



# Muskegon County Green Infrastructure Inventory

March 2010



**WEST MICHIGAN SHORELINE  
REGIONAL DEVELOPMENT COMMISSION  
(WMSRDC)**

The WMSRDC is a regional council of governments representing 120 local governments in the West Michigan counties of Lake, Mason, Muskegon, Newaygo, and Oceana.

The mission of WMSRDC is to promote and foster regional development in West Michigan... through cooperation amongst local governments.



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# Muskegon County **Green Infrastructure** Inventory

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## Chapter 1: Green Infrastructure and Muskegon County

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The term **Green Infrastructure** is used to describe an interconnected network of open spaces and natural areas, such as greenways, wetlands, parks, forest preserves and native plant vegetation, that naturally manages stormwater, reduces flooding and improves water quality.

In other words, Green Infrastructure describes the natural environment's life support system - an organized network of protected land and water that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for communities and people.

In 2005, Muskegon County along with several local units of government adopted a comprehensive land use plan titled the Muskegon Area-wide Plan (MAP). The mission of the Muskegon Area-wide Plan was to involve citizens in the shared vision for the future of Muskegon County. The MAP embraced the Smart Growth Principles and contained five main vision areas including Land Use and Growth; Natural Resources, Open Space, and Environment; Economy and Jobs; Infrastructure; and Quality of Life. The goals and outlined implementation activities of the Natural Resources, Open Space, and Environment vision called for a green infrastructure plan for Muskegon County.

### **Muskegon County Green Infrastructure Goals:**

The MAP set the stage for green infrastructure planning within Muskegon County. The MAP's Natural Resource, Open Space, and Environment Visions and Goals identified the need to protect and maintain land and water resources. These goals provide the framework for the protection and development of green infrastructure and the ecological services that help to maintain a healthy quality of life. These goals include the following:

1. Protect the valuable farm and forestlands, wetlands, surface and groundwater resources, wildlife habitat, and opportunities for passive and active recreation.
2. Develop policies and regulations to address the quantity and quality of water resources.

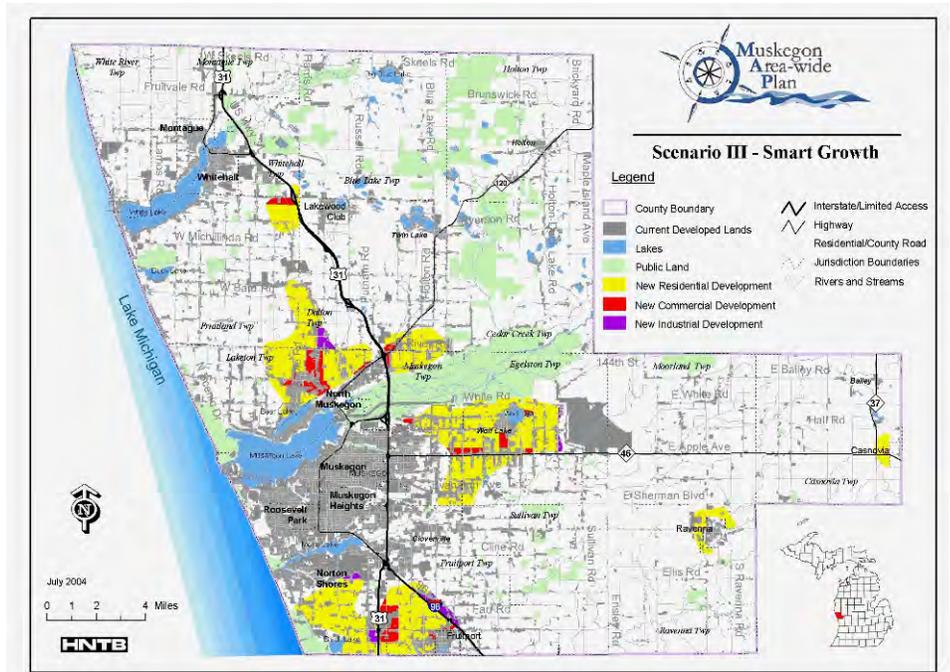
*Green Infrastructure is an interconnected network of open spaces and natural areas, such as greenways, blueways, wetlands, parks and forests that contribute to the health and quality of life for communities and people.*



3. Link natural resource protection with development to reduce the loss of important natural resources and open spaces in urban and rural areas.
4. Mitigate environmental and human health impacts to important natural resources.
5. Foster increased environmental sensitivity and voluntary stewardship through public-private partnerships, federal-state-local cooperation, and public education and outreach.
6. Protect the watersheds and shorelines of Lake Michigan and the inland lakes of Muskegon County.

### Growth with Green Infrastructure in Mind:

As part of the MAP planning process, local communities identified three possible growth scenarios, including Business As Usual, County Build-out, and Smart Growth. The Smart Growth development option was overwhelmingly the preferred scenario amongst community leaders and participants in the MAP process. The Smart Growth development option is illustrated in the adjacent map. The development scenario took into consideration the Smart Growth Principles and encourages future development to take place near and within currently developed areas, as well as available and planned public infrastructure including water, roads, and sewer. This in turn, will protect and preserve the vast natural areas found within Muskegon County. Twenty-four of the 28 local units of government in Muskegon County passed a resolution endorsing the Muskegon Area-wide Plan, the Smart Growth Development Scenario, and the Smart Growth Principles. In addition, each community through the passage of the resolution made a commitment to refer to the MAP document and its findings when making local land use decisions. This is most important since the State of Michigan is a home rule state and all land use decisions and authority are made by the individual local units of government including townships, cities, and villages.



During the development of the Muskegon Area-wide Plan, the MAP Steering Committee conducted a Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis exercise to assess the existing and future conditions of Muskegon County. A SWOT Analysis is a highly effective way to identify a community's existing conditions/attitudes and possible future direction, as well as, assist a community to focus on the areas where it is strong and where it's

greatest opportunities lie. It is important to note that the four (4) top rated issues under the Strengths category all pertained to Muskegon County’s natural resources. They include the following: Abundant Natural Resources, Recreational Opportunities, Waterfront/Recreation, and Lakefronts (inland also).

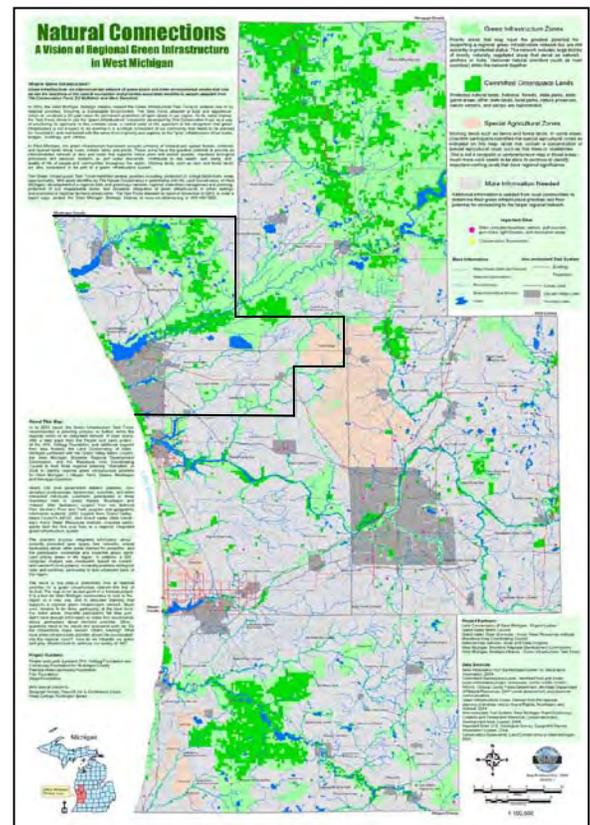
### **A Regional Vision of Green Infrastructure:**

Community leaders in Muskegon County have also participated in the development of the “Natural Connections, a Vision of Green Infrastructure in West Michigan” spearheaded by the West Michigan Strategic Alliance in 2004.

These county-wide and regional planning efforts have inspired local communities throughout West Michigan to invest in the acquisition and development of parks and trails, development of farmland preservation programs, restoration of natural resources, and the protection of forest and open space along the Lake Michigan shoreline. Communities have also approved bond referendums and invested in roads, sewers and other public works or "gray infrastructure” projects that preserve and protect the area’s natural resources.

### **Green Infrastructure Planning:**

Similar to gray infrastructure, green infrastructure should be strategically planned and managed. The foundation of green infrastructure is natural elements such as woodlands, wetlands, rivers, and grasslands. These natural elements work together as a whole to sustain ecological values and functions. Healthy functioning natural or restored ecological systems are essential to ensure the availability of ecological services. Ecological services are further explained later in this chapter.



In addition to the core natural elements that provide ecological services, trails; greenways; other recreational features; cultural and historic sites; and working lands can be developed to create a green infrastructure network for improved community health and quality of life.

Although green infrastructure planning often begins at a regional scale, it becomes increasingly local as land use decisions are made, critical elements are identified, and when implementation projects are being designed. For example, low-impact development practices, and restoration projects are often planned and designed at the parcel scale.

The Muskegon County Green Infrastructure Inventory is another more localized step in the process of planning for green infrastructure. The document is centered around an inventory of

publicly protected natural areas, parks, existing research, and best professional judgment regarding privately owned lands, water quality, and wildlife needs. The purpose of this inventory is to inform and enable communities to develop connections, or “linkages,” that will maximize ecological services of the land such as recreation, wildlife habitat, water quality, and preservation of historic features and working lands such as farms and wood lots.

### **Muskegon County Green Infrastructure Chapter Topics:**

Listed below are many of the topics addressed in this report. Each is described as it relates to the planning and management of green infrastructure and their potential ecological benefits.

#### **Groundwater and Drinking Water:**

- Groundwater resources can provide safe drinking water supplies. With careful, land use planning and practices, local officials can help to ensure that this ecological service continues to be available as an important drinking water resource for Muskegon County residents. In addition to appropriate land use, planning should include the remediation of brownfields and other sites of soil and groundwater contamination.

#### **Wetlands:**

- Wetlands can provide flood control, fish and wildlife habitat, healthy surface water and recreational opportunities. As part of a regional water quality research project, Grand Valley State University Annis Water Resources Institute (AWRI) analyzed Muskegon County wetlands for their importance in providing these benefits. This information is a resource for local planners, conservation agencies and watershed organizations that plan projects which rely on wetland conservation in order to maximize these benefits.

#### **Forests:**

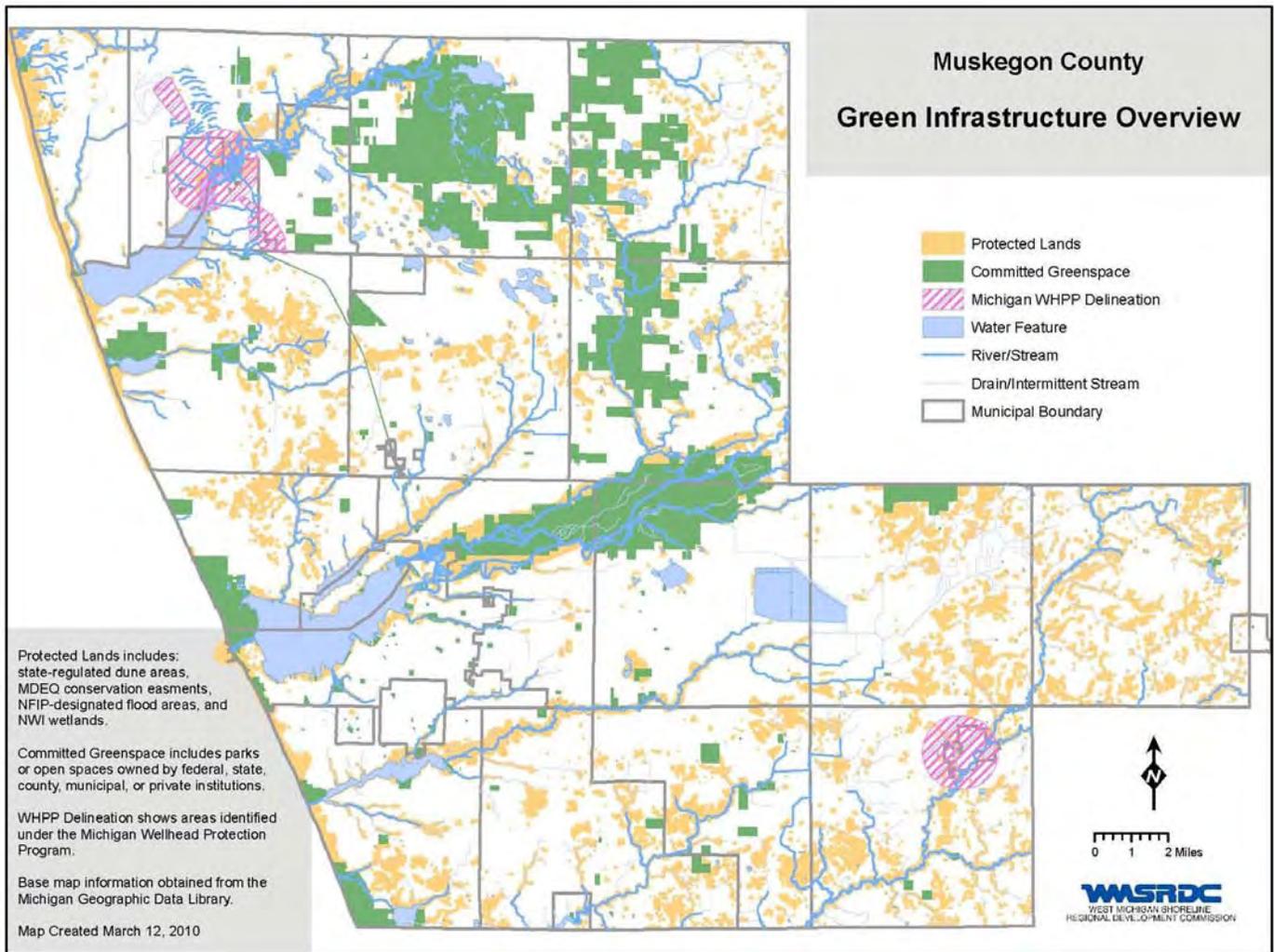
- Forests provide opportunities for scenic views, hunting, wildlife habitat, tourism, cooler temperatures and improved air quality. To illustrate the benefits of forest cover in urban areas, the Urban Forest Ecological Services Assessment, City of Muskegon, 2008 (GVSU Annis Water Resources Institute) presents benefits for air quality, water quality and the economic benefits to the city and residents. An important resources for both urban and rural forest management planning, is the Muskegon Conservation District (MCD). MCD manages hundreds of acres of forest lands throughout Muskegon County, and partners with local governments to utilize them in a way that benefits communities, ecology and the economy. MCD also coordinates a sand dune restoration initiative, based on a survey of the county’s critical dunes. Hundreds of acres are in need of restoration, ranging from erosion control and exotic species eradication to endangered species plant protection and habitat diversity enhancement.

#### **Surface Water:**

- Surface water resources provide drinking water, fish and wildlife habitat, recreation, scenic views, tourism and many quality of life benefits. The quality of lakes, rivers and streams depends on sound land use planning and the proper management of green infrastructure, such as forests, wetlands, and soils.

Farm Land:

- The Muskegon County Farm Land and Open Space Preservation Program and Ordinance was adopted by the Muskegon County Commissioners in 2006. Since that time, the local foods, community gardens and organic food grower movements have also become a stronger voice for sustainable farming in Muskegon County. Sustainable food production is dependent on the availability of green infrastructure, and sustainable farm practices respect the soil, water, air and the economy of local communities.



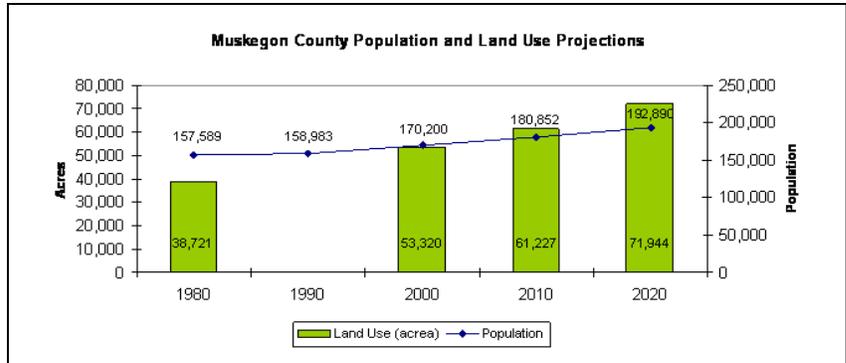
**Mapping Green Infrastructure:**

Mapping is an important part of green infrastructure planning, and a critical component of this inventory. It helps decision makers to visualize geographic features across a landscape, and enhances communication of the existence or lack of features within a spatial context. For example, maps from different time periods can be compared, allowing decision makers to identify temporal trends and assist them in planning for the future. Maps are also important tools for decision makers to communicate the importance of an issue, and to build consensus and support for an initiative.

Maps included within this inventory are intended to help communities and decision makers identify existing green infrastructure features and begin planning for and implementing linkages. An index of maps can be found in the Table of Contents.

**Ecological Services:**

The term **Ecological Services** is used to describe the benefits that natural systems provide in order to help maintain an excellent quality of life for residents; an attractive place for tourism; and economic savings for local governments, businesses, and individuals. However, the landscape of Muskegon County has changed significantly over the past several years, and based on findings of the Muskegon Area-wide Plan (MAP), the landscape will continue to change with a strong potential to cause negative effects on these valuable functioning ecosystems. Land that was once available for ecological services in Muskegon County is predicted to transform into new uses as the county grows and develops. Therefore, it is important to identify significant service areas and develop ways to protect, maintain, or restore them.



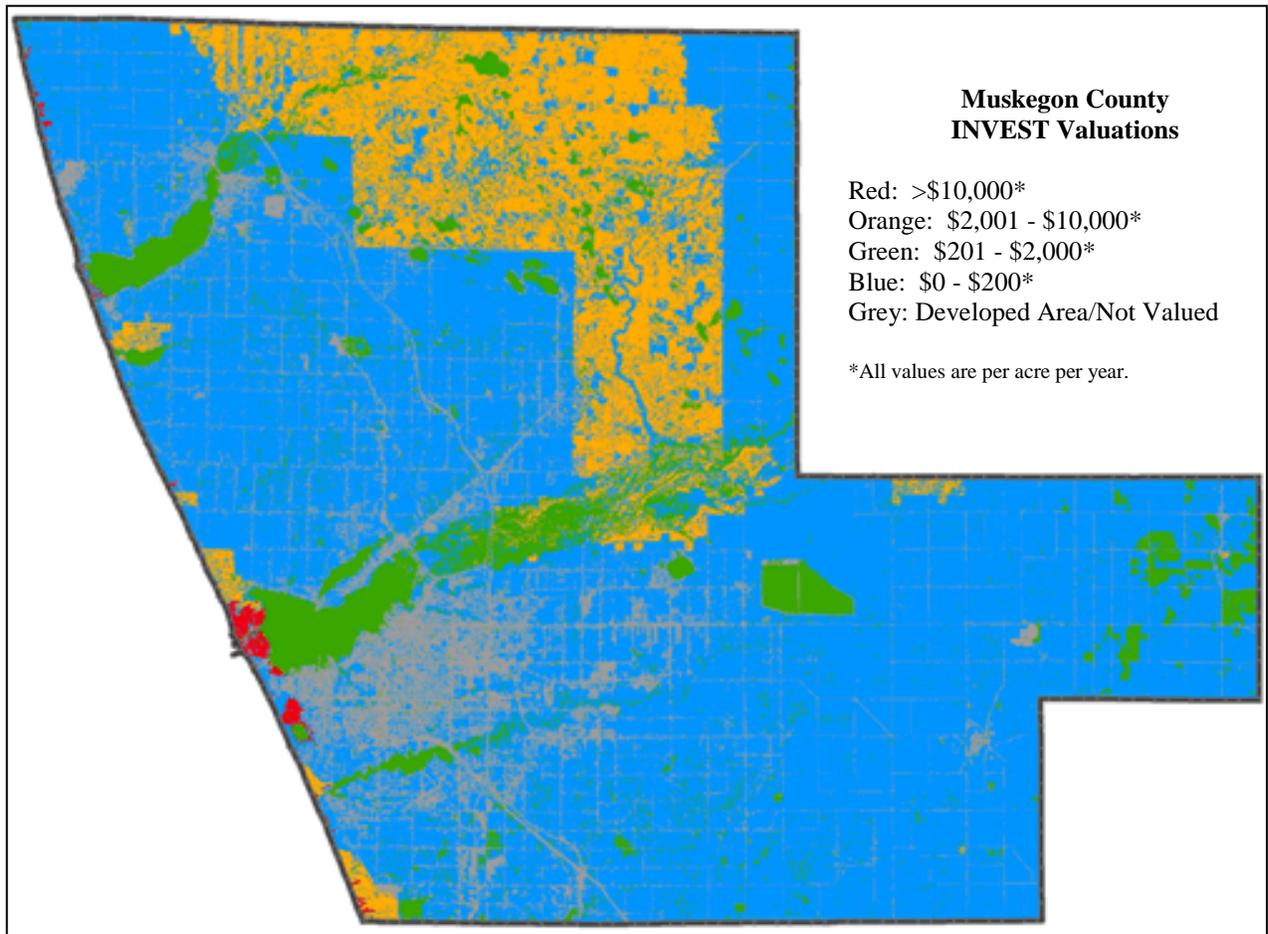
**Benefits of Green Infrastructure and Ecological Services:**

In Muskegon County, opportunities exist to offer ecological services in urban, suburban, and rural areas. Communities are planning for the protection of critical biodiverse areas; redevelopment and cleanup of brownfields; development of trails and greenways; and projects that incorporate low-impact development practices. This localized planning for green infrastructure and ecological services in Muskegon County can result in numerous benefits.

Communities benefit from, and often take for granted, the free services provided by vegetation, soils, and diverse landscapes. This inventory presents information that must be considered when planning for green infrastructure on rural and urban lands. It will help us to understand how the Muskegon County landscape can function to provide communities with services that, otherwise, would be more costly to provide.

**Integrated Valuation of Ecosystem Services Tool (INVEST):**

INVEST is a tool developed by Grand Valley State University to quantify the value of ecological services in a community. According to the tool, preliminary value estimates for ecosystem services in Muskegon County (per acre per year) are approximately \$253.2 million per year. The map on the following page reveals the annual values of land in Muskegon County per acre. More information about INVEST is available at the website: <http://invest.wri.gvsu.edu/index.html>.



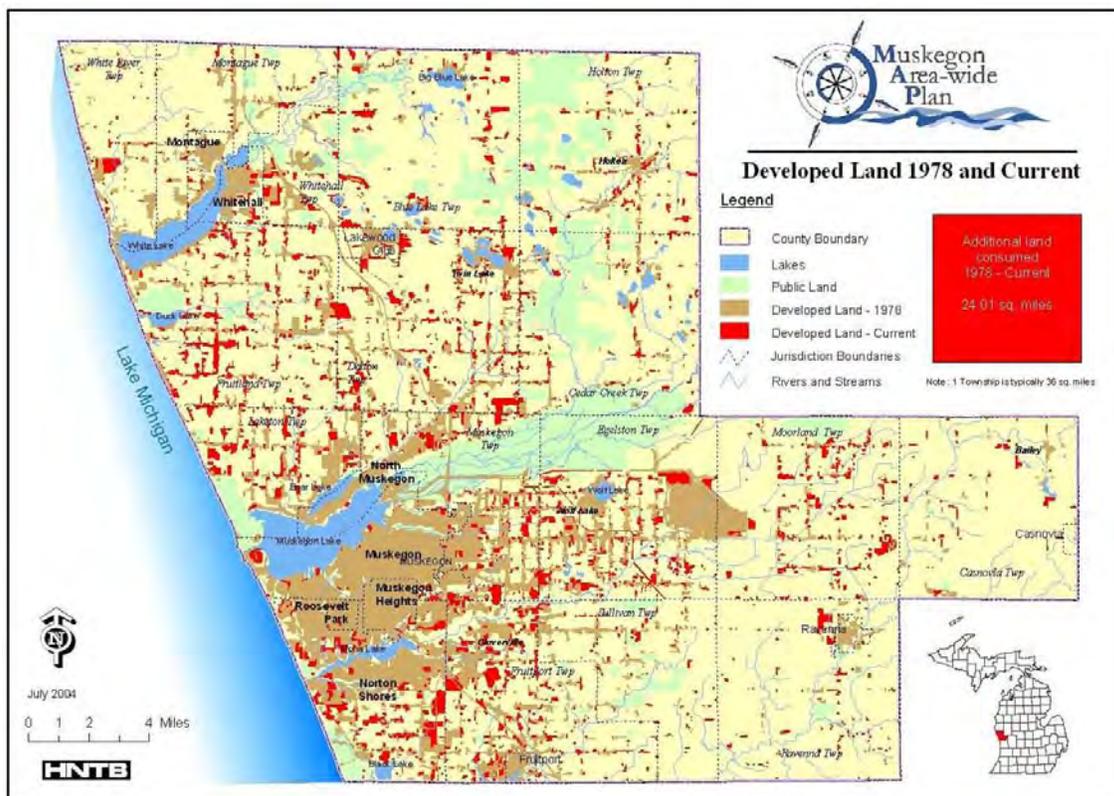
## Chapter 2: Land Cover and Soils

Muskegon County is home to a variety of soil types, topographical features, and land covers. The availability and integrity of these features dictate the fundamental ability of the landscape to provide communities with ecological services. Understanding the functions of vegetation, land cover, and soil types helps decision makers to make informed decisions that can sustain the landscape's ability to function in ways that provide cost-saving benefits.

The protection or degradation of natural resources can be tied directly to the way a region grows. The amount and type of open space that is developed by a growing population can ultimately determine the quality of lakes, wetlands, forests and other sensitive natural resources. In turn, the quality of natural resources affects how the interrelated landscape functions, and ultimately what level of ecological services it is able to provide to communities.

### Land Cover:

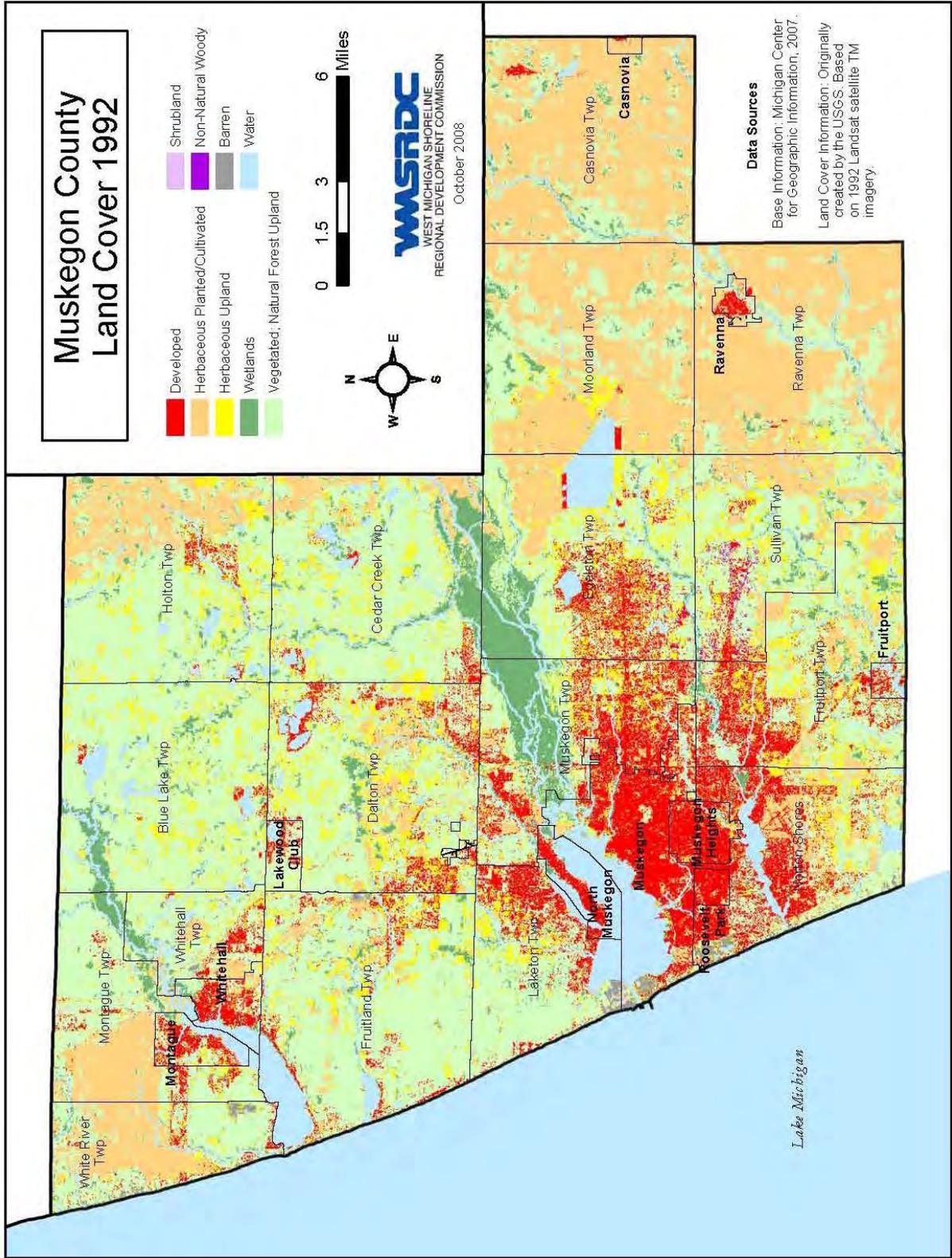
The Muskegon County landscape varies greatly depending on the location. It ranges from highly urbanized, to rural, to natural areas such as shorelines, wetlands, and forests. There are twenty-seven jurisdictions in the county, all of which have planning and zoning authority. The county has a land area of 509 square miles, or 325,760 acres. As of the 2000 US Census, the population density was 334 people per square mile. According to the Muskegon Area-wide Plan, the developed area of the county increased by 24 square miles, or 4.7 percent, between 1978 and 1998. While much of the new development occurred in the areas adjacent to existing urban areas, there was also significant new development that was decentralized in nature.



Land cover of Muskegon County is illustrated in Table #1 as well as the following map. This information, which was compiled by the USGS, is a part of the National Land Cover Dataset and was based on satellite imagery taken in 1992. Although this information is nearly 20 years old, it paints an accurate picture of the distribution of development, natural vegetation, and agriculture found within Muskegon County.

