Chapter 2 – Status of Water Quality in the Watershed

St. Clair County's Northeastern Watersheds (NEW) have a complex history of activities that have impacted water quality for over a century. These activities have included:

- intense logging and agricultural use,
- mining and processing of salt,
- mining of oil and gas reserves,
- mining of sand and gravel,
- filling of low areas with industrial and domestic waste, and
- point source discharges from industry and municipal wastes and wastewaters.

While historically these sources of pollution dramatically impacted the water quality of the Lower Black River (LBR) and St. Clair River Direct Drainage (SRD) subwatersheds, the Lake Huron Direct Drainage (LHD) subwatershed remained primarily a residential area.

Today, pollution sources for the NEW have changed. Few of the mining operations exist, and most urban point source discharges have been controlled. The most prevalent point source discharges in the NEW now consist of failing on-site sewage (septic) disposal systems in rural areas, combined sewer overflow discharges in Port Huron, atmospheric deposition, and occasional sanitary sewer overflows and industrial spills. The impacts from historical point source discharges is limited to isolated areas of moderately contaminated sediments near outfalls and several efforts are being implemented to eliminate these areas. Point source discharges of wastewater (sewage) from combined sewer overflow (CSO) events have been eliminated in the communities of Yale, Marysville, the City of St. Clair, and Marine City, and the City of Port Huron is currently in its ninth year of a $186 million, 15-year project to control its sewage overflows. To date, 75% of the City's work to eliminate CSOs has been completed. Marysville also experiences sanitary sewer overflow (SSO) events primarily due to high amounts of storm and groundwater inputs into its aging sanitary sewer infrastructure from inflow and infiltration (I & I). The City has been working diligently in the past few years to locate the problem areas and upgrade the failing infrastructure. They have also constructed a 1.2 million gallon capacity wet weather station to store sewage for treatment when the main system is overburdened during wet weather. Local municipalities and the County have begun implementing Illicit Discharge Elimination Programs which identify and correct remaining sources such as failing septic systems or sewer cross-connections.

All of the point sources noted above have contributed the following pollutants to area waterways:

- Mercury and other heavy metals (copper, lead, zinc, etc.);
- Chlorinated Organic Compounds:
    - PCBs
    - Organochlorine Pesticides: Chlordane and Dieldrin;
- Polynuclear Aromatic Hydrocarbons (PAHs);
- Volatile Organic Carbons (VOCs):
    - Chlorinated Solvents
    - Fuel Components; and,
- Bacteria/pathogens.

Nationally, numerous studies have proven that nonpoint source pollution dramatically impacts water quality. For the NEW, recent field surveys have confirmed several nonpoint sources of pollution to be impacting the NEW. Stakeholders also suspect other nonpoint sources that have yet to be confirmed by further water quality monitoring and analyses (references used to develop this chapter are provided in Appendix A). The following pollutants (in addition to the pollutants noted above) and hydrological conditions are suspected of impacting water quality throughout the NEW:

- Sediment (soil erosion and sedimentation),
- Nutrients (nitrogen and phosphorus compounds), and
- Flashy hydrology (unstable flow regime causing streambank erosion and channel down-cutting).

The following additional pollutants are impacting the NEW to a much lesser degree based on available data:

- trash and debris,
- pesticides, and
- petroleum-based hydrocarbons (grease and oil).

Sources of these pollutants are related to:

- increasing growth and development (construction, increased impervious surfaces);
- erosion and sedimentation at road/stream crossings, at construction sites, along streambanks, and from agricultural areas;
- discharge of pollutant-laden stormwater runoff from storm sewers and overland flow in urbanized and urbanizing areas;
- failing onsite sewage disposal systems (OSDS);
- hydromodifications (dredging, channel straightening, etc.);
- agricultural runoff (nutrients, bacteria, sediment, pesticides/herbicides); and,
- naturally-occurring sources.

Figures 2.1 through 2.5 below illustrate some common sources of nonpoint source pollutants in the watershed.

Figure 2.1 Nonpoint Source Pollution Pathways in Residential Areas: Lack of Riparian Buffers (photo taken along the Cuttle Creek in the SRD subwatershed)

Figure 2.3 Urbanized Source of Nonpoint Source Pollution: Offsite Soil Erosion and Sedimentation at Construction Sites (photo taken of construction site at the corner of Bunce Avenue and Busha Highway in the SRD subwatershed)

Figure 2.4 Agricultural Sources of Nonpoint Source Pollution: Eroded Streambanks from Lack of Riparian Buffer and Cattle Access to Streams, and Pathways for Pathogens and Bacteria, Nutrients, and Pesticides into Area Waterways (photo taken at Harris Road in the LHD subwatershed)

Figure 2.5 Hydromodifications such as Ditching and Tile Drainage in Agricultural Areas Impact Watershed Hydrology by Increasing Stormwater Runoff Quantities and Decreasing Groundwater Recharge and Baseflows in Streams (photos taken at Norman Road along Thomas Drain in the LBR subwatershed)

2.1 Designated Uses

By law, the State of Michigan protects waterways in order to meet a set of public "designated uses". Designated uses are defined as recognized uses of surface water established by state and federal water quality programs. In Michigan, the goal is to have all waters of the state meet all designated uses. Table 2.1 describes the designated uses for water in the NEW.

Table 2.1 Michigan's Designated Uses for Waterways

	Designated Use	Definition
1	Agriculture	A use of water for agricultural purposes, including livestock watering, irrigation, and crop spraying.
2	Industrial water supply	A water source intended for use in commercial or industrial applications or for non-contact food processing.
3	Public water supply at the point of intake	A surface raw water source that, after conventional treatment, provides a source of safe water for various uses, including human consumption, food processing, cooking, and as a liquid ingredient in foods and beverages.
4	Navigation	A use of water for navigational purposes, such as boating or shipping.
5	Warmwater fishery	A waterbody that contains fish species which thrive in relatively warm water, including any of the following: Bass, Pike, Walleye and Panfish.
6	Other indigenous aquatic life and wildlife	The use of the surface waters of the state by fish, other aquatic life, and wildlife for any life history stage or activity and the protection of fish for human consumption.
7	Partial body contact recreation	Any activities normally involving direct contact of some part of the body with water, but not normally involving immersion of the head or ingesting water, including fishing, wading, hunting, and dry boating.
8	Total body contact recreation (May 1 through October 31)	Any activities normally involving direct contact with water to the point of complete submergence, particularly immersion of the head, with considerable risk of ingesting water, including swimming.

Based on available water quality monitoring data showing water quality standard exceedances for pathogens (bacteria), mercury, and PCBs, the following designated uses have been recognized as being impaired:

- Warmwater fishery
- Partial body contact recreation
- Total body contact recreation

The designated uses that are threatened by other pollution sources in the NEW are the three (3) uses noted above, as well as:

- Public water supply at the point of intake
- Other indigenous aquatic life and wildlife

All other designated uses for water are currently being met in the NEW. Table 2.2 provides a summary of the known and suspected pollutants and concerns that are threatening the above noted designated uses in the NEW.

Table 2.2 Pollutants/Concerns Threatening Designated Uses

Designated Use	Pollutant/Concern*
• Public water supply at point-of-intake	• Chemical spills in the St. Clair River (s) • Bacteria and pathogens (k) • Petroleum by-products (grease/oils) (s)
• Warmwater fishery • Aquatic life/wildlife	• Chemical spills in the St. Clair River (s) • Nutrients (phosphorus and nitrogen) (s) • Sediment (k) • Pesticides/herbicides (s) • Road salt/salt brine (Chlorides) (s) • Petroleum by-products (grease/oils) (s) • Heavy metals (k) • Flashy hydrology (k) • Low-flows during dry weather--loss of groundwater recharge (k) • Shoreline/streambank erosion (k) • Engineered seawalls (lack of natural buffers for protection/habitat) (k) • Degraded in-stream/shoreline habitat (k)
• Partial body contact recreation • Total body contact recreation, May 1 to October 31	• Chemical spills in the St. Clair River (k) • Nutrients (phosphorus and nitrogen) (s) • Sediment (k) • Pesticides/herbicides (s) • Petroleum by-products (grease/oils) (s)

*known (k) and suspected (s)

2.2 Desired Uses

In addition to the designated uses for water, a set of desired uses have been determined for the watershed. Desired uses are uses that have been identified by WAG members and the public through several focus group meetings as important to enhance and/or protect in the watershed; they are also important in helping to foster community support in the development and implementation of a successful WMP. Table 2.3 below lists the desired uses for the NEW (in no particular order):

Table 2.3 Desired Uses for St. Clair County's Northeastern Watersheds

1	Protection of public health and drinking water supplies (public and private)
2	Preservation of rural character (farmland and open space)
3	Acquisition of additional parks and recreational facilities, with a priority along riparian areas
4	Preservation of high-quality natural areas, open space, and greenways
5	Protection of wetlands
6	Protection of forested areas, floodplains, and riparian buffers along Lake Huron, the Black River, and the St. Clair River (including smaller tributaries)
7	Enhancement of public access to Lake Huron, the Black River, and the St. Clair River
8	Enhancement of the "recreational" fishery (warmwater and coolwater species)
9	Maintenance of and/or increasing the aesthetics of the water resources

Desired uses can also be impacted by various activities and pollutants present in the NEW. Table 2.4 summarizes the known and suspected pollutants and concerns affecting the desired uses.

Table 2.4 Known and Suspected Pollutants/Concerns Affecting Desired Uses

Desired Use	Pollutants/Concerns *
Protection of public health and drinking water supplies (public and private)	Bacteria and pathogens (k)
	Toxic compounds (PCBs, mercury) (k)
	Chemical spills (s)
	Over-withdrawal of groundwater supplies (s)
Preservation of rural character (farmland and open space)	Lack of funding for purchase of development rights (k)
	Urban growth and development (k)
	Inadequate plan review procedures and enforcement (k)
Acquisition of additional parks and recreational facilities (with a priority along riparian areas)	Urban growth and development (k)
	Lack of funding for land acquisition (k)
Preservation of high-quality natural features, open space, and greenway corridors	Urban growth and development (k)
	Lack of education regarding stormwater management, land use and management, and nonpoint source pollution prevention (k)
	Lack of protection ordinances (k)
	Inadequate plan review procedures and enforcement (k)
	Lack of funding for plan review, land acquisition, natural features inventories, and ordinance enforcement (k)
Protection of wetlands	Urban growth and development (k)
	Lack of education regarding stormwater management, land use and management, and nonpoint source pollution prevention (k)
	Lack of protection ordinances (k)
	Lack of funding for plan review, natural features inventories, and ordinance enforcement (k)
Protection of forested areas, floodplains, and riparian buffers	Urban growth and development (k)
	Lack of education regarding stormwater management, land use and management, and nonpoint source pollution prevention (k)
	Lack of protection ordinances (k)
	Inadequate plan review procedures and enforcement (k)
	Lack of funding for plan review, natural features inventories, and ordinance enforcement (k)
Enhancement of public access to Lake Huron, the Black River, and the St. Clair River	Desire to increase public access to water resources (k)
Enhancement of the "recreational" fishery (warmwater and coolwater species)	Fish consumption advisories (PCB's, mercury) (k)
	Desire to increase public access to water resources (k)
	Engineered seawalls (lack of natural buffers for protection/habitat) (k)

Table 2.4 Known and Suspected Pollutants/Concerns Affecting Desired Uses

Desired Use	Pollutants/Concerns *
Maintenance of and/or increasing the aesthetics of the water resources	Urban open drains not aesthetically pleasing (not recreational asset) (k)
	Trash/floatables (paper, garbage, illegal dumping, etc.) in surface waters (k)
	Petroleum by-products (grease/oils) (s)
	Engineered seawalls (lack of natural buffers for protection/habitat) (k)
	Shoreline/streambank erosion (k)

*known (k) and suspected (s)

2.3 Sources and Causes of Watershed Pollutants and Concerns

The primary information used to delineate the known and suspected sources of threats and impairments to the designated and desired uses in the NEW were determined through stakeholder input and the following water quality monitoring and field data analyses (much of the data is provided in the Resource Directory; the CD provided with the WMP):

- Upper Great Lakes Connecting Channel Study (1988),
- MDEQ Great Lakes and Environmental Assessment Section (GLEAS) reports,
- MDEQ's 2006 Integrated Section 303(d) and 305(b)Report,
- EPA's STORET Database,
- 2004/2005 Inter-County Lake St. Clair Regional Monitoring Project,
- 2006 SCCHD beach/stream monitoring,
- EPA's "Spreadsheet Tool for Estimating Pollutant Load" (STEPL) modeling,
- St. Clair River Remedial Action Plan (RAP),
- 2004/2005 Road/Stream Crossing Watershed Survey, and the
- 2006 Monitoring in the LHD and SRD subwatersheds.

Table 2.5 provides a summary of the known and suspected sources and causes of each pollutant/concern in the NEW. Each pollutant, source, and cause is described in more detail in subsequent sections of this chapter.

Table 2.5 Summary of Watershed Pollutants, Sources and Causes

Pollutant/ Concern *	Source*	Cause*
1. Nutrients (phosphorus and nitrogen) (s)	1.1 Onsite Sewage Disposal Systems (OSDS)/Sewage Lagoons/Package Treatment Plants (k)	1.1.1 Aging system (s) 1.1.2 Improper maintenance (s) 1.1.3 Lack of a maintenance program (k) 1.1.4 Illicit discharges (k) 1.1.5 Non-permitted systems (older systems) (s)
	1.2 Lawn and garden activities/commercial composting sites (k)	1.2.1 Improper fertilizer application – timing, rates, types (s) 1.2.2 Impervious surfaces (k) 1.2.3 Removal of riparian vegetation (k)
	1.3 Agricultural runoff (s)	1.3.1 Lack of implementation of GAAMPs (k) 1.3.2 Improper fertilizer application rates/times (s) 1.3.3 Removal of riparian vegetation (k) 1.3.4 Improper handling of manure piles (s) 1.3.5 Exposed soils (k)
	1.4 Land application of septage (s)	1.4.1 Improper application rates, times, and locations (s) 1.4.2 Illegal applications (s) 1.4.3 Lack of adequate septage disposal facilities (k)
	1.5 Livestock, pet, and wildlife waste (i.e. cattle, geese, seagulls, dogs) (k)	1.5.1 Unrestricted access to surface waters (k) 1.5.2 Improper/lack of cleanup of wastes (k) 1.5.3 Lack of riparian buffers (k)

Table 2.5 Summary of Watershed Pollutants, Sources and Causes

Pollutant/ Concern *	Source*	Cause*
	1.6 Sanitary sewer systems/CSOs/SSOs (k)	1.6.1 Leaks, breaks, illicit connections/discharges (s) 1.6.2 Overflow events (k) 1.6.3 Lack of funding for sewer construction, reconstruction, and maintenance (k)
	1.7 New development/Redevelopments (k)	1.7.1 Inadequate soil erosion and sedimentation controls at construction sites (Nutrients associated with sediment particles transported in stormwater runoff) (k) 1.7.2 Lack of riparian buffers (k)
2. Sediment (k)	2.1 Erosion at road/stream crossings (k)	2.1.1 Inadequate buffer of vegetation or riprap at crossings to reduce the erosive potential and sediment input from roadway (k) 2.1.2 Steep ditch wall grade (k) 2.1.3 Lack of non-woody vegetation (grasses) along roadside ditch/drain banks to reduce flow velocities (k)
	2.2 Agricultural runoff (s)	2.2.1 Plowing near or through small tributaries running through agricultural fields (s) 2.2.2 Removal of riparian vegetation (k) 2.2.3 Pasturing in/near waterways (k) 2.2.4 Exposed soils (s) 2.2.5 Sedimentation in roadside ditches from untiled fields (k) 2.2.6 Lack of riparian buffers along roadside ditches (k)
	2.3 New development/Redevelopments (k)	2.3.1 Inadequate soil erosion and sedimentation controls at construction sites (k) 2.3.2 Excessive unvegetated cover from lack of staging during construction activities (k) 2.3.3 Inadequate maintenance of soil erosion and sedimentation controls at road/stream crossings (s) 2.3.4 Lack of pervious surfaces/infiltration (k) 2.3.5 Inadequate stormwater management review during site plan review process (k) 2.3.6 Current development design patterns (lack of stormwater management BMPs) (k)
	2.4 Eroding streambanks/shorelines (k)	2.4.1 Flashy hydrology (flow fluctuations) (k) 2.4.2 Pasturing in/near waterways (k) 2.4.3 Lack of local enforcement to prohibit development in floodplains of smaller tributaries that are not mapped by FEMA (k) 2.4.4 Removal of riparian vegetation (k) 2.4.5 Lack of pervious surfaces/infiltration (k) 2.4.6 Inadequate stormwater management review during site plan review process (k) 2.4.7 Inadequate streambank/shoreline stabilization practices (k)
	2.5 Roadways (dirt/gravel) (k)	2.5.1 Increased surface water runoff from lot split developments into roadside ditches that were not originally constructed to handle the additional inputs (k) 2.5.2 Inadequate buffer vegetation or riprap at road/stream crossings (k)
	2.6 Channelized drainage (hydromodifications) (k)	2.6.1 Increased stormwater flow velocities due to channel straightening (increases erosion) (k)

3. Toxics: (k)
• Chlorinated organic compounds:
  • PCBs
  • Pesticides
• Heavy metals
• Polynuclear aromatic hydrocarbons
• Volatile
	3.1 Landfills/Industrial sites/ Municipal waste water treatment plants (k)	3.1.1 Historical point source discharges (k)
		3.1.2 Inadequate treatment technology (k)
		3.1.3 Contaminated surface water runoff/groundwater (k)
		3.1.4 Poor housekeeping practices—improperly sealed landfill (s)

	3.2 Historically contaminated sediments (k)	3.2.1 Illicit discharges (k) 3.2.2 Re-exposure of contaminants in sediment due to increased flow and changes in channel morphology (s)
	3.3 Improper disposal/illicit discharges of household hazardous wastes (s)	3.3.1 Lack of education (s) 3.3.2 Lack of promotion of SCC's proper disposal site (s) 3.3.3 Discharge of contaminants (i.e. heating oil) from sump pump

Table 2.5 Summary of Watershed Pollutants, Sources and Causes

Pollutant/ Concern *	Source*	Cause*
Organic Compounds • Household hazardous wastes		discharges into roadside ditches (k)
	3.4 Atmospheric deposition (k)	3.4.1 Industrial air emissions (k) 3.4.2 Volatilization of compounds (s)
4. Flashy hydrology (k)	4.1 Increased stormwater runoff quantities from developed areas (k)	4.1.1 Lack of stormwater management BMPs (k) 4.1.2 Increased impervious surfaces from development (k) 4.1.3 Loss of floodplain/wetlands (k) 4.1.4 Engineered conveyance systems (point source discharges from stormwater conveyances/drains) (k) 4.1.5 Lack of maintenance of stormwater management BMPs (k) 4.1.6 Sump pumps and rooftop drainage directly connected to roadside ditches and storm drains (k)
	4.2 Modifications to stream/stormwater conveyance channels (hydromodifications) (k)	4.2.1 Previous drain maintenance—dredging, straightening (k) 4.2.2 Engineered conveyance systems (point source discharges from stormwater conveyances/drains) (k) 4.2.3 Loss of connection between stream and floodplain due to development (k) 4.2.4 Removal of riparian vegetation (k) 4.2.5 Increased stormwater flow velocities due to channel straightening (increases erosion) (k)
	4.3 New development/Redevelopments (k)	4.3.1 Removal of riparian vegetation (k) 4.3.2 Increased impervious surfaces (k) 4.3.3 Changes in hydrology from topographical changes (k) 4.3.4 Lack of maintenance of stormwater management BMPs (k) 4.3.5 Inadequate stormwater review during site plan review process (k) 4.3.6 Current development design patterns (k) 4.3.7 Sump pumps and rooftop drainage directly connected to roadside ditches (k) 4.3.8 Lack of state wetland regulation enforcement and local wetland protection (s) 4.3.9 Lack of riparian corridor protection along tributaries (k) 4.3.10 Lack of local enforcement to prohibit development in floodplains of smaller tributaries that are not mapped by FEMA (k) 4.3.11 Lack of legal authority to manage stormwater (need for ordinances and design standards for stormwater management systems) (k)
5. Pesticides (s)	5.1 Excess commercial/residential application (s)	5.1.1 Improper application rates/times (s) 5.1.2 Improper storage, handling, and disposal (s)
	5.2 Agricultural runoff (s)	5.2.1 Improper application rates/times (s) 5.2.2 Stormwater runoff from tiled agricultural fields (s) 5.2.3 Removal of riparian vegetation (k)
6. Salts (chlorides) (s)	6.1 County/municipal/residential/business road salt application (k)	6.1.1 Improper application rates (amounts) (s) 6.1.2 Accumulation of multiple applications on impervious surfaces getting into stormwater runoff (s) 6.1.3 Lack of road maintenance (street sweeping/catch basin cleaning, etc.) (s)
	6.2 Water softener backwash discharges (s)	6.2.1 Water softener backwash into septic systems (s) 6.2.2 Overland flow discharges (s)
	6.3 Landfills/Industrial Sites	6.3.1 Contaminated surface water runoff (k) 6.3.2 Improperly sealed landfill (k)
7. Pathogens/ Bacteria (k)	7.1 OSDS/Sewage Lagoons/Package Treatment Plants (k)	7.1.1 Improper construction (s) 7.1.2 Improper operation and maintenance (s) 7.1.3 Lack of a required maintenance program (k) 7.1.4 Illicit discharges (k) 7.1.5 Improper design/technology (s)
	7.2 Land application of septage (s)	7.2.1 Improper application rates, times, and locations (s) 7.2.2 Illegal applications (s)

Table 2.5 Summary of Watershed Pollutants, Sources and Causes

Pollutant/ Concern *	Source*	Cause*
		7.2.3 Lack of adequate septage disposal facilities (k)
	7.3 Agricultural runoff (s)	7.3.1 Improper handling of manure piles (s)
	7.4 Livestock, pet, and waterfowl waste (i.e. cattle, geese, seagulls, dogs) (k)	7.4.1 Unrestricted access to surface waters (k) 7.4.2 Lack of waste disposal practices (s)
	7.5 Sanitary sewer systems/CSOs/SSOs (k)	7.5.1 Leaks, breaks, illicit connections/discharges (s) 7.5.2 Lack of funding for sewer construction, reconstruction, and maintenance (k) 7.5.3 Overflow events (k)
8. Degraded in-stream/shoreline habitat (k)	8.1 Modifications to channels/shorelines (k)	8.1.1 Loss of in-stream and shoreline habitat (woody debris, cobbles/boulders, pools/riffles, vegetation, etc.) (k)
		8.1.2 Engineered seawalls (lack of natural buffers for protection/habitat) (k)
	8.2 Eroding streambanks (k)	8.2.1 Flashy hydrology (k)
	8.3 Sediment deposition (silt/sand) (k)	8.3.1 See causes for Sediment (Pollutant No. 2)
9. Heavy Metals (mercury, lead, zinc, etc.) (k)	9.1 Atmospheric deposition (k)	9.1.1 Industrial air emissions (k)
	9.2 Urban runoff (k)	9.2.1 Urban stormwater runoff from impervious surfaces (k) 9.2.2 Lack of stormwater BMPs (k)
	9.3 Industrial/Municipal point source discharges (s)	9.3.1 Inadequate treatment technology (s) 9.3.2 Contaminated surface water runoff from exposed wastes (k) 9.3.3 Historical point source discharges (k)
	9.4 Landfill leachate (k)	9.4.1 Contaminated surface water runoff/ groundwater (k) 9.4.2 Poor housekeeping practices—improperly sealed landfill (s)
	9.5 Lead from bullets used in Port Huron State Game Area (s)	9.5.1 Hunting practices (s)
10. Organic matter (k)	10.1 Litter/trash/yard waste; illegal dumping (s)	10.1.1 Lack of education (s) 10.1.2 Lack of enforcement (s)
11. Petroleum by-products (oils and greases) (s)	11.1 Stormwater runoff (s)	11.1.1 Illicit connections/discharges (s) 11.1.2 Lack of education (k) 11.1.3 Lack of stormwater BMPs (k) 11.1.4 Accidental spills and LUSTs (s) 11.1.5 Discharge of contaminants (i.e. heating oil) from sump pump discharges into roadside ditches (k)
12. Thermal pollution (s)	12.1 Stormwater runoff (s)	12.1.1 Increase in impervious surfaces (solar heating of runoff from pavement) (k)
	12.2 Lack of in-stream canopy (k)	12.2.1 Hydromodifications (k) 12.2.2 Removal of riparian vegetation in new developments (k)
	12.3 Industrial/manufacturing point source discharges (s)	12.3.1 Non-contact cooling water discharges from industrial/manufacturing processes (s)
13. Over-withdrawal of groundwater supplies (s)	13.1 New development/Redevelopments (s)	13.1.1 Lack of hydrogeological investigations during site plan review process (s) 13.1.2 Lack of groundwater withdrawal regulations (s) 13.1.3 Lack of accurate/up-to-date groundwater data (k)
	13.2 Industrial/commercial use (s)	13.2.1 Lack of hydrogeological investigations during site plan review process (s) 13.2.2 Lack of groundwater withdrawal regulations (s) 13.2.3 Lack of accurate/up-to-date groundwater data (k)

*known (k) and suspected (s)

2.3.1 Section 303(d) Listed Waterbodies

The Clean Water Act (CWA) requires Michigan to prepare a biennial report on the quality of its water resources as the principal means of conveying water quality protection/monitoring information to the United States Environmental Protection Agency (USEPA) and the United States Congress (called an Integrated Report). The Integrated Report (IR) satisfies the listing requirements of Section 303(d) and the reporting requirements of Sections 305(b) and 314 of the CWA. The Section 303(d) list includes Michigan waterbodies that are not attaining one or more designated uses for water and may require the establishment of Total Maximum Daily Loads (TMDLs) to meet and maintain Water Quality Standards (WQS). A TMDL is a value, usually expressed in pounds per day, which reflects the allowable loading of a pollutant in a waterbody to assure that WQS are met. A TMDL document must be developed by the state for each impaired waterbody and must describe the impairment and the pollutant causing the impairment, the necessary pollutant loading reductions to assure that WQS are met, and any actions underway at the time the TMDL is developed that will contribute to attaining the necessary pollutant load reductions. TMDLs provide a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of these water resources.

