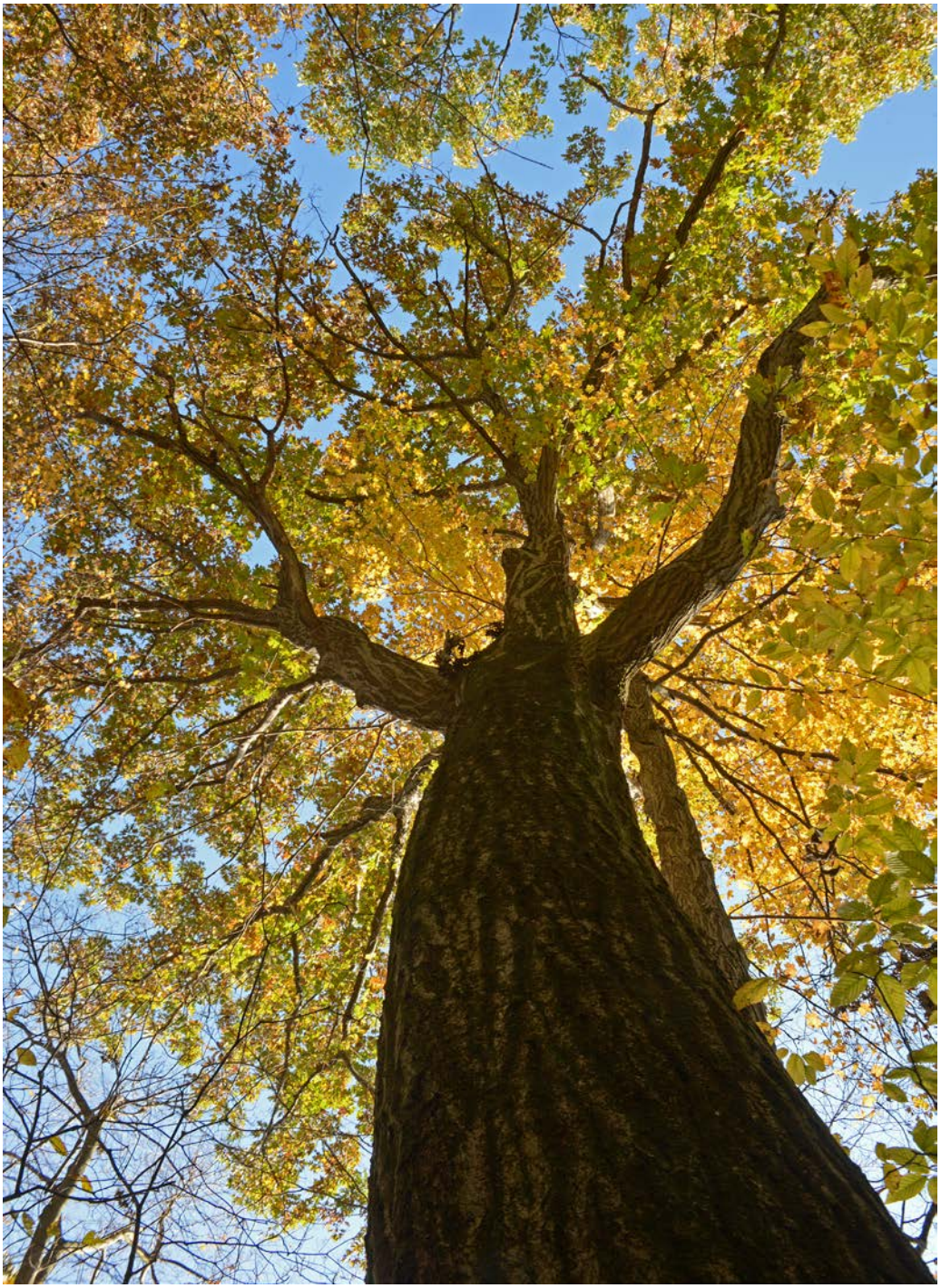
Landscape Stewardship Plan for Monroe County



March 2017

Landscape Stewardship Plan for Monroe County, Michigan

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Acknowledgements

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The Stewardship Network
Connect to Conserve

Table of Contents

1. Executive Summary

The Landscape Stewardship Plan covering Monroe County and adjacent areas of western Lake Erie in Southeastern Lower Michigan is one of nine stewardship plans developed through a grant by the U.S. Forest Service (USFS) and administered by Michigan Department of Natural Resources (DNR). The project is a collaborative effort between the Michigan Department of Natural Resources: Forest Resource Division, The Nature Conservancy, Huron Pines, and The Stewardship Network. The intent of this project is to connect people and organizations with each other and to foster stewardship information, resources, and assistance programs, thereby increasing our collective capacity to protect and maintain the forest products, services, and values of the region. The plans will provide local landowners with appropriate information about their regional forest resources, engage them in education about current conditions and threats, and spark an interest in forest stewardship within stakeholders. With a concentrated effort by all of the stakeholders, working collaboratively at the landscape scale, we can begin to address the regional challenges that threaten the health and sustainability of our forests and other natural resources.

Michigan's diverse forests has been thousands of years in the making. After the retreat of the Wisconsin glacier over 13,000 years ago, boreal forests began appearing in much of the Lower Peninsula. Several thousand years later, the more complex pine and hardwood forests and swamp forests that we are familiar with today began occupying areas of the Lower Peninsula including Monroe County. These were the forests that the Paleo-Indian and native tribes used sustainably for their daily needs for hundreds of years. By the early 19th century, however, a flood of European immigrants moved into Michigan from the eastern United States, and began clearing the prime timber for economic gain and utilizing the deforested land for farming. Since then, forests have continued to be used for their timber resources- expanding and contracting, depending on timber demands, climate, and increased demands for land needed for food production and urban expansion. What remains is a highly fragmented landscape throughout Monroe County and most of southeastern Michigan. Today, only 26% of total land area in Southern Lower Michigan is forested, and only 43,000 acres, or about 10% of Monroe County, remains forested, the majority of that being privately held. These numbers underscore the critical nature of developing a regional strategy for managing the remaining tracts of forest that provide essential ecosystem services.

Once dominated by forests, prairies, and wetlands, the Monroe County landscape is now mostly agricultural land, upon which many of the rural communities rely. Over the past several decades, forests have been harvested and wetlands drained to provide sufficient cropland. With this change in landscape, many unique ecosystems have been severely diminished or degraded, threatening the ability of native species to thrive in these areas. This diverse landscape is essential to the quality of life in Monroe County. However, management of these ecosystems has become increasingly challenging and emphasizes the need for a coordinated management effort across both public and private land.

To help address those needs, the Michigan Department of Natural Resources offers information and small grants to landowners to develop Forest Stewardship Plans for their properties. Forest Stewardship Plans characterize existing resource features found on a particular property and identify strategies for meeting each landowner's management goals through on-the-ground stewardship activities. For properties that do not qualify for DNR programs, individuals can hire a consultant to assist in the development of a stewardship plan. Information provided in this document and other State and Federal resources are available for individuals to use to write their own plans. Once written, additional support is available for conducting on the ground stewardship activity. The Western Lake Erie Cluster of The Stewardship Network is extremely active in conducting community conservation stewardship programs in Monroe County and throughout the western Lake Erie basin. Monroe County has been a major focus for local restoration efforts due to its unique natural history and current land use. In recent years, local efforts focused on the restoration of remnant native ecosystems have been successful in preserving and developing numerous natural areas across the county.

This document provides information about current management plans associated with this region. It highlights the stakeholders and resource providers relevant to forestry that are available for public and private landowners. Information about prominent resources unique to this region included, and recommendations that have been proposed for successful forest management are discussed. An important component of this Landscape Stewardship Plan is the collection of stewardship stories told by people living and working in Monroe County. Local land owners and land managers share their experiences and why they are active stewards of their forest systems. These stories are shared in the hope of sparking an interest in landowners, land managers, and local stakeholders to actively steward their forest resources. This collective landscape scale approach to stewardship is critical if we are to protect the ecological and cultural elements of Monroe County for present and future generations.

2. Project Introduction

This Landscape Stewardship Plan focuses on the Stewardship Network's Western Lake Erie Cluster in the southern Lower Peninsula, with emphasis on Monroe County. This plan was developed by The Stewardship Network as part of a larger collaboration to promote sustainable stewardship of private and public forest land across the state of Michigan. The larger project began in 2015 when the Michigan Department of Natural Resources received a grant from the United State Forest Service to partner with The Stewardship Network (TSN), The Nature Conservancy (TNC), and Huron Pines (HP)—all of which are 501(c)(3) nonprofit and non-governmental conservation organizations—to develop nine Landscape Stewardship Plans, each covering unique Michigan ecosystems (Figure 2.1).

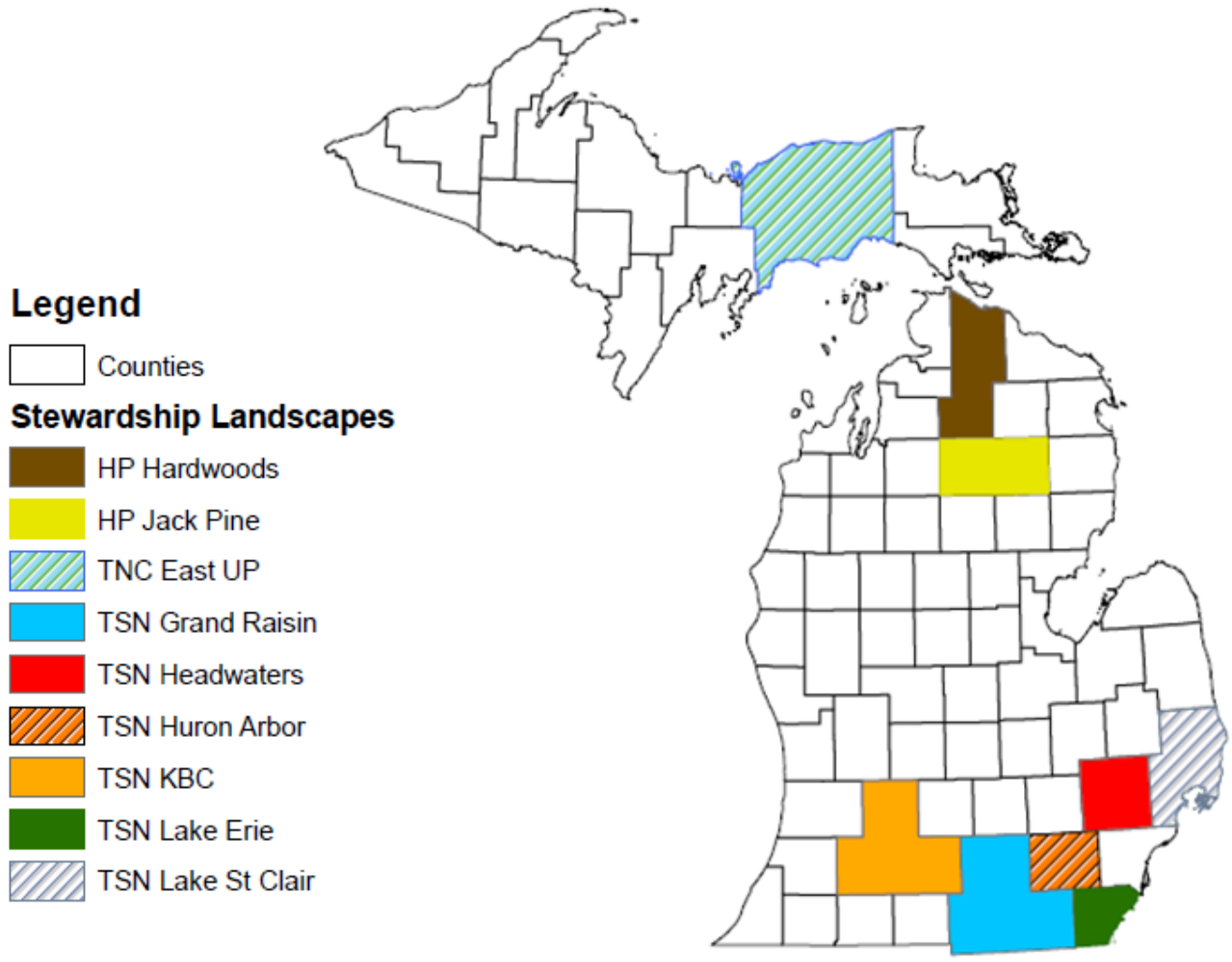


Figure 2.1 The nine Landscape Stewardship Plan areas. This report focuses on TSN Lake Erie.

Each plan covers a one to four county area in Michigan, characterizes the physical and cultural context of the focal landscape, and connects landowners to assistance programs and resources by summarizing available opportunities and providing program contact information. Each Landscape Stewardship Plan also includes a collection of stewardship stories told by the local landowners and land managers working within it. Rather than simply listing recommended land management practices, these stories let real people tell, in their own words, how and why they choose to actively manage their land, the challenges they face, and the resources that they have found helpful.

These Landscape Stewardship Plans aim to inspire people to become more active land stewards by showcasing opportunities through stories and by connecting people with resources for woodland management. By increasing voluntary participation in land stewardship activities, we are ultimately working to protect and preserve Michigan's unique natural resources through collective impact. This can only be achieved at the landscape scale—with private and public land managers working together to maintain healthy forests, clean water, and other natural resources for the use and enjoyment of current and future generations.

The Stewardship Network developed six Landscape Stewardship Plans covering a large swath of the southern Lower Peninsula of Michigan. This region is a mosaic of urban areas, agricultural lands, and small private forests. There is comparatively little forest land under public ownership in southern Michigan, where 75% of Michigan's 10 million residents live, but deliberate and responsible land management activities here have the potential to affect a large number of people.

The Nature Conservancy developed one Landscape Stewardship Plan for the eastern Upper Peninsula, which covers parts of Alger, Luce, Mackinac, and Schoolcraft counties—an area dominated by large blocks of both public and private forest land.
Huron Pines developed two Landscape Stewardship Plans, one focusing on the Jack Pines Ecosystem and one featuring Michigan's Northern Hardwoods in Cheboygan and Otsego counties.

These Upper Peninsula and northern Lower Peninsula landscapes contain fairly large tracts of forest land under a mixture of private, state, and federal ownership. This rural area contains intact and functional forests, but the long-term protection of these resources faces many challenges.

While the lead organizations were responsible for developing their respective Landscape Stewardship Plans, the content of each plan was generated with substantial input from other resource professionals, the landowners, and land managers willing to tell their stories, and based on existing resource assessments, stewardship plans, and other available literature.

Project partners also worked with Dr. Stuart Gage, Michigan State University professor emeritus, to install acoustic monitoring devices to capture the "soundscape" of each landscape.

The sounds of the forest tell their own story. An interactive website to be developed will allow people to view stories in their region, share their own stories, and listen to the sound stories.

Finally, a portion of the grant funding will be administered by the DNR to provide cost-share to landowners within the nine landscape focus areas for developing and implementing unique Forest Stewardship Plans for their properties.

2.1 Project Goals and Objectives

Michigan's forests face a myriad of threats—invasive species, tree diseases, habitat fragmentation, over browsing by deer in some areas, financial challenges for landowners and managers—that sometimes make it difficult to achieve forest stewardship goals. A recent study estimated that only 20% of Michigan's 11 million non-industrial private forest lands are being actively managed, yet active stewardship of private forest land is vital to the long-term health and productivity of the forest resources (including soil, water and wildlife) on which our local economies and communities depend. Therefore, the overarching goal of this project is to increase interest, awareness, and participation in active forest stewardship opportunities through the development of nine Landscape Stewardship Plans covering strategic and unique forest ecosystems throughout the state of Michigan.

Specific objectives that we seek to accomplish in order to achieve that goal include:

- Objective 1: Describe the physical, cultural, and resource management context of each of the nine landscapes to serve as a comprehensive reference for landowners and land managers.
- Objective 2: Facilitate collaborative management of multi-county areas by state, federal and local resource agencies, nonprofit conservation organizations, private sector professionals and individual landowners.
- Objective 3: Promote sustainable forest management practices and encourage people to be more active stewards of their land (e.g., develop and implement a Forest Stewardship Plan).
- Objective 4: Connect people with tools, resources and programs to help them take the next steps toward achieving their personal land management goals and increase our collective capacity to manage forest resources at the landscape scale.

These Landscape Stewardship Plans also aim to support and inform strategies for addressing national priorities and state-level issues identified in "Michigan Forest Resource Assessment and Strategy," which was completed by the DNR in 2010. These priorities and issues are:

- National Priority 1: Conserve Working Forest Landscapes
  - Issue 1.1: Promote Sustainable Active Management of Private Forests
  - Issue 1.2: Reduce Divestiture, Parcellization and Conversion of Private Forestlands
  - Issue 1.3: Reduce the High Cost of Owning Private Forestland

- National Priority 2: Protect Forests from Threats

- Issue 2.1: Maintain and Restore Aquatic Ecosystems and Watersheds
- Issue 2.2: Reduce Threats from Invasive Species, Pests and Disease
- Issue 2.3: Reduce Impact of Recreational Activities on Forest Resources

- National Priority 3: Enhance Public Benefits from Forests
  - Issue 3.1: Maintain Markets for Utilization of Forest Products
  - Issue 3.2: Maintain Ecosystem Services from Private Forestlands
  - Issue 3.3: Provide Effective Conservation Outreach for Private Forestlands
  - Issue 3.4: Maintain Community Quality of Life and Economic Resiliency
  - Issue 3.5: Maintain and Enhance Scenic and Cultural Quality on Private Forestland
  - Issue 3.6: Maintain Forested Ecosystems for Biodiversity and for Wildlife Habitat
  - Issue 3.7: Maintain and Enhance Access to Recreational Activities on Private Forestlands

2.2 The Need for Active Forest Stewardship

Forest land accounts for 55% of Michigan's total land area, and of Michigan's 20 million acres of forests, 12 million (60%) are privately owned. State and federal agencies are responsible for managing public lands, but the overall health of Michigan's unique forest, water, and wildlife resources ultimately depends on the collective management activities of all landowners.

The condition of a particular forest property is highly dependent on the condition of other forest lands throughout the entire landscape. Conversely, the management actions (or lack of active forest management) on a single property can also impact forests, rivers, wildlife, property, and people far beyond the boundary of that individual piece of land. Native wildlife, forest fires, harmful invasive species, tree diseases, and insect pests all move freely among private and public land, obviously not recognizing man-made property boundaries. Likewise, rivers and streams flowing from one property to the next carry the effects of poor land management activities downstream (or even upstream, as is the case with dams or poorly designed road crossings that block fish passage). The interconnectedness of landscape scale ecosystems, regardless of the particulars of property ownership, requires collective management for successful conservation and sustainability efforts.

Maintenance of healthy forest landscapes is also important at the regional and global scale. We depend on our forests for timber and other forest products, to provide wildlife habitat, to help mitigate climate change, to protect the quality and quantity of our water resources, and for the myriad aesthetic, recreational, and spiritual values they provide. Protecting our forest products, services, and values starts with the active stewardship of individual properties by landowners and land managers. Because widespread threats to forest health act scales larger than single parcels, our approach to maintaining healthy, functional and sustainable forests must also incorporate landscape-scale considerations. The purpose of this project is to encourage and

inspire people to actively manage their forests to realize benefits for both individual landowners and the larger community. The next section describes our methodology for doing so.

2.3 Methodology: A Landscape Approach to Natural Resource Conservation

The Michigan DNR applied for and was awarded funding by the USFS in 2015 to coordinate with The Stewardship Network, The Nature Conservancy, and Huron Pines to develop nine Landscape Stewardship Plans. These partners strategically identified landscape types containing a set of unique physical and cultural features that help define each landscape area while also distinguishing them from other landscapes. Of course, ecological landscapes do not adhere to our political boundaries and tend to transition gradually and unevenly from one landscape type to another. However, for the purpose of managing landscape-scale issues and challenges while also keeping the project areas manageable and relevant to local landowners and land managers, we've defined each landscape area as ranging from one to four counties in geographic scope. One advantage of defining the project area based on county boundaries is that these align with jurisdictional areas of different resource agencies and nonprofit organizations. Therefore, the assistance programs, resources, and opportunities offered within each landscape project area are generally consistent and the background information and stewardship stories are tailored to a particular local audience. Nevertheless, people in surrounding counties or other areas with similar characteristics will generally also find that these Landscape Stewardship Plans are useful.