<b>Muskegon County Land Cover in Acres</b>				
<i>land cover categories</i>	<i>%</i>	<i>land cover subcategories</i>	<i>countywide acreage</i>	<i>%</i>
<b>Water</b>	3.90%	open water	13,147.54	3.90%
<b>Developed</b>	9.51%	low intensity residential	22,981.84	6.81%
		high intensity residential	4,570.66	1.36%
		commerce/industry/transport	4,531.52	1.34%
<b>Barren</b>	0.53%	bare rock/sand/clay	1,357.28	0.40%
		quarries/strip mines/gravel pits	415.43	0.12%
<b>Vegetated; Natural Forest Upland</b>	46.12%	deciduous forest	84,597.22	25.08%
		evergreen forest	37,907.87	11.24%
		mixed forest	33,067.22	9.80%
<b>Shrubland</b>	0.06%	Shrubland	186.37	0.06%
<b>Non-natural Woody</b>	0.13%	orchards/vineyards/other	433.67	0.13%
<b>Herbaceous Upland</b>	7.99%	grasslands/herbaceous	26940.47	7.99%
<b>Herbaceous Planted/ Cultivated</b>	24.70%	pasture/hay	35,479.54	10.52%
		row crops	42,494.32	12.60%
		small grains	1,428.22	0.42%
		urban/recreational grasses	3,929.05	1.16%
<b>Wetland</b>	7.07%	woody wetlands	18,427.19	5.46%
		emergent herbaceous wetlands	5,420.21	1.61%

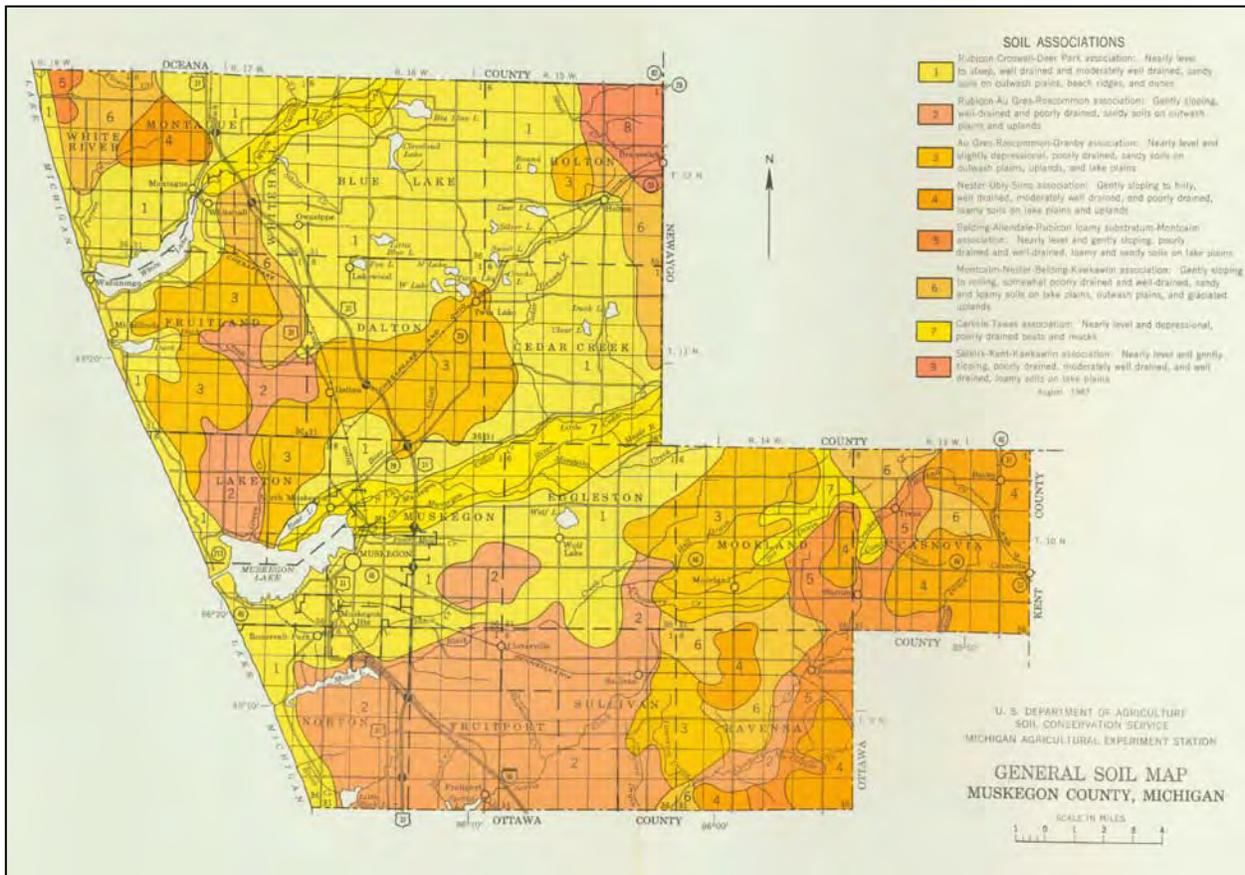
*Estimates based on USGS National Land Cover Dataset, 1992.*



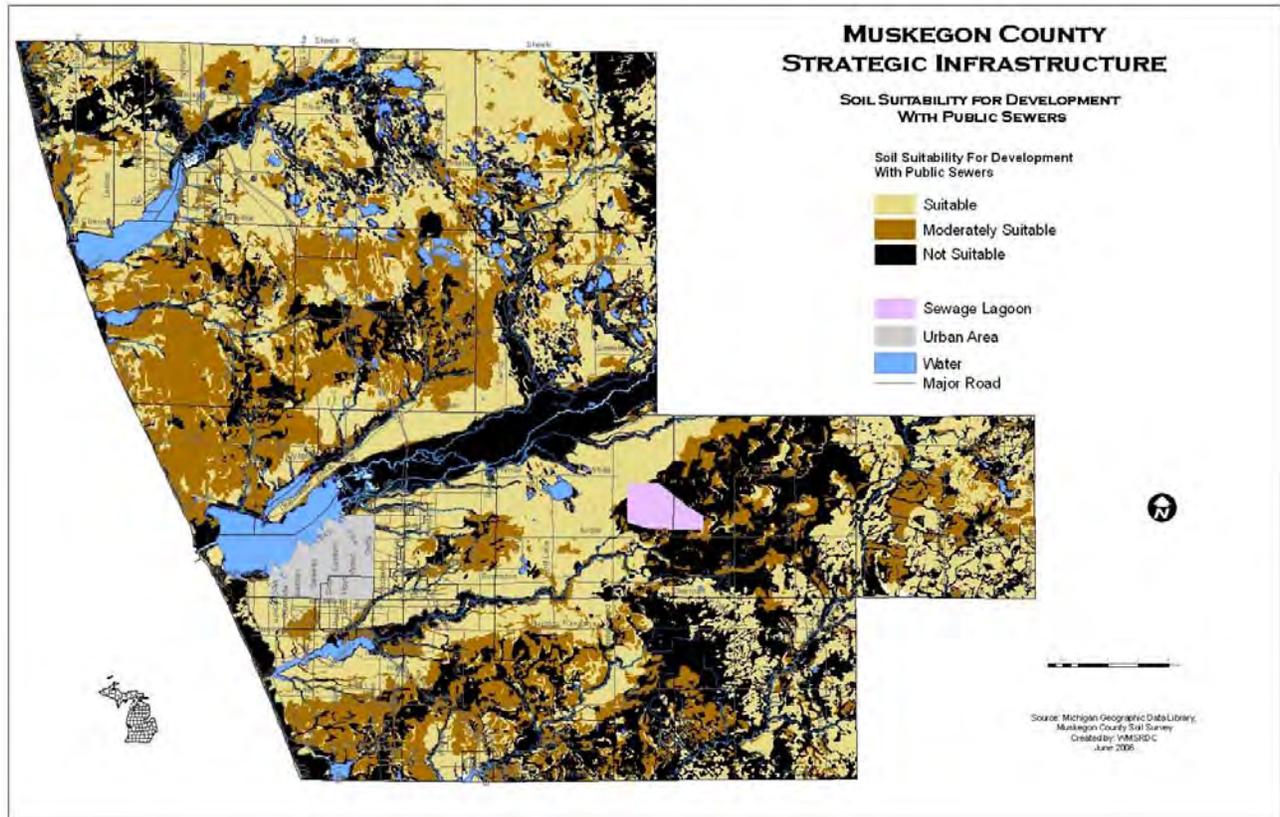
## Soils:

Soil information is a valuable resource for decision makers in a community. It is helpful in and locating soils that are suitable for various kinds of development, agriculture, or vegetation. With respect to green infrastructure planning, soils play an important role in promoting rainwater percolation, evapotranspiration, and filtration. Soils also help determine the suitability of various types of vegetation at a given site. This is important to consider when efforts are made to preserve or restore natural landscape features.

Soil information for Muskegon County is readily available in the Soil Survey of Muskegon County, which was published by the US Department of Agriculture, Soil Conservation Service in 1968. The general soils map, shown below, reveals the soil associations in Muskegon County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern or proportion.

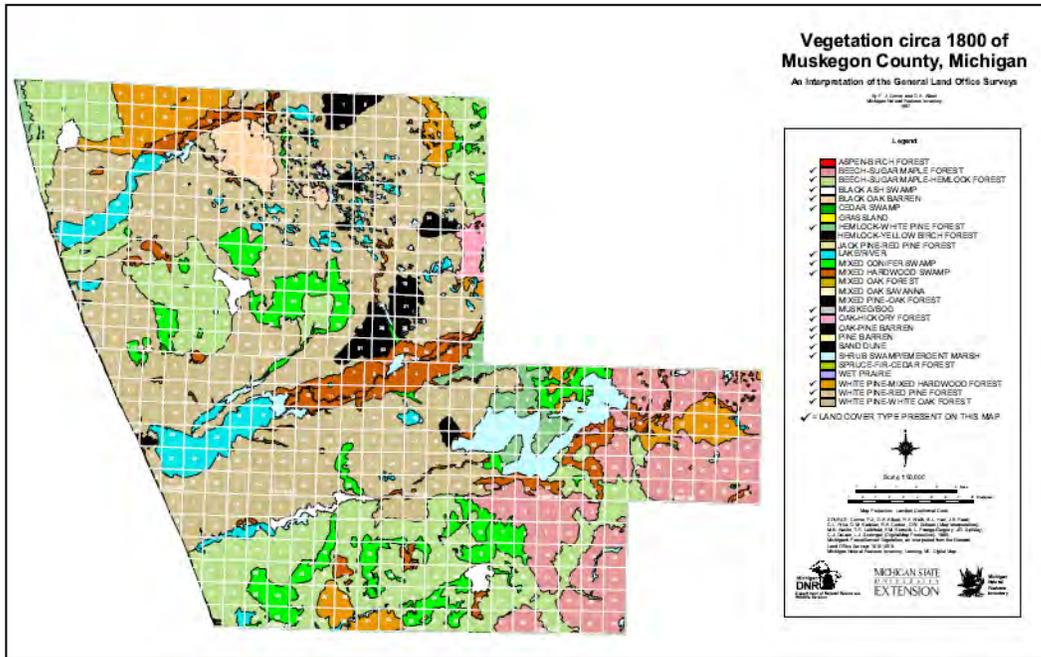


A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.



In addition to soil associations, the Muskegon County Soil Survey also illustrates the soil types within the associations as well as their characteristics. The Muskegon County soil suitability map is an example of the soil information available within the Soil Survey. The map identifies suitability for development based on various soil types. The soils on the map are categorized into three groups including suitable, moderately suitable, and not suitable. This map should be considered when expanding infrastructure and new developments. Areas with soils moderately suitable or not suitable for wells or septic systems should be served with public water and/or sewer. This will assist in protecting the county's groundwater and public health.

Native plant communities and unique natural features, such as sand dunes and barrens are also important factors to consider when developing green infrastructure restoration and preservation projects. The pre-settlement vegetation map provides the types of plant communities that have evolved with native soils and other conditions. Choosing the appropriate plant types for green infrastructure restoration projects will reduce the need for long-term maintenance, and the dependence upon chemical fertilizers and pesticides.



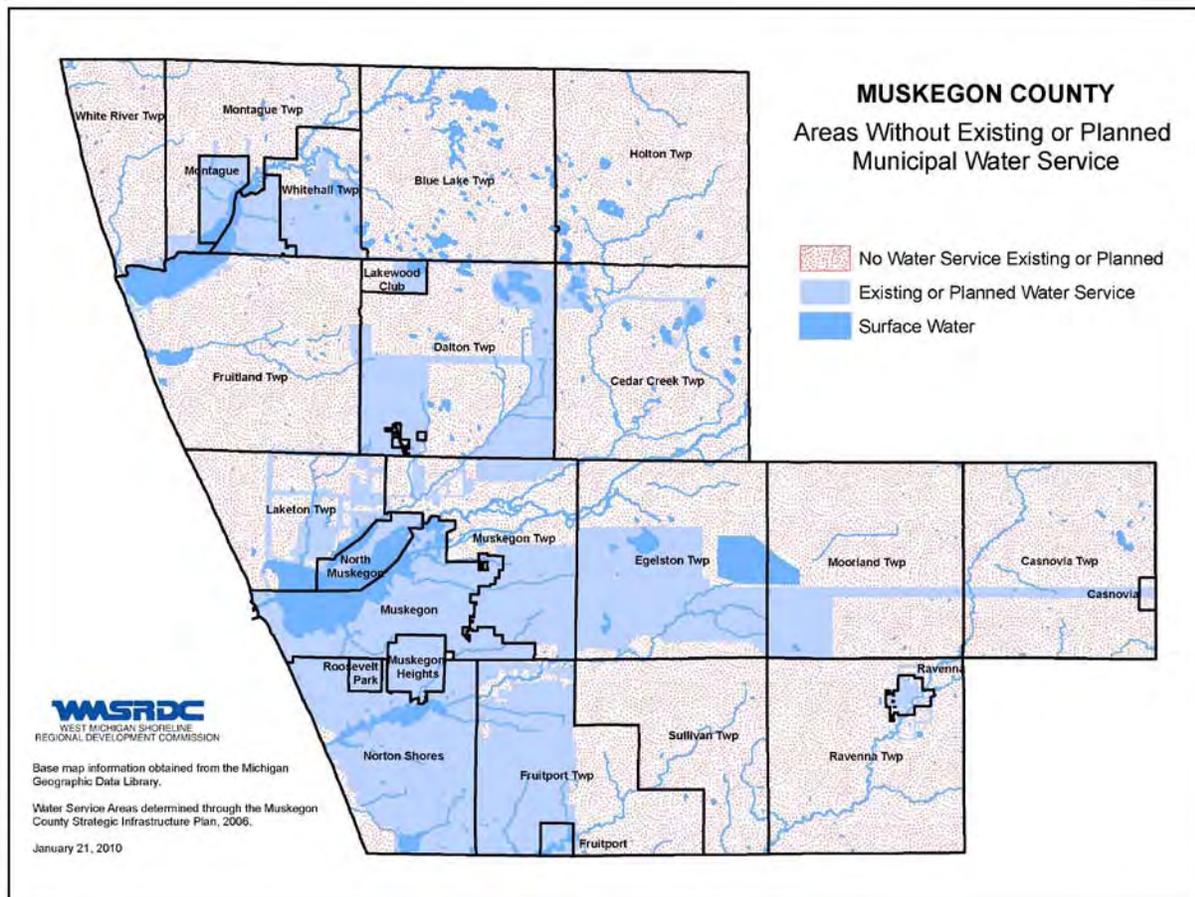
## Chapter 3: Drinking Water

It is important to acknowledge that the quality and quantity of drinking water resources in a community are directly linked to land use decisions, and that the incorporation of green infrastructure planning with traditional land use planning can have a significant impact on water quality in a community.

This chapter reviews groundwater and municipal water sources of drinking water in Muskegon County, as well as some of the existing threats to the public water supply such as brownfields, wastewater, and existing or abandoned oil and gas wells.

Muskegon County enjoys access to significant surface water sources and an abundant supply of groundwater. Its communities utilize either groundwater or surface water resources for drinking water, depending on the location. Groundwater aquifers are situated in unconsolidated glacial till consisting predominantly of loose sand, which makes them highly susceptible to contamination.

The following map provides a view of existing and planned municipal water service areas in Muskegon County. It highlights the fact that a majority of land in the county is not, or will not be, serviced by municipal water service, and therefore must rely on well water drawn directly from groundwater aquifers.



## **Municipal Surface Water Supply Systems:**

The two municipal water systems in Muskegon County that utilize surface water are owned and operated by the City of Muskegon and the City of Muskegon Heights. Coincidentally, these are the two largest municipal water supply systems in the county. Both draw and filter water from Lake Michigan, and include distribution systems which pump, transmit, and store water. Although there is some variation in the size and number of individual treatment plant process units, the water source (Lake Michigan) and the treatment process (alum flocculation, settling, and rapid sand filtration) is identical in each plant.

Each treatment plant contains the following process units:

- Lake Michigan intake
- Shore well with low lift pumps
- Pretreatment comprised of chemical addition, rapid mixing, and flocculators in sedimentation basins and clarifiers
- Rapid sand filters
- Chemical storage and feeding facilities for chlorine, alum, fluoride, and activated carbon
- Treated water storage
- High service pumping
- Sludge lagoons

Each plant has multiple units to provide for reliability of operation. Neither plant has experienced a substantial failure that would result in a prolonged plant shut down. Additionally, both plants have undertaken extensive upgrades within the past ten years. They serve a combined total of 41,407 households in Muskegon County.

The Muskegon Heights Water Filtration Plant provides a municipal water supply to:

- 19,832 households in the cities of Muskegon Heights, Norton Shores, Village of Fruitport and Fruitport Township.

The City of Muskegon Water Filtration Plant provides a municipal water supply to:

- 21,575 households in the cities of Muskegon, Roosevelt Park, North Muskegon, Muskegon Township, and a portion of Muskegon County. It serves a population of 57,446 persons.

## **Groundwater Supply Systems:**

About one-third of water users in Muskegon County depend on either private well or municipal well drinking water systems that utilize groundwater. The vast majority of these users are households. Three municipal systems in the county treat groundwater for public water supplies in the communities of Ravenna, Whitehall, and Montague. The Ravenna system serves households in the Village of Ravenna, and Ravenna Township. The Whitehall and Montague systems, under the White Lake Water Authority, serve households in the City of Whitehall, City of Montague, Whitehall Township, and Montague Township.

- Ravenna System: Serves 550 households, including commercial and industrial users.
- Whitehall System: Serves 1,078 households, with 341 commercial and industrial users, including 33 in the township.
- Montague System: Serves 1,076 households, including commercial and industrial users.

The Public Health Muskegon County oversees water well installation for both drinking water and irrigation purposes, and should be the primary contact for information regarding water wells in Muskegon County. Its Onsite Drinking Water Program is administered with the goals of protecting the groundwater from contamination by improperly constructed or poorly maintained drinking water wells; and protecting the public from contaminated drinking water.

### **Subdivision Well and Septic Requirements for Groundwater Protection:**

In Muskegon County, there are 179 subdivision developments that maintain agreements that outline septic and well restrictions for residents, so they can protect their groundwater wells for safe drinking water supplies.

The Public Health Muskegon County maintains records of the deed restrictions and guidelines for each development site. Homeowners are responsible for meeting these requirements to ensure the safety of their drinking water.

Private well owners must take responsibility to ensure the safety of groundwater. Public Health Muskegon County has water testing available for individuals who would like to know the quality of their groundwater/drinking water supply. For more information, contact Public Health Muskegon County. Ask for the Environmental Health Division.

### **Protection of Drinking Water Resources:**

The Michigan Department of Natural Resources and Environment is a valuable resource for information regarding the protection of drinking water resources. The DNRE has primary enforcement authority in Michigan for the Federal Safe Drinking Water Act under the legislative authority of the Michigan Safe Drinking Water Act. As such, the division has regulatory oversight for all public water supplies, including approximately 1,500 community water supplies and 11,000 non-community water supplies. In addition the program regulates drinking water well drilling. The DNRE also investigates drinking water well contamination, and oversees remedial activities at sites of groundwater contamination affecting drinking water wells.

### **Michigan Wellhead Protection Program:**

This program equips municipalities with groundwater-supplied drinking water systems with activities and management practices for protecting public groundwater supply systems from contamination. Involvement in the WHPP minimizes the potential for contamination by identifying and protecting the area that contributes water to municipal water supply wells and

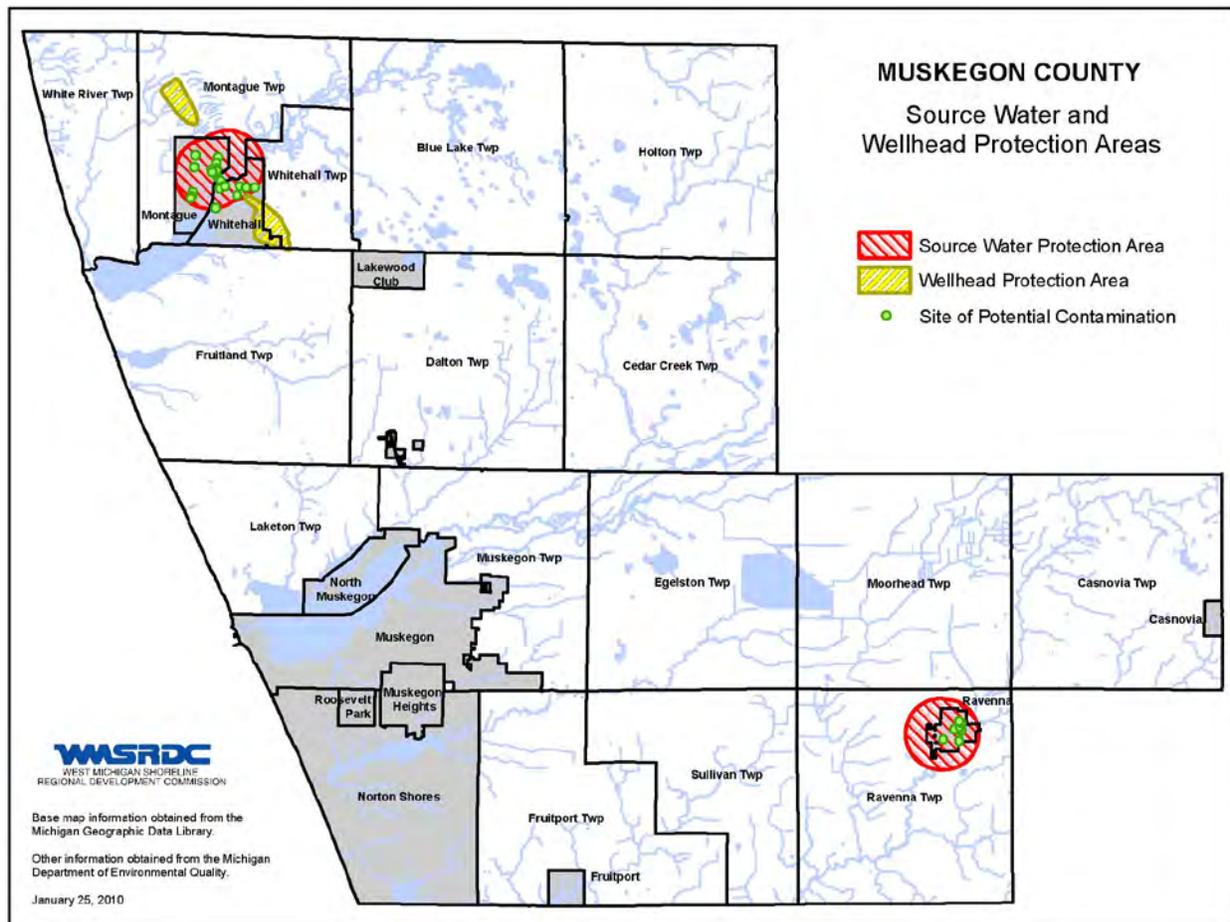
avoids costly groundwater clean-ups. The program has been approved by the US Environmental Protection Agency.

Communities with a WHPP receive a higher level of environmental review in the state permitting process. In addition, permitting for underground and aboveground storage tanks, spillage of polluting materials, and discharging to groundwater include more stringent requirements within Wellhead Protection Areas (WHPAs). A WHPA is the surface area that overlies the aquifer that is directly contributing water to a well. As a result, communities that have designated WHPAs are able to better safeguard their groundwater from contamination.

*A WHPA is the surface area that overlies the aquifer that is directly contributing to a water well.*

In addition to the WHPP, the State of Michigan is developing guidance for communities for development of a Surface Water Intake Protection Program (SWIPP). This will be a program based on the same logic, only applies to surface water sources of municipal drinking water.

Funding for WHPP activities is available through a state grant program and is designed to assist communities in the development and implementation of WHPP's. For more information regarding Michigan's Wellhead Protection Program, visit the website at [http://www.michigan.gov/deq/0,1607,7-135-3313\\_3675\\_3695---,00.html](http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3695---,00.html).



The map above illustrates the areas in Muskegon County that have participated in Michigan's WHPP. These communities include the cities of Montague and Whitehall, the Village of Ravenna, and the townships of Montague, Ravenna, and Whitehall. The map also identifies potential sites of contamination located within the delineated protection areas. The sites are based on Michigan DEQ databases of Part 201, environmental remediation; Part 211, underground storage tanks; and Part 213, leaking underground storage tanks.

**Community Water Supply Program:**

The State of Michigan also administers the Community Water Supply Program, which oversees the primary EPA program that sets forth minimum standards for safe drinking water, as well as administering the requirements of Michigan's Safe Drinking Water Act. The program's primary function is regulatory oversight of approximately 1,450 community public water supplies in Michigan.

A Non-community Water Supply (otherwise known as a "Type II") is a water system that provides water for drinking or household purposes to 25 or more persons at least 60 days per year or has 15 or more service connections. A few examples are schools, restaurants, churches, campgrounds, industries and highway rest stops with their own water supply. In contrast, a Community Water Supply (or Type I) is a water system that provides year-round service to at least 15 living units or 25 residents. Examples include cities, villages, apartment complexes and mobile home parks.

<b>Public Water Supply Classifications</b>		
<i>Classification</i>	<i>Description</i>	<i>Examples</i>
<b>Type I Community Public Water Supply</b>	Provides year-round service to not less than 25 residents OR not less than 15 living units	Municipalities, Apartments, Nursing Homes, Mobile Home Parks
<b>Type II Nontransient Noncommunity Public Water Supply</b>	Serves not less than 25 of the SAME people for at least six months per year	Schools, Industries, Places of Employment
<b>Type II Transient Noncommunity Public Water Supply</b>	Serves not less than 25 people OR not less than 15 connections for at least 60 days per year	Hotels and Restaurants (with less than 25 employees), Campgrounds
<b>Type III Public Water Supply</b>	Anything not considered a Type I or Type II water supply; serves less than 25 people AND 15 connections, OR operates for less than 60 days per year	Small Apartment Complexes and Condominiums, Duplexes, all Others
<b>Private Water Supply</b>	Serves a single living unit	Single Family Home

**Threats to Groundwater / Private Drinking Water Supplies:**

The number one threat to groundwater drinking water supplies is nitrates originating from fertilizer and on-site sewage systems. As previously mentioned, groundwater aquifers in Muskegon County are situated in unconsolidated glacial till consisting predominantly of loose sand, and are therefore highly susceptible to contamination.

Many of the historic sites of soil and groundwater contamination within Muskegon County have undergone extensive investigation and cleanup. However, many sites remain a threat to the quality of groundwater. This condition requires that communities be aware of potential threats,

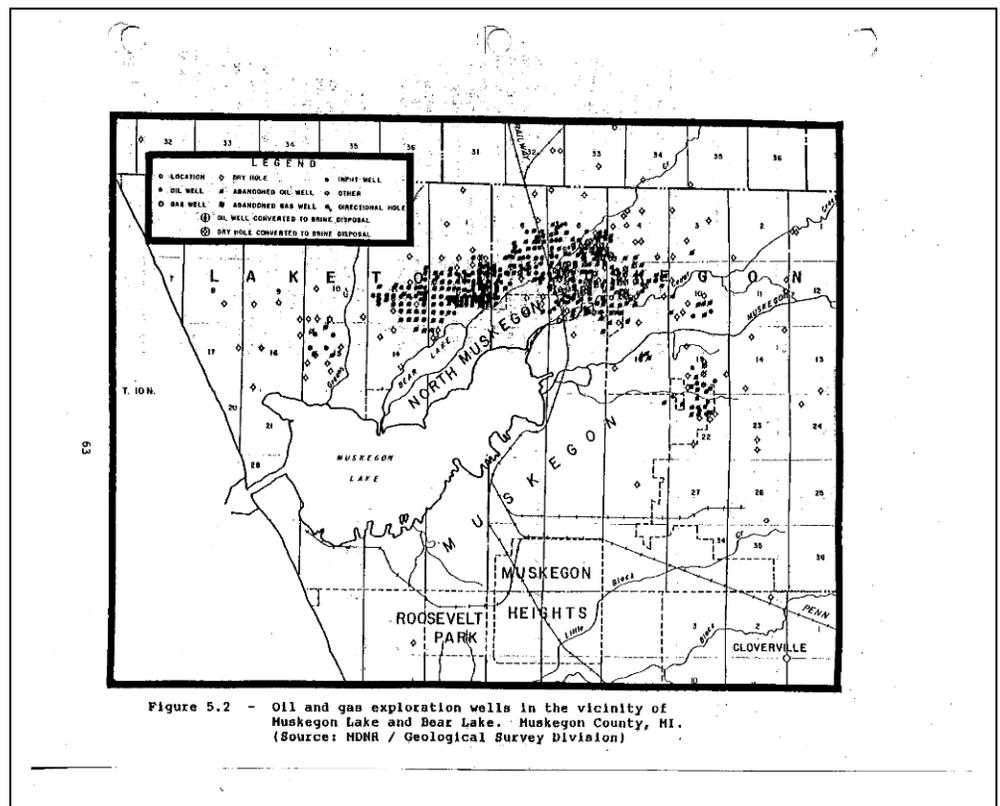
and that green infrastructure planning take into account the need for remedial actions and site designs that eliminate the risk of exacerbating exposure to pollution. Planning for green infrastructure requires a proactive approach rather than a reactive one. Steps taken to prevent damage to groundwater supplies can greatly outweigh costs needed to compensate for poor planning.

The concerns that environmental contamination present for green infrastructure planning are not insurmountable. Communities are encouraged to be aware of threatening conditions, and to keep informed about administrative and regulatory changes that may affect the progress of existing cleanup projects. The following paragraphs provide a general overview of the scope of this concern stemming from the presence of abandoned oil and gas wells, Part 201 sites, Superfund sites, and other identified brownfield sites in Muskegon County.