In the NEW, there are just over 419 miles of waterbody reaches that are impaired by pathogens/bacteria, PCBs, and/or mercury and are classified as Category 5 waterbodies. As outlined in MDEQ's 2006 IR, the primary sources of pathogens/bacteria to the nonattaining waterbodies include CSOs, urban runoff/storm sewers, and/or illicit connections. For PCBs and mercury, atmospheric deposition is considered to be the major source of these persistent, bioaccumulative chemicals; however, there are also reports of some localized sources such as contaminated sediments and historical industrial/municipal point source inputs. Information on additional pollutants impacting the NEW is provided in the following sections of this Chapter.

Table 2.6 below summarizes the waterbodies, reach size, pollutant impairing it, the source of the pollutant, and the year of TMDL development.

Table 2.6 Summary of 303(d) Listed Waterbodies in St. Clair County's Northeastern Watersheds (MDEQ, 2006)

Pollutant/ Impairment	Waterbody	Miles Impaired	Reach Impaired	Source	TMDL Year
PCBs	Black River	390	St. Clair River confluence upstream to include all tributaries	• Atmospheric Deposition • Historic industrial/ municipal point source discharges • Localized contaminated sediments	2010
	St. Clair River	27	Vicinity of Algonac, Lake St. Clair inlet upstream to Lake Huron outlet at Port Huron		2010
	St. Clair River	27	Same as noted above for a Fish Consumption Advisory		2010
Mercury	Black River	1	Water Street boat launch downstream of RR bridge		2011
Pathogens/ Bacteria (*E. coli*)	Black River	1.5	St. Clair River confluence upstream to I-94 in the vicinity of	• CSOs • Urban runoff/storm sewers	2009

Table 2.6 Summary of 303(d) Listed Waterbodies in St. Clair County's Northeastern Watersheds (MDEQ, 2006)

Pollutant/ Impairment	Waterbody	Miles Impaired	Reach Impaired	Source	TMDL Year
			Port Huron	• Illicit connections	
	Lake Huron	0.12	Krafft Road Beach in the vicinity of Port Huron		2015
	St. Clair River	27	Vicinity of Algonac, Lake St. Clair inlet upstream to Lake Huron outlet at Port Huron		2009
	St. Clair River	0.5	Chrysler Beach in Marysville		2016
Habitat Modification – Channelization	Carrigan Drain (in the LHD subwatershed)	1.5	Lake Huron confluence upstream; north of Port Huron	• Drain maintenance	None required; (Category 4c waterbody)

Four (4) beaches in the NEW that previously required TMDLs in 2005 for pathogens/bacteria were delisted from the 2004 Section 303(d) list from Category 5 waterbodies and were reclassified into Category 2 waterbodies in 2006 since WQS were met. Those beaches include:

1. **Lake Huron – Lakeside Park Beach**
   (WBID#: 061504C)
   Location: Vicinity of Port Huron.
   Size: 0.5 Mile (M)
2. **Lake Huron – Lakeport State Campground Beach**
   (WBID#: 210101D)
   Location: Lakeport State Park, north of Lakeport.
   Size: 1 M
3. **Lake Huron – Metcalf Road Beach**
   (WBID#: 210101E)
   Location: East end of Metcalf Road.
   Size: 1 M
4. **Lake Huron – Burtchville Township Park Beach**
   (WBID#: 210101F)
   Location: East end of Harris Road.
   Size: 1 M

A fifth TMDL for pathogens/bacteria was delisted from the 2004 Section 303(d) list in 2006 and placed in Category 3 (requires further evaluation) since WQS were met, but two daily average sample values exceeded the daily average value of 300 *E. coli*/100 mL.

5. **Lake Huron – Keewahdin Road Beach**
   (WBID#: 210101G)
   Location: East end of Keewahdin Road.
   Size: 1 M

Each category designation discussed above is defined below:

- **Category 2 waterbodies**: reaches where available water quality data and/or information indicate that some, but not all of the designated uses are supported.

- **Category 3 waterbodies:** reaches where there is insufficient available data and/or information to make a use support determination.

- **Category 4c waterbodies**: reaches where a designated use impairment that is not due to a pollutant, but rather from other activity associated with the reach that does not require a TMDL.

- **Category 5 waterbodies**: reaches not attaining at least one designated use due to a pollutant(s) for which one or more TMDL is needed.

As stated in MDEQ's, "2006 Methodology for Determining Water Bodies Requiring Total Maximum Daily Loads", the following criteria are used to evaluate WQS attainment for each waterbody where data are available:

- Waterbodies with combined sewer overflows (CSOs) or untreated sewage discharges are considered as not attaining WQS for pathogens.

- Public beach *E. coli* monitoring analytical results provided by the county health department are evaluated on a biennial basis. Waterbodies that exceed either of the following are considered not attaining WQS:

    - *E. coli* concentrations exceed the average WQS of 130 counts/100 milliliters (mL) based on weekly samples collected over the 16-week total body contact recreation period.
    - Ten percent of the sample results exceed the daily maximum WQS of 300 counts/100 mL.
    - Two or more of the sample results exceed the partial body WQS of 1,000 counts/100 mL.

- Waterbodies with site-specific Fish Consumption Advisories (FCAs) established by the Michigan Department of Community Health are considered as not attaining WQS for the parameters for which the water body is listed, except for those water bodies listed for mercury. Michigan has a generic, precautionary statewide FCA for mercury that applies to all inland lakes.

- Ambient PCB water chemistry exceedances of the Michigan WQS are determined by comparing available data with existing numerical WQS. For PCBs, a single sample is considered sufficient information to determine WQS nonattainment. This approach is justified by the existence of a large PCB data set for the state as a whole, which shows virtually 100% exceedance of the WQS for total PCBs (0.026 nanograms per liter [ng/L]).

- Ambient mercury water chemistry exceedances of the Michigan WQS are determined by comparing available data to existing numerical WQS. A total of at least four (4) or more samples is desirable; however, there is no minimum sample size requirement that is applied in this methodology as an absolute exclusionary rule. Attainment/nonattainment is determined by calculating the geometric mean mercury concentration for a sampling location, and comparing this value with the WQS for total mercury (1.3 ng/L). If the geometric mean exceeds the WQS, a determination of nonattainment is made; if it is equal to or less than the WQS, a determination of attainment is made.

In MDEQ's 2006 Integrated Report, it is noted that the TMDL development for waters impaired primarily by atmospheric sources of mercury and PCBs will most likely be addressed by a "common approach" and are therefore scheduled for development in 2010 and 2011, respectively. Also, the waterbodies affected by CSOs are scheduled for TMDL development based on the scheduled implementation of the approved long-term CSO Control Programs for those facilities (MDEQ, 2006). The sources of pathogens in the NEW will continue to be addressed through implementation of the Phase II storm water program and the actions outlined in this WMP.

The 2006 303(d) and 305(b) Integrated Report can be obtained by going online to: **http://www.deq.state.mi.us/documents/deq-wb-integrated2006draft.pdf.**

2.3.2 Point Source Discharges and Spills

Point source discharges refer to manufacturing and sanitary wastewaters, as well as stormwater, that is released through a sewer, ditch, or swale from an industrial, municipal or commercial site to waters of the state. Discharges from these sources is typically treated, except for stormwater discharges which to do not receive any treatment prior to discharge. Spills are untreated discharges of pollutants that typically include chemicals, fuels, and sewage most commonly from industrial, municipal, commercial, and agricultural sources.

Historically, point source discharges and spills have had a significant impact on water quality in areas of the NEW and surrounding watershed, and some sediment contamination from past practices continues to have environmental impacts in the SRD and LBR subwatersheds of the NEW. Today, industrial discharges now contribute fewer pollutants than in the past (USACE, 2004). The permit process, NPDES regulations, and an increase in permittee awareness have significantly reduced point source discharges from municipal and industrial sources and resulted in marked improvement in the quality of the Black and St. Clair Rivers. The 2005 files of the MDEQ Water Bureau for all the permitted point source discharges in the NEW were recently reviewed and, in general, it was found that the discharges are in compliance with the limits placed on the quality of their discharges. A few of the facilities were cited by the MDEQ for deficiencies in material storage; however, none were cited for water quality problems (2006 HRC file review).

Similarly, the number and size of spills has reduced dramatically in recent years. "Between 1990 and 2001, spills on the U.S. side (of the St. Clair River) have decreased from 28 to 18 annually. Canadian records indicate an even greater reduction, from between 70 and 135 spills annually between 1986 and 1989, to between 7 and 12 spills between 1998 and 2002" (USACE, 2004). Some of the historical discharges that impacted water quality in the NEW included wastewaters and spills from:

- The processing of agricultural products, notably the processing of sugar beets along the upper Black River near Croswell, depleted oxygen in the river down through Port Huron and caused fish kills and odor problems. Runoff from silage was another source of fish kills in the NEW.

- The processing of wood products at sawmills along the Black River and at the mouth of Bunce Creek, as well as at the two surviving paper manufacturing plants in the NEW: E. B. Eddy, Inc. and Dunn Paper Company in Port Huron. Discharges included wood fiber, chemicals including chlorine, sulfur, organic dies and starches, and bacteria slimes that result from the treatment of paper wastewaters.

- The solution mining and processing of salt. Much of the area of the NEW is underlain by a salt dome and associated petroleum deposits, the remnants of an ancient sea. The salt and petroleum formations have supplied raw material for a number of industries in the NEW. Two plants in the SRD subwatershed were involved in solution mining of salt: Morton Salt in Marysville (out of business) and Cargill Salt Division (formerly: Diamond Crystal Salt) in St. Clair. The plants were known to have wastewaters discharge to the St. Clair River that were high in chlorides, total dissolved and/or suspended solids.

- The generation of electrical power and steam. DECO (Detroit Edison Company) has three active plants in the area: the St. Clair and Marysville Plants in the SRD subwatershed, and the Greenwood Plant in the LBR subwatershed. The facilities historically discharged large volumes of non-contact cooling water which at times contained oils, metals, and suspended solids; the predominant discharge of pollutants from these plants today is through air emissions.

  Additional concern from area residents regarding coal ash leachate from these facilities has been cited; however, water quality threats from pollutants contained in this by-product are very low considering that each DECO facility has treatment processes in place to collect any runoff from storage/holding areas which is then treated and discharged. Each DECO facility has an NPDES permit to discharge water from these collection systems which includes a monitoring strategy to ensure that water quality standards of these discharges are met.

- The processing of metal. A number of facilities in the NEW did forging, casting, forming, and machining of metals. The Mueller Brass Company in Port Huron and Marysville, and some of the past and present occupants of the "Dow Complex" in Marysville had discharges of wastewaters that contained metals (copper, lead and zinc), oils, and other chemicals.

- General manufacturing facilities, such as Daimler-Chrysler and the former Wilkie Conveyors and St. Clair Rubber Company plants in Marysville, discharged process wastewaters to the St. Clair River and small tributaries that typically contained metals, organic compounds, and solids.

- Sewage treatment plants. All of the communities along the St. Clair River have sophisticated treatment plants for domestic sewage that discharge to the St. Clair and Black Rivers. Also, there are three (3) facilities that treat their sewage in lagoons and the treated waste discharges to tributaries in the NEW. Several of these plants have had problems with systems being overburdened during heavy wet weather events that have necessitated the discharge of partially treated or untreated sewage (See Section 2.3.3 for additional information on CSO/SSO events in the NEW). These events introduce bacteria (and potentially pathogens), nutrients, and other contaminants such as heavy metals to surface waters which can be harmful to both humans and aquatic life.

- A detailed summary of chemical releases and waste management activities from industrial facilities in the NEW (reporting years 1997-2003) that are subject to the environmental reporting requirements described in Section 313 of the federal Emergency

Planning and Community Right-to-Know Act (EPCRA) of 1986, also known as Title III of the Superfund and Reauthorization Act (SARA Title III), and the Pollution Prevention Act of 1990, are provided in the Resource Directory (a CD provided with the WMP that contains reports and data used in preparing the WMP). Today, most industry in the NEW is limited to small, light-industrial manufacturing, predominately engaged in the production of plastic and other parts for the automotive industry. Generally, these facilities discharge only non-contact cooling water (which is relatively free of pollutants), and also discharge stormwater runoff to the surface waters of the NEW.

There are a total of eleven (11) major effluent dischargers in the NEW. Major discharges are defined as those that exceed discharges of over one million gallons of effluent per day. Of the 11 facilities, four (4) are wastewater treatment plants (WWTPs), six (6) are industrial facilities, and one (1) is a water filtration plant (WFP). Table 2.7 below outlines the facility information for each major discharger in the NEW, and Figure 2.6 below shows the locations of the major NPDES permitted dischargers in the NEW. See Appendix B for a full list of facilities with NPDES permits to discharge stormwater and other types of effluent in the NEW.

Table 2.7 Major NPDES Dischargers in St. Clair County's Northeastern Watersheds (MDEQ, 2006)

Permittee Name	Facility/Discharge Type	Facility Location	Permit No.	Receiving Water	Flow Output*
Detroit Edison Co.-Greenwood Plant	• Steam Electric Power Plant • Discharges non-contact cooling water, ash transport water, cleaning wastewater	7000 Kilgore Road, Kenockee	MI0036978	Jackson Creek, tributary to the Black River	17 MGD (combined)
Detroit Edison Co.-Marysville Plant	• Steam Electric Power Plant • Discharges non-contact cooling water, ash transport water, cleaning wastewater	301 Gratiot Boulevard, Marysville	MI0001694	St. Clair River	366.6 MGD (combined)
Detroit Edison Co.-St. Clair Plant	• Steam Electric Power Plant • Discharges non-contact cooling water, ash transport water, cleaning wastewater, coal pile runoff and stormwater	4901 Point Drive, East China	MI0001686	St. Clair River	1,395 MGD (combined)
Cargill Salt Div.-St. Clair	• Mining and processing of salt • Discharges process wastewater and non-contact cooling water	916 S. Riverside Avenue, St. Clair	MI0001031	St. Clair River	9 MGD
Dunn Papers, Inc. (Previously Curtis Papers)	• Discharges non-contact cooling water, treated process wastewater, filter backwash and stormwater	218 Riverview Street, Port Huron	MI0003450	St. Clair River	4 MGD
E. B. Eddy Paper, Inc.	• Discharges sand filter backwash	1700 Washington Avenue, Port Huron	MI0002160	Black River	1.6 MGD
	• Discharges non-contact cooling water and treated process water			St. Clair River	8 MGD
Port Huron WWTP	• Discharges from combined sewer overflows (CSOs)	100 Merchant Street, Port Huron	MI0023833	Black River	Varies per event
	• Sanitary Wastewater Treatment Plant			St. Clair River	20 MGD
Marine City WWTP	• Sanitary Wastewater Treatment Plant	1696 S. Parker Street, Marine City	MI0020893	St. Clair River	1.0 MGD
Marysville WWTP	• Sanitary Wastewater Treatment Plant	980 E. Huron Boulevard, Marysville	MI0020656	St. Clair River	2.4 MGD
St. Clair WWTP	• Sanitary Wastewater Treatment Plant	300 Cedar Street, St. Clair	MI0020591	St. Clair River	Over 1.0 MGD
Detroit Water and Sewerage Department-Lake Huron WTP	• Water Treatment Plant	3993 Metcalf Road, Fort Gratiot	MIG640028	Galbraith Drain and Lake Huron	15.2 MGD (combined)

*MGD: Million Gallons per Day

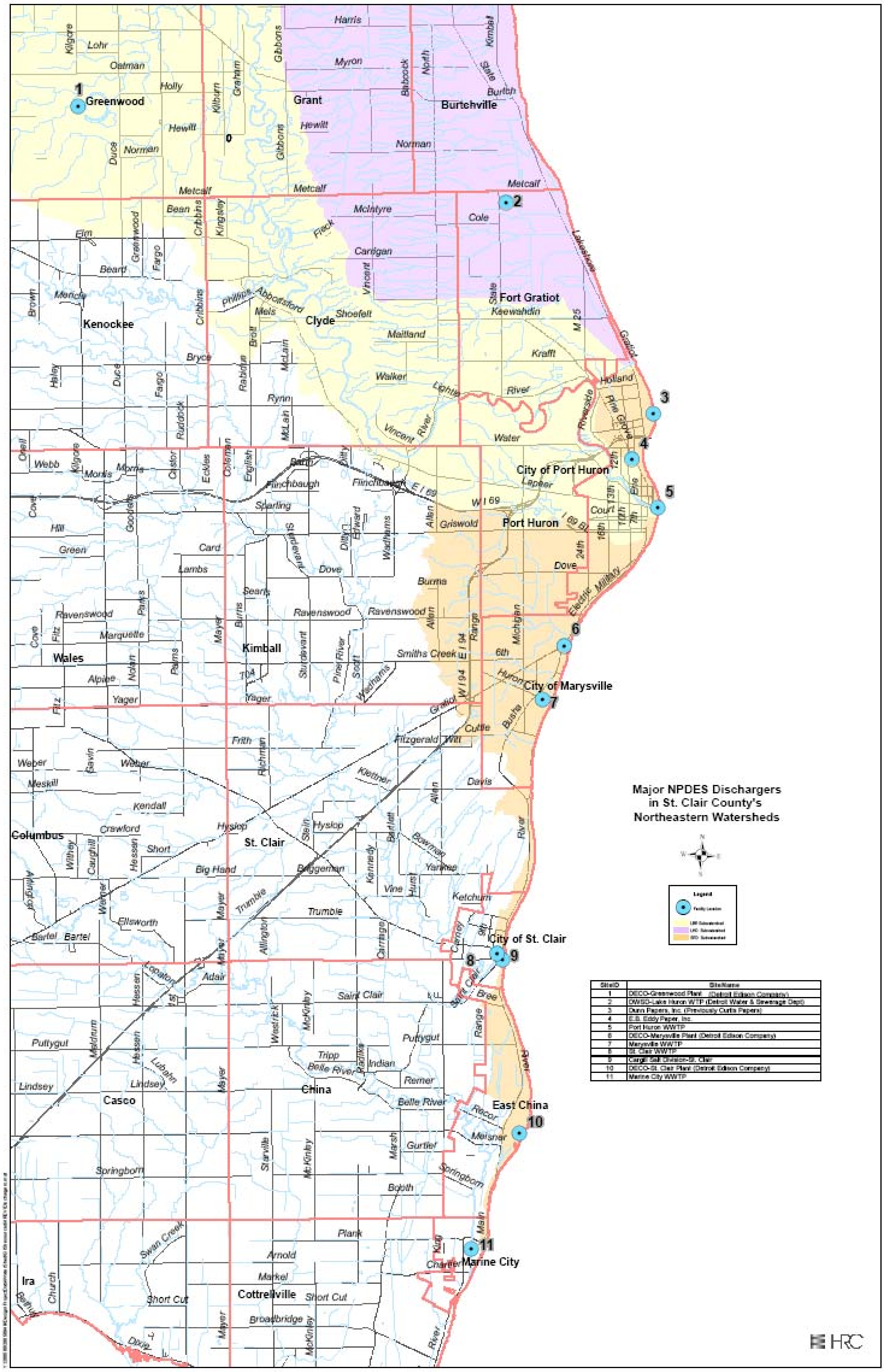


Figure 2.6 Major NPDES Dischargers in St. Clair County's Northeastern Watersheds

In terms of industrial sites with permits to discharge stormwater, there are a total of four (4) major industrial stormwater discharge permit holders in the LBR subwatershed, 25 in the SRD subwatershed, and none in the LHD subwatershed.

2.3.3 Toxic Pollutants in the Watershed

The St. Clair River, Lake Huron, the Black River, and Bunce Creek in the SRD subwatershed have all been documented as having contamination from any one of the following toxic pollutants:

- Heavy metals: chloride, cadmium, copper, lead, mercury, and zinc;
- Organochlorine Pesticides (Chlordane and Dieldrin);
- The chlorinated organic compound: total PCBs;
- Volatile organic compounds (VOCs): hexachlorobenzene, tetrachloroethylene, and carbon tetrachloride; and,
- Polynuclear aromatic hydrocarbons (PAHs)

Sources of these contaminants is documented as coming from decades of industrial and municipal discharges, combined sewer overflows, and urban and agricultural nonpoint source runoff (EPA, 2006). Each pollutant is further defined in subsequent sections of this chapter. A summary of Part 201 Sites, "Sites of Environmental Contamination", is provided in Section 2.3.4 and may help to provide additional information on some of the sources of these toxic pollutants in the NEW.

2.3.3.1 Heavy Metals

There are 35 metals of concern regarding occupational or residential exposure, 23 of which are "heavy metals". Some of these metals are not toxic in small amounts and are in many of the foods we eat everyday and are essential for good health; however, in large amounts they may cause acute or chronic toxicity (poisoning). Heavy metals become toxic when they are not metabolized by the body and accumulate in soft, or fatty, tissues. Heavy metals can enter the body through food, water, air, or absorption through the skin and are typically associated with use in agriculture, manufacturing, pharmaceutical, industrial, or residential settings (i.e. lead paint or old plumbing). Industrial exposure is the most common route of exposure in adults; in children, ingestion is the most common route. The most commonly encountered toxic heavy metals are: arsenic, lead, mercury, cadmium, iron, and aluminum (Life Extension, 2006). Each of these heavy metals is further explained at the following website: **www.lef.org.**

Sediment in the St. Clair River on the Michigan side was found to be "heavily polluted" with iron; sediments in the lower St. Clair River, downstream of the mouth of the Pine River, exceeded Ontario Ministry of the Environment (OMOE) guidelines for arsenic, chromium, iron and nickel and were classified as heavily polluted by the EPA in 1983. In the Upper Great Lakes Connecting Channel Study (UGLCCS), high levels of lead (270 μg/g) and elevated levels of copper (160 μg/g) were reported in bottom sediments of the Black River (1988, Vol. II, p. 247 to 249). Another study completed by the MDNR in 1988 found the highest levels of copper and zinc (470 and 310 mg/kg, respectively) in sediments just downstream of the Mueller Brass discharge, with decreasing concentrations towards the river mouth (MI/DNR/SWQ-90/026). Copper and zinc are the major components of brass. At the time, Mueller Brass did not have an NPDES discharge permit and was "out of compliance" and was a significant source of contamination to river sediments at the time. This study also reported that sediments in the Black River were not contaminated by chlorinated organic compounds (PCBs) or heavy metals from above the Port Huron diversion canal at river mile 4.4 downstream for about 1.5 miles. Currently, mercury is the only heavy metal that is on the Section 303(d) list for WQS exceedances in the NEW for the Black River near the Water Street Boat Launch (1 mile reach), which is explained in more detail below.

2.3.3.1.1 Mercury

Mercury is a naturally occurring, toxic trace element found in air, water, soil and rocks, and is a member of a group of elements called heavy metals. The atmosphere is the major nonpoint source of mercury in Michigan (MDEQ, 2006), and can come from waste incinerators, coal burning power plants, metal smelting plants, municipal and industrial wastewater, and natural emissions (the source of approximately 50% of mercury in the global atmosphere) (USACE, 2004). Mercury was once used as a pesticide in the U.S.; however, it was voluntarily cancelled by the manufacturer in 1994. Mercury's largest use today in the nation is at chlor alkali plants that produce chlorine gas and caustic soda (EPA, 2006).

