigations of the greatest exceedances throughout the county will continue in 2006 (Macomb County, 2005).

The MCPWO and MCHD each have Clean Michigan Initiative-Clean Water Fund (CMI-CWF) projects as part of the Macomb County Illicit Connection Elimination project. The Macomb Count Illicit Connection Elimination project is part of the Macomb County MS4 SWPPP. The goal of the project is to improve the quality of storm water that enters the Clinton River watershed by identifying and eliminating illicit discharges to the storm water drainage system discharging to the Red Run Drain watershed. The project includes identifying and performing dry weather surveys of all outlets to enclosed drains (MCPWO) and to open waterways (MCHD) and to provide assistance to local units of government for follow-up investigations to locate the source of any discovered illicit discharges. These follow-up investigations include repeat sampling and televising drains. The Sterling Relief Drain and Schoenherr Relief Drain (which transports storm flow from the city of Warren to the Red Run Drain) were among several drains included in the MCPWO project. During the time period of July 2005 through March 2006, the MCHD surveyed more than 100 miles of open water drains. They identified more than 1000 outfalls and found 126 outfalls that showed evidence of an illicit connection. At least 50 of those outfalls have been fully investigated and corrected while the remaining are still under investigation (MCPWO, 2005 and MCHD, 2005b)

The Oakland County Drain Commissioner (OCDC) has also received a CMI-CWF grant to do similar illicit connection elimination in the Clinton River watershed, including tributaries that discharge to the Red Run Drain (OCDC, 2006). The grant started in September 2004. In the most recent quarterly report (December 2005) the OCDC indicated that investigations of the large enclosed drains that drain to Bear Creek in Madison Heights and Hazel Park are

scheduled for the summer of 2006. The OCDC has also applied for USEPA funds to investigate wet and dry weather illicit discharge sampling.

Another project funded by the CMI-CWF that is part of the Macomb County Illicit Discharge Elimination Program, explained above, began in January 2005. It is also part of the Illicit Discharge Elimination Program for the cities of Warren and Center Line, both of which discharge storm water to Bear Creek. The MCPWO reported that 35 percent of the drains sampled in dry weather had exceedances of the WQS of 300 *E. coli* 100 ml. In wet weather, 95 percent had exceedances of the WQS and 66 percent of these exceedances had counts greater than 3000 *E. coli* per 100ml (MCHD, 2005c). The goal of this project is also to improve the quality of the storm water entering Red Run Drain. Dye testing is the primary tool used in the project to identify illicit discharges from industrial, commercial, and institutional buildings. Dye test studies, which use nontoxic dyes to trace the pathway of sanitary water, are used on a regular basis to find illicit connections of sanitary systems to storm drains and/or surface waters of the state. As of March 2006, 32 percent of facilities tested had illicit connections identified and corrected. Work is continuing along the 9-Mile Road corridor and drain, where many illicit connections have been found (MCHD, 2005).

In September 2005, the MCHD received a CMI-CWF grant to begin facility and residential dye testing in several cities including Warren and Center Line. A surface water improvement and monitoring team was formed to address the failing septic systems in the county and was charged with monitoring the storm water quality. Plans for this project have been completed and they are starting implementation (MCHD, 2005d)

A point of sale regulation will continue to be enforced throughout Macomb County (Macomb County, 2005). This regulation requires that on-site sewage disposal and/or on-site water supply systems be evaluated prior to property transfer. In 2004 and 2005, 726 septic repair permits were issued throughout Macomb County (Macomb County, 2005). Although most sanitary discharges are connected to a municipal sanitary system, those few that are not would be affected by this program. These types of identification and repair activities may lead to reduced *E. coli* concentrations.

The Red Run Drain has a subwatershed advisory group that consists of representatives from all communities, departments, schools, and organizations that are located in the watershed. Efforts made by this advisory group for the period of October 1, 2004 to September 30, 2005, included holding two community forums to allow residents the opportunity to share ideas on the development of a watershed management plan for the Red Run Drain watershed. The plan is currently being developed and should be ready by November 2006.

A stakeholder meeting for this TMDL was held on July 26, 2006, at the MDEQ Southeast District office in Warren, Michigan. Stakeholders were determined by identifying municipalities (i.e., counties, townships, and cities) and watershed groups (i.e., Clinton River Watershed Council and the local soil conservation district) within the TMDL watershed. Copies of the draft TMDL were available upon request, at the stakeholder meeting, and posted on the MDEQ Web site.

Prepared by: Tamara Lipsey, Aquatic Biologist
Surface Water Assessment Section
Water Bureau
Michigan Department of Environmental Quality
August 25, 2006

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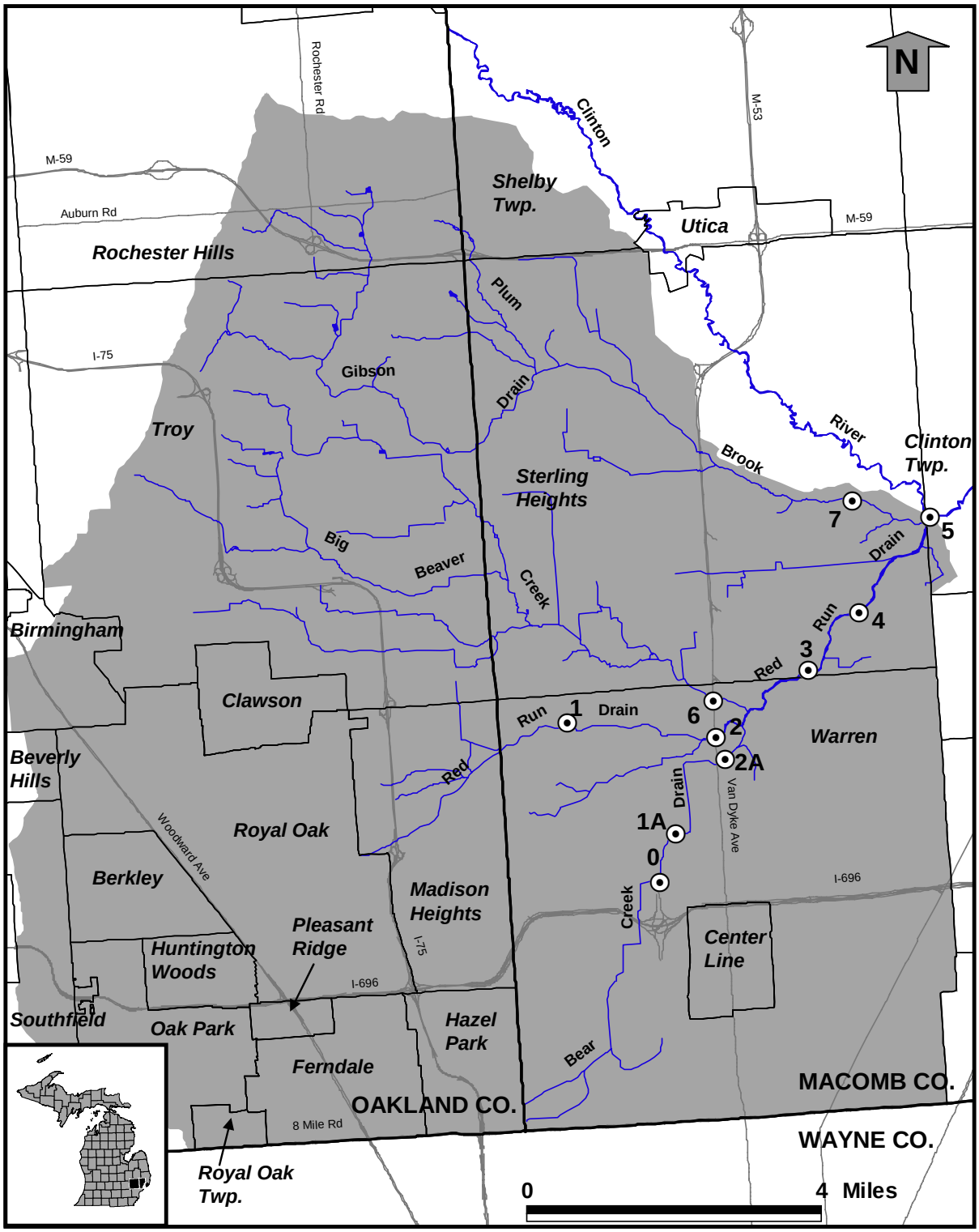


Figure 1. Red Run Drain watershed and *E. coli* sampling locations, Macomb and Oakland Counties, Michigan, 2004.

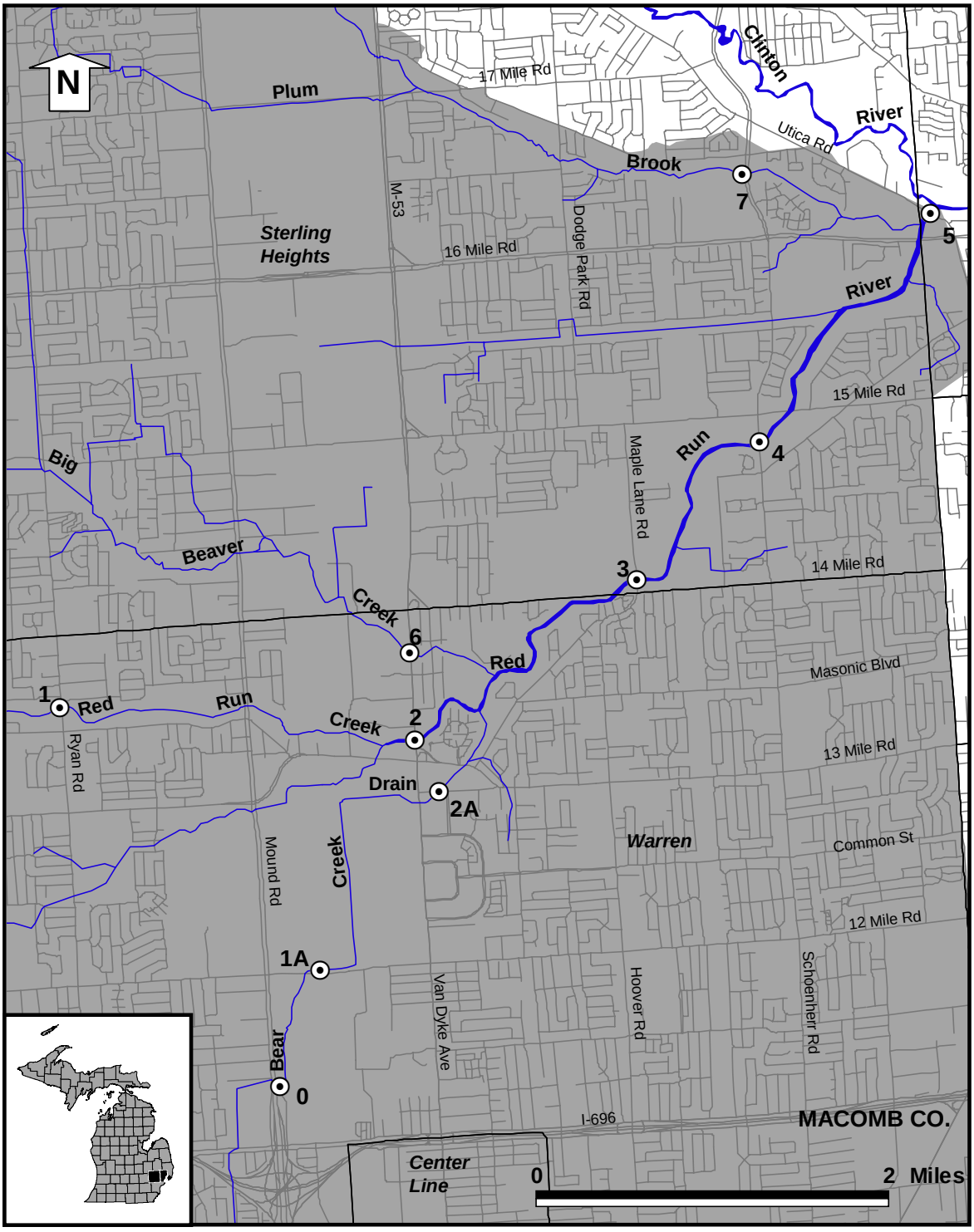


Figure 2. Red Run Drain watershed *E. coli* sampling locations, Macomb County, Michigan, 2004.

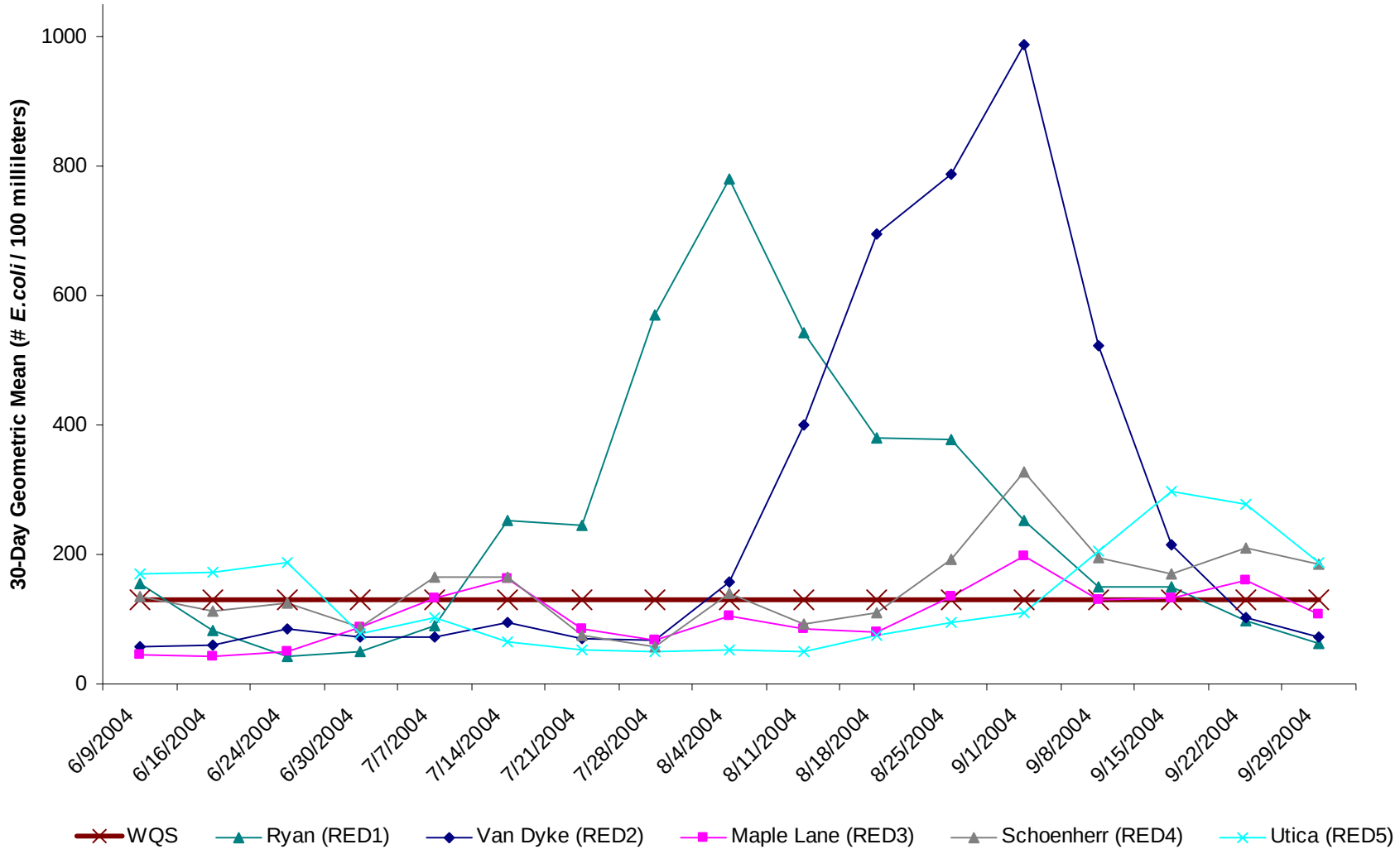


Figure 3. 30-day geometric mean for *E. coli* in Red Run Drain, Macomb County, Michigan, 2004. Stations are listed from upstream to downstream location.

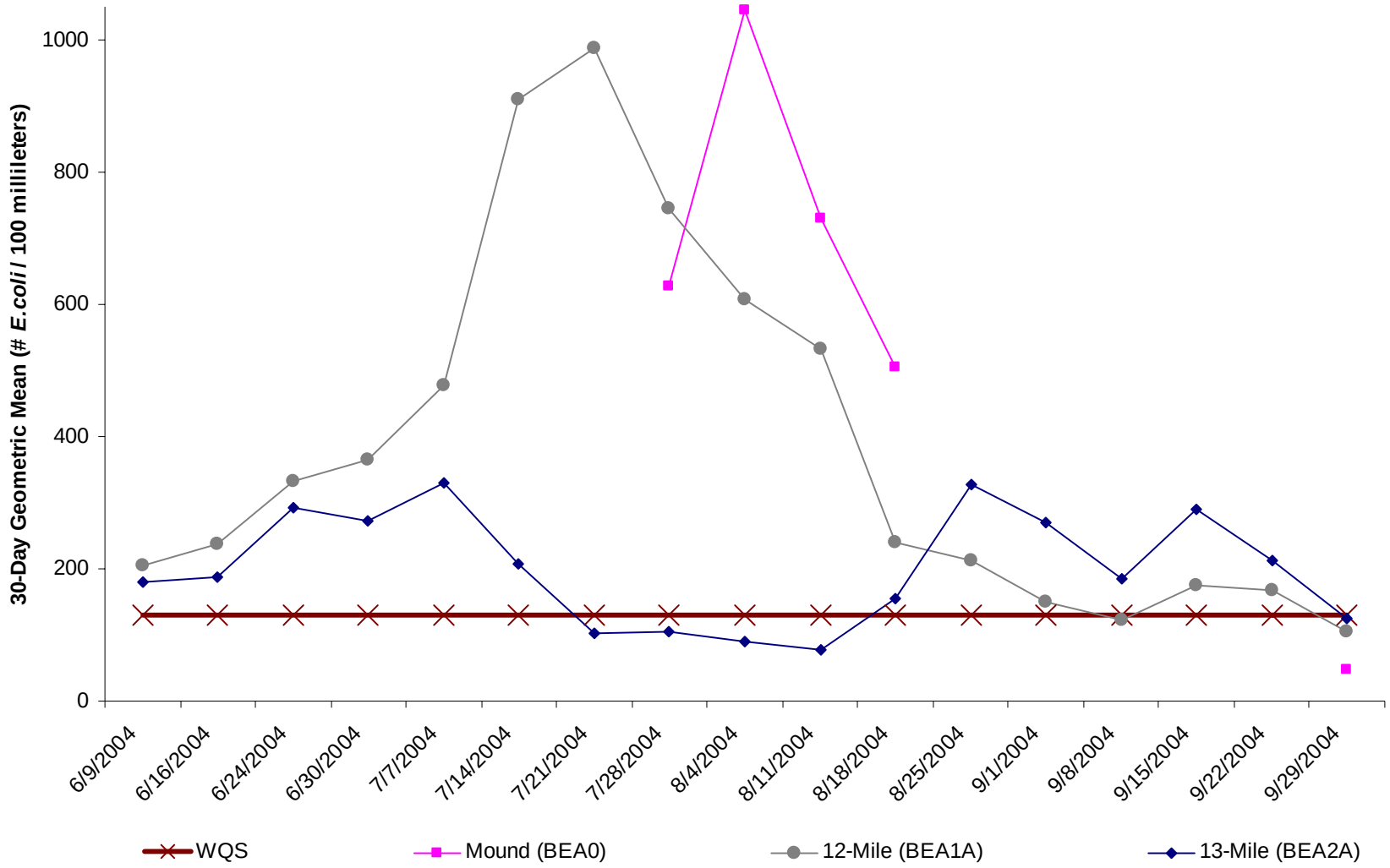


Figure 4. 30-day geometric mean for *E. coli* in Bear Creek, Macomb County, Michigan, 2004.

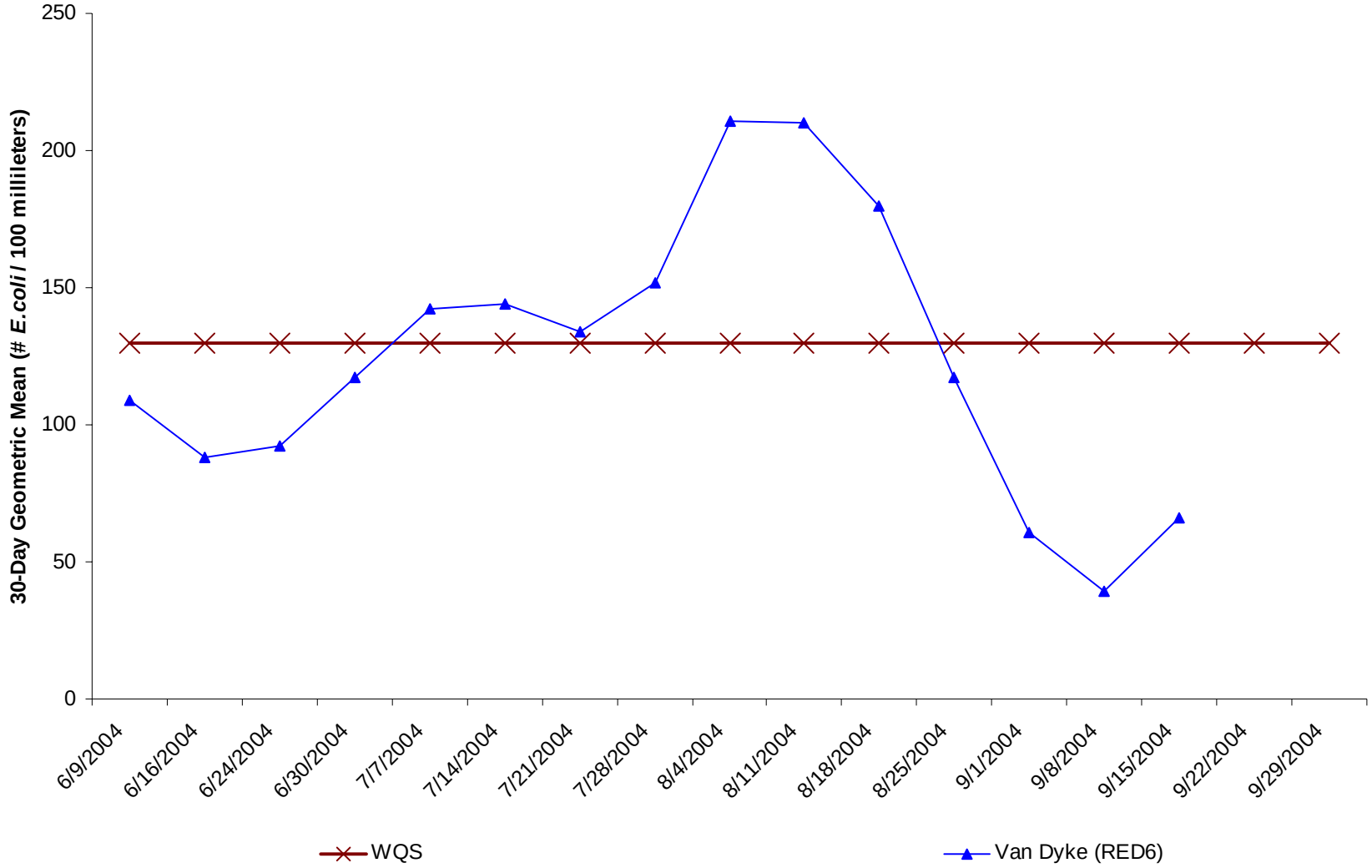


Figure 5. 30-day geometric mean for *E. coli* in Big Beaver Creek, Macomb County, Michigan, 2004.

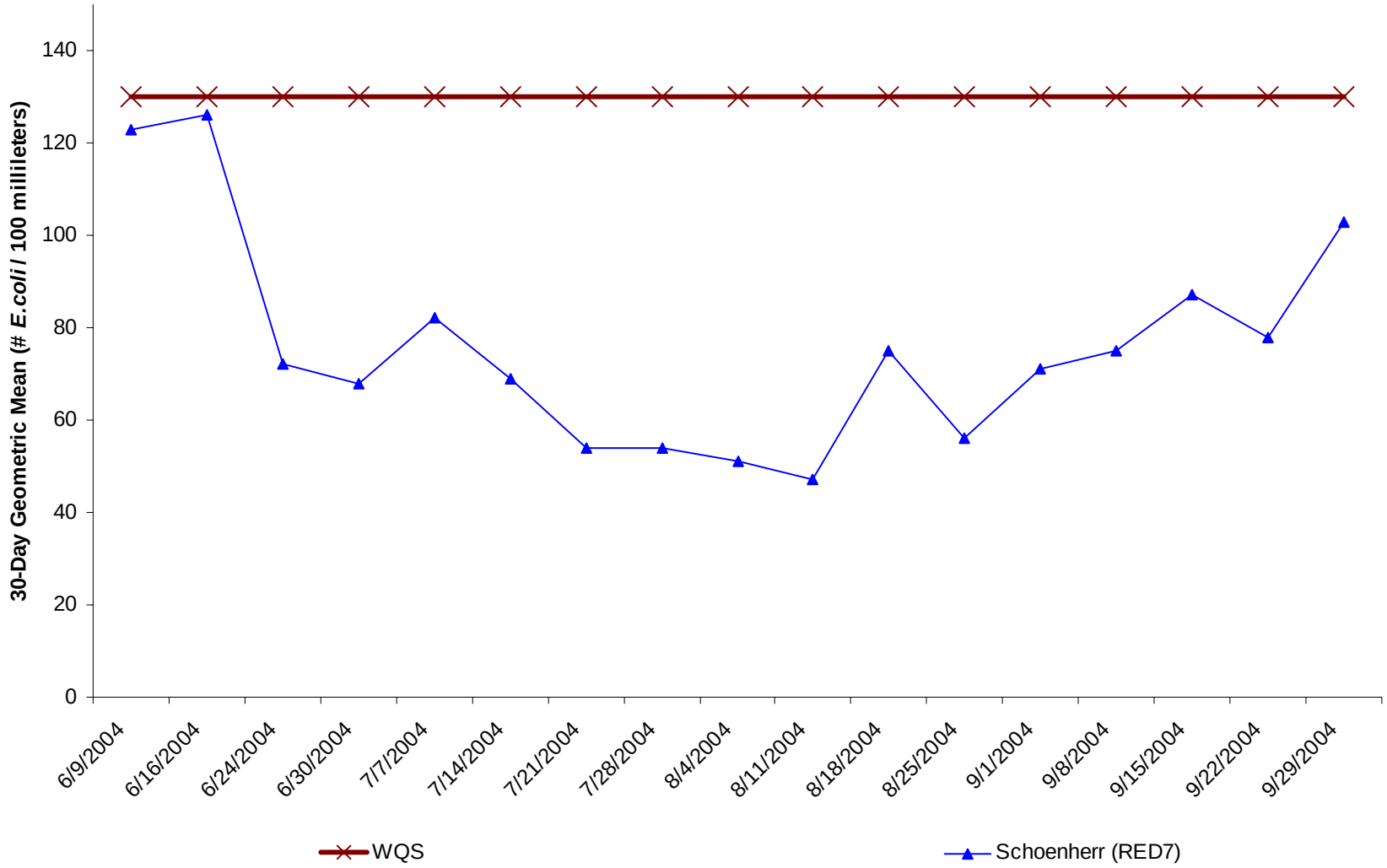


Figure 6. 30-day geometric mean for *E. coli* in Plum Brook, Macomb County, Michigan, 2004.

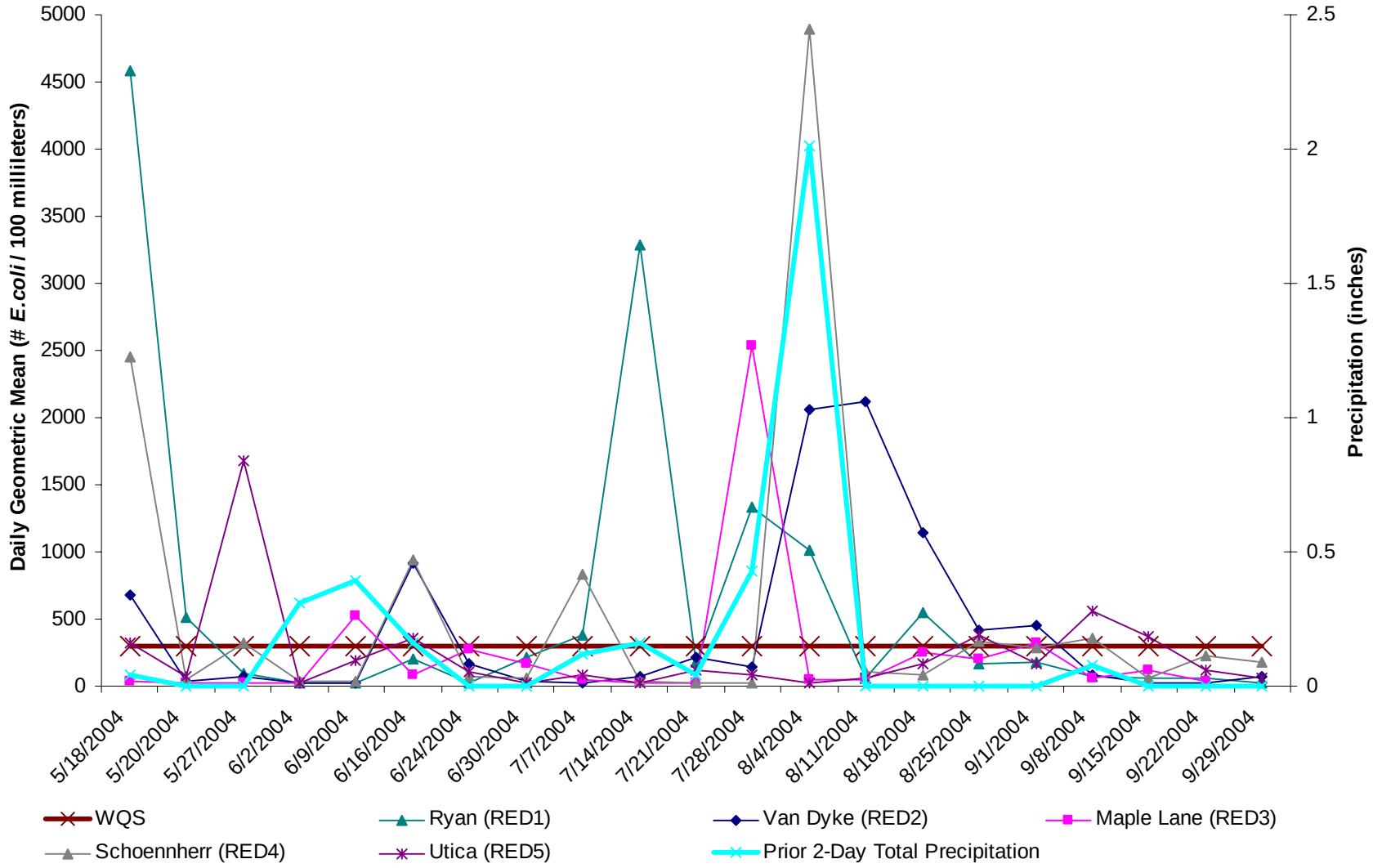


Figure 7. Daily geometric mean for *E. coli* in Red Run Drain, Macomb County, Michigan, 2004.

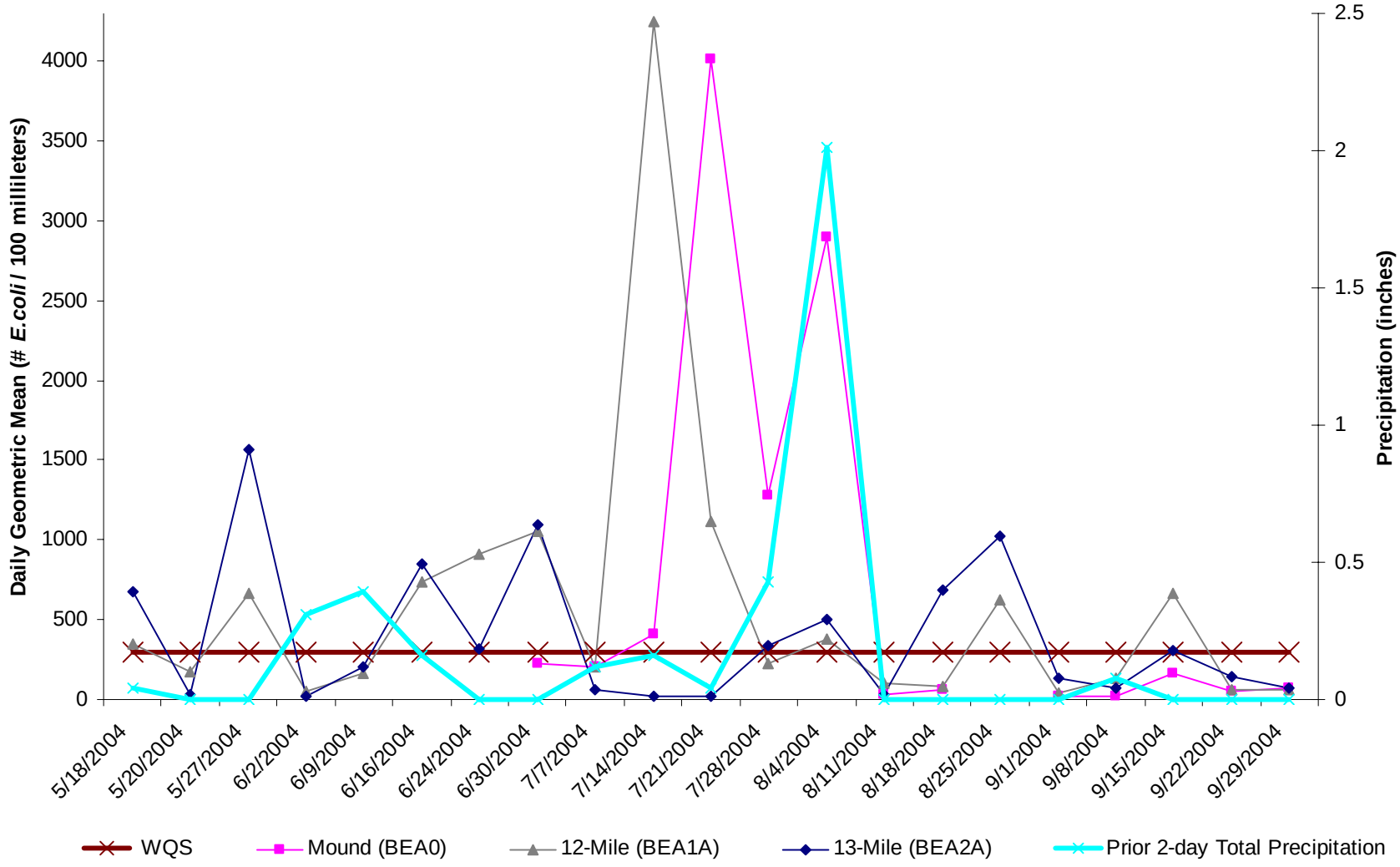


Figure 8. Daily geometric mean for *E. coli* in Bear Creek, Macomb County, Michigan, 2004.

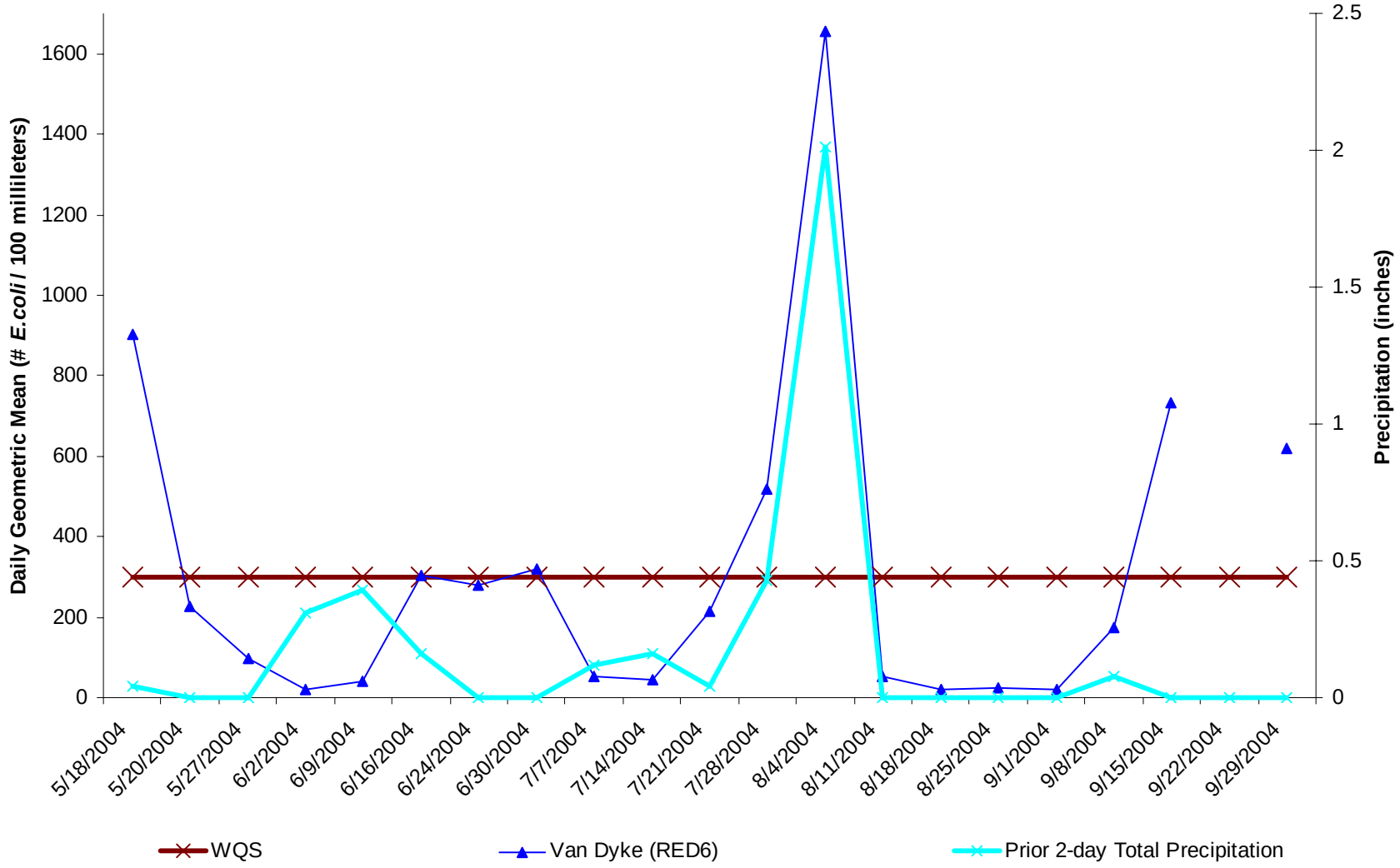


Figure 9. Daily geometric mean for *E. coli* in Big Beaver Creek, Macomb County, Michigan, 2004.

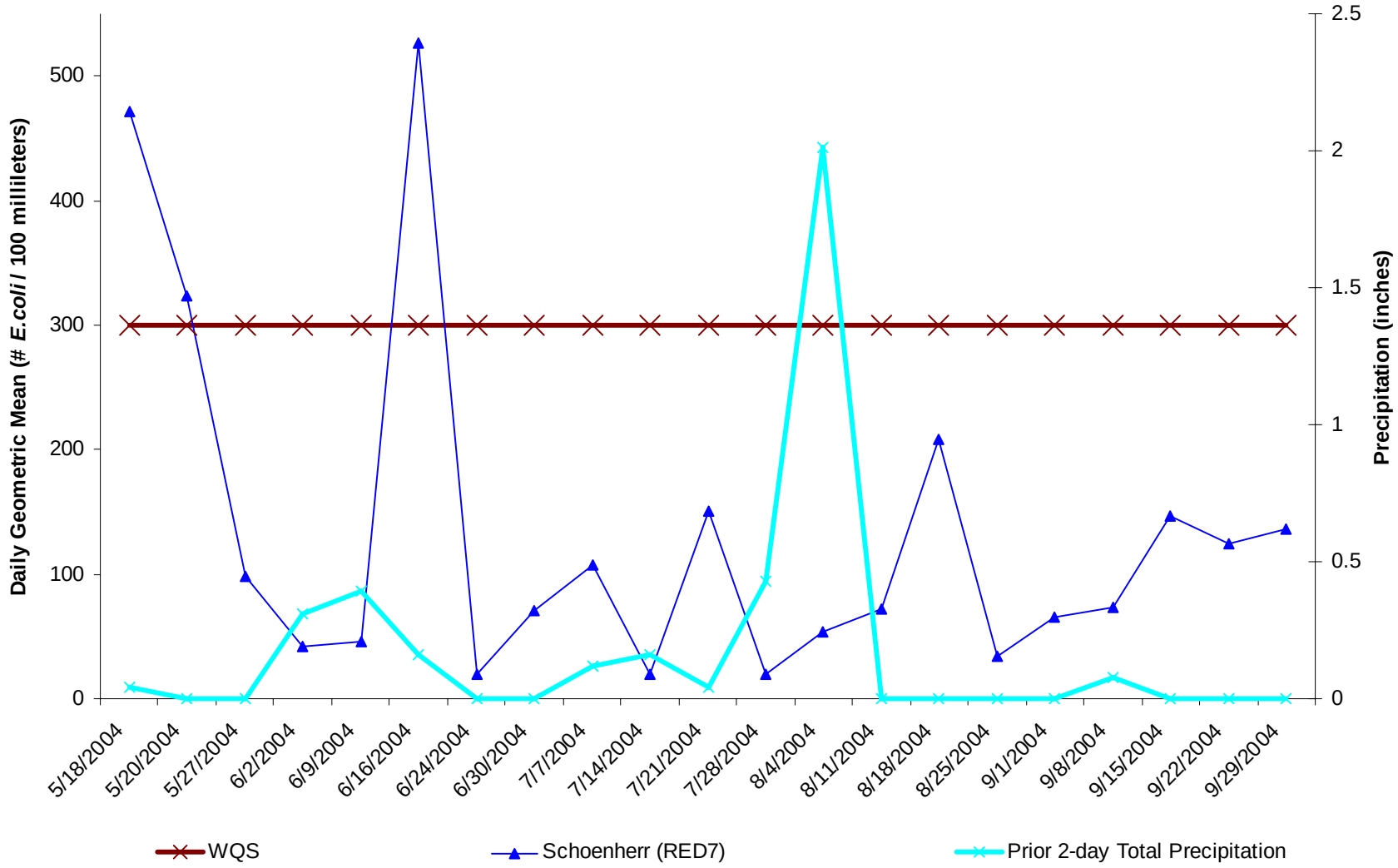


Figure 10. Daily geometric mean for *E. coli* in Plum Brook, Macomb County, Michigan, 2004.

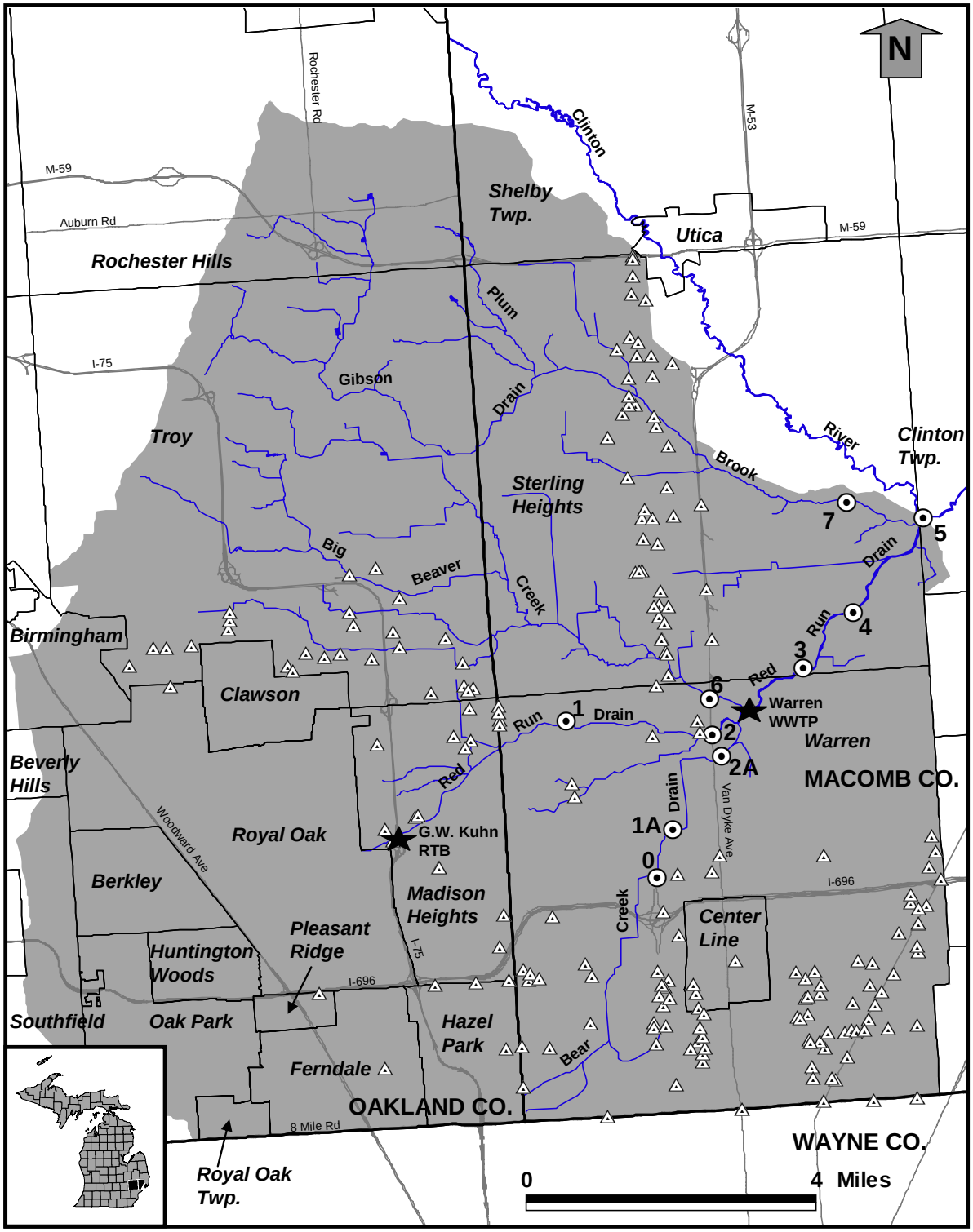


Figure 11. NPDES permitted discharges to the Red Run Drain/Bear Creek TMDL reach, Macomb and Oakland Counties, Michigan, 2004. (Note: figure does not contain MS4 permits or permits-by-rule).

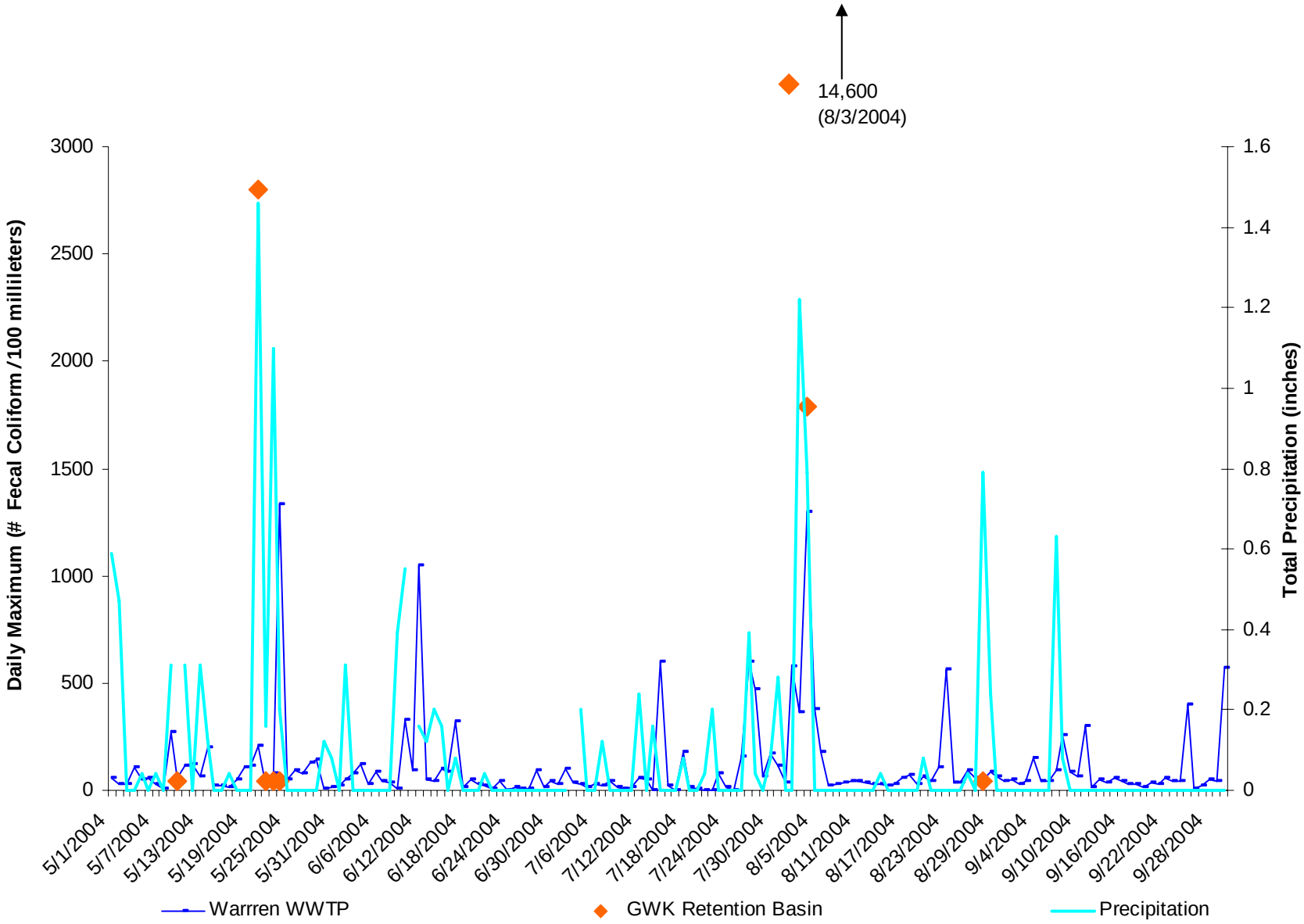


Figure 12. Daily maximum fecal coliform numbers discharged to Red Run Drain and total precipitation data for two facilities in Oakland and Macomb Counties, Michigan, 2004. Precipitation Data is from Hazel Park, Michigan.

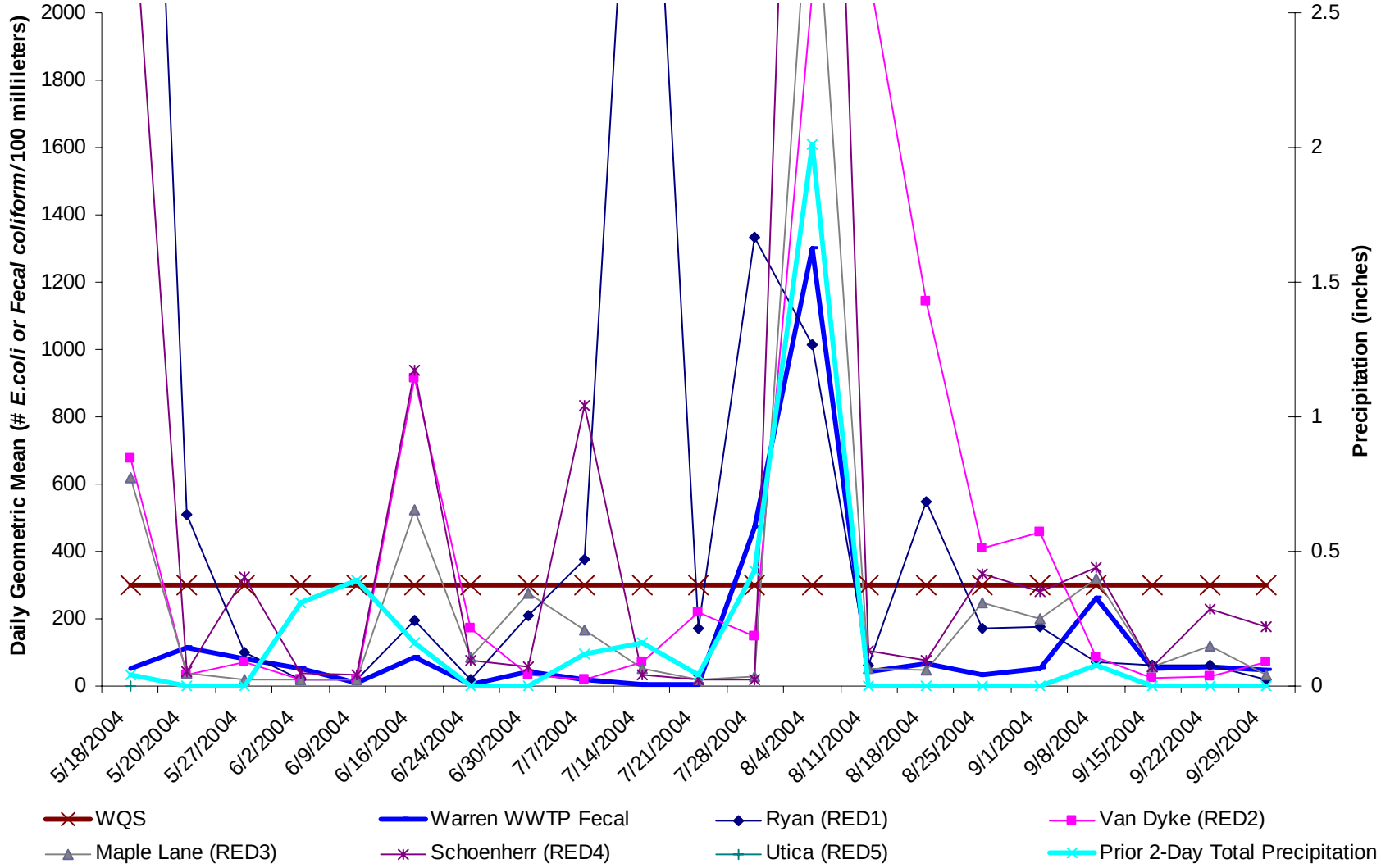


Figure 13. Daily geometric mean for *E. coli* numbers present in Red Run Drain and total fecal coliform numbers discharged from Warren WWTP, Macomb County, Michigan, 2004. Precipitation Data is from Hazel Park, Michigan.

Table 1. MDEQ 2004 *E. coli* monitoring data (*E. coli*/100 ml) for Red Run Drain. Shaded areas indicate exceedances of the WQS. Data are presented upstream to downstream.

