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WATER QUALITY AND POLLUTION CONTROL IN MICHIGAN 2010 SECTIONS 303(d), 305(b), AND 314 INTEGRATED REPORT

Michigan Department of Environmental Quality
Water Bureau
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Due to the extensive number of pages contained in these documents, all appendices are available electronically at http://www.michigan.gov/deqwater under Water Quality Monitoring, Assessment of Michigan Waters.

LIST OF ACRONYMS

ADB	Assessment Database
ANS	Aquatic Nuisance Species
AOC	Areas of Concern
BCC	Bioaccumulative Chemicals of Concern
BEACH Act	Beaches Environmental Assessment and Coastal Health Act of 2000
BMP	Best Management Practice
BPJ	Best Professional Judgment
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CAFO	Concentrated Animal Feeding Operation
CAZ	Critical Assessment Zone
CMI	Clean Michigan Initiative
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
DDT	Dichlorodiphenyltrichloroethane
GIS	Geographic Information System
GLEC	Great Lakes Environmental Center
HCV	Human Cancer Value
HNV	Human Noncancer Value
HUC	Hydrologic Unit Codes
IR	Integrated Report
LaMP	Lakewide Management Plan
LHD	Local Health Department
LWMD	Land and Water Management Division
MDA	Michigan Department of Agriculture
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MS4	Municipal Separate Storm Sewer System
MSU	Michigan State University
MTBE	Methyl tert-butyl ether
NHD	National Hydrography Dataset
ng/L	Nanograms per liter
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NREPA	Natural Resources and Environmental Protection Act
P51	Procedure 51
PBB	Polybrominated Biphenyl
PCB	Polychlorinated Biphenyl
pg/L	Picograms per liter
SWQIF	Strategic Water Quality Initiatives Fund
TMDL	Total Maximum Daily Load
TSI	Trophic Status Index
USEPA	United States Environmental Protection Agency
ug/L	Micrograms per liter
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WB	Water Bureau
WCMP	Water Chemistry Monitoring Project
WMP	Watershed Management Plan
WQS	Water Quality Standards

EXECUTIVE SUMMARY

The federal Water Pollution Control Act (PL 92-500), also known as the Clean Water Act (CWA), requires states to provide the United States Environmental Protection Agency (USEPA) with an assessment of the quality of their waters [Section 305(b)], a list of waters that do not support their designated uses or attain water quality standards (WQS) and require the development of total maximum daily loads (TMDLs) [Section 303(d)], and an assessment of status and trends of publicly owned lakes (Section 314). Similar to the 2008 reporting cycle, the Michigan Department of Environmental Quality (MDEQ) is fulfilling these CWA reporting requirements in 2010 through the submission of an Integrated Report (IR).

A primary objective of this IR is to describe attainment status of Michigan's surface waters relative to the designated uses specified in Michigan's WQS. Michigan's WQS are consistent with the Great Lakes Initiative, establish minimum water quality requirements by which the waters of the state are to be managed, and provide the primary regulatory framework that guides the MDEQ's water quality monitoring/assessment and water protection activities. To describe the attainment status of surface waters, each water body is placed in at least one of five reporting categories based upon the degree of designated use support, the amount of information known about the water body's water quality status, and the type of impairment preventing designated use support.

This IR includes a description of the scope of Michigan waters covered; a summary of MDEQ programs designed to protect and restore water quality; an overview of water quality monitoring in Michigan; a description of Michigan's current assessment methodology; summaries of monitoring results and designated use support in the Great Lakes (including connecting channels and bays), inland lakes and reservoirs, rivers, and wetlands; information regarding water bodies not supporting designated uses, including water bodies requiring the development of a TMDL [i.e., Section 303(d) listings]; and a summary of the public participation process used in the development of this IR.

With the biennial development of each Section 305(b) report, Section 303(d) report, or IR, Michigan continues to refine its data management and assessment methodology. Implementation of data management and assessment methodology changes initiated for the 2008 IR continued in the preparation of this IR. These changes advanced Michigan's mapping capabilities for Section 305(b) and Section 303(d) listings. As a result, listing information in the form of maps became available to the pubic in December 2009 via the Michigan Surface Water Information Management System (MiSWIMS) www.michigan.gov/miswims.

Detailed lists of designated use support are contained in this report (Appendix B) as well as designated use support summaries for Great Lakes (including connecting channels and bays), inland lakes and reservoirs, rivers, and wetlands (Tables 5.2, 5.3, 6.2, 7.2, and 8.1, respectively). Overall, many of Michigan's surface waters are impacted by polychlorinated biphenyls (PCBs) and mercury and consequently do not support the other indigenous aquatic life and wildlife designated use and/or the fish consumption designated use. Atmospheric deposition is considered to be the major source of these persistent bioaccumulative chemicals. Excluding PCBs and mercury, physical/chemical and biological assessments of inland lakes and rivers indicate designated uses are supported in a majority of water bodies.

CHAPTER 1
INTRODUCTION

1.1 Purpose

The federal Water Pollution Control Act (PL 92-500), also known as the CWA, requires states to provide the USEPA with an assessment of the quality of their waters [Section 305(b)], a list of waters that do not support their designated uses or attain WQS and require the development of TMDLs [Section 303(d)], and an assessment of status and trends of publicly owned lakes (Section 314). Similar to the 2008 reporting cycle, the MDEQ is fulfilling these CWA reporting requirements in 2010 through the submission of an IR. Where possible, Michigan's 2010 IR was developed consistent with the USEPA's "Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act" and supplemental guidance information for 2008 and 2010 IRs prepared by the USEPA dated October 12, 2006, and May 5, 2009, respectively (IR Guidance).

A primary objective of this IR is to describe attainment status of Michigan's surface waters relative to the designated uses specified in Michigan's WQS (available upon request or at http://www.michigan.gov/deqwater under DEQ Laws and Rules, Rules, Water, Part 4). Michigan's WQS, initially promulgated in December 1973, were most recently revised and promulgated in January 2006 pursuant to Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). Michigan's WQS are consistent with the Great Lakes Initiative, establish minimum water quality requirements by which the waters of the state are to be managed, and provide the primary regulatory framework that guides the MDEQ's water quality monitoring/assessment and water protection activities. To describe the attainment status of surface waters, each water body is placed in at least one of five reporting categories (see Section 4.11) based upon the degree of designated use support, the amount of information known about the water body's water quality status, and the type of impairment preventing designated use support.

The remainder of this chapter includes a description of the scope of Michigan waters covered in this IR. Chapter 2 summarizes MDEQ programs designed to protect and restore water quality. Chapter 3 contains an overview of water quality monitoring in Michigan. Chapter 4 details Michigan's current assessment methodology. Chapters 5, 6, 7, and 8 are more technical in nature and provide summaries of monitoring results and designated use support in the Great Lakes (including connecting channels and bays), inland lakes, rivers, and wetlands, respectively. Chapter 9 addresses all water body types not supporting designated uses, including water bodies requiring the development of a TMDL [i.e., Section 303(d) listings]. Chapter 10 includes information regarding the public participation process in the development of this IR.

2010 IR Highlight

Data Management and Assessment Methodology Updates

With the biennial development of each Section 305(b) report, Section 303(d) report, or IR, Michigan continues to refine its data management and assessment methodology.

Michigan underwent extensive data management and assessment methodology changes to prepare the 2008 IR. All data (i.e., records) were transferred from the Michigan developed Water Body System to the USEPA ADB. Use of the ADB makes Michigan's IR listings compatible with the USEPA's national reporting system. During this database migration, records were georeferenced using the National Hydrography Dataset (NHD) and renamed using a 12-digit hydrologic unit code (HUC)-based naming convention. Michigan's assessment methodology underwent extensive revisions to ensure that all relevant designated uses were evaluated for all water bodies. A few changes were also made regarding data interpretation, which are explained in the 2008 IR. Implementation of data management and assessment methodology changes contained in the 2008 IR has continued in the 2010 IR and will continue over the next reporting cycle.

For the 2010 IR, Michigan changed from using the NHD 1:100,000 resolution to 1:24,000 resolution. This update resulted in an increase in the number of river miles available for assessment and the listing of various water bodies (e.g., headwater stream reaches) that were previously not included in the 2008 IR. Generally, the assessment decision for existing records was extended upstream to include the headwater stream reaches.

The data management and assessment methodology changes implemented in the 2008 and 2010 IRs advanced Michigan's mapping capabilities for Section 305(b) and Section 303(d) listings. Listing information in the form of maps became available to the public in December 2009 via the MiSWIMS 170Hwww.michigan.gov/miswims. The MiSWIMS is an interactive application that allows users to view and download surface water-related data and information collected by the MDEQ and MDNR.

Due to data management and assessment methodology changes, designated use support summary tables (e.g., Tables 5.2, 5.3, 6.2, 7.2, and 8.1) are not directly comparable to previous IRs. Similar to previous IRs, trends in designated use support are not discussed in this IR. Analysis of designated use support trends based on information presented in this and previous reports (e.g., change in number of river miles supporting designated uses) would be misleading. As assessment coverage increases and water bodies are evaluated for the first time or when more sophisticated and sensitive monitoring techniques are applied (e.g., low level PCB analysis), the proportion of supporting versus not supporting water bodies will change between reporting cycles. However, such a proportion change between reporting cycles may not constitute a real overall change in water quality.

1.2 Michigan's Waters

Michigan is blessed with a wealth of surface water resources, including Great Lakes and their connecting channels, inland lakes, rivers, and wetlands. Most of Michigan also has an abundant supply of high quality groundwater.

Table 1.1 Michigan Atlas (all values are approximations).

Topic	Number	Area	Length	Source
State population	10 million			United States Census Bureau 2008 Estimate
State surface area		96,760 mi^2		Sommers, 1977
Great Lakes, Great Lakes bays, and Lake St. Clair		42,167 mi^2 (~45% of total Great Lakes area)		USGS NHD (1:24,000 scale)
Inland lakes and reservoirs with surface area ≥ 0.1 acre	46,000	872,076 acres		USGS NHD (1:24,000 scale)
Rivers and streams (including connecting channels)			76,295 mi	USGS NHD (1:24,000 scale)
Wetlands		5,583,400 acres		USFWS National Wetland Inventory

In general, the open waters of the Great Lakes have good to excellent water quality. The inland waters of Michigan's Upper Peninsula and the northern half of the Lower Peninsula support diverse aquatic communities and are commonly found to have good to excellent water quality. Many lakes and rivers in this mostly forested area of the state support cold water fish populations. Lakes and rivers in the southern half of Michigan's Lower Peninsula generally have good water quality and support warmwater biological communities as well as some cold water fish populations. The southern portion of the state contains Michigan's major urban areas with much of the rural land in agricultural production. Recent years have witnessed rapid rates of urbanization and housing development that influence pollutant and hydrologic loadings to surface waters tributary to the Great Lakes. Many of Michigan's rivers and lakes receive direct discharge of treated effluent from municipal and industrial sources as well as runoff from urbanized areas, construction sites, and agricultural areas. Sedimentation, nutrient enrichment, and toxic pollutant loading are problems associated with runoff that can impact surface water quality. Surface water quality is generally showing improvement where programs are in place to correct problems and restore water quality.

1.2.1 Great Lakes, Bays, Connecting Channels, and Lake St. Clair

The Great Lakes contain 20% of the world's fresh surface water and are a unique natural resource. The protection of the Great Lakes is shared by the United States and Canadian federal governments; the states of Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, and New York; and the Canadian Provinces of Ontario and Quebec. Various Native American tribal organizations are also stakeholders and play a role in protecting Great Lakes water quality.

Michigan lies almost entirely within the watersheds of Lakes Superior, Michigan, Huron, and Erie (Table 1.2). The state maintains jurisdiction over approximately 45% (by surface area) of the 4 bordering Great Lakes (38,865 of a total area of 86,910 square miles). Significant Great Lakes bays include Grand Traverse Bay and Saginaw Bay. In this IR, the St. Marys, St. Clair, and Detroit Rivers (connecting channels) and Lake St. Clair are generally discussed in the Great Lakes Chapter (see Chapter 5). The term "connecting channels" used in this report is slightly different than the term "connecting waters" defined in Michigan's WQSs. In this IR, the Keweenaw waterway (i.e. the Portage Lake ship canal, Portage Lake, Portage River, etc.) is reported as river miles and inland lakes. Michigan's WQSs include the Keweenaw waterway in the "connecting waters" definition.

Table 1.2 Jurisdictional control of the four Great Lakes bordered by Michigan.

Great Lake	Canadian* (miles^2)	United States* (miles^2)	Michigan† (miles^2)	Total* (miles^2)
Superior	11,100	20,600	16,400	31,700
Michigan	---	22,300	13,250	22,300
Huron	13,900	9,100	9,100	23,000
Erie	4,930	4,980	115	9,910
Total	29,930	56,980	38,865	86,910

*Strum, 2000; †United States Census Bureau 2002 estimate

Generally, the open waters of the upper Great Lakes (Superior, Michigan, and Huron) have excellent water quality. Exceptions include a few impaired locations restricted to nearshore zones influenced by large, densely populated, and heavily industrialized areas. Great Lakes' water quality has benefited from pollutant control and remedial efforts in tributaries. These activities have reduced the discharge of conventional and toxic pollutants, including nutrients, persistent organic compounds, metals, and oils.

Aquatic Nuisance Species (ANS) continue to have dramatic indirect and direct effects on the Great Lakes (see Section 2.25.2). ANS are responsible for increases in water clarity, loss of organisms and biodiversity, disruption of food webs, and impacts on economically important fish species (International Association for Great Lakes Research, 2002). Emerging research also shows that ANS cause changes in nutrient cycling and availability and contribute to increased plant and algae growth in many nearshore areas, such as Saginaw bay and the western basin of Lake Erie.

The Great Lakes have problems with selected persistent bioaccumulative chemicals. Fish consumption advisories in the Great Lakes serve as reminders that certain pollutants, such as PCBs, chlordane, dioxins, and mercury remain elevated in the water column and fish tissue. The use of PCBs and dichlorodiphenyltrichloroethane (DDT) was banned in the 1970s and concentrations of these chemicals in Great Lakes fish have declined; however, concentrations in some species still require consumption advisories. Atmospheric deposition, tributary loadings, and the dynamic exchange and cycling between air, water, and sediment within the Great Lakes basins are the key factors influencing contaminant levels in Great Lakes fish.

1.2.2 Inland Lakes and Reservoirs

Michigan has approximately 46,000 inland lakes (including lakes, ponds, and river impoundments) with a surface area of at least one-tenth of an acre or greater. Lakes with the largest surface area include Houghton (Roscommon County), Torch (Antrim and Kalkaska Counties), Charlevoix (Charlevoix County), Burt (Cheboygan County), Mullett (Cheboygan County), Gogebic (Gogebic and Ontonagon Counties), Manistique (Luce and Mackinac Counties), Black (Cheboygan and Presque Isle Counties), Crystal (Benzie County), Portage (Houghton County), and Higgins (Crawford and Roscommon Counties).

Michigan has 730 inland lakes that are deemed "public access lakes" (Table 1.3). The list of public assess lakes includes lakes with a public boat launch and a lake surface area of at least 50 acres as well as a few recreationally important small lakes (less than 50 acres) that have public boat launches. There are 345 public access lakes located in the southern Lower Peninsula, 219 in the northern Lower Peninsula, and 166 public lakes in the Upper Peninsula. The average public access lake size is 341 acres in the southern Lower Peninsula, 1,342 acres in the northern Lower Peninsula, and 731 acres in the Upper Peninsula.

Michigan has 156 inland lakes that are deemed “cisco lakes.” The cisco (*Coregonus artedi*) is a member of a trout and salmon (Salmonidae) subfamily that usually occupies the cooler and deeper niches of high quality freshwater inland lakes and many parts of the Great Lakes. In North America, cisco can be found from Alaska to New England. Ciscos are, or were, present in at least 156 lakes in 41 Michigan counties ranging from the Indiana border to Keweenaw County in the Upper Peninsula. The cisco is currently identified as a state threatened species pursuant to the NREPA. Ciscos require relatively deep inland lakes with cool, well-oxygenated waters. During summer stratification, cisco are rarely found in waters above 20°C or at dissolved oxygen concentrations less than 3.0 parts per million. This species is very sensitive to habitat degradation and has been extirpated from lakes where these minimum thermal and dissolved oxygen conditions are not met. In 2003, the MDEQ and Michigan Department of Natural Resources (MDNR) initiated a study to assess the status of the cisco populations in Michigan. The intent of this ongoing study is to identify inland lakes in which populations are extant and increase awareness of this species so that protective best management practices (BMPs) are promoted.

Although Michigan’s inland lakes generally have good to excellent water quality, some water quality issues remain. Of the public access lakes that do not meet WQS, the primary cause is fish consumption advisories for PCBs or mercury. A statewide mercury-based fish consumption advisory applies to all of Michigan’s inland lakes, reservoirs, and impoundments. The majority of Michigan’s public access lakes have moderate or low nutrient levels; however, nutrient levels are high enough in several lakes to warrant corrective action through the development and implementation of a TMDL. Many lakes with moderate to high nutrient levels are located in the southern Lower Peninsula where large population centers and fertile soils exist. Many lakes with low nutrient levels are located in the northern Lower Peninsula and Upper Peninsula where the population density is lower, soils are less fertile, and lakes tend to be larger and deeper. Contaminated sediments are also an issue in several inland lakes, and remediation efforts are being planned or have been undertaken.

Table 1.3 Michigan's public access and cisco lakes by county. *Indicates that the lake is a public access lake and a cisco lake. †Indicates that the lake is a cisco lake only.

ALCONA	BARRY	CALHOUN	CHIPPEWA
Alcona Dam Pond	Baker	Duck	Caribou
Brownlee	Barlow†	Goguac	Carp
Cedar	Big Cedar†	Homer	Frenchmans
Crooked	Bristol	Lane	Hulbert†
Hubbard*	Carter	Lee	Monacle*
Jewell	Chief Noonday	Nottawa	Shelldrake Impoundment
North	Clear	Prairie	
Vaughn	Cloverdale	Upper Brace	CLARE
	Crooked	Wabascon	Arnold
ALGER	Deep	Warner's	Big Long
AuTrain Basin	Duncan	Winnipeg	Budd
AuTrain Lake	Fine		Cranberry
Deer†	Fish*	CASS	Crooked
Fish	Gun	Baldwin*	Five
Grand Sable	Jordan	Belas	George
Kingston	Leach	Birch*	Lily
Nawakwa	Lime†	Bunker†	Little Long
	Little Cedar†	Chain†	Mud
ALLEGAN	Long (Hope Twp)	Christiana	Perch
Allegan	Long (Johnstown Twp)*	Curtis†	Shingle
Baseline	Long (Yankee Springs Twp)	Day†	Silver
Big	Lower Crooked	Dewey	Windover
Duck	Middle	Diamond	
Eagle	Payne	Donnell*	CLINTON
Green*	Pine	Driskels	Ovid
Hutchins	Thornapple	Fish	Park
Kalamazoo		Harwood*	
Lower Scott	BENZIE	Hemlock	CRAWFORD
Miner	Ann*	Indiana†	Jones
Osterhout	Betsie	Juno/Painter	K.P.
Selkirk	Crystal*	Kirk*	Margrethe
Swan	Herendeene	Lewis†	Section One
Swan Creek Pond	Little Platte	Lime†	Shupac
	Lower Herring	Magician	
ALPENA	Pearl	Mill	DELTA
Beaver*	Platte	North Twin	Boney Falls
Fletcher Pond	Stevens	Paradise	Camp 7
	Turtle	Round†	Corner
ANTRIM	Upper Herring	Shavehead*	Dana
Bellaire*		South Twin	Pole Creek Lake
Benway	BERRIEN	Stone	Round
Birch	Paw Paw	Tharp†	Skeels
Clam			
Elk*	BRANCH	CHARLEVOIX	DICKINSON
Ellsworth	Archer*	Charlevoix*	Antoine
Intermediate*	Bartholomew†	Deer	Bass
Lake of the Woods	Cary	Hoffman	Carney
St. Clair	Coldwater*	Six Mile	Edey
Torch	Craig	Susan	Hamilton
Wilson	East Long*	Thumb	Louise†
	George	Walloon*	Mary*
BARAGA	Gilead		Norway
Beaufort	Kenyon	CHEBOYGAN	Pickeral
Big Keewaydin	Lavine	Black	Rock
King	Marble*	Burt*	Sawyer
Parent	Matteson	Douglas†	Silver
Prickett Dam	Morrison	Lancaster	Six Mile
Ruth	North	Long	
Vermilac	Oliverda	Mullett*	EATON
	Randall	Silver	Narrow
	Rose (Lake of the Woods)	Twin Central†	Saubee†
	Silver	Twin North†	
	South	Twin South †	
	Union		

Table 1.3 continued. Michigan's public access and cisco lakes by county. *Indicates that the lake is a public access lake and a cisco lake. †Indicates that the lake is a cisco lake only.

EMMET	GRAND TRAVERSE	IOSCO	JACKSON
Crooked	Arbutus	Floyd	Brown†
Larks	Bass	Foote Dam Pond	Center
Paradise	Bass	Indian	Clark
Pickeral	Boardman	Londo	Crispell
Round	Bridge†	Long	Gilletts
	Brown Bridge Pond	Loon*	Grass
GENESEE	Cedar	Loud Dam Pond	Pleasant
C.S. Mott Impoundment	Cedar Hedge*	Round	Portage
Fenton	Dubonnet	Sand	Round
Holloway Reservoir	Duck*	Tawas	South Lime
Kearsley Reservoir	Fife	VanEtten	Swain's*
Lobdell*	Green*	West Londo	Vandercook*
Ponemah	Long		Vineyard
Thread	Silver	IRON	Wampler's
	Spider	Bass	
GLADWIN		Brule	KALAMAZOO
Lake Four	HILLSDALE	Buck	Austin
Pratt	Baw Beese	Cable	Barton
Secord Impoundment	Bear*	Camp	Crooked†
Wiggins	Bird	Chicagon	Eagle
Wixom Impoundment	Carpenter†	Deer	Eagle
	Cub	Ellen	Gourdneck
GOGEBIC	Diane	Emily	Gull*
Allen	Hemlock*	Fire	Hogsett
Bass	Long (Reading Twp)*	First Fortune	Howard†
Beatons	Long (Stubin Co., IN)	Gibson	Indian*
Bobcat	Round	Golden	Long
Chaney	Sand North†	Hagerman	Morrow Pond
Cisco*	Sand Middle†	Hannah Webb	Paw Paw*
Clark*	Sand South†	Indian	Portage (Blue)
Clearwater	Wilson†	Iron	Ruppert
Crooked†		James	Sagmaw†
Dinner	HOUGHTON	Kidney	Sherman
Duck	Bob	Little Smoky	Sugarloaf
Eel	Boston	Long	West
Gogebic*	Emily	Mary	Whitford
Henry Impoundment	Otter*	Michigamme	
Lac Vieux Desert	Pike	Norway	KALKASKA
Loon†	Portage*	Ottawa	Bear
Langford	Rice	Perch	Blue (Big)*
Little Oxbow	Roland	Runkle	Big Guernsey
Lake Pomeroy	Sandy	Smoky*	Cub
Marion	Torch*	Stager	East
McDonald		Stanley	Indian
Moon	INGHAM	Sunset	Manistee
Moosehead	Lansing	Swan	North Blue†
Moraine		Tamarack	Pickeral
Noorwood†	IONIA	Tepee	Starvation
Ormes	Long	Winslow	Skegmog*
Sunday	Morrison		Twin (Big)*
Taylor*	Sessions	ISABELLA	
Thousand Island*	Woodard	Coldwater*	
		Halls	
		Littlefield*	
		Stevenson	

Table 1.3 continued. Michigan's public access and cisco lakes by county. *Indicates that the lake is a public access lake and a cisco lake. †Indicates that the lake is a cisco lake only.

KENT
- Bass
- Big Myers
- Big Pine Island
- Big Wabasis
- Camp
- Campau
- Campbell
- Lime
- Lincoln
- Murray*
- Pratt
- Reeds
- Ziegenfuss†

KEWEENAW
- Bailey
- Desor†
- Fanny Hoe*
- Gratiot
- Lac LaBelle
- Medora
- Ritchie†
- Sargent†
- Siskiwit†
- Thayer's

LAKE
- Big Bass
- Big Star
- Harper
- Idlewild
- Little Bass†
- Paradise
- Reed
- Wolf

LAPEER
- Big Fish
- Davidson
- Long
- Minnewanna
- Nepessing
- Otter

LEELANAU
- Cedar
- Davis
- Glen*
- Lime
- Little Glen
- Little Traverse*
- North Lake Leelanau*
- School
- South Lake Leelanau*

LENAWEE
- Allens
- Deep
- Devils
- Hudson
- Round
- Round
- Sand

LIVINGSTON
- Appleton*
- Baseline*
- Bass†
- Bennett†
- Bishop
- Chemung*
- Fish†
- East Crooked*
- Hiland
- Limekiln†
- Ore†
- Portage†
- Runyan†
- Sandy Bottom†
- Thompson
- West Crooked*
- Whitmore
- Woodland
- Zukey†

LUCE
- Bass
- Bodi
- Culhane
- Kaks
- Muskallonge
- North Manistique*
- Perch
- Pike
- Twin

MACKINAC
- Brevoort*
- Little Brevoort
- Manistique*
- Milakokia
- Millicoquins
- South Manistique*

MACOMB
- Stony Creek Impoundment

MANISTEE
- Arcadia
- Bear
- Canfield
- Healy
- Manistee
- Pine*
- Portage

MARQUETTE
- Anderson
- Ann†
- Arfelin
- Bass
- Bass
- Big Shag
- Dead River Storage Basin
- Engmans
- Greenwood Reservoir
- Horseshoe
- Independence*
- Ives†
- Johnson
- Little
- Little Shag
- Michigamme
- McClure Storage Reservoir
- Mountain†
- Pike
- Pine†
- Rush†
- Silver†
- Sporley*
- Squaw
- Witch
- Wolf

MASON
- Bass
- Ford
- Gun
- Hackert (Crystal)
- Hamlin
- Lincoln
- Pere Marquette
- Pliness
- Round

MECOSTA
- Bergess
- Blue
- Chippewa
- Clear
- Hillsview
- Horsehead
- Jehnsen
- Martiny
- Mecosta
- Merrill
- Pretty
- Rogers Pond
- Round
- School Section
- Townline

MENOMINEE
- Long

MIDLAND
- Sanford

MISSAUKEE
- Crooked
- Goose
- Long
- Missaukee
- Sapphire

MONTCALM
- Baldwin
- Bass
- Clifford
- Cowden
- Crystal
- Derby
- Dickerson
- Halfmoon
- Horseshoe
- Little Whitefish
- Loon
- Montcalm
- Mud
- Muskellunge
- Nevins
- Rainbow
- Rock
- Tamarack
- Townline
- Whitefish
- Winfield

MONTMORENCY
- Atlanta
- Avalon*
- Avery
- Clear
- East Twin
- Ess
- Gaylanta
- Grass
- Lake Fifteen
- Long*
- McCormick
- Muskellunge
- Rush
- Sage
- West Twin

MUSKEGON
- Bear
- Big Blue
- Duck
- East Twin
- Fox
- Half-Moon
- Mona
- Muskegon
- North
- White
- Wolf

Table 1.3 continued. Michigan's public access and cisco lakes by county. *Indicates that the lake is a public access lake and a cisco lake. †Indicates that the lake is a cisco lake only.

NEWAYGO
- Baptist
- Benton
- Bills
- Blanch
- Brooks
- Croton Dam Pond
- Crystal
- Diamond
- Englewright
- Fremont
- Hardy
- Hess
- Kimball*
- Nichols*
- Pettibone
- Pickerel*
- Robinson
- Sand
- Woodland

OAKLAND
- Angelus†
- Big
- Cass*
- Cedar Island*
- Crescent
- Deer*
- Dickinson
- Dunham†
- Green†
- Hammond†
- Heron
- Kent
- Lakeville
- Long
- Loon*
- Lotus*
- Lower Pettibone
- Maceday*
- Middle Straits
- Oakland
- Orchard*
- Orion
- Oxbow†
- Pontiac
- Seven
- Silver†
- Squaw/Clear
- Tipsico
- Townsend†
- Union*
- Upper Proud
- Upper Pettibone†
- Valley
- White
- Wildwood
- Wolverine

OCEANA
- Crystal
- McLaren
- Pentwater
- Schoolsection
- Silver
- Stony

OGEMAW
- Au Sable
- Bush
- Clear
- DeVoe*
- George
- Grousehaven*
- Hardwood
- Horseshoe
- Lake George
- Peach
- Rifle
- Sage
- Tee

ONTONAGON
- Bond Falls
- County Line

OSCEOLA
- Big
- Diamond
- Hicks
- Rose
- Sunrise
- Todd
- Wells

OSCODA
- McCollum
- Mio Dam
- Pond
- Tea

OTSEGO
- Big
- Big Bass
- Big Bear
- Bradford
- Dixon
- Emerald
- Heart
- Manuka
- Opal
- Otsego
- Pickerel
- Twenty Seven

OTTAWA
- Crockery
- Macatawa
- Pigeon
- Spring

PRESQUE ISLE
- Big Tomahawk
- Emma
- Essau
- Grand
- Long
- Lost
- May
- Nettie
- Shoepac
- Sunken

ROSCOMMON
- Higgins*
- Houghton
- St. Helen

SCHOOLCRAFT
- Boot
- Colwell
- Dodge
- Gemini
- Gulliver*
- Indian*
- Island
- Kennedy
- McDonald
- Petes
- Ross
- Snyder

ST JOSEPH
- Big Fish
- Clear
- Corey*
- Crotch
- Fisher's
- Klinger*
- Long
- Long
- Palmer
- Pleasant*
- Portage
- Prairie River*
- Sand
- Sturgeon
- Tamarack†
- Thompson*
- Three Rivers Impoundment

TUSCOLA
- Caro Reservoir
- Murphy
- North

VAN BUREN
- Ackley
- Banksons
- Brandywine
- Cedar
- Clear
- Cora
- Eagle
- Eleven
- Fish
- Fourteen
- Gravel
- Halls
- Huzzy's
- Lake of the Woods
- Maple
- North Scott
- Round
- Rush
- Saddle
- School
- Section
- Shafer
- South Scott
- Three Legged
- Three Mile
- Upper Jeptha
- Upper Reynolds
- VanAuken
- Wolf†

WASHTENAW
- Big Portage
- Blind†
- Bruin*
- Cedar
- Crooked
- Ford
- Four Mile
- Green
- Half Moon*
- Joslin
- Mill
- Mud
- North
- Pickerel†
- South*
- Sugar Loaf
- Winnewanna

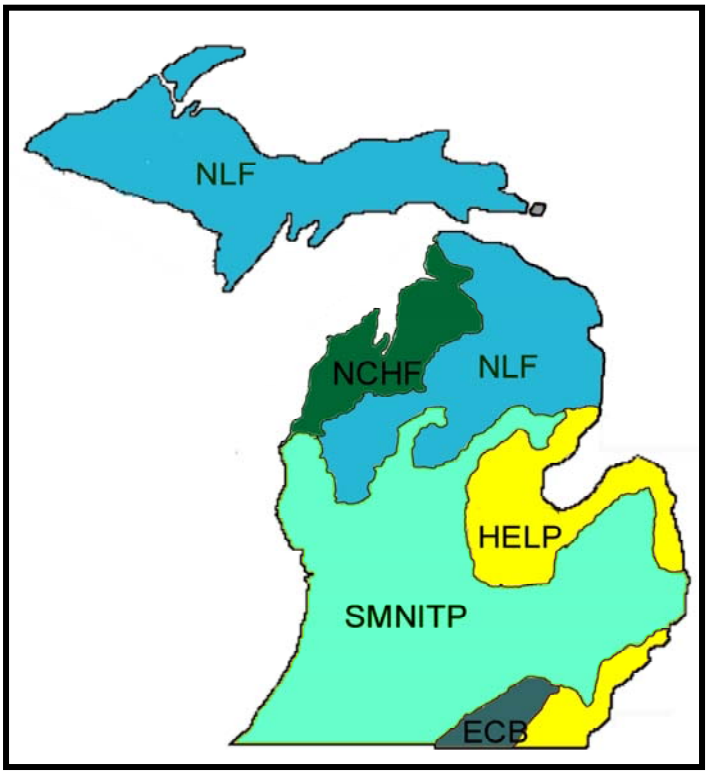
WAYNE
- Belleville
- Newburgh

WEXFORD
- Berry
- Cadillac
- Hodenpyl Dam Pond
- Long
- Mitchell

1.2.3 Rivers

Michigan's rivers can be grouped by the distinct ecoregions through which they flow. Each of the five ecoregions in Michigan consists of areas that exhibit relatively similar geological landform characteristics (Omernik and Gallant, 1988). Factors used to delineate ecoregions include climate, soils, vegetation, land slope, and land use. This framework provides information on the environmental characteristics that tend to occur within each ecoregion. In order by size (largest to smallest area), the five ecoregions in Michigan are Southern Michigan/Northern Indiana Till Plains, Northern Lakes and Forests, North Central Hardwood Forests, Huron-Erie Lake Plains, and Eastern Corn Belt Plains (Figure 1.1).