Mercury can be converted to its much more toxic form, methylmercury, by microorganisms in the aquatic environment. The predominant health risk to humans is consumption of fish that have bioaccumulated harmful levels of mercury in their fatty tissues. Figure 2.7 illustrates how bioaccumulation in aquatic organisms can work its way up the food chain and ultimately pose a risk to humans that eat contaminated species.

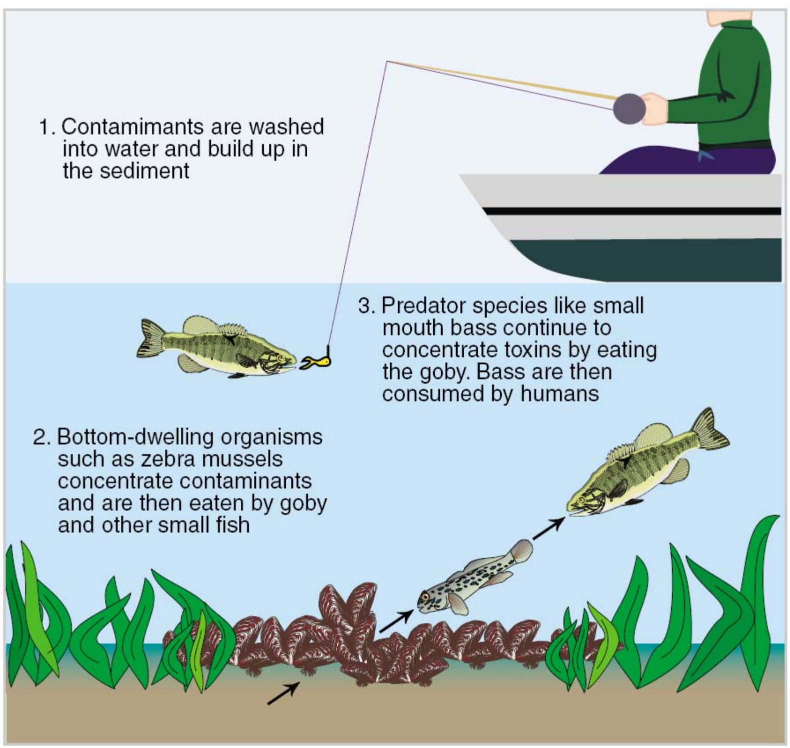


Figure 2.7 Pathway of Bioaccumulation in Aquatic Organisms (USGS, 2000)

There is a blanket statewide FCA for mercury in Michigan. Mercury poisoning can cause central nervous system, kidney, and liver damage in humans, and impaired child development. There is currently a 2011 TMDL scheduled for mercury for a one mile stretch of the Black River near the Water Street boat launch downstream of the railroad bridge. Available data from the EPA's STORET database from 2000 through 2004 showed that mercury levels at this sampling station are present at an average of 1.8715 ng/L (WQS for mercury is a maximum of 1.3 ng/L) for 20 sampling events (See the Resource Directory for water quality data at this station); however, data could not be found as to the exact source of the elevated mercury levels in this reach of the Black River.

The MDEQ has reported that the mercury TMDL will be addressed through a "common approach" since the primary source is coming from atmospheric deposition. Other documented approaches to reducing mercury in the environment can be achieved through:

- Requiring state-of-the-art emission controls on existing and proposed municipal waste incinerators;
- Implementing hazardous waste collection/recycling programs;
- Developing stricter regulation for, or elimination of, uncontrolled sources of solid waste combustion; and,
- Obtaining better information regarding the amounts and forms of mercury from coal-fired power utilities in order to determine the most appropriate and effective control options to be required (Fischer, et al., 1993).

2.3.3.2 Chlorinated Organic Compounds

In the NEW, PCBs and organochlorine pesticides (Chlordane and Dieldrin) have been detected as exceeding Michigan WQS. Chlorinated organic compounds can be man-made, as well as naturally occurring. The presence of these compounds in nature are important and useful to understand since there will always be a baseline concentration which cannot be eliminated and must be recognized when considering environmental quality issues. Weathering of surface rocks and minerals over millions of years yields large quantities of dissolved chlorine to rivers, which ultimately finds its way to the oceans. Scientists have actually documented over 2,000 naturally occurring chlorine-containing organic compounds. Manufactured compounds are used for industrial purposes, as well as in everyday products such as plastics and pharmaceuticals (Chlorine Chemistry Council, 2006). The difference between the naturally occurring and some of the man-made chlorinated organic compounds is that the naturally-occurring compounds do break down in nature, whereas the man-made compounds, like PCBs, do not. In addition, it is the toxicity of some of the man-made compounds that are persistent, and can bioaccumulate in aquatic species, which when eaten by humans, can induce negative health effects.

2.3.3.2.1 PCBs

Polychlorinated biphenyl's (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs and they exist as either oily liquids or solids that are colorless to light yellow; some PCBs can exist as a vapor in air and hence can contaminate land and water through atmospheric deposition. Vaporized PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name "Aroclor". PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence that they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, as well as old microscope and hydraulic oils.

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes, and it is also a suspected human carcinogen. PCBs are taken up by small organisms and fish in water and by other animals that eat these aquatic animals as food. Human exposure to this chemical from the environment in contaminated areas can come through:

- Eating fish or wildlife caught from contaminated locations.
- Ingestion of contaminated river sediments and sediment in river floodplain areas.

The EPA has set a limit of 0.0005 milligrams per liter (0.0005 mg/L) in drinking water. Discharges, spills, or accidental releases of one pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry, and red meat contain no more than 0.2 – 3.0 parts per million (ppm) in food (ASTDR, 2005).

There are currently three (3) TMDLs scheduled for 2010 to address PCBs in the NEW. The river reaches identified as being impacted by PCBs are summarized below:

- The Black River, including all tributaries (390 impaired miles), and
- The St. Clair River, from the vicinity of Algonac at the Lake St. Clair inlet, upstream to the Lake Huron outlet at Port Huron (27 impaired miles); the second TMDL associated with this reach is for a Fish Consumption Advisory for PCBs.

The St. Clair River RAP indicates that PCB contamination of the St. Clair River was discovered in the early 1970s and major sources were identified along the Canadian shore, near Sarnia, and nonpoint sources and Lake Huron have contributed at least ten percent of the total PCB loadings to the St. Clair River. The source of PCBs in the Black River watershed has not been well documented, but it is suspected of coming from historical industrial point source discharges approximately one mile upstream of the railroad bridge (located approximately 4 miles upstream of the mouth of the Black River at the St. Clair River), as well as through atmospheric deposition. In 1988, the MDNR found unquantifiable traces of PCB in sediments downstream of the railroad bridge (MI/DNR/SWQ-90/026). There were no other organic contaminants detected above their respective detection limits in sediment samples upstream of this location. In the UGLCCS (1988), data showed that the Port Huron WWTP was a principal point source of PCB-loading to the St. Clair River, contributing 33.4% of the total load at 0.002 kg/day at a concentration of 0.025 µg/L (53.3% was from Dow Chemical in Sarnia, Ontario). Given this, there is likely a PCB-source upstream of the treatment plant that could be coming from the SRD and/or the LBR subwatershed.

It is unclear at this time why all tributaries in the Black River watershed are on the 303(d) list for PCBs and additional water quality monitoring will be necessary to further assess the impacts in the river. The PCBs in the TMDL reaches are most likely associated with contaminated bottom sediments and, since PCBs do not readily break down in the environment, the primary mitigation technique to cleanup PCB contamination is through dredging and disposal of the contaminated sediments. This approach has been taken on the Canadian side of the St. Clair River which has eliminated much of the pollutant in this portion of the watershed. Another approach is simply to leave the contaminated sediments in place in the hopes that upstream sediment will continue to be deposited on top of it over time and cap it in place, preventing further downstream migration. Each situation needs to be evaluated on a case-by-case basis.

2.3.3.2.2 Organochlorine Pesticides

Chlordane is a manufactured chemical that was used as a pesticide in the U.S. from 1948 to 1988. It is technically a mixture of pure chlordane mixed with many related chemicals. It does not occur naturally in the environment. It is a thick liquid whose color ranges from colorless to amber and has a mild, irritating smell. Some of its trade names are Octachlor and Velsicol 1068. Until 1983, it was used as a pesticide on crops like corn and citrus, and on home lawns and gardens. The EPA banned all used of chlordane in 1983, except to control termites; however, in 1988, it was completely banned for all uses.

Dieldrin was used from the 1950s until 1970 where it was used extensively as insecticides on crops such as corn and cotton. The U.S. Department of Agriculture canceled all uses of dieldrin in 1970. In 1972, EPA approved dieldrin for killing termites until 1987 when the manufacturer voluntarily canceled the registration for use in controlling termites.

These products readily bind to soil particles at the surface, and are not likely to enter groundwater. They can stay in the soil for over 20 years, but mostly leave soil by evaporation. They break down very slowly and do not dissolve easily in water. They can bioaccumulate in the tissues of fish, birds and mammals. Human contact can come through eating crops grown in soil containing chlordane, eating contaminated fish and shellfish, breathing air or touching soil near contaminated waste sites or landfills, or near homes treated for termites. They affect the central nervous system, the digestive system, and the liver in people and animals. They do not appear to be carcinogenic (ATSDR, 2006). Available water quality data shows that chlordane has been detected in Lake Huron water, fish, and wildlife, and dieldrin has been detected in the St. Clair River (EPA, 2006).

2.3.3.3 Volatile Organic Compounds

These compounds can be grouped into two categories: chlorinated solvents and fuel components. Examples of chlorinated solvents include perchloroethylene (PCE), trichloroethylene (TCE), trichloroethane, and carbon tetrachloride; examples of fuel components include benzene, toluene, and xylenes. These compounds are among the most frequently detected groundwater contaminants in the United States. The examples listed above are known or suspected to be carcinogenic or are mutagenic in humans. They are readily transported by groundwater and are not reduced to acceptable concentrations for human consumption by most municipal water supply treatments, thus posing a significant hazard to the human population if consumed (Holt, et al., 1997). Volatile organic compounds (VOCs) are not usually found in drinking water from a surface water source such as a lake or river because they tend to evaporate from the water into the air. Hence, contamination is limited to soils and groundwater.

Volatile organic contaminants found in sediments on the Michigan side of the river included hexachlorobutadiene, hexachlorobenzene and octachlorostyrene. Concentrations of these parameters in sediments immediately downstream of the mouth of the Black River were elevated above those from the St. Clair River upstream of the mouth of the Black River, indicating that this tributary is a likely source of many of these contaminants. These three organic pollutants also occurred at concentrations in sediment during 1984 that were elevated relative to upstream stations in the vicinity of the Marysville WWTP (St. Clair River RAP, 1998 Stage I Report).

These substances have also been found at several sites of environmental contamination in the NEW (see Section 2.3.4) and are linked to sources such as on-site septage disposal systems, landfills, hazardous waste dumps, industrial facilities, and illegal dumping (New Jersey Department of Health and Senior Services, 2006). Given that most of the known environmental contamination in the NEW is associated in urbanized areas near the St. Clair River (where most people get their drinking water from surface water sources), there would be a low risk to human health from these contaminants.

It should be noted that less toxic forms of chlorinated solvents are also found in items like common household cleaners; however, at the low-level of exposure in the home, health effects are negligible, passing out of the body within a few days.

2.3.3.4 Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot. Sources of PAHs are typically from industrial emissions, industrial and wastewater treatment plant discharges, automobile exhaust, and asphalt roads. The Department of Health and Human Services (DHHS) has determined that some PAHs may be reasonably expected to be carcinogens, and animal studies have shown that PAHs can cause harmful effects on the skin, body fluids, and the ability to fight disease after both short- and long-term exposure, though these effects have not been seen in humans (ATSDR, 2006).

In a preliminary sediment contamination study done in 2004 by Huron Consulting for the Bunce Creek in the SRD subwatershed, it was determined that an area approximately 1,000 feet west of Gratiot Road in Marysville, east to the St. Clair River confluence, needed remediation for sediments contaminated with PAH compounds that exceeded criteria established by the EPA for surface water sediments. This site is located alongside a Detroit Edison Plant, and Jowett Machine and Tool in Port Huron is located just upstream of this location; both may be a potential source of these contaminated sediments in Bunce Creek. Jowett Machine and Tool is listed as a site of environmental contamination by the MDEQ for metals and petroleum (see Site #11 in Table 2.8 in Section 2.3.4.1).

In the UGLCCS (1988), it was identified that groundwater is not a principal route of contaminant transport from many waste sites due to the low hydraulic conductivities of surficial materials which restrict infiltration and groundwater movement. Surface runoff from waste sites to storm drains, and small tributaries which flow to major surface water bodies, appears to be of greater probability as a contaminant transport pathway; however, it was noted that the presence of unidentified discontinuous tracts of sand and gravel deposits may serve to enhance contaminant transport locally (Vol. II, p. 269 and 272).

2.3.4 Sites of Environmental Contamination

Sites of environmental contamination are areas known to be contaminated with any one of a combination of hazardous substances that either are or may be injurious to human health or the environment. These substances may include industrial or municipal wastes, pesticides, solvents, and other organic chemicals and heavy metals that can impact surface water, soil, and groundwater. Sites of environmental contamination are addressed by various programs of the Remediation and Redevelopment Division (RRD) of the MDEQ. The RRD administers Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 Public Act 451, as amended, and portions of the federal Superfund program established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Within these programs, the RRD conducts and oversees investigations and cleanup activities performed by private parties at contaminated sites throughout the state.

2.3.4.1 Part 201 Sites

There are a total of 20 sites of environmental contamination on file by the MDEQ from various manufacturing, industrial, and landfill operations in the NEW. As of February 2006, thirteen (13) of these sites are currently undergoing remediation, six (6) of the sites are inactive (meaning no actions have been taken to address the contamination), and one (1) site has been fully remediated. The information available regarding the extent and location of each contamination site was severely limited; however, Table 2.8 summarizes the best information available. The location of each known site is shown in Figure 2.8. Additional information available regarding historical operations and the extent of contamination on several industrial sites and landfills in the area is outlined below:

- **Fort Gratiot Sanitary Landfill** (Map ID#1): This 68-acre landfill operated from 1971 until 1994. The property is currently owned by the State due to tax reversion. Numerous leachate outbreaks are occurring on all sides of the landfill, in a building's floor drains, in a retention pond, and in cracks in the parking lot. Surface water samples have identified contaminants in the leachate and in the soil that are above residential criteria. The construction of a leachate/stormwater collection system is underway and landfill capping has been completed (MDEQ, 2004).

- **Winchester Disposal** (Map ID#3): This 35-acre parcel was an illegal landfill located in a low marshy area at the western extension of Petit Street in Port Huron Township. The facility is owned by the State via tax reversion and Port Huron Township Economic Development Corporation as part of a proposed industrial park. Remedial investigation activities found that a broad spectrum of contaminants was impacting the soils, adjacent wetlands, and groundwater of the facility and that contaminated groundwater has migrated off-site.

  Contaminants include 5,500 parts per billion (ppb) of vinyl chloride, other chlorinated and petroleum-related volatile organic compounds, metals (cadmium, copper, lead, zinc and iron), polynuclear aromatic hydrocarbons (PAHs), pesticides, and PCBs. The State has completed both a Phase I and II investigation and is currently trying to determine if methane is present in order to determine whether or not response actions are needed to protect public health (MDEQ, 2004; UGLCCS, 1988, Vol. II, p. 271).

- **Prestolite Wire Corporation** (Map ID#7): This company was a generator and treatment/storage/disposal facility. Various halogenated and non-halogenated solvents, electroplating wastes, lead and ketones were stored in containers on site (UGLCCS, 1988, Vol. II, p. 271).

- **A and B Waste Disposal** (Map ID#9): This was a transfer facility where wastes were sorted for resale/recycling and disposal. Soil and groundwater samples contained toluene, xylene, TCE, and tetrachloroethylene. There were alleged incidents of dumping paint thinner on the ground (UGLCCS, 1988, Vol. II, p. 271).

- **Hoover Chemical Reeves Company** (Map ID#10): The Reeves Company bought and distributed paint products locally. The facility also built fiberglass building for the Port-a-John company. Hoover Chemical manufactured adhesives. Drums containing paint and adhesive waste were located on the site. In 1988, there were 5 monitoring wells (UGLCCS, 1988, Vol. II, p. 271).

- **St. Clair Rubber-Wills Street Dump** (Map ID#14): This site is located within 0.5 mile from the St. Clair River. Drums from the St. Clair Rubber-Michigan Avenue plant were dumped into open pits each year for approximately 8 years. The liquid wastes included toluene, acids, and polyurethane. Over the 8-year period, as many as 1,500 drums were dumped. A ditch just east of the site emptied into the St. Clair River. This site was not submitted to the EPA because Marysville's drinking water surface water intake is located 1.5 miles upstream of this site and 90 feet of clay overlies the aquifer used for drinking water; however, the site is near a wetland. On-site soil samples contained low levels of 1,1-dichloroethane, 1,1,1-trichloroethane, and toluene. Elevated levels of phenols and Arochlor-1260 (PCBs) were also found on site (UGLCCS, 1988, Vol. II, p. 271).

- **River Road Contamination Site** (Map ID#17): This site is located on River Road in Marysville along the St. Clair River. This site is a vacant lot of approximately 4 ha (10 acres). It was once part of an industrial firm that had conducted various solid waste management activities. A site investigation was conducted and results revealed extensive soil and groundwater contamination. The site is contaminated with various metals, volatile organics, halogenated hydrocarbons, pesticides, and other potentially hazardous substances. Also, paint-like wastes, solid wastes such as metal bands, crushed drums, and batteries were found in the soils. Volatile and semi-volatile organics were found in the groundwater. The responsible party is currently completing the remedial investigation/feasibility studies to determine the extent of contamination and to develop a remedial action plan (St. Clair River RAP, Stage I).

- **Huron Development Landfill** (Map ID#20): This site is a 40-acre landfill licensed from 1977 until 1988; however, landfill operation continued after licensure was denied. The facility was abandoned in 1991. The current owner is Marine City. The site is severely eroded and has exposed waste which is generating leachate due to contact with surface water runoff. The leachate is running off the landfill and onto surrounding properties. The landfill is capped and investigations are underway to ensure that public health is protected (MDEQ, 2004).

It should also be noted that input from area residents also indicated that there is typically at least one illegal landfill location in each municipality in the watershed. As these areas become better known, the appropriate authorities should be contacted to ensure that measures are taken to gather the necessary information to ascertain the extent of possible environmental contamination and to seek out recommendations, guidance, and financial assistance for cleanup activities from various federal or state sources, as appropriate.

Table 2.8 Sites of Environmental Contamination in St. Clair County's Northeastern Watersheds (MDEQ, 2006)

Map ID	State Site ID	Site Name	Address	City	Facility Type	Pollutant Released	Cleanup Status	Subwatershed Location
1	74000161	Fort Gratiot Sanitary Landfill	3290 Keewahdin Rd	Fort Gratiot	Refuse Systems	Chloride; Magnesium; Sodium; Sulfate; Calcium sulfates	Remedial action in progress: Leachate/stormwater collection system in operation; Overseeing PRP actions.	LBR
2	74000157	Acheson Colloids	1600 Washington Avenue	Port Huron	Petroleum & Coal Products	Trichloroethane (TCE)	Interim response in progress	LBR
3	74000013	Winchester Disposal	Western extension of Petit Street	Port Huron Township	Illegal Landfill	Vinyl chloride; Volatile Organic Compounds (VOCs); Chlorinated organic compounds; Metals; Polynuclear Aromatic Hydrocarbons (PAHs); PCBs	As of 2004, groundwater and methane investigations in progress.	LBR/SRD
4	74000011	Total Oil Storage	Griswold Street	Port Huron	N/A	Petroleum	Interim response in progress	SRD
5	74000002	Grand Trunk Railroad	Griswold & Michigan	Port Huron	Railroad Transportation	Diesel fuel	Interim response in progress	LBR
6	74000084	Huron St. Clair, Inc.	1721 Dove Street	Port Huron	Miscellaneous Metal Work	N/A	Inactive - no actions taken to address contamination	SRD
7	74000015	Prestolite Wire Corp.	3529 24th Street	Port Huron	N/A	Heavy manufacturing; Paint products	Interim response in progress	SRD
8	74000154	Gibraltar Sprocket Company	3529 Military Street	Port Huron	Fabricated Metal Products	Lead; Zinc; Metals; PAHs	Interim response in progress	SRD
9	74000001	A and B Waste Disposal	3541 32nd Street	Port Huron	Scrap & Waste Materials	Benzene; Ethylbenzene; Perchloroethane (PCE); Toluene; TCE; Xylenes	Inactive - no actions taken to address contamination	SRD
10	74000004	Hoover Chemical/ Reeves Product	3905 32nd Street	Port Huron	Paints & Allied Products	Methylene chloride; TCE; Paint/oils	Remediated and Closed 3/1/02	SRD
11	74000155	Jowett Machine and Tool	3386 Ravenswood	Port Huron	Metal Working Machinery	Metals; Petroleum	Inactive - no actions taken to address contamination	SRD
12	74000009	St Clair Rubber-Marysville	1765 Michigan Avenue	Marysville	Rubber & Plastic Products	Heavy manufacturing	Inactive - no actions taken to address contamination	SRD
13	74000028	Wilkie Brothers Marysville Marina	1880 River Road	Marysville	Industrial Buildings & Warehouses	Lead; Heavy metals: chromium, copper, arsenic	Inactive - no actions taken to address contamination	SRD
14	74000010	St Clair Rubber/ Wills Street Dump	2408 Wills Street	Marysville	Scrap & Waste Materials	Barium; Ethylbenzene; Lead; TCE; Xylenes; Zinc; Heavy manufacturing	Inactive - no actions taken to address contamination	SRD
15	74000143	Eugene Welding	2420 Wills Street	Marysville	Metal Working Machinery	Waste oil	Interim response in progress	SRD
16	74000020	F and W Drum Site	5830 Klettner Road	Marysville	Scrap & Waste Materials	Chlorobenzene; Toluene; CFC-11	Interim response in progress	SRD
17	74000019	River Road Contamination Site	2917 River Road	Marysville	Metal Coating & Allied Service	Ethylbenzene; Lead; Xylenes; trans-1,2 Dichloroethane (DCE)	Interim response in progress	SRD
18	74000014	Diamond Crystal Salt-Amoco Oil	916 South Riverside	St Clair	Nonmetallic Minerals	Brine; Chloride	Interim response in progress	SRD
19	74000116	Detroit Edison-St Clair Power Plant	4901 Pointe Drive	East China Twp	N/A	Toluene; Xylenes	Interim response in progress	SRD
20	74000162	Huron Development Sanitary Landfill	Springborn & Indian Trail	China Twp	Refuse Systems	Waste chemicals	Interim response in progress: Proposed actions include maintenance of the landfill cap to manage leachate and protect public health and the environment (MDEQ, 2006)	St. Clair River via the Belle River

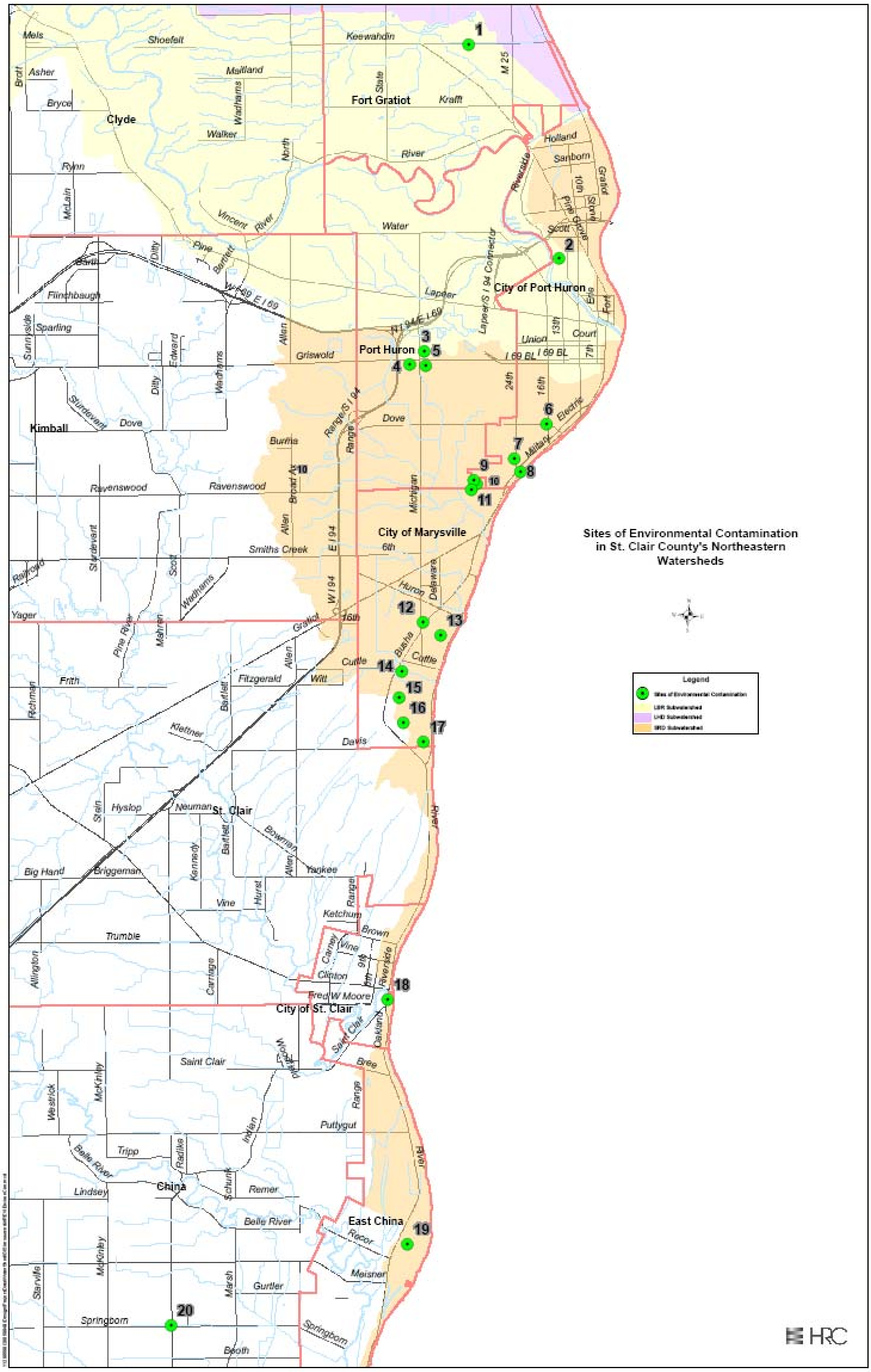


Figure 2.7 Sites of Environmental Contamination in St. Clair County's Northeastern Watersheds

2.3.4.2 Part 213 Sites

Environmental contamination to groundwater, surface water, and soils can originate from leaking underground storage tanks (LUSTs) that typically hold gasoline and diesel fuel, but may also contain other hazardous substances. There are approximately 100 "Open LUST" sites throughout the NEW; however, current information provided by the MDEQ indicated that the releases from only three (3) tanks potentially pose a threat to groundwater and soils (personal communication with Faye Mitchell, 2/14/06). The MDEQ reported that they are currently awaiting additional information from the owner's of these sites before moving forward with additional investigations. There are approximately 130 "Closed LUST" sites in the NEW. "Open" and "Closed" LUST sites are defined by the MDEQ as follows:

- **Open LUST:** a location where a release has occurred from an underground storage tank system, and where corrective actions have not been completed to meet the appropriate land use criteria. An open LUST site may have more than one confirmed release.