### Abandoned Oil & Gas Exploration Wells:

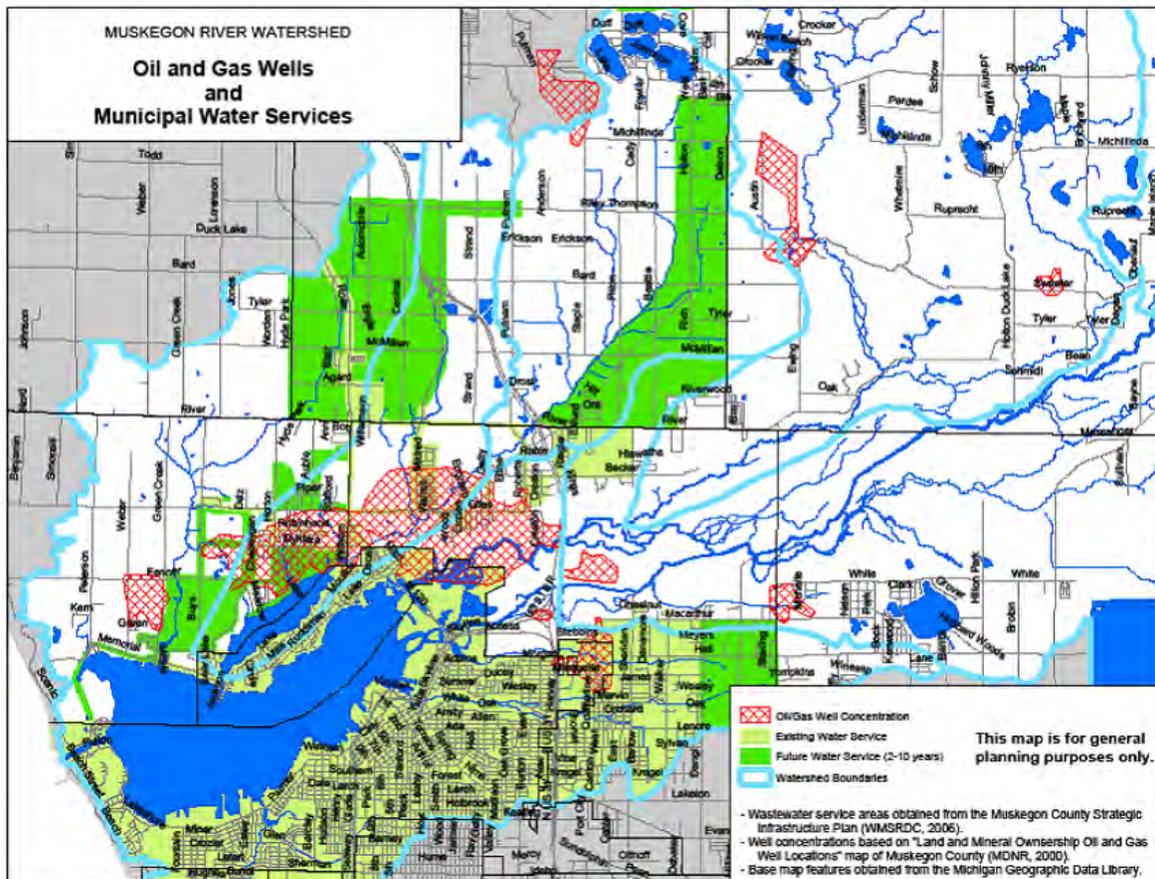
Approximately 300 oil and gas exploration wells were drilled within the watershed of the Muskegon Lake Area of Concern (AOC) between 1928 and 1970. Exploration and extraction continues, with the most recent gas well permits issued in 2009. In general, wells plugged prior to the 1970's were done so improperly. This accounts for the majority of the wells in the watershed. As the rural area underwent residential development and commercial development, wells were plugged on a case-by-case basis. According to the 1987 Muskegon Lake Remedial Action Plan (RAP), the Michigan Department of Natural Resources recommended fourteen priority oil wells for plugging (M. Cote, 1983, District 12 Geologist). In 1987, Muskegon Lake was designated an AOC, and the abandoned oil wells were listed as a major source of pollution (Muskegon Lake Remedial Action Plan (RAP), Michigan Department of Natural Resources, 1987).

Public Health  
Muskegon County  
completes permit  
reviews for the drilling  
of drinking water wells  
at the time of  
construction. The  
review includes visual  
survey for evidence of  
exact well location,  
strict construction,  
pump test and sampling  
requirements. However,



in the past 15 years, well drillers have encountered crude in the upper aquifer 3 times while installing the water well. On one occasion, the well water contained dissolved oil byproduct detected in the sample. Despite attempts to ensure safe drinking water, experience has shown that the oil, brine and related pollutants often are pulled into the water intake only after prolonged use of the water supply. In addition, there is evidence the natural release of gasses deep within the oil bearing strata is re-pressurizing the oil and gas bearing layers, and pushing oil, gas, and brine up the improperly plugged casings into upper water bearing zones. Therefore, there is no way to determine if or when oil field byproducts may contaminate the upper drinking water aquifer. Thus, the abandoned oil field continues to threaten drinking water.

The Oil and Gas Wells and Municipal Water Services map, shown below, indicates where the significant concentrations of improperly plugged oil wells exist in relation to areas currently served by public water supply, areas where public water supply is planned, and areas where no public water supply is planned.



**State Information on Contaminated Sites:**

The Michigan Department of Natural Resources and Environment (DNRE) administers programs that involve the cleanup and redevelopment of contaminated properties to achieve a healthier, cleaner, and more productive environment for Michigan's citizens. The primary legislative authority for the state cleanup program is Part 201, Environmental Remediation, and Part 213,

Leaking Underground Storage Tanks, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. The state program has a unique, causation-based liability scheme, land use based cleanup requirements, and a strong emphasis on redevelopment and reuse of contaminated property. Resources are available on the DNRE Remediation and Redevelopment Division website that explain the options available to a person who is cleaning up contaminated property, the obligations of liable parties, and the responsibilities of parties who own contaminated property (known as "Due Care"). Technical information about aspects of the program such as cleanup criteria and laboratory analytical methods are also covered. For more information, utilize the contact information provided below.

MDEQ, Remediation and Redevelopment Division  
P.O. Box 30426, Lansing, MI 48909-7926  
517-373-9837  
[http://www.michigan.gov/deq/0,1607,7-135-3306\\_28608---,00.html](http://www.michigan.gov/deq/0,1607,7-135-3306_28608---,00.html)

The DNRE publishes several databases regarding contaminated properties on the internet, including Part 201, sites of contamination; Part 213, leaking underground storage tanks; and Brownfield-USTfields. Each of the databases is described below.

Part 201 (Environmental Remediation) of the Natural Resources and Environmental Protection Act (NREPA) regulates sites of environmental contamination (or facilities) in Michigan. The Part 201 database includes properties which are regulated; including liable party cleanup sites, sites assessed to require no further remediation, and those sites addressed by the state. The identified sites have undergone environmental risk assessments, to rank them according to the risk each poses to human health and the environment, and been scored. This database lists 109 Part 201 sites in Muskegon County, and can be accessed through the following website: <http://www.deq.state.mi.us/part201/>.

Part 213 of the NREPA regulates Leaking Underground Storage Tanks (LUSTs) and the inventory includes both those sites where corrective actions have not been completed to meet the appropriate land use criteria (OPEN LUSTs) and those where corrective actions have been completed (CLOSED LUSTs). Usually petroleum products are involved but there are other regulated substances, additionally covered by Part 213, which could be leaking. This database lists 141 Part 213 sites in Muskegon County, and can be accessed through the following website: [http://www.deq.state.mi.us/sid-web/LUST\\_Search.aspx](http://www.deq.state.mi.us/sid-web/LUST_Search.aspx).

The Brownfield-USTfield database contains property information about state funded cleanup and redevelopment sites, from the Part 201 list, as well as LUST sites which have had a Baseline Environmental Assessment (BEA) submitted to MDEQ for redevelopment purposes. The definition of a USTfield is very similar to the definition of brownfield: abandoned or under-used industrial and commercial properties where revitalization is complicated by real or perceived environmental contamination from underground storage tanks. This database lists 51 sites in Muskegon County, and can be accessed through the following website: <http://www.deq.state.mi.us/ustfields/>.

## **Federal Information on Contaminated Sites:**

The U.S. Environmental Protection Agency (EPA) also publishes on the Internet several databases identifying contaminated sites. They are related to the Superfund program, created by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. The goal of CERCLA is to clean up the nation's uncontrolled hazardous waste sites which contain abandoned, accidentally spilled, or illegally dumped hazardous waste that pose a current or future threat to human health or the environment.

Sites become superfund sites through an evaluation process, including completion of Hazard Ranking System (HRS) evaluation, screening and public solicitation of comments about the proposed site, and nomination to the National Priorities List (NPL). Should a site be placed on the NPL, it is regarded as posing an immediate or significant public health threat to the local community. It is, therefore, eligible for extensive, long-term cleanup action under the Superfund program.

There are eight National Priority List (NPL) sites of environmental contamination in Muskegon County. The NPL sites, also known as Superfund sites are among the nation's top priorities for environmental cleanup. Detailed information about the status of each Superfund site can be found at the local data repository, normally located at the city or township hall in which the site is located. Fact sheets about the sites are available at <http://www.epa.gov/region5superfund/npl/michigan/index.html>. To ensure that the most current information is received, communities are encouraged to contact the site EPA Project Manager directly.

Listed below are the National Priority List Superfund sites in Muskegon County, their locations, and contact information for the EPA Remedial Project Manager in charge of the site.

- Bofors Nobel, Inc., Egelston Township  
John Fagiolo  
[fagiolo.john@epa.gov](mailto:fagiolo.john@epa.gov)  
(312) 886-0800
- Ott/Story/Cordova Chemical Company, Dalton Township  
John Fagiolo  
[fagiolo.john@epa.gov](mailto:fagiolo.john@epa.gov)  
(312) 886-0800
- Thermo-Chem, Inc., Egelston Township  
John Fagiolo  
[fagiolo.john@epa.gov](mailto:fagiolo.john@epa.gov)  
(312) 886-0800
- Peerless Plating Company, Muskegon  
Linda Martin  
[martin.lindab@epa.gov](mailto:martin.lindab@epa.gov)  
(312) 886-3854

- SCA Independent Landfill, City of Muskegon Heights  
Ronald Murawski  
[murawski.ronald@epa.gov](mailto:murawski.ronald@epa.gov)  
(312) 886-2940
- Duell and Gardner Landfill, Dalton Township  
Pamela Molitor  
[molitor.pamela@epa.gov](mailto:molitor.pamela@epa.gov)  
(312) 886-3543
- Kaydon Corporation, City of Norton Shores  
Sam Chummar  
[chummar.sam@epa.gov](mailto:chummar.sam@epa.gov)  
(312) 886-1434
- Muskegon Chemical Company, City of Whitehall  
Sheri Bianchin  
[bianchin.sheri@epa.gov](mailto:bianchin.sheri@epa.gov)  
(312) 886-4745

According to available data, three of the eight sites in Muskegon County, remain a potential threat to private drinking water well supplies. They are Ott/Story/Cordova, Duell and Gardner Landfill, and Muskegon Chemical Company. The following groundwater and drinking water information was obtained from [www.scorecard.org](http://www.scorecard.org), a pollution information website.

#### Ott/Story/Cordova

Were drinking water wells shut down due to contamination?	Yes
Population served by the wells now shut down:	101 - 500
Are drinking water wells potentially threatened?	Yes
Population served by the threatened wells:	1 - 24
Aquifer discharges into:	Surface water
Population served by water wells in the aquifer:	1 - 24

#### Duell and Gardener Landfill

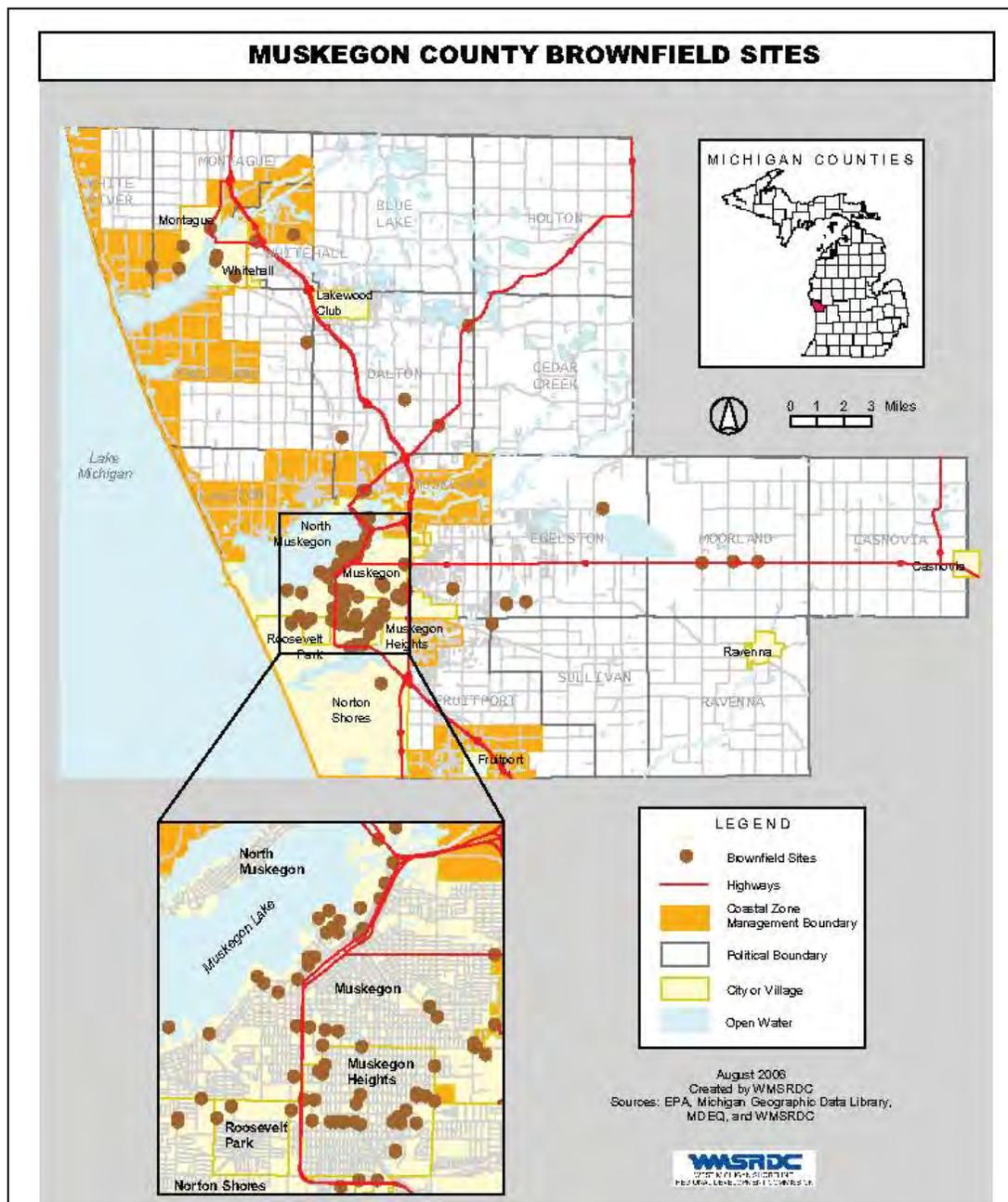
Were drinking water wells shut down due to contamination?	No
Are drinking water wells potentially threatened?	Yes
Population served by the threatened wells:	1 - 24
Aquifer discharges into:	Surface water
Population served by water wells in the aquifer:	101 - 500

#### Muskegon Chemical Company

Were drinking water wells shut down due to contamination?	No
Are drinking water wells potentially threatened?	Yes
Population served by the threatened wells:	25 - 100
Aquifer discharges into:	Surface water
Population served by water wells in the aquifer:	No data

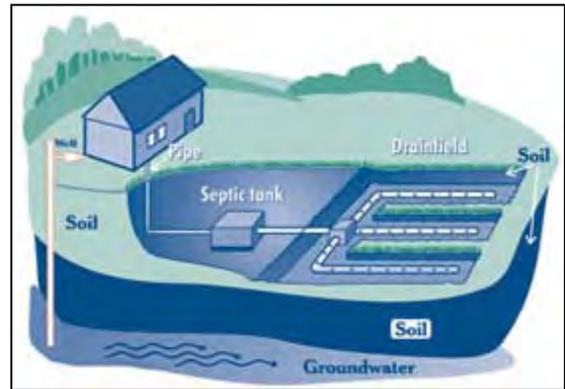
## Muskegon County Brownfields:

The West Michigan Shoreline Brownfields Inventory and Plan for Implementation, authored by the WMSRDC in 2006, identified 103 brownfield sites in Muskegon County. Research for the document included the state and federal databases discussed in the preceding pages. The Muskegon County Brownfield Sites map, taken from the Brownfields plan, reveals a close correlation between urban areas and brownfield sites. Even though most of the county's brownfields are located within populated areas with public water service, there are some brownfields located in areas where private households rely on private water wells for drinking water. These areas should receive special attention in order to prevent contamination of groundwater resources.



## Wastewater Treatment Systems:

On-site systems serve as the permanent wastewater infrastructure for a significant sector of Michigan's residents, and have been cited as significant contributors to contamination of groundwater and surface water. There are an estimated 1.4 million individual on-site wastewater systems serving homes and businesses in the state; with the total number of systems continuing to increase. Presently approximately 50% of new homes constructed utilize individual or small community systems.



The MDEQ regulation of on-site wastewater systems has been identified as a necessary critical component of effective land use. A secure long-term state funding mechanism for the conduct of DEQ on-site wastewater program activities does not exist. Historically the program has had general fund support, which has been eliminated. The Michigan Groundwater Discharge Program targets groundwater monitoring to specific sites with groundwater permits, to assess potential impacts on private wells from these sites. It regulates discharge to groundwater under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451 and Part 22 Rules. Groundwater staff reviews applications for authorizations to discharge wastes and wastewaters to the ground or groundwaters of the state. Authorizations include permits, self-certifications, and exemptions.

Some of the duties performed by groundwater staff include:

- Review of effluent and groundwater sampling data;
- Inspection of discharge facilities to ensure legal requirements are being met;
- Review and issuance of permits for the construction of public sewerage systems, under Part 41 of the NREPA;
- Review of compliance with hazardous material storage requirements under the Part 5 Rules, under Part 31 of the NREPA.

Upon completion of an application review, staff makes recommendations leading to the determination of appropriate action including issuance or denial of an authorization to discharge. It should be noted that the issuance of a Groundwater Discharge permit does not authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other DEQ permits, or approvals from other units of government as may be required by law.

## Chapter 4: Wetlands

The Michigan Department of Environmental Quality (MDEQ) defines a wetland according to Michigan's wetland statute, Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451 (NREPA, as amended, as "land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh." The definition applies to public and private lands regardless of zoning or ownership.

### A wetland is...

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

-MDEQ

Most people are familiar with the cattail or lily pad wetland found in areas with standing water, but wetlands can also be grassy meadows, shrubby fields, or mature forests. Many wetland areas have only a high ground water table and standing water may not be visible. Types of wetlands include deciduous swamps, wet meadows, emergent marshes, conifer swamps, wet prairies, shrub-scrub, swamps, fens, and bogs. The State of Michigan wetland website offers more information at (<http://www.michigan.gov/deqwetlands>).

According to the NREPA Part 303, Wetlands Protection, a person may not do any of the following activities in a wetland without a permit from the DEQ:

Activity	Example (Partial List Only)
Deposit or Permit the Placing of Fill Material	Bulldozing, Grading, Dumping
Dredge, Remove, or Permit the Removal of Soil or Minerals	Removing Tree Stumps, Bulldozing, Digging a Pond
Construct, Operate, or Maintain any Use or Development	Construction of Buildings or Structures, Boardwalks, Peat mining, Water treatment
Drain Surface Water	Diverting Water to Another Area via Ditch, Pump or Drain

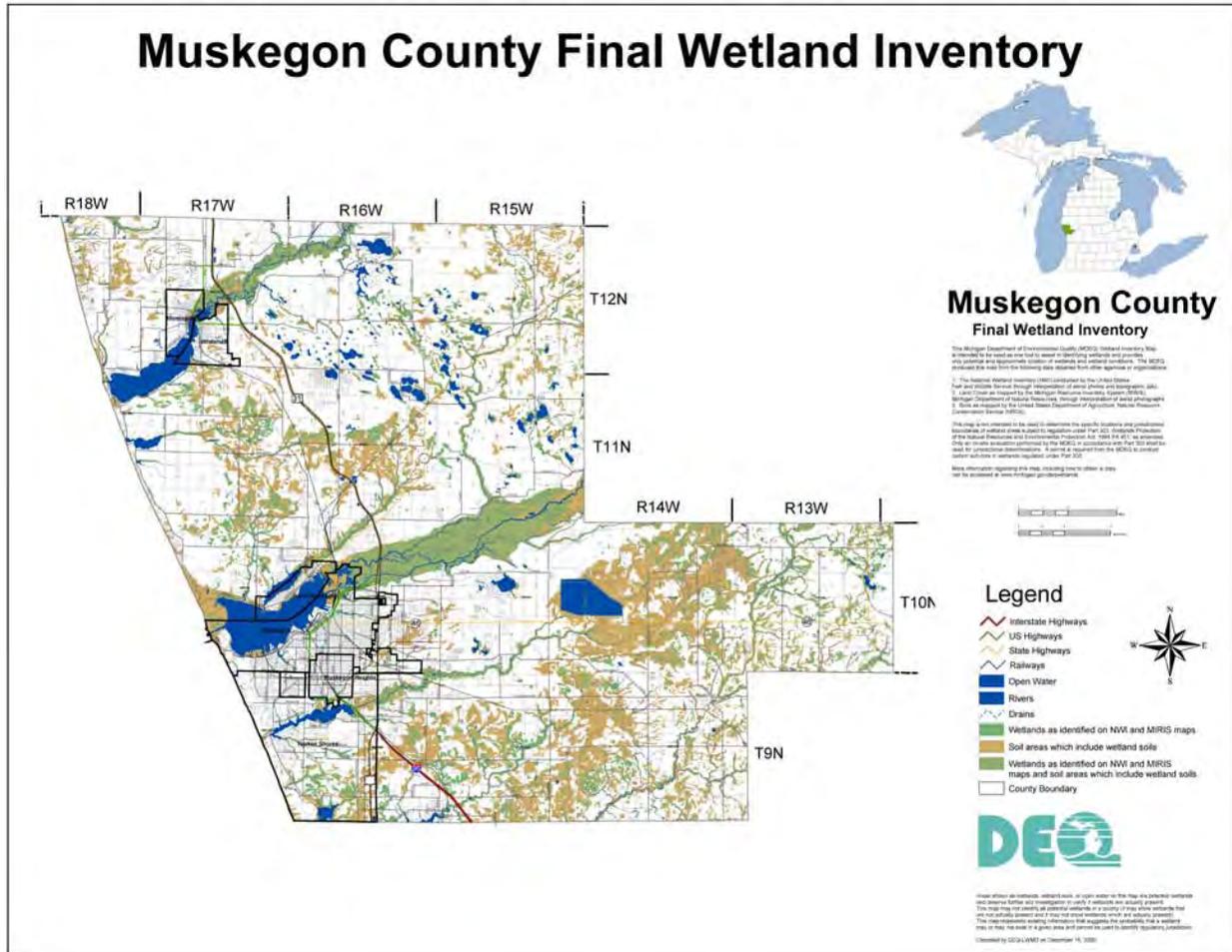
### Muskegon County Wetlands:

Out of 527 square miles in Muskegon County, 74 sq. miles are wetlands, or 14%, of the landscape is considered a wetland. Pursuant to the NREPA, the MDEQ completed a County Wetland Inventory to provide potential and approximate locations of wetlands and wetland conditions throughout the state. It is intended to be used as a tool in planning for development, open space designations, zoning, etc. as a way to protect wetland resources. The maps are not intended to be used to determine the specific locations and jurisdictional boundaries of wetland areas subject to regulation under Part 303. Only an on-site evaluation performed by the MDEQ in accordance with Part 303 can be used for jurisdictional determinations. The MDEQ has a

wetland identification program to assist property owners with identifying the location of any wetlands on their property and whether the wetlands are regulated.

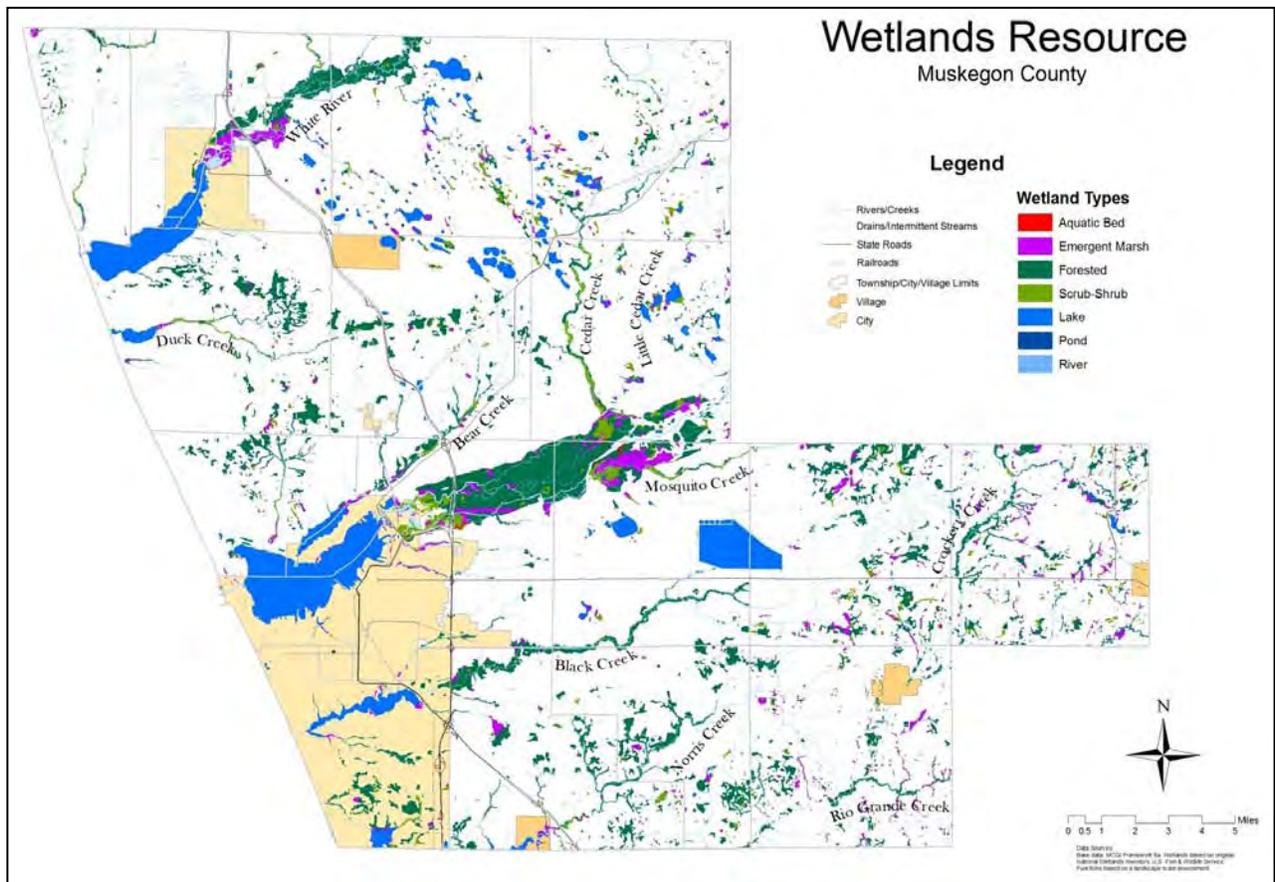
The Muskegon County Wetland Inventory map reveals wetland areas in Muskegon County. The map is also available in PDF format through the link below:

[http://www.michigan.gov/documents/CGI\\_Muskegon\\_prelim\\_wi\\_75137\\_7.pdf](http://www.michigan.gov/documents/CGI_Muskegon_prelim_wi_75137_7.pdf)



Muskegon County Wetland Resources		
Waterbody Type	Acres	Percent
Natural Lake	10,809	76.0
Dammed River Valley Lake	138	1.0
Excavated Lake	2,067	14.5
Diked/Impounded Lake	42	0.3
Natural Pond	313	2.2
Diked/Impounded Pond	55	0.4
Excavated Pond	190	1.3
River (Wide)	452	3.2
Open Water Wetlands	14,226	

Source: Annis Water Resources Institute



## **Ecological Services of Wetlands:**

Wetlands are a significant factor in the health and existence of other natural resources such as inland lakes, groundwater, fisheries, wildlife, and the Great Lakes. Michigan's wetland statute recognizes the following benefits provided by wetlands:

- Flood and storm control by the hydrologic absorption and storage capacity of wetlands.
- Wildlife habitat by providing breeding, nesting, and feeding grounds and cover for many forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened, or endangered wildlife species.
- Protection of subsurface water resources and provision of valuable watersheds and recharging ground water supplies.
- Pollution treatment by serving as a biological and chemical oxidation basin.
- Erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.
- Sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.

These benefits, often referred to as wetland functions and values, often play a vital role in recreation, tourism, and the economy in Michigan. According to a 1991 United States Fish and Wildlife Service Wetland Status and Trends report, over 50% of Michigan's original wetlands have been drained or filled, thereby making the protection of remaining wetlands that much more important.

## **AWRI Functional Wetlands Assessment:**

The information presented in this section illustrates the beneficial functions of wetlands that can be considered by local communities as part of their green infrastructure planning, site development planning, and wetland restoration projects. As part of the Mega Model Project - Muskegon Watershed Research Partnership, funded by the Great Lakes Fishery Trust, the Grand Valley State University Annis Water Resources Institute (AWRI) completed the "Landscape Scale Functional Wetlands Assessment - for Muskegon County." This assessment utilized data from the National Wetlands Inventory of the U.S. Forest and Wildlife Service to help identify how different types of wetlands can function to benefit communities through the ecological services that they naturally provide.

Functions of importance include:

- Floodwater storage
- Streamflow maintenance
- Nutrient transformation
- Retention of sediment
- Shoreline stabilization
- Fish, Waterfowl, Marsh Bird, Amphibian and Other Habitat

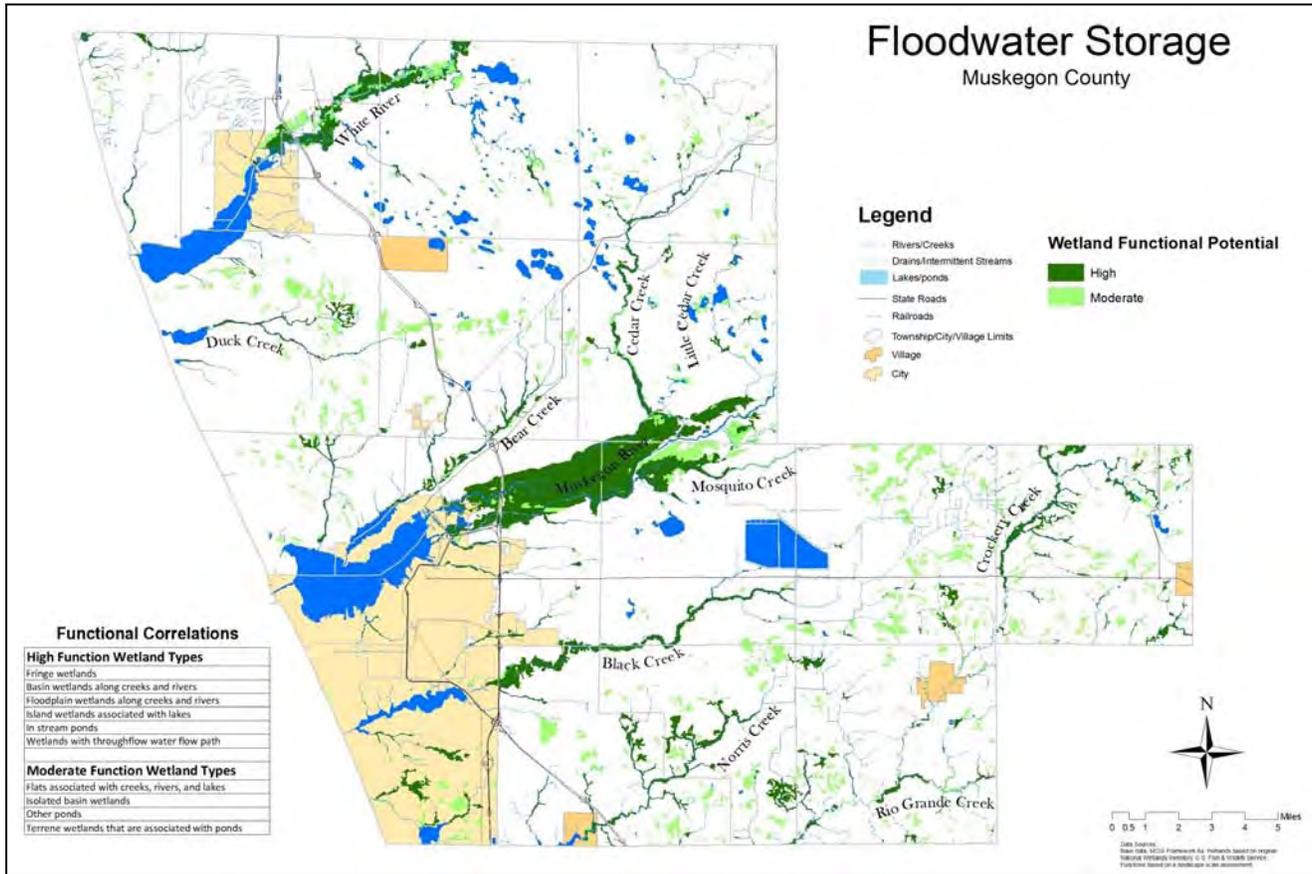
The table below summarizes the potential of wetlands in Muskegon for provided various ecological services. It was a product of the Functional Wetlands Assessment.