	Red Run Drain @ Ryan Road (RED 1)			Red Run Drain @ Van Dyke (RED 2)			Red Run Drain @ Maple Lane (RED 3)			Red Run Drain @ Schoenherr (RED 4)			Red Run Drain @ Utica Road (RED 5)			Prior 2-Day Precipitation in inches
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
5/18/2004	6800	4578	---	1240	675	---	300	621	---	980	2448	---	960	326	---	0.04"
	8400			1380			1000			1440			1800			
	1680			180			800			10400			20			
5/20/2004	20	511	---	20	32	---	40	36	---	220	44	---	820	69	---	0.0"
	980			80			20			20			20			
	6800			20			60			20			20			
5/27/2004	20	99	---	280	70	---	20	20	---	20	326	---	20	1679	---	0.0"
	400			60			20			1200			11600			
	120			20			20			1440			20400			
6/2/2004	20	20	---	20	20	---	20	20	---	20	38	---	20	20	---	0.31"
	20			20			20			140			20			
	20			20			20			20			20			
6/9/2004	20	20	156	20	20	57	20	20	45	100	34	136	400	186	170	0.39 "
	20			20			20			20			160			
	20			20			20			20			100			
6/16/2004	1200	197	83	960	916	60	640	526	43	2000	936	112	200	363	173	0.16"
	80			800			380			540			500			
	80			1000			600			760			480			
6/24/2004	20	20	43	140	171	85	220	85	51	560	77	125	560	104	188	0.0"
	20			200			140			20			100			
	20			180			20			40			20			
6/30/2004	80	210	51	20	32	72	180	275	87	80	58	88	20	20	78	0.0"
	360			40			320			60			20			
	320			40			360			40			20			
7/7/2004	1440	376	91	20	20	72	340	168	133	5800	834	164	20	79	102	0.12"
	20			20			700			5000			1240			
	1840			20			20			20			20			
7/14/2004	5400	3291	252	20	72	94	20	53	162	100	34	164	20	20	65	0.16"
	2200			940			380			20			20			
	3000			20			20			20			20			
7/21/2004	20	173	246	340	220	70	20	20	84	20	20	76	100	118	52	0.04"
	540			260			20			20			20			
	480			120			20			20			820			

Table 1 Continued:

DATE	Red Run Drain @ Ryan Road (RED 1)			Red Run Drain @ Van Dyke (RED 2)			Red Run Drain @ Maple Lane (RED 3)			Red Run Drain @ Schoenherr (RED 4)			Red Run Drain @ Utica Road (RED 5)			Prior 2-Day Precipitation in inches	30-Day Total Precipitation in inches
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN		
7/28/2004	600	1332	569	400	147	68	60	29	68	20	20	58	20	82	50	0.43"	1.47"
	4800			20			20			20			60				
	820			400			20			20			460				
8/4/2004	810	1016	780	3600	2060	157	3600	2541	106	12600	4898	141	40	25	52	2.01"	3.84"
	2400			1500			7600			12600			20				
	540			1620			600			740			20				
8/11/2004	280	61	542	2000	2125	400	20	53	84	100	106	93	520	59	49	0.0"	3.52"
	40			1200			20			120			20				
	20			4000			380			100			20				
8/18/2004	60	546	379	20	1141	695	20	46	81	20	78	110	360	166	75	0.0"	3.16"
	1720			12800			20			1180			640				
	1580			5800			240			20			20				
8/25/2004	520	171	378	260	411	787	680	248	135	620	334	193	1400	383	95	0.0"	2.92"
	20			580			140			200			2000				
	480			460			160			300			20				
9/1/2004	20	178	252	2400	458	988	180	199	198	2400	281	328	20	171	110	0.0"	3.20"
	2800			20			440			20			12600				
	100			2000			100			460			20				
9/8/2004	20	72	149	40	85	523	2800	319	131	20	352	194	1260	565	205	0.08"	1.90"
	20			780			580			1600			340				
	940			20			20			1360			420				
9/15/2004	20	64	150	20	25	215	40	56	132	20	56	170	200	373	297	0.0"	1.86"
	20			40			20			40			1000				
	660			20			220			220			260				
9/22/2004	80	61	97	20	29	103	40	120	160	940	229	211	700	119	277	0.0"	1.82"
	20			60			360			20			60				
	140			20			120			640			40				
9/29/2004	20	20	63	20	71	73	20	34	108	320	178	186	20	54	188	0.0"	0.99"
	20			220			100			20			20				
	20			80			20			880			400				

Table 2. MDEQ 2004 *E. coli* monitoring data (# *E. coli*/100ml) for Bear Creek. Shaded areas indicate exceedances of the WQS. Data are presented upstream to downstream. ("No Sample" due to delayed start date for Bear Creek).

	Bear Creek @ Mound Road (BEA 0)			Bear Creek @ 12-Mile Road (BEA 1A)			Bear Creek @ Old 13-Mile Road (BEA 2A)			Prior 2-Day
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Precipitation in inches
5/18/2004	No sample	---	---	600	351	---	1160	674	---	0.04"
	No sample			40			440			
	No sample			1800			600			
5/20/2004	No sample	---	---	280	171	---	100	34	---	0.0"
	No sample			100			20			
	No sample			180			20			
5/27/2004	No sample	---	---	600	665	---	20	1563	---	0.0"
	No sample			720			12400			
	No sample			680			15400			
6/2/2004	No sample	---	---	140	55	---	40	25	---	0.31"
	No sample			60			20			
	No sample			20			20			
6/9/2004	No sample	---	---	720	166	206	280	204	179	0.39 "
	No sample			20			20			
	No sample			320			1520			
6/16/2004	No sample	---	---	800	741	239	620	850	188	0.16"
	No sample			620			620			
	No sample			820			1600			
6/24/2004	No sample	---	---	260	908	333	20	317	293	0.0"
	No sample			1600			1080			
	No sample			1800			1480			
6/30/2004	320	227	---	800	1055	365	1240	1100	273	0.0"
	140			1360			1220			
	260			1080			880			
7/7/2004	21400	205	---	22400	208	476	20	65	331	0.12"
	20			20			20			
	20			20			700			
7/14/2004	20	410	---	4200	4252	911	20	20	208	0.16"
	1080			11440			20			
	3200			1600			20			
7/21/2004	1480	4010	---	1400	1111	988	20	25	103	0.04"
	6600			1400			40			
	6600			700			20			

Table 2 Continued: ("No Sample" due to laboratory error)

	Bear Creek @ Mound Road (BEA 0)			Bear Creek @ 12-Mile Road (BEA 1A)			Bear Creek @ Old 13-Mile Road (BEA 2A)			Prior 2-Day Precipitation in inches
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
7/28/2004	12800 20 8200	1280	628	80 200 680	222	745	780 60 820	337	104	0.43"
8/4/2004	1220 4000 5000	2900	1046	6200 20 440	379	607	40 400 8000	504	89	2.01"
8/11/2004	20 100 20	34	731	20 340 180	107	532	40 40 20	32	77	0.0"
8/18/2004	40 340 20	65	505	20 20 1200	78	239	4200 20 3800	683	156	0.0"
8/25/2004	220 500 No sample	---	---	1060 260 900	628	213	660 740 2200	1024	328	0.0"
9/1/2004	20 20 20	20	---	20 140 20	38	150	760 20 140	129	270	0.0"
9/8/2004	20 20 20	20	---	5600 20 20	131	121	20 1080 20	76	185	0.08"
9/15/2004	20 460 480	164	---	580 880 580	666	175	700 220 180	303	290	0.0"
9/22/2004	180 40 20	52	---	80 140 20	61	166	360 20 440	147	213	0.0"
9/29/2004	280 80 20	77	48	600 20 20	62	105	240 80 20	73	126	0.0"

Table 3. MDEQ 2004 *E. coli* monitoring data (*E. coli*/100 ml) for Big Beaver Creek and Plum Brook. Shaded areas indicate exceedances of the WQS. Data are presented upstream to downstream.

	Big Beaver Creek @ Van Dyke (RED 6)			Plum Brook @ Schoenherr (RED 7)			2-Day
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Precipitation in inches
5/18/2004	1440	903	---	140	472	---	0.04”
	640			660			
	800			1140			
5/20/2004	1260	226	---	440	323	---	0.0”
	460			320			
	20			240			
5/27/2004	440	96	---	340	98	---	0.0”
	20			140			
	100			20			
6/2/2004	20	20	---	20	42	---	0.31"
	20			20			
	20			180			
6/9/2004	20	40	109	20	46	123	0.39 "
	20			240			
	160			20			
6/16/2004	800	304	88	560	526	126	0.16"
	880			480			
	40			540			
6/24/2004	220	281	92	20	20	72	0.0"
	180			20			
	560			20			
6/30/2004	420	318	117	100	71	68	0.0"
	640			180			
	120			20			
7/7/2004	360	52	142	60	107	82	0.12"
	20			1020			
	20			20			
7/14/2004	20	43	144	20	20	69	0.16"
	20			20			
	200			20			
7/21/2004	240	214	134	20	151	54	0.04"
	340			280			
	120			620			
7/28/2004	1400	519	152	20	20	54	0.43”
	20			20			
	5000			20			

Table 3 Continued: **("No Sample" due to stagnant conditions.)**

	Big Beaver Creek @ Van Dyke (RED 6)			Plum Brook @ Schoenherr (RED 7)			2-Day
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Precipitation in inches
8/4/2004	2060	1657	211	400	54	51	2.01"
	1840			20			
	1200			20			
8/11/2004	20	51	210	20	72	47	0.0"
	20			40			
	340			460			
8/18/2004	20	20	180	460	208	75	0.0"
	20			980			
	20			20			
8/25/2004	40	25	117	20	34	56	0.0"
	20			20			
	20			100			
9/1/2004	20	20	61	700	65	71	0.0"
	20			20			
	20			20			
9/8/2004	280	173	39	40	73	75	0.08"
	920			120			
	20			80			
9/15/2004	780	734	66	20	147	87	0.0"
	940			440			
	540			360			
9/22/2004	No Sample	---	---	20	124	78	0.0"
	No Sample			120			
	No Sample			800			
9/29/2004	860	620	---	20	136	103	0.0"
	220			420			
	1260			300			

Table 4. Distribution of land for each municipality in the Red Run Drain /Bear Creek TMDL reach, Oakland and Macomb Counties, MI, 2006.

Municipality	Square Miles in Watershed	Percent in Watershed
City of Warren	34.44	24.2
City of Troy	27.8	19.5
City of Sterling Heights	25.93	18.2
City of Royal Oak	11.83	8.3
City of Madison Heights	7.12	5.0
City of Rochester Hills	6.82	4.8
City of Oak Park	4.45	3.1
City of Ferndale	3.86	2.7
Charter Township of Shelby	2.92	2.0
City of Hazel Park	2.83	2.0
City of Southfield	2.59	1.8
City of Berkley	2.59	1.8
City of Clawson	2.21	1.6
City of Birmingham	2.02	1.4
City of Center Line	1.72	1.2
City of Huntington Woods	1.47	1.0
Charter Township of Royal Oak	0.69	0.5
City of Pleasant Ridge	0.56	0.4
Village of Beverly Hills	0.36	0.3
Charter Township of Clinton	0.27	0.2
TOTAL	**142.48**	**100**

Table 5. Notice of Coverage permits in the Red Run Drain/Bear Creek TMDL watershed. Source: MDEQ, Water Bureau's NPDES Permit Management System.

Designated Name	Permit No.	Facility Location City
19 Holdings Office Park	MIR109220	Clinton Township
21 Mile Sanitary Sewer	MIR108301	Shelby Township
2400 E-Kenning Sq Condos	MIR109106	Birmingham
A-1 Home Inv-Highwood Subdiv	MIR107773	Southfield
Admiral Dev-Admirals Cove Cond	MIR107603	Sterling Heights
Admiral-Windmill Pond Condo	MIR108031	Shelby Township
Ag-B&A Steel Parcel A	MIR106939	Clinton Township
Albert Weine & Sons-Huron Crk	MIR107617	Southfield
Almar Homes-Plum River Estates	MIR109425	Sterling Heights
Almar-Forest Creek # 3	MIR107407	Sterling Heights
Almar-Hidden Meadow	MIR106389	Sterling Heights
Ambassador-Timbers Edge	MIR106275	Shelby Township
Amer Land-Harvard Village Condo	MIR109219	Madison Heights
Angelina Estates Sub 2	MIR108214	Shelby Township
Aspen/Auburn-Northbrooke Condo	MIR107217	Southfield
Aspen-Atwater Commons	MIR106559	Southfield
BIK Co-Mulberry Meadows Condo	MIR109540	Shelby Township
Bluffs of Beaufait Farms	MIR106132	Clinton Township
Brandenburg-Lakeview Est	MIR106709	Shelby Township
Brandenburg-Secluded Woods	MIR106710	Shelby Township
Brentwood-Sherwood Est Sub	MIR108177	Sterling Heights
Brg-Dutton Corporate Ctr	MIR107237	Royal Oak
Brookshire Office Plaza	MIR109198	Sterling Heights
Brookwood Counen & Homeowner	MIR107303	Rochester Hills
C/M-Fev Engine Tech Warehouse	MIR106787	Southfield
Catenacci-Siena Gardens Sub	MIR107394	Clinton Township
Cavaliere-Reg Commerce Ctr #2	MIR107530	Hazel Park

Table 5 Continued:

Designated Name	Permit No.	Facility Location City
Cavaliere-Shoppes at The Trail	MIR107480	Warren
Centex Homes-Spring Haven	MIR109226	Southfield
Centex-Elmhurst Site Condo	MIR108071	Sterling Heights
Chaldean Comm Cultural Ctr	MIR106460	Southfield
Chawney-Hampton Woods	MIR107274	Beverly Hills
Chesterfield Commons	MIR106878	Shelby Township
Chippewa Valley High School	MIR109562	Clinton Township
Chippewa-Wyandot Middle School	MIR109466	Clinton Township
Choice Dev-Wattles Pk Condo	MIR106280	Troy
City of Troy-Maplelawn Rd Rec	MIR107514	Troy
Ck-Kirkway Ravines Condo	MIR106852	Southfield
Coda-Birchcrest Condo	MIR106847	Clinton Township
Const Solutions-Bradford Acad	MIR109536	Southfield
CPD-Mollertech Expansion	MIR109559	Shelby Township
Creekside Vill of Shelby #3	MIR105646	Troy
Crystal Commons Retail Center	MIR107982	Clinton Township
Ctry Club Vill of Rh Ph I	MIR107188	Southfield
Cueter Prop-Toussaint Farms	MIR109268	Sterling Heights
Cueter-Avalon Meadows	MIR107402	Sterling Heights
Curtis Prop-Papa Joes Dev	MIR108610	Rochester Hills
Daj-Estates @ Cambridge	MIR106620	Troy
DAlasandro-Brookside Villas	MIR106492	Clinton Township
Deflorio Home-Rhode Island Est	MIR107636	Troy
DeLaura-Crystal Pines Condos	MIR108880	Shelby Township
DeSano-Village at Shelby	MIR108090	Sterling Heights
DESCO-Sterling Heights West	MIR109482	Sterling Heights
Dilorenzo Towncenter	MIR105322	Clinton Township
Dilorenzo-Emerald Ck Ph III/IV	MIR105607	Clinton Township
Dilorenzo-Twin Rivers Sub Ph I	MIR105452	Clinton Township

Table 5 Continued:

Designated Name	Permit No.	Facility Location City
Dimercurio-Brookfield Condos	MIR105825	Shelby Township
Eagle Creek Condominiums	MIR107986	Shelby Township
Ecro Corp-Partridge Creek Vill	MIR107622	Troy
Elro-Fallbrooke Farms	MIR106920	Troy
Eltel-Pontiac Woods/Tech Park	MIR105993	Southfield
Fairview Estates Condo	MIR106461	Rochester Hills
Fairview Village-Pontiac	MIR106848	Rochester Hills
Ferndale HS/MS Activity Field	MIR108634	Ferndale
Fieldstone Golf & Tennis #1	MIR105905	Birmingham
Fieldstone Village # 2	MIR106781	Birmingham
Fifth Third Bank-Rochester H	MIR108982	Rochester Hills
Fisher Co Stamping Facility	MIR107460	Troy
Forester Square	MIR105477	Troy
Frank Karam Emerald Green	MIR105285	Sterling Heights
Froling-Palmer Woods Est	MIR105650	Sterling Heights
G & V-Eddington Woods	MIR105402	Rochester Hills
Gardens at Clinton	MIR108379	Clinton Township
Garrett-Spring Lk Sub #3	MIR106083	Troy
Gateway Village	MIR105838	Southfield
GFA Dev-Hidden Forest	MIR108013	Troy
Gh-Colleen Meadows Condo	MIR106845	Shelby Township
Ginzinger-Wyndridge Est	MIR105777	Rochester Hills
Golden Park Condos	MIR106021	Shelby Township
Grand/Sakwa Prop-M-59/Adam Dev	MIR109203	Rochester Hills
Grand/Sakwa-Central Pk North	MIR109496	Shelby Township
Grand/Sakwa-Heritage Village	MIR108458	Warren
Grandview Site Condo-Rochester	MIR108132	Rochester Hills
Grt-Adrienne Estates Sub #2	MIR105942	Clinton Township
Gst II-Macomb Corp Ctr #2	MIR105352	Madison Heights

Table 5 Continued:

Designated Name	Permit No.	Facility Location City
GTR Bldrs-Parkview Estates	MIR107550	Clinton Township
Gtr-Brook Run Sub	MIR106016	Clinton Township
Gtr-Chesterfield Ind & Tech	MIR107619	Clinton Township
GTR-Rose Gardens Estates	MIR108938	Clinton Township
Gulf-Meadow Creek Condos	MIR105560	Southfield
Gvc-Pine Creek Condo	MIR106494	Shelby Township
H & C-Rochester Maples Condo	MIR109505	Troy
Hall Meadows Condominiums	MIR106077	Clinton Township
Hall-Partridge Ck Commercial	MIR109168	Clinton Township
Hamlin-Avon Lk Vill # 4	MIR107286	Troy
Hazel Park Jr High School	MIR106184	Hazel Park
Hbf-Bay Winds Townhomes	MIR105726	Sterling Heights
Heritage Vill Senior Housing	MIR109279	Warren
Heritage Village Duplex A	MIR109280	Warren
Heritage Village Duplex B	MIR109281	Warren
Heritage Village Single Fam C	MIR109282	Warren
Hickory Highland-Cobblestone 3	MIR105497	Troy
Hickory Ridge Site Condo	MIR109382	Rochester Hills
Hrn-Liberty Techne Ctr	MIR105671	Southfield
Icon Bldg-Garwood Est Condos	MIR105985	Clinton Township
Icon-Lakes Professional Bldg	MIR107127	Clinton Township
Ionia Prop-Plumcreek Est	MIR106284	Birmingham
Izzi-Plymouth Village	MIR105415	Clinton Township
JBD-Crooks and Auburn Dev	MIR108101	Rochester Hills
John Carlo Dev-Clinton Twp	MIR109156	Clinton Township
Joslyn Commerce Park	MIR106300	Southfield
Kaplan-Stonegate Condos	MIR105547	Sylvan Lake
Kayto-24 Mile Commercial	MIR109071	Shelby Township
Kirco Medical Office Bldg	MIR106175	Troy

Table 5 Continued:

Designated Name	Permit No.	Facility Location City
Lakeside Budget Storage	MIR108064	Sterling Heights
Ld Angelo-Wingate Lk Est Ph I	MIR106370	Southfield
Lear Corp-New Headquarters	MIR108311	Southfield
Lincoln Center/Villa Bella	MIR108017	Clinton Township
Lo Chirco-Windemere Multi	MIR106855	Shelby Township
Lochirco-Birchfield Condo	MIR106422	Shelby Township
Lochmoor Homes-Southfield	MIR108052	Southfield
Lombardo Roch Hills-Sheffield	MIR109537	Rochester Hills
Lowes of Madison Heights	MIR108716	Madison Heights
Maas-Silver Pines Vill Condos	MIR106147	Sterling Heights
Macomb Co New Public Works	MIR108619	Clinton Township
Macomb Co-Jewell Road	MIR108199	Shelby Township
Macomb CRC-Metro Pky	MIR108725	Clinton Township
Macomb Emergency Serv Training	MIR109561	Clinton Township
Mancini-Bellagio Subdivision	MIR107571	Shelby Township
Maple Lake Farms Sub	MIR105411	Troy
Marcast-Castle Mar Subdivision	MIR105378	Shelby Township
Market Place Center	MIR108955	Sterling Heights
Mccomb-Peacock Farms	MIR105939	Troy
MDOT-I696/M10 Interchange Mod	MIR108989	Southfield
MDOT-M-10 Beck and Lahser	MIR108423	Southfield
MDOT-M-59 at Adams Rd	MIR109565	Rochester Hills
Meadowbrook Village	MIR105349	Troy
Meram-Angelina Estates	MIR106912	Shelby Township
Meridian Homes-Lochaven Woods	MIR108507	Troy
Middlecreek Estates	MIR106802	Sterling Heights
Misd-Ed Service Ctr Addition	MIR106024	Clinton Township
MJC-Ashford Crossing	MIR108853	Shelby Township
Mlm-Lia Industrial	MIR106833	Clinton Township

Table 5 Continued:

Designated Name	Permit No.	Facility Location City
Modena-Orchard Golf Est	MIR106971	Shelby Township
Mondrian-Chesapeake Grove Cond	MIR109193	Troy
Moravian-Bella Court Condo	MIR108549	Sterling Heights
Mt Elliot-New Mansoleum	MIR106399	Clinton Township
Munaco-Sheldon Court Est	MIR105831	Shelby Township
Neumann Homes-Sterling Woods	MIR109105	Sterling Heights
Nino Homes-Briarwood Condo	MIR108124	Shelby Township
Nino Homes-Oakview Est Sub	MIR108386	Shelby Township
Nino Homes-Whispering Hill Sub	MIR108509	Shelby Township
Nino-Oakwood Condominiums	MIR108145	Shelby Township
North Pointe Condominiums 3	MIR108650	Sterling Heights
Northampton Community	MIR107297	Southfield
Northwood-Pinewood Est Sub #3	MIR106187	Shelby Township
Oakland Co-47051-Rochester Rd	MIR108362	Rochester Hills
Oakland Co-Dequindre Rd	MIR106312	Beverly Hills
Oakland Co-Milford Rd 3r Proj	MIR105990	Beverly Hills
Oakland Co-Nine Mile Rd	MIR106011	Beverly Hills
Oakland Co-Walton Blvd	MIR106012	Beverly Hills
Oakland CRC-Maple Road	MIR107513	Beverly Hills
Oakland Mall-Lord and Taylor	MIR107575	Troy
OCRC-Crooks Rd Reconstruction	MIR109278	Rochester Hills
Old Orchard-Windsong W Condo	MIR106566	Beverly Hills
Oliver-Cranberry Meadows Sub	MIR106550	Sterling Heights
Orco-Birchcrest Condos	MIR106282	Troy
P & D-Tall Oaks Condo	MIR108746	Clinton Township
Palazzolo Bro-Wellington Green	MIR107937	Sterling Heights
Palazzolo-Preserves No 2	MIR105641	Sterling Heights
Park Place of Oak Park Condo	MIR109435	Oak Park
Park South-Oxford Est Condos	MIR105599	Southfield

Table 5 Continued:

Designated Name	Permit No.	Facility Location City
Partridge Creek Fashion Pk	MIR109307	Clinton Township
Partridge Creek Golf-M-59 Conn	MIR108436	Clinton Township
Peg-Hadsell/Bloomfield H-Lands	MIR106380	Rochester Hills
Pine Ridge Senior Village	MIR109319	Clinton Township
Pinewood Plaza	MIR107680	Shelby Township
Plute-Strathmore Sub	MIR107169	Royal Oak
Professional Med Prop-Sterling	MIR108161	Sterling Heights
Providence Park-24 Mile Rd	MIR108003	Shelby Township
Pulte Land-Hills at Indianwood	MIR107728	Royal Oak
Pulte-Arcadia Park	MIR106225	Royal Oak
Pulte-Canterbury Woods	MIR106685	Royal Oak
Pulte-Carrington Garden	MIR106452	Royal Oak
Pulte-Silvercreek/belmonte	MIR106440	Royal Oak
Pulte-Wyngate of Troy	MIR108035	Troy
R & D-King of The Wld Frms	MIR107421	Clinton Township
Rau-Rauhorn Electric Company	MIR107521	Shelby Township
Realistic Builders-Prescot Wds	MIR108494	Sterling Heights
Regency Commerce Ctr #2	MIR105864	Sterling Heights
Regency Commerce Ctr No 2	MIR105840	Sterling Heights
Reserve at Tull Lake	MIR106102	Southfield
Riley-Parkway Chrysler/Jeep	MIR108976	Clinton Township
Rochester Hill-Hitchmans Haven	MIR106779	Rochester Hills
Rochester Hill-Rochdale Water	MIR106780	Rochester Hills
Rochester Klem Gardens	MIR105276	Rochester Hills
Rochester Tienken Shelden	MIR105269	Rochester Hills
Rochester Wal-Mart 2354-01	MIR109410	Rochester Hills
Rochester-ACE School	MIR108852	Rochester Hills
Rochester-Reuther MiddleSch	MIR108849	Rochester Hills
Rochester-Support Service Bldg	MIR108851	Rochester Hills

Table 5 Continued:

Designated Name	Permit No.	Facility Location City
Rochester-Van Hoosen MiddleSch	MIR108893	Rochester Hills
Roncelli Inv-J H Hart Facility	MIR108137	Sterling Heights
Roscommon-Butler Ridge Ph II	MIR106897	Troy
Rwt-Crestwood Condo	MIR107096	Troy
Ryan Rd Shelby-Glen Arbor Cond	MIR108850	Shelby Township
Sable Realty-Central Pk Ph II	MIR109488	Shelby Township
Sable-Manors @ Central Park	MIR107001	Sterling Heights
Samohin-Lakeside Industrial	MIR106907	Sterling Heights
Scalabrino-Hidden Woods Condos	MIR107880	Shelby Township
Sd-Country Club Vill of RH	MIR107765	Southfield
Sd-Golf Highlands 2-5	MIR106929	Southfield
Selective Delaware-Brookstone	MIR105736	Southfield
Seville-Whispering Pines #2	MIR106408	Clinton Township
Shelby Prop Invest-Willow Ck	MIR108889	Shelby Township
Shelby Ridge Estates	MIR108102	Shelby Township
Shelby-23 Mile Rd San Sewer	MIR108727	Shelby Township
Silver Pines Village Condo II	MIR106697	Sterling Heights
Singh Dev-Waltonwood Lakeside	MIR108845	Sterling Heights
Soccer City-Shelby Township	MIR109385	Shelby Township
Soulliere-Elk Horn Est Condos	MIR105834	Oak Park
Sterling Creek Condo	MIR106671	Sterling Heights
Sterling Hghts-19 Mile Rd Blvd	MIR109499	Sterling Heights
Tadian-Pineridge Estates	MIR105602	Troy
Target Store T-2207	MIR109471	Southfield
Ten/Ten Southfield-Mixed Use	MIR109403	Southfield
Terraces at Rose Gardens Est	MIR109348	Clinton Township
Terrance Les-Les Site	MIR108354	Clinton Township
Tienken-City Walk	MIR109223	Rochester Hills
Towncenter Shoppes-Shelby Twp	MIR108480	Shelby Township

Table 5 Continued:

Designated Name	Permit No.	Facility Location City
Trinity Territory	MIR106917	Clinton Township
Troy-Baker New Middle School	MIR109250	Troy
Unity Properties-Chelsea Court	MIR107522	Sterling Heights
Utica Schools-Aux Serv Complex	MIR107963	Sterling Heights
V & M-Tesner Park Sub	MIR106203	Shelby Township
Ventimiglia Retail Center	MIR109346	Shelby Township
Ventimiglia-Gloede Park Subdiv	MIR107581	Warren
Vesper Const-Creekside Manor	MIR107843	Clinton Township
Village @ Cornerstone	MIR105740	Troy
Vitale-Vitale Plaza	MIR108465	Shelby Township
Wake Pratt-Cedar Pines Est	MIR108116	Troy
Warren Community Center	MIR105592	Warren
Warren-City Ctr Infrastructure	MIR107811	Warren
Warren-Detroit Testing Labs	MIR109367	Warren
Washington Twp-Bradbury Condo	MIR107813	Troy
Washington Woods Sub	MIR105416	Shelby Township
Waterstone-Shelby Woods North	MIR109152	Shelby Township
Webber Dev-Parcel B	MIR106674	Clinton Township
Weber-Bluffs of Beaufait 2	MIR106616	Clinton Township
WLC-Willow Ridge Farms	MIR106118	Clinton Township
Woodside Bible Church-Troy	MIR107482	Troy

Table 6. Individual permits and Certificates of Coverage in the Red Run Drain/Bear Creek TMDL watershed. Source: MDEQ, Water Bureau's NPDES Permit Management System.

Permit #	Facility Name	Latitude	Longitude	Receiving Water	CITY
MI0024295	Warren WWTP	42.53167	-83.01833	Red Run Drain	Warren
MI0026115	George W Kuhn RTB CSO	42.50583	-83.11639	Red Run Drain	Madison Heights
MI0057364	MDOT MS4			Statewide	
MI0053881	Warren MS4			Red Run Drain, Bear Creek, Beaver Creek	
MI0053899	Sterling Heights MS4			Clinton River, Red Run Drain, Beaver Creek, Plum Brook Creek	
MIG610042	Oakland Co MS4			Clinton River, Flint River, Huron River, Shiawassee River, Rouge River	
MIG610052	Macomb Co MS4			Clinton River, Lake St. Clair, Stony Creek, Red Run	
MIG610053	Troy MS4-Oakland			Shanahan Drain, Nelson Drain, Big Beaver Creek, Sturgis Drain, Spencer/Bernard Drain, Sprague Drain, Lane Drain, Olson Drain, Fetterly Drain, Renshaw Drain, Ferry Drain	
MIG610115	Shelby Twp MS4-Macomb			Clinton River, Longstaff Drain, Stokes Drain, Bannister Drain	
MIG610251	Hazel Park MS4-Oakland			Bear Creek, Kutchey Drain	
MIG610283	Rochester Hills MS4-Oakland			Clinton River, Rouge River, Paint Creek, Gibson Drain, Galloway Drain, Stony Creek, Sargent Creek	
MIG610295	Madison Heights MS4-Oakland			Bear Creek, McCoy Drain, Red Run, Sharkey Drain	
MIG610299	Clinton Twp MS4-Macomb			Clinton River, North Branch Clinton River	
MIG610304	Center Line MS4-Macomb			Center Line Tile Drain, Center Line Relief Drain, Lorraine Drain	
MIG250009	Weyerhaeuser Co-Warren	42.4633	-82.9933	Red Run Drain	Warren
MIG250015	Wolverine Die Cast-Hoover Rd	42.4614	-83.0053	Red Run Drain	Warren
MIG250062	DaimlerChrysler-Dodge City	42.4536	-83.0422	Bear Creek	Warren
MIS110048	Warren Recycling Center	42.4833	-82.9806	Red Run Drain	Warren
MIS110049	Mayco Plastics-Sterling Hts	42.60444	-83.04556	Plum Brook Creek	Sterling Heights
MIS110054	BAE Industries-Centerline	42.4725	-83.0358	Bear Creek	Center Line

Table 6 Continued:

Permit #	Facility Name	Latitude	Longitude	Receiving Water	CITY
MIS110060	Levy-Clawson Concrete-Plt 16	42.58972	-83.04111	Plum Brook Creek	Sterling Heights
MIS110062	Curtis Metal Finishing	42.59167	-83.04167	Plum Brook	Sterling Heights
MIS110063	American & Import Auto Parts	42.56528	-83.04167	Plum Brook	Sterling Heights
MIS110064	Amplas Compounding Inc	42.54583	-83.04167	Clinton River	Sterling Heights
MIS110065	Luckmarr Plastics Inc	42.55556	-83.04167	Big Beaver Creek	Sterling Heights
MIS110068	Orlandi Gear-Sterling Heights	42.54333	-83.04056	Big Beaver Creek	Sterling Heights
MIS110076	Leonard Tool & Die-Warren	42.4619	-83.0056	Red Run Drain	Warren
MIS110079	CPS Process Systems Inc	42.46667	-83.04750	Bear Creek	Warren
MIS110081	Schwartz Machine Co-Warren	42.44750	-83.06111	Bear Creek	Warren
MIS110082	Apex Broaching Systems-Warren	42.4619	-83.0056	Red Run Drain	Warren
MIS110088	Cook Industries-Warren	42.46556	-83.04750	Bear Creek	Warren
MIS110089	Sturdy Broaching Service	42.5000	-82.9697	Red Run Drain	Warren
MIS110093	Classic Tool & Boring Inc	42.57083	-83.04583	Moore Drain	Sterling Heights
MIS110095	Valiant Industries Inc	42.56000	-83.04639	Big Beaver Creek	Sterling Heights
MIS110097	GM-Powertrain Div-Warren	42.46583	-83.04444	Bear Creek	Warren
MIS110100	Cadillac Plating-Warren	42.4714	-82.9858	Red Run Drain	Warren
MIS110102	Nor-Cote Inc-Warren	42.4667	-83.0089	Bear Creek	Warren
MIS110103	Parton and Preble Mix-Warren	42.4689	-82.9875	Red Run Drain	Warren
MIS110106	Ring Screw Works-Screw Div	42.4583	-83.0347	Bear Creek	Warren
MIS110107	Super Steal Treating Co	42.47538	-83.04328	Clinton River	Warren
MIS110112	Mich Metal Fabricators-Warren	42.4747	-83.0061	Bear Creek	Warren
MIS110117	Capri Tube Inc	42.4762	-83.0037	Red Run Drain	Warren
MIS110127	Metallurgical Processing Co	42.46222	-83.07583	Bear Creek	Warren
MIS110128	Tank Truck Mfg	42.47833	-83.08226	Bear Creek	Warren
MIS110148	Moore Flame Cutting	42.59250	-83.05000	Plum Brook Creek	Sterling Heights
MIS110149	Ex-Cell-O Machine Tools Inc	42.55972	-83.04806	Beaver Creek	Sterling Heights
MIS110164	Wear-Ever Surface Treating	42.4644	-82.9764	Red Run Drain	Warren
MIS110165	FJ Manufacturing-Troy	42.54278	-83.14306	Spencer Drain	Troy
MIS110166	Plating Specialties	42.47639	-83.08639	Red Run Drain	Madison Heights
MIS110167	National Induction Heating	42.47500	-83.13750	Bear Creek	Hazel Park
MIS110170	Atlas Gear	42.53276	-83.09437	Red Run Drain	Madison Heights
MIS110171	UPS-Madison Heights	42.52611	-83.09417	Red Run Drain	Madison Heights
MIS110175	DuPont-Troy	42.54361	-83.12028	Spencer Drain	Troy
MIS110176	Controlled Power-Troy	42.55333	-83.12583	Spencer Drain	Troy
MIS110177	Sulzer Metco-Troy	42.53944	-83.17500	Spencer Drain	Troy
MIS110178	Adaptive Technologies-Troy	42.54167	-83.14167	Spencer Drain	Troy
MIS110182	Birmingham Hydraulics-Troy	42.54917	-83.11417	Hawthorn Drain	Troy
MIS110183	Compound Technologies-Troy	42.54444	-83.13306	Spencer Drain	Troy
MIS110194	Yarema Die & Engineering	42.53750	-83.09556	Spencer Drain	Troy
MIS110197	Bokum Tool-Madison Heights	42.53028	-83.08639	Red Run Drain	Madison Heights

Table 6 Continued:

Permit #	Facility Name	Latitude	Longitude	Receiving Water	CITY
MIS110198	Howard Finishing-Madison Hts	42.53194	-83.08639	Red Run Drain	Madison Heights
MIS110199	KC Jones Plating-Hazel Park	42.47583	-83.10639	Red Run Drain	Hazel Park
MIS110200	ND Industries-Troy	42.55083	-83.15861	Spencer Drain	Troy
MIS110211	Smart-Troy	42.55250	-83.15833	Spencer Drain	Troy
MIS110212	Ogura Corp-Madison Hgts	42.51083	-83.11000	Red Run Drain	Madison Heights
MIS110217	Inergy Automotive Sys-Troy	42.54722	-83.17917	Spencer Drain	Troy
MIS110219	H & L Tool-Madison Hgts	42.53306	-83.08639	Red Run Drain	Madison Heights
MIS110222	Duramic Abrasive Product	42.4714	-83.0025	Red Run Drain	Warren
MIS110230	Manufacturers Products Co	42.48444	-83.04000	Red Run Drain	Warren
MIS110234	Paslin Co-Warren	42.47917	-83.06556	Red Run Drain	Warren
MIS110235	Sur-Flo Plastics-Warren	42.4750	-82.9825	Sweeny Drain	Warren
MIS110242	Doan Companies-Warren Plt	42.4658	-82.9897	Red Run Drain	Warren
MIS110251	J & J Burning & Fabricating	42.47389	-83.04444	Bear Creek	Warren
MIS110254	Sheridan Auto Parts-Groesbeck	42.4536	-82.9989	Red Run Drain	Warren
MIS110257	Sheridan Auto Parts-Edom	42.4539	-83.0000	Red Run Drain	Warren
MIS110260	Harry & Sons Auto Parts-Warren	42.4897	-82.9769	Sweeny Drain	Warren
MIS110264	DaimlerChrysler-Sterling Stamp	42.55556	-83.02889	Red Run Drain	Sterling Heights
MIS110274	Warner Elect Formsprag Clutch	42.4672	-83.0058	Bear Creek	Warren
MIS110279	Warren WWTP	42.53167	-83.01833	Red Run Drain	Warren
MIS110303	Flex-N-Gate Stamping-Warren 1	42.4942	-82.9686	Red Run Drain	Warren
MIS110305	Plymouth Shafting Corp-Nagel	42.4603	-83.0017	Red Run Drain	Warren
MIS110306	Plymouth Shafting Corp-Hoover	42.4561	-83.0050	Red Run Drain	Warren
MIS110308	M & W Manufacturing Co	42.4636	-82.9844	Clinton River	Warren
MIS110309	Vac-Met Inc-Warren	42.52861	-83.03278	Red Run Drain	Warren
MIS110310	Nitro-Vac Heat Treat-Warren	42.46250	-83.08333	Bear Creek	Warren
MIS110328	Carboloy Inc	42.4492	-83.0025	Red Run Drain	Warren
MIS110329	Weyerhaeuser Co-Warren	42.4633	-82.9933	Red Run Drain	Warren
MIS110330	A G Simpson Inc	42.54278	-83.04028	Beaver Creek	Sterling Heights
MIS110335	Milco Manufacturing Co-Warren	42.47639	-83.08083	Bear Creek	Warren
MIS110336	Valley Industries-Madison Hgts	42.53167	-83.08639	Clinton River	Madison Heights
MIS110339	Welform Electrodes Inc-Warren	42.47750	-83.08056	Bear Creek	Warren
MIS110342	Tonys Die & Machine-Warren	42.4750	-82.9825	Seeny Drain	Warren
MIS110353	Fini Finish Products-Warren	42.47417	-83.04500	Bear Creek	Warren
MIS110357	Conway Central Express-XPN	42.52917	-83.08639	Red Run Drain	Warren
MIS110373	Flex-N-Gate Stamping-Warren 2	42.46222	-83.04694	Bear Creek	Warren
MIS110376	TRW Automotive US-Sterling Hts	42.54528	-83.02833	Big Beaver Creek	Sterling Heights
MIS110380	Experi-Metal-Sterling Hts	42.57056	-83.04278	Moore Drain	Sterling Heights
MIS110387	Warhoops Auto & Truck Parts	42.60000	-83.04167	Clinton River	Sterling Heights
MIS110388	Automotive Plastic Tech	42.55028	-83.04222	Clinton River	Sterling Heights
MIS110392	Ace Finishing-Warren	42.4494	-82.9772	Red Run Drain	Warren

Table 6 Continued:

Permit #	Facility Name	Latitude	Longitude	Receiving Water	CITY
MIS110393	PPG Industries-Sterling Height	42.55278	-83.04222	Big Beaver Creek	Sterling Heights
MIS110402	Deluxe Stamping & Die Co	42.54556	-83.04167	Big Beaver Creek	Sterling Heights
MIS110406	Ultimate Hydroforming Inc	42.60250	-83.03611	Clinton River	Sterling Heights
MIS110412	Regal Prototypes Inc	42.62083	-83.04583	Clinton River	Sterling Heights
MIS110413	IMPCO	42.54902	-83.04077	Clinton River	Sterling Heights
MIS110416	USPS-Royal Oak Processing	42.55583	-83.11222	Sturgis Drain	Troy
MIS110418	Fisher Corp-Troy	42.54750	-83.16889	Spencer Drain	Troy
MIS110454	Norbert Industries Inc	42.57250	-83.04500	Plum Brook	Sterling Heights
MIS110464	DaimlerChrysler-Sterling Hghts	42.57333	-83.02972	Moore Drain	Sterling Heights
MIS110734	Mich Tile & Marble Co	42.58750	-83.05417	Plum Brook Creek	Sterling Heights
MIS110740	Central Metal Products-Warren	42.4492	-82.9889	Red Run Drain	Warren
MIS110755	Tool-Dex Inc-Warren	42.4617	-83.0028	Red Run Drain	Warren
MIS110762	AMCOL CORP-Hazel Park	42.45417	-83.08333	Bear Creek	Hazel Park
MIS110771	Metaldyne-Troy	42.54722	-83.17556	Spencer Drain	Troy
MIS110781	Visteon Corp-Sterling	42.57917	-83.04917	Moore Drain	Sterling Heights
MIS110794	Hi-Tech Coatings Inc	42.4772	-82.9878	Red Run Drain	Warren
MIS110796	Everfresh/LaCroix Beverages	42.46250	-83.03583	Bear Creek	Warren
MIS110798	Hercules Welding Products	42.4664	-83.0081	Bear Creek	Warren
MIS110831	Raybestos Auto Components Co	42.62500	-83.04583	Clinton River	Sterling Heights
MIS110882	Inalfa/SSI Roof Syst-Warren	42.4633	-82.9961	Red Run Drain	Warren
MIS110888	Acco Systems-Warren	42.4636	-82.9942	Bear Creek	Warren
MIS110889	AL-Craft-Troy	42.54222	-83.09556	Spencer Drain	Troy
MIS110900	Barrett Paving Materials-Troy	42.55417	-83.15833	Spencer Drain	Troy
MIS110902	Best Block Co-Warren	42.4583	-82.9956	Red Run Drain	Warren
MIS110904	Castall Products-Troy	42.53694	-83.09306	Spencer Drain	Troy
MIS110905	DaimlerChrysler-Dodge City	42.4536	-83.0422	Bear Creek	Warren
MIS110908	Conrail-Warren	42.4597	-83.0347	Red Run Drain	Warren
MIS110909	Consolidated Rail-Sterling Hts	42.57694	-83.03889	Moore Drain	Sterling Heights
MIS110912	Fettes Mfg-Sterling Heights	42.58750	-83.05444	Moore Drain	Sterling Heights
MIS110915	Ceratizit Michigan	42.4760	-83.0087	Red Run Drain	Warren
MIS110917	Detroit Hoist & Crane	42.54556	-83.04167	Big Beaver Creek	Sterling Heights
MIS110918	E & E Engineering-Warren	42.52611	-83.03222	Red Run Drain	Warren
MIS110924	Gentz Industries-Warren	42.4850	-82.9750	Red Run Drain	Warren
MIS110925	Proto Gage Inc	42.55250	-83.03972	Gamble Drain	Sterling Heights
MIS110927	Scott Specialty Gases-Troy	42.54528	-83.13778	Spencer Drain	Troy
MIS110934	Red Industries	42.46222	-83.08750	Bear Creek	Hazel Park
MIS110937	J & N Fabrication-Warren	42.51389	-83.06667	Red Run Drain	Warren
MIS110938	Modern Broaching Serv-Warren	42.4731	-83.0019	Bear Creek	Warren
MIS110944	Warren Abrasives Inc	42.4853	-82.9750	Red Run Drain	Warren
MIS110948	Keo Cutters-Warren	42.4792	-82.9753	Red Run Drain	Warren

Table 6 Continued:

Permit #	Facility Name	Latitude	Longitude	Receiving Water	CITY
MIS110949	Mark Engineering Co	42.60833	-83.04722	Chrissman Drain	Sterling Heights
MIS110953	Punchcraft Co-Warren	42.51639	-83.06722	Red Run Drain	Warren
MIS110954	Modern Hard Chrome Service Co	42.4633	-82.9928	Red Run Drain	Warren
MIS110955	Wolverine Die Cast-Hoover Rd	42.4614	-83.0053	Red Run Drain	Warren
MIS110959	Sterling Concrete-Sterling Hgt	42.56667	-83.04583	Moore Drain	Sterling Heights
MIS110960	Shuert Industries-Sterling Hts	42.62444	-83.04583	Clinton River	Sterling Heights
MIS110964	Wyatt Services-Sterling Hts	42.58564	-83.03776	Plumbrook Drain	Sterling Heights
MIS110967	Invecast Corp-Warren	42.4611	-83.0339	Bear Creek	Warren
MIS110970	Soramatic Precision Machining	42.47639	-83.07806	Bear Creek	Warren
MIS110973	Proficient Products Inc	42.55250	-83.04361	Big Beaver Creek	Sterling Heights
MIS110978	Metro Technologies-Troy	42.56250	-83.11833	Sturgis Drain	Troy
MIS110985	Zimmerman Handling Systems	42.50833	-83.11833	Red Run Drain	Madison Heights
MIS110999	Ajax Paving-M-430	42.50000	-83.10417	various	Madison Heights
MIS111000	Ajax Paving-M-522	42.50000	-83.10417	various	Madison Heights
MIS111001	Ajax Paving-M-482	42.50000	-83.10417	various	Madison Heights
MIS111002	Ajax Paving-M-400	42.50000	-83.10417	various	Madison Heights
MIS111003	Ajax Paving-M-524	42.50000	-83.10417	various	Madison Heights
MIS111013	Grosse Tool & Machine-Warren	42.4658	-82.9894	Red Run Drain	Warren
MIS111020	Universal Trim-Madison Heights	42.48333	-83.08861	Bear Creek	Madison Heights
MIS111023	Cape Industries-Warren	42.47000	-83.04500	Bear Creek	Warren
MIS111025	Inland Diamond Products Co	42.52722	-83.09889	Red Run Drain	Madison Heights
MIS111035	Precision Mold & Engineering	42.4636	-82.9906	Bear Creek	Warren
MIS111045	Macomb Auto Salvage-Warren	42.4911	-82.9769	Bear Creek	Warren
MIS111046	Wolverine Die Cast-Nagel Ave	42.48925	-83.07404	Bear Creek	Warren
MIS111064	Flex-N-Gate Forming-Warren	42.4889	-82.9728	Red Run Drain	Warren
MIS111073	Central Gear-Madison Hgts	42.51111	-83.10944	Red Run Drain	Madison Heights
MIS111074	DHL Express-Troy	42.54500	-83.12861	Spencer Drain	Troy
MIS111085	Weldaloy Products Company	42.4706	-83.0064	Bear Creek	Warren
MIS111086	Distel Tool & Machine-Warren	42.4778	-82.9917	Red Run Drain	Warren
MIS111087	Wico Metal Products-Warren	42.4636	-83.0347	Bear Creek	Warren
MIS111088	Reska Spline Products-Warren	42.4806	-82.9758	Red Run Drain	Warren
MIS111089	Eleven Mile Truck Frame & Axle	42.49000	-83.08694	McCoy Drain	Madison Heights
MIS111099	Troy Aggregate-Sterling Hgts	42.59417	-83.04639	Plum Brook	Sterling Heights
MIS111112	Express Coat Corp-Warren	42.4969	-82.9717	Red Run Drain	Warren
MIS111113	Wico Metal Products-Ryan Rd	42.46694	-83.06472	Bear Creek	Warren
MIS111117	Commodore Cartage-Donegal Prop	42.47722	-83.04611	Bear Creek	Warren
MIS111118	Wico Metal Products-Centerline	42.4742	-83.0364	Bear Creek	Warren
MIS111121	GM-Technical Center-Warren	42.52583	-83.04500	Red Run Drain	Warren
MIS111124	Textron Fastening-Sterling Hts	42.59417	-83.04806	Plumbrook Drain	Sterling Heights

Table 6 Continued:

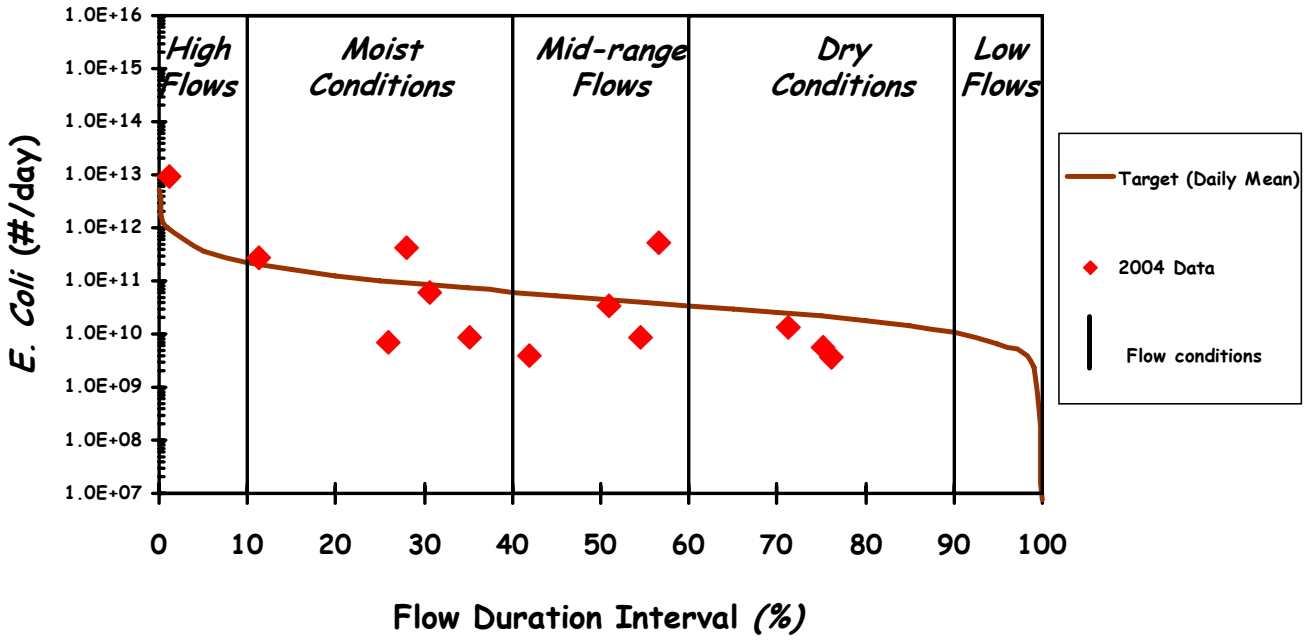
Permit #	Facility Name	Latitude	Longitude	Receiving Water	CITY
MIS111142	Ajax Metal Processing-Cold	42.4564	-83.0053	Bear Creek	Warren
MIS111153	Venture Corp-Mound Facility	42.60556	-83.05083	Chrissman Drain	Sterling Heights
MIS111157	SLC Recycling Industries Inc	42.4483	-83.0247	Bear Creek	Warren
MIS111166	AZ Automotive-Warren	42.4789	-83.0250	Red Run Drain	Warren
MIS111170	Advanced Assembly-Madison Hts	42.47611	-83.09528	Clinton River	Madison Heights
MIS111175	Tesma Sterling Heights	42.53611	-83.04361	Beaver Creek	Sterling Heights
MIS111185	Ajax Paving-M-604	42.50000	-83.10417	various	Madison Heights
MIS111186	Magna International Inc-Vehma	42.54583	-83.11250	Spencer Drain	Troy
MIS111194	Tool Dex Inc	42.47667	-83.06389	Bear Creek	Warren
MIS111206	Vehma International Amer	42.54389	-83.18556	Spencer Drain	Troy
MIS111215	J G Kern Enterprises Inc	42.61722	-83.04639	Chrissman Drain	Sterling Heights
MIS111220	Comtrex LLC-Warren	42.4708	-83.0056	Red Run Drain	Warren
MIS111224	Charter Steel Detroit	42.4694	-83.0353	Red Run Drain	Center Line
MIS111228	Hi-Tech Tool-Sterling Heights	42.55972	-83.04694	Gamble Drain	Sterling Heights
MIS111232	Midwest Gear & Tool Inc	42.4633	-83.0006	Red Run Drain	Warren
MIS111234	Machining Enterprises Inc	42.4539	-83.0050	Red Run Drain	Warren
MIS111236	AZ Automotive-Sterling Heights	42.60722	-83.04528	Chrissman Drain	Sterling Heights
MIS111245	Casadei Structural Steel Inc	42.61583	-83.04250	Clinton River	Sterling Heights
MIS111249	DE-STA-CO Industries	42.52472	-83.09583	Red Run Creek	Madison Heights
MIS111251	Radar Industries Inc-Warren	42.5032	-82.9705	Harrington Drain	Warren
MIS111253	PPI Aerospace Acquisition	42.4729	-82.9890	Red Run Drain	Warren
MIS111254	SET Enterprise Inc	42.50083	-83.02833	Bear Creek	Warren
MIS111257	Noble Metal Processing Inc	42.49707	-83.03960	Bear Creek	Warren
MIS111258	AZ Automotive-Mound Rd	42.47222	-83.04583	Bear Creek	Warren
MIS111270	AZ Automotive-Centerline	42.4683	-83.0338	Clinton River	Center Line
MIS111274	InveCast Corp-Dodge St-Warren	42.46095	-83.03795	Bear Creek	Warren
MIS111275	Yarema Die & Engineering-Troy	42.55064	-83.12475	Spencer Drain	Troy
MIS111278	HP Pelzer-Sterling Heights	42.59623	-83.04795	trib to Clinton River	Sterling Heights
MIS111302	Overhead Conveyor Co-Ferndale	42.45916	-83.12045	Red Run Drain	Ferndale
MIS111307	American MSC Inc-Troy	42.53618	-83.10457	Lake St. Clair	Troy
MIS111309	SportRack Auto-Sterling Hts	42.59986	-83.04813	Chrissman Drain	Sterling Heights
MIS111315	Yarema Die & Eng-Troy 2	42.53648	-83.09458	Henry Graham Drain	Troy
MIS111322	TransForm Auto-Sterling Hts	42.53817	-83.04021	Red Run	Sterling Heights
MIS111324	Cadillac Products Auto-Warren	42.4882	-82.9748	Red Run Drain	Warren
MIS111331	Ajax Materials Corp-Plant 7-W	42.48957	-83.04394	Bear Creek	Warren
MIS111334	MW Scott Machine Products Co	42.52611	-83.11944	Red Run Drain	Madison Heights
MIS111343	Visteon Sterling II Plt	42.60417	-83.04167	Chrissman Drain	Sterling Heights
MIS111349	SMW Automotive-Warren	42.4692	-82.9937	Red Run Drain	Warren
MIS111357	Frito-Lay-Sterling Hts	42.57106	-83.03708	Plum Brook	Sterling Heights
MIS111358	Wico Metal Prod-Sherwood Ave	42.47174	-83.04312	Red Run Drain	Warren

Table 6 Continued:

Permit #	Facility Name	Latitude	Longitude	Receiving Water	CITY
MIS111378	US Mfg Corp-Warren	42.49735	-83.03037	Clinton River	Warren
MIS111401	Vehma Int-Bellingham Road	42.54754	-83.10021	Hawthorn Drain	Troy
MIS111403	Diversified Industries	42.49076	-83.03040	Clinton River	Center Line
MIS111409	Horiba ATS	42.56125	-83.12531	Big Beaver Creek	Troy
MIS120006	Henkel Surface Technologies	42.4653	-83.0353	Bear Creek	Warren

Table 7. Types of General Permits and Permits by Rule

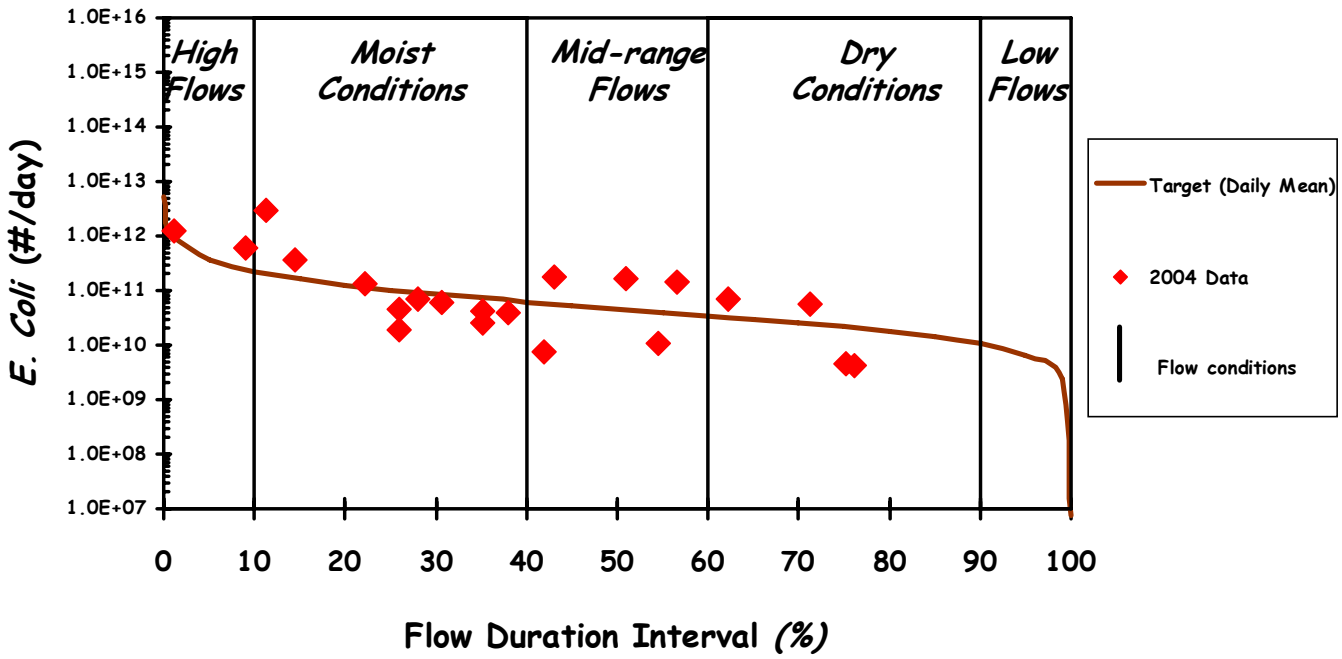
Permit Number	Description
General Permit	
MIS110000, MIS120006	Stormwater from industrial activities
MIG619000	Storm water discharges from Municipal Separate Storm Sewer Systems (MS4) subject to watershed plan requirements
MIG250000	Non-contact cooling water discharge
Permits-by-Rule	
MIR100000	Storm water discharges from construction activities



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-1. Bear Creek at Mound Road (BEA 0). Load duration curve based on daily geometric mean.

