Cheboygan River/Lower Black River Watershed Initiative 2006-07 Update

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Michigan's Nonpoint Source Program

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PROJECT OVERVIEW

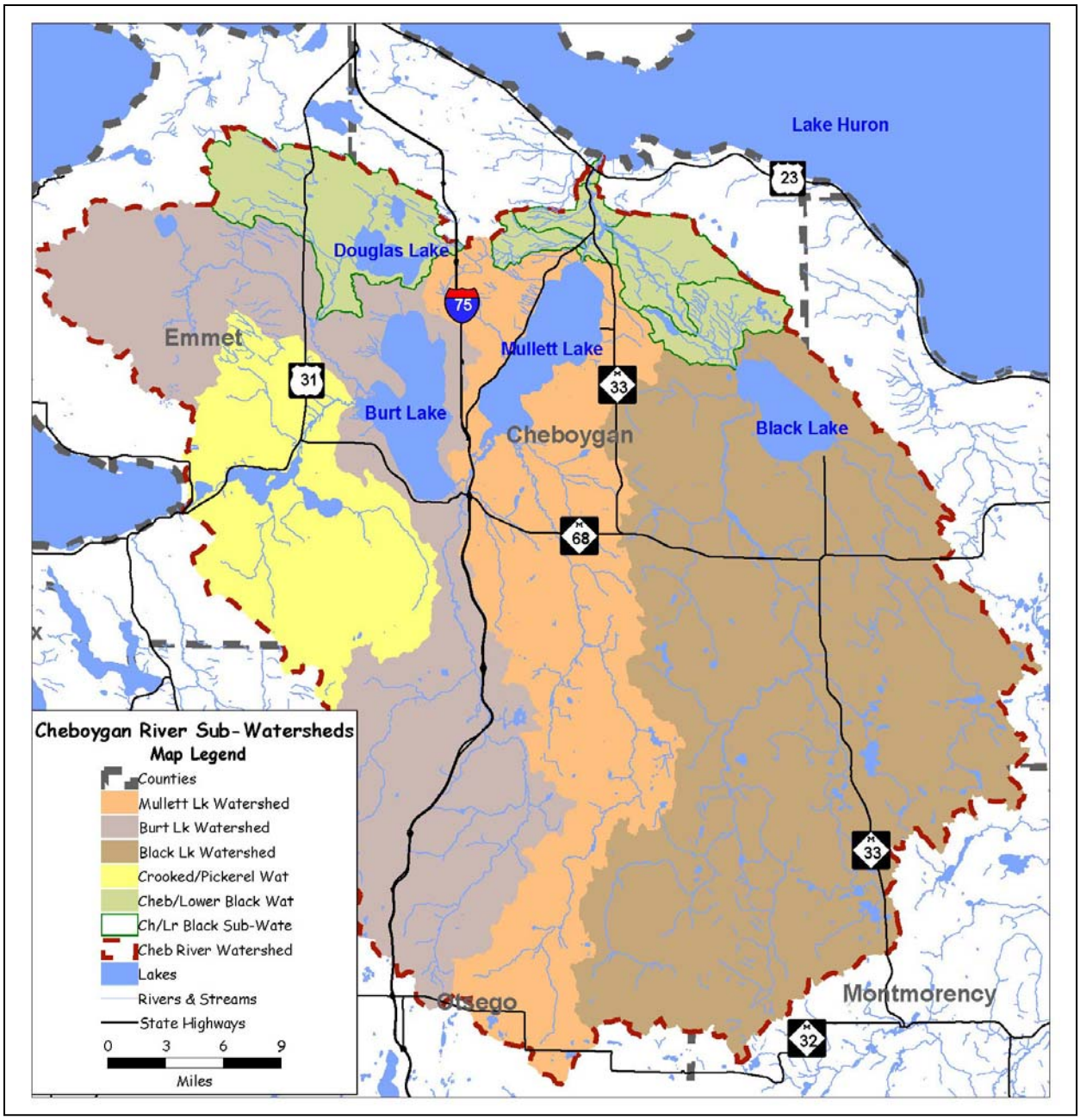
Background

In 1986, the State of Michigan, Department of Natural Resources (DNR), Surface Water Quality Division initiated a Nonpoint Source Pollution Control Program to begin the effort of eliminating and preventing nonpoint source pollution from surface waters. Nonpoint source pollution differs from point source, as it is not a direct discharge from a pipe entering a waterbody. Instead its origin is from diffuse sources, such as runoff from construction sites, agricultural activities, etc.; primarily pollution resulting from man's activities on land. Grant programs, from state and federal sources, provided funding for local efforts to develop and implement a watershed approach to nonpoint source pollution prevention and remediation.

The Northeast Michigan Council of Governments (NEMCOG), applied for and received its first nonpoint source watershed management grant through the State's "Clean Water Incentives Program" in 1986. In partnership with local agencies and organizations, an effort began to develop a watershed management plan for the entire Cheboygan River Watershed. However, due to its vast size, the watershed was divided into sub-watersheds for project planning and implementation purposes. The Burt Lake (sub) Watershed was the first nonpoint source management plan developed, followed by three years of implementation funding. The Mullett Lake (sub) Watershed Nonpoint Source Management Plan was the second sub-watershed to receive funding, followed by three years of implementation funding. Black Lake (sub) Watershed Nonpoint Source Management Plan was written in 1991, and updated in 2002. Implementation funding has not yet been received for the watershed. The Crooked/Pickerel Lakes (sub) Watershed Nonpoint Source Management Plan was funded in 1995 and was followed by three years of implementation funding.

The Cheboygan River/Lower Black River sub-watershed is the final phase in the development of a Nonpoint Source Pollution Management Plan for the entire Cheboygan River Watershed. Although, the primary focus of this plan was on the river systems, other smaller sub-watersheds not included in previous plans were included as part of this planning effort. This planning effort includes portions of the Lake Sixteen Bog, Lower Black River, Cheboygan River, Terry Creek, Sipper Creek, Laperell Creek, Van Creek, the 529-acre Munro Lake, 400-acre Long Lake, 3733.5-acre Douglas Lake, the Twin Lakes, and the many tributaries of these water bodies. Approximately two-thirds of the watershed, including the Cheboygan and Lower Black rivers, is located in Cheboygan County. At the western edge of Cheboygan County and into Emmet County lies Douglas Lake and its tributaries. **Map 1** displays the Cheboygan River Watershed and the sub-watersheds mentioned above.

Map1: Cheboygan River Sub-Watersheds



Project Partnerships and Public Input Process

The following agencies and organizations were involved in providing input into the overall development of the nonpoint source watershed management plan. Agencies and organizations were asked to participate due to their area of expertise or general interest in the project.

STEERING COMMITTEE

Northeast Michigan Council of Governments
City of Cheboygan
Huron Pines Resource Conservation and Development Council
Douglas Lake Association
District Health Department #4
Northeast Michigan Council of Governments (NEMCOG)
Petoskey Regional Audubon Society
Michigan Department of Environmental Quality (MDEQ)
Little Traverse Conservancy
United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS)
Michigan Groundwater Stewardship Program
Tip of the Mitt Watershed Council
Cheboygan Tribune
Cheboygan County Conservation District
Michigan State University Extension (MSUE)
Township Officials

AGENCIES PROVIDING TECHNICAL STAFF

Agencies providing technical staff to the project and their corresponding duties included the following:

Northeast Michigan Council of Governments (NEMCOG)
Responsibilities:

- Organize steering committee meetings, send out meeting notices and agendas
- Development and dissemination of informational materials
- Provide information, gather input at township, county and area organization meetings
- Hold public meetings on draft plan to gather input and provide information
- Conduct Road/Stream Crossing Inventory of critical area
- Write up results of inventory. Include sections on: purpose and importance of inventory, tables that summarize results, description of methods used in data collection including any formulas used in calculations, results, recommendations and BMP's, and a map indicating sites inventoried.
- Gather watershed information, write plan

Tip of the Mitt Watershed Council (TOMWC)
Responsibilities:

- Facilitate meetings
- Assist in development and dissemination of newsletters and informational materials.
- Provide assistance in plan write-up.
- Conduct Stormwater Inventory of critical area
- Conduct Shoreline Inventory of critical area

- Write up results of inventories. Include sections on: purpose and importance of inventory, tables that summarize results, description of methods used in data collection including any formulas used in calculations, results, recommendations and BMP's, and a map indicating sites inventoried.

Conservation Districts/ USDA-NRCS
Responsibilities:

- Assist in organization and provide input and direction at meetings
- Assist in development and dissemination of newsletters and informational materials.
- Conduct Agriculture Site Inventory of critical area
- Participate in Streambank Inventory of tributaries in critical area
- Write up results of inventories. Include sections on: purpose and importance of inventory, tables that summarize results, description of methods used in data collection including any formulas used in calculations, results, recommendations and BMP's, and a map indicating sites inventoried.

Huron Pines Resource Conservation & Development Council (RC&D)
Responsibilities:

- Assist in organization and provide input and direction at meetings
- Assist in development and dissemination of newsletters and informational materials.
- Conduct Stormwater Inventory of critical area
- Conduct Shoreline Inventory of critical area
- Write up results of inventories. Include sections on: purpose and importance of inventory, tables that summarize results, description of methods used in data collection including any formulas used in calculations, results, recommendations and BMP's, and a map indicating sites inventoried.
- Research and compile zoning and ordinance information for watershed

Meetings

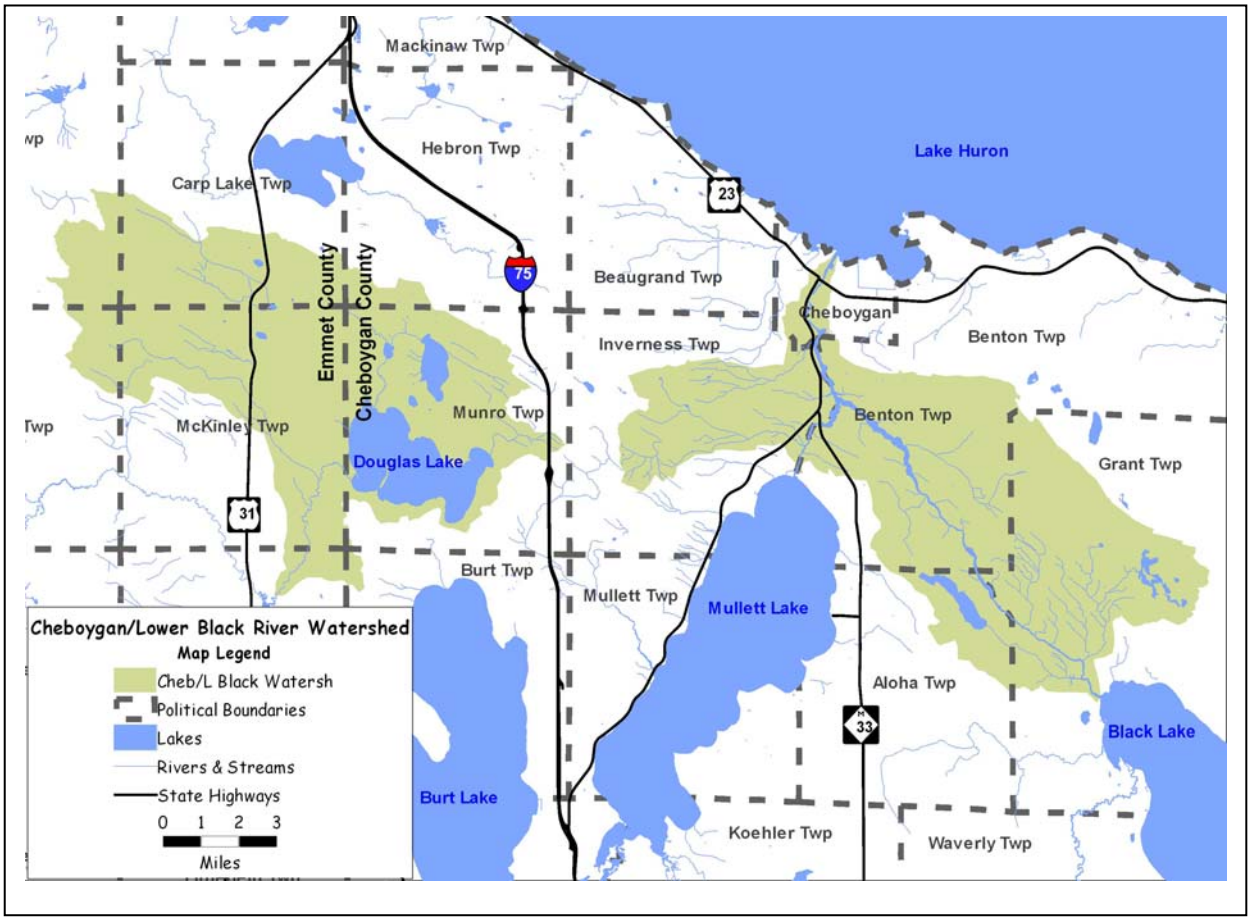
Quarterly meetings of the Cheboygan River Watershed Committee were initiated on April 30, 2002, continued throughout the Watershed planning phase (9/12/2002, 12/5/2002, 3/5/2003, 6/5/2003, 7/5/2003, and 12/5/2003) and concluded in December 2003. Committee members attended the majority of the meetings and were actively engaged in discussions surrounding the development of the plan. Input provided from committee members involved various issues concerning the watershed's system of rivers and lakes, as well as overall project direction.

The public meetings were intended to provide an overview of the planning process and to gather input on watershed issues and concerns. A public meeting was held at the end of the two-year planning phase to review and finalize completion of the draft plan. The meeting was publicized in local newspapers and members of the community were encouraged to attend. This provided committee members and the general public an opportunity to comment on the results of the draft plan.

CHAPTER 1 GETTING TO KNOW THE CHEBOYGAN RIVER/LOWER BLACK RIVER AND DOUGLAS LAKE WATERSHEDS

The watersheds of Cheboygan River, Lower Black River, and Douglas Lake are primarily located in northeastern Lower Michigan and cover 94,130.65 acres, principally in Cheboygan County. Ranging over the northern one-third of Cheboygan County, the watershed includes all or parts of Aloha, Benton, Grant, Inverness, and Monroe townships and touches on Carp Lake, Center, Maple River, and McKinley Townships in Emmet County. **Map 2** displays the Cheboygan River/Lower Black River Watershed and political boundaries.

Map 2: Cheboygan/Lower Black River Watershed

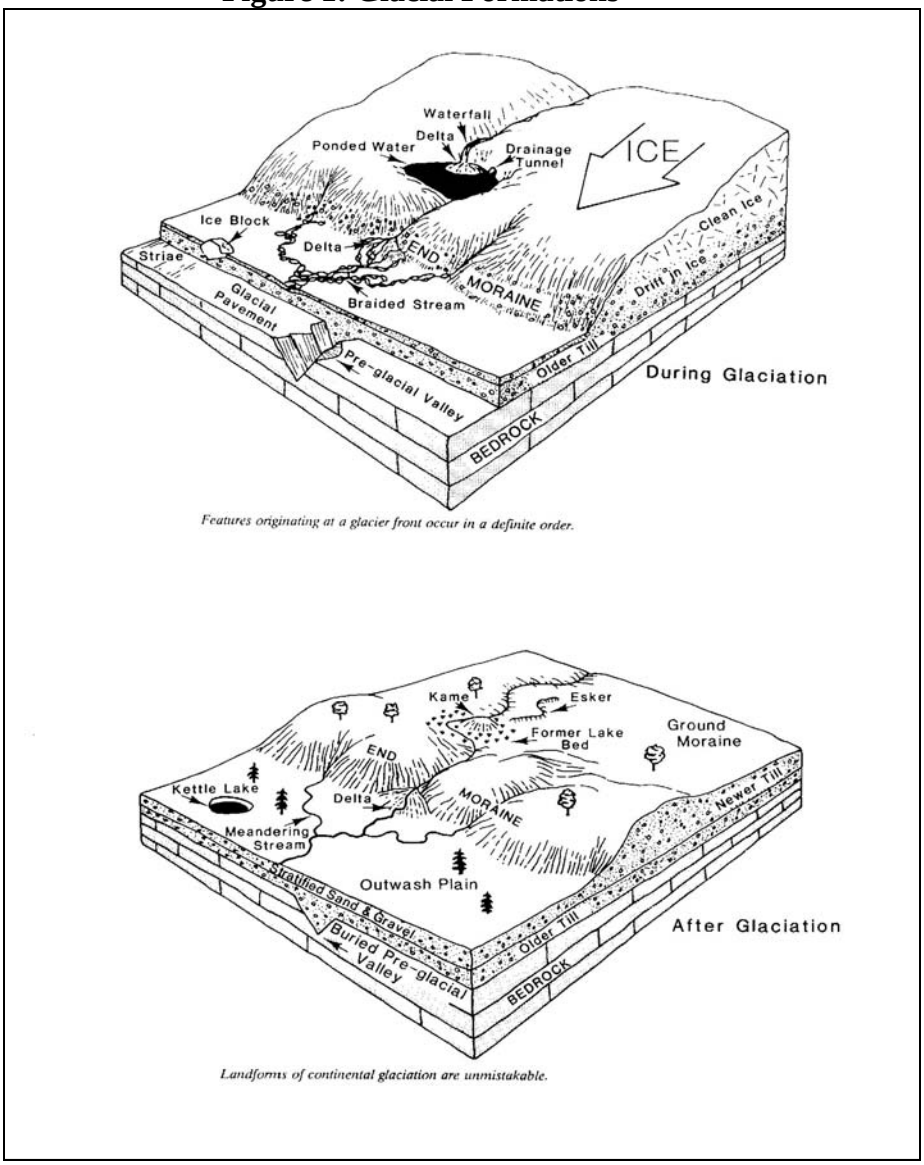


The Cheboygan River and the Lower Black River are between 577 and 643 feet above sea level. The remaining watershed area is 644 to 709 feet above sea level, with the exception of the Douglas Lake portion, which has an elevation of 710 to 774 feet.

Geology

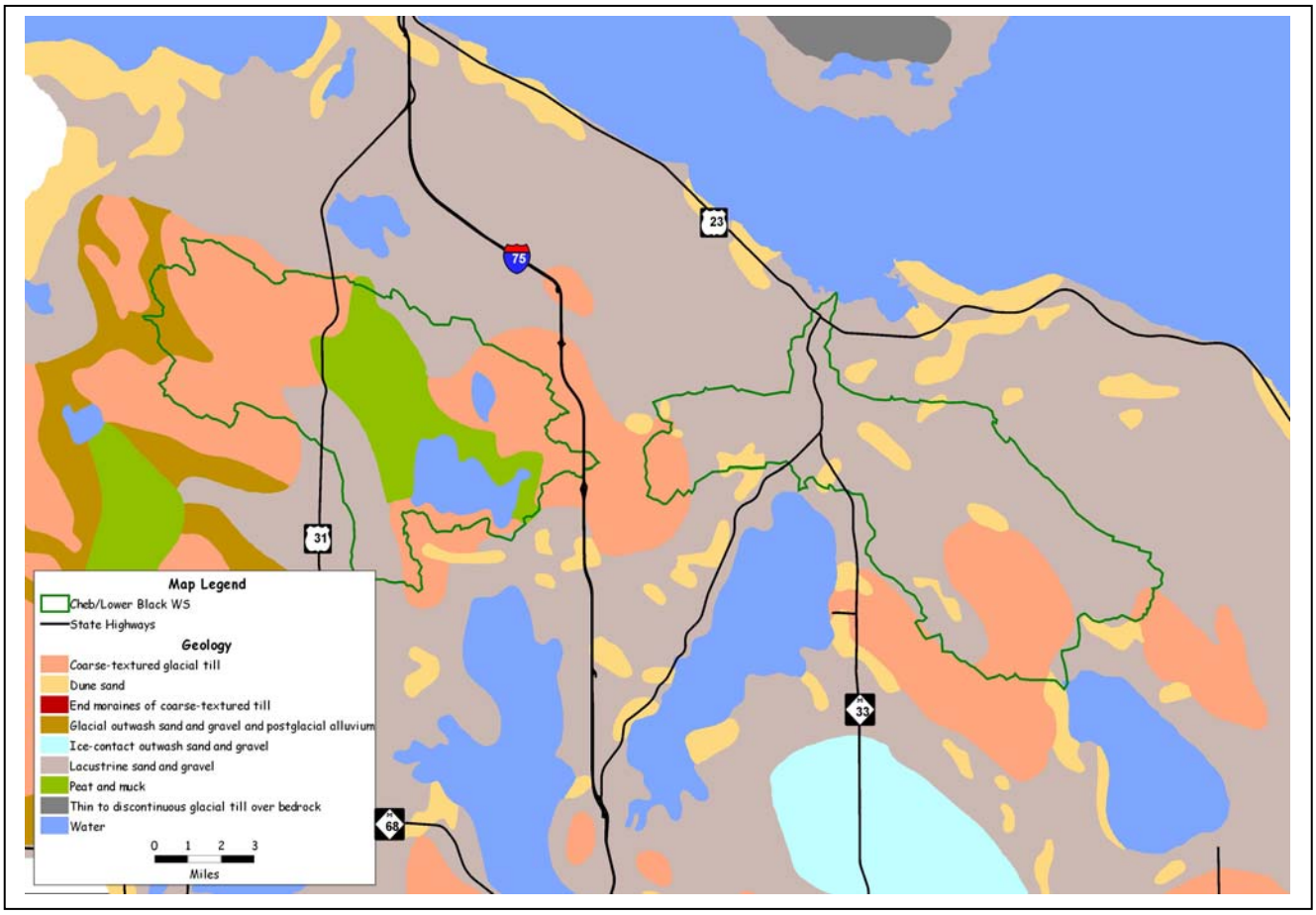
Throughout prehistory of the Great Lakes Region glaciers advanced and retreated repeatedly, creating various surface and subsurface landforms. Occurring nearly 12,000 years ago, the last glacial advance was instrumental in the formation of the existing landscape. Three major surface types dominate the watershed area; lacustrine sand and gravel, peat and muck, and glacial till. (See **Figure 1** and **Map 3**)

Figure 1: Glacial Formations



Many northern Michigan lakes were formed when the glaciers melted, leaving behind large blocks of ice. The Douglas and Munro lakes of Cheboygan County were created in this way. As the ice receded further north, meltwaters flooded many areas of northern Michigan. The higher elevations, above water, formed islands. During this period the lacustrine sands, (sand and gravel deposited as sheet sands and beaches) covering much of the watershed were deposited on the lakebed of glacial Lake Algonquin.

Map 3: Geology



As indicated on **Map 3** peat and muck cover much of the watershed's western portion, surrounding Douglas Lake on three sides, and spreading into Emmet County. Peat and muck are both comprised of organic soil material, with muck containing more minerals than peat. In peat, the original plant parts are recognizable, but are unrecognizable in muck. North of Douglas Lake lies a three mile long esker, a long, narrow, sinuous, steep-sided ridge composed of irregularly stratified sand and gravel. (See **Figure 1**) This sand and gravel ridge was formed when a stream flowing between ice walls, or in an ice tunnel of a retreating glacier, deposited materials that were left behind when the ice melted. Eskers range in length from less than a mile to nearly 100 miles long.

Glacial till covers most of the eastern portion of the watershed. (See **Map 3**) Glacial till is unsorted material deposited by glacial ice and consists of a mixture of clay, silt, sand, gravel, stones, and boulders. A drumlin field can be found on the till plain in the southeast corner of the watershed, near Black Lake.

Drumlins are low, smooth, spoon-shaped hills or mounds of compacted till. The tail of a drumlin always runs parallel to the glacier flow, so that all the drumlins in a field are oriented in the same direction.

Subsurface geology ranges from limestone in Benton and eastern Inverness townships to shale in western Inverness, and a combination of limestone and shale in most watershed portions located in Emmet County.

Soils

Soils information is important in the determination of types and intensity of land uses. Water quality of a river system is partially based on the nature of the soils and the slope of the land within the drainage basin. These factors determine potential land use, soil infiltration rates, water-holding capacity and soil erodibility and therefore are directly related to the amount of non-point source pollution in the watershed. The construction of roads, buildings, and septic systems on steeply sloped areas or areas with organic and hydric soils require special design considerations. If developed improperly the impacts to natural resources, particularly water quality, can be far-reaching.

The soils of the Cheboygan River/Lower Black River Watershed cover moraines, drumlins, lake terraces, and till plains. These soils are often found on uplands and post-glacial lake islands. Slope gradients range from 0 to 50 per cent, but are predominantly 2 to 30 per cent. Soils are well drained or moderately well drained with low to high potential surface runoff, depending on slope. Permeability is moderately rapid in the upper sandy material and very slow in the lower loamy horizons. Most of the watershed soil is in woodland. Many of the steeper areas are kept in permanent forest vegetation, but a few areas are used as pasture. Nearly level to moderately sloping sites are frequently used for pasture or growing hay and small grains, especially in the western portion of the watershed.

The Natural Resource Conservation Service (NRCS) completed a detailed soil survey of Cheboygan and Emmet Counties. A digital or computerized version of the soil survey maps was acquired from the Michigan Department of Natural Resources, MIRIS program. The following information is derived on the published soil surveys, and highlights hydric soils, slopes 12 percent and greater and soils with septic system limitations.

Hydric Soils and Steeply Sloped Areas

Map 4 shows hydric soils and areas of steep slopes. Lower density and less intensive development should be directed to these areas with severe building constraints. Hydric soils are saturated, flooded or ponded during part of the growing season and are classified as poorly drained to very poorly drained. Hydric soils have poor potential for building site development and sanitary facilities. Wetness and frequent ponding are severe problems that are difficult and costly to overcome. Sites with high water tables may be classified as wetlands and a wetlands permit would be required to develop these areas.

According to information presented in the Cheboygan County and Emmet County Soil Surveys, areas with hydric soils make up roughly 13 percent of land in the watershed. Most of these wet areas are found in the western half of the watershed, from Douglas Lake in Munro Township, Cheboygan County, through McKinley and Carp Lake Townships, in Emmet County. Much of the hydric soils in these townships are found on state land and on land owned by the University of Michigan Biological Station. While the threat of over-development is low on U. of M. and

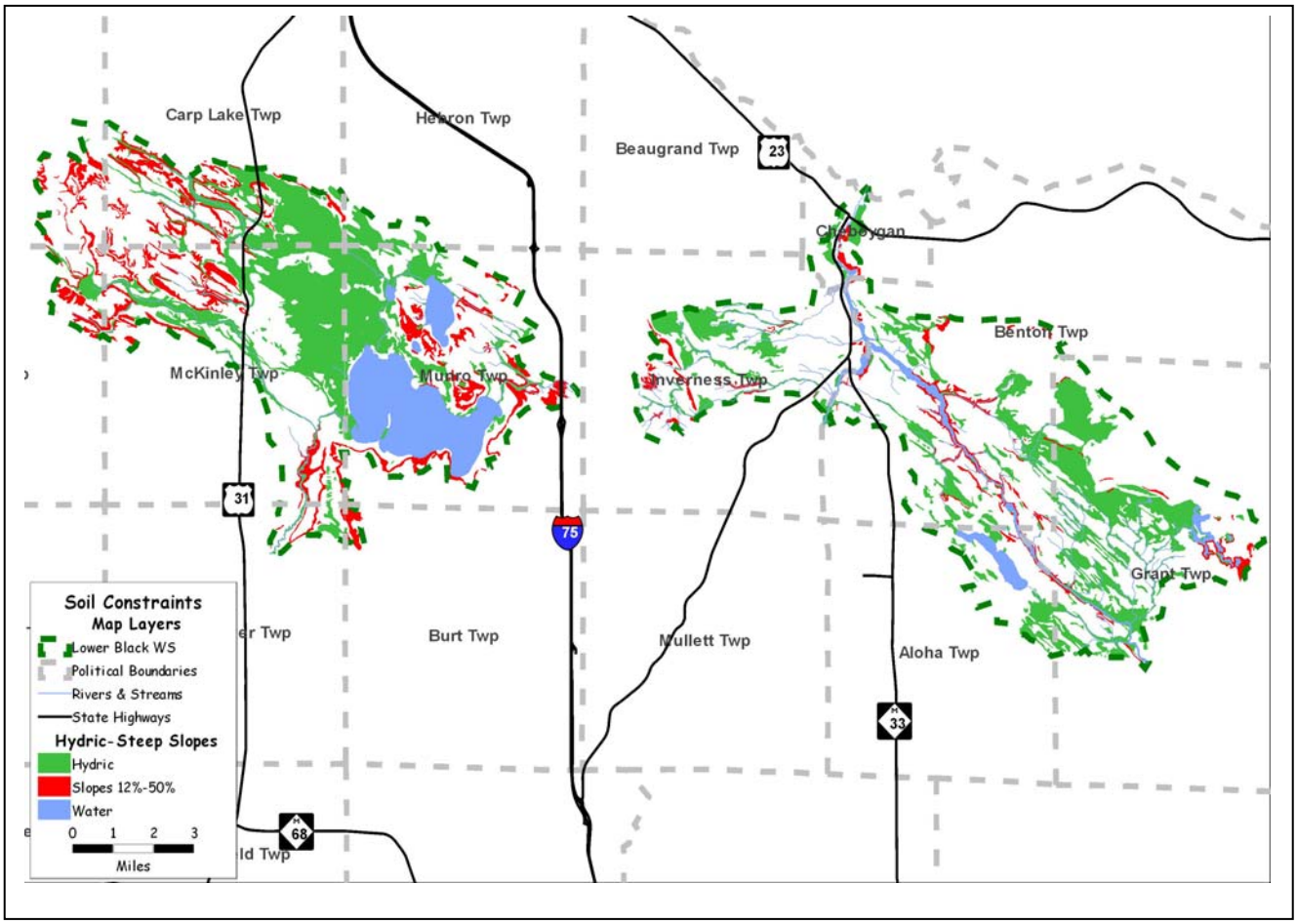
State lands, the threat remains high for hydric soils owned by the private sector, as large parcels are increasingly fragmented to accommodate the population's ever growing desire for rural and riparian housing.

While less prominent than in the western portion, hydric soils still have an influence on land use in the eastern half of the watershed. There are several pockets of hydric soils in Inverness Township, in the northwestern section of the eastern portion of the watershed. Several larger concentrations can be found in Benton, Grant and Aloha Townships on the watershed's east side.

Hills and steeply rolling terrain may provide opportunities for spectacular views of the landscape. However, steeply sloped sites have severe building constraints, and are more difficult and costly to develop. Maintenance costs tend to be higher on steeply sloped terrain. Special design standards such as erosion control measures, limiting size of disturbed areas, retaining natural vegetation, revegetation, slope stabilization and on-site retention of water run-off from impervious surfaces would all serve to minimize resource impacts.

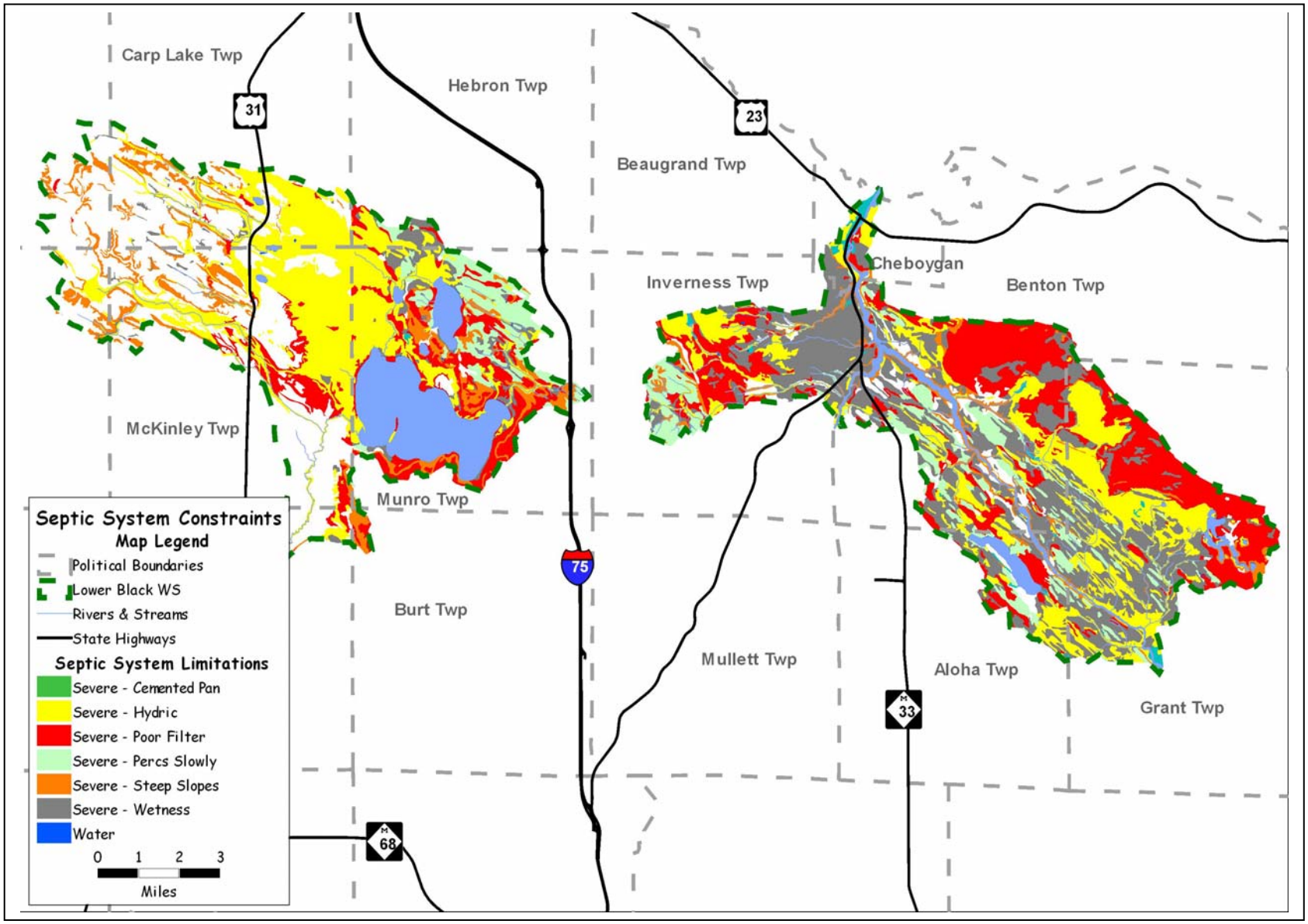
Information derived from the Cheboygan County and Emmet County Soil Surveys indicate that areas with slopes 12 percent and greater are minimal in the eastern portion of the watershed, with most steeply sloped areas found adjacent to the Cheboygan River. The western portion of the watershed is considerably hillier, with several steeply sloped areas found in the vicinity of Douglas Lake and the Maple River. Steep slopes are also found scattered throughout Center, McKinley and Carp Lake Townships in the westernmost section of the watershed.

Map 4: Soil Survey



Using a computer mapping system, soils maps were color coded to indicate the areas of severe septic system limitations as defined by the USDA Natural Resource Conservation Service. Criteria include depth to water table, wetness, soil filtering capacity and ability to percolate water. Severe septic system limitations due to hydric soils affect much of the watershed. Hydric soils are those that are saturated with water long enough during the plant growing season to become anaerobic. These soils will usually be characterized by anaerobic soil zones and wetland vegetation. Hydric soils cover a large area in the western half of the watershed. (See **Map 5)** The entire eastern half of the watershed also has severe septic system limitations. Much of this is caused by widespread hydric soils. In addition, this portion of the Watershed contains sandy soils with severe limitations due to poor filtration of septic effluents. This is a critical issue when the water table is close to the surface or when high density development occurs. Other severe limiting factors for development include steep slopes, soils that percolate slowly and areas of cemented pan.

Map 5: **Septic System Soil Constraints**



Hydrology

The amount of flow in rivers changes throughout the year. In general, flow is greater in late winter and early spring when snowmelt and rainfall produce more surface runoff. Although summer is a period of high precipitation, much water is lost through evaporation and transpiration, causing river flow to be lowest in late summer.

One factor greatly affecting hydrology of the watershed is the *lake effect snow* produced by Lake Huron and Lake Michigan. Lake effect snow can occur when cold winds blow across a large lake. Evaporation of warm surface water increases the amount of moisture in the colder drier air above the lakes surface, causing water vapor in the cold air to condense and form ice-crystal clouds. When these clouds reach the lake's edge, they deposit heavy snowfall along the shoreline. Once the snow begins to melt the water may be absorbed by the ground and may enter the lakes and streams as groundwater or may flow over land and enter surface water as runoff.

The Cheboygan and Lower Black Rivers are part of the famed “Inland Water Route”, with over 40 miles of connective rivers and lakes that extend from the Village of Conway, located at the western end of Crooked Lake, 3 miles east of Lake Michigan, to the City of Cheboygan, located on the Lake Huron end of the Straits of Mackinac.

Cheboygan River (the fifteenth largest river in the state) flows roughly seven miles from its source of Mullett Lake through the City of Cheboygan to discharge into Lake Huron. The upper part of the river is separated from the lower by the Cheboygan Dam.

The Cheboygan River’s mean streamflow as recorded by the United States Geological Survey (USGS) from 1942-10-01 to 1982–09-30, near Cheboygan, MI, is 1461 cubic feet per second. Throughout this period the peak streamflow fluctuated from a low of 1000 cubic feet per second in 1958 to a high of 2000 cubic feet per second in 1980.

Flow, from the upper portion of the Cheboygan River watershed, as recorded by the USGS, indicates the following: Indian River (flows into Mullett Lake) has a peakflow recorded in 1982 of 1350 cubic feet per second (cf/s), and a low of 610 cf/s in 1957. Also discharging into Mullett Lake is the Pigeon River. The Pigeon River’s flow data as recorded by the USGS gage station near Afton ranges from a low of 265 cf/s in 1958 to a peak of 1,170 cf/s in 1960. In the upper portion of the watershed, the Crooked River, (discharges to Burt Lake), as measured by the USGS near the town of Alanson between 1987 – 2004 averaged 1090 cf/s. Also flowing into Burt Lake is the Maple River with an average streamflow of 1460 cubic feet per second.

The Lower Black River flows from its origin of Black Lake approximately 4.3 miles to a small private dam. From there the river continues its course about 5.25 miles to merge with the Cheboygan River. According to USGS data, the mean stream flow between 1942-12-01 and 1974-09-30 was 419 cf/s. During this period, the mean stream flow fluctuated from a peak of 1708 cf/s in April of 1952, to a low of 77 cf/s in July of 1962.

Land Use

The type and intensity of a land use can greatly influence non-point source pollution. Therefore, developing an accurate representation of the existing land use conditions within the watershed is a critical step in the planning process.

METHODOLOGY

Michigan Resource Information System (MIRIS) land cover/use data for the portion of the Cheboygan River/Lower Black River Watershed lying in Cheboygan County was compiled by the Michigan Department of Natural Resources (MDNR) in the early 1980's using 1978 aerial photographs. In 1998, this computerized land cover/use information was updated using 1987 and 1992 aerial photography, and field inspections. The land use data for the portion of the watershed lying in Emmet County was compiled using the original 1978 land use data from the MDNR and updated with the 1998 Digital Ortho Photo Quads from the Center for Geographic Information. A land use map was then created for the watershed by merging data from both counties. The MIRIS land classification system was used for the update. Urban/built-up categories were mapped to greater detail than during the 1978 land cover/use inventory, which had a minimum type size of 2.5 to 5 acres. The smaller type size provides a better representation of various urban built-up categories.

In addition to the general watershed land use inventory, an inventory of three six-section blocks was conducted in summer 2003. Two six-section blocks were surveyed for land use changes in Cheboygan County. One of the blocks consisted of primarily *Residential land* in Inverness Township, the other of primarily *Agricultural land* in Grant Township. A six-section block representing *Forest land* was surveyed in McKinley Township, Emmet County. The information gathered indicates trends in general land use changes for the watershed, and will be discussed in the appropriate land use categories below.