- **Closed LUST:** a location where a release has occurred from an underground storage tank system, and where corrective actions have been completed to meet the appropriate land use criteria.

Cleanup activities mandated by Part 213, Leaking Underground Storage Tanks, of the NREPA are basically under the control of the owner/operator. The owners/operators are required to hire Qualified Underground Storage Tank Consultants (QC) to perform corrective actions. The QC must use risk-based corrective action and must submit required reports to the MDEQ within mandated time frames. The RRD of the MDEQ has primarily an audit role, wherein field staff selectively audit reports and conduct field audits. A summary of all known active and inactive storage tanks in the NEW as of February, 2006 are included in the Resource Directory. A searchable database is available at the MDEQ website to find out the status of a particular LUST site at: **http://www.deq.state.mi.us/sid-web/LUST_Search.aspx.**

2.3.5 Combined Sewer Overflows and Sanitary Sewer Overflows (CSOs/SSOs)

Originally, many of the sewer systems in the NEW were "combined" meaning that, when it rained, they carried both stormwater and sanitary wastes in the same pipe. In a combined system, when the carrying capacity of the sewer is exceeded, they are designed to overflow into the river causing combined sewer overflows (CSOs). Increased development in CSO-serviced areas can exacerbate problems by using carrying capacity and increasing stormwater runoff. Figures 2.9 through 2.11 below illustrate the schematic of a combined sewer system in wet and dry weather conditions, and a separated sewer system.

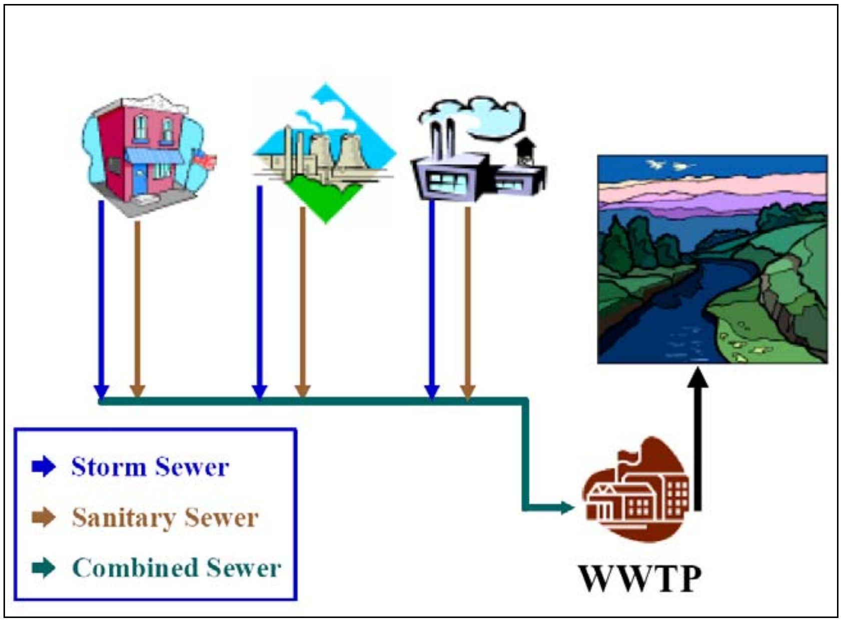


Figure 2.8 Combined Sewer System – Dry Weather Conditions (MDEQ, 2004)

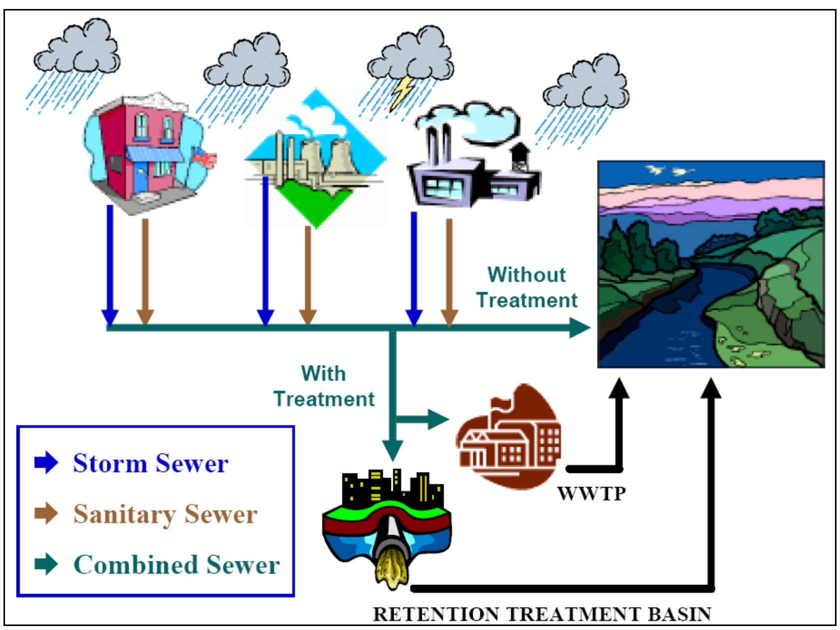


Figure 2.9 Combined Sewer System – Wet Weather Conditions (MDEQ, 2004)

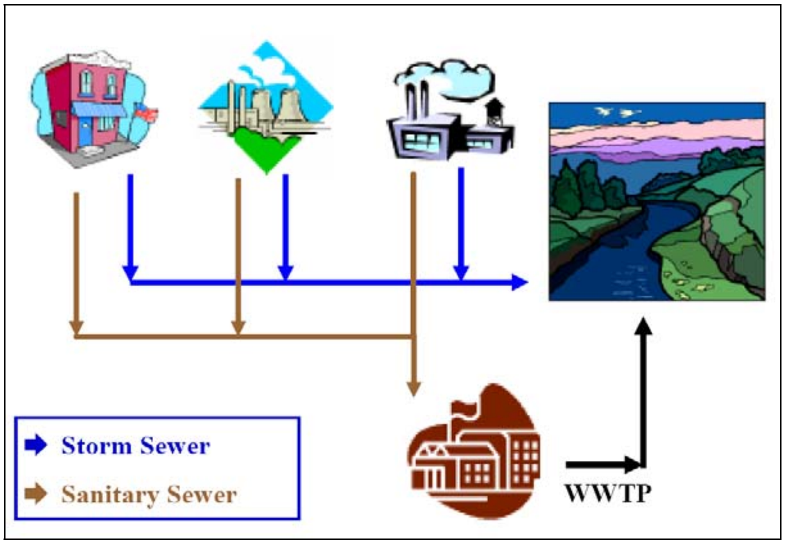


Figure 2.10 Typical Separated Sewer System (MDEQ, 2004)

Extensive efforts have taken place in recent years to correct CSOs in the NEW and most combined systems have been converted to separate systems (including the cities of Yale, Marysville, St. Clair, and Marine City); however, separation/correction work still remains to be completed in Port Huron (USACE, 2004). Available data from July, 1999 through February 4, 2006 showed that a total of 673.08 million gallons of raw sewage was discharged to the St. Clair and Black Rivers. That would equal approximately 23.7 million gallons per year (MDEQ, 2006). As of May 2005, a CSO separation project in Port Huron reduced the number of CSO outfalls in the Black and St. Clair Rivers from 19 to 6 which led to a 68% reduction in the amount of combined sewage discharged from the sewer system (MDEQ, 2004). The one (1) remaining CSO outfall to the Black River from Port Huron is planned to be eliminated by 2008 (sewer separation for this sewer network is currently underway). The other five (5) CSO outfalls to the St. Clair River from Port Huron are planned to be eliminated by 2012 (NEW WAG, 2006).

Sanitary sewer overflows, or SSOs, are discharges of raw or inadequately treated sewage from separate sanitary sewer systems. These systems are designed to carry sanitary sewage but not stormwater. When an SSO occurs, sewage is released into areas such as streets and streams rather than being transported to a treatment facility. They are illegal and often constitute a serious environmental and public health threat. Sewage discharges into basements may also occur, but these events are not required to be reported to the MDEQ.

In the NEW, there have been approximately eighteen (18) total SSO events between 2000 and 2005 (MDEQ, 2006) that were mainly caused by complications with the northeast power grid failure on August 14, 2003, as a result of facility maintenance, or as a result of infiltration of heavy rain and snowmelt into sanitary sewer pipes (a significant problem in the City of Marysville). A summary of the SSO events are provided below:

- There were twelve (12) reported SSO events in Marysville that discharged approximately 30.6 million gallons of raw or partially treated sewage to the St. Clair River. The primary cause is due to high amounts of infiltration and inflow (I & I) into aging sanitary sewer systems in the City. The City has taken extensive efforts in the past few years to locate the sources of the I & I problems. Inflow sources have been found to be coming from downspout and footing drain connections. In addition, flow monitoring studies verified inflow to sanitary sewers during wet weather events. The City has begun implementing a downspout disconnection program and is considering an ordinance to prohibit footing drain connections. The City also invested in a 1.2 million gallon capacity wet weather storage facility at the end of 2005 to temporarily store sewage overflows for treatment until the treatment plant regains its treatment capacity after wet weather events. The City is also evaluating upgrades to its infrastructure including manhole rehabilitation and replacement, and sewer lining and replacement.

- There have been two (2) events in Port Huron; one was due to an illicit discharge of 150 gallons of wastewater mixed with gasoline—corrective actions were taken to clean up the discharge; the other event was associated with the power grid failure in 2003 that caused the primary effluent reservoir at the WWTP to overflow and discharge approximately 4 million gallons of sewage to the St. Clair River.

- There were four (4) events in the City of St. Clair (two at the WWTP, and two at other locations in the City) with a total discharge of approximately 2.4 million gallons of sewage to the Pine and St. Clair Rivers.

Data on CSO and SSO activity in the NEW can be found online at: **http://www.deq.state.mi.us/csosso/find_event.asp** or by reviewing the annual "Combined Sewer Overflow and Sanitary Sewer Overflow" reports at: **http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3715---,00.html.**

2.3.6 Nonpoint Source Pollutants and Stressors

Nonpoint source pollution is caused when rain, snowmelt, or wind carry pollutants off the land and into lakes, streams, wetlands, and other waterbodies, and the term refers to a diffuse source of pollutants that comes from several points of origin, including human and natural sources. While concerns from many of the point sources of pollution have largely been addressed in recent decades, according to EPA, nonpoint source pollution is considered the greatest threat to our nation's waterways (lakes, streams, wetlands). Other factors or "stressors" can directly or indirectly affect the health of use of waterways may be more land use or management based such as hydraulic structures (weirs, dams, and culverts), increased stormwater runoff quantities, aesthetic issues, and loss of aquatic habitat. In the NEW, the primary nonpoint source pollutants and stressors that have been shown to impact waterways to varying degrees are:

- Bacteria and Pathogens,
- Sediment and Turbidity,
- Nutrients,
- Total Dissolved Solids and Road Salt,
- Pesticides and Herbicides,
- Heavy Metals,
- Petroleum By-Products,
- Altered Hydrology,
- Depressed Dissolved Oxygen,
- Stream Temperature,
- Stream Barriers,
- Degradation of Aesthetics, and
- Degraded In-Stream/Shoreline Habitat.

The predominant sources of nonpoint source pollution in the NEW are from:

- agricultural runoff
- runoff from urbanized areas
- soil erosion and sedimentation from construction sites and in-stream channel erosion
- failing septic sites

In the NEW, land use is predominately agricultural, grassland and shrub areas at 61.1%. The second highest land use category is woodlands and wetlands at 17.7%, followed by single-family residential at 13.2%. All other land uses are below 2%. Given that agricultural areas dominate the land area of the NEW, they are likely one of the most significant sources of water quality impacts contributing the greatest loadings of pathogens/bacteria, sediment, nutrients, pesticides, and herbicides.

In the more urbanized areas along Lake Huron and the St. Clair River, impacts are likely associated with heavy metals, bacteria, nutrients, and sediment. In studies of urban areas and the pollutants associated with stormwater runoff, the following information was determined (Bannerman, 1993, and Steuer, 1997):

- Residential driveways did not contribute loadings of many pollutants, such as PAHs and metals.
- Residential lawns are the greatest source of nutrients and organic matter. Less permeable soils will produce even higher loadings.
- Parking lots contributed a disproportionate share of the pollutant load, including most of the PAHs and much of the metals, although they made up less than 5% of the subwatershed area.
- Higher hydrocarbon and metal loadings were found where street traffic was greater.
- Although rooftop runoff was relatively clean, high levels of zinc and copper can be present, particularly from commercial and industrial roofs, and roofs with galvanized or copper materials.

During the construction phase of development, urban areas can produce more sediment per acre of disturbed soil than agricultural land use areas. In general, commercial and industrial land uses produce higher stormwater pollutant loadings than residential areas; however, individual source areas of pollutants such as streets, parking lots, driveways, rooftops, and lawns can contribute very different runoff volumes and pollutant concentrations. Consequently, when trying to optimize effective stormwater Best Management Practices (BMPs), it is important to understand which individual source areas produce the bulk of the pollutant loadings to the receiving waterbody.

Currently, there is data to verify the impacts from excessive sediment and nutrients, and limited data on pesticides in urban and agricultural runoff. A summary of each nonpoint source pollutant suspected or known to be impacting the NEW is further described in more detail in subsequent sections of this chapter. Further descriptions of terminology and interpretation of water quality data is provided in Appendix C.

2.3.6.1 Bacteria and Pathogens

Waterborne pathogens are a great concern in the NEW due to the importance of water-related recreation, particularly in lower Lake Huron and the St. Clair River. Most waterborne pathogens may be classified as viruses, bacteria (typically indicated by *Escherichia coli*), or protozoa. Pathogens typically cause intestinal diseases, leaving the host in the fecal material, contaminating the water, and then entering the recipient by ingestion. These organisms can be harmful to both humans and the other aquatic life and wildlife that come into contact with them. *Escherichia coli* (*E. coli*) is the most common indicator used in monitoring strategies to determine the potential presence of harmful pathogens. However, *E. coli* is present at some levels almost everywhere: in soil, water, beach sands, and on pavement. Bacteria come from a variety of sources making it difficult to know whether or not its presence is due to a human sewage problem. Also, the *E. coli* survival period in water varies widely and is influenced by many factors such as the presence of organic substrate, salinity, and temperature.

The potential threat of the presence of pathogens is determined by testing water samples for *E. coli* content which is measured in colony forming units per 100 milliliters of water (CFU/100 mL). The Michigan WQS are 130 CFU/100mL for a 30-day geometric mean [or no more than 300 CFU/100 mL based on three (3) samples for the same event] for total body contact recreation, and 1,000 CFU/100mL for partial body contact recreation. If the *E. coli* levels are higher than these standards, then the beach will be closed. In the NEW, the SCCHD conducts *E. coli* sampling at:

- 14 public beaches on a weekly basis, and
- 14 other sites weekly.

Each monitoring site is illustrated in Figure 2.12.

The total number of beach closures throughout the NEW tends to have declined in recent years as shown in Table 2.9 below.

Table 2.9 SCCHD Bathing Beach Closure Assessment in the NEW

BEACH	Total Number of Days Closed							
	1997	1998	1999	2000	2001	2002	2003	2004
Beechgrove Campground	0	7	0	0	0	0	0	0
Burtchville Twp. Park	29	8	3	0	3	3	0	0
Chrysler Park	16	6	36	3	7	33	3	0
Conger/Lighthouse Park	3	0	3	3	0	8	0	0
Holland Road	3	0	3	3	0	6	0	0
Jeddo Road	3	0	3	0	3	9	4	0
Keewahdin Road	14	0	3	6	0	0	0	0
Krafft Road	0	0	3	3	0	14	0	2
Lakeport State Campground	10	0	0	3	0	0	0	0
Lakeport State Park	0	0	4	7	3	0	3	0
Lakeside Park	3	0	3	3	0	6	4	0
Marine City Park	0	0	0	0	0	0	0	0
Marine City Diving Area	0	21	0	0	0	0	0	0
Metcalf Road	6	6	0	9	0	10	0	0
Washington Street	N/A	N/A	N/A	N/A	N/A	N/A	0	2
Total Number of Days Closed During the Season	**87**	**48**	**61**	**40**	**16**	**89**	**14**	**4**

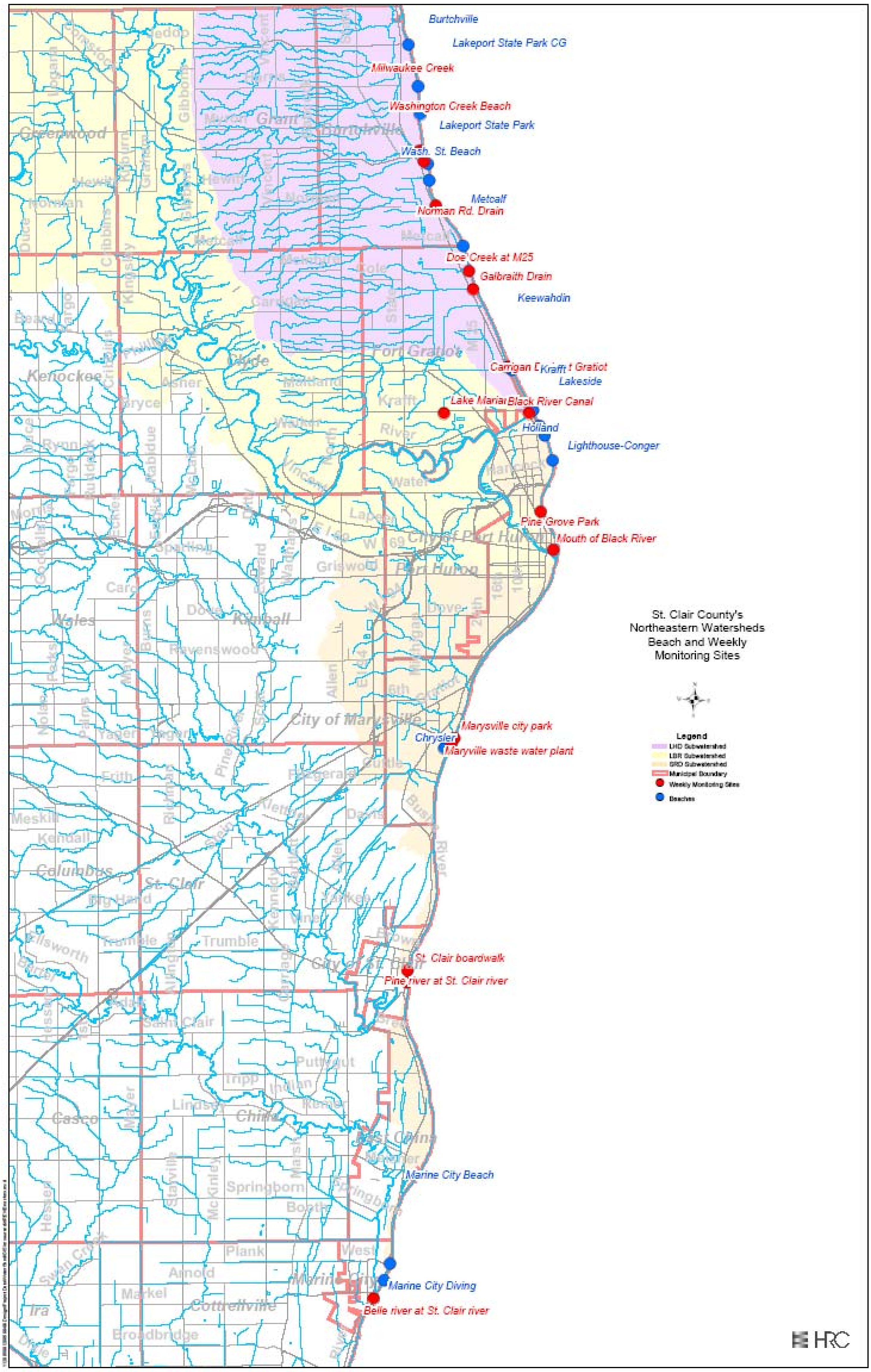


Figure 2.12 *E. coli* Monitoring Locations in St. Clair County's Northeastern Watersheds

Several waterways (other than beaches) are monitored to determine possible sources of *E. coli*. Almost all of the tributaries in the NEW that regularly exceed the partial body contact criteria are in the LHD subwatershed. From 1999 to 2004, the following weekly monitoring sites frequently exceeded 1,000 CFU/mL:

- Brandymore Drain at Krafft Road
- Burtch Creek at M-25
- Lake Street Creek at Burtchville Twp. Park
- Milwaukee Creek at M-25
- Norman Road Drain at M-25
- Metcalf Drainage Ditch at Metcalf Road Beach
- Doe Creek at M-25
- Carrigan Drain at Lakeshore
- Marysville wastewater treatment plant

If pathogen levels are too high in a waterbody, it can affect the state-designated uses of full body contact or partial body contact. Wastewater treatment plants (WWTPs) clean used water and sewage so that it can be safely returned to the environment; however, because municipal wastewater can also contain household chemicals, WWTPs may discharge low levels of other various pollutants (USACE, 2004). Possible inputs of bacteria and pathogens in the NEW can come from a variety of sources including:

- Combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs),
- Failing Onsite Sewage Disposal Systems (OSDS),
- Urban runoff/storm sewers,
- Illicit connections/discharges from improperly connected sanitary pipes or floor drains that discharge to a storm sewer system or through overland conveyance (Figure 2.13), and
- Waterfowl, pets, wild animals, and farm animals. A significant concern at the Marysville public beach where geese are encountered by beach monitoring staff on a regular basis. (Figure 2.14).

Figure 2.13 Illicit Discharge found Discharging to Local Waterway (note discolored flow-path)

Figure 2.14 Waterfowl and Wildlife on Public Beach in Marysville

Rule 62 of the Michigan WQS states that wastewater treatment plants that discharge treated or untreated human sewage are required to monitor for fecal coliform bacteria on a frequent basis and must comply with the limits of no more than 200 fecal coliform bacteria per 100 mL of water as a monthly average, and 400 fecal coliform bacteria per 100 mL of water as a 7-day average. Bacteria numbers can be effectively reduced by disinfection procedures such as chlorination and ozonation, and if chlorine is used for disinfection, the treated wastewater must be dechlorinated prior to discharge to protect fish and other aquatic life.