Rivers in the Northern Lakes and Forests and North Central Hardwood Forests ecoregions tend to support cold water fish within at least a portion of their systems. These rivers commonly have relatively small watersheds, high relief topography, substantial groundwater inputs, and are naturally low in productivity. Most rivers in the Northern Lakes and Forests ecoregion are perennial, often originating from lakes or wetlands. Although relatively free of sediment, surface waters in this ecoregion often have a characteristic brownish color because of elevated concentrations of dissolved organic material, including tannins and lignins. In the North Central Hardwood Forests ecoregion, river flow is highly variable. Flow is entirely intermittent in some portions of the ecoregion and entirely perennial in other areas. These rivers typically drain soils with much poorer nutrient content than in bordering ecoregions to the south.



SMNITP - Southern Michigan/Northern Indiana Till Plains
NCHF - North Central Hardwood Forests
NLF - Northern Lakes and Forests
HELP - Huron-Erie Lake Plains
ECB - Eastern Corn Belt Plains

Figure 1.1 Ecoregions of Michigan (Level III) (adapted from Omernik and Gallant, 1988).

Rivers in the Southern Michigan/Northern Indiana Till Plains ecoregion are generally of good water quality in the headwaters. This ecoregion is drained predominantly by perennial rivers. Such rivers are typically sluggish and are bordered, often extensively, by wetland tracts. Drainage ditches and channelized rivers have been a common solution to assist drainage of areas that are too wet for settlement and agricultural needs.

Upland features related to poor soil drainage heavily influence the rivers in the Huron-Erie Lake Plains and Eastern Corn Belt Plains ecoregions. Broad and nearly level lake plain is crossed by beach ridges and low moraines, which has resulted in the formation of poorly drained soils. More than half of the rivers in the Huron-Erie Lake Plains ecoregion are intermittent, and river flows are commonly runoff-dependent. In addition to the construction of numerous drainage ditches, the headwaters of many rivers are extensively channelized for quicker drainage and to improve upland field conditions. About half of the rivers in the Eastern Corn Belt Plains ecoregion are perennial and many have been channelized to assist soil drainage. This ecoregion is almost entirely farmland, and river quality is influenced by increased soil and water runoff from agricultural land uses.

1.2.4 Wetlands

Michigan's aquatic resources include approximately 5,583,400 acres of wetlands, some of exceptional quality and rarity. About 15% of Michigan's land area is wetland. Several inventories of wetlands in Michigan have been undertaken by different agencies. At this time, however, no practical method has been developed to accurately track all wetlands gains and losses on a statewide basis. Sources of wetland loss include permitted activities; unpermitted activities (i.e., violations of Section 404 of the CWA and state law); agricultural and silvicultural practices, which are exempt under state and federal law; the loss of small, isolated wetlands that are not under state or federal jurisdiction; natural processes (e.g., beaver activity); and indirect effects (e.g., alteration of drainage networks due to urbanization). Wetland acreage may increase for some of the same reasons (e.g., changes in drainage pathways). However, most wetland gains are attributed to voluntary wetland restoration projects, pond construction, and mitigation for permitted impacts.

Estimates of wetland losses since European settlement range from 35%, based on the Michigan Natural Features Inventory presettlement inventory to 50% based on the United States Fish and Wildlife Service (USFWS) Status and Trends reporting. During 2006, the MDEQ, Wetlands Unit, housed in the Land and Water Management Division (LWMD), contracted with Ducks Unlimited Great Lakes/Atlantic Regional Office to perform an update to the original National Wetland Inventory dataset that was completed in the late 1970s and early 1980s. The contract specifies updating the National Wetland Inventory dataset to the two most recent, statewide, aerial photography flights conducted in the state, that being the 1998 United States Geological Survey (USGS) Digital Ortho Quarter Quads data and the 2005 National Agriculture Imagery Program data. At the conclusion of this effort, the MDEQ will be able to readily quantify wetland gains/losses in the state over the last 30 years, which happens to be the same time period wetland regulations have been in effect. Completion of this project is expected in the fall/winter of 2008.

The Michigan Natural Features Inventory published a preliminary assessment entitled, "Wetland Trends in Michigan Since 1800" (Comer, 1996), based on a comparison of original land surveys conducted by the General Land Office from 1816 to 1856 and Michigan Resource Information System land use/land cover maps. This publication includes a county-by-county estimate of historical wetland types and losses since pre-European settlement. In addition, the pre-European settlement maps have been digitized and are available for review in a Geographic Information System (GIS).

The Great Lakes Coastal Wetlands Consortium has recently completed a GIS-based inventory of Great Lakes coastal wetlands in cooperation with the Great Lakes state and provinces. This inventory will be available through the Consortium's Web site at http://www.glc.org/wetlands.

Part 303, Wetlands Protection, of the NREPA requires the MDEQ to make a preliminary inventory of all wetlands in the state on a county-by-county basis. County wetland inventories are now completed for all 83 counties in the state, and have been made available to the public on the Internet at http://www.michigan.gov/deqwater under Wetlands Protection, Wetland Inventory Maps or by submitting a request for a large-format print to the MDEQ, LWMD. The county wetland inventories were produced by overlaying data from the following sources: the USFWS National Wetland Inventory maps, Natural Resources Conservation Service soil survey maps, and Michigan Resource Information System land use/land cover maps. County wetland inventories are intended to be used as planning tools that provide potential and approximate locations of wetlands and some information regarding wetland condition, but are not intended to be used to determine the jurisdictional boundaries of wetland areas subject to regulation.

CHAPTER 2
WATER PROTECTION PROGRAMS

The MDEQ has a number of programs designed to protect and restore water quality. These programs establish WQS, provide regulatory oversight for public water supplies, issue permits to regulate the discharge of industrial and municipal wastewaters, provide technical and financial assistance to reduce pollutant runoff, ensure compliance with state laws, and educate the public about water quality issues. This chapter provides descriptions of Michigan's water quality protection programs and highlights several special initiatives and costs/benefits.

2.1 Abandoned Well Management

Unplugged abandoned wells threaten the quality of drinking water obtained from privately owned and publicly owned drinking water supply wells. The Water Bureau (WB) has implemented a comprehensive Abandoned Well Management Program to coordinate statewide abandoned well location and plugging activities. Plugging abandoned wells protects the groundwater source aquifers that are used by nearly one-half of Michigan's citizens for drinking water. The goal of the Abandoned Well Management Program is to identify and properly plug as many abandoned wells as possible.

The WB also administers an Abandoned Well Management Grants Program that is funded by the Clean Michigan Initiative (CMI). Abandoned well management grants target and fund the location and plugging of abandoned wells in community public water supply wellhead protection areas.

The MDEQ conducts training and public education/outreach activities to raise the level of public awareness concerning the environmental and public health threats associated with unplugged abandoned wells. Groundwater protection seminars that include abandoned well-related topics are sponsored for general audiences. Technical training programs covering abandoned well plugging techniques and requirements are conducted for registered water well drilling contractors, local health department (LHD) staff members, environmental consultants, and other state of Michigan departments.

The Michigan Department of Agriculture (MDA) administers a cost share grants program, the "Farm*A*Syst" Program that can pay up to 90% of the cost for plugging abandoned wells on agricultural lands.

LHDs enforce abandoned well plugging requirements through field inspections and review of abandoned well plugging records that are submitted by registered well drilling contractors and property owners. The WB conducts compliance and enforcement actions in cooperation with the Office of Criminal Investigations, the Michigan Department of Attorney General, and LHDs. Many successful enforcement actions have been taken in recent years.

2.2 Aquatic Nuisance Control

The MDEQ has the authority, under Part 33, Aquatic Nuisance Control, of the NREPA, to regulate the chemical control of nuisance aquatic plants, algae, and swimmer's itch. Each application for a permit must undergo a thorough review to assess the environmental impact to the water body and any human health and safety issues. A large majority of these treatments are carried out by commercial pesticide applicators licensed by the MDA. The MDEQ works with the MDA to assure those treatments and the applicators comply with the requirements of the permits and the pertinent laws. Program staff also review new chemical products proposed for use in Michigan waters, survey Michigan lakes to determine the composition of the native plant community and presence of exotic plant species, and seek to educate riparian property owners about the management of aquatic plants and a variety of related lake management issues.

2.3 Beach Protection

In Michigan, LHDs have jurisdiction to test and otherwise evaluate water quality at bathing beaches to determine whether the water is safe for bathing purposes. The LHDs advise beach owners when beaches should be closed and the local health officer may petition the county circuit court to close a beach if needed. Beach monitoring results collected by the LHDs and swimming advisories are readily made available to the public by the LHDs via the MDEQ's statewide beach monitoring Web site (http://www.deq.state.mi.us/beach). Signs are posted at bathing beaches stating whether or not the beach has been tested for *E. coli*. Since 2000, the MDEQ has provided grants to LHDs to support and augment beach monitoring throughout Michigan. These grants are funded by a combination of state CMI bond money and federal Beaches Environmental Assessment and Coastal Health Act (BEACH Act) funds. The BEACH Act authorizes the USEPA to award program development and implementation grants to eligible states, territories, tribes, and local governments. These annual grants support microbiological monitoring of coastal recreation waters, including the Great Lakes, which are adjacent to beaches or similar points of access used by the public. BEACH Act grants also support development and implementation of programs to notify the public of the potential exposure to disease-causing microorganisms in coastal recreation waters.

2.4 Biosolids

The treatment of municipal wastewater generates a residue called biosolids. Biosolids may be disposed of through incineration or landfilling, or they may be recycled. Because biosolids contain nutrients and can therefore have a beneficial use as fertilizer or soil conditioner, recycling is an effective alternative to incineration or landfilling. The MDEQ encourages the use of biosolids to enhance agricultural and silvicultural production in Michigan. However, if biosolids are not properly handled and enter surface water or groundwater, their associated chemical character could severely degrade water quality. To prevent such problems, the land application of biosolids is a regulated activity.

Under federal regulations, criteria for biosolids management have been established. National Pollutant Discharge Elimination System (NPDES) and state groundwater discharge permits require management of biosolids and other residuals from wastewater treatment facilities. Permittees are required to develop and obtain MDEQ approval of a Residuals Management Program. The MDEQ district staff members also inspect the facilities generating the biosolids and the land application sites.

2.5 Coastal Management

The Coastal Zone Management Act, originally passed in 1972, enables coastal states, including Great Lakes states, to develop a Coastal Management Program to improve protection of sensitive shoreline resources, to identify coastal areas appropriate for development, to designate areas hazardous to development, and to improve public access to the coastline. Michigan was one of the first states to have its Coastal Management Program approved in 1978. Through Michigan's Coastal Management Program, the MDEQ, Environmental Science and Services Division, provides financial and technical assistance to local units of government to address shoreline issues and improve their coastal resources.

2.6 Community Water Supply

The MDEQ oversees approximately 1,470 community water systems that furnish drinking water year-round to residential populations of 25 or more, to ensure that the USEPA's minimum standards for safe drinking water and Michigan Safe Drinking Water Act, 1976 PA 399, as amended (Act 399), requirements are met. Over the last decade, 99% or more of the population have been served by community water supplies meeting all health standards. Since 1998, the Drinking Water Revolving Loan Fund has provided low interest loans for projects designed to protect community water supply systems.

2.7 Compliance and Enforcement

The MDEQ, WB, Enforcement Unit and Field Operations Division staff are responsible for conducting compliance and enforcement actions taken by the WB. Field Operations Division staff conduct compliance inspections to ensure they are following the requirements of state water pollution control statutes and rules, surface and groundwater discharge permits, and violations of administrative or judicial orders. Other compliance and enforcement activities include response and investigation of complaints and the follow-up of corrective actions.

Enforcement action may be used to bring the entity into compliance as quickly as possible, restore any natural resource damages caused by the violation, assess appropriate penalties, eliminate financial gain that may have been realized as a result of noncompliance, and drive improvements in water quality. Enforcement actions are generally progressive in nature. They include any number of possible actions, including issuance of notices of violation, preparation of final orders of abatement, settlement via administrative consent orders, or referrals to the Michigan Department of Attorney General for civil or criminal litigation. The Enforcement Unit serves as the WB's liaison with the Michigan Department of Attorney General and also works with the USEPA and the United States Department of Justice on joint state/federal enforcement cases.

MDEQ staff collect effluent samples from NPDES facilities to evaluate compliance with permit limits. Additionally, the MDEQ conducts special studies to support water quality enforcement actions. These studies may include water, sediment, biological, and/or toxicity sampling, depending on the specific issue. Water quality monitoring in response to spills is also conducted. Monitoring activities to support enforcement actions are implemented as needed, and are always developed with input from Enforcement Unit and Field Operations Division staff.

2.8 Conservation Reserve Enhancement

The MDEQ works closely with the MDA to implement the Conservation Reserve Enhancement Program, a federal-state-local conservation partnership designed to reduce significant environmental effects related to agriculture. The Conservation Reserve Enhancement Program is being implemented in four critical watersheds (Saginaw Bay, Macatawa River, River Raisin,

and western Lake Erie basin) that have intense agricultural land use. The objectives of the program are to improve and protect water quality and to promote and enhance wildlife habitat by providing incentives to Michigan citizens for implementing conservation practices for a period of 15 years. Eligible conservation practices include grass plantings, filter strips, riparian buffer strips, field windbreaks, and wetland restoration. The MDEQ also supplies Section 319 and CMI funds for livestock exclusion, implementation of Natural Resources Conservation Service approved conservation practices, Conservation Reserve Enhancement Program technical assistance, and permanent conservation easements.

2.9 Contaminated Sediment

The Contaminated Sediment Program consists of activities to coordinate and implement remediation at sites of environmental contamination that impact water quality. Sites range from current incidents of spills or losses of pollutants due to accidents or poor facility operations, to historic incidents where pollutants have been in the environment for many years. Some of these sites impact surface waters directly. Others may impact surface waters by the movement of contaminated groundwater, through treatment and permitted discharge of contaminated groundwater, or through discharges of contaminated groundwater to treatment facilities. The MDEQ staff members investigate sites of environmental contamination, make recommendations regarding proposed site remediation and treatment, evaluate treatment proposals and pollutant discharges from remediation systems, and provide other technical and project management support as necessary. As part of the CMI, $25 million was set aside for the investigation and remediation of contaminated sediments in Michigan lakes, rivers, and streams. Summaries of these projects are contained in the MDEQ's Consolidated Report (MDEQ, 2009).

2.10 Drinking Water Contamination Investigation

The MDEQ assists LHDs in conducting drinking water quality investigations in areas of known or suspected environmental contamination. Such technical assistance may involve monitoring design, analytical support, toxicological assessment, and/or health advisory notice development.

The MDEQ is also responsible for administering drinking water replacement activities. Administration is primarily accomplished through contracts awarded to local units of government and/or private well drillers to extend community water lines and to replace contaminated water wells. Provision of bottled water, installation of treatment devices, and well abandonment is also addressed through this program.

The MDEQ also administers a statewide contract to monitor drinking water quality in wells adjacent to sites of environmental contamination and to replace contaminated water wells. Contaminated wells are replaced with water wells drilled to a deeper, protected aquifer, or the homes are connected to community water that is extended into the area.

2.11 Environmental Health

Working closely with LHDs, the MDEQ protects public health and the environment through administration of regulatory programs dealing with manufactured housing communities, campgrounds, and public swimming pools. The MDEQ also assures that suitable site conditions are present for proposed residential or commercial developments dependent on individual on-site sewage systems and wells, and regulates the proper collection and disposal of wastes by septic tank pump and haul operators.

2.12 Drinking Water and Wastewater Infrastructure Financial Assistance

The WB, in conjunction with the Michigan Municipal Bond Authority, operates three revolving fund loan programs that can provide financial assistance to local units of government and public water suppliers for the construction of needed wastewater and drinking water infrastructure. These programs provide loan assistance at interest rates well below open market, with the intention of supporting the department's compliance programs and reducing the costs to be passed on to the users of water and wastewater systems. Debt service payments are returned to the funds and hence "revolved" as they are lent out again. The three programs are:

- Clean Water State Revolving Fund (CWSRF): The CWSRF has been in operation in Michigan since 1989 and to date has tendered 372 loans totaling over $3.4 billion. The CWSRF has played a critical role in the state's Combined Sewer Overflow (CSO) and Sanitary Sewer Overflow Control Programs, and will operate in perpetuity to provide assistance to wastewater system owners for ongoing capital improvement needs. In addition to financing Section 212 projects (Publicly Owned Treatment Works) the CWSRF can also fund Section 319 projects (nonpoint source [NPS] pollution control projects). The fund is capitalized by an annual federal grant and a required state match, with potential access to proceeds from the sale of Great Lakes Water Quality Bonds.

- Drinking Water Revolving Fund: The Drinking Water Revolving Fund has been in operation in Michigan since 1998 and to date has tendered 202 loans totaling over $570 million. Patterned after the CWSRF, the Drinking Water Revolving Fund continues to play a critical roll in furthering the MDEQ's public water system program and ensuring the protection of the health of Michigan citizens who are served by public water supplies.

- Strategic Water Quality Initiatives Fund (SWQIF): The SWQIF program was created in 2002 and is capitalized solely by proceeds from the sale of Great Lakes Water Quality Bonds. The SWQIF can fund two specific kinds of projects that are not eligible under the CWSRF because the facilities constructed would not be in public ownership: (1) The on-site upgrade or replacement of failing septic tanks/tile fields; and (2) The removal of storm water or groundwater from sanitary or combined sewer leads. Through Fiscal Year 2009 the SWQIF has tendered 9 loans totaling over $10 million.

2.13 Great Lakes

The Great Lakes form a portion of the international boundary between the United States and Canada, and both countries have jurisdiction over their use. The first Great Lakes Water Quality Agreement between the two federal governments was developed in 1972 and established objectives and criteria for the restoration and enhancement of water quality in the Great Lakes system. A revised Great Lakes Water Quality Agreement was signed in 1978 recognizing the need to understand and effectively reduce toxic substance loads to the Great Lakes. The 1978 Great Lakes Water Quality Agreement adopted general and specific objectives and outlined programs and practices necessary to reduce pollutant discharges to the Great Lakes system. Under the 1987 Protocol that amended the 1978 Great Lakes Water Quality Agreement, the United States and Canadian governments identified 43 of the most polluted areas in the Great Lakes basin that had serious water quality problems known to cause Beneficial Use Impairments of the shared aquatic resources. These areas have been formally designated by the two governments as Areas of Concern (AOCs). Three AOCs were subsequently restored and delisted.

Ten AOCs are exclusively under Michigan jurisdiction: Clinton River, Deer Lake, Kalamazoo River, Manistique River, Muskegon Lake, River Raisin, River Rouge, Saginaw River/Bay, Torch Lake, and White Lake (Figure 2.1). The Menominee River AOC is shared with Wisconsin, and

the Detroit River, St. Clair River, and St. Marys River are binational AOCs. The latter AOCs are managed jointly by a binational governance structure created under the Four Agency Letter of Commitment (also called the Four Agency Agreement) that was signed on April 17, 1998, by the Environment Canada, USEPA, MDEQ, and Ontario Ministry of the Environment.

Figure 2.1. Great Lakes AOC (Environment Canada, 2009).

The 1987 Protocol called for cleanup of the AOCs through the development of Remedial Action Plans. Each Remedial Action Plan is required to identify problems that have led to Beneficial Use Impairments, identify actions needed to restore the beneficial uses, and provide documentation when beneficial uses are restored. Both federal governments play an active role in the implementation of the Remedial Action Plans. All of Michigan's 14 AOCs have completed Remedial Action Plans that are currently at various stages of implementation. Information regarding Michigan's AOCs and Remedial Action Plans is available at http://www.michigan.gov/deqwater in the AOC section under the Great Lakes, or from the Michigan Statewide Public Advisory Council at http://www.glc.org/spac/. A copy of the state's Guidance for Delisting Michigan's Great Lakes AOCs can be found at http://www.michigan.gov/deqwater in the AOC section under Great Lakes.

The 1987 Protocol required the development and implementation of Lakewide Management Plans (LaMPs) for each of the Great Lakes. The purpose of the LaMPs is to address critical pollutants and provide a strategy to protect and restore beneficial uses impacted in the open waters of each Great Lake. The USEPA, in cooperation with other government and nongovernment agencies, has developed LaMPs for Lakes Erie, Michigan, and Superior. Each LaMP includes an assessment of Beneficial Use Impairments, causes of the impairment, and recommendations on actions necessary to restore the beneficial uses. In undertaking the development of the LaMPs, the stakeholders recognized the need to address other water quality

issues unique to each Great Lakes basin. The LaMPs have been updated biennially, with the most recent updates completed in 2008.

A LaMP has not yet been developed for Lake Huron. Instead, the MDEQ, USEPA, Environment Canada, Ontario Ministry of the Environment, and Ontario Ministry of Natural Resources have formed the core of a Lake Huron Binational Partnership to coordinate environmental activities in the Lake Huron basin. A flexible membership is being promoted that is inclusive of other agencies and levels of government, tribes, nongovernment organizations, and the public on an issue-by-issue basis. The group developed a Lake Huron Binational Partnership Action Plan and has updated it biennially on the same schedule as the LaMPs.

2.14 Groundwater Discharge

The MDEQ's Groundwater Discharge Program regulates discharges to the ground through the development and issuance of permits and self-certifications. A "program review team" was established to develop and implement recommendations as needed for the Groundwater Discharge Program. Some specific program accomplishments include the conversion of the groundwater permit database into the NPDES Management System to increase permitting effectiveness, section procedure updates to consolidate and streamline groundwater permitting procedures, development and implementation of the Groundwater Expired Permit Initiative to address permits that expired prior to March 1, 2005, and review of the groundwater permit application to improve permit applications and decrease processing time.

2.15 Industrial Pretreatment

The MDEQ implements federal and state rules designed to limit pollution from industrial discharges to municipal wastewater treatment facilities. In 1983, the USEPA approved Michigan's pretreatment program and formally authorized the state of Michigan to oversee the program. To assure that pollutant discharges are controlled, many municipalities have been required to develop and implement local industrial pretreatment programs as a condition of their NPDES permit. Michigan operates under a two-tiered system: municipalities subject to industrial pretreatment program regulation with design flows greater than five million gallons per day must develop a federal local industrial pretreatment program, while municipalities subject to industrial pretreatment program regulation with design flows less than or equal to five million gallons per day must develop a Michigan local industrial pretreatment program.

Municipalities developing industrial pretreatment programs are required to submit them to the MDEQ, WB, for review and approval. Subsequent changes to an approved local industrial pretreatment program, as well as periodic reports of local program operations, must also be submitted for review. MDEQ field staff conduct periodic inspections of local industrial pretreatment programs to identify deficiencies and initiate actions necessary to assure effective operation. Information derived from inspections and reports submitted by the municipalities are entered into the NPDES Management System database.

2.16 Infrastructure Security

Due to terrorist attacks on September 11, 2001, and recent federal legislation and state authorizations, the MDEQ actively participates in numerous Infrastructure Security Program activities. The federal Public Health Security and Bioterrorism Preparedness and Response Act of 2002 requires drinking water systems to comply with requirements by certain dates as a part of the nation's homeland security efforts. The MDEQ plays a critical role in training and assisting the drinking water and wastewater system personnel to comply with the federal Infrastructure Security Program. The MDEQ helps to protect supply systems from malevolent acts by providing training to complete vulnerability assessments and emergency response

plans, participating in water security tabletop exercises, and helping local units of governments to receive the Threat Advisory Notification System.

2.17 Inland Lakes and Streams

The Inland Lakes and Streams Program is responsible for the protection of the natural resources and the public trust waters of the inland lakes and streams of the state. The program oversees and regulates activities including dredging, filling, constructing or placement of a structure on bottomlands, constructing or operating a marina, interfering with natural flow of water, or connecting a ditch or canal to an inland lake or stream.

The most common projects associated with inland lakes and streams regulated under Part 301, Inland Lakes and Streams, of the NREPA include shore protection, permanent docks or boat hoists, beach sanding, and dredging or excavation. Other types of activities may also require permits.

2.18 National Pollutant Discharge Elimination System

Discharges to state surface waters from municipal, industrial, and commercial facilities must be authorized by permit under the NPDES Program. All Concentrated Animal Feeding Operations (CAFOs) in Michigan are also required to obtain an NPDES permit, except for those CAFOs that are granted a "No Potential to Discharge" determination by the MDEQ. The purpose of an NPDES permit is to control the discharge of pollutants into surface waters of the state to protect the environment. The USEPA delegated the program to Michigan, and the MDEQ has responsibility for processing NPDES permits. The maximum term for an NPDES permit is five years, after which they must be reissued.

The MDEQ reissues NPDES permits according to the five-year rotating watershed cycle, two years after the monitoring year (Figure 3.1). Under this approach, all of the permits in each individual watershed expire and are reissued in the same year. This approach allows the MDEQ to consider cumulative impacts of all dischargers on water quality in the watershed. Discharges to lakes, streams, and wetlands must not cause a violation of Michigan WQS. As part of the permit issuance process, limits are developed for pollutants to avoid a violation of WQS and ensure compliance with the treatment technology regulations of the CWA. Draft permits are prepared containing pollutant limits and any appropriate special conditions. The draft permits are placed on public notice, allowing the opportunity for public comment.

The MDEQ was instrumental in amending the NREPA in 2004 to establish NPDES permit fees to assist in funding the NPDES Program.

Permits for regulated storm water discharges are also processed and issued by the MDEQ under the NPDES program. The Storm Water Program is also funded by fees collected from the dischargers. Under Phase I of the Storm Water Program, individual NPDES permits were issued to owners or operators of municipal separate storm sewer systems (MS4) serving a population of 100,000 or greater. In 2003, the MDEQ promulgated rules to obtain the legal authority to implement Phase II requirements. As a result, owners or operators of MS4s serving populations less than 100,000 within urbanized areas were required to apply for NPDES permits by March 2003. Phase II permittees include cities, villages, townships, county road commissions, and county drain commissions, among others. A jurisdictional-based general permit, as well as the watershed-based general storm water permit, is used to provide permit coverage.

Michigan uses a general permit for industrial storm water discharges. The general permit requires the permittee to have a certified storm water operator and prepare and implement a

Storm Water Pollution Prevention Plan. The applicability of this permit includes storm water discharges associated with industrial activity as defined in the federal regulations, and from special use areas (state- or federally-mandated secondary containment structures, areas designated on Michigan's List of Sites of Environmental Contamination pursuant to Part 201, Environmental Remediation, of the NREPA, and other activities subject to federal storm water regulation where storm water monitoring is necessary on a case-by-case basis). Monitoring is required only from the special use areas. Industrial storm water general permits and Certificates of Coverage are reissued on a watershed-basis with approximately one-fifth of the five-year permits reissued each year.

The MDEQ has continued implementation of the state's CSO Control Program, which has resulted in annual reductions of the volume of untreated combined sewage discharged to the surface waters of the state. Through implementation of the CSO Control Program, numerous CSO discharges are being eliminated at various locations around the state, while at other locations, treatment and disinfection of combined sewage discharges that comply with WQS and protect public health are being provided on an increasing basis.

2.19 NPS Control

The NPS Program assists local units of government, nonprofit entities, and other state, federal, and local partners to reduce NPS pollution statewide. The basis for the program is watershed management; the MDEQ provides assistance and funding to develop watershed management plans (WMPs) and to implement NPS control activities in these plans. The NPS Program consists of five parts:

- Technical assistance to help organizations develop and implement WMPs, including BMP selection, land use planning activities, and engineering review of site plans.
- Information and education, including activities/tools created by the MDEQ and grantees, to educate people about NPS of pollution.
- Grants to implement BMPs, land use planning tools, and information/education activities.
- Compliance and enforcement, including response and investigation of complaints, follow-up requiring corrective actions, and occasionally participating in escalated enforcement actions.
- Monitoring and field investigations to identify NPS problems and evaluate the effectiveness of corrective or preventive actions.

The NPS Program has provided a considerable amount of technical and financial assistance to implement BMPs. As of October 2009, these efforts have resulted in over 74,100 acres of conservation tillage practices in watersheds around the state and installation of over 983,200 linear feet of filter strips through grants and partnerships with the Michigan Agriculture Environmental Assurance Program. Additional BMPs include the stabilization of a total of 220,129 linear feet of eroding stream banks, acquisition of 11,685 acres of permanent conservation easements, treatment of over 3,100 acres of critical areas highly susceptible to erosion, and installation of over 89 miles of fence for animal exclusions. Through support to the Conservation Reserve Enhancement Program, over 34,000 acres of filter strips have been installed and 17,000 acres of wetlands have been restored.