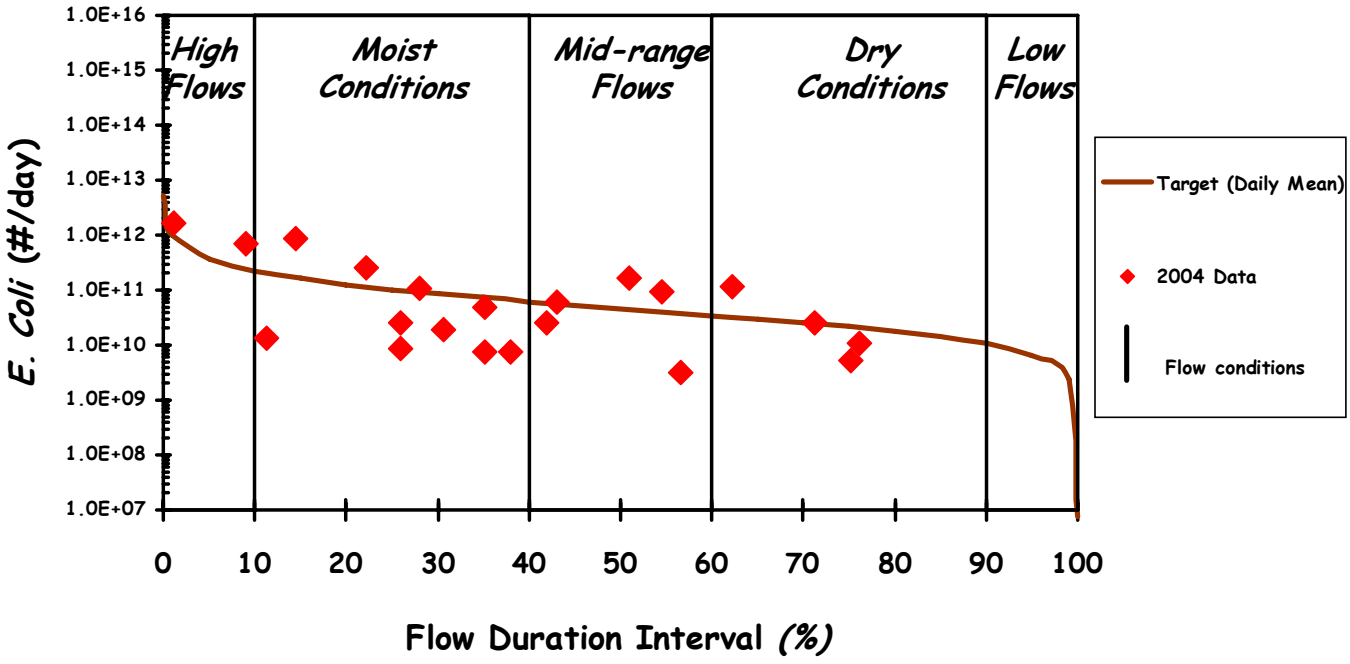
Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-2. Bear Creek at 12-Mile Road (BEA 1A). Load duration curve based on daily geometric mean.

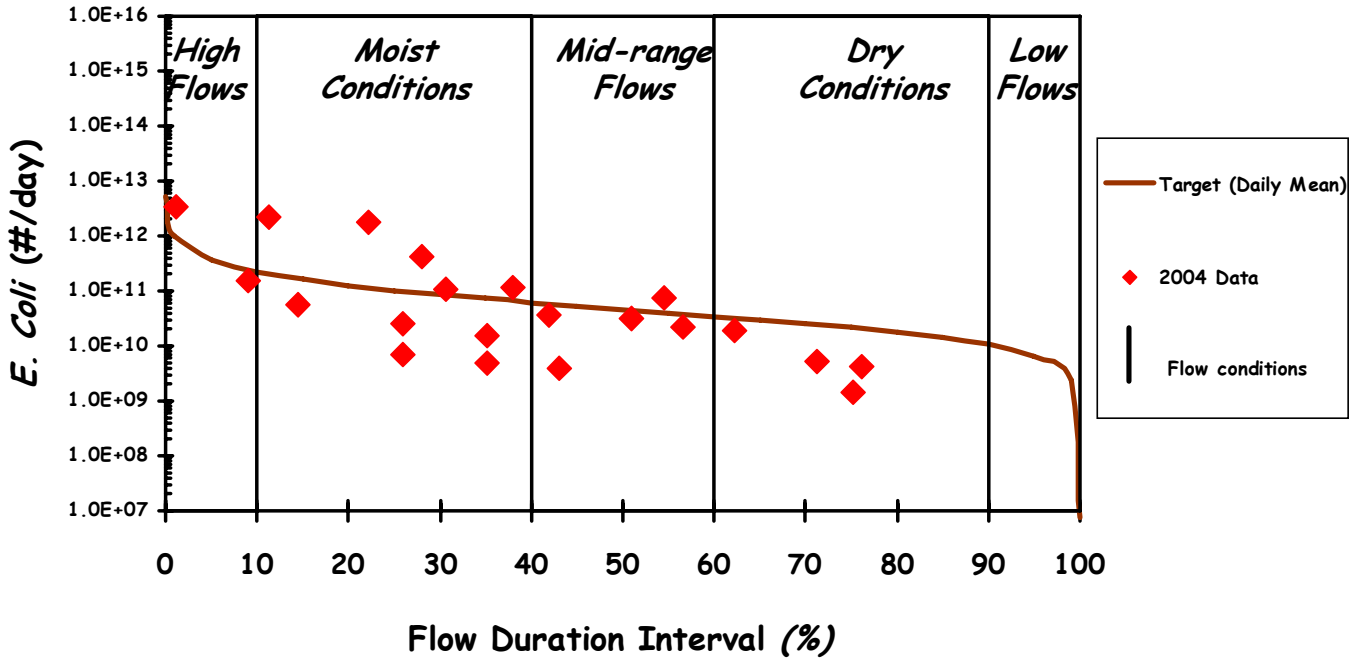
Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-3. Bear Creek at Old 13-Mile Road (BEA 2A). Load duration curve based on daily geometric mean.

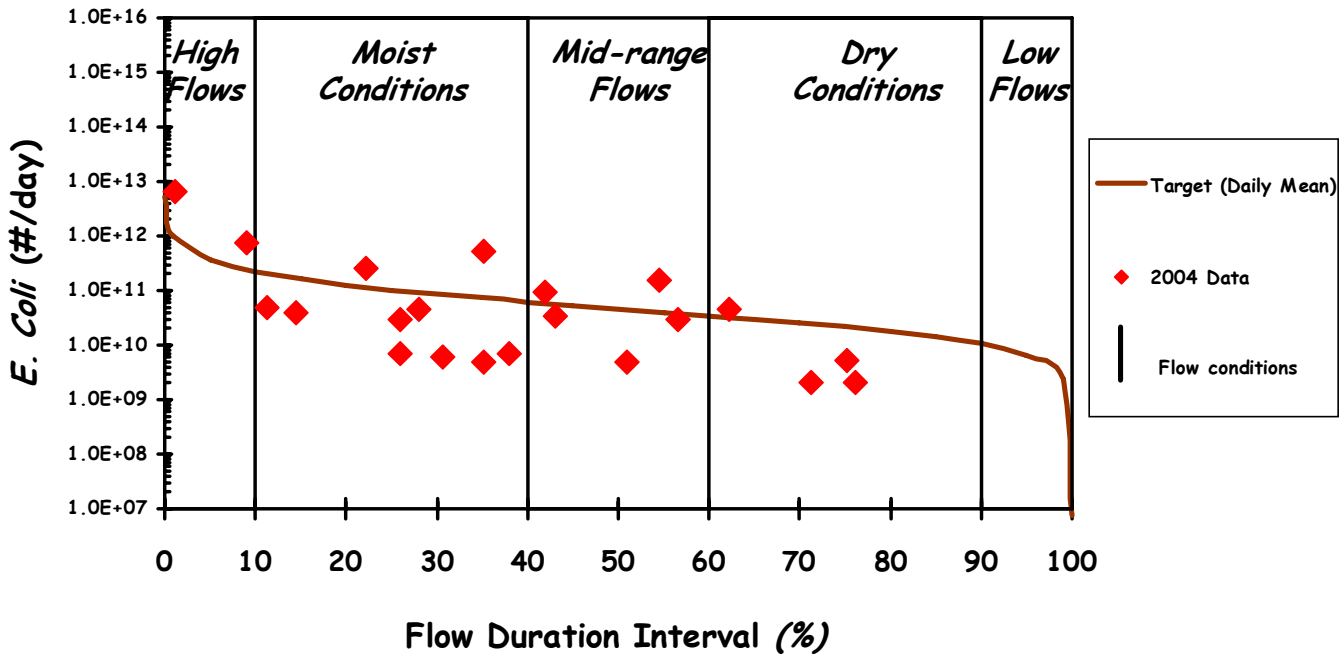
Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-4. Red Run Drain at Ryan Road (RED 1). Load duration curve based on daily geometric mean.

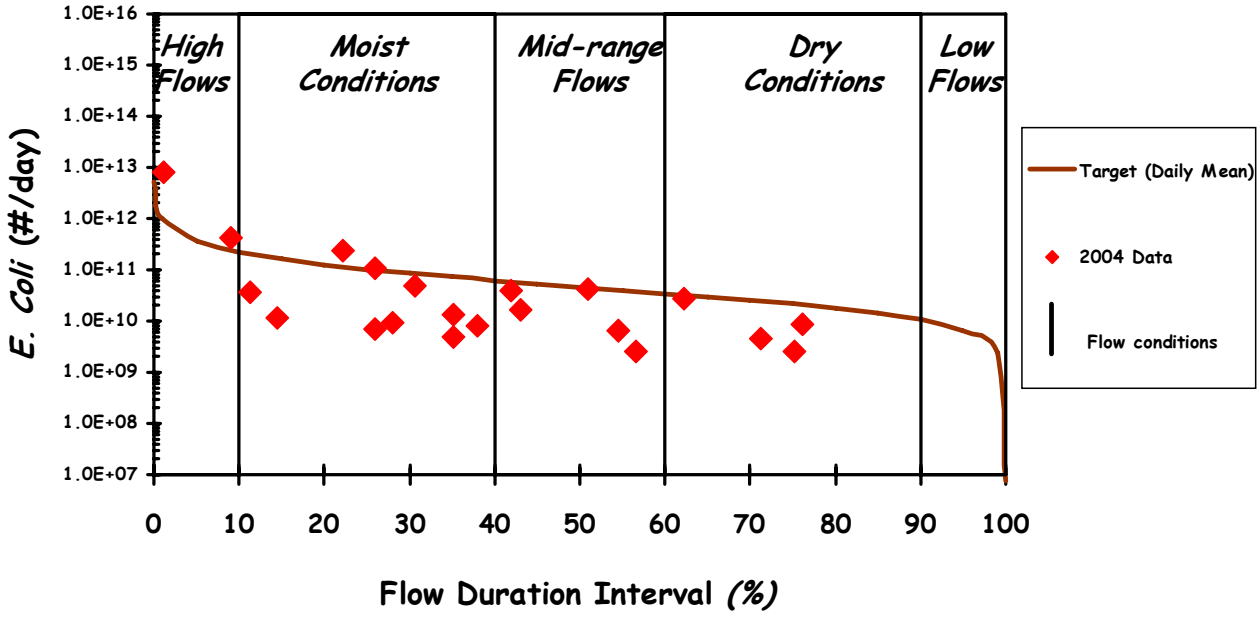
Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-5. Red Run at Van Dyke Road (RED 2). Load duration curve based on daily geometric mean.

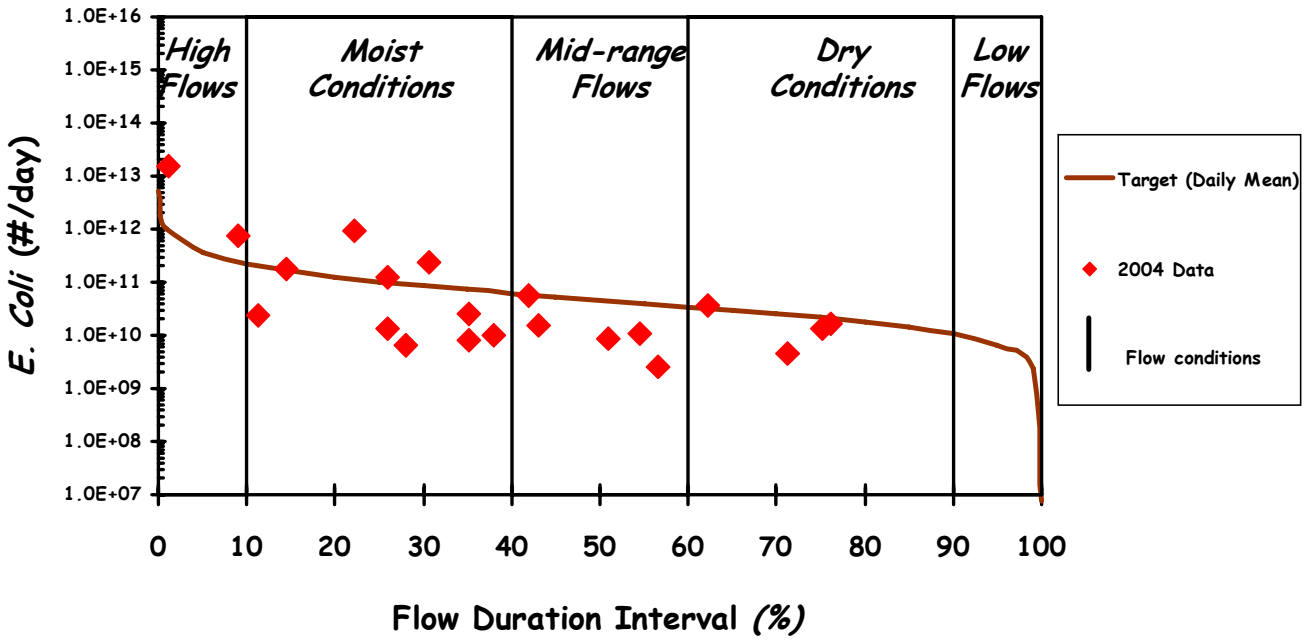
Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-6. Red Run at Maple Lane (RED 3). Load duration curve based on daily geometric mean.

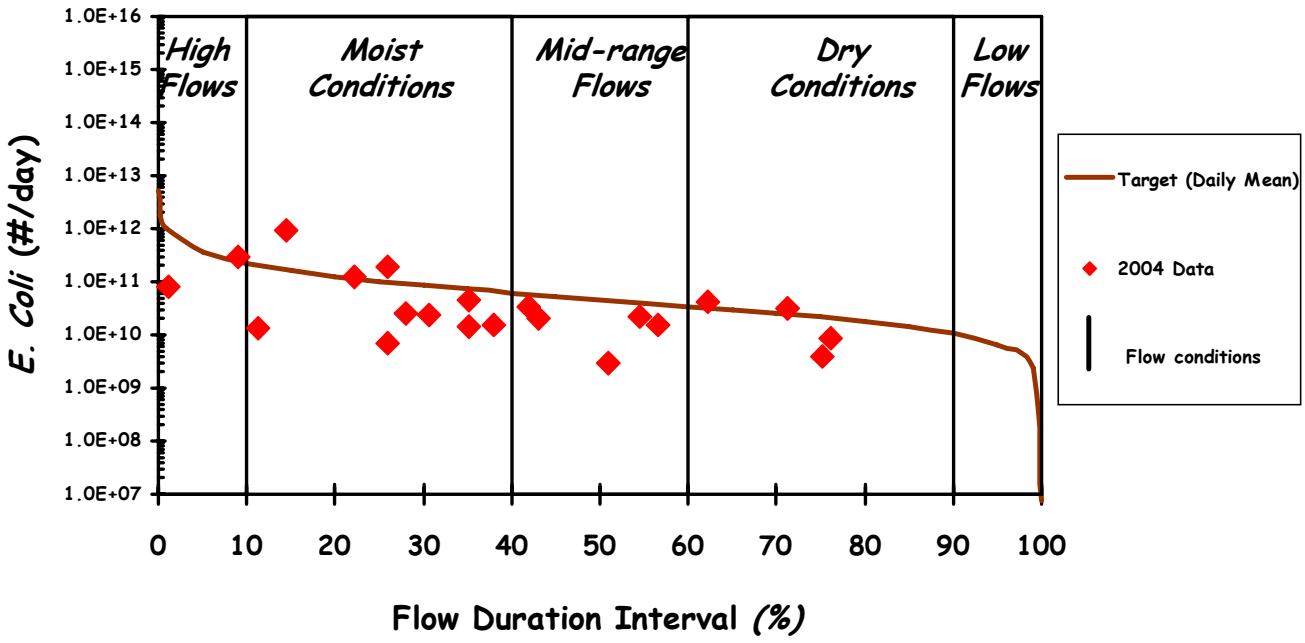
Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-7. Red Run at Schoenherr Road (RED 4). Load duration curve based on daily geometric mean.

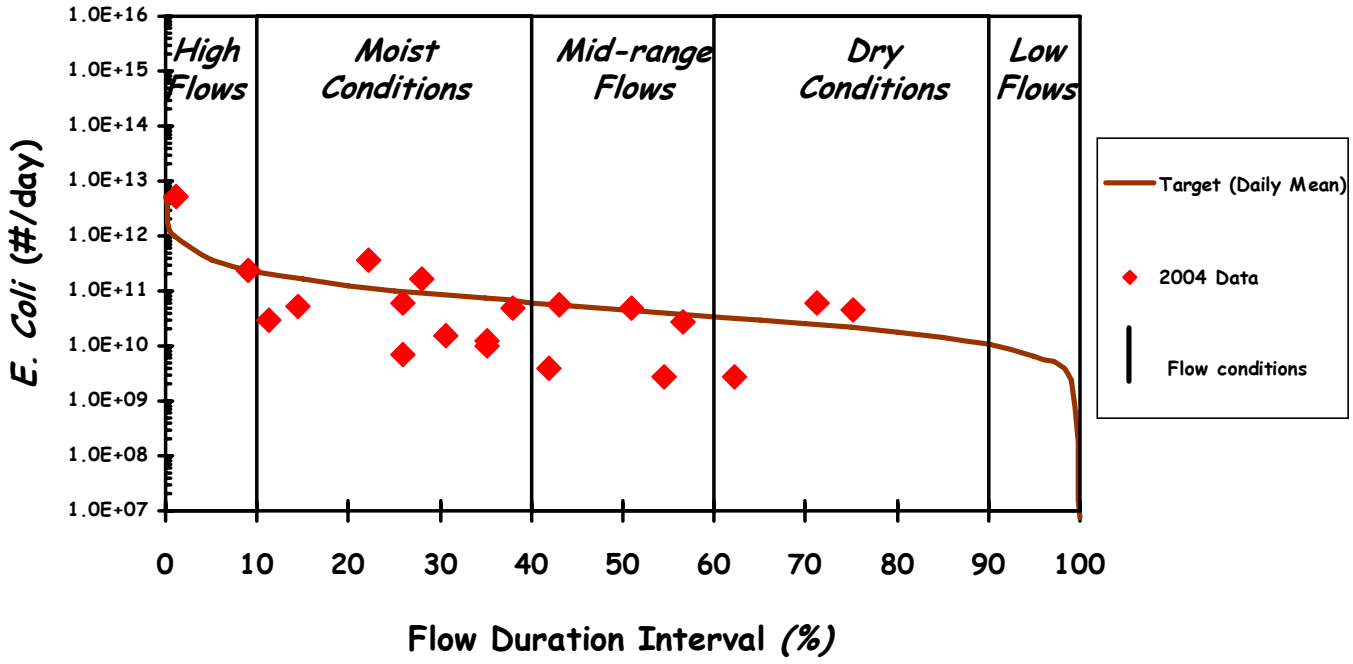
Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-8. Red Run at Utica Road (RED 5). Load duration curve based on daily geometric mean.

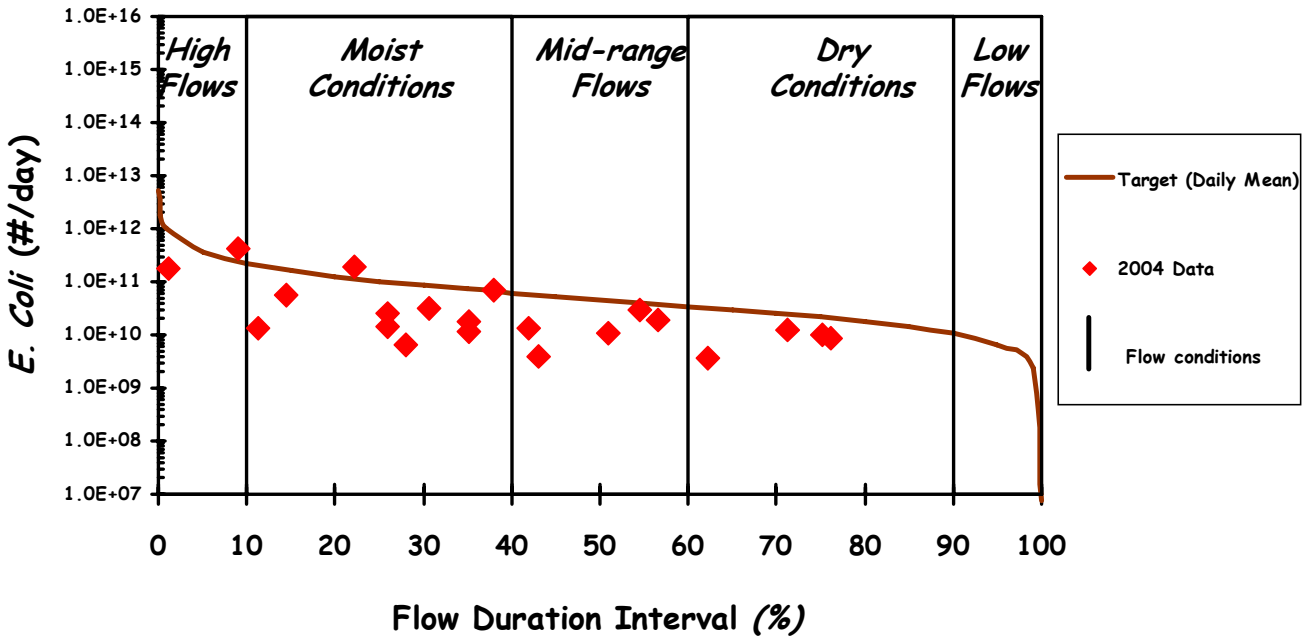
Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-9. Big Beaver Creek at Van Dyke Avenue (RED 6). Load duration curve based on daily geometric mean.

Appendix A Continued:



E. Coli Data & USGS Gage Duration Interval *16.5 square miles*

A-10. Plum Brook at Schoenherr Road (RED 7) Load duration curve based on daily geometric mean.

APPENDIX B

List of Acronyms for Red Run Drain and Bear Creek Total Maximum Daily Load for *E. coli.*

Bear Creek Clean Water Initiative	BCCWI
Best Management Practices	BMP
Certificate of Coverage	COC
Clean Michigan Initiative-Clean Water Fund	CMI-CWF
Code of Federal Regulations	CFR
Combined Sewer Overflow	CSO
Escherichia coli	*E. coli*
Load Allocation	LA
Macomb County Health Department	MCHD
Macomb County Public Works Office	MCPWO
Margin of Safety	MOS
Michigan Department of Environmental Quality	MDEQ
Michigan Department of Transportation	MDOT
Milliliters	ml
Municipal Separate Storm Sewer System	MS4
National Pollutant Discharge Elimination System	NPDES
Oakland County Drain Commissioner	OCDC
Sanitary Sewer Overflow	SSO
Storm Water Pollution Prevention Plan	SWPPP
Total Maximum Daily Load	TMDL
United States Environmental Protection Agency	USEPA
United States Geological Survey	USGS
Waste Load Allocation	WLA
Wastewater Treatment Plant	WWTP
Water Quality Standards	WQS

Michigan Department of Environmental Quality
Water Bureau
August 2007

Total Maximum Daily Load for Biota for the River Rouge Watershed, Including Bishop and Tonquish Creeks Washtenaw, Wayne, and Oakland Counties

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations [CFR], Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources.

The purpose of this TMDL is to identify the appropriate actions to achieve the biological (fish and macroinvertebrate) community targets that will result in WQS attainment, specifically through reduction in sediment loadings from sources in the Rouge River watershed, including Bishop and Tonquish Creeks, thereby addressing in-stream habitat loss and hydrologic changes. Three separate Section 303(d) listings for poor fish and macroinvertebrate communities appear in the Rouge River watershed (explained below); all three are addressed herein due to their proximity and the similarity in both their TMDL goals and the impacts on those listed reaches (Figure 1). This TMDL encompasses the entire Rouge River watershed because of the inability to separate the drainage-wide impacts of land use and storm water runoff on the specific listed reaches and to recognize the necessity of watershed-wide efforts to address water quality, habitat quality, and hydrologic modification.

PROBLEM STATEMENT

The TMDL reach for River Rouge appears on the Section 303(d) list as:

River Rouge WBID#: 061305G
(Main Br., Upper Br., Middle Br., Lower Br., Bell Br., Franklin Br., Evans Ditch)
County: Oakland/Wayne Size: 91 M
Location: River Rouge Detroit River confluence u/s to include the Main Br. River Rouge (u/s to Big Beaver Road), Upper River Rouge (u/s to Rt. 696), Middle Br. River Rouge (u/s to 8 Mile Rd.), Lower Br. (u/s to Beck Road), Bell Br. (u/s to 7 Mile Rd.), Evans Ditch (u/s to Lahser Rd.), and the Franklin Br. (u/s to Big Beaver Rd.).
NHD Reach Code: 04090004000014
Problem Summary: Fish and Macroinvertebrate Communities rated poor.
TMDL YEAR(s): 2007

The River Rouge was placed on the Section 303(d) list due to poor macroinvertebrate and fish communities throughout the watershed based on data collected in the 1980s and early 1990s. More current monitoring in 2000 found acceptable macroinvertebrate communities at all 14 sites sampled and four poor fish communities out of four sites in the TMDL reach. Monitoring in 2005 found one poor macroinvertebrate community out of 18 sites and an acceptable fish community at the only site sampled in the TMDL reach. While information from the 2000 and 2005 surveys indicate that the listed reaches are generally achieving acceptable community ratings for macroinvertebrates, the scores continue to be at the lowest end of the range for an acceptable

rating indicating the continued threatened status of the listed reaches and the need for the TMDL.

The TMDL reach for Tonquish Creek appears on the Section 303(d) list as:

Tonquish Creek WBID#: 061304H
County: Wayne Size: 10 M
Location: Middle River Rouge confluence u/s. Vicinity of Nankin Mills.
NHD Reach Code: 04090004000503
Problem Summary: Fish and Macroinvertebrate Communities rated poor.
TMDL YEAR(s): 2007

Tonquish Creek was placed on the Section 303(d) list due to poor fish and macroinvertebrate community data collected in the 1980s and early 1990s. Monitoring in 2000 found poor fish and macroinvertebrate communities at the one station surveyed. Surveys conducted in 2005 found poor macroinvertebrates at two of five stations and poor fish at two out of two stations in the TMDL reach.

The TMDL reach for Bishop Creek appears on the Section 303(d) list as:

Bishop Creek WBID#: 061304O
County: Wayne Size: 4 M
Location: Middle Br. River Rouge confluence u/s (including Ingersoll Creek).
NHD Reach Code: 04090004000071
Problem Summary: Macroinvertebrate community rated poor.
TMDL YEAR(s): 2007

Bishop Creek was placed on the Section 303(d) list due to poor macroinvertebrate communities at two sites in biological surveys conducted in 2000. Surveys conducted in 2005 found poor macroinvertebrates at two of four stations sampled in the TMDL reach. The two poor stations were uppermost in the watershed.

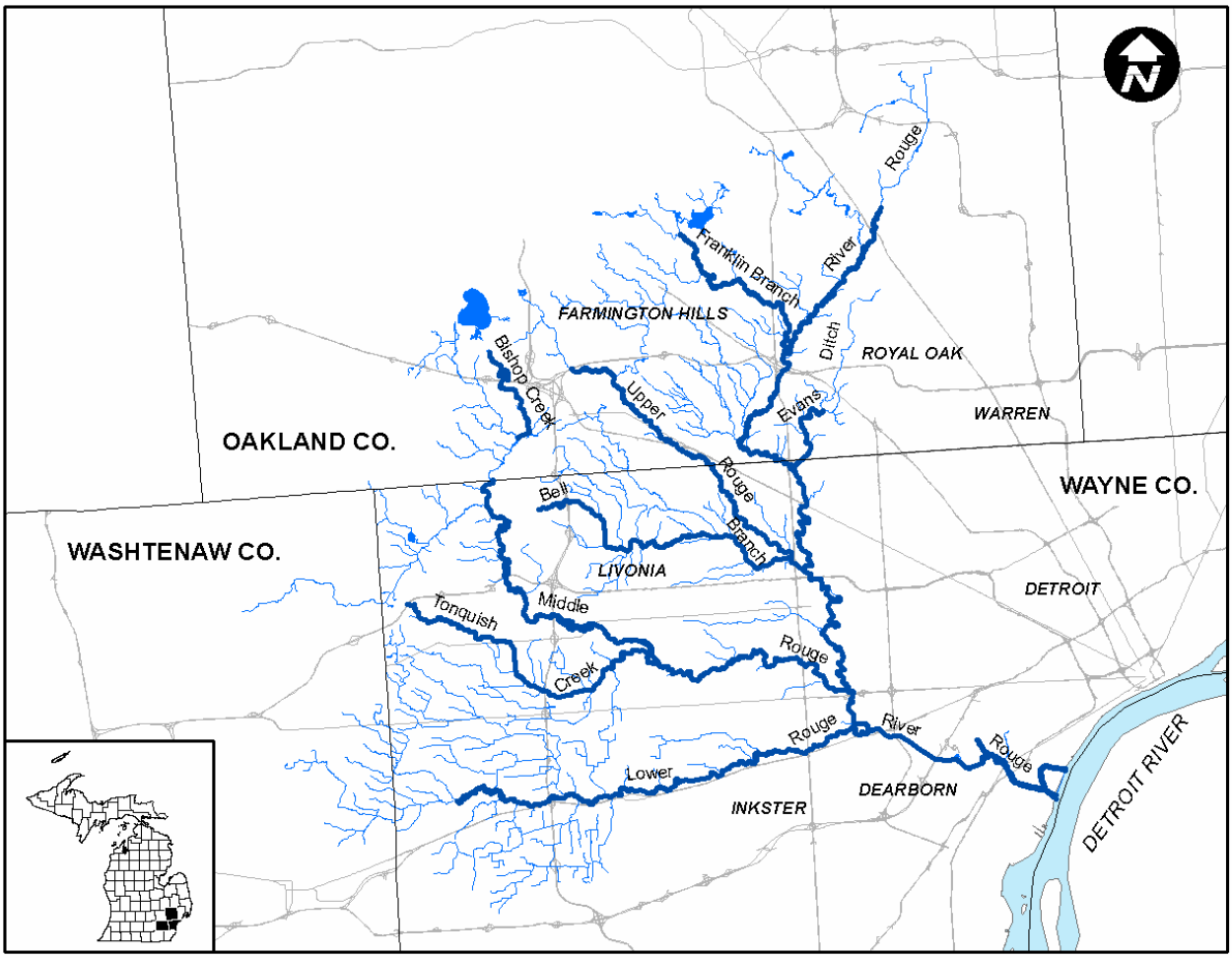


Figure 1. Rouge River Watershed 303(d) listed biota TMDL reaches (in bold).

NUMERIC TARGET

The impaired designated uses addressed by this TMDL for the Rouge River, and Bishop and Tonquish Creeks are related to the poor fish and macroinvertebrate communities found in these reaches. The designated use rule (R 323.1100 of the Part 4 rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended) requires the protection of, among other things and specific to this TMDL, the warmwater fishery and other indigenous aquatic life and wildlife (R 323.1100(1)(d) and (e)).

The primary numeric target is based on the Procedure 51 biological community assessment protocol (MDEQ, 1990). This biota TMDL target is the reestablishment of fish and macroinvertebrate communities that, when monitored, result in a consistent 'acceptable' or 'excellent' rating. Macroinvertebrate and fish communities will be evaluated based on a minimum of two Procedure 51 biological assessments conducted in successive years, following the implementation of efforts like Best Management Practices (BMPs) to stabilize runoff discharges and extremes in stream flow conditions, and minimize sediment loadings to the watershed.

A secondary numeric target based on Suspended Solids (SS) concentration will be used to assess improvements in the Rouge River watershed. This secondary target is a mean annual in-stream SS concentration of 80 milligrams per liter (mg/L) for wet weather events. Achievement of the biological target will override this secondary target; however, if the SS target is met, but the biological target not achieved, then the secondary target may be reevaluated.

The secondary numeric target is intended to help guide proper control over excessive SS loads from runoff, as well as the runoff discharge rates and volumes that affect increased stream flow instability, stream bank erosion, and increased SS 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. A report titled, *Ecological Targets for the Rehabilitation of the Rouge River*, concluded, in part, that "Significant, basin-wide reductions in storm runoff are necessary to achieve fisheries rehabilitation targets" (Wiley et al., 1998).

The mean annual target concentration of 80 mg/L SS is based on a review of existing conditions and published literature on the effects of SS to aquatic life. Vohs et al., (1993) indicated that a chemically inert SS concentration of 100 mg/L appears to separate those streams with a fish population from those without. Gammon (1970) demonstrated decreases in the standing crop of both fishes and macroinvertebrates in river reaches continuously receiving SS loadings below 40 mg/L. The European Inland Fisheries Advisory Commission stated that, in the absence of other pollution, a fishery would not be harmed at SS concentrations less than 25 mg/L (EIFAC, 1980).

Alabaster and Lloyd (1982) provided the following water quality goals for SS for the protection of fish communities:

Optimum	=	$\leq$ 25 mg/L
Good to Moderate	=	> 25 to 80 mg/L
Less than Moderate	=	> 80 to 400 mg/L
Poor	=	> 400 mg/L

Because the purpose of this TMDL is to identify possible steps to restore the biological community to an acceptable condition, thereby working toward attaining WQS, a value of 80 mg/L as a mean annual target for wet weather events was chosen for the Rouge River watershed as a secondary target.

It should be noted that it is not expected that the approximately three mile long concrete-lined portion of the Main Branch Rouge River will have the other indigenous aquatic life and warmwater fishery designated uses fully restored regardless of these numeric targets due to impacts in that reach that are nonpollutant based.

DATA DISCUSSION

Recent Rouge River watershed biological assessments have demonstrated a continued impact to the biological communities throughout the drainage. Macroinvertebrate community assessments, although generally rating at the low end of acceptable in the listed Rouge River and Bishop Creek TMDL reaches, continue to produce poor community scores in nonlisted portions of the watershed and throughout the Tonquish Creek listed TMDL reach. Twenty stations were sampled outside the TMDL reaches in 2005, six of which rated poor for macroinvertebrate communities. Fish community monitoring has continued to produce poor scores at all but a few stations during recent monitoring efforts.

Monitoring in 2000 in the Rouge River TMDL reach did not produce any poor ratings for the 14 macroinvertebrate communities assessed (Goodwin, 2002). Four stations sampled for fish communities in the same year in the TMDL reach all scored poor. Two stations sampled in the Bishop Creek TMDL reach for macroinvertebrates both scored poor and no fish monitoring was conducted in this reach. Similarly, one station was sampled in the Tonquish Creek TMDL reach in 2000, rating poor for both macroinvertebrate and fish communities. Twenty-five stations were

sampled outside the TMDL reaches in 2000, all of which rated acceptable for macroinvertebrate communities; one also included fish sampling, which was rated poor.

Habitat assessments conducted in 2000 concurrent with the macroinvertebrate and fish communities noted that there were ubiquitous issues in the Rouge River watershed with flashy stream flows and resultant poor in-stream habitat, including increased siltation leading to homogenization of the stream substrate (Goodwin, 2002).

Monitoring in 2005 in the Rouge River TMDL reach found one of 18 stations rating poor for the macroinvertebrate community (Goodwin [in draft], 2007). One station was sampled for fish community, rating acceptable. Four stations were sampled in the Bishop Creek TMDL reach, the two uppermost rating poor for the macroinvertebrate communities with the other two rating acceptable. Five stations were sampled in the Tonquish Creek TMDL reach in 2005, two of which rated poor for macroinvertebrates. The two stations sampled for fish community on Tonquish Creek also rated poor in 2005 (Goodwin [in draft], 2007).

Habitat surveys conducted in 2005 concurrent with the macroinvertebrate and fish monitoring also reflected a widespread lack of in-stream habitat able to be colonized by biota. Siltation/sedimentation and indications of flashy stream flows were also predominant in the watershed.

Data from the Friends of the Rouge (FOTR) volunteer stream monitoring program's spring and fall data from 2001 through 2005 showed twice the number of poor ratings in listed TMDL reaches compared to the rest of the watershed (22 cumulative historic poor ratings in the TMDL reaches versus 12 outside the listed reaches) even though the same time period had a total of approximately 80 cumulative samples within the listed TMDL reaches and 125 cumulative samples outside the TMDL reaches (FOTR, 2005). Similarly, the same data set showed 11 good ratings in the listed TMDL reaches versus 51 outside those reaches. Notably, the FOTR monitoring found consistent poor macroinvertebrate communities over the five years of monitoring at two of three locations on Tonquish Creek (within the listed TMDL reach), and consistent fair/poor communities in the TMDL listed portions of the Lower Branch, Main Branch, and the Upper Branch Rouge River.

Fish community data collected in 1995 during the Department of Natural Resource (DNR), Fisheries Division's Rouge River Assessment (Assessment) was analyzed using the current Procedure 51 scoring criteria to provide additional fisheries information. Of the 13 stations in the TMDL reaches for which data was provided in the Assessment (Beam and Braunsheidel, 1998), 11 rated poor, and 2 rated acceptable. The DNR conducted an additional analysis of the assessment data using the Index of Biotic Integrity (Karr, 1981) producing similar results to the Procedure 51 scoring/rating criteria; all TMDL reach sites rated either fair (3) or in the poor range (10) using the Index of Biotic Integrity (Leonardi, 1996).

The Assessment provided discussion surrounding the fish communities in the watershed and placed a great deal of focus on the highly altered hydrology and its impacts on the fish community in the watershed. Additionally, the Assessment noted the lack of connectivity in the Rouge River watershed with respect to fish movement, migration, and recolonization potential that has been lost due to the many dams throughout the watershed (Beam and Braunsheidel, 1998).

Background SS data for the Rouge River watershed came from the Rouge River National Wet Weather Demonstration Project (Rouge Project) (Rouge Project, 2006). Watershed-wide data from 1994 to 2001 was taken under both wet and dry weather flow conditions. Average SS concentrations were calculated under both wet and dry conditions for each branch of the Rouge River watershed and for the entire watershed collectively (Table 1). Wet weather data was taken for events that followed a dry period (generally three days minimum) and following a

precipitation event that caused the river to respond significantly (generally greater than 0.25 inches) (Hufnagel, 1996).

Table 1. Average SS concentrations in the Rouge River watershed in mg/L SS (Rouge Project, 2006)

Branch	Wet Weather Average SS	Dry Weather Average SS
Upper Rouge	152	30
Middle Rouge	95	19
Lower Rouge	191	37
Main Branch Rouge	114	27
Entire Watershed	138	28

SOURCE ASSESSMENT

The listed reaches for the Rouge River total approximately 106 miles and include the Main, Upper, Middle, Lower, Bell, and Franklin Branches and Evans Ditch (91 miles collectively); Bishop Creek (4 miles), and Tonquish Creek (10 miles), in Wayne and Oakland Counties in southeastern Michigan. The municipalities in the TMDL watershed are divided into Storm Water Management Areas (SWMAs) by the local units of government, as shown in Figure 2. Table 2 shows the land use distribution for the Rouge River watershed by SWMA (Southeast Michigan Council of Governments, 2003). Table 3 shows the land distribution for the Rouge River watershed by community. The entirety of the Rouge River watershed is addressed in this TMDL with the recognition that the listed TMDL reaches are impacted by land use and storm water within, and upstream, from them.

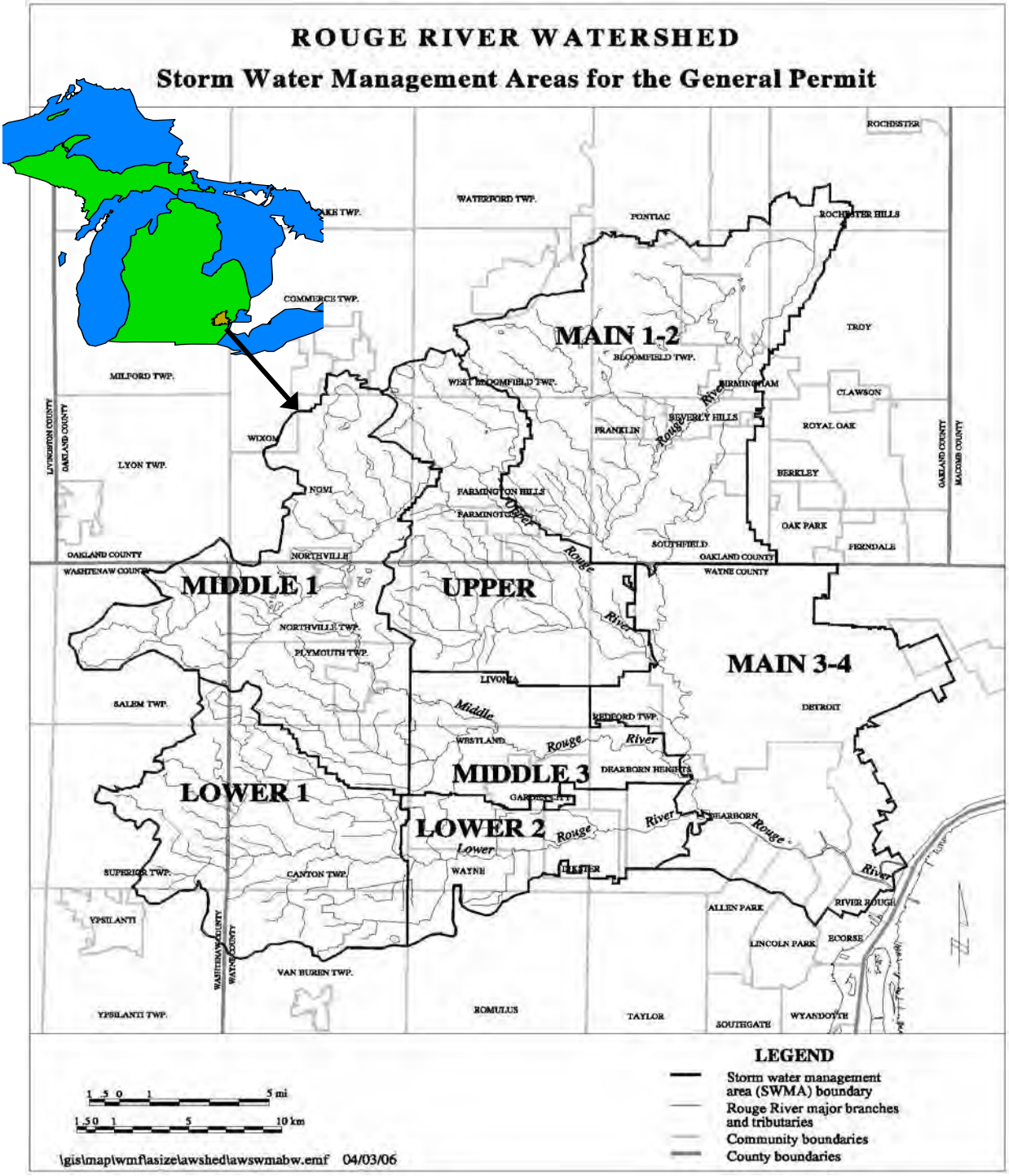


Figure 2. Rouge River Watershed SWMAs.

Table 2. Land Use Distribution for Rouge River Watershed by SWMA, 2000

Land Use Category	Storm Water Management Areas (SWMA) as Percentages of Total Drainage Area							
	MAIN 1-2 103 square miles	MAIN 3-4 91 square miles	UPPER 64 square miles	MIDDLE 1 81 square miles	MIDDLE 3 32 square miles	LOWER 1 62 square miles	LOWER 2 33 square miles	TOTAL 466 square miles
Forest/Rural open	5.8%	2.1%	8.5%	19.9%	4.0%	19.5%	4.5%	9.5%
Urban open	5.4%	6.8%	7.3%	5.5%	5.7%	5.5%	6.1%	6.0%
Agricultural	0.2%	0.0%	0.4%	9.4%	0.1%	25.2%	2.2%	5.2%
Medium density residetial	63.4%	52.1%	53.9%	31.8%	50.4%	22.6%	51.7%	47.2%
High density residential	5.2%	4.3%	5.2%	4.1%	4.8%	1.4%	2.7%	4.1%
Commercial	11.5%	15.6%	13.8%	7.1%	14.1%	2.5%	12.7%	10.9%
Industrial	1.5%	13.8%	4.2%	8.9%	12.1%	9.4%	8.6%	7.8%
Highways	2.0%	4.0%	2.6%	2.9%	0.7%	1.8%	1.2%	2.5%
Water/wetlands	4.9%	1.4%	4.2%	10.4%	8.0%	12.1%	10.3%	6.6%
TOTALS (%)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3. Land Distribution for Rouge River Watershed by Community

Community	Area (acres)	Land Distribution (Percent)	Community	Area (acres)	Land Distribution (Percent)
Allen Park	892	0.30%	Northville	1,298	0.43%
Auburn Hills	191	0.06%	Northville Twp.	10,603	3.55%
Beverly Hills	2,382	0.80%	Novi	15,231	5.10%
Bingham Farms	783	0.26%	Oak Park	82	0.03%
Birmingham	1,978	0.66%	Orchard Lake	159	0.05%
Bloomfield Hills	3,219	1.08%	Plymouth	1,410	0.47%
Bloomfield Twp.	16,303	5.46%	Plymouth Twp.	10,251	3.44%
Canton Twp.	23,123	7.75%	Pontiac	450	0.15%
Commerce Twp.	606	0.20%	Redford Twp.	7,215	2.42%
Dearborn	15,659	5.25%	River Rouge	1,370	0.46%
Dearborn Heights	5,301	1.78%	Rochester Hills	1,977	0.66%
Detroit	38,779	12.99%	Romulus	2,458	0.82%
Ecorse	5	0.00%	Salem Twp.	10,339	3.46%
Farmington	1,706	0.57%	Southfield	14,982	5.02%
Farmington Hills	21,311	7.14%	Superior Twp.	10,371	3.48%
Franklin	1,680	0.56%	Troy	3,835	1.29%
Garden City	3,752	1.26%	Van Buren Twp.	8,421	2.82%
Highland Park	902	0.30%	Walled Lake	585	0.20%
Inkster	3,696	1.24%	Wayne	3,829	1.28%
Lathrup Village	963	0.32%	West Bloomfield Twp.	11,081	3.71%
Livonia	22,952	7.69%	Westland	12,457	4.17%
Lyon Twp.	468	0.16%	Wixom	548	0.18%
Melvindale	1,726	0.58%	Ypsilanti Twp.	1,097	0.37%

These TMDL reaches are focused in Wayne and Oakland Counties, which are largely urbanized. Possible sources of SS include storm water runoff, natural background conditions (this is primarily a lake plain system flowing through sedimentary, fine particled soils), and in-stream sources (erosion) exacerbated by significantly increased flashiness.

The Michigan Department of Environmental Quality (MDEQ), Water Bureau's National Pollutant Discharge Elimination System (NPDES) permit management system found the following permitted discharges in the Rouge River watershed (Appendix A): 13 individual industrial permits, 6 individual municipal permits, 12 individual combined sewer overflow (CSO) permits, 10 gas/petroleum cleanup wastewater certificates of coverage (COC) under general permit MIG080000, 2 hydrostatic pressure test water COCs under general permit MIG670000, 5 noncontact cooling water COCs under general permit MIG250000, 221 industrial storm water COCs under general permits MIS210000, MIS220000 and MIS319000, 2 municipal storm water COCs under general permit MIS710000, 68 Municipal Separate Storm Sewer System Phase II (MS4) COCs under the MS4 general permit (numbers MIG610000 and MIS04000), and 1 individual MS4 permit (Michigan Department of Transportation) (NMS, 2007).

Additionally, at the time of this TMDL preparation there were approximately 1217 active or pending notices of coverage (NOC) under Permit-by-Rule issued by the MDEQ in the Rouge River watershed. Construction activities of five acres or more, with a point source discharge to

surface waters of the state are required to obtain a Soil Erosion and Sedimentation Control (SESC) Permit and submit an NOC for coverage under the Permit-by-Rule. However, submittal of the NOC is not required for regulated construction activities that disturb one to five acres. These sites have automatic coverage under Permit-by-Rule if they have obtained coverage under the SESC Program. The SS loads from these NOCs are assumed to be accounted for in the land use-based load calculations addressed below (see Table 4 and Appendix B for additional information).

Estimation of the annual SS loads in the Rouge River watershed from the various land use categories involved using the estimated acreage of each land use category (Southeast Michigan Council of Governments, 2003), a mean annual rainfall estimate of 33 inches, and the USEPA's Simple Method model approach (USEPA, 2001). Simple Method is an empirical approach for estimating pollutant loadings, using the following equation:

$$L_P = \Sigma_u(P*P_J*R_{VU}*C_U*A_U*2.7/12)$$

Where:

L_P = Pollutant load, lbs.
u = Land use type
P = Precipitation, inches/year
P_J = Ratio of storms producing runoff (default = 0.9)
R_{VU} = Runoff Coefficient for land use type u, $inches_{run}/inches_{rain}$, = 0.05 + (0.9 *$I_U$)
I_U = Percent Imperviousness
C_U = Event Mean Concentration for land use type u, mg/L
A_U = Area of land use type u, acres

Suspended Solids event mean concentrations for each land use category were developed for the Rouge River watershed (Cave et al., 1994). The pollutant load for each land use type was divided by 365 days to obtain a pollutant load per day. This same process was used to determine the target SS loading by appling the 80 mg/L target to those land use categories with Event Mean Concentrations over 80 mg/L (Appendix B).

The estimated total current annual SS load from all sources in the Rouge River watershed is 69,701,172 pounds (Table 4). The annual load represents a summation of NPDES-permitted point source and storm water SS loads (67,611,967 pounds) and the nonpoint source land use category (2,089,205 pounds) (Table 4). The use of annual load estimates for SS helps to identify the most probable sources and their relative contribution to the SS loads to the Rouge River watershed and allows for understanding changes between existing and targeted loading when the recommended annual average 80 mg/L SS target is applied.

Table 4. Land use categories and estimated current SS loads (pounds/year) and target SS load reductions in the Rouge River watershed, Washtenaw, Wayne, and Oakland Counties, Michigan.