The Stewardship Network's Western Lake Erie Cluster, comprising of Monroe County and immediately adjacent areas, lies in the extreme southeast corner of Lower Michigan near the Greater Detroit Metropolitan area—the most heavily populated part of the state. Monroe County contains the entire or part of 15 large and small watersheds. This region is a mosaic of primarily agricultural lands (214,500 acres) and small private forests (43,000 acres). The Southeast Michigan Counsel of Governments (SEMCOG) estimates that only 20% of the entire county, including both suburban and urban areas, is considered to have a tree canopy. There is comparatively little forest land under public ownership in southern Michigan, so effective forest stewardship requires engaging interest and coordinating efforts among park systems, land conservancies, and many small private landowners. While coordinated and collaborative land management poses many challenges, it can have many benefits: 75% of Michigan's 10 million residents live in this region, so land management activities can affect a large number of people.

The Stewardship Network coordinated with the landscape stewardship project partners to develop the text in Section 2, including the project background and project goals, objectives and methodology. To complete Section 3: Landscape Context, The Stewardship Network reviewed existing resource assessments and management plans/strategies. They also met with government agencies, private resource providers, and nonprofit organizations to collect information on the various assistance programs and opportunities that are available, with a

focus on forest stewardship. Contacts for each program are included as a resource for property owners and land managers.

A key focus has also been to collect stewardship stories, told by local landowners and land managers, illustrate opportunities and practices in the area (Section 4). Rather than simply providing a list of forest recommendations for property owners, we offer these stories to provide real-life examples of context and experience to inspire others to learn more and to take advantage of resources and programs that have been useful to Monroe County residents. The Stewardship Network and our partners identified people who are actively stewarding their land and who want to tell their stories. We had conversations with individual and institutional land owners and managers to hear about the many ways people are caring for the woodlands. All landowner stories were provided voluntarily for inclusion in this plan and with permission to distribute in the hopes of encouraging other landowners to become active land stewards.

3. Landscape Context

Monroe County is home to The Stewardship Network's Western Lake Erie Cluster, a diverse, collaborative community made up of organizations, individual volunteers and landowners, professional researchers, natural resource managers, government agencies, and native peoples. This community works together to restore, preserve, and protect their land and water. Situated at the delta of the Detroit River and on the westernmost end of Lake Erie, Monroe County is positioned in a key location for trade, development, and transportation- opportunities that were not lost on Native Americans, French, British, and eventually American settlers who all inhabited the region over the centuries.

3.1 The Physical, Ecological, and Cultural Landscape

Monroe County is located in the southeastern-most corner of the state of Michigan and borders the state of Ohio to the south, Washtenaw and Wayne Counties to the north, and Lenawee County to the west (Figure 3.1). Lake Erie spans the entire eastern border of the county. The unique geography of Monroe County lends itself to a unique culture, with influences from the county's close proximity to the urban centers of Detroit and Toledo, and a strong sense of independence stemming from its mostly rural landscape with a rich history of agriculture. The county is a thoroughfare for the manufacturing industries, primarily those related to automotive production and steel, and contains major highways and railroads that run north to south. Monroe County is an active member of both the Toledo Metropolitan Area Council of Governments (TMACOG) and SEMCOG.

3.1.1 Geographic Scope

This Landscape Stewardship Plan focuses on Monroe County, although the issues and stories arise from and apply to adjacent areas as well. Monroe County covers roughly 680 square miles in Southeast Michigan and includes the cities of Milan, Luna Pier, Monroe, Petersburg, and part of Flatrock and the villages of Carleton, Dundee, Estra Beach, Maybee, and South Rockwood.

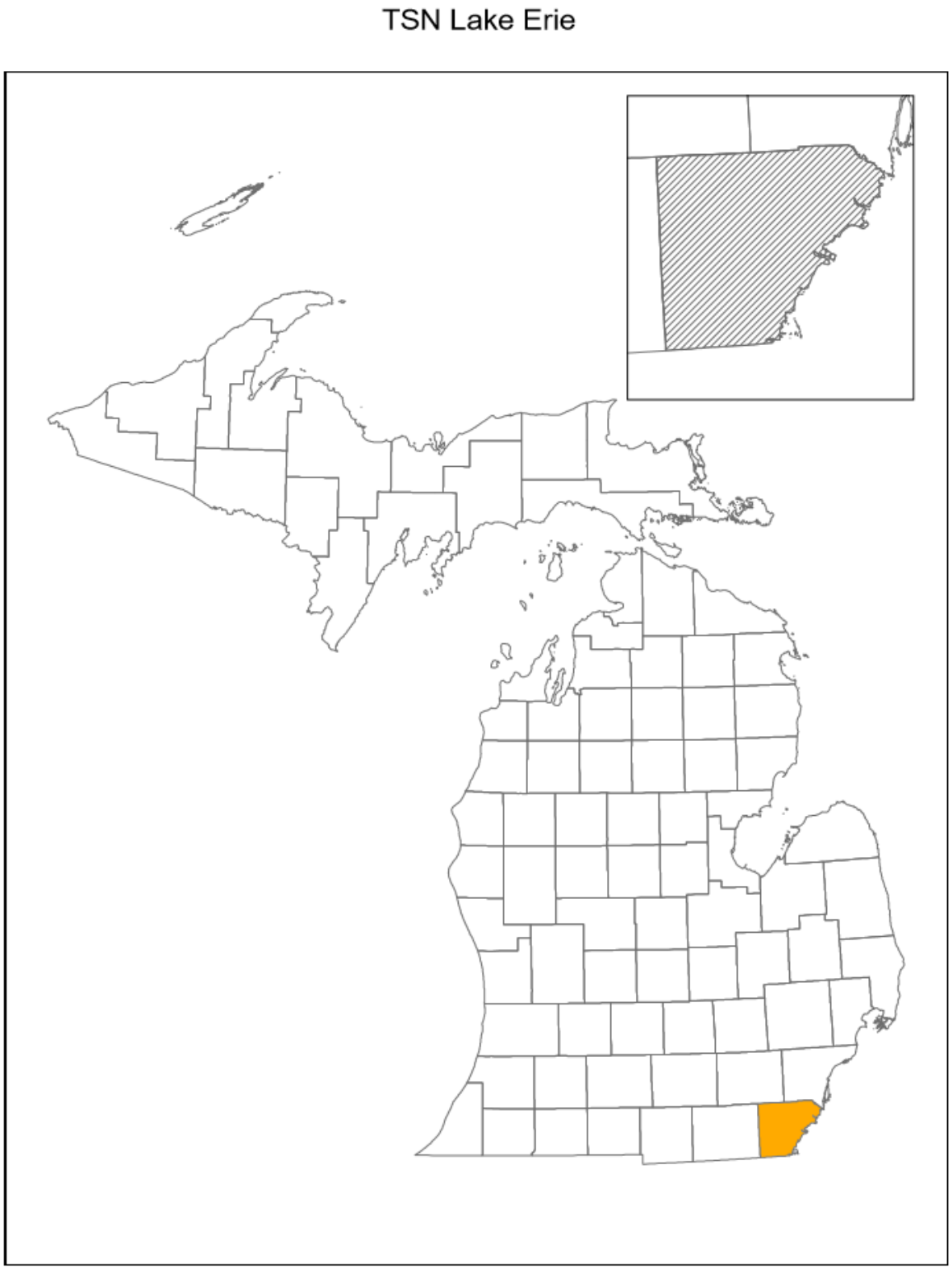


Figure 3.1. General map of Monroe County's location within the southeast Michigan region. (DNR, 2017)

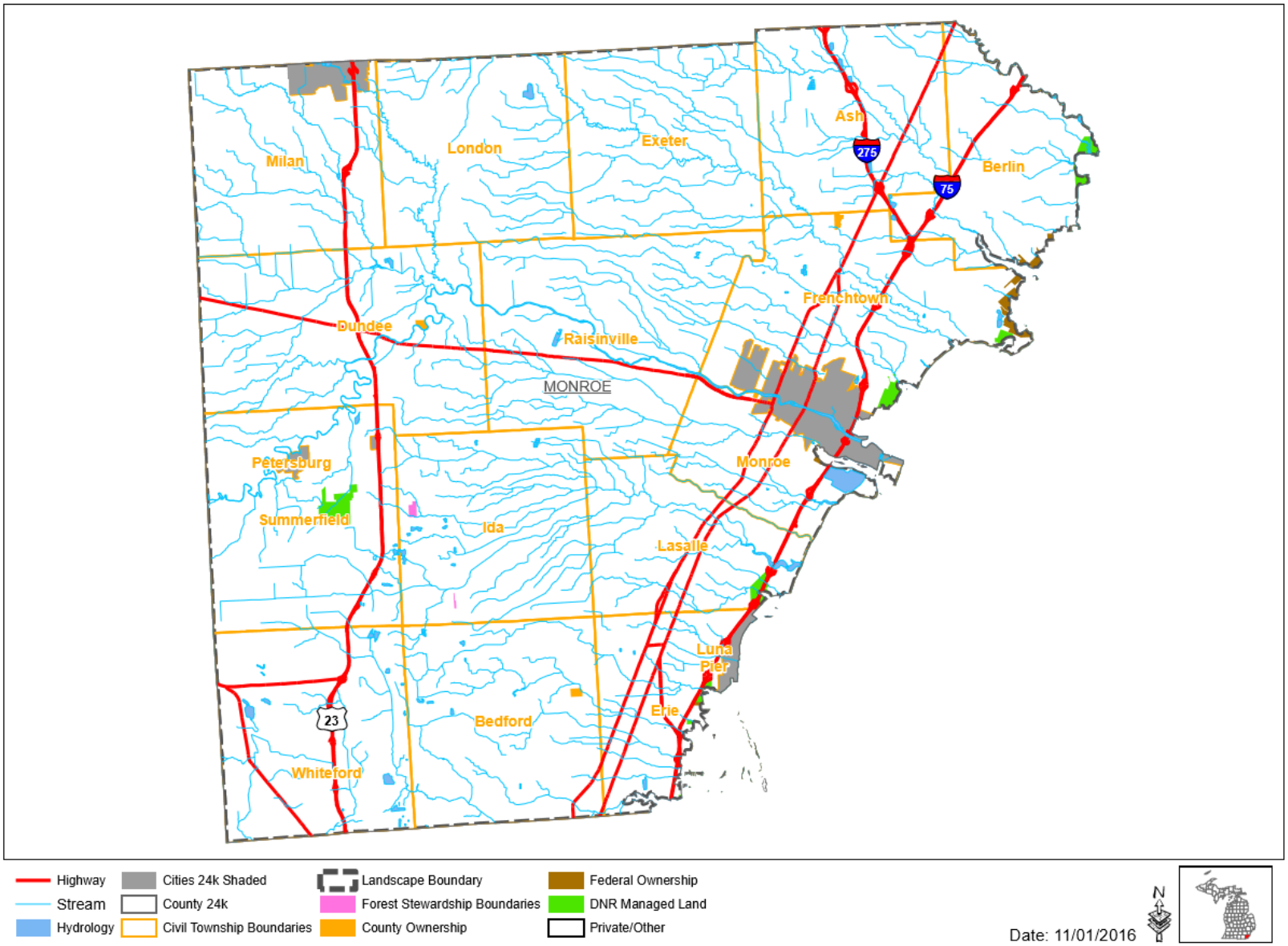


Figure 3.2: Base data map showing township boundaries, highways, streams, and cities within Monroe County, Michigan (DNR, 2017)

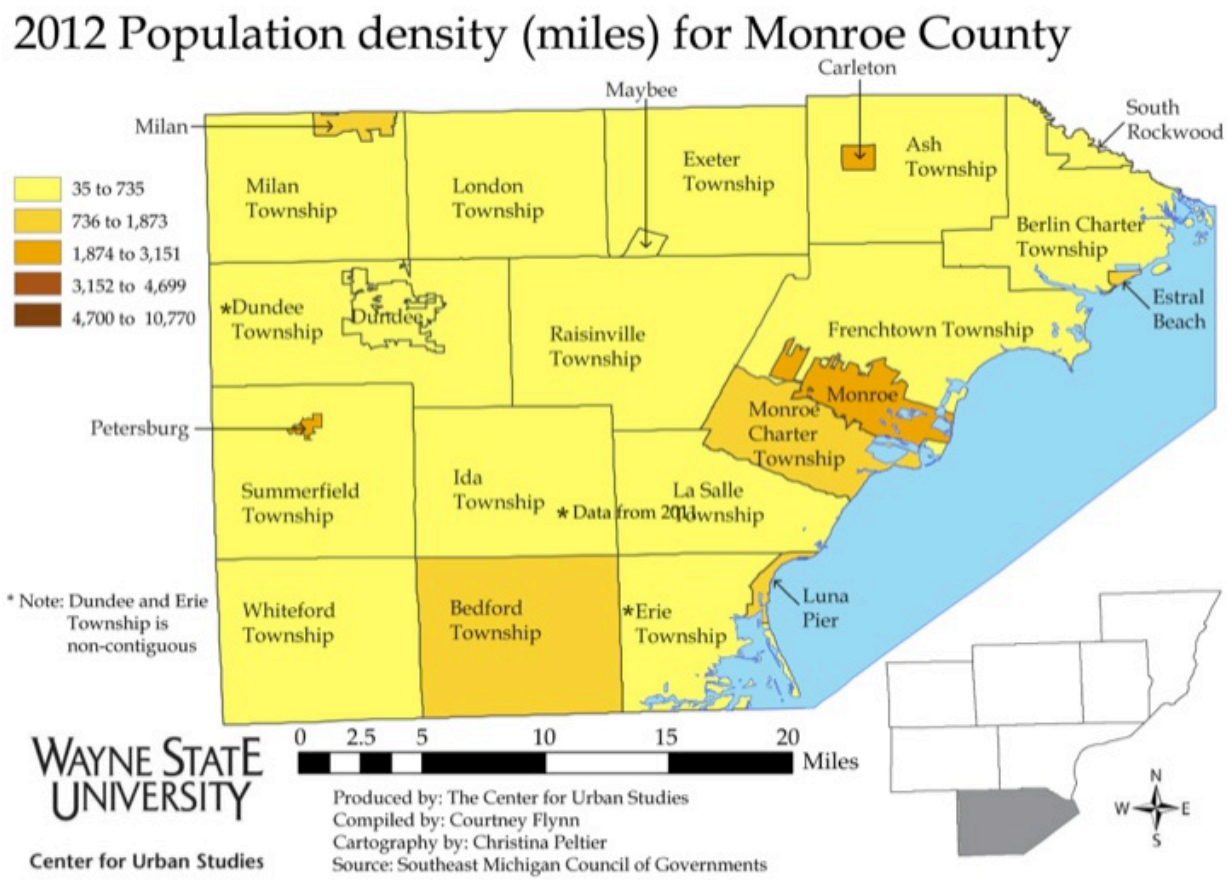


Figure 3.3: Population Density Map for Monroe County (Wayne State University's Center for Urban Studies, 2012)

Although this plan has been specifically tailored for the landowners and land managers living or working in Monroe County, most of its information and many of the listed resources, assistance programs, and Best Management Practices (BMPs) contained within this plan are applicable to adjacent areas. Furthermore, many of the issues confronting Monroe County woodlands are similar to those in other Detroit Metro area counties, which are covered in landscape forest stewardship plans that TSN is doing for neighboring cluster areas (Figure 2.1).

- Lake St. Clair (St Clair and Macomb Counties)
- Headwaters (Oakland County)
- Huron-Arbor (Washtenaw County)

3.1.2 Cultural Landscape and Land Use

The Western Lake Erie coastal plain has been utilized by Native Americans since prehistoric times who used the area's diverse plant and animal communities for food and other natural resources. Lake Erie and its tributaries, particularly the River Raisin, provided easy access to a

large geographic area. Twelve separate Native American tribes can trace back some of their history to this area, most notably the Pottawatomi and Wyandot tribes (Paskus, 2017).

Monroe County was established in 1817 and named for then President James Monroe. Original European occupation of the area dates back to the 1780's when French settlers built ribbon farms, long thin parcels of land that provided the farmer both access to the river and upland resources. The settlement of Frenchtown was also formed along the banks of the River Raisin. This was the site of the Battle of Frenchtown, the worst American defeat in the War of 1812. The site of the battle is now part of the River Raisin National Battlefield Park. The area is also known for being claimed by both the Michigan Territory and the newly formed state of Ohio in 1803, which lead to the Toledo War border dispute. Resolution to the conflict came in 1836 when President Andrew Jackson granted the Toledo strip (then part of Monroe County) to Ohio in exchange for Michigan receiving the Upper Peninsula.

Today, agriculture is the primary land use of Monroe County with over 50% of the area being cropland. Monroe County ranks 4th in the State in revenue from vegetables, 5th from nursery, greenhouse, and floriculture, and 8th in total crop sales. According to SEMCOG's estimate, the county's population was 149,176 in 2016, down 1.9% from the number recorded in the 2010 US Census. The largest city and county seat is the City of Monroe. Major employers of the County include the Fermi II nuclear power plant, Promedica Monroe Regional Hospital, Lay-Z-Boy, Tenneco Inc., Monroe County Community College, and Gerdau-Macsteel.

Current Land Use	Acres	Percent
Agricultural	193,439.2	54.2%
Single-family residential	110,715.8	31%
Multiple-family residential	879.7	0.2%
Commercial	8,397.8	2.4%
Industrial	8,133.8	2.3%
Governmental/Institutional	5,780.3	1.6%
Park, recreation, and open space	10,066.1	2.8%
Airport	316.1	0.1%
Transportation, Communication, and Utility	14,036.2	3.9%
Water	4,980.9	1.4%
Total	356,745.8	

Figure 3.4 Land use in Monroe County (SEMCOG, 2008)

The forested ecosystems of Monroe County, as with those across the entire state of Michigan, has been thousands of years in the making. After the retreat of the Wisconsin glacier over 13,000 years ago, boreal forests began appearing in much of the Lower Peninsula. Several thousand years later, the more complex pine and hardwood forests and swamp forests that we are familiar with today began occupying areas of the Lower Peninsula, including Monroe

County. These were the forests that the Paleo-Indian and native tribes used for their daily needs in a sustainable way for hundreds of years. By the early 19th century, however, a flood of European immigrants moved into Michigan from the eastern United States, and began clearing the prime timber for economic gain and in order to make room for farming. After the Civil War, the timber industry took off in Michigan as increasing industrialization fueled the demand for timber products. By the late 1800s, Michigan was producing more lumber than any other state.

The early decades of the 20th century brought a series of droughts and economic depression, which some say led to the abandonment of less productive farmland. Second-growth forest expanded during this period to reclaim marginal lands that were formerly tilled or grazed. During that time, soil conservation programs promoted reforestation, often with fast-growing, non-native species selected for timber production and commercial harvest. Land use in Monroe County continued to be influenced by agriculture, residential development, and commercial/industrial development along the shoreline of Lake Erie. Agricultural programs aimed at stabilizing crop prices and promoting production of commodity crops sprang up in the early to mid-1900s, affecting the amount of land set aside for conservation purposes.

Early twentieth century conservation movements in Michigan gave birth to efforts like the Depression-era Civilian Conservation Corp (CCC), which greatly contributed to the reforestation efforts in the state. Continued concerns over agricultural surpluses and environmental degradation led to the establishment of the Conservation Reserve Program in 1985 and the Wetlands Reserve Program in 1990, in which farmers could receive payments to leave land out of cultivation, with some programs promoting prairie and even forest plantings. Much of the public land now owned by the State of Michigan is tax delinquent land that was either abandoned by early timber companies or by families who failed at attempts to farm it.