As of October 2009, the MDEQ has awarded over 500 grants for the implementation of NPS pollution control projects. The program has seen dramatic reductions in pollutant loadings into Michigan surface waters. BMPs will reduce sediment loads by over 720,000 tons per year, based on all years' previous BMP implementations, through the NPS Program, and through partnership with the Michigan Agriculture Environmental Assurance Program. Large reductions in nutrient (phosphorus and nitrogen) loads are also occurring.

More than 130 WMPs have been developed at the local level utilizing MDEQ grants. WMPs serve as guides for communities to protect and improve water quality. A list of MDEQ-approved WMPs that meet CMI and/or Section 319 criteria for implementation is available at http://www.michigan.gov/deqnps.

Water quality data are often used to evaluate the effectiveness of BMPs. The specific information required depends upon the problem being addressed, but data may consist of biological, chemical, or physical parameters. The MDEQ's NPS Environmental Monitoring Strategy (NPS Strategy) explains in detail how monitoring is used to support NPS efforts (MDEQ, 2005a). Specifically, it describes how the MDEQ's NPS monitoring priorities are set, how monitoring is used to track improvements in water quality following implementation of NPS controls, and how the monitoring results are communicated and used in program decisions. The NPS Strategy divides NPS monitoring into four broad categories, including statewide trend monitoring, problem identification monitoring, TMDL development and effectiveness monitoring, and NPS control effectiveness monitoring.

The NPS Program staff have identified a number of priority watersheds in which to focus pollution control activities to achieve the restoration and protection goals identified in the NPS Program Plan. The use of the words "threat" or "threatened" in this section does not imply that the water body is expected to not support one or more designated uses by the next reporting cycle; rather, the use of these words is consistent with USEPA guidelines contained in the *Federal Register* Vol. 68, No. 205, October 23, 2003, Nonpoint Source Program and Grants Guidelines for States and Territories Section III.B.3. The following is a brief summary of the attributes and NPS threats in watersheds that will be a focus for restoration and protection activities:

Lake Superior Basin

- **Huron River**

  The Huron River watershed is a relatively pristine, unimpounded watershed with a high quality cold water biological community. There is a very large, diverse, and active group of stakeholders who have been working together for over a year locating resources to protect and restore the watershed. The watershed contains large parcels of corporately owned land that will soon become parceled and sold; therefore, the watershed may be subjected to land use changes including private development.

- **Menominee River**

  The Menominee River watershed has a wide variety of issues that are not yet wholly covered under a WMP. There are many active and interested stakeholders who have been discussing potential studies and projects and funding opportunities. This watershed is experiencing municipal development in many areas, which increases the need for education about urban storm water runoff. The Menominee River also flows through many agricultural areas. Some areas of the watershed have mercury and PCB issues, while others require protection of pristine trout habitat. A WMP would include both protective and restorative initiatives.

Lake Michigan Basin

- **Bear River (Little Traverse Bay)**

  The Bear River is the major tributary to Little Traverse Bay, a high quality oligotrophic embayment of Lake Michigan. This high-gradient river is impacted by urban storm water

runoff as it flows through the steep topography of the city of Petoskey. The river's elevation drop in the last mile is the greatest in Michigan's Lower Peninsula. Sedimentation from stream bank erosion and road crossings are problems in the upstream reaches. The cold water fishery has been impacted by hydrological changes from development and dams. A "Healing the Bear" initiative is sponsored by area organizations and has been successful at implementing several restoration and protection projects. Environmental issues in the Bear River are addressed through actions identified in the Little Traverse Bay WMP, which has been approved under both the state CMI and federal CWA Section 319 programs.

- **Lake Charlevoix**

  Lake Charlevoix is a high quality oligotrophic lake and its largest tributary, the Jordan River, is a state designated Natural River. The watershed also includes the Boyne River. Lake Charlevoix is Michigan's fourth largest inland lake with the second longest shoreline and the fifth largest watershed. The primary lake pollutants of concern are nutrients. Nutrients and sediment are pollutants of concern in the tributaries. The Lake Charlevoix Watershed Advisory Committee is one of the most active in northern Michigan and has excellent participation by local governments. Area organizations have implemented numerous projects over the last several years as identified in the CMI approved WMP. Work is currently underway to update the WMP to meet Section 319 criteria.

- **Grand Traverse Bay Shoreline Watersheds along West Bay and East Bay**

  The Grand Traverse Bay watershed is one of the premier tourist and outdoor recreation areas in the Midwest, primarily because of the high quality of its water resources. But this popularity has contributed to rapid population growth that threatens the oligotrophic waters of Grand Traverse Bay as well as its numerous small tributaries. These tributaries drain much of Traverse City, the largest city in the northern Lower Peninsula, and portions of two of the three fastest growing counties in the state, Grand Traverse and Leelanau Counties.

  The primary pollutants of concern for the Grand Traverse Bay are nutrients and pathogens. Documented increases in the number and size of macrophyte beds over the past decade highlight the concern of nutrient inputs to near shore areas. Sedimentation and water temperature are concerns within the small tributary watersheds.

  Recognition of the aesthetic, recreational, and economic value of the Grand Traverse Bay watershed's high quality waters, along with a concentration of many relatively affluent and well-educated residents, has resulted in the formation of numerous active environmental organizations and inland lake/river associations in the area. These organizations worked jointly with local governments and business representatives to develop a WMP that has been approved by the MDEQ as meeting both state CMI and federal Section 319 program requirements. The organizations continue to cooperatively pursue the funding and effective implementation of many environmental protection actions.

- **Boardman River**

  The Boardman River is a blue ribbon trout stream and state designated Natural River. The lower portion of the watershed is a high priority for pollution control activities. This reach extends from the river's mouth at Grand Traverse Bay south about 7.5 miles to the north boundary of Section 14 of Blair Township, where an unnamed tributary enters the

Boardman River opposite the west end of Sleight Road. This subwatershed includes most of Traverse City west of Old Mission Peninsula. Sediment deposition originating from road stream crossings, stream bank erosion, and construction is the primary pollutant in the Boardman River. This watershed is covered by both the CMI approved Boardman River WMP and the CMI/Section 319 approved Grand Traverse Bay WMP. The Boardman River is currently receiving increased local attention as three major dams on the main stem have been identified for removal, which provides a unique opportunity to educate the public on NPS pollution issues and potentially create large expanses of riparian buffers in the newly exposed bottomlands of the drained reservoirs.

- **Glen Lake/Crystal River**

  The Glen Lake watershed includes portions of the famed Sleeping Bear Dunes National Lakeshore, the only national park in Michigan's Lower Peninsula, which comprises 40% of the land in the watershed. Glen Lake is oligotrophic with excellent water quality. The Crystal River is a cold water stream that flows from Glen Lake to Lake Michigan through a large dune and swale wetland community, which is considered by the Michigan Natural Features Inventory and other management agencies as a globally rare ecological community. Furthermore, the Michigan Natural Features Inventory has stated that few, if any, higher quality and less impacted examples of a dune/swale community exist in Michigan. Partly as a result, the watershed is home to several species that are either of concern, threatened, or endangered at both the state and federal levels. Increasing development pressure threatens to degrade conditions in the lake through nutrient enrichment, in the river through sedimentation, and in the wetland areas associated with the groundwater-fed streams through the loss of habitat. The Glen Lake/Crystal River watershed is covered by a CMI/319 approved WMP.

- **Betsie River from Dair Creek Downstream**

  The Betsie River was the second river in Michigan to be designated a state Natural River and land use zoning covers building setbacks and vegetated buffers. The river is noted for its salmon and steelhead fishing throughout the main stem. Dair Creek is the most downstream of the two important tributaries that contain exceptional trout habitat and provide cold water to the warmer lower Betsie River. Sediment, nutrients, and thermal inputs are the most significant pollutants of concern. Sources include road stream crossings, stream bank erosion at historical log roll away sites, construction sites, and riparian land uses. There is a CMI approved WMP for the Betsie River watershed, which includes Crystal Lake.

  Crystal Lake is a cold, oligotrophic lake that drains to the Betsie River through the Crystal Lake Outlet, an artificial channel built in 1873. Crystal Lake is Michigan's ninth largest inland lake with a surface area over 15 square miles, and the state's third deepest lake (behind only Torch and Elk Lakes), reaching a maximum depth of 190 feet. Part of the northern portion of the watershed is adjacent to the Sleeping Bear Dunes National Lakeshore. The lake's main tributary, Cold Creek, has historically been channelized.

- **Portage Lake (Manistee County)**

  Portage Lake is a mesotrophic lake. The watershed drains to Lake Michigan through an outlet channel originally constructed in 1871, which lowered the lake level by several feet. Unlike many watersheds in Michigan's northern Lower Peninsula, there is very little state or federal public land in the watershed. Private land practices associated with forestry, agriculture, recreation, and commercial, industrial, and residential uses have a

significant impact on water quality. Nutrient enrichment and habitat loss are the primary environmental concerns. A CMI/Section 319 approved WMP has been completed for Portage Lake and plan implementation is being coordinated through the Portage Lake Watershed Forever committees.

- **Manistee River - Bear Creek and Bear Lake**

  The Manistee River supports one of Michigan's best cold water fisheries and is particularly renowned for salmon. The Manistee River system's high water quality has resulted in the designation of two large areas as state Natural Rivers, as well as the designation of three distinct river reaches as federal Wild and Scenic Rivers, one of which is Bear Creek. The primary pollutant of concern in Bear Creek is excessive sand bedload. Nutrients are the main pollutant of concern for Bear Lake. Water quality protection efforts are coordinated through the Bear Creek Watershed Council and the Bear Lake Watershed Alliance. The Bear Creek watershed has a CMI approved WMP and funding is currently being sought to upgrade the plan to meet Section 319 criteria.

- **Pere Marquette River**

  Often referred to as one of the finest trout streams in the Midwest, the Pere Marquette River is rather unique in Michigan for a river of its size in that it has remained free-flowing, with no dams on the main stem. Partly because of its high water quality, the Pere Marquette River has been designated as both a federal Wild and Scenic River and a state Natural River, which provide it special protection status. The Pere Marquette River has also been identified by the Nature Conservancy as one of only two watersheds in the northern Lower Peninsula (the Au Sable River is the other) that is a priority watershed for conservation action because of its high biological significance, ongoing threats, and opportunities for protective action.

  Some of the earliest watershed protection efforts in Michigan were taken in the Pere Marquette watershed, and the Pere Marquette Watershed Council remains active in implementing additional protection measures. Excessive sand bedload is the most significant water quality issue, although there are signs of potential nutrient enrichment in some areas. The Pere Marquette River is has a CMI approved WMP and a Section 319 update is in progress.

- **Lake Michigan Tributary - Duck Creek**

  Duck Creek drains directly to Lake Michigan north of Muskegon. It is one of the remaining watersheds in the area that is not covered by a WMP. Based on Muskegon Conservation District data, this cold water stream may be vulnerable due to temperature problems. With the planned expansion of the Michigan Adventure amusement park near Muskegon and the resulting land use changes, this watershed would benefit from the development and implementation of a WMP to protect existing high quality waters. The MDEQ staff have been working with the local community for the last three years to develop a proposal with planned participation by decision makers. A local entity recently received money from the West Michigan Strategic Alliance Green Infrastructure Program to look for opportunities to incorporate smart growth and low impact development in the area around Michigan Adventure.

- **Upper Muskegon River (from Wolf Creek confluence north)**

  The Muskegon River is unique among large Michigan river systems in that it is classified as a coolwater system. Cold water stream reaches blend with other areas that have

warmwater conditions; consequently, it has many characteristics midway between those of cold water and warmwater rivers. These temperature characteristics result in the support of a diverse aquatic community. The area in the river's headwaters, surrounding Higgins and Houghton lakes and immediately downstream, contains by far the largest acreage of biodiversity priority areas in the Muskegon watershed identified by the Nature Conservancy, particularly for aquatic species.

The varying aquatic characteristics within the watershed are dramatically represented by the stark differences between Houghton and Higgins Lakes, which are separated by only three miles. Houghton Lake is a shallow eutrophic lake, and though it is Michigan's largest inland lake with a surface area over 30 square miles, it has a maximum depth of only 22 feet and an average depth of just 7.5 feet. Conversely, Higgins Lake, Michigan's seventh largest lake with a surface area over 16 square miles, is a deep oligotrophic lake reaching a maximum depth over 130 feet and half the lake is over 50 feet deep. Higgins Lake was declared by National Geographic magazine as the sixth most beautiful lake in the world.

The primary pollutants of concern for the lakes are nutrients and pathogens. Nutrients, temperature, sediment, and hydrologic flow are issues for the upper Muskegon River. Butterfield Creek and the West Branch Muskegon River are both identified in the CMI/Section 319 approved Muskegon River WMP as critical areas because of temperature fluctuation, surface water runoff, and land use issues.

- **Mona Lake**

  Mona Lake is a small, urbanized watershed near Muskegon. This watershed faces a mix of problems including sedimentation, excessive nutrients, pathogens, and invasive plants. The local watershed group has strong leadership, good community support, a working relationship with a wide variety of stakeholders, and a focus on finding innovative solutions.

- **Upper Grand River - Portage River**

  There is a growing group, headed by the Jackson County Conservation District, that is working to address issues in the Grand and Portage Rivers. The Portage River subbasin WMP identifies sedimentation as a crital issue that affects biota and dissolved oxygen. Actions needed include buffer installation, wetland restoration, and improvement of agriculture practices.

- **Looking Glass River**

  The Looking Glass River has good water quality for most of its length; however, development continues to increase in the watershed. Construction of large commercial developments and subdivisions are taking place with minimal storm water controls. In addition, homes are being built in crop fields and along the riparian corridor. A strong education program combined with useable storm water controls is needed throughout the entire watershed. This watershed is a priority for implementation efforts to address development in historically agricultural areas and consideration of protection practices.

- **Maple River**

  The extent of agricultural land use is significant in the Maple River watershed and several CAFOs are present. New residential development also impacts the area. Previous stream modifications to enhance drainage have resulted in altered flows, bank

erosion, and sediment deposition. Impacts from agricultural drainage, water withdrawal, and failing septic systems need to be evaluated. A Section 319 planning grant was awarded, which has encouraged a growing watershed group and expanded public interest. This watershed is a priority for continued support of planning and implementation efforts. These activities should extend beyond Clinton County to areas throughout the watershed and include cooperative efforts between the MDEQ, county agencies, and local communities.

- **Thornapple River**

  The Thornapple River watershed, located in the southwestern portion of Michigan, includes 31 subwatersheds and is the largest subbasin of the lower Grand River watershed. The Thornapple River watershed extends from Potterville westward to the western portion of Barry County then north to its confluence with the Grand River in Ada. Though the prevalent land use in the watershed is agricultural, 17 of its streams are designated trout streams, including the main stem of the Coldwater River.

  Streams in much of the upper and middle portions of the watershed were historically channelized for agricultural purposes and are currently maintained as drains. Channelization affects the ability of several of the watershed's designated trout streams to support a cold water fishery.

  Many collaborative projects are currently taking place in the watershed with a variety of funding sources to address water quality concerns. These projects are directed through local groups such as Barry-Eaton District Health Department, Barry County Conservation District, the City of Hastings, Trout Unlimited, Thornapple River Watershed Council, and Coldwater River Watershed Council as well as state and federal agencies such as the MDNR and USFWS. Projects include a well and septic inspection ordinance, riparian protection ordinances, volunteer monitoring, ongoing dam removals, development of WMPs, and fisheries habitat restoration and protection.

- **Lake Macatawa**

  Lake Macatawa, in southern Ottawa County and northern Allegan County, is a 1,780-acre drowned river mouth lake that discharges to Lake Michigan. The prevalent land use in the watershed is agricultural. Turbidity, color, settable solids, suspended solids, and deposits are problems in the lake.

  Many collaborative projects are currently taking place in the watershed with a variety of funding sources to address water quality concerns. These projects are directed through the Macatawa Area Coordinating Council. The Macatawa Area Coordinating Council is an area-wide association, comprised of government units located adjacent to Lake Macatawa, which facilitates consensus building on public policy decisions that impact the greater Holland/Zeeland communities.

- **Kalamazoo River - Rabbit River**

  The Rabbit River is a tributary of the Kalamazoo River located primarily in Allegan County with a watershed that encompasses 187,200 acres. Land use in the watershed is primarily agricultural, but forested and urban areas are also represented. The Rabbit River WMP states that water quality threats and impairments are caused by sedimentation, nutrient inputs, and high-flow occurrences. The sources of sediment include stream banks, cropland, construction sites, and road crossings/road ditches.

Nutrients enter the stream from agricultural production and residential area runoff. Damaging high flows result from uncontrolled storm water runoff due to development and past drainage practices. The MDEQ staff effort focuses on restoration of three Rabbit River subwatersheds that have identified impairments: Green Lake Creek (Tollenbar Drain), Headwaters Little Rabbit River (Red Run Drain), and Black Creek.

- **Kalamazoo River - Gun River**

  The Gun River watershed encompasses an area of 73,272 acres in Allegan and Barry Counties. The Gun River flows from Gun Lake through agricultural land into the urbanizing area of Otsego Township, Allegan County, where it joins the Kalamazoo River. The watershed has been significantly altered from its presettlement conditions, primarily due to agricultural development. Many of the forests have been cleared and the wetlands drained. Sedimentation and excessive nutrient inputs have resulted in areas of the watershed exhibiting degraded aquatic habitat, decline of biodiversity, and reduced fish populations.

  The MDEQ staff effort focuses on restoration of two Gun River subwatersheds that have identified impairments: Fenner Creek, and an upstream stretch of the Gun River between Gun Lake and Orangeville Creek.

- **Kalamazoo River - Augusta and Gull Creeks**

  The Augusta and Gull Creeks watershed within the Kalamazoo River watershed includes a number of high quality streams and lakes. Gull Lake is a large, mesotrophic lake. While phosphorus levels in the watershed remain at acceptable levels, development pressures are a concern. Agriculture is also a potential source of nutrients. There are three recently constructed CAFOs in the watershed, which include new and expanded operations. Therefore, preservation of the riparian land is critical to provide an adequate buffer between agricultural operations and the water bodies.

- **Kalamazoo River - Spring Brook**

  Spring Brook is a cold water tributary to the Kalamazoo River immediately downstream of the city of Kalamazoo. A 1991 MDEQ biological survey conducted on Spring Brook indicated that this stream had the highest habitat quality for fish and other aquatic life of any cold water stream of similar size that was sampled in southwestern Michigan. Brown trout of varying sizes were observed as well as high numbers and diversity of aquatic insects. A more recent biosurvey, conducted in 2004, found that approximately one mile of the riparian zone had been completely removed and replaced by subdivisions and lawns near Riverview Drive. A survey conducted further upstream, at DE Avenue, found a largely unimpacted riparian zone and an excellent macroinvertebrate community. Pollutants associated with development including sediment, phosphorus, and thermal inputs are the primary threats to this watershed.

- **St. Joseph River - Paw Paw, Black, Dowagiac, and Rocky Rivers**

  The St. Joseph WMP indentified the Paw Paw, Dowagiac, and Rocky Rivers subwatersheds as the highest priority (i.e., the top three critical areas) for preservation efforts based on: (1) a scoring system for percentage of wetland and forest cover and trout lakes and streams in the subwatershed; (2) the top three preservation subwatersheds form a contiguous land mass surrounded on all sides by urban and developing areas; (3) potential for regional cooperation; and (4) existence of a sub-WMP.

The Paw Paw River has several designated trout streams. In particular, the east branch of the Paw Paw River is identified as a top quality, cold water fishery. The mouth area of the watershed is impacted by urbanization,but there is a need for protection in the form of land use planning in the middle and upper portions of the watershed.

The Two Rivers Coalition, a recently incorporated nonprofit organization, is a strong proactive watershed group representing both the Paw Paw River and Black River watersheds. Sediment and nutrients are the largest pollutants of concern in the Black River watershed. The Two Rivers Coalition is a partner on a Section 319 NPS grant recently awarded to the Van Buren Conservation District, which will focus on wetland protection and restoration in the watershed.

Many tributaries to the Dowagiac River as well as the Dowagiac River itself are designated as cold water streams. The river is being considered by the MDNR for the Natural Rivers Program. A 2002 MDEQ biological survey found “acceptable” to “excellent” macroinvertebrate communities; although, habit was only rated “fair” to “good.” Sediment is the primary pollutant of concern. Despite extensive historic channelization, the river proper is quite stable. A pilot meander restoration project has been completed.

The Rocky River is relatively undeveloped along the river corridor, but it is threatened by development along the US-131 corridor in the vicinity of the city of Three Rivers. Some natural trout production takes place in the cold headwaters. Macroinvertebrate communities and habitat are generally rate “good;” but, there are undetermined sources of sediments in the watershed that may be natural. Historic channelization in tributaries has limited habitat and biological communities.

- **St. Joseph River - Prairie River**

  Channelization and agricultural land drainage have been identified as a concern in the Prairie River subwatershed. A 2002 MDEQ biological survey report indicated that macroinvertebrate communities rated “acceptable” (although nearly excellent) to “excellent.” Stream habitat was mostly “fair” with one station “good.” A 2007 MDEQ biological survey report indicated support of the cold water fisheries designated use at the Bowers Road station; although, this segment is designated as warmwater. Another site farther downstream supported an abundance of warmwater fish taxa rating acceptable with warmwater metrics; although, this segment is designated as cold water. Local interest in watershed planning has been expressed for the Prairie River watershed.

- **St. Joseph River - Fawn River**

  Based on results of Soil and Water Assessment Tool modeling, the Fawn River watershed was identified in the St. Joseph River WMP as one of the top three critical subwatersheds for mitigation of agricultural impacts. Sediments and nutrients are the primary pollutants of concern. Recent MDEQ biological surveys indicated largely “excellent” macroinvertebrate populations, minimal disturbance of stream habitat despite abundance of agricultural land use, diverse stream habitat, wide-wooded floodplain, and “good” water quality.

- **Galien River**

  The Galien River is a priority due to the existing problems with pathogens with source areas covering a majority of the watershed. Other major pollutants threatening and impairing the watershed are sediment and nutrients. There is an active watershed group, lead by The Conservation Fund. The Conservation Fund is currently implementing a Section 319 NPS grant focusing on septic system awareness efforts, including a social indicators survey.

Lake Huron Basin

- **Lake Huron Coast - Duncan and Grass Bays**

  Located just east of the city of Cheboygan, the Duncan and Grass Bays area was identified as the most significant priority area to protect along the Lake Huron coast in the Northeast Michigan Coastal Stewardship Project completed in 2009. The area is a state designated environmentally sensitive area with high biological rarity, and includes shoreline ridge swale habitats, dune swale complexes, large tracts of public land, and extensive wetlands. Protecting adjacent land is a priority considering the high rate of population growth and development in the area, which contributes to sedimentation from construction site erosion as well as habitat loss and fragmentation. There is not a CMI or Section 319 approved WMP that covers this area.

- **Ocqueoc River - Silver Creek**

  Silver Creek is one of only two major tributaries to the Ocqueoc River and provides the majority of high quality, cold water habitat within the Ocqueoc River system.
  Silver Creek is a designated trout stream home to native brook trout and used by steelhead and possibly salmon from Lake Huron. Sedimentation from eroding stream banks, road crossings, and livestock access is the most significant pollutant problem in Silver Creek. Temperature is also a concern given the importance of maintaining this cold water tributary within the overall warmer waters of the Ocqueoc River watershed. A CMI/Section 319 approved WMP is used by the Ocqueoc River Commission to improve and protect the water resources.

- **Devils River**

  Devils Lake, located just south of the city of Alpena in the Devils River watershed of Lake Huron's Thunder Bay, ranked high in the Northeast Michigan Coastal Stewardship Project. The Devils River watershed contains an extensive wetlands complex threatened by development and subsequent sedimentation issues from construction sites and road stream crossings. This area does not have a CMI or Section 319 approved WMP.

- **South Branch Au Sable River**

  The Au Sable River is a federally designated Wild and Scenic River and is often referred to as providing the finest brown trout fly fishing east of the Rocky Mountains. The Au Sable River watershed has also been identified by the Nature Conservancy as one of only two watersheds in the northern Lower Peninsula (the Pere Marquette River is the other) that is a priority watershed for conservation action because of its high biological significance, ongoing threats, and opportunities for protective action.

The South Branch of the Au Sable River is a state designated Natural River that flows through the famed Mason Tract in the Au Sable State Forest. Actions to address water quality in the upper Au Sable River, which includes the South Branch, are coordinated through the Au Sable River Watershed Restoration Committee and the Upper Au Sable River CMI approved WMP. The primary pollutants affecting this world-class trout stream are sand bedload from stream bank and road crossing sediment erosion, as well as urban storm water runoff. There is current local interest in evaluating storm water runoff from the village of Roscommon; and, Roscommon County is pursuing the development of storm water management standards. This interest follows the recent successful implementation of numerous storm water runoff controls in the city of Grayling, which were designed to decrease Grayling storm water runoff to the Au Sable River by 80%.

- **Rifle River**

  The Rifle River is a state designated Natural River and is heavily used for recreation including fishing and canoeing. The Rifle River is threatened by sediment inputs from uncontrolled livestock access, gully erosion sites, stream bank erosion, and erosion from road stream crossings. Urban storm water discharges from the city of West Branch also pose a potential threat to this cold water river. A watershed implementation grant has been completed for the Rifle River and the Rifle River Restoration Committee is currently active in implementation practices. This committee is well supported by the two resource conservation and development councils that cover the area.

- **Kawkawlin River**

  The Kawkawlin River has been identified as a critical watershed as part of the Saginaw Bay Coastal Initiative Program. The Kawkawlin River watershed drains to the southwestern portion of Saginaw Bay and provides important recreational opportunities. This area has, and continues to experience, problems with pathogens. Historically, the Kawkawlin River has also experienced impacts from elevated phosphorus levels (nuisance algae and duckweed). The local community is working on a watershed planning grant.

- **Tittabawassee River - Cedar River**

  The Cedar River, a tributary to the Tittabawassee River, has stretches that are declared blue ribbon trout streams. The watershed is threatened by sediment inputs from uncontrolled livestock access, gully erosion sites, stream bank erosion, and erosion from road stream crossings. The watershed should be a focus for protection as it remains relatively undeveloped. The local community currently has two watershed grants to implement BMPs and permanent conservation easements.

- **Shiawassee River**

  The Shiawassee River is a good quality warmwater stream. However, the size of the main channel likely buffers sources of pollution, of which on-site septic systems are a general concern. In Livingston County, 80 percent of the homes use on-site wastewater treatment and there is no point-of-sale ordinance to determine the status of the systems. In Shiawassee County, the river flows primarily through rural areas served by septic systems. There are efforts to protect Shiawassee River water quality in Livingston County (as part of the MS4 NPDES permit) and there is a Section 319 implementation grant in Shiawassee County. However, there is no coordination in the watershed among communities or agencies in addressing sources of pollution, priorities,

goals, and practices. It is a priority to coordinate environmental protection efforts throughout the watershed and tie them more closely to water quality improvements.

- **Flint River**

  The Flint River watershed drains approximately 1,332 square miles and has 18 subwatersheds. The watershed has a population of over 600,000 people, 250,000 of which depend on the Flint River as an emergency backup supply for drinking water. Major tributaries include the South and North Branch Flint Rivers, and Kearsley, Thread, Swartz, and Misteguay Creeks. Moderately stable flow is found in the upper South Branch Flint River and in the headwater reaches of some tributaries. Land use in the Flint River watershed is dominated by agriculture (49%) followed by forested (16%), nonforested (15%), urban development (15%), and wetland (3%). The loss of wetlands from channelization and tiling has decreased flow stability, increased erosion and sedimentation, and altered stream temperature regimes.

  Four subwatersheds, Swartz Creek, Kearsley Creek, Gilkey Creek, and the South Branch of the Flint River have approved WMPs and active stakeholder involvement. NPS pollution from septic systems, stream bank erosion, agricultural runoff, fertilizers, pesticides, and increased development are of concern within these watersheds. The South Branch of the Flint River watershed is a high priority for both restoration and protection practices due to its hydrologic stability, in-stream habitat, and biological diversity.

- **Pinnebog River**

  The Pinnebog River has been identified as a critical watershed as part of the Saginaw Bay Coastal Initiative Program. The Pinnebog River has been noted as having elevated phosphorus levels, and organic deposits have been a problem near the river mouth for the last several years. The local community is currently finishing a WMP for this water body and applying for an implementation grant.

Lake Erie Basin

- **St. Clair River/Lake St. Clair**

  This high priority area includes the Pine, Black, and Belle Rivers, as well as direct drainage watersheds to the St. Clair River and Lake St. Clair in St. Clair and Macomb Counties. Lake St. Clair and the St. Clair River provide drinking water to more than five million residents in Michigan and Ontario, and are among the most heavily used recreational areas in the Great Lakes for fishing, boating, and swimming. It is estimated that nearly 50% of all sport fish caught in the Great Lakes are caught in Lake St. Clair, and that recreational boating in the lake contributes over $200 million a year to the economy of southeast Michigan. Abundant shoreline along the river and lake also provides many recreational opportunities for local residents and tourists.

  The St. Clair River has been identified as a Great Lakes AOC by the United States and Canadian federal governments. Lake St. Clair was identified as a Biodiversity Investment Area at the 2000 State of the Lakes Ecosystem Conference as well as a priority “eco-reach” that provides critical habitat for numerous plant and animal species, especially in the region’s coastal wetlands. In the Belle River watershed, recent surveys have confirmed very high mussel species diversity that includes endangered mussel species.

Intermittent beach closures due to elevated bacteria levels, failing or inadequate septic systems, sites of unrestricted cattle access, and illicit discharges are problems in the area. Despite the significant progress made over the past five years to correct problems, issues remain due to soil type and historical development in the area.

- **Clinton River - North Branch**

  The Clinton River North Branch subwatershed is located primarily in Macomb County, encompassing a large portion of the central and northern areas of the county and extending into Oakland, Lapeer, and St. Clair Counties. These headwater streams are high quality, cold water designated trout streams that provide recreational activities for the region.

  Historically, the Clinton River North Branch subwatershed experienced a significant loss of wetlands as agriculture and other land uses expanded in the region. Today, the land use in the Clinton River North Branch remains predominately agricultural. However, due to the area's close proximity to metro Detroit, development pressure continues to threaten the remaining wetlands, natural areas, and agricultural land of the subwatershed. This development pressure has created an increasing need to take preventive/proactive actions to help preserve the water quality of the Clinton River North Branch.

  A WMP has not been developed for the Clinton River North Branch, but an active watershed group has formed and is meeting regularly. With an active watershed group, high quality streams, and development pressure, there is a unique opportunity for the NPS program staff to facilitate and promote a more sustainable development path for the Clinton River North Branch.