High Function Potential	
Wetland Function	% of Vegetated Wetlands
Floodwater Storage	50
Streamflow Maintenance	41
Nutrient Transformation	78
Sediment and other Particulate Retention	55
Shoreline Stabilization	50
Fish Habitat	68*

\* Of all wetland types

### Floodwater Storage:

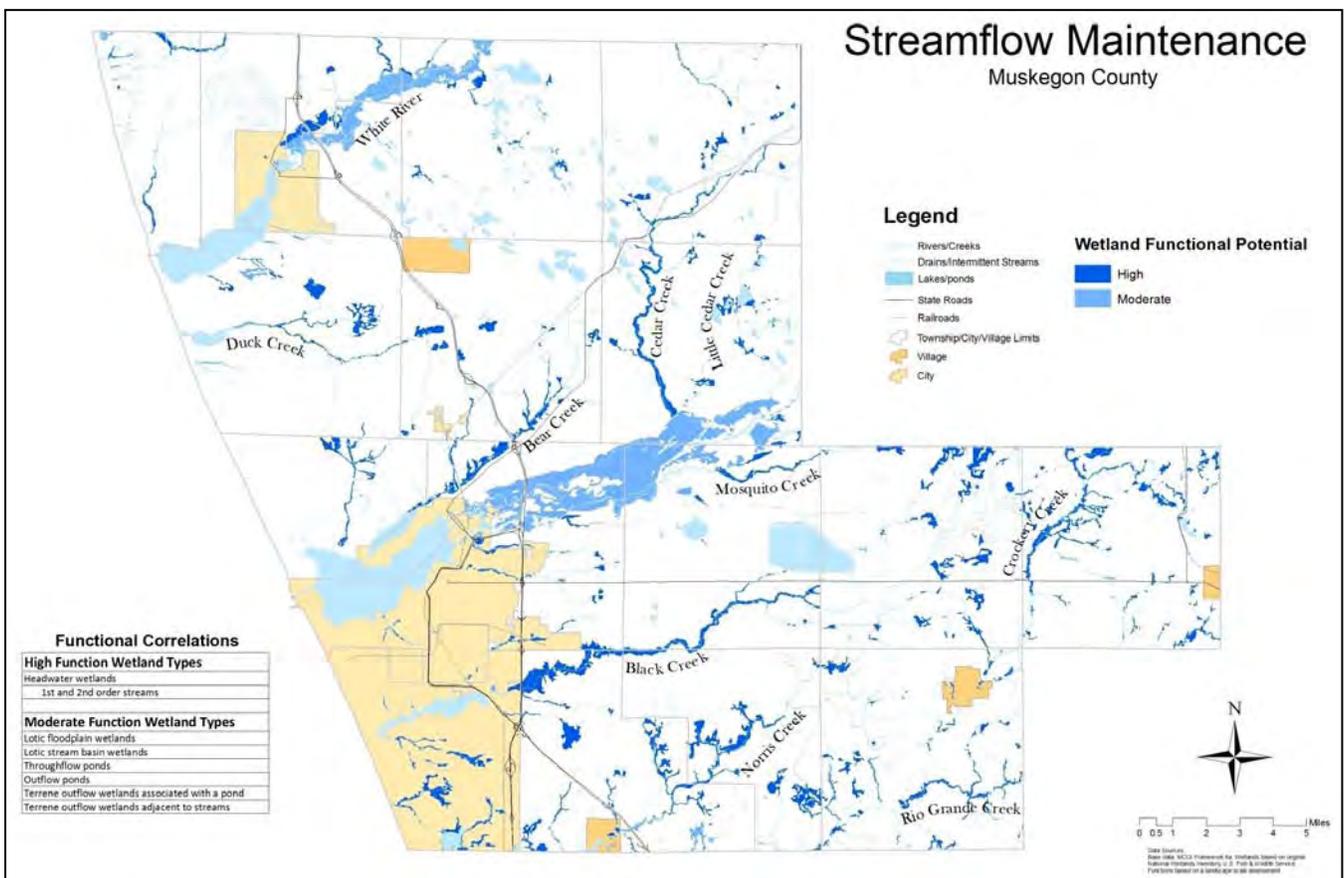
Floodwater storage is an important benefit provided by wetlands. In Muskegon County, 50% of vegetated wetlands, have a high capacity to prevent flooding. The water-holding capacity of wetlands reduces downstream flooding, including the “flashiness” of urban and rural creeks. Even moderate storm events can cause flashiness, which in turn is damaging to the quality of stream habitats for the fish and wildlife that depend on them.



Watersheds with 40% wetland coverage can significantly reduce flood flows, by as much as eighty percent (80%) (Novitzki, 1979). Wetlands that provide this ecological service include fringe wetlands, floodplain wetlands along rivers and creeks, and basin wetlands along rivers and creeks.

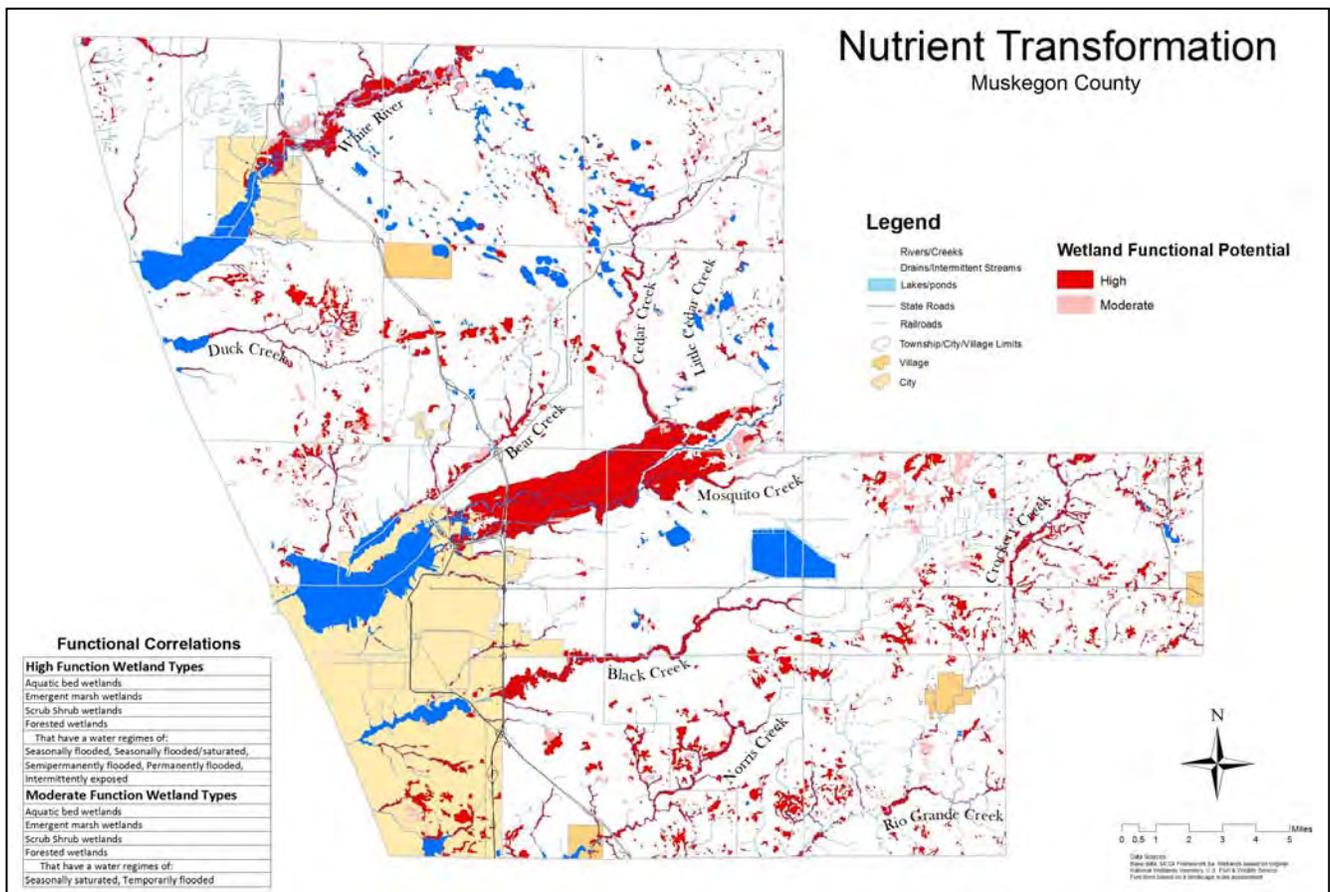
**Streamflow Maintenance:**

Many wetlands are sources of groundwater discharge, and if in a headwater position, typically are sources of streams. Examples of wetlands that are sources of surface water are those that are present along 1<sup>st</sup> and 2<sup>nd</sup> order streams. Approximately 41% of the vegetated wetlands in Muskegon County have a high functional potential for streamflow maintenance.



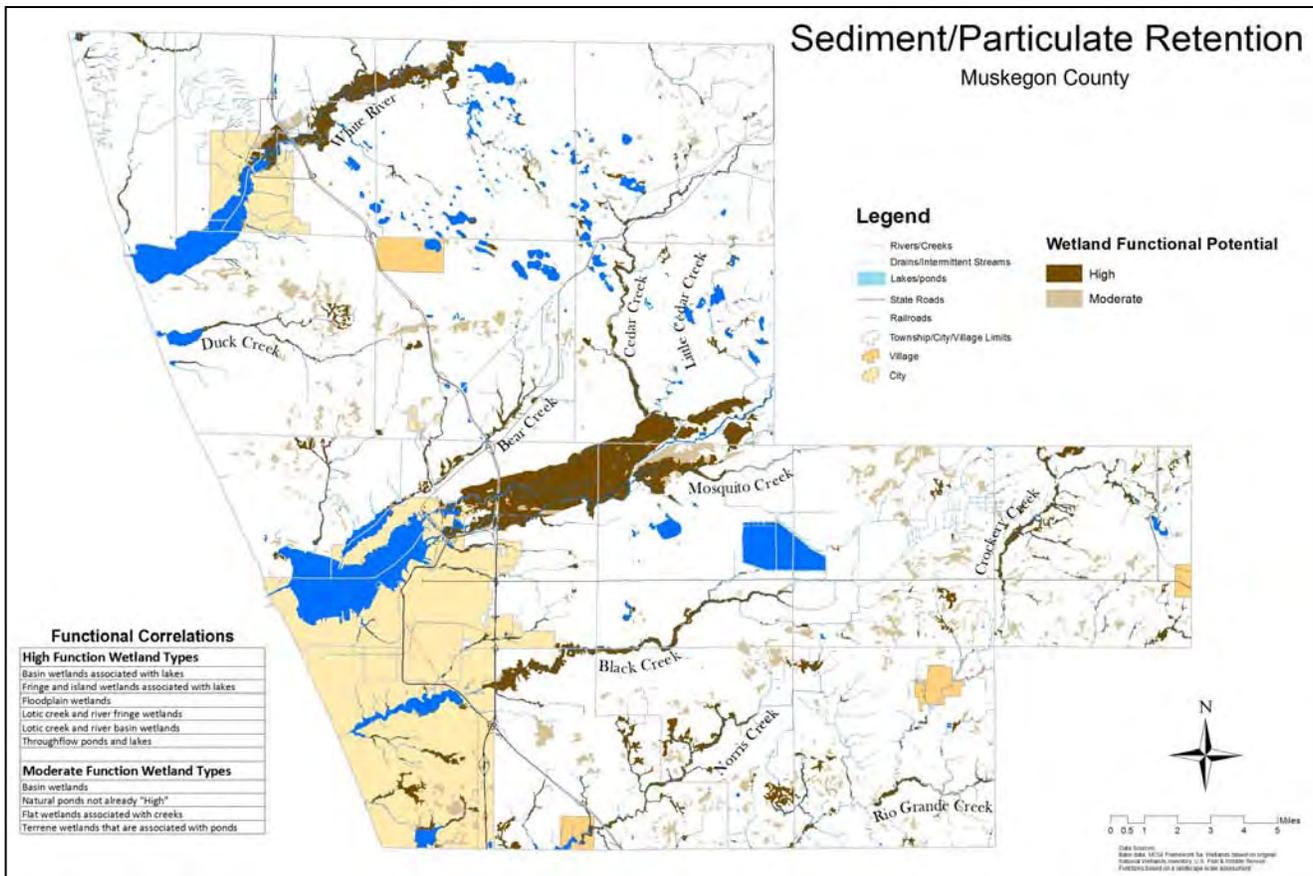
## Nutrient Transformation:

Of the vegetated wetlands in Muskegon County, 78% are estimated to have a high functioning potential for nutrient transformation. Recycling nutrients such as nitrogen and phosphorous is an important function that a wetland can provide. Organic soils found in wetlands are well-equipped to process nutrients, and wetland vegetation is responsible for phosphorous uptake. All vegetated wetlands that are seasonally flooded, semi-permanently flooded, permanently flooded, or intermittently exposed aid in the uptake of phosphorous. Phosphorous is a nutrient that can cause algae blooms in surface water. The uptake of phosphorous within wetlands helps to prevent the accelerated aging of lakes, or eutrophication. In Muskegon County, 7 of lakes are considered eutrophic, and 2 are hypereutrophic. These water features are further addressed in Chapter 7, Surface Water.



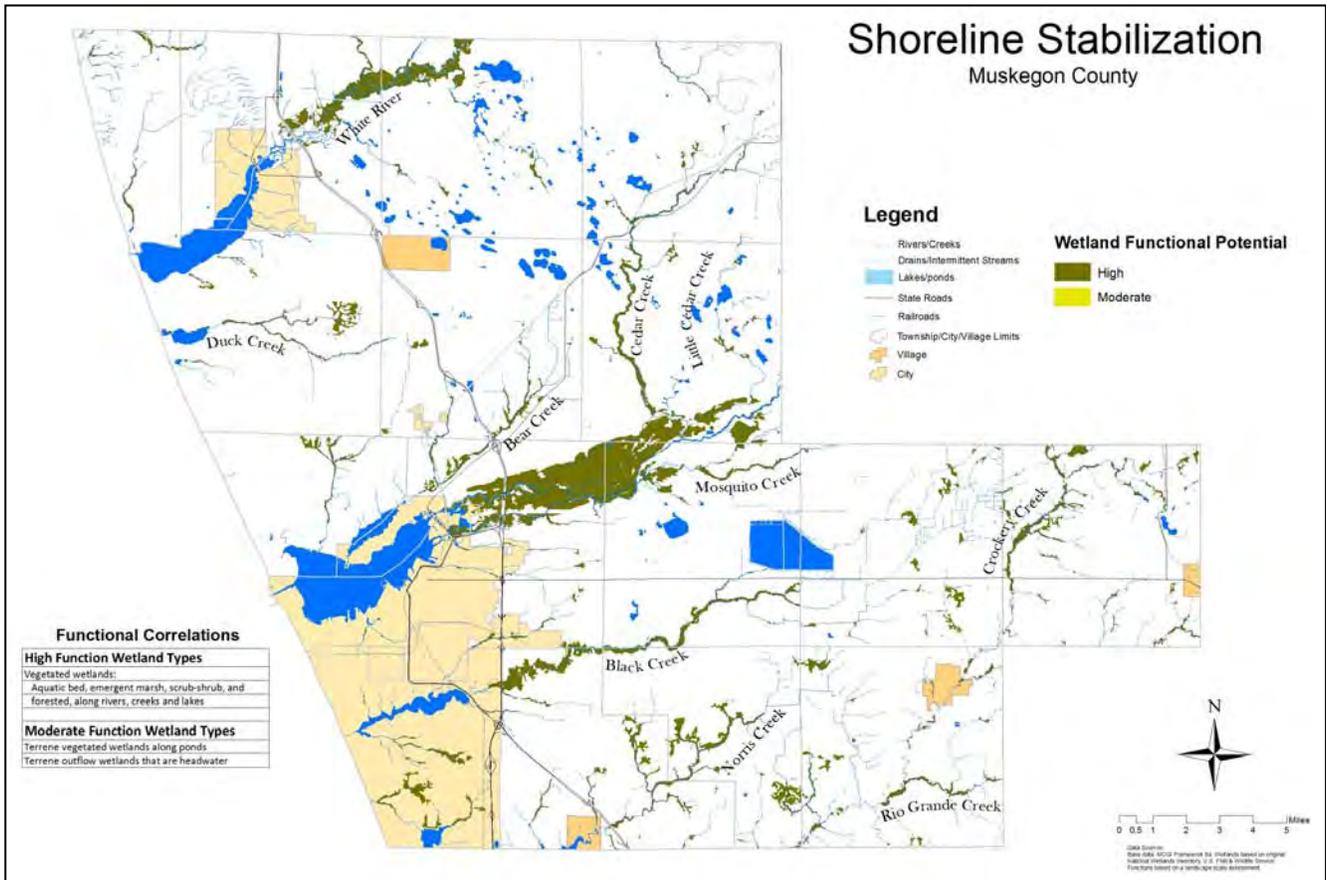
## Sediment and other Particulate Retention:

Floodplain wetlands, basin and fringe wetlands associated with lakes, lotic river/creek basin and fringe wetlands, and lakes/ponds with throughflow all possess the potential to aid in sediment and other particulate retention. This function captures sediments with bonded nutrients or heavy metals. Of all the vegetated wetlands in Muskegon County, 55% are estimated to have a high potential to provide this function.



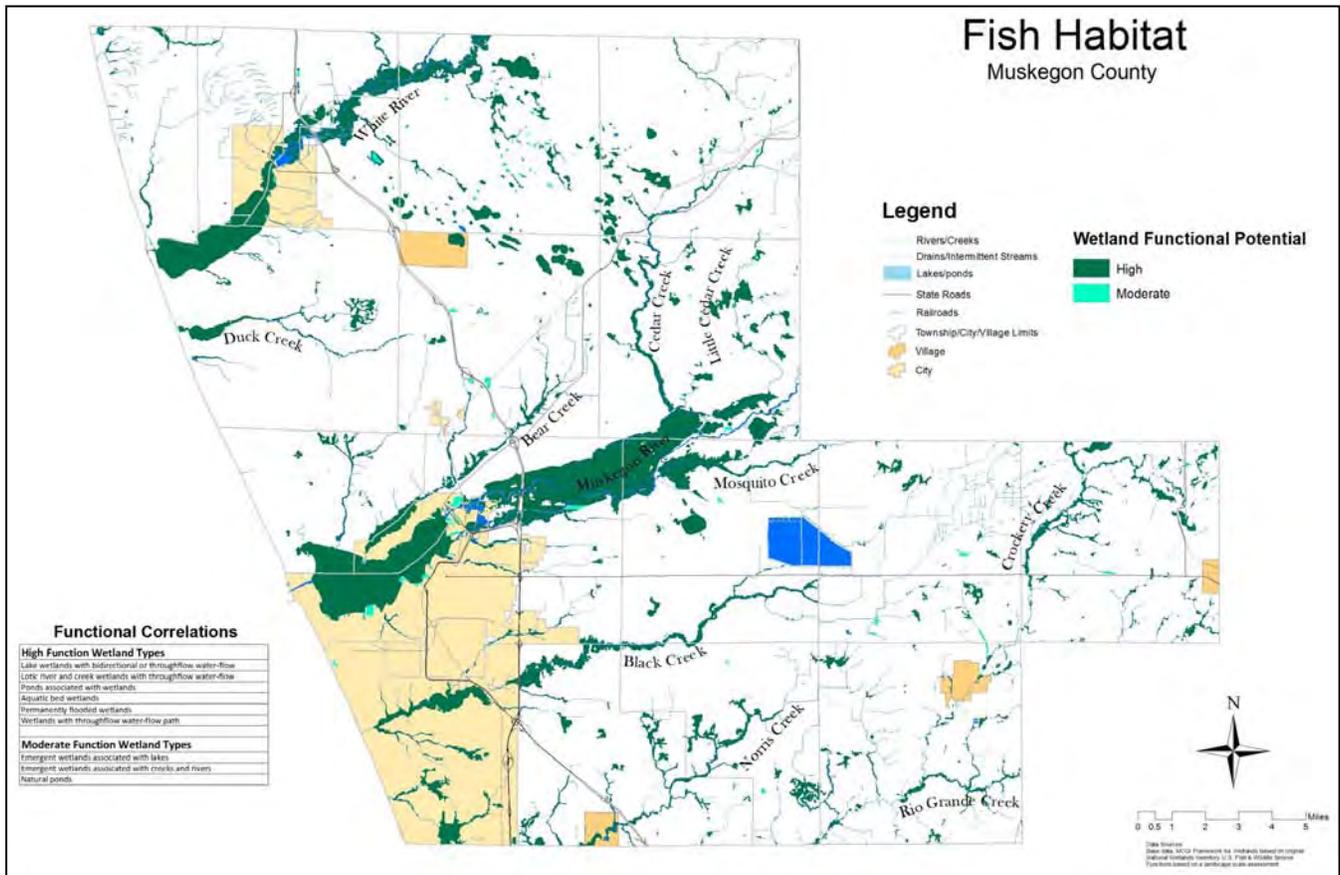
## Shoreline Stabilization:

Erosion is accelerated by the velocity of flowing water in rivers and creeks and wave action along shorelines. Wetland vegetation reduces the potential for erosion by stabilizing soil. Examples of wetlands that prevent erosion are aquatic bed, emergent marsh, shrub-scrub, and forested wetlands along rivers and creeks. In Muskegon County, 50% of vegetated wetlands possess a high functional potential for shoreline stabilization.

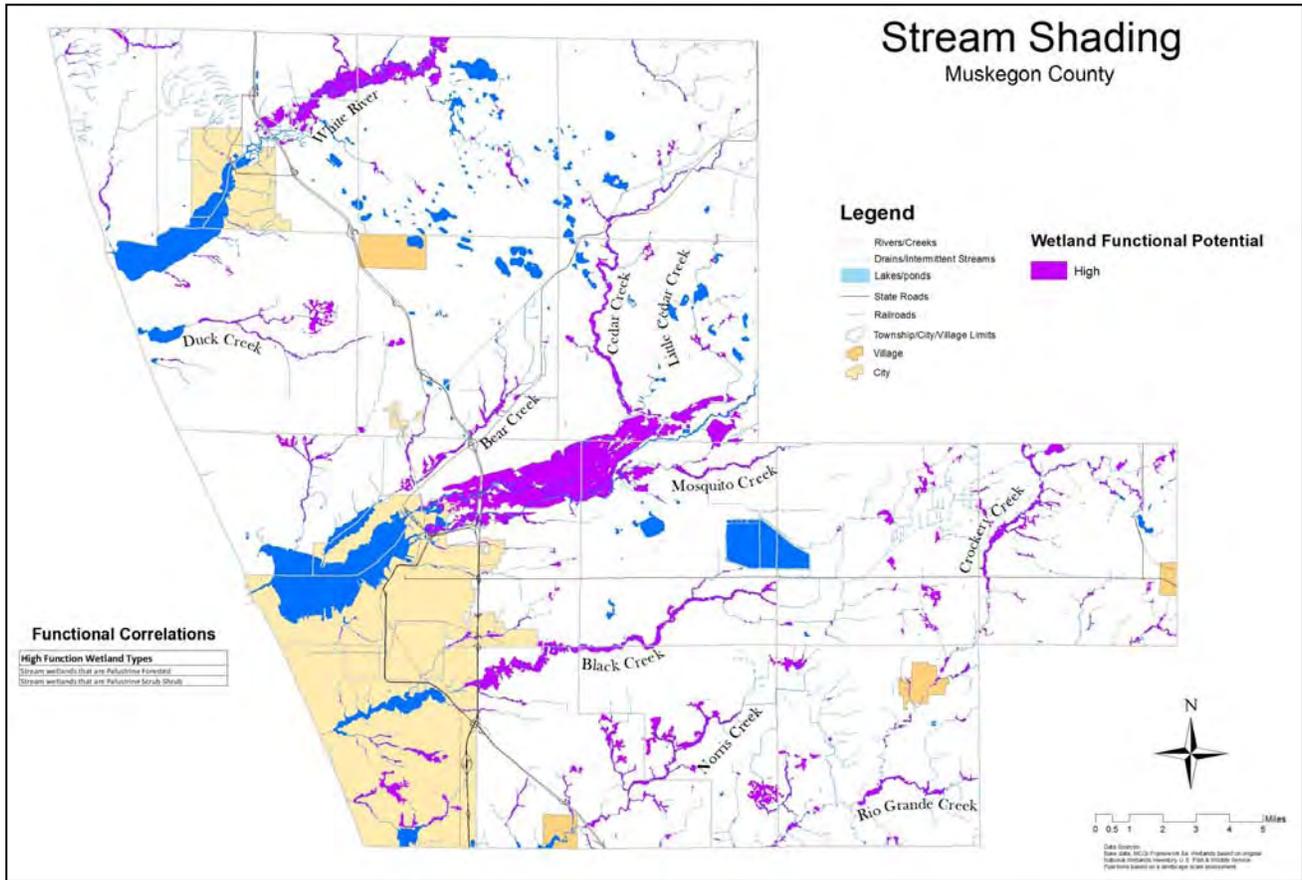


## Fish Habitat:

A healthy fishery depends on the availability of diverse, quality aquatic habitats. Wetlands provide nursery grounds for juvenile fishes, and feeding grounds for some adult fishes. Wetlands help to moderate water levels, ensuring a longer duration of adequate water levels for the life cycles of many important fish species. Examples of wetlands that provide quality fish habitat are lentic wetlands, wetlands associated with ponds, and outflowing aquatic bed wetlands. Out of all wetlands in Muskegon County, 68% carry a high functional potential to provide fish habitat.



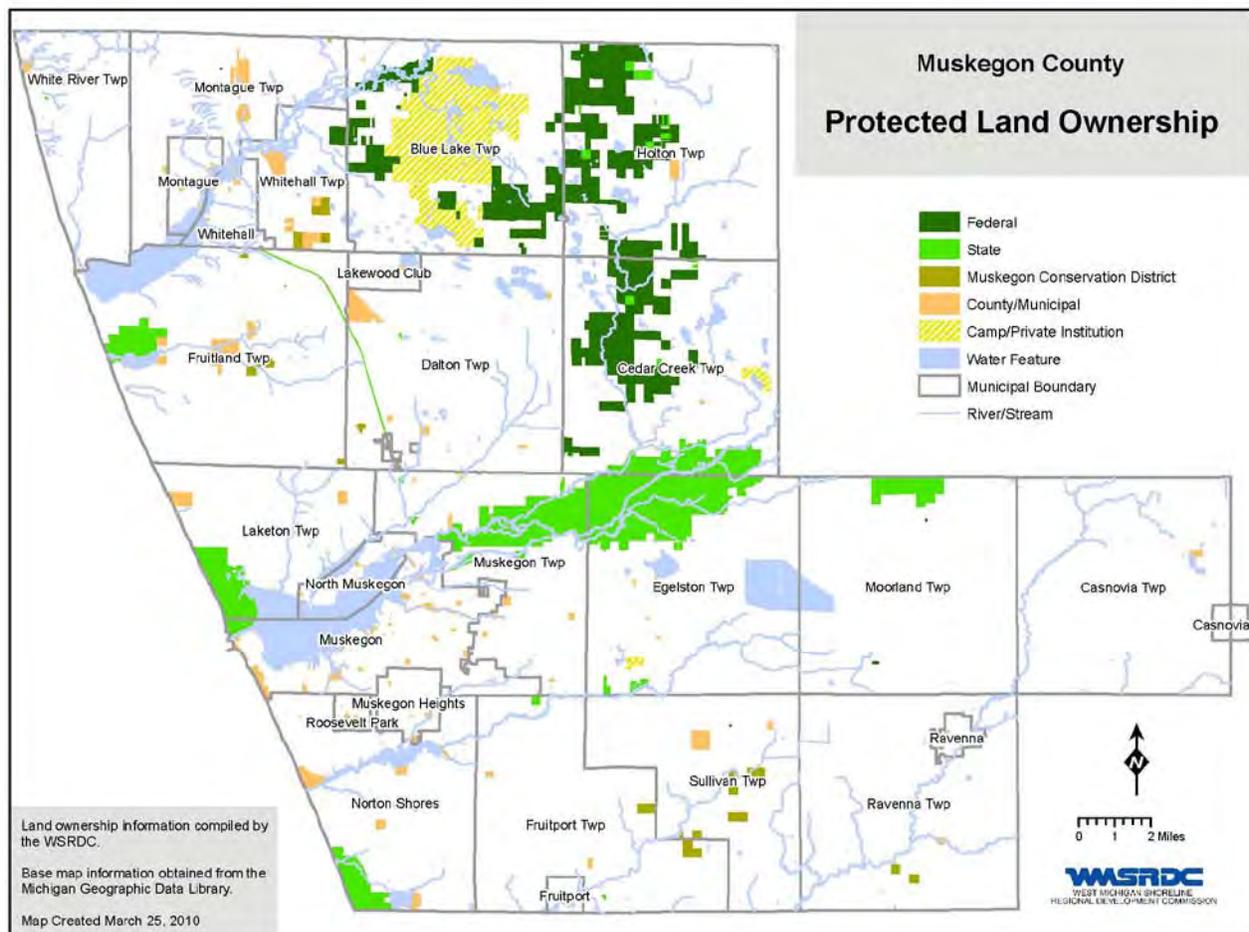
Stream corridors that are shaded by vegetation have cooler water, the ability to sustain food supplies, and other necessary habitat components for quality fish and wildlife habitat. Natural woody debris and leaf litter provide food for aquatic insects, which are needed by juvenile fish, ducks, and other wildlife. Examples of wetlands that provide these benefits are forested and shrub-scrub wetlands along rivers and creeks.



## Chapter 6: Forests

Large, forested natural areas provide communities with benefits associated with wildlife, recreation, hunting, water quality, clean air, wild foods, and scenic views. In urban areas, tree canopies provide cooler temperatures in residential neighborhoods. Trees provide creeks and streams with the shade necessary to protect water quality by keeping them cool. Communities that protect and maintain large trees in commercial corridors and town centers offer visitors and residents a unique and attractive sense of place.