RESULTS

One of the features that attract people to northern Michigan is the rural character of the area. Data from a 1998 update of the 1978 MIRIS land cover/use inventory shows that 49.6 percent of the Watershed's 94,131 total acreage was forested, with another 17.4 percent in agriculture, 16.51 percent open land, 3.69 percent wetlands and 6.6 percent water (see **Table 1-1**). Just over six percent of the watershed's land was used for urban-type purposes in 1998, which included commercial, industrial, institutional/recreational and residential uses. **Map 6** is a color coded thematic map of the 1998 Existing Land Use Inventory for the Cheboygan River/Lower Black River Watershed.

Table 1-1: Watershed Land Use		
Land Use Category	**Acres**	**Percent of Watershed**
Residential	4235.99	4.50%
Commercial	469.29	0.50%
Industrial	567.56	0.60%
Institutional/Recreational	539.91	0.57%
Agriculture	16394.34	17.42%
Open Lands	15540.34	16.51%
Upland Forest	32741.72	34.78%
Lowland Forest	13970.49	14.84%
Wetland	3475.1	3.69%
Water	6191.97	6.58%
Beach/Dune	3.94	0.00%
Watershed Total	**94131.11**	**100%**

Source: 1998 update of 1978 MIRIS Land Cover/Use Inventory by Wade-Trim

Land Use Categories

Residential

According to the MIRIS Land Cover/Use update, 4.5 percent or 4235.99 acres of the watershed's total land area was used for residential purposes. For the most part, residential development found in the watershed consists of single-family dwellings, however, single family duplexes, multi-family residential, condominiums, mobile homes and mobile home parks are also included in this category. Residential uses are concentrated in the City of Cheboygan. Many of the lakes, for example, Twin Lakes, Munro Lake, Long Lake and Douglas Lake, as well as the major rivers have high concentrations of residential development, both along the lake shores and in subdivisions adjacent to the lakes. In addition to new dwellings being built on waterfront property, many of the once seasonal and weekend developments have undergone a transition to year-round residences. Residential development is also occurring along county roads throughout the watershed as larger parcels are split into ten-acre and smaller parcels.

The 2003 land use update conducted over sections 7,8,9,16,17 and 18, in heavily residential Benton and Inverness Townships, shows a 2.25% increase of residences in that six-section area. This increase coincides with a 1.62% decrease in the land use category *Open-land,* as well as smaller losses in *Lowland Forest* and *Agriculture* land use types. This increase in residential land is a trend that can be seen not only in the Cheboygan River/Lower Black River Watershed, but throughout the state.

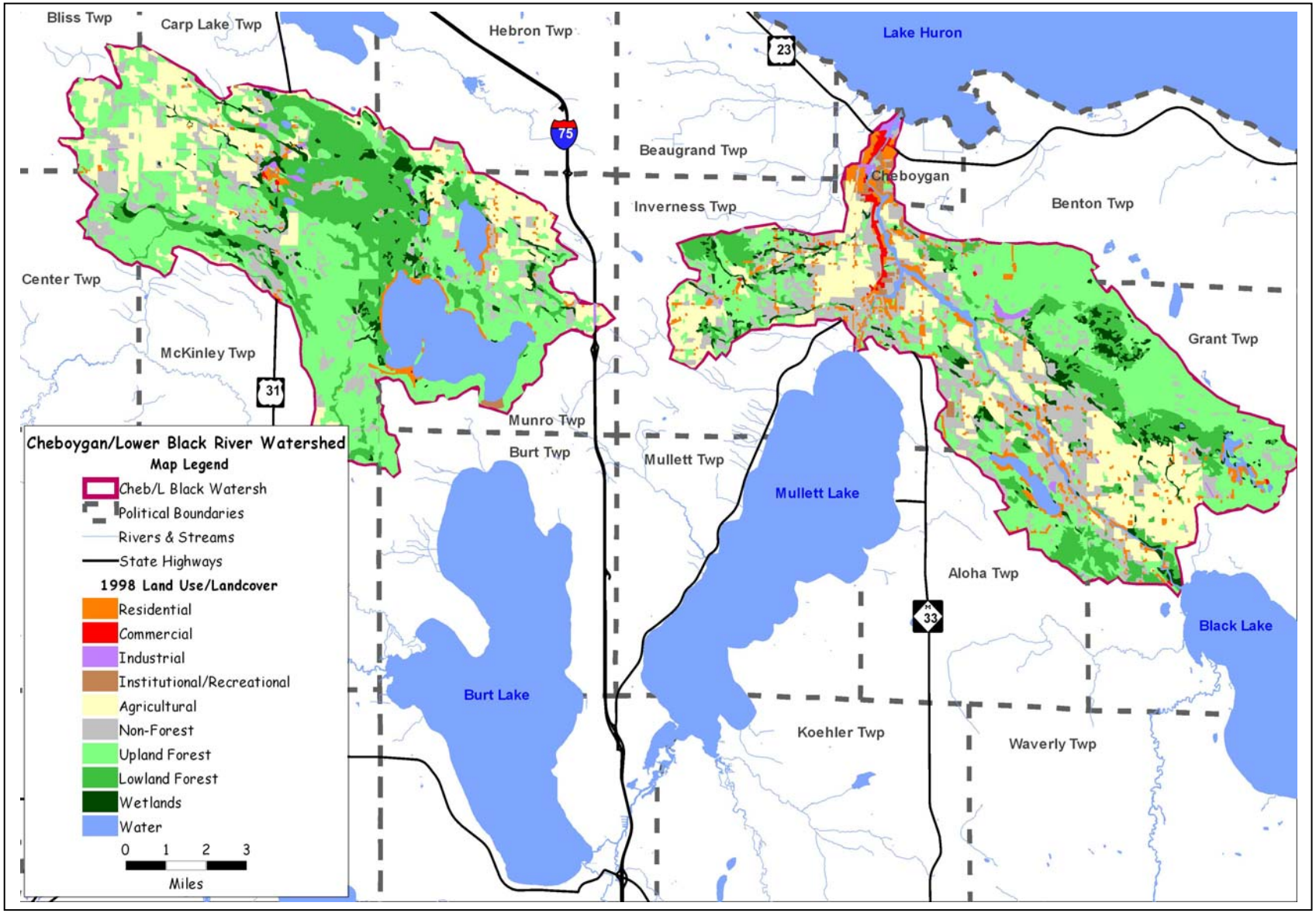
Commercial

Commercial land uses include primary/central business districts, shopping center/malls, and secondary/neighborhood business districts, including commercial strip development. The 1998 land use inventory identified 469 acres (0.5%) in commercial use. Commercial facilities are found primarily within the City of Cheboygan and south of the city limits, along M-27. A smaller commercial service center exists in the urbanized community of Levering, and limited services can be found in other outlying sections of the watershed.

Industrial

In addition to industrial and extractive development, this land use category includes transportation, oil and gas, communication and utility facilities. Development falling under this category made up only 0.6 percent of the total watershed land area. These land uses cover approximately 568 acres of the watershed. Much of the industrial development is located near the main community centers.

Map 6: Land Use



Institutional/Recreational

Land devoted specifically for institutional and recreational purposes amounted to approximately 0.57 percent, or about 540 acres of the watershed. Land uses included in this category are public parks and campgrounds, golf courses, schools, churches and public buildings.

Agricultural Lands

With some 16,394 acres classified as farmland, agriculture is the watershed's second largest land use category. Although the bulk of agricultural land is found in the eastern portion of the watershed, in Cheboygan County's Inverness, Benton, and Grant Townships, large sections of farmland can also be found in the western portion, primarily in Munro Township, Cheboygan County and Carp Lake Township of Emmet County. It is interesting, but not surprising, to note that much of the agricultural property is found along or very near the area's major rivers and lakes. The predominate agricultural land uses are pastures, hayland and rotational crops such as beans, oats, barley and corn.

A six-section area (sections 4, 5,6,7,8 and 9) in Grant Township, Cheboygan County was updated in 2003 and the results were compared to the 1998 land use update for the same six sections. Despite a slight increase in lands used for residential purposes, agricultural lands experienced a less than one percent change in land use. In this predominantly agricultural area, open-land saw a larger land use change (down slightly over one percent, coinciding with a 1.4 percent increase in residential) than did agriculture.

Open-Lands

Open-land is defined as areas supporting early stage of plant succession consisting of plant communities characterized by grasses or shrubs. Open-land makes up nearly 17 percent of the watershed's land area. One type of opening was created by turn of the century logging operations and subsequent wildfires. Other Open-land areas consist of abandoned or idle farm land. A majority of these areas are located within the active agriculture band mentioned above, with the largest portions of this land type found around the City of Cheboygan, Inverness and Benton Townships. Typical grass species are quack grass, Kentucky bluegrass, upland and lowland sedges, reed canary grass and clovers. Typical shrub species include blackberry and raspberry briars, dogwood, willow, sumac and tag alder.

Upland Forests

Upland forests make up 32,741 acres or 34.8 percent of the watershed’s surface area. The following species predominate areas classified as upland forests: sugar and red maple, elm, beech, yellow birch, cherry, basswood, white ash, all aspen types, white, red, jack and scotch pines and any managed Christmas Tree plantations. Other upland conifers include white spruce, balsam fir and hemlock.

Lowland Forests

The county’s land use inventory shows that 13,970 acres or 14.8 percent of the watershed’s surface area consists of lowland forests. Lowland forests are defined as those containing ash, elm and soft maple, along with cottonwood, balm-of-Gilead. Lowland conifers, such as cedar, tamarack, black and white spruce and balsam fir stands are also included.

The upland and lowland forests combine to encompass 46,712 acres, or 49.6 percent of the watershed’s total surface area. Forests, therefore, constitute the largest single land use category for the Cheboygan River/Lower Black River Watershed. Large tracts of forested land can be found throughout the watershed, with especially high concentrations in McKinley Township, Emmet County, and Benton and Grant Townships, Cheboygan County.

McKinley Township has nearly 7000 acres of upland forests, plus over 3000 acres of lowland forest. Land use for a six-section block (sections 3, 4, 5, 8, 9, and 10) within McKinley Township was updated in 2003, and compared to the 1998 land use patterns for those same six sections. During the five years between land use updates, the six section block lost less than one percent of its forests due to changing land uses. There was a 1.7 percent increase of residential uses for the area. Other land use types, such as agriculture, open-lands, and wetlands also experienced slight decreases over the five year period.

Wetlands

As can be noted from **Table 1-1**, 3,475.1 acres or about 3.7 percent of the Watershed's land area was identified as non-forested wetlands. Wetlands are those areas between terrestrial and aquatic systems where the water table is at, near, or above the land surface for a significant part of most years. The hydrologic regime is such that it permits the formation of hydric soils or it supports the growth of hydrophytic vegetation. Examples of wetlands include marshes, mudflats, wooded swamps and floating vegetation situated on the shallow margins of bays, lakes, rivers, ponds, streams. These wetland categories include of shrub wetlands, fresh-water marshes, wet meadows, open bogs, emergent wetlands and aquatic bed wetlands.

In some situations, lands classified as lowland forests are treated as wetlands. Combining the land use types of wetlands and lowland forests, for Cheboygan County, reveals that 17,446 acres or 18.53 percent of the surface area could be considered to be wetland types.

It is important to note that existing land use statistics used in this report are based on Michigan Resource Information System (MIRIS) data. Forested and wetland information contained in the MIRIS data was not verified by field inspection when the data was compiled. Thus, areas shown as wetlands on the MIRIS system may not actually meet State and Federal criteria for legally regulated wetlands. However, the information is still valuable for general land use planning decisions.

Beaches/Dunes

Only 3.94 acres of the county's surface area is classified as beaches. Beaches include all sloping accumulations of exposed sand and gravel along shorelines and sand dunes.

Surface Water

The Cheboygan River/Lower Black River Watershed is home to four significant inland lakes; Munro, Long, Douglas and Twin Lakes and several major rivers. In fact, surface water makes up nearly 7 percent of the watershed's land use types (about 6,192 acres). The combination of wetland types (including lowland forests) and surface water makes up over one third of the watershed's surface area. Therefore, protecting the water and wetland resources should be a major priority in land use planning.

Recreation

The two counties of the Cheboygan River/Lower Black River watershed offer a wide variety of recreational opportunities with over 100 boat-water access sites; 9 campgrounds; many hiking trails; several public parks, picnic areas and playgrounds; over 30 public fishing access sites, marinas and harbors; numerous soccer and softball fields; tennis, volleyball, shuffleboard, racket ball and basketball courts; 2 indoor ice rinks (both in Cheboygan), 2 bowling alleys (one in each county) and 31 golf courses, 15 of which lie in Emmet County. Large portions of the watershed are available for hunting, fishing, snow-shoeing, cross-country skiing, swimming, and downhill

skiing (Emmet County is famous for its ski slopes). The Cheboygan County Historical Museum and the Little Traverse Historical Society offer locals and visitors a glimpse into the area's past. Year round indoor entertainment is available at the Cheboygan Opera House, Victories Casino in Petoskey, and local theaters in both counties.

Recreational properties owned by Cheboygan County are barrier-free, with the exception of the Boy Scout Camp. The camp is presently used only as a picnic area. If plans for re-development of the site are implemented, handicap accessibility will be an integral part of the project. Any future recreational projects will include compliance with handicap accessibility standards.

According to the Emmet County Comprehensive Recreation Plan, there are buildings included in the county's park system that are not now barrier free. However, these structures came with the larger resource environmental properties, and were not constructed by Emmet County. As improvements are made, barrier free design features will be incorporated, as some already have. The recreation plan also further states that it is Emmet County's intent to assess physical barriers to handicapped persons who may wish to enjoy county park properties, and to take measures to mitigate existing barriers. New construction will incorporate barrier free design and meet applicable code standards.

Governmental Units

The Cheboygan River/Lower Black River Watershed covers portions of two northern Michigan counties; Cheboygan and Emmet. A nine-member Board of Commissioners oversees Cheboygan County, with support from various departments, including the County Administrator and County Clerk/Register. The county also has a Planning Commission, a Zoning Commission and a Road Commission. The population center of the watershed is the city of Cheboygan, which is governed by a Mayor, a Mayor Pro Tem, a City Manager, various departments and a seven-member City Council. Cheboygan has its own Planning Commission.

Emmet County is managed by a seven-member Board of Commissioners and several departments, including County Clerk, Road Commission, Drain Commission, and Planning and Zoning Administration. The population center for Emmet County, the city of Petoskey, lies outside the watershed boundary. Petoskey is governed by a Mayor, a City Manager and four Council Members. Each council member oversees one of the city's four wards. The city government includes a Department of Finance, Administration Department, a Department of Public Works, and a Department of Public Safety.

The watershed area ranges over five townships in Cheboygan County and over another five in Emmet County. Each township in both counties has a governing body, which includes a township supervisor, a clerk, a treasurer, and an assessor, with the exceptions of Grant and Munro Townships in Cheboygan County, which do not have an assessor position. None of the townships in the watershed have their own zoning laws, but are zoned through their respective counties.

Planning and Zoning Review

Watershed management requires the use of many different techniques in order to be effective. Tools include educational outreach programs, voluntary land protection incentives for property owners of critical habitat areas, on-the-ground implementation of Best Management Practices to restore nonpoint source pollution sites, research & monitoring, and incorporating conservation-

friendly design standards into new developments. Land use planning and zoning, at the local level, is another important tool for watershed protection. In addition to the direct benefits for aquatic resources, planning and zoning are tools used for ensuring the conservation of wildlife habitat, providing for sustainable development, protecting property values and maintaining community character.

A sound planning and zoning program requires that a community not only "buy-in" to the idea, but dedicate the trained personnel and funding make the program work; effective planning and zoning thus takes commitment and resources.

In the state of Michigan, planning and zoning are implemented at the township, municipal, or county level. The enabling legislation for land use planning can be found within five state acts:

Public Act 285 of 1931 -- Municipal Planning Act
Public Act 168 0f 1959 -- Township Planning Act
Public Act 282 of 1945 -- County Planning Act
Public Act 281 of 1945 --Regional Planning Act
Public Act 226 of 2003 -- Joint Municipal Planning Act

In 2001, for the first time in decades, major amendments were made to Michigan's Planning Enabling Acts. Among other things, the Acts changed the procedure through which a plan is developed and adopted.

M.C.L. 125.101 et seq.
M.C.L. 125.321 et seq.
M.C.L. 125.31 et seq.

Following adoption of a master plan, the local unit of government creates a zoning ordinance. The zoning ordinance must be based on the goals set forth in the master plan.

The state has one legislative zoning act that enables local units of government to control land uses through regulation of activities on the land:

Public Act 110 of 2006 -- Michigan Enabling Zoning Act

In addition to planning & zoning, there are state regulations that are intended to help conserve natural resources. Relevant state laws for water resource protection include (this is only a brief summary, please see the respective law or contact MDEQ for more information):

Act 451, Part 91, Soil Erosion Control and Sedimentation Act
(for earth changes within 500 feet of the shoreline)

Act 451, Part 303, Wetland Protection
(covers the dredging, draining, or filling of regulated wetlands; however, non-contiguous wetlands in rural counties are generally not regulated wetlands)

Act 451, Part 301, Inland Lakes & Streams Act
(covers work conducted below the ordinary high water mark)

Public Act 368 (1978), Aquatic Nuisance Control

For some of the issues related to watershed management, agencies (beyond the local unit of government) have a regulatory role. In the case of soil erosion & sedimentation, the Michigan Department of Environmental Quality (MDEQ) has jurisdiction; they have an agreement with counties to enforce the program at the local level (thus counties have a Soil Erosion Officer). With regard to regulation of wetlands, MDEQ also has jurisdiction (authorized through the federal Clean Water Act). Questions regarding wetlands and the permitting process should be directed to MDEQ's Land & Water Management Division. Regulations for septic systems are handled through the District Health Department. In all three of the areas listed above, a local community may adopt their own programs for managing the resource (standards adopted cannot be weaker than what the state would otherwise use). Such a decision to adopt a local ordinance may lead to more work for the local unit of government and a greater expenditure of fiscal resources; it may also create an opportunity to better achieve the goals laid out in community's comprehensive master plan.

In any event, a local unit of government should develop a comprehensive land use plan (based on public input) that allows them to plan for the future while maintaining what is important to the community. The plan becomes the basis for the zoning ordinance. Attention should be paid to whether the standards in the zoning ordinance actually achieve the goals set forth in the comprehensive master plan; oftentimes they do not. Once local government units have "good" land use policies in place, there is still work that needs to be done -- the governing body must keep their policies up-to-date and make decisions regarding infrastructure and zoning in accordance with their plan.

Oftentimes, volunteers on local zoning boards are pressured to make a decision on a site-specific issue without considering the whole system. Zoning standards and decisions must be made with the comprehensive master plan in mind; it can be extremely difficult to step back from a particular issue and consider the big picture, but that is exactly what trained planning commission officials must do. In addition, zoning regulations need to be enforced and followed up. Without enforcement, the majority that make the effort to follow land use regulations are, in effect, penalized, as they have went to greater effort and expense than those not following regulations. Such systems will eventually break down for local units of government -- either most everyone will eventually give up on trying to follow the rules or the court system will not hold up the regulations.

This following review of local land use regulations in the watersheds of the Lower Cheboygan River and Douglas Lake was prepared by Huron Pines Resource Conservation & Development Area Council in December 2003. This review is not intended evaluate the history of planning and zoning within the watershed, nor is intended to be the sole basis for determining the effectiveness of policies regarding water resource management. It may provide insight into how effective local unit of government are at protecting aquatic resources and help to identify some of the glaring weaknesses within current zoning ordinances.

Summary of Local Planning & Zoning Efforts

Townships located in a county with zoning have the option of having the county handle the entire planning and zoning program or administering their own. (In rare cases, neither a county nor township may have a zoning ordinance, these areas are considered "un-zoned"). Within the Lower Cheboygan/Douglas Lake watersheds, the townships are covered under county zoning, while the City of Cheboygan administers its own program. Below is a list of local government

units within the watershed and the adoption date of their master plans and zoning ordinances. (In those instances where major revisions appear to have been made, the "revised" plan/ordinance date is used, rather than the "adopted" date.)

Table 1-2: Planning and Zoning Jurisdictional Units Within the Cheboygan River/Lower Black River Watershed

Government Unit	**Zoning Ordinance** Last Date of Revision or Adoption	**Comprehensive Master Plan** Last Date of Revision or Adoption
Cheboygan County (Benton, Grant, Aloha, Inverness, Beaugrand, Hebron, and Munro townships)	1983	2002
City of Cheboygan	2001	1988*
Emmet County (Carp Lake, McKinley, Maple River, Center, and Bliss townships)	2001	1997

*The City is currently updating their master plan.

To determine, in part, the efficacy of regulatory coverage for aquatic resources within the Cheboygan River/Lower Black River Watershed, local zoning ordinances were reviewed to evaluate what, if any, "environmental provisions" were in place that may have an impact on water resources. The ordinances were specifically reviewed for the following:

- *Vegetative Buffer Zones* (Greenbelts): With regard to minimizing the impact of residential development along the waterfront, ensuring that vegetation is left along the shoreline is generally considered on of the most important actions that can be taken. Vegetative buffers help to filter nutrients, reduce erosion, and provide natural habitat. Although much research has been done through the years to verify the effectiveness of vegetative buffers, there are several practical difficulties with having a "greenbelt ordinance." It can be difficult to enforce, many local officials and residents are unaware of what an effective greenbelt consists of, historic patterns of development have already degraded many areas (and these may be "grandfathered" in), zoning language is often poorly worded for proper enforcement, and citizens are often unaware that there is an ordinance in place. Even with the negatives, however, maintaining a greenbelt is essential to protecting water resources – even a 25-foot greenbelt can be effective. A mowed lawn to the water's edge is not a greenbelt.

- *Setbacks of structures* along the waterfront are important for reducing the amount of impervious surface near the water, helping to ensure that a greenbelt can be maintained, and reducing the potential for serious resource problems. A structure that is setback only 30 or 40 feet is more likely to be associated with negative impacts to water resources than a structure 75 or 100 feet away from the water's edge. Unfortunately, many local units of government that do have an effective setback for homes will make many exceptions for large decks and boathouses. Such exemptions defeat the intent of the setback, as impervious surface cover will still be present near the water's edge. Furthermore, while many local units of

government may have a greenbelt requirement of 50 or 75 feet width, they allow the structure setback to be less than the greenbelt restriction. Such a scenario significantly reduces the effectiveness of the greenbelt requirement. In addition, during the construction period, a structure being built less than 50 feet from the water will have a construction site that runs right down to the water. This leads to the unavoidable problem of the destruction of the greenbelt during construction. Maintaining the natural greenbelt in the first place is much easier than restoring a greenbelt. Setback requirements should be regarded as a key element for water resource protection.

- *Minimum Lot Width for waterfront parcels* is important for waterbodies because it ultimately determines the number of homes that will be built on the water. Developed shorelines with less than a 100-ft minimum lot width often experience water resource problems. Generally, the smaller the lot width around a lake, the more homes, greater wastewater treatment needs, increased user conflicts, fertilizer inputs, stormwater runoff, increased erosion, and loss of native vegetation, as well as an increase in the amount of impervious cover in the critical near-shore areas of surface water.

- *Open space preservation* is used for communities to protect their rural character, as well as maintain prime recreational, farm or forest land. Unfortunately, most zoning ordinances, if implemented correctly, are not written in such a way to accomplish those goals. Many local units of government that have open space guidelines in this watershed typically state something to the effect of, "At least 40% of the total gross project shall be left as open space." Some only require 25%, which is not a way to accomplish their community goals.

  An improvement to the open space section of their ordinances would be to require the developer to increase the amount of open space to 50 or 60% and also make sure that some of the set aside acreage is from the developable portion of the site. Steep slopes, surface water, wetlands, etc., should be excluded from this calculation; otherwise only the most undesirable areas will be set aside as open space. Ordinance language should be something such as, "A minimum of 60% of the parent parcel's gross acreage shall be set aside as permanently protected open space. This area shall include at least half of the parcel's buildable land area."

  There are incentive programs that local communities can adopt to encourage open space preservation, such as allowing higher development densities on the remaining land in a development or through setting up a Purchase of Development Rights (PDR) program.

- *Septic Systems* are under the jurisdiction of the District Health Department. Typically, only severe problems are addressed, departments are understaffed, and there are poor records of septic systems. Some local units of government have begun to initiate their own programs for inspections, maintenance, or replacement requirements. Generally, such a program is being run as a “Point of Sale” program, whereby inspections of septic systems are required at the time of property transfer. System upgrades are then required for those that are not working properly.

- *Wetland Protection* is handled through the state Department of Environmental Quality. For rural northern Michigan, the law does not apply to isolated wetlands. Some communities have addressed this oversight by adopting their own wetland regulatory program, which is authorized through the state wetland act. Only those ordinances that have standards *in addition to those at the state level* are noted.

- *Stormwater Management* is recognized as critical for keeping oils, greases, organic debris, and trash from running directly into a waterbody. While stormwater control measures are often taken during construction, the post-construction runoff of stormwater is a problem that is often overlooked. Proper management would require that new developments handle their own stormwater on-site (or at least do not increase the amount of runoff that would otherwise occur at the undeveloped site), rather than move the stormwater off their site as quickly as possible (which has been the historic practice).

- *Lot Coverage/Impervious Cover* is, on a watershed-wide level, an important indicator for overall watershed health. (Studies have been conducted that show water quality declines once 10% of the land area in a watershed is covered by impervious surfaces and that serious problems occur once more than 25% of the land area is covered.) Communities that recognize this fact sometimes attempt to address this problem on a parcel by parcel level by placing a maximum on the amount of land that can be covered by impervious cover. While well intended, these standards typically state that the buildings can only occupy a certain percentage of land, but fail to address roads, driveways, decks, patios, and walkways, which are all a part of the impervious cover issue.

Table 1-3 is a general summary of "environmental provisions" by local government unit.

Table 1-3: Summary Of Environmental Provisions			
Water Quality Regulations	**Local Government Unit**		
	Cheboygan County	**City of Cheboygan**	**Emmet County**
Vegetative Buffer Zones (greenbelts)	Buffer strips *must* be at least 40 ft in width along water. (Lake & Stream Protection District.)	Not addressed	*Recommended* (35 ft) for waterfront properties.
Waterfront Setbacks	40 ft	20ft (but this can be used for parking)	60 ft setback for homes & 25 ft for decks/patios
Minimum Lot Width for Riparian Parcels	100 ft for Lake & Stream Protection District	Not addressed	100 ft
Impervious Cover	Not addressed	35% maximum, although this does not apply to waterfront district.	Yes, a maximum 30% of each lot can be covered by impervious surface.
Open Space	Preservation of open space is encouraged through a PUD density bonus	Yes	Addressed within Planned Unit Development section of ordinance.
Septic Systems	Must be at least 100 ft from the water's edge, but 150 ft back from the River Protection District on the Upper Black	Not applicable	No special restrictions, ordinance references health code.
Wetland Protection	Not addressed	Not addressed	Not addressed
Stormwater Management	Yes	The county stormwater program is administered within the city limits.	Yes

Agencies and Organizations

The following agencies and local organizations are involved with environmental programs and concerns within the watershed:

Michigan Department of Environmental Quality
Mission Statement: The mission of the Michigan Department of Environmental Quality (DEQ) is to drive improvements in environmental quality for the protection of public health and natural resources to benefit current and future generations. This will be accomplished through effective administration of agency programs, providing for the use of innovative strategies, while helping to foster a strong and sustainable economy.

Huron Pines Resource Conservation & Development Area Council
Huron Pines RC&D Council is a non-profit, non-governmental organization serving the eleven county region of Northeast Michigan. It's goals are:

1.) Sponsor collaboration in the sustainability of renewable natural resources through orderly development and accepted conservation practices.
2.) Foster citizen appreciation through education of the need for healthy ecosystems as critical to the area's long-term social and economic stability.
3.) Improve the quality of life and economic conditions in our service area by helping to nurture land, water, mineral, and living resources as the enduring basis for desirable communities, first-rate tourism, and thriving industry.

Tip of the Mitt Watershed Council
The Tip of the Mitt Watershed Council, founded in 1979, is celebrating its 20th year as the lead organization for water resources protection in Antrim, Charlevoix, Cheboygan, and Emmet Counties. A coalition of citizens, lake associations, businesses, and resorters, the Watershed Council works to maintain the environmental integrity and economic and aesthetic values of lakes, streams, wetlands, and ground water.

US Department of Agriculture
Mission: Enhance the quality of life for the American people by supporting production of agriculture:

- Ensuring a safe, affordable, nutritious, and accessible food supply
- caring for agricultural, forest, and range lands
- supporting sound development of rural communities
- providing economic opportunities for farm and rural residents
- expanding global markets for agricultural and forest products and services
- working to reduce hunger in America and throughout the world.

Natural Resource Conservation Service
Mission Statement: The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment.

Conservation Districts
Michigan's Conservation Districts are "unique" local units of State Government that utilize state, federal and private sector resources to solve today's conservation problems. The guiding philosophy of all Conservation Districts is that decisions on conservation issues should be made at the *local level*, by *local people*, with technical assistance provided by government.

Northeast Michigan Council of Government
Mission Statement: NEMCOG is committed to facilitating the development of intergovernmental cooperation and coordination within the eight-county region of Northeast Michigan. The agency is also committed to providing for a controlled growth policy; to preserve and improve the

environment, to pursue greater efficiency and responsiveness of local units of government, and to improve the ecological, social, and economic well being of citizens within the region.

District Health Department #4
Mission Statement: "It shall be the responsibility of this board to continually and diligently endeavor to prevent disease, prolong life, and promote the public health through organized programs including prevention and control of environmental health hazards; prevention and control of disease; prevention and control of health problems of particularly vulnerable population groups; development of health care facilities and health service delivery systems; and regulations of health care facilities and health service delivery systems to the extent provided by law"

Michigan State University Extension
Mission: "Michigan State University Extension (MSUE) helps people improve their lives through an educational process that applies knowledge to critical issues, needs and opportunities."

Since its beginning, Michigan Extension has focused on bringing knowledge-based educational programs to the people of the state to improve their lives and communities. Today, county-based staff members, in concert with on-campus faculty members, serve every county with programming focused on agriculture and natural resources; children, youth and families; and community and economic development.

US Fish and Wildlife Service
"The U.S. Fish and Wildlife Service's mission is, working with others, to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."

Little Traverse Conservancy
The Conservancy is a broad coalition of individuals, families, and businesses who agree that the acquisition and protection of natural land is important if we are to retain the quality of life which makes northern Michigan so attractive. The Little Traverse Conservancy is supported entirely by people who willingly donate their time, talent, and financial support to protect irreplaceable natural land.

Petoskey Regional Audubon Society
Mission Statement: Michigan Audubon Society is a nonprofit organization that promotes the awareness, understanding, enjoyment, and stewardship of the environment and natural resources of the upper Great Lakes region by educating the public, supporting ecological research, maintaining sanctuaries, and by taking part in appropriate advocacy to protect the environment, with emphasis on birds and their habitats.

Science and Environmental Education-North
Mission Statement: SEE-North's mission is to foster people's connections with the plants, animals, and habitats of northern Michigan; to deepen their knowledge of the natural world; and to inspire in people of all ages a sense of responsibility for their place in nature.

Douglas Lake Stewards
The Douglas Lake Stewards are a group of volunteers that meet for about a half day every two weeks from May-October. Environmental efforts are concentrated on or near Douglas Lake and

the University of Michigan Biological Station lands. The stewards work closely with Biological Station staff when involved in projects located on U. of M. property.

Douglas Lake Association
Long Lake Association
Twin Lakes Association

Demographics

The watershed area has a permanent population of approximately 11,832, clustered mainly in Benton and Inverness townships. This figure reflects a 28.9% increase since 1990 (see **Table 1-4***)*. Nearly all of the townships within the watershed have been growing at a significant rate, particularly Aloha Township in Cheboygan County (47.2% since 1990) and Maple River Township in Emmet County (65.8% since 1990). The only township within the watershed to show a decrease in population during this time period was Center Township in Emmet County (-3.5%). Another population increase of at least 10% is expected for the watershed by the year 2010. According to the U. S. Department of Commerce, 20% of the population in Canada and the U. S. live within 500 miles of Emmet and Cheboygan Counties, making the area an attractive vacation destination for a great number of people. The main population center for the watershed is the city of Cheboygan, but the resort town of Petoskey in Emmet County draws vacationers to the area from a large portion of the Midwest. Although Petoskey lies outside the watershed boundaries, this seasonal influx of roughly 20,000 visitors has a strong impact on the watershed.

Table 1-4: Watershed Population by Township
Cheboygan and Emmet Counties (1990-2000)

Cheboygan County				Emmet County			
Township	**1990 Population**	**2000 Population**	**Percent Change**	**Township**	**1990 Population**	**2000 Population**	**Percent Change**
Aloha	707	1041	47.2%	Carp Lake	597	807	35.2%
Benton	2388	3080	29.0%	Center	517	499	-3.5%
Grant	686	947	38.0%	Maple River	743	1232	65.8%
Inverness	1952	2278	16.7%	McKinley	1080	1269	17.5%
Munro	512	679	32.6%				
TOTAL	6245	8025	28.5%	TOTAL	2937	3807	29.6%
Population Totals For Watershed							
1990	9182	**2000**	11,832	**Percent Change**	28.9%		

Source: U.S. Census Bureau

Cheboygan County has experienced a 28.5% population growth over the last ten years, and a 20% increase in all *housing units* (physical residential living structures, both occupied and unoccupied). The number of seasonal homes, however, has dropped by 8.7%, reflecting the fact that fewer vacation homes are presently being built while those already in existence are being converted to year-round residences (**Tables 1-4** and **1-5***)*. The number of *households* (occupied housing units) in Cheboygan County that lie within the watershed boundaries has been increasing at an even greater rate than in the county as a whole. Between the years 1990 and 2000 the number of households in the watershed has jumped by 39.1% compared to a 32.1% increase experienced over the entire county.

Table 1-5: Watershed Housing Units by Township Cheboygan and Emmet Counties (1990-2000)						
Cheboygan County						
Township	**1990**		**2000**		**Percent Change**	
	Seasonal	**Total**	**Seasonal**	**Total**	**Seasonal**	**Total**
Aloha	220	535	206	670	-6.4%	25.2%
Benton	349	1272	312	1627	-10.6%	27.9%
Grant	409	714	347	817	-15.2%	14.4%
Inverness	229	1037	221	1226	-3.5%	18.2%
Munro	363	591	347	650	-4.4%	10.0%
TOTAL	1570	4149	1433	4990	-8.7%	20%
Emmet County						
Carp Lake	377	681	354	728	-6.1%	6.9%
Center	70	223	86	301	22.9%	35.0%
Maple River	72	354	72	533	0.0%	50.6%
McKinley	38	479	63	572	11.0%	19.4%
TOTAL	557	1737	575	2134	3.2%	22.9%

Watershed Housing Totals					
1990		**2000**		**Percent Change**	
Seasonal	**Total**	**Seasonal**	**Total**	**Seasonal**	**Total**
2127	5886	2008	7124	5.6%	21.0%

Source: U.S. Census Bureau

Emmet County's population is growing at a slightly faster rate than Cheboygan County--29.6% over the last ten years (**Table 1-4***)*. Housing in Emmet County has been keeping pace with its population growth, showing a 22.9% increase in housing. This figure includes a 3.2% growth in seasonal homes, reflecting the resort nature of the surrounding area. Emmet County's increase is highlighted by the significant decrease of seasonal homes seen in Cheboygan County (**Table 1-5**).

While the population, number of housing units and number of households in the watershed have all been on the increase, household size has decreased from 2.58 persons per household in 1990 to 2.43 persons per household in 2000. As shown in **Table 1-6**, these figures represent a 5.8% drop in household size. This tendency toward smaller household size is seen through out the country and reflects the changing lifestyles in the United States. The watershed area may be even more strongly affected by this trend as its seasonal residents reach retirement age and settle in the area on a permanent basis.

Table 1-6: Watershed Households 1990-2000						
Within Cheboygan County						
Townships In Watershed	**Total Households**			**Persons per Household**		
	1990	**2000**	**Percent Change**	**1990**	**2000**	**Percent Change**
Aloha	278	423	52.2%	2.54	2.45	-3.7%
Benton	877	1248	42.3%	2.71	2.44	-9.9%
Grant	275	428	55.6%	2.49	2.21	-11.4%
Inverness	738	914	23.8%	2.64	2.49	-5.9%
Munro	193	270	39.9%	2.65	2.47	-6.9%
Total	2361	3283	39.1%	2.60	2.41	-7.3%
Total for County	8201	10835	32.1%	2.58	2.41	-6.6%
Within Emmet County						
Carp Lake	239	339	41.8%	2.50	2.38	-4.7%
Center	127	192	51.2%	2.90	2.55	-12.0%
Maple River	267	434	62.5%	2.78	2.84	2.1%
McKinley	388	459	18.3%	2.76	2.76	0.0%
Total	1021	1424	39.5%	2.74	2.63	4.0%
Total for County	9516	12577	32.2%	2.58	2.44	-5.5%
Watershed Total	**17717**	**23413**	**32.1%**	**2.58**	**2.43**	**-5.8%**

Source: U. S. Census Bureau

CHAPTER 2 WATER QUALITY

Introduction

The testing of physical and chemical parameters, including temperature, dissolved oxygen, total suspended solids and levels of nutrients and toxins is performed to see if any changes have occurred over time. The results of these measurements can be used to determine the quality of the water in a particular water body.

The temperature of a water body is a key parameter when gauging water quality because many of the physical, biological and chemical characteristics of a river are directly affected by temperature. Water temperature affects: the amount of oxygen that can be dissolved in water, rate of photosynthesis by aquatic plants, sensitivity of organisms to toxins, and the metabolic rates of aquatic organisms. Water temperature can vary with the amount of sun exposure, air temperature, and runoff volume. Thus, removing streambank vegetation can greatly affect the temperature of the water body.

An adequate concentration of Dissolved Oxygen (DO) in water is needed to support fish and other aquatic life. The flow of streams causes water to "capture" oxygen from the air. Oxygen also enters a water body by means of diffusion from the atmosphere and as a by-product of photosynthesis from aquatic plants. Key factors influencing DO levels include excess sediment and nutrient concentrations, intensity of aquatic plant growth, and water temperature. A minimum average DO of 5 mg/L is recommended for a warm-water fishery and 7 mg/L for a cold-water fishery.

Suspended Solids refer to the loose particles of clay, silt and sand that suspend in a body of water and eventually settle to the bottom. While suspended solids, or sediment, are a natural part of a watersheds ecosystem, excessive amounts can be harmful. Excessive sediment can smother benthic (bottom-dwelling) plants and animals, carry high concentrations of nutrients and toxins, impede navigation, and cloud the water. Turbid, or cloudy, waters absorb more sunlight raising the temperature more quickly.

Nutrients, like Nitrogen and Phosphorous, occur naturally in water and are essential to aquatic plant life. However, excessive concentrations of nutrients can cause uncontrolled growth of aquatic vegetation. The entire water body can become filled with algae and aquatic plants. Eventually, the water body can become anaerobic (without oxygen). This process is known as eutrophication. The main source of excess nutrients is sediment in runoff.

Toxins are chemical contaminants that harm plants, animals, fish, and humans. Examples of toxins include pesticides, oil, grease, and other automotive fluids. Toxins can enter a water body naturally through atmospheric deposition, or as a result of human activities. Examples are stormwater runoff and the discharge of wastewater directly to the waterway. These human causes can be controlled through proper education and enforcement of planning and zoning regulations.