Today, the forested systems of Michigan and Monroe County continue to expand and contract depending on timber and agricultural demands, a changing climate, and urban expansion. What remains now is a highly fragmented landscape throughout Monroe County that mirrors most of southeastern Michigan. Currently, only 26% of total land area in Southern Lower Michigan is forested, the majority of that being privately held (Albert, 1995). In 2014, SEMCOG estimated that the percent of tree canopy for Monroe County, including suburban and urban areas, is only 20% of total land cover. These numbers underscore the critical nature of developing a regional strategy for managing the remaining tracts of forest that provide essential ecosystem services.

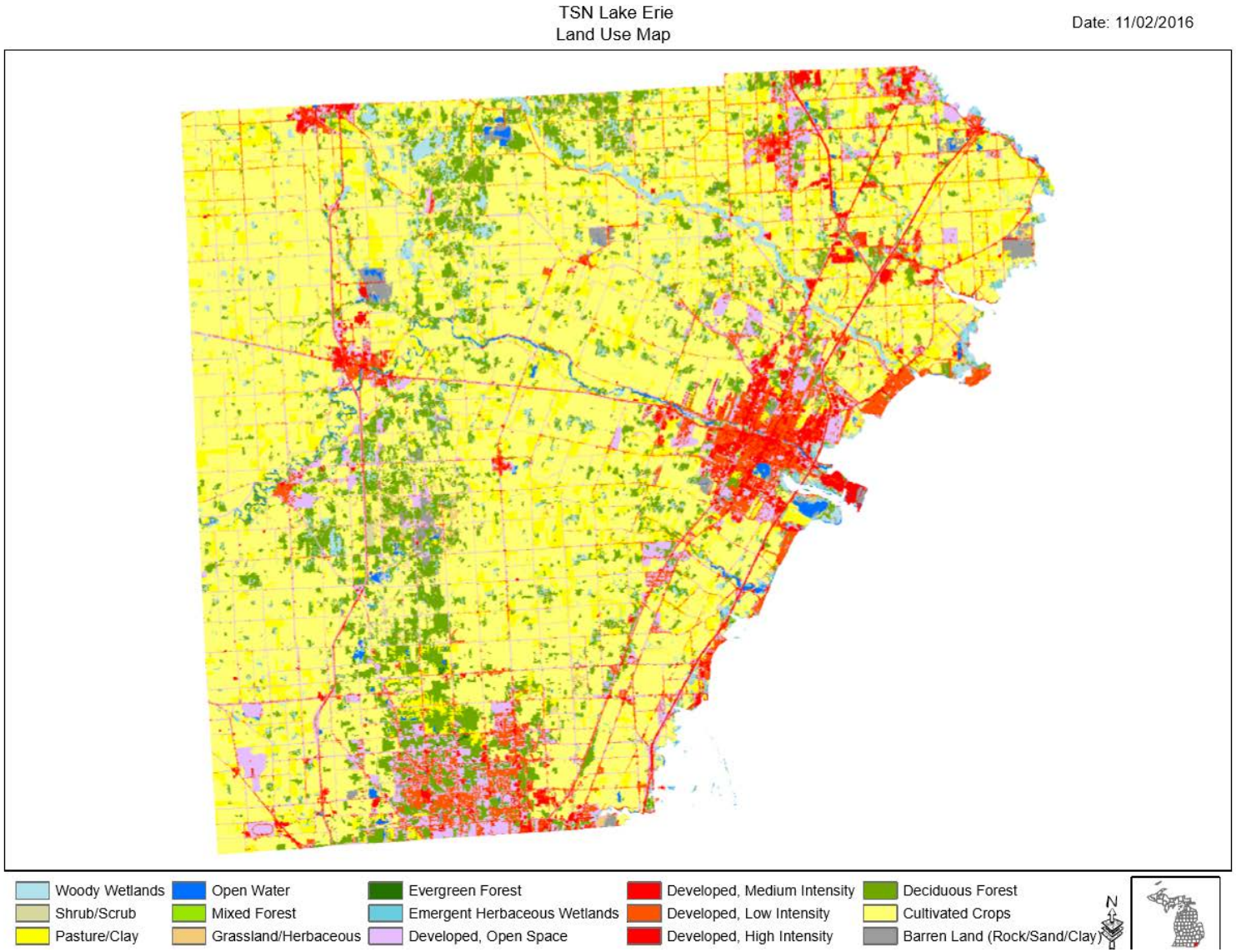


Figure 3.5 Land Use of Monroe County. Cover classes based on aerial imagery and interpretation from the Michigan Department of Natural Resources, Michigan Resources Inventory System/National Land Cover Database

3.1.3 Climate, Geology, Topography, and Land Cover

Climate

Monroe County is in the humid continental climate zone, with temperatures normally ranging from 10 degrees in winter to 90 degrees in the summer. Annual average precipitation totals approximately 30.09 inches of rainfall and an average of 43 inches of snowfall, the lowest average snowfall of any area in the state. Average relative humidity is 45 percent. The sun shines 67% of the time possible in the summer and 38% in the winter.

Annual Weather Averages for Monroe County	
Annual high temperature:	57.4°F (14.1°C)
Annual low temperature:	40.5°F (4.7°C)
Average temperature:	48.95°F (9.41°C)
Average annual precipitation	33.41 inch (84.86 cm)

(USClimatedata.com)

Michigan State University has weather stations at several locations throughout Michigan as part of their Enviroweather network. While there is not a station in Monroe County, one exists in nearby Blissfield to the west. This service provides real-time weather data as well as historical records of air temperature, precipitation, relative humidity, etc. (https://enviroweather.msu.edu/homeAlpha.php)

Climate Change

Most climate models show Michigan getting warmer (average annual temperature has increased 1.5 F in the last 100 years) and to have more extreme weather events such as rainfall in excess of 2 inches. However, warmer summer temperatures and low summer rainfall may lead to an increase in drought. (https://www.epa.gov/climate-impacts/climate-impacts-midwest, http://www.globalchange.gov/explore/midwest)

The Great Lakes Integrated Sciences and Assessments Center (GLISA) has developed localized and easy to understand fact sheets summarizing the best available climate data for an area and explains potential impacts of climate change to key sectors. The report emphasizes that, although climate change presents challenges for forest stewardship and management, the importance of maintaining healthy forests in urban as well as natural areas is becoming increasingly important. (http://glisa.umich.edu/resources/summary)

According to the third U.S. National Climate Assessment, "The composition of the region's forests is expected to change as rising temperatures drive habitats for many tree species northward. The role of the region's forests as a net absorber of carbon is at risk from disruptions to forest ecosystems, in part due to climate change. Among the varied ecosystems of the region, forest systems are particularly vulnerable to multiple stresses. The habitat ranges of many iconic tree species such as paper birch (*Betula papyrifera*), quaking aspen (*Populus tremuloides*), balsam fir (*Abies balsamea*), and black spruce (*Picea mariana*) are projected to decline substantially across

the northern Midwest as they shift northward, while species that are common farther south, including several oaks and pines, expand their ranges northward into the region."
(NCA, Ch. 18: Midwest. www.globalchange.gov)

The Northern Institute of Applied Climate Science (NIACS) and Northern Michigan University have produce vulnerability reports for Michigan forests, identifying "winners" and "losers" among tree species and forest communities (www.nrs.fs.fed.us/pubs/45688). Another report on future tree species distribution under warmer temperatures, published by the US Forest Service, expects most oaks to benefit from climate change in Michigan, but most conifers are negatively impacted. http://www.nrs.fs.fed.us/atlas/tree

Geology

Monroe County is located in a geological region known as the Michigan basin, which is characterized by successive bands of sedimentary rock formed between 325 and 360 million years ago and underlain by a strata of Paleozoic rock consisting of limestone and dolomite, sandstone and shale (Bowman, 1981).

Throughout much of the county, the bedrock is within 10 or 20 feet of the surface, and in some instances that rock is exposed. Where the bedrock is close to the surface, several of the formations have proven economically useful. While no metallic minerals are present, the limestone of the area has proven useful for cement production and the sandstone for high quality glass manufacturing.

Karst landforms are also present in many areas of Monroe County. Karst is formed when the underlying carbonate rocks have dissolved as a result of contact with mildly acidic water. These underground voids can lead to sinkholes, caves, and other unstable, and sometimes changing, surface topography. Karst formations may also impact groundwater quality and quantities, by creating direct conduits between the surface and underground water, providing a potential pathway for the pollution of drinking water. Karst sinkholes have been found in many areas of Monroe County. A unique karst feature known as the Great Sulfur Spring is located in the Erie Marsh, which is a tufa mound spring fed from the karstic bedrock aquifer.

Glacial Geology

Almost the entire state of Michigan is covered by glacially deposited material, known as glacial drift. Although many parts of the state have complex hills, ridges, and valleys which were the result of glacial features such as moraines, eskers, and kames, Monroe County owes its general lack of topographic relief to ancient lake beds. The bedrock in Monroe is, in general, directly overlain by a layer of clay till, deposited as a till plain by receding glaciers. This till layer is, in turn, overlain by glacial lake bed sediments, composed of various textures but primarily lake plain clay and lake plain sand. Beach ridges, deposited as ancient Lake Erie successively rose and fell over time, left long sandy ridges in the western half of the county running roughly parallel to the present shoreline.

Topography

Monroe County is located within the Maumee Lakeplain sub-subsection (sub- subsection VI.1.1) and the Huron/Erie Lakeplains ecoregions. The Maumee Lakeplain is an extremely flat and poorly drained landscape with narrow bands of sand over clay of glacial origin. Sandy beach ridges, formed by glacial lakes, are common on both the clay plain and broad drainages, particularly further inland. Monroe County contains the lowest elevation in the state of Michigan, on the shores of Lake Erie, measuring at 571 feet above sea level. The floodplains of rivers such as the River Raisin are gently sloping toward the east to Lake Erie. Slopes range from 0 to 6%. In the relatively flat landscape of the lakeplain, even slight changes in topography interact with soil and climate to define distinctive plant communities.

The US Geologic Survey has published topographic maps covering 7.5 minutes (one eighth of a degree of latitude and longitude) which have a scale of 1:24,000 so that 1 inch on the map represents 2,000 feet on the land. These maps generally have contour intervals of 10 feet (vertical dimension) and show a number of useful features: forests, rivers, wetlands, etc. The maps are available from multiple sources including: http://www.michigan.gov/dnr/0,4570,7-153-10371_14793-31264--,00.html

Land Cover

The landscape of Monroe County is a mixed land use of agriculture, forest, wetlands, and developed or urban areas. The dominant land use, approximately 54% of the county, is agriculture, a combination of row crops, vegetable, and nursery/floriculture. Urbanized areas, residential, commercial, industrial, and governmental, make up the second most common land use. Approximately 10% of Monroe County is covered by trees, or considered forested. Generally speaking, naturally forested landscapes are a mosaic of vegetation types transitioning from one to another. The DNR land cover analysis classifies forests in broad categories: deciduous forest, mixed forest, evergreen forest, and woody wetlands. Other classifications make finer distinctions among different forest types, based on characteristic soils and species. Donald Dickmann (2004) offers a more detailed classification in *The Michigan Forest Communities Guide* from a forestry perspective—including human-created plantation forests—while Michigan Natural Features Inventory (MNFI, https://mnfi.anr.msu.edu/communities/), which surveys plant and animal species and habitats throughout the state, offers an ecological view.

Monroe County contains a variety of natural areas, including upland and lowland hardwood forests, wetlands, and open space. However, little remains of the extensive pre-settlement forest communities of the area. The remaining forested systems in the county are highly fragmented with most of the present woodlands being small (10 -60 acres) woodlots scattered throughout the county. Forest fragmentation has significant ecological consequences. In addition to reducing habitat size and carrying capacity of the area, recent research has documented an array of negative effects of fragmentation: edges are warmer and drier, with more potential for drought stress; higher susceptibility of edge trees to wind damage; and greater potential for species invasions, both by non-native plants and by birds that are nest predators (Snyder, 2014).

Presettlement Vegetation

Between 1816 and 1856, Michigan was systematically surveyed by the General Land Office (GLO) and information collected by the land surveyors was used to reconstruct Michigan's pre-European settlement landscape. Surveyors took detailed notes on the location, species, and diameter of each tree used to mark section lines and section corners. Biologists from the Michigan Natural Features Inventory developed a methodology to translate the notes of the GLO surveys into a digital map that can be used by land managers and the general public to assess historical plant communities. Figure 3.6 shows this data for Monroe County.

Maps for each county in Michigan are available at: https://mnfi.anr.msu.edu/data/veg1800.cfm

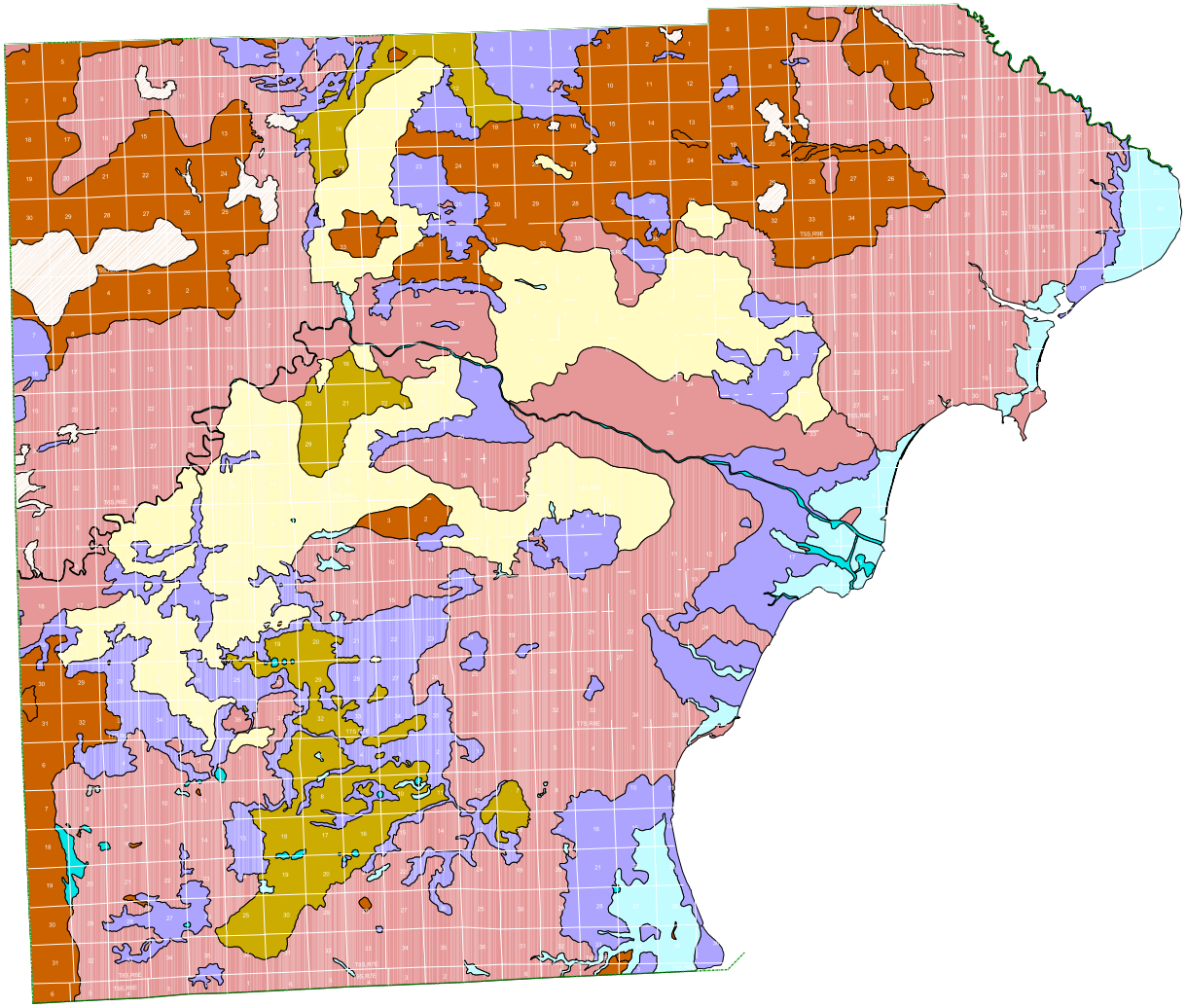


Figure 3.6 Monroe County vegetation circa 1800 (MNFI, 1995)

3.1.4 Soils

Soil is the long-term result of weathering on glacial landforms. There is also a biological component of soil that includes decomposing organic matter and the organisms that live in it, so the properties of soils can vary greatly across a landscape and strongly shape plant communities. Soil types, water, and climate are the major determinants of vegetation in a region. Soil sustains growth, holds and filters water, provides habitat for microbes and other living organisms, and recycles dead material, thus providing the nutrients needed to support future growth. Land management practices can greatly enhance soil health by increasing the amount of organic matter in the soil. Landowners can benefit from understanding the relationship between soil characteristics and appropriate land use.

The soils of Monroe County range from mature (those formed in glacial deposits and exposed to soil forming factors) to young (those formed recently such as alluvial sediment and lacustrine deposits). These soils are well suited for agricultural use, especially when drained, but often have limitations for development. Some of the most frequently mapped in the area are Pewamo clay loam, Selfridge loamy sand, Lenawee silty clay, and Hoytville silty clay loam (Bowman, 1981). All the soils in the county have fair suitability for woodlands, although wetlands can cause slow growth and poor regeneration.

Properties	Ecological Habitats				
	Xeric ⟷	Dry – mesic ⟷	Mesic ⟷	Wet – mesic ⟷	Hydric*
Average moisture during the growing season	Very dry	Somewhat dry	Moist	Very moist; water may stand in spring	Very wet
Drainage	Excessively drained	Very well-drained	Well-drained	Somewhat poorly drained	Very poorly drained or undrained
Surface soil textures	Sand to loamy sand	Loamy sand to sandy loam	Sandy loam to loam	Loam to clay loam	Sand to clay loam or organic (muck or peat)
Natural fertility	Infertile	Moderately infertile to fertile	Very fertile	Fertile to moderately fertile	Moderately fertile to very infertile

Figure 3.7: Soil properties and ecological habitats (Dickmann, 2004)

The US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) has conducted soil investigations in Monroe County, and the results have been mapped at a scale of 1:15,840 which is fine enough to represent areas larger than about two acres. The

mapping is supported by a database that contains information about basic soil properties and the appropriate use of soil areas based on those characteristics. They provide numerous interpretations of cover crop production, hydric soils, recreational development, soil health, etc. Under the land management heading, there are several interpretations that relate to forestry such as haul roads, erosion hazard, harvest equipment, seedling mortality, and windthrow hazard.

This detailed soil information is available in printed form from the Monroe County Conservation District offices as well as Web Soil Survey, an internet site that shows recent aerial imagery, allows the user to select an area of interest to assess the soil map units present, and search interpretations such as suitability for paths and trails. The print versions of Soil Survey show appropriate trees to plant on various soil types and a site index for examples of the most common trees that are adapted to the soil characteristics for the mapped area.
Web Soil Survey: (http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm),

Scientists who study soils developed a taxonomic system for classifying types of soils based on biological, chemical, or physical properties. There are 12 possible classifications that are also explored and defined on the NRCS website for landowners who are especially interested in the specific details of the soil on their property:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_053588

Smart phone users can take advantage of the SoilWeb app which uses the device's GPS location to display the most common soils at that site. It has basic information that includes a soil profile, landscape position, and simple graphs that display sand, silt, clay, organic matter, and pH with depth.

The Soil and Plant Nutrient Laboratory housed at Michigan State University (http://www.spnl.msu.edu/) offers a variety of analytical services to landowners from their samples of soil, compost, plant tissue, water, and other materials related to the growing of plants. Determining pH and nutrient status of the soil through testing is a key method of determining which amendments (lime and fertilizer) should be added for optimal plant growth. For more detailed understanding of the soils on a particular site, contact the Natural Resources Conservation Service or Michigan State University Extension (see Appendix D).