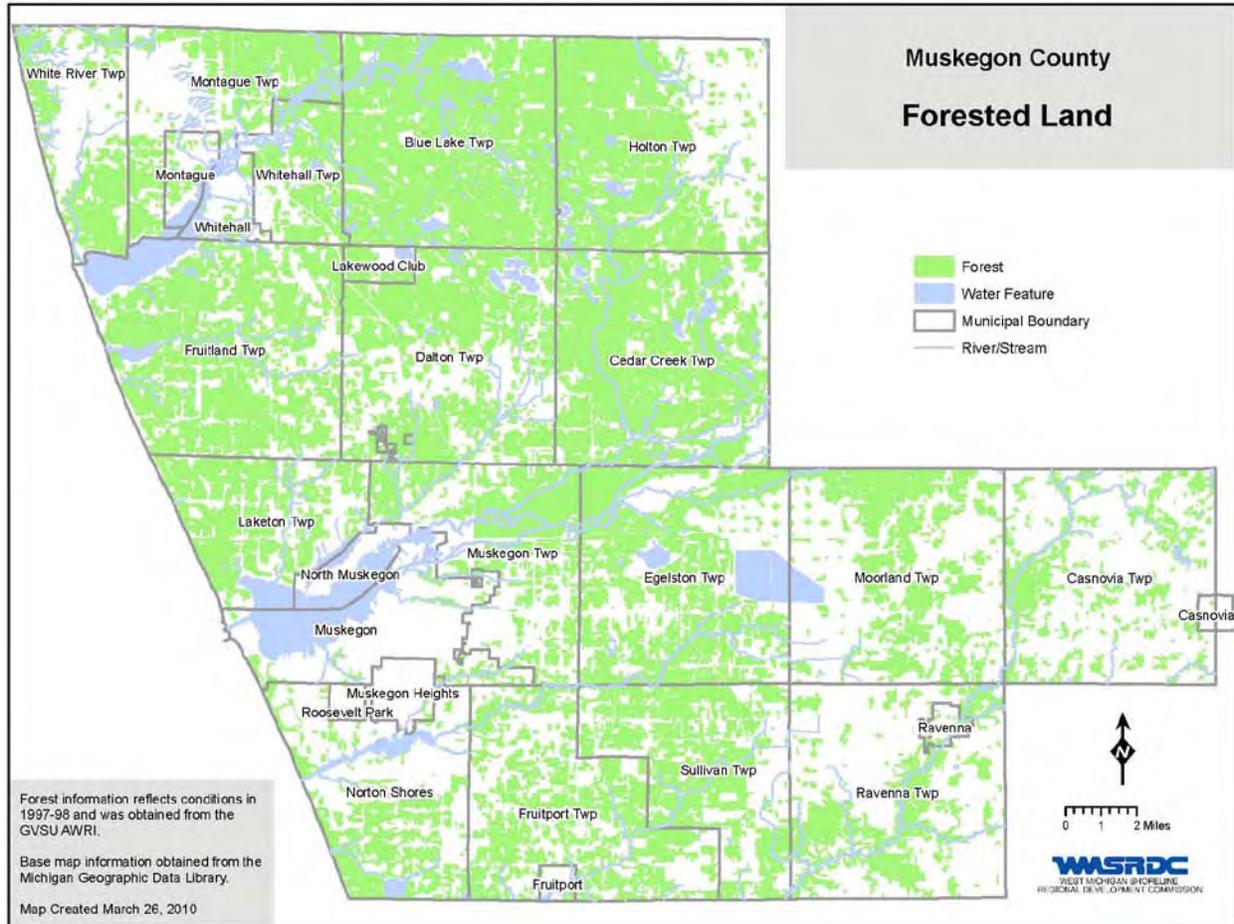
Muskegon County contains significant areas of protected land under the ownership of federal, state, local, or private institutions; much of which is forested. This chapter includes discussion of the extent, condition, and ownership of forested areas in the county.



### Forestry:

Muskegon County's largest land use is in forest cover, approximately 50%. A majority of this forest land is in private ownership with the principal forest cover types as oak/hickory and maple/beech/birch. Standing softwood in the county is almost half that of hardwoods and

continues to decrease as original stands are being converted for urban development or are maturing to hardwood dominated stands.



Much of Michigan is worried about the emerald ash borer and trying to figure out how to stop its progress. That is not the case in Muskegon County, where the primary concerns of landowners revolve around the pine bark beetle in pine plantations in the eastern townships, and oak wilt and other diseases throughout the county. Muskegon County has many scotch pine and red pine plantations that are no longer being managed. Most of the scotch pine plantations came about as Christmas tree farms that were not successful or have been sold to new owners no longer managing trees. The red pine plantations were originally planted to prevent erosion of the sandy soils that exist throughout the county. Many of these plantations are now being divided up and sold as smaller parcels to new landowners that lack knowledge, ambition, or know-how when it comes to management of these stands. As a result, there are high populations of the pine bark beetle in many areas of the county that are feeding on and killing both stressed and healthy pine trees and stands. Proper management of the pine stands is the best defense against the pine bark beetle and includes thinning the stand when the trees become crowded.

Oak wilt has also become a threat to all oak trees in Muskegon County and throughout the state. Oak wilt is a disease that is caused by a fungus within the vascular tissue of the tree. It kills red oaks within the first year of showing symptoms and white oaks can be killed anytime from one

to twenty years after being infected. Because there is not cure for oak wilt, prevention is key to management success.

Management issues in the near future will surround managing small parcels and urban lots with a focus on turning from marketability to merely maintaining forestry health. Fortunately, because of Muskegon's forestry heritage and abundant forest resources from prior large lot management, the overall health of parcels are sustainable and should remain so for the next few decades; especially in the southeastern and northern portions of the county. However, it is still imperative that District integrate larger land use initiatives to preserve open space for the forest product market and wildlife populations.

### **Forests and Water Quality:**

Trees and forests improve stream quality and watershed health primarily by decreasing the amount of stormwater runoff and pollutants that reaches nearby waters. Trees and forests reduce stormwater runoff by capturing and storing rainfall in the tree canopy and releasing water into the atmosphere through evapotranspiration. In addition, tree roots and leaf litter create soil conditions that promote the infiltration of rainwater into the soil. This helps to replenish our groundwater supply and maintain streamflow during dry periods.

The presence of trees also helps to slow down and temporarily store runoff, which further promotes infiltration, and decreases flooding and erosion downstream. Trees and forests reduce pollutants by taking up nutrients and other pollutants from soils and water through their roots, and by transforming pollutants into less harmful substances. In general, trees are most effective at reducing runoff from smaller, more frequent storms.

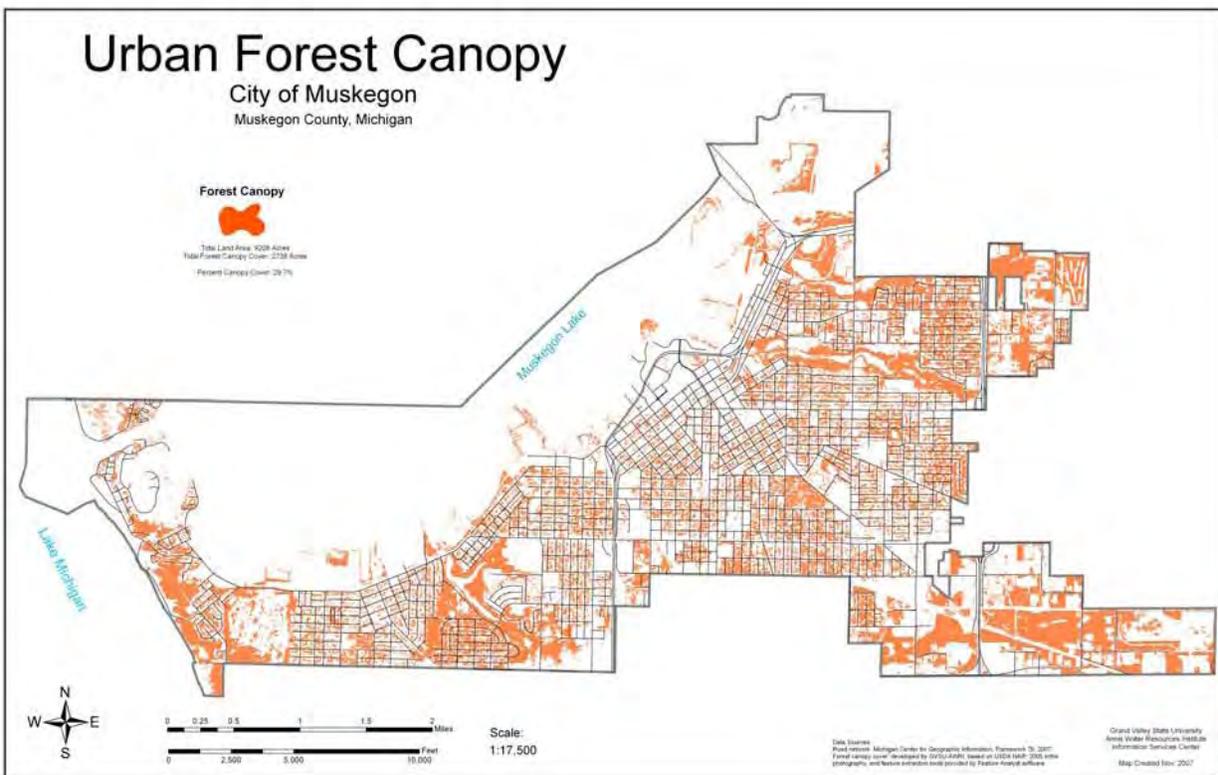
### **Urban Forestry:**

Trees and vegetation within an urban setting provide numerous benefits to the community. By adsorbing and filtering out pollutants in their leaves, urban trees perform a vital air cleaning service that directly affects the well-being of urban dwellers. Trees remove carbon dioxide from the air through their leaves and store carbon in their biomass. Approximately half of a tree's dry weight is carbon. For this reason, large-scale tree planting projects are recognized as a legitimate tool in many national carbon-reduction programs. Trees also decrease total stormwater volume helping cities to manage their stormwater and decrease detention costs.

The Annis Water Resources Institute (AWRI) completed an Urban Forest Ecological Services Assessment for the City of Muskegon in 2008. The study identified the city's forest canopy and quantified the value of urban forestry in Muskegon. Some of the study's findings are summarized on the next page.

By The Numbers: Muskegon Urban Forestry	
30	Percent of land in the city covered by tree canopy.
2,738	Acres of land in city covered by tree canopy.
118,692	Metric tons of carbon that trees absorb annually.
177,691	Pounds of air pollutants that trees remove annually.
\$451,390	Amount of money saved by trees absorbing air pollutants.
\$706,656	Money saved annually by trees absorbing carbon.
15,884,398	Cubic feet of rainwater stored by the city's trees when 2.2 inches of rain falls in a 24-hour period.
\$88,522,236	Value of ecological services that Muskegon's urban tree canopy provides.

Source: Grand Valley State University. AWRI



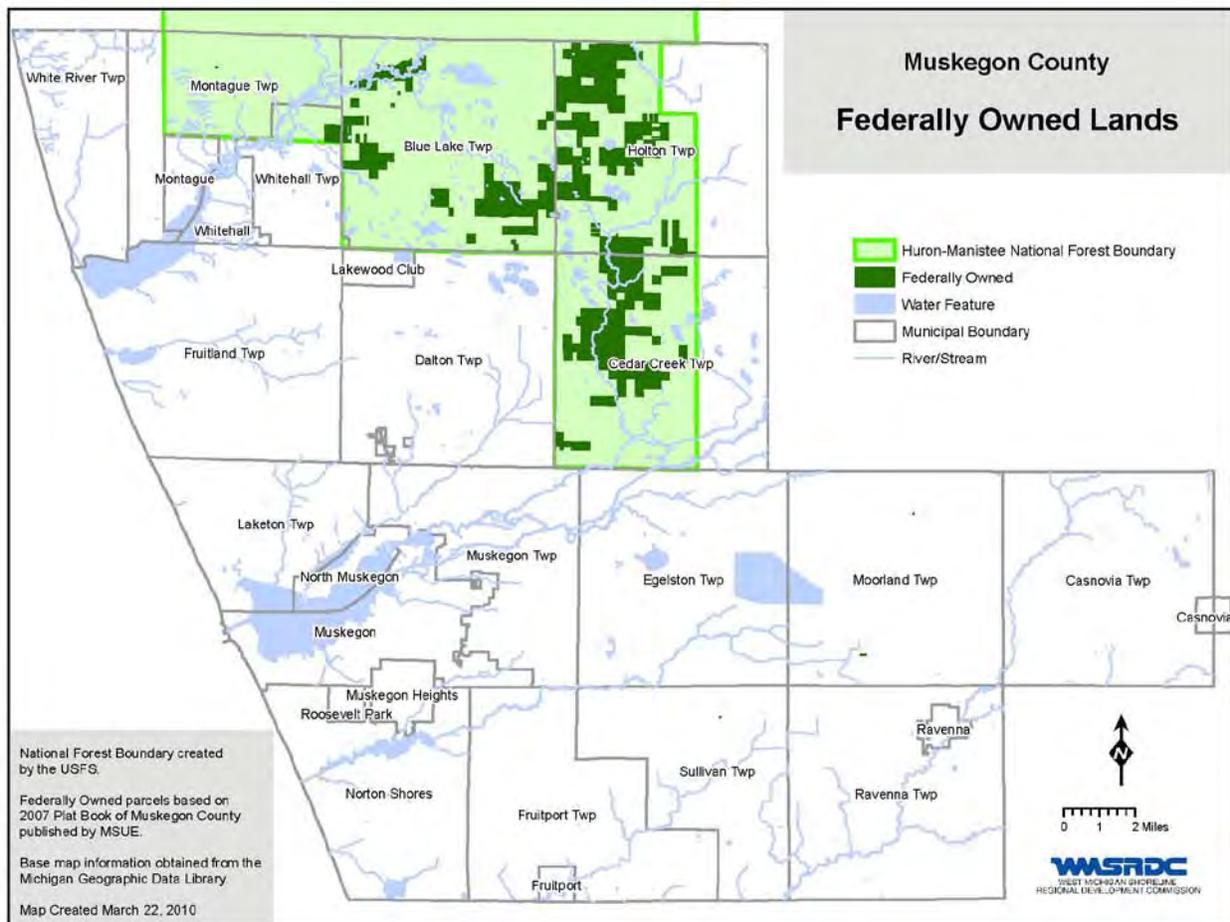
There are three Certified Tree Cities in Muskegon County, including Muskegon, Montague, and Whitehall. The following description of the Tree City USA program is quoted from the Arbor Day Foundation’s website, [www.arborday.org](http://www.arborday.org). “Tree City USA program, sponsored by the Arbor Day Foundation in cooperation with the USDA Forest Service and the National Association of State Foresters, provides direction, technical assistance, public attention, and national recognition for urban and community forestry programs in thousands of towns and cities that more than 135 million Americans call home. The many benefits of being a Tree City include creating a framework for action, education, a positive public image, and citizen pride.”

Tree Cities in Muskegon County	
City	Tree City Years
Montague	6
Muskegon	10
Whitehall	17

## Huron-Manistee National Forest:

The Huron and Manistee National Forests are two separate forests administered together out of the US Forest Service Office in Cadillac, Michigan. Together they total approximately one million acres of public land. The forests' boundary extends from the shores of Lake Michigan to the shores of Lake Huron. Water is one of the most important natural resources flowing from forests. The US Forest Service manages the largest single source of water in U.S., with about one-fifth originating from 193 million acres of land. A network of water and watershed resource specialists support stewardship efforts at all levels of the organization to promote healthy, sustainable watersheds fundamental to ecosystems and people. More information about forests and watersheds can be found at <http://www.fs.fed.us/biology/watershed/index.html>.

Manistee National Forest land in Muskegon County is located within the townships of Blue Lake, Cedar Creek, Holton, Montague, and Whitehall. The US Forest Service District Office serving Muskegon County is located at the Huron-Manistee National Forest's Baldwin/White Cloud Ranger Station at 650 North Michigan Avenue, Baldwin, MI 49304. Other federally-owned parcels are located in Moorland and Sullivan townships.



## **U.S. Fish and Wildlife Service:**

The U.S. Fish and Wildlife Service (FWS) is a bureau within the Department of the Interior. Its mission is to work with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation is a partnership effort between the FWS, states, and national conservation organizations. It is a useful tool that quantifies the economic impact of wildlife-based recreation, and has become one of the most important sources of information on fish and wildlife recreation in the United States. Federal, state, and private organizations use this detailed information to manage wildlife, market products, and look for trends. The 2006 survey is the eleventh in a series of surveys conducted about every 5 years that began in 1955. The survey was conducted by the Census Bureau for the FWS, who in turn prepares printed reports of the survey.

According to the 2006 National Survey 87.5 million U.S. residents fished, hunted, or watched wildlife in 2006. They spent over \$122 billion pursuing their recreational activities, contributing to millions of jobs in industries and businesses that support wildlife-related recreation. Funds generated by licenses and taxes on hunting and fishing equipment pay for many of the conservation efforts in Muskegon County and provide many hours of fishing, hunting, and wildlife-associated recreation.

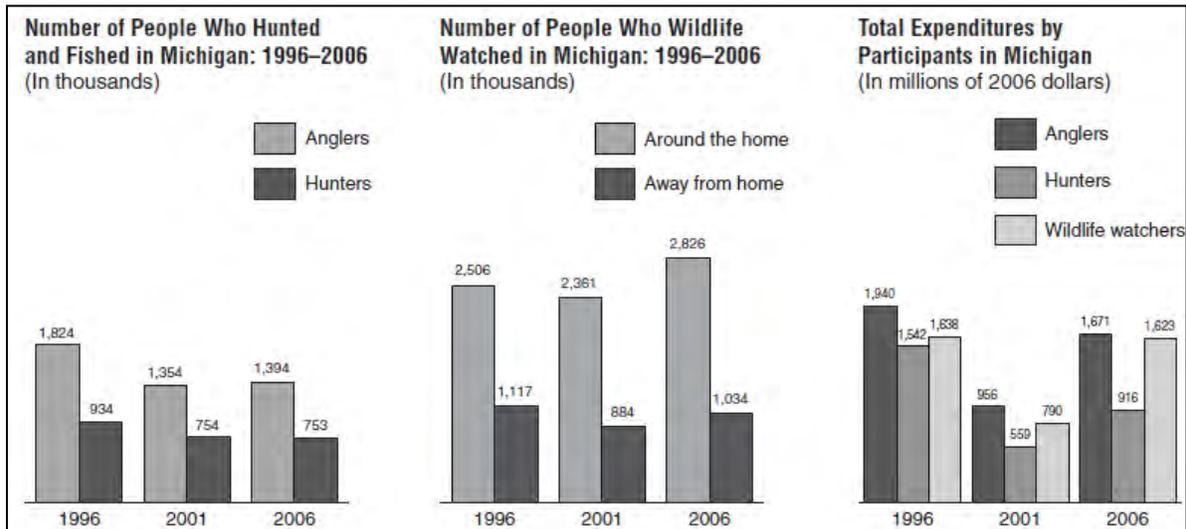
National Survey of Fishing, Hunting, and Wildlife-Associated Recreation reports and data are organized by survey year and are available for download from the Census Bureau website at <http://www.census.gov/prod/www/abs/fishing.html>. The 2006 Michigan Survey can be found at <http://www.census.gov/prod/2008pubs/fhw06-mi.pdf>.

The types of data presented in the reports include:

- Number of anglers, hunters, and wildlife-watching participants, by type of activity.
- Trips and days spent on different types of activities.
- Expenditures (trip, equipment, etc.), by type of fishing and hunting and wildlife-watching activity.
- Number of persons and days of participation by animal sought.
- Demographic characteristics of participants (including age, income, sex, race, and education).

A CD containing data used to prepare the reports and hard copies of the reports and products still available can be obtained by contacting the U.S. Fish and Wildlife Service:

NCTC Publication Unit  
698 Conservation Way  
Shepherdstown, WV 25443  
(304) 876-7203 or email: [pubs@fws.gov](mailto:pubs@fws.gov)

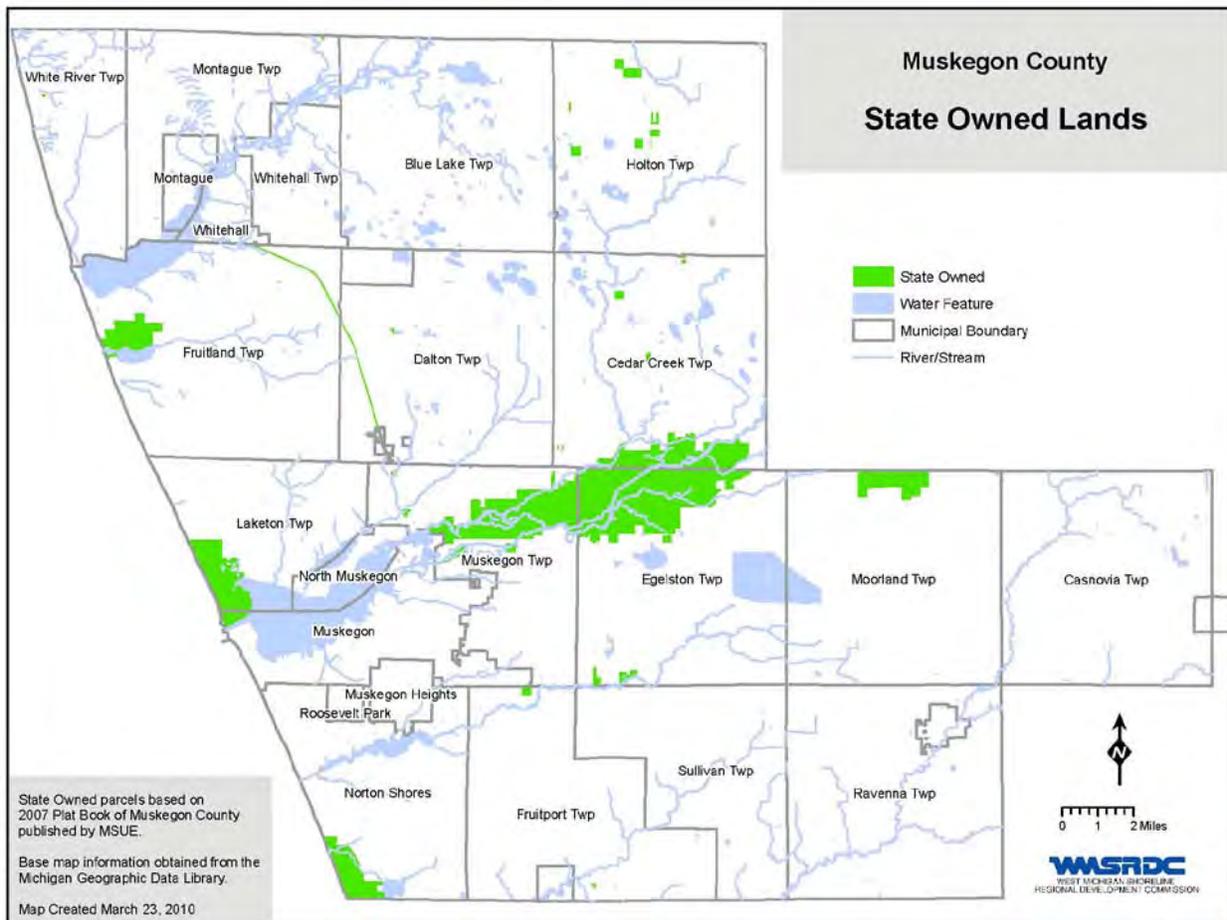


U.S. Fish & Wildlife Service

2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation—Michigan

### Muskegon State Game Area:

The Muskegon State Game Area is a 10,500-acre natural area in Muskegon and Newaygo counties along the Muskegon River and its tributaries. The site is primarily forested, with river floodplain and wetland areas spread throughout the interior. Most of the area is not accessible by vehicles, so hikers and canoeists can enjoy an excellent wilderness experience. Area headquarters are located off of Maple Island Road, just south of the Muskegon River.

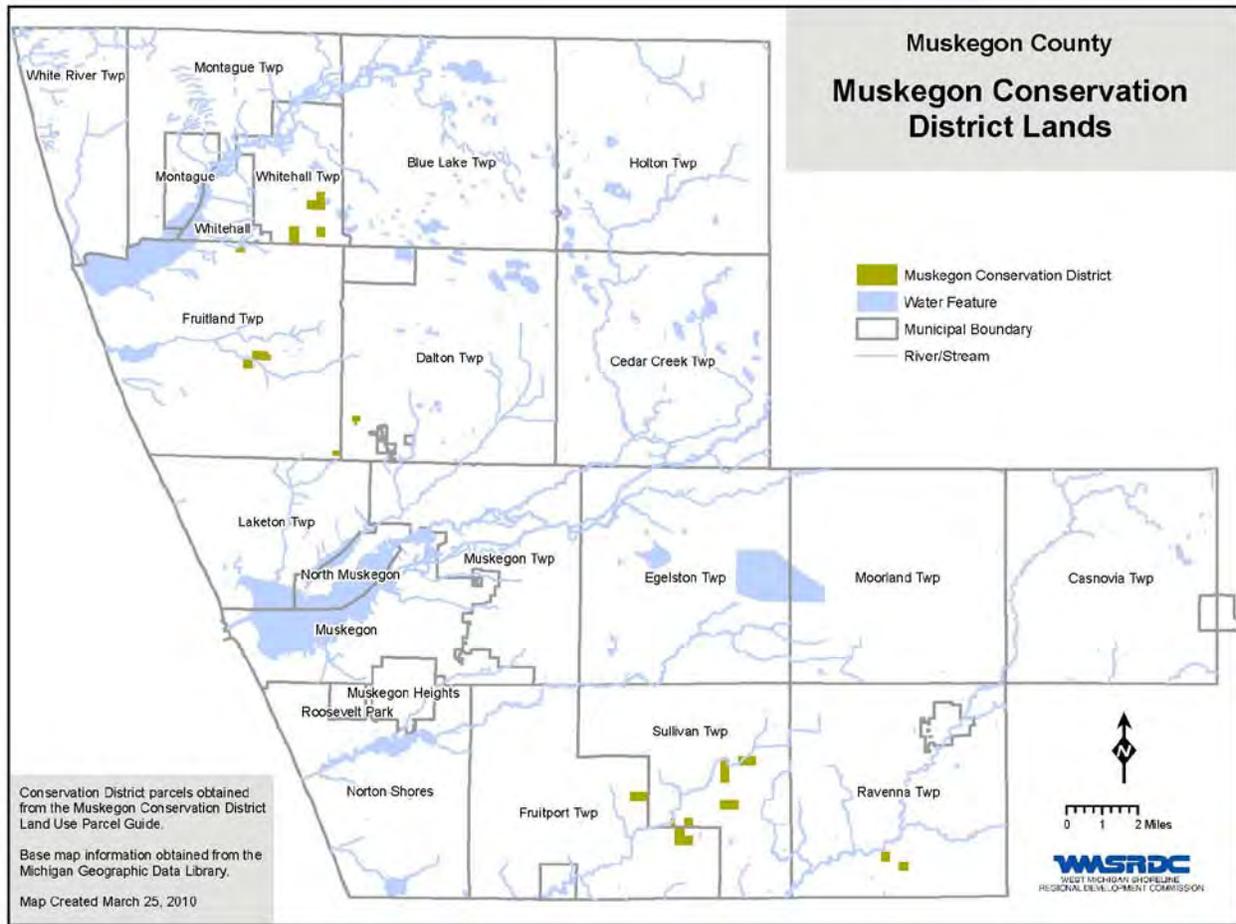


## Muskegon Conservation District:

The Muskegon Conservation District is a unique governmental subdivision of the state created to serve as stewards of our natural resources. The guiding philosophy is that local people should make decisions on conservation issues at the local level, with technical assistance provided by local resource professionals. District projects and programs are as diverse as the landscape and are continually changing to meet the environmental challenges in local communities. The Muskegon Conservation District was formed in 1938, and remains active to this day helping the community restore, protect, and manage natural resources.

*The mission of the Muskegon Conservation District is serving, educating, and empowering our community for natural resource protection by providing site-specific technical assistance and information to landowners in all aspects of natural resource management.*

The Muskegon Conservation District owns a total of 1,025 acres of land scattered throughout the Muskegon County townships of Dalton, Fruitland, Fruitport, Ravenna, Sullivan, and Whitehall. These properties have a conservation easement in place that will protect them from future development. This land is open to the public for minimal impact recreation, and in certain cases it can be used for hunting and trapping. The majority of these parcels were deeded over to the



District from the U.S. Forest Service. They range in size from 20 to 120 acres. These lands are open to recreational activities that do not hinder the ability of the District to utilize the property for its intended purpose, forest management demonstration.

Muskegon Conservation District contact information:

940 N. Van Eyck St.  
Muskegon, MI 49442  
Phone (231) 773-0008  
Fax (231) 767-1207

### **Forestry Assistance Program:**

Almost 50% of the forestland in Michigan is owned by private individuals. That's over 8.3 million acres in the hands of private landowners. Many of these private lands are small parcels, under 30 acres, and are not actively managed. For many landowners, they are not sure what value their woodlot has financially, but are also not sure as to the benefits they provide as wildlife habitat, as recreational areas, or for aesthetic appeal.

The Forestry Assistance Program (FAP) is offered to residents of Muskegon County through the Muskegon Conservation District to provide those non-industrial private landowners with information on how they can manage their forest resources in a way that will achieve their specific goals. Management is not always the cutting of trees for financial gain. A woodlot or forest can be managed to attract more wildlife, or provide recreational areas such as nature trails, ski trails, wildlife viewing opportunities and more.

With the idea that “good stewardship begins with good planning,” the FAP helps citizens achieve forest management goals. Conservation planning begins by walking through the forest with a Conservation District Forester to learn about its condition, its potential, management options, and the landowner’s goals. A plan is then written, to include a description of the forestland, management objectives, and actions needed to achieve those objectives. The plan may include practices such as invasive species control and removal, forest erosion control, timber harvesting, forest stand improvement, windbreak establishment, and wildlife habitat enhancement.