Water Quality of the Cheboygan River/Lower Black Watershed

The Cheboygan River/Lower Black River Watershed contains over 5,000 acres of surface water in its lakes, in addition to hundreds of miles of rivers, streams and tributaries. The quality of these important waterbodies becomes increasingly at risk as development of natural areas continues and forested lands are converted to commercial and residential parcels. As these and other land use changes continue to take place, the associated pollution impacts to lakes, streams and rivers increase. During periods of high runoff (rainstorms, snowmelts, etc.) contaminants such as fertilizers, sediments, nutrients, oil, grease, road salt and toxic chemicals are flushed from streets, parking lots, yards and agricultural lands. The pollutant laden water can either move overland to the nearest lake, stream or wetland or percolate through the soil into the groundwater. Storm sewers and drains, which increase with development, provide an even more direct route for runoff to reach the water resources.

According to the DEQ's Surface Water Information Management System (SWIM) water quality data, the Cheboygan River is classified as an oligotrophic river with low nutrient values and high alkalinity. Fisheries information indicates that the river supports a fish population of walleye, burbot, and chub. According to the MI Department of Natural Resources (DNR) Stream Temperature Survey Information of 6/28/05 to 10/6/05, the average stream temperature, during summer months is 72 degrees.

Also from the SWIM data, the Lower Black River is classified as oligotrophic, with low nutrients and high alkalinity and is primarily groundwater driven with very high base flow. The average summer temperature is cool at 61.96 degrees. Fisheries include populations of brook trout, walleye, burbot, and creek chub.

The results of water quality sampling data obtained from the EPA STORET Database are summarized in **Table 2-1**.

Table 2-1: Cheboygan River/Lower Black Rivers Water Quality Data Summary

Temperature degrees F				
Sampling Site	**Sampling Period**	**Mean**	**Max**	**Min**
Cheboygan Rv @ mouth	63/03/12 - 73/10/10	50	78.8	32
Cheboygan Rv @ US 23	73/11/19 - 90/11/05	50	74.3	32
Cheboygan Rv @ Lincoln Ave	79/06/06 - 79/09/19	66.2	72.5	59
Cheboygan Rv @ VFW Rd	80/08/29	71.6		
Cheboygan Rv @ M-33	80/08/29	69.4		
Cheboygan Rv @ Parkway	80/08/29	70.3		
Lower Black Rv @ Frances Ln	80/08/29	72.3		
Lower Black Rv @ Black Rv Rd	90/04/09 - 90/11/05	58.7	73.4	39.2
Upper Black Rv @	90/03/26 - 90/11/05	54.8	70.7	35.6
Dissolved Oxygen (DO) mg/L				
Sampling Site	**Sampling Period**	**Mean**	**Max**	**Min**
Cheboygan Rv @ mouth	63/03/12 - 73/10/10	10.9	14.7	6.7
Cheboygan Rv @ US 23	73/11/19 - 90/11/05	11.1	15.1	4.8

Table 2-1: Cheboygan River/Lower Black Rivers Water Quality Data Summary (cont.)				
Cheboygan Rv @ Lincoln Ave	79/06/06 - 79/09/19	8.4	9.7	7.5
Cheboygan Rv @ VFW Rd	NA			
Cheboygan Rv @ M-33	NA			
Cheboygan Rv @ Parkway	NA			
Lower Black Rv @ Frances Ln	NA			
Lower Black Rv @ Black Rv Rd	90/04/09 - 90/11/05	9.7	12.7	7.8
Upper Black Rv @	90/03/26 - 90/11/05	9.4	11.8	7.4
Total Alkalinity (CACO3) mg/L				
Sampling Site	**Sampling Period**	**Mean**	**Max**	**Min**
Cheboygan Rv @ mouth	68/04/23 - 73/10/10	146	195	115
Cheboygan Rv @ US 23	73/11/19 - 90/11/05	147	175	54
Cheboygan Rv @ Lincoln Ave	79/09/19	156		
Cheboygan Rv @ VFW Rd	80/08/29	140		
Cheboygan Rv @ M-33	80/08/29	142		
Cheboygan Rv @ Parkway	80/08/29	140		
Lower Black Rv @ Frances Ln	80/08/29	142		
Lower Black Rv @ Black Rv Rd	90/04/09 - 90/11/05	138	149	122
Upper Black Rv @	90/03/26 - 90/11/05	160	182	95
Total Nitrogen (NO2 & NO3) mg/L				
Sampling Site	**Sampling Period**	**Mean**	**Max**	**Min**
Cheboygan Rv @ mouth	73/01/10 - 73/10/10	0.08	0.12	0.05
Cheboygan Rv @ US 23	73/11/19 - 90/11/05	0.07	0.21	0.01
Cheboygan Rv @ Lincoln Ave	79/06/06 - 79/09/19	0.02	0.04	0.01
Cheboygan Rv @ VFW Rd	80/08/29	0.02		
Cheboygan Rv @ M-33	80/08/29	0.02		
Cheboygan Rv @ Parkway	80/08/29	0.02		
Lower Black Rv @ Frances Ln	80/08/29	0.02		
Lower Black Rv @ Black Rv Rd	90/04/09 - 90/09/05	0.02	0.06	0.01
Upper Black Rv @	90/03/26 - 90/11/05	0.03	0.05	0.02
Total Phosphorous mg/L				
Sampling Site	**Sampling Period**	**Mean**	**Max**	**Min**
Cheboygan Rv @ mouth	68/03/12 - 73/10/10	0.05	0.49	0
Cheboygan Rv @ US 23	73/11/19 - 90/10/16	0.02	0.15	0.001
Cheboygan Rv @ Lincoln Ave	79/06/06 - 79/09/19	0.012	0.013	0.011
Cheboygan Rv @ VFW Rd	80/08/29	0.011		
Cheboygan Rv @ M-33	80/08/29	0.006		
Cheboygan Rv @ Parkway	80/08/29	0.006		
Lower Black Rv @ Frances Ln	80/08/29	0.012		
Lower Black Rv @ Black Rv Rd	90/04/09 - 90/10/16	0.014	0.033	0.009
Upper Black Rv @	90/03/26 - 90/10/16	0.012	0.017	0.009

Table 2-1: Cheboygan River/Lower Black Rivers Water Quality Data Summary (cont.)				
Fecal Coliform MFM-FCBR/100ml				
Sampling Site	**Sampling Period**	**Mean**	**Max**	**Min**
Cheboygan Rv @ mouth	67/01/03 - 73/06/13	405	3500	10
Cheboygan Rv @ US 23	73/12/12 - 79/09/19	252	3400	10
Cheboygan Rv @ Lincoln Ave	79/06/06 - 79/09/19	17	20	10
Cheboygan Rv @ VFW Rd	NA			
Cheboygan Rv @ M-33	NA			
Cheboygan Rv @ Parkway	NA			
Lower Black Rv @ Frances Ln	NA			
Lower Black Rv @ Black Rv Rd	NA			
Upper Black Rv @	NA			
Total Suspended Solids mg/L				
Sampling Site	**Sampling Period**	**Mean**	**Max**	**Min**
Cheboygan Rv @ mouth	69/09/17 - 73/10/10	210	585	156
Cheboygan Rv @ US 23	73/11/19 - 90/11/05	195	293	88
Cheboygan Rv @ Lincoln Ave	79/06/06 - 79/09/19	190	195	188
Cheboygan Rv @ VFW Rd	NA			
Cheboygan Rv @ M-33	NA			
Cheboygan Rv @ Parkway	NA			
Lower Black Rv @ Frances Ln	NA			
Lower Black Rv @ Black Rv Rd	90/04/09 - 90/11/05	197	207	188
Upper Black Rv @	90/03/26 - 90/11/05	21	237	162

Douglas Lake is a 3,726 acre lake in the northwestern portion of the Cheboygan River Watershed. It is the 28th largest lake in Michigan with a maximum water depth of 80 feet. There are 7 distinct basins with shoals, areas less than 15 feet deep, extending over a large percentage of the lake's acreage. Based on information from the Department of Natural Resources (DNR), Status of Fishery Resource Report, and DEQ Storet data, the lake is considered a mesotrophic lake with limited oligotrophic characteristics which provide suitable levels of dissolved oxygen in cold water depths. Liminological studies were conducted in 1959 and 1967 by the Michigan Department of Conservation and found the lake to be thermally stratified in June, 1959 with dissolved oxygen below 4 ppm at 45 feet below the surface. June of 1967 sampling indicated the water column as thermally stratified, with dissolved oxygen not dropping below 6ppm at 55 depth locations.

Analysis, as reported in the MDNR Fishery Resource Report of 2004, revealed that the overall fish community of Douglas Lake has not changed much in time. Fisheries management by the State began in the late 1920's with the fish stocking of yellow perch. The fish community at the time of the survey in 2004 was characterized as the following: an average growing and diverse pan fish community; an abundant rough fish community; a remnant cold water fish community,

and a predator game fish of northern pike and small mouth bass. The lake supports fisheries of yellow perch, bluegill, northern pike and walleye.

Impaired Uses

Michigan water bodies that are not attaining one or more designated use are listed on the State's Clean Water Act Section 303(d) list and 305(b) Report. These water bodies require the establishment of Total Maximum Daily Loads (TMDLs). The 303(d) list indicates that within the Cheboygan River Watershed (see **Table 2-2**) Burt, Crooked, Mullett and Pickerel Lakes are all on the State's 303(d) non-attainment list for fish tissues due to mercury level exceedances. Burt lake is scheduled for development of a TMDL in 2010. Crooked, Mullet and Pickerel Lakes are scheduled for development of TMDLs in 2011. The Cheboygan River is listed on the 303(d) list for exceedances of PCBs with TMDL development scheduled for 2010.

Table 2-2: River Segments/Lakes Not Meeting Water Quality Standards: "NonAttainment" Status

River or Lake	Designated Uses Not Met	Reason for Non Attainment Status
Cheboygan River: Lake Huron confluence upstream to Mullet Lake to include the Black River Watershed	Fish Consumption Aquatic Life	WQS exceedance for PCB's
Burt Lake	Fish Consumption	Mercury
Crooked /Pickerel Lakes	Fish Consumption	Mercury
Mullet Lake	Fish Consumption	Mercury

Upstream Watersheds: Nonpoint Source Pollution Protection and Remediation Efforts.

Management of nonpoint source pollution has been actively underway in the Cheboygan River Watershed since 1986. The first efforts began in the Burt Lake Watershed where an inventory was completed with recommendations identified to reduce the priority pollutants: sediment, nutrients, and toxins. A Nonpoint Source Management Plan was developed and implementation began immediately after the year long planning timeframe. Sediments were addressed by restoring streambanks along the Sturgeon River, beginning in the headwaters and working down stream. NEMCOG partnered with NRCS, Conservation District, and Huron Pines RC&D for installation of the BMPs utilizing work crews administered by the Cheboygan County Conservation District. At this time, road stream crossings were not specifically addressed, due to what was felt the significant cost of replacement. Stream bank erosion sites adjacent to the crossing were inventoried as a part of the implementation activities. One road/stream crossing was replaced during this project's implementation phase which resulted in a large (not quantified at the time) reduction of sediment to the Sturgeon River. The County, with input from partners of the Burt Lake project, installed BMP's (runoff diversions, grassed waterways, sloping back of the approach, and revegetation of banks). In addition, an animal waste system was installed along with the establishment of buffer strips, exclusionary fencing, and watering systems at agricultural areas of concern. To reduce nutrient loading from areas of dense development along Burt Lake, water conservation devices were installed in homes to allow for enhanced treatment of the wastewater (costs for alternative onsite treatment was not feasible). A Septic System Inspection Program at the Time of Home Sale was also initiated to remediate failing systems.

Protection efforts include shoreline resident education, school water quality monitoring programs, and landuse BMP education.

Efforts to protect the Burt Lake Watershed continue today through the Lake Association, Tip of the Mitt Watershed Council, and the Little Traverse Conservancy. The Sturgeon River Inventory was updated, water quality monitoring continues, and shoreline restoration efforts continue to be promoted through the organizations.

The Mullet Lake Watershed and Crooked/Pickerel Lakes Nonpoint Source Management Programs followed parallel paths as that of the Burt Lake Nonpoint Source Watershed project. For both watershed projects, funding was received for three years each to implement protection and remediation programs. Some of the activities involved restoration efforts for agricultural remediation, road stream crossings, stream bank, and greenbelt reestablishment along Crooked/Pickerel Lakes. In addition, educational and proactive measures were undertaken for the various target audiences: shoreline riparian, realtors, local government officials, farmers, road commissions, etc. Conservation measures partnering with Little Traverse Conservancy resulted in significant riparian parcels on Crooked/Pickerel Lakes and Needlepoint on Mullett Lake being permanently protected through donations and fundraising. These parcels were identified in both the Mullett Lake Watershed and Crooked/Pickerel Lakes Watershed Nonpoint Source Management Plans in need of protection. Although funding was discontinued after three years, nonpoint source activities continued. Today, through activities of the Lake Associations, Tip of the Mitt Watershed Council and other agencies and organizations efforts continue to protect these significant water resources.

A Nonpoint Source Management Plan was also completed for the Black Lake Watershed. Although funding was not specifically obtained to implement the management plan, efforts through local clubs and organizations have been remediating erosion sites on the Upper Black River and road/stream crossings in the watershed. The City of Onaway also recently installed a sewer system for the City of Onaway. Soils in the area along with the karst topography made onsite systems unsuitable for treatment of waste. This was identified in the plan as a serious threat to surface and ground water quality in the Black Lake watershed.

Upstream Watersheds: Water Quality Data

Water quality sampling efforts were completed during development of both the Burt Lake and Mullett Lake Watershed Management Plans. A review of this data can be found in **Appendix H**.

CHAPTER 3 DESIGNATED AND DESIRED USES

Designated Uses in the State of Michigan

Michigan surface waters are protected by water quality standards for specific designated uses. Part 31of the Natural Resources and Environmental Protection Act, P.A. 451 of 1994, as amended requires all surface waters of the state of Michigan are designated for and shall be protected for the following uses:

1) Agriculture
2) Industrial water supply
3) Navigation
4) Public water supply at the point of intake
5) Warm or cold water fishery
6) Other indigenous aquatic life and wildlife
7) Partial body contact recreation
8) Total body contact recreation between May 1 and October 31.
9) Fish consumption

If a body of water or stream does not meet the water quality standards established for a designated use, then it is referred to as "nonattainment". Each year the DEQ publishes a listing titled "Section 303(d) Report" that contains the bodies of water and streams that are in nonattainment.

Water quality is monitored by the State DEQ. At least once every five years, on a rotating basis, the DEQ monitors the State's 58 major watersheds.

Designated Uses within the Cheboygan River/Lower Black River Watershed

The Designated Uses being protected in the Cheboygan River/Lower Black River Watershed are:

1) Agriculture
2) Industrial water supply
3) Navigation
4) Cold water fishery
5) Other indigenous aquatic life and wildlife
6) Partial body contact
7) Total body contact recreation between May 1 and October 31
8) Fish consumption

Public water supply was omitted from the Cheboygan River/Lower Black River Watershed designated use list as there is not a public water supply system that draws water from the

Cheboygan or Lower Black rivers. However, fish consumption was added as a designated use due to the rivers being heavily used for fishing and (duck/goose) hunting.

The Cheboygan River/Lower Black River Watershed exceeds the State's Water Quality Standards (WQCs) for PCB's in the Cheboygan and Black Rivers (see Chapter 2) and is indicated on the 303(b) Non-attainment list. In addition, there is widespread mercury contamination in fish throughout all of northern Michigan's lakes. Mullett, Burt, and Crooked/Pickerel lakes, upstream from the Cheboygan/Lower Black River watershed all are on the nonattainment list due to mercury contamination found in fish.

PCB and mercury contamination primarily enter the watershed through atmospheric deposition. Due to the magnitude of this issue, PCB's and mercury are not addressed in this plan outside the recommendation of continued monitoring and fish consumption advisories by the DEQ (see Fish Consumption Advisory in Appendix I.

The DEQ is the lead agency on the issue of toxic and mercury pollution in Michigan. The agency has developed pollution prevention and abatement strategies to reduce atmospheric and point source loading of mercury and other toxins to the surface waters of the State.

Impacted Designated Uses

At the present time, the Cheboygan River/Lower Black River and Douglas Lake Watersheds are not impaired on a watershed-wide scale. However, as the population within the watersheds continues to grow, impacts from land use changes may threaten the designated uses. Threatened waterbodies are defined as those that currently meet the State's water quality standards but may not in the future.

The threatened designated uses were determined by existing subwatershed plans of the Cheboygan River Watershed, Tip of the Mitt Watershed reports, County Soil Erosion and Zoning Officer reports, steering committee members, and DEQ Reports.

Table 3-1: Threatened Designated Uses in the Cheboygan/Lower Black River Watershed

Designated Use	
Agriculture	Threatened
Industrial Water Supply	Threatened
Navigation	Threatened
Cold water Fishery	Threatened
Other indigenous aquatic life and wildlife	Threatened
Partial Body Contact	Threatened
Total Body Contact Recreation (May 1 – Oct 31)	Threatened

Desired Uses

Desired uses are factors deemed important to the watershed community for present and future uses. A list of desired uses for the Cheboygan River/Lower Black River Watershed was developed by the steering committee at the initial steering committee meeting, with input from the technical committee and concerned community members. The Desired Uses for the watershed are listed below:

- Greenbelts in-place along the river and lake corridors
- Open-space protected through conservation easements
- Recreational trails along Cheboygan River corridor (as identified in City of Cheboygan Recreation Plan).
- Public and handicapped accessible sites along river for fishing and river access

CHAPTER 4 WATER QUALITY CONCERNS & ISSUES

Threatened Designated Uses: Pollutants, Sources, Causes

The Cheboygan/Lower Black river systems are actively utilized for a variety of uses. The rivers are highly renown for recreational boating, swimming and fishing opportunities as well as an attractive retirement and seasonal home area. Wetlands along the waterways provide excellent habitat for aquatic and wildlife and protect lands from flooding. Many are also provided their economic livelihood as soil in the watershed is suitable for farming activities, and water from the river has been used for industrial manufacturing. The designated uses selected for protection in this study directly relate to activities currently ongoing in the watershed, and if left unmanaged may result in the loss of opportunities currently enjoyed today.

Each of the designated uses to protect may be threatened by pollutants as changes occur within the watershed (see **Table 4-1**). Examples of pollutants include sediment entering river system due to runoff from road-stream crossings, construction sites, and road ways; nutrients from livestock due to unlimited access to streams; and shoreline lawn-care practices; and pathogens from failing onsite waste water treatment systems. In addition, impacts to water resources may also occur from environmental factors (called impairments in this plan) such as loss of habitat, loss of wetlands, low dissolved oxygen levels, changes to hydrology.

Table 4-1: Pollutants Affecting Designated Uses in the Cheboygan/Lower Black River Watershed

Pollutant/Impairment	Designated Uses Affected
Sediment	Navigation Warm/Coldwater Fishery Other Indigenous Aquatic Life/Wildlife
Nutrients	Warm/Coldwater Fishery Other Indigenous Aquatic Life/Wildlife Partial/Total Body Contact
Toxins (oil, grease, pesticides, chemicals, chlorides, etc)	Warm/Coldwater Fishery Other Indigenous Aquatic Life/Wildlife Fish Consumption
Pathogens (E. Coli and Fecal Coliform Indicators)	Partial/Total Body Contact
Invasive Species	Navigation Warm/Coldwater Fishery Other Indigenous Aquatic Life/Wildlife Partial/Total Body Contact
Loss of Habitat	Warm/Coldwater fishery Other Indigenous Aquatic Life/Wildlife
Loss of Wetlands	Warm/Coldwater Fishery Other Indigenous Aquatic Life/Wildlife

Sources and Causes of Pollutants

A list (**Table 4-2**) was developed that identified sources and causes of pollutants in the watershed as well as environmental factors that may or are affecting water quality. This comprehensive list provides a summary to begin the development of proactive and remedial measures for long-term water resource protection.

Potential pollutants, sources, and causes were identified using a variety of methods: review of existing reports, review of subwatershed nonpoint source management plans, steering committee input, observations during windshield survey of watershed, and aerial photography review. **Table 4-2** shows pollutants along with the known or suspected source and/or cause of each pollutant. Known was defined as identified by technical staff through their observations, inventories or past investigations or studies. Suspected was defined as not identified by technical staff or supporting data/study, but may be associated with the activity.

Table 4-2: Pollutants, Sources and Causes

Pollutant / Impairment	**Threatened/Impaired Use**	**Sources** K = known, S = suspected P = potential	**Causes** K = known, S = suspected P = potential
Sediment (k)	Navigation Warm/ Coldwater Fishery Other Indigenous Aquatic Life	Agricultural activities (k)	Unrestricted livestock access (k)
		Road-stream Crossings (s)	Undersized or deteriorating culverts (s) Lack of erosion/runoff controls (s) Steep Approaches (s) Poor design/maintenance (s)
		Stormwater runoff (s)	Poor storm water management practices(s)
		Streambank /Shoreline Erosion (k)	Inadequate/lack of erosion control measures s) Removal of streambank and shoreline vegetation.(s) Dam operations (k) Lack of shoreline vegetation (k) Boat traffic Foot Traffic (recreational activities) (s)
Nutrients (s)	Warm/Coldwater Fishery Other Indigenous Aquatic Life Total Body Contact	Septic Systems (s)	Improperly sited, designed or maintained system (s)
		Fertilizers (s)	Improper farm and lawn fertilizer application (s)
		Animal Waste (s)	Uncontrolled livestock access(s) Ducks/geese in river/along shoreline (s)
		Ash deposition (s)	Burning of yard waste (s)

Table 4-2: Pollutants, Sources and Causes (continued)			
Toxins (s) **Pesticides, oil, gas, etc.**	Warm/Coldwater Fishery Other Indigenous Aquatic Life Fish Consumption	Stormwater Runoff (s)	Lack/poor stormwater management practices (s)
		Improper disposal of oil /vehicle fluids (s)	Lack of public education of proper disposal. (s) Lack of HHW collection facilities (s)
		Atmospheric Deposition(k)	Vehicle combustion (k) Industrial /municipal facilities (s)
		Motor Boats (s)	Fuel spillage/leaks (s)
		Industrial discharge(s)	Discharge limit violations (s)
		Contaminated Sites (k)	Leaking underground storage tanks (k)
Pathogens (s)	Partial/Total Body Contact	Animas Waste (s)	Failing Systems(s)
		Septic Systems (s)	Livestock in stream (s) Ducks/geese (excessive numbers) in water/shore (s)
Invasive Species	Navigation Warm/Coldwater Fishery Other Indigenous Aquatic Life	Boats (s	Lack of boater knowledge on preventative measures to avoid transfer of invasive species. (s) Invasive species brought in by boats which travel to other waterbodies (s) Beach /recreational Toys (s)
		Waterway Connected to Great Lakes (k)	Great Lakes ships able to dump bilge water due to a lack of regulations (k)
		Human Activities(s)	Beach/ Water Recreational Toys (i.e. buckets, rafts)
Loss of habitat (s)	Warm/Coldwater fishery Other Indigenous Aquatic/Wildlife	Human Activities (s) Dam Operations (k)	Removal of streambank/shoreline vegetation (s) Fluctuating water levels (s)
		Development (k)	Inadequate enforcement of laws (s) Fragmentation of habitat due to development and filling of wetlands (s)
Loss of Wetlands	Warm/Coldwater Fishery Other Indigenous Aquatic/Wildlife	Development (k) Riparian Activities (s)	Fill of wetlands (k) Removal of wetland vegetation (s)

Priority Pollutant Ranking

The pollutants listed on **Table 4-3** were ranked based on the outcome of the inventories and the affect they would have, either existing or potential on the watershed's threatened designated uses. Sediments are of high priority concern due to the impact or potential impact that excessive sedimentation may have on the river systems. In addition, sediments often carry nutrients which may attach to the soil particles. Toxins were ranked number three as urban stormwater, as well as numerous road stream crossings identified in the inventories, provide a direct conduit for runoff carrying sediments, possible nutrients, and toxins to the waterways. Impairments were listed of equal ranking due to their interrelationships, and the means to quantify the amount of each impairment was beyond the scope of this project.

As indicated on **Table 4-3**, sediments and nutrients were ranked the top two pollutants of concern. Toxins were also identified as pollutants of concern for the watershed.

Table 4-3: Priority of Pollutants

Pollutant/Impairment	Ranking
Sediments	1
Nutrients	2
Toxins	3
Pathogens	4
Invasive Species	5
Habitat Loss	5
Wetland Loss	5

Designated Uses and Pollutants

In the Cheboygan River/Lower Black River Watershed designated uses can be affected by the priority pollutants. The following designated uses were determined to be adversely affected by one or more of the pollutants stated above. Organic materials, such as sediments and nutrients are the priority pollutants to control for protecting navigation, warm/coldwater fisheries, total/partial body contact, and aquatic life. Toxins, i.e. heavy metals/oils/grease/ pesticides were also identified as threatening the designated uses. **Table 4-4** shows the relationship between the pollutants and their impact on each designated use.

Table 4-4: Designated Use Pollutants

Designated Use	Pollutant
Agriculture	Sediment Nutrients Toxins
Industrial Water Supply	Sediment Nutrient Toxins Invasive Species
Navigation	Sediment
Warm/Cold Water Fishery	Sediments Nutrients Toxins Invasive Species
Other Indigenous Aquatic/Wildlife	Sediment Nutrients Toxins
Total/Partial Body Contact	Nutrients Toxins Pathogens
Fish Consumption	Toxins Pathogens

Sources of Pollution

The main sources of pollution, as identified by the steering committee and based on the results of the nonpoint pollution inventories, were road/stream crossings, stormwater runoff, and fertilizers. Other sources of pollution include streambanks, agricultural activities, development sites, residential lawns, and contamination sites. These pollution sources were then ranked by the steering committee using the process described previously, with a ranking of one being the highest concern. **Table 4-5** lists these sources by rank and type of pollutant.

Table 4-5: Sources of Pollution

Pollutant	Rank	Source	Rank
Sediments	1	Agriculture	1
		Road Stream Crossings	2
		Stormwater Runoff	3
		Streambanks	4
Nutrients	2	Agriculture	1
		Road Stream Crossings	2
		Agricultural Activity	2
		Stormwater	3
		Streambanks Agricultural Activity	4
Toxins	3	Stormwater runoff	1
		Contamination Sites	1
Pathogens	4	Livestock Waste	1
		Failing Septic Systems	2
Invasive Species	5	Boats	1
		Waterway connected to Great Lakes (ships)	2
		Human Activity	3
Wetland Loss	5	Development	1
		Riparian Activity	2
Habitat Loss	5	Development	1
		Human Activity	2

Causes of Pollution

In order to correct existing nonpoint source pollution and prevent future pollution problems from occurring, sources and causes for each pollutant were identified, and steering committee members were asked to select the causes of pollution they felt were most detrimental to the watershed. Causes of pollution in the Cheboygan River/Lower Black River Watershed are ranked in **Table 4-6** below, with a ranking of number one indicating the highest priority cause of pollution.

Table 4-6: Pollutant Causes

Cause of Pollution	Rank	Pollutant Source
Sediments		
Unrestricted Livestock	1	Agricultural activity
Undersized/deteriorating culverts	1	Road/stream crossings
Poor Storm Water Management Practices	1	Stormwater runoff
Removal of streambank and shoreline vegetation	1	Streambank/shoreline erosion
Poor design/maintenance	2	Road/stream crossings
Foot Traffic	2	Road/stream crossings
Lack of erosion/runoff controls	3	Streambank/shoreline erosion
Boat Traffic	3	Road/stream crossings
Steep Approaches	4	Streambank/shoreline erosion
Inadequate/lack of erosion control measures	4	Streambank/shoreline erosion
Lack of Shoreline vegetation	5	Streambank/shoreline erosion
Dam operations	6	Streambank/shoreline erosion
Nutrients		
Improperly sited, designed or maintained systems	1	Septic systems
Uncontrolled Livestock access	1	Animal saste
Improper farm and lawn fertilizer application	1	Fertilizers
Burning of yard waste	1	Ash deposition
Ducks/geese in river/along shoreline	2	Animal saste
Failing system or improper siting ,design or maintenance of on-site waste water treatment systems	3	Septic systems
Toxins		
Vehicle combustion	1	Atmospheric deposition
Industrial/municipal facilities	1	Atmospheric deposition
Lack/poor stormwater management	2	Stormwater runoff
Discharge limit violations	3	Industrial discharge
Leaking underground storage tanks	4	Contaminated sites
Lack of public education of proper disposal	5	Improper disposal of oil/vehicle fluids
Lack of HHW collection facilities	6	Improper disposal of oil/vehicle fluids
Fuel spillage/leaks	7	Motor Boats
Pathogens		
Livestock in stream	1	Animal waste
Ducks/geese (excessive numbers) in water/shore(s)	2	Animal waste
Failing Systems	3	Septic systems

Table 4-6: Pollutant Causes (continued)		
Invasive Species		
Invasive species brought in by boats which travel to other waterbodies	1	Boats
Great Lakes Ships able to dumb bilge water due to a lack of regulations	2	Waterway connected to Great Lakes
Lack of boater knowledge on preventative measures to avoid transfer of invasive species	3	Boats
Beach/recreational toys	4	Boats
Loss of Habitat		
Fragmentation of habitat due to development and filling of wetland(s)	1	Development
Inadequate enforcement of law(s)	2	Development
Removal of streambank/shoreline vegetation(s)	2	Streambank/shoreline erosion
Loss of Wetlands		
Fill of wetlands	1	Development/riparian activities
Removal of wetland vegetation	2	Development/riparian activities

CHAPTER 5 WATERSHED CRITICAL AREA

Critical Area Determination

The Critical Area of a watershed are those areas which now, or may in the future, contribute the largest amounts of pollutants to the watershed. These critical areas are identified for a variety of reasons. Most importantly, it can be used to narrow the scope of the plan and prioritize implementation efforts. There are several methods for determining the critical area of a watershed. One technique is the corridor method, which defines the critical area as a standard distance from the center of the waterbodies. The subwatershed method is another way in determining the critical area. This method uses smaller hydrologically distinct "subwatersheds" that have specific problems, or areas, that can have an effect on overall water quality. Other criteria used to develop watershed critical areas are land use analyses and stakeholder concerns or observations.

The critical area for the Cheboygan River/Lower Black River Watershed was determined using a combination of all the methods stated above. First, the corridor method was used to determine an overall Area of Concern. Next, the subwatershed method was used to identify individual stream corridors, lakeshores and wetland areas of concern. Finally, the results of the above two methods were compared with the results of the land use analyses to determine the five critical areas of the watershed. The five critical areas identified were, Agricultural Lands, Urban Areas, Lakeshore, Riparian Corridors, and Wetlands. Focusing implementation efforts on these critical areas of the watershed will provide the greatest reduction in pollutants for the time and money invested. **Map 7** displays the five critical areas of the Cheboygan River/Lower Black River Watershed.

Definition of Critical Areas

Agricultural Lands
Agricultural operations can often introduce large amounts of pollutants to a watershed. Wind and water erosion, combined with inadequate green belts allow excessive sedimentation. Livestock in close proximity, or direct contact, to the water can contribute nutrients and pathogens degrading the water quality. Excessive fertilizer applications add large concentrations of nutrients to the watershed system. Pesticide and herbicides can be deposited in the waterbodies by means of runoff. All areas labeled as agricultural during the land use analyses were include in this critical area category.

Urban Areas
All substances that find their way onto impervious surfaces are likely to be washed into nearby waterbodies by rainfall or snowmelt. Increased development creates more impermeable surfaces, thus leading to more runoff. The increased runoff introduces more pollutants to the water body. Major storm events can cause hydrologic fluctuations often resulting in streambank erosion sites. Another effect of increased imperviousness is an increase in water temperature. The entire City of Cheboygan is included in the urban critical area.

Lakeshore

Lakeshores are often subject to intense residential development, and thus often contribute significant amounts of pollutants to the waterbodies. The high level of development can lead to an increase in impervious surface areas, causing increased and polluted runoff. Improper lawn care activities can contribute excessive nutrients and pesticide contaminates to the water body. Failing septic systems release nutrients, e. coli and other pathogens which can degrade water quality. The lakeshore critical area includes all land within 200 feet of the lakeshore and adjacent areas of dense residential development.

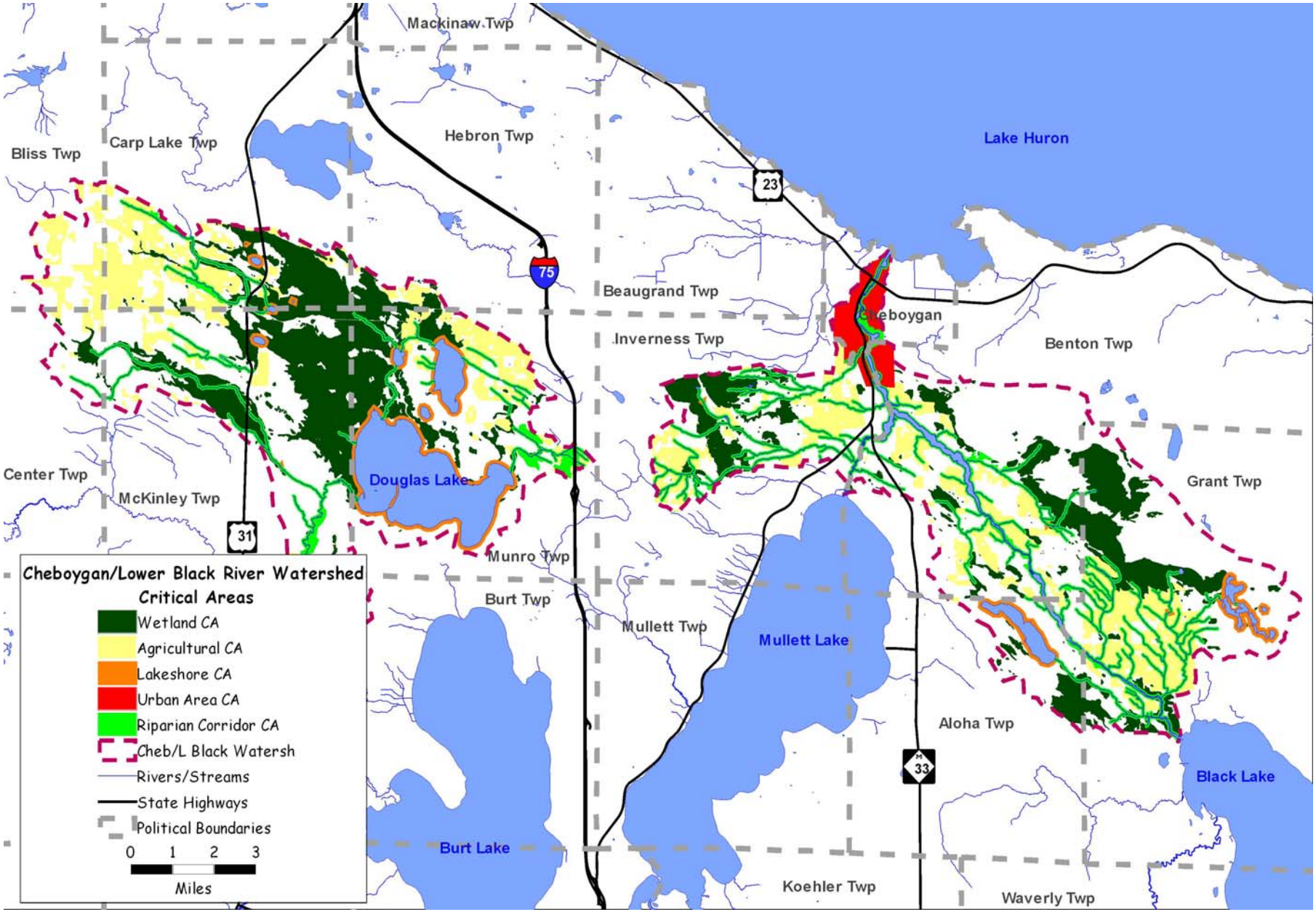
Riparian Corridors

Like lakeshores, riparian corridors often have areas of intense residential development. Open areas and public lands along streams and rivers frequently experience high levels of recreational activities. Stream access for activities such as fishing, swimming and canoeing can cause streambank erosion or the introduction of invasive species. Road/stream crossings (anywhere a road and a stream intersect) can be major contributors of sediment and other pollutants. This excessive sedimentation can destroy aquatic habitat and impede navigation, among other things. The riparian corridors critical area encompassed all land within 200 feet of the stream and adjacent areas of steep slopes.

Wetlands

Wetlands are some of the most valuable areas within a watershed and yet are often the first areas sacrificed in the name of development. Wetlands act as a “giant sponge” within the watershed. They store excess water from runoff, releasing it slowly or allowing it to enter the groundwater system. This provides valuable natural flood control to a river system. Wetlands trap sediment, and filter out other pollutants. Aquatic organisms in wetlands, such as algae and bacteria, take up minerals and break down organic matter. Wetlands provide excellent habitat and, as a result, greatly contribute to the diversity and abundance of fish and other wildlife. Therefore, the protection of wetlands is critical in maintaining water quality. The wetland critical area includes all land classified as a wetland by the U.S. Fish and Wildlife Service National Wetlands Inventory.

Map 7 Critical Area



CHAPTER 6 CHEBOYGAN RIVER/LOWER BLACK RIVER NONPOINT SOURCE INVENTORIES

Introduction

Nonpoint source pollution can find its way into a water system through various means. When streambanks and shorelines erode, sediments are deposited into lakes and rivers. Sediments and other pollutants can be washed into streams at road/stream crossings. Agricultural and residential areas contribute fertilizers and pesticides, and storm drains provide an even more direct route for pollutants to enter waterways during a storm event. Several inventories, including streambank, road/stream crossing, agriculture, and storm drains were conducted during spring through autumn of 2002 to gather information regarding the state of the watershed. Materials used in the assessment of the watershed included topographic maps, MIRIS land use maps, plat books, aerial photographs, watershed maps, and county road maps. Water quality data and zoning ordinances were also used to supplement the spatial data. The field inventories were conducted by car, boat, canoe, and/or by walking the watershed. The resulting data sets were used to determine which pollutants are threatening or impairing the watershed's designated and desired uses.

Streambank Erosion Inventory

Eroding streambanks deposit excess soil into the river system. This sedimentation can reduce water clarity, impede navigation, contribute excessive nutrients, and degrade habitat for fish and other aquatic life. Evaluation of the streambanks in the watershed is critical in determining not only which sites need immediate attention, but also in identifying sites that may pose potential sedimentation problems in the future.

In order to determine the quantity, severity and location of streambank erosion sites within the watershed, a field inventory was conducted in summer 2002 and concluded in spring 2003.

METHODOLOGY

The streambank inventory was conducted using a variety of methods, including topographical maps, soil studies, and where navigable, various watercrafts were used. Each erosion site was given an identification number, the condition of the site was documented, and photographs were taken of the streambank. Data collected at each site include: area of eroded bank; slope of bank; soil type; amount of vegetation present; the condition of the bank; and the extent and causes of the erosion. A sample data collection form can be found in **Appendix A**. In order to identify the

most critical erosion sites, a ranking system that evaluates the collected data was used, and each erosion site was determined to be either a *Minor*, *Moderate*, or *Severe* environmental concern. The severity scoring sheet used to determine the severity index rating can be found in **Appendix B**.

Pollutant Loading Estimates

The total sediment loading was calculated for each streambank erosion site identified within the watershed. The Channel Erosion Equation (CEE) was used to calculate the total sediment loading in tons per year.

$$\text{CEE} = \text{Length (ft)} * \text{Height (ft)} * \text{LRR (ft/year)} * \text{Soil Weight (ton/ft}^3\text{)}$$

The Lateral Recession Rate (LRR) is the thickness of soil eroded from the bank surface (perpendicular to the face) in an average year. For this application, the LRR was calculated using the data collected during the field inventory. A copy of the calculation sheet used to determine the LRR can be found in **Appendix C**.