There are three (3) sewage lagoons in the NEW that discharge two times per year, for no more than ten days at a time, and a recent study indicated that the lagoon effluent samples were elevated to the point that they could result in water quality standard exceedances in the receiving stream (ECT, 2004); however, given the short-term duration of these events, this would not be a significant source of pathogens/bacteria to the NEW. There have been many complaints filed by area residents of aesthetic and odor problems during discharge events. Discharges have been documented to turn stretches of receiving streams bright green because of the algae present in the discharge.

Land application of septage removed from on-site septage disposal systems or other sources currently occurs at only one (1) licensed site in St. Clair County and is a source of concern for Macomb and St. Clair Counties. Because the closest septage disposal site to Macomb and St. Clair is in Mt. Clemens, it is suspected that there may be illegal discharges of septage disposal by local haulers. In order to address this concern, the St. Clair County Environmental Services Department at the Smiths Creek Landfill (Figure 2.15) in Kimball Township has arranged to begin accepting septage as part of a pilot project for increased biodegradation of refuse beginning in 2007.

Figure 2.15 Aerial View of Smiths Creek Landfill in Kimball Township

Reducing inputs of bacteria to the environment is a priority in the NEW, and is already being addressed through public education efforts and other programs such as the Illicit Discharge Elimination Program (IDEP), which is currently being implemented by all Phase II permittees. The IDEP, as well as the SCCHD's extensive bacteria monitoring program, help to ensure that sources of excessive bacteria and pathogens, if they exist, are tracked and eliminated.

2.3.6.2 Sediment and Turbidity

Soil erosion is the detachment of soil by wind or water and sedimentation is the settling out of particles in a lake or stream. Turbidity is the relative clarity of the water measured as the extent to which light penetration is reduced; therefore, turbidity is an indirect measure of suspended solids.

In general, excessive inorganic fine sediments (silt and clay) have the greatest impact on stream ecology because they are supply limited. In contrast, an increased supply of coarser bedload material can affect stream channel stability by exceeding the stream's sediment transport capacity or stream competence. In addition to the ecological impacts, excessive sedimentation can lead to:

- Property loss
- Lower aesthetic quality and possibly lower property values
- Destruction of aquatic habitat
- Increased channel width
- Increased sediment deposition resulting in reduced hydraulic capacity
- Increased algae and nuisance weeds from associated nutrient loadings

Rule 50 of the Michigan WQS states that waters of the state shall not have any of the following unnatural physical properties in quantities which are, or may become, injurious to any designated use: turbidity, color, oil films, floating solids, foam, settleable solids, suspended solids, and deposits. This kind of rule, which does not establish a numeric level, is known as a "narrative standard". It is generally considered that water with a TSS concentration of less than 20 mg/L is "clear". Water with TSS levels between 40 and 80 mg/L tends to appear cloudy, while water with concentrations over 150 mg/L usually appears "dirty". The nature of the particles that make up the suspended solids may cause these numbers to vary, as well (MDEQ, 2006).

The estimated nonpoint source loadings of sediment in the NEW based on the EPA's STEPL model is further explained in Section 2.3.10.

The main sources of sediment inputs into surface waters of the NEW is likely coming from agricultural runoff (exposed soil in fields and ditch-bank erosion), areas under development, erosion at road/stream crossings, and streambank erosion. Figures 2.16 through 2.20 illustrate many of the typical sources of sediment into area waterways in the NEW.

Figure 2.16 Sediment Pathway to Surface Water through Stormwater Conveyance System

Figures 2.17a&b Unrestricted Livestock Access to Streams

Figure 2.18 Erosion at Road/Stream Crossing at Norman Road in the LBR Subwatershed

Figure 2.19 Streambank Erosion along Burtch Creek in the LHD Subwatershed

Figure 2.20 Erosion Around Drainage Structure

2.3.6.3 Nutrients

Nitrogen and phosphorus are two important nutrients that provide plants and algae the essential elements for growth. Although nutrients are required, excessive amounts can lead to eutrophication or undesirable algae and aquatic plant growth. In eutrophic waters that become devoid of oxygen, high ammonia levels can be toxic to organisms if the pH is high (DeBarry, 2004). Several other factors can be impacted indirectly such as odors, aesthetics, dissolved oxygen, and biological communities. Evidence of excess nutrients in streams and ditches in the NEW are illustrated in Figures 2.21a&b below.

Figures 2.21a&b Algae Growth in Local Waterway and Along Roadside Ditch

Although Michigan does not currently have specific numerical Water Quality Standards for nutrients, the State may be developing such standards. The USEPA water quality criterion for phosphorus is 0.1 mg/L in streams to control algae growth. The USEPA quality limit for nitrate is 10 mg/L. Additional guidelines and reference values are provided in Appendix C.

Based on relatively recent monitoring data of the lower Black River, it was found to have highly variable monthly concentrations of total phosphorus, nitrite-nitrate nitrogen, and ammonia (common nutrients found in surface water) concentrations (MDEQ, 1994); however, these levels were above the average values reported by previous studies (Lundgren, 1992). Earlier studies of the Black River noted that phosphorus concentrations ranged from 0.03 to 0.73 mg/L, and averaged 0.14 mg/L (UGLCCS, 1998, Volume II, Page 267). The source of most nutrients to the Black River are likely from agricultural land use and from in-stream erosion and, given the highly variable concentrations found in the river, annual nutrient loadings will depend on the amount of runoff in a given year. Waterways should be monitored for increases in nutrient loadings due to the potential impacts. The estimated nonpoint source loadings for phosphorus and nitrogen in the NEW based on the EPA's STEPL model is further explained in Section 2.3.10.

Rule 60 of the Michigan WQS limits phosphorus concentration in point source discharges to 1.0 mg/L of total phosphorus as a monthly average. The rule also states that more stringent limits may be placed in discharge permits, if deemed necessary. In addition, the rule states that nutrients be limited as necessary to prevent excessive growth of aquatic plants, fungi, or bacteria which could impair designated uses of the surface water (MDEQ, 2006).

In terms of point source loadings, data showed that the Port Huron WWTP was a principal point source of phosphorus-loading to the St. Clair River, contributing 15.5% of the total load at 24.6 kg/day at a concentration of 480 μg/L (or .480 mg/L) (27.4% of the loading was from the Sarnia Water Pollution Control Plant in Ontario) (UGLCCS, 1998, Volume II, Page 257). In addition, this data indicated that commercial fertilizers are applied to approximately 78% of tillable land, while livestock wastes are added to 8%. The total quantity of phosphorus generated from manure was estimated at 3800 tons/year.

There are three (3) sewage lagoons (example shown in Figure 2.22) that discharge two times per year, for no more than ten days at a time, and a recent study indicated that there is a potential for nutrient impacts downstream that could result in nuisance algal growths (ECT, 2004); however, given the short-term duration of these events, this would not be a significant source of nutrients to the NEW. There have been many complaints filed by area residents of aesthetic and odor problems during discharge events.

Discharges have been documented to turn stretches of receiving streams green because of the algae present in the discharge (Figures 2.22 - 2.24).

Figure 2.22 Sewage Lagoon that Discharges to Galbraith Drain in the LHD Subwatershed

Figure 2.23 Algae-Laden Discharge from Sewage Lagoon (note green discoloration)

Figure 2.24 Algae-Laden Runoff into Local Waterway (note green discoloration)

Excess nutrients can come from both point and nonpoint sources. Urban and agricultural runoff can be high in nitrogen and phosphorus compounds. Typically, wastewater treatment plants are the most prominent point source of nutrients, particularly phosphorus. Failing OSDS can also introduce excess nitrate and phosphorus levels to the environment. Nonpoint sources of nutrients predominantly enter waterways from:

- agricultural runoff which may contain fertilizers and animal wastes,
- residential runoff from fertilizers and animal wastes,
- businesses,
- public parks where pet owners do not cleanup after their pets, or where waterfowl may overtake beach areas or open turf grass spaces
- illegal dumping, such as from homeowners that dump grass clippings or other organic wastes near streams as shown in Figure 2.25 below.

Figure 2.25 Organic Waste Dumping along Waterway

Effective strategies to reducing nutrient inputs that can enter surface waters is through the use of adequate vegetative buffers along lakes, streams, rivers, and ditches/drains (Figure 2.26 and 2.27), cleaning up after pets, livestock exclusion and proper waste management in agricultural areas, and reduction in the use of phosphorus fertilizers.

Figure 2.26 Example of Well-Buffered Urban Stream in the LHD Subwatershed

Figure 2.27 Healthy Riparian Buffer on Residential Property along the St. Clair River

2.3.6.4 Total Dissolved Solids and Road Salt

Total dissolved solids measures the total amount of organic and inorganic material in water that is smaller than 0.45 µm. Typical sources of total dissolved solids in the NEW include discharges from septic tank, tile field systems and runoff from agricultural chemical and road salt applications. Several other related terms are defined in Appendix C. In water, a salt is completely dissociated into ions and a comprehensive five-year scientific assessment determined that, in sufficient concentrations, road salts pose a risk to plants, animals and the aquatic environment (Environment Canada, 2001).

According to the Michigan WQS, the waters of the state designated as a public water supply source shall not exceed 125 milligrams per liter (mg/L) of chlorides as a monthly average, except for the Great Lakes and connecting waters, where chlorides shall not exceed 50 mg/L as a monthly average. Data collected from 2000-2004 at the Water Street Boat Launch in the LBR subwatershed indicated chloride levels that averaged 33 mg/L over this sampling period (see Resource Directory), well within the water quality standards.

Data collected in 1967 during high and low flow conditions in the NEW indicated some of the highest concentrations of total dissolved solids, sulfates, chloride, and hardness in the state (Wood, 1970); however, the concentration of some chemical constituents in Michigan streams show regional patterns that are mostly a function of geology and evapotranspiration; therefore, these water quality characteristics may be a product of the local geology, drainage practices, and deforestation. Wood also found that, in areas of urbanization, the concentration of dissolved constituents can vary as much as three orders of magnitude within a small stream reach. Because the area is naturally high in dissolved solids due to local geology, sensitive species in the NEW tributaries may be susceptible to the levels of dissolved solids typically found in spring runoff due to road salt. Due to a lack of recent water quality data for these parameters, additional water quality sampling and monitoring is needed.

2.3.6.5 Pesticides and Herbicides

Pesticides and herbicides are chemical substances used to kill pests such as weeds, insects, algae, rodents, and other undesirable agents. The chemicals can get into surface water by misapplication, transportation in stormwater runoff, or by wind and these chemicals can be harmful to humans, aquatic life, wildlife and aquatic plants. The most common types of pesticides/herbicides used are:

- Broad-spectrum chemicals which are harmful to many types of organisms/plants
- Selective-spectrum pesticides which are harmful to specific group of organisms/plants

Research conducted between March 1996 and February 1998 found that many pesticides, such as Atrazine and Metolachlor, are used exclusively or predominantly on row crops while others, such as the herbicide prometon and the insecticide diazinon, are most frequently detected in urban areas. The highest concentrations of pesticides have been found to be transported by surface water runoff and tile drains into streams between May and July in agricultural areas.

One of the sampling stations in the study was on the Black River near Jeddo, Michigan and research showed that the annual time-weighted average concentrations of pesticides never exceeded the maximum contaminant level (MCL) for pesticides established with MCL's in this location along the Black River; however, between May and July, the height of the season when pesticides are transported to area waterways, Atrazine was found in the water at levels exceeding human health and aquatic life benchmarks (a total of 3.00 μg/L) indicating impaired use (Frey, 2001). Other statistics reported in the 1988 Upper Great Lakes Connection Channels Study showed that some 500,000 kg of agricultural pesticides were used annually on the U.S. side of the St. Clair River. This research indicated that the majority (75%) of the compounds used were herbicides, with Atrazine, alachlor (now banned in Canada), cyanazine, and metolachlor being the most frequently used (Volume II, Page 267). In 1985, pesticide loads in the Black River for Atrazine, alachlor, cyanazine, and metolachlor were reported as 0.3, 0.22, 0.99, and 0.07 g/hectare, respectively (Volume II, Page 267).

Some of the more toxic forms of organochlorine pesticides have been detected in the St. Clair River (as discussed in Section 2.3.3.2.2) which were primarily used in the 1970's and 1980's, but are no longer manufactured and used due to their toxicity. Analysis of sediments in the St. Clair River tributaries yielded the use of restricted-use pesticides (Chlordane and metabolites of DDT) was present in 70% of the samples (Volume II, Page 268).

It is clear that that amount of pesticides that get into the environment is closely linked to the land uses in which it is applied. In order to address pollution prevention of some of today's more common pesticide applications, measures should be taken by agricultural landowners, homeowners, and municipalities to reduce the amount of chemicals applied to crops, gardens and turf grass, as well as the proximity that chemicals are applied to surface waters and drains where it can easily enter into area surface waters, and to a lesser extent, contaminate shallow groundwater supplies (Frey, 2001). Integrated pest management (IPM) is also an effective way to reduce the use of harmful chemicals. Other effective protective measures can be achieved by maintaining natural vegetative cover, as well as trees and shrubs (especially along streambanks) which can prevent erosion and intercept and filter runoff from farm fields (USGS, 2001). See Chapter 6 for a description of additional pollution prevention BMPs.

2.3.6.6 Heavy Metals

Heavy metals are metallic and metalloid elements with high atomic weights (greater than sodium) that tend to be toxic, do not degrade over time, and bioaccumulate (Figure 2.7). Predicting the toxic effects of metals based on concentration in water or sediment samples is difficult due to the complex processes which control bio-availability and fate. However, the long-term detrimental effect of persistent heavy metals accumulating in the aquatic foodchain is well documented.

Arsenic, cadmium, copper, lead, mercury, and zinc are the most common nonpoint source pollutants associated with urban runoff. Many of these heavy metals have been found in sediments in Lake Huron and are associated with degradation of benthos, and plankton communities and result in restrictions on dredging in navigation harbors. Some sediment monitoring data is available for heavy metals in the Black and St. Clair Rivers, but heavy metal concentrations in urban stormwater runoff have not been studied in the NEW.

Sediment contamination in the St. Clair River on the Michigan side was found to be "heavily polluted" with iron concentrations; sediments in the lower St. Clair River, downstream of the mouth of the Pine River, exceeded Ontario Ministry of the Environment (OMOE) guidelines for arsenic, chromium, iron and nickel and were classified as heavily polluted by the EPA in 1983. In the Upper Great Lakes Connecting Channel Study (UGLCCS), high levels of lead (270 µg/g) and elevated levels of copper (160 µg/g) were reported in bottom sediments of the Black River (1988, Vol. II, p. 247 to 249). Currently, mercury is the only heavy metal that is on the Section 303(d) list for WQS exceedances in the NEW for the Black River near the Water Street Boat Launch (1 mile reach), at an average concentration of 1.8715 ng/L (WQS for mercury is a maximum of 1.3 ng/L) for 20 sampling events (see Resource Directory for water quality data at this station); however, data could not be found as to the exact source of the elevated mercury levels in this reach of the Black River.

Cadmium, copper, lead and zinc have been found in sediments in Lake Huron and are associated with degradation of benthos, and plankton communities and result in restrictions on dredging in navigation harbors. In most cases, existing concentrations are due to historical discharges. Also, dredging activities are impaired on the Ontario shoreline of the St. Clair River due to contaminated sediments from heavy metals (EPA, 2006). Given that many of the historical sites of environmental contamination are near the St. Clair River (see Section 2.3.4.1), surface water runoff is likely the greatest source of heavy metal inputs, among other contaminants, into the river.

2.3.6.7 Toxic Organic Compounds

The types and concentrations of toxic organic compounds in stormwater runoff are largely determined by land use patterns and automobile activity in the watershed. Toxic organic compounds also include pesticides and herbicides, but because their source areas and management practices differ from vehicular sources, they are covered separately in Section 2.3.6.5. The compounds of most interest from washoff of impervious areas are polycyclic aromatic hydrocarbons (PAHs). Other compounds may be detected in residential, agricultural, and industrial areas, such as wood preservatives, paints, and plasticizers. Their impacts may periodically be significant in some areas, but they are not often monitored.

Petroleum and petroleum by-products (oil, gasoline and grease) are urban pollutants that may be transported by runoff from roads, vehicle storage areas, and parking lots. Oil sheens may also result from illicit dumping of used motor oil into storm drains or ditches. Industrial and fuel storage sites can also contribute hydrocarbons to surface water and groundwater (including LUSTs, see Section 2.3.4.2).

In the Black River, there are no indications that surface waters have been impacted by these pollutants; although, there is very limited data. Ambient water quality monitoring has not been conducted for in the LHD or SRD. Oil sheens were recorded in 2 out of 110 road stream crossing sites monitored in 2004 - on the Galbraith Drain (LHD) and Bunce Creek (SRD). However, oil-like sheens can occur due to naturally-occurring bacteria. The presence of oil and grease were not verified.

2.3.6.8 Altered Hydrology

According to MDEQ, "hydrology is the science that encompasses the occurrence, distribution, movement and properties of the waters of the earth and their relationship with the environment within each phase of the hydrologic cycle." Similar to streams, watersheds are in equilibrium with precipitation, surface runoff, evapotranspiration, groundwater recharge, and interflow known as the hydrologic balance (DeBarry, 2004). Land use impacts such as urbanization, deforestation, tile drainage, and loss of wetlands drastically alter the components of the hydrologic budget. Changes in discharge, sediment size or loading, or channel morphology (such as channelization) alter in-stream hydraulic factors which can lead to channel instability (i.e. streambank erosion and channel down-cutting). Figures 2.28 – 2.30 provide illustrations of these conditions.

Figure 2.28 a & b Examples of Streambank Erosion in the LBR subwatershed (left) and LHD Subwatershed (right)

Figure 2.29 Example of Drain Maintenance along the Thomas Drain in the LHD Subwatershed

Figure 2.30 Tile Drainage into Thomas Drain with Erosion and Nutrient Inputs

The tributaries of the SRD subwatershed may have the greatest level of recently modified hydrology compared to the rest of the NEW based on an initial review of minimal precipitation data to responding discharge, reports of localized flooding, and channel erosion. However, the hydrology of the LHD and LBR subwatersheds has been modified from historical conditions due to loss of wetlands, deforestation, tile drainage, and drainage practices.

There are currently no active USGS gauge flow monitoring sites in the LHD and SRD subwatersheds. There is and only one gauge station remains in the LBR (one of only two remaining in the County). Without local gauge flow data, the flow regimes occurring in the watershed after precipitation events and associated hydrologic responses are largely unknown. Predictions can only be assessed based on the physical characteristics of the stream at this time, and those characteristics indicate conditions of flashy hydrology in many of the local watercourses. For example, field visits to the Burtch Creek in the northern portion of the LHD subwatershed along areas from its headwaters to areas farther downstream showed how the changes in land use have impacted lower reaches. Historically altered watershed hydrology and increased sediment supply have caused miles of deeply incised channel.

Research has shown that forest cover is the best use of land to reduce stormwater runoff (Schueler, 2005). As such, priority should be given to preserving and protecting the remaining forested areas throughout the NEW, especially in headwater areas (see Section 1.5 in Chapter 1 and Chapter 3, Critical Areas). In addition, efforts need to be taken by agricultural land owners, particularly in headwater areas, to reduce the impacts from stormwater runoff and agricultural drainage in order to protect downstream areas. A series of recommended agricultural runoff control BMPs is included in Chapter 6.

2.3.6.9 Depressed Dissolved Oxygen

Dissolved oxygen (DO) concentration measures the amount of free (not chemically combined) oxygen gas in the water, usually in mg/L or % concentration (% saturation at given pressure and temperature). Depressed dissolved oxygen occurs when the oxygen dissolved in water and readily available to aquatic organisms drops below optimal levels. Aeration and photosynthesis are the main sources of DO in surface water. Maintaining minimum DO levels in streams is necessary for the protection of fish and other aquatic species.

Rule 64 of the Michigan WQS states that surface waters designated as coldwater fisheries must meet a minimum DO standard of 7 mg/L, while surface waters protected for warmwater fish and aquatic life must meet a minimum DO standard of 5 mg/L. Dissolved oxygen limits may also be placed on effluent discharges from wastewater treatment plants, food processing and manufacturing operations, and landfills in conjunction with limits determined for biochemical oxygen demand (BOD) and ammonia nitrogen. Treatment plants typically achieve minimum DO levels of their effluent with proper aeration accomplished by adding bubbles of oxygen, or running the water over rocks or "steps" to increase the transfer of oxygen across the air-water interface (MDEQ, 2006).

A recent study of sewage lagoon discharges in the county showed the following trends:

- The BOD from seasonal discharge lagoons is typically not stabilized before the effluent is discharged;
- The concentration and continued oxygen demand of the BOD and ammonia in the discharge could impact the receiving stream to the point that a critical DO situation could occur; and,
- The potential downstream DO impact is intensified where the majority of the flow in the receiving stream is lagoon effluent.

In this study, two of the three (3) sewage lagoon discharges into waterways of the NEW had inconclusive data as to if there was BOD impact to the streams due to *Daphnia* that was present in the samples. The *Daphnia* likely skewed the data analysis as they continued to consume oxygen from the sample through respiration and it was recommended that additional sampling be conducted at these lagoons during future discharge periods (ECT, 2004). Given that these types of discharges are only permitted by the MDEQ to occur every six months, and occur at periods of no longer than 10 days, it is not likely that there is a significant long-term impact on surface water quality, but very well may cause short-term impacts and aesthetic concerns for downstream property owners.

Dissolved oxygen can be depleted through respiration, decay of organic matter, and direct chemical oxidation (Brown, 1985). Other physical processes affecting DO concentrations are temperature and organic pollution. Because temperature has an inverse relationship with gas solubility, warmer water will hold less gas than colder water. During a storm event, urban and agricultural runoff can increase organic nutrient levels dramatically. The resulting increase in bacterial reproduction and respiration rates exert a BOD. Oxygen depletion may occur during the storm event, but more likely will occur later when associated with the BOD. Pollution from human activities may lead to low oxygen conditions when large inputs of sewage or yard wastes are introduced into the stream.

During the 2004 Road/Stream Crossing Inventory conducted by the SCCHD, average DO levels in tributaries of the NEW averaged 7.0 mg/L, above the WQS. The estimated nonpoint source loadings of BOD in the NEW based on the EPA's STEPL model is further explained in Section 2.3.10.

2.3.6.10 Stream Temperature

One impact that is often overlooked is stream warming. Thermal pollution is an elevation in water temperature due to human activities. A significant increase in stream temperature can have the following impacts (Burton and Pitt, 2002):

- Reduces dissolved oxygen levels
- Increases nuisance plant growth
- Increase in the toxicity of ammonia
- Affects the survival of pathogens
- Contributes to a loss of coolwater fish and aquatic species

Rules 69 through 75 of the Michigan WQS specify temperature standards which must be met in the Great Lakes and connecting waters, inland lakes, and rivers, streams, and impoundments. Monthly maximum temperatures for each waterbody or grouping of waterbodies are listed in the rules (MDEQ, 2006).

Stream temperatures taken during the 2004 Road/Stream Crossing Survey throughout the NEW indicated that nearly half of the readings (48 out of 98) were 20°C or higher, which is a generally accepted guideline for the optimal maximum daily temperature for coldwater species. Although the tributaries of the NEW are not actively managed for coldwater or coolwater fisheries, some may have that potential. Approaches should be taken through various stormwater management BMPs such as the use of riparian buffers, conservation of forested areas along stream corridors, and low-impact development strategies that maintain canopy cover and limit the amount of impervious surfaces built which will all help to limit the amount of stream warming that could occur throughout the NEW.

Stream temperatures can become elevated due to a lack of vegetative canopy (Figures 2.31 - 2.33 show examples of poor and good canopy) or a combination of direct and indirect discharges such as:

- Decreased base flow,
- Asphalt runoff,
- Deforestation,
- Industrial/municipal point source discharges (i.e. non-contact cooling water),
- Releases from lake and river impoundments, and
- Stormwater retention/detention facilities such as wet detention ponds.

Figure 2.31 Complete Removal of Canopy Cover and Riparian Buffer along Jackson Creek in the LBR Subwatershed

Figure 2.32 Lack of Canopy Cover and Riparian Buffer in Urbanized Area

Figure 2.33 Example of Good Stream Canopy along the Black River

2.3.6.11 Stream Barriers

As linear ecosystems, streams are vulnerable to fragmentation. Human-caused barriers such as dams, weirs, and perched culverts disrupt the continuity of flow and are recognized by MDNR as impacting trout and salmon migration. The character of rivers emerging downstream of a dam may be significantly altered from the river entering an impoundment (MDNR, 2006):

- Aquatic community health is closely linked to water temperature tolerances and impounded waters may discharge at significantly higher or lower temperatures than normally encountered in the stream.
- Flow patterns reflecting normal high and low water conditions over time may also be fundamentally altered, affecting stream channel configuration, fisheries habitat, and many other physical and biological processes.