*Good stewardship begins  
with good planning.*

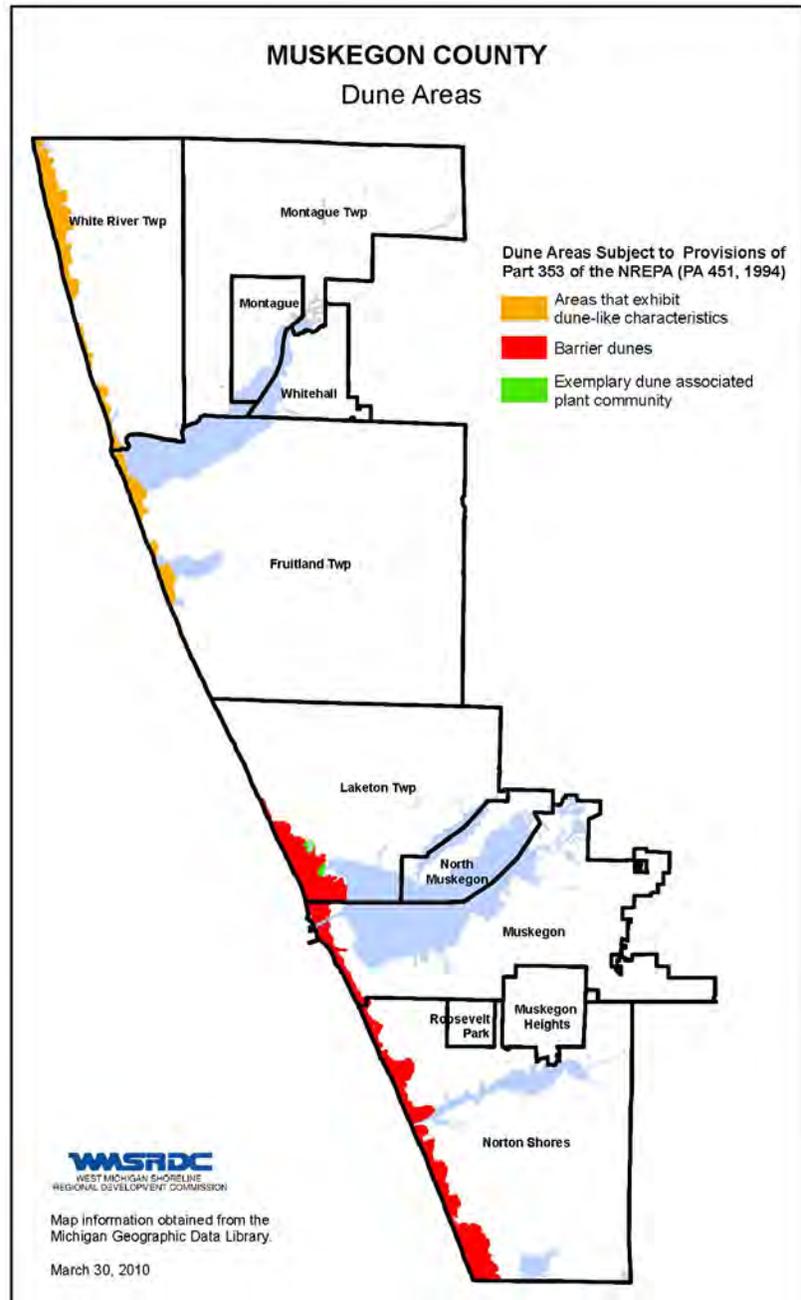
Once the plan has been written, the Muskegon Conservation District can help carry out many of the management activities. It can provide referral to professionals including tree planters, private consulting foresters, industrial foresters, loggers, and seeding contractors. In addition, many conservation practices are eligible for cost sharing through government programs. The Muskegon Conservation District can help identify the appropriate programs based on a landowner’s planned activities. To participate in the Forestry Assistance Program, contact the Muskegon Conservation District office and arrange a site visit.

## Critical Dune Areas:

Muskegon County contains significant dune areas along the shores of Lake Michigan; many of which are forested. Forests and vegetation help to prevent erosion and preserve coastal dune ecosystems.

Sand dunes are globally unique, irreplaceable, and fragile resources that provide significant recreational, economic, scientific, geological, scenic, botanical, educational, agricultural, and ecological benefits. Designated areas of Michigan are legally protected by provisions of Part 353 of the Michigan Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994. The Critical Dune Areas (CDA) program is administered under the authority of Part 353, Sand Dune Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. The CDA program protects the extremely fragile areas of Michigan's dunes by promoting the use of design and construction techniques to minimize impacts of uses on the dunes. As defined in part 353, "use" means "a developmental, silvicultural, or recreational activity done or caused to be done by a person that significantly alters the physical characteristic of a critical dune area or a contour change done or caused to be done by a person."

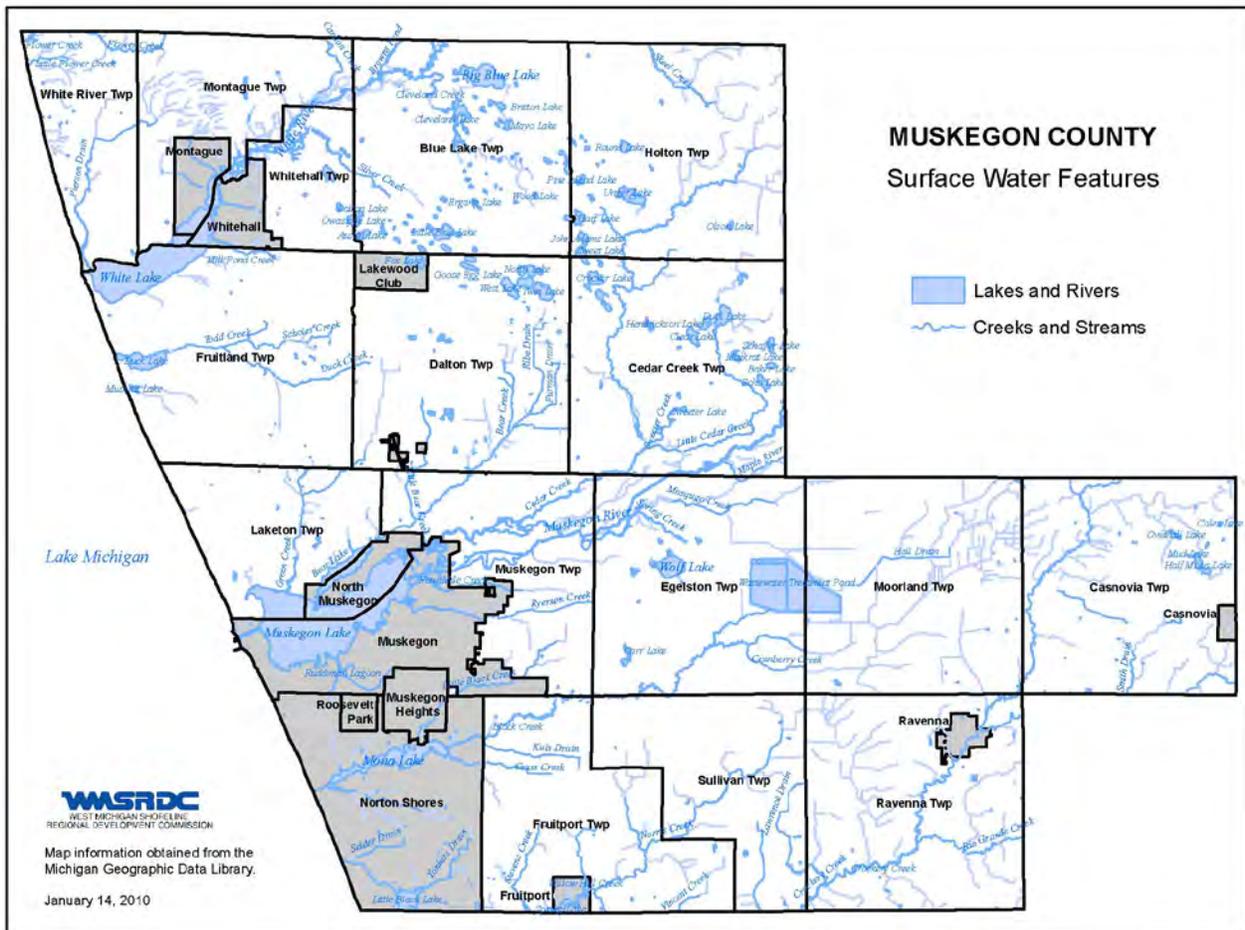
A Michigan Department of Natural Resources and Environment permit is required for any use within a CDA. Regulated activities include construction of buildings, septic systems, water wells, driveways, all excavation and filling, and vegetation removal within the CDAs. These



areas are identified in the “Atlas of Critical Dune Areas” dated February 1989, and adopted by the Michigan Legislature under Part 353. Section 35313(c) requires that all applications for permits for the use of a CDA include in writing: “assurances that the cutting and removing of trees and other vegetation will be performed according to the instructions or plans of the local soil conservation district. These instructions or plans may include all applicable silvicultural practices as described in the “voluntary forestry management guidelines for Michigan” prepared by the Society of American Foresters in 1987. The instructions or plans may include a program to provide mitigation for the removal of trees or vegetation by providing assurances that the applicant will plant on the site more trees and other vegetation than were removed by the proposed use.”

## Chapter 7: Surface Water

A clean and healthy water body can contribute to a community's quality of life by providing fresh water for drinking, as well as offering numerous recreational opportunities such as swimming, fishing, boating, and kayaking. Quality water bodies also support vast biological networks which provide habits for wildlife such as fish, water fowl, and migratory birds. With literally hundreds of miles of shoreline in the county along creeks, rivers, lakes, and Lake Michigan, surface water is one of the most visibly prominent forms of green infrastructure in Muskegon County.



Surface water is also an important factor in the location of industrial facilities. This is a fragile aspect of surface water as a form of green infrastructure. Some industries require waterways for shipping and transportation, while others may require large quantities of cool, fresh water for their industrial processes.

The existence and prosperity of many Muskegon County communities can be linked to the presence of surface water resources. In the late 1800's and early 1900's the Muskegon and White rivers were utilized to transport fresh-cut timber downstream to lumber mills, which

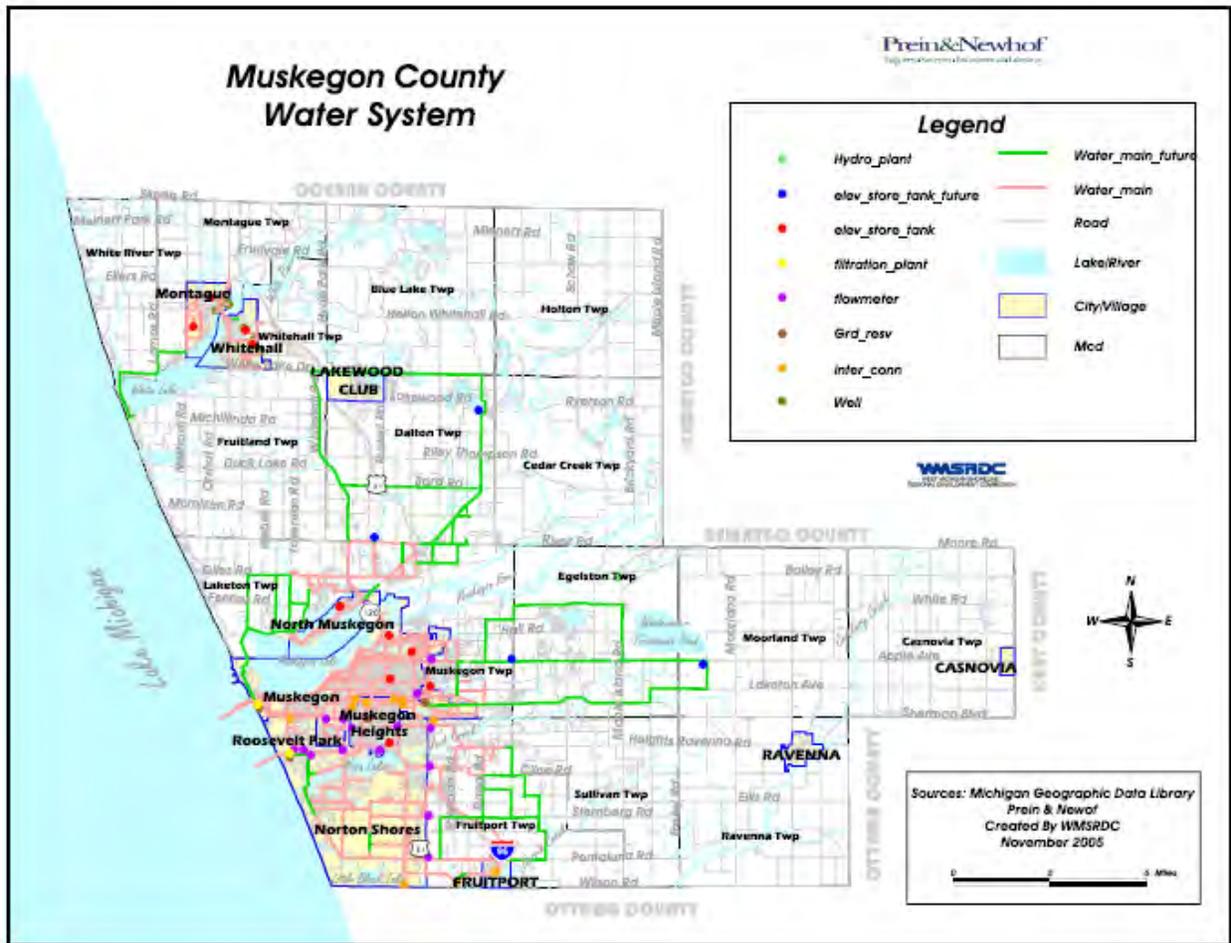
would process the wood and then ship it out via Lake Michigan. As the lumber industry waned, new industries stepped in over time to utilize the seemingly abundant and endless fresh water resources. The historical presence of lumber mills, foundries, and other industry has left many of the county's water bodies polluted; however recent planning and remediation efforts have been successful in mending some of the damages sustained in the past. Today, the water bodies of Muskegon County remain a tremendous asset as economic turmoil takes its toll. The presence of surface water has allowed Muskegon to maintain a sense of place, and has continued to provide its citizens with a wealth of outdoor activities.

The Muskegon County Wastewater Management System (MCWMS) collects and transmits the wastewater to the MCWMS facility via a network of County owned and operated gravity sewer, pump stations, and force mains. MCWMS is the only permitted wastewater facility in the County of Muskegon besides a small lagoon in Ravenna. MCWMS serves 15 municipalities and permits 177 industries. The cities include Montague, Muskegon, Muskegon Heights, North Muskegon, Norton Shores, Roosevelt Park, and Whitehall. The townships include Cedar Creek, Dalton, Egelston, Fruitport, Laketon, Montague, Muskegon, and Whitehall.

Within the 15 municipalities, there are 177 general industrial permits which include 31 Significant Industrial Users and 10 groundwater cleanup sites. Each municipal and industrial user owns and operates its own wastewater collection system which connects to the county system.

The 11,000-acre MCWMS site is permitted to receive 43 million gallons per day and consists of a complete mix aeration basin, an aerated settling basin, 5 billion gallon storage lagoons, and a 5,000-acre, slow-rate irrigation system. The treated effluent and intercepted groundwater is gathered through underdrains and drainage ditches running throughout the site and discharged to the Muskegon River. The map on the following page was originally published in the Muskegon County Strategic Infrastructure Plan, authored by the WMSRDC in 2006. It provides an overview of existing and planned municipal water services in the county.

As of April 2007, the MCWMS had not discharged any untreated wastewater into the surrounding streams, lakes, or wetlands. In 2005, MCWMS took the initiative to upgrade the system to handle storm events from all 15 communities. The county continues to reduce any potential discharges and is obligated to help other communities eliminate their inflow and infiltration into the system.



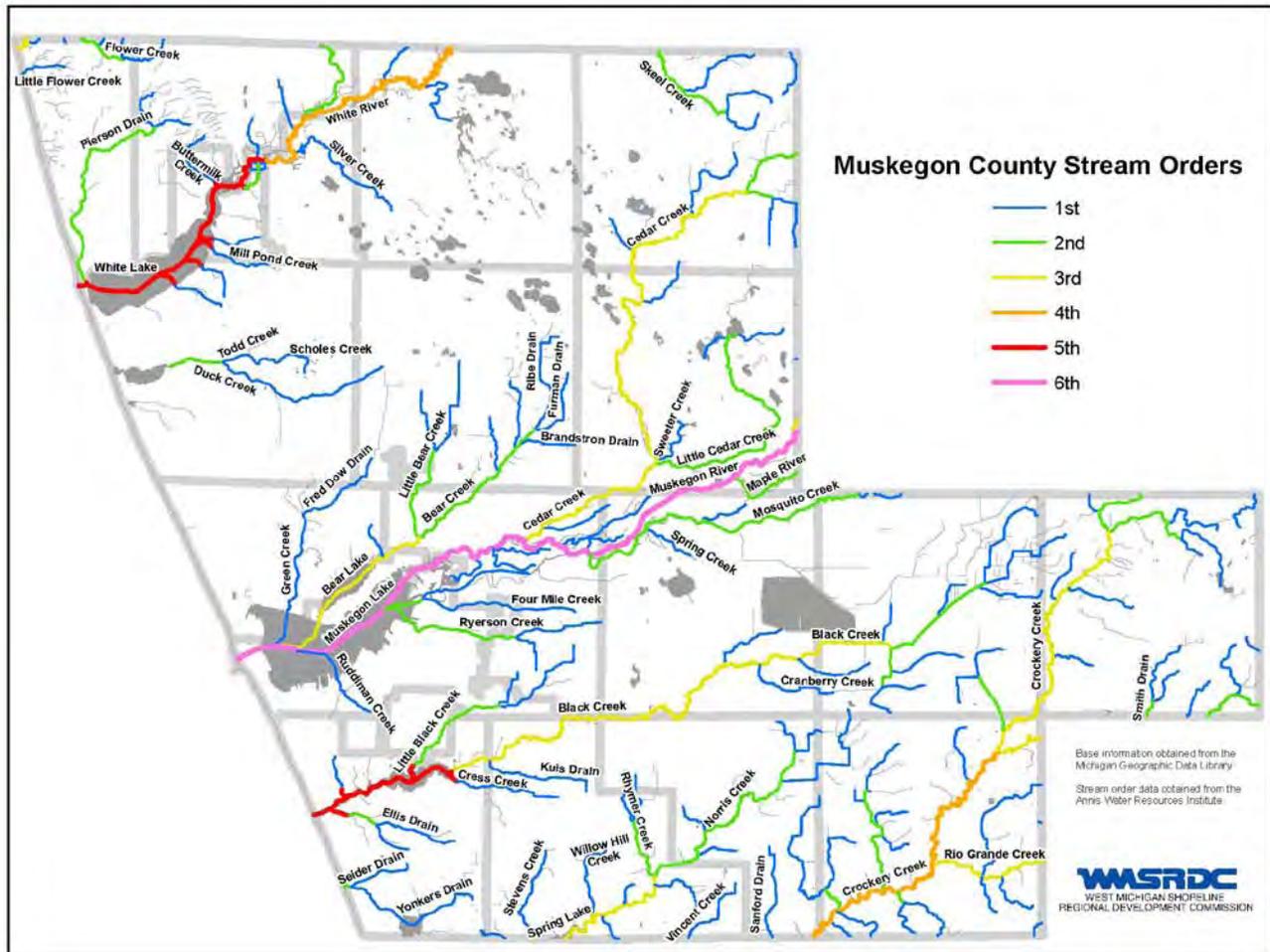
### Lakes, Rivers, and Streams:

Anchored by Lake Michigan, the lakes of Muskegon County are plentiful. They provide for a range of activities, from commercial shipping to boating, fishing, swimming, and paddling. While lakes Mona, Muskegon, and White have battled industrial, wastewater, and stormwater pollution in the past, their current conditions are ever-improving. Smaller, more rural lakes risk pollution from individual septic systems and stormwater runoff. This is an issue of increasing importance as areas without public wastewater service become developed.

Muskegon County contains a diverse collection of waterways, ranging from first- and second-order streams, to navigable rivers. The navigable rivers include the Muskegon and the White. These rivers are important features of their respective communities, Muskegon and Whitehall/Montague, and mirror each other in numerous ways: both were utilized during the lumber era; both flow from east to west; and both terminate in lakes that feed into Lake Michigan. The Muskegon River is about 234 miles long, making it the second longest river in Michigan. The White River, which begins in Newaygo County near the City of White Cloud, is an MDEQ-designated “Natural River.” Both of these waterways are considered coldwater fisheries which depend on feeder creeks and streams in order to maintain their cool temperatures.

## Surface Water Quality:

One of the many benefits of clean and healthy surface waters is the presence of fish and wildlife. Water quality and overall health of water bodies in Muskegon County greatly rely upon the condition of the sources that feed them, such as groundwater, wetlands, and streams. The county contains a number of first- and second-order streams, which are revealed on the Muskegon County Stream Orders map shown below. These areas, in addition to groundwater and wetland resources discussed in Chapters 4 and 5, should be a high priority for protection and/or conservation as critical natural areas.



The quality of a water body is often linked to its trophic state. Trophic status is a measure of nutrients the water. In general, a lake with more nutrients will contain less oxygen, and therefore hinder the fishery. The table below reveals the “trophic status” of Muskegon County’s largest public access lakes. The table includes three levels of water quality, ranging from mesotrophic (fewer nutrients), to eutrophic (well-nourished), to hypereutrophic (nutrient-rich).

<b>Muskegon County Water Quality</b>			
<i>Name</i>	<i>Watershed</i>	<i>Acreage</i>	<i>Trophic Status</i>
Bear Lake	Muskegon Lake/River	415	H
Blue Lake	White River	330	M
Duck Lake	Duck Creek	313	M
East Twin Lake	Bear Creek	111	E
Fox Lake	White River	80	H
Half Moon Lake	Crockery Creek	58	M
Mona Lake	Mona Lake	695	E
Muskegon Lake	Muskegon River	4,150	E
North Lake	Bear Creek	59	E
White Lake	White River	2,571	E
Wolf Lake	Muskegon River	207	E
Spring Lake	Grand River	1,047	E

Trophic Status Key: M = Mesotrophic; E = Eutrophic; H = Hypereutrophic

Sources: MDEQ Water Quality and Pollution Control in Michigan 2006 Sections 303(d), 305(b), and 314 Integrated Report; Michigan CGI, Dept. of Information Technology; MDEQ Land and Water Management Division, Hydrologic Studies Unit. Compiled by West Michigan Shoreline Regional Development Commission

Muskegon County contains nine Total Maximum Daily Load (TMDL) water bodies that do not meet state and federal water quality standards. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards. The MDEQ is required to perform TMDL assessments to help determine actions that will assist communities in bringing them into attainment. These bodies are listed in the table below, along with additional details regarding challenges they face.

<b>Impaired Water Body Problem Summary by Lake and Stream</b>		
<i>Name</i>	<i>Problem Summary</i>	<i>Local Description</i>
<b>Muskegon Lake Watershed</b>		
Bear Lake	FCA-PCBs; nutrient enrichment, nuisance algal growths	Tributary to Muskegon Lake located north of Muskegon Lake, Laketon Twp., T10N,R17W, Section 13, 14 and 23. Entire lake
Muskegon Lake	WQS exceedances for PCBs and mercury	Located in Laketon and Muskegon Twps. T10N,R17W and R16W. Entire lake
Ruddiman Creek	Fish and macroinvertebrate communities rated poor; pathogens (Rule 100)	Trib. to Muskegon Lake. Laketon Twp., T10N,R17W, Sec.36
Ryerson Creek	Fish and macroinvertebrate communities rated poor	Tributary to Muskegon Lake
<b>Mona Lake Watershed</b>		
Black Creek	Fish community rated poor	Trib. to Mona Lake
Little Black Creek	Fish and macroinvertebrate communities rated poor; pathogens (Rule 100); nuisance algae, nutrient enrichment	Tributary to Mona Lake S. of Muskegon. Seven mile reach from Muskegon Twp., T10N,R16W, Sec. 26. Dis. to Norton Shores Twp., T9N,R16W, Sec. 5 (inlet to Mona Lake)
Mona Lake	FCA-PCBs	Trib to Lake Michigan
<b>White Lake Watershed</b>		
White Lake	FCA-PCBs and chlordane	Located in Fruitland and Whitehall Twp USGS Quad Maps- Flower Creek, Michillinda and Montague. Entire lake
Mill Pond Creek	WQS exceedances for triethylene glycol dichloride, bis-2-chloroethyl ether and tetrachloroethylene	Tributary to White Lake just west of Whitehall

Source: Institute of Water Research, Michigan State University and Michigan Department of Environmental Quality

Also located in Muskegon County are two internationally designated Areas of Concern (AOC), Muskegon Lake and White Lake. The Great Lakes Water Quality Agreement, between the United States and Canada provides an international framework for a program to clean up contaminated sediment and to restore beneficial uses in 42 AOCs. Local, watershed-based organizations are very involved with local, state, and federal agencies in planning and carrying out the actions needed to restore these water bodies and to remove them from the Great Lakes list of AOCs.

### **Water Quality Planning:**

There are many environmental and conservation groups and programs working in Muskegon County to improve water quality and fish and wildlife habitat. This section provides examples of international, federal, state, and local programs that are having a positive effect on water quality in the area. A detailed listing of watershed and conservation contacts for Muskegon County and the surrounding region can be found in the “West Michigan Watershed Partners Inventory.” That report, completed by the WMSRDC in December 2008, is available on the WMSRDC web site at [www.wmsrdc.org](http://www.wmsrdc.org).

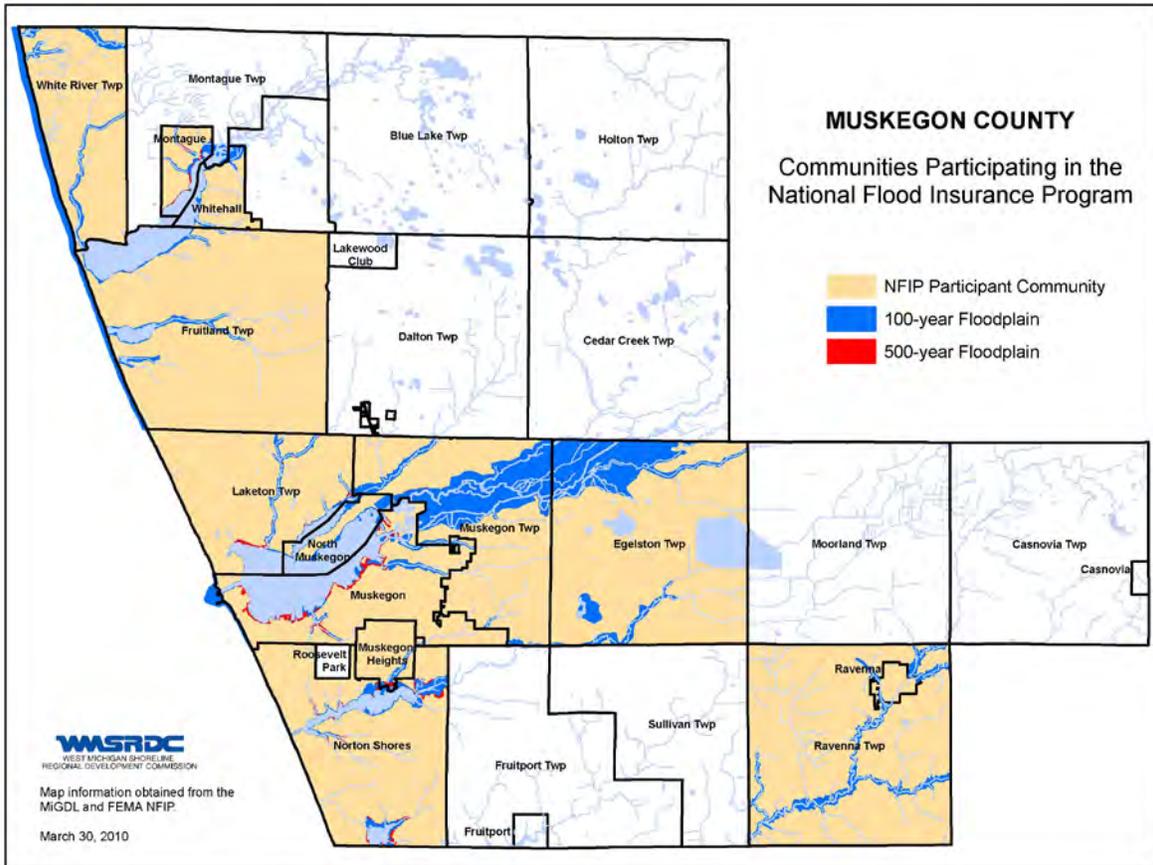
### Lake Michigan Lakewide Management Plan:

As part of the Great Lakes Water Quality Agreement between the United States and Canada, work on the *Lake Michigan Lakewide Management Plan (LaMP)* began in the early 1990s. The LaMP is used to identify, guide, and assess restoration of the chemical, physical, and biological functions of Lake Michigan and the water bodies that make up its watershed.

The Lake Michigan LaMP reports that the watershed is undergoing an intermediate to high rate of land development conversions. Of the 3.0 million acre watershed, 24,028 acres of wetland, 193,624 acres of agricultural land, and 142,157 acres of forest land were developed between 1992 and 2001. For more information on the LaMP and the LaMP Forum, visit [www.lkmichiganforum.org](http://www.lkmichiganforum.org).

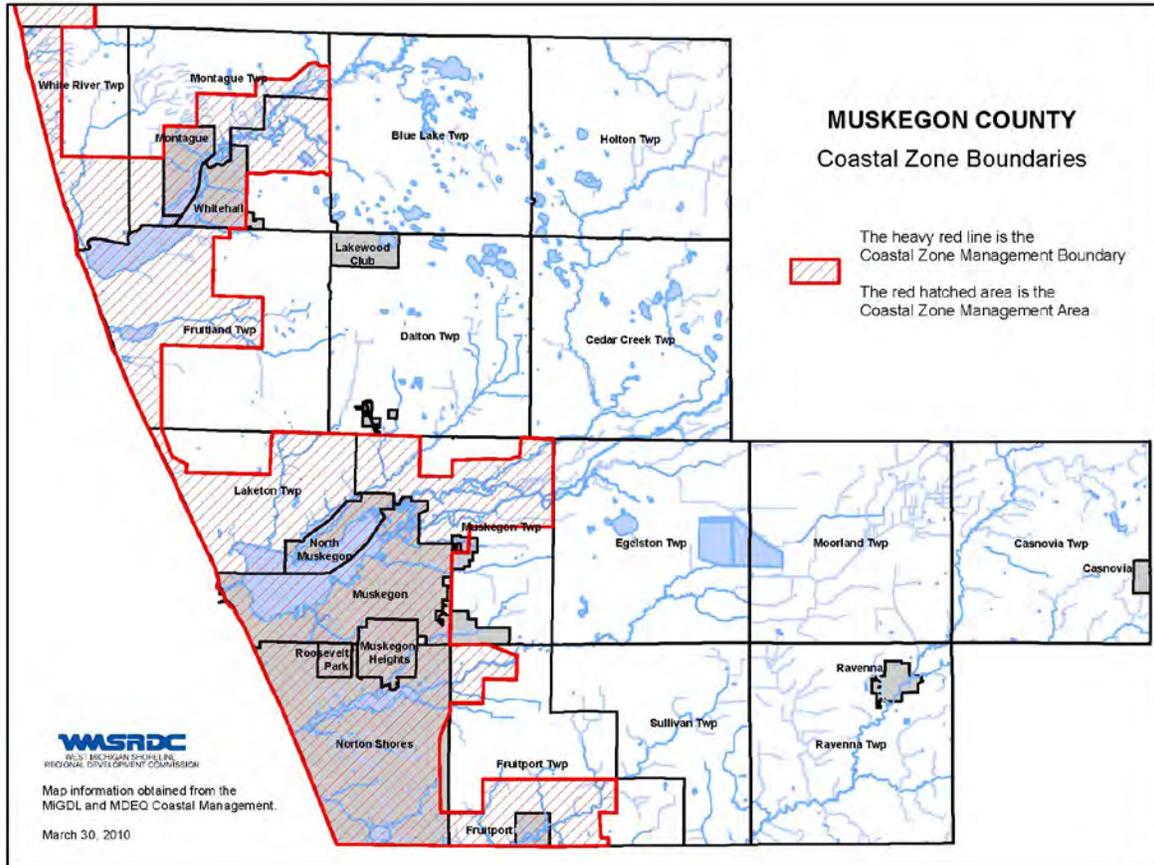
National Flood Insurance Program:

Another program that addresses environmental quality along with community safety is the National Flood Insurance Program. It includes floodplain identification and mapping, floodplain management, and flood insurance. There are 13 communities in Muskegon County that are active participants in the NFIP. Participation at the municipal level is required for a community's citizens to be eligible to purchase flood insurance. For additional information about the NFIP, see <http://www.fema.gov/business/nfip/>.