- **Clinton River - Stony Creek and Paint Creek**

  Stony and Paint Creeks are hydrologically separate subwatersheds; however, they are considered as one by the Stony/Paint subwatershed group due to their close proximity and shared communities within their drainage areas. Both creeks are high quality, cold water tributaries of the Clinton River. Stony Creek continues to retain many high quality characteristics, but it is threatened by increasing development, particularly in the southern end of the subwatershed. Stony Creek is home to a wealth of unique natural areas that are protected in both the public and private domains. Paint Creek is managed as a trout stream from Lake Orion to its confluence with the Clinton River. Brown trout reproduce in Paint Creek, but they are supplemented with an annual stocking by the MDNR. Much of the stream is bordered by public land and recreational trails, making it valued by the public in southeast Michigan due to its numerous recreational opportunities and high potential for sport fishing.

  As development in the watershed continues, the potential for negative environmental effects on Stony and Paint Creeks increases. Problems of concern include water quality impacts from erosion, sedimentation, and increased inputs of storm water pollutants, as well as water quantity impacts from more impervious surfaces and the loss of wetlands, woodlands, and riparian vegetation.

  Fourteen communities, two counties, and two school districts were involved in the development of the Stony Creek/Paint Creek WMP and they continue to meet regularly.

- **Rouge River - Johnson Creek**

  Johnson Creek is widely recognized as one of the highest quality streams in the Rouge River watershed. Stream characteristics such as cool, clear water; significant groundwater discharge; cobble and gravel substrates; and sensitive fish, plant, reptile, amphibian, and macroinvertebrate taxa, make Johnson Creek a valuable ecological and recreational resource to protect and restore. Johnson Creek is the only designated cold water stream in the Rouge River watershed. Its unique recreational use as a brown trout fishery and its ability to support a threatened fish population (the redside dace) make Johnson Creek deserving of aggressive protection and restoration measures.

  Maintaining cool and clear water will require thoughtful planning of development and storm water management practices as well as preservation of priority natural areas and the riparian corridor. Measures should be taken to reduce the impact of impervious surfaces and to increase native stream bank vegetation and shading along Johnson Creek. In addition to pending land use change in its watershed, the creek is also at risk due to high storm water flows, high nutrient loads, and high sediment loads that threaten the integrity of the creek. Further, fecal inputs from sanitary seepage, improper septic system maintenance and operation, and other sources must be minimized.

  There are several active groups working on the protection and restoration measures in the Johnson Creek watershed. Johnson Creek is included in the Rouge River Watershed Middle One WMP. Thirteen communities, three counties, and one school district were involved in the development of the plan. These municipalities continue to meet and work to implement watershed protection goals. A citizen-based watershed group called the Johnson Creek Protection Group was also recently established. In this organization, residents, businesses, and local officials work together to identify actions to preserve and restore water quality as well as educate the public regarding their role in this ongoing endeavor. The group mobilizes the public to protect Johnson Creek through hosting educational events and supporting volunteer inventory, restoration, and advocacy work. Finally, Friends of the Rouge is another active nonprofit organization that works within the Johnson Creek watershed and the greater Rouge River basin to promote restoration and stewardship. Friends of the Rouge programs include volunteer watershed-wide monitoring information and outreach workshops, restoration projects, and Rouge River cleanup events.

- **Upper Huron River/Kent Lake**

  The Kent Lake subwatershed of the Huron River is located in southwestern Oakland County and extends into Brighton and Green Oak townships in Livingston County. The drainage area is 556 square miles extending from the headwaters of the Huron River downstream to the Kent Lake impoundment in the Kensington Metropark. The subwatershed contains nearly 700 individual lakes comprising approximately 9,000 acres, Pettibone and Norton Creeks, and innumerable wetlands.

  Land use in the Kent Lake subwatershed ranges from heavily commercial and residential areas in the east and south to small rural farms and housing in the north and west. There are two Metroparks and four state recreation areas in the subwatershed, along with numerous county, city, and village parks totaling roughly 22,000 acres of publicly owned land. So exceptional is the ecological value of this area that the Nature Conservancy recently deemed portions of the subwatershed as “globally significant.”

Water quality concerns in the watershed range from nutrient and bacterial loading issues that result in many beach closings in the area, to issues of water clarity and toxicity. Additional water quality concerns include turbidity, conductivity, pesticides, and pollutants such as PCBs and mercury. Fourteen communities, one county, and one school district were involved in the development of the Kent Lake/Upper Huron WMP and they continue to meet.

- **Upper Huron River/Chain of Lakes**

  The Huron Chain of Lakes Watershed is located within Livingston, Oakland, and Washtenaw Counties. Within the watershed, nutrients are a continuing concern in Brighton, Ore, and Strawberry Lakes.

  Livingston County is one of the fastest growing counties in Michigan. Due to this increased development and long lake retention times, stormwater controls in the watershed are necessary. Implementation efforts are needed to address nutrient concerns and meet water quality goals. While ordinances are in place within areas of the watershed, a coordinated effort is necessary to achieve results throughout the whole system.

- **Middle Huron River Subbasins**

  The Huron River watershed is one of Michigan's natural treasures. It supplies drinking water to more than 150,000 people, supports one of Michigan's finest smallmouth bass fisheries, and is the only state designated Natural River in southeast Michigan. Yet, the Middle Huron watershed has water quality issues related to phosphorus, sediment, and pathogens.

  There is an active group of communities and institutions that have been implementing actions to reduce phosphorus since 1995. The highest ranking subwatersheds for phosphorus loading are Mill Creek, Mallets Creek, and Fleming Creek. Of these, Fleming Creek is in need of a WMP to guide restoration activity. Sediment is a concern in several Middle Huron subbasins including Honey Creek, Millers Creek, Mallets Creek, and Swift Run. Of these, Honey Creek is in need of a watershed plan to guide restoration activity. These subbasins have also been highly modified by hydrologic alterations and need activities aimed at detention, wetland restoration, or other means of keeping water on site longer. Lastly, Honey Creek has issues with pathogens with possible sources including failed septic systems, animal or pet waste, and illicit connections.

- **Portage Creek Subbasin**

  The Portage Creek watershed covers 56 square miles of the 908 square mile Huron River watershed. It lies upstream of the Middle Huron section. It encompasses parts of six townships, two villages, and four counties. Nearly 16,000 acres of lakes and wetlands are located in the watershed. More than 11,300 acres are publicly-owned state land. The protected natural areas contain some of the most diverse and rich native ecosystems remaining in the Portage Creek watershed and southeastern Michigan. It is also one of the most unstable streams in the Huron River watershed and is threatened by altered hydrology as well as lack of development standards and protection ordinances.

Areas of high habitat quality and species diversity persist in the watershed due to the extent of state-owned lands, undeveloped private lands, and land protected through conservation easements. The connectedness and expansiveness of the remaining natural areas and native habitats directly impact the water quality in the watershed. As the Portage Creek watershed communities develop, there is potential for negative environmental impacts to increase, including water quality impacts from erosion, sedimentation, and increased inputs of storm water pollutants. Hydrology is impacted as wetlands, woodlands, floodplains, and other natural features that regulate water quantity are altered or replaced with impervious surfaces.

The remaining natural areas in the Huron River watershed were mapped and prioritized in 2002, and updated in 2007, through the Bioreserve Project of the Huron River Watershed Council. One hundred and two sites (23,908 acres) in the Portage Creek watershed were identified as priority natural areas. The priority goals and objectives of the Portage Creek planning project include maintaining and increasing the natural buffers, increasing the amount of protected land through ordinances and conservation easements, restoring converted wetlands, and increasing the use of development standards and promoting low impact development concepts.

- **Raisin River - Headwaters**

  The headwater portions of the Raisin River, specifically Iron Creek, Goose Creek, Evans Creek, and the Upper Raisin River, have been identified by the Nature Conservancy as having significant regional ecological importance due to the remaining diverse mussel beds. This region has the most historically intact assemblage of mussels and other aquatic species of any river in southern Michigan. Currently, water quality is fairly good in these upper reaches. The Raisin River WMP lists these as high priority areas for protection measures including land use controls, buffers, easements, and ordinances.

- **Lower Raisin River Subbasin in the Vicinity of Deerfield and Blissfield**

  This portion of the Raisin River has issues with pathogens and nitrates and needs restoration to support the public water supply and total and partial body contact recreation designated uses. The Raisin River has three surface water intakes, which is more than any other watershed in Michigan. The main pollutants of concern are nitrogen, phosphorus, and pathogens from the largely agricultural land use. There are several CAFOs suspected of contributing pollutants. The River Raisin Watershed Council began a watershed planning project in 2006 and the plan was completed in 2009. The plan lists agricultural fertilizers and animal waste as the priority sources of pollutants. Drain tiles are a suspected source of pollutants. The highest priority subbasins for restoration activities are the South Branch of the Raisin River and Black Creek. Recommended practices include improving fertilizer and manure application rates and timing; applying cover crops; maintaining drain tiles; and constructing wetlands, buffers, and sub-irrigation systems.

- **West Branch of the St. Joseph River (Headwaters of the Maumee River)**

  Drainage from the West Branch of the St. Joseph River, located in Hillsdale County, flows through three states before entering Lake Erie. The West Branch of the St. Joseph River is important because it forms the headwaters of the system, contains unique mussel populations and high quality habitat, and receives significant amounts of sediment and pesticides. It is also one of the last remaining watersheds in the area without an MDEQ approved WMP; although, it is covered by a larger tri-state watershed

planning effort, which provides background information and a framework for a planning project to build upon.

There is coordination among the Hillsdale Conservation District, the Nature Conservancy, and the St. Joseph River Watershed Initiative. The Nature Conservancy operates an Upper St. Joseph River watershed project in Angola, Indiana, focused on protection of the East Fork of the West Branch. This tributary contains a mussel community that represents the best remaining example of a biological community that was once common in the western Lake Erie watershed.

The St. Joseph River Watershed Initiative is a group working on behalf of the entire tristate St. Joseph watershed and acts as a coordinator by using its resources and expertise to gather data, identify critical areas, and lead management planning in the subbasins. The overall goal of the St. Joseph River Watershed Initiative is to reduce the loads of sediment, pesticides, pathogens, and nutrients to meet target loads by organizing stakeholders in the subbasins and developing WMPs. The St. Joseph River Watershed Initiative prepared a WMP for the larger tristate St. Joseph watershed and submitted it to the MDEQ for Section 319 approval. The MDEQ provided comments in response, but to date, the plan has not been resubmitted nor does it have CMI approval. Although the plan has been approved by Indiana for Section 319, a WMP should be developed and implemented for the Michigan portion of the watershed.

2.20 Septage

Septage is a domestic waste pumped from septic tanks, portable toilets, etc. The Septage Program regulates the septage hauling industry and septage disposal practices. Companies, as well as the vehicles they use, must be licensed. In addition, a permit is required to apply septage to the land. Septage may be taken to a municipal wastewater treatment facility or may be applied to agricultural land. The MDEQ administers the program with assistance from participating LHDs.

2.21 Soil Erosion and Sedimentation Control

The Soil Erosion and Sedimentation Control Program is administered under the authority of Part 91, Soil Erosion and Sedimentation Control, of the NREPA. Part 91 provides for the control of erosion and prevention of off-site sedimentation from earth change activities. Part 91 is administered and enforced by state, county, and municipal agencies with oversight by the MDEQ.

The MDEQ's major responsibilities are to train staff members of the Part 91 agencies in the proper administration and enforcement of Part 91 and to conduct periodic audits of the administering agencies to ensure their Soil Erosion and Sedimentation Control Programs are in compliance with Part 91.

2.22 Source Water Assessment

The reauthorization of Act 399 requires federal guidance and defines state requirements for a Source Water Assessment Program. Act 399 requires the state to identify the areas that supply public tap water, inventory contaminants and assess source water susceptibility to contamination, and inform the public of the results. In 1998, the MDEQ convened a Source Water Assessment Program Advisory Committee composed of key stakeholders to assist with Source Water Assessment Program development. Michigan's Source Water Assessment Program was approved by the USEPA in October 1999.

Information on nearly 18,000 drinking water sources serving approximately 10,600 noncommunity water systems and 1,250 community water systems was collected over a 6-year period. Potential sources of contamination were inventoried, and susceptibility to contamination was determined. The completed Source Water Assessment Program Report and all data were transmitted to the USEPA in December 2004. The Source Water Assessment Program Report is available at http://www.michigan.gov/deqwater under Drinking Water, Source Water Assessment. The MDEQ also continues to encourage surface water suppliers to plan and implement protection activities. Ira Township in St. Clair County is the first community to receive state approval for their Source Water Intake Protection Program.

2.23 Wellhead Protection

The MDEQ's Wellhead Protection Program assists local communities that utilize groundwater for their municipal drinking water supply systems to protect their water source. A Wellhead Protection Plan minimizes the potential for contamination by identifying and protecting the area that contributes water to municipal water supply wells. Such protection help avoids costly groundwater cleanups.

Under the Wellhead Protection Grant Program communities using groundwater continue to develop wellhead (source water) protection programs.

2.24 Wetlands Protection

2.24.1 Wetland Regulation

The MDEQ, LWMD, has administered a statewide wetland regulatory program for over 25 years. The LWMD also manages Michigan's wetland resources through public education programs that encourage wetland preservation and restoration, cooperation with governmental and nongovernmental agencies to encourage the evaluation and management of wetlands on a local and watershed basis, and development of a monitoring and assessment program.

Michigan's Goemaere-Anderson Wetland Protection Act was passed in 1979 (Part 303 of the NREPA). Through passage of the Wetland Protection Act, Michigan took direct legislative action to regulate and minimize wetland losses. This act provides for the preservation, management, protection, and use of wetlands; requires permits to alter wetlands; and provides penalties for illegal wetland alteration. A wetland is defined in Part 303 as:

> ". . . land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life and is commonly referred to as a bog, swamp, or marsh."

The Wetland Protection Act further defines regulated wetlands as those wetlands contiguous to the Great Lakes or Lake St. Clair, an inland lake, pond, river, or stream; and noncontiguous wetlands greater than five acres in size. The state also has the authority to regulate any noncontiguous wetlands that are determined to be essential to the preservation of the natural resources of the state once the landowner has been notified. Part 303 requires that persons planning to conduct certain activities in regulated wetlands apply for, and receive, a permit from the state before beginning the activity.

Michigan's Wetland Protection Program was approved by the USEPA in accordance with the requirements of Section 404(h) of the CWA in August 1984. With this approval, Michigan became the first state to assume administration of Section 404. The CWA limits state assumption of Section 404 authority in "traditionally navigable waters." The United States Army Corps of Engineers, Detroit District, retains Section 404 jurisdiction in these waters, which

includes the Great Lakes, connecting channels (such as the Detroit River), and river mouth areas upstream to the limits of the traditional navigational channel or the Great Lakes ordinary high water mark.

The MDEQ processes approximately 4,000 to 6,000 permit applications per year under Section 404, funded in part by permit fees. About 1,500 to 3,000 of these applications propose wetland impacts; the remainder propose to alter lakes and streams only. The MDEQ staff work with permit applicants to redesign proposals, when necessary, to avoid and minimize resource impacts.

Michigan's regulatory program generally requires mitigation for all wetland impacts, although the MDEQ staff may waive this requirement for projects impacting less than one-third acre if no reasonable opportunity for mitigation exists, or for projects having a basic purpose of creating or restoring wetlands. Mitigation may be considered only after the applicant has demonstrated avoidance and minimization of impacts, and it has been determined that a project is otherwise permitable. A mitigation proposal must result in no net loss of wetlands upon completion of a project. Mitigation requirements and ratios are established by rule and are defined by staff as a condition of the permit decision. Financial assurances are required to ensure completion of any mitigation project that is not completed in advance of associated impacts. Mitigation sites must be permanently protected through a conservation easement or deed restriction. Administrative rules defining the establishment and use of mitigation banks were promulgated in 1997 (see R 281.951, Wetland Mitigation Banking). Eleven mitigation banks are currently listed in Michigan's Wetland Mitigation Bank Registry. A number of other mitigation bank sites are currently under consideration or development.

Part 303 authorizes regulation of wetlands by a local unit of government provided that the local unit uses the same definition of wetlands as Part 303, and permit criteria that are consistent with Part 303. In 2004, the MDEQ initiated a program to encourage the protection of wetlands by local units of government. Workshops to explain and encourage local wetland regulation have been conducted at a number of locations across the state in cooperation with the East Michigan Environmental Action Council and the Tip of the Mitt Watershed Council.

2.24.2 Wetland Restoration

Michigan's State Wetland Conservation Plan outlines both short- and long-term goals for the achievement of no net loss of wetlands. Short-term objectives include the restoration of 50,000 acres of wetlands (1% of historic losses) by 2010. Long-term objectives, with no specific time frame, include the restoration of 500,000 acres (10% of historic losses). Tracking of wetland gains under various restoration programs was limited in the initial years following completion of the State Wetland Conservation Plan. However, recent summaries indicate that an estimated 19,100 acres of wetland were restored in Michigan from 2000 to 2004 through a variety of voluntary state, federal, and private partnership programs. Wetland restoration has continued at the rate of approximately 3,800 acres per year.

The State Wetland Conservation Plan recommended continuation of an interagency team to coordinate wetland restoration and other actions in Michigan. In response, the MDEQ organized and now leads the Wetland Work Group, an informal interagency team including various state, federal, and nongovernmental organizations concerned with wetland restoration and management.

In addition to the efforts outlined above, LWMD staff have been working closely with the MDEQ, WB, NPS 319 staff and watershed groups to assist in locating areas that have a high potential for wetland restoration. Using existing datasets and GIS technology, LWMD staff created a GIS layer that highlights these wetland restoration areas and ranks them in terms of their potential

(high, moderate, and low). Maps were generated for 30 watersheds across the state utilizing these data, and are available to outside agencies and the public through the Michigan Spatial Data Library at http://www.mcgi.state.mi.us/mgdl/?action=thm. This dataset is already in use by a large number of state, federal, and nongovernmental organizations concerned with wetland restoration and management.

2.24.3 Watershed Planning

Planning for wetland management on a watershed scale will not only promote effective and comprehensive management of the aquatic ecosystem as a whole, but can improve regulatory decisions by providing better information on the functional importance of wetland areas on a local or regional basis. To encourage consideration of wetland issues, the LWMD provides technical assistance to local watershed planning organizations. The Wetland Work Group established two major goals for this effort: (1) develop WMPs that incorporate wetland restoration and protection as major components; and (2) use these plans as models for future projects. This effort was successful in generating 30 WMPs that incorporate wetlands to a significant degree.

The LWMD completed a project in 2007 to develop and test the use of a more formal landscape-scale wetland assessment method on the Paw Paw River watershed in southwest Michigan. Methods developed by the USFWS and utilized by the LWMD make use of GIS data, including National Wetland Inventory maps, to provide a preliminary evaluation of wetland functions in a cost effective manner across an entire watershed. From this preliminary information, planners on the Paw Paw River Watershed Committee are now making more effective decisions regarding the need for wetland protection, restoration, or management in the watershed to meet defined goals. In addition, this analysis was included in the Section 319 Request for Proposal as one possible tool watershed groups could create and utilize to manage, protect, and restore wetlands in the context of watershed management planning. There are currently numerous projects in Michigan making use of this analysis under supervision of an LWMD expert, and several more efforts that have already been completed.

2.24.4 Protection of Exceptional Wetland Resources

The LWMD is taking a number of steps to ensure that Michigan's rarest, most significant, and most vulnerable wetland resources are protected to the greatest extent possible.

On April 21, 2004, Michigan Governor Jennifer M. Granholm signed Executive Directive 2004-4, directing the MDEQ to extend Part 303 of the NREPA, protection to critical, noncontiguous wetlands located on public lands. This Executive Directive requires the MDEQ to designate critical, small, isolated wetlands as "essential to the preservation of the natural resources of the state," thus extending regulatory protection to these vulnerable wetland sites. The process of compiling and updating information on previously nominated sites in a GIS format has been initiated. Site inspections to confirm the current condition of wetland sites, and completion of the designation process, will continue in the coming years.

The MDEQ also provides for protection of wetlands through the use of conservation easements that offer comprehensive and permanent protection to these properties. Conservation easements over exceptional wetland sites may be provided to fulfill mitigation requirements, as appropriate. Wetlands that are avoided during the planning of an authorized construction project may also be protected under an easement. The MDEQ now holds over 1,100 recorded conservation easements, covering 12,600 acres of land. The LWMD is currently developing a compliance monitoring framework for MDEQ-held easements.

In addition, the LWMD is cooperating with the USEPA and the Michigan Natural Features Inventory through a state wetland program development grant to generate additional technical information regarding rare wetland ecosystems in Michigan. This funding will also provide additional LWMD staff to assist the management of Great Lakes coastal wetland systems.

2.25 Water Protection Program Special Initiatives

2.25.1 Mercury Reduction/Prevention Efforts

There is widespread atmospheric mercury deposition into Michigan's surface waters. The organic form of mercury, methylmercury, is a highly bioaccumulative, toxic pollutant that is harmful to wildlife and human health. Elemental mercury is converted to the organic form through natural processes that occur particularly in inland lakes. The cycle of mercury in the environment has caused elevated mercury concentrations in inland lake sediments and fish tissues throughout the state. As a result of elevated mercury concentrations in fish tissue, there is a generic, statewide, mercury-based fish consumption advisory that applies to all of Michigan's inland lakes (MDCH, 2009).

The MDEQ's mercury reduction initiative focuses on quantifying mercury concentrations in the environmental media, identifying all sources that contribute mercury to the environment, and reducing or eliminating these sources. Numerous tools will be utilized including regional agreements, state legislation, statewide regulations and policies, the state permitting processes, outreach/education and pollution prevention efforts, as well as voluntary partnerships with various stakeholders. For example, the MDEQ will continue to work with the University of Michigan, Michigan State University (MSU), Clemson University, USGS, USEPA, and Michigan Department of Community Health (MDCH) to collect data on mercury concentrations in air, water, sediment cores, fish, eagles, and herring gulls. The MDEQ will continue to implement limits on air and water discharges including the requirement for certain dischargers to surface waters to develop and implement mercury minimization plans. The MDEQ will continue to participate in the Binational Toxics Strategy with the USEPA and Environment Canada, Environmental Council of States Quicksilver Caucus, USEPA's mercury roundtable efforts, and the Great Lakes Regional Collaboration - Mercury in Products Phase-Down Strategy. The MDEQ will also continue to work with various sectors on pollution prevention and energy efficiency initiatives to reduce mercury use and release. In January 2008, the MDEQ released the Mercury Strategy Workgroup Report (available upon request or at www.michigan.gov/deq under the mercury banner), which documents the current status and recommends future activities toward the goal of eliminating anthropogenic mercury use and releases in Michigan.

2.25.2 Aquatic Nuisance Species

As defined in R 324.3101 of Part 31 of the NREPA, ANS means a nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural, or recreational activities dependent on such waters.

Significant and detrimental changes in the Great Lakes ecosystem have occurred in recent years due to ANS. For example, Lake Erie and Saginaw Bay water clarity has improved dramatically because of the filtering capabilities of the zebra mussels. This change has contributed to excessive aquatic plant and algae growth, among other issues.

ANS that are an immediate concern to Michigan's aquatic ecosystems include, but are not limited to, zebra mussels (*Dreissena polymorpha*); three fish species: sea lamprey (*Petromyzon marinus*), ruffe (*Gymnocephalus cernuus*), and round goby (*Neogobius melanostomus*); three

zooplankton species: the spiny water flea (*Bythotrephes cederstroemi*), fishhook flea (*Cercopagis pengoi*), and a third water flea species (*Daphnia lumholtzi*); and three plant species: Eurasian milfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus*), and purple loosestrife (*Lythrum salicaria*). Other exotic species that have the potential to invade Michigan's aquatic ecosystems include four plants: flowering-rush (*Butomus umbellatus*), European frog-bit (*Hydrocharis morsus-ranae*), hydrilla (*Hydrilla verticillata*), and European water chestnut (*Trapa natans*); and the New Zealand mud snail (*Potomopyrgus antipodarum*) (Hart et al., 2000).

The federal Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (amended by the National Invasive Species Act of 1996) addresses the issue of invading species. This law has five purposes:

- Prevent unintentional introductions.
- Coordinate research, control, and information dissemination activities.
- Develop and carry out environmentally sound control methods.
- Minimize economic and ecological impacts.
- Establish a research and technology program to benefit state governments.

State legislation enacted in 2005, including Public Acts 74-81, provide additional state prevention and control mechanisms. These laws establish lists of prohibited and restricted species and penalties for possession, create an Invasive Species Council addressing both terrestrial and aquatic species, establish an Invasive Species Fund to be used for administration and information/education, and require the creation of a Web site providing information about ANS to the public. The MDNR is the lead agency.

Michigan's ANS State Management Plan was updated in 2002 and includes key recommendations for legislation and policy, research and monitoring, and information and education. Implementation of the plan is coordinated by Michigan's ANS Council, established by Executive Order No. 2002-21 in November 2002. Michigan's ANS State Management Plan Update and information regarding Michigan's ANS Council are available at http://www.michigan.gov/deqwater under Great Lakes, Aquatic Invasive Species.

Several publications, including the *Aquatic Nuisance Species Handbook for Government Officials,* which provide information regarding identification, management, and environmental impacts of exotic species in Michigan and in the Great Lakes area, are available at the aquatic invasive species website (see above).

2.25.3 Saginaw Bay Coastal Initiative

The Saginaw Bay Coastal Initiative was formed in August 2006. Through the Saginaw Bay Coastal Initiative, the MDEQ and other state agencies are working with citizens, local government officials, and multiple regional and federal agencies to develop and implement a comprehensive approach to promoting environmentally sound economic development and resource restoration in the Saginaw Bay coastal areas by:

- Identifying methods to enhance the economic development of the Saginaw Bay coastal area and the quality of its parks and beaches and other natural areas.
- Seeking partnerships to develop new cultural, recreational, and social resources for Saginaw Bay area citizens and visitors.
- Working with local interests to improve water quality in Saginaw Bay and its associated waterways.

The Saginaw Bay Coastal Initiative encourages regular discussions to determine how state, federal, and local interests can work together to achieve resource protection, improve environmental quality, and expand economic development. This includes opportunities to discuss the local impact of state and federal programs and to look for opportunities to meet the goals of these programs through new and innovative means. Additional information regarding the Saginaw Bay Coastal Initiative can be found at www.michigan.gov/deq/ under Issues to Watch.

Shoreline deposits of decaying organic matter, abundant plant and algae growth, and beach closures are a concern along Saginaw Bay and other Great Lakes near shore areas (see Chapter 5). In 2008, the National Oceanic and Atmospheric Administration initiated an extensive, five-year study of Saginaw Bay to generate a better understanding of the multiple stressors that are affecting the character of both the nearshore and open water regions of Saginaw Bay. This study is devoted to understanding the mechanisms and processes that are affecting the bay. The MDEQ is collaborating with researchers in an effort to address questions about designated use support. The MDEQ recently supported additional research by various university scientists to help understand issues that affect some portions of the bay (e.g., shorelines).

2.25.4 Wet Weather

In October 2008, the MDEQ embarked on a year-long initiative to improve understanding of issues related to wet weather discharges and develop a proactive strategy to enable more effective protection of water quality from such discharges. MDEQ staff from multiple program areas are exploring wet weather issues related to land application of wastes, development and other types of earth change, urban areas, monitoring, and development and applicability of WQS and water quality-based effluent limits. In addition, the MDEQ is collaborating with University of Michigan researchers to benchmark other states' activities in these areas. Final reports are expected in 2010.

2.26 Cost/Benefit Assessment

The activities described in this chapter are carried out by several MDEQ divisions and offices. Full quantification of expenditures is not possible at this time. However, the WB alone spent approximately $47.3 million in Fiscal Year 2008 and $48.2 million in Fiscal Year 2009 for the implementation of water quality protection, restoration, and monitoring programs. Sources include federal funds, state general funds, CMI state bond funds, and fees. These expenditures support MDEQ staffing and operating expenses as well as grants and loans to local governments and organizations. A variety of water quality protection activities are implemented through these funds, including regulatory requirements, technical and financial assistance, and education/outreach efforts. These expenditures also leverage substantial local funds and services, since many of the programs and grants have cost-share or match requirements.

The benefits associated with the implementation of these programs are numerous, although it is not possible to accurately quantify the benefits in strictly monetary terms. From a financial perspective, tourism currently is Michigan's second largest source of jobs and revenue, after manufacturing. Citizens and out-of-state tourists spend billions of dollars each year in Michigan, much of that on outdoor sports and recreation that depend on clean water, air, and forests. Popular activities include hunting, fishing, boating, and swimming at Great Lakes and inland beaches. The revenues from these activities far exceed the money spent on water quality protection and monitoring activities each year. Aside from strictly financial considerations, clean water is also essential to protect human health, drinking water quality, biological diversity, and quality of life issues, which attract many businesses and citizens to live and work in Michigan.

CHAPTER 3
WATER QUALITY MONITORING

Environmental monitoring is an essential component of the MDEQ mission. Comprehensive water quality monitoring is necessary to improve natural resource management, maintain sustainable ecosystems, and protect public health. Although the MDEQ is the lead state agency responsible for monitoring, assessing, and managing the state's surface water and groundwater, effective water resource management is best achieved through the formation and implementation of meaningful coalition partnerships with outside entities including other state and federal agencies, Canadian organizations, local governments, tribes, universities, industry, environmental groups, and citizen volunteers. Wherever possible, the MDEQ strives to organize and direct the resources and energies created by these partnerships through a "watershed approach" to protect the quality and quantity of the state's water resources.

Many MDEQ water quality monitoring and water pollution control programs are integrated and implemented according to a five-year rotating watershed cycle to facilitate effective watershed management. Michigan has 57 major watersheds based on the USGS's 8-digit HUCs. Water quality assessment efforts focus on a subset (approximately 20%) of these major watersheds each year (Figure 3.1).

In January 1997, the MDEQ completed a monitoring report entitled, "A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters" (Strategy) (MDEQ, 1997). It was developed specifically to identify the activities and resources needed to establish a comprehensive, state-of-the-art water quality monitoring program, and has guided Michigan's monitoring program implementation. The Strategy consists of nine interrelated elements: fish contaminants, water chemistry, sediment chemistry, biological integrity, wildlife contaminants, bathing beaches, inland lake quality and eutrophication, stream flow, and volunteer monitoring. The Strategy specifically identifies four monitoring goals:

- Assess the current status and condition of waters of the state and determine whether WQS are being met.
- Measure spatial and temporal water quality trends.
- Evaluate the effectiveness of water quality protection programs.
- Identify new and emerging water quality issues.

The evolving nature of management and program needs, technology, and technical monitoring guidance/science requires continuous evaluation of existing activities to ensure effective, comprehensive monitoring and to identify opportunities for improvement. Program assessment led to an update of the 1997 Strategy in May 2005 (MDEQ, 2005b) (available at http://www.michigan.gov/deqwater under Water Quality Monitoring, Assessment of Michigan Waters). Another impetus for the update was a requirement by the USEPA that states produce a comprehensive monitoring program strategy that serves all water quality management needs

and addresses all state waters. The purpose of the update was to: (1) describe ongoing monitoring activities (including monitoring objectives, study design, indicators, data analysis, data management, and reporting); (2) identify potential future monitoring activities, to the extent possible; (3) identify program gaps and a timeline for addressing them; and (4) specify resource needs (staff, funding, and technical).