The sediment load estimate for each erosion site was used to calculate the estimated amount of attached nutrients, specifically phosphorus and nitrogen, which are transferred into the water body. This process uses information collected by USDA-ARS researchers and starts with a phosphorus concentration of 0.0005 lbP/lb of soil and a nitrogen concentration of 0.001 lbN/lb of soil. The following equations were used to calculate the nutrient loading:

$$\text{Phosphorus Loading} = \text{Sediment Load (ton/yr)} * 0.0005 \text{ (lbs P/lb soil)} * 2000 \text{ (lbs/ton)} * \text{soil correction factor}$$

$$\text{Nitrogen Loading} = \text{Sediment Load (ton/yr)} * 0.001 \text{ (lbs N/lb soil)} * 2000 \text{ (lbs/ton)} * \text{soil correction factor}$$

Soil texture is determined and a correction factor is used to better estimate nutrient holding capacity of the soil (MDEQ, 1999). The soil correction factor for sandy soils is 0.85 and for clay soils is 1.15.

Pollutant Reduction Estimates

With an analysis of both the causes and severity of each streambank erosion site, best management practices (BMPs) were recommended. Installation of vegetative buffers on eroded sites will reduce approximately 75% of sediment loading into a river system. Sediment reduction estimates were calculated by multiplying the sediment load for each erosion site by a value of 0.75 for the BMP efficiency.

Because the nutrient load estimates are based on the total sediment loading, the load reduction estimates for phosphorus and nitrogen are based on the amount of sediment reduction.

$$\text{Phosphorus Reduction} = \text{Sediment Reduction (ton/yr)} * 0.0005 \text{ (lbs P/lb soil)} * 2000 \text{ (lbs/ton)} * \text{soil correction factor}$$

$$\text{Nitrogen Reduction} = \text{Sediment Reduction (ton/yr)} * 0.001 \text{ (lbs N/lb soil)} * 2000 \text{ (lbs/ton)} * \text{soil correction factor}$$

RESULTS

Nineteen streambank erosion sites were located within the watershed (See **Map 8**). Six of the sites show minor amounts of erosion, twelve have moderate erosion, and one site was considered severe. The causes of erosion varied from site to site. A few of the erosion sites were naturally occurring from a bend in the river, wildlife access or bank seepage. The erosion at many of the sites, however, was the result of human activities. Sites where livestock had access to streams and fishing and boat-launch sites in particular often showed moderate to severe signs of erosion. **Table 6-1** provides a summary of pollutant sources, recommended treatments, erosion severity, and the sediment loading and reduction estimates. When implementing streambank BMPs, priority should be given to those sites contributing the highest amounts of sediment to the river system. However, variables such as landowner cooperation, partner involvement and the level and availability of funding may also be considered. Implementation of BMPs at the six sites contributing the most sediment would result in a 59% reduction of sediment loading from streambank erosion.

Map 8 Streambank Erosion Sites

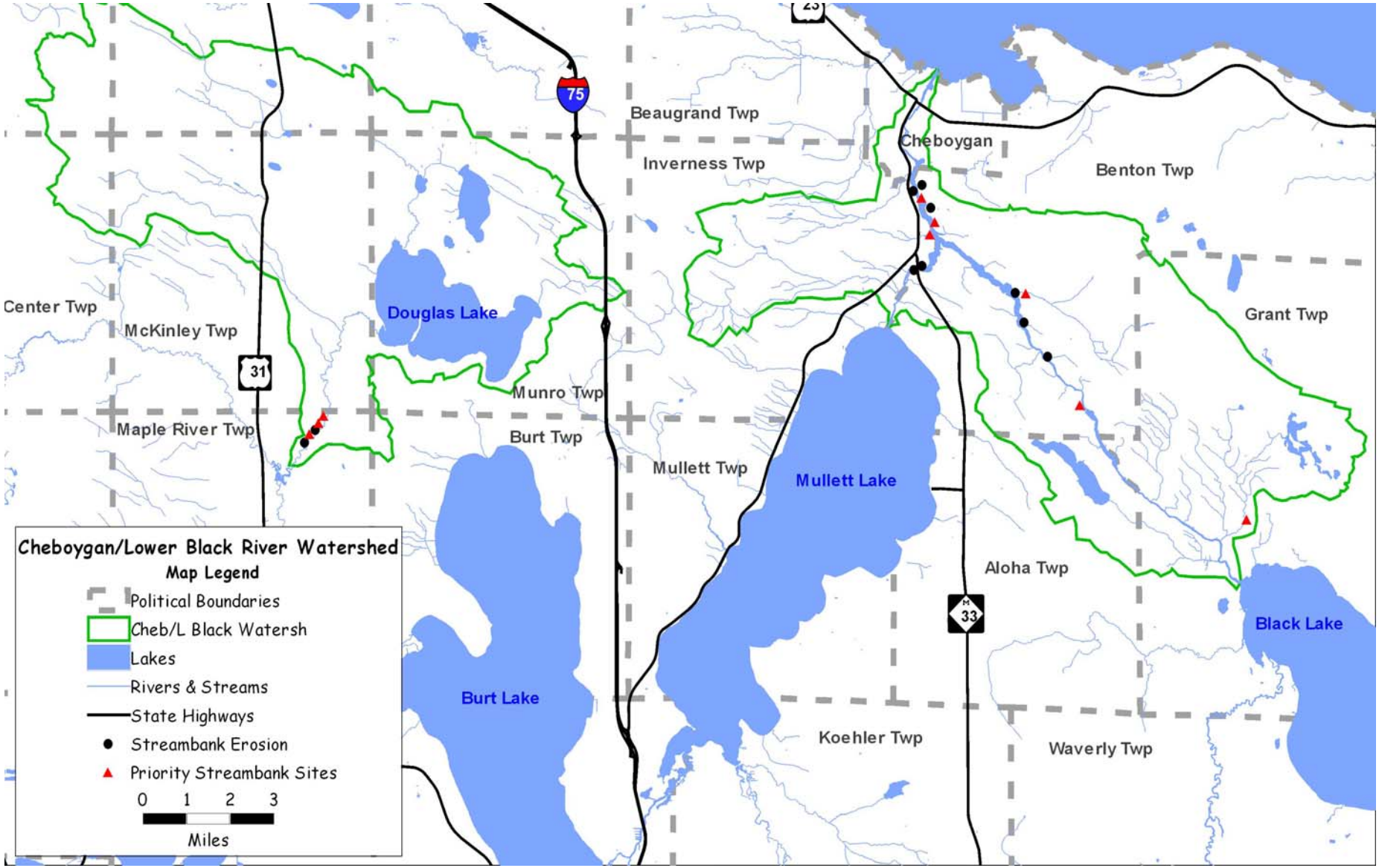


Table 6-1: Sediment Load Reduction for Streambank Erosion Sites							
Water Body	**Site ID**	**Pollutant Source**	**Recommended Treatment**	**Length/Height of Site (ft)**	**Severity**	**Current Load (tons/year)**	**Estimated Reduction (tons/year)**
Cheboygan River	001	Wave action	Revegetation; biolog; tree revetment	35 / 8	Minor	0.46	0.35
	002	Development; clear cutting	Revegetation; biolog; tree revetment	12 / 4	Minor	0.13	0.10
	003	Development; wave action; seepage	Revegetation; biolog; tree revetment	400 / 8	Moderate	12.32	9.24
	004	Wave action; seepage	Bank sloping; revegetation	30 / 6	Moderate	0.59	0.44
	005	Seepage	Bank sloping; revegetation	100 / 12	Moderate	4.62	3.47
	006	Development; access traffic	Revegetation; biolog; tree revetment	50 / 12	Severe	13.20	9.90
	007	Wave action; seepage	Revegetation; biolog; tree revetment	30 / 10	Moderate	1.65	1.24
	008	Foot traffic; boat access	Revegetation; biolog; tree revetment	20 / 3	Minor	0.17	0.13
	Subtotal					**33.14**	**24.86**
Myers Creek	009	Development		150 / 12	Moderate	9.90	7.43
	Subtotal					**9.90**	**7.90**
Owens Creek	010	Livestock access	Rock rip rap; revegetation; fencing	300 / 4	Moderate	3.15	2.36
	Subtotal					**3.15**	**2.50**
Maple River	011	Foot traffic	Revegetation; biolog; tree revetment	25 / 4	Moderate	1.10	0.83
	012	Bend in river	Revegetation; biolog; tree revetment	50 / 10	Moderate	4.95	3.71
	013	Obstruction: beaver dam	Obstruction removal; revegetation	30 / 10	Moderate	1.49	1.12
	014	Foot traffic; campsite	Revegetation; biolog; tree revetment	35 / 7	Moderate	1.75	1.31
	015	Bend in river; foot traffic	Stairway; revegetation; bank sloping	25 / 6	Moderate	0.58	0.44
	Subtotal					**9.87**	**7.40**
Lower Black River	016	Peaking	Revegetation; biolog; tree revetment	100 / 60	Moderate	6.30	4.73
	017	Sloughing from clay soils	Revegetation; biolog; tree revetment	100 / 12	Minor	0.42	0.32
	018	Access traffic	Revegetation; biolog; tree revetment	100 / 15	Minor	0.53	0.40
	019	Clay banks	Revegetation; biolog; tree revetment	30 / 6	Minor	0.06	0.05
	Subtotal					**7.31**	**5.48**
Total						**63.37**	**48.14**

Table 6-2 outlines the current loading for phosphorus and nitrogen as well as the estimated nutrient reductions with BMP implementation.

Table 6-2: Phosphorus & Nitrogen Load Reduction for Streambank Erosion Sites					
Water Body	**Site ID**	**Phosphorus (lbs/year)**		**Nitrogen (lbs/year)**	
		Current Load	**Estimated Reduction**	**Current Load**	**Estimated Reduction**
Cheboygan River	001	0.39	0.29	0.79	0.59
	002	0.11	0.08	0.22	0.17
	003	10.47	7.85	20.94	15.71
	004	0.50	0.38	1.01	0.75
	005	3.93	2.95	7.85	5.89
	006	11.22	8.42	22.44	16.83
	007	1.40	1.05	2.81	2.10
	008	0.14	0.11	0.28	0.22
	Subtotal	**18.16**	**21.13**	**56.34**	**42.25**
Myers Creek	009	8.42	6.31	16.83	12.62
	Subtotal	**8.42**	**6.31**	**16.83**	**12.62**
Owens Creek	010	3.62	2.72	7.25	5.43
	Subtotal	**3.62**	**2.72**	**7.25**	**5.43**
Maple River	011	0.94	0.70	1.87	1.40
	012	4.21	3.16	8.42	6.31
	013	1.26	0.95	2.52	1.90
	014	1.49	1.12	2.98	2.23
	015	0.49	0.37	0.98	0.74
	Subtotal	**8.39**	**6.29**	**16.77**	**12.58**
Lower Black River	016	7.25	5.43	14.49	10.87
	017	0.48	0.36	0.97	0.72
	018	0.60	0.46	1.21	0.91
	019	0.07	0.05	0.14	0.10
	Subtotal	**8.40**	**6.30**	**16.81**	**12.61**
Total		**56.99**	**42.75**	**114.00**	**85.50**

For maps and more detailed information on each erosion site, see the *Support Document One: Streambank Erosion and Road/Stream Crossing Inventories.*

Shoreline Inventory

A shoreline survey to identify locations of Cladophora growth and other shoreline features was conducted on Long Lake, Douglas Lake, Munro Lake and Twin Lakes by the Tip of the Mitt Watershed Council in July 2002.

Cladophora is a branched, filamentous green algae that occurs naturally in small amounts in Northern Michigan Lakes. Its occurrence is governed by specific environmental requirements for temperature, substrate, nutrients, and other factors. It is found most commonly in the wave

splash zone and shallow shoreline areas of lakes, and can also be found in streams. It grows best on stable substrates such as rocks and logs. Artificial substrates such as concrete or wood seawalls are also suitable. The preferred water temperature is 50 to 70 degrees Fahrenheit. This means that late May to early July, and September and October are the best times for its growth in Northern Michigan lakes.

The nutrient requirements for Cladophora to achieve large, dense growths are greater than the nutrient availability in lakes with high water quality, such as Douglas Lake. Therefore, the presence of Cladophora can indicate locations where relatively high concentrations of nutrients, particularly phosphorus, are entering a lake (it has less usefulness as an indicator of nutrient pollution in streams). Sources of these nutrients can be due to natural conditions, including springs, streams, and artesian wells that are naturally high in nutrients due to the geologic strata they encounter; as well as wetland seepage which may discharge nutrients at certain times of the year. However, Cladophora growths can also be the result of cultural sources such as lawn fertilization, malfunctioning septic systems, poor agricultural practices, soil erosion, and wetland destruction. These nutrients can contribute to an overall decline in lake water quality. Additionally, malfunctioning septic systems pose a potential health risk due to bacterial and viral contamination.

A Cladophora survey can be a valuable lake management tool. Coupled with follow-up on-site visits and questionnaires, controllable sources of nutrients to the lake can be identified. Subsequently, a reduction in nutrient loading and other forms of pollution can often be achieved by working with homeowners to solve problems. These solutions are often simple and low cost, such as regular septic system maintenance, proper lawn care practices, and preservation or establishment of a greenbelt along the shoreline. Prevention of problem situations can also be achieved through the publicity and education associated with the survey.

The 2002 project is the first systematic lake-wide survey conducted on Munro Lake, Long Lake, or Twin Lakes, and the first on Douglas Lake since 1988. Periodic repetitions of shoreline algal surveys are important for identifying chronic problem sites as well as recent occurrences. They are also valuable for determining long term trends of near shore nutrient inputs associated with land use changes, and for assessing the success of remedial actions.

METHODOLOGY

The shoreline was surveyed to develop a database of property parcel features and their description as viewed from the water. Property features include developed platted lots, undeveloped (vacant) lots, large undeveloped parcels, parks, preserves, public access sites, and county road endings. However, it was not possible to identify every distinct parcel in this manner.

For the purpose of this survey, *developed* means the presence of buildings or other significant permanent structures. Included are roadways, boat launching sites, and recreational properties (such as parks with pavilions and parking lots). Properties with only mowed or cleared areas, seasonal structures (such as docks or travel trailers), or unpaved pathways were not considered developed. Additionally, relatively large parcels which may have development in an area far

from the water's edge were not considered developed. The length and area of developed versus undeveloped shoreline was not calculated.

The database field containing the property description contains a sometimes cryptic descriptive phrase up to 50 characters long. For example, *1stsmGry, wh tr, blk sh, rb chm, dck* means that the property has a small one-story gray house with white trim, black shutters, a red brick chimney, and a deck. There is a key to the abbreviations included at the end of the database. Database fields were created for names of property owners and shoreline address of properties; however, few entries were made. This information can be gathered and added at a later time.

The shoreline was also closely inspected for Cladophora growths by traveling in a small boat as close to the shoreline as possible (usually within 20 feet). The Cladophora growths observed were described by estimating the length (feet) of shoreline covered and the density or amount of available substrate that was utilized. Categories and densities are as follows:

Very Light (VL).....up to 25% coverage
Light (L) ..... 25-49% coverage
Light to Moderate (LM)..... 50-59% coverage
Moderate (M)..... 60-74% coverage
Heavy (H) 75-99% coverage
Very Heavy (VH).....100% coverage

For example, if Cladophora covered half the rocks along a 25 foot length of shoreline, it would be described Mx25.

Although the size of the growth on an individual basis is important in helping to interpret the cause of the growth and the severity of the problem, growth features of Cladophora are greatly influenced by such factors as current patterns, shoreline topography, size and distribution of substrate, and the amount of wave action the shoreline is subject to. Therefore, the description has limited value when making year-to-year comparisons at a single location or estimating the relative amount of shoreline nutrient input. Rather, the presence or absence of any significant growth at a single site over several years is the most valuable comparison. It can reveal the existence of chronic nutrient loading problems, and help interpret the cause of the problems and assess the effectiveness of any remedial actions. Comparisons of the total number of algal growths can reveal trends in nutrient input due to changing land use.

Many species of filamentous green algae are commonly found growing in the near shore regions of lakes. Positive identification of these species usually requires the aid of a microscope. However, Cladophora usually has an appearance and texture that is quite distinct to a trained surveyor, and these were the sole criteria upon which identification was based.

Other species of filamentous green algae can respond to an external nutrient source in much the same way as Cladophora, although their value as an indicator species is not thought to be as reliable. When other species occurred in especially noticeable, large, dense growths, they were recorded on the survey maps and described the same as those of Cladophora.

Among other things, the distribution and size of each Cladophora growth is dependant on the amount of suitable substrate present. The extent of suitable substrate should therefore be taken into account when interpreting the occurrence of individual growths, and assessing the overall distribution of Cladophora along a particular stretch of shoreline. The type of substrate present in front of each property was recorded during the survey. Substrates were broadly grouped into five categories: rocks, rock-sand mixture, sand, muck-sand mixture, and muck.

The preservation or establishment of a shoreline greenbelt (also known as a vegetated buffer strip) is considered one of the most important shoreline management techniques. A greenbelt is a strip of diverse vegetation, either naturally growing or planted, along the shoreline of a lake or stream. It usually consists of a mixture of trees, shrubs, ground cover, and wildflowers. Greenbelts minimize polluted runoff, reduce the need for lawn maintenance (including pesticide and fertilizer applications), remove nutrients from septic systems and other sources, strengthen shoreline soils and help prevent erosion, are attractive, offer privacy and dampen sound, attract wildlife, can help save energy, discourage congregations of waterfowl, and may increase property values. Mowed turf grass usually stands in stark contrast to a diverse, well-functioning greenbelt.

Information on the presence or absence of a shoreline greenbelt was also compiled during this survey. The presence and characteristics of a shoreline greenbelt was described using an index with three basic categories:

> **2.5-3.0 Excellent.** Very little disturbance of the natural vegetation outside the "footprint" of the house, especially along the shoreline (including emergent rushes and other aquatic vegetation). These properties have the appearance of a cottage tucked into the woods, and are often difficult to observe from the water during the growing season. This is the best category, one that property owners should strive to attain to ensure maximum water quality protection and biodiversity.
>
> **2.0-2.49 Good.** Although significant areas of natural vegetation remain, large areas have also been converted to lawn or other uses, especially along the shoreline. Properties in this category are generally doing a good job of managing their shoreline with respect to water quality protection, but there is room for improvement.
>
> **1.0-1.99 Poor.** The shoreline has mostly been converted to an urban setting, with little natural or woody vegetation remaining along the shore. These properties are most likely contributing nutrients from surface runoff and could use improvement.

The presence or absence of accelerated shoreline erosion and its relative severity (slight, moderate, or severe) can be ascertained by the following clues:

- An area of bare soil on a steep, high shoreline bank
- Leaning or downed trees, or trees with exposed roots
- Undercut banks
- Rapid rate of recession (often based on personal knowledge)
- Slumping hunks of sod

- Excessive deposits of sediments
- Muddy water during wavy times

Additional information about the nature of the erosion, such as height and length of bank, whether it occurs at the toe or the top of the bank, type of soils, rate of recession, obvious causes, etc. may be added during future surveys. The Shoreline Inventory Database, which contains a database report with the sequential listing of properties (as well as all the other information described), can be found in *Support Document Two: Stormwater, Agricultural & Shoreline Inventories.*

RESULTS

Douglas Lake: The survey identified approximately 341 property parcels. These included several large parcels, especially the University of Michigan Biological Station (UMBS), which contains approximately 48% of the Douglas Lake shoreline. The UMBS parcel included a large portion of shoreline on the eastern half of the lake as well as the area around Maple Bay and a small parcel of land in the northwest corner in Marl Bay. The properties on Pell's Island were also included in the survey. Also included were three road endings, one of which provides the opportunity for the launching of trailerable boats. Of the total property parcels recorded and excluding the undeveloped parcels of the UMBS, approximately 306 (or 90%) were developed.

Habitat generally considered suitable for Cladophora growth was present at 147 properties (48%). Noticeable growths of Cladophora or other filamentous green algae were found in 54 locations (slightly more than one-third of the properties). Numbers of each type of Cladophora growth are as follows:

Very Light ……17
Light …….....21
Light to Moderate 3
Moderate 10
Moderate to Heavy.....3
Heavy …… 6

Most of the Cladophora growths were associated with developed shoreline properties. Although some of the algae growths are undoubtedly associated with septic system leachate or other factors associated with development and human activities, most of the growths are in the very light or light category and few severe water pollution problems were evident along the Douglas Lake shoreline. However, the cumulative impact of many slight problems can be significant.

The shorelines of approximately 8.5% of developed properties were in the excellent greenbelt category, while 4% were in the good category. Most developed properties (87.5%) were in the poor category.

Accelerated erosion in the form of undercut banks, exposed tree roots, or other obvious indications was present at 108 sites throughout the survey area (or about 31%). Accelerated erosion is mostly due to woody vegetation removal, and was predominantly associated with

developed properties with extensive lawns. The relative severity of the erosion was not determined.

Support Document Two contains a database report with the sequential listing of properties (as well as all the other information described), beginning at the public boat launch at the end of Bryant Road, and traveling clockwise around the entire perimeter of the lake. The Pell's Island properties are included at the end of the survey. Those properties were surveyed beginning in the southwest corner of the island and traveling in a clockwise direction.

Long Lake: The survey identified approximately 179 property parcels. These included several large parcels such as Camp Walden and Pines Resort. Also included were three road endings that provide an opportunity for the launching of trailerable boats. Of the total property parcels, approximately 152 (or 85%) were developed.

Habitat generally considered suitable for Cladophora growth was present at 135 properties (89%). Noticeable growths of Cladophora or other filamentous green algae were found in 49 locations (about one-third of the properties). Numbers of each type of Cladophora growth are as follows:

Very Light …….12
Light ……...19
Light to Moderate 7
Moderate 16
Moderate to Heavy.....2
Heavy ……...3

Most of the Cladophora growths were associated with developed shoreline properties. Although some of the algae growths are undoubtedly associated with septic system leachate or other factors associated with development and human activities, most of the growths are in the light to moderate category with few severe water pollution problems evident along the shoreline of Long Lake. However, the cumulative impact of many slight problems can be significant.

The shorelines of approximately 4.5% of properties were in the excellent greenbelt category, while 7% were in the good category. Most properties (88.5%) were in the poor category.

Accelerated erosion in the form of undercut banks, exposed tree roots, or other obvious indications was present at 48 sites throughout the survey area (or about 24%). Accelerated erosion is mostly due to woody vegetation removal, and was predominantly associated with developed properties with extensive lawns. The relative severity of the erosion was not determined.

Support Document Two contains a database report with the sequential listing of properties (as well as all the other information described) beginning at the public boat launch on Manning Road, and traveling counter-clockwise around the entire perimeter of the lake.

Munro Lake: The survey identified approximately 111 property parcels. These included several large parcels such as the Mackinac State Forest in the northwest area of the lake. Also included was one road ending at Brandau Road and one public boat launch that provide an opportunity for the launching of trailerable boats. Of the total property parcels, approximately 89 (or 80%) were developed.

Habitat generally considered suitable for Cladophora growth was present at 56 properties (50%). Noticeable growths of Cladophora or other filamentous green algae were found in 16 locations (about 29% of those properties). Numbers of each type of Cladophora growth are as follows:

Very Light.....0
Light 4
Light to Moderate 0
Moderate 11
Moderate to Heavy.....2
Heavy 1

Most of the Cladophora growths were associated with developed shoreline properties. Although some of the algae growths are undoubtedly associated with septic system leachate or other factors associated with development and human activities, most of the growths are in the moderate category with very few severe water pollution problems evident along the shoreline of Munro Lake. However, the cumulative impact of many slight problems can be significant. The fact that more than 70% of the properties with suitable substrate for Cladophora growth did not have any algae present was a great indication that the lake had very little pollution.

The shorelines of approximately 1% of properties were in the excellent greenbelt category, while 10% were in the good category. Most properties (89%) were in the poor category.

Accelerated erosion in the form of undercut banks, exposed tree roots, or other obvious indications was present at 41 sites throughout the survey area (or about 38%). Accelerated erosion is mostly due to woody vegetation removal, and was predominantly associated with developed properties with extensive lawns. The relative severity of the erosion was not determined.

Support Document Two contains a database report with the sequential listing of properties (as well as all the other information described) beginning at the Brandau Road end, and traveling clockwise around the entire perimeter of the lake.

Twin Lakes: The survey identified approximately 144 property parcels. These included several large parcels such as the Mackinaw State Forest in the southwest area of the lake. Also included was one road ending at Page Road that provides an opportunity for the launching of trailerable boats. Of the total property parcels, approximately 115 (or 78%) were developed.

Habitat generally considered suitable for Cladophora growth was present at 10 properties (7%). Noticeable growths of Cladophora were not found in any locations. There was a plume of

filamentous algae off-shore of an undeveloped area. The algal growth could have been a result of the predominant winds coming across the lake to this bay.

The shorelines of approximately 43% of properties were in the excellent greenbelt category, while 20% were in the good category. Thirty-seven percent were in the poor category.

Accelerated erosion in the form of undercut banks, exposed tree roots, or other obvious indications was present at 22 sites throughout the survey area (or about 15%). Accelerated erosion is mostly due to woody vegetation removal, and was predominantly associated with developed properties with extensive lawns. The relative severity of the erosion was not determined.

Support Document Two contains a database report with the sequential listing of properties (as well as all the other information described) beginning at the Page Road end, and traveling clockwise around the entire perimeter of the lake. All basins of Twin Lakes are in this survey with the exception of the basin east of Krouse Road.

Road/Stream Crossing Inventory

A road/stream crossing site exists wherever a road or street and a stream intersect. Road/stream crossings can be major contributors of sediments and other pollutants to the water system. Dirt and gravel from shoulders of the roads, or from unpaved roads, can be washed into a stream. The resulting build up of sediments in the stream is called *sedimentation*. Although sediments entering waterbodies is a natural process, excess amounts can wreak havoc on the aquatic environment. Some detrimental effects of sedimentation are:

- Destruction of aquatic habitat and the extermination of aquatic wildlife
- Negative impacts on birds and mammals dependent on the aquatic environment
- Restriction of plant productivity due to reduction of sunlight penetration
- Warming of waters, which can lead to destruction of coldwater fisheries
- Release of nutrients into the water system, causing the stimulation of algae growth
- Introduction into the water body of harmful pesticides, toxic metals, and bacteria which may adhere to the grains of sediment
- Disruption of the fish life cycle by affecting their ability to feed, spawn, and inhibiting gill function
- Reduction of width and depth of the stream channel, and the potential increase in flooding events

The amount of sedimentation experienced by a waterbody depends on several factors, such as the length and slope of the approaches, steepness of the embankment, whether or not the road is paved, the amount of vegetative cover along shoulders and ditches at the site, and the runoff path. These factors need to be taken into consideration in the development of any plan proposed to reduce the rate of sedimentation at road/stream crossings.

METHODOLOGY

The road/stream crossing inventory was conducted in the spring and summer months of 2002 by Northeast Michigan Council of Governments (NEMCOG) staff. Using topographical and county road maps, possible road/stream crossings were located and each site was visited. At each site photographs were taken of upstream, downstream, and left and right approaches. Physical condition and measurements of the culvert, the roadway, the length and slope of approach, road width and surface type, stream depth and current, amounts and causes of erosion, and extent of vegetation were recorded. Using the data collected, each site was assigned a ranking of minor, moderate or severe based on the point system found on the severity-ranking sheet. Sample inventory sheets and ranking sheets are included in **Appendices D** and **E**, respectively.

Pollutant Loading Estimates

The total sediment loading was calculated for each road/stream crossing site identified within the watershed. Two equations were used to determine the total sediment loading. First, the Revised Universal Soil Loss Equation (RUSLE) was used to calculate the sediment load for each approach.

$$A = R * K * LS * C * P$$

A = average annual soil loss in tons/acre
R = rainfall-runoff erosivity factor
K = soil erodibility factor
LS = slope factor
C = cover management factor
P = support practice factor

The cover management factor for paved roads is 0.12 and for unpaved roads is 1. The second equation was the Channel Erosion Equation (CEE). The CEE was used to calculate the sediment load of each embankment.

$$CEE = \text{Length (ft)} * \text{Height (ft)} * \text{LRR (ft/year)} * \text{Soil Weight (ton/ft}^3\text{)}$$

The Lateral Recession Rate (LRR) is the thickness of soil eroded from the bank surface (perpendicular to the face) in an average year. For this application, the LRR was estimated by judging the severity of the erosion on each embankment. The following values were used for

LRR: Slight = .02, Moderate = .14, Severe = .4 and Very Severe = .5. The total from each equation, the RUSLE and the CEE, was added together for a total sediment loading estimate per site.

The total sediment load for each road/stream crossing was used to calculate the estimated amount of attached phosphorus and nitrogen which are discharged into the water body each year. This process uses information collected by USDA-ARS researchers and starts with a phosphorus concentration of 0.0005 lbP/lb of soil and a nitrogen concentration of 0.001 lbN/lb of soil. The following equations were used to calculate the nutrient loading:

$$\text{Phosphorus Loading} = \text{Sediment Load (ton/yr)} * 0.0005 \text{ (lbs P/lb soil)} * 2000 \text{ (lbs/ton)} * \text{soil correction factor}$$

$$\text{Nitrogen Loading} = \text{Sediment Load (ton/yr)} * 0.001 \text{ (lbs N/lb soil)} * 2000 \text{ (lbs/ton)} * \text{soil correction factor}$$

Soil texture is determined and a correction factor is used to better estimate nutrient holding capacity of the soil (MDEQ, 1999). The predominant soil texture for road/stream crossings was sand so a soil correction factor of 0.85 was used.

Pollutant Reduction Estimates

The sediment reduction estimates for the approaches were calculated using the RUSLE. The recommended BMP is to pave both approaches, which lowers the cover management factor to 0.12. The sediment reduction estimates for the embankments were made using the same approach as with the streambank erosion sites. Installation of vegetative buffers will reduce approximately 75% of sediment loading into a river system. Sediment reduction estimates were calculated using a value of 0.75 for the BMP efficiency. The sediment reduction estimates from both methods were added together to get a total sediment reduction estimate.

Because the nutrient load estimates are based on the total sediment loading, the load reduction estimates for phosphorus and nitrogen are based on the amount of sediment reduction.

$$\text{Phosphorus Reduction} = \text{Sediment Reduction (ton/yr)} * 0.0005 \text{ (lbs P/lb soil)} * 2000 \text{ (lbs/ton)} * \text{soil correction factor}$$

$$\text{Nitrogen Reduction} = \text{Sediment Reduction (ton/yr)} * 0.001 \text{ (lbs N/lb soil)} * 2000 \text{ (lbs/ton)} * \text{soil correction factor}$$

RESULTS

A total of 194 road/stream crossing sites were inventoried for the Cheboygan River/Lower Black River Watershed (See **Map 9**). The sites were ranked as *Minor, Moderate* or *Severe* contributors of sediments to the river system. Nineteen sites were ranked *Minor,* all of which were located in Cheboygan County. Of the 159 *Moderate* sites inventoried, 124 were located in Cheboygan County and 35 were found in Emmet County. Sixteen of the watershed's road/stream crossings ranked *Severe*. Twelve of the severe sites were found in Cheboygan County, mainly in Inverness

and Munro Townships. Of the four severe sites found in Emmet County, two were found in McKinley Township, one in Carp Lake Township, and one in Center Township.

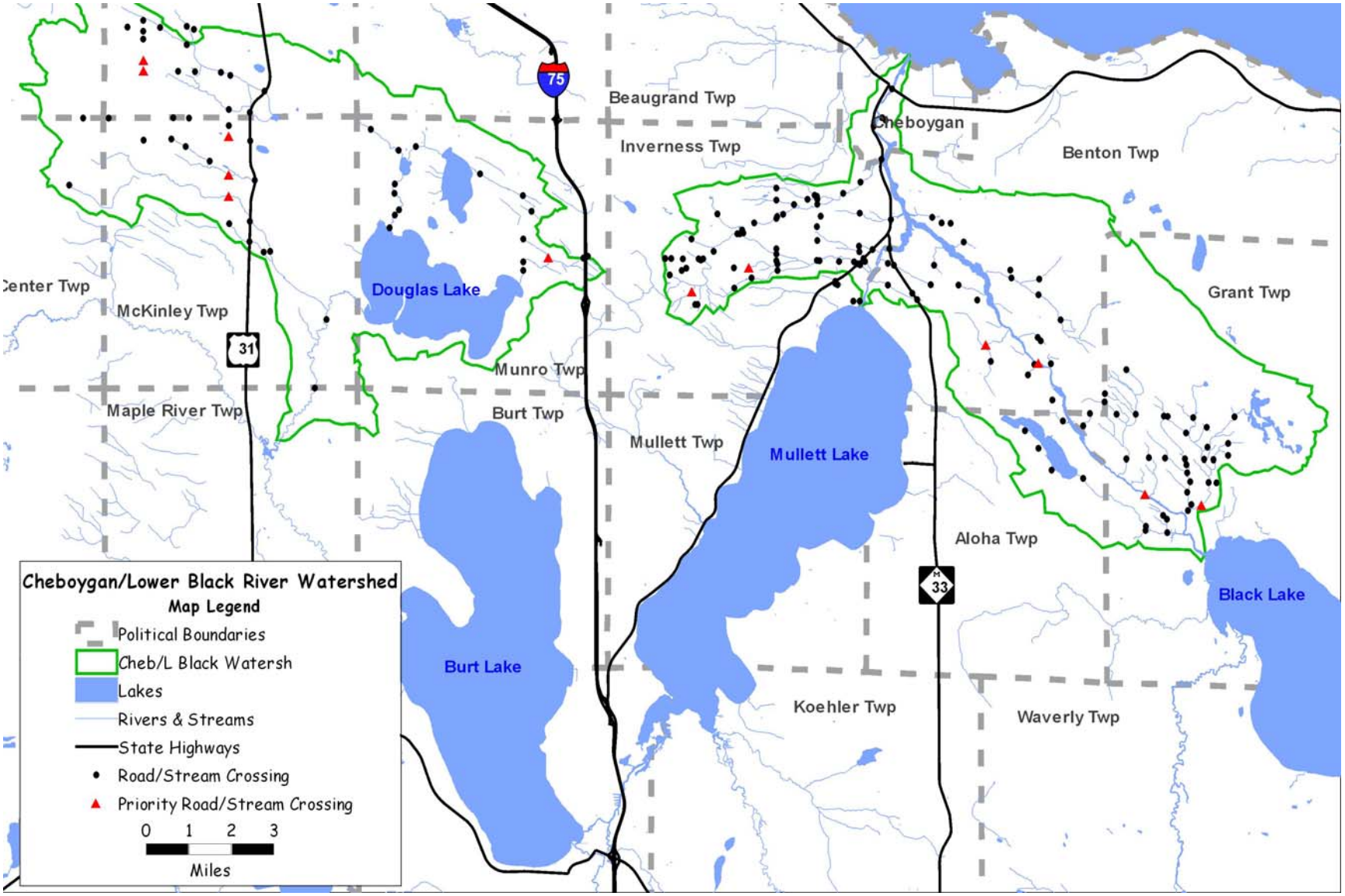
Using the methods stated above, the total pollutant loadings for all identified road/stream crossings were calculated. Road/stream crossings are contributing approximately 671 tons/year of sediment, 570 lbs/year Phosphorus and 1,140 lbs/year of Nitrogen. Twelve sites were identified as priorities for implementation of Best Management Practices. The sites were chosen based on the amount of sediment they contribute to the river system. **Table 6-3** lists the selected road/stream crossings and their estimated pollutant loads and reductions. When implementing BMPs, priority should be give to the sites listed in **Table 6-3** as they are contributing the largest amounts of sediment to the river system. Improvement at these twelve sites, just 6% of the identified sites, would result in a 52% reduction in sediment and nutrient loading from road/stream crossings.

Table 6-3:
Selected Road/Stream Crossing Pollutant Loading & Estimated Reductions

Site ID	Sediment (tons/year)		Phosphorus (lbs/year)		Nitrogen (lbs/year)	
	Current Load	Estimated Reduction	Current Load	Estimated Reduction	Current Load	Estimated Reduction
008	13.01	11.45	11.06	9.73	22.12	19.46
013	38.16	33.53	32.44	28.50	64.88	57.00
074	29.83	25.82	25.35	21.95	50.70	43.89
094	10.14	6.93	8.62	5.89	17.24	11.78
119	17.03	11.55	14.47	9.82	28.95	19.64
134	15.27	13.40	12.98	11.39	25.96	22.79
139	13.43	11.78	11.41	10.02	22.83	20.03
171	42.34	37.24	35.99	31.66	71.97	63.32
172	27.94	24.52	23.75	20.84	47.50	41.69
173	46.64	41.01	39.64	34.86	79.28	69.73
182	52.34	46.02	44.49	39.12	88.97	78.24
183	98.17	86.38	83.45	73.42	166.89	146.84
Total	**404.29**	**349.64**	**343.65**	**297.19**	**687.29**	**594.39**

Detailed site descriptions, and maps of road/stream crossing sites by township can be found in *Support Document One: Streambank Erosion and Road/Stream Crossing Inventories.*

Map 9 Road/Stream Crossing Inventory



Agriculture Inventory

The welfare of fish and wildlife depends on the availability of habitat. Habitat consists of food, shelter, and water, which is essential to survival of all current species. Public concern grows for conservation as observations of the decline of fish and wildlife of the Cheboygan River watershed are noticed. A decline in water quality, habitat and other ecological factors threaten the region's fish and wildlife populations. Problems such as these can be attributed partially to the direct consequences of extensive land use by farmers for agricultural purposes. Public desires to protect the lands from extensive farming have been expressed through legislature, such as the Clean Water Act, the Endangered Species Act and the Farm Bill.

Sediment is often one of the most significant sources of pollution in a watershed. Wind and water flowing across the land allows sediment to detach and provides transportation of sediment into a watershed, causing a loss of topsoil to the farmer and adding excess sediment to a lake, stream, or river. The loss of topsoil is usually countered by the addition of nutrients into the soil, leading to an excess of nutrients that disturb the natural balance of an ecosystem around a watershed as the nutrients collect in the water.

Animal manure also contributes to an excess of nutrients that is easily transported by water and concentrated into lakes and streams, disturbing the sensitive ecosystem of fish and wildlife while at the same time creating the loss of valuable habitat. Excesses of nutrients can affect the quality of drinking water, aquatic habitat, and recreational quality of watercourses.

Nonpoint source pollution is a serious issue, but one which can be brought under control with proper management of our land and resources. The use of BMPs is cost effective in the long run and benefits all wildlife as well as humans. Farmers can produce better yields while humans and wildlife enjoy the quality of a well-maintained watershed. Potentially the state could collect more fees from hunting and fishing licenses, and land values for property owners could increase. A healthy fish and wildlife population can result from the understanding and correction of current and potential nonpoint source pollution.

METHODOLOGY

The Cheboygan County Conservation District (CCCD) and the US Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) conducted the Agricultural Inventory. Agricultural sites were identified using a variety of maps, including aerial photos and plat maps. Utilizing the skills of USDA-NRCS personnel, high priority agricultural sites were identified. Field inventories were conducted by roadside observations. Each agricultural site was evaluated on an Agricultural Inventory Field Data Form, shown in **Appendix F**. The sites were also photographed and a combined form with photos, field data, BMPs, and estimated costs are available in a separate document, *Support Document Two: Stormwater, Agricultural & Shoreline Inventories.* A map of agricultural sites inventoried was developed and is also included with this document.

RESULTS

Two counties, Cheboygan and Emmet, were surveyed for agricultural causes of nonpoint source pollution in the Cheboygan River/Lower Black River Watershed. For the purpose of this inventory, the watershed was divided into three sub-watersheds: Black River; Cheboygan River; and Douglas Lake. For each sub-watershed, the location and any associated nonpoint source pollution problems were documented for agricultural producers in the watershed. See **Table 6-4** below for a summary of the inventory by sub-watershed. **Table 6-5** shows sources of pollution, recommended practices, and pollutant loads for each township in the watershed.