3.1.5 Water and Hydrology

Monroe County contains 13 subwatersheds that drain into Lake Erie. The River Raisin and the Huron River are the largest of the river systems in the county. Several smaller tributaries in the county include Plum Creek, Stony Creek, Swan Creek, Otter Creek, and Halfway Creek. Due to the lack of topography, these waterways are typically short, slow moving streams. Many of the streams have been heavily impacted by dredging and channelization to support economic activity of the area including agriculture. Water quality of these streams has historically been negatively impacted by runoff from agriculture and urbanized activity. The lower portion of

the River Raisin was declared an Area of Concern (AOC) by the U.S. Environmental Protection Agency (EPA) under the 1987 Great Lakes Water Quality Agreement. However, many of the Beneficial Use Impairments (BUIs) listed for the River Raisin have been removed in recent years due to the continued efforts of the local citizens and environmental groups to improve the health of and continuously monitor the river. Despite challenges faced with water quality, many of the streams and rivers hold good populations of fish and freshwater mussels, including several that are listed as special concern, threatened, or endangered.

Beginning in the mid-1800s, the beaver (*Castor canadensis*) population entered a steep decline due to trapping and habitat loss. The loss of beavers (and the dams they masterfully construct) drastically changed the landscape, as previously flooded areas drained allowing woody species to encroach on seasonally inundated areas. This landscape change resulted in natural barriers which suppressed fire and eliminated the natural disturbance necessary to maintain the previously dominant ecosystems. Beaver populations are slowly returning to southeast Michigan, but the role they will play in managing existing systems has yet to be determined.

Many management plans produced for this region have recommended the need to return the county hydrology to a more natural state when beaver populations were higher. This is an objective that is often seen when plans address stormwater, nutrient loading, and natural area habitat restoration. Many times forest management plans reflect the same need because forest type and prevalence can be determined by hydrology. This is a very difficult goal to accomplish when much of the land is used in traditional agricultural production, which the local economy relies on heavily.

Lakes

Lake Erie, the smallest of Michigan's Great Lakes, stretches along Monroe County from the mouth of the Detroit River to the Ohio border. Named for the tribe of Indians that lived on its southern beaches, the surface area of Lake Erie is 9,910 square miles, making it the 11th largest lake in the world. It is the shallowest of the Great Lakes, with an average depth of 62 feet and a maximum depth of 210 feet. Historically, Lake Erie played an important role in transportation and the development of the upper Great Lakes region.

Today, Lake Erie is better known for its sport fishing, particularly of walleye and yellow perch, and several charter fishing services operate out of Monroe harbors. Michigan's only state park on Lake Erie is the 1,300-acre Sterling State Park, which offers over a mile of sandy beach, shore fishing, a boat launch, six miles of trails for hiking, biking, and cross country skiing, and lakefront sites at the seasonal campground.

Nearby Lake Erie Metropark, with three miles of Great Lake shoreline, is home to coastal marshes and wetlands that allow for prime wildlife viewing, notably the raptors, or birds-of-prey, that pass through every year from September to November. This is the site of the annual Hawkfest in September, which attracts birders from all over the world because it is a chance to

see tens of thousands of migrating hawks in a single day. The park also offers a wave pool, a boat launch, 18-hole golf course, and multiple family picnic and play areas.

Pointe Mouillee State Game Area just south of the Metropark is also known for wildlife viewing and hunting. The 4,000-acre site boasts one of the world's largest fresh water marsh restoration projects, less than an hour south of the city of Detroit on Lake Erie.

The only natural inland lake in Monroe County is the 67-acre Lake Ottawa. The majority of the inland bodies of water in the county consist of small ponds and water contained in quarries, though these small ponds and lakes still provide important habitat for a variety of plants and animals. Shoreline vegetation, including trees and woodlands, play an important role in lake ecosystems and water quality. The Department of Environmental Quality's (DEQ) Inland Lakes and Streams program has been participating in the Michigan Natural Shoreline Partnership (See Section 3.2.1) to promote natural shoreline landscaping to protect Michigan's Inland Lakes and to educate property owners about using native plants and technologies that benefit lake ecosystems.

3.1.6 Wetlands

Wetlands are defined as areas with 3 key characteristics, which together form the ecological conditions for various wetland regulations:

- **Wetland vegetation or hydrophytes:** Plants that rely on standing water or saturated soil for at least part of the growing season.
- **Hydric soils**: Soil that formed under conditions of saturation, flooding, or ponding during the growing season to develop anaerobic conditions in the upper part.
- **Wetland hydrology**: The movement of water in wetland that typically leads to soil saturation and to the development of characteristic soils and plant communities.

It has been estimated that prior to European settlement, Monroe County held approximately 264,000 acres of wetland and since that time, over 94% of the wetlands have been lost and degraded due to conversion for agricultural, residential, and industrial development; alteration of groundwater hydrology; and invasion of non-native invasive species, according to the USDA.

Several different wetland types are found in Monroe County. The Maumee Lakeplain is a relatively flat and poorly drained landscape and as a result, a variety of both forested and open wetland communities exist throughout the county. These include mixed hardwood swamps, wet-mesic flatwoods, floodplain forests, and the once common but now scarce lakeplain prairies. Lakeplain prairie is among the most diverse landscapes in the state and is home to a high number of rare plants and animals. These unique natural communities consist of both prairie and wetland species that have adapted to seasonal water level fluctuations. Wet-mesic flatwoods are forested wetlands that contain a mix of both upland and wetland hardwood tree species that are also tolerant of seasonal flooding. Small seasonal pools, called vernal pools, are

abundant in wet-mesic flatwoods and are a critical habitat for aquatic invertebrates and amphibians. Detailed information about these and the other unique natural communities in Monroe County, including species characteristic of various types of woody wetlands, is available from the Michigan Natural Features Inventory website and publications (See Appendix D).

The US Fish and Wildlife Service provides a mapping program called National Wetland Inventory. The Cowardin System of Classification is utilized and indicates the distinctions among palustrine (inland wetland which lacks flowing water), lacustrine (associated with lakes), and riverine systems. The Wetlands Mapper integrates digital map data with other resource information to display wetland type and extent using a biological definition of wetlands. Wetlands Mapper, however, does not define the limits of proprietary jurisdiction of any federal, state, or local government, so landowners should consult with appropriate agencies (Michigan DEQ or USDA) before conducting clearing, earth moving, or other operations that may affect potential wetlands.

Michigan's wetland protection laws and subsequent regulations sought to limit wetland degradation and loss, thus minimizing the loss of ecological function and vast amount of ecosystem services that wetlands provide. Among their most important functions, wetlands help safeguard water quality in surface water (rivers and lakes) and serve as groundwater recharge areas to fill aquifers. They can also slow runoff water and serve as a buffer to reduce flooding downstream, reduce sedimentation in streams and rivers, and improve overall water quality through filtration. They can absorb excess nutrients (from fertilizers applied in nearby agricultural fields) which helps to slow or prevent eutrophication of lakes and ponds. They also filter pollutants out of runoff water and can bind to (or in some cases break down) toxic pollutants that would be incredibly damaging in other ecosystems.

Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, administered by the Michigan Department of Environmental Quality is the main state regulation that affects wetland use and alteration. In Michigan, the Section 404 federal authority associated with inland waters and wetlands was assumed by the State in 1984.

The USDA Natural Resources Conservation Service regulates wetlands on agricultural land. Under the Wetland Conservation provisions, USDA program participants are prohibited from converting wetlands on their property to cropland or pasture, unless the wetland acres, functions, and values are compensated for through wetland mitigation. Established in 2014 by the USDA, the Wetlands Reserve Easements program provides a financial incentive to private landowners to encourage the restoration of previously degraded or drained wetlands. NRCS pays a per-acre easement fee, plus 100 percent of the cost to restore the agricultural lands back to native wetland ecosystems. The landowner retains title, control of access, and hunting rights, but must protect and maintain the restored wetland ecosystem for future generations. The landowner can sell the land, but the easement (and its protections) remain enforced in perpetuity.

In addition to their many water quality benefits, wetlands also provide habitat for diverse species, including waterfowl, wildflowers, fish, frogs, and other amphibian species. Even small seasonal wetlands, such as vernal pools or ponds, benefit biodiversity, often serving as key breeding areas for amphibians, reptiles, snails, mussels, dragonflies, and damselflies. They also provide resources for numerous bird species (Thomas et al., 2010).

Coastal Wetlands

Monroe County hosts 22 miles of Lake Erie coastline. In the early 1800s, the majority of it consisted of coastal wetlands. These wetland systems are considered one of the most productive natural communities in the Great Lakes. They are an extremely dynamic system, ever influenced by the changing water levels of Lake Erie. Great Lakes Marsh systems also include Lakeplain prairies and adjacent wooded wetlands located on the fringes of the marsh. During periods of high water in Lake Erie, these prairies were inundated, allowing more water tolerant plant species to eventually establish themselves. Great Lake Marsh is a rare natural community that is globally imperiled. While these wetlands are the most productive global natural system, they are affected by not only Great Lakes water levels, but more importantly, the development of shoreline areas, urban growth, industrialization, and agriculture, which contribute to the degradation of the wetlands from polluted urban and agricultural stormwater runoff, industrial discharges, and sewer overflows (Paskus, 2017).

3.1.7 Biological Diversity: Natural Communities and Species

While the vast majority of property in Monroe County is either agricultural or urbanized, there still exists a significant amount of land that contains noteworthy native ecological communities. Over 20,000 acres of wetlands, 8,000 acres of parks, 6,000 acres of riparian corridors, and 22 miles of Lake Erie shoreline contain an array of very rare ecosystems and a number of threatened and endangered plant and animal species. One of the largest contiguous areas of lakeplain prairie and oak savanna in Southeast Michigan occurs in Petersburg State Game Area between Monroe and Adrian, which is the release site and now home to the federally endangered Karner Blue Butterfly (Paskus, 2017).

Threatened and Endangered Species

Biological diversity refers to the variety and abundance of species, communities, and ecosystems in a specific area. Michigan is noted for having more vegetation types than any other Midwestern state. The Michigan Natural Features Inventory, which "conducts field surveys to locate and identify threatened and endangered species and communities throughout the state, and maintains a database of all relevant species and community locations" (MDNR, Natural Features Inventory), has created a Natural Community Classification for Michigan that includes 77 communities grouped into 18 ecological groups, defined by their landscape occurrence and vegetation characteristics. According to MNFI's Rare Species Explorer, there are 119 state endangered, threatened, and species of special concern in Monroe County. The MNFI

website can be searched by taxonomy (type of organism), habitat, state and federal status, and county.

The U.S. Fish and Wildlife Service lists three endangered species for Monroe County: The Indiana Bat (*Myotis sodalist*), Karner Blue Butterfly (*Lycaeides melissa samuelis*), and Northern Riffleshell (*Epioblasma torulosa rangiana*). An additional three species are listed as threatened: The Northern Long-eared Bat (*Myotis septentrionalis*), Rufa Red Knot (*Calidris canutus rufa*), and the Eastern Prairie Fringed Orchid (*Platanthera leucophaea*). Spotted and Blanding's turtles (*Clemmys guttata* and *Emydoidea blandingii*) are known to occur in Monroe County and are associated with many of the wetland systems found near the coast. Both turtles are currently under consideration for federal listing. Threatened species are animals and plants that are likely to become endangered in the foreseeable future. Identifying, protecting, and restoring endangered and threatened species is the primary objective of the U.S. Fish and Wildlife Service's endangered species program (USFS Endangered Species list, 2016). See Appendix C for a full list of species listed by the state in Monroe County, according to MNFI.

Four globally rare natural communities occur in Monroe County: Lakeplain Wet and Wet-mesic Prairie, Lakeplain Oak Openings, Wet-Mesic Flatwoods, and Mesic Sand Prairie (Paskus, 2017). All four of these communities are considered imperiled due to the significant habitat loss over the past 200 years. Today, only approximately 1000 acres, or less than .4% of the historical extent of these four communities remain.

Species of Concern	# Species	Partly relies on woodlands, trees	Forest is primary habitat
Bird	13	4	0
Butterfly/Moth	4	3	0
Fish	10	3	0
Insect	6	2	0
Mammal	0	0	0
Mussel/Clam	22	5	1
Reptile/Amphibian	5	6	2
Snail (aquatic)	3	3	1
Snail (terrestrial)	5	5	5
Herbaceous Plants	49	48	20
Grand Total	**119**	**79 (66.3%)**	**29 (24.4%)**

Figure 3.8: Types of species of concern in Monroe County (MNFI)

Wildlife Habitat

Wildlife habitat needs can vary greatly depending on animal species. Territories can range from less than an acre for small mammals to about ten square miles for large predators such as bears and coyotes. Some species prefer forest edge habitat, while others require large blocks of

grassland or forests. What is required by one species may be detrimental to another, so landowners who want to manipulate habitat need to decide which animals they will inevitably favor. Another approach is to concentrate on improving or managing the native habitat or combination of habitat types (mature forest, early successional forest, prairie, wetlands, etc.) that already occur on the property. This strategy most often satisfies the needs of most of the native species that naturally occur in those ecosystems and helps to make the communities more resilient to system stressors like pests and diseases. This approach will typically allow for smaller, targeted species-specific habitat manipulation (such as food plots for deer) depending on the size of the area being managed, without compromising the integrity of the native system. While traditional agricultural land does not have as much biodiversity as natural plant communities, it is the dominant land use in Monroe County and there are practices that can improve the habitat value of working lands. Most stewardship plans address wildlife habitat and there are many practices that can be used to create or improve support for animals, which includes providing opportunity for obtaining food, water, cover, and enough space to live and reproduce. These resources can be provided by appropriate management of existing natural areas or restoration of plant communities that support the target species.

Forest types

The flat topography, poorly drained soil types, and seasonal fluctuation in hydrology of the western Lake Erie basin landscape has led to a drastic change in forest type throughout southeastern Michigan since the 1800s. This change is due to increased urbanization and agricultural land use in rural areas. Roughly 55% of the landscape in Monroe County is used for agriculture (Paskus, 2017). This landscape alteration has led to drastic fragmentation of forested areas, resulting in reduction of historically significant forest types and reduced viability of remaining woodlots. Hardwood swamp, beech-sugar maple, wet-mesic flatwoods, and lakeplain oak openings were historically prevalent in specific areas of southeastern Michigan.

In the early 1800s more than 60% of land cover in a five county span of southeastern Michigan was classified as hardwood swamp and beech-sugar maple forests. During that time 13% of Monroe and 5% of Wayne County acreage were lakeplain oak openings. Historically, fire and beaver activity throughout the southeastern Michigan landscape had favored prairie and savanna communities instead of forest. The suppression of fires and elimination of beaver populations throughout the late 1800s resulted in a shift of land cover favoring certain forest types adapted to the lakeplain area in southeastern Michigan.

The persistence of wet-mesic flatwoods is limited to southeastern Michigan as a result of the glacial lakeplain landscape. Historically, forested stands in southeastern Michigan on poorly drained soils were wet-mesic flatwoods and hardwood swamps. At present there are only six documented occurrences of wet-mesic flatwoods in Michigan, totaling 240 acres; these can be found in Monroe, Wayne, and Macomb counties located in the sand/clay lakeplain bordering western Lake Erie. This forest type is common in this region because of seasonal inundation caused by altered drainage which is a result of impermeable subsurface layers and low stream density (Slaughter et al., 2010).

Wet-mesic flatwoods are characteristic of clay lakeplains with channels of lacustrine sand deposits of low ridges and small dunes that are seasonally wet. The slight changes in elevation common to these areas result in flat uplands and depressed wet areas. This community type receives moisture through surface water and loses it through evapotranspiration. Most of the tree species present in these communities, such as lowland hardwoods, are adapted to flood – drought cycles and have developed adaptations specific to inundation, rapid changes in water level, and low oxygen availability during the growing season (Slaughter et al., 2010). Wet-mesic flatwoods lack sugar and beech maples which are characteristic of more common mesic southern forests.

The depressions found in this topography are seasonally wet, supporting lowland hardwoods including oak, maple, and ash species. Understories of wet-mesic flatwoods generally have low species richness due to regular inundation and a closed canopy. However, the windthrow that is common in these areas causes a "pit-and-mounted topography" by uprooting trees, which provides microhabitats for certain plant species allowing for increased diversity of ground cover (Slaughter et al., 2010). The wet depressions common to wet-mesic flatwoods often form vernal pools which are critical as breeding ponds for amphibians and aquatic invertebrates. Regular disturbances are crucial to the persistence of these ecosystems. Many of the plant species present are disturbance dependent and rely on factors such as wildfires to thrive.

Remaining wet-mesic forest sites are fragmented woodlots found in a degraded agricultural landscapes and have poor viability due to fragmentation, altered hydrology, invasive species, and excessive herbivory by white- tailed deer. Excessive herbivory has detrimental impacts on community structure, species composition, and successional trajectory (Slaughter et al., 2010) in these forested areas. This type of community is historically associated with wetland complexes and occupied higher topography. The successional turnover of upland areas to wetland communities is often the result of altered hydrology, such as that caused by beavers for example. Hydrologic disruption resulting from urban and agricultural development have severely limited the presence of wet-mesic flatwoods and reduced them to fragmented woodlots.

Mesic Southern Forests are beech and sugar maple dominated woodlands found in loamy soil type regions. They are thought to be prevalent in Monroe County. However, the number of acres may be overestimated as wet-mesic flatwoods are thought to often be misclassified as the mesic southern forest type. This forest type like other dominate types in Monroe County are common to glacial lakeplains. This forest type can be supported by soils ranging from sand to clay, but soils are typically well-drained and have a high saturation threshold. Soils in this forest type have good soil fertility due to high nutrient input from the decomposition of leaves and woody debris.

The canopy of this forest type is usually dominated by American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*) which generally make up about 80% of canopy cover. Other

prominent species include red oak (*Quercus rubra*), white oak (*Quercus alba*) American elm (*Ulmus Americana*), and white ash (*Fraxinus americana*). Dominant shrub species in the understory include dogwoods (*Cornus spp*.), and ground cover species such as spring beauty (*Claytonia virginica*), jack-in-the-pulpit (*Arisaema triphyllum*), white and yellow trout lily (*Erythronium spp*.), trillium (*Trillium Grandiflorum***)**, and wild geranium (*Geranium maculatum*). Rare plants often found in mesic southern forests that are of state concern and common to this region include stiff gentian (*Gentianella quinquefolia*) and prairie trillium (*Trillium recurvatum*) (Kost et al., 2007).

Large tracts of mature mesic southern forests are crucial habitat to many species. Cavity nesters and canopy dwelling species rely on these forested areas as do amphibian species that require vernal pools for reproduction. These species include many state threatened or concerned hawks, warblers, salamanders, and turtles.

The most important management objective for preserving biodiversity in these systems is to preserve and restore large tracts of mature growth. In order to restore woodlands to successful tracts, important factors are the management of white tailed deer (*Odocoileus virginianus*) populations to low densities, reducing anthropogenic disturbance, and preventing the introduction of invasive species. These factors can impede the structural features that are necessary to forest's complex function as wildlife habitat.

Hardwood Swamps are a forested wetland type historically prominent in southern Michigan. Approximately 1,200,000 acres of lowland hardwood forest occurred in Southern lower Michigan in the 1970s (Slaughter et al. 2010). This forest type was characteristic of southern lower Michigan due to the influence of windthrow and fluctuating water levels. Community structure and species composition are influenced by these natural processes. The poorly drained soils that resulted in glacial lakeplains often have dominate clay subsurface layers that impede drainage and result in seasonal ponding in surface depressions. These depressions that allow for seasonal pooling of surface water are characteristic of southern hardwood swamps. The seasonal fluctuation in surface and ground water levels allows hardwood species to outcompete other tree species and prevents these forest types from being dominated by shrubs and herbaceous ground cover. The weak structure of organic, often anaerobic (low oxygen) soils associated with wetland ecosystems makes trees present susceptible to windthrow. (Slaughter, 2009).