The Strategy does not specifically address wetland monitoring. The LWMD submitted a Wetland Monitoring and Assessment Strategy to the USEPA, Region 5, in January 2009. This strategy recognizes that gaps remain in Michigan's wetland monitoring program. The USEPA Wetland Program Development Grant funding has been provided to the LWMD to address remaining gaps, including steps to encourage integration of wetland monitoring into existing statewide water quality monitoring. The LWMD is also cooperating with Central Michigan University and other academic partners to implement coastal wetland monitoring protocols developed through the Great Lakes Coastal Wetland Consortium with funding from the USEPA.

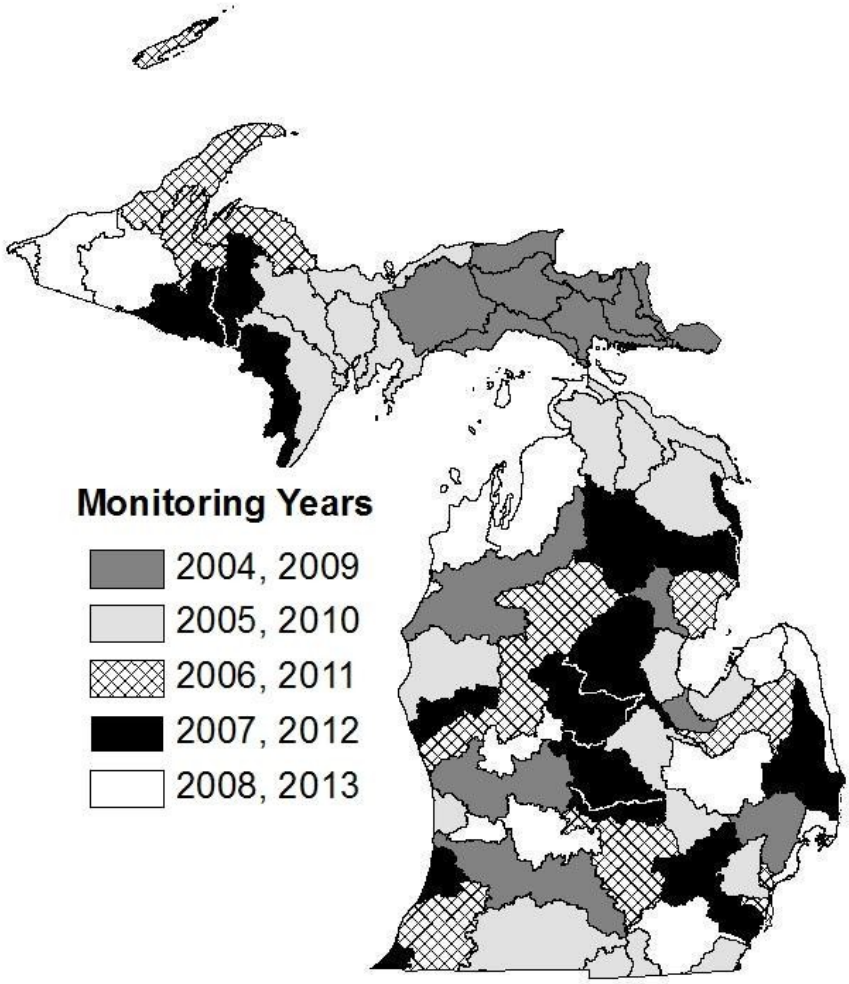


Figure 3.1 Five-Year Rotating Watershed Cycle.

CHAPTER 4
ASSESSMENT METHODOLOGY

4.1 Introduction

Michigan's assessment methodology describes the data and information used to determine designated use support, explains how these data and information are used to determine designated use support for surface waters of the state, and describes how data are reported using five categories. Ultimately, this methodology describes the process used to develop several of the appendices and summary tables included in this IR to satisfy the requirements of Sections 305(b) and 303(d) of the federal CWA.

The internal coordination and review process used to generate Sections 305(b) and 303(d) lists is carried out by a team of MDEQ technical staff and managers with considerable knowledge of local watershed conditions/issues and expertise in aquatic and fisheries biology, limnology, ecology, environmental engineering and chemistry, microbiology, and mammalian/aquatic toxicology.

4.2 Data and Information Used to Determine Designated Use Support

The MDEQ considers readily available and quality checked data and information collected and submitted by the MDEQ, its grantees and contractors, other agencies, and the public (including volunteer monitoring groups). Sources of data and information include:

- The MDEQ's water quality monitoring program data that includes eight interrelated elements: fish contaminants, water chemistry, sediment chemistry, biological integrity and physical habitat, wildlife contaminants, bathing beach monitoring, inland lakes monitoring, and stream flow (see Chapter 3).

  As part of the MDEQ's water quality monitoring program, sites for biological integrity and water chemistry monitoring are selected using both targeted and probabilistic study designs. The probabilistic monitoring approach is used to address statewide and regional questions about water quality. Targeted monitoring is used to fulfill specific monitoring requests, assess known or potential problem areas or areas where more information is needed, achieve assessment coverage of a watershed, and provide information to support and evaluate the effectiveness of MDEQ water protection programs (e.g., NPDES, NPS, and Site Remediation). All site-specific data are considered to determine designated use support. Generally, the other types of monitoring are conducted using targeted study designs.

- Michigan's 2008 IR (LeSage and Smith, 2008), which serves as a baseline for the 2010 IR and is modified using new data and information.

- Fish Consumption Advisories established by the MDCH as of May 2009.

- Dilution calculations, trend analyses, or predictive models for determining the physical, chemical, or biological integrity of surface water bodies.

- Reports of fish kills and chemical spills.

- Surface water quality monitoring data submitted by the general public or outside agencies. This information was solicited by the MDEQ in a notice on the MDEQ Web-based Calendar in the following publications: March 30, April 13, April 27, May 11, and May 25, 2009. Information was also solicited from the MDNR Fisheries Division, Michigan Department of Transportation, MDA, United States Forest Service, USFWS, and USEPA via e-mail on April 14, 2009.

- Surface water, drinking water, and source water quality assessments conducted under Section 1453 of the federal Safe Drinking Water Act, enacted by Public Law 93-523, December 16, 1974, as amended through August 6, 1996, being Title 42 of the United States Code (U.S.C.), Section 300j-13.

- Remedial investigation/feasibility studies to support Records of Decision under the Comprehensive Environmental Response, Compensation, and Liability Act, 1980 PL 96-510 or Part 201, Environmental Remediation, of the NREPA.

To ensure adequate time for proper data analysis, the MDEQ applies a cutoff date for newly collected data considered for the IR (i.e., data that were not used for development of the 2008 IR). For the 2010 IR, the MDEQ considered all new readily available and quality-checked water quality data and information collected by the MDEQ and its grantees/contractors within the two-year period immediately following the data considered for the 2008 IR. In other words, data collected during the period from January 1, 2007, to December 31, 2008, were considered for the 2010 IR. Data collected prior to January 1, 2007, that were unable to be used for the 2008 IR were considered for the 2010 IR using the current assessment methodology. Water Chemistry Monitoring Project (WCMP) data collected through 2007 were used for this IR. WCMP data collected in 2008 were not quality-checked in sufficient time to be used for this IR. Data collected after the December 31, 2008, cutoff date were considered for inclusion in the 2010 IR on a case-by-case basis as determined appropriate by the MDEQ. TMDL documents completed in 2009 were used to prepare this IR. Water quality data collected since January 1, 2007, and submitted to the MDEQ by June 5, 2009, by other parties (e.g., in response to the data solicitation described in the above bulleted list, from the Michigan Clean Water Corps volunteer monitoring database, etc.) were evaluated according to this assessment methodology and potentially used to help prepare the 2010 IR.

The quality assurance/quality control requirements for water, sediment, and fish tissue chemistry and biological data collected by the MDEQ are described in the MDEQ's Quality Management Plan (MDEQ, 2005c). To ensure acceptable data quality, the MDEQ also requires all grantees or vendors receiving state or federal money for the purpose of conducting water quality monitoring to prepare Quality Assurance Project Plans prior to sample collection (MDEQ, 2002a). Other data, such as data submitted by outside agencies or the public, must satisfy the MDEQ's quality assurance/quality control requirements to be used to make designated use support determinations of supporting or not supporting, to change the designated use support, or to reassign water bodies to different categories. Data that do not fully satisfy the MDEQ's quality assurance/quality control requirements or data that are collected and analyzed using techniques that are less rigorous than techniques used by the MDEQ to make designated use support determinations may be used to list a water body for further evaluation (i.e., as insufficient information).

Each dataset for a water body is evaluated to determine if the data are representative of existing conditions and of adequate quality to make designated use support decisions. Data may not be representative of existing conditions if land use, point sources, or hydrologic conditions were substantially modified. Data may not be of adequate quality if field or laboratory methods changed. In addition, the quantity of data; duration, frequency, magnitude, and timing of WQS exceedances; analytical method sensitivity; and contextual information (e.g., naturally occurring, weather, and flow conditions, etc.) are considered. Target sample sizes may be given in this assessment methodology to determine designated use support; however, these sample sizes are not applied as absolute rules. Generally, data that are collected to determine compliance with permitted activities, such as NPDES discharge data, are not used to determine designated use support; however, ambient data that are collected for this purpose may be considered.

4.3 Determination of Designated Use Support

At a minimum, all surface waters of the state are designated and protected for all of the following designated uses: agriculture, navigation, industrial water supply, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, and fish consumption [Rule 100; R 323.1100(1)(a)-(g)] of the Part 4 rules, WQS, promulgated under Part 31, Water Resources Protection, of the NREPA). In addition, all surface waters of the state are designated and protected for total body contact recreation from May 1 to October 1 [R 323.1100(2)]. Specific rivers and inland lakes as well as all Great Lakes and specific Great Lakes connecting waters are designated and protected for cold water fisheries [R 323.1100(4)-(7)]. Several specific segments or areas of inland waters, Great Lakes, Great Lakes bays, and connecting channels are designated and protected as public water supply sources [R 323.1100(8)]. The Part 4 rules, WQS, form the basis for this assessment methodology.

Most designated uses have one or more types of assessment that may be used to determine support. For example, to determine support for the other indigenous aquatic life or wildlife designated use, biological or physical/chemical assessment (e.g., rapid bioassessment of the macroinvertebrate community or chemical analysis of water samples) may be used. The assessment types include biological, habitat, physical/chemical, toxicological, pathogen indicators, other public health indicators, and other aquatic life indicators (default types from the USEPA Assessment Database [ADB]). In addition, a variety of parameters may be considered for the same assessment type. For example, physical/chemical assessments to determine fish consumption designated use support may include analysis of mercury concentration in fish tissue or PCB concentration in the water column.

Michigan uses the principle of independent applicability when making a support determination for each designated use for each water body. If data for more than one parameter are available that are used to determine support for the same designated use, then each data type is evaluated independently to determine support for the designated use. If any one type of data indicates that the designated use is not supported, then generally, the water body is listed as not supporting that designated use. In some instances, data require reevaluation to resolve discrepancies. Some particular data types or situations may require consideration of multiple data types in combination. If no data are available for any assessment methods, then a water body is considered not assessed.

A single parameter may be used to make support determinations for more than one designated use. For example, appropriate data for a water body may reveal that water column mercury concentrations exceed the wildlife and human noncancer value (HNV) (non-drinking water) (R 323.1057); therefore, both the other indigenous aquatic life and wildlife, and fish consumption designated uses are not supported. Another example includes the situation where water column copper concentrations exceed the WQS and lead to both poor macroinvertebrate and

warmwater fish communities; therefore, both the other indigenous aquatic life and wildlife, and warmwater fishery designated uses are not supported. The inclusion of a parameter under a specific designated use in this assessment methodology does not preclude the use of that parameter to make support determinations for a different designated use.

This section of the IR describes how data and information are generally used by the MDEQ to make a decision to report for a water body, one of the following conditions for each designated use: supporting, not supporting, insufficient information, or not assessed. This assessment methodology attempts to list the main assessment types and parameters that are used to determine support for each designated use. Water body, assessment, or data types that are not specifically discussed in this assessment methodology (including uncommon data or unusual circumstances) are considered on a case-by-case basis using best professional judgment (BPJ) and are evaluated consistent with WQS. When BPJ is used to make a designated use support determination, justification is documented in the designated use comment field in the ADB record. Water bodies listed as having insufficient information will generally be revisited in the correct basin year as resources allow (Figure 3.1).

4.4 Designated Uses: Agriculture, Navigation, and Industrial Water Supply

4.4.1 Assessment Type: No Specific Indicator or Assessment Method

The MDEQ does not conduct specific assessments to evaluate support of the agriculture, navigation, and industrial water supply designated uses. These uses are assumed to be supported unless there is site-specific information indicating otherwise. In a scenario where site-specific information is used, the information is evaluated on a case-by-case basis using BPJ.

4.5 Designated Use: Warmwater Fishery and Cold Water Fishery

All surface waters of the state are designated and protected for warmwater fishery. In addition, specific rivers and inland lakes as well as all Great Lakes and specific Great Lakes connecting waters are designated and protected for cold water fishery per R 323.1100(4)-(7).

4.5.1 Assessment Type: Physical/Chemical

4.5.1.1 Dissolved Oxygen Concentration

The number of instantaneous dissolved oxygen measurements needed to make a support determination for the warmwater and cold water fishery designated uses is made on a case-by-case basis using BPJ. Continuous data collected over a longer time period (e.g., two weeks) that are representative of conditions and capture environmental variability (e.g. due to changes in weather and temperature) are preferred over periodic single samples. Consideration of contextual information is especially important when making designated use determinations using dissolved oxygen concentrations (sample collection time of day, weather conditions, etc.). Ambient dissolved oxygen data are compared to WQS per R 323.1064 and R 323.1065, depending on water body type.

4.5.1.2 Temperature

The amount of temperature data needed to make a support determination for the warmwater and cold water fishery designated uses is made on a case-by-case basis using BPJ. Continuous data collected over a longer time period (e.g., two weeks) that are representative of conditions and capture environmental variability (e.g. due to changes in weather and temperature) are preferred over periodic single samples. Ambient temperature data are

compared to WQS per R 323.1069, R 323.1070, R 323.1072, R 323.1073, and R 323.1075, depending on water body type.

4.5.1.3 Ammonia (un-ionized) Concentration

The number of total ammonia measurements needed to make a support determination for the warmwater fishery designated use is made on a case-by-case basis using BPJ. Supporting site-specific pH and temperature data are generally required. Continuous pH and temperature data over a longer time period (e.g., two weeks) are preferred. Calculated un-ionized ammonia data are compared to standards per R 323.1057.

4.5.1.4 Dissolved Solids

Designated use support determination using dissolved solids data is made on a case-by-case basis using BPJ and R 323.1051.

4.5.1.5 pH

The number of pH measurements needed to make a designated use support determination is made on a case-by-case basis using BPJ. Ambient pH data are compared to WQS per R 323.1053.

4.5.2 Assessment Type: Biological

4.5.2.1 Fish Community

In addition to chemical and physical assessment types, Michigan uses rapid bioassessment of fish communities in wadeable streams and rivers [generally Procedure 51 (P51) (MDEQ, 1990)] to determine support for the warmwater fishery and cold water fishery designated uses. Fish community biosurvey sites are selected using targeted study designs.

Rivers and streams with no site-specific fish community biosurvey results are considered not assessed.

Using P51, warmwater fish communities are scored with metrics that rate water bodies from excellent (+5 to +10) to poor (-10 to -5). Fish ratings from -4 to +4 are considered acceptable.

Water bodies with warmwater fish communities rating acceptable or excellent using P51 are determined to support the warmwater fishery designated use. Fish communities collected from designated cold water streams using P51 are determined to support the cold water fishery designated use if the relative abundance of salmonids is equal to or greater than 1%. One bioassessment result is generally considered sufficient to make this determination.

Using P51, a determination of not supporting or insufficient information is made for water bodies that have metrics that rate the warmwater fish community poor, have cold water fish communities with salmonid relative abundance of less than 1%, or if fewer than 50 fish are collected or if the relative abundance of fish with anomalies exceeds 2% (applies to both warmwater and cold water fisheries) depending on the quality and amount of supporting contextual information available. For example, a poor fish community result may require the collection of additional information to determine data representativeness. In this case, a determination of insufficient information is made. Generally, targeted biosurvey results should have sufficient supporting information available to determine survey representativeness and to list the water body as not supporting using one survey result.

For biological communities that rate poor, current and past weather conditions, assessments of biological communities in adjacent stream or river segments, and the source and frequency of pollutant exposure are considered to determine if conditions are ongoing or temporary. If conditions are determined to be temporary, a water body may be listed as having insufficient information. For example, a water body with a temporarily poor biological community due to a short-term chemical spill may be listed as having insufficient information if remediation occurred and the community was expected to recover.

Fish community data for wadeable streams and rivers collected using methods other than P51 are evaluated on a case-by-case basis using BPJ. Biological integrity data regarding instances where P51 is not appropriate (e.g., wetlands, lakes, ephemeral water bodies, nonwadeable rivers, etc.) will be evaluated on a case-by-case basis using BPJ. For example, one of the factors considered to determine support of the cold water fishery designated use in cold water lakes is the presence of indicator species such as cisco.

4.6 Designated Use: Other Indigenous Aquatic Life and Wildlife

4.6.1 Assessment Type: Physical/Chemical

4.6.1.1 Water Column Toxic Substance Concentrations

To determine other indigenous aquatic life and wildlife designated use support for toxic substances, ambient water column chemical concentrations are compared to Wildlife, Aquatic Maximum, and Final Chronic Values per R 323.1057 using Figure 4.1. Water chemistry monitoring sites are selected using both targeted and probabilistic study designs. All site-specific water column chemistry data are used to determine other indigenous aquatic life and wildlife designated use support.

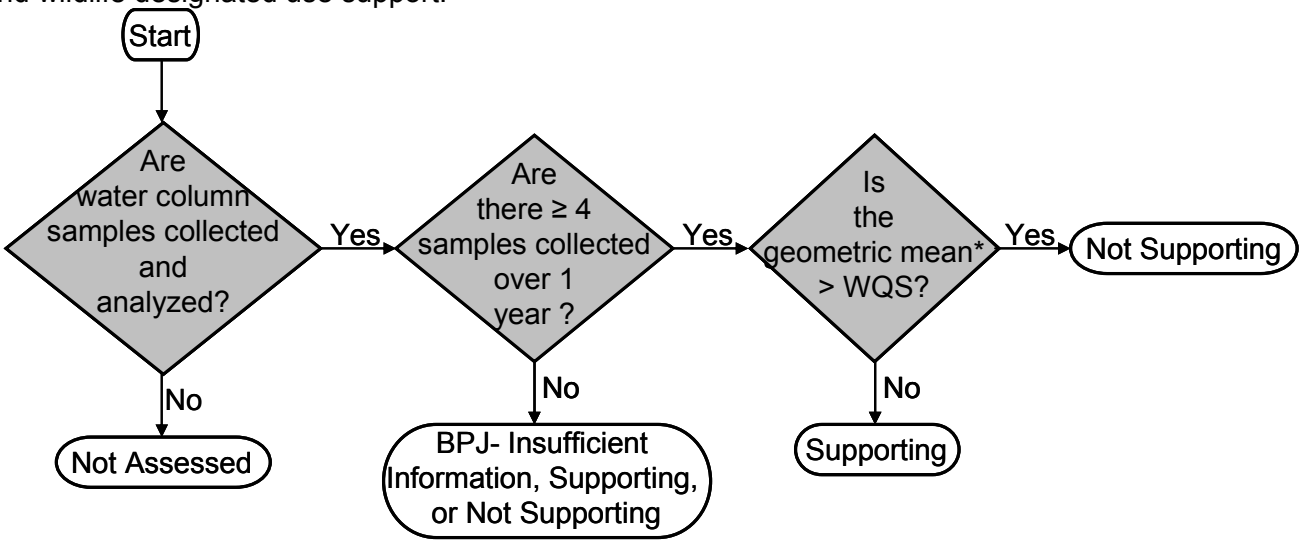


Figure 4.1. Determination of other indigenous aquatic life and wildlife designated use support using water column toxic substance concentration. *Geometric mean is used per R 323.1207(1)(g)(iii).

4.6.1.2 Water Column Nutrient Concentrations

Ambient water column nutrient concentrations are used in conjunction with biological indicators to determine support of the other indigenous aquatic life and wildlife designated use per R 323.1060 using BPJ since Michigan does not have numeric standards for ambient concentrations of plant nutrients. Samples collected during the period of July through

September, when the impacts due to nutrient expression are most likely to occur, are particularly important for making designated use support determinations.

For inland lakes, Carlson's trophic status index (TSI) in conjunction with aquatic macrophyte surveys, are considered to determine designated use support. Individual TSI values are calculated for each trophic state indicator: summer secchi depth (transparency), total phosphorus concentration (epilimnetic), and chlorophyll *a* concentration (photic zone) (Table 4.1). An overall TSI is determined from the mean of the individual TSI values and the trophic status classification is determined based on the criteria listed in Table 4.2. Inland lakes classified as oligotrophic, mesotrophic, or eutrophic are generally determined to support the other indigenous aquatic life and wildlife designated use. Inland lakes that are classified as hypereutrophic are generally listed as insufficient information or not supporting.

Table 4.1. Carlson's TSI Equations.	
$TSI_{SD} = 60 - 33.2 \log_{10}SD$	SD = Secchi depth transparency (m)
$TSI_{TP} = 4.2 + 33.2 \log_{10}TP$	TP = total phosphorus concentration (ug/l)
$TSI_{CHL} = 30.6 + 22.6 \log_{10}CHL$	CHL = chlorophyll *a* concentration (ug/l)

Table 4.2 Michigan Inland Lakes Trophic Status Classification Criteria.

Trophic State	Carlson's TSI	TP (ug/l)	SD (m)	CHL (ug/l)
Oligotrophic	<38	<10	>4.6	<2.2
Mesotrophic	38-48	10-20	2.3-4.6	2.2-6
Eutrophic	48-61	20-50	0.9-2.3	6-22
Hypereutrophic	>61	>50	<0.9	>22

4.6.1.3 Physical Characteristics

R 323.1050 addresses the following physical characteristics of a water body: turbidity, color, oil films, floating solids, foams, settleable solids, suspended solids, and deposits. Michigan does not have specific assessment methods or numeric standards for these physical characteristics; therefore, BPJ (including visual observation) in conjunction with other assessment types (e.g., biological) is used to determine the other indigenous aquatic life and wildlife designated use support based on this narrative standard.

4.6.2 Assessment Type: Biological

4.6.2.1 Macroinvertebrate Community

In addition to chemical and physical assessment types, Michigan uses rapid bioassessment of macroinvertebrate communities in wadeable streams and rivers (generally P51; MDEQ, 1990) to determine support for the other indigenous aquatic life and wildlife designated use. Using P51, macroinvertebrate communities are scored with metrics that rate water bodies from excellent (+5 to +9) to poor (-5 to -9). Macroinvertebrate ratings from -4 to +4 are considered acceptable. Biosurvey sites are selected using both targeted and probabilistic study designs. All site-specific biosurvey data are considered to determine other indigenous aquatic life and wildlife designated use support.

Rivers and streams with no site-specific macroinvertebrate community biosurvey results are considered not assessed.

Water bodies with macroinvertebrate communities rating acceptable or excellent (i.e., total P51 macroinvertebrate community score -4 to +9) are determined to support the other indigenous aquatic life and wildlife designated use. One bioassessment result is generally considered sufficient to make this determination.

A determination of not supporting or insufficient information is made for water bodies with macroinvertebrate communities rated poor (total P51 macroinvertebrate community score -5 to -9) depending on the quality and amount of supporting contextual information available. For example, a poor macroinvertebrate community result from a biosurvey conducted as part of probabilistic monitoring may require the collection of additional information to determine data representativeness. In this case, a determination of insufficient information is made. Generally, targeted biosurvey results should have sufficient supporting information available to determine survey representativeness and to list the water body as not supporting using one survey result. For biological communities that rate poor, current and past weather conditions, assessments of biological communities in adjacent stream or river segments, and the source and frequency of pollutant exposure are considered to determine if conditions are ongoing or temporary (see Section 4.5.2.1).

Macroinvertebrate data for wadeable streams and rivers collected using methods other than P51 are evaluated on a case-by-case basis using BPJ. Biological integrity data regarding instances where P51 is not appropriate (e.g., wetlands, lakes, ephemeral streams, etc.) will be evaluated on a case-by-case basis using BPJ.

Nonwadeable rivers are assessed using Michigan's Qualitative Biological and Habitat Survey Protocols for Nonwadeable Rivers (MDEQ, Nonwadeable Procedure, in preparation). Using this nonwadeable procedure, macroinvertebrate communities are scored with metrics that rate water bodies from excellent to poor. Macroinvertebrate ratings from 76-100 are considered excellent, 50-75 good, 25-49 fair, and 0-24 are considered poor.

Nonwadeable rivers with macroinvertebrate communities rating excellent, acceptable, or fair (i.e., total macroinvertebrate community score ≥25) are determined to support the other indigenous aquatic life and wildlife designated use. One bioassessment result is generally considered sufficient to make this determination.

Similar to determinations made for wadeable streams and rivers, a determination of not supporting or insufficient information is made for nonwadeable rivers with macroinvertebrate communities rated poor (total macroinvertebrate community score 0-24) depending on the quality and amount of supporting contextual information available.

4.6.2.2 Bacteria, Algae, Macrophytes, and Fungi

Site-specific visual observation of bacteria, algae, macrophytes, and fungi may be used to make a support determination for the other indigenous aquatic life and wildlife designated use. In addition, water column nutrient concentrations may also be used to support this determination (see Section 4.6.1.2).

A determination of not supporting may be made if excessive/nuisance growths of algae (particularly, *Cladophora*, *Rhizoclonium*, and cyanobacteria) or aquatic macrophytes are present. Although the determination of excessive, nuisance conditions is made using BPJ, P51 offers the following guidance to make these determinations for streams:

- *Cladophora* and/or *Rhizoclonium* greater than 10-inches long covering greater than 25% of a riffle.
- Rooted macrophytes present at densities that impair the designated uses of the water body.
- Presence of bacterial slimes.

For inland lakes, chlorophyll *a* (used as a surrogate for algal biomass) is a component of the TSI calculation and is used quantitatively to determine the trophic state (see Section 4.6.1.2).

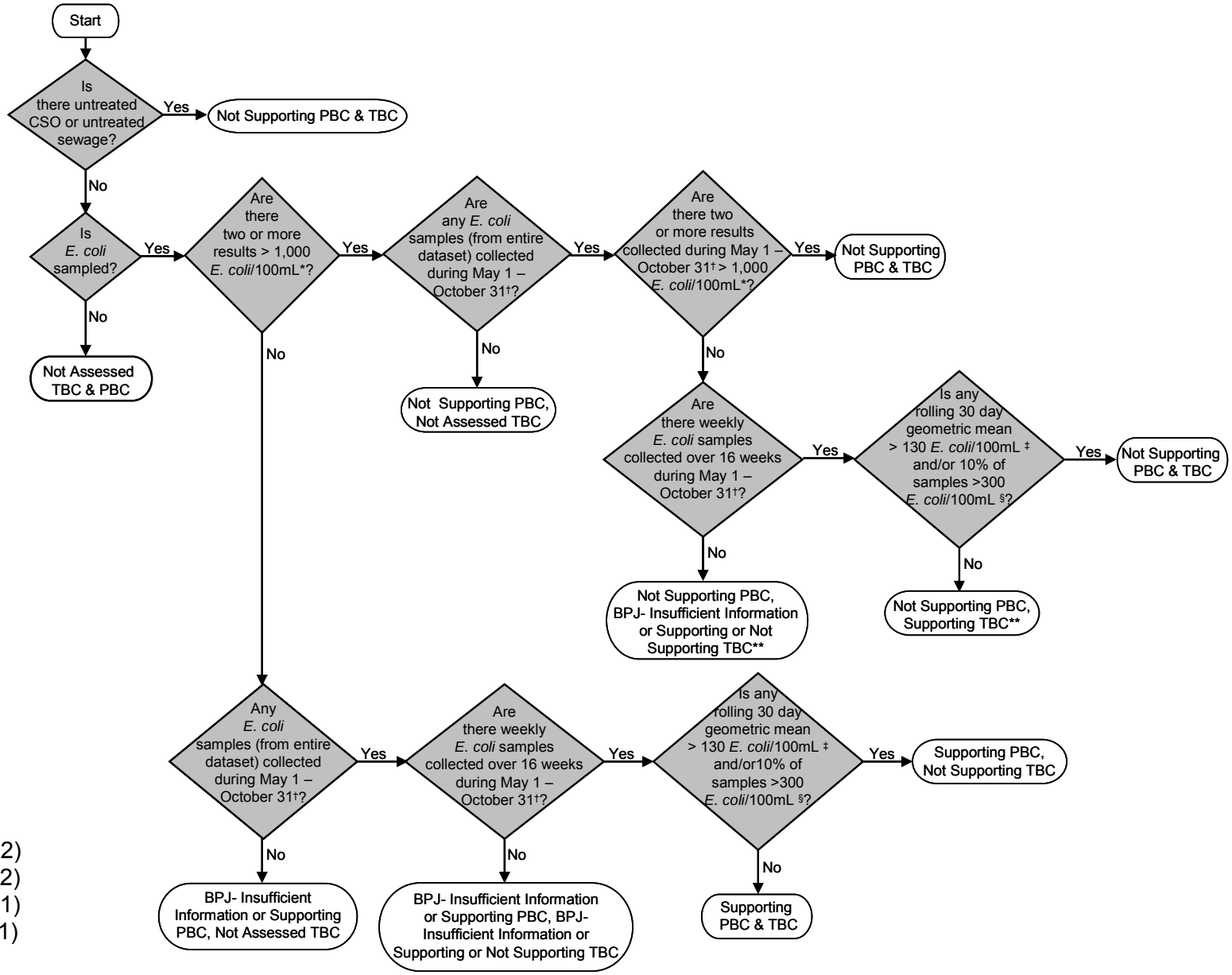
4.7 Designated Use: Partial Body Contact Recreation and Total Body Contact Recreation

The partial body contact recreation designated use applies to all water bodies year-round while the total body contact recreation designated use applies to all water bodies during May 1 to October 31.

4.7.1 Assessment Type: Pathogen Indicators

4.7.1.1 E. coli

Michigan uses ambient *E. coli* concentration to determine partial body contact and total body contact recreation designated use support using Figure 4.2.



* See R 323.1062(2)
† See R 323.1100(2)
‡ See R 323.1062(1)
§ See R 323.1062(1)

** It is possible to arrive at a decision of supporting for total body contact recreation (TBC) and not supporting for partial body contact recreation (PBC) if *E. coli* concentrations are low during the total body contact recreation season (May 1-October 31) and high during the nonrecreation season.