Table 6-4: Agricultural Sites by Sub-Watershed

Sub-Watershed	Total Sites	Minor	Moderate	Severe	Total Cost
Black River	53	25 (47%)	25 (47%)	3 (6%)	$1, 689,800
Cheboygan River	50	34 (68%)	13 (26%)	3 (6%)	$494,400
Douglas Lake	74	52 (70%)	21 (28%)	1 (1%)	$645,200
Total Watershed	**177**	**111 (63%)**	**59 (33%)**	**7 (4%)**	**$2,829,400**

Table 6-5: Pollutant loads from Agriculture Sources

Township	Pollutant Source	Management Practice	Soil Tons/year	P lbs./year	N lbs./year
Benton Township	Approximately 400 acres of cropland, 3 Livestock feed lots, (Approximately 200 cattle)	Exclusion Fencing Buffer Strips Stream Crossings Waste facility	326	137	173
Grant Township	4 Livestock feed lots (approximately 268 cattle, 465 acres of cropland)	Exclusion Fencing Buffer Strips Stream Crossings Waste facility	436	184	232
Inverness Township	270 acres cropland, 8 Livestock feed lots (approximately 536 cattle/bison,)	Exclusion Fencing Buffer Strips Stream Crossings Waste facility Watering facility	872	368	464
Munro Township	Approximately 190 acres cropland, 1 livestock feedlot (approximately 100 cattle)	Exclusion fencing, erosion control, manure storage, buffers	109	46	58
McKinley Township	Approximately 113 acres cropland, 1 livestock feedlot (approximately 70 cattle)	Watering facility, stream crossing, grazing, exclusion fencing, buffers	109	46	58
Carp Lake Township	Approximately 478 acres cropland, 6 livestock feedlots (Approximately 400 cattle)	Exclusion fencing, buffers, manure storage	650	276	348
Totals	Approximately 1,916 acres of cropland, 23 feed lots, with about 1,574 cattle/bison		**2,393**	**1,057**	**1,333**

Table 6-6 lists agricultural sites by township and severity ranking, and includes cost estimations for each township. For a more detailed list of agricultural sites and cost estimations, see the Agricultural Inventory Table in **Appendix G**. A total of 177 agricultural sites were identified and inventoried in fall 2002 through spring 2003.

Table 6-6: Summary of Agricultural Inventory and Estimated Costs			
MINOR SITES	Township	Number of Sites	Cost
Cheboygan County	Aloha	1	$1,500
	Benton	14	$537,800
	Grant	13	$17,400
	Inverness	32	$65,200
	Munro	16	$16,000
Emmet County	Bliss	7	$7,000
	Carp Lake	10	$10,000
	Center	5	$5,000
	Maple River	4	$4,000
	McKinley	10	$10,000
Cheboygan Totals		75	$637,900
Emmet Totals		36	$36,000
Total Minor Sites Inventoried		**111**	**$673,900**
MODERATE SITES	Township	Number of Sites	Cost
Cheboygan County	Benton	13	$165,000
	Grant	13	$287,300
	Inverness	12	$177,000
	Munro	9	$99,200
Emmet County	Bliss	2	$24,000
	Carp Lake	7	$84,000
	Center	1	$12,000
	McKinley	2	$24,000
Cheboygan Totals		47	$728,500
Emmet Totals		12	$144,000
Total Moderate Sites Inventoried		**59**	**$872,500**
SEVERE SITES	Township	Number of Sites	Cost
Cheboygan County	Benton	2	$470,000
	Grant	2	$350,000
	Inverness	2	$113,000
	Munro	1	$350,000
Cheboygan Totals		7	$1,283,000
Emmet Totals		0	$0
Total Severe Sites Inventoried		**7**	**$1,283,000**
Total Sites Inventoried:		**177**	**$2,829,400**

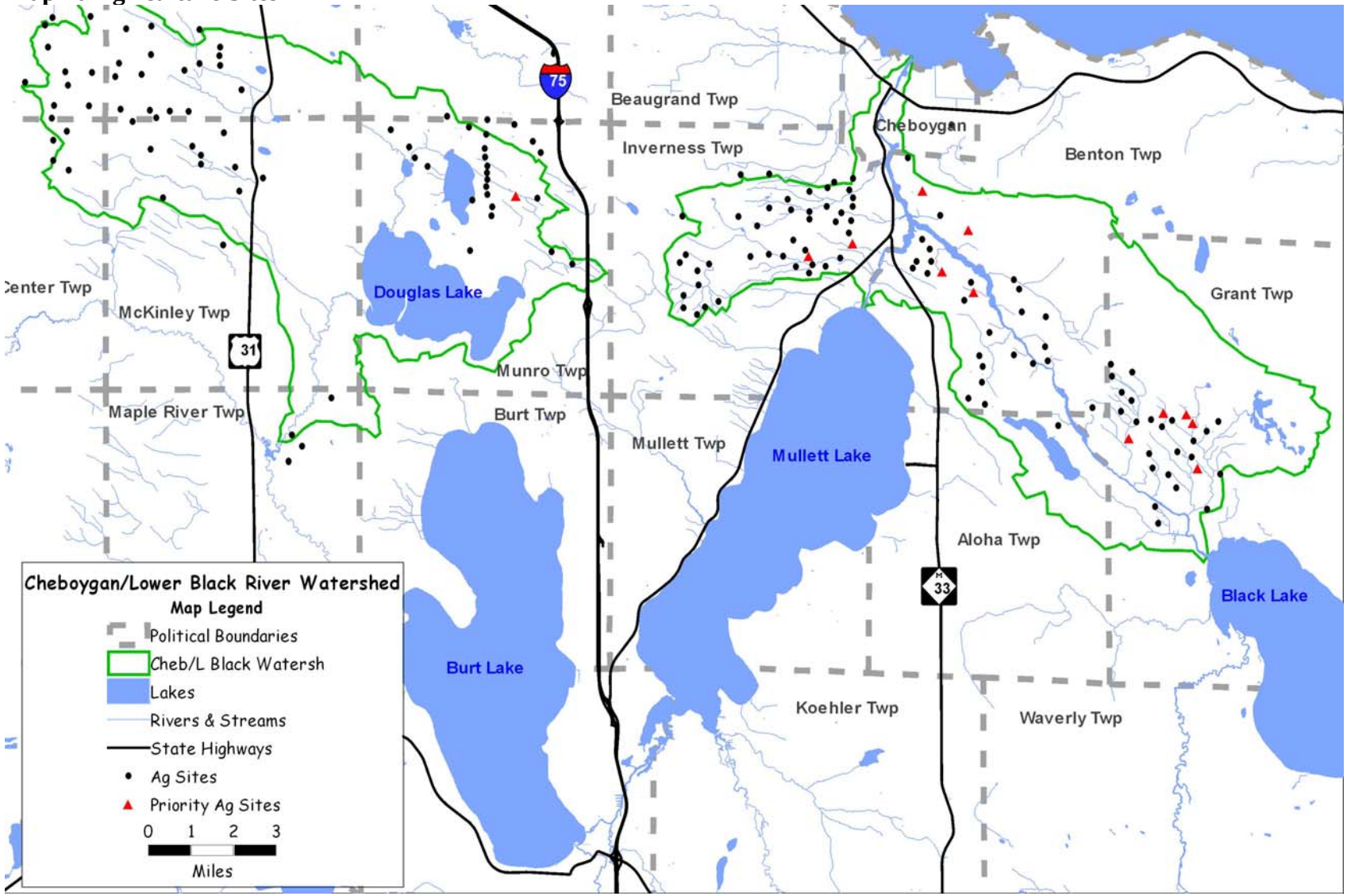
SUMMARY

Agricultural lands constitute a significant portion of the watershed total acreage (17.4%). All of the agricultural sites inventoried for the NPS Management Plan have a water feature on site. Definitive data on most of the agriculture sites is unavailable, but loads from the stream portion of each site have been calculated. Pollutants derived from other portions of the site are at least as serious if not more so than the area directly adjacent to the stream. **Table 6-7** describes the pollutant load reductions, along with the recommended treatment for agricultural operations of concern in the watershed. **Table 6-8** shows pollutant reduction estimates by type of land use.

Table 6-7: Agriculture Load Reductions for Livestock Feedlots											
Township	**Practice**	**Contributing Area (acres)**	**Load before BMP**			**Load Reduction**			**Load after Bmp**		
			Soil (T/yr)	**P (Lbs/yr)**	**N (Lbs/yr)**	**Soil (T/yr)**	**P (Lbs/yr)**	**N (Lbs/yr)**	**Soil (T/yr)**	**P (Lbs/yr)**	**N (Lbs/yr)**
Benton	Waste Storage	3	8	126	606	N/A	76	394	8	50	212
	Filter Strips	3	8	126	606	3	107	N/A	5	19	606
Grant	Waste Storage	4	11	183	1,671	N/A	110	1,086	11	73	585
	Filter Strips	4	11	183	1,671	7	155	N/A	4	28	N/A
Inverness	Waste Storage	8	23	358	2,697	N/A	215	1,753	23	143	944
	Filter Strips	8	23	358	2,697	14	304	N/A	9	54	N/A
Munro	Waste Storage	1	3	55	257	N/A	33	167	3	22	90
	Filter Strips	1	3	55	257	2	47	N/A	1	8	N/A
McKinley	Waste Storage	1	3	54	418	N/A	32	272	3	22	146
	Filter Strips	1	3	54	418	2	46	N/A	1	8	N/A
Carp Lake	Waste Storage	6	17	263	1,897	N/A	158	1,233	17	105	664
	Filter Strips	6	17	263	1,897	10	223	N/A	7	40	N/A

Table 6-8: Watershed Total Agriculture Load Reductions by Land Use										
Land Use	**Contributing Area (acres)**	**Load before BMPs**			**Load Reduction**			**Load after BMPs**		
		Soil (T/yr)	**P (Lbs/yr)**	**N (Lbs/yr)**	**Soil (T/yr)**	**P (Lbs/yr)**	**N (Lbs/yr)**	**Soil (T/yr)**	**P (Lbs/yr)**	**N (Lbs/yr)**
Feedlots	23	65	1,039	7,546	38	1,039	4,905	27	0	2,641
Cropland/Pasture	192	542	975	1,689	542	975	1,689	0	0	0
Total	**215**	**607**	**2,014**	**9,235**	**580**	**2,014**	**6,594**	**27**	**0**	**0**

Map 10 Agriculture Sites



Stormwater Inventory

All substances that find their way onto impervious surfaces (streets, roofs, sidewalks, etc.) are likely to be washed into nearby waterbodies by rainfall or snowmelt, especially when streets are curbed, guttered, and drained by roadside ditches or underground pipes. Phosphorus and sediment are two of the most serious pollutants, but storm sewers also contribute many other pollutants such as oil, salt, bacteria, trash, and other potentially toxic substances. Direct discharge of these pollutants to a water body can create very serious (and expensive) problems. Runoff from storm events, runoff at base flow (the normal discharge/flow at the stream during particular times of the year), and the spill potential within such a system all pose challenges for water resource management.

Increased development creates more impermeable surfaces, thus leading to more runoff. Theoretically, any type of development on a site will increase the amount of runoff, as well as its velocity and pollutant concentration. A small development on a large tract of land will generally result in an insignificant increase in runoff, unless it is adjacent to a water body or linked by a storm sewer.

Management of stormwater runoff in urban areas has become an important aspect of water resource protection. Basically, the goal is to preserve or restore pre-development hydrologic characteristics through a variety of techniques – including minimizing impervious surfaces, preserving open or green space, detention of runoff, infiltration trenches, water quality treatment basins, and "Low Impact Design Techniques".

As part of the Lower Cheboygan Watershed Project, staff from Tip of the Mitt Watershed Council and Huron Pines Resource Conservation & Development Council (Huron Pines RC&D) conducted an assessment of the storm sewer impacts from the single large urban area located on the Cheboygan River – the City of Cheboygan. The findings are summarized in **Table 6-9.**

METHODOLOGY

To better understand the potential impacts of stormwater runoff on the Lower Cheboygan River, an inventory and assessment of the storm sewer system in the City of Cheboygan was conducted in the Fall of 2002, with follow-up research conducted in the Winter of 2003. The assessment consisted of identifying the land uses (e.g., commercial/industrial, residential, undeveloped/open land) within the City boundaries, reviewing maps of the City storm sewer system, delineating drainage areas, identifying locations of stormwater outfalls, and estimating pollutant loading using models developed in nationwide studies. Water sampling and testing were not conducted during this inventory assessment. To estimate the amount of pollutants from stormwater runoff a common model called the "Simple Method" was used. Developed by Schueler in 1987, this method estimates stormwater pollutant loads as the product of mean concentrations and runoff depths over a one-year period.

The Simple Method estimates stormwater pollutant loads based on various levels of development and rainfall. Storm pollutant exports from a developed area can be determined by solving the equation:

$$L=\{(P)(Pj)(Rv)/12\}(C)(A)(2.72)$$

Where L=Annual load (pounds)
P=Rainfall depth (inches)
Pj=factor that corrects P for storms that produce no runoff (.9)
Rv=Runoff coefficient
C=Mean concentration of the pollutant in urban runoff
A=Area in acres
The Rv for a site depends on the nature of soils, topography, and cover. However, the primary influence of the runoff coefficient is the degree of imperviousness in the drainage zone.
Rv=0.05+0.009(I) where I=the percent of site imperviousness

The City also has stormwater runoff that enters Cemetery Creek, Little Black River, and Smith's Creek (all within City limits), although these runoff amounts are much smaller in scale than the discharges to the Cheboygan River, and all are outside of the Lower Cheboygan Watershed and beyond the scope of this report. A map of the discharge area directly to the Cheboygan River is provided in *Support Document Two: Stormwater, Agricultural & Shoreline Inventories.*

RESULTS
Water quality studies conducted by the Watershed Council have documented that the pollution and water quality impacts of storm sewer effluent from other Northern Michigan communities is similar to the predictive model.

Table 6-9: City of Cheboygan Storm Sewer Summary	
Area of city (acres)	4428
Area of city draining to river via storm sewers	1087
Percent of city draining to river via storm sewers	25%
Number of stormwater outfalls inventoried	46
Drains managed as part of the city system	29
Drains from commercial development	17*
Land use within the city's direct discharge zone	
Undeveloped or open land	16%
Commercial/industrial	26%
Residential	58%
Estimated pollution contributions from storm sewers**	
Phosphorus	900 lb.
Sediment	275 Tons

*This is the actual number inventoried. It is likely there are several more.
**Annual storm events only – not base flow

Results of the studies indicate that there are 46 stormwater outfalls discharging directly to the Cheboygan River (see **Table 6-9**). Twenty-nine of these are part of the City's storm sewer system. Seventeen outfalls were identified as commercial/industrial, indicating that the stormwater from the commercial development along the waterfront (which is not part of the City's system) drains to the Cheboygan River. The seventeen identified privately-owned outfalls typically drained parking areas adjacent to the Cheboygan River. It is likely that there are more of these outfalls than were discovered through the inventory process.

All 46 of these outfalls, and their respective estimated drainage areas, are shown on **Map 11. Table 6-10** below, shows the approximate amount of acreage for each drainage zone, the size of outfall pipe, annual runoff, percent imperviousness, type of land-use, and annual pounds of phosphorous and sediment. As the estimates reveal in **Table 6-10**, a large amount of pollution is presently occurring due to the combined effects of stormwater and storm sewers draining into the lower Cheboygan River.

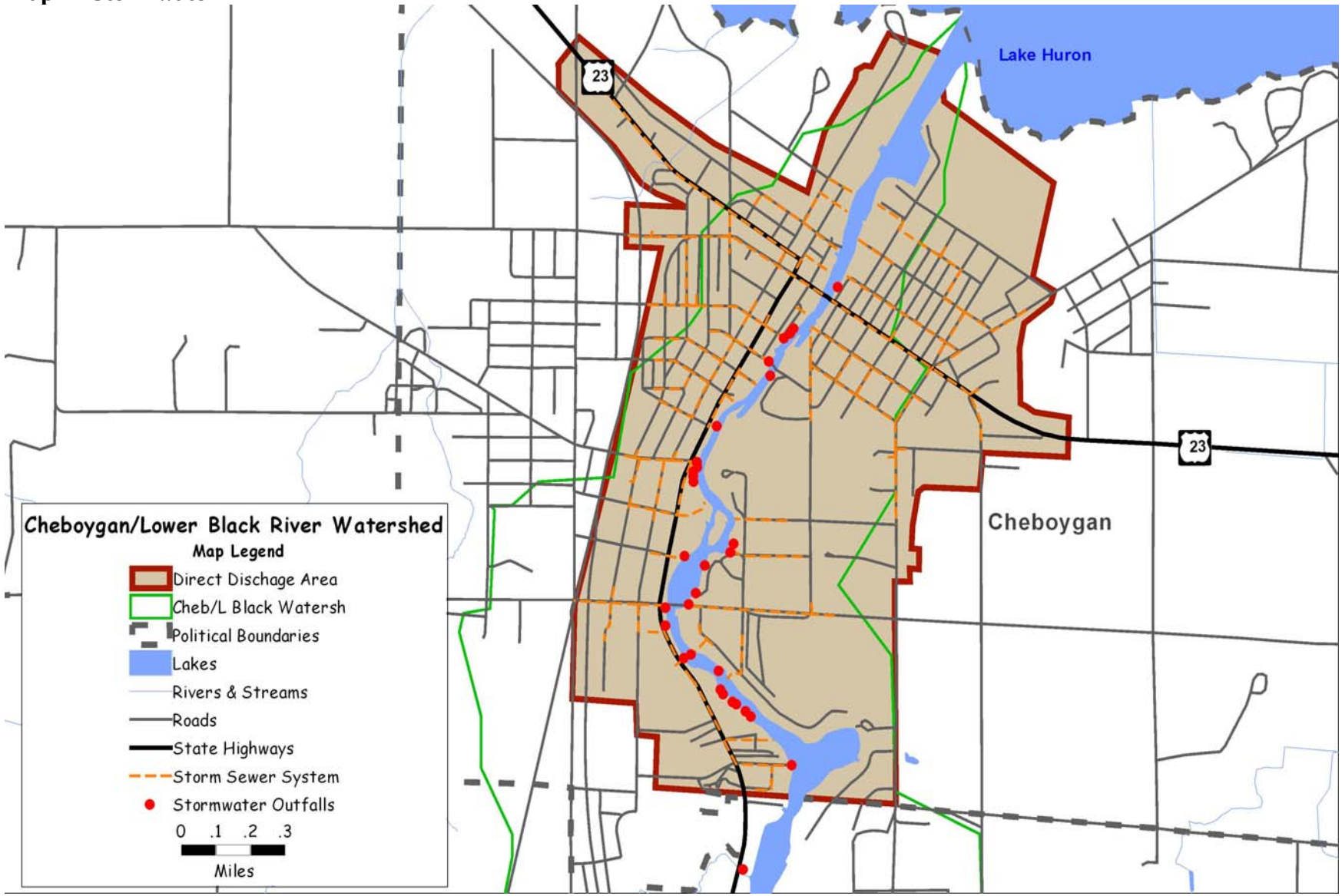
At this time, recommended management practices for the individual stormwater outfall sites within the City of Cheboygan have not been developed. **Table 6-11** lists a few of the available urban stormwater management techniques, and the potential pollutant reductions that will likely occur following implementation. Load reductions are calculated from information found on the American Society of Civil Engineers (ASCE) Database. **Table 6-12** shows the volume of runoff in the City by land use.

Table 6-10: Watershed Urban Stormwater Outfall Data							
Site #	**Drainage Area (acres)**	**Outfall Size (inches)**	**Type of Land Use**	**% Impervious**	**Runoff Volume (Gal/year)**	**Nutrients (Lbs/yr.)**	**Sediment (T/yr.)**
5	31	24	Residential/ Commercial	50	10,106,000	39	5
6	5	12	Residential	90	1,141,000	4	1
7-12	6	5-12	Commercial/ Residential	90	3,912,000	15	21
13	5	24	Residential	30	1,141,000	4	1
14	6	12	Residential	30	1,369,200	5	1
15	17	18	Commercial/ Industrial	90	11,084,000	42.5	60
16	15	36	Commercial/ Industrial	90	9,780,000	37.5	5
17	130	36	Residential	30	29,666,000	114	16
18	30	28	Residential	30	6,846,000	26	37
19-20	9	12, 18	Commercial/ Industrial	90	5,868,000	22.5	32
21-22	18	6, 12	Commercial/ Industrial	90	11,736,000	45	6
23	7	18	Residential	30	1,597,400	6	1
24	6	12	Residential	30	1,369,200	5	1
25	22	36	Commercial/ Industrial	90	1,434,400	55	8
26-29	.3	8	Commercial/ Industrial	90	195,600	.8	0.11
30	12	48	Commercial/ Residential	50	4,694,400	18	3
31	10	24	Residential	30	2,282,000	9	12
32	3	18	Commercial/ Industrial	90	1,956,000	75	2
33	2	18	Commercial/ Industrial	90	1,304,000	5	1
34	.5	12	Open	10	48,900	.2	0
35	48	36	Residential	30	10,953,600	42	6
36	34	8	Residential/ Commercial	50	13,300,800	51	7
37-38	1	12, 8	Commercial	90	652,000	2.5	0.4
39	99	36	Residential	30	22,591,800	87	12
40	3	15	Commercial	90	1,956,000	7.5	2
41	35	36	Residential/ Commercial	50	13,692,000	53	7
42	39	21	Residential	30	8,899,800	34	5
43	1	12	Residential	30	228,200	0.9	.12
44	71	48	Residential	30	16,202,200	62	9
45	19	21	Residential	30	4,335,800	17	2
46	1	15	Residential	30	228,200	.9	0.12
47	11	15	Commercial	30	2,510,200	10	2
48	5	18	Commercial/ Industrial	90	3,260,000	13	2
49	56	42	Residential	30	12,779,200	49	7
50	4	21	Commercial/ Industrial	90	2,608,000	10	2

Table 6-11: Potential Urban Stormwater Pollutant Load Reductions						
BMP	Solids (Tons/year)			Nutrients (Lbs./year)		
	Before BMP	Reduction	After BMP	Before BMP	Reduction	After BMP
Drain Inlet Insert	246	25	221	823	41	782
Extended Detention Basin	246	185	61	823	206	617
Vegetated Swales	246	172	74	823	247	576
Filter Strips	246	209	37	823	329	494
Media Filters	246	209	37	823	329	494

Table 6-12: Stormwater Runoff by Land Use				
Type of Land Use	Drainage Area (acres)	Runoff Volume (Gal/year)	Nutrients (Lbs/yr.)	Sediment (T/yr.)
Commercial	15	5,118,200	20	4
Residential/Commercial	118	3,2013,200	176	43
Commercial/Industrial	95	49,226,000	306	115
Residential	1,033	151,068,400	466	111
Open Space	0.5	48,900	0.2	0

Map 11 Stormwater



Septic System Inventory

The health of a watershed can be influenced by the state of the septic and sewer systems within its boundaries. When a septic system malfunctions or overflows, bacteria and nutrients are released and may contaminate the lakes, streams or groundwater of the watershed. Poorly installed or improperly sited systems and older systems that were installed prior to the adoption of current zoning ordinances are potential contributors of this type of non-point pollution. Another potential problem for the watershed is seasonal homes that are converted for year round use without updating and expanding existing systems. The increased load may cause a septic system failure and as a result, contaminate area wells and waterbodies.

METHODOLOGY

An inventory of septic systems within the Cheboygan River/Lower Black River Watershed was conducted by NEMCOG in the spring of 2003. Information on septic systems was compiled using data obtained from various sources such as the Emmet County Health Department, the Cheboygan County Health Department, U.S. Bureau of Census, The Environmental Protection Agency, and the Department of Environmental Quality. By comparing data from these various sources and **Map 5: Septic System Soil Constraints,** it was possible to discern generally which areas have the oldest systems, which are being heavily developed, and areas that are most susceptible to septic problems and therefore least suitable for increased development.

RESULTS

Nearly the entire watershed is under severe constraints for septic systems. The cause for severity varies from section to section, and even from parcel to parcel. In the western portion of the watershed, particularly in Carp Lake and McKinley Townships, constraints are due mainly to large areas covered by hydric soils. Hydric soils are saturated for most of the year, and when soils are too wet, oxygen is not available for organisms that break down waste. Septic systems constructed in hydric soils therefore may not operate properly during wet seasons, resulting in groundwater contamination.

Hydric soils and areas of wetness also impact the effectiveness of septic systems in the eastern half of the watershed. In addition, much of this area is covered by sandy soils, which are poor filtering agents. These soils are mainly located in Grant and Benton Townships on Mackinaw State Forest land where development is not an issue. Several severe septic system constraints exist in Inverness Township. Along with areas of sandy soils, the Township has several sections adjacent to the Cheboygan River where severe constraints are due to wetness (see **Map 4**). These sections have seen steady development over the last thirty years. In addition, **Table 6-13** Shows that the Township has a substantial number of homes that were built prior to 1970, before current zoning ordinances were in place. Continued development combined with a large number of older systems creates a potential risk to the future health of the watershed.

Munro Township in Cheboygan County is another area that bears watching. This Township also has a large number of septic systems that were installed prior to 1970. While development has been light in much of the Township, some areas such as Section 9 adjacent to Munro Lake, and Sections 17 and 18 adjacent to Douglas Lake have seen substantial growth. Here again, the combination of older systems, heavy development, hydric soils and poor filter material create a potential problem for the watershed.

Table 6-13: Septic System Inventory			
Township	**Total Septic Systems**	**Installed 1970-2003**	**Installed Before 1970**
Aloha	434	336	98
Benton	1461	634	827
Grant	838	388	450
Inverness	1215	678	537
Munro	637	217	420
Carp Lake	711	516	195
McKinley	490	567	77

Nearly all of the lands designated residential or agricultural for the watershed lie within areas of severe septic constraints due to hydric, wet or poor filtering soils, as can be seen when **Map 5: Septic System Soil Constraints** is compared to **Map 6: Land Use**. If the trend of expanding residential areas continues as more and more agricultural lands are parceled out for development, increased potential for contamination to the water supply is inevitable. Septic system and soil constraints will need to be considered carefully in any future development in these areas and great care will need to be taken to ensure the continued health of the Cheboygan River/Lower Black River Watershed.

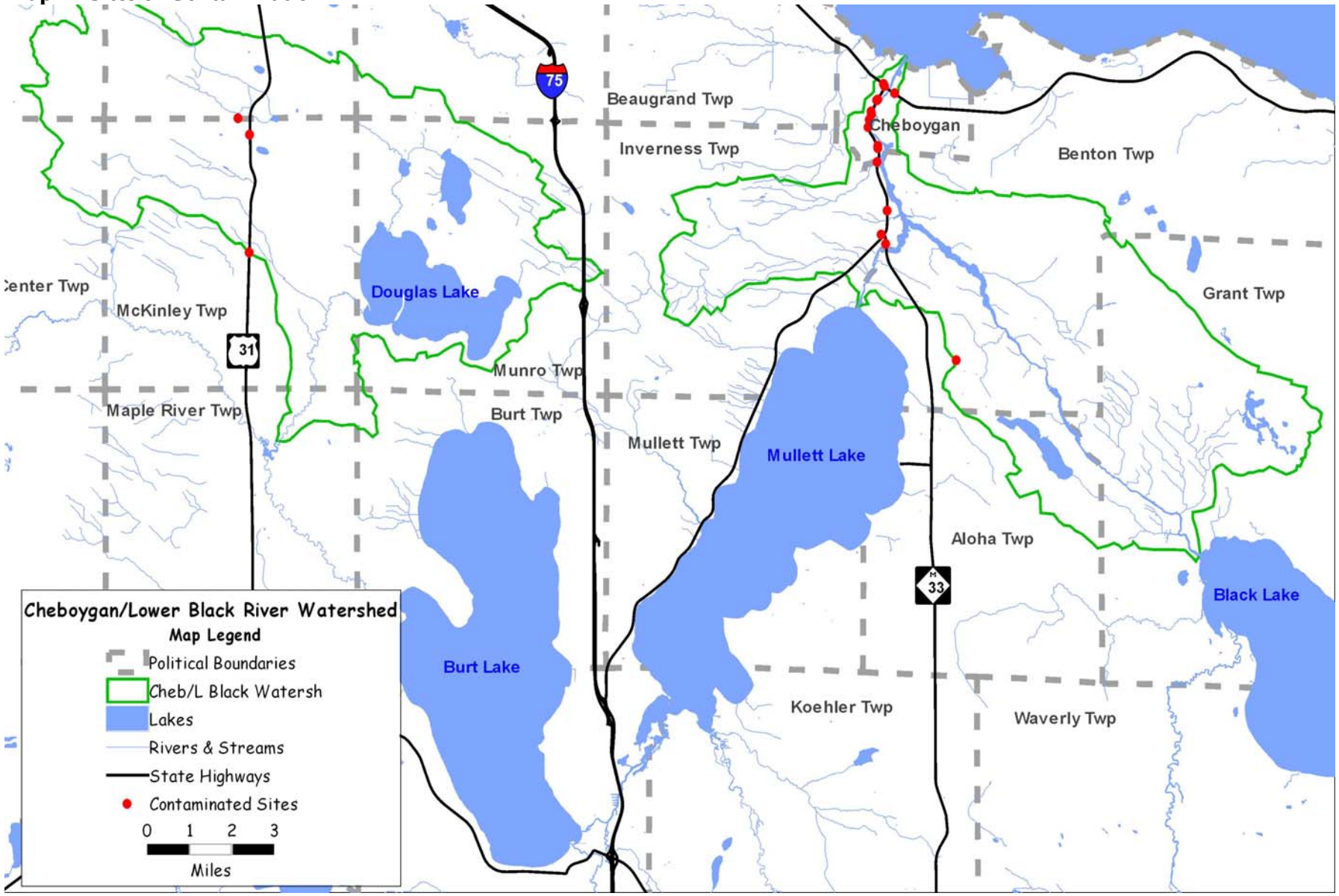
Areas of Contamination

There is a direct link between surface water and ground water contamination. For the Cheboygan River/Lower Black River Watershed, as well as virtually all of northeast Michigan, ground water is the only source of drinking water. It is therefore imperative that groundwater be protected from contamination. It is far less costly to use contamination preventative measures than it is to restore a contaminated ground water site to a potable state. Along with pollutants carried into the water system via stormwater drains, road/stream crossings and residential and agricultural runoff, contamination from abandoned wells, leaking underground storage tanks and other industrial sources may also find its way into ground water.

METHODOLOGY
In order to determine the presence and extent of chemical contaminants in the watershed, DEQ and EPA documents were reviewed to identify Leaking Underground Storage Tanks (LUST) and other sites of contamination.

RESULTS
According to the Michigan Department of Environmental Quality (MDEQ), there are nineteen leaking underground storage tanks in the Cheboygan River/Lower Black River Watershed, sixteen in Cheboygan County and three in Emmet County. The contaminants found at these sites are most often gasoline and diesel fuel. Other contaminated sites are monitored by the MDEQ's Environmental Response Division (ERD). As of November 2003, ERD lists thirteen sites of contamination in the watershed, eleven in Cheboygan County and two in Emmet County. Contaminants found at these sites include Barium, Zinc, Lead, PCE, Naphthalene, Chrysene, Acenaphthene, Fluorine, Chlorine, Benzene, Cyanide, Petroleum, Diesel Fuel, and Gasoline.

Map 12 Sites of Contamination



Summary

Sediment and nutrients were ranked the top two pollutants of concern in the watershed. Agricultural operations and road/stream crossings were determined to be the two leading sources of sediments, with stormwater runoff and streambank erosion also contributing significantly to the problem. Toxins such as pesticides, oils and grease, and heavy metals were also identified as pollutants of concern for the watershed. While all four of the above mentioned sources contribute significant amounts of pollution to the water resources of the watershed, the source determined to be most critical was agriculture, followed by road/stream crossings. These two sources should be given high priority when considering allocation of time and funds available for task implementation and community education. **Table 6-14** lists the estimated pollutant loadings by source.

Table 6-14: Estimated Loadings by Source

Source	Sediment (tons/year)	Phosphorous (lbs/year)	Nitrogen (lbs/year)
Agriculture	2393	1057	1333
Road/Stream Crossing	671	570	1140
Stormwater	275	900	
Streambank Erosion	63.37	56.99	114
Total	**3402.37**	**2583.99**	**2587**

CHAPTER 7 WATERSHED GOALS AND OBJECTIVES

The Cheboygan River/Lower Black River Watershed and Douglas Lake subwatershed are valued by tourists, seasonal and year-round residents as an area highly desired for recreation as well as residential living. The water bodies need to be protected and enhanced to ensure the designated uses as defined in this plan continue to be met. The overall mission of the Cheboygan River/Lower Black River Watershed Initiative "is to ensure high water quality and provide for the protection of aquatic life and wildlife by reducing the amount of sediments, nutrients and toxic pollutants entering the watershed." Working actively towards the achievement of the mission will ascertain that designated and desired uses of the watershed continue to be met for present and future generations to come.

Using input from the Steering Committee, the following goals and objectives for the watershed were developed.

Table 7-1: Watershed Goals

Goal	Designated Use	Pollutant/Impairment Addressed
1. Provide for the protection and enhancement of the water resources by reducing sediment loading to the water bodies.	Agriculture Navigation Warm/Coldwater Fishery Other Aquatic Life/Wild Life	Sediment Nutrients Toxins
2. Reduce nutrient loading to the waterways for long-term protection and enhancement of the watershed.	Agriculture Industrial Water Supply Navigation Warm/Coldwater Fishery Other Aquatic Life/Wild Life	Sediments Nutrients Toxins Pathogens
3. Enhance the overall integrity of the Cheboygan River by reducing stormwater runoff to the river system.	Agriculture Navigation Warm/Coldwater Fishery Other Aquatic Life/Wild Life Partial/Total Body Contact Fish Consumption	Sediments Nutrients Toxins Pathogens
4. Provide for the protection of the watershed through Conservation Measures and the Adoption and Enforcement of Land Use policies and regulations.	Agriculture Industrial Water Supply Navigation Warm/Coldwater Fishery Other Aquatic Life/Wild Life Partial/Total Body Contact	Sediment Nutrients Toxins Pathogens
5. Protect and enhance aquatic and terrestrial ecosystems in the watershed.	Navigation Warm/Coldwater Fishery Other Aquatic Life Partial/Total Body Contact	Sediment Nutrients Toxins Invasive Species
6. Increase the understanding of actions the public can initiate to reduce nonpoint source pollution.	Agriculture Industrial; Water Supply Navigation Warm/Coldwater Fishery Other Aquatic Life/Wild Life Partial/Total Body Contact Fish Consumption	Sediment Nutrients Toxins Pathogens Invasive Species

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Goal #1
Provide for the protection and enhancement of the water resources by reducing sediment loading to the water bodies.

Objective 1: Reduce the amount of sedimentation within the watershed by the installation of BMP's at identified areas of agricultural sites of concern.

- Restrict livestock access to rivers and tributaries by installing watering devices, fencing, and stream crossings.
- Provide filter strips and buffer zones.
- Correct stream erosion and runoff problems.
- Install animal waste storage facility.
- Educate farmers on nutrient management and overall BMP's.

Objective 2: Correct identified road/stream crossings that are contributing sediments to the water bodies.

- Replace or repair identified problem sites.
- Educate road commissions on BMP's for road stream crossings.

Objective 3: Reduce sediment loading to the river systems by eliminating direct stormwater runoff discharges.

- Implement stormwater BMPs for drains discharging directly to the rivers.
- Ensure new development does not increase amount of storm water runoff through the adoption and enforcement of local stormwater regulations.

Objective 4: Correct streambank erosion sites to reduce sediment delivery to rivers.

- Implement erosion control measures at identified streambank sites.
- Restore streambank vegetation to protect banks and to provide filter systems.
- Improve existing public access sites for canoes, fishing, etc.
- Educate riparian landowners on means of preventing erosion and enhancing land for aquatic life/wildlife.

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Goal #2
Provide for the long-term protection and enhancement of the water quality of the Cheboygan River/Lower Black River Watersheds through the reduction and prevention of sources of nutrients.

Objective 1: Reduce nutrient loading from agricultural sites of concern by the installation of BMPs.

- Restrict livestock access to rivers and tributaries by installing watering devices, fencing, and stream crossings.
- Provide filter strips and buffer zones.
- Correct stream erosion and runoff problems.
- Install animal waste storage facility.
- Educate farmers on nutrient management and overall BMP's.

Objective 2: Correct existing stormwater system through remedial and proactive measure.

- Install stormwater management systems which allows for detention, retention, and /or diversion of stormwater runoff to the river systems.
- Prevent future direct discharges by the adoption of stormwater ordinance(s).
- Educate the public on stormwater runoff through a Drain Stenciling Program as well as through dissemination of educational information.

Objective 3: Improve riparian management of shorelines and streambanks.

- Educate public on identification of cladophora growths and what presence indicates.
- Inform owners of cladophora growth of results of survey.
- Repeat survey on an ongoing basis (every 5 years) for water quality awareness and management practices.
- Add information to database to facilitate identifying locations of Cladophora growths for repeat surveys and landowner contact.
- Create maps showing property parcels, cladophora locations, and other resource information.

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Goal #3
Enhance the overall integrity of the Cheboygan River/Lower Black Watershed by reducing stormwater runoff to the river systems.

Objective 1: Correct existing stormwater system through remedial and proactive measure.

- Install stormwater management systems which allows for detention, retention, and /or diversion of stormwater runoff to the river systems.

Objective 2: Prevent future stormwater issues through adoption of stormwater management ordinance(s).

- Develop a model stormwater ordinance for local adoption.
- Provide for the enforcement of stormwater regulations.

Objective 3: Educate the public and business owners on means to prevent stormwater pollution.

- Establish a Drain Stenciling Program.
- Develop and disseminate educational information.

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Goal #4
Provide for the protection of the watershed through Adoption and Enforcement of Land Use Policies and Regulations.

Objective 1: Improve local land use planning and zoning standards for water resource protection.

- Develop model ordinances and language for adoption into existing master plans and zoning that ordinances that address site plan review requirements, set back provisions, greenbelts, stormwater management, etc.
- Provide training and education on local enforcement of regulations.

Objective 2: Provide for the permanent protection of areas significant to aquatic resources through conservation measures.

- Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases.
- Provide educational workshops on conservation easements, and other means of land protection.

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Goal #5
Protect and enhance aquatic and terrestrial ecosystems in the watershed.

Objective One: Protect and restore significant wetlands adjacent to the water resources**.**

- Identify significant wetlands for water resource protection and enhancement.
- Develop protection/restoration plan(s).

Objective Two: Protect and restore habitat for aquatic organisms.

- Restore and/or maintain greenbelts along streambanks and shorelines.
- Educate landowners on streambank /shoreline BMPs.
- Improve aquatic habitat by the placement of woody debris in select sites.
- Conduct annual river/lake clean-ups.

Objective Three: Provide for the protection of the water resources through the establishment of a water quality monitoring program.

- Conduct physical, chemical and biological water quality testing.
- Analyze results.
- Complete Annual Report.

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Goal #6
Increase the understanding of actions the public can initiate to reduce nonpoint source pollution.

Objective 1: Inform the general citizenry of watershed management through a public information and education (I/E) program.

Objective 2: Develop and implement a school education and water quality sampling program.

Objective 3: Develop a riparian owner targeted education program to include water quality information on: soil testing, fertilizer application, lawn care practices, wastewater treatment system maintenance, stormwater runoff, etc.

Objective 4: Provide educational workshops for target audiences in the watershed: contractors/developers, planning/zoning commissions, realtor associations, chamber of commerce, etc.

CHAPTER 8 IMPLEMENTATION PLAN

Even though the Cheboygan River/Lower Black River Watershed currently exhibits high water quality, both remedial and proactive measures are necessary to provide for the protection and enhancement of the river system.

Remediation of identified areas of degradation include: installation of BMP's at agriculture areas of concern, road/stream crossing upgrades, stormwater management and streambank erosion control. In order to provide for the long-term protection of the Cheboygan River/Lower Black River system, proactive measures need to be implemented. A proactive approach to watershed management includes such measures as information and education programs, land use policies and regulations such as zoning ordinances, septic maintenance programs and establishment of greenbelts.