Source Category	Acres	Current SS Estimate lb/yr (lb/day)	Target SS Load* lb/yr (lb/day)
WLA Components			
NPDES Non-storm water load **	NA	6,621,299	6,621,299
Urban/Industrial/Built-up Land (covered under multiple storm water permits)			
Residential (Medium Density)	140,769	25,924,906	25,924,906
Residential (High Density)	12,228	4,052,015	3,341,868 (17.5% reduction)
Transportation (MDOT)	7,456	3,718,448	2,109,758 (43.3% reduction)
Commercial	32,508	9,307,152	9,307,152
Urban Open	17,894	912,620	912,620
Industrial	23,263	17,075,527	9,168,068 (46.3% reduction)
WLA Total	**234,118**	**67,611,967 (185,238 lb/d)**	**57,385,671 (15% reduction) (157,221 lb/d)**
LA Components			
Agricultural Land	15,508	1,026,263	566,214 (44.8% reduction)
Forested/Rural Open Land	28,333	659,474	659,474
Water/Wetlands	19,684	403,467	403,467
LA Total	**63,525**	**2,089,205 (5,724 lb/d)**	**1,629,155 (22% reduction) (4,463 lb/d)**
Overall Total	**297,643**	**69,701,172 (190,962 lb/d)**	**59,014,827 (15.3% reduction) (161,684 lb/d)**

*The basis for proposed reductions is discussed in the Loading Capacity Development - WLAs section, Page 14. See Appendix B for more detailed information.
**See Appendix A for NPDES non-storm water permits from which the load was derived.

LINKAGE ANALYSIS

The stream flow conditions throughout much of the Rouge River watershed are highly variable. Altered hydrology has long been identified as the basis in the Rouge River watershed for channel scouring, siltation, and degraded in-stream habitat. Oemke and Stroh (1993) provided a synopsis of earlier MDEQ water quality studies in the watershed, all pointing toward a combination of highly variable flows and poor storm water quality (based largely on CSO discharges) that was leading to the poor biological communities throughout the watershed. More recent studies conducted in 2000 and 2005 resulted in habitat information suggesting that stream flashiness and extreme flows result in a loss of in-stream habitat from siltation, scouring, and bank erosion thereby homogenizing and greatly reducing colonizeable habitat for fish and macroinvertebrates (Goodwin, 2002; Goodwin [in draft], 2007).

Ecological targets investigated by Wiley et al. (1998) focus the rehabilitation of fish communities in the Rouge River watershed around issues largely related to flow and connectivity. Amelioration of the low base flows and elevated storm flows that are a result of urbanization are estimated to be necessary for fisheries rehabilitation in the watershed (Wiley et al., 1998).

An analysis of the flashiness of streams around Michigan using the recently developed Richards-Baker Flashiness Index (RB-index) (Baker et al., 2004) resulted in the estimation that 5 of 6 stations for which data were available in the Rouge River watershed showed increasing stream flashiness over the period of record of 40 to 70 years (Fongers et al., [*in draft*], 2007). The Rouge River stations were almost all in the highest quartile of the flashiness index for

Michigan Rivers, similar to many other lake plain drainages analyzed in the state (Fongers et al. [*in draft*], 2007), illustrating the expression of the common geology and often similar land use patterns associated within these areas. The RB-index provides a useful tool for tracking stream flashiness over time with no additional data collection, provided that river gauges are maintained.

The Assessment (Beam and Braunsheidel, 1998) notes the importance of the headwater areas of the watershed in the persistence and protection of fish communities. Relative to the rest of the watershed, these areas continue to exhibit more stable flow regimes and have undergone a lesser degree of degradation from human development and therefore retain a semblance of the original conditions in the Rouge River.

Many portions of the main branches of the Rouge River have been protected by park land and other green space. The maintenance of good riparian protection, thereby continuing to provide shading, connections to the floodplain for attenuation of high flows, and large woody debris supply is an important aspect to the continued and increasing protection of the Rouge River watershed. Projects involving impacts to the riparian corridor and stream channel should be mindful of the impacts on the biota and efforts should be taken to maintain the protection of the riparian corridor and enhance in-stream cover for the rehabilitation and maintenance of fish and macroinvertebrate communities.

The Assessment noted a lack of cover for fish and invertebrates during normal stream flows due to frequent and increased flood flows (Beam and Braunsheidel, 1998). This view is echoed by Leonardi (1996) following his assessment of the fish community in the Rouge River citing the greatly impacted flow regime and its erosive effects including “reduced bank stability, U-shaped channelization, increased sedimentation, and high turbidity” as influential in biological degradation in the Rouge River.

Habitat surveys conducted by the MDEQ as part of the assessments in the Rouge River watershed consistently point to diminished in-stream habitat as a ubiquitous feature of the drainage except in some remaining, less impacted, headwater areas (e.g., Johnson Creek) (Goodwin, 2002). The immediate riparian protection throughout much of the watershed is in reasonably good shape thereby continuing to provide functions like shading, woody debris (critical for fish and macroinvertebrate habitat in many systems), organic material input such as leaves (thus forming a base for the macroinvertebrate food web), and some level of streambank protection against the highly erosive flashy storm flows. This relatively intact riparian corridor was noted by Wiley et al., (1998) as one of the key aspects of the watershed that needed to be maintained for thermal protection of the Rouge River for fish communities.

The SS data from the Rouge Project (see Data Discussion section) demonstrate that the majority of loading occurs during wet weather events. Besides the physical scouring force of storm flows, the SS impacts the fish and macroinvertebrate communities in a myriad of ways, from physical abrasion to elimination of feeding and spawning habitats. For a complete summary of the many ways that SS may impact aquatic communities see Waters (1995). In summary, reducing SS loads in the Rouge River watershed, along with the commensurate decrease in flow volume and rate, should increase macroinvertebrate and fish community diversity and abundance, thus providing a tangible target towards meeting WQS.

LOADING CAPACITY (LC) DEVELOPMENT

Concurrent with the selection of numeric targets, development of the LC requires identification of the critical conditions. The “critical condition” is the set of environmental conditions (e.g., flow) used in developing the TMDL that result in attaining WQS and with an acceptably low frequency of occurrence that, if protected for, should also be protective of other more frequent occurrences. The critical conditions for the applicability of WQS in Michigan are given in

Rule 90 (R 323.1090), Applicability of WQS. R 323.1090 requires that the WQS apply at all flows equal to or exceeding the water body design flow, generally the lowest of the 12 monthly 95 percent exceedance flows (the stream flow equal to or exceeded 95 percent of the time), thus the critical condition for biological communities is under low flows. However, the habitat degradation and poor biological communities in the Rouge River watershed are linked to the excessive flows attributable to wet weather driven discharges. Because the numeric target of 80 mg/L SS is aimed at wet weather discharge conditions, and because elevated SS concentrations are most typically associated with wet weather flows in the Rouge River watershed, the critical condition for the SS target is wet weather/high flows; it is expected that this target concentration will be met under lower flow conditions as well.

LC

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

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

The LC represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall LC is subsequently allocated into WLAs for point sources, LAs for nonpoint sources, and the MOS. The proposed total annual SS load capacity in the Rouge River watershed (WLA + LA + MOS) is 59,014,827 pounds/year.

WLAs

The estimated total annual SS load from the seasonal, non-storm water NPDES permitted point sources is 6,621,299 pounds (Tables 4 and 5). This load was estimated by multiplying the facility design flows by the monthly average SS concentration effluent limits or by using the monthly average loading limit as defined in the permits associated with the facilities, then summing daily loads over a year. For facilities without SS data or limits, a maximum monthly average discharge concentration of 30 mg/L was assumed to be worst-case-scenario, based on the limits imposed on other Rouge River watershed facilities (Table 5).

Based on the acres of land use categories and SS loading factors derived from the Rouge Project (Cave et al., 1994), a current total loads estimate of approximately 60,990,668 pounds/year is attributable to NPDES permitted storm water discharges to the Rouge River watershed (Appendix B). Approximately half of the categories listed are predicted to be meeting the 80 mg/L target, with the exception of the industrial, transportation, and high density residential land uses. To achieve the goal of 80 mg/L as an annual average during wet weather runoff events from all point sources, a reduction of 17.5 percent (710,147 pounds/year) from high density residential, 43.3 percent (1,608,690 pounds/year) from transportation, and a 46.3 percent reduction (7,907,459 pounds/year) from industrial sources will result in a projected annual WLA target load of 57,385,671 pounds of SS, a 15 percent reduction in loads from regulated point sources (Table 4 and Appendix B).

Table 5. Detailed NPDES non-storm water SS load estimations.

Name	Permit	Daily Load (Lbs./day)	Annual Load (Lbs./year)
YCUA Regional WWTP	MI0042676	767.3	280057
Carmeuse Lime-River Rouge	MI0057126	117.6	42922
Dearborn CSO Const Dewatering	MI0057738	36.0	13151
Dearborn CSO Const Dewater 2	MI0057886	36.0	13151
Triton Petroleum-Detroit	MI0058068	1.1	411
Buckeye Terminals-Detroit	MIG670079	525.4	191778
BP Products NA Inc-River Rouge	MIG670081	250.2	91323
Oakland Co Walled Lk/Novi WWTP	MI0024287	712.6	260100
Onyx Arbor Hills LF	MI0045713	21.6	7901
Salem Twp WWTP	MI0054798	14.5	5286
Commerce Twp WWTP	MI0025071	1400.0	511000
St Marys Cement Co	MI0004243	62.3	22746.5
Severstal North America Inc	MI0043524	9223.6	3366614
Double Eagle Steel Coating Co	MI0044415	418.5	152753
Dearborn Ind Generation Plt	MI0056235	280.0	102200
Ford-Wayne Assembly Plt	MI0046183	0.3	91
Steel Technologies Inc	MIG250070	55.0	20091
Buckeye Pipeline-Plymouth	MIG080782	5.0	1826
Falcon Center GWCU	MIG081027	6.8	2466
Diversified Fuels-Northville	MIG081077	12.6	4603
Detroit Diesel Corp	MIG250058	35.8	13059
Rock Tool & Machine-Plymouth	MIG250484	9.0	3288
Diversified Fuels - Livonia	MIG081086	12.6	4603
Robert Bosch Corp	MIG250066	450.4	164381
Norfolk Southern RR-Detroit	MIG081017	31.3	11415
Sunoco-River Rouge Term	MIG081067	3.6	1315
Michigan Fuels Inc	MIG081075	23.5	8584
Ford-Rouge Mfg Complex	MIG250460	3377.7	1232861
BP Products NA Inc-River Rouge	MIG080778	250.2	91323
	TOTAL	18,141	6,621,299

LAs

The LA component of the TMDL defines the fraction of the LC for SS from nonpoint sources including the following land use categories: agricultural, forested/rural open land, and water (Table 4). An estimated annual SS load of 2,089,205 pounds is attributed to these categories in the Rouge River watershed. All but the agricultural land uses are treated as background loading sources because the modeled runoff concentrations of SS are typically less than the 80 mg/L numeric target. The only targeted source load reduction is from the agricultural land use, which has an estimated average runoff SS concentration of 145 mg/L (Cave et al., 1994; Appendix B). A 45 percent annual reduction (from 1,026,263 to 566,214 pounds) from agricultural areas in the watershed is recommended resulting in an LA SS target of 1,629,155 pounds based on achieving a mean annual runoff concentration of 80 mg/L SS during wet weather events.

MOS

The MOS in a TMDL is used, in part, to account for variability in source inputs to the system and is either implicit or explicit. A MOS is implicit in a biota TMDL because the quality of the biological community, its integrity, and overall composition represent an integration of the effects of spatial and temporal variability in sediment loads to the aquatic environment. Ultimately it is the reflection by the biological community, signified by an acceptable or higher rating using Procedure 51, which is the goal of this TMDL thereby providing a MOS for the numeric SS goal. Follow-up biological and habitat quality assessments will be conducted to determine the

progress in attaining the TMDL goals and will reflect this integration. Additionally, the goal of 80 mg/L SS for a mean annual runoff concentration integrates a MOS because it is based on literature values from longer-term exposure concentrations versus the event-driven target used herein.

In summary, the proposed total annual SS load target in the Rouge River watershed (WLA + LA + MOS) is 59,014,827 pounds/year, an overall 15.3 percent reduction from existing estimated loads. The sources of SS to the Rouge River watershed include 11.2 percent (6,621,299 pounds/year) allocated to individual and general non-storm water NPDES permitted sources (WLA), 86 percent (50,764,373 pounds/year) allocated to the NPDES permitted storm water sources (WLA), and 2.8 percent (1,629,155 pounds/year) is attributed to the LA.

To achieve the secondary numeric TMDL target of 80 mg/L mean annual SS concentration during wet weather events, and thereby address the primary target of biological communities increasing in quality, a reduction in the wet weather runoff of SS is necessary. It is likely that steps will need to be taken to control runoff rates and volumes during precipitation events. It may be necessary to require employing BMPs to attenuate the runoff delivery rates and volume to reduce flashiness, SS resuspension, and excessive siltation/sedimentation that impact habitat quality, and therefore biological integrity, throughout the Rouge River watershed.

SEASONALITY

Seasonality is addressed in this TMDL through specified sampling periods for fish and macroinvertebrate communities. To minimize temporal variability in the biological community, sampling will be conducted between June and September during stable, low flow conditions, following Procedure 51. These summer conditions are particularly critical because dilution of pollutants is minimal and stream temperatures are elevated, which may affect dissolved oxygen fluctuations and increase metabolic rates of the biota, providing additional stress on these in-stream organisms. Support of the designated uses using these biological indicators further addresses seasonality by their presence in the aquatic environment over their entire (or large portions of) life cycles, thereby being reflective of seasonal shifts in condition of the water body.

For assessing SS loading to the Rouge River watershed, seasonal event monitoring will be conducted, if necessary, once source control measures are in place to better define and characterize SS loading and the associated hydrologic pattern that influences the biota in the TMDL reaches.

MONITORING

Monitoring will be conducted by the MDEQ to assess progress toward meeting the biota TMDL target following implementation of applicable BMPs and control measures. Follow-up biological assessments will be conducted from June through September and under stable, low flow conditions, following Procedure 51. Additionally, the Rouge River watershed will continue to be monitored on a five-year rotating basis, regardless of TMDL activity, and the information from those surveys will be available to assess the condition of the biological communities as well.

In-stream monitoring of SS concentrations may be conducted by the MDEQ, if necessary and as resources allow, to augment ongoing monitoring efforts by the Rouge Project. This type of information, from appropriate sources, will be used in determining whether the secondary SS target is met.

REASONABLE ASSURANCE ACTIVITIES

The Rouge River has suffered from typical urban watershed stressors including CSOs, Sanitary Sewer Overflows, nonpoint sources, and industrial discharges, all of which influence the water

quality and natural flow regime. The restoration of the Rouge River began by focusing on the primary public health pollutant threat, CSOs. At the start of the project in 1992, 168 CSOs were identified, with a tributary service area of approximately 59,300 acres (approximately 20 percent of the watershed). The CSO control program, while at the heart of the Rouge Project, is only one element of the overall Rouge River restoration effort. The impressive improvements in water quality and recreational use in the Rouge River can also be attributed to the multitude of other Rouge Project programs including illicit connection elimination, storm water management activities, and developing better public, industry, and community awareness of pollution control and prevention. These programs and others are all part of the watershed approach being successfully implemented in the Rouge River watershed.

Industrial Storm Water

Federal regulations require certain industries to apply for an NPDES permit if storm water associated with industrial activity at the facility discharges into a separate storm sewer system or directly into a surface water. A storm water permit is not required if storm water does not discharge from the facility or is discharged into a sewer system that leads to a Wastewater Treatment Plant.

The state of Michigan began issuing industrial storm water permits in 1994. There are three types of permits available in Michigan: a generic baseline general permit, a generic general permit with monitoring requirements, or a site-specific individual permit. There are approximately 4,000 facilities statewide with storm water discharge authorization, with approximately 265 within the Rouge River watershed. Michigan's storm water permit authorization requires facilities to obtain a certified operator who will have supervision and control over the control structures at the facility, eliminate any unauthorized non-storm water discharges, and develop and implement a storm water pollution prevention plan for their facility that includes structural and nonstructural control measures. Prior to obtaining permit coverage, applicants must certify that they do not have any unauthorized discharges. Additionally, general permits MIS210000 and MIS220000 contain requirements specific to TMDLs stating the need for the “identification of actions to limit the discharge of significant materials in order to comply with TMDL requirements.”

Municipal Storm Water

The USEPA, MDEQ, and most water resources professionals advocate holistic and adaptive watershed management approaches to the protection and restoration of aquatic ecosystems by encouraging pollution control strategies that are developed through collaborative partnerships within a hydrologic boundary. Michigan was one of the first states to embrace and help develop the concept of watershed-based general storm water permitting.

In 1997, as part of the Rouge Project, stakeholders in southeastern Michigan worked with the MDEQ to develop a voluntary watershed-based general permit for storm water discharges. The permit was originally voluntary because there was no legal requirement for the storm sewer operators in the Rouge River watershed to have a permit. Now a regulatory requirement, the MDEQ offers a watershed-based general permit as one of two options for compliance with the NPDES Phase I and II storm water regulations (MDEQ, 2007). The other option is a jurisdictional permit.

Within the Rouge River watershed, 67 local municipalities have obtained Phase II MS4 permit coverage. The municipalities include counties, cities, villages, townships, school districts, colleges and universities, airport authorities, and the Michigan Department of Transportation. The majority of these municipalities have had permit coverage since 1997 (voluntary permit between 1997 and mid-2003; required permit from 2003 to present). A number of additional school districts are currently in the process of obtaining MS4 permit coverage.

A requirement of the MS4 watershed permit is the development of Watershed Management Plans which, in part, define the long-term watershed goals including the protection of designated uses and the identification of priority problems and opportunities in the watershed, including determination of the actions needed to attain compliance with any established TMDL. The Watershed Management Plan should address concerns related to TMDLs in the watershed and detail actions specific to storm water controls. Additionally, the MS4 watershed permit states that "an emphasis of the Watershed Management Plan shall be to mitigate the undesirable impacts caused by wet weather discharges," such as discussed in this TMDL's Linkage Analysis section. It is anticipated that this document will assist in guiding portions of the various Watershed Management Plans in the Rouge River watershed.

In the Rouge River watershed, 49 individual municipal entities and 3 counties selected the watershed-based general storm water permit. Additionally, in August 2003, the communities and counties in the Rouge River watershed formed the Rouge River Watershed Local Management Assembly (Assembly of Rouge Communities) to continue the restoration of the Rouge River watershed into the future.

In 2004, the Assembly of Rouge Communities supported the passage of state legislation to authorize local governments to form watershed alliances; this was subsequently signed into law as Act No. 517, Public Acts of 2004, "Watershed Alliance Act." In November 2005, the Assembly of Rouge Communities became the public entity "Alliance of Rouge Communities" when 20 eligible members approved bylaws (modeled after the former Memorandum of Agreement for operation of the Assembly) developed under the Watershed Alliance Act. As of April 30, 2006, there were 41 Alliance of Rouge Communities members that had approved the bylaws. The Alliance of Rouge Communities collaborates on storm water management planning and permitting commitments to develop integrated plans that take advantage of economies of scale and produce more cost-effective solutions. Each member contributes financial support for storm water management compliance activities such as public involvement and education, water quality monitoring, and illicit discharge elimination programs. For more information about the Alliance of Rouge Communities, see the Web site http://www.rougeriver.com/alliance/.

The Rouge River watershed is approximately 466 square miles and includes all or parts of 47 communities and 3 counties. To manage this large area more effectively under the MS4 watershed permit, local units of government decided to divide the Rouge River watershed into seven subwatersheds (SWMAs) based on the four main branches of the Rouge River; the Main Branch, the Upper Branch, the Middle Branch, and the Lower Branch, and certain political jurisdictions.

Long-term watershed management plans have been developed for all seven SWMAs, and implementation of BMPs and other pollution prevention activities have been underway under these plans since 2001. All seven watershed management plans include at least one goal that addresses the protection of the warmwater fishery and other indigenous aquatic life and wildlife designated use, including:

- Minimization of soil erosion and sedimentation.
- Improvement and maintenance of habitat for fish and wildlife.
- Minimizing flow variability.

Permits-by-Rule

Construction activities covered under a Permit-by-Rule have SESC explicitly built into the process, thereby addressing SS loadings from wet weather runoff. Under this permit the site must have an SESC permit or plan, properly maintained and operated soil erosion control

measures, and the owner or easement holder is required to provide for weekly inspections of the SESC practices identified in their SESC permit. In addition, the site should be inspected after major rain events that cause a discharge from the site. These inspections should be conducted by a storm water operator who is trained and certified by the MDEQ (MDEQ, 2007). Additionally, it is assumed that the SS loading factors developed for the Rouge River watershed (Cave et al., 1994) and used in the Simple Method calculations account for these types of construction activities and so can be considered reflective of these conditions.

Public Education and Involvement

Under the MS4 permits, municipalities are required to develop a public education plan for the purpose of encouraging the public to reduce the discharge of pollutants in storm water to the maximum extent practicable. Many Rouge municipalities have established comprehensive programs to achieve this goal and fulfill the permit requirement in a variety of ways; some of which are summarized below. The following discussion is not meant to be all-inclusive, but representative of the types of activities occurring throughout the watershed. For additional information on the activities identified below as well as other activities, see the Rouge River watershed Web site at www.rougeriver.com, or the individual annual reports submitted to the MDEQ by the permittees.

1998-2006 Public Education and Involvement

Municipalities have undertaken efforts to educate the public about water quality using various types of media. Water quality and/or riparian protection brochures were distributed to new residents in many communities, including Northville and Bloomfield Townships. Communities within the Main 1-2 SWMA periodically publish a newsletter called, *Waterside Living*, and distribute it to riparian landowners throughout the watershed. Several communities undertake outreach efforts to educate homeowner's associations about water quality. For example, the Washtenaw County Drain Commissioner's, "Homeowner's Association Handbook, A Guide to Water Quality Protection for Homeowner Associations and Households," was distributed to Rouge watershed townships as a water quality education tool for homeowner associations. The city of Westland had several posters designed and displayed in city buildings and shopping malls to educate the public about the Rouge River. The city of Westland also mailed a brochure to all homeowners and commercial and industrial establishments and sent out 60,000 messages with water bills in 1998.

The Southeast Michigan Partners for Clean Water was formed to protect and improve the quality of the water resources through a coordinated and consistent storm water management effort. The Southeast Michigan Partners for Clean Water includes representatives from counties, municipalities, watershed councils, the private sector, and water quality professionals in southeast Michigan. The partners promote keeping pollutants out of storm drains, among other topics, using numerous materials that have been developed as part of their Regional 7 Simple Steps to Clean Water Campaign.

Many municipalities also use cable and radio public service announcements to educate the public about water quality. The Oakland County Drain Commission, for example, has been airing cable shows for three years that provide tips on how to improve water quality and protect the environment.

The Van Buren Township Environmental Department, as well as many other communities, use their municipal Web sites, newsletters, and/or community newspapers to further education on environmental issues. Additionally, the Rouge Project Web site was developed with the intent of being a primary tool for information dissemination about watershed activities and to increase storm water education.

Among the several videos produced for watershed education, the Rouge River Public Involvement Team developed a ten-minute video called, “Reclaiming the Rouge: A Partnership in Restoration and Preservation.” This video was produced by the Rouge Project to describe the Rouge River National Wet Weather Demonstration Project and to highlight the many successes throughout the watershed. Featured projects included educational projects in Salem Township, downspout disconnection in Livonia, stream bank restoration in Dearborn, the construction of CSO Retention and Treatment Basins in Oakland and Wayne Counties, activities of the FOTR, and many other projects and programs. A 15-minute public education video, “Storm Sewers Are Not Garbage Cans,” was also developed by Farmington Hills that covers how the actions of homeowners can impact the river. Guidelines for car washing, environmentally friendly lawn and garden care, preservation of streamside buffers, proper hazardous waste disposal, and other homeowner activities that can affect the river are reviewed in the video. Two copies were distributed to each upper subwatershed advisory group member with the intent that it would be shown on local cable television channels, distributed for public viewing through area libraries, and presented at meetings of local service clubs and neighborhood associations.

Most municipalities also display and distribute educational information within municipal buildings and at municipal events. The Wayne County Department of Environment, for example, distributed approximately 65,000 pieces of public information material relating to water pollution issues at community events or festivals, staff training sessions, workshops, leadership presentations, departmental presentations, or office display racks.

A number of festivals are held annually within the watershed. The Rouge River Water Festival is held annually for fifth grade students, where students visit exhibits and sessions related to water quality, native plants, composting, the water cycle, wetlands, and stream bank erosion. The Wayne County Festival, hosted annually at the University of Michigan-Dearborn, hosted 3,600 fifth grade students from 66 elementary schools in 12 Rouge River watershed communities and 3 downriver communities in 2005. The Oakland County Festival, hosted annually at Cranbrook Institute of Science, hosted approximately 1,300 students in 2005. An annual festival is also hosted in the Johnson Creek subwatershed by Northville Township and the Johnson Creek Protection Group. In 2005, native plantings were demonstrated during Johnson Creek Day.

Rouge Rescue, an annual river cleanup day, is hosted on the first Saturday in June by FOTR, a nonprofit organization that has been dedicated to promoting restoration and stewardship of the Rouge River through education and citizen involvement since 1986. FOTR programs also include volunteer watershed-wide monitoring (volunteers conduct frog and toad surveys twice per month at several hundred quarter sections in watershed); volunteer macroinvertebrate surveys three times per year at approximately 30 sites watershed-wide; information and outreach workshops; and restoration projects. FOTR also coordinates the Rouge Education Project, a program that promotes awareness and stewardship of the Rouge River watershed through school-based water quality monitoring, investigation, and problem solving. Schools collect and analyze river data and encourage taking action to improve the health of the Rouge River watershed based on their findings.

FOTR also coordinated a watershed-wide storm drain marking program (individual communities have subsequently taken over program management) that, through 2006, has enabled the marking of thousands of storm drains. In 2004, for example, more than 280 volunteers, organized by FOTR, marked a total of 2,250 storm drains in 8 communities during 22 projects. Storm drain marking, in part, helps to educate the public about the connection between these drains and nearby lakes and streams. To further increase awareness about the Rouge watershed and water quality, a large number of road signs have been installed at entry points into the watershed and at river crossings throughout the watershed.

Another example of a Rouge watershed education and monitoring effort is the one that was initiated with lake association groups in Bloomfield Township. The Forest Lake Outlet Watershed, a group of riparian landowners from multiple lake areas, in conjunction with Bloomfield Township, developed management strategies and set long- and short-term goals in an effort to improve water quality. The Forest Lake Outlet Watershed group also conducts water quality testing on several open water bodies.

Several environmental incentive programs have also been developed. The RiverSafe Homes program, for example, is under development by the Washtenaw County Drain Commissioner's Office to provide homeowners the opportunity to self assess their water quality protection practices and be awarded a "RiverSafe Home" plaque for display. A Rouge Friendly Business program was also developed and implemented within the watershed.

A number of surveys have been conducted to gauge public knowledge of storm water issues. Results from a public involvement survey of 1999 showed that public involvement techniques being used in the watershed were working. Almost half of the respondents indicated that they knew of the Rouge River project, a majority said that they were changing their practices on lawn fertilizing, and a majority felt that continuing actions by government would be needed to sustain the restoration. Future surveys will gauge the effectiveness of current education efforts. A 2004 survey was also conducted by the Southeast Michigan Council of Governments of 3,720 households within southeast Michigan concerning their knowledge of sources of pollution, watershed awareness, and other similar topics.

Other Projects

Reasonable assurance activities that are not included in the above categories are discussed in this subsection. The following discussion is not meant to be all inclusive, but representative of the types of activities occurring throughout the watershed. For additional information on the activities identified below as well as other activities, see the Rouge River watershed Web site at www.rougeriver.com or the individual annual reports submitted to the MDEQ by the permittees.

1998-2006 Other Projects

Wayne County established a grant program to support activities by communities and agencies that obtained MS4 permits in the Rouge. This program allocated several million federal dollars to the seven subwatersheds for illicit discharge elimination, public education, and subwatershed management plans.

Additionally, a number of projects have been implemented within the Rouge watershed to improve water quality and provide storm water detention. These projects include:

- Detention pond retrofit projects in Northville Township to provide outlet control, wetland plantings, prairie seeding, and create a wet pond among other tasks.

- Establishment of a regional storm water detention facility in the city of Livonia, constructed to manage storm water and provide significant pollutant removal from a 2,700 acre watershed, which is approximately 65 percent developed.

- Riparian zone improvement in Canton. In April 2001, roughly 150 students, parents, teachers, and friends volunteered their time to plant native trees, flowers, and seeds along the banks of Truesdell Creek; a site on the grounds of Field Elementary School in Canton that is used as an outdoor classroom over the school year.

- Construction of a swale with an underdrain on a gravel road as an alternative to constructing enclosed storm drains in the city of Beverly Hills, thereby providing system

storage, storm water attenuation, ground water recharge, and solids and nutrient removal through vegetative linings.

- Construction of rain gardens at Comcast Communications in Plymouth Township. The rain gardens provide benefits such as groundwater recharge, wildlife habitat, chemical filtration of phosphates and nitrates, sediment removal, and reduction of runoff and erosion.

- Retrofitting four detention basins in Canton Township. The designs included a combination of regrading, dredging, wetland plantings, tree and shrub plantings, habitat improvements, and outlet structure modifications. Canton's Public Works Division completed the grading work while community staff and residents installed the plantings during volunteer planting days in the spring.

- Construction of the Fellows Creek Naturalization and Flow Reduction regional storm water wetland. In addition to reducing flashiness, this wetland also filters pollutants in the storm water runoff, thus improving the storm water quality. A walking path was constructed around the perimeter of the wetland with access points to areas of the stream where in-stream habitat is enhanced. Educational signage was installed describing in-stream habitat enhancements, descriptions of fish and macroinvertebrates species that might be observed, wetland features, and other habitat that may exist in the wetland.

- The Wayne County Parks Department and Wayne County Department of Environment Watershed Management Division implemented of a variety of streambank stabilization methods to improve the aesthetics, recreational desirability, and water quality of the Nankin Mill race.

- Van Buren Township constructed a recreational and interpretive area within a historically important wooded wetland complex. The township also worked with Visteon Corporation to design and construct a wetland fringe for an existing 36-acre (former gravel pit) lake. This project was completed in order to protect water quality, mitigate the impact of storm water pollutants on the lake, and provide fish and wildlife habitat for the lake.

- Oakland County Parks and Recreation grounds maintenance staff at the Glen Oaks Park have maintained and expanded vegetative buffers and planted shade trees along the stream to enhance riparian habitat and provide thermal protection for the stream.

Several municipalities within the Rouge watershed have adopted storm water ordinances. These municipalities include:

- *Wayne County*. The Wayne County Commission adopted the Wayne County Storm Water Management Ordinance and Administrative Rules in October 2000. These documents, along with the Wayne County Storm Water Standards Manual, are now being fully implemented to address storm water issues in the county. The ordinance requires that storm water management measures be incorporated into new development or redevelopment projects including peak runoff rate restrictions, buffer strips, and first flush treatment, among others.

- *Washtenaw County.* Washtenaw County established storm water design rules in May 2000. In addition, Washtenaw County has developed model ordinances for local units of government for regulating storm water, natural features, storm water system use (what can be discharged to a storm sewer), and reduction of phosphorus from new developments.

- The c*ity of Novi.* The city of Novi adopted a storm water ordinance that not only manages increased storm water runoff from new developments, but also addresses the water quality aspect of storm water runoff.

Inventory projects have been undertaken in several portions of the Rouge watershed including:

- *The Lower 1 SWMA*. Assessment of 125 wetlands in the six communities of the Lower 1 SWMA was completed. Communities were provided with maps, reports, and digital information so that the analysis of the project as well as recommendations for protecting wetland functions could be accessed as needed.

- *The Main 1-2 SWMA*. The Oakland County Drain Commission completed an inventory of detention ponds in the Main 1-2 SWMA, and made recommendations for improvements to the existing detention facilities to increase their pollutant removal efficiency.

- *The Main 1-2 SWMA*. The Oakland County Drain Commission performed a streambank inventory of the Rouge River and its tributaries in the area of the Main 1-2 SWMA, including open county drains. The inventory sites were located using a global positioning system, photographed, and surveyed to include the following parameters: condition of the bank, apparent cause of erosion, amount of erosion, slope ratio, river conditions, and soil texture.

- *Northville Township*. Northville Township inspected all privately owned detention basins in 2003 and required maintenance to be performed, as needed.

- *Westland, Livonia, and Bloomfield Township*. These communities have also completed detention basin inventory projects.

Future Projects

Grants were recently awarded by the MDEQ to the FOTR for continued support of the FOTR program including monitoring and educational activities and to support a monitoring program in the Bell Branch.

The United States Army Corps of Engineers is in the process of planning and evaluating the removal of the concrete lining above the normal water mark in the lined portion of the Main Branch Rouge River (Main 3-4) in an effort to reconnect riparian habitats and reestablish linear wetlands and other features.

Prepared by: Kevin Goodwin, Aquatic Biologist
Surface Water Assessment Section
Water Bureau
Michigan Department of Environmental Quality
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Appendix A. Permitted outfalls to the Rouge River watershed. Source: MDEQ, Water Bureau's NPDES Permit Management System. *Facilities used in NPDES non-storm water load calculations (see Table 4 and WLA Section)

Facility	Number	County	MAIN BRANCH Latitude	Longitude	Receiving Water
Individual Permit					
MDOT MS4	MI0057364	Statewide	---	---	---
St Marys Cement Co*	MI0004243	Wayne	42.2833	-83.1367	River Rouge
Detroit WWTP	MI0022802	Wayne	42.2842	-83.1281	---
River Rouge CSO RTB	MI0028819	Wayne	42.2792	-83.1314	River Rouge
Birmingham CSO RTB	MI0025534	Oakland	42.5406	-83.2281	River Rouge
Oakland Co-Acacia Park CSO RTB	MI0037427	Oakland	42.5231	-83.2456	River Rouge
Severstal North America Inc*	MI0043524	Wayne	42.2978	-83.1578	River Rouge
Double Eagle Steel Coating Co*	MI0044415	Wayne	42.3119	-83.1583	River Rouge
Bloomfield Village CSO RTB	MI0048046	Oakland	42.5367	-83.2467	---
Dearborn Ind Generation Plt*	MI0056235	Wayne	42.3053	-83.1528	River Rouge
Carmeuse Lime-River Rouge*	MI0057126	Wayne	42.2792	-83.1292	River Rouge
Dearborn CSO Const Dewatering*	MI0057738	Wayne	42.3064	-83.2156	River Rouge
Dearborn CSO Const Dewater 2*	MI0057886	Wayne	42.3	-83.1997	River Rouge
Triton Petroleum-Detroit*	MI0058068	Wayne	42.2817	-83.1419	River Rouge
General Permit MIG080000	Wastewater from Cleanup of Water Contaminated by Gasoline & Related Petroleum Products				
BP Products NA Inc-River Rouge*	MIG080778	Wayne	42.2767	-83.1248	---
BP Products NA Inc-River Rouge*	MIG670081	Wayne	42.2767	-83.1248	---
Norfolk Southern RR-Detroit*	MIG081017	Wayne	42.2792	-83.1667	River Rouge
Sunoco-River Rouge Term*	MIG081067	Wayne	42.2954	-83.1539	River Rouge
Michigan Fuels Inc*	MIG081075	Oakland	42.4812	-83.2857	River Rouge
General Permit MIG250000	Non Contact Cooling Water				
Ford-Rouge Mfg Complex*	MIG250460	Wayne	42.3058	-83.1639	River Rouge
General Permit MIG619000	Municipal Separate Storm Sewer System				
Beverly Hills MS4-Oakland	MIG610005	Oakland	42.5253	-83.2642	---
Bingham Farms MS4-Oakland	MIG610006	Oakland	42.5069	-83.2856	---
Lathrup Village MS4-Oakland	MIG610013	Oakland	42.5031	-83.2225	---
Allen Park MS4-Wayne	MIG610020	Wayne	42.2447	-83.2222	---
W Bloomfield Twp MS4-Oakland	MIG610022	Oakland	42.5639	-83.3611	---
Pontiac MS4 - Oakland	MIG610023	Oakland	---	---	---
Bloomfield Twp MS4-Oakland	MIG610026	Oakland	42.5603	-83.2992	---
Southfield MS4-Oakland	MIG610027	Oakland	42.4883	-83.2861	---
Auburn Hills MS4 - Oakland	MIG610031	Oakland	---	---	---
Franklin MS4-Oakland	MIG610041	Oakland	42.5000	-83.3083	---
Oakland County MS4	MIG610042	Oakland	---	---	---
Birmingham MS4-Oakland	MIG610044	Oakland	42.5417	-83.2208	---
Troy MS4-Oakland	MIG610053	Oakland	---	---	---
Rochester PS	MIG610250	Oakland	---	---	---
Orchard Lake MS-Oakland	MIG610270	Oakland	---	---	---
Rochester Hills MS4-Oakland	MIG610283	Oakland	---	---	---
Bloomfield Hills MS4-Oakland	MIG610284	Oakland	---	---	---
Oak Park MS4-Oakland	MIG610285	Oakland	---	---	---
Avondale PS MS4-Oakland	MIG610294	Oakland	---	---	---
General Permit MIS040000	Storm Water Discharges from Municipal Separate Storm Sewer Systems (MS4s) with Controls				
Dearborn PS MS4-Wayne	MIS040012	Wayne	---	---	---
West Bloomfield PS MS4-Oakland	MIS040014	Oakland	---	---	---
Bloomfield Hills PS MS4-Oakland	MIS040048	Oakland	---	---	---
Melvin-N AP PS MS4-Wayne	MIS040052	Wayne	---	---	---
Wayne-Westland PS MS4-Wayne	MIS040060	Wayne	---	---	Rouge River
Detroit MS4-Wayne	MIS040066	Wayne	---	---	Rouge River
Henry Ford Comm Coll MS4-Wayne	MIS040067	Wayne	---	---	Rouge River
Birmingham PS	MIS040072	Oakland	---	---	---
Southfield PS	MIS040074	Oakland	---	---	---

Appendix A (cont). MAIN BRANCH

Facility	Number	County	Latitude	Longitude	Receiving Water
River Rouge	MIS040079	Wayne	---	---	---
General Permit MIS210000	Storm Water Discharges From Industrial Activities				
Arlans Manufacturing	MIS210290	Oakland	42.4442	-83.2781	Rouge River
Wisne Center-Southfield	MIS210293	Oakland	42.4444	-83.2781	Rouge River
Progressive Tool & Industries	MIS210299	Oakland	42.4456	-83.2781	Rouge River
Angelo Iafrate-Southfield	MIS210301	Oakland	42.4442	-83.2311	Rouge River
Waste Mgmt MI-Recycle America	MIS210303	Oakland	42.4442	-83.2386	Rouge River
Great Lakes Waste-Southfield	MIS210314	Oakland	42.4433	-83.2528	Rouge River
Waste Mgt of Mich-Detroit N	MIS210324	Oakland	42.4442	-83.2303	Rouge River
Dearborn Sausage Co	MIS210332	Wayne	42.3042	-83.1472	Rouge River
Levy-Clawson Concrete Plt 12	MIS210352	Oakland	42.4442	-83.2311	Rouge River
Owens Corning-Detroit	MIS210366	Wayne	42.2869	-83.1447	Rouge River
Yellow Freight System-Detroit	MIS210368	Wayne	42.2933	-83.1103	Rouge River
Mich Foundation Co-Wayne Plt 4	MIS210374	Wayne	42.2686	-83.4161	Rouge River
Peterson Spring-Southfield	MIS210391	Oakland	42.4458	-83.2781	Rouge River
USG Corp-River Rouge	MIS210411	Wayne	42.2792	-83.1319	Rouge River
Carmeuse Lime-Detroit	MIS210438	Wayne	42.2958	-83.1511	Rouge River
General Permit MIS210000	Storm Water Discharges From Industrial Activities				
Smart-Inkster	MIS210441	Wayne	42.2847	-83.3358	Rouge River
DHL Express-Southfield	MIS210586	Oakland	42.4478	-83.2531	River Rouge
Crystal Auto Parts-Dearborn	MIS210655	Wayne	42.3189	-83.1642	Rouge River
Ford-Rouge Mfg Complex	MIS210753	Wayne	42.3058	-83.1639	Rouge River
Superior Mtls-Plt 17-Detroit	MIS210782	Wayne	42.3582	-83.097	Rouge River
Detroit Diesel Corporation	MIS210789	Wayne	42.4393	-83.2075	Rouge River
Bernal Inc-Rochester Hills	MIS210812	Oakland	42.6358	-83.1953	Sprague Branch
A Raymond Inc-Rochester Hills	MIS210813	Oakland	42.6414	-83.1942	Sprague Branch
Saturn Electronics Corp	MIS210845	Wayne	42.2226	-83.3249	Rouge River
X-Cel Industries Inc	MIS210857	Oakland	42.4446	-83.2803	Trib to Rouge River
International Wholesale Inc	MIS210880	Oakland	42.4455	-83.2469	Owens Drain
General Permit MIS220000	Storm Water Discharges with Required Monitoring				
Great Lakes Agg-River Rouge	MIS220028	Wayne	42.2661	-83.1286	River Rouge
	UPPER BRANCH				
Individual Permit					
MDOT MS4	MI0057364	Statewide	---	---	---
Commerce Twp WWTP*	MI0025071	Oakland	42.5458	-83.4625	---
Wayne Co/RDFrd/Livonia CSO	MI0051535	Wayne	42.4061	-83.2947	Upper River Rouge
General Permit MIG080000	Wastewater from Cleanup of Water Contaminated by Gasoline & Related Petroleum Products				
Speedway SuperAmerica 2236	MIG081070	Oakland	42.4636	-83.364	---
Diversified Fuels – Livonia*	MIG081086	Wayne	42.3831	-83.3736	River Rouge
General Permit MIG250066	Non contact cooling water				
Robert Bosch Corp*	MIG250066	Oakland	42.4914	-83.4233	---
General Permit MIG619000	Municipal Separate Storm Sewer System				
Farmington MS4-Oakland	MIG610010	Oakland	42.4683	-83.3872	---
Farmington Hills MS4-Oakland	MIG610011	Oakland	42.4828	-83.3919	---
Livonia MS4-Wayne	MIG610015	Wayne	42.3917	-83.35	---
Redford Twp MS4-Wayne	MIG610016	Wayne	42.4028	-83.2953	---
Commerce Twp MS4-Oakland	MIG610033	Oakland	---	---	---
Wayne Co MS4	MIG610040	Wayne	42.4083	-83.2917	---
General Permit MIS040000	Storm Water Discharges from Municipal Separate Storm Sewer Systems (MS4s) with Controls				
Farmingto Hill PS MS4-Oakland	MIS040047	Oakland	---	---	---
Livonia PS MS4-Wayne	MIS040054	Wayne	---	---	---

Appendix A (cont). UPPER BRANCH

Facility	Number	County	Latitude	Longitude	Receiving Water
General Permit MIS210000	Storm water discharges from industrial activities				
Specialty Steel Treating-FHill	MIS210007	Oakland	42.4408	-83.3564	Upper Rouge River
Trend Tool Inc-Livonia	MIS210268	Wayne	42.3728	-83.3664	Shaw Drain
Prince Industries-Livonia	MIS210270	Wayne	42.3728	-83.3689	Shaw Drain
Sure Fit Metal Products	MIS210288	Wayne	42.38	-83.3458	Shaw Drain
Diamond Automation	MIS210294	Oakland	42.4614	-83.4344	Upper River Rouge
Washers Inc-Livonia	MIS210295	Wayne	42.3767	-83.3697	Belle Branch
BASF Corp-Livonia	MIS210296	Wayne	42.3775	-83.4017	Barlow Drain
Corrigan-Farmington Hills	MIS210305	Oakland	42.4639	-83.4286	Walled Lake
GM-Powertrain Div-Livonia	MIS210318	Wayne	42.3761	-83.3331	Shaw Drain
US Fabricating-Walled Lake	MIS210333	Oakland	42.5408	-83.4378	Seeley Drain
Quality Metalcraft Inc	MIS210342	Wayne	42.3767	-83.3681	Shaw Drain
Standard Die & Fabricating Inc	MIS210345	Wayne	42.3772	-83.3881	Barlow Drain
Kopacz Industrial Painting Inc	MIS210346	Wayne	42.3744	-83.3528	Shaw Drain
Sales & Engineering-Livonia	MIS210347	Wayne	42.3797	-83.3681	Shaw Drain
Fittings Prod Co-Livonia	MIS210349	Wayne	42.3772	-83.3139	Bell Branch
US Postal Service-Livonia	MIS210361	Wayne	42.3697	-83.3522	Shaw Drain
UPS-Livonia	MIS210362	Wayne	42.3831	-83.3381	Rouge River
Argent Limited-Livonia	MIS210370	Wayne	42.3714	-83.3644	Shaw Drain
Tru-Line-31100 Industrial	MIS210377	Wayne	42.3789	-83.3461	Shaw Drain
Tru-Line-30844 Industrial	MIS210378	Wayne	42.3806	-83.345	Shaw Drain
Tru-Line-30622 Industrial	MIS210379	Wayne	42.3806	-83.3431	Shaw Drain
Dept Army-AMSA 134G	MIS210382	Wayne	42.3817	-83.3828	Barlow Drain
Giffin-Farmington Hills	MIS210389	Oakland	42.4606	-83.4278	Upper River Rouge
ATW-Adv Tech & Testing-Livonia	MIS210394	Wayne	42.3789	-83.3789	Barlow Drain
Ductile Chrome Process-Livonia	MIS210414	Wayne	42.3794	-83.3461	Rouge River
Williams Panel Brick-Detroit	MIS210417	Wayne	42.4419	-83.3139	Upper River Rouge
Cass Erectors-Livonia	MIS210422	Wayne	42.3792	-83.3789	Barlow Drain
Ryan Transportation	MIS210440	Wayne	42.3728	-83.3722	Shaw Drain
Ideal Fabricators-Livonia	MIS210537	Wayne	42.3825	-83.3453	Shaw Drain
Fendt Builders-Farmington	MIS210587	Oakland	42.4525	-83.3858	Tarabusi Creek
City of Livonia DPS-Livonia LF	MIS210590	Wayne	42.3769	-83.3664	Shaw Drain
MSD Stamping LLC-Livonia	MIS210591	Wayne	42.3728	-83.37	Shaw Drain
O Keller Tool Engineering Co	MIS210593	Wayne	42.3772	-83.3139	Bell Branch
General Permit MIS210000	Storm water discharges from industrial activities				
Trio Tool Co-Livonia	MIS210596	Wayne	42.3817	-83.3822	Barlow Drain
Dedoes Industries-Walled Lake	MIS210597	Oakland	42.5378	-83.4781	Seeley Drain
Williams Diversified-Livonia	MIS210602	Wayne	42.3781	-83.3528	Shaw Drain
Quigley Industries-Farm Hills	MIS210626	Oakland	42.4706	-83.4297	Walled Lake
Metaldyne-Farmington Hills	MIS210640	Oakland	42.4728	-83.4186	Upper River Rouge
CSM Manufacturing Corp-Plt 1	MIS210642	Oakland	42.4711	-83.4247	Walled Lake
State Fabricators Inc	MIS210656	Oakland	42.4411	-83.3461	Upper Rouge River
Wayne Craft-Livonia	MIS210666	Wayne	42.3803	-83.3886	Barlow Drain
Lockwood Manufacturing-Livonia	MIS210667	Wayne	42.3778	-83.3456	River Rouge
Chemical Systems Corp-Livonia	MIS210671	Wayne	42.3772	-83.3886	Barlow Drain
Piedmont Concrete Inc	MIS210675	Oakland	42.4411	-83.3397	Upper River Rouge
Carlesimo Products Inc	MIS210682	Oakland	42.4411	-83.3383	Upper Rouge River
Quality Metalcraft-Livonia	MIS210683	Wayne	42.3767	-83.3697	Bell Branch
TAG Mfg-Farmington Hills	MIS210691	Oakland	42.4642	-83.4211	Tarabusi Creek
Producto Chemicals	MIS210714	Wayne	42.38	-83.3458	Bell Branch
A & J Precision Inc	MIS210762	Oakland	42.4592	-83.4225	Tarabusi Creek
Microheat Inc-Farmington Hills	MIS210769	Oakland	42.4956	-83.4197	Seeley Drain
Country Fresh LLC-Livonia	MIS210780	Wayne	42.3711	-83.3558	Shaw Drain
Tramar Industries-Redford	MIS210810	Wayne	42.3803	-83.2906	Bell Branch
Autotek Sealants Inc	MIS210843	Oakland	42.4588	-83.4321	River Rouge
Gehring LP	MIS210858	Oakland	42.4782	-83.3943	Upper Rouge River
Quality Metalcraft Inc-Livonia	MIS210868	Wayne	42.3775	-83.3702	Hawkins Drain

Appendix A (cont). UPPER BRANCH

Facility	Number	County	Latitude	Longitude	Receiving Water
General Permit MIS710000	Storm water from municipally operated industrial activity				
Commerce Twp WWTP	MIS710004	Oakland	42.5458	-83.4625	trib to Greenaway Dr
		MIDDLE BRANCH			
Individual Permit					
MDOT MS4	MI0057364	Statewide	---	---	---
Oakland Co Walled Lk/Novi WWTP*	MI0024287	Oakland	42.5086	-83.4978	---
Wayne Co-Lift Station 1A	MI0026123	Wayne	42.3292	-83.2486	Walled Lake Branch
Onyx Arbor Hills LF*	MI0045713	Wayne	42.4014	-83.5458	Johnson Drain
Wayne Co/Dearborn Heights CSO	MI0051489	Wayne	42.3444	-83.2731	Walled Lake Branch
Redford Twp CSO	MI0051829	Wayne	42.3675	-83.2756	Ashcroft-Sherwood Drain
Salem Twp WWTP*	MI0054798	Washtenaw	42.3994	-83.5781	Johnson Drain
CECO-Northville Compressor	MI0058016	Wayne	42.4322	-83.5514	Sump Drain
General Permit MIG080000	Wastewater from Cleanup of Water Contaminated by Gasoline & Related Petroleum Products				
Buckeye Pipeline-Plymouth*	MIG080782	Wayne	42.3897	-83.4383	River Rouge
Falcon Center GWCU*	MIG081027	Wayne	42.3533	-83.4519	---
Diversified Fuels-Northville*	MIG081077	Oakland	42.4374	-83.493	---
General Permit MIG250000	Non Contact Cooling Water				
Detroit Diesel Corp*	MIG250058	Wayne	42.3758	-83.2694	---
Rock Tool & Machine-Plymouth*	MIG250484	Wayne	42.3858	-83.5029	Walled Lake Branch
General Permit MIG619000	Municipal Separate Storm Sewer System				
Westland MS4-Wayne	MIG610001	Wayne	42.3167	-83.3736	---
Dearborn Heights MS4-Wayne	MIG610009	Wayne	42.3256	-83.3014	---
Garden City MS4-Wayne	MIG610012	Wayne	42.3206	-83.3425	---
Northville MS4-Oakland	MIG610024	Oakland	42.4375	-83.4875	---
Northville Twp MS4-Wayne	MIG610025	Oakland	42.4361	-83.4806	---
Walled Lake MS4-Oakland	MIG610028	Oakland	---	---	---
Novi MS4-Oakland	MIG610030	Oakland	42.4656	-83.4428	---
Plymouth MS4-Wayne	MIG610032	Wayne	42.3681	-83.4528	---
Lyon Twp MS4-Oakland	MIG610034	Oakland	---	---	---
Wixom MS4-Oakland	MIG610035	Oakland	---	---	---
Plymouth Twp MS4-Wayne	MIG610038	Wayne	42.3875	-83.4708	---
Plymouth-Canton PS MS4-Wayne	MIG610343	Wayne	---	---	---
General Permit MIS040000	Storm Water Discharges from Municipal Separate Storm Sewer Systems (MS4s)				
Wayne-Westland PS MS4-Wayne	MIS040060	Wayne	---	---	Tonquish Creek
			---	---	
Novi Twp MS4-Oakland	MIS040061	Oakland			Thornton Creek
Salem Twp MS4-Washtenaw	MIS040068	Washtenaw	---	---	---
Novi PS	MIS040076	Oakland	---	---	---
Northville PS	MIS040076	Oakland	---	---	---
General Permit MIG670000	Hydrostatic Pressure Test Water				
CECO - Newburgh Rd Pipeline	MIG670325	Wayne	42.4042	-83.4875	Walled Lake Branch
General Permit MIS210000	Storm Water Discharges From Industrial Activities				
Baron Drawn Steel Corp-Canton	MIS210006	Wayne	42.3431	-83.4542	Rouge River
Corrigan Moving Systems-Novi	MIS210009	Oakland	42.4847	-83.4936	Walled Lake
Koenig Fuel-Plymouth Yard	MIS210256	Wayne	42.3714	-83.2753	Ashcroft-Sherwood Drain
C & B Machiner-Livonia	MIS210269	Wayne	42.3697	-83.4094	Middle River Rouge
Nagle Paving Co-Livonia	MIS210282	Wayne	42.3747	-83.4053	Middle Rouge River
Metaltec Steel Abrasive-Canton	MIS210286	Wayne	42.3517	-83.4467	Deer Drain
Wisne Automation & Engineering	MIS210292	Oakland	42.4664	-83.4661	Walled Lake
Lacy Tool-Novi	MIS210298	Oakland	42.4733	-83.445	Bishop Creek
Ajax Materials-Plt 5	MIS210300	Wayne	42.3542	-83.3125	Sherman Drain
Temperform Corp-Novi	MIS210306	Oakland	42.4767	-83.4744	Walled Lake
Plymouth Plating Works	MIS210307	Wayne	42.35	-83.4583	Tonquish Creek
Spartan Distribution-Plymouth	MIS210310	Wayne	42.355	-83.4447	Tonquish Creek
Xmation	MIS210313	Oakland	42.4664	-83.4689	Walled Lake
Lyon Manufacturing-Livonia	MIS210316	Wayne	42.3778	-83.4119	Middle River Rouge
Vico Products-Plymouth	MIS210317	Wayne	42.3589	-83.4508	Tonquish Creek