- Water quality may decline in impounded streams if excessive nutrients, sediments, and aquatic plants accumulate in the impoundment.
- Stream changes induced by dams and other watershed conditions are often reflected in the fish community.
- Native and desirable stream species are almost always displaced in river segments affected by dams.
- Dams also limit the normal movement of fish, other aquatic organisms, and system organic material.
- The loss of sediment bedload downstream of a dam commonly results in channel degradation (bed erosion) because the water has its full capacity to entrain and transport sediment.

The current trend is towards the removal of stream barriers that need replacement and are not providing considerable benefits. Culverts should be sized and aligned in concert with the stream morphology to avoid causing channel incision. In some cases, stream barriers may block the migration of invasive species and the reach below the barrier, with its low sediment load, may be a haven for sensitive mussel species; therefore, dam or weir removal should be considered on a case-by-case basis. Guidelines should be developed to insure that road culverts are designed with consideration of proper capacity, alignment, slope, and channel morphology.

The following hydraulic structures were identified in the NEW:

- LBR - Fords Dam on the LBR , Sec. 8, 19.1 miles upstream of mouth
- SRD - Cuttle Creek, inline pond at golf course

2.3.7 Degradation of Aesthetics

Maintaining the aesthetics of the water resources and surrounding natural resources throughout the NEW is of primary importance to stakeholders since water-related recreation plays such an integral role throughout the area. Degradation of aesthetics can occur from litter or the input of excess sediment and nutrients into area waterways by creating turbid water and promoting excessive aquatic plant growth or algae blooms. In addition to minimizing inputs of these pollutants, attention should be given to the way that streambanks and shorelines along riparian areas are maintained. The optimal strategy to a well-maintained and environmentally-friendly riparian area is one that is well-stabilized with native vegetation. Shoreline plantings help to keep water clean by protecting the shoreline, trapping sediment, and removing nutrients that may otherwise pollute the water. It is also common practice to stabilize shorelines with rip-rap along the St. Clair River. Both strategies can be effective to not only maintain aesthetic appeal, but also encourage healthy aquatic habitats along the shoreline—a critical objective given the importance of recreational fishing in the area. Where conditions allow, appropriate vegetative practices are preferred for stabilizing streambanks. Vegetation is more adaptive, self-maintaining, and less costly, whereas riprap tends to “send erosive energy downstream” and can require on-going maintenance.

Figure 2.34 illustrates an example of shoreline stabilization along the St. Clair River shoreline near the Acheson Property in the City of Port Huron. A more aesthetically pleasing form of stone stabilization is shown in the left of the figure whereas, on the right side of the figure, the rubble and asphalt were haphazardly placed and generally degrade aesthetics. The need for visually-appealing stabilization of steep banks, while encouraging recreational access is another priority goal in the NEW. Unsightly stabilization practices and unsafe access has been observed in many areas along the St. Clair River and at many road crossings along the Black River. These conditions are illustrated in Figures 2.34 - 2.36.

Figure 2.34 Varying Degrees of Shoreline Stabilization along the St. Clair River

Figure 2.35 Example of Unstable and Unsightly Public Access to the Black River

Individuals gaining access to riverbanks for fishing commonly erode pathways to the water, especially under the bridges along the main branch of the Black River. Figure 2.36 illustrates an example of erosion along a public access site on the St. Clair River shoreline. This site is known as the "rope swing" located near the YMCA south of Lincoln Street in Port Huron.

Figure 2.36 Eroded Area at "rope swing" South of Lincoln Street

Important considerations when stabilizing many shoreline areas is to, not only prevent erosion, but also provide stable public access. Shoreline stabilization practices should also incorporate methods to enhance aquatic and riparian habitat, as further described in the next section.

2.3.7.1 Degraded In-Stream/Shoreline Habitat

An option that many homeowners and businesses along major waterways, such as the Black River and the St. Clair River, choose for shoreline stabilization along their property is the use of seawalls. As mentioned above, utilizing a more natural means to protecting shorelines not only aids in removing pollutants from surface water runoff, it also provides invaluable aquatic habitat through the use of naturalized shorelines that incorporate native vegetation, rocks such as cobbles and boulders, and even large woody debris in shallow water areas (Figure 2.37).

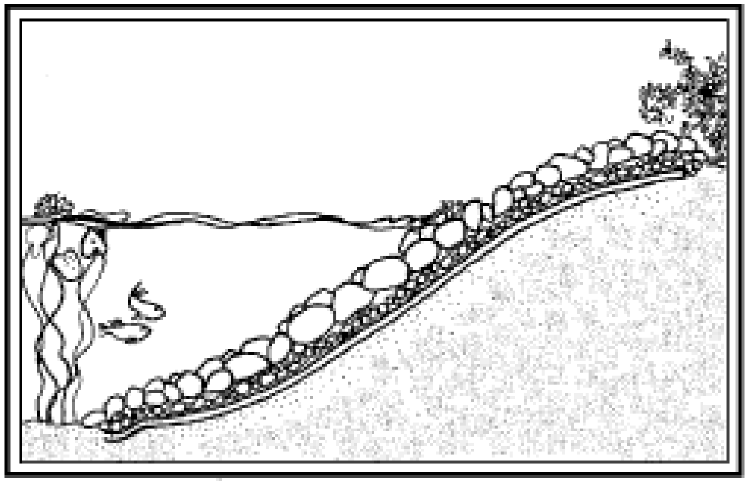


Figure 2.37 Schematic of Shoreline Erosion Control Method that Provides Aquatic Habitat

The environmental drawback to the use of seawalls is that they can cause the greatest amount of functional and aesthetic impact to the natural shoreline because seawalls are constructed with an inflexible, vertical surface that protect shorelines by reflecting wave energy, rather than absorbing it like riprap or vegetation. As a result, a seawall can worsen wave action on a waterbody and increase erosion in front and to the sides of the seawall. In addition, near vertical seawalls can permanently degrade shoreline habitat by replacing the naturally sloping shore zone with a vertical face that cannot be used by plants or animals, and all but eliminates the gradual and diverse changes in water depth near-shore. Inflexible seawall materials can also cost substantially more to install than other erosion control techniques. Seawalls often require regular maintenance to repair damage from direct wave impact, undercutting by currents or waves, and seepage from the landward side. Due to these various stresses, seawall strength decreases over time. Common causes associated with failure include inadequate toe protection, subsidence of backfill soil, build-up of pressure behind the seawall from inadequate drainage or weak anchoring, and direct wave impact exceeding the design specifications of the seawall (IDNR, 1999). Seawalls should be used only as a last resort where it can be shown that other methods may result in a threat to life or property.

One of the primary educational efforts that can be taken by permittees in the NEW is to encourage naturalized shoreline and streamside management techniques that will provide a sustainable form of stabilization. Vegetative practices may also improve water quality and increase aquatic and riparian habitat. In-stream, shoreline, and riparian habitat have been lost throughout much of the NEW and continue to be impacted by channelization, stream channel instability, sediment, and detrimental riparian management practices. Strategies for more effective riparian land management and stream restoration should be encouraged for private landowners, and implemented on municipally-owned properties to help enhance in-stream habitat.

Degraded in-stream habitat may be characterized by having "fair" or "poor" in-stream habitat quality ratings in MDEQ's GLEAS reports based on metrics related to substrate and instream cover, channel morphology, and riparian and bank structure and is exemplified by:

- A loss of pool and riffle structure
- Lack of in-stream cover
- Less variety of substrate material (or increased siltation)
- Flat bed topography, shallow or steep pools, flat riffles, or >50% of the stream length consisting of any one facet type (i.e., riffle, run, glide, or pool)

- Excessive bank erosion, bed degradation or aggradation (defined in Appendix D)
- Bank vegetative stability and streamside cover

Degraded aquatic habitat can also be demonstrated by fair to poor ratings for fish and macroinvertebrate populations and diversity. Impervious cover serves as a rough measure of human influences in a watershed, but is not a reliable predictor of biological conditions. Even in urban areas of the NEW, most tributaries have the potential to be restored to a level that provides "good" aquatic and riparian habitat. The best habitat is provided by a stable, functioning stream system, as opposed to installing habitat structures in a non-functioning stream. Stream restoration should consider channel hydraulics, sediment transport, geomorphology, and aquatic ecology. These factors can be successfully integrated while incorporating other goals such as flood control, aesthetics, and reduced long-term maintenance.

2.3.8 Road/Stream Crossing Survey

The purpose of the 2004 Road/Stream Crossing Survey was to ground-truth the suspected pollutants and hydrological conditions impacting the NEW, as well as try to ascertain the sources and causes of the pollutants and hydrologic conditions. The survey was conducted using the guidelines of the MDEQ Water Bureau's Procedure 51. The intention of this type of survey is to be used as a quick screening tool (5-10 minutes per site) to increase the amount of information available on the quality of Michigan's rivers, and the sources of pollutants to the rivers. The survey procedure was designed to provide a standardized assessment and data recording procedure that can be used by both trained staff and volunteers.

Several parameters were inventoried at each road/stream crossing survey site. The chemical parameters included dissolved oxygen (DO) and pH.

Physical parameters inventoried included:

- Water color,
- Stream flow type (dry, stagnant, low, moderate, high),
- Presence of aquatic plants and algae,
- Presence of oil sheens/foam,
- Presence of trash,
- Evidence of flashy hydrology (indicated by undercut banks, streambank erosion, etc.)
- Streamside land cover (bushes, grasses, trees, etc.), and
- Amount of canopy cover.

Approximately 50% of the road/stream crossing sites was evaluated for DO and pH. The average values of the sites evaluated were found to have a DO of 7.0mg/L and a pH of 7.0 (see Resource Directory), which is representative of good water quality.

Based on visual observations, the survey rated most tributaries fair to good, with only 15% of the sites visited ranking poorly; however, the ranking system can be fairly subjective and is not a reliable primary indicator of overall site conditions throughout the NEW; however, the rankings do help to provide a basis for sites needing follow-up investigations and remedial measures. For those sites that were in fair to poor condition, it was confirmed that the following pollutants and hydrological conditions are impacting much of the NEW:

- Sediment,
- Nutrients,
- Limited areas of trash and debris,
- Flashy hydrology (undercut banks and streambank erosion, including in-stream erosion), and

- Degraded in-stream habitat.

The survey confirmed that the predominant sources and causes of the impacts to the NEW are coming from:

1. Urbanized/Urbanizing Areas:
    - Construction areas: lack of soil erosion and sedimentation control measures;
    - Residential areas: lack of adequate riparian buffers;
2. Agricultural areas:
    - Livestock access to streams;
    - Lack of adequate riparian buffers;
    - Plowing through drainage swales;
    - Ditch maintenance (see hydromodifications)
3. Hydromodifications:
    - Channelization and Dredging:
        - Removal of riparian canopy cover;
        - Removal of in-stream habitat;
        - In-stream erosion—channel downcutting and streambank erosion;
4. Easily erodible soils in upstream reaches that have higher relief (steeper slopes);
5. Low- or no-flow in streams due to either:
    - Reduced groundwater recharge and groundwater inputs for constant baseflow;
    - Many of the streams are intermittent and flow only during wet weather events; as such, flow is completely dependent on surface water runoff inputs;
6. Overgrowth of vegetation such as cattails, or invasive species, such as *Phragmites*.

All information compiled during the road/stream crossing survey, including photos and summary spreadsheets with comments on each site's condition, is included in the Resource Directory.

The overall rankings (good, fair, poor) given to each site were based on the severity of the contribution of pollutants likely being delivered to the stream. The basis for the rankings is derived from visual observations made by the site surveyors based on several factors as outlined below:

- Proximity to waterbody – generally the closer the use, or land disturbance activity, is to the waterbody, the greater the likelihood for pollutant delivery.
- Slope to waterbody – generally the steeper the slope/topography to the waterbody, the greater the likelihood of overland pollutant delivery.
- Conveyance to waterbody (ditch, pipe, etc.) – generally a conveyance from the use, or land disturbance activity, increases the likelihood of pollutant delivery.
- Imperviousness – impermeable surfaces reduce the amount of land area available for water infiltration and increase the potential for overland runoff. Additionally, if a watershed is greater than 10% impervious, it will start to show some systemic problems due to impacts from flow. If a watershed is greater than 25% impervious, the natural hydrology is generally heavily impaired.
- Intensity and type of use, or land disturbance activity – generally the more intensive the activity the greater the likelihood for the generation of pollutants.

- Certain activities may have specific types of pollutants associated with them.
- Size of erosion area – generally the larger the erosion area the greater the likelihood for sediment delivery.
- Soil type – clay is less permeable than sand, and therefore would create a greater potential for overland runoff of pollutants.

- Presence and type of vegetation – the greater the vegetative buffer around a waterbody, the better the filtration of pollutants from nearby land disturbance and use activities. Certain types of vegetative buffers work better than others and should be evaluated on a case-by-case basis.

Based on these designations, the sites found to be the least disturbed by land use activities would be rated as a "good" site whereas a site found to be heavily impacted by land uses such as cattle access to streams or construction activities causing erosion and sedimentation into waterways would be a "poor" site and some measures will need to be taken at those sites to achieve a better site ranking. Figure 2.38 below provides an overview of the survey sites visited during the 2004 road/stream crossing survey. Table 2.11 summarizes the location of each site visited, along with the site name, subwatershed location, and overall site ranking. It is highly recommended that a strategy be devised to conduct road/stream crossing surveys to follow-up on sites of concern, and inventory additional sites that need to be addressed in some way to prevent further water quality degradation.

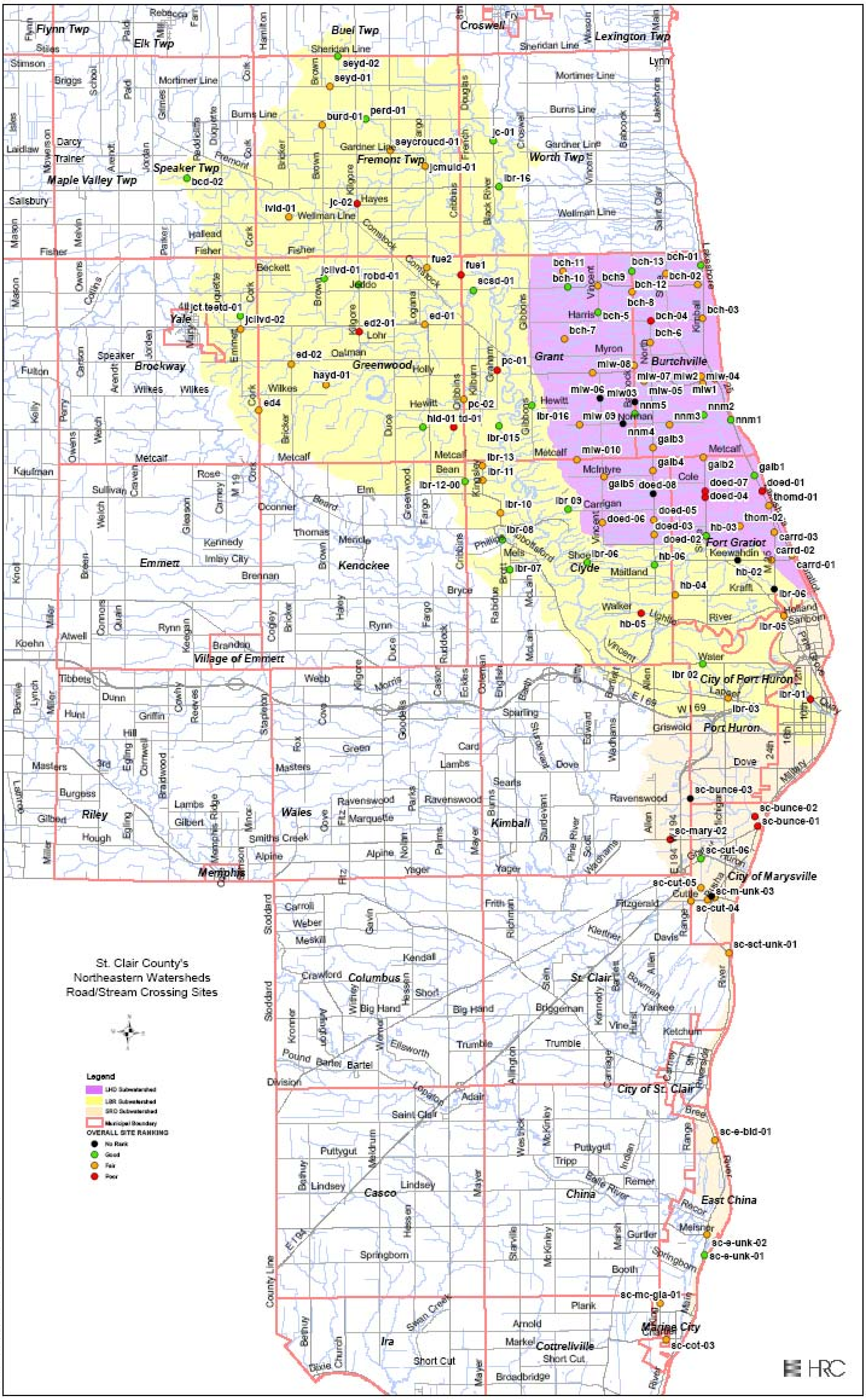


Figure 2.38 Road/Stream Crossing Survey Sites

Table 2.10 Road/Stream Crossing Survey Site Locations, Station IDs and Site Rankings

Subwatershed	Site ID	Location	Site Ranking
LBR	jc-02	at Kilgore Road between Galbraith Line and Wellman Line Roads	Poor
LBR	lbr-01	at 10th Street Bridge	Poor
LBR	pc-01	at Graham Road, between Oatman and Hewitt Roads	Poor
LBR	td-01	at Norman Road, between Cribbins and Fargo Roads	Poor
LBR	ed2-01	at Kilgore Road, between Yale and Lohr Roads	Poor
LBR	fue1	at Cribbins Road, between Jeddo and Fischer Roads	Poor
LBR	bcd-02	at M-19 between Galbraith Line and Gardner Line Roads	Good
LBR	perd-01	at Burns Line Road between Todd and Kilgore Roads	Good
LBR	seyd-02	at Sheridan Road between Kilgore and Brown Roads	Good
LBR	lbr-16	at Wellman Line Road between Croswell and Black River Roads	Good
LBR	jc-01	at Black River Road between Gardner Line and Burns Line Roads	Good
LBR	robd-01	at Kilgore Road, between Jeddo and Fischer Roads	Good
LBR	jclivd-01	at Brown Road, between Jeddo and Fischer Roads	Good
LBR	jct teetd-01	at Emmet Road, between Jeddo and Yale Roads	Good
LBR	lbr 02	at West Water, between Michigan and Range Road	Good
LBR	hb-03	at State, between Keewahdin and Carrigan	Good
LBR	hb-06	at Wadhams Road North, between Keewahdin and Maitland Roads	Good
LBR	lbr-06	at Shoefelt Road, west of Vincent Road	Good
LBR	lbr 09	at Wildcat Road, between Carrigan and Fieck	Good
LBR	lbr-07	at Brott Road, between Emily City and Brice	Good
LBR	lbr-08	at Abbottsford, between Beard and Bruce Roads	Good
LBR	lbr-12-00	at Cribbins Road, south of Bean Road	Good
LBR	lbr-015	at Norman Road, between Cribbins and Gibbons Roads	Good
LBR	lbr-016	at Gibbons Road, between Hewitt and Birch Roads	Good
LBR	hld-01	at Norman Road, between Fargo and Deuce Roads	Good
LBR	scsd-01	at Jeddo Road, between Cribbins and Black River Roads	Good
LBR	lvld-01	at Bricker Road between Galbraith Line and Wellman Line Roads	Fair
LBR	burd-01	at Brown Road between Burns Line and Gardner Line Roads	Fair
LBR	seyd-01	at Mortimer Line Road between Kilgore and Brown Roads	Fair
LBR	jcmuld-01	at Fargo Road between Galbraith Line and Wellman Line Roads	Fair
LBR	seycroucd-01	at Todd Road between Galbraith Line and Gardner Line Roads	Fair
LBR	jclivd-02	at Emmet Road, between Yale and Oatman Roads	Fair
LBR	lbr-03	at Lapeer Road, between Herbert and 40th Street	Fair
LBR	lbr-05	at Pine Grove Road, between Holland and North River Roads	Fair
LBR	hb-04	at Krafft Road, between Campbell and State	Fair
LBR	lbr-10	at Avoca Road, north of Beard Road	Fair
LBR	lbr-11	at Kingsley Road, between 136 and Metcalf Road	Fair
LBR	lbr-13	at Kingsley Road, between Metcalf north Branch of Oatman	Fair
LBR	pc-02	at Cribbins Road, between Holly and Hewitt Roads	Fair
LBR	hayd-01	at Brown Road, between Wilkes and Oatman Roads	Fair
LBR	ed-01	at Yale Road, between Loghana and Fargo Roads	Fair
LBR	ed-02	at Bricker Road, between Oatman and Wilkes Roads	Fair
LBR	fue2	at Fargo Road, between Fischer and Comstock Roads	Fair
LBR	ed4	at Cork Road, between Wilkes and Norman Roads	Fair
LBR	lbr-06	at Pine Grove Road, between Krafft and Keewahdin Roads	-
LBR	hb-02	at Keewahdin Road, between State and Parker Roads	-
LHD	bch-04	at Harris Road, north of North Street	Poor
LHD	doed-01	at M-25 and Brace Road	Poor
LHD	doed-04	at State, between Brace and Carrigan	Poor
LHD	doed-07	at State and Brace Roads	Poor
LHD	hb-05	at Walker Road, between North and Wadhams Roads	Poor
LHD	bch-5	at Vincent Road, first tributary north of Harris Road	Good
LHD	bch-10	at Jeddo Road, first tributary east of Wildcat Road	Good
LHD	bch-13	at Babcock Road, between Jeddo and Fischer Roads	Good
LHD	bch-01	at M-25, between Jeddo and Fischer Roads	Good
LHD	galb1	at M-25, between Brace and Metcalf Roads	Good
LHD	nnm1	at M-25, just north of Norman Road	Good

Table 2.10 Road/Stream Crossing Survey Site Locations, Station IDs and Site Rankings (cont.)

Subwatershed	Site ID	Location	Site Ranking
LHD	nnm2	at State Road, just north of Norman Road	Good
LHD	nnm5	at Babcock Road, second tributary north of Norman Road	Good
LHD	bch-6	at North Road, first tributary north of Myron Road	Fair
LHD	bch-7	at Wildcat Road, north of Myron Road	Fair
LHD	bch-8	at Babcock Road, south of Jeddo Road	Fair
LHD	bch9	at Vincent Road, first tributary south of Jeddo Road	Fair
LHD	bch-11	at Wildcat Road, second tributary north of Jeddo Road	Fair
LHD	bch-12	at Campbell Road, first tributary north of Jeddo Road	Fair
LHD	mlw2	at State, south of Burtch Road	Fair
LHD	mlw-04	at State, north of Burtch Road	Fair
LHD	mlw-05	at Burtch Road, between North and Babcock Roads	Fair
LHD	mlw-07	at Babcock Road, north of Burtch Road	Fair
LHD	mlw-08	at Burtch Road, between Vincent and Wildcat Roads	Fair
LHD	mlw 09	at Norman Road, between Vincent and Wildcat Roads	Fair
LHD	mlw-010	at Metcalf Road, between Vincent and Wildcat Roads	Fair
LHD	bch-02	at Jeddo Road, between M-25 and Campbell Road	Fair
LHD	bch-03	at Harris Road	Fair
LHD	galb2	at State, south of Metcalf Road	Fair
LHD	galb3	at North Road, north of Metcalf Road	Fair
LHD	galb4	at North Road, just north of McIntyre Road	Fair
LHD	galb5	at McIntyre Road, between Vincent and North Roads	Fair
LHD	nnm3	at Campbell Road, first tributary south of Norman Road	Fair
LHD	mlw1	at M-25, north of Burtch Road	Fair
LHD	carrd-01	at Lakeshore Drive, between Keewahdin Road	Fair
LHD	carrd-02	at Carrigan Road, just west of M-25 crossroad	Fair
LHD	carrd-03	at M-25, between Keewahdin and Carrigan Roads	Fair
LHD	thomd-01	at M-25, between Carrigan Drain and Brace	Fair
LHD	thom-02	at Carrigan and Parker Roads	Fair
LHD	doed-02	at State, between Keewahdin and Carrigan	Fair
LHD	doed-03	at North Road, between Beard and Carrigan	Fair
LHD	doed-05	at North Road, between Carrigan and Beard	Fair
LHD	doed-06	at Vincent Road, between Carrigan and Beard	Fair
LHD	mlw03	at Babcock, south of Burtch Road	-
LHD	mlw-06	at Vincent Road, south of Burtch Road	-
LHD	nnm4	at Norman Road, between Vincent and Babcock Roads	-
LHD	doed-08	at North Road, between Carrigan and Cole	-
SRD	sc-mary-02	at Smith Creek and Pickford Street	Poor
SRD	sc-bunce-01	at Busha Highway, north of Gratiot Boulevard	Poor
SRD	sc-bunce-02	at Mobile Home Park off of Ravenswood Drive	Poor
SRD	sc-cut-06	at Gratiot Boulevard	Good
SRD	sc-mary-01	at Montana Road, between Smith Creek and 4th Street	Good
SRD	sc-e-unk-01	at Point Drive	Good
SRD	sc-cut-04	at Cuttle and Range Roads	Fair
SRD	sc-cut-05	at 18th Street, between Range and Michigan Roads	Fair
SRD	sc-cot-03	at Chartier, between King Road and M-29	Fair
SRD	sc-mc-gla-01	at King Road, between West Boulevard and Marine City Highway	Fair
SRD	sc-e-unk-02	at Orchard and M-29	Fair
SRD	sc-e-bld-01	at M-29, after Puttygut Road	Fair
SRD	sc-sct-unk-01	at River Road off of M-29	Fair
SRD	sc-m-unk-02	at Cuttle Road, between Range Road and M-29	Fair
SRD	sc-m-unk-01	at M-29, between Cuttle and Covington Roads	Fair
SRD	sc-bunce-03	at Range Road, between Ravenswood and Dove Street	-
SRD	sc-m-unk-03	at Cuttle Road	Fair

2.3.9 2005/2006 Water Quality Monitoring – SCCHD Tributary Monitoring

Three monitoring sites were established by the St. Clair County Health Department in 2005 to collect water quality data to "fill in the gaps" for tributaries with no existing data. Two sites were selected in the LHD subwatershed - Burtch Creek (a more rural site), Carrigan Drain (a suburban site), and one urban site along Cuttle Creek was selected in the SRD subwatershed. The physical process of monitoring itself provided a "hands-on" means of quantifying the difference between the two subwatersheds for which there was a lack of data. The results are described in detail in Appendix D.