MDEQ Coastal Zone Management:

An important tool for the protection and enhancement of all coastal watersheds is the Coastal Zone Management (CZM) program, administered by MDEQ. Michigan's CZM program was developed under the federal Coastal Zone Management Act. Since 1978 it has assisted local governments, watershed groups and community organizations by funding coastal management projects that enhance Great Lakes coastal habitats and increase recreational opportunities.



Muskegon Area-wide Plan:

In addition to producing the West Michigan Watershed Partners Inventory, the WMSRDC organized and authored the first-ever Muskegon County land use plan, known as the Muskegon Area-wide Plan (MAP) in April 2005. One section of this comprehensive planning document identifies goals, objectives, and recommendations for Muskegon County regarding natural resources and the environment. This Muskegon County Green Infrastructure Inventory is a specific task listed in the MAP, which available to the public on the WMSRDC website, [www.wmsrdc.org](http://www.wmsrdc.org).

## Muskegon County Watersheds:

Muskegon County is home to three major river watersheds, several smaller lake and stream watersheds, and coastal areas that drain directly to the Lake Michigan nearshore through creeks and groundwater. All water bodies are important from both a local and regional perspective. Green infrastructure planning on a watershed-basis is an important way for communities in West Michigan to realize positive results in local water quality, and to contribute to the overall health of the Lake Michigan and its unique and fragile ecosystem.

The remainder of this section identifies Muskegon County watersheds, along with detailed information originally compiled in the afore-mentioned West Michigan Watershed Partners Inventory.

### Bear Creek / Bear Lake Watershed – HUC Code: 04060102

#### Size and Location:

The Bear Creek / Bear Lake Watershed is located north of Muskegon Lake and is approximately 11.5 miles long from its start in Dalton Township down to its mouth at Bear Lake Channel at Muskegon Lake. The Bear Creek and Bear Lake Watershed covers a land area of 19,058 acres or approximately 29 square miles. The watershed lies entirely within Muskegon County and is shared by five local governments: Dalton Township, Laketon Township, Cedar Creek Township, Muskegon Township, and the City of North Muskegon.



#### Watershed Management:

The Bear Creek and Bear Lake Watershed Management Plan was completed by the Muskegon River Watershed Assembly and the Muskegon Conservation District in 2005. It was approved under the CMI administrative rules and was funded under section 319. It improved the water quality of its watershed by reducing non-point source pollutants to restore warm-water and cold-water fishery.

#### Remedial Action Plan:

The Bear Creek / Bear Lake watershed also lies within the boundary of the Muskegon Lake Area of Concern (AOC). In 2006, the Muskegon Lake Watershed Partnership set a water quality improvement target to restore water quality and to remove eutrophication as one of the AOC's Beneficial Use Impairments.

#### Stormwater Management:

The Muskegon County Municipal Stormwater Committee includes all of the Bear Creek / Bear Lake watershed local governments. They work together to meet requirements of the Phase II stormwater rules through MDEQ's Voluntary Stormwater Permit Program. The Muskegon

Area Stormwater Committee (MASC) completed their watershed plan in November, 2005. The Muskegon Lake Watershed Partnership provides public input for the watershed plan and stormwater pollution prevention initiatives. The Muskegon Conservation District provides public education. The City of North Muskegon developed a Phase II stormwater permit program independently from the MASC.

**Total Maximum Daily Load Assessment:**

The 2008 TMDL Assessment for Bear Lake is being developed by the Michigan Department of Environmental Quality. Water quality sampling for nutrients was completed by GVSU-Ann Arbor Water Resources Institute in 2007. Three public meetings have been held to engage the public in the TMDL process. The MDEQ developed the TMDL Assessment and it was approved by US EPA in December, 2008.

**Fisheries and Habitat:**

Little Bear Creek is a designated coldwater trout stream.

**Watershed Highlights:**

As of 2008, the Phase II stormwater regulated townships no longer participate in the voluntary stormwater permit program. Local organizations and agencies are developing a watershed-based partnership to utilize the TMDL and to build on the 319 Plan to develop a focused Information & Education Strategy and to work with local governments to develop policies for improved natural resources and water quality.

**Duck Lake Watershed – HUC Code: 04060102**

**Size and Location:**

The Duck Lake Watershed, which includes Duck Creek, is located north of Muskegon Lake and is approximately 9 miles long. It lies entirely within Muskegon County and is shared by three local governments: Dalton Township, Fruitland Township and Lakewood Club. The watershed covers a land area of 13,950 acres, or approximately 22 square miles. The coverage begins in western Dalton Township and drains into Lake Michigan in Fruitland Township through the Duck Lake Channel.



**Watershed Management:**

The Muskegon Conservation District applied for a MDEQ 319 Watershed Management Plan for the Duck Creek Watershed in 2008. If funded, goals and objectives of the plan aim to improve water quality by reducing non-point source pollutants to restore the warm-water and cold-water fisheries.

**Fisheries and Habitat:**

Duck Creek is a designated coldwater trout stream.

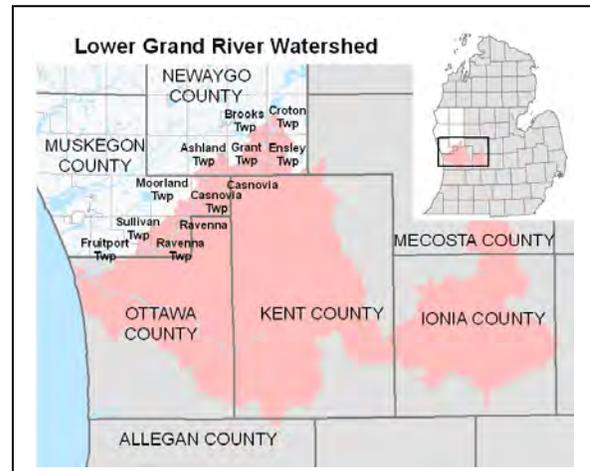
### Watershed Highlights:

Duck Creek is an MDEQ-recognized high quality watershed. A Duck Creek Watershed Assembly meets regularly to engage stakeholders in the development of a watershed plan and related conservation planning to preserve and restore the integrity of the Duck Creek / Duck Lake ecosystem.

### Lower Grand River Watershed – HUC Code: 04050006

#### Watershed Size and Location:

The Lower Grand River watershed is approximately 3,020 square miles. The Grand River flows into Lake Michigan at Grand Haven. Most of the watershed is covered by residences, urban centers, forests, and agriculture. The watershed is 53% agricultural, and includes the metropolitan area of Grand Rapids. The riparian habitat is 25-50% forested and includes 1,108 perennial stream/river miles. The drainage area encompasses portions of Ottawa, Muskegon, Newaygo, Kent, Ionia and Mecosta Counties.



#### Grand River Watershed in Muskegon County:

In Muskegon County, the Grand River watershed includes portions of the Crockery Creek, Norris Creek and Spring Lake watersheds and traverses portions of Casnovia, Moorland, Ravenna, Sullivan and Fruitport Townships and the Village of Ravenna.

#### Green Infrastructure Planning and Watershed Management:

The Lower Grand River 319 Watershed Management Plan (WMP) was completed by the Grand Valley Metropolitan Council in September, 2004 to address poor fish and macroinvertebrate communities, sedimentation, elevated nutrient levels, and excessive algae growth. It reduced nutrients, sedimentation, mercury, pathogens, and Polychlorinated Biphenyls contamination to protect and preserve fisheries, agricultural, and recreational opportunities.

#### Total Maximum Daily Load Assessment:

The Total Maximum Daily Load (TMDL) assessment for *Escherichia coli* for Rio Grande Creek in Muskegon and Ottawa Counties was completed by MDEQ in January, 2003. The MDEQ has identified 36 water bodies within the LGRW that require TMDLs. Pollutants of concern include polychlorinated biphenyls (PCBs), mercury, sediment, nutrients, pathogens (*E. coli*), low dissolved oxygen, and untreated sewer discharges. MDEQ biological surveys have reported that urbanization of the watershed, with increased impervious surfaces, is accelerating sedimentation and flow fluctuations from storm water runoff, which causes impairments to its streams. Nonpoint source pollution from agricultural sources was cited as a source of nutrients and possibly pathogens. Biota TMDLs have been approved by the USEPA for reaches totaling

107 stream/river miles in this watershed, while 53 miles still require TMDL development. *E. coli* TMDLs have been approved by the USEPA for reaches totaling 86 stream/river miles in this watershed, while 62 miles still require TMDL development. Approximately 11.5% (127 of 1,108 perennial stream/river miles) of the Grand River watershed is listed as impaired due to a fish consumption advisory for PCBs or elevated fish tissue mercury concentrations. The entire lower Grand River watershed (1,108 miles) is impaired due to water quality standard (WQS) exceedances for PCBs in water. In addition, 92 stream/river miles are impaired due to WQS exceedances for mercury in water, while 47 miles are impaired due to other water quality parameters. In 2004, macroinvertebrate and habitat surveys were conducted at 45 sites. Of these, 41 were attaining WQS for aquatic life (MDEQ, Rockafellow, 2005). Based on 2004 and previous data, a total of 181 miles are not attaining WQS due to a poor macroinvertebrate/fish community.

#### Stormwater Management:

The Lower Grand River Watershed (LGRW) includes 39 governmental entities working on stormwater management through the National Pollutant Distribution and Elimination System (NPDES) and the MDEQ's voluntary stormwater permit program. Within the WMSRDC region, there are seven (7) jurisdictions working cooperatively on the watershed-based program, including Ferrysburg, Grand Haven, Spring Lake Village, Spring Lake Township, Ottawa County Road Commission and Ottawa County Administration and Drain Commission. Robinson Township is utilizing the jurisdictional permit to meet NPDES stormwater regulations.

#### Fisheries and Habitat:

A Michigan DNR acquisition, through the Michigan Natural Resource Trust Fund and other sources preserved the 550-acre Bakale Tract (Ottawa County) parcel on the Grand River by Grand Haven. It protects a diverse wetland habitat complex and provides recreational opportunity. The project generated sufficient partner match to facilitate a \$1 million North American Waterfowl Conservation Act (NAWCA) grant for the Grand River watershed. It was administered by Ducks Unlimited and provided almost 2,000 additional acres of wetland and associated upland habitat projects in the Grand River watershed.

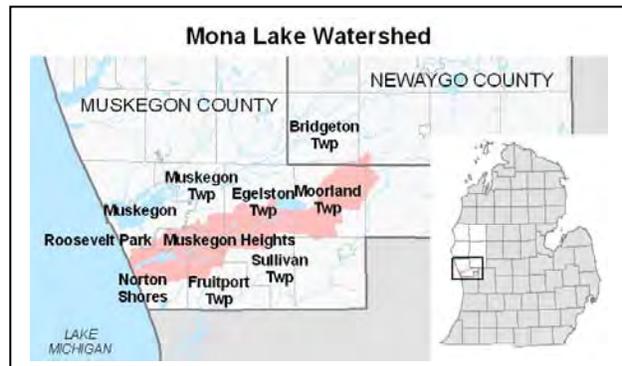
#### Watershed Highlights:

Recent and ongoing monitoring and protection activities for the lower Grand River watershed include: in FY 2004, ongoing NPS grant projects in the lower Grand River watershed included one Section 319, one Clean Water Action Program, and four CMI grants (MDEQ, 2004a); MDEQ-approved NPS watershed management plans have been written for several streams/ivers in the watershed; the MDNR, Fisheries Division, has completed the first two years of a five-year river assessment project (the completion date is scheduled for 2007); the MDNR, Fisheries Division, awarded an Inland Fisheries Grant to the village of Diamondale to remove the Wilson Dam (Diamondale Dam); and several volunteer monitoring organizations, including the Coldwater River Watershed Council, Friends of the Looking Glass River, and West Michigan Environmental Action Council, monitor sites in the lower Grand River watershed.

## Mona Lake Watershed – HUC Code: 04060101

### Size and Location:

The Mona Lake watershed is 46,000 acres in size, covering areas of Muskegon and Newaygo counties. The watershed includes portions of the cities of Norton Shores, Muskegon, Muskegon Heights, and Roosevelt Park and the townships of Fruitport, Sullivan, Egelston, Muskegon, Moorland, Bridgeton, Casnovia, Ashland and Ravenna.



### Watershed Management:

The Mona Lake Watershed Study was published by WMSRDC in 1996 as a service to the Mona Lake Watershed Study Steering committee. The document served as both a policy guide for decision-makers and as a useful reference tool regarding conditions in the watershed.

In December, 2003 Grand Valley State University Annis Water Resources Institute published a preliminary watershed / ecological assessment. It was conducted to provide a new baseline of information, in the hope that this effort would catalyze actions to improve the health of the watershed. Mona Lake water quality has improved since the early 1970s, although nutrient concentrations are still above water quality standards. The complete study can be viewed at [www.gvsu.edu/wri/director](http://www.gvsu.edu/wri/director).

In 2004, the Mona Lake Watershed Council began work on a Watershed Management Plan, outlining pollutants, sources and causes and specific projects for implementation. The completed plan is posted on the MDEQ website at [http://www.michigan.gov/deq/0,1607,7-135-3313\\_3682\\_3714\\_4012-95955--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3714_4012-95955--,00.html). The Citizen's Version of the plan can be downloaded from the Mona Lake Watershed Council's website at [www.monalakewatershed.org](http://www.monalakewatershed.org).

### Total Maximum Daily Load Assessment:

The MDEQ performed a Total Maximum Daily Load assessment for biota in Black Creek in August, 2003 and in September, 2003 completed one for Little Black Creek.

### Stormwater Management:

Municipalities within the Mona Lake watershed participate in the MDEQ voluntary stormwater permit program to meet Phase II stormwater requirements. A Mona Lake watershed management plan was developed for the Muskegon County Municipal Stormwater Committee and approved by MDEQ. In 2007, GVSU Annis Water Resources Institute (AWRI) began a \$348,415 project to study the effects of surface runoff from the highly concentrated road network impacting the Little Black Creek basin. The study will assist decision makers in selecting and implementing appropriate restoration and remediation activities.

#### Fisheries and Habitat:

A reach of Black Creek above Maple Island Road does not meet water quality standards due to habitat modifications from channelization.

#### Watershed Highlights:

During the spring and summer of 2003, the Lake Michigan Forum, a committee of public stakeholders providing input to the US Environmental Protection Agency on the Lake Michigan Lakewide Management Plan (LaMP), conducted an assessment of environmental stewardship in Michigan's Mona Lake watershed. The Mona Lake Watershed Stewardship Assessment process was aimed at identifying opportunities for creating a permanent ethic of environmental stewardship among leaders and the general public in the local watershed. The study provided baseline information about the watershed tributaries and water quality.

#### Green Infrastructure:

Some of the green infrastructure practices that the MLWP plans to pursue include the following:

- Urban reforestation to increase city tree canopy and transform unnecessary paved areas into areas landscaped with trees, creating new green infrastructure.
- Working with a few large land owners in the industrial park to better manage stormwater on site with cisterns and other LID techniques.
- Repairs to Little Black Creek corridor by connecting the creek channel to adjacent wetlands. Dredge spoils along the banks have separated stream flow from adjacent wetlands.
- Looking along the Black Creek and Little Black Creek corridor for conservation easement and restoration projects.

#### Contact:

Brenda Moore, AICP, PCP  
Mona Lake Watershed Council  
P.O. Box 4072  
Muskegon, MI 49444  
[info@monalakewatershed.org](mailto:info@monalakewatershed.org)  
(231) 740-7521

## Muskegon River Watershed – HUC Code: 04060102

### Size and Location:

The Muskegon River Watershed (Clare, Lake, Mecosta, Missaukee, Montcalm, Muskegon, Newaygo, Osceola, Roscommon, and Wexford Counties) is the second largest watershed in Michigan.

### Watershed Management:

A watershed management plan was approved under the CMI administrative rules and was funded under section 319. The Muskegon River was originally threatened by development and a variety of nonpoint sources. Logging, the clearing of land for agriculture, development, and the location of hydro dams on the river have aggravated the impact of sedimentation on the waterways.

### Total Maximum Daily Load Assessments:

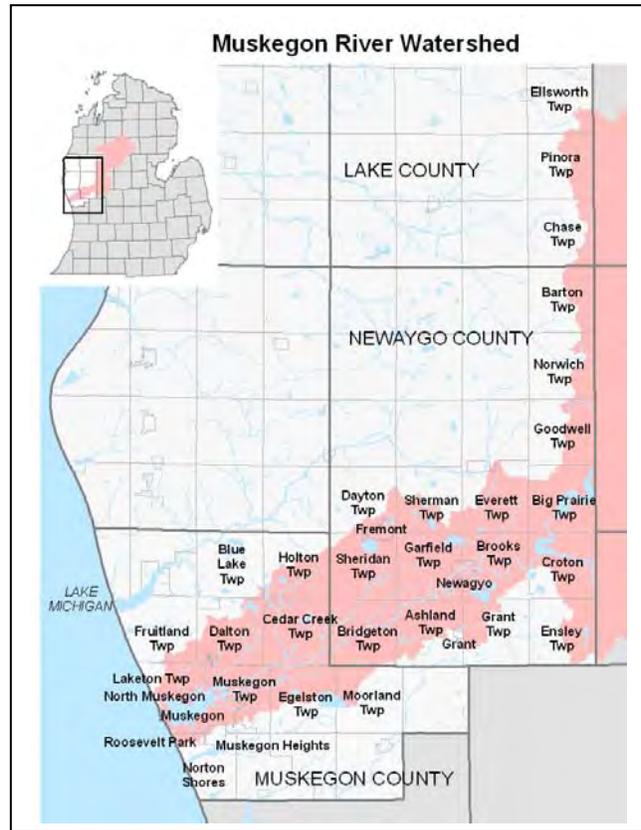
All TMDL water bodies are in the Muskegon Lake watershed. For more information, see the Muskegon Lake Watershed summary (below) and Chapter 3.

### Stormwater Management:

All of the Muskegon River watershed Phase II, regulated stormwater communities are within the Muskegon Lake portion of the watershed. They are summarized under Muskegon Lake Watershed (below).

### Fisheries and Habitat:

The Muskegon River Management Plan was published by the Michigan Department of Natural Resources Fisheries Division in February, 2003. The Plan is a companion document to the Muskegon River Watershed Assessment, (O’Neal 1997). The river assessment describes physical characteristics and biological communities of the Muskegon River as well as unique resources found within the watershed. The purpose of the river assessment is to identify opportunities and problems related to the aquatic resources and fisheries within the watershed; provide a mechanism for public comment into fisheries management decisions; and serve as a reference document for those seeking information regarding the Muskegon River watershed. The Muskegon River Watershed Assessment was drafted by Fisheries Division personnel, then went through a significant period of peer and public review and comment, and was completed in July, 1997.



The following reports and management plans are available to guide fisheries and watershed management efforts in Muskegon Lake and the Muskegon River watershed:

- O'Neal, R. P. 1997. Muskegon River Watershed Assessment. Michigan Department of Natural Resources, Fisheries Division Special Report 19, Ann Arbor.
- O'Neal, R. P. 2003. Muskegon River Management Plan, River Management Plan 04, Michigan Department of Natural Resources, Fisheries Division, Ann Arbor.
- O'Neal, R. P., and G. J. Soulliere. 2006. Conservation Guidelines for Michigan Lakes and Associated Natural Resources. Michigan Department of Natural Resources, Fisheries Division Special Report 38, Ann Arbor.

The Muskegon River Watershed Assessment can be found at this website:

[http://www.michigan.gov/dnr/0,1607,7-153-10364\\_10951\\_19056---,00.html](http://www.michigan.gov/dnr/0,1607,7-153-10364_10951_19056---,00.html)

The Walleye Population and Fishery of the Muskegon Lake System, Muskegon and Newaygo Counties, Michigan in 2002 can be found at this website:

[http://www.michigan.gov/documents/dnr/Sr40\\_199576\\_7.pdf](http://www.michigan.gov/documents/dnr/Sr40_199576_7.pdf)

For additional information, contact: Richard P. O'Neal, Michigan Department of Natural Resources Fisheries Division Muskegon State Game Area 7550 E. Messenger Road Twin Lake, MI 49457 Telephone, 231-788-6798; Fax, 231-788-5249; E-mail: [onealr@michigan.gov](mailto:onealr@michigan.gov)

#### Watershed Highlights:

The Muskegon River watershed begins at Houghton and Higgins Lake and enters Lake Michigan at Muskegon Lake. The river is considered a “cool” water stream, including warm and cold water fisheries. Muskegon Lake is a “drowned river mouth” lake and an internationally designated Area of Concern (AOC). For more information about watershed improvement and stewardship in the Muskegon River watershed, please visit the Muskegon River Watershed Assembly web site at [www.mrwa.org](http://www.mrwa.org)

#### Muskegon Lake Watershed – HUC Code: 04060102

#### Size and Location:

Muskegon Lake is a 4,149 acre drowned river-mouth coastal lake located in Muskegon County, Michigan along the east shoreline of Lake Michigan.

#### Watershed Management:

Muskegon Lake is a high quality fishery, but it is impacted by urban storm water runoff, agricultural runoff, erosion, and sedimentation. Boating, fishing, urban runoff, road-stream crossings and residential encroachments all deliver sediment to Muskegon Lake tributaries, which alters channel morphology and increases bank erosion. Several non-point source



projects have been implemented to reduce sediment, nutrient and storm water pollution into the Muskegon River and Muskegon Lake by stabilizing eroding banks and installing vegetative buffers along the water's edge.

#### Remedial Action Plan:

The 1978 Muskegon Lake Remedial Action Plan, along with the 1994 and 2002 updates, were developed to address the 1985 Muskegon Lake designation as an Area of Concern (AOC). The lake was identified as an AOC because of water quality and habitat problems associated with shoreline alterations, the historical discharge of pollutants into the AOC, and the potential adverse effect the pollutants could have on Lake Michigan. The high levels of nutrients, solids, and toxics entering the lake had caused a series of problems including nuisance algal blooms, reduced oxygen in the lake's deeper water, tainted taste of fish due to petroleum products in the water and contaminated sediments. The pollutant discharges also were suspected of contributing to the degradation of benthos (bottom-dwelling organisms, also referred to as the benthic community), the contamination of fish, and the reduction in fish and wildlife habitat. In addition, the post-World War II development of chemical, petrochemical, and heavy industries was causing localized groundwater contamination that was moving toward the lake and its tributaries.

The AOC includes the entire lake and its immediate tributaries, including Ryerson Creek, Ruddiman Creek, Green Creek, Four Mile Creek, Bear Lake and a portion of Little Bear Creek. Mosquito Creek and Cedar Creek are not within the AOC boundary.

The Muskegon Lake Watershed Partnership (MLWP) provides coordination, educational and technical support to implement the 2002 Muskegon Lake Community Action Plan. Priorities include remediation of contaminated sediments in the lake and tributaries, prevention of eutrophication, nonpoint source pollution control, brownfield and waterfront restoration, and habitat restoration. The MLWP works on projects to improve the ecosystem and to restore nine Beneficial Use Impairments (BUIs). In 2006 and 2007, the MLWP worked with Grand Valley State University-Annis Water Resources Institute and the MDEQ to develop a set of targets to measure progress toward restoring BUIs.

#### Total Maximum Daily Load Assessment:

A total of four TMDL assessments are scheduled for the Muskegon Lake watershed, including each of the following water bodies: Muskegon Lake, Bear Lake, Ruddiman Creek and Ryerson Creek. (For more information about TMDLs, see chapter 3.)

#### Stormwater Management:

The Muskegon Lake Stormwater Management Plan was completed by Fishbeck, Thompson, Carr & Huber for the Muskegon County Municipal Stormwater Committee, in consultation with the Muskegon Lake Watershed Partnership. The plan was approved by the MDEQ in 2005. The watershed municipalities have each developed Storm Water Pollution Prevention Initiatives (SWPPIs) outlining Best Management Practices that meet the goals of the watershed plan.

#### Fisheries and Habitat:

The following reports and management plans are available to guide fisheries and watershed management efforts in Muskegon Lake and the Muskegon River watershed:

- O'Neal, R. P. 1997. Muskegon River Watershed Assessment. Michigan Department of Natural Resources, Fisheries Division Special Report 19, Ann Arbor.
- O'Neal, R. P. 2003. Muskegon River Management Plan, River Management Plan 04, Michigan Department of Natural Resources, Fisheries Division, Ann Arbor.
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The Muskegon River Watershed Assessment can be found at this website:

[http://www.michigan.gov/dnr/0,1607,7-153-10364\\_10951\\_19056---,00.html](http://www.michigan.gov/dnr/0,1607,7-153-10364_10951_19056---,00.html)

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For additional information, contact: Richard P. O'Neal, Michigan Department of Natural Resources Fisheries Division Muskegon State Game Area 7550 E. Messenger Road Twin Lake, MI 49457 Telephone, 231-788-6798; Fax, 231-788-5249; E-mail: [onealr@michigan.gov](mailto:onealr@michigan.gov)

#### Watershed Highlights:

In 2006, 90,000 cubic yards of contaminated sediments in Ruddiman Creek were cleaned up through the US Environmental Protection Agency (EPA) Great Lakes Legacy Act and Michigan Clean Michigan Initiative (CMI) partnership.

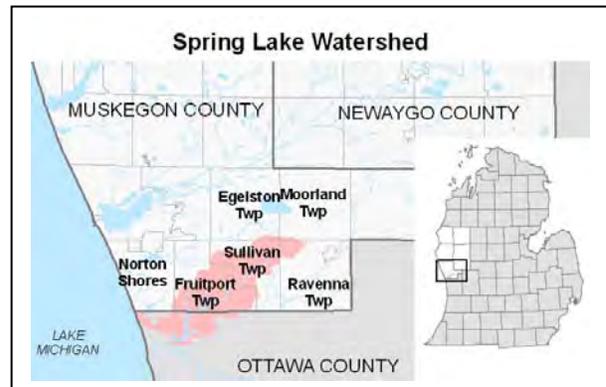
In 2007, the Division Street Outfall sediment investigation was completed and a 2008 feasibility study is underway to develop alternatives for the cleanup of approximately 180,000 cubic yards of sediment contaminated with mercury, oil, grease and PAHs.

In 2007, the US EPA Great Lakes National Programs Office, Biohabitats and the MLWP developed a community-based ecological habitat restoration master plan for a portion of Muskegon Lake's south shoreline and the Ruddiman Creek riparian corridor. The US Fish and Wildlife Service Coastal Program is partnering with MLWP and Muskegon River Watershed Assembly with support for fish and wildlife habitat restoration, invasive species management and monitoring.

## Spring Lake Watershed – HUC Code: 04050006

### Size and Location:

Spring Lake is eutrophic lake, located in west Michigan along the shores of Lake Michigan near the mouth of the Grand River. The Ottawa County lake was being impacted by agricultural land in the headwater region of the 16,263-acre watershed and urban lands surrounding the lake. Spring Lake and the Grand River are impacted by high levels of phosphorus and potentially-toxic cyanobacteria blooms and the nearshore areas of Lake Michigan are showing signs of impairment from nonpoint source pollution.



### Watershed Management:

The Spring Lake Watershed Plan (Spring Lake – Lake Board, 2001) was approved under the CMI administrative rules and was funded under section 319. The overall goal of the plan is to protect threatened designated uses and restore impaired designated uses of navigation, warm water fishery, indigenous aquatic wildlife, partial body contact recreation, and total body contact recreation. Spring Lake is also included in the Lower Grand River Watershed Management Plan (Grand Valley Metro Council, 2004).

### Stormwater Management:

The *Lower Grand River Stormwater Management Plan* addresses the Spring Lake watershed. Spring Lake Village, Spring Lake Township, Village of Fruitport, Fruitport Township and Ferrysburg are the Phase II communities included in the plan. (For more information about Phase II Stormwater Communities, see chapter 5).

In March 2010, the Annis Water Resources Institute (AWRI) completed the “*Rein in the Runoff*” *Integrated Assessment of Stormwater Management Alternatives for the Spring Lake Watershed*. This integrated assessment was a collaborative, community-based project that examined the causes and consequences of, and corrective alternatives available to control stormwater discharges to Spring Lake and its tributary streams, the Grand River, and ultimately, Lake Michigan. The goals of this project, funding by Michigan Sea Grant and AWRI, were to:

- Increase Spring Lake area residents' and decision makers' general knowledge and understanding of the causes and consequences of stormwater runoff, and how they apply specifically to Spring Lake, the Grand River, and Lake Michigan
- Increase stakeholder stewardship of the water resources surrounding Spring Lake Township and the Village of Spring Lake, and in particular, increase participation in stormwater control and management
- Identify inconsistencies between state regulations and/or local ordinances that can improve local stormwater management and control

- Provide a suite of alternative stormwater management Best Management Practices (BMPs) tailored to Spring Lake Township and the Village of Spring Lake

For complete details regarding this project, including the results, conclusions, final report, watershed map atlas, and other community resources, please visit the project website: <http://www.gvsu.edu/wri/reininthrunoff>.

**Watershed Highlights:**

*The Reduction of Internal Phosphorus Loading Using Alum in Spring Lake, Michigan* was published by GVSU-AWRI in February, 2004.

**Green Infrastructure:**

The Integrated Valuation of Ecosystem Services Tool (INVEST), provides value estimates for ecosystem services associated with green infrastructure in West Michigan. This project includes Muskegon, Newaygo, Ottawa, Allegan, Kent, Ionia, and Barry counties. Additional information about the INVEST online tool can be found at: <http://INVEST.wri.gvsu.edu>.

**Contact:**

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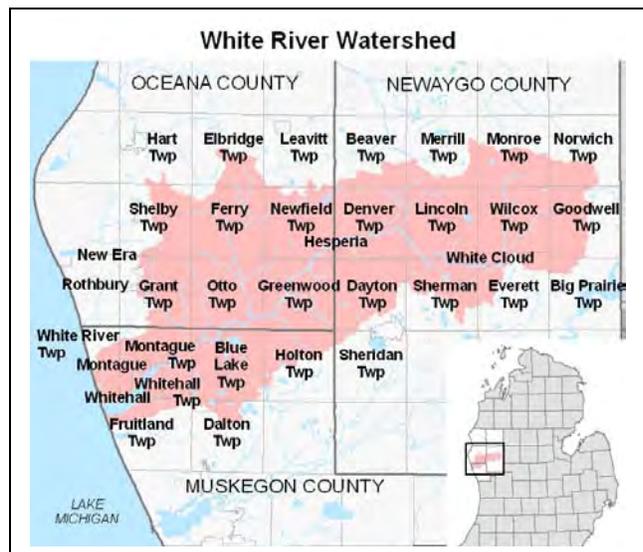
White River Watershed – HUC Code: 04060101

**Size and Location:**

The White River flows 120 miles through Michigan. Its watershed covers 344,166 acres of mostly forested and agricultural land. The continued loss of stream-side vegetation and the resulting erosion is affecting the system.

**Watershed Management:**

The Michigan Department of Environmental Quality has awarded GVSU-Annis Water Resources Institute \$154,918 to develop a 319 watershed management plan to reduce the negative impact that nonpoint source pollutants are having on water quality. The White River Watershed



Partnership, the White Lake Association, the Muskegon Conservation District, the White Lake Public Advisory Council, and the Annis Water Resources Institute have committed match to the project bringing the project total to \$177,000. The project will be carried out over a two-year period, beginning November 1st, 2006. Project updates, events, and volunteer opportunities will be posted on the White River Watershed Partnership website and in the newsletter.