Based on inventory results, the Cheboygan River/Lower Black River Watershed steering committee developed the following strategies for reduction of nonpoint sources of pollutants in the watershed. The recommendations utilize a combination of both reactive and proactive measures. Each recommendation integrates Best Management Practices (BMPs), information and education strategies, partnerships, and intergovernmental coordination. Each task targets a specific objective of the plan. Milestones, timelines, priority, BMPs, estimated costs, and evaluation methods are outlined following each objective. Timelines for each objective are based on the following: Short-term: 1-3 years; Mid-term: 3 - 7 years; and Long–term: 7-15 years.

Order of implementation of the recommendations will be based on steering committee input, and in many cases the order will be determined by available funds. When installing structural BMP's, the sites ranked most severe will be considered first. **Table 8-1** indicates the cost of implementation for each inventory, as well as the total for the entire implementation project.

Table 8-1: Costs of Project Implementation	
Agricultural Treatments	$1,270,000
Road/stream Crossing Treatments	$130,098
Stormwater Treatment Projects	$2,538,000
Streambank Protection Projects	$51,500
Shoreline Protection Projects	$30,000
Information/Education Strategies	$106,000
Land Use Projects	$45,000
Voluntary Land Protection Projects	$90,000
Total Cost of Implementation	**$4,260,600**

GOAL #1
Provide for the protection and enhancement of the water resource by reducing sediment loading to the water bodies.

Objective 1: Reduce the amount of sedimentation within the watershed by the installation of BMPs at identified areas of agricultural sites of concern.
The agricultural community is a vital component of the Cheboygan River/Lower Black River Watershed. The crops and livestock produced locally benefit the economy of the area, and provide a rural atmosphere many visitors and permanent residents alike find aesthetically pleasing. Unfortunately, like many other watershed components, the agricultural industry can contribute significant amounts of pollution to the watershed. Sediments, nutrients, and bacteria are natural by-products of farming activities. Best Management Practices such as exclusion fencing to keep livestock out of streams, adequate manure storage facilities, proper livestock crossings, nutrient management and buffers along streambanks can significantly lower the amounts of pollution entering the water system

Tasks

Task 1: Develop site specific plans of priority agricultural area of concern for installation of BMPs, i.e. alternate means for watering livestock, proper stream crossings, buffer strips, fencing, etc. for the following sites**:** A003; A017; A018; A028; A030; A043; A061; A062; A067; A076; A082; & A128

Task 2: Work with NRCS, and other potential funding sources to secure funds for BMP's animal waste systems, etc.

Task 3: Initiate BMP installation at priority agricultural areas of concern.
- Subtask A: Meet with farmers to explain cost-share program.
- Subtask B: Sign-up willing farmers.
- Subtask C: Organize/purchase materials for BMP installation.
- Subtask D: Secure crew for installation.
- Subtask E: Install BMPs.

Milestones:

Year 1 – 7	Funding procured.
Year 1 - 2	50% of farmers signed up.
Year 2-4	50% of fence installed.
Year 5	Buffer strips and fencing completed.
Year 6	Manure storage systems installed.
Year 7	Wells and stream crossings completed.

Timeline: Mid-term

Priority: High

BMPs: Fencing, stream crossings, watering devices, buffers strips, manure storage systems

Pollutants Reduced: Sediments
Nutrients
Pathogens

Coordination Agencies: Conservation District, NRCS, Huron Pines RC&D, farmers

Evaluation: Number of sites completed, documented by before and after photographs.
No increase in total phosphorus, or total suspended solids in stream.
Calculate before and after sediment load reductions.
No e-coli exceeding state water quality standards.

Estimated Cost: $1,270,000

Objective 2: Correct identified road/stream crossings that are contributing sediments to the water bodies.

Sediments, including dirt and gravel from shoulders of the roads (especially unpaved roads) can be deposited into the river system wherever a road and stream intersect. Sedimentation of streams is a natural process. Excessive amounts of sediments can, however, negatively impact several of the designated uses for the watershed, such as aquatic wildlife and habitat (including the watershed's cold water fisheries), birds and mammals dependent on an aquatic environment, and aquatic plant life. Sedimentation can also, by reducing the width and depth of the stream channel, restrict navigation and promote an increase in flooding of the stream.

Tasks

Task 1: Conduct preliminary work for installation of BMP's at sites: 008; 013; 074; 094; 119; 134; 139;171; 172; 173; 182; 183.

Task 2: Implement BMP's at the selected site(s).

Milestones:

Year 1: Develop site plans for select sites.
Year 1 – 3: Obtain permits and approvals.
Year 2: Organize work crew.
Year 1 -7: Determine and purchase construction materials.
Year 1-7: Install BMPs.

Timeline: Mid-term

Priority: High

BMPs: Replacement of culverts, reduce grade of approaches, pave approaches, pave curb and gutter, re-vegetate, and erosion control structures.

Pollutants Reduced: Sediments
Nutrients
Toxins

Coordination Agencies: Huron Pines RC&D, County Road Commissions.

Evaluation: Document number of sites completed by taking before and after photographs.
Calculate before and after erosion rate calculations.
No increase in Total Suspended Solids (TSS) in stream.

Estimated Cost: $130,098

Objective 3: Reduce sediment loading to the river systems by eliminating direct stormwater discharges.

There are currently at least 46 outfalls (within the Cheboygan City limits) discharging directly to the river, and additional sites are added each year. With few exceptions, these drainage zones have no treatment. The stormwater simply flows from city streets, rooftops, parking lots, etc., carrying with it oil, grease, trash, and sediment that is sent directly to the Cheboygan River.

Retrofitting of the existing City stormwater system may be the most difficult task in reducing the City's contribution of runoff to the river. At least 29 drainage zones have been identified; these carry pollutants from commercial, residential, and light industrial sections of the City and discharge directly to the river. Treatment options for stormwater runoff from the City should be developed on a zone-by-zone basis. Stormwater prevention through regulations and education is addressed in Goal 4 and 6.

Tasks

Task 1: Develop design plans for a phased (by zones) approach to remediate direct discharges of stormwater outfalls to the Cheboygan River**.**

Task 2: Install stormwater management BMPs to eliminate direct discharges to river.

Milestones:

Year 1: Develop site plans for zones.
Year 1**:** Determine costs.
Year 1**:** Select priority areas for remediation.
Year 2–15: Secure funding.
Year 2-15: Retrofit 2-3 sites per year.

Timeline: Long-term

Priority: High

BMPs: Detention ponds, infiltration basins, filter strips, rain gardens, constructed wetlands.

Pollutants Reduced: Sediments
Nutrients
Toxins

Coordination Agencies: Huron Pines RC&D, City Council, County, Road Commission, Tip of the Mitt Watershed Council, NEMCOG

Evaluation: Number of sites completed documented by before and after photographs.
No increase in Total Suspended Solids (TSS) in stream.

Estimated Cost: $2,538,000 +

Objective 4: Correct streambank erosion sites to reduce sediment delivery to rivers.
Erosion of streambanks and lake shores can result in sedimentation of lakes and rivers. This can lead to a degradation of water quality and to the impairment of designated uses, particularly uses for wildlife/aquatic habitat and navigation, within the watershed. Streambank erosion can occur in several ways such as foot traffic by humans and wildlife, boat and canoe access, loss of vegetation to anchor streambanks, among others. Educational efforts will be addressed in Goal 6.

Tasks

Task 1: Develop site specific plans for erosion sites: #003; 005; 006; 009; 010; 012 & 016.

Task 2: Improve existing access sites for canoe and public access at sites S014 and S015**.**

Milestones:
Year 1: Develop site plans.
Year 1**:** Procure permits and landowner permission.
Year 1-5**:** Secure funding.
Year 1-5: Organize work crews and order materials.
Year 1-5: Complete 2-sites per year.

Timeline: Short-term

Priority: Medium

BMPs: Tree revetments, rock rip-rap, brush placement, re-vegetation, stairways, platforms, paths, fencing

Pollutants Reduced: Sediments
Nutrients

Coordination Agencies: Tip of the Mitt Watershed Council, Conservation Districts, NEMCOG, Huron Pines RC&D Council

Evaluation: Number of sites completed. Documented before and after photographs.
No increase in Total Suspended Solids (TSS) in stream.
Biological surveys above and below sites.

Estimated Cost: $51,500

GOAL #2
Provide for the long-term protection and enhancement of the water quality of the Cheboygan River/Lower Black River Watershed through the reduction and prevention of sources of nutrients.

Objective 1: See Goal 1: Objective 1 and Goal 6: Objective 3

Objective 2: See Goal 1: Objective 3 and Goal 6: Objective 3

Objective 3: Improve riparian management of streambank and shoreline areas.
A shoreline inventory of the lakes within the Cheboygan River/Lower Black River Watershed was conducted in summer 2002 to determine the presence, extent and potential habitat of cladophora, a type of algae that occurs naturally in small amounts in northern Michigan waters. Cladophora proliferates in the presence of excessive nutrients and can be used as an indicator species for a decline in water quality.

The full value of a shoreline survey is only achieved when the information is used to educate lakefront property owners about preserving water quality, and to help them rectify any problem situations. Educational efforts are addressed in Goal 6: Objective 3.

Tasks

Task 1: Send a general summary of the survey results to all shoreline residents, along with a packet of informational brochures to provide information about practical, feasible, effective actions to protect water quality.

Task 2: Inform those owners of properties with cladophora growths of the specific results for their property.

Task 3: Repeat the survey periodically (every five years or so), coupled with follow-up mailings in order to promote water quality awareness and good management practices in an ongoing basis.

Task 4: Add parcel information to database to facilitate identifying the locations of Cladophora growths during repeat shoreline surveys and in making property owner contacts.

Task 5: Encourage lake associations in shoreline monitoring activities.

Task 6: Compile and manage water resource information from lake association and other sources.

Milestones:

Year 1:	Completed survey results.
Year 1**:**	Completed parcel layer information.
Year 1**:**	Data information system in place.
Year 2:	Survey results sent to all property owners and to those identified with cladophora growth.
Year 3-5	Lake/stream monitoring.
Year 3-5:	Annual results received from lake associations and agencies.
Year 3-5:	Results analyzed and sent to lake associations and agencies.

Timeline: Short-term

Priority: Medium

BMPs: Proper lawn care management: low/no phosphorus fertilizer usage, no burning, runoff diverted, greenbelts, proper on-site wastewater treatment system.

Pollutants Reduced: Sediments
Nutrients
Pathogens

Coordination Agencies: Tip of the Mitt Watershed Council, NEMCOG

Evaluation: Surveys sent to all riparian owners.
Cladophora reduction.
Ability to identify location of cladophora by parcel.

Estimated Cost: $90,000

GOAL #3
Enhance the overall integrity of the Cheboygan River/Lower Black River Watershed by reducing stormwater runoff to the systems.

Objective 1: See Goal 1: Objective 3 and Goal 6: Objective 3.

Objective 2: Prevent future stormwater issues through adoption of stormwater management ordinances.

Tasks

Task 1: Develop a model stormwater ordinance for local adoption.

Task 2: Present ordinance to municipalities and county planning and zoning commissions.

Task 3: Continue to work with communities for local adoption.

Task 4: Provide for enforcement of regulation.

Milestones:
Year 1: Ordinance developed.
Year 2**:** Adopted ordinance.
Year 3**:** Regulations enforced.

Timeline: Short-term

Priority: High

BMPs: Stormwater BMPs (retention ponds, runoff control structures, detention basins, rain gardens, etc. required for new development).

Pollutants Reduced: Sediments
Nutrients
Toxins

Coordination Agencies: NEMCOG, City/County Planning and Zoning Commissions.

Evaluation: Ordinance adopted.
Ordinance Enforced.

Estimated Cost: $15,000

Objective 3: See Goal 6: Objective 3.

GOAL #4
Provide for the protection of the watershed through Conservation Measures and the Adoption and Enforcement of Land Use Policies and Regulations.

Objective 1: Improve local land use planning and zoning standards for water resource protection.
Implementation of land use policies and regulations is a critical component of strategy used by local, State and Federal units of government for protecting water quality. In addition to benefits for aquatic resources, planning, zoning and conservation easements are tools used for ensuring the conservation of wildlife habitat, providing for sustainable development, protecting property values, and maintaining community character. Another avenue for protecting the watershed's natural resources and rural characteristic is through voluntary land protection. Many options are available to those landowners wishing to protect high quality natural areas, critical areas, or areas where development may pose a risk of degrading the high water quality currently exhibited by the Cheboygan River/Lower Black Watershed.

Tasks

Task 1: Develop model land use ordinances and regulations for water resource protection.

Task 2: Draft development guidelines specific to the Cheboygan River/Lower Black River Watershed (model after the Grand Traverse Bay Guidelines & Recommended Land Use Regulations).

Task 3: Work with local government on the adoption of guidelines & regulations that provide for the protection of the water resources.

Task 4: Develop and distribute at meetings: handouts covering model stormwater management, site plan review standards, recommended setback distances, stormwater management guidelines, greenbelt provision language, and a checklist

Task 5: Revise NEMCOG's PowerPoint Presentation on the connection between land use practices, nonpoint source pollution and water quality.

Task 6: Provide presentations to City/County Planning Commissions and County Chapters of the Michigan Townships Associations

Milestones:

Year 1:	Model land use ordinance developed.
Year 1:	Site Plan Review Checklist developed.
Year 2:	Development Guidebook completed and distributed to local units of governments.
Year 2:	Three presentations provided to City and County(s) Planning Commissions.
Year 3:	Two Presentations to MTA Chapters.
Timeline:	Short-term

Priority: High

BMPs: Development guidelines: i.e. greenbelts, access management, runoff controls, cluster development/open space protection, detention/retention basins, filter strips, etc.

Pollutants Reduced: Sediments
Nutrients
Toxins

Coordination Agencies: Tip of the Mitt Watershed Council, NEMCOG, Planning and Zoning Official, City of Cheboygan

Evaluation: Guidebook completed.
Guidebook distributed to all local units. A Site Plan provided to local unit with guidebook recommendations included.
Ordinance adopted.

Estimated Cost: $30,000

Objective 2: Provide for the permanent protection of areas significant to aquatic resources through conservation measures.

Tasks

Task 1: Develop database of Priority Parcels within watershed.

Task 2: Develop criteria for determining what constitutes a priority parcel.

Task 3: Identify priority parcels of land utilizing GIS data from watershed Inventory.

Task 4: Develop priority parcel map for watershed.

Task 5: Obtain landowner information of priority parcels from County Equalization Department.

Task 6: Provide voluntary land protection information to riparian landowners.

Task 7: Develop and/or compile informational materials on easement and land donation programs to priority property owners.

Task 8: Assemble information packets and distribute to owners of priority land parcels in the watershed.

Task 9: Organize and hold a workshop on voluntary land protection techniques.

Task 10: Contact and meet with at least ten priority property owners for consideration of conservation easement, and/or land donation.

Milestones:

Year 1: Database with parcels is completed.
Year 1: Criteria are established.
Year 1: Priority parcels are identified and mapped.
Year 2: Workshop is held.
Year 2: 3 landowner contacts and meetings have been held.
Year 3 –5 7 landowner meetings.
Year 5: 25% of lands identified are under conservation easements.

Timeline: Short-term

Priority: High

BMPs: Land conservation easements.

.

Pollutants Reduced: Sediments
Nutrients
Toxins

Coordination Agencies: Little Traverse Conservancy

Evaluation: Completed database.
Landowner contacts completed.
25% of priority lands secured in conservation easements or purchased through donations.

Estimated Cost: $45,000

GOAL #5
Protect and Enhance aquatic and terrestrial ecosystems in the watershed.

Objective One: Protect/restore sensitive areas such as wetlands and riparian corridors.

Tasks

Task 1: Identify riparian wetlands.

Task 2: Develop protection/restoration plan.

Task 3: Secure funding for restoration/ protection plan.

Milestones:

Year 1: Database with wetland parcels is completed.
Year 1: Criteria are established.
Year 1: Priority parcels are identified and plan is developed.
Year 2: 5 landowner contacts and meetings have been held.
Year 3 –5: 7 landowner meetings.
Year 5: 25% of lands identified are protected through conservation easements/purchase.

Timeline: Mid-term

Priority: Medium

BMPs: Land conservation easements.

.

Pollutants Reduced: Sediments
Nutrients
Toxins

Coordination Agencies: Little Traverse Conservancy

Evaluation: Completed database.
Landowner contacts completed.
25% of priority wetlands protected.

Estimated Cost: $ 20,000

Objective Two: Protect and restore habitat for aquatic organisms.

Tasks

Task 1: Restore greenbelts through voluntary greenbelt reestablishments.
Subtask A: Promote assistance in greenbelt reestablishment.
Subtask B: Work with interested landowners in selection of plants and design.

Task 2: Coordinate with streambank restoration work for woody debris placement.

Task 3: Work with local organizations to establish and conduct annual rive/lake clean-up days.

Milestones:

Year 1:	Promoted greenbelt assistance program throughout watershed.
Year: 1-2:	Assisted 5 riparian landowners with greenbelt reestablishment.
Year: 2, 3, 4:	Placed woody debris in river.
Year: 1:	Organized River Clean-up.
Year: 1-5:	Held annual river/lake clean-ups.

Timeline: Short-term

Priority: Medium to Low

BMPs: Greenbelts.
.

Pollutants Reduced: Sediments
Nutrients
Toxins

Coordination Agencies: Tip of the Mitt Watershed Council, Conservation District, NEMCOG, Huron Pines RC&D.

Evaluation: Completed 25 designs for greenbelt reestablishment in 5 years.
Placed woody debris in select sites in river.
Held 5 clean-up days.

Estimated Cost: $25,000

Objective Three: Provide for the protection of the water resources through the establishment of a water quality monitoring program.

Tasks

Task 1: Organize meeting(s) of Test Agencies (MDEQ, MDNR,TOMWC) to implement water quality monitoring plan.

Task 2: Conduct water quality monitoring of 5 selected sites (see Table 8-3).

Task 3: Analyze results and compare to past data and applicable State Standards.

Task 4: Complete bi-annual Water Quality Monitoring Report.

Milestones:

Year 1: Meeting held, monitoring scheduled with MDEQ ,MDNR and TOMWC.
Year: 2, 3, 4: Annual monitoring conducted for temperature, E. coli. Report completed.
Year 2- 5: Water chemistry conducted. Analysis completed.
Year: 5: Habitat and biological assessment completed. Analysis completed.

Timeline: Mid-term

Priority: Medium

BMPs: NA

.

Pollutants Reduction Analyzed:

Sediments
Nutrients
Toxins

Coordination Agencies: Tip of the Mitt Watershed Council, MDEQ, MDNR

Evaluation: Completed monitoring of 5 sites by year 5.
Biannual report completed.

Estimated Costs: $50,000

GOAL #6
Increase the understanding of actions the public can take to reduce nonpoint source pollution.
Information/Education Strategy

Objective One: Develop a targeted Information/Education Strategy to increase the understanding on methods for reducing nonpoint source pollutants.
Education is the critical component in a successful watershed management program. The primary function of the Information and Education Strategy for the watershed plan is to provide educational information to local officials, shoreline residents, contractors and developers, school children and the general public. Learning about the watershed that is so fundamental to the sustainability of the region's economy and way of life will enable citizens to make decisions that will enhance and protect the waters of the Cheboygan River/Lower Black River Watershed.

Listed below are the information and education strategies based on the goals and objectives stated earlier. Based on the sources of pollution, each educational strategy will be directed towards a specific target audience.

Pollutant: Sediments

Source: Uncontrolled livestock access to streams

Target Audience: Landowners, agricultural operations

Message: Control livestock access, establish fencing, create proper stream crossings, information on alternate funding sources.

Delivery Mechanism: Brochures, work with NRCS, provide information at fairs, trade-shows and local events.

Tasks

Task 1: Develop educational materials and display.

Task 2: Sign-up for local fairs, tradeshows, etc.

Task 3: Attend events and disseminate information.

Milestones:
Year 1: Materials and display completed.
Year 1-2: Attend 4 events.
Year 1-15: Materials distributed and events attended.

Timeline: Long-term

Priority: High

BMPs: Stream crossings, exclusionary fencing, watering devices, waste management

Pollutants Reduced: Sediments
Nutrients

Coordination Agencies: NEMCOG, NRCS, Conservation Districts, MSU Extension, Tip of the Mitt Watershed Council

Evaluation: Numbers of events attended
Number of pamphlets disseminated
Follow-up Surveys

Estimated Cost: $5,000

Pollutant: Sediments

Source: Road/stream crossings

Target Audience: Road Commissions

Message: Explore alternatives to road maintenance at road/stream crossings

Delivery Mechanism: Seminars for County Road Commissions

Tasks

Task 1: Organize seminars.

Task 2: Develop/gather information.

Task 3: Hold Seminars.

Milestones:
Year 1: Organize Seminar.
Year 1: Hold Seminar.

Timeline: Short-term (although repeated periodically throughout the years)

Priority: Medium

BMPs: Snowplowing, grading, techniques
.
Pollutants Reduced: Sediments

Coordination Agencies: Huron Pines RC&D, NRCS

Evaluation: Event Held

Estimated Cost: $5,000

Pollutant: Sediments

Source: Streambank Erosion

Target Audience: Riparian landowners, developers, contractors, construction companies

Message: Encourage landowners to leave a conservation buffer, provide attractive landscaping for natural vegetation, inform developers, construction companies of importance of greenbelts

Delivery Mechanism: Information material distributed to Real Estate agencies, area businesses, riparian landowners

Tasks

Task 1: Develop informational materials**.**

Task 2: Develop mailing database for information dissemination.

Task 3: Disseminate information**.**

Milestones:
Year 1: Brochures developed.
Year 2: Brochures mailed to 95% (some will be returned) of target audience.

Timeline: Short-term

Priority: Low

BMPs: Greenbelts
.
Pollutants Reduced: Sediments, nutrients

Coordination Agencies: Tip of the Mitt Watershed Council

Evaluation: 500 Brochures mailed.

Estimated Cost: $5,000

Pollutant: Sediments

Source: Lake and stream access sites

Target Audience: Fishing enthusiasts, kayak/canoe/tube rentals and sales, ORV users, boat owners

Message: Protect river by using designated access sites and stairs when provided, staying on designated trails, and reducing wake speeds

Delivery Mechanism: Post signs at access points, provide information to canoe liveries, sporting goods stores and at ORV parking

Tasks

Task 1: Determine location for signage.

Task 2: Design sign and brochures.

Task 3: Order signs and materials.

Task 4: Obtain permission for sign placement.

Task 5: Disseminate educational information.

Milestones:

Year 1: Post signs at 50% of access sites.

Year 1: Disseminate 1,000 brochures/ information sheets to stores and organizations and place in key locations.

Timeline: Short-term

Priority: Low

BMPs: Greenbelts, runoff control

.

Pollutants Reduced: Sediments
Nutrients

Coordination Agencies: Tip of the Mitt Watershed Council

Evaluation: 100% of signs posted.
1,000 brochures provided to area businesses.

Estimated Cost: $8,000

Pollutant: Nutrients

Source: Agricultural lands

Target Audience: Agricultural operations; landowners

Message: Unrestricted livestock access to surface water threatens the health of the watershed

Delivery Mechanism: Brochures, work with NRCS, provide information at fair, trade-shows and local events

Tasks

Task 1: Develop educational materials and display.

Task 2: Sign-up for local fairs, tradeshows, etc**.**

Task 3: Attend events and disseminate information.

Milestones:
Year 1: Materials and display completed.
Year 1-2: Attend 4 events annually.
Year 1-15 Materials distributed and events attended.

Timeline: Long-term

Priority: High

BMPs: Stream crossings, exclusionary fencing, watering devices, waste management

Pollutants Reduced: Sediments
Nutrients

Coordination Agencies: NEMCOG, NRCS, Conservation Districts, MSU Extension, Tip of the Mitt Watershed Council

Evaluation: Numbers of events attended
Number of pamphlets disseminated
Follow-up Surveys

Estimated Cost: $5,000

Pollutant: Nutrients

Source: Wastewater/ residential septic systems/lawns

Target Audience: Homeowners, riparian businesses

Message: Properly maintain septic systems to prevent degradation of water quality; discourage improper/over application of fertilizers on lawns; encourage soil tests and the use of low/no phosphate fertilizers

Delivery Mechanism: Create an educational water quality kit for homeowners including brochures for septic system maintenance, environmentally friendly lawn care

Tasks

Task 1: Develop materials and folder for water quality kit

Task 2: Order/print materials

Task 3: Compile kits

Task 4: Distribute kits to area realtors and river/lake associations.

Milestones:
Year 1: Kits completed
Year 2: 250 kits distributed

Timeline: Short-term

Priority: Low

BMPs: Lawn care practices, soil tests, septic maintenance.
.

Pollutants Reduced: Nutrients, pathogens

Coordination Agencies: Tip of the Mitt Watershed Council

Evaluation: 250 kits distributed.

Estimated Cost: $7,500

Pollutant: Toxin: Pesticides

Source: Residential lawns; agricultural operations

Target Audience: Landowners, agriculture managers

Message: Encourage proper application of pesticides to protect aquatic/wildlife habitats, and promote a healthy watershed

Delivery Mechanism: Brochures, work with various agencies such as lake associations, NRCS; provide information at fairs, trade-shows and events

Tasks

Task 1: Develop educational materials and display.

Task 2: Sign-up for local fairs, tradeshows, etc**.**

Task 3: Attend events and disseminate information.

Milestones:
Year 1: Materials and display completed.
Year 1-2: Attend 4 events annually.
Year 1- 5: Materials distributed and events attended.

Timeline: Long-term for brochure dissemination

Priority: Medium

BMPs: Stream crossings, exclusionary fencing, watering devices, waste management

Pollutants Reduced: Sediments
Nutrients

Coordination Agencies: NEMCOG, NRCS, Conservation Districts, MSU Extension, Tip of the Mitt Watershed Council

Evaluation: Numbers of events attended
Number of pamphlets disseminated
Follow-up Surveys

Costs: $5,000

Pollutant: Toxins: Oil, Grease, Metals and Other Toxic Substances

Source: Stormwater runoff

Target Audience: County Drain Commission; riparian businesses; riparian landowners

Message: Provide surface runoff control to reduce and filter harmful substances from entering the river via stormwater runoff

Delivery Mechanism: Drain stenciling; informative seminars for local officials; brochures covering such topics as hazardous household wastes and where stormwater goes; tours of model stormwater site

Tasks

Task 1: Organize drain stenciling event

Task 2: Stencil drains

Task 3: Develop brochures

Task 4: Disseminate brochures

Milestones:
Year 1: Hold drain stenciling event.
Year 1: Send business brochure to 25 area businesses

Timeline: Short-term

Priority: Medium

BMPs: Stormwater runoff controls, detention/retention basins, rain gardens, filter strips, etc.

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Pollutants Reduced: Sediment
Nutrient
Toxins

Coordination Agencies: Tip of the Mitt Watershed Council

Evaluation: Drain Stenciling completed.
Brochures disseminated to businesses Drain Commissioner and landowners.

Estimated Cost: $6,000

Objective 2: Develop and implement a school education and water quality sampling program.

Tasks

Task 1: Make SEE-North's water quality testing kits available for classrooms.

Task 2: Establish interactive database to which students can enter classroom data.

Task 3: Facilitate participation by students in conference at U. of M. Biological Station.

Task 4: Review and compile existing instructional materials for elementary and secondary students that focus on water resources.

Task 5: With input from teachers, modify selected materials in ways that make these more locally relevant.

Task 6: Compile an on-line resource library for teachers on SEE-North's website for teachers; establish an on-line learning community of people involved in water resources.

Milestones:

Year 1: Water quality testing conducted by 2 area schools.
Year 2: Schools are able to access interactive database.
Year 2: Conference held.
Year 2: Online resource Library established.
Year 1-5: Schools conduct sampling.

Timeline: Short-term

Priority: High

BMPs: BMP's related to agriculture, riparian land management, streambank erosion control, stormwater etc.

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Pollutants Reduced: Sediment
Nutrient
Toxins

Coordination Agencies: SEE-North

Evaluation: School water quality conducted.
Interactive data base operational. Conference survey
Teacher survey of effectiveness of programs

Estimated Cost: $40,000

Objective 3: Provide educational workshops for target audience in the watershed.

Tasks:

Task 1: Organize and hold educational workshops/demonstrations on BMP's for water resource protection.

Task 2: Conduct a tour for local officials and interested community members of a model stormwater site

Milestones:

Year 1: BMP Workshop for agricultural community.
Year 1: Workshop for sediment reduction targeted to contractors, road commissions
Year 2: BMP Workshop for riparian landowners

Year 2: Workshop for planning/zoning commissions on landuse/development guidelines or water resource protection.
Year 2: Conduct stormwater site tours.
Year 3: Local Government Workshop of accomplishments

Timeline: Short-term

Priority: Medium

BMPs: BMP's related to agriculture, riparian land management, streambank erosion control, stormwater etc.

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Pollutants Reduced: Sediment
Nutrient
Toxins

Coordination Agencies: NEMCOG, Tip of Mitt Watershed Council

Evaluation: Workshops held annually.
Workshop surveys of program effectiveness, etc

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Estimated Cost: $20,000

Evaluation Plan

The purpose of the Nonpoint Source Pollution Management Plan is to maintain the Watershed's high water quality, and to improve water quality where it is threatened or impaired. In order to determine the overall effectiveness of the watershed management plan, an evaluation process is essential. Listed below are the evaluation methods for the Cheboygan River/Lower Black River Watershed Initiative, as recommended in the DEQ Handbook: Developing a Watershed Management Plan for Water Quality.

- Physical water quality monitoring
- Chemical water quality monitoring
- Biological life measurements
- Photographic or visual evidence, before and after photos
- Documentation of site BMPs installed
- Pollutant loading measurements
- Stakeholder surveys, evaluate knowledge or change in behavior

The evaluation process is an important component of a management as it allows for a review of watershed conditions and impairments as the evaluation is conducted. In addition, the evaluation process also determines the effectiveness of the selected management systems determined during the planning phase.

Several different evaluation methods are incorporated into the plan, one for BMP evaluation and one for water quality. Using both of these monitoring methods will provide not only a measure of implementation progress, but also a determination of overall water quality.

Best Management Practice Evaluation

In order to document the installation of Best Management Practices (BMP's), before and after photos will be taken at road/stream crossings, streambank restoration sites, newly installed greenbelts, and livestock crossings. Focus groups, interviews and surveys will be used when changing viewpoints and management strategies need to be documented and structural BMPs were not recommended. Re-calculating pollutant loads, and reductions, for each BMP installed helps assess the effectiveness of the BMP, as well as overall impact on the Watershed and water quality. One way to assess their impact is to compare the cost of the BMPs to the amount of pollutant reduced. A summary of the BMP Evaluation can be found in **Table 8-2**.

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Table 8-2: BMP Evaluation Summary					
Item to be monitored	**Baseline Data**	**Desired Levels**	**Monitoring Methods**	**Monitoring Preformed by**	**Schedule**
Ag BMPs Goal 1: Obj. 1	12 Priority sites	50% load reduction by Year 4	Installed Ag BMPs Before and after photos	Watershed Coordinator	2 sites completed annually
Sediment Nutrients Pathogens	WQ sampling prior to installation of BMP: TP, N03, TSS, e coli.	E- coli below State Water quality Standards (appendix J). No further degradation, TP below .1mg/l	Water sampling before and after Benthic Macroinveterbrate Survey (GLEAS Procedure #51)*	DEQ Tip of the Mitt Watershed Council	
Road/stream crossing BMPS Goal 1: Obj.2 Sediment Nutrient	12 priority sites. Erosion load calculated at 404 tons of sediment per year	50% reduction of sediment loading by Year 4	Before and after photos Load calculations after BMPs installed	Watershed Coordinator DEQ	2 sites completed annually
	WQ sampling prior to installation of BMPs: N03, TP, TSS.	NO3: oligotrophic < .3 Mg/1 or mesotrophic < .3-.5 mg/1 P: oligotrophic < 10-30 ug/1 No increase in TSS	Water sampling before and after system replacement upstream and down stream of site Benthic Macroinveterbrates Survey (GLEAS Procedure #51)*:	Tip of the Mitt Watershed Council	

Table 8-2: BMP Evaluation Summary (Continued)					
Item to be monitored	**Baseline Data**	**Desired Levels**	**Monitoring Methods**	**Monitoring Preformed by**	**Schedule**
Stormwater BMP Goal 1: Obj.. 3 Sediment Nutrients Toxins	275 tons sediment /year 4 site plans developed annually	50% sediment reduction by Year 10. NO3: oligotrophic < .3 Mg/1 or mesotrophic < .3-.5 mg/1 P: oligotrophic < 10-30 ug/1 Mesotrophic < 10- No increase in toxins	Before and after photos Load calculations after BMPs Water sampling before and after system replacement upstream and down stream of site	Watershed Coordinator DEQ Tip of the Mitt Watershed Council	2 sites completed annually
Streambank Erosion Goal 1: Obj. 4 Sediments Nutrients	56.7 tons sediment /ear 7 Priority Sites	50 % load reduction achieved by year 3	Bank Erosion Pins measured quarterly to determine bank erosion	Watershed Coordinator	3 sites restored annually
Riparian Mgmt. Goal 2: Obj. 3 Nutrients Pathogens	Cladophora locations Survey	Reduction of areas of cladophora growth Informed landowners	Resurvey of cladophora to compare w/ prior survey Analysis of surveys	Watershed Coordinator	Year 1: Data system Year 2: Survey Year 5: Cladophora survey results

Table 8-2: BMP Evaluation Summary (Continued)					
Item to be monitored	**Baseline Data**	**Desired Levels**	**Monitoring Methods**	**Monitoring Preformed by**	**Schedule**
Policies and Regulations Goal 3: Obj. 2 Goal 4: Obj:1 Sediments Nutrients Toxins Pathogens	Existing Policy/Regulation	Increase policies and regulations for water resource protection	Guidelines adopted Ordinances adopted.	Watershed Coordinator	End of Year 1: Ordinance is Developed End of Year 2: Ordinance is Adopted
Goal 4: Obj. 2 Conservation Measures Sediments Nutrients Toxins	Established number of priority parcels	25% of lands identified in conservation easements or conservancy ownership	Number of parcels in easements or conservancy ownership	Watershed Coordinator	Year 1: Workshop Year 5: 25% lands protected
Goal 5: Obj.1 Wetland Protection	Inventory of Wetlands. Determine Approx. converted/loss	Reestablishment of prior converted wetlands, no net loss of wetlands	Wetland Reserve Program, Education	Watershed Coordinator	Year 1: Database Year 5: 25% of Wetlands protected
Goal 5: Obj.2 Habitat Protection	Inventory to determine denuded banks	Reestablishment greenbelts on 5 parcels per year	Site plans designed (5/yr) Greenbelts reestablished	Watershed Coordinator	Year 1: Completed Landowners contacts Year 3: Woody Debris in river. Clean-up days held Year 5: 25 designs completed
Goal 6: Obj.1 Information & Education Program	Minimal ownership by watershed landowners and users	Ownership of watershed project by landowners and users. Enroll 10 new volunteers per year	Numbers of Volunteer, Landowner survey.	Watershed Coordinator	Annual assessment of milestones

Table 8-2: BMP Evaluation Summary (Continued)					
Item to be monitored	**Baseline Data**	**Desired Levels**	**Monitoring Methods**	**Monitoring Preformed by**	**Schedule**
Goal 6: Obj2 School Prog.	Minimal education on watershed management. by area schools	Ownership of watershed monitoring by schools Conduct annual water quality testing	Database accessed by schools. Number of schools participating in testing	SEE-North TOMWC Huron Pines RC & D	Year 1: Database created 2 schools conducting sampling Year 5: All schools participating
Goal 6: Obj3 Workshops	6 Workshops	Educated target audience(s)	Workshop Surveys of participants	Watershed Coordinator TOMWC	Years 1 -3: 2 workshops per year

* Great Lakes and Environmental Assessment Section rapid bio-assessment protocol for wadable streams, which is based on a mixed-habitat sample of 100 organisms. Benthic Macroinveterbrates: i.e mayflies, caddisflies, stoneflies (GLEAS Procedure #51)*:

Water Quality Monitoring

Water quality monitoring is an important component for long term evaluation of the health of the watershed. Physical, chemical, and biological parameters will be measured at selected sites. The MDEQ conducts chemical and biological water quality monitoring at select sites on a five year rotational basis. This monitoring may be supplemented with additional locations if local agencies within the watershed contact the MDEQ and ask them to establish a specific monitoring site. A summary of the water quality monitoring efforts can be found in **Table 8-3**.

Table 8-3: Water Quality Monitoring Summary (see Goal 5, Obj. 3)					
Monitoring Site	**Parameter Target (1)**	**Type of Analysis**	**Method**	**Frequency (2)**	**Test Agency**
Cheboygan River At US 23	S,N,DO,T,B	Suspended Sediment Concentration	Water Quality Measure	1X/mo-summer	MDEQ
		Total Phos & Nitrogen Concentrations	Water Quality Measure	1X/mo-summer	MDEQ
		Avg Max Daily Summer Temp	Onset Temp Logger	2 yr interval:June,July,Aug	TOMWC, MDNR, MDEQ
		Dissolved Oxygen	Water Quality Measure	1X/mo-summer	MDEQ
		E. coli MPN/100 ml	Water Quality Measure	3X/Yr:May,Jul,Sep	MDEQ
Cheboygan River At M-33	S,N,DO,T,B	Stream Habitat Assessment	EPA Rapid Bioassessment	3- 5 yr interval	MDEQ
		Suspended Sediment Concentration	Water Quality Measure	1X/mo-summer	MDEQ
		Total Phos & Nitrogen Concentrations	Water Quality Measure	1X/mo-summer	MDEQ
		Avg Max Daily Summer Temp	Onset Temp Logger	2 yr interval:June,July,Aug	TOMWC, MDNR, MDEQ
		Dissolved Oxygen	Water Quality Measure	1X/mo-summer	MDEQ
		Benthic Macroinvertebrates	EPA Rapid Bioass. Prot. III	3- 5 yr interval	MDEQ
		E. coli MPN/100 ml	Water Quality Measure	3X/Yr:May,Jul,Sep	MDEQ
Cheboygan River At Parkway	S,N,DO,T,B	Stream Habitat Assessment	EPA Rapid Bioassessment	3- 5 yr interval	MDEQ
		Suspended Sediment Concentration	Water Quality Measure	1X/mo-summer	MDEQ
		Total Phos & Nitrogen Concentrations	Water Quality Measure	1X/mo-summer	MDEQ
		Avg Max Daily Summer Temp	Onset Temp Logger	2 yr interval:June,July,Aug	TOMWC, MDNR, MDEQ
		Dissolved Oxygen	Water Quality Measure	1X/mo-summer	MDEQ
		Benthic Macroinvertebrates	EPA Rapid Bioass. Prot. III	3- 5 yr interval	MDEQ
		E. coli MPN/100 ml	Water Quality Measure	3X/Yr:May,Jul,Sep	MDEQ
Lower Black River At Frances Lane	S,N,DO,T,B	Stream Habitat Assessment	EPA Rapid Bioassessment	3- 5 yr interval	MDEQ
		Suspended Sediment Concentration	Water Quality Measure	1X/mo-summer	MDEQ
		Total Phos & Nitrogen Concentrations	Water Quality Measure	1X/mo-summer	MDEQ
		Avg Max Daily Summer Temp	Onset Temp Logger	2 yr interval:June,July,Aug	TOMWC, MDNR, MDEQ
		Dissolved Oxygen	Water Quality Measure	1X/mo-summer	MDEQ
		Benthic Macroinvertebrates	EPA Rapid Bioass. Prot. III	3- 5 yr interval	MDEQ
		E. coli MPN/100 ml	Water Quality Measure	3X/Yr:May,Jul,Sep	MDEQ
Lower Black River At Black River Rd	S,N,DO,T,B	Stream Habitat Assessment	EPA Rapid Bioassessment	3- 5 yr interval	MDEQ
		Suspended Sediment Concentration	Water Quality Measure	1X/mo-summer	MDEQ
		Total Phos & Nitrogen Concentrations	Water Quality Measure	1X/mo-summer	MDEQ
		Avg Max Daily Summer Temp	Onset Temp Logger	2 yr interval:June,July,Aug	TOMWC, MDNR, MDEQ
		Dissolved Oxygen	Water Quality Measure	1X/mo-summer	MDEQ
		Benthic Macroinvertebrates	EPA Rapid Bioass. Prot. III	3- 5 yr interval	MDEQ
		E. coli MPN/100 ml	Water Quality Measure	3X/Yr:May,Jul,Sep	MDEQ

(1) S= Sediment; N= Nutrients; DO= Dissolved Oxygen; T= Temperature; B= Bacteria

(2) Monitoring frequency according to MDEQ 5 year rotational basis. Samples taken once/month during open water season.