Hardwood swamps present in lakeplain ecosystems are often adjacent to wet-mesic or lakeplain forest and prairie natural communities. Silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*) are often dominant, but American elm and cottonwood (*Populus deltoides*) are also common to this forest type because of their high tolerance of water level fluctuation. However, sites that do not experience extreme fluctuation in water levels often have canopies dominated by red maple (*Acer rubrum*) and black ash (*Fraxinus nigra*). Conifers are often a rarity or are more commonly absent from this community.

Southern hardwood swamps sites adjacent to permanent bodies of water are likely to have higher diversity of amphibians due to the availability of appropriate breeding habitat. This forest type provides habitat for many important amphibian species such as the northern spring peeper, green frog, and striped chorus frog. Many species of birds prefer this forest type for nesting and utilize mature trees for their nesting sites. Some notable species are:

- Great blue heron (*Ardea herodias*)
- Red-shouldered hawk (*Buteo lineatus*)
- Barred owl (*Strix varia*)
- Pileated woodpecker (*Dryocopus pileatus*)
- White-breasted nuthatch (*Sitta carolinensis*)
- Wood thrush (*Hylocichla mustelina*)
- Eastern wood-pewee (*Contopus virens*)
- Rose-breasted grosbeak (*Pheucticus ludovicianus*)
- Black-capped chickadee (*Parus atricapillus*)

Perhaps the most influential species to this ecosystem is the non-native beetle, the Emerald Ash Borer (*Agrilus planipennis*), which thrives in this environment and considers all Michigan ash species potential hosts. This beetle has caused tremendous ash tree mortality since its introduction in 2002. Lastly, while present in diminished populations in Monroe County, the beaver is making a comeback and does inhabit hardwood swamps. Beavers have a huge influence on the succession of hardwood swamps. The disturbance that beavers create by selecting for specific tree species and causing increased and prolonged inundation through the construction of dams has the potential to turn hardwood swamps into emergent marsh wetland or wet meadows. In Monroe, where there are likely few, small, isolated woodlots of this forest type, private landowners should make an effort to ensure that a portion of the surrounding land is suitable for native plants and can allow the woodlot to succeed into a corridor. This effort helps to alleviate the effects of fragmentation and provides suitable habitat and corridors for species dispersal. It is also crucial to maintain structural diversity by leaving large, dead logs in place. These logs assist with the establishment of plants and provide necessary habitat for many species (Slaughter, 2009).

In the 1800's, Michigan's lakeplain oak openings were located on the glacial lakeplain along the shoreline of Lake Huron in Saginaw Bay, within the St. Clair River Delta, and near Lake Erie (Cohen, 2001). This historical prominence has been degraded to remnants throughout the entire range. The remaining occurrence of this forest type is roughly 0.02% of the historical extent, which was approximately 0.20% of Michigan. About 63% of that 0.20% was present in Monroe County. The remaining acreage was located in Wayne and St. Clair Counties. Currently, less than 0.004% of the surface area of Michigan is considered lakeplain oak openings. Many lakeplain oak openings that occured in wetland areas were drained for agriculture and others were subject to residential and industrial development. The lowered water table, demand for oak timber across Michigan in the early 1900s, and suppression of wildfires as a result of this development has dramatically reduced the historical range of lakeplain prairies and oak openings. Oak species are dependent on fire disturbance and the decrease of both the

occurrence and the intensity of fires in this region allowed for many of these areas to turn into denser forest types. The absence of fire leads to a closed canopy oak community in as little as 20 years as fire-intolerant species invade and thrive (Cohen, 2001).

The oak opening system is so rare because this forest type is specific to the sand channels formed along the Lake Erie shoreline as a result of glacial meltwater streams. This forest type thrives in this region because of the moderate water-retaining capacity of the soils. Historically, they are found in mosaics including sand flatwoods, hardwood swamps, lakeplain wet, wet-mesic, and mesic prairies. The wet-mesic variation found in flat, poorly drained areas is generally dominated by oak species with a ground layer similar to lakeplain wet and wet-mesic prairies and a canopy containing red maple, silver maple, green ash, and cottonwoods. The average canopy often only has 33% coverage (Bakowsky, 1988). They include numerous shrub types characteristic of sandy ridges and a ground layer dominated by graminoids and forbs. The presence of anthropogenic disturbance and the absence of fire provide the opportunity for invasive species to become established, reducing biodiversity of the native plant community.

An amazing, educational resource that illustrates all of the unique aspects of an Oak ecosystem is Living in the Oak Openings created by The Nature Conservancy Ohio's Green Ribbon Initiative. This book has been produced for numerous years with the third edition being released to the public in 2016. It is available online to download or in print at the local office. This resource provides landowners with an understanding of the oak ecosystems. It explains dominate and rare species of these ecosystems, the wildlife that it supports, its historic presence, and appropriate management for the ecosystem. It serves as a field guide as well as an educational tool for management.

3.1.8 Forest Resources

Most rural properties in Michigan have at one point or another utilized forests as a source of income, food, and other benefits (wildlife, aesthetics, recreation, etc). While not as common, urban properties can often utilize forests resources in much the same way but on a much more limited basis. The Soil Survey for Monroe County states that most soils in the county are suitable for growing trees, although there may be some limitations due to wetness. The publication offers information on soil suitability for specific tree species and productivity attributed to local soil types.

Landowners who are interested in increasing tree cover on their property have a variety of options to choose from:

1) Transplanting of commercially available nursery stock
2) Relocation from another site using a tree spade or other heavy equipment
3) Planting seedlings or directly from seed
4) Allowing natural regeneration to occur from adjacent trees.

Each option has pros and cons. Options one and two typically have higher survival rates and the end goal of achieving tree cover is realized much faster, however the number and variety of tree species, especially native species, may be limited. The down side of transplants is the process can be quite expensive, especially if many are needed on a large parcel of property. The third option of planting seedlings is the most common approach is suitable for all project sizes. The results are faster than planting from seed, survival rate is typically good, it is relatively inexpensive, and a wide variety of trees species, including native species, are usually readily available (many of the conservation districts and other resource organizations offer tree sales). The last option, natural regeneration, is initially the least expensive, however, it may not produce the most desirable of species, and the process of site clearing or thinning of undesirable trees can be very time consuming.

The landowner will need to take into account their properties specific soil type & fertility, moisture availability, light conditions, and other factors in order to achieve the best results. The use of native trees is highly preferred because they have evolved under local environmental conditions and provide more food for native birds and other wildlife than non-native species. Plantings should be monitored regularly, especially over the first several years, and may need to be watered and mulched to encourage healthy growth. Tree guards may also be necessary if the area has significant populations of deer and rodents. The placement of new trees is always important. Property owners should avoid planting near utilities, especially power lines, and to stay a reasonable distance from sidewalks, driveways, and structures. The local conservation district can provide native tree recommendations and typically sells bare-root seedlings in the spring.

Forest age and structure can vary widely depending on the environmental conditions of the selected site. Determining harvest goals and methods are often tied to forest structure. Even-aged stands are those with trees of similar age while uneven-aged stands can have a wide distribution of tree ages. The following general harvest methods are typically utilized to meet specific landowners' goals.

- A single or selective cut is the removal of specific trees that will favor an uneven-aged stand.
- A shelterwood cut is accomplished in several phases with the first cut setting the stage for the establishment of a seed bed for a new age class and a later removal cut that releases the already established small trees.
- Clear cutting removes all trees in an area with site reforestation being accomplished by natural regeneration or by planting seeds or seedlings to create an even-aged stand.

Some species (shade intolerant species in this case) such as aspen benefit from a clear cut because they regenerate by root sprouting and require full sunlight to encourage growth. Clear cuts can vary in size, with small ones being called patch cuts, and can be a variety of shapes, such as a strip cut.

Justification of a commercial harvest typically requires enough trees to be logged at one time to make it economically worth the effort. Advice on the feasibility of tree harvest can be obtained from a certified forester (see Appendix D). A professional forester will mark trees that have reached their optimal size and should be harvested, but, equally important, identify trees to be retained to optimize yield or be used as seed trees for the next generation. A professional forester will have a strong understanding of how to maintain the productivity and health of the forest. In tree farm systems, a sustainable yield of timber products can be obtained by harvesting less biomass than what is growing. In most areas, a local conservation district forester can provide cost-free assistance to landowners interested in harvesting a woodlot.

Careful harvesting is often used to mimic natural disturbances (death due to diseases, insects, fire, or windthrow) that happen to forests. These disturbances may create a small opening or gap (such as is created by a single mature tree knocked over by wind) or may remove many trees from a large area (large-scale disturbance such as tornado or fire). These disturbances facilitate succession and produce the next generation of trees. Forests that lack a harvest program tend to favor shade tolerant species such as sugar maple and beech. Managing light availability can affectively dictate which species dominate in an area that has been harvested.

There is a wide range of tree-harvesting techniques and equipment, with the simplest tools being a chainsaw and a tractor. Individuals who wish to stick to traditional methods or want to minimize damage to the forest floor often use draft horses. Commercial loggers may use skidders which gather and drag cut trees to loading areas or a forwarder that picks up and carries the cut timber to a loading area. Tree companies that cut large volumes of timber may use a harvester, a machine that cuts the tree off at the stump and then trims the log and cuts it into desired lengths, all in one operation. Tree shears are also used (some have jaws that can cut trees up to 15 inches in diameter) and a feller-buncher (cuts trees off with a saw or shears and then stacks for pickup). All of these machines can potentially cause significant damage to soil (compaction, rutting, or erosion) so it is preferable to harvest when soils are dry or frozen. Care should also be taken to avoid introduction of weed seed from other work sites.

The value of a timber harvest depends on many factors including the species logged, the end use of the log (veneer material, saw timber, pulpwood, pallet wood, etc.) and distance to the mill or processor. Private foresters, Michigan State University Extension Service, and Conservation District Foresters can all assist the property owner is assessing if a harvest may be worthwhile.

In addition to traditional logging, forests can yield a variety of other products, many of which can be commercial enterprises. Since Michigan has an abundance of sugar maple, the production of maple syrup is common among private landowners. In this process, sugar maples can be tapped to obtain sap, which is boiled down to make maple syrup (about 40-50 gallons of sap for one gallon of syrup). Edible products such as nuts, berries, and mushrooms can be harvested for family use or for sale. (visit http://www.edibleforestgardens.com/ for more information)

Permaculture

Permaculture is an agricultural approach designed to be self-sustaining and regenerative by utilizing natural ecosystems, and very often, these systems include many tree species. Permaculture was developed in Australia by Bill Mollison and David Holmgren in 1968, but has gained popularity around the world. Design elements include layers (canopy to soil layer) and zones that typically concentrate labor intensive activities close to the dwelling with grazing, forestry, and other less active land uses farther out. Mollison said, "Permaculture is a philosophy of working with, rather than against nature; of protracted and thoughtful observation rather than protracted and thoughtless labor; and of looking at plants and animals in all their functions, rather than treating any area as a single product system."

Agroforestry

The Center for Agroforestry at the University of Missouri has published a manual that provides information on agroforestry (the combination of agriculture and forestry). This involves practices such as silvopasture (trees in grazing areas), alley cropping (having herbaceous plants between rows of trees), windbreaks, and forested riparian buffers. (http://www.centerforagroforestry.org/pubs/training/index.php)

3.1.9 Forest Health

Monroe County's forests have continued to go through dramatic shifts since Europeans first settled there 200 years ago. Cessation of fire as used by Native Americans, large-scale logging, and the ever increasing demands for agriculture and industry have all contributed to forever changing the landscape of Southeastern Michigan. However, these forces where not the only influences to shape the forests that stand today. Since the early 1900s, Michigan's forests have been hit by successive waves of insect and disease outbreaks, often originating from non-native pests and pathogens. Attacks by chestnut blight; Dutch elm disease; gypsy moths; and Emerald Ash borer have killed millions of trees in this area Michigan and have dramatically reshaped Monroe County forests. The introduction and proliferation of non-native invasive species like autumn olive, buckthorn, honeysuckle, and garlic mustard all threaten forest health and can have devastating effects in a relatively short amount of time. These and other threats to forest health make the effort of every landowner important. DNR and local stakeholders offer guidance including web resources and classes to provide tools for responding to forest threats. This section outlines major threats to Monroe County's woodlands, along with resources for learning more and reporting pests.

Pests and Pathogens

Chestnut blight (*Cryphonectria parasitica*) was first introduced in New York in 1904 and rapidly spread to decimate chestnut trees throughout the northeastern U.S. It reached Michigan in 1930 and virtually eliminated chestnuts, which occurred primarily in the southeastern counties near Lake Erie, from naturally occurring forests. With the native American Chestnut virtually eliminated, there have been many efforts to develop blight-resistant American chestnut

(*Castanea dentata*) varieties (American Chestnut Foundation, https://www.acf.org/resources/faqs/, and Horton, 2013), as well as hybrids with various Asian species and cultivars. Landowners interested in planting chestnuts for nut production or forest restoration can find trees available online and can consult the Michigan Nut Growers Association, which has a special interest group devoted to chestnuts (https://michigannut.org/special-interest-groups/).

Dutch Elm disease (*Ophiostoma ulmi* and two related species), a non-native fungal pathogen spread by bark beetles, arrived in New York on imported timber in 1928. It was first documented in Wayne County in 1950 and since then has killed tens of thousands of mature American elms (*Ulmus americana*) in Michigan. Although large elms have disappeared from most Michigan forests, smaller trees often survive and can be locally numerous, often reaching 6–10 inches in diameter before they succumb to the disease. The disease is carried by both native and non-native bark beetles that carry the deadly spores from tree to tree. Chemical and biological controls have had mixed success, and preventive treatments can be very costly. Efforts are currently underway at several facilities, including test plots at Michigan State University, to develop resistant cultivars of American-only genotypes and hybrids. Landowners looking to plant elms should research cultivars carefully. Some "blight-resistant" types have succumbed to blight over time, and tree growers will need to decide whether they prefer fully American genotypes or will accept hybrids with Asian species.

Gypsy moths (*Lymantria dispar*) were introduced on the east coast of the U.S. in the 1860s and have killed tens of thousands of trees in the Northeast during periodic outbreaks. Michigan experienced the first major outbreak in 1986, when the Gypsy Moth caterpillars defoliated millions of trees on over 64,000 acres in the state. Six years later, a 1992 outbreak resulted in 750,000 acres of Michigan trees defoliated, with other severe outbreaks in 1998 (Figure 3.8) and local outbreaks in 2008, 2013, and 2016. Many of the counties in Southeast Michigan participated in the Michigan Department of Agriculture's Gypsy Moth Suppression Program. The program assessed gypsy moth damage, provided landowners with information on the species and treatment, and treated areas where landowners permitted with aerially applied Bt and Gypcheck, which successfully supplied relief to the infestation. Defoliation may not outright kill trees, but it does leave them more vulnerable to drought, disease, and future insect outbreaks.

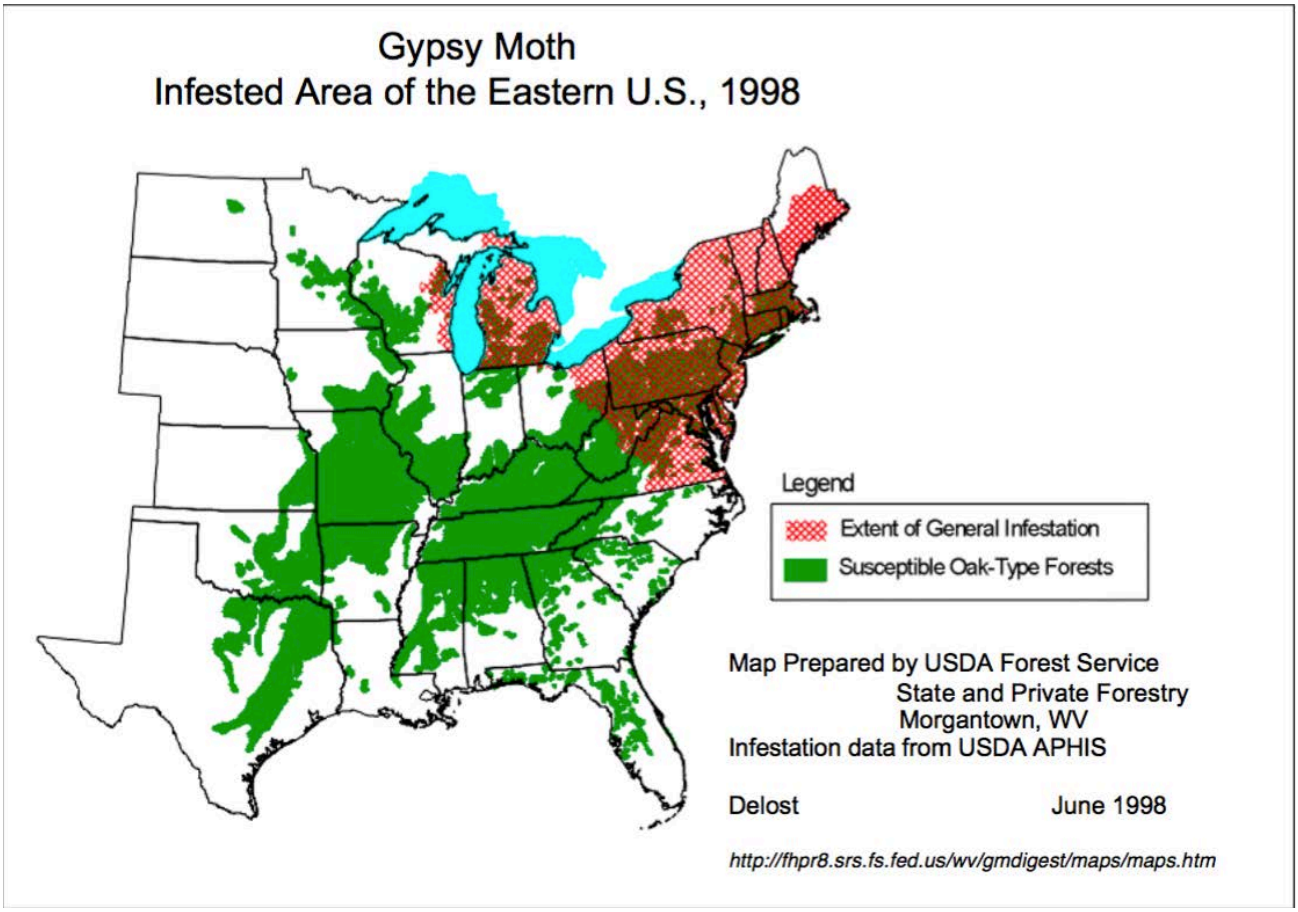


Figure 3.8. Gypsy moth infestation and forests at risk, 1998. (USFS, 1998)

Over recent years Gypsy moth outbreaks have declined in both frequency and severity as natural and introduced biological controls, including a naturally occurring virus [nucleopolyhedrosis virus (NPV)] and a naturally occurring fungus (*Entomophaga maimaiga*), reduced and helped maintain populations at low levels for a number of years in Southern Michigan. Various websites offer guidance to landowners about gypsy moth identification and treatment. Landowners should be observant and contact their local conservation district or MSU Extension if they observe populations again reaching the nuisance level.

Emerald Ash Borer (EAB) (*Agrilus planipennis*) is an invasive beetle whose larvae feed on tissue in the bark of ash trees. It was accidentally brought to the US from Asia and was first documented in Michigan in the early 2000s. Due to the beetle's specificity in targeting ash trees, it has had a significant impact on the wooded areas prominent throughout across Michigan (Slaughter et al. 2010). By 2007, EAB had killed tens of millions of white, green, and black ash trees (*Fraxinus americana, F. pennsylvanica*, and *F. nigra*) in southeastern Michigan (McCullough 2013). Control of EAB is currently limited to prevention of human introduction of this species to new locations through transport of infected firewood, raw wood products, and living trees that might be hosting the beetles (Slaughter, 2009).