Baron Drawn Steel Corporation	MIS210320	Wayne	42.3489	-83.4531	Tonquish Creek

Appendix A (cont). MIDDLE BRANCH

Facility	Number	County	Latitude	Longitude	Receiving Water
Polynorm Automotive-Novi	MIS210330	Oakland	42.4839	-83.4894	Walled Lake
Fendt Transit Mix-Novi	MIS210334	Oakland	42.4783	-83.4761	Walled Lake
Accum-Matic Systems Livonia	MIS210335	Wayne	42.3711	-83.3669	Middle Rouge River
Tower Automotive Inc	MIS210336	Wayne	42.3825	-83.4775	Middle River Rouge
Packaging Corp Amer-Plymouth	MIS210340	Wayne	42.3822	-83.4806	Tonquish Creek
E & E Manufacturing-Plymouth	MIS210343	Wayne	42.3725	-83.4483	Middle Rouge River
Hercules Drawn Steel Corp	MIS210348	Wayne	42.3742	-83.4264	Newburgh Lake
CSX Transportation-Plymouth	MIS210364	Wayne	42.3797	-83.4678	Middle Rouge River
General Permit MIS210000	Storm Water Discharges From Industrial Activities				
Cadillac Asphalt-Plt 3A-Wixom	MIS210392	Oakland	42.4964	-83.4503	Novi Lyon Drain
AAA Industries-Detroit	MIS210405	Wayne	42.3764	-83.2792	Middle Rouge River
Applied Process-Livonia	MIS210413	Wayne	42.3733	-83.4114	Middle Rouge River
National Concrete Products	MIS210415	Wayne	42.3625	-83.4583	Tonquish Creek
Sun Plastic Coating-Plymouth	MIS210421	Wayne	42.3564	-83.4597	Tonquish Creek
Plastomer Corp-Livonia	MIS210423	Wayne	42.3808	-83.4147	Patter Drain
Nat Block Co-Westland	MIS210431	Wayne	42.3236	-83.4239	Willow Creek
Mcgean-Rohco Inc	MIS210432	Wayne	42.3811	-83.4228	Gunn Branch
Ford-Livonia-Transmission Plt	MIS210444	Wayne	42.3678	-83.3992	Middle River Rouge
E & E Mfg Co-Plymouth	MIS210522	Wayne	42.3722	-83.4486	Middle Rouge River
Unco Automotive Products	MIS210531	Wayne	42.3694	-83.4092	Middle River Rouge
Mich Truck Parts-Westland	MIS210538	Wayne	42.3236	-83.4203	Willow Creek
Gil-Mar Mfg-Canton	MIS210553	Wayne	42.3442	-83.4528	Tonquish Creek
Automotive Comp Hold-Sheldon	MIS210588	Wayne	42.3533	-83.4716	Tonquish Creek
NSS Ind-Plymouth	MIS210592	Wayne	42.3544	-83.4542	Tonquish Creek
Westside Flame Hardening	MIS210611	Wayne	42.3297	-83.4175	Tonquish Creek
Plymouth Concrete Inc	MIS210617	Wayne	42.3797	-83.4692	Middle Rouge River
Dynamic Metal Treating-Canton	MIS210619	Wayne	42.3431	-83.4522	Tonquish Creek
Guardian Manufacturing-Livonia	MIS210633	Wayne	42.3719	-83.4017	Middle River Rouge
Tony Angelo-Heltzel 902TA	MIS210636	Oakland	42.4886	-83.5103	various
Tony Angelo-Heltzel 902 BC	MIS210637	Oakland	42.4886	-83.5103	various
Tony Angelo-Rex Model S	MIS210638	Oakland	42.4886	-83.5103	various
Tony Angelo-Heltzel 1000	MIS210639	Oakland	42.4886	-83.5103	various
NSS Ind-Ronda Plt	MIS210641	Wayne	42.3458	-83.4528	Tonquish Creek
Northfield Mfg Inc-Westland	MIS210647	Wayne	42.3269	-83.4211	Willow Creek
Tony Angelo-Hagan Model	MIS210662	Oakland	42.4886	-83.5103	various
AAR Cargo Systems-Livonia	MIS210672	Wayne	42.3772	-83.3139	Livonia storm sewer
Global CNC Industries	MIS210677	Wayne	42.3689	-83.4092	Rouge River
Key Plastics-Plymouth	MIS210681	Wayne	42.3731	-83.4372	Middle Rouge River
Inch Memorials-Northville	MIS210685	Wayne	42.4247	-83.4742	Johnson Drain
Webasto Roof-Livonia	MIS210692	Wayne	42.3786	-83.4092	Gunn Branch
General Filters Inc-Novi	MIS210696	Oakland	42.4819	-83.4803	Rouge River
General Permit MIS210000	Storm Water Discharges From Industrial Activities				
Fed Ex Ground	MIS210709	Wayne	42.3742	-83.4222	Newburgh Lake
Precision Com	MIS210725	Wayne	42.3947	-83.4992	Tonquish Creek
Great Lakes Agg-Northville	MIS210732	Washtenaw	42.4111	-83.5725	Rouge River
Novi Industries-Autotech	MIS210748	Oakland	42.4825	-83.4831	Walled Lake
Biologix-Novi	MIS210759	Oakland	42.4824	-83.4881	Walled Lake Branch
Spring Engin & Mfg-Canton	MIS210761	Wayne	42.3417	-83.4569	Tonquish Creek
Owens Corning Automotive-Novi	MIS210763	Oakland	42.5002	-83.5039	Walled Lake
Veolia ES Arbor Hills Landfill	MIS210766	Washtenaw	42.3975	-83.5508	unnamed trib to Johnson Dr
GDM Tool & Mfg-Canton	MIS210771	Wayne	42.3464	-83.4574	Tonquish Creek
AW Transmission Engineering	MIS210772	Wayne	42.3926	-83.5078	Middle Rouge River
Durr Industries-Rouge River	MIS210776				
J L Becker Co-Plymouth	MIS210778	Wayne	42.3539	-83.447	Tonquish Creek
Shiloh Ind-Canton-Haggerty	MIS210796	Wayne	42.3381	-83.4500	Tonquish Creek
AW Transmission Eng-Plymouth	MIS210797	Wayne	42.3926	-83.5078	unnamed tributary to Tonquish Cre
4 M Industries-Livonia	MIS210802	Wayne	42.3736	-83.3799	Ryder Drain
First Tech Safety Sys-Plymouth	MIS210806	Wayne	42.4366	-83.4511	Tonquish Creek

Appendix A (cont). MIDDLE BRANCH

Facility	Number	County	Latitude	Longitude	Receiving Water
Frito-Lay-Great Lakes Facility	MIS210822	Wayne	42.3875	-83.4875	Tonquish Creek
Schuler	MIS210830	Wayne	42.3475	-82.8856	Tonquish Creek
LOC Performance Prod-Plymouth	MIS210835	Wayne	42.3791	-83.4482	Middle River Rouge
J & J Machine Products	MIS210855	Wayne	42.3755	-83.3117	Rouge River
US Farathane-Plymouth	MIS210859	Wayne	42.3858	-83.5029	Tonquish Creek
Durcon Laboratory Tops Inc	MIS210860	Wayne	42.343	-83.4524	Koss Drain
Durcon Laboratory Tops Inc	MIS210860	Wayne	42.343	-83.4524	Rouge River
Durcon Laboratory Tops Inc	MIS210860	Wayne	42.343	-83.4524	Tonquish Creek
Master Automatic Inc-Plymouth	MIS210870	Wayne	42.3903	-83.4389	Rouge River
Hayes Trucking Facility	MIS210881	Oakland	42.4898	-83.4835	Walled Lake Branch
Hayes Portable Crusher	MIS210882	Oakland	42.4898	-83.4835	various receiving waters
Rock Tool & Machine-Plymouth	MIS210883	Wayne	42.3858	-83.5029	Tramp Hollow Drain
General Permit MIS220000	Storm Water Discharges with Required Monitoring				
AVL North America Inc	MIS220038	Wayne	42.3819	-83.5125	Tonquish Creek
General Permit MIS319000	Storm Water Discharges From Industrial Activities				
Waste Mgt of Mich-Romulus	MIS310278	Wayne	42.1614	-83.3053	Sherman Drain
General Permit MIS710000	Storm water from municipally operated industrial activity				
Oakland Co Walled Lk/Novi WWTP	MIS710020	Oakland	42.5086	-83.4978	Fenley Drain
		LOWER BRANCH			
Individual Permit					
MDOT MS4	MI0057364	Statewide	---	---	---
Dearborn CSO	MI0025542	Wayne	42.3125	-83.2125	River Rouge
YCUA Regional WWTP*	MI0042676	Washtenaw	42.2236	-83.5531	Lower Rouge River
Ford-Wayne Assembly Plt*	MI0046183	Wayne	42.2778	-83.4069	Lower Rouge River
Wayne Co/Inkster/Drbrn Hts CSO	MI0051462	Wayne	42.3017	-83.2906	Lower Rouge River
Wayne Co/Inkster CSO	MI0051471	Wayne	42.2967	-83.3092	Lower Rouge River
Inkster/Dearborn Heights CSO	MI0051837	Wayne	42.3008	-83.2958	Lower Rouge River
Visteon Headquarters-Van Buren	MI0057156	Wayne	42.2364	-83.4377	---
General Permit MIG250000	Non Contact Cooling Water				
Steel Technologies Inc*	MIG250070	Wayne	42.2658	-83.4867	---
General Permit MIG619000	Municipal Separate Storm Sewer System				
Canton Twp MS4-Wayne	MIG610002	Wayne	42.3083	-83.4917	---
Superior Twp MS4-Washtenaw	MIG610003	Washtenaw	42.3083	-83.5875	---
Dearborn MS4-Wayne	MIG610008	Wayne	42.3039	-83.2431	---
Inkster MS4-Wayne	MIG610014	Wayne	42.2889	-83.3047	---
Romulus MS4-Wayne	MIG610017	Wayne	---	---	---
Wayne MS4-Wayne	MIG610019	Wayne	42.2786	-83.3719	---
Van Buren Twp MS4-Wayne	MIG610021	Wayne	---	---	---
Melvindale MS4-Wayne	MIG610029	Wayne	42.2917	-83.1708	---
Ypsilanti Twp MS4-Washtenaw	MIG610037	Washtenaw	---	---	---
Washtenaw CDC MS4	MIG610039	Washtenaw	---	---	---
Wayne Co MS4	MIG610040	Wayne	---	---	---
Washtenaw CRC MS4	MIG610314	Washtenaw	---	---	---
Willow Run Airport MS4	MIG610368	Wayne	---	---	---
General Permit MIS040000	Storm Water Discharges from Municipal Separate Storm Sewer Systems (MS4s)				
Van Buren PS MS4-Wayne	MIS040011	Wayne	---	---	---
General Permit MIG670000	Hydrostatic Pressure Test Water				
Buckeye Terminals-Detroit*	MIG670079	Wayne	42.2811	-83.1419	Lower Rouge River

Appendix A (cont). LOWER BRANCH

Facility	Number	County	Latitude	Longitude	Receiving Water
General Permit MIS210000	Storm Water Discharges From Industrial Activities				
Levy-Dearborn-Falcon Trucking	MIS210252	Wayne	42.3158	-83.1508	Lower Rouge River
Levy-Dearborn-Stacy Trucking	MIS210253	Wayne	42.3106	-83.1406	Lower Rouge River
Levy-Detroit Plt 6	MIS210254	Wayne	42.2903	-83.1592	Lower Rouge River
Levy-Dearborn Plt 2	MIS210255	Wayne	42.3147	-83.1453	Baby Creek
Swiss American Screw	MIS210258	Wayne	42.2644	-83.4753	Yost Drain
Procoil-Canton	MIS210271	Wayne	42.2683	-83.4464	Lower Rouge River
Hajjar Plating-Wayne	MIS210285	Wayne	42.2667	-83.4125	Wilbur Drain
Weiser Recycling Inc	MIS210308	Wayne	42.2758	-83.3931	McClaughrey Drain
Levy-Clawson Concrete Plt 1	MIS210311	Wayne	42.2853	-83.1231	Lower Rouge River
Daikin Clutch Corp-Belleville	MIS210319	Wayne	42.24	-83.445	McClaughrey Drain
L & W Engineering Co-No 2	MIS210322	Wayne	42.2611	-83.4458	Bell Drain
Frito Lay-Allen Park	MIS210337	Wayne	42.2939	-83.1878	Lower Rouge River
Darling & Co-Melvindale	MIS210339	Wayne	42.4514	-83.1708	Lower Rouge River
Sauk Trail Hills	MIS210356	Wayne	42.2703	-83.4558	Lower Rouge River
Veolia ES Solid Waste Midwest	MIS210358	Wayne	42.3047	-83.1753	Lower Rouge River
Browning-Ferris-Wayne	MIS210365	Wayne	42.2669	-83.4089	Lower Rouge River
Causley Trucking-Melvindale	MIS210369	Wayne	42.2858	-83.1842	Lower Rouge River
Best Block Company-Canton	MIS210372	Wayne	42.27	-83.4872	Rouge River
Imperial Industries-Belleville	MIS210397	Wayne	42.2636	-83.4753	McKinstry Drain
AB Myr Industries-Belleville	MIS210399	Wayne	42.2625	-83.55	Belleville Lake
Norfolk Southern-Wayne	MIS210403	Wayne	42.2778	-83.4192	Bell Drain
Doan Companies-Inkster Plt	MIS210406	Wayne	42.2900	-83.3258	Lower Rouge River
GM-CPC-Romulus Engine	MIS210409	Wayne	42.2522	-83.4017	McClaughrey Drain
General Metal & Abrasive Co	MIS210412	Wayne	42.2514	-83.4142	McClaughrey Drain
Reilly Plating Co-Melvindale	MIS210418	Wayne	42.2806	-83.1708	Lower Rouge River
Linde Gas LLC-Canton	MIS210419	Wayne	42.2711	-83.4828	McKinstry Drain
Ford-Wayne Integral Stamping	MIS210420	Wayne	42.2783	-83.4103	Lower Rouge River
Plastipak Packaging	MIS210425	Wayne	42.3122	-83.4181	Hunter Drain
Waste Mgt-Woodland-Van Buren	MIS210435	Wayne	42.2656	-83.4264	Wilbur Drain
General Permit MIS210000	Storm Water Discharges From Industrial Activities				
H & H Metals-Inkster	MIS210437	Wayne	42.29	-83.3267	Lower Rouge River
Means Industries-Melvindale	MIS210540	Wayne	42.2753	-83.1931	Tyre Drain
US Postal Service-Allen Park	MIS210542	Wayne	42.2878	-83.2019	Allen Drain
Scrap Busters Auto & Truck	MIS210544	Wayne	42.2728	-83.4258	Bell Drain
Steel Technologies Inc	MIS210585	Wayne	42.2658	-83.4867	McKinstry Drain
L & W Engineering Co-No 1	MIS210600	Wayne	42.2561	-83.4456	Bell Drain
Galaxy Precision Products	MIS210601	Wayne	42.2667	-83.5042	Sines Drain
Broomes Auto Parts	MIS210643	Wayne	42.2733	-83.3994	McClaughrey Drain
Collins & Aikman-Westland Oper	MIS210648	Wayne	42.2972	-83.4072	Leng Drain
Bishop Auto Wrecking-Inkster	MIS210657	Wayne	42.2897	-83.3233	Lower Rouge River
Advanced Material Process	MIS210688	Wayne	42.2797	-83.3728	Lower Rouge River
NYX-Cherry Hill-Westland	MIS210764	Wayne	42.3067	-83.2884	Leng Drain
Powertrain Prod-Canton	MIS210791	Wayne	42.2625	-83.4375	Bell Drain
Plastech Eng Prod-Romulus	MIS210801	Wayne	42.2519	-83.4142	McClaughrey Drain
Norfolk Southern-Triple Crown	MIS210815	Wayne	42.2769	-83.1722	Rouge River
Norfolk Southern-Auto Ramp	MIS210816	Wayne	42.2797	-83.1631	Rouge River
Ford-Mich Truck Plt	MIS210829	Wayne	42.2753	-83.4139	Lower Rouge River
General Permit MIS220000	Storm Water Discharges with Required Monitoring				
Red Spot-Westland	MIS220019	Wayne	42.3000	-83.4125	Leng Drain
American Jetway Corp-Wayne	MIS220022	Wayne	42.2792	-83.375	Boyce Drain
SNF Polychemie Inc-Wayne	MIS220025	Wayne	42.2656	-83.4242	Wilbur Drain
Unistrut International Corp	MIS220040	Wayne	42.2761	-83.3900	McClaughrey Drain
General Permit MIS319000	Storm Water Discharges From Industrial Activities				
Woodbridge Corp-Romulus	MIS310219	Wayne	42.2833	-83.1958	Carter Drain
Ford-Allen Park Clay Mine LF	MIS310398	Wayne	42.2833	-83.2058	Allen Drain
Manfredi Motor Transit-Taylor	MIS310432	Wayne	42.2453	-83.2914	Lower Rouge River

Appendix B. Total annual SS loading calculation based on the Simple Method (USEPA, 2001) and concentration and imperviousness data from the Rouge River National Wet Weather Demonstration Program (Cave, 1994).

Land Use	Acres (*Au*)	SS concentration (*Cu*)	Percent Imperviousness (*Iu*)	Annual Precipitation (*P*)	*Pj*	Runoff Coefficient (*Rvu*)*	SS annual load**	Target SS	Target Load	Percent Reduction
WLA										
Residential Med	140769	70	38	32.9	0.9	0.392	25,924,906	--	25,924,906	0
Residential Hi	12228	**97**	51	32.9	0.9	0.509	**4,052,015**	**80**	**3,341,868**	**17.5**
Transportation (MDOT)	7456	**141**	53	32.9	0.9	0.527	**3,718,448**	**80**	**2,109,758**	**43.3**
Commercial	32508	77	56	32.9	0.9	0.554	9,307,152	--	9,307,152	0
Urban Open	17894	51	11	32.9	0.9	0.068	912,620	--	912,620	0
Industrial	23263	**149**	76	32.9	0.9	0.509	**17,075,527**	**80**	**9,168,068**	**46.3**
NPDES Non-storm water Permits							6,621,299	--	6,621,299	0
						WLA Total	*67,611,967*		*57,385,671*	
LA										
Forest/Rural Open	28333	51	2	32.9	0.9	0.068	659,474	--	659,474	0
Water/Wetlands	19684	6	51	32.9	0.9	0.509	403,467	--	403,467	0
Agricultural	15508	**145**	2	32.9	0.9	0.068	**1,026,263**	**80**	**566,214**	**44.8**
						LA Total	*2,089,205*		*1,629,155*	
Total Acres	297643					***Total Load***	***69,701,172***		***59,014,827***	***15.3***

BOLD: Land use categories with background SS runoff concentrations higher than the 80 mg/L target (needing reduction).

* Runoff coefficient (Rvu) is defined as: 0.05+(0.009**Iu*).

** Annual Load is defined as: *P*Pj*Rvu*Cu*Au**2.72/12

Michigan Department of Environmental Quality
Surface Water Quality Division
May 2000

Total Maximum Daily Load (TMDL) for Phosphorus in Strawberry Lake

Location: Strawberry Lake is a 257 acre (104 ha) inland lake of the Huron River located in Livingston County (Figure1). It is the upstream most lake in a chain of lakes including Strawberry, Gallagher, Whitewood, and Baseline Lakes. Strawberry Lake is downstream of four other lakes in which phosphorus TMDLs are being developed, including Brighton, Kent, Limekiln, and Ore Lakes.

Pollutant: Total Phosphorus.

Phosphorus Data and Goal:

Year	Total Phosphorus Concentration (mg/L)	Total Load to Lake (lbs/yr)	Actual Point Source Contribution (lbs/yr)	Nonpoint Source Contribution (lbs/yr)
1978		**16,700**	**9,100**	**7,600**
1997	**0.020**	13,760	**2,067**	11,696
1998	**0.022**	15,130	**1,972**	13,158
1999	**0.022**	**15,575**	**1,794**	**13,781**
Average 1997-99	0.021	14,822	1,944	12,878

	Total Phosphorus Concentration (mg/L)	Loading Capacity (lbs/yr)	Waste Load Allocation (lbs/yr)	Load Allocation (lbs/yr)	Margin of Safety (lbs/yr)
TMDL Goal	0.025	17,100	5,877	11,000	223

Bold numbers indicate actual measured values.

Background: In the 1970s, Strawberry Lake was classified as a eutrophic lake in which phosphorus was identified as the most appropriate nutrient for controlling algae growth (Tierney and Massey, 1979). In 1978, the total phosphorus load to Strawberry Lake was 16,700 pounds/year (lbs/yr) (Tierney and Massey, 1979). Of that 16,700 pounds of phosphorus, approximately 54 percent was from point source contributions and 46 percent was from nonpoint source contributions. In 1980, a point source phosphorus allocation was established by the Water Resources Commission to be protective of Strawberry Lake. This point source allocation included Brighton WWTP, Ford Motor Company-Wixom, Milford WWTP, Northfield Township WWTP, South Lyon WWTP, Vision Metals, and Wixom WWTP, with a total permitted phosphorus discharge upstream of Strawberry Lake of 7,353 lbs/yr. Based on retention in upstream lakes (Tierney and Massey, 1979) approximately 5,825 lbs/yr of the permitted phosphorus loading could potentially reach Strawberry Lake. In August 1991, the Ford Motor Company-Wixom diverted its effluent from the Huron River system to the Wixom WWTP, and its portion of the allocation was given to Wixom WWTP. Currently, the total permitted point source contribution upstream of Strawberry Lake is limited to 8,218 lbs/yr, including Brighton Township WWTP, a newly permitted facility, and General Motors Proving Grounds in Milford. Based on updated retention factors in upstream lakes (Alexander, 2000) approximately 5,877 lbs/yr of the permitted phosphorus loading could potentially reach Strawberry Lake.

Based on the data gathered through 1998, Strawberry Lake is currently meeting designated uses, but was listed as a threatened waterbody on Michigan's 1998 Section 303(d) list of waterbodies needing TMDLs due to the rapid growth in this area. The primary issue identified as threatening Strawberry Lake was nutrient enrichment (phosphorus). This TMDL was developed consistent with the Brighton Lake TMDL, the Kent Lake TMDL, and the Ore Lake TMDL.

In April 1998, a 12-month phosphorus loading analysis was begun to determine the most appropriate predictive phosphorus model for Strawberry Lake (Alexander, 2000). This phosphorus analysis showed a total phosphorus load to Strawberry Lake of 15,575 pounds from April 1998 to March 1999. The April 1999 average spring phosphorus concentration was 0.022 micrograms per liter (mg/L), and the predicted in-lake phosphorus concentration using the Reckhow General Model (Reckhow, 1978) was 0.023 mg/L. Based on comparison of the actual in-lake phosphorus concentration and the predicted phosphorus concentration, the Reckhow General Model was determined to be a good predictor for phosphorus, both for loading and in-lake concentration for Strawberry Lake (Alexander, 2000).

Of the total phosphorus loading to Strawberry Lake from April 1998 to March 1999, 12 percent (1,794 pounds) was attributed to the seven upstream point sources and the remaining 88 percent (13,791 pounds) was attributed to nonpoint source contributions. In 1997, the average spring phosphorus concentration was 0.020 mg/L (Alexander, 1998). Using the Reckhow General Model, total phosphorus loading in the preceding 12 months was estimated to be 13,760 lbs/yr. Of the total loading for 1997, 15 percent was estimated to be from point source contributions and 85 percent from nonpoint source contributions. In 1998, average spring phosphorus concentration was 0.022 mg/L (Alexander, 2000). Using the Reckhow General Model, total phosphorus loading in the preceding 12 months was estimated to be 15,130 lbs/yr with point source contributions making up 13 percent of the total and nonpoint source contributing the remaining 87 percent. Based on this data, the nonpoint source phosphorus contributions account for a much larger portion of the total phosphorus loading today when compared to the 1978 loading results.

A goal of 0.030 mg/L in-lake phosphorus concentration was originally recommended in the draft TMDL for phosphorus in Strawberry Lake, which was public noticed from January 18, 1999 to February 19, 1999. After reviewing the considerable public comments received and considering the existing condition of Strawberry Lake, an in-lake phosphorus concentration goal of 0.025 mg/L was established for Strawberry Lake. This goal will allow the lake to meet the requirements of Water Quality Standards R 323.1060(2) for plant nutrients. This rule states "nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi, or bacteria which are or may become injurious to the designated uses of the waters of the state."

Waste Load Allocation: The waste load allocation was established at 5,877 lbs/yr total phosphorus load to Strawberry Lake, using current National Pollutant Discharge Elimination System permit limits, upstream lake retention factors, and TMDLs for Brighton, Kent, and Ore Lakes. The individual waste load allocations are given in Table 1. Phosphorus loading from the seven point source discharges averaged 1,944 lbs/yr during 1997, 1998, and 1999 (Table 2), significantly less than the 9,100 lbs/yr in 1978.

Load Allocation: The estimated total nonpoint source contribution during 1997, 1998, and 1999 averaged 12,878 lbs/yr with a range of 11,696 lbs/yr to 13,986 lbs/yr. This is more than the 7,600 lbs/yr in 1978 in prior studies. Based on this information, it can be assumed that there is some variability in nonpoint source contributions and that there has been an increase in nonpoint source loading since 1978. Therefore, a load allocation of 11,000 lbs/yr of phosphorus

was established for nonpoint source contributions to Strawberry Lake. This load allocation equates to a reduction of 15 percent (1,878 lbs/yr) from the average phosphorus nonpoint source contributions. The Michigan Department of Environmental Quality anticipates this reduction will be achieved through work to be conducted by the Huron River Watershed Council (HRWC) in the upper Huron River Watershed. It is anticipated that the HRWC will be given a Section 319 Grant to develop best management practices (BMPs) for reduction of the nonpoint source phosphorus contributions in the Kent Lake and Limekiln Lake Watersheds. These reductions should aid in reaching the needed reductions in Strawberry Lake. Additionally, the BMPs developed by the HRWC should be applicable throughout the upper Huron River Watershed and can be applied where appropriate to reach the load allocation goal of the Strawberry Lake TMDL. This will likely occur over the time period that point source loads are increasing. Therefore, it is anticipated that Strawberry Lake will continue to meet the goal of 0.025 mg/L during this period.

Margin of Safety: The remaining 223 lbs/yr of phosphorus loading is allocated to a margin of safety. This is appropriate due to the good predictions found with the model used in the TMDL development process.

Summary: The TMDL for Strawberry Lake allocates 11,000 pounds of phosphorus to nonpoint source loads, 5,877 pounds of phosphorus to point source loads, and 223 pounds for a margin of safety. These loads are necessary on an annual basis to meet the goal of 17,100 lbs/yr total loading and an in-lake total phosphorus concentration of 0.025 mg/L.

References:

Alexander, M. A. 2000. Water quality and phosphorus loading analysis of Strawberry and Limekiln Lakes, Livingston and Oakland Counties, April 1998-September 1999. MDEQ, Surface Water Quality Division, Report #MI/DEQ/SWQ-00/020.

Alexander, M. A. 1999. Water quality and phosphorus loading analysis of Brighton, Kent, and Ore Lakes, Livingston and Oakland Counties, April 1998-April 1999. MDEQ, Surface Water Quality Division, Report #MI/DEQ/SWQ-99/107.

Alexander, M. A. 1998. A nutrient chemistry survey of Brighton, Kent, Ore, Portage, Sandy Bottom, and Strawberry Lakes, Livingston, Oakland, and Washtenaw Counties, April, June, and August 1997. MDEQ, Surface Water Quality Division, Report #MI/DEQ/SWQ-98/010.

Reckhow, K. H. 1978. Quantitative techniques for the assessment of lake quality. Prepared for: Michigan Department of Natural Resources. p. 138.

Tierney, D. and A. Massey. 1979. Water quality and phosphorus loading analysis of Strawberry Lake, Livingston County, 1977-1978. MDEQ, Surface Water Quality Division, Report #84590.

Prepared by: Michael Alexander, Aquatic Biologist
Great Lakes and Environmental Assessment Section
Surface Water Quality Division
Michigan Department of Environmental Quality
March 16, 2000

Table 1. Current permit limits and waste load allocations for facilities discharging upstream of Strawberry Lake.

Facility	Current Limits (lbs/yr)	Percent Retention in Upstream Lake*	Waste Load Allocation to Strawberry Lake (lbs/yr)
Brighton WWTP	600	40	360
Brighton Twp WWTP	525	0	525
GM Proving Grounds Milford	340	0	340
Milford WWTP	900	22	702
Northfield Twp WWTP	1,826	0	1,826
South Lyon WWTP	1,387 (800)**	50	400
Vision Metals	840 (640)**	50	320
Wixom WWTP	1,800	22	1,404

*Based on retention factors of 22 percent for Kent Lake, 50 percent for Nichwagh/Limekiln/Sandy Bottom Lakes (combined), and 40 percent for Ore Lake. These retention factors are based on the average retention of the Ore Lake and Kent Lake 1978 and 1999 data (Tierney and Massey, 1975 and Alexander, 1999). The 50 percent retention for Nichwagh Chain of Lakes was selected due to the uncertainty associated with the loading data collected during the two sampling periods.
**These are the proposed new annual phosphorus permit limits of 800 pounds per year for South Lyon WWTP and 640 pounds per year for Vision Metals. The column for Waste Load Allocation to Strawberry Lake depicts potential loading to Strawberry Lake with the new permit limits for South Lyon and Vision Metals.

Table 2. Recent actual phosphorus data for facilities discharging upstream of Strawberry Lake.

Facility	Year	Design flow (MGD)	Avg. flow (MGD)	Total load (lbs/yr)	Percent retention in upstream lake*	Load to Strawberry Lake (lbs/yr)
Brighton WWTP	1997	1.52	1.01	100	40*	60
	1998		1.17	139	40*	83
	1999		1.17	109	35**	71
Milford WWTP	1997	1.04	0.44	178	22*	139
	1998		0.74	187	22*	146
	1999		0.59	261	13**	227
GM Proving Grounds Milford	1997	0.45	0.18	215	0	215
	1998		0.16	206	0	206
	1999		0.15	182	0	182
Northfield Twp WWTP	1997	3	0.84	521	0	521
	1998		0.86	378	0	378
	1999		0.67	200	0	200
South Lyon WWTP	1997	1.5	1.04	281	50*	141
	1998		0.99	289	50*	145
	1999		0.98	341	72**	95
Vision Metals	1997	1.0	0.35	145	50*	73
	1998		0.43	262	50*	131
	1999		0.38	187	72**	52
Wixom WWTP	1997	2.8	2.34	1177	22*	918
	1998		2.34	1132	22*	883
	1999		2.41	1112	13**	967

* Based on retention factors of 22 percent for Kent Lake, 50 percent for Nichwagh/Limekiln/Sandy Bottom Lakes (combined), and 40 percent for Ore Lake. These retention factors are based on the average retention of the 1978 and 1999 data (Tierney and Massey, 1979 and Alexander, 1999).
** Based on retention factors from the 1999 data only (Alexander, 1999).

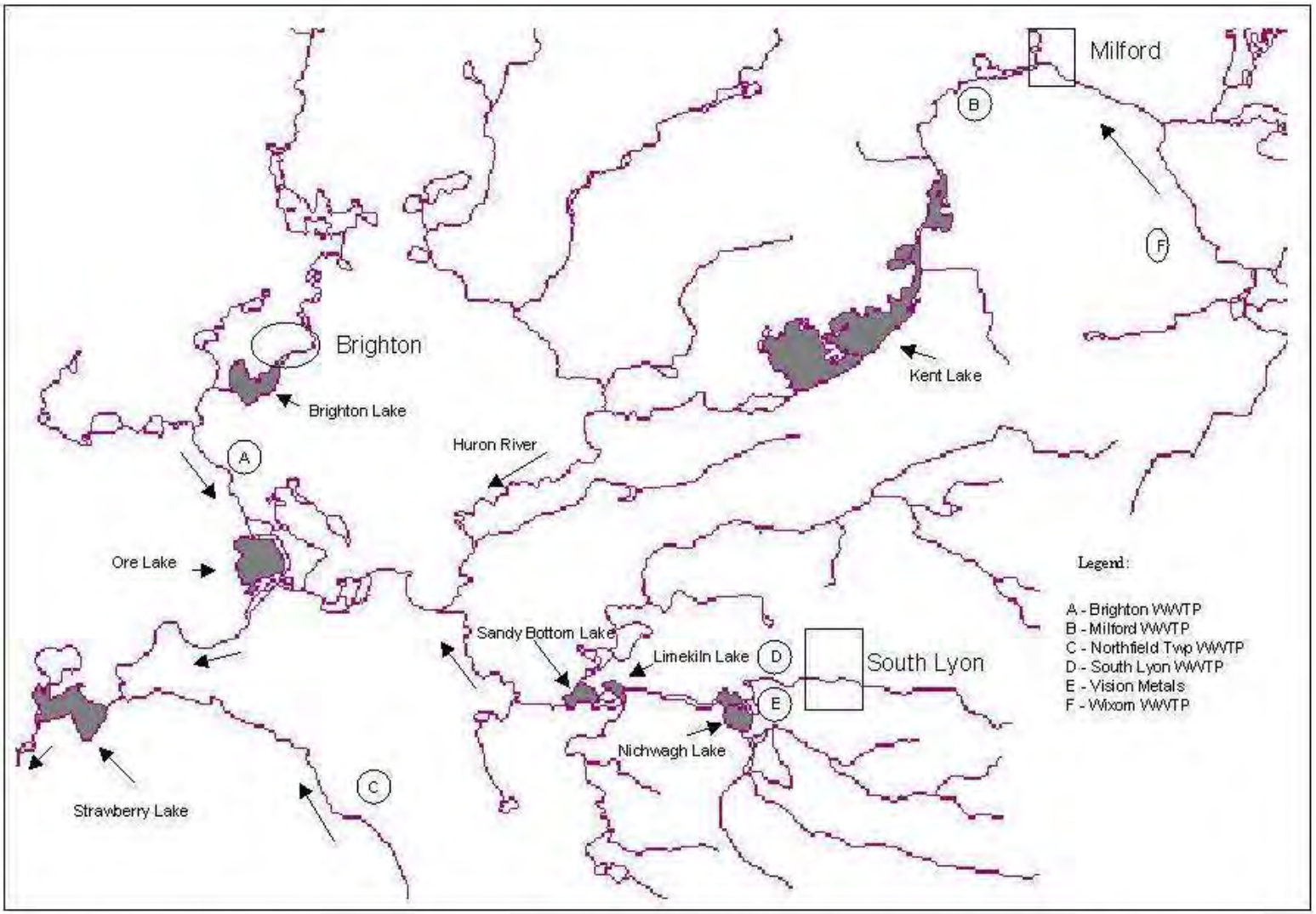


Figure 1. Upper Huron River watershed showing the five TMDL lakes Brighton, Kent, Limekiln, Ore, and Strawberry Lake and the current point source discharges.

APPENDIX F

Contact Agency Letters



1 - Augusta Drain	11 - Sprague Drain
2 - Mainland Drain	12 - GWK Parking Lot
3 - Lower Straits Lake	13 - Catalpa Park
4 - Hamlin Drain	14 - Red Oaks Water Park
5 - Patterson Holly Drain	15 - Lane Drain Phase II
6 - Nelson Drain	16 - Sylvan Glen Phase III
7 - Silvercrest Drain	17 - WaterTowns
8 - Pontiac Creek Extension	
9 - Minnow Pond Drain	
10 - Pebble Creek Drain	

Legend

- Project Sites
- Watershed Boundary
- Municipal Boundary
- Hydrology
- Lakes

Document Path: Y:\2022021\2022021803_Studies\Working\Project_Plan\Project Background\GIS\20220414_County_Projects.mxd

Figure II-3

County Wide Project Locations
SRF Project Plan 2022

N W E S

0 2.5 5 10 Miles

WRC WATER RESOURCES COMMISSIONER *Jim Nash*

HRC HUBBELL, ROTH & CLARK, INC CONSULTING ENGINEERS SINCE 1915

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824

SHIPPING: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360

PHONE: 248-454-6300
WEBSITE: hrcengr.com

April 8, 2022

Bay Mills Indian Community
12140 W. Lakeshore Drive
Brimley, MI 49715

Attn: Paula Carrick, THPO

Re: Oakland County at Large 2022 SRF Project Plan HRC Job No. 20220218

Dear Ms. Carrick:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

- Augusta Drain (City of Pontiac) - Green Infrastructure
- Mainland Drain (Waterford Township) - Stormwater Wetlands and Stream Restoration
- Lower Straits Lake (Commerce Township) - County Drain Establishment and Restoration
- Hamlin Drain (Bloomfield Hills) -Regional Stormwater Detention Facility
- Patterson Holly Drain (Holly Township) - Drain Restoration
- Nelson Drain (City of Troy) - Bank Stabilization and Sediment Trap
- Silvercrest Drain (City of Pontiac) - Regional Stormwater Detention Facility
- Pontiac Creek Extension (Waterford Township & City of Pontiac) Wetland and Stream Restoration
- Minnow Pond Drain (City of Farmington Hills) – Water Quality Improvements
- Pebble Creek Drain (City of Farmington Hills) - Drain Restoration
- Sprague Drain (City of Troy) -Pond and Stream Restoration
- GWK Parking Lot (City of Madison Heights) - Green Infrastructure Improvements
- Catalpa Park (City of Southfield) - Green Infrastructure Improvements
- Red Oaks Water Park (City of Madison Heights) - Green Infrastructure Improvements
- Lane Drain Phase II (City of Troy) - Drain Restoration
- Sylvan Glen Phase III (City of Troy) - Habitat Restoration
- Water Towns (City of Pleasant Ridge) - Green Infrastructure Improvements

The SRF Project Plan requirements state that your office is to be notified so that a determination can be made of whether the new proposed projects could impact religious or culturally significant tribal lands in the vicinity of the project. Maps of the project areas are attached.

Please review the attachments and provide a written response regarding impact or no impact to your tribal lands. If you have any questions or would like any additional information, please contact the undersigned.

Very truly yours,

HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

Attachment

c: OCWRC; Lynne Seymour
HRC; A. Allen, J. Burton

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824

SHIPPING: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360

PHONE: 248-454-6300
WEBSITE: hrcengr.com

April 8, 2022

Grand Traverse Band of Ottawa and Chippewa Indians
2605 N. West Bay Shore Drive
Peshawbetown, MI 49682

Attn: Sammie McClellan-Dyal

Re: Washtenaw County 2022SRF Project Plan Update HRC Job No. 20220218

Dear Sammie:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

- Augusta Drain (City of Pontiac) - Green Infrastructure
- Mainland Drain (Waterford Township) - Stormwater Wetlands and Stream Restoration
- Lower Straits Lake (Commerce Township) - County Drain Establishment and Restoration
- Hamlin Drain (Bloomfield Hills) -Regional Stormwater Detention Facility
- Patterson Holly Drain (Holly Township) - Drain Restoration
- Nelson Drain (City of Troy) - Bank Stabilization and Sediment Trap
- Silvercrest Drain (City of Pontiac) - Regional Stormwater Detention Facility
- Pontiac Creek Extension (Waterford Township & City of Pontiac) Wetland and Stream Restoration
- Minnow Pond Drain (City of Farmington Hills) – Water Quality Improvements
- Pebble Creek Drain (City of Farmington Hills) - Drain Restoration
- Sprague Drain (City of Troy) -Pond and Stream Restoration
- GWK Parking Lot (City of Madison Heights) - Green Infrastructure Improvements
- Catalpa Park (City of Southfield) - Green Infrastructure Improvements
- Red Oaks Water Park (City of Madison Heights) - Green Infrastructure Improvements
- Lane Drain Phase II (City of Troy) - Drain Restoration
- Sylvan Glen Phase III (City of Troy) - Habitat Restoration
- Water Towns (City of Pleasant Ridge) - Green Infrastructure Improvements

The SRF Project Plan requirements state that your office is to be notified so that a determination can be made of whether the new proposed projects could impact religious or culturally significant tribal lands in the vicinity of the project. Maps of the project areas are attached.

Please review the attachments and provide a written response regarding impact or no impact to your tribal lands. If you have any questions or would like any additional information, please contact the undersigned.

Very truly yours,

HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

Attachment

c: OCWRC; Lynne Seymour
HRC; N. Kolinski, J. Burton

From: Marcella Hadden <MlHadden@sagchip.org>
Sent: Tuesday, April 19, 2022 8:20 AM
To: Purdy, Christine
Subject: RE: Oakland County Project Inquiry

I always like to know what the State determines first. I can check with them as this is such a large area. Thank you.

Marcella L Hadden
TRIBAL HISTORIC PRESERVATION OFFICER
THPO
Tribal Historic Preservation Office
6650 E. Broadway
Mt. Pleasant, MI 48858
989.775.4751
mlhadden@sagchip.org

From: Purdy, Christine [mailto:CPurdy@hrcengr.com]
Sent: Friday, April 15, 2022 9:12 AM
To: Marcella Hadden
Subject: [External E-Mail] RE: Oakland County Project Inquiry

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or on clicking links from unknown senders.
Good morning Marcella,

I contacted all the THPOs and representatives according to the list provided on MiPlace (Michigan Tribal Historic Preservation Officers and Tribal Cultural Representatives | MiPlace). Is there anyone else I should contact in addition? This is my first time writing these letters and I want to ensure all the proper representatives have been contacted.

Sincerely,

Christine Purdy
Staff Environmental Analyst
Hubbell, Roth and Clark, Inc.
555 Hulet Drive
P.O. Box
Bloomfield Hills, MI 48303-0824
Mobile: 248-535-6178
Email: cpurdy@hrcengr.com

Engineering. Environment. Excellence.

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

From: Marcella Hadden <MlHadden@sagchip.org>
Sent: Thursday, April 14, 2022 3:27 PM
To: Purdy, Christine <CPurdy@hrcengr.com>
Subject: RE: Oakland County Project Inquiry

Hi Christine - has the SHPO been made aware of this and have they approved that all the locations are clear?

THPO

Marcella L Hadden
TRIBAL HISTORIC PRESERVATION OFFICER
Tribal Historic Preservation Office
6650 E. Broadway
Mt. Pleasant, MI 48858
989.775.4751
mlhadden@sagchip.org

From: Purdy, Christine [CPurdy@hrcengr.com]
Sent: Sunday, April 10, 2022 2:58 PM
To: William Johnson
Cc: Kolinski, Nancy, J; Marcella Hadden
Subject: [External E-Mail] RE: Oakland County Project Inquiry

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or on clicking links from unknown senders.

Mr. Johnson,

My sincere apologies. Thank you for directing me to the correct contact.

Ms. Hadden, it is nice to meet you. I look forward to hearing from you.

I hope you all are enjoying your weekend.

Sincerely,

Christine

From: William Johnson <WJohnson@sagchip.org>
Sent: Friday, April 8, 2022 5:05 PM

To: Purdy, Christine <CPurdy@hrcengr.com>
Cc: Kolinski, Nancy, J <NKolinski@hrcengr.com>; Marcella Hadden <MlHadden@sagchip.org>
Subject: RE: Oakland County Project Inquiry

Ms. Purdee, Marcella Hadden is the Saginaw Chippewa Indian Tribe of Michigan's Tribal Historic Preservation Officer. I have cc'd her on this email. She is out of the office until Tuesday, April 12, 2022. Please consider yourselves electronically introduced. Willie J.

William Johnson, Interim Director
Ziibiwing Center of Anishinabe Culture & Lifeways
6650 E. Broadway
Mt. Pleasant, Michigan 48858
1-989-775-4730



From: Purdy, Christine [mailto:CPurdy@hrcengr.com]
Sent: Friday, April 08, 2022 3:32 PM
To: William Johnson
Cc: Kolinski, Nancy, J
Subject: [External E-Mail] Oakland County Project Inquiry

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or on clicking links from unknown senders.
Good afternoon William,

Hubbell, Roth, & Clark is working with Oakland County Water Resources Commissioner to apply for funding through Michigan's Clean Water State Revolving Fund Loan Program for 17 construction projects across Oakland County. We are required to gather input from Tribal Preservation Officers to ensure protection of religious and cultural lands.

Please let us know if **any** of the proposed projects impact religious or culturally significant tribal lands.

If you have any questions, comments, or concerns please let me know as soon as you are able.

Thank you,

Christine Purdy
Staff Environmental Analyst
Hubbell, Roth and Clark, Inc.
555 Hulet Drive
P.O. Box
Bloomfield Hills, MI 48303-0824
Mobile: 248-535-6178
Email: cpurdy@hrcengr.com

Engineering. Environment. Excellence.

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CONSULTING ENGINEERS SINCE 1915

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MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824

SHIPPING: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360

PHONE: 248-454-6300
WEBSITE: hrcengr.com

April 8, 2022

Match-E-Be-Nash-Shee-Wish Gun Lake Band of Potawatomi Indians
2872 Mission Drive
Shelbyville, MI 49344

Attn: Lakota Pochedley

Re: Washtenaw County 2022 SRF Project Plan Update HRC Job No. 20220218

Dear Lakota:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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- Water Towns (City of Pleasant Ridge) - Green Infrastructure Improvements

The SRF Project Plan requirements state that your office is to be notified so that a determination can be made of whether the new proposed projects could impact religious or culturally significant tribal lands in the vicinity of the project. Maps of the project areas are attached.

Please review the attachments and provide a written response regarding impact or no impact to your tribal lands. If you have any questions or would like any additional information, please contact the undersigned.

Very truly yours,

HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

Attachment

c: OCWRC; Lynne Seymour
HRC; N. Kolinski, J. Burton

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824

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Bloomfield Hills, MI 48302-0360

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WEBSITE: hrcengr.com

April 8, 2022

Hannahville Potawatomi Indian Community
N-14911 Hannahville B-1 Road
Wilson, MI 49896

Attn: Cory Sagataw

Re: Washtenaw County 2022SRF Project Plan Update HRC Job No. 20220218

Dear Cory:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

Attachment

c: OCWRC; Lynne Seymour
HRC; N. Kolinski, J. Burton

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Bloomfield Hills, MI 48303-0824

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Bloomfield Hills, MI 48302-0360

PHONE: 248-454-6300
WEBSITE: hrcengr.com

April 8, 2022

Keweenaw Bay Indian Community
16429 Bear Town Road
Baraga, MI 49908

Attn: Alden Connor, THPO

Re: Washtenaw County 2022SRF Project Plan Update HRC Job No. 20220218

Dear Mr. Connor:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

Attachment

c: OCWRC; Lynne Seymour
HRC; A. Allen, J. Burton

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Bloomfield Hills, MI 48302-0360

PHONE: 248-454-6300
WEBSITE: hrcengr.com

April 8, 2022

Lac Vieux Desert Band of Lake Superior Chippewa Indians
P.O. Box 249
Watersmeet, MI 49908

Attn: Alina Shively, THPO

Re: Washtenaw County 2022 SRF Project Plan Update HRC Job No. 20220218

Dear Ms. Shively:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

Attachment

c: OCWRC; Lynne Seymour
HRC; N. Kolinski, J. Burton

HUBBELL, ROTH & CLARK, INC
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MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824

SHIPPING: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360

PHONE: 248-454-6300
WEBSITE: hrcengr.com

April 8, 2022

Little River Band of Ottawa Indians
2608 Government Center Drive
Manistee, MI 49660

Attn: Jonnie J. Sam, Director

Re: Washtenaw County 2022 SRF Project Plan Update HRC Job No. 20220218

Dear Jonnie:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

Attachment

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April 8, 2022

Little Traverse Bay Band of Odawa
7500 Odawa Circle
Harbor Springs, MI 49740

Attn: Melissa Wiatrolik, THPO

Re: Washtenaw County 2022SRF Project Plan Update HRC Job No. 20220218

Dear Melissa:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

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HRC; N. Kolinski, J. Burton

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Bloomfield Hills, MI 48302-0360

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WEBSITE: hrcengr.com

April 8, 2022

Nottawaseppi Band of Huron Potawatomi
1301 T Drive S
Fulton, MI 49052

Attn: Douglas R. Taylor, THPO

Re: Washtenaw County 2022 SRF Project Plan Update HRC Job No. 20220218

Dear Douglas:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

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WEBSITE: hrcengr.com

April 8, 2022

Pokagon Band of Potawtomi
58620 Sink Road
Dowagiac, MI 49047

Attn: Matthew J.N. Bussler, THPO

Re: Washtenaw County 2022 SRF Project Plan Update HRC Job No. 20220218

Dear Mr. Bussler:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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April 8, 2022

Saginaw Chippewa Indian Tribe of MI
6650 E. Broadway
Mt. Pleasant, MI 48858

Attn: Marcella Hadden, THPO

Re: Washtenaw County 2022 SRF Project Plan Update HRC Job No. 20220218

Dear Marcella:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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April 8, 2022

Sault Ste. Marie Tribe of Chippewa
2 Ice Circle Chi Mukwa
Sault Ste. Marie, MI 49783

Attn: Marie R. Richards

Re: Washtenaw County 2022 SRF Project Plan Update HRC Job No. 20220218

Dear Marie:

Oakland County Water Resources Commissioner is submitting a 2022 State Revolving Fund (SRF) Project Plan through the Michigan Department of Environment Great Lakes and Energy (EGLE) to improve water quality within Oakland County. A project plan is required as the first step in applying for an SRF loan. HRC is preparing the application to fund these water quality improvements for 17 projects. Please see attached maps for locations of the projects throughout Oakland County. These water quality improvements include streambank stabilization, increasing detention basin storage, adding rain gardens, and improving wetland habitat, to name a few. For the 2022 SRF Project Plan, there are a total of 17 projects including:

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- Minnow Pond Drain (City of Farmington Hills) – Water Quality Improvements
- Pebble Creek Drain (City of Farmington Hills) - Drain Restoration
- Sprague Drain (City of Troy) -Pond and Stream Restoration
- GWK Parking Lot (City of Madison Heights) - Green Infrastructure Improvements
- Catalpa Park (City of Southfield) - Green Infrastructure Improvements
- Red Oaks Water Park (City of Madison Heights) - Green Infrastructure Improvements
- Lane Drain Phase II (City of Troy) - Drain Restoration
- Sylvan Glen Phase III (City of Troy) - Habitat Restoration
- Water Towns (City of Pleasant Ridge) - Green Infrastructure Improvements

The SRF Project Plan requirements state that your office is to be notified so that a determination can be made of whether the new proposed projects could impact religious or culturally significant tribal lands in the vicinity of the project. Maps of the project areas are attached.

Please review the attachments and provide a written response regarding impact or no impact to your tribal lands. If you have any questions or would like any additional information, please contact the undersigned.

Very truly yours,

HUBBELL, ROTH & CLARK, INC.