**Stormwater Management:**

There are no Phase II-regulated stormwater communities in the watershed.

**Watershed Highlights:**

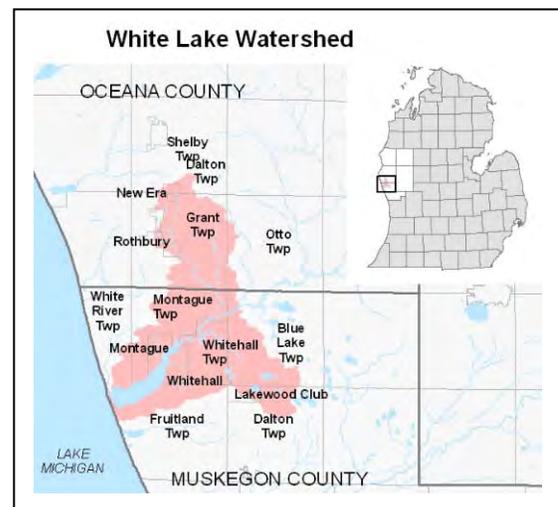
Michigan’s White River and its watershed comprise one of the few urban river systems in the United States that still contains large tracts of relatively pristine landscape. As pressure to develop this land increased, Alcoa and more than 40 local stakeholders worked together to develop preservation strategies to ensure the unique and irreplaceable assets of the river system would not be lost forever. In 2002, Alcoa Foundation provided a \$100,000 grant to initiate the preservation of this freshwater ecosystem, a task carried out by the Community Foundation for Muskegon County, Alcoa, its Howmet Castings Whitehall Operations, and local stakeholder groups. These groups included environmental organizations, citizens groups, corporate interests, school districts, regional university scientists, governmental agencies, and elected officials.

The White River Watershed Partnership (WRWP) is a Michigan 501 (c)(3) Not-for-Profit Organization, established in 2003. The WRWP recognized that the White River Watershed is a unique resource that needs protection. The White River is a MDED designated Natural River.

White Lake Watershed – HUC Code: 04060101

**Size and Location:**

White Lake is a 2,570 acre coastal, drowned river mouth lake located in Muskegon County along the east shore of Lake Michigan, in the vicinity of the communities of Montague and Whitehall. The Area of Concern (AOC) includes White Lake and White River Watershed. Most of the land around the lake is wooded or grassy, with sand dunes located along Lake Michigan. Land use in the White River Watershed is primarily recreational and agricultural, with the uses around White Lake being residential, commercial, industrial, and agricultural.



**Watershed Management:**

White Lake / White River priorities for watershed management are eutrophication and nutrient management, and riparian corridor restoration. These White Lake issues are being addressed

as part of the White River Watershed Management Plan (described in White River section, above).

#### Remedial Action Plan:

The original White Lake AOC Remedial Action Plan (RAP) was developed in 1987. It was updated in 1995 and again in 2002 as the White Lake Community Action Plan. The Muskegon Conservation District and the Natural Resources Conservation Service assist the White Lake Public Advisory Council (PAC) with project staff, as well as educational and technical support to coordinate implementation of the White Lake RAP.

AOC priorities include contaminated sediment remediation, eutrophication control, remediation of groundwater and former industrial site contamination, and wildlife habitat and population restoration. White Lake was originally listed as an AOC primarily due to contaminated groundwater migrating to the lake from the Occidental Chemical Site (formerly Hooker Chemical Company). There are eight other sites of contamination with the potential to affect the lake, some of them in varying states of remediation.

The RAP process identified seven of the Great Lakes Water Quality Agreement's 14 beneficial uses as being impaired. Beneficial Use Impairments (BUI) in the AOC include Restrictions on Fish and Wildlife Consumption, Loss of Fish and Wildlife Habitat, Degradation of Fish and Wildlife Populations, Degradation of Benthos, Restrictions on Dredging Activities, Restrictions on Drinking Water Consumption or Taste and Odor Problems, and Degradation of Aesthetics.

#### Total Maximum Daily Load Assessments:

The Mill Pond Creek TMDL assessment was completed by MDEQ in 2004. The White Lake TMDL assessment is scheduled for 2009.

#### Stormwater Management:

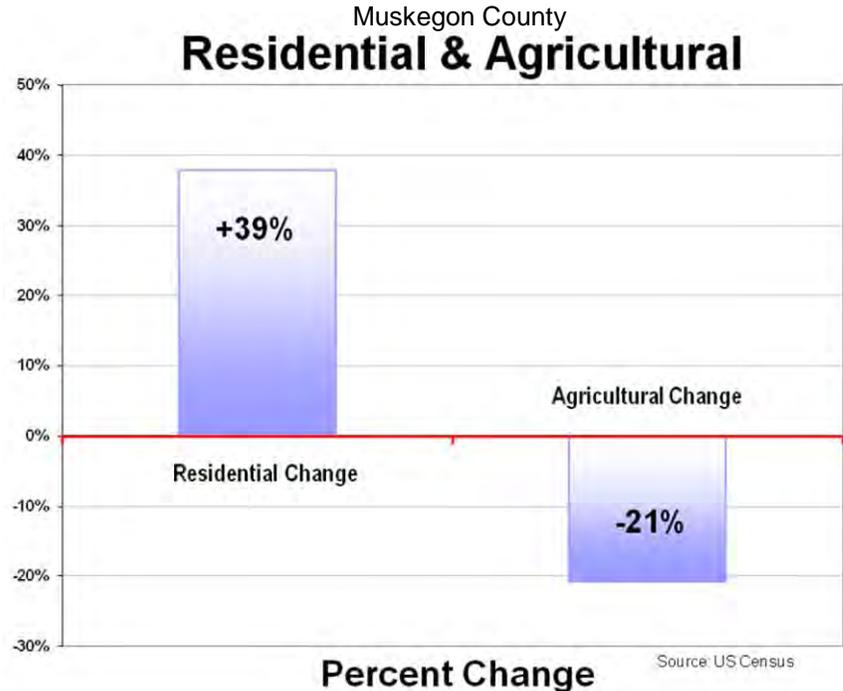
There are no NPDES regulated municipal stormwater communities within the White Lake watershed.

#### Watershed Highlights:

The White Lake Public Advisory Council (PAC) worked with Grand Valley State University - Annis Water Research Institute (GVSU-AWRI) to develop delisting targets for five of the seven BUIs in 2006. The targets have been approved by the PAC and will go through a technical review by the MDEQ to be officially approved. In 2007, the White Lake Public Advisory Council worked with the Muskegon Conservation District to develop restoration and delisting targets for the Degradation of Fish and Wildlife Populations, Loss of Fish and Wildlife Habitat BUIs and Restrictions on Drinking Water Consumption, to be reviewed for MDEQ approval in 2008.

## Chapter 7: Farm Land

People depend on green infrastructure for food. Local food production illustrates the basic, natural connection that people have with the land. People often view themselves as separate from nature, although most agree that food quality and security depend on a healthy ecosystem. Soil health and other natural features make up the building blocks of the green infrastructure that provides people with one of the most critical ecological service benefits – our food.

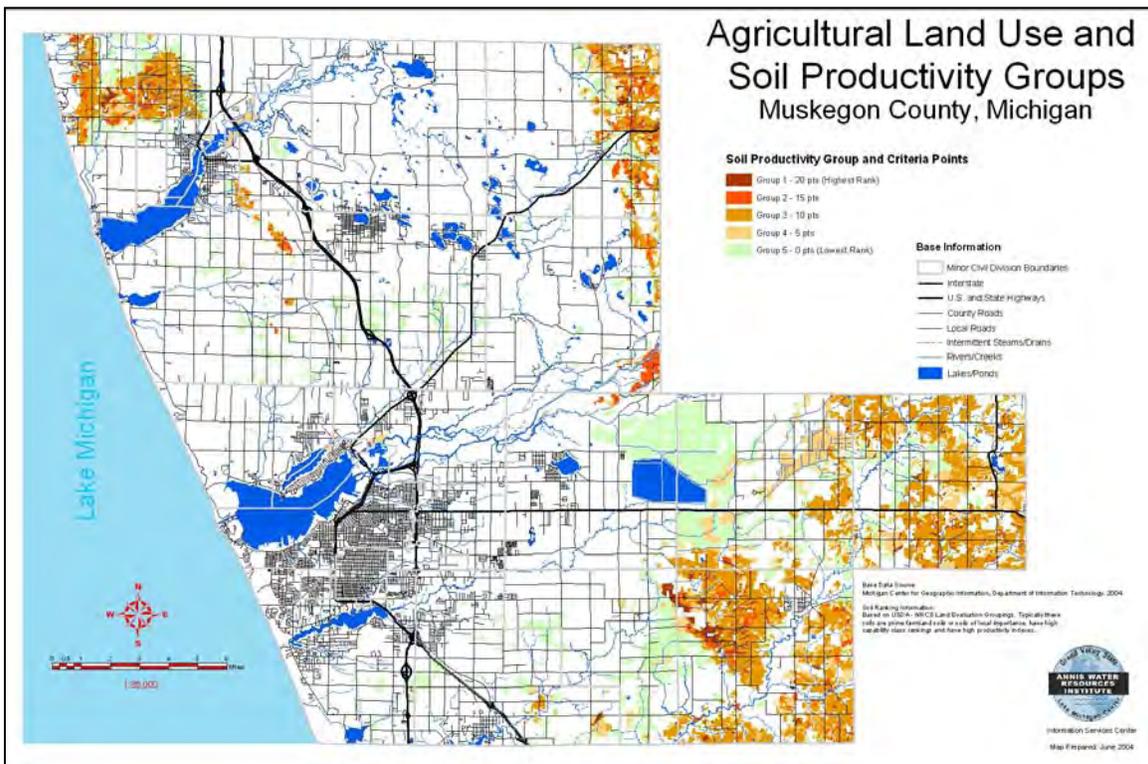
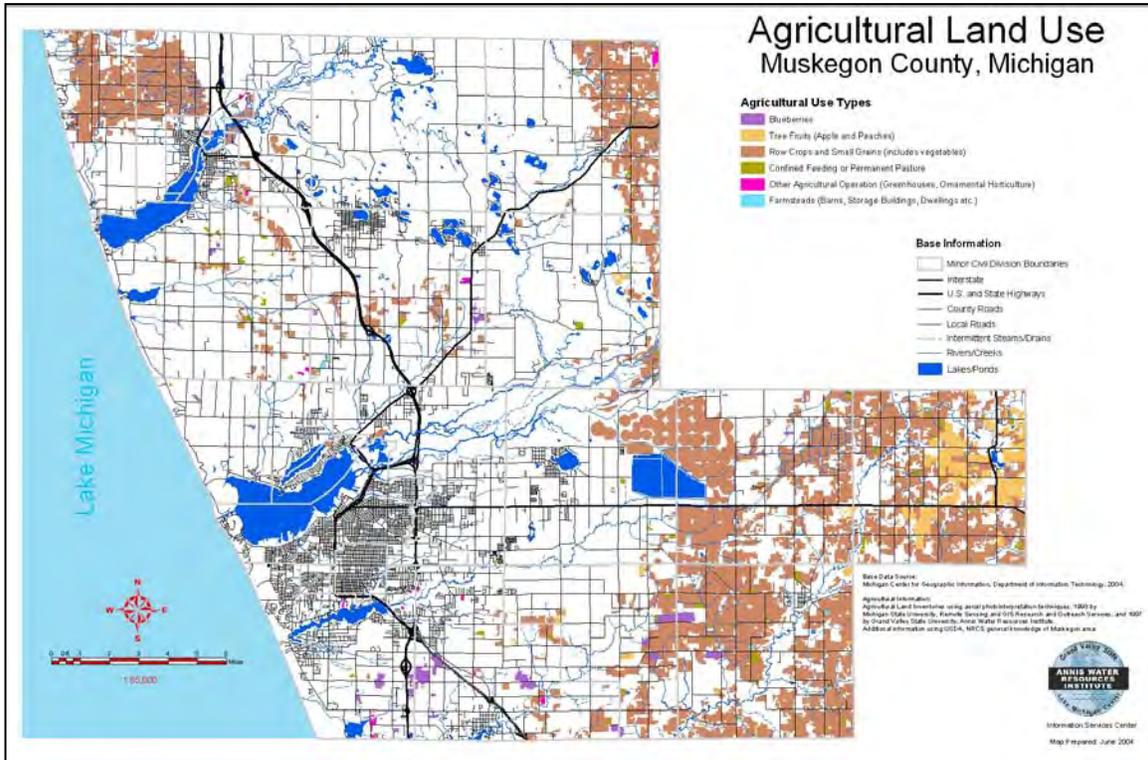


### Farmland in Muskegon County:

Muskegon County's agricultural land is a unique and economically important resource. These lands support a locally important and globally unique agricultural industry that includes: dairy, livestock, food from grains, vegetables, fruit and nursery and greenhouse crops. Muskegon County's climate, topography and accessibility, make it well suited to the production, processing and distribution of agricultural products on a regional, national and international level. Muskegon County's economic base is also supported by a variety of agriculturally related businesses, including: farm equipment, fuel, veterinarians, grain dealers, packaging plants, and professional services.

In addition to its economic benefits, the county's farmland contributes significantly to the open space and natural resource benefits, including rural character, scenic beauty, cultural heritage, hunting and other recreational opportunities, and the environmental benefits including watershed protection and wildlife habitat. By enhancing the scenic beauty and rural character of the county and providing other open space benefits, the county's farmland increases the overall quality of life and makes the county an attracting place to live and work for all of the county's residents.

The Agricultural Land Use and Soil Productivity Groups maps, shown below illustrate the locations and extent of agriculture in Muskegon County. Significant concentrations of farmland in Muskegon County are located predominately in the northwest corner and across the eastern one-third.



### **Muskegon Area-wide Plan:**

According to the Muskegon Area-wide Plan (MAP), population in Muskegon County is increasing in rural areas and decreasing in urbanized areas. It is estimated that residential development will replace farmland in 30 to 50 years, and that current development trends will result in a decrease of both farmland and open space lands.

A county-wide survey conducted for the MAP quantified support and opposition to policy ideas to control or encourage growth. Ninety-four percent of the respondents gave support to the idea of purchasing locally grown or produce foods to support local farmers. Eighty four percent supported the idea of tax incentives for landowners who voluntarily preserve farmland and open space.

One of the MAP goals related to agriculture is to “protect the valuable farm and forestlands, wetlands, surface and groundwater resources, wildlife habitat, and opportunities for passive and active recreation. One of the MAP implementation strategies is to “support and foster the farmland preservation program in Muskegon County, which will assist in the use of purchase of development rights to voluntarily conserve private agricultural lands.”

### **Muskegon County Farmland Preservation Program:**

In 2004, the Muskegon County Board of Commissioners initiated a project to preserve farmland and open space. With local contributions and a grant from the Community Foundation for Muskegon County, the Timberland Resource Conservation & Development Council led a collaborative planning effort to develop the Muskegon County Farm Land Open Space Preservation (FLOS) Program. Development of the program was integrated with the development of the MAP. Partners included WMSRDC, Muskegon Conservation District, GVSU Annis Water Resources Institute, local farmers, realtors, cities, villages, and townships. The planning process culminated with the adoption of the enabling ordinance by Muskegon County Commissioners in 2006.

The Muskegon County Farmland Development Rights Ordinance “protects farmland by acquiring development rights voluntarily offered by landowners, authorizes the cash purchase and/or installment purchases of such development rights, places an agricultural conservation easement on the property which restricts future development and provides the standards and procedures for the purchase of development rights and the placement of an agricultural conservation easement.”

Information about the Muskegon County Board of Commissioners, as well as the complete Farmland Development Rights Ordinance, is available on the Muskegon County Board of Commissioners website: <http://co.muskegon.mi.us/boardofcommissioners/citizens.htm>.

### **Michigan Conservation and Climate Initiative (MCCI):**

The Michigan Conservation and Climate Initiative (MCCI) is a joint project between the Michigan Association of Conservation Districts, the Delta Institute, and the State of Michigan. The project allows farmers and landowners to earn greenhouse gas emissions credits when they use conservation tillage, plant grasses or trees, or capture methane with manure digesters. Conservation practices store carbon in the soil and plants that would otherwise form carbon dioxide in the atmosphere. Manure digesters produce energy and prevent methane from being released to the atmosphere. Both carbon dioxide and methane are greenhouse gases that contribute to global climate change.

The Chicago Climate Exchange (CCX) is a voluntary member-based market that quantifies, credits, and sells carbon credits from certain conservation practices. The credits generated through conservation practices are pooled together from many different producers and landowners and are sold to CCX members (large companies, municipalities, and institutions) that have made commitments to reduce their greenhouse gas emissions. Chicago Climate Exchange members must reduce their greenhouse gas emissions to meet legally binding targets or mitigate a portion of their emissions through the purchase of offset credits generated by eligible practices. The Delta Institute, a 501(c)(3) non-profit organization, aggregates and sells these credits on the Chicago Climate Exchange on behalf of the landowner. The revenue from the sale, minus aggregation and trading fees, is returned to the landowner. The Michigan Association of Conservation Districts, and individual Conservation Districts throughout the State, serve as approved verifiers to ensure enrolled land meets eligibility requirements, and may assist landowners in during the application process.

MCCI provides a financial incentive for farmers and landowners to use conservation practices. While the primary purpose of these conservation practices is to sequester carbon dioxide, the conservation practices have secondary benefits, such as wildlife habitat and limiting soil and nutrient run-off to streams and lakes. Eligible practices may include conservation tillage, grass plantings, tree plantings, and methane digesters. For assistance with the application process, contact the Muskegon Conservation District at (231) 773-0008.

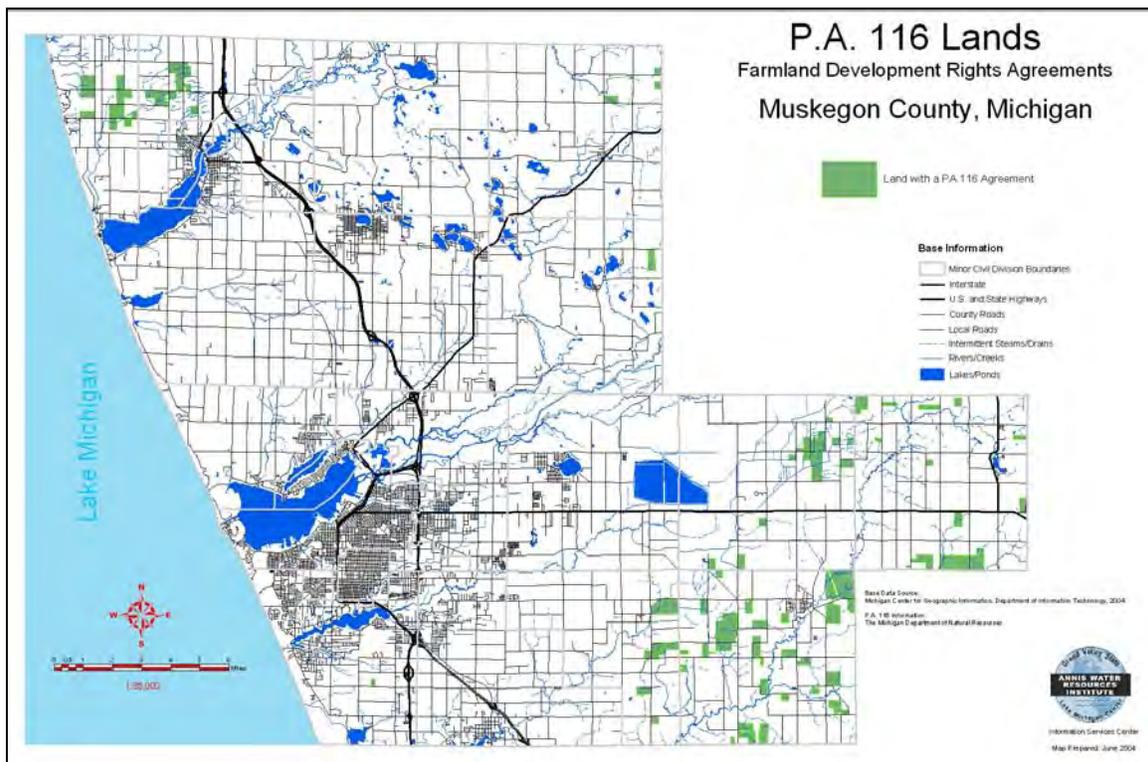
### **Michigan Department of Agriculture, Farmland and Open Space Preservation Program:**

This program is designed to preserve farmland and open space through agreements that restrict development, and provide tax incentives for program participation. The program consists of the following methods for preserving farmland and open space:

- Farmland Development Rights Agreements – A temporary restriction on the land between the State and a landowner, voluntarily entered into by a landowner, preserving their land for agriculture in exchange for certain tax benefits and exemptions for various special assessments. (commonly known as PA 116).
- Conservation Easement Donations – A permanent restriction on the land between the State and a landowner, voluntarily entered into by a landowner, preserving their land for either open space or agriculture.
- Agricultural Preservation Fund – A fund established to assist local units of government in implementing a local purchase of development rights program.

- Local Open Space Easement – A temporary restriction on the land between the local government and a landowner, voluntarily entered into by a landowner, preserving their land as open space in exchange for certain tax benefits and exemptions for various special assessments. Click here for a copy of the registration form.
- Designated Open Space Easement – A temporary restriction on specially designated lands between the State and a landowner, voluntarily entered into by a landowner, preserving their land as open space in exchange for certain tax benefits and exemptions for various special assessments. If you are interested in requesting land be conserved in by applying for a Designated Open Space Easement, click here.
- Purchase of Development Rights – A permanent restriction on the land between the State and a landowner, voluntarily entered into by a landowner, preserving their land for agriculture in exchange for a cash payment for those rights. Currently funding is not available for this program. Contact your township or county to see if there is a local PDR program established.

Much more information about Michigan Department of Agriculture and its agriculture programs is available at its website: <http://www.michigan.gov/mda>.



## **Other Farm Land Resources:**

### Know Your Farmer Know Your Food:

This is a USDA-wide effort to create new economic opportunities by better connecting consumers with local producers. It is also the start of a national conversation about the importance of understanding where your food comes from and how it gets to your plate. According to the USDA, there is too much distance between the average American and their farmer. It is therefore marshalling resources from across USDA to help create the link between local production and local consumption.

Visit <http://www.usda.gov/wps/portal/usda/knowyourfarmer?navid=KNOWYOURFARMER> for more information.

### Farm to School Network:

Farm to School connects schools (K-12) and local farms with the objectives of serving healthy meals in school cafeterias, improving student nutrition, providing agriculture, health and nutrition education opportunities, and supporting local and regional farmers. Forty-four states in the U.S., including Michigan, have operational Farm to School programs.

For more information about Farm to School, visit [www.farmtoschool.org](http://www.farmtoschool.org). Details about Farm to School programs operating in Michigan, visit <http://www.farmtoschool.org/state-home.php?id=13>.

### Michigan Integrated Food and Farming Systems:

The Michigan Integrated Food and Farming Systems (MIFFS) is a statewide, non-profit organization whose purpose is to improve Michigan's triple bottom line: economy, environment, and the social well-being of communities by promoting family farms, local food, and sustainable agriculture. According to MIFFS, "agriculture is vital to the economy and to the many cultures that give Michigan its unique personality. Although Michigan is diverse and rich in agricultural traditions, our food system faces sobering economic, environmental, and social challenges." The average age of farmers is increasing while the number of farms is steadily dropping.

According to MIFFS, some of the challenges to the preservation of farms include:

- Access to mainstream markets has steadily decreased for small and medium-size farms.
- Consumers often don't understand how or where their food is produced.
- Productive farmland is rapidly being depleted for suburban development.
- Policy makers often don't understand how their decisions impact farmers, consumers, and communities.
- Many groups that have not traditionally worked together as allies share concerns about economic, environmental, and social issues surrounding food and farming.

Muskegon County Community Gardens Program:

Public Health-Muskegon County developed its first county community garden ten years ago with the purpose of growing a healthy community with healthy, non-substance abusing youth. It has been successful in more ways than initially anticipated. First, an abandoned tennis court was reclaimed as prime garden property. Working with city government, county government, and neighborhood volunteers, as well as employees from several county programs, the hard surface was removed and the soil was nourished utilizing organic gardening techniques. This garden project gave participants the opportunity to influence governmental institution watering and fertilizing methodologies, snow removal, and other land-sharing concerns.

Community gardens grow healthy children, healthy families, and neighborhoods that are freer from substance abuse, crime, and violence. Gardens nurture the community, increase property values and provide the very basis for substance abuse prevention – clear boundaries and expectations, understood consequences for behavior, opportunities to serve the community, and recognition for having served, the most critical of protective factors. Garden participants get out in fresh air, grow fresh food, and develop friendships. Local regional food production is also a solution for access to fresh foods to reduce obesity and childhood onset diabetes. To find out more about community gardens in neighborhoods throughout Muskegon County, please refer to the contacts listed below.

Twenty-four community gardeners from Muskegon County met as a group, for the first time, in March, 2010. The group works to promote increased communication and cooperation between gardens and gardeners. Volunteers from the Lakes Community Garden plan to double its size this growing season. The Nelson Neighborhood Garden Committee wants to build more raised beds. The Peace Garden at Bunker Middle School is expanding and developing a relationship with a neighborhood restaurant. The pioneering Healthy Garden at the County Building continues to grow. The Jackson Hill Neighborhood is planting three new community gardens in the spring of 2010. The McLaughlin Grows project is completing its season extending hoop house and it is acquiring an EBT machine to make healthy local food available to neighborhood residents. The Organization for Community Development is building a new garden with 20 raised beds. This is just a sample of the flurry of new garden activity in our community. Mercy Health Partners intend to work with community groups to promote social justice and public health through community gardens.

Community Gardens in Muskegon County

Chris Bedford	<a href="mailto:chrisbedford@charter.net">chrisbedford@charter.net</a>	Harmony Gardens
Terry & Cathy Luce	<a href="mailto:tluce@verizon.net">tluce@verizon.net</a>	Lakes Community Garden
Tom Parks	<a href="mailto:tomparks@lakescommunitynaz.com">tomparks@lakescommunitynaz.com</a>	Lakes Community Garden
Sarah Rinsema-Sybenga	<a href="mailto:sarah@communityencompass.org">sarah@communityencompass.org</a>	McLaughlin Grows
Bill Krick	<a href="mailto:billkrick@comcast.net">billkrick@comcast.net</a>	Nelson Community Garden
Bridgette Coon	<a href="mailto:dejasblues@aol.com">dejasblues@aol.com</a>	Nelson Community Garden
Ann Craig	<a href="mailto:angelfire1@comcast.net">angelfire1@comcast.net</a>	Nelson Community Garden
Deb Tober	<a href="mailto:debtober@yahoo.com">debtober@yahoo.com</a>	Nelson Community Garden

Dollie Hippchen	<a href="mailto:dolliehippchen@comcast.net">dolliehippchen@comcast.net</a>	Nelson Community Garden
Jim Thompson	<a href="mailto:taylortom2007@yahoo.com">taylortom2007@yahoo.com</a>	Nelson Community Garden
Lora Swenson	<a href="mailto:le_swenson@yahoo.com">le_swenson@yahoo.com</a>	Nelson Community Garden
Rebecca Flowers	<a href="mailto:rebeccaflowers11263@yahoo.com">rebeccaflowers11263@yahoo.com</a>	Nelson Community Garden
Susie Kroes	<a href="mailto:susie.kroes@gmail.com">susie.kroes@gmail.com</a>	Nelson Community Garden
Spencer Norman	<a href="mailto:speni@aol.com">speni@aol.com</a>	Aamodt Park Garden
Pam Goodmen	<a href="mailto:bjamesmg@aim.com">bjamesmg@aim.com</a>	The Healthy Garden
Michael Miller	<a href="mailto:millermi@trinity-health.org">millermi@trinity-health.org</a>	Mission Integration
Paul Kurdiel	<a href="mailto:pkurdzie@mpsk12.net">pkurdzie@mpsk12.net</a>	"From Seed to Feed"
Charlotte Johnson	<a href="mailto:hnp@communityencompass.org">hnp@communityencompass.org</a>	McLaughlin Grows
Jill Keast	<a href="mailto:montgomerykeastji@co.muskegon.mi.us">montgomerykeastji@co.muskegon.mi.us</a>	Community Garden Col.
Doug Wood	<a href="mailto:doug.wood@orchardview.org">doug.wood@orchardview.org</a>	MAP
Megan Byard	<a href="mailto:meganbyard@wrace.org">meganbyard@wrace.org</a>	WRACE
Terrie Hampel	<a href="mailto:terriham@hotmail.com">terriham@hotmail.com</a>	Schneider Haus
Poppy Hernandez	<a href="mailto:poppysh@aol.com">poppysh@aol.com</a>	Seed to Feed
Rae & Rich Mitchell	<a href="mailto:lumbertownfarm@verizon.net">lumbertownfarm@verizon.net</a>	Lakes Community Garden
Brian Clincy	<a href="mailto:bclincy@daonlinebiz.com">bclincy@daonlinebiz.com</a>	ACHIEVE Chart
Lowell Kirksey	<a href="mailto:lowell.kirksey@postman.org">lowell.kirksey@postman.org</a>	City of Muskegon

For information about Community Gardens in Muskegon County, please contact:

Muskegon County Community Gardens  
Public Health-Muskegon County  
209 E. Apple Avenue  
Muskegon, MI 49442

Contact: Poppy Sias-Hernandez, (231) 724-1211 or [hernandezpo@co.muskegon.mi.us](mailto:hernandezpo@co.muskegon.mi.us)

Contact: Jill Montgomery Keast, (231)-557-9440 or [montgomerykeastji@co.muskegon.mi.us](mailto:montgomerykeastji@co.muskegon.mi.us)

## Chapter 8: Summary and Conclusion

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The Muskegon County Green Infrastructure Inventory is an important step toward the eventual development of a green infrastructure plan for Muskegon County. The inventory builds upon the regional green infrastructure vision, which was developed in part by the West Michigan Strategic Alliance as a “first cut” at identifying West Michigan’s green infrastructure network. The Muskegon County inventory was able to gather available information and refine it to be more precise and accurate to Muskegon County. The inventory reveals the current condition of various green infrastructure components in the county, supplemented with an extensive collection of maps, resources, and contacts.

The process to meet the Muskegon Area-wide Plan recommendation for a county-wide green infrastructure plan has been a step by step, and sometimes piece-meal, approach. Many excellent green infrastructure projects and assessments have been undertaken in Muskegon County. But, in order to develop a county-wide plan, a green infrastructure goal is needed.

The next step in the process of developing a county-wide green infrastructure goal and plan will be to meet with local jurisdictions to discuss the inventory, receive input, enhance the inventory with new information, and to develop a set of recommendations for next steps. Meeting with local leaders will achieve two important outcomes. First, it will educate and inform leaders about the importance and benefits of planning for green infrastructure. Second, the local meetings will help to start building a county-wide consensus on green infrastructure priorities and goals, which will be critical to the development of a meaningful green infrastructure plan.

*Special thanks for the expert input and cooperation from our local project partners from the Muskegon Conservation District, Public Health-Muskegon County, and the GVSU Annis Water Resources Institute.*

*The Muskegon County Green Infrastructure Inventory was developed, in part, to implement the Lake Michigan Lakewide Management Plan. Financial support for the project was received from Chicago Metropolitan Agency for Planning and the US Environmental Protection Agency Great Lakes National Program Office through participation in the Lake Michigan Watershed Academy.*



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