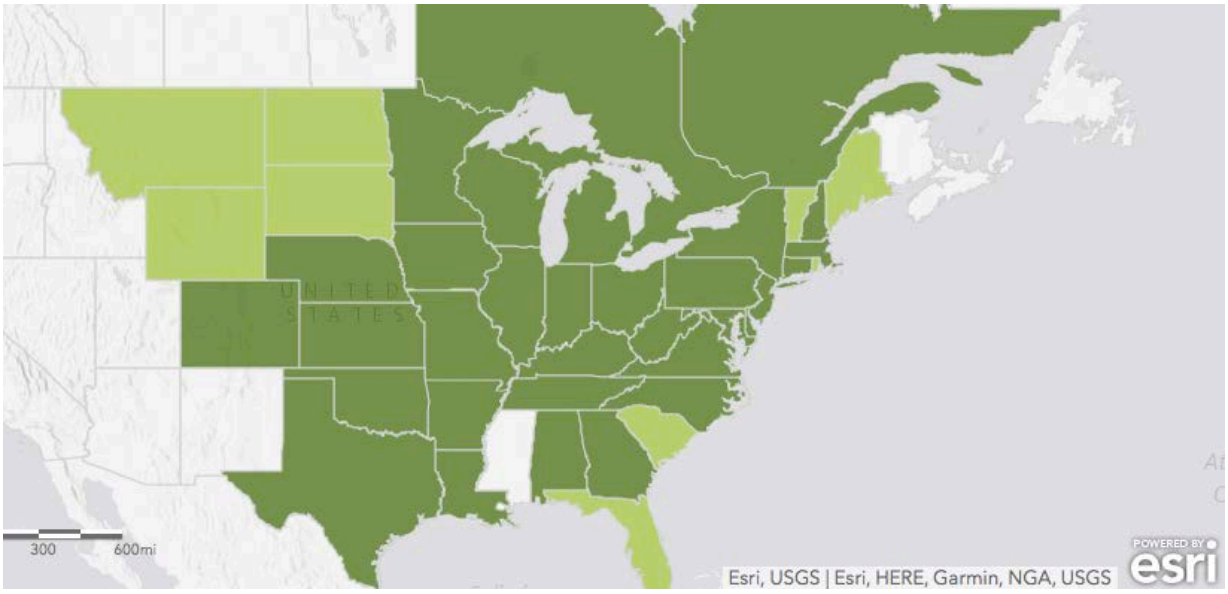


Figure 3.9. Emerald Ash Borer range in the U.S. and Canada, 2017. From http://www.emeraldashborer.info/index.php.

Asian long-horned beetle (ALB) (*Anoplophora glabripennis*) has the potential to become a serious threat to Michigan forests because its preferred host is maple and more than one billion maple trees that occur in the state could be at risk. It is also known to attack dozens of other tree species (from 12-15 plant genera), including poplar, willow, sycamore, and horse chestnut. This large, showy beetle was accidentally introduced into the U.S., probably in wood crating or pallets shipped from Asia. ALB larvae feed in tunnels (called galleries) in the wood of tree branches and trunks. The galleries cause branches or entire trees to break and the infestation eventually kills the tree. North American trees have little or no resistance to infestation, which is almost always fatal.

ALB populations are known to be present in areas of southern Ohio, Massachusetts, and New York but has not yet been detected in Michigan. Early detection and eradication are key to controlling this pest. As with other pests, ALB can be transported into new areas in logs and firewood. If ALB is not eradicated and populations spread across North America, the economic and ecological impacts would be enormous. The Michigan Department of Agriculture urges landowners to pay attention to trees, especially maples, with dying branches, and to report any suspect trees or beetles, take photos, record the location, try to collect suspect beetles in a jar, and report to MDA:

- Email: MDA-Info@michigan.gov
  Phone: MDARD Customer Service Center (800) 292-3939
  Midwest Invasive Species Information Network: www.misin.msu.edu

- Learn more: www.michigan.gov/exoticpests, www.asianlonghornedbeetle.com, https://www.dontmovefirewood.org/pest_pathogen/asian-long-horned-beetle-html/

[Text in this section excerpted and modified from MDARD's Forest Pest Alert: http://www.michigan.gov/documents/mdard/AsianLonghornedBeetle_3-14_453144_7.pdf.]

Beech bark disease occurs when an invasive sap feeding insect, beech scale (*Cryptococcus fagisuga*), injures American beech trees (*Fagus grandifolia*), allowing them to become infected with two species of fungus (*Nectria* spp.). The fungus kills areas of woody tissue, which may girdle and kill the tree if the affected area becomes large enough. Up to 75% of trees appear to be killed within three to six years following the start of the infection. During the infestation period, infected trees have abundant dead branches that are easily blown off in windstorms (a condition known as "beech snap"). The beech scale was brought into Nova Scotia, Canada in 1890 and has gradually moved west. It was first documented in Michigan in 2000 and has since spread widely in the state, although it has not yet been reported in Southern Lower Michigan which generally has fewer Beech trees in the forest makeup.

Although there appears to be some natural resistance among beech trees to beech bark disease, there are few control options in natural forest stands. Thinning is recommended to reduce beech density, as lower density stands may be less susceptible to the spread of the scale and fungus, along with removing trees that are affected (McCullough et al. 2005).

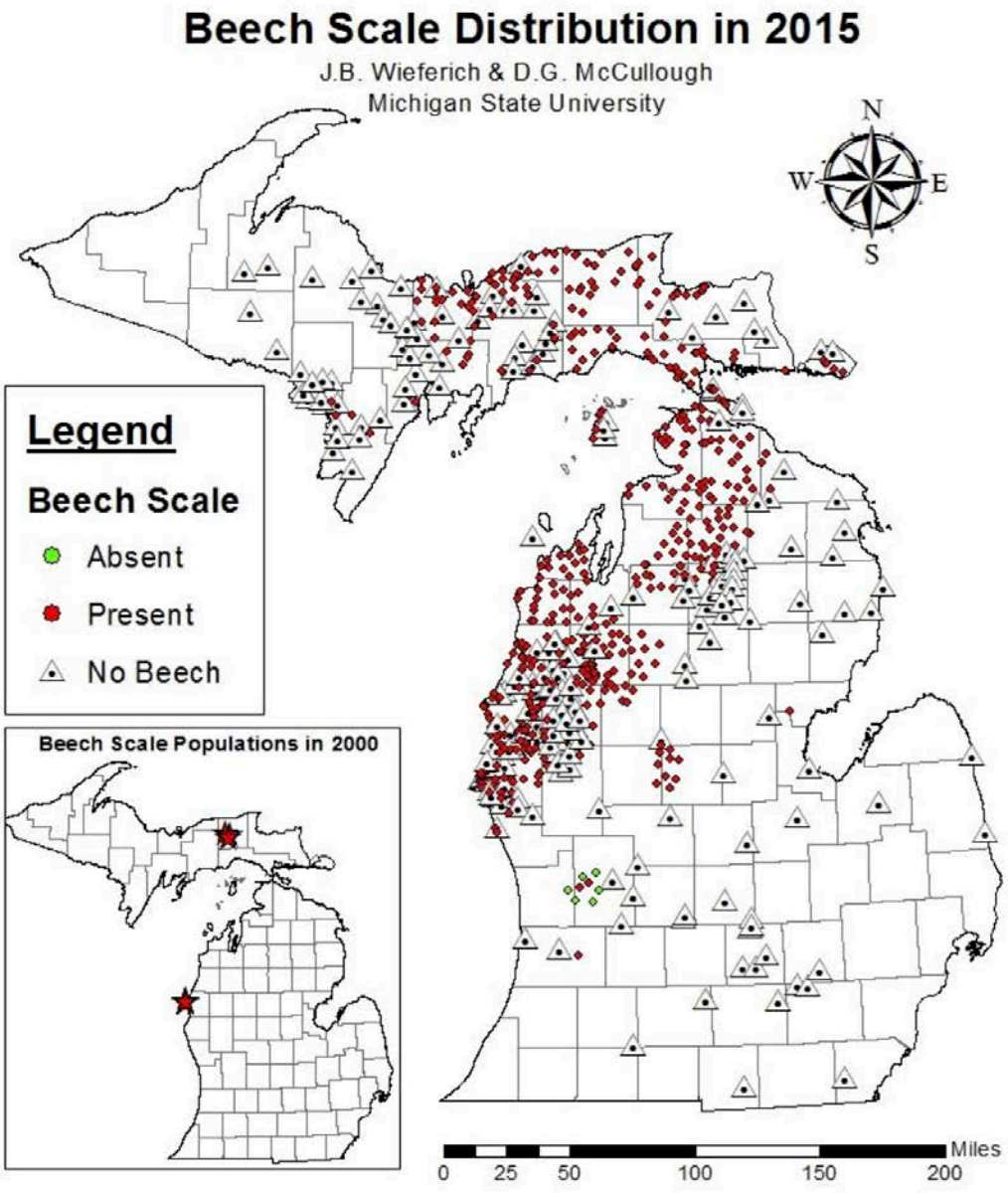


Figure 3.10. Beech scale distribution in Michigan, 2015.
https://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.html

Oak Wilt *(Ceratocystis fagacearum)* is a fungal disease that has become a growing threat in Southeastern Michigan over the past two decades. Since oak trees are a major component of the state's landscape, the disease has the potential to have devastating effects on forests, as well as residential and urban areas. No oak species is known to be immune to the damaging effects of this fungus, and the disease is highly transferrable. Oak wilt kills healthy red oaks, often within a few months, and all species in the red oak group (including black oak and northern pin oak,

(*Q. velutina* and *Q. ellipsoidalis*) are especially susceptible. White oaks may also be affected but appear to be more resistant and less vulnerable to mortality from the disease. Once infected, mortality of red oaks with oak wilt is nearly 100%, and there is no treatment to save the infected tree. Oak wilt moves slowly through root systems and can move from tree to tree via root grafts, which connect the roots of adjacent trees. The fungus also travels short distances over land when new spores are moved by beetles from an infected tree to a freshly pruned or injured tree. Currently, the best management practice for containing Oak Wilt is to trench an infected tree by digging around the tree, cutting off the roots to damage any grafts between neighboring oak trees. This eliminates the pathway through which the disease spreads, protecting neighboring oaks from contracting it. Once an infected tree is trenched, it can be cut and removed (Cook, 2016). In this region of Michigan, oak trees–especially red oaks–are a popular choice for both homeowners and municipalities because they grow well in the local soil, are good for wildlife, and are aesthetically pleasing. The estimated value of red oak timber in Michigan is approximately 1.6 billion dollars (based on Forest Inventory Analysis data from 2011 and current timber prices). The potential widespread mortality of oaks could have enormous, negative impacts in Michigan, ecologically, economically, and aesthetically. Oak Wilt is an issue that will likely become more prominent throughout Southeast Michigan in the very near future and will require attention from all types of landowners and managers.

To report suspected cases of oak wilt:
Email: DNR-FRD-Forest-Health@michigan.gov
Phone: (517) 284-5895
For more information, visit the Midwest Invasive Species Information Network's webpage: www.misin.msu.edu

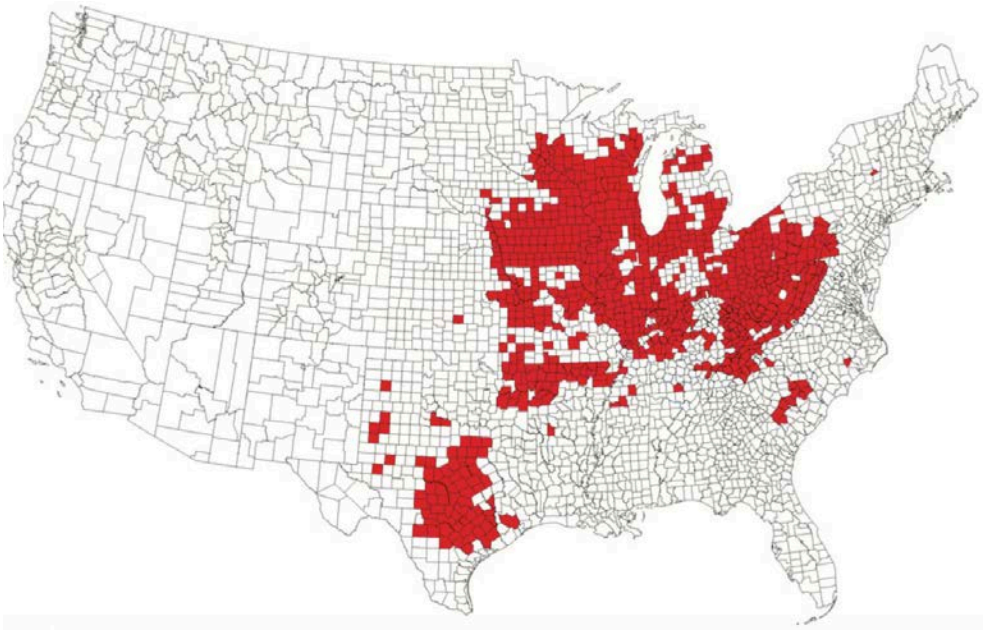


Figure 3.11 Distribution of Oak Wilt in the U.S. From U.S. Forest Service, *How to Identify and Prevent Oak Wilt.* (O'Brian e. al., 2017)

Thousand Cankers Disease (TCD): A newly identified fungal pathogen *(Geosmithia morbida*) being spread by an insect native to the southwestern U.S., the walnut twig beetle *(Pityophthorus juglandis)* is a relatively recent but potentially serious concern for black walnut trees (*Juglans nigra*). When the beetles drill tiny holes to feed on tree branches, they introduce the TCD fungus, which kill small areas of tissue, forming what are called "cankers." In time, more cankers form, branches die, and the entire tree succumbs, although it may take 10 years before the tree dies entirely.

TCD has not yet been found in Michigan but it has been killing black walnut trees in California and other western states since the 1990s. By 2015, it had been found in six eastern states, including Indiana, Ohio, and Pennsylvania. An effective biological or chemical control for TCD has not yet been identified. A high proportion of black walnut trees will likely die if it becomes established in Michigan. Rapid early detection, removal, and destruction of infected trees are recommended to prevent the disease from spreading.

As noted in a USDA Forest Pest Alert, "Michigan's forests are home to approximately 8.5 million black walnut trees with an economic value of more the $86 million and ecological value as a food source for birds, mammals and other wildlife. There are also more than 80 walnut growers in Michigan with approximately 4,000 trees in nut production…. Black walnut is a valuable timber species and important for wildlife." TCD can be transported into new areas in firewood, logs, and woodworking staves. A quarantine in Michigan restricts transport of these materials, as was done for EAB.

Report suspected forest infestations:
Email: MDA-Info@michigan.gov
Phone: MDARD Customer Service Center (800) 292-3939
Midwest Invasive Species Information Network: www.misin.msu.edu

Evergreen Diseases
In recent years, Michigan residents have been observing the die off of many spruce trees. Of the spruce varieties often planted for landscaping, Colorado Blue Spruce (*Picea pungens*) is one of the most common species chosen in Michigan. Because Colorado Blue Spruce is not native to Michigan, they have more difficulty when exposed to pathogens since they did not evolve in these environmental conditions. The humid Michigan summers are ideal for pathogens and there are at least 4 common fungal pathogens that are known to cause problems in spruce species planted in Michigan. It is not uncommon for more than one pathogen to be responsible for a decline in tree health. Identifying a problem and contacting an arborist or tree care professional to diagnose the problem is crucial to preventing further decline of the tree's health and spreading the disease to other trees. Fungicide may prove effective on new growth if applied with appropriate timing. Diversifying landscaping and planting certain species in areas with desired conditions can increase the resilience of tree species to pests and diseases. (Cregg et al., 2015).

Non-native (invasive) species

Non-native invasive species are a huge concern for native ecosystem preservation. In southeast Michigan, numerous invasive species thrive in forest and grassland areas. They can be very difficult to eradicate. Many invasive species tolerate a wide range of environmental conditions; they grow and reproduce rapidly and abundantly, often maturing at a young age; they can be aggressive and effective competitors for resources including water, light, and soil nutrients; and they may lack the suite of specialist enemies that help to keep them in balance in their native ranges. The effort to prevent the establishment of new invasive species in Michigan and the spread of existing ones has drawn a lot of attention in the last few decades. Funding and resources have been allocated to this cause and have contributed to the successful development of best management practices for treatment of many established invasive species. Private landowners are very likely to find many of the invasive species common to this region on their own property. Listed below are some of the most prominent established invasive species found throughout Monroe County affecting forest resources:

- Phragmites (*Phragmites australis*)
- Reed canary grass (*Phalaris arundinacea*)
- Autumn olive (*Elaeagnus umbellate*)
- Buckthorn: common (*Rhamnus cathartica*) glossy (*R. frangula*)
- Honeysuckles (*Lonicera spp*.)
- Tree of Heaven (*Ailanthus altissima*)
- Siberian Elm (*Ulmus pumila*)
- Dame's rocket (*Hesperis matronalis*)
- Japanese barberry (*Berberis thunbergii*)
- Spotted knapweed (*Centaurea maculosa*)
- Garlic mustard (*Alliaria petiolate*)

Invasive species can negatively impact ecosystems in complex ways. They can outcompete and displace native species; reduce or alter wildlife habitat (although several invasive species were intentionally introduced and planted with the intent to benefit wildlife); reduce forest health, productivity, and regeneration; and alter ecosystem processes including nutrient cycling, beneficial soil fungus (mycorrhizae), and leaf litter dynamics. These species need to be actively managed. If left unchecked, they can take over an entire area by out-competing native plants and invade fields and forest openings so densely that recreation and trails are negatively affected. Not only do they have a significant negative impact on the native plants, but they also affect native wildlife. Many of these invasive species are not a food source for wildlife. By outcompeting native plants and not meeting the resource needs of native wildlife, they disrupt the food webs of terrestrial ecosystems and deplete the necessary resources for native plants and animals to survive.

A key to avoiding infestation by invasive plants is to have a healthy community of native or intentionally introduced plants (crops, orchards, etc.) and to monitor them regularly. The more robust the desired vegetation is, the less likely invasive species will proliferate. Soil-disturbing

activities such as plowing, land clearing, and vehicle use can create a favorable condition for invasive plant establishment. Disturbed areas should always be followed up quickly by reseeding or planting to limit invasive species competition and monitored thereafter for possible infestation.

Timber harvests can have serious unintended negative effects on a forest ecosystem if the landowner does not realize that there are invasive species present. Landowners should be aware of invasive species in the area and plan to treat such infestations prior to a harvest.

Private landowners should learn to identify commonly found species and become familiar with how to appropriately treat them so that they may prevent the degradation of their land and natural resources. Since cutting or mowing is not always effective on many of these species (and in some cases, this can exacerbate the problem) and the task of eradicating these invasive species may be too much for a landowner to take on, numerous resource providers and contractors in this region can be utilized to provide technical assistance to landowners. Landowners are encouraged to seek treatment recommendations from the Michigan DNR, Western Lake Erie Cluster of The Stewardship Network, or their local conservation districts. The contact information for these organizations may be found in Appendix D.

Invasive Shrubs

Woody invasive shrubs are a pervasive challenge in Monroe County, with dense thickets of non-native shrubs invading natural areas, open fields, and forests. They are a particularly important problem because they completely alter the forest community and, in many cases, prevent the growth of native species. Some key species of concern are:

- Autumn olive (*Elaeagnus umbellata*)
- Buckthorn: common (*Rhamnus* cathartica) glossy (*R. frangula*)
- Bush honeysuckles (*Lonicera* spp.)
- Japanese barberry (*Berberis thunbergii*)
- Multiflora rose (*Rosa multiflora*)
- Privet (*Ligustrum vulgare*)

Many of these invasive shrubs out compete native Michigan varieties by leafing out earlier, often in March, and retaining leaves later into the fall, making it difficult for other plants to survive in their shade. Many are forest invaders, thriving in or tolerating shade. All of these species fruit abundantly, producing thousands of seeds that can be transported by birds and mammals. Control can be achieved by several methods, and often a combination of methods is the most effective. Fire will set the plant back, but will not usually kill the shrub, especially larger plants. Because the plant stump sprouts after fire or cutting, it is usually treated with herbicide (triclopyr appears to be an effective chemical) afterwards. The herbicide can be sprayed on a cut stump (avoid spring when sap is rising), applied to foliage (normally done in late fall when other plants are dormant), or as a basal bark treatment (apply to lower 18 inches of trunk except when sap is rising).