Christine Purdy
Staff Environmental Analyst
cpurdy@hrcengr.com

Attachment

c: OCWRC; Lynne Seymour
HRC; N. Kolinski, J. Burton

APPENDIX G

SITE PHOTOS



Photo 1 – Perry Park: Green Infrastructure Improvements


Photo 2 – Perry Park: Green Infrastructure Improvements



Photo 3 – Oakland Park: Green Infrastructure Improvements



Photo 4 – Oakland Park: Green Infrastructure Improvements



Photo 5 – Red Oaks Water Park: Green Infrastructure Improvements


Photo 6 – Red Oaks Water Park: Green Infrastructure Improvements



Photo 7 – Lower Straits Lake: County Drain Establishment & Restoration



Photo 8 – Lower Straits Lake: County Drain Establishment & Restoration



Photo 9 – Hamlin Drain: Regional Stormwater Detention Facility



Photo 10 – Hamlin Drain: Regional Stormwater Detention Facility



Photo 11 – Patterson Holly Drain Restoration



Photo 12 – Patterson Holly Drain Restoration



Photo 13 – Nelson Drain: Bank Stabilization and Sediment Trap



Photo 14 – Nelson Drain: Bank Stabilization and Sediment Trap



Photo 15 – Pontiac Creek Extension: Wetland & Stream Restoration



Photo 16 – Pontiac Creek Extension; Wetland & Stream Restoration



Photo 17 – Minnow Pond Drain: Flood Control Basin Conversion



Photo 18 – Minnow Pond Drain: Flood Control Basin Conversion



Photo 19 – Pebble Creek Drain Restoration



Photo 20 – Pebble Creek Drain Restoration



Photo 21 – Sprague Drain: Pond & Stream Restoration



Photo 22 – Sprague Drain: Pond & Stream Restoration



Photo 23 – Catalpa Park: Green Infrastructure Improvements



Photo 24 – Catalpa Park: Green Infrastructure Improvements



Photo 25 – Lane Drain Restoration: Phase II



Photo 26 – Lane Drain Restoration: Phase II



Photo 27 – Sylvan Glen Habitat Restoration: Phase III



Photo 28 – Sylvan Glen Habitat Restoration: Phase III



Photo 29 – WaterTowns Green Infrastructure Improvements
Cambridge Blvd/Oxford Blvd Intersection Pavement Reduction & Bioretention

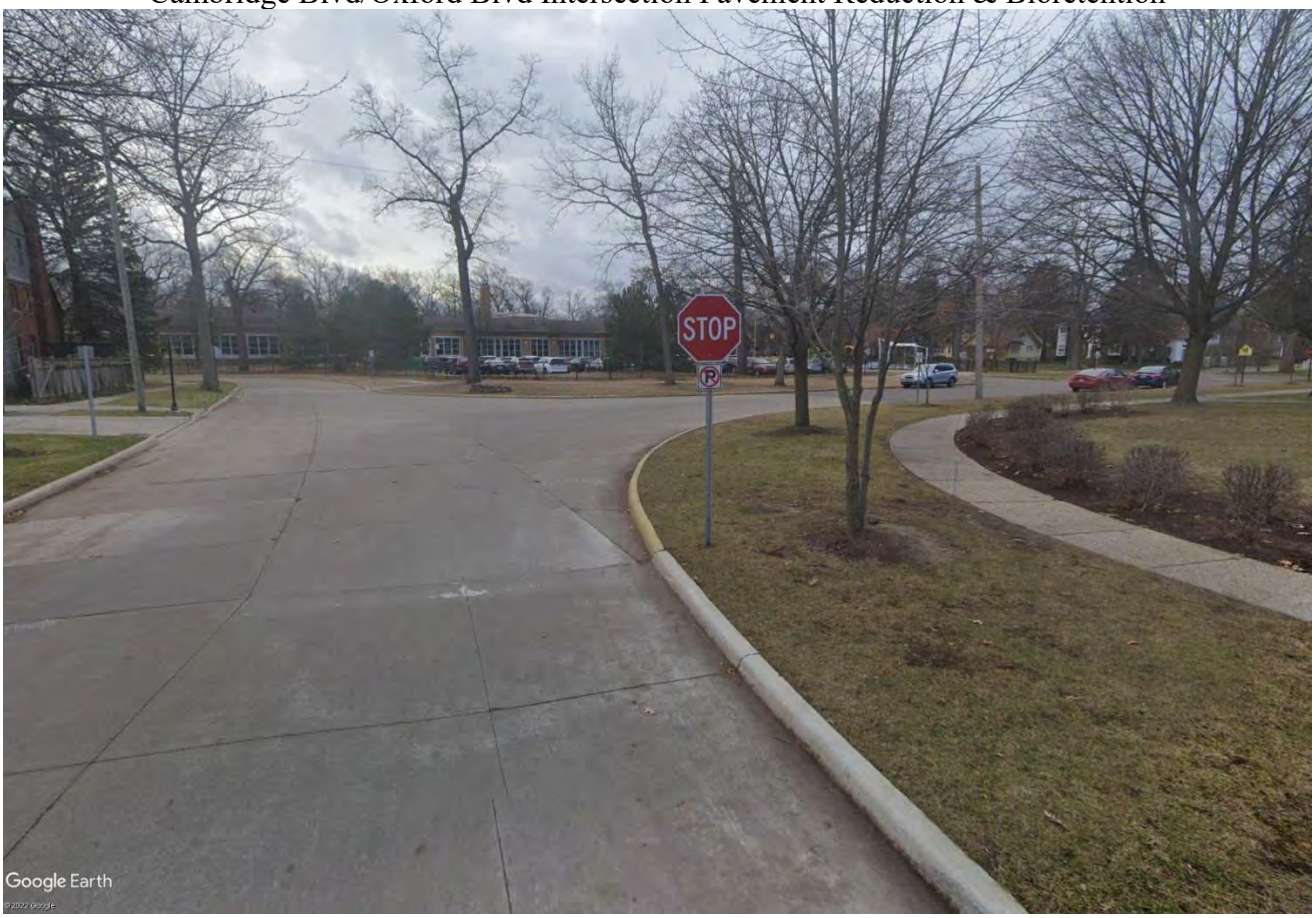


Photo 30 – WaterTowns Green Infrastructure Improvements
Cambridge Blvd/Oxford Blvd Intersection Pavement Reduction & Bioretention



Photo 31 – WaterTowns Green Infrastructure Improvements
Poplar Blvd Bioretention Swale



Photo 32 – WaterTowns Green Infrastructure Improvements
Poplar Blvd Bioretention Swale



Photo 33 – WaterTowns Green Infrastructure Improvements
Poplar Blvd Bioretention End Caps

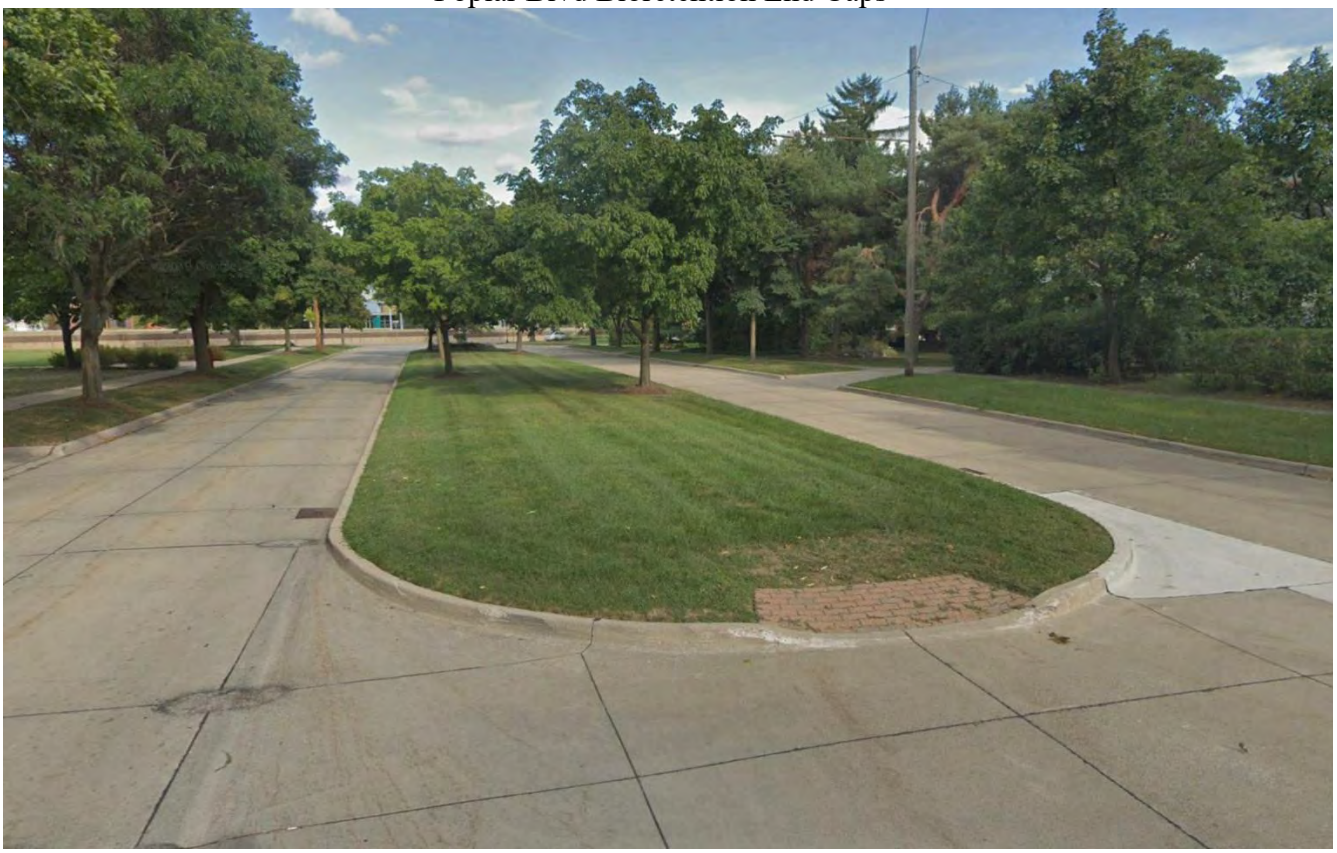


Photo 34 – WaterTowns Green Infrastructure Improvements
Poplar Blvd Bioretention End Caps



Photo 35 - WaterTowns Green Infrastructure Improvements
Elm Blvd Bioretention



Photo 36 - WaterTowns Green Infrastructure Improvements
Elm Blvd Bioretention



Photo 37 - WaterTowns Green Infrastructure Improvements
Police Dept. Permeable Pavers

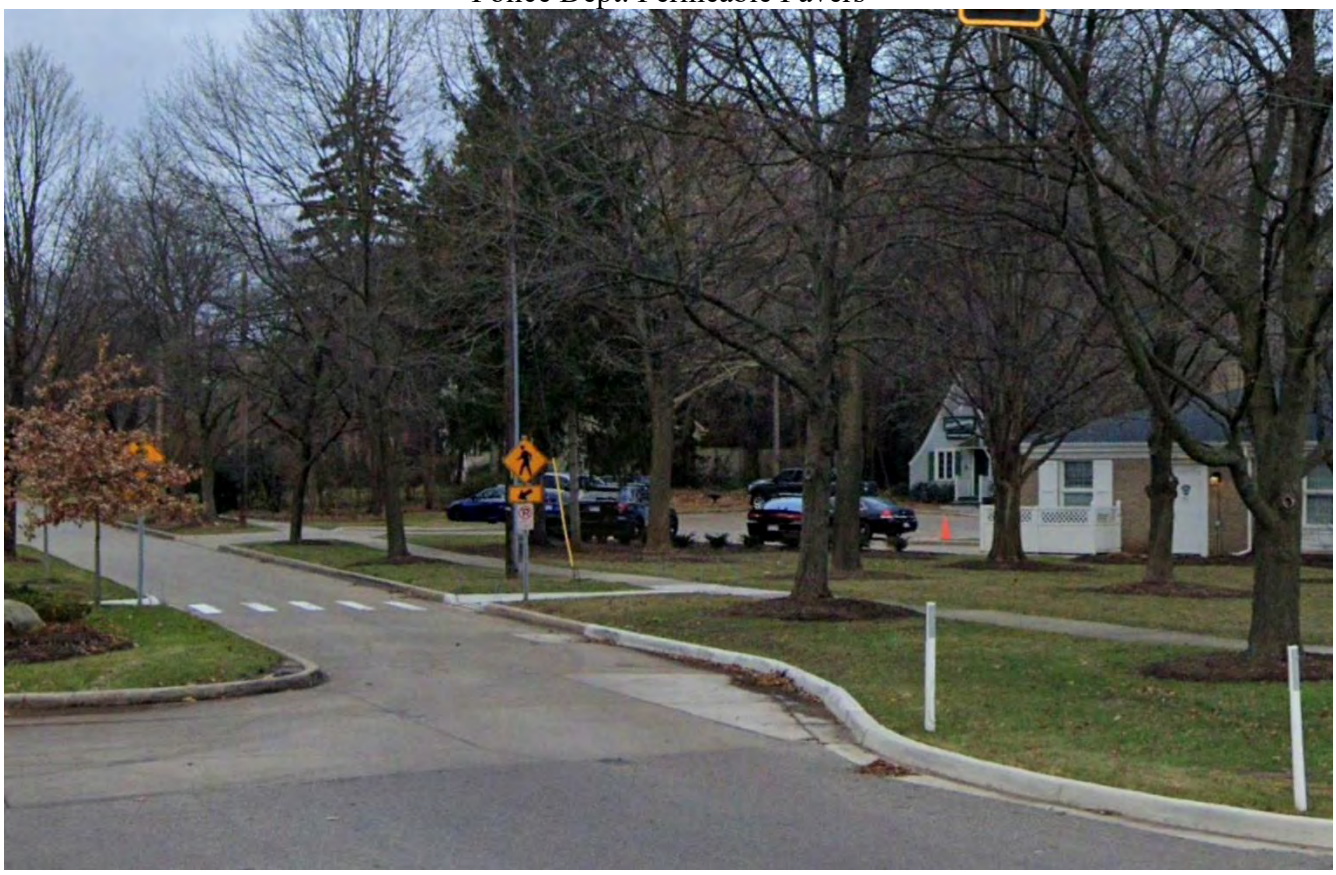


Photo 38 - WaterTowns Green Infrastructure Improvements
Police Dept. Permeable Pavers

APPENDIX H

WATERSHED MANAGEMENT PLAN

Chapter 1
Executive Summary

Clinton River Subwatersheds

The Clinton River Watershed includes seven (7) subwatersheds, three (3) of which are subwatersheds of the main Clinton River, the other four (4) of which are subwatersheds of the major tributaries entering the Clinton River. These subwatersheds are smaller areas with similar features, land uses and drainage patterns that help to facilitate effective watershed planning activities.

Clinton Main Subwatershed

The Clinton Main subwatershed is over 70 square miles in area and is located within the central portion of Oakland County. A total of twelve (12) communities, one (1) county, two (2) school districts and one (1) university are located within this subwatershed are listed as follows:

- Avondale Schools
- City of Auburn Hills
- Bloomfield Township
- City of Keego Harbor
- City of Lake Angelus
- Oakland County
- Oakland University
- City of Orchard Lake Village
- Orion Township
- City of Pontiac
- City of Rochester
- City of Rochester Hills
- Rochester Schools
- City of Sylvan Lake
- Waterford Township
- West Bloomfield Township

Each of these representatives has received a storm water permit (Permit No. MIG619000) from the Michigan Department of Environmental Quality NPDES Phase II Storm Water Permit program. This means that each of these permittees has watershed coverage for storm water discharges from municipal separate storm sewer systems (MS4s) and which are subject to watershed plan requirements. In addition to the above listed permittees, the Clinton River Watershed Council (CRWC) is also very active in each of the subwatersheds previously listed and also provides extensive opportunities for involvement by communities, businesses and other volunteers to help improve the quality of the natural resources within the watershed. Although the watershed council is not covered under the MDEQ Phase II permit program, services are provided to the communities to help meet the permit requirements. These invaluable services help communities and other permitted representatives economically share the costs associated with meeting the storm water permit requirements.



Clinton Main Subwatershed Open House

Purpose of the Clinton Main Subwatershed Management Plan

One component of the Phase II permit requirements includes developing a subwatershed management plan for the Clinton Main Subwatershed. The representatives identified above, along with other

subwatershed stakeholders, have collectively prepared this plan as part of an overall effort to develop management plans for all seven (7) subwatersheds within the Clinton River basin. The purpose of the Clinton Main Subwatershed Management Plan is to create a vision for long-term protection and restoration of the Clinton Main branch and its associated tributaries. Successful watershed planning encompasses multiple disciplines, including planning, engineering, ecology, wildlife/habitat, recreation as well as many more. An understanding of the interrelationships of these disciplines is crucial to implementing watershed management activities.

This Clinton Main Subwatershed Management Plan describes the existing conditions and characteristics within the subwatershed. The existing conditions describe a variety of topics including Land Use Planning, Landscape Characteristics, River Flow Characteristics, River Water Quality, Physical Characteristics, Biological Conditions, Quality of Lakes, State of Public Opinion and finally a description of prioritized findings within the subwatershed. Following existing conditions, goals and objectives for the subwatershed are outlined for long-term protection and restoration of the river. Goals and objectives are then accompanied by actions, sometimes referred to as best management practices and management alternatives. Each of the representatives has also indicated their commitments to implementing these actions or management alternatives within their own jurisdiction in order to ultimately achieve the objectives and long-term goals of the subwatershed.

Current Conditions in the Clinton Main Subwatershed

Current conditions or existing characteristics of the subwatershed are reflected by a variety of attributes, all of which have a role in the quality of the subwatershed.


Orchard Lake

Land use types are varied across the subwatershed. The top land use in the Clinton Main Subwatershed is single family residential. This accounts for more than 27% of the subwatershed, and points to the importance of citizen action and education in the improvement of water quality. Road right-of-ways account for 13% of the land use within the subwatershed, showing the extent of intense development throughout the urban areas of the subwatershed. Another significant land use is vacant land, accounting for 12% of the subwatershed. A unique characteristic of this subwatershed is the amount of surface waters, or lakes. They account for 10% of the land area in the subwatershed. Many of the large lakes in the subwatershed were created by impounding streams in the western portion of the subwatershed. Historically, the shorelines of the lakes were developed as summertime retreats, with cottages and recreational amenities. Over time, communities were built up around the lakes, and the cottages were renovated into year-round homes. The impoundments present many challenges for water quality. These include runoff from lawns and roadways, lack of shoreline vegetation, water temperature, sediments built up behind dams/water level control structures, and dams acting as impediments to fish migration, among others.

Communities within this subwatershed are experiencing both development and redevelopment, both of which present unique challenges to managing the water resources. Communities experiencing development pressures are also faced with managing unique natural features and ecosystems all the while implementing storm water best management practices that will minimize further impacts to the river.

Communities undergoing redevelopment face challenges with retrofitting existing sites to properly manage storm water runoff so as to reduce flow and water quality impacts.

As this subwatershed undergoes continued development and redevelopment, it will be important to identify opportunities for minimizing impacts associated with increased impervious surfaces. At the same time, communities are focused on evaluating opportunities for enhancing existing conditions of the river, providing access to the watershed resources and improving public education regarding the importance of individual actions.

Water Quality Impairments of the Clinton Main Subwatershed

Current water quality impairments in the Clinton Main Subwatershed have been evaluated through a variety of methods during this watershed planning timeframe. These methods have included detailed sampling studies, long-term geomorphic and flow analyses, computer modeling of nonpoint source pollutants and field surveys of macroinvertebrates, bank erosion and physical riparian characteristics. Primary pollutants associated with the Clinton Main subwatershed are further described as follows:

- Hydrology – USGS gages along the Clinton Main and Galloway Creek have shown large increases in both Annual Mean Stream Flow and Peak Stream Flows over the last forty years. Bankfull flows which are equivalent to a 1.5-year rain event, are significant to analyze for a watershed because these flows are "channel forming" due to their frequent occurrence. Therefore, significant increases in the bankfull flows often indicate a stream's instability leading to high amounts of bank erosion. The bankfull flow trend has also shown a significant increase over the last forty years and which is indicative of the increase in impervious surface within the subwatershed. It's also important to note that the water level control structures located within the Clinton Main also have a significant impact on the downstream Clinton River conditions. It is for these combined reasons, that flow and hydrology be effectively managed so as not to further impact the valuable resources of the Clinton River.

- Sediment – Sediment is one of the primary pollutants within the Clinton Main subwatershed. Sediment load into the creeks and river is often much higher during wet weather (or rain events) than dry weather loadings, indicating storm water runoff as the conveyance medium for sediments. In addition, sediment from bank erosion, due to fluctuating flows in the creeks and river, is also a significant contributor to the sediment load within the river system. Sediment within the water column reduces dissolved oxygen concentrations, decreases light penetration for aquatic plants, clogs gills of aquatic organisms and fish, and impairs the aesthetic and recreational uses of the river.

- Nutrients – Phosphorus is the primary nutrient of concern throughout the Clinton River Watershed, including this subwatershed. Sources of phosphorus include fertilizers from lawns, golf courses, failing septic systems, pet and waterfowl wastes and illicit connections between sanitary and storm sewers. Excessive amounts of phosphorus cause aquatic plants to grow out of control and algae blooms are common. These problems are well documented both instream and in upstream lakes and privately/publicly-owned detention ponds and other structure best management practices. Management of phosphorus is most successful by controlling the source as opposed to solely treating the problems observed.

- Bacteria – Excessive levels of bacteria can impair both the aquatic community and threaten public health. Sampling results have demonstrated high concentrations during rain events demonstrating that storm water runoff is a significant source of bacteria into the river. Elevated concentrations can be attributed to pet and waterfowl waste, illicit connections and typically failing septic systems.

Other pollutants are further described in Chapters 3 and 4 of this plan; however, the four described here provide the main focus for the development of the goals, objectives and actions of this plan.

Goals and Objectives of the Clinton Main Subwatershed

Listed below are the collective long-term goals and short-term objectives as agreed upon by the subwatershed representatives:

Goal 1: Reduce sources of pollution.

Objectives:

1.A. Develop/enhance ordinances, guidelines and/or standards as appropriate, to reduce pollutant loading.

1.B. Develop educational stewardship programs promoting source control to the public.



Clinton River Fishing: photo courtesy of CRWC Nina Ignaczak 2001

1.C. Encourage establishment and implementation of innovative BMP programs for effective reduction of pollutants.

Goal 2: Increase public understanding of their role in protecting and enhancing watershed resources.

Objectives:

2.A. Develop and/or promote existing and future public education and outreach programs.

2.B. Promote and encourage participation in educational opportunities for land-use decision makers.

2.C. Collaborate with the Clinton River Watershed Council, the Clinton River Public Advisory Council, SEMCOG, and other regional groups on watershed-wide activities.



River Woods Park: photo courtesy of CRWC Jessica Opfer 2003

Goal 3: Protect and restore Clinton River fisheries.

Objectives:

3.A. Develop and implement a fisheries restoration/enhancement plan.

3.B. Collaborate with and support efforts by regional groups, such as Trout Unlimited (TU) and Michigan Department of Natural Resources (MDNR).

Goal 4: Improve recreational opportunities and access (boating, fishing, trails, canoeing, etc.)

Objectives: 4.A. Develop & implement an opportunities and enhancement plan for passive and active recreation.

Goal 5: Reduce flow variability.

Objectives: 5.A. Address the impact of lake level control structures.


Water Level Control Structure

5.B. Develop/enhance ordinances, guidelines and/or standards as appropriate, to reduce storm water peak flows.

5.C. Establish and implement BMPs for effective storm water peak flow reduction from new developmentsand redevelopments.

5.D. Protect natural areas, such as wetlands and floodplains that naturally function to manage peak flows into the river.

Goal 6: Enhance and protect waterfront areas.

Objectives: 6.A. Develop a riparian corridor management plan.


Orchard Lake Nature Sanctuary

6.B. Protect and/or establish naturally vegetated buffers for water quality and habitat.

6.C. Promote and encourage participation in educational opportunities for land-use decision makers.

6.D. Improve and protect the aesthetics of the river (odor, trash, color, turbidity, foams, suspended solids, severe log jams, etc.).

Goal 7: Protect and mitigate loss of natural features and open spaces in the watershed.

Objectives: 7.A. Conduct a natural features assessment to determine opportunities for

protection/restoration of natural features.

7.B.Develop/enhance ordinances, guidelines and/or standards as appropriate, for managing natural features.

7.C. Participate in local and regional efforts to promote green infrastructure (tree rows, trails, natural beauty roads, utility corridors, waterways, riparian corridors, etc.).

Best Management Practices and Management Alternatives


Wetland Detention Best Management Practice

A variety of actions and management alternatives were identified by the Clinton Main Subwatershed Advisory Group to meet the goals and objectives described above. Each representative faces unique challenges and situations within its own jurisdictional boundaries and must determine which actions will be most effective in achieving the goals and objectives of the plan. Actions and management alternatives range from ordinances and standards to actual construction of new and retrofitted best management practices. In addition, each representative has also identified the most effective good-housekeeping activities to implement within and on their own properties. The recommended best management practices and management alternatives are outlined in Chapter 5. This chapter also includes a matrix of commitments by the individual subwatershed representatives along with associated tables that identify costs, responsible parties and timeframes for action implementation.

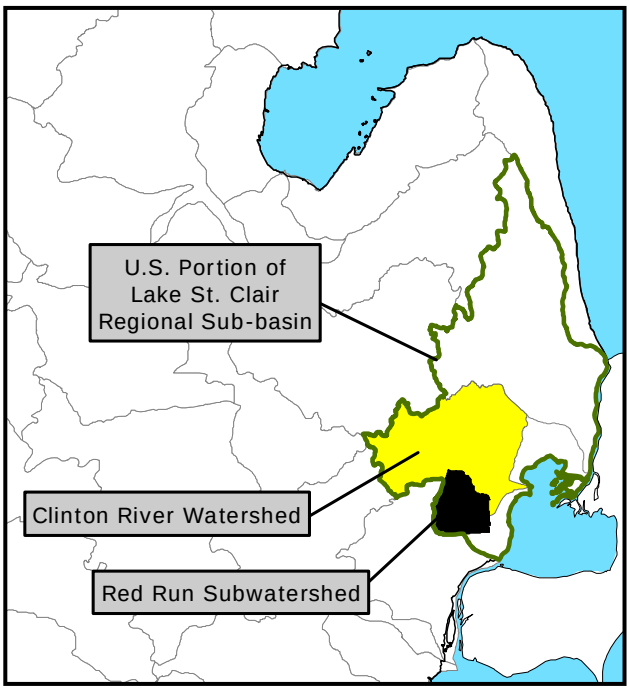

Clinton River in Waterford Township

Successful implementation of this plan will depend upon the continued commitment of the Clinton Main communities, Oakland County, school districts, business owners and residents to protect and improve the water resources and other natural features within the Clinton Main subwatershed. One of the most important aspects of watershed management is monitoring activities and evaluating progress. Monitoring is either quantitative or qualitative; because financial resources for quantitative water quality monitoring is so limited, the use of qualitative evaluation methods is critical in following progress of this plan. In addition, the active involvement of residents in monitoring and stewardship will be critical to protecting the river over the long term.

Each community/representative participating in this plan will develop or revise their unique Storm Water Pollution Prevention Initiative (SWPPI), which outlines their specific actions and management alternatives along with associated timelines to achieve the short-term objectives and long-term goals of the plan. The SWPPIs and the subwatershed plan will be reviewed and revised on a regular basis to assess progress and make any necessary changes based upon new information or technologies.

Executive Summary

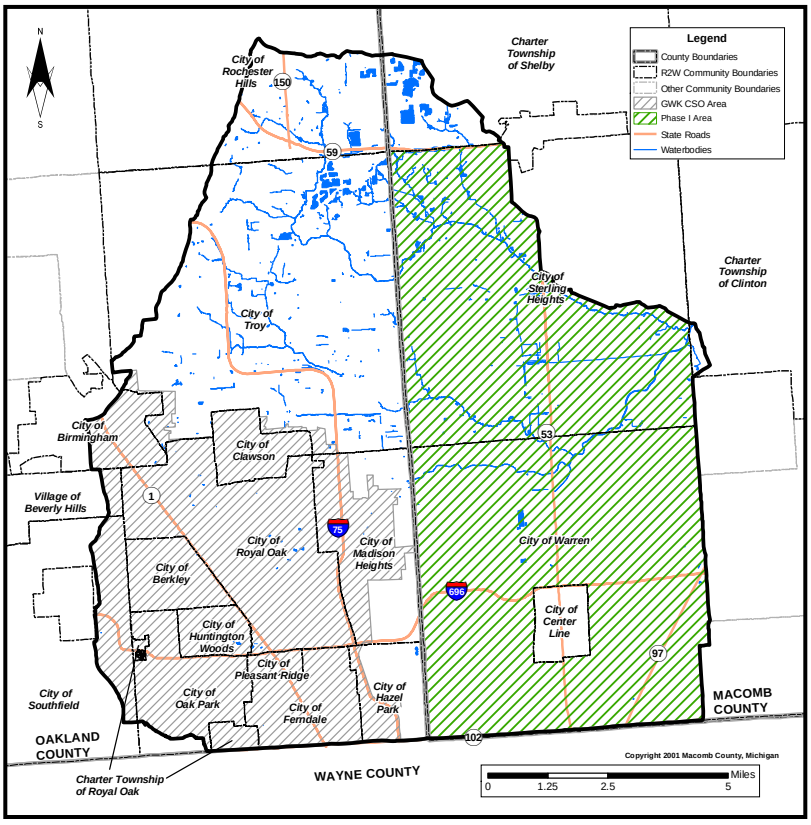




The Clinton River Watershed encompasses approximately 760 square miles in four Southeast Michigan Counties and is home to over 1.4 million people. The headwaters of the Clinton River are in Independence and Springfield Townships of Oakland County, where the river water begins its meandering 80 mile trek, passing through Macomb County, then finally discharging into Lake St. Clair.

The Red Run Subwatershed (R2W), the focus of this watershed management plan (WMP), includes the Red Run upstream of its confluence with the Clinton River and all of its tributaries. The R2W is a 142 square mile Michigan Department of Environmental Quality (MDEQ)-approved basin that also incorporates other waterbodies, such as Plum Brook and Big Beaver Creek, and is home to 550,000 people.

This WMP was developed by the R2W Subwatershed Advisory Group (SWAG) to: 1) fulfill the National Pollutant Discharge Elimination System (NPDES) Phase II requirements (MDEQ's *General Permit No. MIG619000 for Coverage of Storm Water Discharges for Municipal Separate Storm Sewer Systems Subject to Watershed Plan Requirements*) for non-Phase I governmental units in the urbanized area; and 2) make all of the entities represented in the subwatershed eligible for various grant funding opportunities to implement actions for watershed improvement.



The contents of this plan, including the goals and objectives and the actions to meet them, were developed cooperatively by SWAG members with consideration of the input from community leaders, residents, environmental and citizen groups, local businesses, schools, and universities. This WMP was also developed to be consistent with other planning efforts affecting the subwatershed, including: the Lake St. Clair Comprehensive Management Plan (U.S. Army Corps of Engineers), the Clinton River Watershed Remedial and Preventative Action Plan (Clinton River Public Advisory Council), and the Water Quality Management Plan for Southeast Michigan (Southeast Michigan Council of Governments).

In the 1830s, the subwatershed was primarily forest land (80 square miles) and swamp / wetland (59 square miles). Since that time, permanent human settlement has transformed this land into developed types such as residential, commercial, and industrial (140 square miles). Today, only 3 square miles of agricultural and natural areas remain.

This past and continuing development has been and will continue to be a major factor that impacts the quality of water in the subwatershed. This is because traditional development practices have dramatically increased impervious surfaces which subsequently increase runoff and pollutant transfer to nearby waterbodies. Other factors which have and continue to impact water quality in the subwatershed include: sewer systems and practices, riparian corridor and waterbody modifications, and point sources such as pollution control facilities.

The health of waterbodies in the subwatershed can be gauged from water quality standards (WQS), defined by the MDEQ, to: 1) protect health and public welfare, 2) enhance and maintain the quality of water, 3) protect the state's natural resources, and 4) meet the requirements of state and federal law. The WQS contain requirements for designated uses that the waters of the state must meet, including:

- Agricultural Water Supply;
- Public Water Supply;
- Other Aquatic Life/Wildlife;
- Industrial Water Supply;
- Navigation;
- Warmwater Fishery;
- Coldwater Fishery (specifically identified water bodies only);
- Total Body Contact (May 1st through October 31st); and
- Partial Body Contact.

Water quality monitoring has been and continues to be conducted by various organizations and agencies. While some historical data exist, the bulk of monitoring began in the 1970s, spurred by the passage of the Clean Water Act and other environmental initiatives. Analysis of this data tells a story of a severely impacted subwatershed that has improved over the past 30 years but still exhibits some problems. Impairments, as listed by the MDEQ in 2006 include: Habitat Modification – Channelization in the Red Run, Gibson Drain, and Spencer Drain and, Pathogens in the Red Run, Bear Creek, and all their tributaries in Warren, Center Line, Madison Heights, Troy, and Clawson. Additionally, all waterbodies in the subwatershed are impaired due to elevated PCB levels.

The subwatershed, as part of the Clinton River Area of Concern, is affected by some beneficial use impairments that indicate other problems, including:

- Degradation of aesthetics;
- Beach closings and other "full body contact" restrictions;
- Degradation of benthos;
- Loss of fish / wildlife habitat;
- Restrictions on dredging activities;
- Eutrophication / undesirable algae populations;
- Degradation of fish / wildlife populations; and
- Restrictions on fish / wildlife consumption.

Detailed analysis of water quality data has led to the identification of four major stressors that impact the subwatershed. These stressors are: sediment, phosphorus, pathogens, and flow variability. They have been treated to detailed analysis in the plan that includes discussion of: impacts, indicators, standards, load estimates and reduction goals, critical areas, monitoring, and improvement ideas. The framework for discussion of

Phase II Permittees

The Phase II Permittees covered by this plan are:

- Center Line, City of;
- Clinton Charter Township;
- Hazel Park, City of;
- Lamphere Public Schools;
- Macomb County;
- Madison Heights, City of;
- Oakland County;
- Rochester Hills, City of;
- Shelby Charter Township; and
- Troy, City of.

Nested Jurisdictions

Nested jurisdictions in the subwatershed are associated with county-level government (except where indicated in parentheses) and include:

- Center Line Public Schools;
- Fitzgerald Public Schools;
- Troy School District;
- Van Dyke Public Schools;
- Warren Consolidated Schools;
- Warren Woods Public Schools;
- Avondale Schools;
- US Army – Detroit Arsenal (City of Warren); and
- Hazel Park Schools (City of Hazel Park).

these stressors makes the implementation of actions to improve their conditions potentially eligible for grant funding.

In addition to addressing the problems causing the waterbody impairments and beneficial use impairments, this WMP also seeks to address issues of public stakeholders. Various meetings were held during the planning process to allow the stakeholders to express their issues and concerns as well as their goals and visions for the subwatershed.

Consideration of the public input and the measurable water quality impairments led to the goals and objectives of the WMP, as well as the main principle:

> "To improve and protect ecological, hydrological, and cultural resources of the Red Run Subwatershed."

Specifically, the goals of the WMP are:

I. To protect, restore, and enhance water quality of the subwatershed;

II. To educate the public in how to protect, restore, and enhance water quality;

III. To promote and enhance recreational opportunities in the subwatershed;

IV. To appropriately manage suitable habitat for aquatic life, wildlife, and fisheries in the subwatershed;

V. To reduce runoff impacts through sustainable stormwater management;

VI. To seek out opportunities to sustain implementation of the plan; and

VII. To promote opportunities to preserve, protect, restore, and enhance natural features.

Meeting the goals and objectives of the plan in an economically responsible way requires the implementation of numerous actions over many years. As presented in the plan, there are many actions that address the goals and objectives of the WMP and even more resources that provide assistance relative to these actions.

The planned actions have been grouped into the following eight categories:

- Watershed Planning, Institutionalization, and Implementation – includes funding, plan revision, and reporting actions;
- Public Education and Participation – includes community education, employee training, demonstration projects, signage, and meetings;
- Ordinances, Zoning, and Development Standards – includes stormwater standards, managing development, preserving natural features, and pollution prevention ordinances;
- Good Housekeeping and Pollution Prevention – includes sewer operations and maintenance, waste management, municipal property practices, and spill preventions and response;
- Stormwater Best Management Practices: Non-Construction Related Soil Erosion and Sedimentation Control – includes soil and streambank repair, use exclusion, and structural controls;
- Stormwater Best Management Practices: Other Pollutant Load Reducing Controls – includes impervious surface mitigation,

infiltration, filtration, vegetative buffers and conveyance, and retention / detention; and

- Natural Features and Resources Management – includes identification, protection, and restoration of natural features
- Recreation Promotion and Enhancement – includes program coordination and opportunity enhancement (parks, boat launches, trails, fishing spots).

The actions in these categories have specific details, including: the lead agency, the schedule, cost estimates, technical and financial assistance, the authority related to the action, any clarifying comments, permit requirement commitments (where appropriate), and applicability to the major stressors affecting the subwatershed.

As with any plan that is part of an adaptive management scheme, this WMP contains procedures for its evaluation and revision. Evaluation measures fall into six levels:

1. Compliance with Activity-Based Permit Requirements;
2. Changes in Knowledge/Awareness;
3. Behavioral Change / BMP Implementation;
4. Load Reductions;
5. Changes in Discharge Quality; and
6. Changes in Receiving Water Quality.

The evaluation measures in the six categories are also classified as: 1) a measure of activity completions (including milestones), 2) a measure of usage, or 3) a measure of change.

The data to drive the evaluations will come from various existing and additional volunteer programs. The assessment of the various measures (including checking achievement of goals and objectives) will drive the modifications and revisions to the WMP.



The implementation of the WMP (actions, evaluation, and revision) will be through the SWAG and its individual members. The SWAG will continue its current voluntary structure but will consider alternate organizational structures and funding mechanisms and will initiate them as appropriate for the most effective implementation.

Watershed planning is meant to be an iterative process that provides for continuous input and revision of procedures, processes, and products. It is a tool in a comprehensive and systematic approach to balancing land uses and human activities to meet mutually agreed upon social, economic, and environmental goals and objectives in a watershed.

This WMP is a living document and is meant to be used, revised, and altered to fit the changing needs of the subwatershed as new information becomes available and new priorities arise.

SECTION 1 - EXECUTIVE SUMMARY

The goal of the Middle Flint River Watershed Management Plan is to recognize and catalog the current conditions impacting the water quality of The Flint River and its tributaries, address actions that can be taken to resolve existing problems and prevent future degradation. In 2004-2005, the representatives from both county and local communities have worked together to develop this plan by:

- Developing a Public Participation Plan
- Identifying stakeholders
- Gathering available information on: water quality, stormwater flow, habitat
- Identifying known impairments to the river and its tributaries
- Identifying and prioritizing the sources of the pollutants
- Obtaining input from community officials, stakeholders and the general public
- Establishing and prioritizing goals for the watershed
- Identifying the actions for which the communities would take responsibility
- Highlighting areas where gaps existed between the goals and the actions
- Developing a list of recommended activities to be implemented by the local governmental agencies
- Presenting this information to stakeholders and the general public

This plan has since been revised in 2007-2008 to reflect changes required by the watershed review. The above planning process resulted in a Stormwater Management Plan that fulfills Genesee & Oakland Counties and those Phase II community's requirements under the Michigan Department of Environmental Quality (MDEQ) Phase II Watershed-based Stormwater Permit. This plan also allows the county's agencies and communities to qualify for future grant funding for implementation of the activities recommended in this plan.

BACKGROUND

The initial emphasis of the National Pollution Discharge Elimination System (NPDES) under the Federal Clean Water Act of 1972 was to control discharges from industrial and large municipal wastewater treatment plants. Once these discharges were substantially under control, it became apparent that the combined impact of various smaller widespread (non-point) pollution sources was preventing many streams and receiving waters from meeting state water quality standards. These diffuse sources include failing septic systems, stormwater runoff from residential lawns, agricultural fields, parking lots, roadways and construction sites, illegal dumping, and airborne deposition. Adequate control of all these point and non-point sources is necessary to restore and maintain the use of the nation's water resources.

Instead of imposing discharge limitations and stormwater control programs, the Michigan Department of Environmental Quality is allowing local units of government to establish goals to improve water quality through development and implementation of a watershed management plan. In 2001, Genesee County designated the Drain Commissioner's Office as the county agency responsible to engage in watershed management activities

and establish a system of stormwater management services under Act 342, Public Acts of Michigan, 1939, as amended (“Act 342”). Although not all of the communities located within Genesee County are regulated under the NPDES Phase II program, all the communities have signed a contract under Act 342 with the Genesee County Drain Commissioner’s Office to provide stormwater management services which includes:

- Applying for Certificate of Coverage on communities’ behalf under Michigan's Phase II Watershed-based Stormwater Permit.
- Organize and direct the development of a Public Participation Plan
- Organize and oversee the Public Education and Participation Sub Committee
- Organize and oversee the New Construction Standards and Post Construction Practices Sub Committee
- Organize and oversee the Monitoring and Mapping Sub Committee
- Organize and direct the watershed workgroup in developing the Stormwater Management Plan.
- Assist the contract communities in preparing individual SWPPIs
- Coordinating between the communities and the school districts that have signed contracts as nested jurisdictions.

The Oakland County Drain Commissioner's Office (OCDC) is the agency for the Oakland County Phase II Stormwater Permit. The OCDC coordinates communication between Oakland County departments, as well as acting as a resource for watershed and sub watershed groups. Phase II communities within Oakland County are either implementing the watershed plan(s) on their own or are making arrangements to partner with other watershed groups within adjoining watersheds.

Lapeer County and its Middle Flint Watershed communities are not regulated under the NPDES Phase II program, but are invited to participate in the development of the Stormwater Management Plan.

By working together, these public agencies designed a watershed management plan that is built on the strengths of existing programs, resources, and addresses local water quality concerns.

SECTION 2 - INTRODUCTION

MIDDLE FLINT RIVER WATERSHED

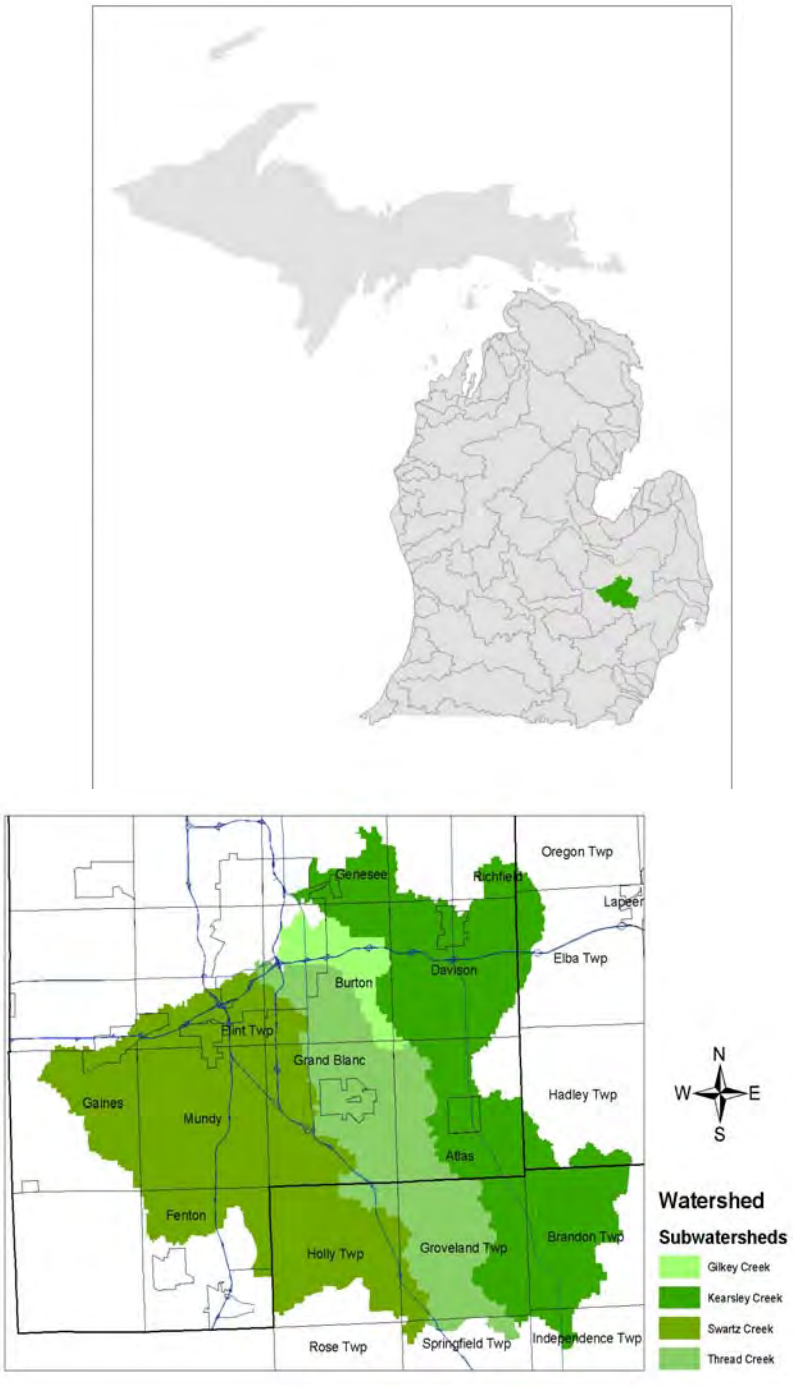


Figure 2-1 Location Map

The **Middle Flint River Watershed** is located in southern Genesee County, Northern Oakland County and a small area along the western Lapeer County border in Michigan's lower peninsula. The 329 square-mile (210,628 acres) watershed is comprised of 4 smaller watersheds. From west to east the watersheds are the Swartz Creek, Thread Creek, Gibson Drain & the Kearsley Creek. These watersheds all drain into a 7.5 mi stretch of the Flint River that flows through the City of Flint. The Middle Flint River Watershed contains 745 lakes, covering approximately 4235 acres and more than 406 miles of rivers and drains, providing many values, including water quality, habitat for indigenous species and recreation opportunities where access to the public is available.

Everything in this watershed is connected from the rain that falls on the ground until it flows to the swales that drain to the ditches into the creeks and finally into the Flint River. From there it goes on northwest out of the City of Flint where it joins the Shiawassee River in Saginaw County. The Shiawassee, Tittabawassee, and Cass rivers merge to form the Saginaw River, near Saginaw. The Saginaw River flows into Saginaw Bay and Lake Huron.

Land use in the Middle Flint watershed varies greatly from commercial and residential areas in the north half of the watershed to rural residential and agricultural throughout much of the headwaters in the south. Within the last decade the agricultural land uses are rapidly being converted to urban and suburban uses by increased development. The change in land use this basin is facing today will have profound effects on the Flint River and its tributaries for many decades to come. Through watershed planning, there is the opportunity for consideration of alternative strategies for protection, rehabilitation, and enhancement of the health of the Flint River and it's tributaries with the hope of also raising its recreational and aesthetic aspects. Much like the Watershed Planning process, which is, developed through many sources from political entities, to stakeholders and the general public's input, the health of the Flint River and its tributaries are determined by many sources from hydrologic, geomorphic, and biologic realities to ordinances, land changes and the release of pollutants into the watershed. What the Flint River and its tributaries become in the future will depend not only on our actions and desires, but also on the nature of its catchments and its connections to larger, regional systems.

The Flint River serves as the drinking water back up supply for the City of Flint. The upper reaches of Kearsley Creek has been was identified as a second quality cold water stream. What this means is that the stream was classified to contain significant trout population maintained by stocking.

The Middle Flint River Watershed has gone through many changes throughout the years, most recently a significant portion of this watershed has been changed from agricultural to developed residential and commercial land.

Problems within the watershed include bank erosion, increased sediment carried into the watercourses from both new development and agricultural runoff. As areas are urbanized there is a reduction or loss of wetlands and low areas that hold or detain water.

PURPOSE OF THE WATERSHED MANAGEMENT PLAN

The goal of the Middle Flint River Watershed Management Plan is to recognize and catalog the current conditions impacting the water quality of The Flint River and its tributaries, address actions that can be taken to resolve existing problems and prevent future degradation.

Watershed planning is an innovative way to address Phase II NPDES permit requirements. Michigan is one of the few states to offer this permitting option. With over 300 communities in Michigan needing to apply for Phase II Permit coverage, over 250 have decided to use the watershed planning option, due to its many benefits over a traditional permitting program.

Some benefits of the watershed approach include, access to grant funding including the State Bond Fund known as Clean Michigan Initiative (CMI), expanded schedules for watershed management planning, and choices on how and when implementation will occur. A watershed approach involves coordination with both public and private sectors focusing efforts to address the highest priority problems.

WHAT IS A WATERSHED

A watershed is any area of land that drains to a common point. That common point may be a lake, the outlet of a river, or any point within a river system. Throughout this Watershed Management Plan, the terms basin, sub-basin, watershed, sub-watershed, and catchment are used to describe the drainages of the river.

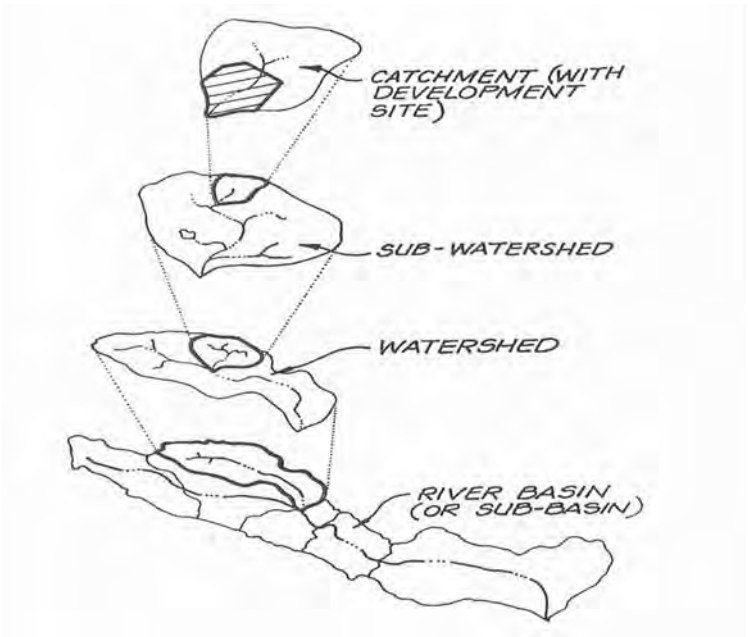
The largest watershed management unit is the basin. A basin drains to a major receiving water, such as a large river, estuary or lake. Within each basin are a group of sub-basins, that are a mosaic of many diverse land uses, including forest, agriculture, range and urban areas. Sub-basins are composed of a group of watersheds, which, in turn, are composed of a group of sub-watersheds. Within sub-watersheds are catchments, which are the smallest units in a watershed, defined as the area that drains an individual development site to its first intersection with a stream (Center for Watershed Protection)

Table 2-1 Description of the Various Watershed Management Units

Watershed Management Unit	Typical Area (square miles)	Influence of Impervious Cover	Sample Management Measures
Catchment	0.05 to 0.50	Very strong	BMP and site design
Subwatershed	1 to 10	Strong	Stream Classification and management
Watershed	10 to 100	Moderate	Watershed-based zoning
Subbasin	100 to 1,000	Weak	Basin planning
Basin	1,000 to 10,000	Very weak	Basin planning

(CWP, 1998)

Figure 2-2 Watershed Management Units



PLAN REQUIREMENTS

According to the MDEQ NPDES Permit for Storm Water Discharges from municipal separate storm sewer systems, subject to watershed plan requirements, the WMP shall contain the following, at a minimum:

- *an assessment of the nature and status of the watershed ecosystem to the extent necessary to achieve the purpose of the WMP;*
- *short-term measurable objectives for the watershed;*
- *long-term goals for the watershed (which shall include both the protection of designated uses of the receiving waters as defined in Michigan's Water Quality Standards, and attaining compliance with any TMDL established for a parameter within the watershed);*
- *determination of the actions needed to achieve the short-term measurable objectives for the watershed;*
- *determination of the actions needed to achieve the long-term goals for the watershed;*
- *assessment of both the benefits and costs of the actions identified above (a "cost/benefit analysis" is not required);*
- *commitments, identified by specific permittee or others as appropriate, to implement actions by specified dates necessary to achieve the short-term measurable objectives;*
- *commitments, identified by specific permittee or others as appropriate, to implement actions by specified dates necessary to initiate achievement of the long-term goals; and*
- *methods for evaluation of progress, which may include chemical or biological indicators, flow measurements, erosion indices, and public surveys.*

RELEVANT FEDERAL, STATE AND REGIONAL PROGRAMS

Clean Water Act

Growing public awareness and concern for controlling water pollution led to enactment of the Clean Water Act (CWA). The Act established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry. The CWA also continued requirements to set water quality standards for all contaminants in surface waters. The Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. It also funded the construction of sewage treatment plants under the construction grants program and recognized the need for planning to address the critical problems posed by nonpoint source pollution.

Subsequent enactments modified some of the earlier CWA provisions. Revisions in 1981 streamlined the municipal construction grants process, improving the capabilities of treatment plants built under the program. Changes in 1987 phased out the construction grants program, replacing it with the State Water Pollution Control Revolving Fund, more commonly known as the Clean Water State Revolving Fund. This new funding strategy addressed water quality needs by building on EPA-State partnerships.

NPDES Municipal Storm Water Phase II

As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating discharges of pollutants into waters of the United States. Phase I of the NPDES storm water program required permit coverage for large or medium municipalities that had populations of 100,000 or more. Phase II of the NPDES Storm Water program builds upon the existing Phase I program by requiring smaller communities, also known as small municipal separate storm sewer systems (MS4s), to be permitted.

Once a permit application is submitted by the operator of a regulated small MS4 and a permit is obtained, the conditions of the permit must be satisfied and periodic reports must be submitted on the status and effectiveness of the program. The Final Phase II Rule requires small MS4 operators to design programs for permit compliance to:

- reduce the discharge of pollutants to the "maximum extent practicable" (MEP);
- protect water quality; and
- satisfy the appropriate water quality requirements of the Clean Water Act.

Michigan's Department of Environmental Quality (MDEQ) has developed a strong permitting process for Phase II and is the responsible permitting agency for the State of Michigan. Michigan developed two permitting options including a jurisdictional based permit and a watershed based general permit. PA 451 of 1994 sections 3103 and 3106 Part 21 R 323.2161a of Michigan Law regulate municipal storm water discharge requirements and the minimum permit requirements for the State of Michigan.

Michigan is unique nationally as one of the few states that have formalized their NPDES Storm Water Phase II compliance through the use of a general permit based on watershed management planning. This special permitting approach has resulted in a large majority of Michigan's regulated Phase II communities using watershed management planning as a tool to implement their Phase II Program.

Total Maximum Daily Load Program (TMDLs)

A TMDL is an acronym used to describe a scientific study conducted on how much pollutant load a lake or stream can assimilate. TMDLs are conducted when a lake or stream does not meet (or the pollutant exceeds) water quality standards (WQS). An individual lake or stream can be tested for several pollutants such as: sediment, pathogens, pesticides, mercury or metals also it will be tested for normal levels of dissolved oxygen, temperature, pH, nutrients and Organics in the water. The TMDL takes into account point source discharges, such as discharge from a wastewater treatment plan, and nonpoint source discharges, such as stormwater runoff.

The Clean Water Act, section 303, establishes the water quality standards and TMDL programs. Water quality standards are set by States, Territories, and Tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. Within the Middle Flint River Watershed those water bodies that do not meet water quality standards are on the Genesee County Impaired water bodies map on page 51.

The State of Michigan administers the TMDL Program in Michigan. These rules define the water quality goals for a lake or stream. MDEQ defines Water quality standards as **"**state rules established to protect the Great Lakes, the connecting waters, and all other surface waters of the state". The goals are in three areas, including the uses of the lake or stream, such as swimming and fishing; safe levels to protect the uses, such as the minimum oxygen level needed for fish to live; and procedures to protect high quality waters." (MDEQ website summary)

Public Act 451 of 1994 – Natural Resources and Environmental Protection Act

Michigan Act 451 of 1994 is an act to protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; to prescribe the powers and duties of certain state and local agencies and officials; to provide for certain charges, fees, and assessments; to provide certain appropriations; to prescribe penalties and provide remedies; to repeal certain parts of this act on a specific date; and to repeal certain acts and parts of acts.

Notable parts of the act relating to storm water include: Part 41 – Sewerage Systems; Part 31 – Water Resources Protection; Part 91 – Soil Erosion & Sedimentation Control; Part 87 – Groundwater and Freshwater Protection; Part 301 – Inland Lakes and Streams; Part 303 – Wetland Protection; and Part 305 – Natural Rivers Act.

Public Act 40 of 1956 – The Drain Code

Michigan Act 40 of 1956 in an act to codify the laws relating to the laying out of drainage districts, the consolidation of drainage districts, the construction and maintenance of drains, sewers, pumping equipment, bridges, culverts, fords, and the structures and mechanical devices to properly purify the flow of drains; to provide for flood control projects; to provide for water management, water management districts, and subdistricts, and for flood control and drainage projects within drainage districts; to provide for the assessment and collection of taxes; to provide for the investment of funds; to provide for the deposit of funds for future maintenance of drains; to authorize public corporations to impose taxes for the payment of assessments in anticipation of which bonds are issued; to provide for the issuance of bonds by drainage districts and for the pledge of the full faith and credit of counties for payment of the bonds; to authorize counties to impose taxes when necessary to pay principal and interest on bonds for which full faith and credit is pledged; to validate certain acts and bonds; and to prescribe penalties.

State Programs and Permits

State programs that directly enforce and assist in compliance with federal and state storm water regulations include the following MDEQ Water Division groups: Storm Water, Soil Erosion and Sedimentation Control, NPDES Permits, and Nonpoint Source Pollution. State-level funding programs that support storm water related projects include: the Water Pollution Control Revolving Fund, the Strategic Water Quality Initiative Fund, and the Clean Michigan Initiative.

Despite the NPDES permitting process that covers storm water-specific issues, other permits may apply for a specific case. Many state and federal permits are covered

under the MDEQ/U.S. Army Corps of Engineers Joint Permit Application (JPA) package. The JPA covers activities relating to: wetlands, floodplains, marinas, dams, inland lakes and streams, great lakes bottomlands, critical dunes, and high-risk erosion areas. Other permits not included in the JPA include: the Sewerage System Construction Permit and the Groundwater Discharge Permit.

Additional Programs

The MDEQ maintains a number of programs that may relate to storm water issues, including: Dam Safety, National Flood Insurance, Wetlands Protection, Watersheds, Surface Water Enforcement, Source Water Assessment, Septage, Sanitary and Combined Sewer Overflow, Land Development, Inland Lakes, and Groundwater Discharge. Other MDEQ, Michigan Department of Natural Resources, regional, or local programs may also relate to storm water issues.

Specific situations may invoke numerous other federal, state, and local programs that directly or indirectly relate to storm water issues. The following list presents some of these:

- The federal Safe Drinking Water Act establishes wellhead protection provisions that are implemented at the state (MDEQ Water Wellhead Protection program) or local level. Wellhead protection may involve managing and treating storm water to prevent aquifer pollution.
- Coastal and shoreline areas invoke numerous federal laws such as the Shoreline Erosion Protection Act and the Coastal Zone Act, state laws, and state programs such as Coastal Management, Sand Dune Protection, and Shoreland Management.
- Commercial/industrial facilities (mines, landfills, agriculture facilities, etc.) have numerous laws and regulations controlling on-site materials use and site-related runoff control requirements that are designed to minimize environmental impacts. Example laws include: the Surface Mining Control & Reclamation Act, the Resource Conservation and Recovery Act, and the Federal Insecticide, Fungicide, and Rodenticide Act.

EXECUTIVE SUMMARY

Introduction to the Kent Lake Subwatershed

The Kent Lake Subwatershed is located in southwestern Oakland County. This 556 square-mile (100,000 acres) area, which extends from the headwaters of the Huron River downstream to the Kent Lake impoundment in the Kensington Metropark, contains nearly 700 individual lakes comprising approximately 9,000 acres, Pettibone and Norton Creeksheds, and innumerable wetlands providing water quality and aesthetic value. The subwatershed lies within Oakland County and comprises all or portions of Commerce Township, Highland Township, Lyon Township, Milford Township, Springfield Township, Village of Milford, Village of Orchard Lake, Village of Wolverine Lake, Waterford Township, West Bloomfield Township, White Lake Township, the City of Walled Lake, and the City of Wixom. Land use in the Kent Lake Subwatershed ranges from heavily commercial and residential areas in the east and south to small rural farms and housing in the north and west. Included in the subwatershed are two Metroparks and four state recreation areas, along with numerous county, city, and village parks, totaling roughly 22,000 acres of publicly owned land. So exceptional is the ecological value of this area that The Nature Conservancy recently deemed portions of the subwatershed as "Globally Significant."