The following types of monitoring were conducted in 2005 and 2006 at the three stations:

1. Water quality samples were measured for nutrient concentrations.
2. Stream discharge monitoring data was collected so that sediment and nutrient concentrations could be correlated to flow.
3. Sediment discharge data was collected for total suspended solids (TSS) and bedload.
4. A rapid biomonitoring screening was conducted for a general characterization of benthic organisms.
5. A Level I fluvial geomorphic characterization was performed to compare the shapes, erosive processes and stability of the drains.

Burtch Creek is a natural stream within a predominantly agricultural land use area. Approximately one third of the smaller tributaries appear to be poorly managed (Appendix D, Fig. D-2.1). Common practices with negative impacts include farming within and directly adjacent to tributaries, cattle access, removing riparian vegetation, channelization, perched culverts, and conversion of riparian vegetation to turf grass. At a monitoring site near State Street in the LHD watershed, sediment appears to have deposited within the floodplain (as defined in Appendix D) to the extent that the channel is now relatively straight and incised due to historic land use practices (Appendix D, Fig. D-2.2). The channel is unstable with high sediment and nutrient loadings; however, pockets of sensitive aquatic species exist which indicate that the stream may respond well to restoration and a reduction in sediment loads.

Carrigan Drain is an established County Drain located within a predominantly urban land use area. Mostly due to the width of the available floodplain, Carrigan Drain is the most stable of the three reaches monitored with less flashy flows and reduced sediment loads. A lack of bed topography, which was typical of all three sites, reduces habitat variability and the ability for the stream to assimilate pollutants. However, nutrient levels are seasonally high and the aquatic diversity and habitat are impaired.

Similar to Carrigan Drain, Cuttle Drain is a suburban County Drain. However, the floodplain width is narrower and maintains a predominantly trapezoidal shape (Appendix D, Fig. D-4.2b) and most of the banks of the drain are mowed and/or regularly cleared of brush. As a result, the flows are flashier than Carrigan Drain, the sediment and nutrient loads are higher, and the aquatic diversity and habitat are even more impaired. The Cuttle Drain can generally be described as moderately unstable (i.e., rated in between the Carrigan Drain and Burtch Creek).

2.3.10 Estimated Nonpoint Source Pollutant Loadings

In order to provide a baseline of estimated pollutant loadings from nonpoint sources to the NEW, the US EPA's "Spreadsheet Tool for Estimating Pollutant Load" (STEPL Version 3.0) was used to quantify the estimated nonpoint source loadings for phosphorus (P), nitrogen (N), and Biological Oxygen Demand (BOD) (an indirect measure of the concentration of biologically degradable material present in surface water), and sediment loadings on both a subwatershed and watershed-wide basis.

The model utilizes information regarding watershed-based land use, annual precipitation, agricultural animal type, septic system data, the Universal Soil Loss Equation (USLE), average hydrologic soil group, reference runoff curve number, estimated nutrient concentration in runoff (in mg/L) and urban land use distribution (which includes commercial/office, under development, recreational/cultural, industrial, institutional, transportation, multiple-family and single-family residential land uses). A significant consideration in the analysis of the estimated nonpoint source pollutant loadings is that much of the data used in the model is approximated. As such, the loadings shall be comparatively considered as gross estimates for planning purposes only. For example, the USLE provides estimates for sheet and rill erosion from upland areas and does not consider gully or streambank erosion. Therefore, the sediment loadings from some tributaries of the NEW are underestimated. A more comprehensive model such as WARSSS (EPA, 2006) would be required to accurately include these sources.

To insure model accuracy, soils and land use information were analyzed on a subwatershed basis, agricultural data was compiled, slopes and drainage characteristics were analyzed, and the results were compared with regional and measured data. Based on the most current information available, Tables 2.12 through 2.16 and Figures 2.39 through 2.42 illustrate the estimated nonpoint source pollutant loadings for N, P, BOD, and sediment on a subwatershed basis. Table 2.12 summarizes the total annual pollutant loadings for each of the three subwatersheds and the entire NEW.

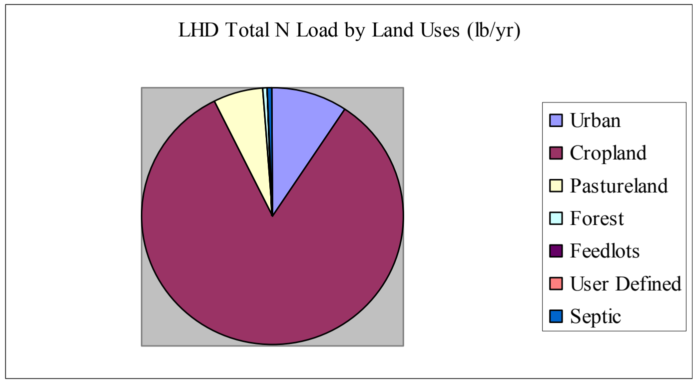
Table 2.11 Summary of Annual Pollutant Loadings (assumes no BMPs)

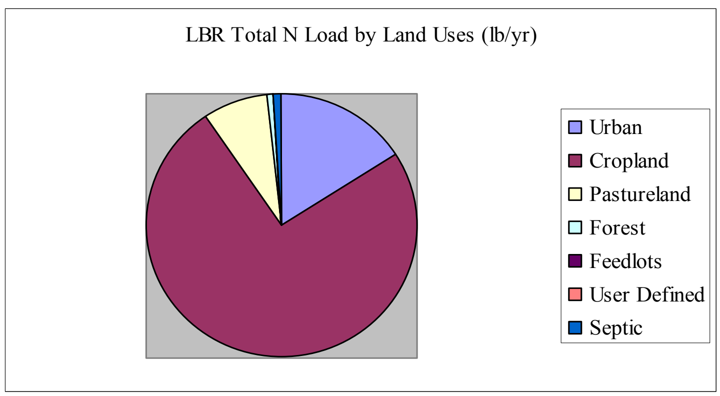
Subwatershed	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (tons/yr)
LHD	195,338	37,418	424,009	3,619
LBR	407,457	77,997	951,683	3,823
SRD	66,086	13,108	201,768	1,014
NEW	**668,881**	**128,523**	**1,577,461**	**8,456**

The LHD subwatershed has a higher delivery ratio of nonpoint source pollutants due to the smaller drainage area of the tributaries and the topography (LS factor). Agricultural areas tend to have higher sediment and nutrient loadings than urban areas.

Table 2.12 Nitrogen Loading per Subwatershed

Subwatershed	Loading (lb/ac)
Lake Huron Direct Drainage	6.3
Lower Black River	4.2
St. Clair River Direct Drainage	4.2





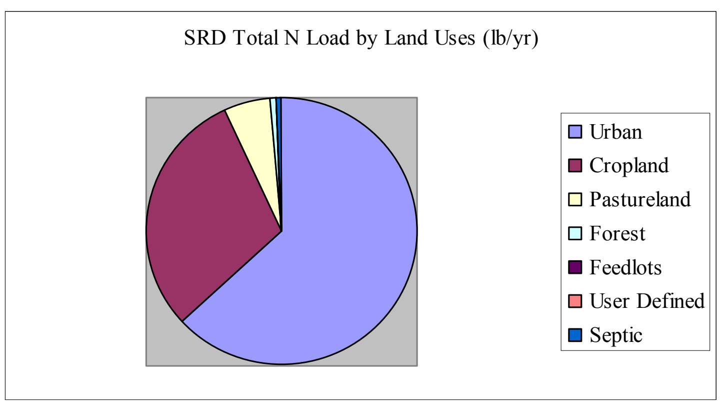
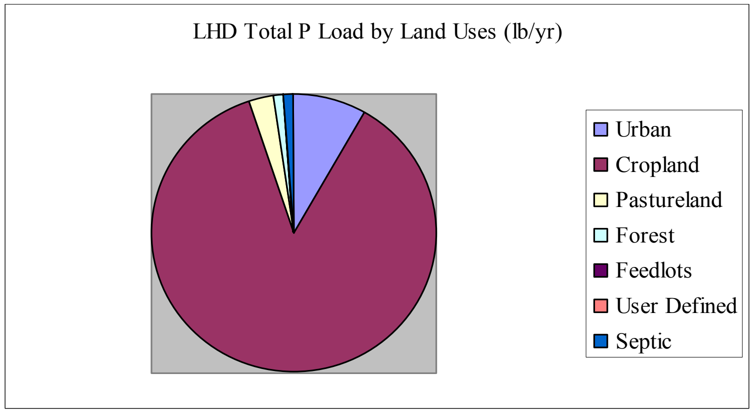
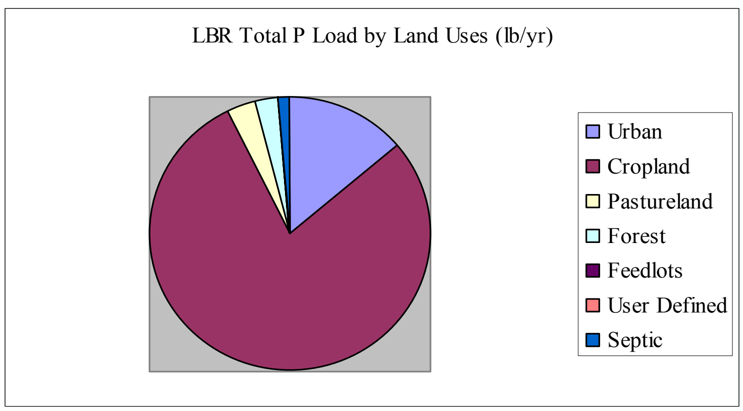


Figure 2.39 Nitrogen Loading (lb/yr) by Land Use per Subwatershed

Table 2.13 Phosphorus Loading per Subwatershed

Subwatershed	Loading (lb/ac)
Lake Huron Direct Drainage	1.2
Lower Black River	0.8
St. Clair River Direct Drainage	0.8





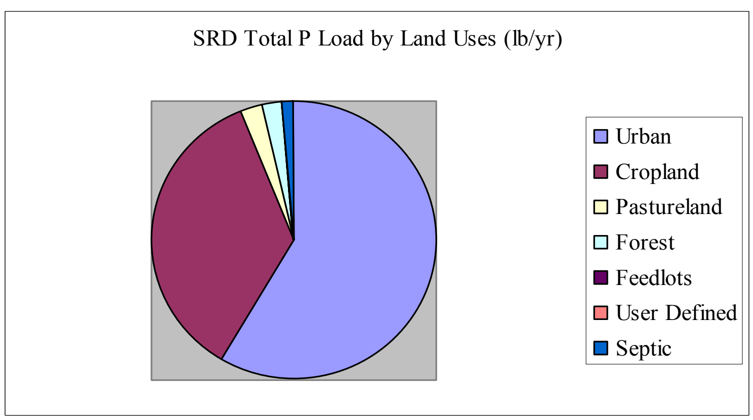
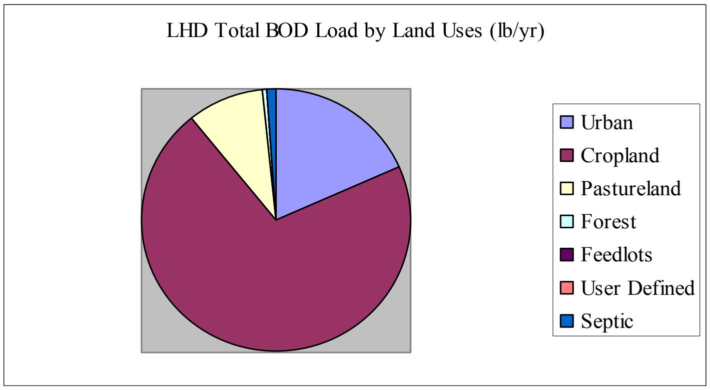
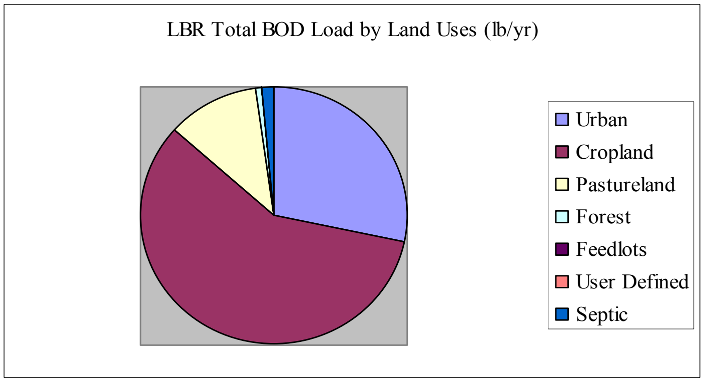


Figure 2.40 Phosphorus Loading (lb/yr) by Land Use per Subwatershed

Table 2.14 Biological Oxygen Demand Loading per Subwatershed

Subwatershed	Loading (lb/ac)
Lake Huron Direct Drainage	13.7
Lower Black River	9.8
St. Clair River Direct Drainage	1.5





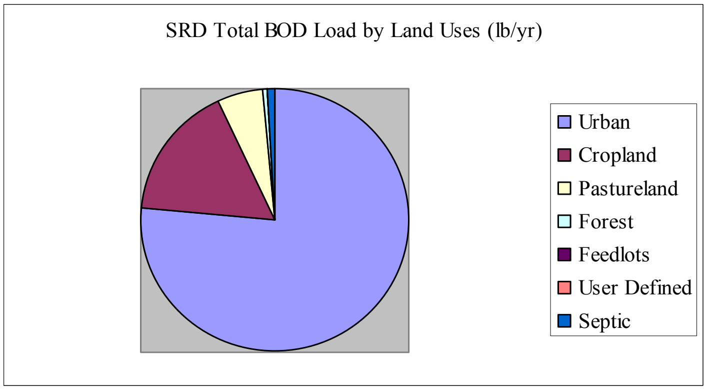


Figure 2.41 Biological Oxygen Demand Loading (lb/yr) by Land Use per Subwatershed

Table 2.15 Sediment Loading per Subwatershed

Subwatershed	Loading (lb/ac)
Lake Huron Direct Drainage	234.8
Lower Black River	79.1
St. Clair River Direct Drainage	128.7

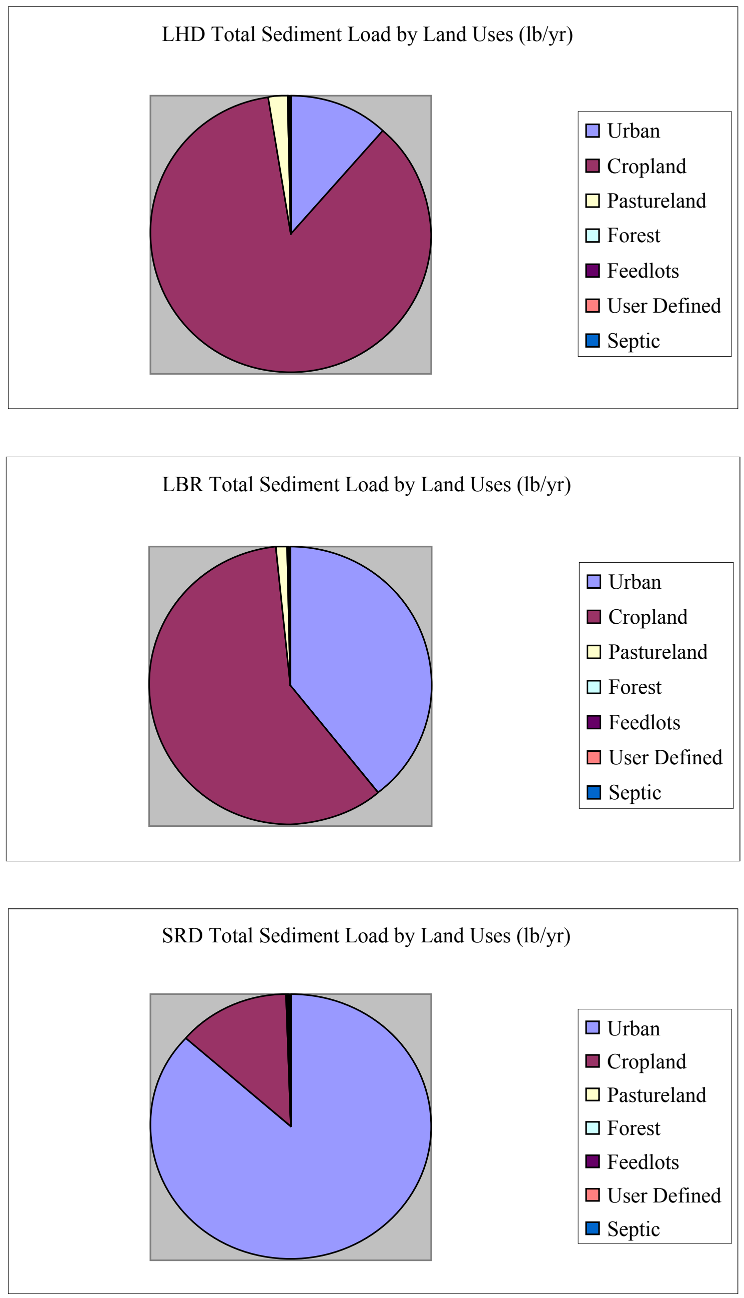


Figure 2.42 Sediment Loading (lb/yr) by Land Use per Subwatershed

As each community and agency implements the recommended BMPs (see Chapter 6) throughout the watershed, the pollutant load reductions can be calculated based on several factors utilizing the MDEQ's "Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual" (1999) which can be found at: **http://www.deq.state.mi.us/documents/deq-swq-nps-POLCNTRL.pdf**.

The document provides a framework to measure estimates of nonpoint source pollutant load reductions of nutrients and sediment and helps to facilitate a standardized, uniform system for estimating pollutant load reduction. The methods are simple in concept and workable within a field office and include instructions and examples regarding the calculation and documentation of pollutant reductions for: 1) sediment; 2) sediment-borne phosphorus and nitrogen; 3) feedlot runoff; and 4) commercial fertilizer, pesticides and manure utilization. This document does not cover estimates of impacts from wind erosion or impacts of BMPs on groundwater quality as they are not well enough understood to be feasible. Any questions related to the use of this document can be directed to the MDEQ, Nonpoint Source Unit.

Table 2.17 provides a summary of the estimated pollutant removal efficiencies of some of the standard BMPs that are already being implemented, or are recommended to implement over the course of the permit cycle for the agencies and communities in the NEW.

An analysis of specific pollutant load reduction based on the types of BMPs to be implemented/or are recommended for implementation were not performed as part of the scope of the NEW WMP as there are no known TMDLs that need to be met with specific load reductions at this time.

Table 2.16 Pollutant Removal Efficiencies for Select Stormwater Best Management Practices

Best Management Practice	Pollutant Removal Efficiencies					
	Total Phosphorus	Total Nitrogen	TSS	Metals	Bacteria	Oil and Grease
High-powered street sweeping	30-90%		45-90%			
Riparian buffers	forested: 23-42%; grass: 39-78%	forested: 85%; grass: 17-99%	grass: 63-89%			
Vegetated roofs	Note: 70-100% runoff reduction, 40-50% of winter rainfall. 60% temperature reduction. Structural addition of plants over a traditional roof system.					
Vegetated filter strips (150ft strip)	40-80%	20-80%	40-90%			
Bioretention	65-98%	49%	81%	51-71%		
Wet extended detention pond	48 - 90%	31-90%	50-99%	29-73%	38-100%	66%
Constructed wetland	39-83%	56%	69%	(-80)-63%	76%	
Infiltration trench	50-100%	42-100%	50-100%			
Infiltration basin	60-100%	50-100%	50-100%	85-90%	90%	
Grassed swales	15-77%	15 - 45%	65-95%	14-71%	(-50) - (-25)%	

Table 2.16 Pollutant Removal Efficiencies for Select Stormwater Best Management Practices

Best Management Practice	Pollutant Removal Efficiencies					
	Total Phosphorus	Total Nitrogen	TSS	Metals	Bacteria	Oil and Grease
Catch basin inlet devices		30-40% sand filter	30-90%			
Sand and organic filter	41-84%	22-54%	63-109%	26-100%	(-23) - 98%	
Stabilize soils on construction sites			80-90%			
Sediment basins or traps at construction sites			65%			

Sources: Claytor, R. and Schueler, T. 1996. Design of Stormwater Filtering Systems. Center for Watershed Protection, Ellicott City, MD.
Ferguson, T., Gignac, M., Stoffan, M., Ibrahim, A. and Aldrich, J. 1997. Cost Estimating Guidelines, Best Management Practices and Engineered Controls. Rouge River National Wet Weather Demonstration Project.
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U.S. EPA. 2002. National Menu for Best Management Practices for Stormwater Phase II.

2.4 Subwatershed-Specific Characteristics and Conditions

The LHD and LBR subwatersheds are very similar in their land uses and are faced with the same challenges in regards to water quality degradation from hydromodifications. The LBR has been impacted much more by point source discharges from industrial sources in its lower reaches, whereas the LHD subwatershed has remained primarily an agricultural and residential area. The SRD subwatershed is the most urbanized subwatershed, and its land uses have historically impacted the St. Clair River by point source discharges. As with the other two subwatersheds, the SRD subwatershed is impacted by hydromodifications and degraded habitat in many of its tributaries. Table 2.18 below provides an overall summary of the current conditions in each subwatershed of the NEW identifying: the drainage area, soil types and topography, hydrology, predominant land use, water quality impairments/concerns, the significant pollutants, and the pollutant sources identified for each subwatershed. A more descriptive summary of each subwatershed is provided in subsequent sections of this chapter.