Water Quality Criteria

A set of water quality criteria must be established to assess current water quality and set goals for the future. A review of past MDEQ water quality sampling results concludes that the waterbodies of the Cheboygan River/Lower Black River Watershed can be classified as high quality waters. Protecting the resources of the watershed to prevent any water quality degradation is an overall goal of this watershed management plan. A summary of current water quality conditions and future goals can be found in **Table 8-4.**

Table 8-4: Water Quality Criteria Summary

Parameter	Methodology	Current Condition	Water Quality Goal
Sediment	Suspended Solid Concentration	>190 mg/l	<100 mg/l
Total Phosphorous	Total phosphorous concentration measure	<.05 mg/l	No significant increase
Total Nitrogen	Total nitrogen concentration measure	<.08 mg/l	No significant increase
Dissolved Oxygen	Dissolved oxygen concentration measure	>8 mg/l	No decrease
Temperature	Avg Max Daily Summer Temp	<73 deg F	No temperature increase
Pathogens	Fecal Coli concentration	<400 MFM-FCBR/100ml	Remain below state water quality standards
	E. Coli concentration	Not currently established	Remain below state water quality standards
Benthic Macroinvertebrates	EPA Rapid Bioassessment	"good" to "excellent"	Maintain "good" to "excellent" status

APPENDIX A

Streambank Erosion Inventory

Site Number:_____ Date:_____
County:_____ Map Sheet Number_____
Photo Numbers:_____ Personnel:_____

LOCATION

Township Name:_____ Township Number:_____Range_____Section_____

GPS Coordinates_____N_____W

Owners: FEDERAL COUNTY STATE PRIVATE_____

Landmarks, Features:_____

SITE INFORMATION

BANK--While looking downstream: RIGHT LEFT

Is there access to the site for equipment?: YES NO

If no, distance to nearest road (estimate):_____

CONDITION OF BANK (Circle)

A. TOE IS UNDERCUTTING
B. TOE IS STABLE, UPPER BANK ERODING
C. TOE AND UPPER BANK ERODING
D. PERCENT OF VEGETATIVE COVER ON BANK: 0-10% 10-50% 50-100%
E. OTHER (Describe):_____
F. PROBLEM TREND: INCREASING DECREASING

APPARENT CAUSE OF EROSION (Circle any applicable)

A. LAND USE (MOWING, CLEARCUTTING, DEVELOPMENT)
B. FOOT TRAFFIC, BOAT ACCESS, FISHING SITE
C. PEAKING (THUNDER BAY POWER)
D. SURFACE WATER ENTERING
E. BEND OR OBSTRUCTION IN RIVER
F. WILDLIFE USE
G. WAVE ACTION
H. BANK SEEPAGE
I. OTHER:_____

Streambank Erosion Inventory, continued

AMOUNT OF EROSION AND SLOPE RATIO

A. SIDESLOPE OF BANK (Circle one):
Vertical 1:1 2:1 3:1 4:1 or Flatter
B. LENGTH OF ERODED BANK: _____
C. AVERAGE HEIGHT OF ERODED BANK: _____

RIVER CONDITIONS

A. APPROXIMATE WIDTH OF RIVER:_____
B. DEPTH OF RIE:_____AT_____FROM THE BANK
C. CURRENT: SLOW MODERATE FAST

SOIL TEXTURE

SAND CLAY LOAM GRAVEL STRATIFIED SAND OVER CLAY
OTHER_____

SEVERITY OF SITE: MINOR MODERATE SEVERE

TYPE OF RECOMMENDED TREATMENT (Circle all that apply);

A. ROCK RIP-RAP
B. BIOLOGS/TREE REVETMENTS
C. TREE REVETMENT
D. BANK SLOPING
E. STAIRWAYS
F. BANK SEEDING OR PLANTING
G. BRUSH PLACEMENT
H. FENCING
I. OTHER_____

DRAWING OF SITE, COMMENTS

APPENDIX B

Cheboygan River/Lower Black River Watershed
Streambank Erosion Severity Index

Condition of bank	Points	Soil type or texture	Points
Toe and upper bank eroding	5	Sand	3
Toe undercutting	3	Gravel	2
Toe stable, upper bank eroding	1	Stratified	2
		Clay, loam	1
Problem trend		**Vegetative cover on bank slope**	
Increasing	5	0-10%	5
Decreasing or stable	1	10-50%	3
		40-100%	1
Side-slope of bank		**Apparent cause of erosion**	
Vertical, 1:1	5	Light access traffic	1
2:1, 3:1	2	Obstruction in river	1
4:1 or flatter	1	Bank seepage	1
		Gullying by side channels	1
		Bend in river	2
		Wave action (impoundments)	2
		Road-stream crossing; grade/shoulder runoff	3
		Moderate access traffic	3
		Heavy access (foot, horse, etc.) traffic	5
Length of eroded bank		**Mean height of eroded bank**	
More than 50 ft.	5	More than 20 ft	7
20 to 50 ft.	3	10 to 20 ft	5
Less than 20 ft.	1	5 to 10 ft	3
		less than 5 ft	1
Depth of river		**Current**	
3 ft or over	2	Fast	2
Less than 3 ft	1	Slow	1
		Total Points for Site	

Accumulative points indicate extent of erosion, i. e., the site rating, as follows:

More than 36-----Severe
30 to 36----------Moderate
Less than 30------Minor

Appendix C
Calculating Lateral Recession Rate

River: _____ Date_____ Name of Observer _____

Right or Left bank (circle one)—Right or left is determined when looking downstream.

Describe location:_____

Length (L) of eroding bank:_____

Average Height (H) of eroding bank:_____

Lateral Recession Rate (LRR)_____

Soil texture	T=	0.3 clay, silty clay, silty clay loam 0.6 sandy clay, loam, silt loam 1.0 loamy sands, gravel
Stream Alignment	S=	0.3 straight to slightly curved 0.6 moderately curved 1.0 sharply curved, near 90°
Vegetation at top of bank	V=	0.3 trees 0.6 weeds, grass, shrubs 1.0 crop, pasture, lawn, road
Stream gradient	G=	0.3 slight (few to no riffles) 0.6 moderate (balance of pools & riffles) 1.0 high (primarily riffles)
Bank slope	B1=	0.3 slight (3:1 or less) 0.6 moderate (>3:1 but <1:1.1) 1.0 steep (1:1 to vertical)
Slope of inside depositional bar	B2=	0.3 steep (>3:1) 0.6 moderate (<3:1 but >10:1 1.0 slight (<10:1)

Lateral Recession Rate (LRR)= T x S x V x G x B1 x B2 =

-------x -------- x -------- x ------- x -------- x ------- = ---
---

APPENDIX D
ROAD STREAM CROSSING FIELD DATA FORM

Collected By: _____ Field ID: _____
Date: _____ Site ID: _____

LOCATION

Stream Name:_____County:_____Road Name:_____
Crossing Name:_____Township:_____T_____R_____Sec._____

Type of Crossing:
_____Bridge
_____Single Culvert
_____Twin Culvert
_____Triple Culvert
_____Box Culvert
_____Other_____

Adjacent Landowners:
_____USA
_____State
_____Local Gov't
_____Private
_____Other

ROAD DATA

Width at Crossing: _____ft.
Road Surface: _____Paved
_____Gravel
_____Sand
_____Other_____

Maintenance: _____Seasonal
_____Year around

Approaches:

	Left		Right
Length:	_____ft.		_____ft.
Slope:	_____	0%	_____
	_____	1-5%	_____
	_____	6-10%	_____
	_____	>10%	_____

Ditch Shoulder Vegetation:

Upstream		Downstream
_____	None	_____
_____	Partial	_____
_____	Heavy	_____

Location of Low Point:
_____At stream
_____Other _____
_____

Existing Drainage Control Features:
_____None _____Present and Functional
_____Need Repair_____

Width of Grade, including Shoulder and Ditches:_____ft.

Runoff Path:_____Roadway _____Ditch

CULVERT DESCRIPTION

Length: _____ft.
Diameter: _____ft.
Material: _____Galvanized
_____Concrete
_____Other_____

Condition: _____Good
_____Fair
_____Poor

Flow Through Culvert: _____Clear
_____Obstructed

Fish Passage Problems:_____

	Inlet	Outlet
Fill Depth:	_____ft.	_____ft.
Embankment:	_____Vertical	_____
	_____ 1:1	_____
	_____ 1.5:1	_____
	_____ 2:1	_____
	_____ >2:1	_____

STREAM CHARACTERISTICS

	Upstream		Downstream
Ave. Width:	_____ft.		_____ft.
Ave. Depth:	_____ft.		_____ft.
Ave Current:	_____	Slow	_____
	_____	Moderate	_____
	_____	Fast	_____
Predominate Substrate:	_____	Sand	_____
	_____	Sand/gravel	_____
	_____	Gravel	_____
	_____	Muck	_____

Adjacent Wetlands: _____Yes _____No
Water Temperature: _____
Visible Down cutting: _____

Comments: _____
_____
_____

CONDITIONS AND TREATMENT

Erosion Conditions:

_____ Streambank Erosion Adjacent to Crossing
_____ Embankment Erosion
_____ Culvert Outlet Erosion
_____ Pool Formation at Culvert Outlet
_____ Shoulder/Ditch Erosion
_____ Sand/Soil Over Crossing
_____ Other_____

Recommended Treatment:

_____Pavement
_____Pave Curb & Gutter
_____Erosion Control Structures ( )
_____Sediment Basins ( )
_____Extend Culvert ( )
_____Diversion Outlets ( )
_____Increase Fill
_____Replace Culverts ( )
_____Other_____

Extent:
_____Minor _____Moderate _____Severe

Reason for Recommendation:_____

Cause: _____
_____

PHOTOS Film Numbers:_____

SITE SKETCH

APPENDIX E

Severity Scoring Worksheet

Road/Stream Crossing Inventory
Cheboygan River/ Lower Black River Watershed

Site I. D. _____

Factors Contributing to Severity	**Points**	**Site Score**
ROAD SURFACE	Paved: 0 pt Gravel: 3 pt Sand and Gravel: 6 pt Sand: 9 pt	
LENGTH OF APPROACHES	0-40 ft: 1 pt 41-1000 ft (0.008-0.189 mi.): 3 pt 1001-2000 ft (0.19-0.379 mi.): 5 pt > 2000 ft (>0.379 mi.): 7 pt	
SLOPE OF APPROACHES	0 %: 0 pt 1-5%: 3 pt 6-10 %: 6 pt >10 %: 9 pt	
VEGETATIVE COVER OF SHOULDERS & DITCHES	Heavy: 1 pt Partial: 3 pt None: 5 pt	
WIDTH OF ROAD, SHOULDERS & DITCHES	< 15 ft: 0 pt 16-20 ft: 1 pt > 20 ft. 2 pt	
EMBANKMENT SLOPE	Bridges: 0 pt >2:1 slope: 1 pt 1:5-2:1 slope: 3 pt Vertical or 1;1 slope: 5pt	
STREAM DEPTH	0-2 ft: 1 pt >2 ft: 2 pt	
STREAM CURRENT	Slow: 1 pt Moderate: 2 pt Fast: 3 pt	
EXTENT OF EROSION	Minor: 1 pt Moderate: 3 pt Severe: 5 pt	
TOTAL	**0-15 Minor** **16-29 Moderate** **≥ 30 Severe**	

Agricultural Inventory for the Thunder Bay River Watershed

(Data form for farm operations within 1000 feet of surface water.)

Date:_____ Observer:_____ Stream:_____

1) LOCATION

County Township No.: Range: Section:
GPS Coordinates:
Property Owner:

2) FARM INFORMATION

Type of operation: ☐ Livestock ☐ Crops ☐ Orchard
Estimated size of farm:_____acres
General topography: ☐ Flat ☐Gently rolling ☐ Moderately rolling ☐ Steeply rolling
Estimated riparian frontage of farm:_____feet

3) SITE INFORMATION

Soil type: ☐ Clay ☐ Organic ☐ Sand ☐ Loam
Stream Conditions:

- Approximate width of stream:_____ • Current:____fast ____moderate ____ slow

Are there drains at this site? ☐ Yes ☐ No
Are there foreseeable risks to: ☐ surface water, ☐ groundwater, or ☐ wetlands from the farm site?

4) APPARENT POLLUTANT SOURCES

☐ Unrestricted Livestock Access to Water

- Approximate length length of access:_____

☐ Crop production adjacent to water (poor buffer/filter strip)

- Approximate length of production area along waterway:_____
- Distance from crops to water:_____ • Type of crops:_____
- Conservation tillage (reduced till or no till)_____

☐ Feedlot runoff

- Size of feedlot:_____ • Proximity to waterway_____ft. • Slope_____

☐ Manure Storage area runoff

- Size of area:_____ • Proximity to waterway_____ft. • Slope_____

☐ Manure Application within 150 feet of a waterway
☐ Poor storage of fertilizer/pesticides
☐ Is the land Irrigated Y N
☐ Other (please describe, such as oil & gas operation, silage runoff, milking parlor runoff, mining, farm road runoff, etc.):_____

5) RECOMMENDED TREATMENT

a. Exclusion Fencing
   - Total amount of fencing (for both sides of stream, if necessary) needed:_____ft.
b. Livestock crossing/livestock access
c. Alternate water source
d. Riparian buffer/filter strip
   - Width of buffer strip recommended:_____ft. • Length of buffer strip:_____ft.
e. Fertilizer/pesticide storage
f. Erosion control structures:_____
g. Animal waste facility
h. Feedlot diversion and water retention basin
i. Nutrient Management Plan
j. Other:_____

6) SEVERITY OF SITE

☐ Slight ☐ Moderate ☐ Severe

7) PERCEIVED LEVEL OF COOPERATION FROM LANDOWNER (if known)

☐ Very willing to implement BMPs ☐ Somewhat willing ☐ Unwilling ☐ Unknown

Please sketch map of site, showing direction of runoff, proximity to waterbody, and noting any site-specific concerns.

Additional notes for treatment (cost estimate):

Appendix G
Agriculture Inventory Table

CHEBOYGAN COUNTY									
MINOR SITES									
ALOHA TOWNSHIP		BENTON TOWNSHIP		GRANT TOWNSHIP		INVERNESS TOWNSHIP		MUNRO TOWNSHIP	
Site ID	Cost	Site ID	Cost	Site ID	Cost	Site ID	Cost	Site ID	Cost
34	$ 1,500	2	$ 500	32	$ 1,500	46	$ 1,500	103	$ 1,000
		4	200,000	37	1,500	47	2,000	104	1,000
		6	12,000	39	1,500	48	800	105	1,000
		7	12,000	41	1,200	50	1,500	106	1,000
		8	1,500	42	1,500	51	1,500	107	1,000
		9	250,000	44	1,500	52	1,500	108	1,000
		11	2,000	56	1,500	54	800	109	1,000
		12	20,000	57	1,500	55	6,000	110	1,000
		14	25,000	59	1,500	58	1,200	112	1,000
		16	1,200	60	1,500	70	25,000	114	1,000
		19	1,200	63	1,500	72	1,200	121	1,000
		21	1,200	65	1,200	73	1,000	122	1,000
		25	1,200			75	1,200	123	1,000
		29	10,000			77	1,000	124	1,000
						78	1,000	125	1,000
						80	1,000	126	1,000
						81	1,200		
						83	1,200		
						84	1,200		
						85	1,200		
						86	1,000		
						91	1,200		
						93	1,000		
						94	1,000		
						95	1,000		
						96	1,000		
						97	1,000		
						98	1,000		
						99	1,000		
						101	1,000		
						102	1,000		
						119	1,000		
Total Minor Sites	Cost	Total Minor Sites	Cost	Total Minor Sites	Cost	Total Minor Sites	Cost	Total Minor Sites	Cost
1	$ 1,500	14	$537,800	12	$17,400	32	$65,200	16	$16,000

Agriculture Inventory Table, Continued

MODERATE SITES									
ALOHA TOWNSHIP		BENTON TOWNSHIP		GRANT TOWNSHIP		INVERNESS TOWNSHIP		MUNRO TOWNSHIP	
		1	$20,000	31	$ 15,000	45	$ 6,000	111	$15,000
		5	50,000	33	20,000	49	16,000	113	1,200
		10	15,000	35	25,000	53	25,000	115	12,000
		13	20,000	36	15,000	71	23,000	116	2,000
		15	6,000	38	14,000	74	12,000	117	12,000
		17	6,000	40	125,800	79	12,000	118	21,000
		20	29,000	43	12,000	87	9,000	120	12,000
		22	1,000	62	9,000	88	12,000	127	12,000
		23	1,000	64	15,000	89	8,000	129	12,000
		24	1,000	66	1,500	90	20,000		
		26	4,000	67	12,000	92	20,000		
		27	8,000	68	15,000	100	14,000		
		28	4,000	69	8,000				
Total Moderate Sites	Cost	Total Moderate Sites	Cost	Total Moderate Sites	Cost	Total Moderate Sites	Cost	Total Moderate Sites	Cost
0	$0	13	$165,000	13	$287,300	12	$177,000	9	$99,200

SEVERE SITES									
ALOHA TOWNSHIP		BENTON TOWNSHIP		GRANT TOWNSHIP		INVERNESS TOWNSHIP		MUNRO TOWNSHIP	
		3	$350,000	30	$180,000	76	90,000	128	$350,000
		18	120,000	61	170,000	82	23,000		
Total Severe Sites	Cost	Total Severe Sites	Cost	Total Severe Sites	Cost	Total Severe Sites	Cost	Total Severe Sites	Cost
0	$0	2	$470,000	2	$350,000	2	$113,000	1	$350,000

EMMET COUNTY									
MINOR SITES									
BLISS TOWNSHIP		CARP LAKE TOWNSHIP		CENTER TOWNSHIP		MAPLE RIVER TOWNSHIP		MC KINLEY TOWNSHIP	
Site ID	Cost	Site ID	Cost	Site ID	Cost	Site ID	Cost	Site ID	Cost
142	$1,000	161	$1,000	151	$1,000	157	$1,000	131	$1,000
143	1,000	164	1,000	152	1,000	158	1,000	132	1,000
144	1,000	165	1,000	153	1,000	159	1,000	133	1,000
145	1,000	166	1,000	154	1,000	160	1,000	134	1,000
146	1,000	167	1,000	156	1,000			135	1,000
149	1,000	168	1,000					136	1,000
150	1,000	169	1,000					137	1,000
		172	1,000					138	1,000
		174	1,000					139	1,000
		175	1,000					141	1,000
Total Minor Sites	Cost	Total Minor Sites	Cost	Total Minor Sites	Cost	Total Minor Sites	Cost	Total Minor Sites	Cost
7	$7,000	10	$10,000	5	$5,000	4	$4,000	10	$10,000

Agriculture Inventory Table, Continued

MODERATE SITES									
BLISS TOWNSHIP		CARP LAKE TOWNSHIP		CENTER TOWNSHIP		MAPLE RIVER TOWNSHIP		MC KINLEY TOWNSHIP	
147	$12,000	162	$12,000	155	$ 12,000			130	$12,000
148	12,000	163	12,000					140	12,000
		170	12,000						
		171	12,000						
		173	12,000						
		176	12,000						
		177	12,000						
Total Moderate Sites	**Cost**	**Total Moderate Sites**	**Cost**	**Total Moderate Sites**	**Cost**	**Total Moderate Sites**	**Cost**	**Total Moderate Sites**	**Cost**
2	$24,000			1	$12,000	0	$0	2	$24,000
NO SEVERE SITES FOUND IN EMMET COUNTY									

WATER QUALITY WITHIN THE BURT LAKE WATERSHED

Existing Water Quality Within the Burt Lake Watershed

Burt Lake

The trophic status of a lake is based on its level of nutrient enrichment. Since Burt Lake is considered to be phosphorus limited, it is the nutrient of primary concern and is the primary trophic status indicator. A lake trophic status can also be determined from secchi disc depth and chlorophyll-a concentration. Recent data from the Watershed Council's yearly monitoring of secchi disc depth and chlorophyll-a indicates that Burt Lake is borderline mesotrophic-oligotrophic. Secchi disc and chlorophyll-a data for the last three years is given in Table 4.

Table 4. Secchi disc and chlorophyll-a data for 1984, 1985 and 1986

Year	Secchi Disc Depth (ft.)	Chlorophyll-a Concentration (ug/l)	Carlsons Tropic Status Index No.
1984	13.6	2.9	40
1985	12.5	1.8	39
1986	11.3	1.1	37

The dividing line between mesotrophic and oligotrophic on Carlson's trophic status index (TSI) scale is 38. TSI numbers below 38 are oligotrophic while numbers from 39-50 are mesotrophic. Data collected in April 1987 showed that total phosphorus during spring turnover was less than 10 ug/l, which indicates that the lake is oligotrophic. Federal Storet System data from 1979 and 1981 show spring total phosphorus concentration of 6 ug/l, also indicating oligotrophic conditions.

Even though Burt Lake has high water quality, data recorded in the Storet System shows that hypolimnetic oxygen depletion does occur after several months of stratification (Appendix B). This indicates that enough organic matter is accumulating and decomposing to depress dissolved oxygen levels. The more nutrient enrichment a lake receives, the more common this phenomenon becomes.

Burt Lake's water quality is controlled in part by the physical characteristics of the lake and its watershed (Table 5).

Table 5. Morphometric Features of Burt Lake and Its Watershed

Lake surface area	6928 ha (17,120 acres)
Watershed area	102,192 ha (252,520 acres)
Maximum depth	22 m (73 ft.)
Mean depth	12 m (40 ft.)
Maximum length	15.6 km (9.7 miles)
Maximum width	7.7 km (4.8 miles)
Volume	632,173,568 cubic meters (512,512 ac. ft.)
Shoreline development factor	1.8
Shoreline length	51.5 km (32 miles)
Watershed area: lake area	14.8:1
Water retention time	1.04 years

Its low shoreline development factor limits the amount of shoreline influence on water quality and its water retention time is very short helping to prevent nutrients from concentrating in the lake water. Lakes which have a large watershed relative to lake size are generally more susceptable to nutrient enrichment from non-point source than lakes with proportionally smaller watersheds. Burt Lake has a very large watershed to lake size ratio of 14.8:1. Fortunately more than 90% of the watershed is currently in land uses that characteristically don't export excessive levels of nutrients.

Tributaries

Water quality sampling of Burt Lake's tributaries was performed twice during the spring of 1987. Streamflows were unusually low due to below normal precipitation during the winter and spring, and water quality may have been affected by this. Samples were collected on both branches and the main stem of the Maple River, Hasler Creek, the Crooked River at Alanson and below a residential area called Devils Elbow, the Sturgeon River immediately above the Village of Indian River and at the rivers mouth (Figure 4). The Indian River which discharges from Burt Lake was also sampled on April 28.

Water samples from the other sample points were collected on April 28 and May 19. The May 19 samples were collected within 12 hours of a rainstorm to see if there was any appreciable affect on water quality. Data sheets are located in Appendix C.

Depth integrated samples were collected in polyethylene bottles, preserved with hydrochloric acid when necessary, and placed on ice. Samples were packed in styrofoam coolers and shipped to the State Environmental Laboratory the same day they were collected. The water samples were analyzed for ortho-phosphorus, total phosphorus, and total suspended solids. Whenever possible, flow volumes were determined with a flow meter at the time of sample collection. Flow volumes could not be determined on the Crooked River, the mouth of the Sturgeon River, or the Indian River because they were too deep to wade. Water quality data is summerized in Table 6.

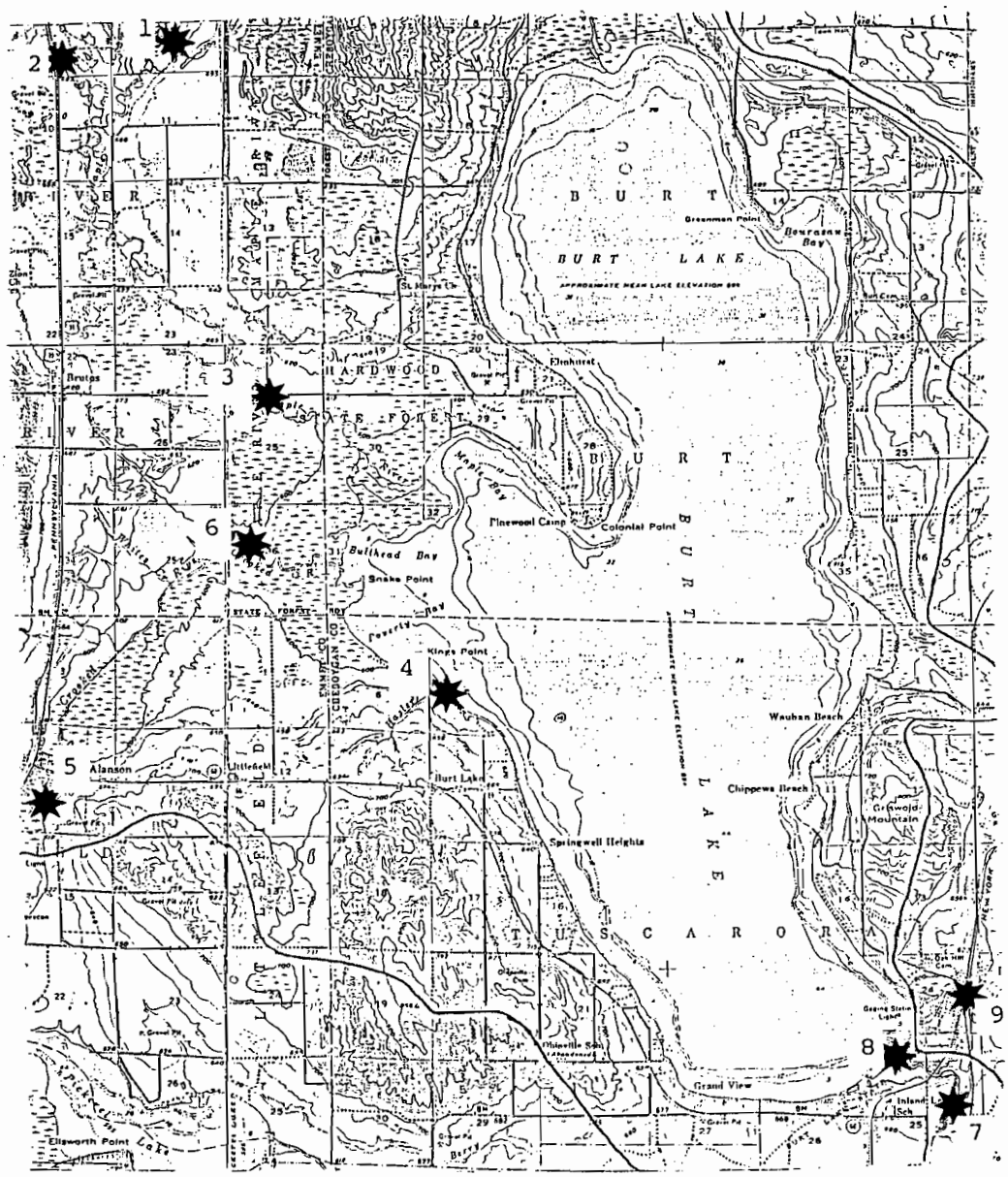
Since it is not possible to analyze the data statistically, it is difficult to draw firm conclusions on streamflow and nutrient delivery. The flow volumes measured after the May 19 rainstorm are generally lower than those measured on April 28. The only exception to this was the flow of the Maple River's west branch which was slightly higher than that recorded on April 28. Since continuous flow monitoring data was not available, it is impossible to determine if the rainstorm was of sufficient intensity to produce an increase in streamflow volumes.

In general, the ortho-phosphorus concentrations were quite low and did not appear to change appreciably at any station from one sampling to the next.

The total phosphorus (total P) and total suspended solids data was more variable. The total-P at all three Maple River sample sites decreased in the storm flow sample while the suspended solids concentration either decreased or stayed the same. This may be due to dilution from increased flow. It could also indicate a lack of nonpoint source influence on the Maple River. Storm runoff is usually expected to result in increased concentration of these parameters if agriculture and erosion is a problem within a watershed.

Hasler Creek does have some agriculture in the headwaters of its watershed and all three parameters showed an increase in concentration during the stormflow. It is possible that the rainfall resulted in increased sediment and nutrient runoff to the creek.

FIGURE 4 TRIBUTARY SAMPLING LOCATIONS



Bold line indicates Watershed Boundary.

STATION 1 - Maple River East Branch - Dam Site

STATION 2 - Maple River West Branch - M-68 Crossing

STATION 3 - Maple River Main Branch - Brutus Road

STATION 4 - Hasler's Creek - Ellinger Road Crossing

STATION 5 - Crooked River Upstream - Alanson

STATION 6 - Crooked River Downstream - Mission Road

STATION 7 - Sturgeon River Upstream #1-off Wilson Road

STATION 8 - Sturgeon River Downstream #2-Mouth of Burt Lake

STATION 9 - Indian River Downstream of U.S. 27 Bridge

TABLE 6.

SUMMARY OF WATER QUALITY DATA FROM TRIBUTARY SAMPLING

Location No.	River	Date	Flow Volume	Ortho-Phosphorous	Total Phosphorous	Total Suspended Solids
1	East Branch of Maple River	4/28	25 CFS	.001 mg/l	.004 mg/l	6 mg/l
		5/19	18 CFS	.001 mg/l	.001 mg/l	< 4 mg/l
2	West Branch of Maple River	4/28	33.5 CFS	.002 mg/l	.011 mg/l	4 mg/l
		5/19	40 CFS	.001 mg/l	.003 mg/l	< 4 mg/l
3	Main Branch of Maple River	4/28	118 CFS	.002 mg/l	.011 mg/l	< 4 mg/l
		5/19	86 CFS	.001 mg/l	.003 mg/l	< 4 mg/l
4	Hasler Creek	4/18	0.4 CFS	.003 mg/l	.010 mg/l	4 mg/l
		5/19	0.3 CFS	.005 mg/l	.019 mg/l	7 mg/l
5	Crooked River at Alanson	4/28	N/A	.001 mg/l	.005 mg/l	11 mg/l
		5/19	N/A	.001 mg/l	.001 mg/l	< 4 mg/l
6	Crooked River at Devil's Elbow	4/28	N/A	.001 mg/l	.001 mg/l	6 mg/l
		5/19	N/A	.001 mg/l	.001 mg/l	4 mg/l
7	Sturgeon River above Indian River	4/28	243 CFS	.001 mg/l	.011 mg/l	5 mg/l
		5/19	222 CFS	.001 mg/l	.016 mg/l	10 mg/l
8	Sturgeon River at mouth	4/28	N/A	.001 mg/l	.009 mg/l	7 mg/l
		5/19	N/A	.001 mg/l	.028 mg/l	10 mg/l
9	Indian River at M-27 Hwy. Bridge	4/28	N/A	<.01 mg/l	.20 mg/l	14 mg/l

The Crooked River showed no change in ortho-phosphorus, but a slight decrease in total-phosphorus and total suspended solids was observed at the Alanson sample point. At the Devils Elbow site, the only parameter that changed was total suspended solids which decreased slightly in the storm flow sample. Once again, this may indicate a lack of nonpoint source influence on the Crooked River.

Ortho-P was not observed to change at anytime at either location on the Sturgeon River. It remained consistently low at .001 mg/l. A comparison of the two sample sites in the river indicates that the concentration of total suspended solids was slightly higher at the downstream station during the fair weather flow but remained unchanged during the storm flow. Total-P was more variable. During the April 28 sampling total-P was slightly lower at the mouth of the Sturgeon River than at the upstream sample point. This could be due to groundwater dilution during fair weather flow. At the upstream sample point, the total-P concentration was higher during the storm flow than that found during fair weather. During the storm flow total-P was 0.019 mg/l higher at the river mouth than the concentration of the fair weather sample at the same site. Not only did total-P increase at each individual sample point but it also increased by 0.012 mg/l between the upstream sample point and the mouth during the storm flow. It appears that the storm flow caused an increase in total-P at each sample point and between sample points. This may be the result of some nonpoint affects of runoff from the Village of Indian River. However, this interpretation is purely speculative since the concentration of total suspended solids remained unchanged between the two stations during the storm flow.

A single sample was taken on April 28 from the Indian River which discharges from Burt Lake through the Village of Indian River. No comparison between the Indian River and Burt Lake's tributaries is possible for ortho-P because the data was reported as less than 0.01 mg/l, while the other data was reported in the range of 0.001-0.005 mg/l. Total-P however was substantially higher in the Indian River at 0.20 mg/l. The next highest reported value for total-P was 0.028 mg/l at the Sturgeon River's mouth during the storm flow.

The concentration in the Indian River was more than seven times higher. It is also substantially higher than background total-P concentrations in the lake which are in the .006-.01 mg/l range. This indicates that there is an external source of phosphorus to the Indian River itself. However, the Indian River is not within the Burt Lake Watershed, and the determination of the source or sources will not be addressed here.

Nutrient and sediment loading rates in pounds per day have been calculated and tabulated (Table 7) for those locations where flow volume was determined. It must be noted that these are single day loading calculations, and extrapolation into annual loading rates is not appropriate. Discharge at the mouth of the Sturgeon River was assumed to be the same as that measured above the Village of Indian River. There is no flow monitoring of the Crooked River by any public agency, and its depth prevented manual flow determination. The same situation exists for the Indian River.

Loading rate calculations indicate that the west branch of the Maple River is carrying a heavier nutrient and sediment load than the east branch. The loading rate calculation for the mainstem indicates less nutrient and sediment was transported in the storm flow due to lower flow volume and concentrations.

In Hasler Creek, on the other hand, loading rates increased during the storm flow, even though the flow volume was actually less than that measured on April 28. This tends to indicate some source of nonpoint influence on Hasler Creek. Due to the creek's small flow volume, overall loading to the lake is extremely small.

Even though the flow volume of the Sturgeon River was lower during the storm flow sampling, the overall loading to the lake of total-P and total-suspended solids increased because of higher concentrations during the storm flow. Storm flow loading of total-P was almost three times greater during the storm flow, while the total suspended solid loading increased by 23%. Ortho-P decreased by about 8%. This tends to indicate that nonpoint sources may result in increased sediment and nutrient loading during storm flows.

Table 7. Tributary Loading Rates

Location	Parameter	4/28	5/19
East Branch of Maple River	ortho-P	.135 lb./day	.097 lb./day
	Total-P	.53	.097
	Total Susp. Solids	810	389
West Branch of Maple River	ortho-P	.362	.216
	Total-P	1.99	.648
	Total Susp. Solids	724	864
Mainstem Maple River	ortho-P	1.27	.46
	Total-P	7	1.39
	Total Susp. Solids	2549	1858
Hasler Creek	ortho-P	6.48 x10-3	8.1x10-3
	Total-P	.022	.031
	Total Susp. Solids	8.6	11.3
Sturgeon River above Indian River	ortho-P	1.31	1.20
	Total-P	14.43	19.18
	Total Susp. Solids	6561	11988
Sturgeon River at Mouth	ortho-P	1.31	1.20
	Total-P	11.81	33.57
	Total Susp. Solids	9185	11988

Existing and Potential Water Quality Problems

Currently the Maple River has no significant water quality problems. However, the beef cattle operation and eroding fishermen access points have the potential to degrade the water quality and fishery habitat. The effect of cattle and erosion on the river appears to be slight. The river still supports a healthy trout fishery and its nutrient and sediment concentrations are quite

low. However, further sampling immediately below these potential problem sites during snowmelt or storm flow may indicate problems that are not as yet apparent.

Further home development in the wetlands bordering the Crooked River has the potential to increase nutrient loading to Burt Lake. The Crooked River has a boating channel directly to the lake, so the wetlands at its mouth probably do little to reduce nutrient and sediment transport to Burt Lake. Virtually all of the 30 homes in the Devil's Elbow area have mounded septic drainfields because of the high water table in the hydric soils.

The Sturgeon River has excellent water quality. However, eroding sand banks along the river are contributing to the rivers bedload which is being deposited at the river's mouth. While the sand is probably quite low in nutrients, it is still a problem because of delta formation. The shallow water of the delta sometimes causes ice jams which flood nearby homes and septic systems. The flooding could result in a public health threat, and be a source of septic nutrients to the lake. Another potential problem is urban runoff from the Village of Indian River which might be reaching the Sturgeon River. Further storm runoff sampling would help to clarify this possibility.

Burt Lake itself has extremely good water quality to date. However, some local nearshore problems have been noted. Canals entering the lake at Plymouth Beach and in the Village of Indian River are highly nutrient enriched and support dense algae growths. Shoreline algae (cladophora) problems have also been observed along various portions of the lake. There are generally three external sources of nutrients which allow cladophora to grow: septic system leachate, lawn maintenance fertilizers, and natural springs and seeps. In some cases, it is possible that springs and seeps are carrying septic leachate and lawn fertilizer to the lake.

Nutrient loading to the lake from all of the sources mentioned have the potential to degrade water quality if allowed to continue at existing levels. Increased loading is quite possible as lake shore development continues, as more older septic systems begin to fail, and if agriculture becomes more prevalent in the watershed. There also appears to be a trend of converting seasonal cottages to year-round homes without upgrading septic systems to handle the increased waste load. It is also possible that the groundwater and

lake water could become contaminated from leaking underground storage tanks as they continue to age. Thirty-eight private underground storage tanks have been identified along the Burt Lake shoreline. Most of the tanks are for fuel oil and gasoline storage. Proper monitoring of tanks in use and proper abandonment of those no longer in use will help protect water quality and public health.

Description of All Sources of Each Pollutant of Concern

Burt Lake Shoreline

The soils that surround the Burt Lake shoreline all have severe limitations for septic system drainfield effluent filtration. Inadequate filtration of effluent is a problem along the shoreline because the soils are either too coarse (poor filter), have fine textured horizons (perc slowly), or are too wet (high water table, ponding). These conditions are conducive to transport of inadequately filtered septic effluent to the lake. This can occur when septic system drainfields are poorly sited, hydraulically overloaded, inadequately maintained, or are undersized for the amount of use they receive.

To date, a septic leachate detection survey has been conducted along six sections of shoreline containing 288 homes, more than 27% of all homes along the lakeshore. Twenty-eight homes (10%) had strong septic leachate plumes as identified with the Model 15 Peeper Beeper septic leachate detector produced by KV-Associates. Six shallow groundwater samples were taken at identified plumes and analyzed for total-phosphorus nitrate and ammonia concentrations. Two background samples and one streamwater sample were also analyzed. The leachate plumes contained concentrations of three parameters that were much higher than ambient background groundwater samples. A complete discussion of septic leachate detector survey methods and results are given in the Burt Lake Shoreline Inventory methods on page 37.

The six lakeshore sections that have been inventoried are shown on Figure 5. Results of the survey by lakeshore section are summarized in Table 8.

EXISTING WATER QUALITY IN THE MULLETT LAKE WATERSHED

Mullett Lake

Dissolved Oxygen

The water quality of Mullett Lake has been studied by various groups for a number of years. Much of the information on the water quality of the lake concerns summer hypolimnetic dissolved oxygen (D.O.) concentrations.