Problem Statement

Based on water quality monitoring studies, in 1998 the Michigan Department of Environmental Quality (MDEQ) listed Kent Lake as threatened on the State's 303(d) list of impaired waters requiring Total Maximum Daily Load (TMDL) establishment. The reason for the threatened status was cited as excess nonpoint source phosphorus loading in the subwatershed that eventually enters Kent Lake.

Simply stated, nonpoint source pollution is defined as a diffuse source of pollution that cannot be traced to a particular discharge such as an industrial or wastewater treatment plant. Rainfall or snowmelt moving over and through the ground is the main cause of nonpoint source pollution. As the runoff travels, it picks up and carries pollutants to lakes, rivers, and wetlands, or even to underground sources of drinking water. Pollutants often found in stormwater runoff are numerous and include phosphorus and nitrogen, dirt and sediments, oils/greases, vehicle lubricants, herbicides and insecticides, metals, and garbage.

The intensity and frequency of nonpoint source pollution is directly related to the amount of hard (impervious) surfaces in a subwatershed because these areas facilitate the travel of water over ground. The anticipated increase in development and subsequent hard surfaces in the Kent Lake Subwatershed, combined with the loss of open space, is expected to cause an increase in an already excessive nonpoint source pollution situation.

Purpose of the Kent Lake Subwatershed Management Plan

The Kent Lake Subwatershed Management Plan sets forth a comprehensive, long-term effort to restore and protect the water quality of the area with the goal of attaining the Total Maximum Daily Load for Kent Lake. Secondly, the Kent Lake Subwatershed contains numerous communities who will be required to obtain a state or federal permit for stormwater runoff under the National Pollutant Discharge Elimination System Phase II program. This plan aims to establish a protocol to help those communities wishing or required to obtain a permit to meet the minimum requirements of the program.

Kent Lake Subwatershed Workgroup

In 2000, communities, county agencies, key business interests, citizen groups, and other stakeholders in the subwatershed were invited to participate in establishing a Workgroup to help guide the development of the comprehensive subwatershed plan. This group has met quarterly since the spring of 2000 and is the essential guiding group in the development of this subwatershed plan.

Management Alternatives

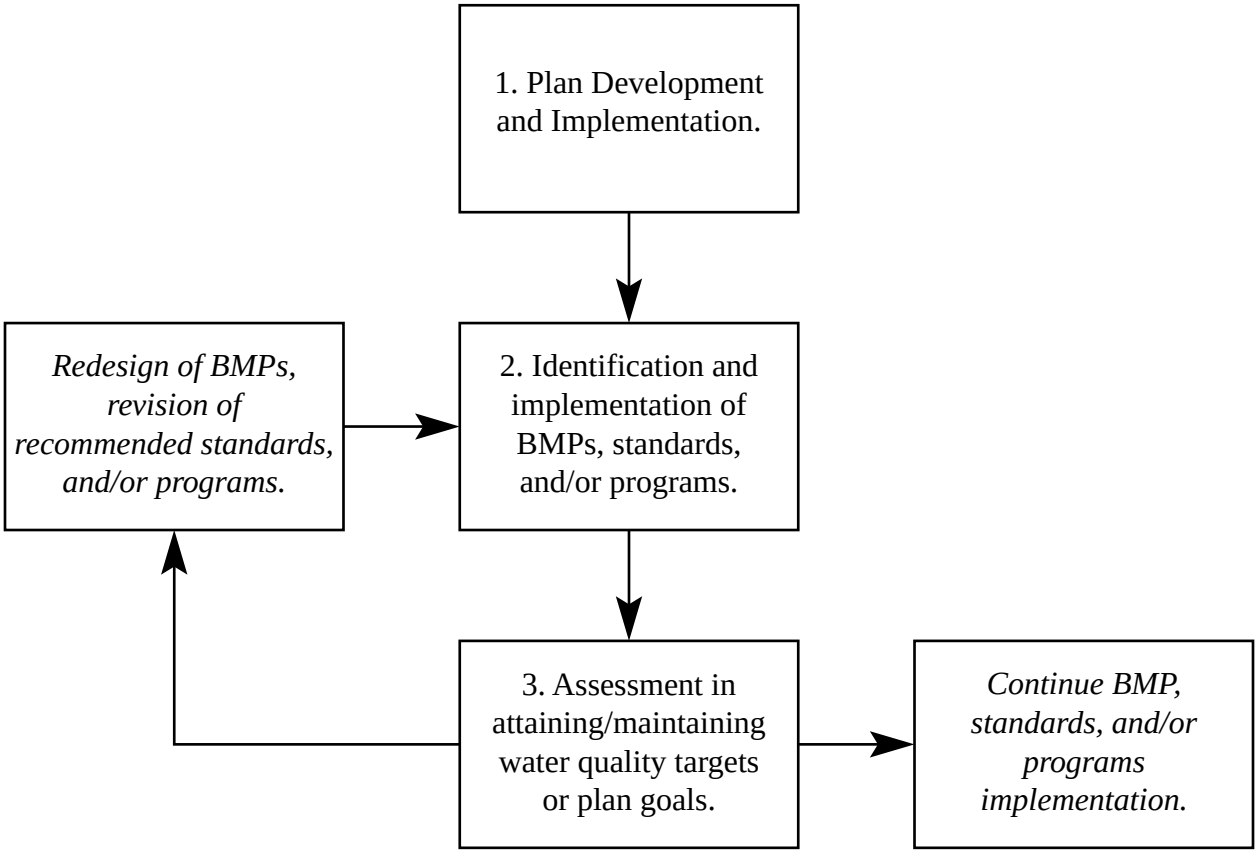
After establishing goals for the subwatershed, the Workgroup discussed various management alternatives which would conceivably meet the Total Maximum Daily Load and address subwatershed concerns. This resulted in four distinct categories of management alternatives, or Best Management Practices (BMPs), for the subwatershed.

- ***Structural Stormwater BMP Retrofitting.*** Based on studies performed by Tetra Tech MPS as part of this project, the subwatershed exhibits numerous conditions where the control and mitigation of stormwater runoff is either non-existent or inadequate. Utilizing a cost-efficiency model, this condition can be significantly mitigated and the Total Maximum Daily Load met by the implementation of grassed swales, constructed wetlands, infiltration, bioretention, and other BMPs in key areas of the subwatershed.
- ***Conservation Planning and Standards Adoption/Revision.*** The future of the subwatershed holds many concerns, including increased nonpoint source pollution from projected land use change. To mitigate the impacts of these changes, the plan recommends enhanced planning and standards such as natural resource inventories and assessments, wetland, stormwater, and natural features protection ordinances, and the revision of community design standards to promote low impact design.
- ***Waterbody Restoration.*** During the course of plan development, it was noted that several waterbodies in the subwatershed exhibited degraded conditions. To address this situation, actions to control the impact of peak flows or address destabilized streambeds and streambanks were considered and an initiative for study and implementation presented.
- ***Education and Stewardship.*** The short and long-term success of any subwatershed plan depends on enhancing the knowledge of water quality and watershed issues. This plan provides the framework for an information and education (I/E) plan and program initiatives to promote stewardship.

Subwatershed Plan Institutionalization, Coordination, and Assessment

One of the most important aspects of any subwatershed plan is assuring implementation, coordination of activities, and assessment of successes and failures. In order to provide well-organized process for implementing this subwatershed plan, a Huron Headwaters Steering Committee (Committee) of Workgroup members and other key stakeholders is proposed as well as a resolution for local government and agency adoption. The basis of the resolution and Committee is the Middle Huron Initiative (MHI) and to a lesser extent the Lake Macatawa Coordinating Committee. During implementation and review of the plan, new data and information may become available which might require a decision to revise or not to revise the plan. The process used to make this decision at regular Committee meetings is based on the Middle One Rouge River Subwatershed Management Plan and is illustrated below.

Subwatershed Plan Revision Process



Executive Summary

This Watershed Management Plan has been developed to document the current conditions of water quality in the Upper Huron/Kent Lake Subwatershed, to determine goals and objectives related to the use, protection and restoration of the subwatershed, and to identify actionable activities to protect, preserve and enhance the subwatershed for the enjoyment of residents and visitors in the region.

The plan builds on previous research, analysis and planning activities facilitated by the Huron River Watershed Council during the period 2000-2002, as well as the Shiawassee & Huron Headwaters Resource Preservation Project (SHHRP) published in March, 2000.

Briefly, the planning process involved a subwatershed advisory group (SWAG) made up of representatives from local government and community agencies who worked together to develop a plan by:

- Affirming the stakeholder groups previously identified with interest in protecting and improving our water resources
- Gathering available water quality, storm water flow and habitat information
- Identifying areas of concern with the watershed, as well as uses that are considered threatened or impaired
- Identifying probable sources of pollution
- Establishing goals and objectives for the watershed
- Identifying the actions for which the subwatershed partners would accept responsiblitiy
- Involving the public at appropriate points throughout the process, including presenting the final plan to stakeholders

The result is this management plan, which is submitted to the Michigan Department of Environmental Quality to fulfill each partner's obligation under the Phase II Watershed-based Storm Water Permit.

Introduction to the Kent Lake Subwatershed

The Kent Lake Subwatershed is located in southwestern Oakland County, extending into Brighton and Green Oak Townships in Livingston County. The drainage area is 556 square-mile (100,000 acres), extending from the headwaters of the Huron River downstream to the Kent Lake impoundment in the Kensington Metropark. The subwatershed contains nearly 700 individual lakes comprising approximately 9,000 acres, Pettibone and Norton Creeksheds, and innumerable wetlands. In Oakland County the subwatershed covers all or portions of Commerce Township, Highland Township, Lyon Township, Milford Township, Springfield Township, Village of Milford, Village of Orchard Lake, Village of Wolverine Lake, Waterford Township, West Bloomfield Township, White Lake Township, the City of Walled Lake, and the City of Wixom. Land use in the Kent Lake Subwatershed ranges from heavily commercial and residential areas in the east and south to small rural farms and housing in the north and

west. There are two Metroparks and four state recreation areas in the subwatershed, along with numerous county, city, and village parks, totaling roughly 22,000 acres of publicly owned land. So exceptional is ecological value of this area that The Nature Conservancy recently deemed portions of the subwatershed as "Globally Significant."

Problem Statement

Based on water quality monitoring studies, in 1998 the Michigan Department of Environmental Quality (MDEQ) listed Kent Lake as *threatened* on the State's 303(d) list of impaired waters requiring Total Maximum Daily Load (TMDL) establishment. The reason for the threatened status was cited as excess nonpoint source phosphorus loading in the subwatershed that eventually enters Kent Lake.

The Huron River Watershed Council (HRWC), working with an advisory group of local government representatives and citizens, completed a Watershed Management Plan in 2002, designed specifically to document water quality issues related to the phosphorus loading and devise goals and objectives to reduce, eliminate or reverse negative impacts related to phosphorus. Water quality data documented in the appendices of that plan have not been repeated here.

Subsequent review of water quality data from a variety of sources, including HRWC's "Adopt-a-Stream" program, Oakland County Beach Monitoring Program data, Lake Sherwood's annual water quality studies and the Management Plan for Wolverine Lake indicate a variety of other issues. These include declining fish and macroinvertebrate populations, persistent toxins (including metals and PCB's), reduced water quality (such as low dissolved oxygen and high suspended solids), bacterial contamination resulting in beach closures, as well as nitrates and chlorides in water supplies. These water quality concerns are among issues to be addressed in this Watershed Management Plan prepared as part of the National Pollutant Discharge Elimination System, Phase II Stormwater Permits required of the partner communities and agencies located in the subwatershed.

One-third of all lakes monitored within the subwatershed have been closed one or more times in the period of 1995-2003 due to bacterial contamination. Stream locations near the City of Wixom were characterized as poor habitat through the HRWC "Adopt-a-Stream" program. Tests in Lake Sherwood and Wolverine Lake show moderate levels of enrichment due to nitrates and phosphorus.

Of particular concern in the watershed is pollution attributed to nonpoint sources. Simply stated, nonpoint source pollution is defined as a diffuse source of pollution that cannot be traced to a particular discharge such as an industrial or wastewater treatment plant. Rainfall or snowmelt moving over and through the ground is the main cause of nonpoint source pollution. As the runoff travels, it picks up and carries pollutants to lakes, rivers, and wetlands, or even to underground sources of drinking water. Pollutants often found in stormwater runoff are numerous and include phosphorus and nitrogen, dirt and sediments, oils/greases, vehicle lubricants, herbicides and insecticides, metals, and garbage.

The intensity and frequency of nonpoint source pollution is directly related to the amount of hard (impervious) surfaces in a subwatershed because these areas facilitate the travel of water over ground. The anticipated increase in development and subsequent hard surfaces in the Kent Lake Subwatershed, combined with the loss of unaltered land, is expected to cause an increase in already excessive nonpoint source pollution situation.

Watershed Concerns

The SWAG presented the water data quality results to the stakeholders and general public in meetings held July, 2004. The public was asked to comment on their concerns about the watershed, as well as identify desired uses. Volunteers also solicited input at other events. The concerns identified for the Kent lake subwatershed include nutrient and bacterial loading, decreased water quality, erosion and sedimentation, issues which were confirmed through evaluation of water quality data. Other concerns include flooding, trash and litter on roadways and within stream corridors.

Stakeholders in the subwatershed are concerned with striking an appropriate balance between economic development and environmental protection, and believe that there are many opportunities to promote natural connections to the watershed for recreation. Communities could also capitalize on their natural water resources as an attractive amenity in commercial areas.

Many stakeholders are concerned about the loss of open space and natural features as development paves its way through the communities within the subwatershed. The Michigan Natural Features Inventory has identified substantial natural areas within the subwatershed, much of which is protected by state, regional, and local park systems. However, a great deal of sensitive land is not protected.

Finally, stakeholders are concerned that the public is not educated about the value of the natural and water resources within the Kent Lake subwatershed and what their individual role is in protection of these resources. Since the majority of land within the subwatershed is owned by private individuals, public education is critical to the future status of water resources.

The SWAG explored each of these concerns in greater depth to identify possible sources and causes. This analysis was utilized in determining goals and objectives, as well as identifying potential actions to address each of the issues.

Goals and Objectives

Goals and objectives were developed to address each of the concerns identified within the subwatershed. These goals and objectives were developed during a stakeholder workshop, in which stakeholders broke up into small groups, developed a set of goals and objectives, and then came back together to compare results. The output from this initial workshop was combined and refined through additional discussion.

These goals and objectives are guidelines for each community to follow as they develop their Stormwater Pollution Prevention Initiative (SWPPI) document, which is the enforcing document of the Phase 2 stormwater permit. Each community will identify their own unique solutions for addressing the goals and objectives presented here, based upon their own unique situations, opportunities, and resources. The objectives were further identified as long-term (LT) or short-term (ST) objectives, to document the partners' expectations regarding progress towards the goals and to help partners establish priorities.

Goal # 1: Promote and maximize community assets and recreational opportunities related to water resources.

Objective # 1-1: Provide information to the public on access to the water resources and riparian lands in the watershed, and available uses and recreational opportunities. (ST)

Objective # 1-2: Improve and maintain fisheries and wildlife habitat. (LT)

Objective # 1-3: Pursue harmonious economic development approaches through intentional connection with the natural environment. (LT)

Goal # 2: Enhance and improve protection of open space, greenways, and natural features.

Objective # 2-1: Coordinate planning approaches with neighboring communities using a systems approach to protection of natural features. (ST)

Objective # 2-2: Identify planning opportunities for protection of open space, greenways, and natural features and investigate the implementation of tools appropriate to each community. (ST)

Objective # 2-3: Develop and maintain a working relationship with a local land conservancy, if applicable. (ST)

Goal # 3: Reduce water quality degradation and address the Kent Lake TMDL (Total Maximum Daily Load).

Objective # 3-1: Investigate sources of water quality degradation, including bacterial and nutrient loading, erosion, and sedimentation. (LT)

Objective # 3-2: Develop and evaluate methods for source reduction. (LT)

Objective # 3-3: Promote public awareness of the effects of pollutants such as trash, litter, and fertilizer on the water quality and aesthetic conditions. (ST)

Goal # 4: Educate, engage, and empower the public to protect water resources.

Objective # 4-1: Faithfully implement Public Education Plans (PEP). (ST)

Objective # 4-2: Identify, promote, and encourage participation in educational opportunities targeting land-use decision-makers in their role in protecting water resources. (ST)

Objective # 4-3: Promote participatory experiences to foster a personal connection and sense of responsibility between the public and local lakes, rivers, streams, and wetlands. (ST)

Goal # 5: Improve management of stormwater and watershed hydrology.

Objective # 5-1: Consider the function of natural hydrologic systems through coordinating stormwater management with neighboring communities when appropriate. (LT)

Objective # 5-2: Identify watershed-wide and community-scale planning, design, and engineering alternatives to manage stormwater, protect wetlands, floodplains, and other natural features that protect water quality and quantity, and incorporate those alternatives where appropriate. (LT)

Objective # 5-3: Develop and maintain a working relationship with the Huron River Watershed Council. (ST)

<u>Goal # 6:</u> Develop resources to address the concerns, goals, and objectives outlined in the subwatershed management plan.

<u>Objective # 6-1:</u> Continue regular operation of the Kent Lake Subwatershed advisory Group and incorporate additional stakeholder interests as appropriate to share resources. (ST)

<u>Objective # 6-2:</u> Form a subcommittee to investigate potential funding options/sources and opportunities to leverage resources for addressing watershed concerns, goals, and objectives. (ST)

Best Management Practices and Community Action Plans

The Goals and Objectives identified previously in this plan can be addressed by a number of Best Management Practices (BMP's). BMP's may include public education programs, policies and regulations to encourage more environmentally sensitive site design, municipal "housekeeping" practices and even structural improvements to improve water quality.

The SWAG prepared a "menu" of options, some of which can be addressed through cooperative action, and some of which require initiative of each individual agency or government. The BMP's identified in the plan will form the basis for each partner to create their Stormwater Pollution Prevention Initiatives Plan or SWPPI.

The BMP's have been loosely grouped in the following categories:

- *Ordinances, Regulations and Standards:* including such issues as local fertilizer ordinances, onsite sewage disposal system, native landscaping, natural features setbacks, soil erosion and sedimentation control improvements, wetlands, woodlands and tree replacement ordinances.

- *Coordinated Planning Activities:* including such opportunities as recreation plans, working with conservancies to acquire conservation easements, integrating natural resources protection into land use planning practices, and utilizing a comprehensive planning process for wastewater treatment facilities.

- *Public Education and Stewardship Opportunities:* these include programs designed to address specific stewardship messages or to target specific stakeholder groups such as lawn care behavior programs, animal/pet waste programs, household hazardous waste collection, litter and debris cleanup, recycling programs, support of local river groups, golf course turf management and promotion of generally accepted agricultural management practices (GAAMPS)

- *Municipal/Organization Housekeeping Practices:* includes programs such as training and education for employees and decision makers, identifying and eliminating illicit discharges, maintaining detention basins, street sweeping and catch basin cleaning, reducing fertilizer, pesticide and herbicide, and improved management of other public facilities.

- *Structural Improvements:* includes specific construction, maintenance or repair projects associated with storm water management, sediment control devices, streambank stabilization and similar projects.

The subwatershed partners also agree to commit to meeting regularly to share information, coordinate public education activities and events, and identify ways to share resources where appropriate to more effectively implement the plan than would be possible on a jurisdiction by jurisdiction basis.

Methods of Evaluating Progress

Much of our hope for a sustainable, healthy watershed lies in changing public perceptions and modifying human behavior. Except in light of a perceived crisis, these changes occur gradually over time, and may not be immediately manifested in terms of measurable improvements in water quality. The evaluation program will therefore include some measurement of effort, not only measurement of results.

To provide a means of gauging public awareness of and sensitivity to watershed issues, as well as the "willingness to change", SEMCOG conducted a Regional Water Quality Survey in the summer of 2004. The survey was designed to provide a benchmark to determine the effectiveness of public outreach campaigns. Results have been compiled on a watershed basis. The study will presumably be updated in the future to provide a means of evaluating progress.

Each community will monitor its own progress in meeting the obligations of its Stormwater Pollution Prevention Iniatives (SWPPI). This will likely be "task-based" evaluation.

The Subwatershed Advisory Group (SWAG) will periodically take up the question of whether we are making satisfactory progress as a group, based in part on the individual partner's annual reports. The SWAG is responsible for updating the watershed management plan every two years. Additional evaluation methods will be needed to determine if we are meeting our goals and objectives. This will include a review of which best management practices have been adopted, and how well they have been received by the decision makers and public. It will also include an assessment of which best management practices were not implemented, and what obstacles or barriers must be eliminated for future progress.

EXECUTIVE SUMMARY



Brighton Lake *Photo: HRWC*

Huron Chain of Lakes Watershed

The Huron Chain of Lakes Watershed covers 253 square miles of the 908-square-mile Huron River Basin, draining an area from just below the Kent Lake dam on the Oakland County/Livingston County border to two miles below Portage Lake in Washtenaw County. Within this area, the Huron River flows southwest for 27 miles through a series of wetland complexes and large glacial kettle lakes. Eight major tributaries and numerous smaller streams provide an estimated 593 miles of streams, which comprise the eight "creeksheds" in the Huron Chain of Lakes Watershed. Over 22,000 acres of wetlands remain in the Watershed as of 2000, comprising over 13% of the total watershed area, along with 172 lakes greater than 5 acres in size. The watershed contains a number of protected natural areas including Island Lake State Recreation Area, Huron Meadows Metropark, Gregory State Game Area, Brighton State Recreation Area, portions of Pinckney State Recreation Area and Hudson Mills Metropark. These areas contain high quality habitat and biological diversity, including several threatened and endangered species.

The majority of the watershed lies within Livingston County, with eastern portions in southwest Oakland County and southernmost areas in Washtenaw County. All or portions of 20 local communities are situated in the Huron Chain of Lakes Watershed, of which the largest portions are within the townships of Brighton, Genoa, Lyon, Green Oak, Hamburg, and Putnam, as well as the Village of Pinckney, the City of Brighton, and the City of South Lyon. Other communities with smaller areas in the watershed include the townships of Highland, Hartland, Oceola, Milford, Marion, Unadilla, Salem, Northfield, Webster, and Dexter, as well as the City of Novi. The Huron Chain of Lakes Watershed is experiencing intense development pressures from a growing economy and urban sprawl. Livingston County has been the fastest growing county in Michigan for the past decade, and most of the County's growth over the next 30 years is expected to take place in the Huron Chain of Lakes Watershed.

The purpose of the WMP is to identify and execute the actions needed to resolve water quality and water quantity concerns by fostering cooperation among the various public and private entities in the watershed

Purpose of the Watershed Management Plan

The Huron Chain of Lakes Watershed Management Plan is part of an effort undertaken by the communities of Huron Chain of Lakes Watershed seeking the NPDES

Wastewater Discharge General Permit MIG619000 (watershed-based). As that permit states "the permittee shall participate in the development and implementation of a Watershed Management Plan (WMP). The purpose of the WMP is to identify and execute the actions needed to resolve water quality and water quantity concerns by fostering cooperation among the various public and private entities in the watershed…. The emphasis of the WMP shall be to mitigate the undesirable impacts caused by wet weather discharges from separate storm water drainage systems." This Watershed Management Plan is a strategy document that is intended to define the state of the watershed by describing its natural resources

A TMDL refers to a lake or portion of a stream that has been determined by the MDEQ as failing to meet the State's minimum water quality standards due to excessive pollutant

As required by the General Permit, this Plan also will address Total Maximum Daily Loads (TMDLs) established within the Huron Chain of Lakes Watershed. A TMDL refers to a lake or portion of a stream that has been determined by the MDEQ as failing to meet the State's minimum water quality standards due to excessive pollutant loads. TMDLs in the Watershed are addressed by detailing appropriate actions specific to storm water controls to meet the TMDLs. To date, three phosphorus TMDLs have been established in the watershed for Brighton, Strawberry, and Ore Lakes. Six TMDLs for other pollutants and impairments are scheduled by MDEQ for future establishment in the watershed.

The permit holders that were involved in the development of this Plan are committed to protecting the sensitive natural areas of the watershed, mitigating the impacts of stormwater discharges and preventing future increases, and restoring degraded areas. While compliance with the NPDES Phase II permitting process is the Plan's primary and mandatory function, the authors intend for the Plan to fit into a broader context of watershed management planning by laying the groundwork for a comprehensive, long-term effort to restore and protect the Watershed's water resources for future generations.

Huron Chain of Lakes Steering Committee

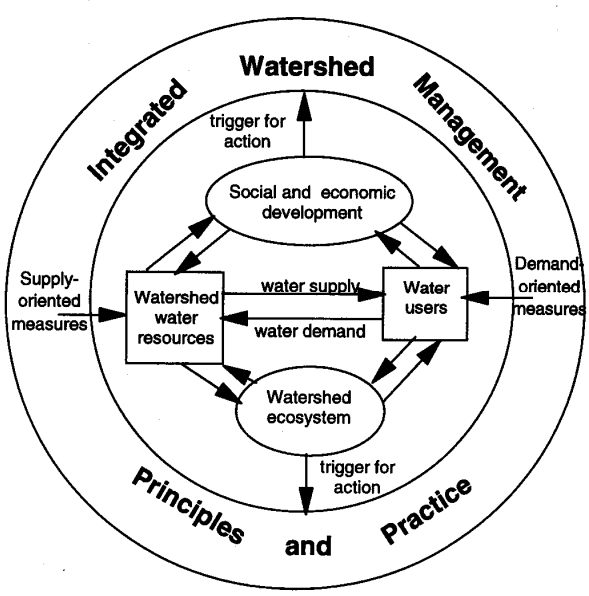
Since December 2002, the Livingston County Drain Commissioner has sponsored monthly meetings to facilitate a coordinated effort among watershed-based Phase II permit holders in Livingston County. These county-wide meetings address administrative and procedural issues common to all watershed-based permit holders. In February 2004 a group of eight local governments and county agencies located within the Huron Chain of Lakes Watershed formed the Huron Chain of Lakes Steering Committee to coordinate the study, development, preparation, and timely filing with the MDEQ of a Huron Chain of Lakes Watershed Management Plan as part of the required NPDES Phase II stormwater compliance. Core members of the Steering Committee represented the following communities and agencies:

City of Brighton	Livingston County Drain Commissioner
Brighton Township	Livingston County Road Commission
Genoa Township	Village of Pinckney
Green Oak Township	Putnam Township

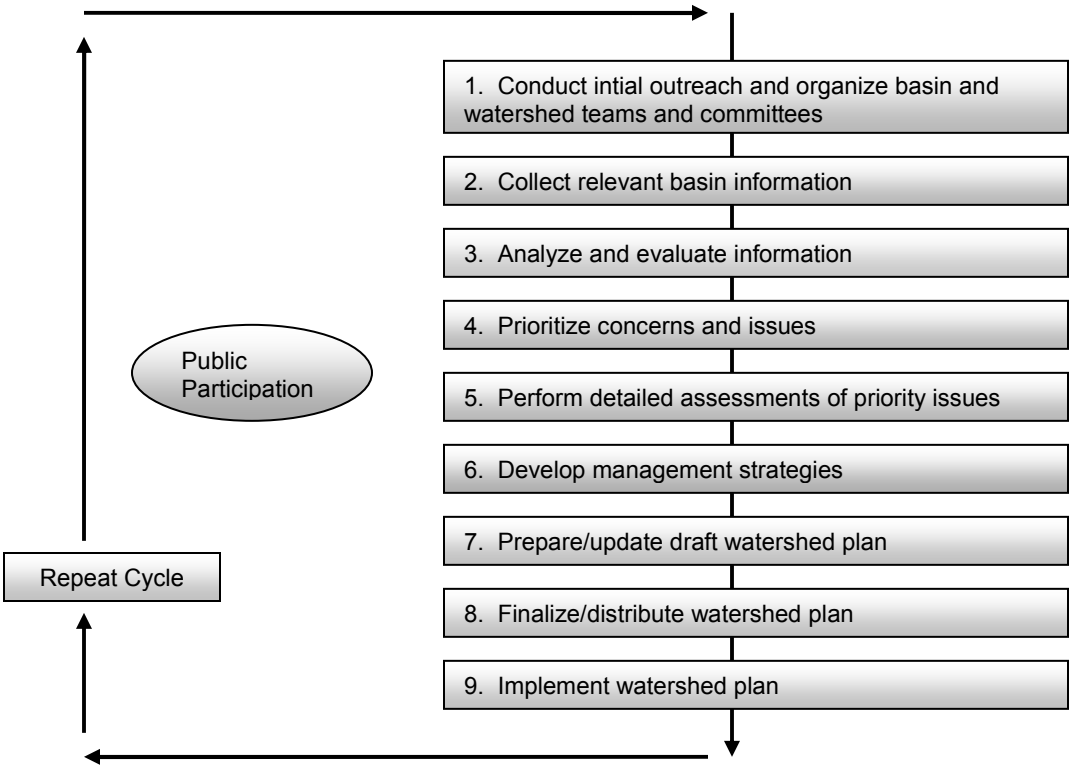
Other communities and agencies located in the Watershed, as well as individual residents, also attended regular meetings of the Steering Committee. The Huron River Watershed Council was commissioned by these same eight local governments and county agencies to work with the Steering Committee to facilitate the development of, and write, the Huron Chain of Lakes Watershed Management Plan.

The Watershed Planning Process

A watershed is a complex integrated system with the whole being greater than the sum of its parts. This complexity stems for the ever-changing interaction of social, economic, and biophysical forces. The interplay of these forces, as shown in the diagram to the right (from Integrated Watershed Management by Isobel W. Heathcote), is the basis for the concept of integrated watershed management.



The Huron Chain of Lakes Watershed Management Plan is rooted in the concept of integrated watershed management and was developed following the process outlined in "Developing a Watershed Management Plan for Water Quality – an Introductory Guide" which was developed by the Michigan State University Institute of Water Research, MSU Extension, and MDEQ. The diagram below outlines a schematic for the general steps of a watershed planning process.



Throughout the nine steps described in the diagram, ongoing public involvement is key to developing a plan that addresses the needs and concerns of the watershed's residents. The last step of repeating the cycle illustrates the iterative nature of watershed planning. A watershed management plan must be updated and revised as new information becomes available and the successes and shortcomings of implementation efforts are realized over time.

Designated and Desired Uses

According to the Michigan Department of Environmental Quality, the primary criterion for water quality is whether the waterbody meets designated uses. Designated uses are recognized uses of water established by the state and federal water quality programs. In Michigan, the goal is to have all waters of the state meet all designated uses. It is important to note that not all of the uses listed below may be attainable, but they may serve as goals toward which the watershed can move.

Designated uses are recognized uses of water established by the state and federal water quality programs.

All surface waters of the state of Michigan are designated for and shall be protected for all of the following uses. Those that apply to the Huron Chain of Lakes Watershed are in boldface:

- **Agriculture**
- **Industrial water supply**
- **Public water supply at the point of intake**
- Navigation
- **Warmwater fishery**
- **Other indigenous aquatic life and wildlife**
- **Partial body contact recreation**
- **Total body contact recreation between May 1 and October 31**
- Coldwater fishery

Due to human impacts throughout the Huron Chain of Lakes Watershed, not all of the designated uses are fulfilled. Warmwater fishery is impaired due to elevated levels of PCBs in Whitmore Lake and Woodland Lake and high mercury levels in fish tissue samples from Bishop Lake. Other indigenous aquatic life and wildlife is also impaired due to poor macroinvertebrate communities in portions of Honey Creek and Horseshoe Lake Drain, and low levels of dissolved oxygen in a small segment of Yerkes Drain between the South Lyon Wastewater Treatment Plant and Nichwagh Lake. Partial and total body contact recreation uses are threatened throughout the watershed due to high nutrient loads that can cause nuisance algal blooms in non-riverine environments – most notably in Brighton, Ore, and Strawberry Lakes, for which phosphorus TMDLs have been established.

In addition to state-designated uses are uses of the watershed that are desired by its residents but not yet achieved. The Steering Committee that developed this Watershed Management Plan identified the following desired uses:

- **Coordinated development**
  Promote a balance of environmental and economic considerations through intentional community planning and coordinated development within and among the Huron Chain of Lakes communities
- **Hydrologic functions of natural features**
  Protect and enhance natural features related to water quantity and quality, including wetlands, floodplains, riparian buffer zones, and stream channels that regulate the flow of stormwater runoff, protect against flooding, and reduce soil erosion and sedimentation
- **Open space and greenways**
  Protect priority natural habitat, recreational areas and trails, and agricultural lands from development in order to maintain their natural functions, preserve rural character, and enhance recreational opportunities for present and future generations

Challenges to the Health of the Huron Chain of Lakes Watershed

The Steering Committee spent one year gathering the information necessary to understand the impairments, or pollutants, to the Watershed, and their sources and causes. While the Huron Chain of Lakes Watershed contains several areas of high quality natural habitat, aquatic ecosystems, and recreational opportunities, analysis of existing data indicate that the Huron Chain of Lakes Watershed also has stretches of medium- and low-quality waterways that require mitigation of existing impairments.

Although the partners who authored the Huron Chain of Lakes Watershed Management Plan intend to address all of these challenges in the long term with targeted programs, it is important to prioritize and identify the most pressing concerns in the watershed so that resources can be spent cost-effectively in a phased approach. The impairments have been prioritized based upon analysis of existing data, the results of the road stream crossing inventory, and contributions from Steering Committee members and citizens. This information was used to prioritize the impairments from greatest threat to least threat. The sources and causes are not prioritized but known causes (k) are listed above suspected causes (s). As additional information is obtained that indicates a lower ranked impairment, source or cause should be elevated in priority, the ranking should be adjusted to reflect the new information. The following table identifies the challenges to the health of the watershed, and their sources and causes.

It is important to prioritize and identify the most pressing concerns in the Watershed so that resources can be spent cost-effectively.

Prioritized Impairments, Sources and Causes in the Huron Chain of Lakes Watershed

Impairment: High Nutrient Loading (k)	
Sources	**Causes**
Excessive runoff from developed areas (k)	Lack of BMPs at existing development areas (k) Impervious surfaces (k) Poor storm drain maintenance (s)
Failing septic tanks (k)	Old units are too small or don't meet codes (k) Lack of a required maintenance program (k) Poor maintenance/lack of education (s)
Fertilizers from residential, commercial, and golf courses (k)	Lack of buffers (k) No ordinance in place (k) Overuse/improper application of fertilizers (s)
Illicit discharges (k)	Aging sanitary sewer infrastructure (s) Inadequate inspection/detection and repair due to cost (s) Illegal septic application and trailer waste disposal (s)
NPDES permitted facilities (k)	Nutrients in effluent (k)
Agricultural runoff from fertilizers/ livestock waste (s)	Lack of BMPs (upland and riparian buffers) (s) Exposed soils (s)
Pet and wildlife waste (s)	Improper disposal of pet waste (s) Ponds increase habitat for waterfowl, wildlife (s)

Impairment: Altered Hydrology (k)	
Sources	**Causes**
Runoff from developed areas (k)	Lack of BMPs at existing development areas (k) Impervious surfaces (k) Removal of woodland/forest, wetlands, and other pervious areas (k)
Runoff from construction sites, new development (k)	Removal of woodland/forest, wetlands, and other pervious areas (k) Rerouting channel for development (k) Lack of resources for enforcement/inspection (s) Site exemptions (s) Lack of education on alternatives (s)
Engineered drains and streams (k)	Loss of connection between stream and floodplain from channelization (k) Removal of riparian buffer (k)

Impairment: Sedimentation, Soil Erosion (k)	
Sources	**Causes**
Eroding stream banks and channels (k)	Flashy flows (k) Channelization (k) Drain maintenance (k) Eroding crossing embankments (k) Clear cutting/lack of riparian buffers (k)
Construction sites (k)	Clear cutting/lack of riparian buffers (k) Lack of resources for enforcement/inspection (s) Lack of soil erosion BMPs and BMP education (s) Exposed soils (s) Site exemptions (s)
Developed areas (k)	Lack of BMPs at existing development areas (k) Impervious surfaces (k) Clearcutting/lack of riparian buffers (k)
Dirt, gravel roads (k)	Poorly designed/maintained road stream crossings (k) Poor road maintenance (s)
Agricultural field runoff (s)	Lack of BMPs (upland and riparian buffers) (s) Exposed soils (s)

Impairment: Pathogens (k)	
Sources	**Causes**
Failing septic tanks (human waste) (k)	Old units are too small or don't meet codes (k) Lack of a required maintenance program (k) Inadequate enforcement by Health Departments (s) Poor maintenance/lack of homeowner education (s)
Illicit Discharges (k)	Aging development sanitary sewer infrastructure (k) Illegal septic application and trailer waste disposal (s) Inadequate inspection/detection and repair due to cost (s) Lack of education (s)

Impairment: Pathogens (k)	
Sources	**Causes**
Pet and waterfowl waste (s)	Improper disposal of pet waste (runoff from paved areas) (s) Ponds increase habitat for waterfowl, wildlife (s)
Illegal/improper septage application (s)	Lack of adequate septage disposal facilities (s)
Livestock waste from agricultural operations (s)	Lack of BMPs (s)

Impairment: Salts, Organic Compounds and Heavy Metals (k)	
Sources	**Causes**
Developed areas (k)	Lack of stormwater BMPs (k) Illegal dumping (s) Illicit connections (s)
Roads (k)	Auto emissions (k) Lack of BMPs during road de-icing (s) Poor road maintenance (s)
Existing in-stream pollution (k)	Illegal dumping (s) Oil spill in Yerkes Drain in 1970s (k) PCBs in Whitmore Lake and Woodland Lake (k) Excessive mercury in Bishop Lake (k)
NPDES permitted facilities (s)	Inadequate inspection (s) Lack of BMPs (upland and riparian buffers) (s)
Turfgrass chemicals from residential, commercial lawns (s)	Improper lawn care (s) Illegal disposal (s)
Agricultural runoff (s)	Lack of BMPS (upland, riparian buffers) (s)

Impairment: High Water Temperature (k)	
Sources	**Causes**
Directly connected impervious areas (k)	Heated stormwater from urban areas (k)
Eroded soil areas (s)	Soil erosion from channel and upland (k)
Solar heating (s)	Lack of vegetated canopy in riparian zone (k)

Impairment: Debris/Litter (k)	
Sources	**Causes**
Roadways, parks, urban areas, residential areas (k)	Illegal littering/dumping (s) Unsecured garbage containers and vehicles (s) Inadequate refuse containers (s)

Goals and Objectives for the Huron Chain of Lakes Watershed

The designated and desired uses for the Huron Chain of Lakes Watershed, along with the watershed's impairments, sources, and causes, provide a basis from which to build long-term goals and objectives. Long-term goals describe the future condition of the watershed toward which the permittees will work. Long-term goals are not expected to be met within the first five years of plan implementation, but are to be met at some time beyond the first five years of implementation. No single community or agency is responsible for achieving all of the goals or any one of the goals on its own. The goals represent the desired end product of many individual actions, which will collectively protect and improve the water quality, water quantity and biology of the watershed. The permittees will strive together to meet these long term goals to the maximum extent practicable, by implementing a variety of BMPs over time. Selection and implementation of applicable BMPs will vary among communities or agencies according to specific priorities, authority, and resources.

The designated and desired uses for the Watershed, along with the watershed's impairments, sources, and causes, provide a basis for developing long-term goals and objectives

The goals represent the desired end product of many individual actions, which will collectively protect and improve the water quality, water quantity and biology of the

Goals and Objectives for the Huron Chain of Lakes Watershed, and the Designated and Desired Uses They Address

Long-Term Goal	Short-Term Objective	Uses(s) Addressed
1. Increase public awareness of their role in protecting water resources	a. Increase opportunities for public involvement in protection of watershed resources b. Promote education, incentive, and stewardship programs that encourage individual source control of pollutants c. Promote coordination among local units of government in educational program development and implementation. d. Encourage partnerships between public and private entities in funding and promoting educational messages and activities	Designated Uses: all Desired Uses: all
	Long-Term Objective	
	e. Reduce pollution impacts to the Watershed by providing practical knowledge to key audiences	
2. Reduce nonpoint source nutrient loading	**Short-Term Objective**	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Partial and total body contact recreation Desired Uses: Hydrologic functions of natural features
	a. Support establishment of water quality monitoring programs to measure progress toward phosphorus TMDL goals. b. Develop ordinances, strategies, and/or programs for reducing nutrient loading. c. Promote implementation of structural and vegetative BMPs at new and existing developed areas.	
	Long-Term Objective	
	a. Meet established TMDL goals for Brighton, Ore, and Strawberry lakes.	

3. Reduce flow variability	**Short-Term Objective** a. Establish current stream flow dynamics through established monitoring strategy b. Increase the use of Low Impact Development (LID) principles c. Develop ordinances, strategies, and/or programs to manage peak flow rates **Long-Term Objective** d. Protect and increase storage in wetlands, floodplains, groundwater, and other pervious areas with infiltration capacity	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Desired Uses: Hydrologic functions of natural features
4. Reduce soil erosion and sedimentation	**Short-Term Objective** a. Establish baseline data for sediment desposits in monitored streams through established monitoring program b. Improve application and enforcement of soil erosion and sedimentation controls (SESC) c. Increase education of BMPs among property owners and the building community **Long-Term Objective** d. Increase clarity in surface waters	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Industrial water supply; Public water supply Desired Uses: Hydrologic functions of natural features
5. Protect and mitigate loss of natural features for indigenous riparian and aquatic animals and plants	**Short-Term Objective** a. Integrate natural features mapping data into land use planning decisions b. Develop policies that protect natural areas c. Monitor water quality and biota to measure progress d. Educate local decision makers and the public about the benefits of critical habitat protection e. Consider groundwater recharge data when identifying priority natural features protection areas **Long-Term Objective** f. Maintain or improve the aquatic community, including meeting TMDL goals for poor macroinvertebrate communities in Horseshoe Lake Drain and Honey Creek. g. Increase areas of natural features, including wetlands, woodlands, riparian buffers, and floodplains	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Industrial water supply; Public water supply Desired Uses: Hydrologic functions of natural features; Open space and greenways
6. Protect existing open space and agricultural land	**Short-Term Objective** a. Identify and prioritize key opportunities for protection of undeveloped lands b. Develop policy and planning tools that address urban sprawl c. Facilitate regional coordination in preserving open space corridors, especially riparian corridors d. Work with land conservancies and other land preservation groups to facilitate use of land protection/conservation tools	Designated Uses: Warmwater fishery; Aquatic life and wildlife; Desired Uses: Hydrologic functions of natural features; Open space/greenways
7. Protect and enhance recreational opportunities	**Short-Term Objective** a. Identify and reduce sources of pollution that inhibit recreational activities b. Increase regional coordination of recreational planning efforts c. Research and pursue grant opportunities for recreational planning efforts	Designated Uses: Partial and total body contact recreation; Warmwater fishery; Desired Uses: Open space/greenways; hydrologic functions of natural features

8. Increase monitoring of water quality, water quantity, and biological indicators	**Short-Term Objective** a. Develop a monitoring strategy b. Secure funding and develop partnerships to conduct short-term and long-term monitoring of key indicators c. Implement and maintain Illicit Discharge Elimination Program (IDEP) investigations	Designated Uses: all Desired Uses: all
9. Balance environmental and economic benefits in the subwatershed	**Short-Term Objective** a. Integrate stormwater management in planning and site plan review process b. Educate land use decision makers and developers on long-term economic benefits of stormwater BMPs, impacts of development on the watershed, and tools for low impact development c. Increase coordinated planning efforts and implementation among local units of government	Designated Uses: all Desired Uses: all
10. Attain full plan implementation	**Short-Term Objective** a. Establish financial and institutional arrangements for WMP fulfillment b. Ensure the long-term viability of the Huron Chain of Lakes Steering Committee to guide watershed-wide planning decisions. c. Increase public awareness of progress in WMP implementation	Designated Uses: all Desired Uses: all

Watershed Management Alternatives (Best Management Practices)

After establishing goals and objectives for the watershed, the Steering Committee discussed various management alternatives, also known as Best Management Practices (BMPs), that could be employed to fulfill them. A stormwater BMP is a technique, measure, or structural control that is used for a given set of conditions to manage the quantity and quality of stormwater runoff in the most cost-effective manner. BMPs fall into one of three categories:

Structural BMPs are engineered and constructed systems that improve the quality and/or control the quantity of runoff such as detention ponds and constructed wetlands. Structural BMPS are inherently site-specific and are designed to treat or manage stormwater at a specific location.

Vegetative BMPs are natural processes that preserve existing vegetation or establishes ground cover to minimize soil erosion. Vegetative BMPs are sometimes considered as a sub-set of structural BMPs.

Non-structural BMPs, also known as **Managerial BMPs**, are institutional, educational or regulatory pollution prevention practices designed to limit the generation of stormwater runoff or reduce the amounts of pollutants contained in the runoff. These BMPs focus on modifying behaviors and practices through a wide variety of activities such as adopting new policies and ordinances, providing watershed education to residents, conducting studies and inventories, and tracing illicit connections.

No single BMP can address all stormwater problems. Each practice has certain limitations based on drainage area served, available land space, cost, pollutant removal efficiency, as well as a variety of site specific factors such as soil types, slopes, depth of groundwater table, etc. Careful consideration of these factors is necessary in order to select the appropriate group of BMPs for a particular location or situation.

Nintey-six management alternatives, are presented in the Action Plan at the end of Chapter 4 as actions that will help achieve the goals and objectives for the Huron Chain of Lakes Watershed. Where applicable, each management alternative in the Action Plan is presented with which goals it addresses, level of effort, estimated capital and maintenance costs, technical and/or financial resources, and intent of the permittees to employ the actions.

A stormwater BMP is a technique, measure, or structural control that is used for a given set of conditions to manage the quantity and quality of stormwater runoff in the most cost-effective manner

Watershed Management Plan Implementation, Coordination and Evaluation

A successful watershed plan is ultimately defined not by what is written on the pages, but by how the recommended plans and programs are put into action. A successful plan for implementation also recognizes that the state of the watershed changes over time. As such, evaluating the effectiveness and appropriateness of the actions taken to implement the Plan, as well as the ability to adapt these actions to the changing conditions of the watershed, is critical.

While individual Phase II permit holders are required to provide the State with annual reports on their NPDES Phase II-related activities, which includes efforts to implement the Watershed Management Plan, a well-organized framework for implementing and revising the Plan on a watershed-wide level still is needed to keep the Steering Committee on track toward achieving the broad goals of water quality and natural resource protection and improvement. To ensure successful implementation, nine key elements should be addressed, as shown below.

Key Elements of Successful Watershed Plan Implementation

1. Appoint a single lead agency to act as an advocate and facilitator for the plan with the community and with political representatives.
2. Strong linkages to existing programs, including local and regional land use planning processes, water quality and flow monitoring programs, and similar programs, to optimize use of available information and minimize duplication of effort.
3. Clear designation of responsibilities, timetables, and anticipated costs for project actions.
4. Effective laws, regulations, and policies to provide a framework for the tasks identified in Element 3.
5. Ongoing tracking of the degree of implementation of management actions and of the success of those actions once implemented.
6. Ongoing monitoring and reporting of progress, both to assess the effectiveness of individual actions and to sustain public and political interest in and enthusiasm for the plan.
7. Ongoing public education and communication programs to consolidate and enhance the social consensus achieved in the planning process.
8. Periodic review and revision of the plan.
9. Adequate funding for these activities.

Advisory Committee Structure

To facilitate implementation of the Huron Chain of Lakes Watershed Management Plan over time, a framework for a series of working groups will help to provide a useful feedback loop for determining how, and the extent to which, the goals and objectives of the Plan are being successfully implemented. These working groups would ideally be comprised of the following groups of stakeholders:

- Managers, planners, coordinators, and their staff members
- Boards and steering committees
- Volunteers (citizens and watershed stewards)
- Environmental Interest Groups
- Funding Groups

These groups of stakeholders should ultimately allow for input and implementation assistance from a broad cross-section of all stakeholder and interest groups in the watershed, as outlined in the Huron Chain of Lakes Watershed Public Participation Plan (see Appendix H).

Expansion of the existing committee structure into two tiers is recommended to oversee the implementation and evaluation of the Plan. In addition to a steering committee, a set of advisory committees and/or sub-committees could be established to allow focus on specific aspects of the plan, such technical, scientific, or public involvement. The steering committee might be comprised of stormwater program managers and staff. The advisory committees and/or subcommittees might be staffed by land use planners, commissions, boards, interested citizens, environmental group advocates, scientists, etc. that would pull together various aspects of the data and results during the implementation phases of the Plan (i.e. water quality data, public education initiatives, illicit discharge investigations, etc.). The Livingston County Drain Commissioner's Office will provide support for, and oversight of, the activities of the Steering Committee and smaller committee/ subcommittee levels.

The importance of public representation and broad stakeholder involvement throughout any advisory committee structure must be stressed, as these individuals are in a position to explain and influence community opinion and help to build support for needed changes. One of the first tasks of the Livingston County Drain Commissioner's Office and current members of the Huron Chain of Lakes Steering Committee should be to begin developing an advisory committee structure that allows for involvement by a broad range of stakeholders as discussed above.

Evaluation Methods

Measurement and evaluation are important parts of planning because they can indicate whether or not efforts are successful and provide a feedback loop for improving project implementation as new information is gathered. The ability to demonstrate measurable results increases support for the Plan from the partnering communities and agencies and local decision makers, and also increases the likelihood of project sustainability and success. Monitoring and measuring progress in the watershed necessarily will be conducted at the local level by individual agencies and communities, as well as at the watershed level, in order to assess the ecological affects

The ability to demonstrate measurable results increases support for the Plan and also increases the likelihood of project sustainability and success.

of the collective entity actions on the health of the Watershed.

Because achievement of water quality standards is the ultimate goal of plan implementation, direct measurement of environmental improvements through instream monitoring is ideal. Such methods are beneficial in monitoring the long-term progress and effectiveness of the cumulative watershed efforts in terms of water quality, water quantity and biological monitoring. Examples of direct measurement of environmental improvements include:

1) Measuring specific water quality or chemistry parameters, such as phosphorus loadings or *E. coli* levels;
2) Physical and hydrological indicators such as physical habitat monitoring, flooding frequencies, or changes in stream shape due to erosion and sedimentation; and
3) Biological indicators such as macroinvertebrate or fish assemblages.

However, directly measuring environmental indicators requires large investments of time and resources. Benchmarks of existing conditions and future targets must be established in order to ascertain improvements in the health of the Watershed.

In addition to directly measuring physical improvements in the environment, progress in implementing various programs or individual program elements can also be measured. Although such methods of measuring progress are not tied directly to measurements in the river, it is fair to assume that the success of these actions and programs, collectively and over time, will impact positively on the instream conditions in the Watershed. Examples of indicators that can be used as surrogates for direct environmental improvement include:

1) Social indicators, such as public awareness surveys and tracking of public involvement in stewardship and monitoring efforts;
2) Programmatic indicators, such as tracking the number of illicit connections identified/corrected, number and types of ordinances adopted/amended, number of structural BMPs installed, and quantities of public education materials distributed;
3) Site indicators, such as BMP performance monitoring at specific sites.

Such indicators provide relatively easy-to-measure and cost-effective alternatives to direct environmental measurements that can be costly and time-consuming. These types of indicators provide a means for measuring interim or short-term progress of individual or specific programs or actions.

The dynamic nature and complex interaction of social, economic, and biophysical forces in the Watershed require a continuous cycle of evaluating the effectiveness of the management alternatives in meeting the Plan's

Watershed Management Plan Revision Process

Implementing the Huron Chain of Lakes Watershed Management Plan in a way that follows the principles of integrated watershed management requires continuous evaluation of the effectiveness of the management alternatives in meeting the Plan's goals and objectives. The concept of "adaptive management" is central to successful implementation of the Plan. Adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn.

The goals and recommendations of this Plan are based on the understanding of the conditions of the natural watershed ecosystem at the time this Plan was developed. However, both the conditions of the watershed and the goals and actions will

change over time as new information is collected, available resources for implementation are assessed, and the values and needs of the watershed's residents evolve.

Changes in social and economic forces can trigger changes in watershed management practices. Similarly, changes in a watershed's ecosystem can indicate a need for altered watershed management practices. Adaptive management recognizes the dynamic interplay of these forces, which implies a need to continually evaluate progress toward the meeting the Plan's goals and objectives.

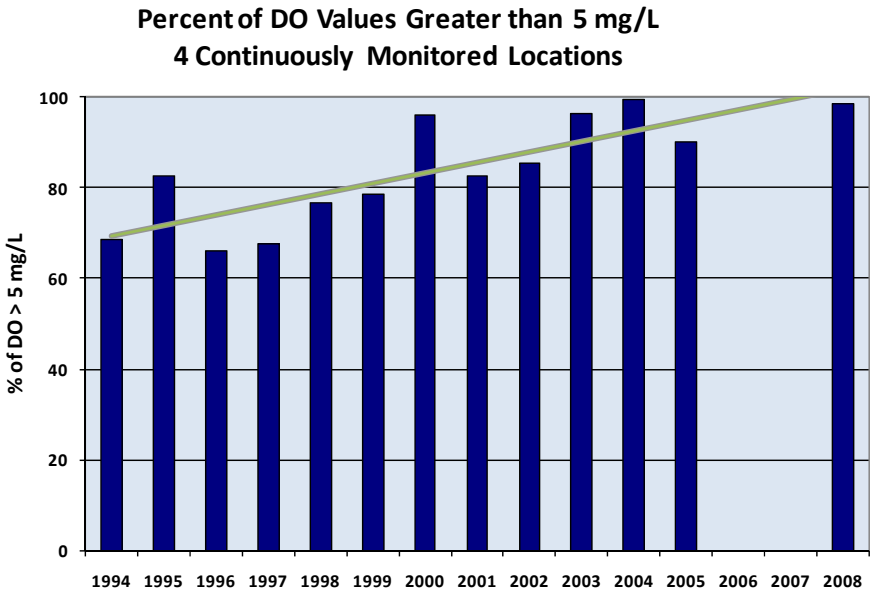
Executive Summary

Rouge River Watershed Management Plan

This plan represents a year-long effort by the Alliance of Rouge Communities (ARC) to update and consolidate seven subwatershed management plans completed in 2001 into one sustainable Rouge River Watershed Management Plan (WMP). It builds on the successes of the past while laying the groundwork for the future.

The overall characteristics and conditions of the Rouge River Watershed demonstrate that much progress has been made in improving water quality over the last decade. Figure E-1 shows improvement in dissolved oxygen in the river due to millions of dollars of restoration efforts across the watershed. Dissolved oxygen is needed to support a healthy waterway and supports fish and aquatic life in the river. Since 1998, the percent of samples with dissolved oxygen concentrations meeting or exceeding the State minimum standard of 5 mg/L has been increasing.

Figure E-1: DO Concentrations



The Rouge River watershed covers 466 square miles of southeast Michigan and is home to more than 1.3 million people in parts Oakland, Wayne and Washtenaw counties. The watershed's 48 communities comprise a diversity of land uses from the urbanized areas of Detroit, Livonia and Southfield to the developing areas of Troy, Canton Township and Novi, to the rural areas of Salem, Superior and Van Buren townships.