Figure 4.2. Determination of partial body contact and total body contact designated use support using ambient *E. coli* water column concentration.

4.8 Designated Use: Fish Consumption

Michigan uses a variety of assessment types and parameters to determine fish consumption designated use support. Data considered include the concentration of bioaccumulative chemicals of concern (BCCs) (as listed in Table 5 of the Part 4 rules) in the water column, fish tissue mercury concentration, fish consumption advisories issued by the MDCH, and final chronic values.

4.8.1 Assessment Type: Physical/Chemical

4.8.1.1 Water Column and Fish Tissue Mercury Concentrations

To be conservative, site-specific water column and fish tissue data are used together to determine fish consumption designated use support. Ambient water column mercury concentrations are compared to the HNV (non-drinking water) WQS (1.8 nanograms per liter [ng/L]); fish tissue mercury concentrations in edible portions are compared to Michigan's fish tissue value for mercury (0.35 milligrams per kilogram [mg/kg]).

Michigan's fish tissue mercury value development method is similar to the USEPA's development method for the national fish tissue criterion (USEPA, 2001). Michigan's fish tissue mercury value (0.35 mg/kg) was derived using the same exposure scenario used to derive Michigan's HNV (non-drinking water) WQS of 1.8 ng/L. Michigan's fish tissue value for mercury is the concentration that is not expected to pose a health concern to people consuming 15 grams or less of fish per day.

The fish tissue mercury value is not an ambient WQS; however, the MDEQ considers the direct use fish tissue mercury data appropriate to help determine fish consumption designated use support.

Fish consumption designated use support for mercury is determined by using Figure 4.3 to make a decision for water column mercury concentration, using Figure 4.4 to make a decision for fish tissue mercury concentration, and finally using Table 4.3 to determine overall fish consumption designated use support for mercury using the results from the Figures 4.3 and 4.4 decision processes. The overall designated use support for mercury determination from Table 4.3 is used for the Sections 305(b) and 303(d) reporting process.

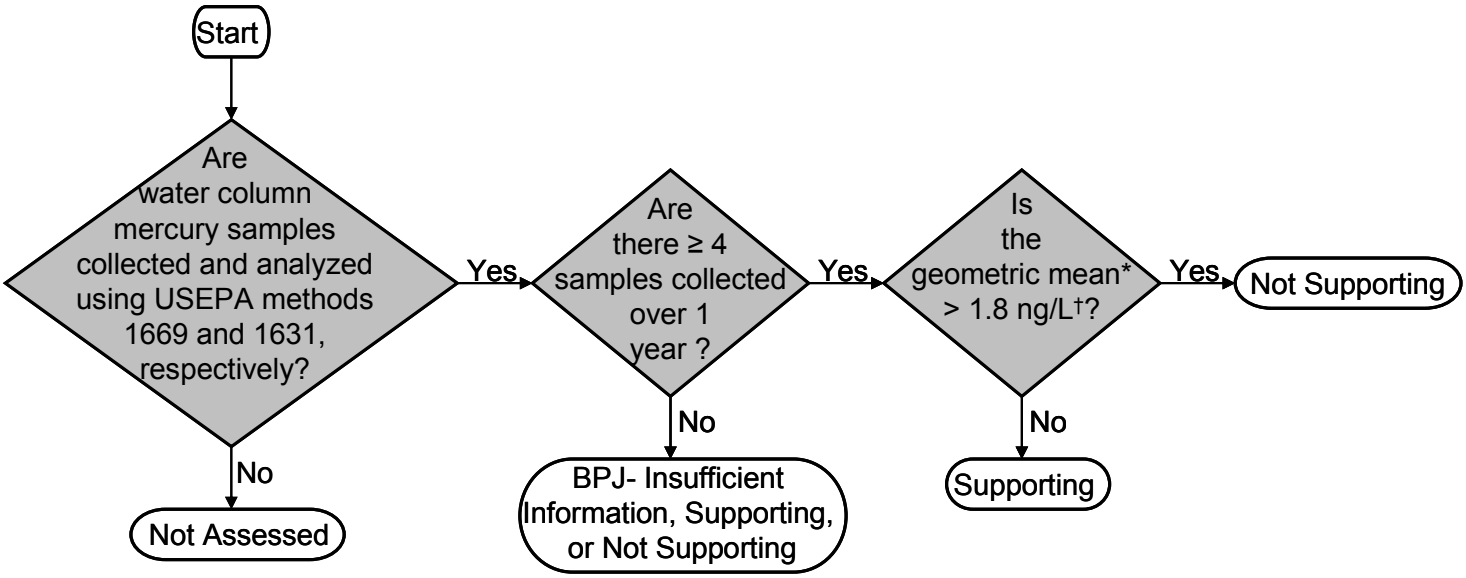


Figure 4.3. Determination of fish consumption designated use support using water column mercury concentration. This figure must be used in conjunction with Figure 4.4. The final overall fish consumption designated use support determination using mercury data is made using Table 4.3. * Geometric mean is used per R 323.1207(1)(g)(iii). † Michigan WQS HNV (non-drinking water) for mercury.

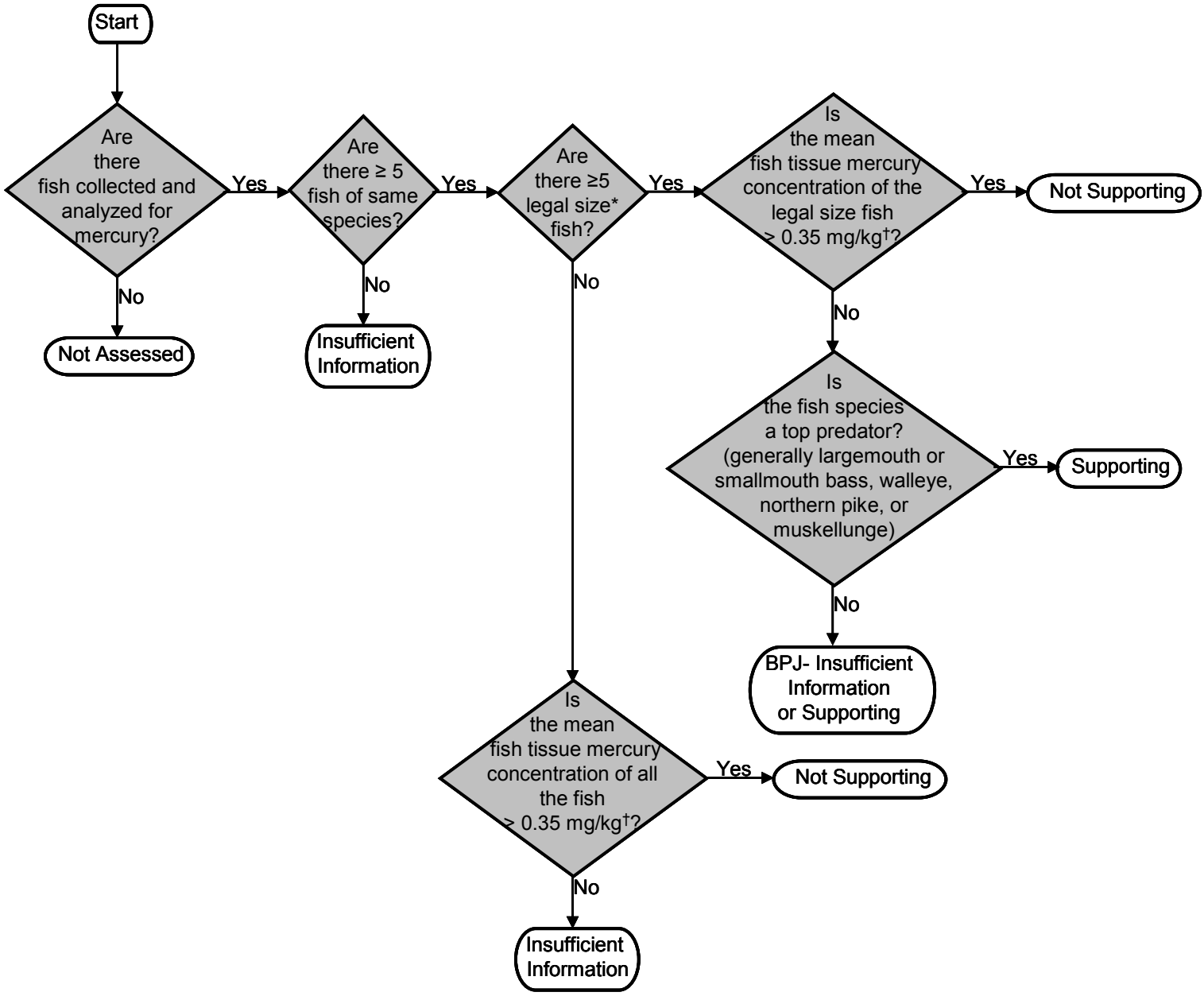


Figure 4.4. Determination of fish consumption designated use support using fish tissue mercury concentration. This figure must be used in conjunction with Figure 4.3. The final overall fish consumption designated use support determination using mercury data is made using Table 4.3. * Legal size fish refers to the current minimum size limit regulations described in Michigan's Fishing Guide and Inland Trout and Salmon Guide published by the MDNR.
† Michigan's fish tissue value for mercury.

Table 4.3. Overall fish consumption designated use support determination for mercury using water column and fish tissue mercury concentration.		
Decision based on mercury water column data (from Figure 4.3)	Decision based on mercury fish tissue data (from Figure 4.4)	Overall fish consumption designated use support for mercury
Supporting	Supporting	Supporting
Supporting	Not Supporting	BPJ*- Supporting, Not Supporting, or Insufficient Information
Supporting	Not Assessed/ Insufficient Information	Supporting
Not Supporting	Supporting	Not Supporting
Not Supporting	Not Supporting	Not Supporting
Not Supporting	Not Assessed/ Insufficient Information	Not Supporting
Not Assessed/ Insufficient Information	Supporting	Supporting
Not Assessed/ Insufficient Information	Not Supporting	Not Supporting
Not Assessed/ Insufficient Information	Not Assessed/ Insufficient Information	Not Assessed/ Insufficient Information

* In addition to the elements discussed in Section 4.2, the size and species of fish collected and analyzed, and the existence or potential for site-specific mercury fish consumption advisories, are considered when making designated use support decisions using BPJ.

4.8.1.2 Water Column PCB Concentration

To determine fish consumption designated use support for PCBs, the ambient water column PCB concentration is compared to the Human Cancer Value (HCV) (0.026 ng/L) (R 323.1057). PCB samples should be collected and analyzed according to protocols published by the USEPA (1997a and 1997b), with the exception that dissolved and particulate fractions are combined. For PCBs, a sample size of 1 is considered sufficient information to determine WQS nonattainment. This approach is justified by the existence of a large PCB dataset for the state as a whole, which shows virtually 100% exceedance of the HCV for total PCBs. If there are no appropriate PCB data, then a water body is considered not assessed. Water bodies with one or more ambient water column PCB sample results greater than the HCV are determined to not support the fish consumption designated use.

4.8.1.3 Water Column BCCs Concentration other than Mercury and PCBs

To determine fish consumption designated use support for BCCs other than mercury and PCBs in the water column, ambient water column chemical concentrations are compared to the HNV and HCV (non-drinking water) per R 323.1057 using Figure 4.1 (see Section 4.6.1.1).

4.8.2 Assessment Type: Other Public Health Indicators

4.8.2.1 Fish Consumption Advisories for BCCs other than Mercury (Primarily PCBs, DDT, Chlordane, and Dioxin)

For contaminants other than mercury, a water body is considered to not support the fish consumption designated use if the MDCH has issued a site-specific fish consumption advisory

for that water body. The MDCH bases their advisories on fish tissue contaminant data collected as part of the Michigan Fish Contaminant Monitoring Program and recommendations made by the MDEQ.

4.9 Designated Use: Public Water Supply

Several specific segments or areas of inland waters, Great Lakes, Great Lakes bays, and connecting channels are designated and protected as public water supply sources [R 323.1100(8)].

4.9.1 Assessment Type: Physical/Chemical

4.9.1.1 Toxic Substances in Water Column

To determine public water supply designated use support for toxic substances other than BCCs, ambient water column chemical concentrations are compared to the HNV and HCV for drinking water per R 323.1057 using Figure 4.1 (see Section 4.6.1.1).

Public water supply designated use support determination for BCCs is problematic and there is generally insufficient information available to make a determination. The HNV and HCV for drinking water (surface WQS) calculations use an exposure scenario that includes human consumption of 15 grams of fish and two liters of water daily. The majority of human exposure to a BCC using this scenario would be from the consumption of fish. In other words, the relative human exposure to a BCC in surface waters via water consumption is minimal. Currently, Michigan's rules do not contain a methodology to derive human health values that protect solely for the consumption of two liters of untreated surface water per day. Maximum contaminant levels, the maximum permissible level of a contaminant in water that is delivered to any user of a public water system, used by the MDEQ, Drinking Water and Environmental Health Section, do not include a specific fish consumption component in the calculation.

WQS (HNV and HCV for drinking water) and maximum contaminant levels are calculated differently and have different purposes. Due to the inconsistency between these values, comparisons of ambient water column BCC concentration to HNVs and HCVs for drinking water are not made. For example, the ambient PCB concentration at the point of a community water supply intake may exceed the PCB HCV drinking water value (0.026 ng/L) while the finished (i.e., treated) water may be determined to be below the PCB maximum contaminant level (0.5 micrograms per liter [ug/L]). The MDEQ, Surface Water Assessment Section and Drinking Water and Environmental Health Section, will work together and with the USEPA to determine a long-term solution for this issue.

4.9.1.2 Taste and Odor

To determine public water supply designated use support, site-specific complaints of taste and odor causing substances in community source waters are considered on a case-by-case basis.

4.10 Assessment Units and Determination of Geographic Extent

Michigan uses the NHD coding scheme (1:24,000 resolution) to georeference water bodies when generating the Sections 305(b) and 303(d) lists. As a base assessment unit, Michigan uses 12-digit HUCs (Appendix A). The geographic extent of a designated use support determination for each water body is made on a case-by-case basis. The 12-digit HUC base assessment unit is used as a default when listing streams and rivers to facilitate record keeping

and mapping. Each 12-digit HUC base assessment unit may be split into multiple assessment units if site-specific information supports a smaller assessment unit (e.g., contextual information such as land use, known areas of contamination, point source pollution location, specific fish consumption advisory geographic information, barriers such as dams that restrict fish migration, etc.). An assessment unit may consist of all water bodies in a 12-digit HUC (as a maximum) or specific stream segments or lakes in a 12-digit HUC.

Beyond using the 12-digit HUC as a base assessment unit, contextual information is considered when making a determination of the geographic extent that data collection points represent. For example, if a macroinvertebrate community survey conducted in the lower reach of a branch of a river indicates support of the other indigenous aquatic life and wildlife designated use and a second survey conducted farther upstream (several 12-digit HUCs upstream) in the same river branch also indicates designated use support, then contextual information may be considered to make a determination that the spanned river miles also support the designated use. In this example, contextual information may include similar physical habitat, similar land use, absence of point sources, absence of contaminated sites, etc. In other words, if contextual information indicates that it is appropriate, data collected from an assessment unit may be used to make designated use determinations for surrounding water body segments in different assessment units that lack data.

Generally, 12-digit HUCs are used as a base assessment unit for the public water supply designated use. For the public water supply designated use in inland intakes, the geographic extent of the assessment unit is the 12-digit HUC in which the intake is located.

For public water supply intakes that are located in the Great Lakes or connecting channels, a concept of a Critical Assessment Zone (CAZ) around each intake was developed based on a Sensitivity Factor calculated for each intake. The two attributes used to develop the Sensitivity Factor are the water depth above the intake structure and the perpendicular distance from shore or length of the intake pipeline. Other factors such as localized flow patterns, thermal effects, wind effects, lake bottom characteristics, benthic nepheloid layers, etc., may be used to complete the sensitivity analysis. A radius for the CAZ, ranging from 3000 feet for the most sensitive intakes to 1000 feet for the least sensitive intakes, is assigned based on the Sensitivity Factor. A shape with this radius is then drawn around the intake to illustrate the CAZ. If the CAZ intersects the shoreline, then the geographic extent of the assessment unit is determined on a case-by-case basis as the most influential 12-digit HUCs that are along the shoreline within the CAZ. For intakes that are located in open waters of the Great Lakes where the CAZ does not intersect the shoreline, the geographic extent of the assessment unit is 1.5 square miles.

Ultra low-level PCB monitoring conducted by the MDEQ indicates that PCB concentrations exceed the HCV WQS (0.026 ng/L) in all waters sampled. Based on these results, all river miles in the individual watersheds sampled for PCBs are listed as not supporting the fish consumption designated use for PCBs in the water column.

The geographic extent of some beaches is not currently available. In these instances, a geographic extent of 0.2 shoreline miles was used as a default value.

Streams and rivers are listed in terms of miles. Wetlands are listed in terms of acres. Generally, inland lakes are listed in their entirety as acres and Great Lakes and bays are listed in terms of square miles, except for Great Lake and inland lake beaches, which are listed in terms of shoreline miles for pathogen concerns.

4.11 Assessment Unit Assignment to Categories

After support determinations for all designated uses and geographic extent decisions are made for an assessment unit, categories are assigned using a multiple category system. The following categories and subcategories are used:

Category 1: All designated uses are supported, no use is threatened.

Category 2: Available data and/or information indicate that some, but not all of the designated uses are supported.

Category 3: There is insufficient available data and/or information to make a designated use support determination.

Category 4: Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed.

- Category 4a: A TMDL to address the impairment-causing pollutant has been approved or established by the USEPA.
- Category 4b: Other approved pollution control mechanisms are in place and are reasonably expected to result in attainment of the designated use within a practical time frame.
- Category 4c: Impairment is not caused by a pollutant (e.g., impairment is due to lack of flow or stream channelization).

Category 5: Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

An assessment unit is considered threatened and is placed in Categories 4 or 5 when water quality data analysis demonstrates a declining trend that is expected to cause that water body to not attain WQS by the next listing cycle (2012). An assessment unit is not attaining WQS when any designated use is not supported (i.e., Category 4 or 5). Assessment units placed in Category 5 form the basis for the Section 303(d) list and the TMDL development schedule (see Chapter 9 for additional information regarding TMDLs).

A few instances exist where the MDEQ has determined that assessment units do not support one or more designated uses, but other appropriate pollution control mechanisms are in place. These assessment units are placed in Category 4b. As described above, the pollution control mechanism for a Category 4b water body is expected to result in the attainment of the designated use within a practical timeframe. Considerations to determine if a pollution control mechanism is appropriate to place a water body in Category 4b include, but are not limited to: the scale of the project (e.g., geographic extent affected, duration, etc.) and the anticipated level of impact on water quality. The MDEQ works closely with the USEPA to develop any new listings in Category 4b.

Assessment methodologies used for streams and rivers are also used for channelized streams, when appropriate, including rapid bioassessment of macroinvertebrate and fish communities according to the five-year rotating watershed cycle.

An assessment unit is listed in Category 4c when sufficient water quality data and information are available to determine all of the following:

- A specific designated use is not supported (e.g., the other indigenous aquatic life and wildlife designated use is not supported based on a P51 poor macroinvertebrate community rating).

- The cause of the designated use nonattainment is due to something other than a pollutant (e.g., channel maintenance activity or beaver dam).

- No pollutant would cause the designated use nonattainment if the above cause did not occur.

Assessment units are only placed in Category 4c when MDEQ monitoring staff determines (using P51 or other appropriate techniques) that sufficient water quality data and information are available to clearly indicate that the Category 4c listing requirements explained in the preceding paragraph fully apply.

Key factors considered by MDEQ monitoring staff to help differentiate whether pollutants or other causes are responsible for the observed nonattainment include: water/sediment chemistry and microbiological data when such data are available for the assessment unit, riparian land use characteristics, and P51 habitat metric scores, particularly those for the epifaunal substrate/available cover, embeddedness, sediment deposition, channel alteration, channel sinuosity, bank stability, bank vegetative protection, and riparian vegetative zone width metrics.

It should be noted that the MDEQ recognizes sediment to be a pollutant. If MDEQ aquatic biologists determine that a pollutant (including riparian sediment) is responsible for an assessment unit not supporting a designated use, then that assessment unit is listed in Category 5. Additionally, if channel modification activities in an upstream assessment unit result in sedimentation problems in a downstream assessment unit to a point which causes a designated use to not be supported, then that downstream assessment unit is listed in Category 5.

Michigan uses a multiple category system; therefore, placement of an assessment unit in Category 4c based on a determination that a designated use is not supported and the cause is not a pollutant does not preclude placement of that assessment unit in Category 5 (or any other category) based on a designated use support determination for a different designated use.

Assessment units that do not support a designated use due to multiple causes may be listed in multiple categories for that designated use. For example, an assessment unit may have a TMDL completed for sedimentation; therefore, the assessment unit is listed in Category 4a for the other indigenous aquatic life and wildlife designated use. The same assessment unit may have a mercury TMDL scheduled but not yet completed; therefore, the assessment unit is also listed in Category 5 for the other indigenous aquatic life and wildlife designated use (see Table 4.4 Assessment Unit 10). In this case, the assessment unit is reported in both Categories 4a and 5 for the other indigenous aquatic life and wildlife designated use.

The following example (Table 4.4) adapted from USEPA guidance, illustrates Michigan's use of a multiple category system.

Table 4.4. Examples of assessment unit assignment to categories using a multiple category system with three designated uses. S = Supporting, NS = Not Supporting, - = Not Assessed, ? = Insufficient Information, / = Designated use does not apply to assessment unit. In designated use support summary tables (e.g., Tables 5.2, 5.3, 6.2, 7.2, and 8.1) Category 3 is reported as two subcategories: Insufficient Information and Not Assessed.

	Designated use A	Designated use B	Designated use C	Assigned Categories
Assessment Unit 1	S	S	S	1
Assessment Unit 2	NS	NS	NS	5
Assessment Unit 3	S	S	-	2, 3
Assessment Unit 4	S	S	?	2, 3
Assessment Unit 5	S	-	?	2, 3
Assessment Unit 6	S	NS (nonpollutant)	S	2, 4c
Assessment Unit 7	S	?	NS	2, 3, 5
Assessment Unit 8	S	NS (nonpollutant)		2, 4c, 3*
Assessment Unit 9	-	NS (TMDL approved)	NS	3, 4a, 5
Assessment Unit 10	-	NS (TMDL approved) NS	-	3, 4a, 5

* Currently designated uses that do not apply to an assessment unit are assigned not assessed in the ADB (e.g., cold water fishery). This issue will be corrected over the next five-year rotating watershed cycle through specific record review process.

Justification for designated use support determination for each assessment unit is contained in the ADB. A comprehensive list of designated use support determinations is provided in Appendix B.

4.12 Impairment Cause and Source

When a determination is made that a designated use is not supported (i.e., an assessment unit is placed in Category 4 or 5), the cause and source of impairment are identified. Generally, the cause of impairment is the parameter(s) used to determine that the designated use is not supported unless a biological indicator is used. The source of impairment is determined using BPJ and supporting contextual information.

In addition, sediment toxic substance concentration data may be used to support other assessment types to make support determinations for the other indigenous aquatic life and wildlife, fish consumption, or other designated uses. Sediment data are collected from water bodies when there is direct knowledge or reasonable expectation of heavy metal or organic chemical contamination at levels that may impair biological communities by direct toxicity or cause fish consumption problems. Contaminated sediments may be listed as the source of impairment when sediment pollutant concentrations exceed screening concentrations (McDonald et al., 2000; Jones and Gerard, 1999; and Ontario Ministry of the Environment, 1993) or when sediment toxicity test results demonstrate excessive toxicity.

4.13 Delisting Category 5 Assessment Units

Assessment units are removed from the Section 303(d) list (i.e., moved from Category 5 to another category) by the MDEQ using representative data and the current assessment methodology. Data analysis used to remove an assessment unit from the Section 303(d) list must be at least as rigorous a data analysis as was originally used to list the water body.

Specific instances that justify the removal of assessment units from Category 5 include:

- A TMDL has been developed for all pollutants and approved by the USEPA (assessment unit is placed in Category 4a).

- A corrective, remediation action plan has been approved to be implemented or the problem source(s) has been removed, thereby, eliminating the need for a TMDL (assessment unit is placed in Category 4b or when water quality is reevaluated and it is determined that the designated use is supported, the assessment unit is placed in Category 2 or Category 1).

- The source of impairment for the initial designated use support determination was an untreated CSO and updated information reveals that the untreated CSO has been eliminated or control plan elements have been implemented in a legally binding document that includes a schedule for elimination of the untreated discharge (assessment unit is placed in Category 3 unless the corrective action program has not yet been completed, then it is placed in Category 4b).

- Reassessment of the assessment unit using updated monitoring data or information, techniques, or WQS, indicates that the water body now supports the designated use (assessment unit is placed in Category 1 or Category 2), or that additional monitoring or information is needed to determine whether the designated use is supported (assessment unit is placed in Category 3). For example, a water body may be moved from Category 5 to Category 3 if one year of new data indicated designated use support, but additional monitoring is needed to ensure continued designated use support.

- Reexamination of the monitoring data or information used to make the initial designated use support determination reveals that the decision was either incorrect or inconsistent with the current assessment methodology.

- Reassessment of a water body indicates that the cause of impairment is not a pollutant (assessment unit is placed in Category 4c).

- The assessment unit is determined to be within Indian Country, as defined in 18 U.S.C., Section 1151. These water bodies are not considered waters of the state of Michigan, and therefore, are not appropriate to include on the Section 303(d) list.

4.14 Assessment Methodology Changes

Minor edits and clarification changes were made to update the 2008 assessment methodology for the 2010 IR. There were no substantial changes to data interpretation methods; however, some of the other updates include:

- Transfer of data from the Michigan-developed Water Body System to the USEPA ADB was reflected in the 2008 IR. Due to this transfer, modification of information in the ADB has continued in the 2010 IR and will continue over the next reporting cycle.

- Change from using the NHD 1:100,000 resolution to 1:24,000 resolution resulted in the listing of various water bodies (e.g., headwater stream reaches) that were previously not included in the 2008 IR (see IR highlight in Chapter 1).

CHAPTER 5
ASSESSMENT RESULTS: THE GREAT LAKES, BAYS, CONNECTING CHANNELS (ST. MARYS, ST. CLAIR, AND DETROIT RIVERS), AND LAKE ST. CLAIR

5.1 Trophic Status

Reductions in phosphorus loading to Lakes Michigan, Huron (Saginaw Bay), and Erie have substantially contributed to improved water quality. Improvements in the Great Lakes are attributable, in part, to effluent nutrient limits in NPDES permits issued to municipal and industrial facilities. For Great Lakes protection, Michigan's WQS restrict point source discharges of phosphorus to 1 mg/L as a maximum monthly average. Lower limits may be, and often are, imposed to protect designated uses in receiving or downstream waters.

Legislation passed in 1977 that reduced the allowable phosphorus content in household laundry detergents sold in Michigan to less than 0.5% phosphorus by weight has contributed to the reduction of phosphorus discharged from point sources. Legislation passed in 2009 reduced the allowable phosphorus content in any cleaning agent intended for use in household clothes washing machines and, beginning July 1, 2010, dishwashers sold in Michigan to 0.5% by weight expressed as elemental phosphorus. This legislation is expected to further reduce phosphorus loads from wastewater treatment plants ond on-site treatment systems. NPS phosphorus reduction efforts have also contributed to improved Great Lakes water quality. The current trophic status of each of Michigan's Great Lakes is presented in Table 5.1.

Table 5.1 Trophic status of the Great Lakes bordering Michigan.

Lake	Trophic Status (nutrient level)
Superior	Oligotrophic* (low)
Huron	Oligotrophic* (low)
Saginaw Bay	Eutrophic† (high)
Michigan	Oligotrophic* (low)
Erie (Central Basin)	Oligotrophic/mesotrophic* (moderate)
Western Basin	Mesotrophic* (moderate)

*USEPA, 2009a; †USEPA, 2009b

5.2 Water Chemistry of the Great Lakes Connecting Channels

Great Lakes connecting channel (St. Marys, St. Clair, and Detroit Rivers) monitoring efforts and results through 2005 are summarized in annual reports prepared by the Great Lakes Environmental Center (GLEC) under contract with the MDEQ (most recent reports - GLEC, 2006a and 2007a). Key findings from water chemistry monitoring of the three Great Lakes connecting channels bordering Michigan (Detroit, St. Clair, and St. Marys Rivers) follow:

- Detroit River nutrient concentrations have decreased significantly since the late 1960s, with an order-of-magnitude decline in total phosphorus concentrations from a high of 0.13 mg/L in 1969. Data collected between 1992 and 2004 indicate seasonal fluctuations in phosphorus and nitrogen parameters, with an increasing trend in total phosphorus concentration. Mercury and trace metals data (cadmium, chromium, copper, lead, nickel, and zinc) obtained from 1998 to 2004 indicate a decreasing concentration trend for lead and an increasing concentration trend for mercury, with some apparent seasonal fluctuations. No trends for cadmium, chromium, copper, nickel, and zinc were indicated. In general, statistically significant differences ($p<0.05$) between upstream and downstream concentrations were not apparent, with the exception of mercury, which was significantly higher at the upstream station.

- St. Clair River total phosphorus concentrations have declined from the 1980s to 2004. Mercury and trace metals data (cadmium, chromium, copper, lead, nickel, and zinc) obtained from 1998 to 2004 indicate that chromium and nickel concentrations decreased, while zinc and lead increased; no trends for cadmium, copper, or mercury were indicated. Spatial analyses indicate that total phosphorus, orthophosphate, ammonia, nitrate, nitrite, cadmium, chromium, copper, lead, nickel, and zinc concentrations increased from upstream to downstream.

- Little historic water chemistry data are available for the St. Marys River, but data obtained from 1998 to 2004 indicate that zinc, ammonia, nitrate, and nitrite concentrations have increased, whereas cadmium, chromium, and nickel concentrations have decreased; no trends for mercury, copper, lead, or total phosphorus were indicated. Nutrient concentrations fluctuated seasonally. Spatial analyses indicate that total phosphorus, orthophosphate, and nitrite concentrations increased from upstream to downstream, as did chromium, copper, lead, and nickel concentrations.

- Comparisons of Great Lakes connecting channel water chemistry data for toxic chemicals with applicable Michigan WQS showed that total PCB concentrations exceeded the applicable Rule 57 water quality value (0.026 ng/L) in 59 of the 60 samples collected at all connecting channel locations, and total DDT concentrations exceeded the applicable Rule 57 water quality value (0.011 ng/L) in 13 of the 24 samples collected at all connecting channel locations. Mercury exceeded the applicable Rule 57 water quality value (1.3 ng/L) in 101 of 245 samples collected at all connecting channel locations. Concentrations of the other trace metals (cadmium, chromium, copper, lead, nickel, and zinc) met the applicable Rule 57 water quality values at all connecting channel locations. Base/neutral and volatile organic compounds were largely not detected above the quantification level.