Invasive Trees

Black locust (*Robinia pseudoacacia*), Norway maple (*Acer pseudoplatanus)*, and tree of heaven (*Ailanthus altissima*) are the key invasive tree species found in Monroe County. These tree species can be locally abundant but are typically not as widespread of a problem as invasive shrubs. Black locust can spread clonally and can become an aggressive invader on sandy post-agricultural areas, but its rot-resistant timber is considered useful for fencing materials. Landowners should be aware of how to identify and treat these species if needed.

Vine Management

Fast-growing non-native vines (oriental bittersweet, English ivy, Japanese honeysuckle, Chinese yam, black swallow-wort, pale swallow-wort, mile-a-minute weed, and kudzu) are growing problems in Michigan. Oriental bittersweet (*Celastrus orbiculatus*) is a particular challenge, creating dense and impenetrable thickets. These vines can shade the trees' leaves and reduce tree growth or kill young trees by out-competing them for resources. They can cause structural problems due to the added weight which can break branches or topple the tree. A few vines even grow thick enough to "strangle" the tree. Some vines start as a groundcover and form a dense mat of leaves, smothering wildflowers and other flora of the forest floor. These dense mats grow around the tree's base, trapping moisture against the trunk which can result in fungal and bacterial diseases. Native grape vines are also capable of causing damage, but poison ivy and Virginia creeper usually do not damage trees and serve as a food source for wildlife.

Invasive Herbaceous Plants

Landowners should be vigilant in looking for herbaceous invasive species such as garlic mustard, dame's rocket, narrowleaf bittercress, black jetbead, spotted knapweed, and others that may invade their forested system.

One of the most prolific species, garlic mustard, is a biennial herbaceous plant that has the ability to dominate the forest floor, limit the growth of other plants, and prevent reproduction of native species. It spends its first year as a small rosette and sends up a flowering stalk in the second year that produces a prolific number of seeds. Seeds can be transported by birds, rodents, deer, and humans and can remain viable for 10 years, even in very harsh conditions. Garlic mustard releases allelopathic compounds that harm other plants by interfering with mycorrhizal relationships (an interaction between fungi and plant roots that provides nutrients to the plant). Control can be achieved by pulling (preferably before flowering), herbicide application (early season application can be done before other plants emerge), limiting disturbance, and maintaining a high level of canopy. Treatment has to be performed over multiple years to reduce the negative impacts of this invasive plant. For invasive species control, monitor the land to determine infestations early in their development, treat satellite populations first, and then work towards more densely infested weed areas to be efficient. The Stewardship Network features an annual Garlic Mustard Challenge, encouraging residents in different cluster areas to compete to see who can remove the most.

Aquatic Invasive Species

There is a wide array of non-native, invasive plants that thrive in water and along shorelines. Property owners on lakes, streams, and wetlands should be aware of them as they can limit land use and cause harm to healthy systems. Major wetland and aquatic invasive species in Monroe County include non-native phragmites, reed canarygrass, non-native cattails, purple loosestrife, flowering rush, Eurasian milfoil, and European frogbit, as well as hydrilla, curly leafed pondweed, elodea, and starry stonewort. The Lake Erie shoreline and coastal wetlands of the county have been especially hard hit by phragmites and non-native cattail. Extensive phragmites control efforts by federal, state, and local government entities as well as partnerships with private stakeholders have made significant progress in controlling phragmites along the Lake Erie coastline. Ongoing monitoring and follow-up treatments will be necessary for the near future to keep the plant in check. Unfortunately, in several instances, with the successful control of phragmites, some land managers are reporting a significant upsurge of flowering rush and European frog-bit in those wetland systems.

Aquatic plant growth is often accelerated by excess nutrients from lawn and agricultural runoff, increased surface runoff due to an increase in area of impermeable surfaces (roads), failed septic systems, and other sources. Landowners should be mindful that their land management practices may affect the water quality of their community, especially the application of fertilizers and pesticides. If landowners have open water bodies or streams on their property, the establishment of natural vegetative shoreline buffers can help reduce storm water runoff and potential issues with problem plants. The treatment of invasive species in wetlands or aquatic systems should only be done with wetland safe products and with the appropriate DEQ permits.

Monroe County has miles of Lake Erie coastline with multiple harbors and boat launches with direct access to some of the finest fishing in the state. Unfortunately, those who utilize the Great Lakes for recreation, drinking water, or as a source for income are now facing several challenges in the form of aquatic invasive species. Some current and possible aquatic invasive animals to contend with are invasive carp (silver, bighead, and grass), Northern snakehead, red swamp crayfish, zebra mussel, quagga mussel, and New Zealand mudsnail. To avoid the spread of these invasive species, boats (motorized and non-motorized) should be fully cleaned, drained of any bilge or other water, and dried before leaving a launch site. Boats should be left to dry for five days before entering another body of water. Tackle should be decontaminated before changing locations, and all bait should be disposed of only in a trash can.

3.1.10 Tourism and Recreation

Tourism is an important element in the economy of both the state of Michigan and Monroe County. The economic impact of all forms of recreation in Michigan was estimated to total $18.7 billion and it accounted for 194,000 jobs in the state. Many of Monroe County's tourist attractions are based on outdoor recreation such as boating, hunting, fishing, and related

activities. Outdoor enthusiasts visit Lake Erie's coastal marshes to view the large number and diversity of both resident and migratory birds. Agricultural offerings such as orchards, berry farms, and nurseries attract tourists during the appropriate seasons.

The Federal Government operates two recreation facilities in the county. The US Fish and Wildlife Service (FWS) established the Detroit River International Wildlife Refuge in 2001 to build a sustainable future for the Detroit River and western Lake Erie ecosystems. The refuge consists of nearly 6,000 acres of unique habitat, including islands, coastal wetlands, marshes, shoals, and waterfront lands within an authorized boundary extending along 48 miles of shoreline, including all of Monroe County's Lake Erie coastal areas. A new visitor center is scheduled for opening in 2017. In 2010, the National Park Service took over land formerly owned in part by Monroe County to form the River Raisin National Battlefield Park, which commemorates the 1813 battle that took place at this location.

The State of Michigan has several facilities in Monroe County, which include a variety of park-types including a State Park (Sterling) and State Game Areas (Erie, Petersburg, and Pte. Mouillee). Sterling State Park is one of Michigan's most heavily used State Parks, and it offers a campground, swimming beach, hiking trails, fishing, boating, and nature study opportunities. A recent land acquisition has created a pedestrian and bicycle connection to the park directly from the City of Monroe. The three State Game Areas (Erie, Petersburg, and Pte. Mouille) offer hunting and fishing, as well as opportunities for hiking and nature study (Monroe County Recreation plan, 2013).

Monroe County has five county parks totaling 221 acres of land.

- Heck Park hosts a Vietnam Veterans Memorial as well as walking paths, shelters, play and exercise areas, basketball courts, benches, grills, landscaping, and drainage improvements. A habitat improvement project has recently (2012) converted a portion of mowed lawn to native prairie vegetation.
- Nike Park, located on Newport Road in Frenchtown, was originally part of a World War II Nike missile base. A 1999 DNR grant allowed for the development of an accessible play area, pathways, parking improvements, and large areas of open space.
- Vienna Park in Bedford Township has a small pond and natural area as well as active recreational facilities such as soccer fields, ball diamonds, and disc golf.
- Waterloo Park, the smallest county park with only 9 acres, is located on the River Raisin at the end of Mulhollen Drive in Monroe Township. The park has many facilities, including a fishing pier, canoe landing, paved path, exercise equipment, and playground, all designed to be barrier-free.
- West County Park consists of sixty acres of former farmland on Rightmire Road in Dundee Township. Much of this site, which fronts the River Raisin, was enrolled in the USDA Conservation Reserve Enhancement Program (CREP) in 2002 and was planted with a mixture of native trees, shrubs, grasses, and wildflowers. The addition of trails,

small shelters, parking areas, and benches have all made this site an attractive nature preserve.

The Navarre-Anderson Trading Post in Frenchtown Township is a county owned historical site consisting of 5.6 acres of restored and recreated historic structures, a historic school house repurposed as a country store, interpretive information, and scenic open space along the River Raisin.

Public trail systems in the county include the River Raisin Heritage Trail, the I-275 trail, and various other trails and pathways within existing parks. The River Raisin Heritage Trail is the designation given to the Sterling State Park trail system and its connection, within the City of Monroe, to the River Raisin Battlefield site.

Marinas
Monroe County has thousands of boat slips in privately owned marinas up and down the Lake Erie coast line. The marinas vary widely in terms of size and facilities. Indoor boat storage, charter fishing, oil and gasoline sales, bait and tackle, boat rental, and other services are available at select locations.

Gun Clubs / Shooting Ranges
The many sportsmen's clubs in Monroe County reflect the area's heritage as one of the region's premier waterfowl hunting areas. Monroe County contains 14 shooting ranges, most of which are private clubs that have facilities for archery, skeet, target shooting, and other firearm activities. A "hunting preserve" in Milan Township provides for the shooting of pheasant.

3.1.11 Archaeological, Cultural and Historic Sites

Archaeological Sites
Landowners who believe they have found Native American artifacts in their forests should contact the State Archaeologist's office at the State Historic Preservation Office, and record and report the artifacts (reporting form available at http://www.michigan.gov/mshda/0,4641,7-141-54317_19320_54320---,00.html, with explanations at http://www.miarch.org/site-recording.html). The State Archaeologist can also offer advice about consulting archaeologists who can help assess the site where possible artifacts are found. Any site that appears to be a burial ground must not be disturbed. According to SHPO guidance, "It is illegal to intentionally disturb human remains and associated artifacts. If you accidentally discover human remains, immediately stop any activities in the area and contact the police and the State Archaeologist. Respect the dignity of burial sites by protecting and reporting them. Do not disturb them." (Michigan State Historic Preservation Office).

Cultural and Historic Sites

Monroe County has 18 historic sites listed on the National Register of Historic places, according to National Park Service listings (https://www.nps.gov/nr/index.htm), and 24 sites that are designated as Michigan State Historic Sites by the Michigan State Historic Preservation Office (http://www.michigan.gov/mshda/0,1607,7-141-54317---,00.html). Most historic sites are in cities, but a few are in rural areas with woodland characteristics.

3.1.12 Challenges and Resources for Forest Stewardship

A review of natural resource documents and web resources for the Northeastern U.S., the state of Michigan, southeastern Michigan, and Monroe County, as well as interviews with stakeholders, suggests that the following are key issues that frame forest stewardship in this landscape:

- Timber is not a major product in Monroe County, but forests are highly valuable for non-timber uses, including harboring biodiversity and wildlife habitat, water quality, recreation and aesthetic enjoyment, agroforestry and non-forest timber products, and hunting.
- Land use patterns (a mix of agriculture and residential development) have led to fragmented forests. Parcellization, the process in which land is divided into smaller parcels, has led to a proliferation of private landowners with small amounts of forest on their land. Only 10% of the County's total forested land remains in parcels ranging between 10-60 Acres.
- Coordinated management is a large challenge in a fragmented and parcellized landscape. Managing in even small ecological units requires a coordinated effort among many different landowners, public and private.
- Despite the fragmented landscape, Monroe forests and associated landscapes harbor considerable biodiversity, with 66% of the County's rare species (threatened, endangered, and special concern plants and animals) relying at least partly on forest habitats and 24% entirely dependent on forests.
- Two forested natural communities merit particular attention in the landscape. Lakeplain Oak Openings and Wet-Mesic Flatwoods are of statewide and national conservation concern due to their rarity.
- Invasive plant species, both shrubs and herbaceous, are major challenges for forest stewardship and are taxing many institutional and private landowners' resources.
- Non-native pests and pathogens have affected Monroe County woodlands in dramatic ways, most recently with the Emerald Ash Borer (EAB) killing off millions of trees. The EAB experience shows the importance of early detection and eradication of new and emerging threats to forest health: Asian Longhorned Beetle, Oak Wilt, Thousand Canker Disease, Beech Bark Disease (Beech Scale), and others.
- Climate change poses additional management challenges, with some forest species increasingly vulnerable to changing weather patterns, but nurturing healthy forests can also contribute to efforts to combat increasing atmospheric carbon dioxide.

3.2 Local Resource Providers and Existing Stewardship Plans

While most forest resource assessments in Michigan are focused on the Northern Lower Peninsula and the Upper Peninsula, where state and national forests have a majority of their holdings, the forests in Southern Lower Michigan are likely valued more for habitat, maintenance of biodiversity, and ecosystem services including water quality, erosion control, recreation, nature connection, and spiritual/aesthetic enjoyment than for timber resources. Accordingly, the primary plans, visions, and resources for forest stewardship are more likely to be in various land use plans and park mission statements, which are available online.

This Landscape Stewardship Plan for Monroe County finds that coordination across multiple owners, both institutional and private, may be one of the biggest challenges in maintaining healthy forests into the future. Our forests are owned and managed by thousands of people, and many are already highly motivated to care for their woodlands. Providing them the resources to support their stewardship efforts is critical to successfully managing our states natural resources.

Many of the government agencies and nonprofit organizations described in Sections 3.2.1 and 3.2.2 have plans that guide resource management in their areas. These sections explain resources that are available to private landowners and discuss some of the planning efforts at each organization. See Appendix D for general contact information and main websites for the organizations and programs in this section.

3.2.1 Government Agencies and Land Managers

Michigan Department of Natural Resources

The Michigan Department of Natural Resources (DNR) has a number of programs to support forestry on private lands in addition to their management of state forests. The DNR Forestry Division provides many useful resources to private landowners including information on growing and harvesting trees, forest health, fire management, and urban and community forestry.

Michigan's four-million acres of state-managed forest land provides critical habitat for wildlife, valuable resources for a thriving timber products industry, and beautiful outdoor spaces for a variety of outdoor recreational activities. To encourage this $14 billion/year industry, the Forest Division has completed several planning activities:

- The State Forest Management Plan written in 2008 provides strategic direction with goals and objectives for management of Michigan's state forests. The plan was amended in 2014 with a 10-year time framework.

- Regional State Forest Management Plans are only available for the Western Upper Peninsula, Eastern Upper Peninsula, and Northern Lower Peninsula (there are not any

state forests in the Monroe area), but the information contained within these plans can be useful for forest management by both private and public landowners.

- Michigan's 2010-2020 Forest Action Plan provides a statewide assessment of forest conditions and trends for all of Michigan's forested land. The plan focuses on private landowner assistance through cooperative programs for forest stewardship, urban and community forestry, forest health, wildfire management, and forest legacy.

- The Forest Resources Division also developed a five-year strategic plan to guide decisions and actions governing the health of Michigan's state forest resources. The goals and objectives of the plan lay the groundwork for meeting the division's mission and complement the DNR's overall strategic direction. The first goal of the Forest Resources Division's Strategic Plan is: Sustainably and proactively manage and protect forest resources.

- Helping Private Forest Landowners Develop Plans for Sustainable Forest Management: A Landowner's Guide.

- Sample Michigan Landowner Forest Stewardship Plan

- Michigan's Forest Legacy Program (FLP) is a partnership with the US Department of Agriculture (USDA) Forest Service with a goal of protecting privately owned and environmentally significant forest lands from being converted to non-forest uses. This voluntary program acquires land through purchase of fee simple title or by conservation easements, legally binding agreements that transfer a negotiated set of property rights without removing the property from private ownership. Conservation easements purchased using FLP funds restrict development, require sustainable forestry practices, and protect a variety of other values. Michigan's FLP encourages partnerships with local governments and land trusts, recognizing the important contributions landowners, communities, and private organizations make to conservation efforts. The program requires public access for fee lands but not for conservation easements.

The DNR state forest resources have been recognized by the Forest Stewardship Council® (FSC®) and the Sustainable Forestry Initiative® (SFI®). Independent auditors have reviewed the DNR's on-the-ground forest practices against biological, social, and economic requirements in the FSC and SFI standards and certified those practices as sound and comprehensive.

- Michigan DNR Wildlife Action Plan
  The goal of Michigan's Wildlife Action Plan is to provide a common strategic framework that will enable Michigan's conservation partners to jointly implement a long-term holistic approach for the conservation of all native wildlife species. The Michigan DNR is in the process of revising its Wildlife Action Plan that addresses Species of Greatest

Conservation Need and the habitats and resources required to support them. The document addresses aquatic and terrestrial landscape features within the Great Lake basin and ecoregion. The Wildlife Action Plan draft summaries for each landscape feature provide sets of priority species; significant threats to the landscape features and associated wildlife; and conservation actions needed to address the identified threats. An example landscape is fen which supports Mitchell's satyr butterfly, massasauga rattlesnake, tamarack tree cricket, and other rare species.

- Fish and Wildlife Habitat Programs
  Most stewardship plans address wildlife habitat and there are many practices that can be used to improve conditions for animals. Support for wildlife habitat is available from both public and nonprofit entities. The DNR has several programs, such as the Private Lands Program and the Wildlife Habitat Grant Program, for government, profit or non-profit groups, and individuals interested in conservation. The US Fish and Wildlife Service has the Partners for Fish & Wildlife program which works with private landowners to improve fish and wildlife habitat on their lands through voluntary, community-based stewardship programs for conservation. There are also several nonprofit organizations dedicated to providing wildlife habitat including: Audubon Society, Ducks Unlimited, National Wild Turkey Federation, Pheasants Forever, Ruffed Grouse Society, the Quality Deer Management Association, and Trout Unlimited. Many of these organizations have programs to provide financial and technical assistance for enhancing wildlife.

- DNR Private Lands Program
  The primary goal of the Private Lands Program (PLP) is to provide private landowners with the resources to create and manage habitat to benefit a variety of wildlife. The PLP provides technical and financial assistance to eligible landowners for habitat improvements that address wildlife needs. Currently, financial assistance is only available for projects involving grasslands, oak savannas, and oak barrens. Financial assistance may be available for restoring native prairie; restoration of oak savanna or oak barrens sites; practices such as prescribed fire, disking or inter-seeding; and invasive species control in and immediately around grassland, savanna, or barrens sites.

  To qualify for technical assistance, projects must generally be larger than 20 acres or be adjacent to sites of high ecological value (i.e. fens, savannahs, sites occupied by Threatened & Endangered species) or grasslands that are in close proximity to other grassed cover type areas. Landowners interested in improving their land for wildlife, and who meet the above criteria, should contact the Private Lands Biologist (See Appendix 4) to discuss your property and wildlife goals and determine what assistance is available.

- The Wildlife Habitat Grant Program (WHGP) purpose is to provide funding to local, state, federal, and tribal units of government, profit or non-profit groups, and individuals to assist the Wildlife Division with developing or improving wildlife habitat for game species. The WHGP is administered by the Michigan DNR through a cooperative effort between Wildlife Division and Grants Management.

- DNR Landowner's Guide (1999) is a useful publication for management of deer as well as many other game and non-game species. This publication also offers instructions on land management planning for forests, grasslands, wetlands, cropland, and backyard habitats.

Michigan Department of Environmental Quality

The Michigan Department of Environmental Quality (MDEQ) regulates air, land, water, and waste generation activities in the state. The MDEQ endeavors to protect water from both point and nonpoint pollution sources by partnering with watershed groups and others. They issue National Pollutant Discharge Elimination System (NPDES) and storm water discharge permits. Large scale water withdrawals are limited by law and the Water Withdrawal Assessment Tool is designed to predict the effect of groundwater use. Under the land category, earth change activities on areas greater than one acre or located within 500 feet of a lake or stream require a Soil Erosion and Construction Storm Water permit. Other programs cover regulation of wetlands, handling of seepage, and use of flood plains.