This is due in large part to the control of untreated sewage being discharged to the Rouge River. Pollutant loads from combined sewer overflows have been cut by 90 to 100 percent during most rain events. Other water quality parameters which were once frequently exceeded in the Rouge River prior to these restoration efforts now meet a majority of water quality standards. The ecosystem health also continues to improve, as is often demonstrated by more frequent sightings of sensitive fish and aquatic life species.

Challenges still remain with managing flow variability, including both flow rates and storm water runoff volume, along with bacterial loading in wet weather conditions. This watershed management plan includes a variety of identified projects and management strategies to that will continue to improve Rouge River water quality, aesthetics and recreational opportunities.

Alliance of Rouge Communities
OURS TO PROTECT
Working together, restoring the river

Previous Watershed Management Planning Efforts

In 1998, the Rouge River Watershed was divided into seven subwatersheds, also called storm water management areas (SWMA) shown in figure E-2. The terms "Storm Water Management Area" and "Subwatershed" are used synonymously throughout this watershed management plan. This provided a mechanism for the Rouge River Watershed communities to focus local resources to address local problems and to allow the stakeholders with challenges to work collectively towards cost effective solutions. These subwatershed advisory groups (SWAGs) worked cooperatively to develop individual management plans for each subwatershed. These original management plans, completed in 2001, laid the groundwork for the Rouge River Watershed communities to restore the uses of the Rouge River impaired by flow variability, high bacteria levels and low dissolved oxygen levels.



Figure E-2: Rouge River Watershed

Accomplishments to Date



Rouge Green Corridor

The Rouge River Watershed stakeholders have addressed many of the challenges since 2001 to improve the river's water quality. A few of the significant accomplishments include the following:

- The establishment of the ARC, a voluntary public watershed entity which provides an institutional mechanism to encourage watershed-wide cooperation and mutual support to meet water quality permit requirements and to restore beneficial uses of the river to area residents.
- The restoration of Carpenter Lake in Southfield, Quarton Lake in Birmingham and Kingswood Lake at Cranbrook Educational Community in Bloomfield Hills.
- The restoration of an oxbow at The Henry Ford in Dearborn.
- The ongoing partnership efforts such as : 1)The Rouge Green Corridor, comprised of the cities of Southfield, Birmingham and Beverly Hills that are working with other partners to preserve the riparian corridor that connects those communities and 2)The Rouge Gateway Partnership leading the effort for environmentally responsible redevelopment within the lower eight miles of the Rouge River's Main Branch.

- The lifting of the state's fish consumption advisory covering the general population for carp, channel catfish and largemouth bass from Newburgh Lake.
- The Lower Rouge Recreational Trail in Canton opened in 2008 and provides much needed improved access to recreational opportunities along the first 2.3 miles of a four-mile stretch of the Lower Rouge River.
- Wayne County's continued expansion of "grow zones," the areas where turf grass has been removed and planted with native plants within the riparian corridors it manages.



31 inch pike caught at Newburgh Lake

Photo credit: Michael Precious

The 2009 Rouge River Watershed Management Plan Update

The overall purpose of this watershed management plan is to build on past successes and to continue to implement a cost-effective approach to improving water quality in the Rouge River as well as meet the requirements of the NPDES Phase II permit that each ARC community must comply with.

The 2009 Rouge River Watershed Management Plan identifies four primary pollutants affecting the Rouge River: pathogens, flow rate and volume, sediment, and nutrients. This watershed management plan is driven by six goals, each of which has associated objectives that will focus efforts on addressing these pollutants, the sources and their respective causes. They are outlined as follows:

1) Improve water quality and reduce sources of pollution that threaten public health.
2) Reduce runoff impacts through sustainable storm water management strategies and programs.
3) Inform and educate the public to become watershed stewards.
4) Protect, restore and/or enhance natural features to maintain/improve river and watershed ecosystems;
5) Maximize community assets related to the watershed.
6) Support regional partnerships for the implementation of the watershed management plan.



Carpenter Lake in Southfield

Protecting public health through controlling the discharges of raw sewage remains a key priority in the effort to restore the Rouge River. CSO and SSO control projects are ongoing as well as programs to eliminate illicit discharges such as cross-connections between sanitary leads and storm sewers and failing septic systems.

This plan has increased the focus on managing storm water flow and volume. The impacts to the Rouge River Watershed due to increased impervious surfaces, such as rooftops, parking lots and roadways, has caused an increase in the total volume of storm water runoff, the frequency of runoff reaching the streams, the peak flow rate of runoff and the quality of runoff. While, historically, storm water ordinances addressed storm water flow rates and runoff, this watershed plan has refined that focus to additionally emphasize the reduction of storm water volume using various "green infrastructure" techniques. Setting a long-term target of reducing storm water volume by approximately 300 million cubic feet across the watershed will significantly reduce the amount of storm water runoff entering the river system.

The Rouge River watershed action plan includes a variety of identified projects and management strategies which will result in improvement of the Rouge River. Examples of these initiatives include the following:

- ***Addressing Storm Water Volumes and Flow:*** Excessive peak flows in the river and storm water runoff volume are substantial problems in the Rouge River and most other urban rivers. They generate large pollutant loads from all land uses through the erosive forces of high velocity overland flow. This excessive water exacerbates the pollutant delivery causing stream banks to collapse, taking with them trees, sediment and backyards. This excess volume of water causes significant changes in the hydrology of the streams which further effects natural features and biological conditions. Excessive flows create more silt which washes over and covers habitat for a variety of bugs, fish and wildlife. (Rouge 2008)
- ***ARC Illicit Discharge Elimination (IDEP)/Total Maximum Daily Load (TMDL) Plan:*** This plan will focus efforts on addressing remaining sources of raw sewage in the river through a cooperative mechanism to sample, identify and search out the illicit connections entering the river system. The extensive monitoring database will allow the ARC Technical Committee to prioritize elimination of identified illicit discharges while also meeting state NPDES Phase II requirements.
- ***ARC Public Education Plan (PEP):*** The ARC PEP will focus annual efforts towards educating the public and training local representatives about watershed management and improving water quality. The plan will be prepared by the ARC Public Involvement and Education Committee and is designed to also meet the requirements of the NDPES Phase II permit. Public education and involvement activities are meant to teach people about the watershed, promote partnerships focused on restoring the resource, or highlight practices that improve the waterway.
- ***Green Infrastructure Campaign:*** This will be a coordinated effort within the ARC to not only implement green infrastructure techniques on local community properties, but to also serve as a demonstration to private property owners about the simplicity with which these techniques may be constructed. Communities and counties are requested to consider application of these techniques, such as rain gardens, bioswales or other grow zones on their properties and submit a request to the ARC PIE for funding consideration. This campaign demonstrates the commitment for working towards reducing storm water volume in the river and its tributaries.
- ***Institutional Relationships:*** The ARC will continue to provide an institutional mechanism to encourage watershed-wide cooperation and mutual support to meet water quality permit requirements and to restore beneficial uses of the river to area residents. Other institutional partners include non-profit organizations, educational institutions and others who are working together to reduce the individual costs of restoring the Rouge River. The ARC Technical and Public Involvement and Education Committees are comprised of a variety of stakeholders, such as government, non-profit organizations, stewardship groups, educational institutions, consultants, and others focused on a specific initiative to address storm water pollution.
- ***Municipal Good Housekeeping Practices and Programs:*** While the ARC continues to strive for cost-effective, collaborative activities and opportunities, local units of government also continue to practice good-housekeeping on their respective properties. As mentioned, green infrastructure is an excellent form



Bioswale in Bloomfield Township



Rain garden at Dearborn DPW yard

of good-housekeeping by reducing storm water runoff. There are other day-to-day actions that should also be considered. Activities include: management of composting/recycling facilities, public works yards, or wastewater treatment plants; construction project management; street repair and maintenance; street sweeping; storm sewer maintenance; park and landscape maintenance; and employee training.

Measuring Success across the Watershed

A well-planned evaluation process will provide measures of the effectiveness of implementation of this Watershed Management Plan and achieving its goals. The evaluation of this Watershed Management Plan will be accomplished through a five-year monitoring plan recently updated in 2008 to be consistent with the activities outlined in this plan. The goals established to protect and restore water uses of the river are ambitious and may take several decades to accomplish. However, significant progress has been made over the past 10-15 years and will continue to be made as actions are implemented.



2008 FOTR Winter Stonefly Search

A large component of the ARC's long-term monitoring plan includes a partnership with Friends of the Rouge (FOTR). The FOTR benthic monitoring program is a cost effective way to monitor improvements in water quality by monitoring the diversity of aquatic life in the river and its tributaries. Additionally, effectiveness will be gauged by flow and water quality monitoring. Finally, a large component of monitoring will include tracking land cover changes from impervious or turf to green infrastructure, such as tree canopy and native vegetation.

Watershed Management Plan Sustainability

The success of the Rouge River WMP depends upon consistent involvement and support from local, county and state governments, non-profit organizations, educational institutions, local businesses and citizens. While each community has unique situations that require case-by-case consideration and implementation, many of the recommendations in the WMP require coordination among all the communities of the watershed to be cost-effective at reducing pollutant loads. Water quality improvements in the Rouge River will continue with collaboration by all the watershed stakeholders.



ARC meeting

Continued involvement by the ARC and the ARC Technical Committee, ARC SWAGs, ARC Public Involvement and Education (PIE) Committee and all interested stakeholders will provide oversight of plan implementation, coordination, evaluation, and revision.

SECTION 1 - EXECUTIVE SUMMARY

The goal of the Shiawassee River Watershed Management Plan is to recognize and catalog the current conditions impacting the water quality of the Shiawassee River, its tributaries and lakes, address actions that can be taken to resolve existing problems and prevent future degradation. Over the last two years, representatives from both county and local communities have worked together to develop this plan by:

- Developing a Public Participation Plan
- Identifying stakeholders
- Gathering available information on: water quality, stormwater flow, habitat
- Identifying known impairments to the river and its tributaries
- Identifying and prioritizing the sources of the pollutants
- Obtaining input from community officials, stakeholders and the general public
- Establishing and prioritizing goals for the watershed
- Identifying the actions for which the communities would take responsibility
- Highlighting areas where gaps existed between the goals and the actions
- Developing a list of recommended activities to be implemented by the local governmental agencies
- Presenting this information to stakeholders and the general public

This planning process resulted in a Stormwater Management Plan that fulfills Genesee, Livingston & Oakland Counties' and those Phase II community's requirements under the Michigan Department of Environmental Quality (MDEQ) Phase II Watershed-based Stormwater Permit. Shiawassee County is not a Phase 2 Community and their participation in the watershed planning process is completely voluntary.

Livingston County through the Livingston County Drain Commissioner's Office has produced a Stormwater Management Plan for the South Branch of the Shiawassee River. That plan is referred to as " Upper-2 Shiawassee River Watershed Management Plan'. Since much of the watershed originally part of this plan has been included under the Upper-2 Watershed plan the watershed boundary line was moved, with a few exceptions to the jurisdiction boundary to minimize duplication. This reduced this 149 mi^2 watershed to 92 mi^2.

BACKGROUND

The initial emphasis of the National Pollutant Discharge Elimination System (NPDES) under the Federal Clean Water Act of 1972 was to control discharges from industrial and large municipal wastewater treatment plants. Once these discharges were substantially under control, it became apparent that the combined impact of various smaller widespread (non-point) pollution sources was preventing many streams and receiving waters from meeting state water quality standards. These diffuse sources include failing septic systems, stormwater runoff from residential lawns, agricultural fields, parking lots, roadways and construction sites, illegal dumping, and airborne deposition. Adequate

control of all these point and non-point sources is necessary to restore and maintain the use of the nation's water resources.

Instead of imposing discharge limitations and stormwater control programs, the Michigan Department of Environmental Quality is allowing local units of government to establish goals to improve water quality through development and implementation of a watershed management plan. In 2001, Genesee County designated the Drain Commissioner's Office as the county agency responsible to engage in watershed management activities and establish a system of stormwater management services under Act 342, Public Acts of Michigan, 1939, as amended ("Act 342"). Although not all of the communities located within Genesee County are regulated under the NPDES Phase II program, all the communities have signed a contract under Act 342 with the Genesee County Drain Commissioner's Office to provide stormwater management services which includes:

- Applying for Certificate of Coverage for the communities and Genesee County under Michigan's Phase II Watershed-based Stormwater Permit.
- Organize and direct the development of a Public Participation Plan
- Organize and oversee the Public Education and Participation Sub Committee
- Organize and oversee the New Construction Standards and Post Construction Practices Sub Committee
- Organize and oversee the Monitoring and Mapping Sub Committee
- Organize and direct the watershed workgroup in developing the Stormwater Management Plan.
- Organize and oversee planning and implementation of the above programs
- Assist the contract communities in preparing individual SWPPIs
- Coordinating between the communities and the school districts that have signed contracts as nested jurisdictions.

The Oakland County Drain Commissioner's Office (OCDC) is the agency for the Oakland County Phase II Stormwater Permit. The OCDC coordinates communication between Oakland County departments, as well as acting as a resource for watershed and sub watershed groups. Phase II communities within Oakland County are either implementing the watershed plan(s) on their own or are contracting to partner with watershed groups within adjoining watersheds to meet their requirements.

The Livingston County Drain Commission (LCDC) has taken the lead on the upstream areas through their separate "Upper-2 Shiawassee River Watershed Management Plan". This plan has been completed and submitted to the Michigan Department of Environmental Quality (MDEQ) for review. The Phase 2 communities within Livingston are implementing the watershed plans on their own with the Livingston County Drain Commissioner's Office (LCDC) providing assistance by coordinating implementation efforts. The Phase 2 Communities can also contract with the LCDC for IDEP work.

Shiawassee County and its communities are not regulated under the NPDES Phase II program, but are invited to participate in the development of the Stormwater Management Plan.

By working together, these public agencies designed a watershed management plan that is built on the strengths of existing programs, resources, and addresses local water quality concerns.

APPENDIX I

U.S. FISH AND WILDLIFE SERVICES BEST MANAGEMENT PRACTICES

Environmental Screening for Eastern Massasauga Rattlesnake in Michigan

March 14, 2017

Background

The Eastern Massasauga Rattlesnake (EMR) is listed as a threatened species under the U.S. Endangered Species Act (Act). The Act protects the EMR and their habitat by prohibiting "take" and may require agencies to coordinate with the U.S. Fish and Wildlife Service (Service) before authorizing or funding an activity affecting the species. To streamline coordination, the Service's Michigan Ecological Services Field Office has developed a set of Best Management Practices (BMPs) for specific activities potentially impacting EMR in Michigan. These BMPs are voluntary and just one of the ways that compliance with the Act may be achieved.

Projects may…

- have no effect to EMR and no need for additional ESA compliance considerations.
- have potential for adverse effects, but use BMPs to avoid adverse effects (i.e., "not likely to adversely affect" EMR) or minimize the adverse effects.
- use surveys to confirm probable absence of EMR (contact the Service for survey guidance).
- use "Informal Consultation" with Service (for actions requiring a Federal permit or funding).
- use "Formal Consultation" with Service (for actions requiring a Federal permit or funding).
- develop a Habitat Conservation Plan and seek an ESA permit, if adverse effects cannot be avoided.

For activities not listed in the BMPs, please contact the Service for project-specific recommendations. In some cases implementation of BMPs may not be sufficient to avoid all adverse impacts to EMR and additional consultation with the Service may be required. The Service can assist planners in determining whether adverse effects are likely as a result of proposed projects, and whether implementation of BMPs is sufficient to remove the risk of adverse effects.

Additional information on compliance with the Act can be found:

For Federal actions/section 7 consultation:
https://www.fws.gov/midwest/Endangered/section7/s7process/index.html

For non-Federal actions:
https://www.fws.gov/midwest/endangered/permits/index.html

For questions or comments you may contact the Service below:
U.S. Fish and Wildlife Service
Michigan Ecological Services Field Office
2651 Coolidge Road, Suite 101
East Lansing, MI 48823
Phone: (517)351-2555
Email: eastlansing@fws.gov

Definitions

Active Season: The active season begins in the spring when snakes emerge from hibernation, generally when maximum air temperatures are above 50°F, and ends in the fall when EMR have returned to their hibernacula and temperatures are consistently below 45°F. In Michigan, the active season is generally April through October. The active season dates will vary by location and weather. **Contact the Service for project-specific dates based on location when work in EMR habitat is planned near the start or end of the active season**.

Affecting hydrology: We consider "affecting hydrology" to include projects that are likely to appreciably change the elevations of surface water upstream or downstream, or in the local ground water (as estimated pre-project vs. post-project). The concern is for changes to local hydrology (e.g., creating new ditches, creating a new impoundment) that might harm EMR hibernating at or near ground water, or actions that significantly alter available suitable habitat either through flooding or drying of EMR wetlands.

Hibernacula: Areas suitable for EMR to overwinter. For most EMR populations, the locations of hibernacula are not known, but these areas are critical to protect. Unfortunately, we lack information on how to reliably identify these areas. EMR usually hibernate below the frost line in crayfish or small mammal burrows, tree root networks or rock cervices in or along the edge of wetlands or in adjacent upland areas with presumably high water tables (areas where the soil is saturated but not inundated). Following egress from hibernacula in the spring, EMR typically remain aboveground in the vicinity for a week or two, and return to these areas in the fall for several weeks prior to entering hibernation. Surveys in the spring (shorting following egress) or fall (prior to ingress) when snakes are congregating in the vicinity may help identify these important areas. Maintaining stable hydrology of these areas is important during the inactive season.

IPaC: "Information for Planning and Conservation" is a project planning tool available on-line to the public that streamlines the Service's environmental review process.

EMR Habitat: "Eastern Massasaugas have been found in a variety of wetland habitats. Populations in southern Michigan are typically associated with open wetlands, particularly prairie fens, while those in northern Michigan are known from open wetlands and lowland coniferous forests, such as cedar swamps. Some populations of Eastern Massasaugas also utilize open uplands and/or forest openings for foraging, basking, gestation and parturition (i.e., giving birth to young). Massasauga habitats generally appear to be characterized by the following: (1) open, sunny areas intermixed with shaded areas, presumably for thermoregulation; (2) presence of the water table near the surface for hibernation; and (3) variable elevations between adjoining lowland and upland habitats." From Michigan Natural Features Inventory (Website: mnfi.anr.msu.edu)

Tier 1 Habitat: Areas known to be occupied by EMR or highly likely to be occupied by EMR.

Tier 2 Habitat: Areas with high potential habitat and may be occupied by EMR.

Within the known range: EMR can occur throughout the Lower Peninsula and on Bois Blanc Island in Mackinac County. Areas within the known range but outside of Tier 1 and Tier 2 are considered less likely to be occupied. EMR is highly secretive and cryptic in nature, and can persist in low densities, which makes them difficult to detect. Further, there are extensive areas of the state that have never been surveyed. It is likely that there are additional and yet-unknown occurrences throughout the Lower Peninsula of Michigan. Mapped habitats are subject to change based on new information identifying current Tier 1 and 2 areas as unsuitable, or based on discovery of new EMR occurrences.

EMR Environmental Screening Step-wise Process

Step 1. Determine if EMR may be present in the action area

- ✓ Determine whether the project is in potential EMR habitat using https://ecos.fws.gov/ipac
  - o You can search for your project location and define the action area by drawing a polygon or uploading a shapefile.
  - o IPaC will give you a list of species that may be present in the area you identified. If you click on the thumbnail for EMR, it will tell you if your project is within Tier 1 or Tier 2 habitat, or within the known range of EMR. If EMR is not listed, you do not need to consider this species. Effects to other listed species should also be considered; contact the Service if you need assistance.
  - o If EMR is listed, it does not necessarily mean that the entire action area is potential habitat, only that some potential habitat is within the action area entered. For large-scale (e.g., county-wide or multi-county projects) consider coordinating the Michigan Ecological Services Field Office for direct assistance.

If your project is within the known range of EMR, including Tier 1 or Tier 2 habitat, continue to step 2:

Step 2. Determine if the project has the potential to affect EMR

Projects have no effect on EMR when…

- ✓ There is no suitable EMR habitat in the project area and no potential impact off-site (e.g., water discharge into adjacent EMR habitat). If project site conditions are determined to be wholly unsuitable for EMR (e.g., project is in regularly mowed turf grass, row crop, graveled lot, existing building, or industrial site), it is not suitable EMR habitat.
- ✓ The project occurs within suitable habitat, but the action will have absolutely no effect on the habitat or EMR.
- ✓ In suitable EMR habitat, but the site is entirely unoccupied by the species. This is typically confirmed through surveys (contact the Service for more information). In some cases it may be easier to assume EMR are present and use BMPs than to conduct surveys for the species.

For projects where there is a potential for effects to EMR, continue to the section of the document as follows:

For Tier 1 Habitat ..... Page 5

For Tier 2 Habitat ..... Page 6

Within the range of EMR ..... Page 7

For projects with a combination of Tier 1 and Tier 2 habitat, follow the instructions for Tier 1.

Tier 1 Habitat

Tier 1: Project will not affect EMR if all of the following apply:

1. Project will not result in any changes to suitable EMR habitat quality, quantity, availability or distribution, including changes to local hydrology
2. If EMR are present in the project area, they are not likely to have any response as a result of exposure to the action or any environmental changes as a result of the action
3. Project includes all General Best Management Practices:
   a. Use wildlife-safe materials for erosion control and site restoration (see Erosion Control Resources side panel). In Tier 1 habitat, immediately eliminate use of erosion control products containing plastic mesh netting or other similar material that could entangle EMR.
   b. To increase human safety and awareness of EMR, those implementing the project should first watch MDNR's "60-Second Snakes: The Eastern Massasauga Rattlesnake" video (available at https://youtu.be/-PFnXe_e02w), or review the EMR factsheet (available at https://www.fws.gov/midwest/endangered/reptiles/eama/pdf/EMRfactsheetSept2016.pdf or by calling 517-351-2555.
   c. Require reporting of any EMR observations, or observation of any other listed threatened or endangered species, during project implementation to the Service within 24 hours.

Tier 1: Project Not Affecting EMR Coordination Recommendation: No pre-project coordination with Service needed. Document the steps above for your records.

Tier 1: All Other Projects: For any other projects in Tier 1 habitat that may affect EMR or its habitat, contact the Service for assistance in evaluating potential impacts. Best Management Practices (starting on page 8) are included for many actions to help with project planning, but may not be sufficient to avoid all adverse impacts. The Service can determine whether additional measures are necessary after a project-specific review.

Erosion Control Resources

There are a variety of products that can be used for soil erosion and control requirements. These products may incorporate plastic mesh netting to help maintain form and function. This plastic netting has been demonstrated to entangle a wide variety of wildlife from birds to small mammals. In Michigan, soil erosion control netting has resulted in the documented mortality of a number of imperiled amphibian and reptile species including the EMR and the Eastern Fox Snake (State Threatened).

Several products for soil erosion and control exist that do not contain plastic netting including net-less erosion control blankets (for example, made of excelsior), loose mulch, hydraulic mulch, soil binders, unreinforced silt fences, and straw bales. Others are made from natural fibers (such as jute) and loosely woven together in a manner that allows wildlife to wiggle free. For more information regarding wildlife-safe erosion control measures contact the USFWS Michigan Ecological Services Field Office.

Tier 2 Habitat

Tier 2: Project is not likely to adversely affect EMR if all of the following apply:

1. Project does not impact more than 1 acre of wetland habitat and includes all applicable activity-specific BMPs (starting on page 8), and
2. Project will not appreciably affect hydrology
3. Project includes all General Best Management Practices:
    a. Use wildlife-safe materials for erosion control and site restoration (See Erosion Control Resources side panel, page 4). In Tier 2 habitat, eliminate the use of erosion control products containing plastic mesh netting or other similar material that could ensnare EMR as soon as is feasible but no later than January 1, 2018.
    b. To increase human safety and awareness of EMR, those implementing the project should first watch MDNR's "60-Second Snakes: The Eastern Massasauga Rattlesnake" video (available at https://youtu.be/-PFnXe_e02w), or review the EMR factsheet (available at https://www.fws.gov/midwest/endangered/reptiles/eama/pdf/EMRfactsheetSept2016.pdf or by calling 517-351-2555.
    c. Require reporting of any EMR observations, or observation of any other listed threatened or endangered species, during project implementation to the Service within 24 hours.

Tier 2: Project Not Likely to Adversely Affect EMR Coordination Recommendation: Informal consultation with Service for actions requiring a Federal permit or funding. For non-Federal projects, document the steps above for your records, but no pre-project coordination with the Service needed.

Tier 2: All Other Projects: Coordinate with the Service for a project-level review to determine potential impacts and whether additional conservation measures are needed to avoid adverse effects.

Within the known range of EMR

For projects within the known range of EMR, but outside of Tier 1 and Tier 2 habitat:

To help ensure your project is unlikely to affect EMR:

1. Project applies the General Best Management Practices:
    a. Use wildlife-safe materials for erosion control and site restoration (See Erosion Control Resources side panel, page 4). By January 1, 2019, eliminate the use of erosion control products containing plastic mesh netting or other similar material that could ensnare EMR (within the known range but outside of Tier1 or Tier 2 habitat).
    b. To increase human safety and awareness of EMR, those implementing the project should first watch MDNR's "60-Second Snakes: The Eastern Massasauga Rattlesnake" video (available at https://youtu.be/-PFnXe_e02w), or review the EMR factsheet (available at https://www.fws.gov/midwest/endangered/reptiles/eama/pdf/EMRfactsheetSept2016.pdf or by calling 517-351-2555.
    c. Require reporting of any EMR observations, or observation of any other listed threatened or endangered species, during project implementation to the Service within 24 hours.
2. Project will not have significant impacts to dispersal, connectivity, or hydrology of existing EMR potential habitat, i.e., filling less than 1 acre of wetland habitat or converting less than 20 acres of uplands of potential EMR habitat (uplands associated with high quality wetland habitat) to other land uses.

Within the Known Range, but Outside Tier 1 or 2 Coordination Recommendation:
Document the steps above for your records and no pre-project coordination with the Service needed. If you cannot implement the General Best Management Practices contact the Service for assistance in evaluating potential impacts.

Activity-Specific Best Management Practices

For Tier 1, BMPs are included; however, even with implementation of the BMPs, project-specific review may be needed to determine whether they are sufficient to avoid all adverse impacts

- In Tier 1 habitat, contact the Service regarding the potential applicability of surveys to determine EMR absence in suitable habitat. In Tier 2, surveys can be conducted to confirm the presence of suitable habitat and/or the presence/probable absence of EMR. If onsite habitat is determined to be wholly unsuitable via desktop analysis (e.g., entirely mowed lawn, row crop, graveled lot, and industrial site), then it can be classified as unoccupied and the BMPs will not be necessary.
- Minimize work in Tier 1 and Tier 2 EMR habitat. When feasible, do not route new construction projects, such as pipelines, facilities, or access roads, through potential EMR habitat. Implement the use of wildlife-friendly corridors (e.g., oversized culverts) into new road design to maintain or enhance habitat connectivity.
- Projects should be designed to minimize the potential for disturbance to EMR during project activities.

Maintenance Activities (includes nominal modifications to existing roads and infrastructure)

1. Ground Disturbing Activities
    a. All
        i. No known EMR hibernacula are destroyed or disturbed at any time of year. Because these areas are often not known:
            1. For Tier 1: contact the Service to determine whether adverse impacts are likely as a result of ground disturbing work in Tier 1 habitat.
            2. For Tier 2: when operating in potential hibernation areas (e.g., EMR wetlands and adjacent areas with crayfish burrows, rodent holes, small mammal burrows, etc.), work is conducted well within the active season (June – August) to avoid when snakes are likely to be present. During this time, they are most likely to be able to move out of the way of disturbance and have greater chances to find alternative hibernation sites. Destroying potential hibernacula may still impact snakes indirectly. Potential hibernation areas should be avoided to the extent possible.
    b. Grading
        i. When working during EMR active season, use exclusionary fencing to separate EMR habitat from the work site to prevent EMR from accessing the disturbance area. For example, in linear projects exclusionary fencing should run parallel to the disturbance, creating a barrier to snake movement. Each end of the exclusionary fencing should be angled away from the area of disturbance to direct snakes traveling along fencing away from the site. The

exclusionary fencing will typically be traditional silt fence that is set up outside of all areas of disturbance and other types of fencing (i.e., snow fence used to delineate the work zone). Do not use fencing materials that can entangle or injure snakes.

ii. Any areas using exclusionary fencing should first be "cleared" by a qualified individual[1] before beginning construction activities. Fencing should be installed a minimum of 1 day before construction activities occur and walked weekly to ensure the integrity of the fence. If snakes are seen within the work zone, activity should stop until the snake can be safely moved, and the fence examined for breeches.

iii. Revegetate all disturbed Tier 1 and Tier 2 habitat with appropriate plant species (i.e., native species or other suitable non-invasive species present on site prior to disturbance). Monitor all restoration plantings for proper establishment and implement supplemental plantings as necessary to ensure restorations are of equal to or better habitat quality than previous conditions.

iv. In Tier 1 and Tier 2, avoid spread of invasive species into EMR habitat by following best practices. This includes inspecting and cleaning equipment and vehicles between work sites as needed to avoid the spread of invasive plant materials.

c. Trenching

i. In Tier 1 and Tier 2, avoid trenching in EMR wetlands when possible. In Tier 1, if open trenching is required install exclusionary fencing (follow measures 1(b)(i)-(iv)) and ensure the area is clear prior to trenching.

d. Fill

i. In Tier 1 and Tier 2, ensure all imported fill material is free from contaminants or invasive species could affect the species or habitat through acquisition of materials at an appropriate quarry or other such measures.

ii. In Tier 1 and Tier 2, use exclusionary fencing around the area to be filled and have the site "cleared" prior to placing fill by a qualified individual (as in 1(b)(i)-(ii).

e. Ditching

i. For Tier 1 and Tier 2, conduct work well within the active season (June-August) when snakes are not likely to be near hibernation sites and can escape disturbance, or contact Service for project specific recommendations.

ii. For Tier 1, use exclusionary fencing around the area to be cleared/graded and have the site cleared by a qualified individual prior to construction activities.

iii. For Tier 1, contact the Service for work greater than 200' for project specific recommendations.

[1] A qualified individual is someone who has received training on the identification and life history of EMR.

2. Site Access with vehicles (both Tiers)
    a. Limit operating vehicles/equipment, clearing trees, etc., in EMR habitat to the inactive season when the ground is frozen. During this time, under these conditions, EMR are most likely underground and will not be impacted by these activities. When possible, use low-impact equipment such as light weight track mounted vehicles with low ground pressure. In Tier 1, if the ground isn't completely frozen (due to weather conditions during the inactive season or if working near seeps and springs that are less likely to freeze), or if working near potential hibernacula, manual access (on foot) may be required.
    b. Strictly control and minimize vehicle activity in known/presumed occupied EMR habitat to the extent possible. During EMR active season, speed limits at facilities and access roads (i.e., 2-track and gravel) in occupied habitat should be <15 MPH.
    c. In Tier 1 and Tier 2 habitat areas, drivers should be aware of the potential danger to the driver of swerving to intentionally drive over snakes as well as legal and conservation implications.

3. Heavy Equipment (both Tiers)
    a. Spill Prevention for oils/fluids
        i. Site staging areas for equipment, fuel, materials, and personnel at least 100 feet from the waterway, if available, to reduce the potential for sediment and hazardous spills entering the waterway. If sufficient space is not available, a shorter distance can be used with additional control measures (e.g., redundant spill containment structures, on-site staging of spill containment/clean-up equipment and materials). If a reportable spill has impacted occupied habitat:
            1. Follow spill response plan;
            2. Call MDEQ and the National Response Center (800-424-8802), and the Service's Michigan Ecological Services Field Office (517-351-2555) to report the release.
    b. Do not use large equipment or perform earth-moving activities, water withdrawal and discharge for hydrostatic testing, or other activities that substantially affect the ground or water levels in potential EMR hibernacula areas. Avoidance measures may include, but are not limited to, re-routing of pipeline and appurtenance facilities, boring or drilling, and timing/weather-related restrictions. Measures will be determined on a site-specific basis, based on local habitat conditions, contact Service for more information.

4. Hydrology impacts (both Tiers)
        i. Water levels in known/presumed occupied habitats should not be artificially manipulated during the inactive season.

ii. Where applicable, water levels should be allowed to flow naturally and not be artificially stabilized. This allows for the restoration of early successional habitats.

Habitat Management and Restoration

5. Vegetation Management
    a. Mowing
        i. In Tier 1, mow during the inactive season.
        ii. For Tier 2, mowing is unrestricted during the inactive season. During the active season, follow daytime mowing restrictions and mow during times of day when snakes are less likely to be active (Figure 1). Increase mower deck height to >8 inches to reduce likelihood of injury to snakes. Higher deck height will reduce the risk of death or injury to snakes in the area.
        iii. In areas with turf grass or areas where trying to discourage EMR (e.g., in areas around buildings), mow regularly and keep grass relatively short (less than 4-6 inches) to reduce its suitability for EMR. If starting with longer grass (greater than 6 inches), mow during the inactive season initially, and then maintenance mowing can occur during the active season (as long as it is regularly maintained and kept shorter than 4-6 inches, so that EMR is unlikely to use those areas). Unmaintained/longer grass may be used by snakes and make them vulnerable to mortality during the next mowing event.

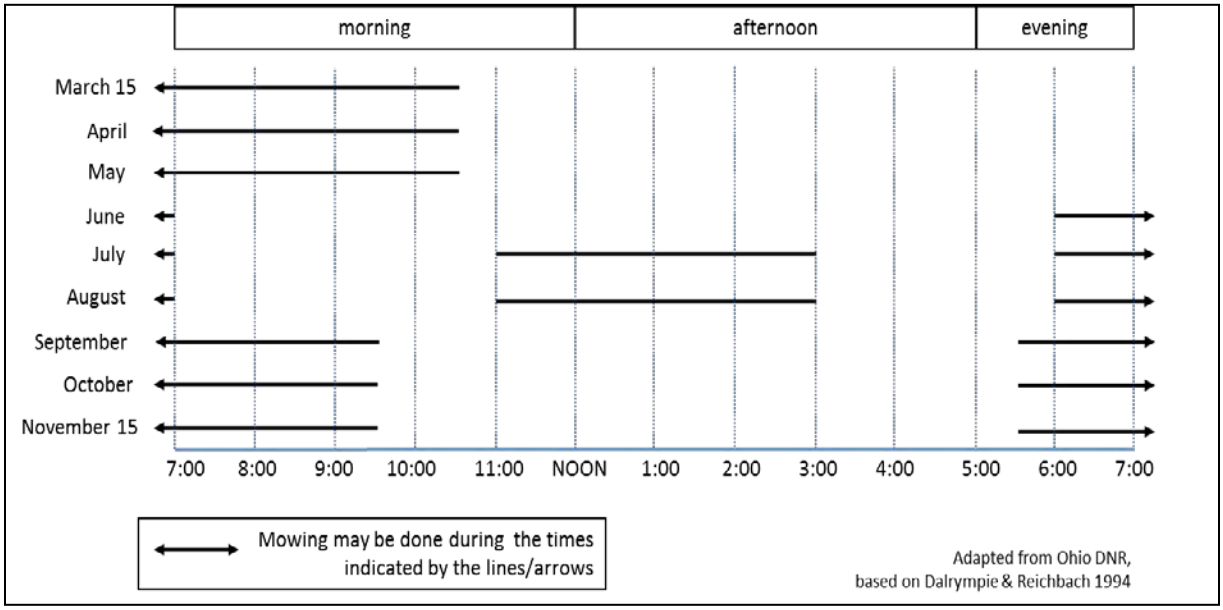


Figure 1. EMR Active season mowing schedule (NiSource Biological Opinion, page 273, USFWS 2015)

b. Cultivation (e.g., disking)
    i. In Tier 1 habitat, disking should be limited to the inactive season, and areas within 50 m of known or potential hibernacula should be avoided. In Tier 2, disking can occur in the active season if area is mowed during the inactive season and maintained shorter than 4-5 inches.
c. Brush/Tree Removal
    i. In Tier 1, conduct brush or tree removal in known/presumed EMR habitat during the inactive season, when the ground is frozen (such that soils can be left undisturbed).
    ii. Use low impact harvest methods in Tier 1 and Tier 2 wetlands to cut and remove individual trees. This includes using low-impact equipment such as light weight track mounted vehicles with low ground pressure. In Tier 1, if the ground isn't completely frozen (due to weather conditions during the inactive season or if working near seeps and springs that are less likely to freeze), or if working near potential hibernacula, use hand tools and access site on foot.
    iii. In Tier 1 and Tier 2, do not burn brush piles during the active season. Dispose of brush offsite or leave in place.
d. Herbicides
    i. Follow all appropriate label instructions regarding which herbicide formulation to use in potential EMR habitat. Avoid spray drift beyond the target species/area (observing label instructions regarding optimal wind speed and direction, boom height, droplet size calibration, precipitation forecast, etc.).
    ii. Avoid broadcast applications of herbicides in Tier 1. Spot spraying or wicking can be used to control invasive plants in occupied habitat. If using broadcast spray in Tier 2, limit the area of exposure to less than half of the available EMR habitat to allow for untreated areas to provide potential areas of refugia from exposure. Contact the Service if you need help in determining this.
e. Prescribed burning (Tier 1 and Tier 2)
    i. Conduct prescribed burns during the inactive season before snakes emerge from hibernation. Walk the burn unit following the burn and report any dead or injured EMR to the Service within 24 hours. Burn only a portion (e.g., one-third) of available EMR habitat in any year to leave suitable cover for EMR and its prey.
    ii. Establish fire breaks using existing fuel breaks (roads, rivers, trails, etc.) to the greatest extent possible. Cultivation (disking or roto-tilling) of burn breaks will be minimized to the extent that human health and safety are not jeopardized. Cultivation and mowing to establish fire breaks will occur during the inactive season.

6. Erosion control
    a. Use wildlife-safe erosion control blankets (without plastic mesh netting in the layers of material) as required in the general BMPs. Remove all silt fence used for erosion control once soils are stable to reduce barriers to EMR movement.
7. Revegetation
    a. Revegetate all disturbed Tier 1 and Tier 2 habitat with appropriate plant species (i.e., native species or other suitable non-invasive species present on site prior to disturbance). Monitor all restoration plantings for proper establishment and implement supplemental plantings as necessary to ensure restorations are of equal to or better habitat quality than previous conditions.
8. Invasive species
    a. In Tier 1 and Tier 2, avoid spread of invasive species into EMR habitat by following best practices. This includes inspecting and cleaning equipment and vehicles between work sites as needed to avoid the spread of invasive plant materials.
9. Wetland restoration
    a. Restoring natural hydrology in areas that have been drained by tiling and ditching may greatly benefit EMR habitat. Conduct tile breaking or excavation well within the active season to avoid potential hibernacula. Have a qualified individual walk in front of the equipment to clear the area. Work with the Service for Tier 1 habitat to ensure no indirect adverse effects are expected as a result of restoration efforts.
10. Water-level manipulation
    a. Water levels should not be artificially manipulated during the inactive season to avoid impacts to hibernating snakes. Contact the Service in Tier 1 habitat when water levels will be manipulated during the inactive season or will result in significant alterations to EMR habitat during the active season.

APPENDIX J

FORMS

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

OVERBURDENED AND SIGNIFICANTLY OVERBURDENED COMMUNITY STATUS DETERMINATION WORKSHEET

The following data is required from each State Revolving Fund (SRF) applicant requesting a determination for overburdened and significantly overburdened community status.

The most recent census and tax data are available in a searchable table on EGLE's State Revolving Fund – Overburdened Community Definition and Scoring Criteria Development webpage along with an excel worksheet to help determine blended Median Annual Household Income (MAHI) and blended taxable value per capita for regional systems. The MAHI and taxable value per capita table will be used to make all FY24 determinations. Applicants are encouraged to visit this page prior to completing this form to see if they qualify based on MAHI (blended MAHI if applicable) or taxable value per capita (blended taxable value per capita if applicable) alone. If so, they only need to fill out lines 1 and 2 of this form, electronically sign it on page 2, and submit.

Alternately, **if the applicant's MAHI or blended MAHI is above the state average - $63,498 for FY24 – they cannot be determined as being overburdened or significantly overburdened for FY24 funding and should not complete or turn in this form**.

For applicants whose MAHI or blended MAHI is below $63,498 but do not automatically qualify based on MAHI or taxable value per capita alone, please complete the entire form and return to:

Mark Conradi
conradim@michigan.gov

Name of Applicant

Oakland County Water Resource Commissioner

Please check the box indicating which funding source this determination is for:

DWSRF ☐

CWSRF ☑

1. Is this a regional system? A regional system refers to any system that serves more than one municipality (cities, townships, and/or villages)

Yes ☐
No ☑

If yes, refer to the instructions at the end of this form to complete calculations for a blended MAHI and blended taxable value per capita. Additionally, page 3 of this form will also need to be completed.

2. Median Annual Household Income from table on the overburdened webpage (blended if applicable)

$36,214

3. Taxable Value Per Capita from table on the overburdened webpage (blended if applicable)

$14,274

4. Total amount of anticipated debt for the proposed project (amount of loan requested for FY24 loan)

$853,600

5. Annual payments on the existing debt for the system

$0

6. Total operation, maintenance, and replacement expenses (OM&R) for the system on an annual basis

$0

7. Number of residential equivalent users (REUs) in the system

N/A for NPS projects

***I (Nathan Melasi) hereby certify that the information in this form is complete, true, and correct to the best of my knowledge.**

04/13/2023

Signature Date

For determinations made using anticipated debt, a final determination will be made based upon the awarded loan amount and not the anticipated amount provided on this form.

Regional System Breakdown (If applicable)

Name of municipality	Percentage of flow
City of Pontiac	100%
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
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Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow

If more spaces are needed, please include them in the email along with this submission. Percentages of flow must add up to 100%.

OVERBURDENED AND SIGNIFICANTLY OVERBURDENED COMMUNITY STATUS INSTRUCTIONS AND GUIDANCE

The following instructions provide guidance to fill out the overburdened and significantly overburdened determination community status worksheet. Systems across the state use many types of methods for billing and some include items that others do not. The purpose of the determination is to put all systems on a level playing field by breaking down system debt, expenses, and number of customers in the same manner. The instructions address each question in the order they are presented on the worksheet.

1. **Regional systems (if applicable) – Blended MAHI and taxable value per capita calculations**

   The definition of overburdened and significantly overburdened communities first requires "(a) Users within the area served by a proposed drinking water project, sewage treatment works project, or stormwater treatment project are directly assessed for the costs of construction." That means that the calculations need to be based on who is paying for the proposed SRF loan.

   For systems that serve more than one municipal entity a blended MAHI and taxable value per capita calculation must be completed. Page 3 of the worksheet includes spaces for a system to list all the municipalities (cities, townships, and/or villages) and the percentage of flow they provide to the system. The flow percentages should be based on the most recent data available.

   The reason flow is used is because most systems add debt costs to customers' bills and those are determined by flow. In rare cases there might be municipal agreements that vary slightly from this method and those will require the applicant to contact EGLE and provide the data separate from this worksheet. EGLE will take each municipality's MAHI and taxable value per capita and multiply it by the percentage of flow and then add them all together to come up with the blended number to be used in the determination (e.g., (municipality A MAHI * flow) + (municipality B MAHI * flow) + (municipality C MAHI * flow = Blended MAHI for the system)). The same formula will be repeated swapping out taxable value per capita for MAHI to determine a blended taxable value per capita.

   The most recent census and tax data are available in a searchable table on EGLE's State Revolving Fund – Overburdened Community Definition and Scoring Criteria Development webpage. This table will be used to make all FY24 determinations. Use the excel FY24 Overburdened Calculation Template also located on the State Revolving Fund – Overburdened Community Definition and Scoring Criteria Development webpage. Tab 1 titled, "Blended MAHI and TVPC calcs" will allow the applicant to input the names of the municipalities, their percentage of flow, the MAHI for each found in the table listed above, and the taxable value per capita for each in the table listed above, to calculate a blended MAHI and blended taxable value per capita of the regional system. **If the blended MAHI is above $63,498 the project cannot qualify for overburdened or significantly overburdened status and the rest of the form should not be filled out or turned in.**

2. **Median Annual Household Income**

   Use the "Fiscal Year 2024 Overburdened Median Annual Household Income (MAHI) and Taxable Values List for SRF Projects; the State of Michigan MAHI is $63,498 for FY24 Projects" searchable table located on the State Revolving Fund – Overburdened Community Definition and Scoring Criteria Development webpage. Search for the system's MAHI and enter it. **If the**

MAHI is above $63,498 the project cannot qualify for overburdened or significantly overburdened status and the rest of the form should not be filled out or turned in.

For regional systems that serve more than on municipality (cities, townships, and/or villages), refer to the instructions for regional systems in step 1 if you have not already completed calculating a blended MAHI for the system. Once the blended MAHI is determined, enter it on line 2 of the worksheet.

3. **Taxable Value Per Capita**

   This data is found in the same location as the MAHI data and was likely already entered by the applicant while completing line 2. If not, repeat the directions for step 2 and enter the taxable value per capita from the table.

   For regional systems that serve more than on municipality (cities, townships, and/or villages), refer to the instructions for regional systems in step 1 if you have not already completed calculating a blended taxable value per capita for the system. Once the blended taxable value per capita is determined, enter it on line 3 of the worksheet.

4. **Total amount of anticipated debt for the proposed project**

   Fill in the total amount of the proposed loan for the project requesting State Revolving Loan financing in FY24.

   EGLE will amortize this amount to determine a yearly cost to the applicant. The excel FY24 Overburdened Calculation Template, also located on the State Revolving Fund – Overburdened Community Definition and Scoring Criteria Development webpage, has this calculation built in so the applicant only needs to enter full FY24 the loan amount when completing that as well.

   Note that this loan amount is an estimate and often changes after project plans are submitted and bids come in. EGLE will run this determination again prior to finalizing the Project Priority List (PPL). Changes in the loan amount can sometimes change an applicant's status from overburdened to not or vice versa if the initial calculation is close to the 1% MAHI threshold.

   Thus, if a system is determined to be overburdened or not based on annual user costs being greater than 1% of system's MAHI vs being determined overburdened by MAHI or state taxable value per capita alone, a loan amount will be provided to the applicant that provides the cutoff loan value to either gain or lose overburdened status.

5. **Annual Payments on the existing debt of the system**

   Fill in the yearly total of any current debt payments for the system. If coming in for a CWSRF project only include debt payments for the wastewater system and if coming in for a DWSRF project only include debt payments for the drinking water system.

   In a regional system the additional debt payments of connected systems may be added if the connected systems are included in the blended MAHI and taxable value per capita calculations and there is no double-counting. For example, if a regional treatment system is coming in for the loan, a connected collection system could add any additional annual debt costs that the

collection system passes onto its customers after paying all debt and expenses to the regional treatment system. This is to account for the fact that the MAHI and state taxable values are being blended so the annual debt payments of the regional system can be blended as well to determine the average user cost of the regional system.

6. Total operation, maintenance, and replacement (OM&R) expenses for the system on an annual basis

As with the annul debt payments, the amount listed here should include only wastewater OM&R for CWSRF loans and only drinking water OM&R for DWSRF loans. If the accounting is combined split the costs as accurately as possible.

The OM&R costs should reflect all annual expenses for the system that are recovered annually through rates. This means that if a community makes an annual contribution of $50,000 a year to a capital improvement fund, they could add that number to the yearly OM&R costs. If they have accumulated $250,000 in that account and plan on using all in the calendar year they are applying for the loan, they cannot claim that amount as it is not a yearly expense; only the $50,000 is. This is also true for depreciation expenses with no cash value or yearly contribution. They cannot be included.

In a regional system the additional OM&R expenses of connected systems may be added if the connected systems are included in the blended MAHI and taxable value per capita calculations, there is no double-counting, and the expenses follow the same OM&R rules listed above. For example, if a regional treatment system is coming in for the loan, a connected collection system could add any additional annual OM&R costs that the collection system passes onto its customers after paying all debt and expenses to the regional treatment system. This is to account for the fact that the MAHI and state taxable values are being blended so the annual OM&R expenses of the regional system can be blended as well to determine the average user cost of the regional system.

7. Number of residential equivalent users (REUs) in the system

REUs refer to number of standard household hookups in a system. In a bedroom community, with little to no commercial or industrial customers, this number clear. However, most systems have a combination of customer types. The purpose of this form is to determine the average bill for a typical residential customer to determine if it is high enough to pose a burden on the ratepayer.

There are two standard ways of determining REUs: meter size and average flow.

- Meter size

  This is the preferred method as it eliminates most variables that using flow may have. To determine the number of REUs in a system take all the systems' meters and convert them down to 5/8^{ths}-inch or ¾-inch (whichever is the system's standard residential size). Use the capacity of the pipe to convert down (e.g., a 2-inch meter would be equivalent to about 8, 5/8^{ths}-inch meters, a 4-inch meter would be equivalent to about 25, 5/8^{ths}-inch meters, etc.). The resulting number of equivalent 5/8^{ths}-inch or ¾-inch meters would be the number of REUs in the system.

- Average flow

  The average flow method requires the system to determine the average yearly flow for a typical residential household (i.e., a 5/8^{ths}-inch or ¾-inch connection). The system takes the most recent yearly flow data of the entire system and divides by the average household usage number to come up with the number of REUs.

EGLE will look at the numbers provided and may have questions based on the population size vs number of REUs. EGLE will reach out and ask to see the calculations in some instances. Applicants are encouraged to include an excel sheet with these calculations along with the submittal of this form to reduce any back-and-forth communications.

Signature

A typed name and accompanying electronic signature are required for the form to be accepted. If this section is left blank the form will be returned to the sender and not reviewed until it has been signed and sent back.

Final Determination

If the system's MAHI or blended MAHI (if applicable) is over the state average - $63,498 for FY24 – it cannot be determined as being overburdened or significantly overburdened for FY24 funding.

EGLE will take the information provided on this form and enter it into the FY24 Overburdened Calculation Template spreadsheet to calculate the average yearly cost per REU. If a community or system is not determined to be overburdened or significantly overburdened based on MAHI or taxable value per capita alone, this calculation will determine if the costs are greater than 1% of the system's MAHI.

The FY24 Overburdened Calculation Template spreadsheet with the calculations and final determination will be sent to the applicant after the review has been completed by EGLE. A blank version is available on the State Revolving Fund – Overburdened Community Definition and Scoring Criteria Development webpage. Ideally the applicant has already completed the calculations using the instructions above prior to submitting. If the applicant completes the worksheet and determines they do not qualify for overburdened status it is requested that they do not submit the completed worksheet unless they have questions. The applicant's preliminary findings using the FY24 Overburdened Calculation Template are not official until they have been reviewed by EGLE as discrepancies and/or questions about some of the numbers may arise. However, EGLE is providing the template to allow applicants to have a good idea of how the determination will result prior to hearing back officially from EGLE.

Please contact Mark Conradi (conradim@michigan.gov) with any questions on the completion of the form.

If you need this information in an alternate format, contact EGLE-Accessibility@Michigan.gov or call 800-662-9278.

EGLE does not discriminate on the basis of race, sex, religion, age, national origin, color, marital status, disability, political beliefs, height, weight, genetic information, or sexual orientation in the administration of any of its programs or activities, and prohibits intimidation and retaliation, as required by applicable laws and regulations. Questions or concerns should be directed to the Nondiscrimination Compliance Coordinator at EGLE-NondiscriminationCC@Michigan.gov or 517-249-0906.

This form and its contents are subject to the Freedom of Information Act and may be released to the public.

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

OVERBURDENED AND SIGNIFICANTLY OVERBURDENED COMMUNITY STATUS DETERMINATION WORKSHEET

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Alternately, **if the applicant's MAHI or blended MAHI is above the state average - $63,498 for FY24 – they cannot be determined as being overburdened or significantly overburdened for FY24 funding and should not complete or turn in this form**.

For applicants whose MAHI or blended MAHI is below $63,498 but do not automatically qualify based on MAHI or taxable value per capita alone, please complete the entire form and return to:

Mark Conradi
conradim@michigan.gov

Name of Applicant

Oakland County Water Resource Commissioner

Please check the box indicating which funding source this determination is for:

DWSRF ☐

CWSRF ☑

1. Is this a regional system? A regional system refers to any system that serves more than one municipality (cities, townships, and/or villages)

Yes ☐
No ☑

If yes, refer to the instructions at the end of this form to complete calculations for a blended MAHI and blended taxable value per capita. Additionally, page 3 of this form will also need to be completed.

2. Median Annual Household Income from table on the overburdened webpage (blended if applicable)

$36,214

3. Taxable Value Per Capita from table on the overburdened webpage (blended if applicable)

$14,274

4. Total amount of anticipated debt for the proposed project (amount of loan requested for FY24 loan)

$491,100

5. Annual payments on the existing debt for the system

$0

6. Total operation, maintenance, and replacement expenses (OM&R) for the system on an annual basis

$0

7. Number of residential equivalent users (REUs) in the system

N/A for NPS projects

***I (Nathan Melasi) hereby certify that the information in this form is complete, true, and correct to the best of my knowledge.**

04/13/2023

Signature Date

For determinations made using anticipated debt, a final determination will be made based upon the awarded loan amount and not the anticipated amount provided on this form.

Regional System Breakdown (If applicable)

Name of municipality	Percentage of flow
City of Pontiac	100%
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
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If more spaces are needed, please include them in the email along with this submission. Percentages of flow must add up to 100%.

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

OVERBURDENED AND SIGNIFICANTLY OVERBURDENED COMMUNITY STATUS DETERMINATION WORKSHEET

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Alternately, **if the applicant's MAHI or blended MAHI is above the state average - $63,498 for FY24 – they cannot be determined as being overburdened or significantly overburdened for FY24 funding and should not complete or turn in this form**.

For applicants whose MAHI or blended MAHI is below $63,498 but do not automatically qualify based on MAHI or taxable value per capita alone, please complete the entire form and return to:

Mark Conradi
conradim@michigan.gov

Name of Applicant

Oakland County Water Resource Commissioner

Please check the box indicating which funding source this determination is for:

DWSRF ☐

CWSRF ☑

1. Is this a regional system? A regional system refers to any system that serves more than one municipality (cities, townships, and/or villages)

Yes ☑
No ☐

If yes, refer to the instructions at the end of this form to complete calculations for a blended MAHI and blended taxable value per capita. Additionally, page 3 of this form will also need to be completed.

2. Median Annual Household Income from table on the overburdened webpage (blended if applicable)

$61,243

3. Taxable Value Per Capita from table on the overburdened webpage (blended if applicable)

$33,624

4. Total amount of anticipated debt for the proposed project (amount of loan requested for FY24 loan)

$292,200

5. Annual payments on the existing debt for the system

$0

6. Total operation, maintenance, and replacement expenses (OM&R) for the system on an annual basis

$0

7. Number of residential equivalent users (REUs) in the system

N/A for NPS project

***I (**Nathan Melasi**) hereby certify that the information in this form is complete, true, and correct to the best of my knowledge.**

04/13/2023

Signature Date

For determinations made using anticipated debt, a final determination will be made based upon the awarded loan amount and not the anticipated amount provided on this form.

Regional System Breakdown (If applicable)

Name of municipality	Percentage of flow
City of Madison Heights	94.48%
Name of municipality	Percentage of flow
City of Troy	5.52%
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow
Name of municipality	Percentage of flow

If more spaces are needed, please include them in the email along with this submission. Percentages of flow must add up to 100%.