Great Lakes connecting channel monitoring efforts continue. Results through 2009 will be summarized in a report that is expected to be completed in 2010.

5.3 Water Chemistry of Saginaw Bay and Grand Traverse Bay

Saginaw Bay and Grand Traverse Bay monitoring efforts and results through 2005 are summarized in annual reports prepared by the GLEC under contract with the MDEQ (most recent reports - GLEC, 2006b and 2007b). Key findings from water chemistry monitoring of Saginaw and Grand Traverse Bays are summarized below.

- Saginaw Bay nutrient and chlorophyll *a* data from 1993 to 2004 reflect mesotrophic to eutrophic conditions, depending on the location sampled. Total phosphorus

concentrations remain relatively constant and continue to be above the target total phosphorus concentration of 0.015 mg/L established by the "Michigan Phosphorus Reduction Strategy for the Michigan Portion of Lake Erie and Saginaw Bay" (MDNR et al., 1985). Average annual chlorophyll *a* concentrations also remain relatively constant and often exceed 10 ug/L, an accepted threshold for eutrophic conditions.

- Grand Traverse Bay nutrient, chlorophyll *a*, and water clarity data reflect oligotrophic conditions and excellent water quality. During 1998-2005, the bay-wide median total phosphorus and chlorophyll *a* concentrations in Grand Traverse Bay were 0.005 mg/L and 2 ug/L, respectively.

- Comparison of recent Saginaw Bay and Grand Traverse Bay trace metals and mercury water chemistry data with applicable Michigan WQS showed that average mercury concentrations in both bays met the mercury Rule 57 water quality value of 1.3 ng/L. All mean concentrations of cadmium, chromium, copper, lead, nickel, and zinc at all sampling locations in Grand Traverse Bay and Saginaw Bay met applicable Rule 57 water quality values.

Saginaw Bay and Grand Traverse Bay monitoring efforts continue. Results through 2009 will be summarized in a report that is expected to be completed in 2010.

5.4 Fish Contaminants

Several projects are being implemented in the Great Lakes basin to monitor temporal and spatial trends in fish contaminant levels:

- Michigan's whole fish contaminant trend monitoring effort, initiated in 1990, focuses on fish collected from ten fixed stations located in the Great Lakes bays and connecting channels.

- The USEPA, Great Lakes National Program Office, collects and analyzes whole lake trout from the open waters of Lakes Superior, Michigan, Huron, and Ontario, and walleye from Lake Erie.

- The federal-state coordinated fillet trend monitoring program collects and analyzes chinook and coho salmon from Lakes Superior, Michigan, and Huron, and rainbow trout from Lake Erie. This program has been discontinued as of 2009.

The USEPA lake trout data for Lakes Superior, Michigan, Huron, and Ontario indicate that total PCB and DDT concentrations in all four lakes declined between the 1970s and 2000. Also, Lake Michigan lake trout had higher levels of total PCBs and total DDT than lake trout from the other Great Lakes. Concentrations of most contaminants in Lake Superior lake trout were lower than concentrations from the other Great Lakes. The USEPA walleye data for Lake Erie indicate that total PCB and DDT concentrations declined since 1977. Additional results and general conclusions from the USEPA lake trout and walleye data and the federal-state chinook and coho salmon fillet trend monitoring, including information regarding PCBs, DDT, chlordane, and toxaphene concentrations, are presented in the Michigan Fish Contaminant Monitoring Program: 2008 Annual Report (Bohr and VanDusen, 2009).

In 1990, Michigan initiated a fixed station fish contaminant trend monitoring project to measure spatial and temporal trends of certain bioaccumulative contaminants. Trend stations in Great

Lakes waters are located in Keweenaw Bay (Lake Superior), Little Bay de Noc and Grand Traverse Bay (Lake Michigan), Thunder Bay and Saginaw Bay (Lake Huron), Lake St. Clair, Brest Bay (Lake Erie), and in the St. Marys, St. Clair, and Detroit Rivers. Adult fish are collected from each site at a target interval of two to five years, and analyzed as whole fish samples. Whole fish fixed station trend monitoring data collected since 1990 were reviewed and general trend conclusions for the Great Lakes and connecting channels are summarized below (Bohr and VanDusen, 2009):

- Lindane, terphenyl, polybrominated biphenyl (PBB), heptachlor, and aldrin were not quantified in any of the fish sampled. However, heptachlor epoxide and dieldrin (breakdown products of heptachlor and aldrin) were quantified in most of the samples analyzed.

- In addition to heptachlor epoxide and dieldrin, several chemicals were quantified in fish consistently, indicating that they are ubiquitous in the aquatic environment. These include mercury, hexachlorobenzene, total PCB, total chlordane, and total DDT.

- Apparent toxaphene was found primarily in walleye and lake trout from the Great Lakes and connecting channels. The highest concentrations of apparent toxaphene were quantified in lake trout from Lake Superior.

- All species from the Great Lakes and connecting channels tended to have higher concentrations of chlorinated organic contaminants than the same species from inland lakes.

- Carp and walleye from the St. Marys River had lower concentrations of organic contaminants than carp from Lake St. Clair and the Detroit River. Carp and walleye from the St. Marys River had higher concentrations of mercury than carp and walleye from Lake St. Clair and the Detroit River.

- Total PCB, DDT, and chlordane concentrations have declined at all 10 Great Lakes and connecting channel trend sites, with declines averaging 6%, 9% and 10% per year, respectively.

- Trends in dioxin toxicity equivalence concentrations have been monitored in lake trout from Lake Superior (Keweenaw Bay), Lake Michigan (Grand Traverse Bay), and Lake Huron (Thunder Bay), and in carp from Lake Huron (Saginaw Bay). Dioxin concentrations have declined at all 4 sites, with an average decline of 8% per year since the early 1990s.

- Mercury concentrations have increased in at least 1 species of fish monitored from each of the Great lakes sampling sites, with 2 exceptions: no trend has been measured in samples from the St. Marys River, and mercury concentrations in carp from the Detroit River have declined 7% per year since 1990.

In addition, edible portion fish tissue contaminant monitoring was conducted in 2007 in Portage Lake/Sturgeon River (Keweenaw Peninsula), Keweenaw Bay, Lake Superior near Marquette, Thunder Bay, and Saginaw Bay. Edible portion sampling is often targeted toward known sites of contamination, sites popular with sport anglers, and sites with public access. Results are presented in the Michigan Fish Contaminant Monitoring Program: 2008 Annual Report (Bohr and VanDusen, 2009).

5.5 Beaches

In 2007, 205 public beaches (owned by a city, county, etc.) on the Great Lakes and connecting channels were monitored and 162 reported no exceedances of the *E. coli* WQS for total body contact. There were 43 beaches that reported a total of 77 exceedances.

In 2008, 208 public beaches were monitored and 174 reported no exceedances of the *E. coli* WQS for total body contact. There were 34 beaches that reported a total of 74 exceedances.

The Michigan Beach Web site (http://www.deq.state.mi.us/beach) provides access to a database containing beach closings and *E. coli* data collected by LHDs. Currently, 602 public beaches located along the Great Lakes are listed in the database; although, water quality data are not available for all beaches. Data for Great Lakes beaches in Michigan are also available at http://oaspub.epa.gov/beacon/beacon_national_page.main.

5.6 Decaying Organic Matter Deposits

Deposits of dead and decaying organic matter are reportedly fouling beaches along Michigan's Great Lakes shoreline including, but not limited to, Grand Traverse Bay, Saginaw Bay, and western Lake Erie. While increased aquatic vegetation growth is typically associated with elevated nutrient concentrations, many of the shoreline deposits are occurring where ambient phosphorus and nitrogen concentrations are very low or declining. Similar problems are being reported along the Wisconsin Lake Michigan shoreline, the Ohio and Pennsylvania Lake Erie shoreline, and the New York Lake Ontario shoreline, where, like Michigan, shorelines are being fouled by decaying organic matter that may interfere with the enjoyment of beaches and nearshore waters.

Once thought to be caused primarily by the presence of excessive nutrients (phosphorus), there is growing evidence that the increased organic matter deposits may be the result of a complex interaction between nutrients and exotic mussel species (Hecky et al., 2004), changes in wind patterns over the Great Lakes (Waples and Klump, 2002), and fluctuating water levels (Harris, 2004). Research is ongoing to identify the causes and sources for these shoreline deposits with the hope that effective solutions can be found. Although phosphorus concentrations do not appear to be solely responsible for the shoreline deposits, programs and policies intended to reduce phosphorus in all waters of the state remain important components of efforts to improve and protect water quality.

The MDEQ has been and will continue to work with the research community, other governmental agencies, and the public toward an understanding of the causes/sources responsible and a solution to the shoreline deposit problem, and to obtain the necessary information to determine whether or not WQS are attained. In October 2008 and April 2009, staff members from the National Oceanic and Atmospheric Administration, MDEQ, MDNR, and various Michigan universities met to review information and evaluate work plans for Saginaw Bay during the 2009 field season. In addition, the MDEQ contacted researchers from the University of Wisconsin-Milwaukee who are conducting intensive monitoring in Lake Michigan and modeling to understand *Cladophora* growth and its relationship to environmental factors.

5.7 Designated Use Support Summary

Designated use support summaries for Michigan waters of the Great Lakes, bays, connecting channels, and Lake St. Clair are presented in Tables 5.2 and 5.3. Michigan uses a multiple

category system (i.e., assessment units may be placed in one or more category, see Section 4.11); therefore, Great Lake square miles and shoreline miles and connecting channel miles are not totaled. Key designated use support results for Michigan waters of the Great Lakes, connecting channels, and Lake St. Clair follow. Impairment cause and source information for assessment units not supporting designated uses is presented in Chapter 9.

- Generally shoreline areas of the Great Lakes are not assessed to determine support for the other indigenous aquatic life and wildlife designated use. Water chemistry was monitored specifically around two small areas (one each on Lake Michigan and Little Traverse Bay) in the vicinity of groundwater seeps associated with cement kiln dust remediation sites.

- Considerable progress has been made to eliminate untreated CSO discharges to the Great Lakes connecting channels. The majority of the St. Clair River, 33.3 miles, supports the total body contact and partial body contact recreation designated uses. A small portion of the St. Clair River, 7.5 miles located from Marysville upstream to Lake Huron, is listed in Category 4b. Ambient *E. coli* data collected in 2007 and 2008 met WQS; however, untreated CSOs remain in the city of Port Huron. CSO elimination is scheduled for completion by 2016. An *E. coli* TMDL was completed for the Detroit River in 2008; therefore, these 25.7 miles are listed in Category 4a. Some untreated CSO discharges still exist; consequently, all of the St. Marys River miles are listed as not supporting the total body contact and partial body contact recreation designated uses.

- The Michigan waters of the Great Lakes, their connecting channels, Saginaw and Grand Traverse Bays, and Lake St. Clair are listed as not supporting the fish consumption designated use due to elevated concentrations of PCBs, DDT, mercury, chlordane, and/or dioxin. Atmospheric deposition is considered to be the major source of these persistent bioaccumulative chemicals.

- Water chemistry results indicate that all 112 Great Lakes connecting channel miles are not supporting the fish consumption and other indigenous aquatic life and wildlife designated uses due to elevated concentrations of PCBs in the water column. The primary source of PCBs is atmospheric deposition. Mercury concentrations in the St. Marys and St. Clair Rivers are usually below the 1.3 ng/L WQS, but mercury concentrations in the Detroit River often exceed 1.3 ng/L.

- Periodic taste and odor problems associated with nuisance growths of blue-green algae, initially reported as *Microcystis,* occur near the Bay City municipal drinking water intakes in Saginaw Bay. As a result of this occasional problem, the two Bay City drinking water intake zones in Saginaw Bay are listed as not supporting the public water supply designated use. A nutrient reduction strategy for Saginaw Bay (MDNR et al., 1985) is in place; therefore, a TMDL is not scheduled for this area. Research activities directed at this intake issue are included in the ongoing Saginaw Bay study conducted by the National Oceanic and Atmospheric Administration.

- Deposits of decaying organic matter along some Great Lakes shorelines is a significant problem and may interfere with beach recreational use and access to the water in some places along Saginaw Bay and western Lake Erie. Microorganisms have been identified in the decaying matter; however, the standards apply only to ambient water. Water quality is routinely monitored at Saginaw Bay beaches and areas where WQS are exceeded are listed as not supporting the total and/or partial body contact recreation designated use and a TMDL is scheduled according to the assessment methodology.

The WQS require that nutrients be limited to the extent necessary to prevent stimulation of plant/algae growths that are or may become injurious to the designated uses. However, it is widely believed that nutrients are only one of the many factors contributing to this problem and the relative importance of nutrients compared with other causes is unclear. The presence of the shoreline deposits where phosphorus concentrations are significantly less than those in Saginaw Bay (e.g., Grand Traverse Bay and Lake Michigan's eastern shore) indicate that this is a legitimate question.

The WQS also require that the state's surface waters not have any "deposits" in "unnatural quantities which are or may become injurious to any designated use." Deposits of decaying organic material occur naturally in aquatic systems, and are frequently observed along the Great Lakes and inland lakes. There is currently no measure to determine what "unnatural quantities" are and the MDEQ does not have enough information from other sites against which to compare deposits along Saginaw Bay to begin to establish that measurement. Any measurement or process used to make such a determination needs to be transferable and meaningful to other areas of the Great Lakes and inland lakes.

A careful evaluation of available data and scientific information, and a comparison against WQS reveals that there is insufficient information to determine whether designated uses are not supported as a result of the decaying organic matter. Consequently, 142 miles of Saginaw Bay and 37.5 miles of western Lake Erie shoreline are listed as having insufficient information to determine support of the total and partial body contact recreation designated uses. In addition, 1262 square miles of Saginaw Bay and western Lake Erie are listed as having insufficient information to determine support of the other indigenous aquatic life and wildlife designated use.

Table 5.2 Designated use support summary for the Great Lakes, bays, and Lake. St. Clair (approximately 42,167 square miles). No Great Lakes and bays are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture (mi^2)	42,167	0	0	0	0	0	0
Navigation (mi^2)	42,167	0	0	0	0	0	0
Industrial Water Supply (mi^2)	42,167	0	0	0	0	0	0
Warmwater Fishery (mi^2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cold Water Fishery (mi^2)	0	0	42,167	0	0	0	0
Other Indigenous Aquatic Life and Wildlife (mi^2 /shoreline mi)*†	280 / 4.2	1,262 / 1	40,625/ 256.2	0	0	0	0
Partial Body Contact Recreation (shoreline mi) †	72	180.4	5.2	0.6	0	0	3.7
Total Body Contact Recreation (shoreline mi) †	22.7	229.3	5.2	0.6	0	0	4.1
Fish Consumption (mi^2)	0	0	0	0	0	0	42,167
Public Water Supply (mi^2) ‡	0	10.5	63	0	3	0	0

* Geographic extent may be reported in two different measurement units for this designated use (mi^2 /shoreline mi). These values represent different assessment units (i.e., shoreline miles do not correspond to the mi^2 listed).

† These designated uses apply to all surface waters of the State; however, these particular values represent shoreline miles/beaches. Shoreline records are created and entered into the ADB on a case-by-case basis where information is available. Records have not been established for all shoreline miles. The total number of Great Lakes shoreline miles entered into the ADB is 262 miles. A number of records exist for beaches or other shoreline miles that have no data available and therefore are not assessed; however, this is not a comprehensive value for all not assessed Great Lakes beaches or other shoreline miles. The total number of Great Lakes beaches is not known.

‡ Approximately 76.5 square miles (mi^2) of the Great Lakes and bays are protected for the public water supply designated use.

N/A indicates that the designated use is not applicable.

Table 5.3 Designated use support summary for the Great Lakes connecting channels (St. Marys, St. Clair, and Detroit Rivers) in Michigan (approximately 112 total miles). No connecting channels are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture (mi)	112	0	0	0	0	0	0
Navigation (mi)	112	0	0	0	0	0	0
Industrial Water Supply (mi)	112	0	0	0	0	0	0
Warmwater Fishery (mi)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cold Water Fishery (mi)	0	0	112	0	0	0	0
Other Indigenous Aquatic Life and Wildlife (mi)	0	0	0	0	0	0	112
Partial Body Contact Recreation (mi)	33.2	0	0	25.7	7.5	0	45.2
Total Body Contact Recreation (mi)	33.2	0	0	25.7	7.5	0	45.2
Fish Consumption (mi)	0	0	0	0	0	0	112
Public Water Supply (mi) *	0	2	3	0	0	0	0

* Approximately 5 of the 112 connecting channel miles are protected for the public water supply designated use.

N/A indicates that the designated use is not applicable.

CHAPTER 6
ASSESSMENT RESULTS: INLAND LAKES AND RESERVOIRS

6.1 Trophic Status

Carlson's TSI is used by the MDEQ to assess and classify Michigan's 730 public access lakes (see Section 1.2.2). This classification system is based on an index derived from a combination of three field measurements: summer Secchi depth (transparency), total phosphorus concentration (epilimnetic), and chlorophyll *a* concentration (photic zone). The numerical value of the index increases as the degree of eutrophication increases. Historically, inland lake monitoring efforts have been directed toward obtaining baseline data for all 730 public access lakes.

During 2007 and 2008, 161 public access lakes were sampled and reassessed as part of the Lake Water Quality Monitoring Assessment Project. The majority (80%) of Michigan's public access lakes that were sampled in 2007 and 2008 have moderate (mesotrophic) or low (oligotrophic) nutrient levels (Table 6.1).

Table 6.1 Trophic status summary of Michigan's public access lakes sampled in 2007 and 2008 (N=161).

Trophic Status	Number of Lakes
Oligotrophic (low nutrients)	40 (25%)
Mesotrophic (moderate nutrients)	88 (55%)
Eutrophic (high nutrients)	29 (18%)
Hypereutrophic (excessive nutrients)	4 (2%)

Results of an MDEQ and USGS cooperative project that sampled 364 inland lakes as part of the Lake Water Quality Monitoring Assessment Project during 2001 through 2005 indicate that 17% are oligotrophic, 53% are mesotrophic, 22% are eutrophic, 4% are hypereutrophic, and less than 5% are transition classes between each major class (Fuller and Minnerick, 2008).

During 2007 and 2008, over 200 lakes were sampled each year as part of the Cooperative Lakes Monitoring Program, under the Michigan Clean Water Corps (for additional information see http://ww.micorps.net). One hundred and twelve of these lakes were sampled for the three primary trophic status indicators (Secchi depth, total phosphorus, and chlorophyll *a*) and trophic status classifications were updated. Of these lakes, 26 were classified as oligotrophic, 82 mesotrophic, 3 eutrophic, and 1 hypereutrophic.

6.2 Fish Contaminants

In 1990, Michigan initiated a fixed station fish contaminant trend monitoring project to measure spatial and temporal trends of certain bioaccumulative contaminants. Adult fish are collected

from each site at a target interval of two to five years, and analyzed as whole fish samples. Fish have been collected from eight inland lakes as part of the fish contaminant trend monitoring project. The lakes are Gogebic, Grand Sable, South Manistique, Higgins, Houghton, Gun, Gull, and Pontiac Lakes. Whole fish fixed station trend monitoring data collected since 1990 were reviewed and general trend conclusions for inland lakes are summarized below (Bohr and VanDusen, 2009):

- Lindane, terphenyl, PBB, heptachlor, and aldrin were not quantified in any of the fish sampled. However, heptachlor epoxide and dieldrin (breakdown products of heptachlor and aldrin) were quantified in most of the samples analyzed.

- In addition to heptachlor epoxide and dieldrin, several chemicals were quantified in fish consistently, indicating that they are ubiquitous in the aquatic environment. These include mercury, hexachlorobenzene, total PCB, total chlordane, and total DDT.

- Fish from inland lakes tended to have higher concentrations of mercury than the same species from the Great Lakes or connecting channels.

- Total PCB concentrations declined at all the inland lake trend sites monitored since 1990 except 1, with an average decline of 9% per year. The exception was Grand Sable Lake, where total PCB concentrations in lake trout increased 9% between 1991 and 1995. No samples have been collected from that lake since 1995.

- Total DDT concentrations declined at 9 of the 10 inland lake trend sites since 1990, with an average decline of 7% per year. The exception was again Grand Sable Lake, where no trend was observed.

- Total chlordane concentrations declined at all of the inland lake trend sites where a trend could be detected, and the average decline was 10% per year. No trend was detected at 2 inland lakes because chlordane concentrations were consistently below the analytical quantification level.

- Significant trends in mercury concentrations have been detected at 2 of the 8 inland lake trend sites. Mercury concentrations in walleye from Lake Gogebic declined 7% per year between 1991 and 2005, and increased in lake trout from Grand Sable Lake between 1991 and 1995.

In addition, edible portion fish tissue contaminant monitoring was conducted recently at 31 inland lakes. Edible portion sampling is often targeted toward known sites of contamination, sites popular with sport anglers, and sites with public access. Results are presented in the Michigan Fish Contaminant Monitoring Program: 2008 Annual Report (Bohr and VanDusen, 2009).

6.3 Beaches

In 2007, a total of 269 public beaches (owned by a city, county, etc.) on inland lakes were monitored and 235 had no exceedances of the *E. coli* WQS for total body contact. There were 34 beaches that reported a total of 68 exceedances.

In 2008, a total of 259 public beaches on inland lakes were monitored and 219 had no exceedances of the *E. coli* WQS for total body contact. There were 40 beaches that reported a total of 80 exceedances.

The Michigan Beach Web site (http://www.deq.state.mi.us/beach) provides access to a database containing beach closings and *E. coli* data collected by LHDs. Currently, 563 public beaches located on inland lakes are listed in the database; although, not all beaches are monitored.

6.4 Designated Use Support Summary

A designated use support summary for Michigan inland lakes and reservoirs is presented in Table 6.2. Michigan uses a multiple category system (i.e., assessment units may be placed in one or more category, see Section 4.11); therefore, inland lake and reservoir acres and shoreline miles are not totaled. Key designated use support results follow. Impairment cause and source information for assessment units not supporting designated uses is presented in Chapter 9.

- Physical and chemical monitoring indicates that approximately 93% of the assessed inland lake and reservoir acres support the other indigenous aquatic life and wildlife designated use. Several water bodies are not supporting this designated use due to nuisance plant/algae growth problems caused by elevated phosphorus concentrations in the water column and/or sediments. Torch (Houghton County) and Crooked (Missaukee County) Lakes are not supporting this designated use and are listed in Category 4b due to historical copper stamp sand contamination and sediment problems from a historic wood chemical factory, respectively.

- Water chemistry and fish tissue monitoring indicates that about 9% of the assessed inland lake and reservoir acres support the fish consumption designated use. Atmospheric deposition continues to be a major source of PCBs and mercury to Michigan's inland lakes and reservoirs; however, localized sources are still contributing to mercury and PCB fish contamination problems in some inland lakes and impoundments.

- Cisco population monitoring indicates that approximately 58% of the inland lake acres assessed for the cold water fishery designated use support the use while the remaining 42% have insufficient information to make a designated use support determination.

- Ten lakes have been listed as having insufficient information to determine support for the warmwater fishery designated use due to the possibility of low pH.

- Generally, the total body contact and partial body contact recreation designated use is reported as shoreline miles for beaches. Three lakes are listed in their entirety as acres due to non-beach issues. *E. coli* data from the Calhoun County Health Department for Lee Lake, St. Joseph River watershed, are available; however, these data are insufficient to make a designated use support determination. An *E. coli* TMDL for Potters Lake, Flint River watershed, was completed in 2004; therefore, this water body is listed in Category 4a. Manistee Lake, at the mouth of the Manistee River, is listed in Category 5 with *E. coli* as the cause and untreated CSOs as the source.

- Three lakes, Little Shag, Bass, and Little Lakes, in the Escanaba watershed near Gwinn, have site-specific information indicating that the navigation designated use is not supported. Historic deposits of partially decayed sawdust from the white pine harvest of the 1800s inhibits outboard motor usage.

- In 2008 and 2009, Phosphorus TMDLs were completed and approved by the USEPA for Bear Lake (Muskegon County) and Morrison Lake (Ionia County). In 2008, a PCB TMDL was completed and approved by the USEPA for Pere Marquette Lake (Mason County) as part of a watershed-wide PCB TMDL.

Table 6.2 Designated use support summary for inland lakes and reservoirs (approximately 872,076 acres). No inland lakes or reservoirs are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture (acres)	872,076	0	0	0	0	0	0
Navigation (acres)	871,244	0	0	0	0	0	832
Industrial Water Supply (acres)	872,076	0	0	0	0	0	0
Warmwater Fishery (acres)	1,082	752	869,949	295	0	0	0
Cold Water Fishery (acres)	130,663	93,979	647,435	0	0	0	0
Other Indigenous Aquatic Life and Wildlife (acres)	429,590	22,795	410,395	2,251	3,139	0	3,906
Partial Body Contact Recreation (acres/shoreline mi) *	0 / 65	126 / 19.8	870,863 / 1	119 / 0.2	0 / 0	0 / 0	969 / 3.2
Total Body Contact Recreation (acres/shoreline mi) *	0 / 16	126 / 68	870,863 / 0.2	119 / 0.2	0 / 0	0 / 0	969 / 4.6
Fish Consumption (acres)	33,278	13,908	514,552	554	173	0	309,698
Public Water Supply (acres) †	0	130	284	0	0	0	0

***** Geographic extent may be reported in two different measurement units for this designated use (acres/shoreline mi). These values represent different assessment units (i.e., shoreline miles do not correspond to the acres listed). In most cases shoreline miles are bathing beaches. The total number (shoreline miles) of inland lake and reservoir beaches is not known. Beaches are evaluated for total body contact and partial body contact recreation designated use support and entered into the ADB on a case-by-case basis where information is available. The total number of shoreline miles of these inland lake and reservoir beaches in the ADB is 89.4 miles. A small number of records exist for beaches that have no data available and therefore are not assessed; however, this is not a comprehensive value for all not assessed inland lake and reservoir beaches or shoreline miles.

† Approximately 414 acres of inland lakes and reservoirs are protected for the public water supply designated use.

CHAPTER 7
ASSESSMENT RESULTS: RIVERS

7.1 Biological Integrity

All available biological assessments (e.g., fish and macroinvertebrate communities, targeted and probabilistic study designs) are evaluated using the assessment methodology (Chapter 4) and potentially used to determine designated use support. As part of the MDEQ's water quality monitoring program, sites are selected using both targeted and probabilistic study designs to assess the biological integrity of rivers and streams using macroinvertebrate communities. The MDEQ's Macroinvertebrate Community Status and Trend Monitoring Procedure (MDEQ, in preparation) is used to estimate the number of river miles supporting the other indigenous aquatic life and wildlife designated use. Results are available for watersheds monitored in 2006, 2007, and 2008 (draft data) (Figure 3.1 and Table 7.1). Results from this project will also be used to assess statewide designated use support status and temporal trends in biological integrity.

Table 7.1 Proportion of river miles (draft data) supporting the other indigenous aquatic life and wildlife designated use based on macroinvertebrate community assessment results for watersheds monitored in 2006, 2007, and 2008 using the MDEQ's status and trend procedure. Proportion of river miles is shown with 95% confidence interval.

Watershed/watershed group	Year monitored	Number of survey stations	River miles (%) supporting the other indigenous aquatic life and wildlife designated use
Northern Upper Peninsula (Keweenaw area)	2006	38	96 ± 4
Muskegon	2006	50	98 ± 4
Upper Grand	2006	40	92 ± 8
St. Joseph/ Paw Paw	2006	32	86 ± 13
Tawas/ AuGres	2006	24	96 ± 9
Cass	2006	37	91 ± 10
Detroit/ Ecorse	2006	30	30 ± 16
Menominee River	2007	29	95 ± 5
White River	2007	32	96 ± 5
Maple/Looking Glass	2007	40	97 ± 5
Black River (SW MI)	2007	5	78 ± 22
Galien River	2007	5	78 ± 22
Black River (NE MI)	2007	16	91 ± 9
Au Sable River	2007	28	95 ± 5
Tittabawassee River	2007	38	96 ± 4
Black River (E MI)	2007	34	96 ± 8
Huron River	2007	30	90 ± 12
Western Upper Peninsula	2008	24	94 ± 6
Northwest Michigan	2008	37	94 ± 9
Rogue/Flat	2008	33	95 ± 5
Thornapple River/Rabbit	2008	44	93 ± 8
Pigeon – Cherry	2008	27	73 ± 32
Flint River	2008	46	92 ± 8
Lake St. Clair Tribs	2008	4	75 ± 77
River Raisin	2008	36	96 ± 4

7.2 Water Chemistry

The MDEQ and its partners collect water samples from many rivers and streams throughout the state as part of the WCMP and other special studies and analyze them for a variety of parameters. Results from monitoring conducted in 2005 as well as older study results and trend analysis are summarized blow. Tributary monitoring efforts continue and results through 2009 will be summarized in a report that is expected to be completed in 2010.

Key results from 2005 monitoring include the following:

- Based on recent WCMP data, the most ubiquitous problem continues to be PCBs. Similar to previous years' results, results from a total of 43 samples (from 10 locations) collected from streams and rivers during 2005 showed that 100% exceeded the most restrictive PCB WQS of 0.026 ng/L (HCV per R 323.1057) (Aiello, 2008). Total PCB concentrations were highest in a sample collected at the Lower Kalamazoo River (18 ng/L) and lowest in a sample collected at the Thunder Bay River (0.082 ng/L).

Because the industrial use of PCBs has been banned, the primary sources of PCBs to water likely are historical sediment contamination and ongoing atmospheric deposition.

- Similar to previous years' results, elevated levels of mercury were relatively common in water samples analyzed from 2005. Of the 98 sites monitored, 48 (49%) had geometric mean mercury concentrations exceeding the most restrictive mercury WQS of 1.3 ng/L (Wildlife Value per R 323.1057) (Aiello, 2008). Geometric mean mercury concentrations were highest at Montgomery Creek, Gogebic County (5.9 ng/L), and lowest at the Shiawassee River, Oakland County (0.31 ng/L). Atmospheric deposition is the primary source of elevated mercury levels.

- All trace metal samples other than mercury from the 98 locations that had sufficient information to make a determination met applicable WQS during 2005 (Aiello, 2008).

- Analysis of tributary monitoring results from 1998-2005 indicates that median normalized total phosphorus, chloride, and TSS concentrations from 1998-2005 exceeded historic background concentrations at approximately 45%, 68%, and 58% of the 31 sites evaluated, respectively (Aiello, 2008).

Key results from monitoring prior to 2005 and trend analysis include the following:

- During 1998-2005, median normalized total mercury ranged from 0.028 ng/L at the Au Sable River to 5.5 ng/L at the Lower Kalamazoo River; median normalized total chromium ranged from 0.02 ug/L at the Au Sable River to 1.8 ug/L at the River Rouge; median normalized total copper ranged from 0.23 ug/L at the Au Sable River to 3.6 ug/L at the Clinton River; and median normalized total lead ranged from 0.04 ug/L at the Au Sable River to 2.3 ug/L at the Flint River (Aiello, 2008).