Hypolimnetic D.O. Concentrations are a valuable means of assessing lake water quality. As the nutrient enrichment of a lake increases the biological productivity increases resulting in more algae and possibly rooted aquatic plants. The decomposition of this organic matter on the lake bottom can depress D.O. concentrations to the point where the bottom waters of a lake become devoid of oxygen. If this occurs, chemical reactions release phosphorus that is normally bound in bottom sediments into the overlying water. At fall overturn the nutrient enriched waters are recirculated to the surface where the nutrients are again available to algae and other aquatic plants. The cyclic internal loading of phosphorus can become a very severe lake management problem on some lakes. Mullett Lake`s level of eutrophication has not progressed to this stage.

Historical D.O. data begins with a 1956 water quality report by the Fisheries Divison of the state Department of Conservation stated that deep water D.O. concentrations were normally found between 7.6 and 8.9 ppm. This is a high level of dissolved oxygen and would be typical of an oligotrophic lake.

The University of Michigan Biological Station field classes have also periodically collect data on the status of mid-summer hypolimnetic D.O. concentrations in Mullett Lake. Table 3 shows unpublished data from Bio Station field work.

The dissolved oxygen concentrations observed by the field classes indicate that no significant mid-summer oxygen depletion was occurring in the mid-1960's and early 1970's.

Table 3.
Hypolimnetic Dissolved Oxygen Concentrations

Year	Date	D.O. (ppm)
1965	8/3	5.2
1966	7/14	6.7
1971	7/26	5.0
1972	7/14	5.7
1973	7/10	7.8

A regional study of water quality performed in 1979 by the Northeast Michigan Council of Governments (NEMCOG) found that the dissolved oxygen concentration in the hypolimnion of the lake was 4.0 ppm on September third.

More recently, investigations by the Tip of the Mitt Watershed Council have found dissolved oxygen concentrations substantially lower than those previously recorded. In August 1983, D.O. was recorded at 1.0 ppm while in September 1987, D.O. was found to be 1.8 ppm. Dissolved oxygen concentrations in this range are characteristic of mesotrophic conditions.

Since the dissolved oxygen data presented here comes from a variety of sources it is not appropriate to draw conclusions about changes in lake water quality based solely on this data.

Phosphorus

Mullett Lake is considered to be phosphorus limited. This means that the availability of phosphorus controls the biologic productivity of the lake. Lakes with high levels of phosphorus generally support large amounts of algae and/or aquatic vascular plants and have poor water quality. High quality lakes, on the other hand, are low in phosphorus and support only minimal amounts of plant growth. Total phosphorus concentrations at spring turnover are considered to be a reliable indicator of a lake's level of nutrient enrichment.

There is a very limited amount of phosphorus data available for Mullett

Lake. The regional water quality study performed by NEMCOG in 1979 found spring turnover total phosphorus concentration of 4.0 parts per billion (ppb). Sampling performed by the Tip of the Mitt Watershed Council in 1987 recorded a total phosphorus concentration that was below the laboratory's detection limit of 10 ppb. A total phosphorus concentration of less than 10 ppb at spring turnover is indicative of oligotrophic conditions.

Secchi Disc and Chlorophyll-a

The measurement of secchi disc transparency and chlorophyll-a concentrations are simple yet useful ways of determining lake water quality. These two parameters have been routinely measured in the Tip of the Mitt Watershed Council Volunteer Lake Monitoring Program since 1983. The two parameters are measured by the participants in the deepest part of the lake. Clarity measurements, which are taken with a Secchi disc, are taken weekly. Composite water samples to twice the secchi depth are collected for chlorophyll-a analysis every two weeks. Both parameters are sampled from June through August.

Average summer secchi disc depth and chlorophyll-a concentrations are used to determine water quality through the Carlson Trophic Status Index (TSI). This allows water quality to be ranked on a numerical scale from one to 100. Water quality increases with lower TSI values. Trophic Status Index values from one to 38 are considered oligotraphic; values from 39 to 49 are considered mesotrophic; and values above 50 are considered eutrophic. Table 4 shows Carlson TSI values recorded in the Volunteer Monitoring Program.

Table 4.

Carlson TSI Values Based on Average Summer Secchi Disc and Chlorophyll-a Values from 1983 to 1988.

1983...42; mesotrophic
1984...42; mesotrophic
1985...39; oligotrophic
1986...39; oligotrophic
1987...38; oligotrophic
1988...43; mesotrophic

Year to year variability of TSI values is common and is related to the variability of climatic conditions. The data indicates that the water quality of Mullett Lake fluctuates near the dividing line between oligotrophic and mesotrophic conditions.

While the TSI data since 1983 shows no clear water quality trend, the low dissolved oxygen concentrations recorded in recent years indicate that the lake is sensitive to hypolimnetic dissolved oxygen depletion. Therefore, further nutrient enrichment of the lake could result in a substantial negative impacts on the lake's water quality and biological integrity.

Tributaries

Indian River

The Indian River is Mullett Lake's largest tributary. The unincorporated village of Indian River covers a significant portion of it's watershed near the river's outlet from Burt Lake. The village contains approximately 700 homes and 150 businesses, and is completely served by individual septic systems and wells. While many of the homes only receive seasonal use, it appears that ever increasing numbers are being converted to year-round use. A large number of wells are artesian indicating the presence of an clay layer beneath the village.

Within the last ten years, there has been a substantial concern about the need to have the community sewered. However, in 1979, community residents defeated a sewer referendum. Since that time the county Health Department has taken steps to upgrade septic systems. Yet due to the high groundwater table beneath the community and it's dense residential and commercial development it is possible that septic systems may be discharging large nutrient loads to the groundwater which discharges to Mullett Lake through the Indian River.

In August of 1988, personnel from the Surface Water Quality Division of the Michigan Department of Natural Resources conducted a survey of the surface waters in and around the community of Indian River (Appendix A). The survey

found only one direct sewer discharge to the Indian River. The report states that sample results from ditches that drain an older residential area may be showing the influence of the large number of drainfields in the area. Dilution from flowing wells are believed to have masked the true magnitude of the problem.

During this survey, water samples taken from the Indian River indicated high water quality. The only difference in water quality between samples taken above and below the influence of the community was a doubling of Kjeldahl nitrogen below the community.

Little Sturgeon River

Very little information is available about the water quality of the Little Sturgeon River. In it's upper reaches the river supports native brook trout so it can be assumed to have cold, clean waters.

As the river approaches the town of Indian River the character of the river changes. Flow velocity decreases and the river becomes wider once the river emerges from it's underground passage under I-75. From this point to it's confluence with the Indian River, the Little Sturgeon River flows through mostly residential land. The river may be receiving nutrients from nearby septic drainfields, lawn fertilizers, and possibly storm sewer discharges.

The MDNR water quality survey of the waters in and around the town of Indian River found that the river generally has good water quality. However, bacterial sampling above and below the influence of the residential areas identified more than a doubling of fecal coliform and more than a tripling of fecal strep. This may indicate the presence of inadequately functioning septic systems along the Little Sturgeon River.

Pigeon River

A water quality study of the Pigeon River was conducted in the summer of 1984 by staff of MDNR in response to a spill of organic silt resulting from the improper drawdown of an impoundment called the Lansing Club Pond. The report

stated that the river is classified as a cold water fishery with very high water quality.

According to the report, above the influence of the silt spill, water quality analysis revealed that the river had very high dissolved oxygen concentraions that were consistently at or near 100% saturation. Biochemical oxygen demand was very low indicating the presence of very little organic matter in the river. Total suspended solids concentrations were also low and ranged from 4 to 12 mg/l. These values were similar to those recorded at the river's outlet to Mullett Lake. It is reasonable to assume that before the silt spill the water quality of the entire river was similar to that at the monitoring station upstream of the spill site.

The silt spill resulted in an immediate and dramatic decline in the river's water quality, killing trout and other aquatic organisms. Water quality degradation was greatest immediately downstream from the spill, and decreased in severity further downstream. In the intervening years since the spill the river has returned to it's former water quality and once again supports a cold water fishery. The impact of the silt spill on the water quality of Mullett Lake was never investigated.

Little Pigeon River

There is no data available on the water quality of the Little Pigeon River. However, the river supports native brook trout so it can be assumed to have cold, clean waters.

Mullett Creek

The water quality of Mullett Creek has never been studied. The creek drains substantial areas of agricultural land in its upper watershed. In this area, the creek is narrow and is generally paralleled by stream bank wetlands and is clear and cool. In the lower portion of its watershed, the creek is approximately 35 feet wide, shallow, with a dark organic bottom. Emergent vegetation is common, and the water is stained brown from wetland drainage.

Mullett Creek may support brook trout in its upper reaches, while the lower portion of the creek appears more suited to warm water fish.

Several agricultural problems have been identified in the watershed and may be increasing the stream's nutrient and sediment load.

Miscellaneous Streams

A large number of small unnamed and unmapped streams flow into Mullett Lake along many portions of the shoreline. These streams usually originate from springs and seepages in wetlands and flow for only a short distance before discharging into the lake. These flows are generally of high quality. However, some may pick up nutrients from lawn fertilizers and septic effluent as they flow through shoreline residential developments.

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3 8 Simple Tips

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1-800-648-6942

www.michigan.gov/mdch-toxic,
then click on Michigan Fish Advisory

Project F.I.S.H

HEALTH BENEFITS AND RISKS OF EATING FISH

HEALTH BENEFITS OF EATING FISH

The Michigan Department of Community Health (MDCH) recommends that adults and children include fish as a regular and healthy part of their diet. Fish are a great low-fat source of protein, vitamins and minerals. The oils (omega-3 fatty acids) found in fish can be important to the healthy development of babies during pregnancy, breast-fed babies and children. Eating fish on a regular basis can also reduce the risk of heart disease in adults as fish, are low in saturated fat.

The American Hearth Association recommends eating fish two times a week.

Health Risks from Chemical Contaminants found in Some Fish

MDCH advises women of childbearing age and children under 15 years old to be extra careful before eating certain types of fish in Michigan.

The Michigan Department of Community Health advises extra caution about eating some species of fish too often. Many chemicals used in society eventually end up in lakes, rivers, oceans and in some of the fish that we eat. The amounts of chemicals found in Michigan fish are not known to cause immediate sickness. It may take months or years of regularly eating contaminated fish to build up to amounts that are a health concern. However, some of these chemicals can reach levels that could be harmful to human health if people eat contaminated fish too often. Chemicals can reach high levels in your body and can affect your health or your children's health. Women of childbearing age that eat contaminated fish may have children with delayed or impaired physical, mental, or behavioral development. Some of these chemicals can damage an adult's immune system, cause changes in liver function or cause cancer.

Get the Benefits and Avoid the Risks

Use Michigan's Fish Consumption Guides:

There are many types of fish that make healthy additions to your diet. Use the information found in Michigan's Fish Consumption Guides to get the benefits of eating fish without the risks from chemical contamination.

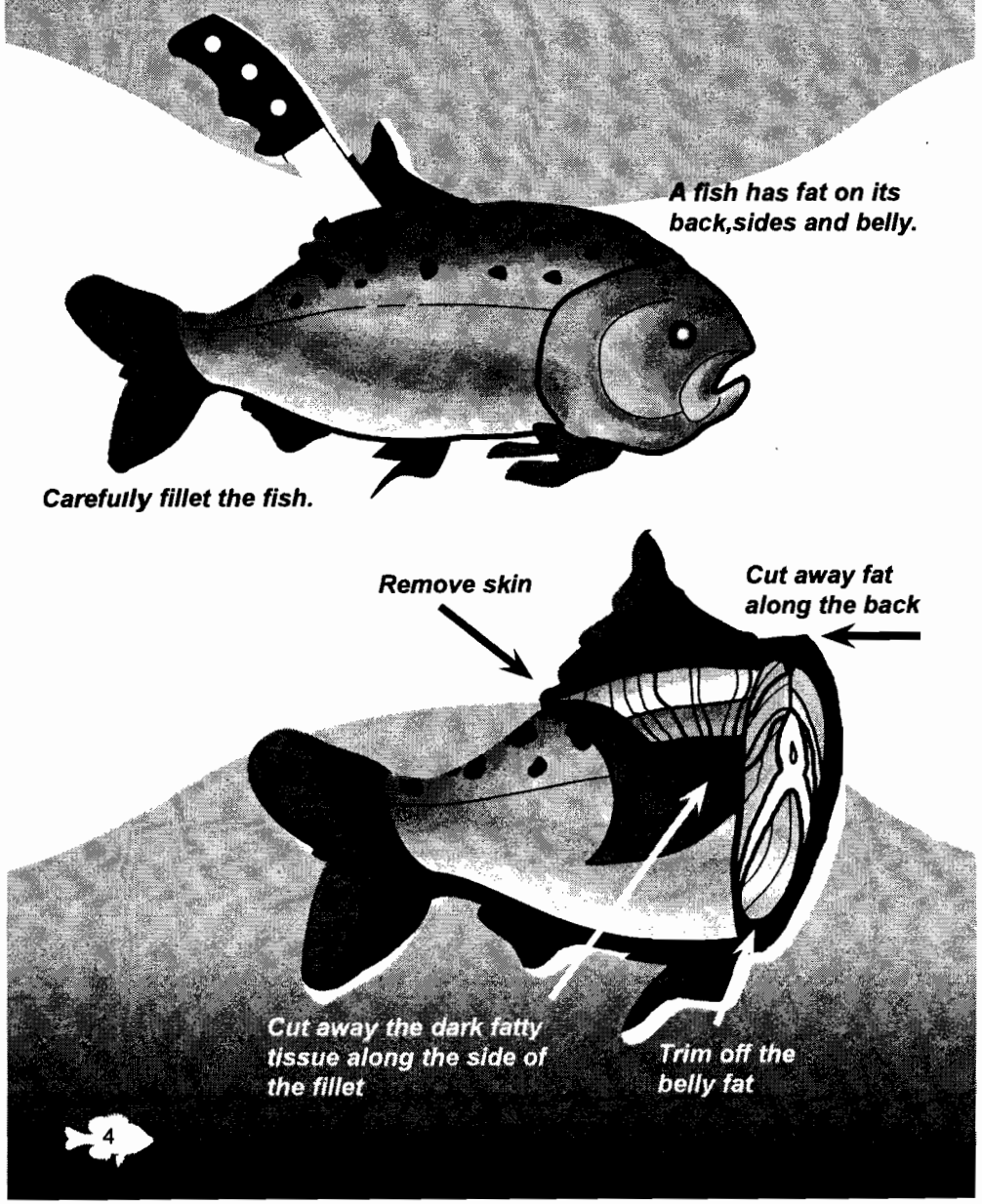
- *Michigan Family Fish Consumption Guide*: This is the booklet you are reading. It contains specific fish consumption advice by water body, fish species, fish length, and by the age and gender of the person eating the fish.
- *A Family Guide to Eating Fish*: This brochure provides the essential fish consumption information for families.
- *Avoid Mercury in Fish and Seafood Shopping and Restaurant Guide*: This brochure contains a list of types of fish that you can buy that have been tested for mercury contamination by the U.S. Food and Drug Administration (U.S. FDA). The U.S. FDA has issued a nationwide advisory about mercury in pur chased fish for women of childbearing age and young children. The brochure provides meal consumption advice.

8 SIMPLE TIPS FOR EATING SAFE FISH

1. Trimming and Cooking
   - Trim away fatty areas (see page 4 for directions).
   - Remove or puncture the fish's skin before cooking. This allows fat to drain off and helps remove fat from under the skin.
   - Cook the fish so the fat drips away by baking, broiling, or grilling on a rack. Throw away the liquid fat and drippings.
   - Do not eat the organs, head, skin or dark fatty tissues.
   - Do not re-use oils used to deep or pan fry fish.
2. Space out your meals of fish.
3. Eat many different types of fish from a variety of sources. You will be more likely to select healthy fish choices.
4. Limit your meals of the kinds of fish that eat other fish. They are likely to contain more mercury and other chemical contaminants.
5. Eat smaller, younger fish. Fish just over the legal size limit or panfish tend to be lower in chemical contamination. Bigger and older fish have had more time to collect more chemicals.
6. Most chemicals (except mercury) collect in fat. Avoid fatty fish like carp and catfish from contaminated waters. Instead, try eating farm-raised catfish from your grocery store.
7. Don't eat shark, tilefish, king mackerel or swordfish. The U.S. FDA has found these species contain high amounts of mercury.
8. Mercury cannot be trimmed or cooked away from fish. Choose species that are low in mercury.

COOKING AND CLEANING FISH

Important reminders.



Mercury Fish Consumption Advisories

Statewide Mercury Fish Consumption Advisory For All Inland Lakes, Reservoirs, and Impoundments

Follow the Statewide Mercury Advisory for lakes, reservoirs, and impoundments that are not listed in the fish consumption advisory tables of this booklet. The Statewide Mercury Advisory does not apply to the Great Lakes or rivers in Michigan.

- No one should eat more than one meal a week of rock bass, yellow perch, or crappie over 9 inches in length from inland lakes, reservoirs, or impoundments in Michigan.
- No one should eat more than one meal a week of largemouth bass, smallmouth bass, walleye, northern pike or muskellunge of any size from inland lakes, reservoirs, or impoundments in Michigan.
- Women of childbearing age and children under 15 years old should eat no more than one meal per month of rock bass, yellow perch, or crappie over 9 inches in length from inland lakes, reservoirs, or impoundments in Michigan.
- Women of childbearing age and children under 15 years of age should eat no more than one meal per month of largemouth bass, smallmouth bass, walleye, northern pike or muskellunge of any size from inland lakes, reservoirs, or impoundments in Michigan.

Nationwide Mercury Fish Consumption Advisory for Store Purchased Fish

The U.S. FDA has issued a nation-wide advisory about mercury in purchased fish to women of childbearing age and young children. MDCH has created the brochure called *Avoid Mercury in Fish and Seafood Shopping and Restaurant Guide*, which provides meal consumption advice based on U.S. FDA's testing of store purchased fish for mercury.

5 STEPS TO USING THE MICHIGAN FAMILY FISH CONSUMPTION GUIDE

The *Michigan Family Fish Consumption Guide* provides fish consumption advice by water body, fish species, and fish length. The fish consumption advice is provided in the tables on pages 8-57. The water bodies are grouped into four sections based on the Great Lakes Watersheds. Follow the Statewide Mercury Fish Consumption Adviosry found on page 5 for inland lakes, reservoirs, and impoundments not listed in the Guide.

Why doesn't the fish consumption guide list every water body?
Water bodies may not be listed because:

1. Fish from the water body have never been tested for chemical contaminants. Michigan has more than 11,000 lakes and 36,000 miles of rivers and streams in addition to the Great Lakes. Waters are more likely to be selected for fish contaminant testing if the water body has known contaminant problems, high recreational use,or may provide useful environmental information.
2. Fish from the water body have been tested but are covered by Statewide Mercury Fish Consumption Advisory for Inland Lakes, Reservoirs, and Impoundments.

Step One:

Decide which Great Lake Watershed your water body is located in.
If you are not sure which Watershed your water body is locatedin, check the two closest Great Lakes Watersheds.

- Erie page 8
- Huron page 20
- Michigan page 30
- Superior page 52

Step Two:

The list of water bodies starts with the name of the Great Lake, followed by the bays on the Great Lake that have additional advisories and then by an alphabetical listing of lakes, rivers, reservoirs, or impoundments. Locate the name of your water body in the first column of the table.

Step Three:

Locate the fish species that you are fishing for in the second column.
Find the length of the fish along the top right side of the table.

Step Four:

Choose the category that matches the person(s) who will eat the fish.

- General Population: Adult men. Boys 15 years or older. Women beyond childbearing age.
- Women & Children: Women ages 15 and older of childbearing age who are pregnant or may have children in the future. Children under the age of 15 years old.

Step Five:

Follow the length column in the category that matches the person eating the fish down to the fish species you caught. The symbol on the table represents the consumption advice according to the following key:

▲ Unlimited consumption.
▼ One meal per week.
● One meal per month.
■ Six meals per year.
◆ Do not eat these fish.

For More Information

For more information on the Fish Consumption Advisory, visit our website at www.michigan.gov/mdch-toxic or call 1-800-648-6942.

▲ Unlimited consumption.
● One meal per month.
▼ One meal per week.
■ Six meals per year.
◆ Do not eat these fish.

Water body	Species	Contaminant(s)	General Population: Length (inches) 6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30 +	Women & Children: Length (inches) 6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30 +
Lake Huron Watershed All other locations refer to general advice on page 5.																				
Lake Huron #	Brown Trout	PCBs			▲	▲	▲	▼	▼	▼	▼			●	●	●	◆	◆	◆	◆
	Burbot	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▼	▼	▼
	Chinook Salmon	PCBs			▲	▲	▲	▲	▲	▲	▲			●	●	●	●	●	●	●
	Coho Salmon	PCBs			▲	▲	▲	▲	▲	▲	▲			●	●	●	●	●	●	●
	Lake Trout	PCBs, Dioxins			▼	▼	▼	▼	▼	◆	◆			◆	◆	◆	◆	◆	◆	◆
	Rainbow Trout (Including Steelhead)	PCBs			▲	▲	▲	▲	▲	▲	▲			●	●	●	●	●	●	●
	Whitefish	PCBs, Dioxins	▲	▲	▲	▲	▲	▼	◆	◆	◆	▼	▼	▼	▼	▼	◆	◆	◆	◆
Saginaw Bay # (Also follow Lake Huron advisories above)	Carp	PCBs, Dioxins	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Channel Catfish	PCBs, Dioxins				▼	▼	◆	◆	◆	◆				◆	◆	◆	◆	◆	◆
	Northern Pike	PCBs							▲	▲	▲							▼	●	●
	Suckers	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	●	●	●	●	●
	Walleye	Mercury, PCBs					▲	▲	▼	▼	▼					▼	●	●	●	●
	White Bass	PCBs, Dioxins	▲	▲	▲	▼	▼	▼				●	●	●	◆	◆	◆			
	White Perch	PCBs	▲	▲	▲	▲						●	●	●	●					
	Yellow Perch	PCBs	▲	▲	▲	▲	▲					▼	▼	▼	▼	▼				
Thunder Bay # (Also follow Lake Huron advisories above)	Carp	PCBs, Dioxins	▲	▲	▲	▲	▲	◆	◆	◆	◆	▼	▼	▼	▼	▼	◆	◆	◆	◆
	Walleye	PCBs					▲	▲	▲	▲	▲					▼	▼	●	●	●
Au Sable River (At Oscoda)	Carp	PCBs	▼	▼	▼	▼	▼	▼	▼	▼	▼	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Walleye	Mercury, PCBs					▲	▲	▲	▼	▼					▼	●	●	●	●
Au Sable River (Middle Branch)	Walleye	Mercury					▼	▼	▼	▼	▼					●	●	●	●	●
Bad River	Carp	PCBs	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●
	Channel Catfish	PCBs				▲	▲	▲	▲	▲	▲				▼	▼	●	◆	◆	◆
	Northern Pike	PCBs							▲	▲	▲							▼	▼	▼
Black River (Sanilac Co.)	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▼	▼	▼

Also applies to tributaries into which migratory species enter.
* For species not listed, see general inland lake mercury advisory on page 5.

▲ Unlimited consumption.
● One meal per month.
▼ One meal per week.
■ Six meals per year.
◆ Do not eat these fish.

Water body	Species	Contaminant(s)	General Population: Length (inches) 6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30 +	Women & Children: Length (inches) 6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30 +
Lake Huron Watershed All other locations refer to general advice on page 5.																				
Burt Lake (Cheboygan Co.)	Walleye	Mercury					▲	▼	▼	▼	▼					▲	●	●	●	●
Cass River (Downstream Bridgeport)	Carp	Dioxins	▲	▲	▲	▲	▲	▲	▲	▲	▲	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Channel Catfish	PCBs, Mercury Dioxins				▲	◆	◆	◆	◆	◆				▼	◆	◆	◆	◆	◆
	Northern Pike	PCBs							▲	▲	▲							▼	●	●
Cass River (Upstream Bridgeport)	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	●	●	●	●	●	●	●	●	●
	Northern Pike	Mercury							▲	▼	▼							▲	●	●
Cass River (Upstream of Caro Dam)	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▼	▼	▼
	Sucker	Mercury	▲	▲	▲	▲	▲	▲	▼	▼	▼	▲	▲	▲	▲	▲	▲	●	●	●
Cheboyganing Creek	Carp	PCBs	▼	▼	▼	▼	▼	▼	◆	◆	◆	●	●	●	●	●	●	◆	◆	◆
	Northern Pike	PCBs							▲	▲	▲							●	●	●
Chippewa River (Midland Co.)	Suckers	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▼	▼	▼
Ess Lake* (Montmorency Co.)	Northern Pike	Mercury							▲	▼	▼							▼	●	●
Guyllinta Lake* (Montmorency Co.)	Northern Pike	Mercury							▲	▼	▼							▼	●	●
Five Lakes#* (Clare Co.)	Largemouth Bass	Mercury					▲	▼	▼	▼						▼	●	●	●	
Flint River (Downstream Flint)	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	◆	●	●	●	●	●	●	●	●	◆
	Smallmouth Bass	PCBs					▲	▲	▲	▲						▼	▼	▼	▼	
Frenchman Lake* (Chippewa Co.)	Northern Pike	Mercury							▲	▼	▼							▼	●	●
Holloway Reservoir* (Genesee Co.)	Channel Catfish	PCBs				▲	▲	▲	▲	▲	▲				●	●	●	●	●	●
Lake Emma* (Presque Isle Co.)	Northern Pike	Mercury	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●
Lake Esau* (Presque Isle Co.)	Smallmouth Bass	Mercury					▲	▼	▼	▼						▼	●	●	●	
Lobdell Lake* (Genesee Co.)	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	●

Also applies to tributaries into which migratory species enter.
* For species not listed, see general inland lake mercury advisory on page 5.

▲ Unlimited consumption.
● One meal per month.
▼ One meal per week.
■ Six meals per year.
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Water body	Species	Contaminant(s)	General Population – Length (inches) 6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30 +	Women & Children – Length (inches) 6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30 +
Lake Huron Watershed All other locations refer to general advice on page 5.																				
Long Lake* (Presque Isle Co.)	Smallmouth Bass	Mercury					▲	▼	▼	▼						▼	●	●	●	
Kawkawlin River	Carp	PCBs	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Northern Pike	PCBs							▲	▲	▲							●	●	●
Kearsley Reservoir* (Genesee County)	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▼	●	●
	Largemouth Bass	Mercury					▲	▼	▼	▼						▲	●	●	●	
Peach Lake* (Ogemaw Co.)	Northern Pike	Mercury							▲	▼	▼							▼	●	●
Pine River* (Alma Impoundment)	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▼	●	●
Pine River* (Downstream Alma dam)	All Species	PBBs, DDT	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Lake Ponemah* (Genesee Co.)	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	●	●	●
	Largemouth Bass	Mercury					▲	▼	▼	▼						▲	●	●	●	
Rifle River	Rock Bass	PCBs	▲	▲	▲	▲	▲					▼	▼	▼	▼	▼				
	Suckers	PCBs	▲	▲	▲	▲	▲	▲	▲	▲		▲	▼	▼	▼	▼	▼	▼	▼	
Saginaw River (Entire Length)	Carp, Catfish	PCBs, Dioxins	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	White Bass	PCBs	▼	▼	▼	▼	▼	▼				■	■	■	■	■	■			
	All other species	PCBs, Dioxins	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	●	●	●	●	●	●	●	●
Sanford Lake* (Midland Co.)	Black Crappie		▲	▲	▲	▲	▲	▲				▲	▲	▲	▲	▲	▲			
	Channel Catfish	Mercury, PCBs				▲	▲	▲	▲	▼	▼				▼	▼	▼	▼	●	●
	Rock Bass		▲	▲	▲	▲	▲					▲	▲	▲	▲	▲				
St. Mary's River	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	●	●	●	●	●	●	●	●	●
	Northern Pike	Mercury							▼	▼	▼							●	●	●
	Walleye	Mercury, PCBs					▲	▲	▼	▼	▼					▼	▼	●	●	●
Sebawaing River	Carp	PCBs	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	●	●	●	●	●
	Northern Pike	PCBs							▲	▲	▲							▼	▼	▼

Also applies to tributaries into which migratory species enter.
* For species not listed, see general inland lake mercury advisory on page 5.

Appendix A

ADMINISTRATIVE RULES

PART 4. WATER QUALITY STANDARDS

(Promulgated pursuant to Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended)

Effective: December 13, 1973
Latest revisions effective: January 13, 2006

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

WATER BUREAU

Part 4. Water Quality Standards

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(Effective December 13, 1973; revised December 2, 1986, and January 13, 2006)

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(Effective December 13, 1973; revised December 2, 1986, and January 13, 2006)

R 323.1097 Materials applications not subject to standards
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(Effective December 2, 1986; rescinded July 29, 1997)

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(Effective December 13, 1973; revised December 2, 1986, and January 13, 2006)

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(Effective May 20, 1994; revised July 29, 1997, and January 13, 2006)

DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER BUREAU
WATER RESOURCES PROTECTION

Filed with the Secretary of State on January 13, 2006

These rules become effective immediately upon filing with the Secretary of State unless adopted under sections 33, 44, 45a(6), or 48 of 1969 PA 306. Rules adopted under these sections become effective 7 days after filing with the Secretary of State.

(By authority conferred on the department of environmental quality by sections 3103 and 3106 of 1994 PA 451, MCL 324.3103 and 324.3106)

R 323.1041, R 323.1043, R 323.1044, R 323.1050, R 323.1053, R 323.1055, R 323.1057, R 323.1060, R 323.1062, R 323.1064, R 323.1065, R 323.1069, R 323.1082, R 323.1090, R 323.1092, R 323.1096, R 323.1097, R 323.1100, R 323.1105, R 323.1116, and R 323.1117 of the Michigan Administrative Code are amended as follows:

PART 4. WATER QUALITY STANDARDS

R 323.1041 Purpose.
Rule 41. The purpose of the water quality standards as prescribed by these rules is to establish water quality requirements applicable to the Great Lakes, the connecting waters, and all other surface waters of the state, to protect the public health and welfare, to enhance and maintain the quality of water, to protect the state's natural resources, and to serve the purposes of Public Law 92-500, as amended, 33 U.S.C. 1251 et seq., Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, MCL 324.3101 to 324.3119, and the Great Lakes water quality agreement enacted November 22, 1978, and amended in 1987. These standards may not reflect current water quality in all cases. Water quality of certain surface waters of the state may not meet standards as a result of natural causes or conditions unrelated to human influence. Where surface waters of the state may have been degraded due to past human activities and attainment of standards in the near future is not economically or technically achievable, these standards shall be used to improve water quality. These standards are the minimum water quality requirements by which the surface waters of the state shall be managed.

R 323.1043 Definitions; A to L.
Rule 43. As used in this part:
(a) "Acceptable daily exposure (ADE)" means an estimate of the maximum daily dose of a substance that is not expected to result in adverse noncancer effects to the general human population, including sensitive subgroups.
(b) "Acceptable wildlife endpoints" means subchronic and chronic endpoints that affect reproductive or developmental success, organismal viability, or growth or any other endpoint that is, or is directly related to, a parameter that influences population dynamics.
(c) "Acute-chronic ratio (ACR)" means a standard measure of the acute toxicity of a material divided by an appropriate measure of the chronic toxicity of the same material under comparable conditions.

Table 1. Aquatic Maximum Values for Protection of Aquatic Life in Ambient Waters.

Chemical	AMV[1] (ug/L)	Conversion Factor (CF)
Arsenic[2]	340	1.0
Cadmium[2]	$(e^{1.128(\ln H)-3.6867})(CF)$	1.136672-(lnH)(0.041838)
Chromium (III)[2]	$(e^{0.819(\ln H)+3.7256})(CF)$	0.316
Chromium (VI)[2]	16	0.982
Copper[2]	$(e^{0.9422(\ln H)-1.7})(CF)$	0.96
Cyanide[3]	22	n/a
Dieldrin[4]	0.24	n/a
Endrin[4]	0.086	n/a
Lindane[4]	0.95	n/a
Mercury[2]	1.4	0.85
Nickel[2]	$(e^{0.846(\ln H)+2.255})(CF)$	0.998
Parathion[4]	0.065	n/a
Pentachlorophenol[4]	$e^{1.005(pH)-4.869}$	n/a
Zinc[2]	$(e^{0.8473(\ln H)+0.884})(CF)$	0.978

[1]AMV is the aquatic maximum value and is equal to 1/2 the FAV. The AMV shall be rounded to 2 significant digits.
[2]Value is expressed as a dissolved concentration calculated using the specified conversion factor.
[3]Value is expressed as free cyanide.
[4]Value is expressed as a total concentration.

Note: The term "lnH" is the natural log of hardness, expressed as mg/L $CaCO_3$.
The term "n/a" means not applicable.

R 323.1058 Radioactive substances.

Rule 58. The control and regulation of radioactive substances discharged to the waters of the state shall be pursuant to the criteria, standards, or requirements prescribed by the United States nuclear regulatory commission in 10 C.F.R. §20.1 et seq. and by the United States environmental protection agency.

R 323.1060 Plant nutrients.

Rule 60. (1) Consistent with Great Lakes protection, phosphorus which is or may readily become available as a plant nutrient shall be controlled from point source discharges to achieve 1 milligram per liter of total phosphorus as a maximum monthly average effluent concentration unless other limits, either higher or lower, are deemed necessary and appropriate by the department.

(2) In addition to the protection provided under subrule (1) of this rule, nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the surface waters of the state.

R 323.1062 Microorganisms.

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

(2) All surface waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples, taken during the same sampling event, at representative locations within a defined sampling area.

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

(4) The department may suspend the provisions of subrule (3) of this rule, for the purpose of discharge permit issuance, from November 1 to April 30, upon an adequate demonstration by the applicant that designated uses will be protected. At a minimum, the provisions of subrule (2) of this rule shall be met.

(5) Acceptable levels of infectious organisms that are not specifically addressed by the provisions of subrules (1), (2), and (3) of this rule shall be established by the department on a case-by-case basis to assure that designated uses are protected.

R 323.1064 Dissolved oxygen in Great Lakes, connecting waters, and inland streams.

Rule 64. (1) A minimum of 7 milligrams per liter of dissolved oxygen in all Great Lakes and connecting waterways shall be maintained, and, except for inland lakes as prescribed in R 323.1065, a minimum of 7 milligrams per liter of dissolved oxygen shall be maintained at all times in all inland waters designated by these rules to be protected for coldwater fish. In all other waters, except for inland lakes as prescribed by R 323.1065, a minimum of 5 milligrams per liter of dissolved oxygen shall be maintained. These standards do not apply for a limited warmwater fishery use subcategory or limited coldwater fishery use subcategory established pursuant to R 323.1100(11) or during those periods when the standards specified in subrule (2) of this rule apply.

(2) Surface waters of the state which do not meet the standards set forth in subrule (1) of this rule shall be upgraded to meet those standards. The department may issue permits pursuant to R 323.2145 which establish schedules to achieve the standards set forth in subrule (1) of this rule for point source discharges to surface waters which do not meet the standards set forth in subrule (1) of this rule and which commenced discharge before December 2, 1986. For point source discharges which commenced before December 2, 1986, the dischargers may demonstrate to the department that the dissolved oxygen standards specified in subrule (1) of this rule are not attainable through further feasible and prudent reductions in their discharges or that the diurnal variation between the daily average and daily minimum dissolved oxygen concentrations in those waters exceeds 1 milligram per liter, further reductions in oxygen-consuming substances from such discharges will not be required, except as necessary to meet the interim standards specified in this subrule, until comprehensive plans to upgrade these waters to the standards specified in subrule (1) of this rule have been approved by the department and orders, permits, or other actions necessary to implement the approved plans have been issued by the department. In the interim, all of the following standards apply:

(a) For surface waters of the state designated for use for coldwater fish, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 6 milligrams per liter at the design flow during the warm weather season in accordance with R 323.1090(2) and (3). At the design flows during other seasonal periods, as provided in R 323.1090(3), a minimum of 7 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.

(b) For surface waters of the state designated for use for warmwater fish and other aquatic life, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season in accordance with R 323.1090(3) and (4). At the design flows during other seasonal periods as provided in R 323.1090(3), a minimum of 5 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.

(c) For surface waters of the state designated for use for warmwater fish and other aquatic life, but also designated as principal migratory routes for anadromous salmonids, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below 5 milligrams per liter as a minimum during periods of migration.

(3) The department may cause a comprehensive plan to be prepared to upgrade waters to the standards specified in subrule (1) of this rule taking into consideration all factors affecting dissolved oxygen in these waters and the cost effectiveness of control measures to upgrade these waters and, after notice and hearing, approve the plan. After notice and hearing, the department may amend a comprehensive plan for cause. In undertaking the comprehensive planning effort the department shall provide for and encourage participation by interested and impacted persons in the affected area. Persons directly or indirectly

discharging substances which contribute towards these waters not meeting the standards specified in subrule (1) of this rule may be required after notice and order to provide necessary information to assist in the development or amendment of the comprehensive plan. Upon notice and order, permit, or other action of the department, persons directly or indirectly discharging substances which contribute toward these waters not meeting the standards specified in subrule (1) of this rule shall take the necessary actions consistent with the approved comprehensive plan to control these discharges to upgrade these waters to the standards specified in subrule (1) of this rule.

R 323.1065 Dissolved oxygen; inland lakes.

Rule 65. (1) The following standards for dissolved oxygen shall apply to the lakes designated for coldwater fish in R 323.1100(4) and (6):

(a) In stratified coldwater lakes which have dissolved oxygen concentrations less than 7 milligrams per liter in the upper half of the hypolimnion, a minimum of 7 milligrams per liter dissolved oxygen shall be maintained throughout the epilimnion and upper 1/3 of the thermocline during stratification. Lakes capable of sustaining oxygen throughout the hypolimnion shall maintain oxygen throughout the hypolimnion. At all other times, dissolved oxygen concentrations greater than 7 milligrams per liter shall be maintained.

(b) Except for lakes described in subdivision (c) of this subrule, in stratified coldwater lakes which have dissolved oxygen concentrations greater than 7 milligrams per liter in the upper half of the hypolimnion, a minimum of 7 milligrams per liter of dissolved oxygen shall be maintained in the epilimnion, thermocline, and upper half of the hypolimnion. Lakes capable of sustaining oxygen throughout the hypolimnion shall maintain oxygen throughout the hypolimnion. At all other times, dissolved oxygen concentrations greater than 7 milligrams per liter shall be maintained.

(c) In stratified coldwater lakes which have dissolved oxygen concentrations greater than 7 milligrams per liter throughout the hypolimnion, a minimum of 7 milligrams per liter shall be maintained throughout the lake.

(d) In unstratified coldwater lakes, a minimum of 7 milligrams per liter of dissolved oxygen shall be maintained throughout the lake.

(2) For all other inland lakes not specified in subrule (1) of this rule, during stratification, a minimum dissolved oxygen concentration of 5 milligrams per liter shall be maintained throughout the epilimnion. At all other times, dissolved oxygen concentrations greater than 5 milligrams per liter shall be maintained.

R 323.1069 Temperature; general considerations.

Rule 69. (1) In all surface waters of the state, the points of temperature measurement normally shall be in the surface 1 meter; however, where turbulence, sinking plumes, discharge inertia or other phenomena upset the natural thermal distribution patterns of receiving waters, temperature measurements shall be required to identify the spatial characteristics of the thermal profile.

(2) Monthly maximum temperatures, based on the ninetieth percentile occurrence of natural water temperatures plus the increase allowed at the edge of the mixing zone and in part on long-term physiological needs of fish, may be exceeded for short periods when natural water temperatures exceed the ninetieth percentile occurrence. Temperature increases during these periods may be permitted by the department, but in all cases shall not be greater than the natural water temperature plus the increase allowed at the edge of the mixing zone.

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