Table 2.17 Current Conditions in each Subwatershed of St. Clair County's Northeastern Watersheds

Subwatershed	Acreage (square miles)	% of Watershed	Soil Types and Topography	Hydrology	Predominant Land Uses (%)	Water Quality Impairments/Concerns	Significant Pollutants/Concerns	Significant Sources
Lower Black River	97,189 (151)	67.5	• Drained somewhat poorly on level to gentle slopes; coarse sand is present in the downstream reaches just east of North Road and Allen Road • Surface runoff is slow to medium and depends on the percentage of slope • Permeability is moderate • Available water capacity is high • Artificial drainage is needed for good crop growth • Slopes are generally level to shallow (0-3%) on water laid moraines and till plains, and steeper (6-12%) along the land bordering the Black River	• Dominated by dredged channels, warm temperatures, turbidity, and slow movement. • Receives approximately 29.6" of rain annually • Approximately 205 miles of tributaries drain to the Black River, which in turn drains to the St. Clair River • Very low gradient throughout watershed • One privately owned dam in Clyde Twp • Diversion canal from Lake Huron to the Black River in Port Huron • There are 12 main tributaries in the LBR subwatershed: 1. Black Creek 2. Upper Black River 3. Black River Canal 4. Lower Black River 5. Eves Drain 6. Jackson Creek 7. Livergood Drain 8. Mill Creek 9. Robertson Drain 10. Seymour Creek 11. Silver Creek 12. Stocks Creek	• Cultivated/Grassland/Shrub (56.7%) • Woodland/Wetland (19.0%) • Single-Family Residential (16.1%) (Totals exclude land area in Sanilac County)	• 2009 TMDL for CSO, pathogens (*E. coli*), for a 1.5 mile stretch from the St. Clair River confluence upstream to I-94 in the vicinity of Port Huron • 2010 TMDL for WQS exceedances for PCBs from the St. Clair River confluence upstream, including all tributaries (390 miles total) • 2011 TMDL for WQS exceedances for mercury for a one mile stretch near the Water Street boat launch downstream of the railroad bridge	• Soil erosion/ Sedimentation • Turbidity • Pathogens, bacteria • Nutrients • PCBs • Mercury • Stormwater runoff quantities • Degraded in-stream/shoreline habitat • Degraded aesthetics of water resources • Flashy hydrology	• Historical industrial point source contamination • Hydromodifications • Agricultural land use • CSOs • Atmospheric deposition • Urban runoff/storm sewers • In-stream channel erosion
St. Clair River Direct Drainage	15,788 (25)	11.0	• Very poorly drained and somewhat poorly drained with a clayey to sandy subsoil in most of the subwatershed • Fine textures and clay occur along the thin strip of land along the southern shoreline • Surface runoff is slow • Permeability of water is rapid in the sandy upper part of the profile and very slow in the underlying clay • Available water capacity is low in the sandy upper part of the profile and moderate in the underlying clay • Slopes of the northwestern portion of the watershed are generally 0-6%, with the majority of them level to shallow (0-3%). Remainder of land is a thin strip bordering the shoreline and contains an elevation loss of about 10 feet from the western edge of the strip to the water.	• Poor drainage and slow moving water in the northwestern portion of the subwatershed; better drainage occurs along shoreline where there are steeper slopes • Receives approximately 30.7" of rain annually • Approximately 50 miles of tributaries drain directly to the St. Clair River • Flooding is a major concern in Marysville and Port Huron and Kimball Townships • There are 3 main tributaries in the SRD subwatershed: 1. Huffman Drain branches 2. Bunce Creek 3. Cuttle Creek	• Single-Family Residential (26.5%) • Cultivated/Grassland/Shrub (26.4%) • Woodland/Wetland (16.4%) • Industrial (12.3%)	• 2009 TMDL for CSO, pathogens (*E. coli*), for a 27 mile stretch from the vicinity of Algonac, Lake St. Clair inlet, upstream to the Lake Huron outlet at Port Huron • 2016 TMDL for pathogens (*E. coli*) for a 0.5 mile stretch of Chrysler Beach in Marysville • 2010 TMDL for WQS exceedances for PCBs for a 27 mile stretch from the vicinity of Algonac, Lake St. Clair inlet, upstream to the Lake Huron outlet at Port Huron • 2010 TMDL for FCA-PCBs for the same stretch of the St. Clair River noted above	• Soil erosion/ sedimentation • Pathogens, bacteria • Nutrients • PCBs • Flashy hydrology • Heavy metals • VOCs • PAHs • Trash/litter • Degraded in-stream/shoreline habitat • Degraded aesthetics of water resources	• Historical industrial point source contamination • Hydromodifications • Urban runoff/storm sewers • CSOs/SSOs • Shoreline modifications (seawalls)

Table 2.17 Current Conditions in each Subwatershed of St. Clair County's Northeastern Watersheds (continued)

Subwatershed	Acreage (square miles)	% of Watershed	Soil Types and Topography	Hydrology	Major Land Use (%)	Water Quality Impairments/Concerns	Significant Pollutants/Concerns	Significant Sources
Lake Huron Direct Drainage	30,881 (48)	21.5	• Shoreline areas and downstream areas are fine-textured till, lacustrine clay/silt, and dune sand with low natural fertility and very low available water capacity • Unconsolidated fines, sand, and gravel covered with loam occur in the western portion of the subwatershed • Slopes in the eastern portion of the watershed are generally flat to rolling with slopes of 1-2%. Topography west of the shoreline area rises approximately 80 feet and is hilly to undulating with slopes ranging from 2-12%.	• Receives approximately 28" of rain annually • Approximately 121 miles of tributaries drain directly to Lake Huron • Drainage is good in the west, but poor along the shoreline areas since slopes flatten out substantially • Many tributaries are seasonal, only carrying water during rain events and wet seasons • There are 5 main tributaries in the LHD subwatershed: 1. Burtch Creek 2. Galbraith Drain 3. Milwaukee Creek 4. Carrigan Drain 5. Doe Creek	• Cultivated/Grassland/Shrub (69.5%) • Woodland/Wetland (14.1%) • Single-Family Residential (12.6%)	• 2015 TMDL for pathogens (*E. coli*) for a 0.12 mile stretch at the Krafft Road Beach in the vicinity of Port Huron • Habitat modification-channelization of the Carrigan Drain from the Lake Huron confluence upstream (1.5 miles of drain)	• Soil erosion/ sedimentation • Pathogens, bacteria • Nutrients • Degraded in-stream/shoreline habitat • Flashy hydrology	• Hydromodifications • Agricultural land use • In-stream channel erosion

2.4.1 Lower Black River Subwatershed Conditions

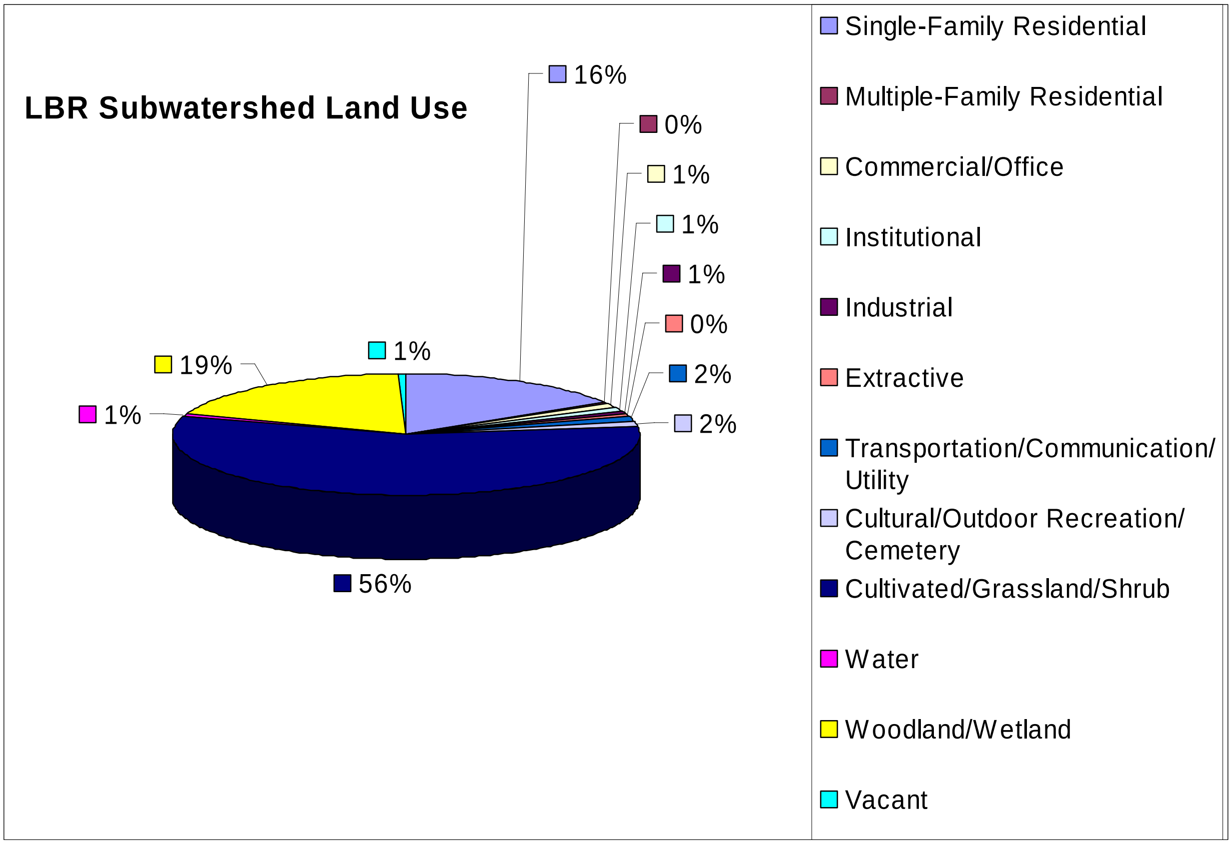

Figure 2.43 Land Use in the LBR Subwatershed

The LBR subwatershed makes up 67.5% of the NEW and, for the land area included in St. Clair County (excluding Sanilac County), is dominated by cultivated/grassland/shrub land uses at 56% (Figure 2.43). The remaining predominant land uses are comprised of woodland/wetland at 19% and single-family residential at 16%. All other land uses account for 2% or less of the land area. Given these land uses, there are significant challenges with controlling sediment, nutrients, pesticides, total dissolved solids, and animal waste inputs (which may contribute nutrients and pathogens) from agricultural runoff from this subwatershed. Many upstream reaches of the tributaries in the LBR subwatershed exhibited some of the worst areas of streambank erosion in the NEW. This is likely the product of the clay-dominated soils and extremely steep slopes of these areas. Concurrently, the LBR is very turbid which is predominately a result of the sedimentation inputs from the surrounding clay soils carried into the river from runoff in its smaller tributaries; also, given that this is one of the highest flowing reaches in the NEW, the clay particles never have a chance to settle out of suspension and give the water it's "muddy" appearance. This subwatershed is also dominated by agricultural land use, and with this land use, channelization of drainage ditches and agricultural tile drains are present throughout the landscape to facilitate drainage. These excess inputs of surface water have impacted the hydrology in downstream reaches with increased in-stream erosion, including streambank erosion and channel downcutting. The agricultural drainage inputs have also greatly impacted hydrology in the watershed by decreasing infiltration and groundwater recharge which act to maintain baseflows to streams during extended periods of dry weather.

The river widens substantially in the downstream areas as it approaches its confluence with the St. Clair River, at which point the subwatershed also becomes more urbanized and the river banks are armored with seawalls to prevent erosion of riverside property owners. It is at this location in the subwatershed where there is a much greater chance for nonpoint source pollution from urban surface water runoff (nutrients, fertilizers, pesticides, pet waste, etc.) to enter into area waterways. The lower reaches of this subwatershed are also impacted by CSO overflows from Port Huron.

Historical point source discharges and atmospheric deposition are likely sources of PCBs and mercury to area waterways which have resulted in TMDLs scheduled for 2010 and 2011, respectively. A 2009 TMDL is scheduled for pathogens. The pathogens are likely originating from nonpoint sources such as agricultural runoff, as well as point sources from CSO events in Port Huron. Heavy metals were found in sediments near the Water Street boat launch near I-75 likely due to urban runoff into the Black River.

Based on the results of the 2004 Road/Stream Crossing Survey, an equal number of sites (42.5%) were rated as good and fair overall (see Figure 2.40). Turbidity was present or abundant in 36% of the LBR tributaries. The presence of trash was recorded at 11% of the sites. Although many of the sites (36%) noted a presence or abundance of algae, the LBR sites had significantly lower occurrence of algae than the other two subwatersheds. Water quality analyses by MDEQ indicate that the nutrient levels in the Black River are highly variable; therefore, the presence of algae is not always a reliable indicator of excessive runoff of nutrients. The lower presence of algae at the LBR sites may be because they were surveyed earlier in the summer, the tributaries' flows were better, or because the other two subwatersheds have even higher nutrient loadings than the LBR subwatershed. Port Huron maintains a canal connecting Lake Huron and the Black River. During periods of low flow in the river, the gate on the canal is opened to allow Lake Huron water to augment the flow of the Black River. It is generally open during the summer except when winds are strong from the northeast to prevent the build-up of silt (MDNR, 1975a). During periods of expected low water quality in the summer, the flow augmentation is effective in improving the quality of water through Port Huron.

Other conditions documented by the 2004 Road/Stream Stream Crossing Survey included low baseflows, streams accessible to cattle, recovery from dredging, and excessive erosion and sedimentation. Streamside and riparian vegetation varied widely. Most sites had either bare eroded banks, a lack of riparian buffers (mowed turf grass), or were overgrown with cattails. Roughly 80% of the soils in the Black River basin are silt loams and sandy loams (Knutilla, 1970).

The biological community in the Lower Black River has improved significantly in the past few decades. Many monitoring studies indicated that habitat and aquatic communities were fair to excellent (MDEQ). Although there are several impacts to the stream biota that still exist such as increased temperature, loss of habitat, dredging, excessive sedimentation, and migration barriers, there are many areas that retain a significant vegetative buffer and good populations of fish, macroinvertebrates, and mussels (slightly impaired). Many more biological surveys have been conducted in the LBR compared to the LHD and SRD subwatersheds.

Additional data on the physical, biological, and chemical conditions in the LBR subwatershed can be found in the Resource Directory.

2.4.2 St. Clair River Direct Drainage Subwatershed Conditions

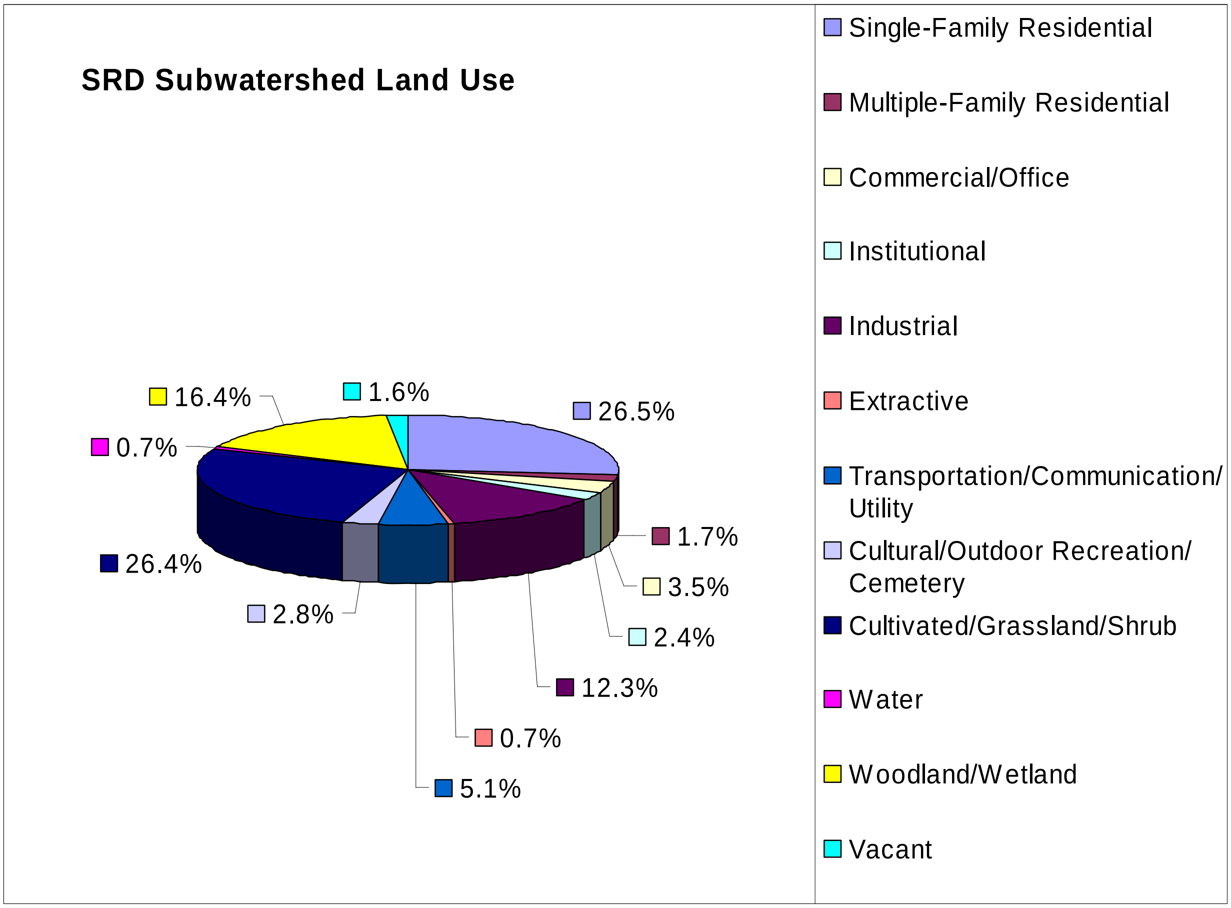

Figure 2.44 Land Use in the SRD Subwatershed

The SRD subwatershed makes up 11.0% of the NEW and its major land uses as shown in Figure 2.44 are divided almost equally between single-family residential (26.5%) and cultivated/grassland/shrub (26.4%). Most of the urbanized area is located along the St. Clair River. This subwatershed also has the highest percentage of industrial land use (12.3%) out of the other two subwatersheds in the NEW. Given these land uses, the SRD subwatershed is challenged to prevent and reduce pollution from both point and nonpoint sources of pollution from urban and agricultural runoff. Given that there is still 16.4% of the land dedicated to woodland/wetland, the opportunity for preserving these natural features should be a priority.

The main pollutants impacting the SRD subwatershed include sediment, bacteria, nutrients, heavy metals, grease and oils, and PCBs. Most of the contamination has come from sites of environmental contamination, historical point source discharges, CSOs and SSOs in Port Huron and Marysville, and urban nonpoint source runoff.

The topography of the subwatershed is relatively flat and natural drainage has been augmented by ditches, channelization, and tile drains, as is the case in the other two subwatersheds. The watercourses exhibit flashy hydrology and downstream reaches often flood, especially in the City of Marysville. The drainage area of Bunce Creek is 10.1 square miles and the average channel slope is 0.174%. The drainage area of Cuttle Creek is 2.12 square miles and the average channel slope is 0.335% (Knutilla, 1973).

Based on the results of the 2004 Road/Stream Crossing Survey, most of the SRD sites (59%) were rated as fair overall and there were more sites rated as poor (18%) than in the other two subwatersheds (Figure 2.40). Turbidity was present or abundant in 28% of the SRD tributaries and, although this level of occurrence was the least of the three subwatersheds, most of the sites noted problems with erosion or sedimentation. Most of the sites (69%) noted a presence or abundance of algae, which was a significantly higher occurrence of algae than in the other two subwatersheds. Litter and trash were noted at many more sites (36%) than in the other two subwatersheds.

Other conditions included low base flows, impacts from construction activities, and significant channel modifications (culverts, impoundments, check dams, channelization, mowing of banks, and riprap). The presence of fish and good habitat were noted at a few sites.

Additional data on the physical, biological, and chemical conditions in the SRD subwatershed can be found in the Resource Directory.

2.4.3 Lake Huron Direct Drainage Subwatershed Conditions

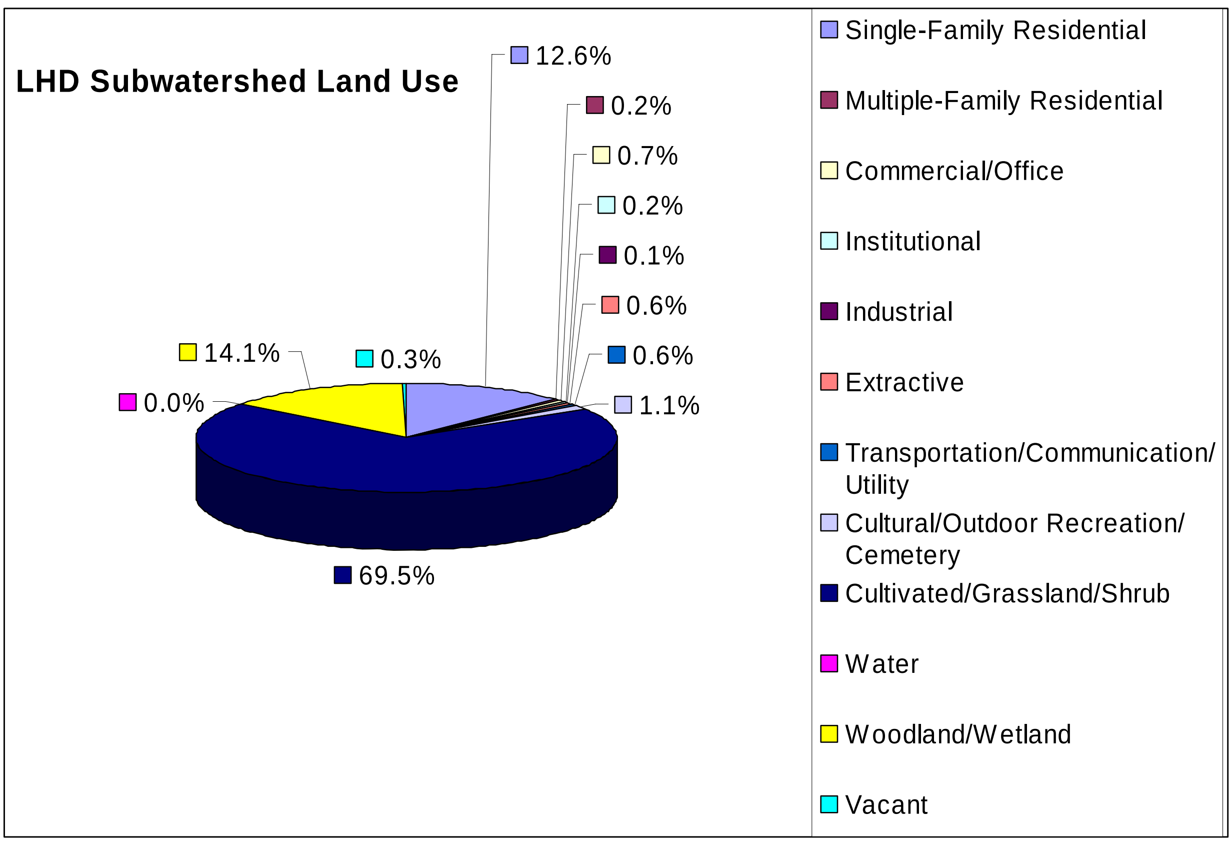

Figure 2.45 Land Use in the LHD Subwatershed

The LHD subwatershed makes up 21.5% of the NEW and is dominated by cultivated/grassland/shrub land uses at 69.5% (Figure 2.45). The remaining predominant land uses are comprised of woodland/wetland at 14.1% and single-family residential at 12.6%. In terms of major land uses, this subwatershed is quite similar to the LBR subwatershed. All other land uses account for 1% or less of the land area. Given these land uses, there are significant challenges with controlling sediment, nutrients, pesticides, total dissolved solids, and animal waste inputs (which may contribute nutrients and pathogens) from agricultural runoff from this subwatershed. Urbanized areas tend to be concentrated along the Lake Huron border of this subwatershed. Significant impacts have occurred to in-stream habitats for aquatic ecosystems due to channelization and ditching practices throughout the subwatershed. Other field investigations of Burtch and Milwaukee Creeks illustrated the severe impacts of flashy hydrology occurring throughout this subwatershed which is causing in-stream channel erosion, including streambank erosion and channel downcutting. It is suspected that this situation exists for many other stream reaches throughout the LHD subwatershed, except for a small number of headwater tributaries in the north that are less modified. The challenges posed for this subwatershed are geared towards attaining a balance between maintaining adequate drainage and preserving habitat and natural features which will improve water quality and in-stream habitat conditions.

Based on a monitoring study completed by the state in the Carrigan Drain (MDNR, 1990), some heavy metals and organic compounds were detected, but all concentrations were within established Michigan Water Quality Standards. Some levels of heavy metals such as lead, copper, zinc, and cadmium are typical of urban stormwater runoff. Based on the 2004 Road/Stream Crossing Survey, the LHD tributaries had the highest percentage of sites with turbidity (39%) and most of the sites (56%) had algae present. These conditions may indicate problems with excessive sedimentation and nutrient runoff. Other conditions included low or stagnant flow, cattle in the streams, films, and bacterial slimes and odors. Streamside and riparian vegetation varied widely; most sites had either bare eroded banks, a lack of riparian buffers (mowed turf grass), or were overgrown with cattails.

Very few bio-monitoring studies have been completed in the LHD subwatershed. The physical habitat conditions of the many tributaries of the subwatershed vary significantly. Some local residents claim that smelt and salmon used to spawn in some of the LHD tributaries, suggesting that some streams may still provide important habitat for non-game fish species.

Additional data on the physical, biological, and chemical conditions in the LHD subwatershed can be found in the Resource Directory.