- Temporal trends in tributaries monitored from 1998-2005 were analyzed for turbidity, dissolved oxygen, pH, specific conductance, temperature, total chloride, TSS, nitrogen (Kjeldahl, ammonia, nitrate, and nitrite), total phosphorus, chromium, copper, lead, and mercury (Aiello, 2008). Thirteen of 31 sites evaluated for temporal trends showed a statistically significant trend ($p \leq 0.05$), whether increasing or decreasing, in one or more of these constituents over the period of interest (1998-2005). Decreasing trends were found more than twice as frequently as increasing trends. For most constituents, a decreasing trend indicates improving stream water quality conditions (Aiello, 2008).

- A total of 30 dioxin and furan samples were collected at 7 locations during 2001-2003 (Aiello, 2003, 2004, and 2005). This sampling took place at the Tittabawassee River and additional sites within the Saginaw Bay watershed. Of these 30 samples, 20 were collected near the mouth of the Tittabawassee River; all 20 exceeded the Rule 57 HCV (0.0086 picograms per liter [pg/L]) applicable to total 2,3,7,8-TCDD toxicity equivalence concentration, and 4 also exceeded the Rule 57 Wildlife Value (0.0031 pg/L) for 2,3,7,8-TCDD. The remaining ten samples were collected at the Cass, Flint, Shiawassee, Saginaw, and West Branch Tittabawassee Rivers; and a station on the Tittabawassee River immediately upstream of Dow Chemical - Midland's outfall 031. Of these locations, all but the West Branch Tittabawassee River had at least 1 sample that exceeded the HCV.

- Numerous emerging issue contaminants, including base/neutral organic compounds, Methyl tert-butyl ether (MTBE), benzene, toluene, ethylbenzene, and xylene (BTEX),

total cyanide, perfluorooctane sulfonates, and perfluorooctanoic acid, have been monitored at the WCMP locations. From 1999 to 2004, a total of 440 samples were analyzed for base/neutral organic compounds, MTBE and BTEX, and 225 samples for total cyanide as part of the WCMP (Aiello, 2003, 2004, and 2005). All samples were below applicable Rule 57 water quality values, and almost all were below analytical quantification. Thus, sampling for these contaminants was discontinued after 2004.

- In addition to water sampling in recent years, the USGS and MDEQ evaluated potential trends for 28 water quality constituents (physical properties, major ions, nutrients, bacteria, pH and alkalinity, and suspended sediments) for selected National Stream Quality Accounting Network stations in Michigan (Syed and Fogarty, 2005). Data were collected from 1973 to 1995 from the Au Sable, Clinton, Grand, Kalamazoo, Manistee, Manistique, Muskegon, and Pigeon Rivers. The study results show an overall improvement in water quality at the Clinton, Manistee, and Pigeon Rivers for some parameters. The Clinton and Pigeon Rivers showed significant negative trends (decreasing concentration) in the concentration of nitrogen compounds. The Kalamazoo and Muskegon Rivers showed significant positive trends (increasing concentrations) in nitrogen compounds. Due to data and analysis method limitations, the Clinton River was the only river that could be analyzed for phosphorus trends; it showed a significant negative trend in total phosphorus concentration.

7.3 Fish Contaminants

In 1990, Michigan initiated a fixed station fish contaminant trend monitoring project to measure spatial and temporal trends of certain bioaccumulative contaminants. Adult fish are collected from each site at a target interval of two to five years, and analyzed as whole fish samples. Carp were collected periodically from five river trend monitoring sites since 1990. These sites were located on the Muskegon, Grand, Kalamazoo, St. Joseph, and Raisin Rivers. Whole fish fixed station trend monitoring data collected since 1990 were reviewed and general trend conclusions for rivers are summarized below (Bohr and VanDusen, 2008):

- Lindane, terphenyl, PBB, heptachlor, and aldrin were not quantified in any of the fish sampled. However, heptachlor epoxide and dieldrin (breakdown products of heptachlor and aldrin) were quantified in most of the samples analyzed.

- In addition to heptachlor epoxide and dieldrin, several chemicals were quantified in fish consistently, indicating that they are ubiquitous in the aquatic environment. These include mercury, hexachlorobenzene, total PCBs, total chlordane, and total DDT.

- Average total PCB concentrations were highest in carp from the Kalamazoo River site. The Kalamazoo River has extensive areas of PCB contaminated sediments, a problem that is being addressed under state and federal programs.

- Total PCB concentrations declined at all 5 river trend sites, with an average decline of 8% per year since 1990.

- Total DDT concentrations declined at 4 of 5 river trend sites, with an average decline of 10% per year since 1990. The exception was the Grand River (at Grand Rapids) where no trend could be detected.

- Total chlordane concentrations declined at all 5 river trend sites, with an average decline of 8% per year since 1990.

- Mercury concentrations decreased 2% per year in fish from the River Raisin. No significant trends were measured in the Grand, Kalamazoo, Muskegon, or St. Joseph Rivers.

The MDEQ uses caged fish to identify sources of bioaccumulative contaminants and identify spatial trends in contaminant concentrations. Caged fish studies were conducted in the Cass, Paw Paw (including Ox Creek and the mouth of the St. Joseph River), and Tawas Rivers watersheds in 2006. Caged fish studies were conducted in the Black (Sanilac and St. Clair Counties), Chippewa, Looking Glass, Maple, and Pine Rivers (Gratiot and Midland Counties) watersheds in 2007.

The Black, Chippewa, and Tawas Rivers are covered by a sport fish consumption advisory due to elevated concentrations of PCBs. The Cass River is covered by a sport fish consumption advisory due to elevated concentrations of PCBs, mercury, and dioxins in certain species. The Looking Glass and Maple Rivers have not been monitored previously using caged fish; these studies were conducted to determine if there are sources of PCBs and other BCCs in the watersheds. A USEPA Superfund site is located on the Pine River; DDT is the primary contaminant of concern. The study in the Paw Paw River was conducted as part of basin year monitoring to identify sources of PCBs and other BCCs.

Results of the caged fish studies conducted in 2006 and 2007 indicate that PCB sources exist in the Cass River watershed between the Frankenmuth and Caro Dams, in the Paw Paw River watershed downstream of Hartford as well as in Ox Creek, and in the Pine River watershed (Gratiot County) between Alma and St. Louis. Total PCBs were quantified at several other caged fish sites, but concentrations were not above background levels.

Net uptake of total DDT was either not quantified or indicated ubiquitous background concentrations in all the watersheds monitored in 2006 and 2007, with 1 exception. The Pine River caged fish study conducted in 2006 indicates that the St. Louis impoundment continues to be a source of DDT. Total chlordane was elevated in caged fish placed at the mouth of Ox Creek, but was quantified at only a few other sites in 2006 and 2007. Measurement of PBDE in selected caged fish samples began in 2006. Based on the limited analyses conducted to-date, it appears that PBDEs are likely to be found at low-levels in most watersheds. Detailed results of these caged fish studies are included in the Michigan Fish Contaminant Monitoring Program: 2007 and 2008 Annual Reports (Bohr and Zbytowski, 2008; and Bohr and VanDusen, 2009).

In addition, edible portion fish tissue contaminant monitoring was conducted recently at five river sites: the Manistique River, Grand River downstream of the 6th Street Dam, Grand River at Ionia, Maple River, and the Galien River. Edible portion sampling is often targeted toward known sites of contamination, sites popular with sport anglers, and sites with public access. Results are presented in the Michigan Fish Contaminant Monitoring Program: 2008 Annual Report (Bohr and VanDusen, 2009).

7.4 Beaches

In 2007, six public beaches on rivers were monitored and three reported no exceedances of the *E. coli* WQS for total body contact. There were three beaches that reported a total of six exceedances.

In 2008, six public beaches on rivers were monitored and four reported no exceedances of the *E. coli* WQS for total body contact. There were two beaches that reported a total of four exceedances.

The Michigan Beach Web site (http://www.deq.state.mi.us/beach) provides access to a database containing beach closings and *E. coli* data collected by LHDs. Currently, 34 public beaches located on rivers are listed in the database; although, not all are monitored.

7.5 Designated Use Support Summary

A designated use support summary for Michigan rivers and streams is presented in Table 7.2. Michigan uses a multiple category system (i.e., assessment units may be placed in one or more category, see Section 4.11); therefore, river miles are not totaled. Key designated use support results follow. Impairment cause and source information for assessment units not supporting designated uses is presented in Chapter 9.

- Over 3,000 river miles are not supporting one or more designated uses indicated by poor biological communities. The majority of these river miles have been highly modified by channel maintenance activities carried out primarily by Michigan's county drain commissions. These channel maintenance activities (including channel straightening, dredging, riparian vegetation removal, and snag removal) may result in poor biological communities caused by nonpollutants (habitat and/or flow alterations); therefore, these river miles are placed in Category 4c. The number of Category 4c river miles for the other indigenous aquatic life and wildlife designated use decreased from 6,738 miles in the 2008 IR. This change in Category 4c mileage is mainly due to availability of new biological data collected in 2008 for Saginaw Bay and Lake Huron coastal tributaries (i.e. Pigeon and Cherry Rivers in Huron County) and reevaluation of designated use support using 2004 assessment methodology changes.

- Of the approximately 4,624 river miles assessed for the total body contact recreation designated use, about 12% were determined to support this designated use. Approximately 49% of the assessed river miles have TMDLs completed with approximately 16% scheduled to have TMDLs completed over the next several years. Most of the remaining assessed river miles have insufficient information to determine total body contact recreation designated use support.

- A small portion of the mouth of the Manistique River is listed in Category 4b. Ambient *E. coli* data collected in 2007 met WQS; however, an untreated CSO remains that could result in the exceedance of WQS. The CSO is scheduled for elimination by December 31, 2019.

- Water column PCB monitoring using highly sophisticated and sensitive sampling/analytical techniques indicates that 100% of the assessed river miles are not attaining PCB WQS; therefore, a significant number of river miles are listed as not supporting the fish consumption designated use and/or the other indigenous aquatic life and wildlife designated use. Atmospheric deposition is considered to be the major source of this persistent bioaccumulative chemical.

- Approximately 93% of the 53,277 river miles assessed for the fish consumption designated use are determined to not support this designated use. The primary causes are PCBs and mercury (in fish tissue and water column). Atmospheric deposition is considered to be the primary source of these persistent bioaccumulative chemicals.

- A 17.7-mile reach of the River Raisin (Lenawee County) is not supporting the public water supply designated use because nitrate-nitrogen concentrations in the source water are above the USEPA's maximum contaminant level for nitrates of 10 mg/L. A USEPA-approved TMDL is in place to remediate this problem. This listing for River Raisin does not strictly follow the assessment methodology (i.e., the listing encompasses an area much larger than the 12-digit HUC; see Section 4.10) since the listing was created prior to the 2008 assessment methodology update and was meant to encompass a stretch of the river between two distinct drinking water intakes.

- Considerable changes in designated use support were made in the Grand River watershed, including the Thornapple and Maple Rivers, and Tittabawassee River watershed based on water chemistry data. In the Grand River watershed, several assessment units were moved from not supporting the other indigenous aquatic life and wildlife designated use to having insufficient information or fully supporting based on new mercury data collected in 2006 and 2007. There data were not available for the 2008 IR. In the 2008 IR, the Tittabawassee River and tributaries located upstream of Dow Chemical Company and several tributaries downstream were erroneously listed as not supporting the other indigenous aquatic life and wildlife or fish consumption designated uses due to dioxin. This error was corrected for the 2010 IR.

- The extent of river miles not supporting the fish consumption designated use is widespread (Figure 7.1). Mercury in fish tissue, mercury in water column, PCB in fish tissue, and PCB in water column are the primary causes for river miles to not support the fish consumption designated use (Figures 7.2 through 7.5). These four parameters have been sampled at many locations statewide. Sampling locations that do not overlay river miles that are not supporting the fish consumption designated use may have insufficient information to determine use support or may indicate designated use support. Please note that a color copy of Figure 7.1 is required to view all information. This IR is available in color at http://www.michigan.gov/deqwater under Water Quality Monitoring, Assessment of Michigan Waters.

- A majority of the river miles support the other indigenous aquatic life and wildlife designated use (Figure 7.6). The primary causes for river miles to not support the other indigenous aquatic life and wildlife designated use are PCB in water column, mercury in water column, and habitat alterations (Figures 7.7 through 7.9). PCB and mercury in the water column have been sampled at many locations statewide (Figures 7.8 and 7.9). Sampling locations that do not overlay river miles that are not supporting the other indigenous aquatic life and wildlife designated use may have insufficient information to determine use support or may indicate designated use support. Please note that a color copy of Figure 7.6 is required to view all information. This IR is available in color at http://www.michigan.gov/deqwater under Water Quality Monitoring, Assessment of Michigan Waters.

- A variety of TMDLs were completed and approved by the USEPA in 2008 and 2009 resulting in newly listed river miles in Category 4a. In 2008, PCB TMDLs were completed for the Pere Marquette River watershed (Lake, Mason, Oceana, and Newaygo Counties). In 2008, dissolved oxygen TMDLs were completed for the Cass River (Tuscola County). In 2008, *E. coli* TMDLs were completed for the Detroit River (Wayne, Oakland, and Washtenaw Counties), Ecorse River (Wayne County), Farmers Creek (Berrien County), and South Branch River Raisin (Lenawee County). In 2009, dissolved oxygen and sedimentation/siltation TMDLs were completed for Norton Creek

(Oakland County). In 2009, phosphorus TMDLs were completed for the Upper Maple River, Peet Creek, and Lost Creek watersheds (Shiawassee, Clinton, and Gratiot Counties). In 2009, *E. coli* TMDLs were completed for Honey Creek (Washtenaw County), Pine and Mill Creeks (Berrien and Van Buren Counties), Smiths Creek (St. Clair County), and Tittabawassee River (Midland County).

Table 7.2 Designated use support summary for rivers in Michigan (approximately 76,295 total miles). No rivers are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture (mi)	76,295	0	0	0	0	0	0
Navigation (mi)	76,295	0	0	0	0	0	0
Industrial Water Supply (mi)	76,295	0	0	0	0	0	0
Warmwater Fishery (mi)	8,471	722	64,805	1,575	3	418	1,042
Cold Water Fishery (mi)	5,927	1,038	69,045	138	4	60	83
Other Indigenous Aquatic Life and Wildlife (mi)	47,158	4,049	14,795	1,939	148	2,972	7,164
Partial Body Contact Recreation (mi)	49	1,032	72,278	2,201	3	0	731
Total Body Contact Recreation (mi)	577	1,048	71,671	2,248	3	0	748
Fish Consumption (mi)	1,912	70	23,018	856	1,867	0	49,418
Public Water Supply (mi) *	0	0.1	555	18	0	0	0

* Approximately 572 of the 76,295 river miles are protected for the public water supply designated use.

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CHAPTER 8
ASSESSMENT RESULTS: WETLANDS

8.1 Designated Use Support Summary

Michigan's WQS apply to all surface waters of the state, including wetlands. However, some criteria may not be applicable to wetlands. For example, a highly productive wetland with abundant vegetation in shallow water and high organic content in the sediment may naturally exhibit low dissolved oxygen levels in the water column. Based on Rule 100(10) of the WQS, use attainability studies are allowed for certain wetlands to address this situation.

Michigan's wetlands are currently assessed for designated use support on an as needed basis. The known designated use support information is listed in Table 8.1. Michigan uses a multiple category system (i.e., assessment units may be placed in one or more category, see Section 4.11); therefore, wetland acres are not totaled. Details regarding the four listed wetlands follow. Impairment cause and source information for assessment units not supporting designated uses is presented in Chapter 9.

- A 10-acre wetland in the Escanaba River watershed (Marquette County) previously listed as not supporting designated uses was remediated in 1997. The other indigenous aquatic life and wildlife designated use of this wetland was restored by the reduction of nickel contamination from an upstream point source discharge.

- A small wetland area in the Grand River watershed (0.25 acres in Jackson County) is listed as having insufficient information to determine if the other indigenous aquatic life and wildlife designated use is supported due to point sources discharges and contaminated groundwater.

- Tobico Marsh (Bay County), a 680-acre marsh adjacent to Saginaw Bay, is not supporting the fish consumption designated use due to elevated PCB concentrations in carp and northern pike populations. Carp, largemouth bass, and northern pike were collected and analyzed in 2007. These new data did not result in a change to the fish consumption advisory.

- Ruddiman Creek Lagoon (21 acres in Muskegon County) is not supporting the fish consumption designated use. This wetland is the subject of a major sediment remediation project that involves the removal of approximately 80,000 cubic yards of sediments contaminated with PCBs, metals, and polynuclear aromatic hydrocarbons.

Table 8.1 Designated use support summary for Michigan wetlands (approximately 5,583,400 total acres). All wetland acres are not entered in the ADB. Wetlands that have specific information are entered into the ADB on a case-by-case basis. No wetlands are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations. N/A indicates that the designated use is not applicable.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture	5,583,400	0	0	0	0	0	0
Navigation	5,583,400	0	0	0	0	0	0
Industrial Water Supply	5,583,400	0	0	0	0	0	0
Warmwater Fishery	0	0	5,583,400	0	0	0	0
Cold Water Fishery	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Other Indigenous Aquatic Life and Wildlife	10	0.25	5,583,389.75	0	0	0	0
Partial Body Contact Recreation	0	0	5,583,400	0	0	0	0
Total Body Contact Recreation	0	0	5,583,400	0	0	0	0
Fish Consumption	0	0	5,582,699	0	0	0	701
Public Water Supply	N/A	N/A	N/A	N/A	N/A	N/A	N/A

CHAPTER 9
WATER BODIES NOT SUPPORTING DESIGNATED USES AND CWA SECTION 303(D) REQUIREMENTS

9.1 Introduction

The purpose of this chapter is to provide additional information regarding water bodies that are determined to not support one or more designated uses (i.e., water bodies that are listed in Categories 4 or 5; see Section 4.11 for a description of the categories). Section 303(d) of the CWA and the USEPA's Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130) require states to develop TMDLs for water bodies that are not meeting WQS (i.e., water bodies that are listed in Category 5). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point sources and NPSs to restore and maintain the quality of their water resources.

9.2 Impairment Cause and Source

When a determination is made that a designated use is not supported (includes both Categories 4 and 5), the cause and source (when known) of impairment is identified (see Section 4.12). Each assessment unit may be listed for one or more causes and sources of impairment. The following tables are sorted by cause or source with the greatest geographic extent listed first.

9.2.1 Great Lakes and Connecting Channels

All of Michigan's Great Lakes, bays, and Lake St. Clair are listed as not supporting one or more designated use with various causes and sources of impairment (Tables 9.1 and 9.2)

Table 9.1 Michigan Great Lakes and bays not supporting designated uses listed by cause of impairment.

Cause	Total mi^2
Toxic organics	
PCBs in fish tissue	42,167
Dioxin	41,937
Pesticides	
Chlordane	29,944
DDT	4,397
Metals	
Mercury in fish tissue	32,857
Nutrients	3
Taste and odor	3
Pathogens	4.7 shoreline mi

Table 9.2 Michigan Great Lakes and bays not supporting designated uses listed by source of impairment.

Source	Total mi^2
Atmospheric deposition	42,167
Agriculture	4,373
Contaminated sediment	1,137
Industrial point source discharge	3
Municipal point source discharge	3
Non-point source	3.6
Collection system failures	3 shoreline mi
Illicit connections	0.2 shoreline mi
Waterfowl	0.4 shoreline mi
Source unknown	1 shoreline mi

All Great Lakes connecting channel miles are listed as not supporting one or more designated use with various causes and sources of impairment (Tables 9.3 and 9.4).

Table 9.3 Michigan connecting channel river miles not supporting designated uses listed by cause of impairment.

Cause	Total miles
Toxic organics	
PCBs in water column	112
PCBs in fish tissue	112
Dioxin	26
Metals	
Mercury in fish tissue	71
Mercury in water column	26
Pathogens	79
Pesticides	
DDT	26

Table 9.4 Michigan connecting channel river miles not supporting designated uses listed by source of impairment.

Source	Total miles
Atmospheric deposition	112
CSOs	79
Illicit connections	79
Source unknown	26

9.2.2 Inland Lakes and Reservoirs

Many inland lakes and reservoirs that do not support one or more designated uses are impacted by atmospheric deposition of mercury and/or PCBs. Several other causes and sources of impairment are also identified (Tables 9.5 and 9.6).

Table 9.5 Michigan inland lake and reservoir acres not supporting designated uses listed by cause of impairment.

Cause	Total acres
Metals	
Mercury in fish tissue	242,552
Copper	3,174
Zinc	480
Mercury in water column	86
Toxic organics	
PCBs in fish tissue	144,693
Dioxin	19,944
Polycyclic Aromatic Hydrocarbons	480
PCBs in water column	125
PBBs	86
Pesticides	
Chlordane	32,945
DDT	86
Nutrients	6,036
Pathogens	1,089 4.8 shoreline mi
Sedimentation	832
Excess algal growth	709

Table 9.6 Michigan inland lake and reservoir acres not supporting designated uses listed by source of impairment.

Source	Total acres
Atmospheric deposition	310,246
Source unknown	16,991 4.6 shoreline mi
Contaminated sediment	8,701
Municipal point source discharges	4,919
Agriculture	4,285 0.2 shoreline mi
Mine tailings	2,659
Industrial point source discharges	1,375
CSOs	969
Historic bottom deposits	832
Internal nutrient recycling	408
Unspecified storm sewer	257
Sewerage discharge in unsewered areas	119
Construction- site clearance	2
Waterfowl	0.2 shoreline mi

9.2.3 Rivers

Many rivers that do not support one or more designated uses are impacted by atmospheric deposition of mercury and/or PCBs. Several other causes and sources of impairment are also identified (Tables 9.7 and 9.8).

Table 9.7 Michigan river and stream miles not supporting designated uses listed by cause of impairment.

Cause	Total mi
Toxic organics	
PCBs in water column	49,541
PCBs in fish tissue	21,914
Dioxin	727
PBBs	189
Petroleum hydrocarbons	10
PCBs in sediment	5
Metals	
Mercury in fish tissue	6,450
Mercury in water column	5,791
Copper	96
Lead	17
Chromium	17
Flow alterations	3,579
Pathogens	3,032
Habitat alterations	2,753
Sedimentation/siltation	1,936
Oxygen depletion	1,413
Nutrients	675
Organic enrichment (sewage)	76
Pesticides	
DDT	189
Chlordane	172
Cause unknown	140
Excess algal growth	80
Oil and grease	38
Thermal impacts	30
Aquatic plants	28
Selenium	20
Solids (suspended/bedload)	17
Total suspended solids	14
Total dissolved solids	8

Table 9.8 Michigan river and stream miles not supporting designated uses listed by source of impairment.

Source	Total mi
Atmospheric deposition	51,876
Source unknown	4,252
Habitat alterations	4,087
Hydromodifications	3,301
Municipal permitted discharges	2,526
Storm water permitted discharges	2,515
Agriculture - grazing	2,015
Agriculture - crop production	2,000
Agriculture - animal feeding/handling	1,944
Urban related runoff/storm water	1,801
Spills and unpermitted discharges	1,537
Legacy/historical pollutants	860
Industrial permitted discharges	693
NPS	545
Land application/waste sites	472
Natural	218
Resource extraction	168
Groundwater loadings	26
Construction	22
Turf management	4

9.2.4 Wetlands

Two wetlands, Tobico Marsh (680 acres in Bay County) and Ruddiman Creek Lagoon (21 acres in Muskegon County), are not supporting the fish consumption designated use. PCBs are the cause of impairment with multiple sources listed (Tables 9.9 and 9.10).

Table 9.9 Michigan wetland acres not supporting designated uses listed by cause of impairment.

Cause	Total acres
Toxic organics	
PCBs in fish tissue	701
PCBs in water column	21

Table 9.10 Michigan wetland acres not supporting designated uses listed by source of impairment.

Source	Total acres
Atmospheric deposition	701
Groundwater loadings	680
Land application/waste sites	680

9.3 TMDL Development

9.3.1 The TMDL Process

Michigan's Section 303(d) list consists of assessment units that are listed in Category 5. A TMDL is developed for each cause (see Section 9.2) or a TMDL may address more than one related causes. In addition to the information used to determine designated use support (see Section 4.2), several references are used to develop the Section 303(d) list: Title 40 of the Code of Federal Regulations, Parts 122, 123, and 130; USEPA Guidance for Water Quality-Based Decisions: The TMDL Process, April 1991; and New Policies for Establishing and Implementing TMDLs (August 8, 1997, Robert Perciasepe memo to USEPA Regional Administrators).

Development of a TMDL is typically preceded by collection of water quality data by the MDEQ or its contractors to document current pollutant loads within the water body of concern and further define potential sources of the pollutant. These data, in addition to any other relevant information, form the basis for determining the necessary pollutant load reductions. A TMDL document is comprised of several sections including identification of the impaired assessment unit and cause of impairment, description of water quality studies conducted to identify the extent and source(s) of the impairment, and calculation of necessary load reductions for the point source and NPS to achieve WQS. The TMDL also identifies any past, current, or future known actions to remedy the impairment and a monitoring schedule to track improvements following implementation of the TMDL.

The TMDL document is typically developed by staff members of the MDEQ. The draft document is made available for public review on the MDEQ's Web site for 30 days. The announcement for the public comment period is published in the MDEQ calendar. During the public comment period, the MDEQ staff hold a public meeting in a community near the impaired water body to describe the TMDL and receive comments. Local stakeholders, including the general public, LHDs, local government, and county extension officials are sought to attend the meetings to contribute their expertise in identifying pollutant sources and discuss source reduction/elimination. Following the comment period, the TMDL is modified as appropriate to address comments received.

The TMDL is finalized following the public comment period and submitted to the USEPA, Region 5, for their review and approval. The USEPA has 30 days to review and approve or disapprove a TMDL. After a TMDL is approved by the USEPA, the water body is removed from the Section 303(d) list (Category 5) and reclassified as Category 4a. For additional information regarding delisting Category 5 assessment units see Section 4.13.

9.3.2 TMDLs Completed

In 2008 and 2009, 82 AUIDs had TMDLs developed and approved for a variety of parameters (Table 9.11). A TMDL may address multiple causes. Additional information regarding approved TMDLs is available at http://www.michigan.gov/deqwater under Water Quality Monitoring, Assessment of Michigan Waters, TMDLs.

Table. 9.11 Number of AUIDs with TMDLs completed and approved in 2008, and 2009.

Year	Parameter	Number
2008	Pathogen	5
	Phosphorus	1
	Dissolved Oxygen	2
	PCB	50
2009	Pathogen	6
	Phosphorus	16
	Dissolved Oxygen and Sedimentation/Siltation	2

9.3.3 TMDL Schedule

To facilitate organization and communication, TMDL groups were created for the 2010 IR. A TMDL group consists of AUIDs in close geographic proximity listed in Category 5 with the same cause(s) and source(s). TMDL groups are listed in Appendix C.

TMDL groups are prioritized for TMDL development considering the existing TMDL schedule (i.e., the number of TMDLs currently scheduled for each year), Michigan's five-year rotating watershed cycle (Figure 3.1), available resources to complete TMDLs, data and supporting information quality and quantity, complexity of the problem and severity of the pollution, and the USEPA's recommendation to develop TMDLs within 13 years of listing.

The number of TMDLs (i.e. groups) projected to be developed in 2010 and over the next 13 years is 128 (Table 9.12). The number of TMDLs scheduled appears to have decreased dramatically compared to the 2008 IR. This discrepancy is a result of the creation and use of TMDL groups rather than the use of individual assessment units to generate Table 9.12. In many instances a TMDL group consists of multiple assessment units.

TMDLs for organic chemicals with atmospheric sources (e.g., PCBs, chlordane, DDT, and dioxin) will be completed over the next several years. TMDL development approaches for waters impaired primarily by atmospheric sources of mercury and PCBs are currently being discussed. Most will likely be addressed by a common approach; therefore, a majority of these TMDLs are scheduled for development in 2011 (mercury), 2013 (inland PCBs), and 2015 (Great Lakes PCBs).

Table 9.12 Projected number of TMDLs per year (i.e. TMDL groups).

Year: Number	Year: Number
2010: 8	2017: 18
2011: 6	2018: 8
2012: 10	2019: 3
2013: 9	2020: 4
2014: 2	2021: 5
2015: 33	2022: 4
2016: 14	2023: 4

9.3.4 Changes to the Section 303(d) List

Modifications to the 2008 Section 303(d) list to create the 2010 Section 303(d) list are provided in Appendix D. This list reflects the addition of 307 assessment units (443 causes) since the 2008 IR. An assessment unit may have more than one cause of impairment associated with it. This list also reflects the removal of 384 assessment units (983 causes) from the Section 303(d) list since the 2008 IR.

CHAPTER 10
PUBLIC PARTICIPATION IN THE IR

10.1 Introduction

The MDEQ provides opportunities for public participation in the development of the IR. The following information is a summary of those opportunities, the comments or information received from the public, and the MDEQ's response.

10.2 Request for Data

The MDEQ, WB, requested ambient water quality data (chemical, biological, or physical) that was obtained by other governmental agencies, nongovernmental organizations, or the public for Michigan surface waters since January 1, 2007. All water quality data submitted to the MDEQ, WB, before June 5, 2009, was evaluated according to the MDEQ's assessment methodology (see Chapter 4) and potentially used to help prepare this IR. This request was published on the MDEQ's calendar on March 30, April 13, April 27, May 11, and May 25, 2009, and e-mailed to key individuals in the MDNR's Fisheries Division, MDA-Right to Farm, Michigan Department of Transportation, United States Forest Service, USFWS, and the USEPA. Data were received from the following organizations: Sierra Club, Tip of the Mitt Watershed Council, National Oceanic and Atmospheric Administration-GLERL, and Alliance for the Great Lakes.

10.3 Public Notice of Draft Assessment Methodology

A draft version of Chapter 4, the assessment methodology, was made available on the MDEQ's Web site for public review and comment. This announcement was published on the MDEQ's calendar on May 25, June 8, and June 22, 2009. Public comments to be considered in the development of Chapter 4 were due June 26, 2009. Comments on the draft assessment methodology were received from the Alliance for the Great Lakes. The MDEQ response is contained in the following section. Public comments, generally in their entirety, are presented in Appendix E.

10.4 Public Notice of the Draft IR

A draft version of this IR was made available on the MDEQ's Web site for public review and comment from XXXX through XXXX, 2010. This announcement was published on the MDEQ's calendar on XXXX.

The MDEQ recognizes the importance of public comments and thanks individuals and organizations that provided input, expressed water quality concerns, or posed questions. The following section summarizes the MDEQ response to public comments pertaining to the Draft 2010 IR. Public comments, generally in their entirety, are presented in Appendix E.

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