- MDEQ's Water Resources Division administers MiWaters, an online database that provides a streamlined electronic permitting process to fulfill federal electronic reporting requirements and gives the public access to that information. The focus of MiWaters is permitting and compliance, including NPDES, storm water, groundwater discharge, aquatic nuisance control, Part 41 construction, and land and water interface.

- Michigan Natural Shoreline Partnership: The Department of Environmental Quality's Inland Lakes and Streams program has been participating in the Michigan Natural Shoreline Partnership (MNSP) to promote natural shoreline landscaping to protect Michigan's inland lakes. Their mission is to "Promot[e] Natural Shorelines through the use of green landscaping technologies and bioengineered erosion control for the protection of Michigan inland lakes." One of the goals of the Michigan Natural Shoreline Partnership is to educate property owners about natural shorelines and technologies that benefit lake ecosystems. It provides support for practices that restore or preserve the ecological function of the shoreline and stabilize shorelines by reducing erosion. They offer educational resources and the website lists contractors who are certified by the program.

- Michigan's Water Strategy is a 30-year plan for Michiganders to protect, manage, and enhance Michigan's water resources for current and future generations. It is organized

around nine goals and outcomes designed to ensure the viability and sustainability of Michigan's water resources over time, placing Michigan on a path to achieving its water vision in a way that builds economic capacity while sustaining ecological integrity of this globally-significant resource.

- The MDEQ website has many useful resources on aquatic plant management, including fact sheets and information on aquatic invasive species.

US Fish and Wildlife Service

- The Partners for Fish & Wildlife Program works with private landowners to improve fish and wildlife habitat on their lands through voluntary, community-based stewardship programs for conservation. To accomplish this work, the Fish and Wildlife Service (FWS) teams up with private conservation organizations, state and federal agencies, and tribes to share funding, materials, equipment, labor, and expertise to meet the landowners' restoration goals. Landowners are required to sign an agreement to leave the project in place for a minimum of 10 years (longer agreements are encouraged), and landowners are responsible for project maintenance.

  In the Midwest, Fish and Wildlife Service restoration projects generally occur in three habitat types: wetlands, prairies, and streams. The Partners Program also restores sensitive habitats supporting endangered or threatened species such as the copperbelly water snake and the Mitchell's satyr butterfly. Wetlands provide critical nesting, feeding, resting, and migration habitat for waterfowl and many other animals. Wetland projects usually involve restoring wetlands that have been drained, which requires heavy equipment to move dirt. Typical wetland restorations involve plugging drainage ditches, removing drainage tiles, or building berms to impound degraded wetlands.

  Grasslands (especially those larger than 20 acres) help provide adequate cover and food throughout the year for declining grassland birds such as bobolinks, meadowlarks, and pheasants, as well as other wildlife. Prairie restoration requires reseeding native warm-season grasses and wild flowers. Once grassland habitats are established, periodic mowing, burning, or grazing is used to control invasive species and woody plants and to assist the growth of native prairie plants, which evolved with wildfire.

  Stream restoration is available for landowners who are interested in protecting their small streams and river banks. These projects often involve reshaping stream banks and fencing to protect banks from erosion. Fish habitat is enhanced by strategically placing rocks and large woody debris to scour pools favored by fish. Fish passage is improved by removing barriers such as dams and non-functioning culverts.

- Landscape Conservation Cooperatives (LCCs) address large scale natural resource challenges that transcend political and jurisdictional boundaries and require a networked approach to conservation—holistic, collaborative, and grounded in science – to ensure the sustainability of America's land, water, wildlife, and cultural resources. The geographic area of the Upper Midwest and Great Lakes LCC transcends state and international borders. It includes portions of Minnesota, Iowa, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York and Vermont, as well as parts of Manitoba, Ontario, and Quebec. The Great Lakes are among the world's largest, and the Great Lakes Fishery Commission has estimated the value of Great Lakes fisheries at $7 billion annually.

  Michigan is in the Upper Midwest and Great Lakes Landscape Conservation Cooperative. The area is home to a diverse range of fish, wildlife plants, and habitats including the Great Lakes, coastal wetlands, boreal forests, major river systems, and prairie-hardwood ecosystems. Physical and social stressors like climate change, energy development, water demands, invasive species, and population growth are all threatening the ecological integrity of the upper Midwest and Great Lakes landscape. The Upper Midwest and Great Lakes LCC is a partnership of more than 30 natural resources agencies and organizations working on a collaborative approach to solve environmental problems.

The Northern Institute of Applied Climate Science (NIACS)
NIACS develops synthesis products, fosters communication, and pursues science in the following focus areas:

- Climate change: Changes in the earth's climate are having substantial effects on forest ecosystems and may reduce the ability of forests to provide important environmental benefits.
- Carbon science and management: Forests store carbon in all components and levels, from soils to shrubs to tall trees. Forests play an important role in the global carbon cycle, and forest management activities can affect the amount of carbon that is stored in forest ecosystems.
- Bioenergy: Bioenergy creates electricity, heat, and fuel from renewable energy sources, including woody materials from forests.

Forest Adaptation Resources
Climate Change Tools and Approaches for Land Managers provides a suite of materials that enables land managers to consider climate change and increase the ability of forests to cope with climate change impacts. It does not provide specific recommendations, but serves as a decision-support tool for incorporating adaptation considerations into current management objectives.

Detroit and Western Lake Erie CWMA
CWMAs are comprised of private landowners, non-governmental organizations, natural resource management groups, governmental agencies, and others who are interested in combating invasive species. Monroe County is included in the Detroit and Western Lake Erie CWMA. This diverse set of partners developed a comprehensive, strategic, and long-term approach for managing invasive species, focusing on phragmites.

Monroe County Planning Department
Monroe County Planning Department has planning staff and a number of resources on their webpages that might be useful for landowners for preparation of stewardship plans for their individual properties. These resources include GIS maps and annual reports and plans that contain pertinent information about the physical attributes and resources in the area.

Monroe Conservation District
The Monroe Conservation District provides information and technical assistance to many different individuals and agencies working in the Monroe areas who are managing land or water. Landowners can be assisted by technicians to execute conservation practices and programs on their properties.

3.2.2 Nonprofit, Non-Governmental Conservation Organizations

Michigan Natural Features Inventory
The Michigan Natural Features Inventory (MNFI) program, administered by Michigan State University Extension, conducts field surveys to locate and identify threatened and endangered species and communities throughout the state; created and maintains a database of all relevant species and community locations; provides data summaries and analysis in support of environmental reviews; and provides biological expertise to individuals, agencies, and other interested parties. (See Appendix 3 for MNFI's threatened and endangered list for Monroe County.)

Southeast Michigan Land Conservancy
The Southeast Michigan Land Conservancy (SMLC) is a regional nonprofit organization dedicated to preserving habitat to support the conservation of natural ecosystems and their services in southeast Michigan. SMLC has the ability to own and manage property for conservation purposes, but they also work with landowners to help them protect their private property for future generations. They assist local governments with public land projects as well. SMLC serves as an educational resource to the broader community and coordinates local volunteer stewardship workdays on managed properties.

The Nature Conservancy
The Nature Conservancy (TNC) works with landowners to restore natural areas and protect native ecosystems. TNC provides technical and sometime financial assistance for restoration projects. Many of these projects take place on private land. Their staff specializes in ecosystem

type characteristics of the region. In Monroe, the Ohio Nature Conservancy is responsible for much of the work being done in the Oak Openings Region. TNC participates in the Detroit & Western Lake Erie Cooperative Weed Management Area and partners with local municipalities and landowners to monitor and treat priority invasive species throughout the western Lake Erie basin. Regional offices often have specialized staff available to provide information or technical assistance for ecological concerns and are generally located within a priority area.

The Stewardship Network (TSN)

The Stewardship Network connects, equips, and mobilizes people and organizations to care for land and water in their communities by providing backbone support, facilitation and training, and resources for collaborative projects across organizations and individuals. They connect conservation minded volunteers and practitioners to experts, government agencies, local organizers, tribes, researchers, and each other. These connections are made to craft and implement solutions to a multitude of the most pressing and challenging community conservation problems (water quality, invasive species control, biological diversity, habitat improvement, local food systems, civic engagement, etc.), which results in real on-the-ground conservation based eco-system vitality. This model is effective because individuals and organizations that care about their community, yet are unsure of what to do, address conservation problems one property at a time at a scale that is personal to those involved and now executable with their resources complemented by those brought to the table by the network.

The Western Lake Erie Cluster of the Stewardship Network, which serves Monroe and Wayne Counties, formed in 2013 with leadership from the River Raisin Institute. We live and work in a very special area, side by side with rare and imperiled terrestrial habitats and Lake Erie – the most biologically diverse body among the Great Lakes. We want to create a strong network between the many groups already working to protect and restore these special areas, and build a better appreciation for these amazing resources among local citizens.

River Raisin Institute

The River Raisin Institute is a local, non-profit organization that provides environmental education, sustainability awareness, and ecological stewardship programming to the Monroe County Community. Staff are available to connect the community with resource providers, share information about environmental issues to the Monroe County Community, and coordinate local volunteer stewardship efforts.

3.2.3 Private Sector Natural Resource Professionals
DNR List of Certified Forest Stewardship Plan Writers

Nikita Brabbit (Consulting Forester)
917 West Genesse Street, Lansing MI 48915
nbrabbit@gmail.com; 507-458-4947
Related Programs: Tree Farm, Commercial Forest

Dan Brown (Consulting Forester)
2167 Gunnell Road, Eaton Rapids, MI 48827
browned94@msu.edu; 517-898-5670
Related Programs: Tree Farm, Commercial Forest

Burhop Forestry Consulting
Carl Burhop (Consulting) Forester
PO Box 362, Dexter, MI 48130
burhopforestry03@yahoo.com; 734-904-5233
Related Programs: Tree Farm, Commercial Forest, TSP
Credentials: Registered Forester, Certified Forester, Association of Consulting Foresters

Darling Forestry LLC
Jason Darling (Consulting Forester)
1111 West Barnes Road, Mason, MI 48854
www.DarlingForestry.com
jason@darlingforestry.com; 517-243-2000
Related Programs: Tree Farm, TSP, Qualified Forest, Commercial Forest
Credentials: Registered Forester

Ecosystems Management LLC
Jack Boss (Wildlife Biologist)
3210 Bewell Avenue SE, Lowell, MI 49331
ecosystemsmgt@att.net; 616-897-8575
Related Programs: TSP, Qualified Forest, Commercial Forest, QDMA
Credentials: Certified Wildlife Biologist

Jacques Forest LLC Forester Type: Consulting Foresters
1251 Spartan Road, Tawas City, MI 48763
Office: 989-362-6245
Tom Jacques (Consulting Foresters) jacquesforest@yahoo.com; 989-329-8079
Jenilee Jacques (Consulting Foresters) jenileerae@gmail.com; 734-272-2365
Related Programs: Tree Farm, TSP, Qualified Forest, Commercial Forest

Spencer Kellum (Biologist)
2318 Parkwood Avenue, Ann Arbor, MI 48104
spencer.kellum@gmail.com; 734-794-3879
Related Programs: Commercial Forest

The Land Steward LLC
Rick McAvinchey (Consulting Forester)
300 Woodbridge Lane, Ortonville, MI 48462
thelandsteward@frontier.com; 248-627-7109
Related Programs: Tree Farm, Commercial Forest
Credentials: Registered Forester, Association of Consulting Foresters

Lee Forestry Services
Doug Lee (Consulting Forester)
404 John K Drive, Auburn, MI 48611
foresterdoug@charter.net; 989-662-0139
Related Programs: TSP, Qualified Forest, Commercial Forest
Credentials: Certified Forester

Dave Mathis (Consulting Forester)
PO Box 28, Chelsea, MI 48118
dmmathis@yahoo.com; 734-395-4113
Related Programs: Tree Farm, Qualified Forest, Commercial Forest

Natural Community Services LLC
John DeLisle (Ecologist)
30775 Longcrest, Southfield MI 48076
j_delisle@hotmail.com; 248-672-7611

Source: http://www.michigan.gov/dnr/0,4570,7-153-30301_34240-298690--,00.html

Credentials
Registered Forester – www.Michigan.gov/Foresters
Certified Forester - www.safnet.org/certifiedforester
Association of Consulting Foresters - www.acf-foresters.org

Professional Forester Classifications

Consulting Foresters
Consulting foresters are independent businesses that work directly for the landowner. Consulting foresters administer timber sales, write Forest Stewardship Plans, manage wildlife habitat, plant trees, and offer other services for forest landowners. There are about 125 consulting foresters in Michigan.
Association of Consulting Foresters : www.acf-foresters.org
Forest Stewardship Plan Writers – www.Michigan.gov/ForestStewardship

Industry Foresters
Industry foresters work for local forest products companies to buy timber from private landowners or to manage forest land owned by their company. Industry foresters buy timber from private landowners and write forest management plans. There are about 100 industry foresters in Michigan.
Michigan Association of Timbermen : www.timbermen.org
Michigan Forest Products Council : www.michiganforest.com
Great Lakes Timber Professionals Association : http://gltpa.org

Government Foresters
Government foresters, funded by your tax dollars, provide general forestry information to landowners. Government foresters conduct workshops, hold field days, write articles, and make professional referrals. There are about 35 government foresters who help private landowners (and another 200 working on public land).
Conservation Districts – 20 foresters in the Forestry Assistance Program – www.Michigan.gov/mifap
MSU Extension – 5 educators statewide: http://msue.anr.msu.edu/topic/info/forestry
DNR – 5 foresters statewide – www.Michigan.gov/PrivateForestLand
USFS : www.fs.fed.us/spf

Southern Lower Michigan Restoration Contractors from The Stewardship Network

Note: The lists provided are for reader's use but do not constitute an endorsement or guarantee of the quality of service. Other contractors not listed may also be available in your area. Available online at: http://stewardshipnetwork.org/resources/southern-michigan-restoration-contractors

- Appel Environmental Design. Ann Arbor, MI.
  Provides site design and analysis based on ecology and human and pet needs, invasive plant removal, native plantings. http://appelenvironmental.com

- ASTI Environmental. Brighton, MI; Grand Rapids, MI. ASTI provides environmental and ecological services, including wetlands / woodlands management and habitat restoration; bat, tree, mussel and threatened / endangered species assessments; phytoremediation; invasive species control and NEPA clearances to commercial, governmental and institutional clients. www.asti¬env.com/services

- Black River Habitats. Fennville, MI. Offers habitat creation, maintenance, and restoration www.blackriverhabitats.com

- Cardno JFNew. West Olive, MI. Offers expertise in wetlands, water resources, wildlife and habitat, sustainability and conservation, restoration, and cultural resource issues as well as expertise in the streamlined management of regulatory permitting and compliance. www.cardnojfnew.com

- Creating Sustainable Landscapes. Novi, MI. Provides consulting and installation services to businesses and private landowners who want to transform their landscapes utilizing sound ecological principles and native plants that support local wildlife. http://creatingsustainablelandscapes.com

- ECT Inc. Ann Arbor & Lansing, MI. Specializes in the resolution of complex environmental issues through cost-effective project planning, management, as well as applied engineering and scientific expertise. www.ectinc.com

- Grand Arbor Group, Inc. Grand Rapids, MI. Offers a variety of professional products and services related to arboriculture www.grandarborgroup.com

- Great Lakes Tree Experts, Inc. Swartz Creek, MI. Provides safe removal of trees and stumps, trim trees, lot clearing, free wood recycling, excavating, landscaping, and mulch. www.greatlakestreeexperts.com

- Hamilton Helicopters, Inc. Hamilton, MI. A Commercial Pesticide Application Business. Licensed in Michigan and in categories: field and vegetable crops, fruit crops, aquatic, mosquito, right of way, forestry, and aerial. http://hamiltonhelicopters.com

- Michigan Wildflower Farm/Farm Enterprises Inc. Portland, MI. Specializes in installation and management of rain gardens, shoreline restorations, detention and retention basins, bioswales, wetland mitigations, CRP and SAFE projects, meadows, prairies and gardens. www.michiganwildflowerfarm.com

- Native Connections. Three Rivers, MI. Ecological restoration and management firm in southern Michigan committed to improving our environment by creating and restoring natural landscapes, providing native wildflower and grass seed, and managing land for biodiversity. http://nativeconnections.net

- Native Plant Nursery. Ann Arbor, MI. Grows only local native species from Michigan seed sources and produce a diverse selection of native perennials and a few species of native trees and shrubs. www.nativeplant.com

- Natural Community Services, LLC. Southfield, MI. Ecological monitoring & restoration, invasive species management, environmental consulting, green infrastructure, and native landscape design! www.naturalcommunityservices.webs.com

- Niswander Environmental, LLC. Brighton, MI. Specializes in site planning, wetland services, treatment wetlands, stream restoration, ecological assessments, threatened and endangered species assessments, GIS services, and NEPA clearance. www.niswander-env.com/

- Owen Tree Service. Attica, MI. Provides innovative, practical, top-quality tree care services and tree care products that set the standard for the tree care industry to follow. www.owentree.com

- PlantWise. Ann Arbor, MI. PlantWise, LLC is a business dedicated to creating, restoring, and interpreting native ecosystems and plant communities throughout Michigan and Ohio. http://plantwiserestoration.com

- PLM - Lake & Land Management Corp. Caledonia, MI. PLM offers a variety of watershed management tools, products and services including lake and pond surveys, vegetation mapping , invasive species management, herbicide and algaecide applications for aquatic and terrestrial species, bathymetric mapping, water quality testing, aquatic harvesting, fish assessments, and right of way management. http://plmcorp.net/

- Restoring Nature with Fire. Ann Arbor, MI. Offers a full range of ecological restoration services specializing in controlled burns. www.restoringnaturewithfire.com

- Wildtype plants. Mason, MI. Provides ecological services for public, commercial and residential projects focusing on restoration. www.wildtypeplants.com

- Oakland Wildflower Farm is a "Grower and Educator" of Michigan native plants located in Brandon Township in northern Oakland County. They grow a variety of native wildflower, grasses, sedges, ferns, shrubs, and trees. All seed sources are documented and seeds are Michigan geno-type, unless otherwise noted (they strive to collect seed from as close to the nursery as possible). Their website hosts a Culture Guide to help you choose the right plant for your place. http://www.oaklandwildflowerfarm.com/

4. Landscape Stewardship Stories

A unique component of this project was to interview public and private landowners who actively manage their forested property. This piece highlights the stewardship efforts of private landowners that often go unnoticed. The stories presented in this plan include numerous accounts of restoration efforts on both public and private lands in Monroe County. Many of these restoration efforts happen to include Oak Opening restorations. This is not surprising because The Ohio Nature Conservancy has had a tremendous presence in Monroe County and has offered numerous educational and financial opportunities for restoration projects.

By speaking with your neighbors and sharing their stories about how they've managed their own forest lands, we hope to inspire other landowners to become more actively engaged in managing their land and encourage them to share their own stories in the future.

4.1 Sisters, Servants of the Immaculate Heart of Mary Campus

Monroe, Michigan
Written by Danielle Conroyd

The Immaculate Heart of Mary (IHM) sisters have committed their lives and resources to responding to the needs of the world. Founded in 1845 as a Catholic community of educators, the mission of the IHM community has evolved – continuing to respond in faith and commitment to the world's changing needs. The IHM sisters have resided on their campus along the River Raisin in Monroe since 1932. As recently as the late 1990s, the IHM campus consisted of 280 acres and contained numerous buildings totaling over 600,000 square feet as well as Sisters Island, a 4-acre island in the River Raisin directly across the street from the main building. Buildings on the campus include the IHM Motherhouse, Saint Mary's Academy (currently mothballed), and the decommissioned powerhouse. A mature landscape consisted of substantial acreage of lawn, crop fields, a pond, a woodlot, and the previously mentioned island in the River Raisin. The construction of the IHM Motherhouse occurred during the height of the Great Depression and the sisters oversaw the transplanting of a thousand trees from Sisters Island to the new site for landscaping. The IHM Motherhouse campus looks very different today than it did 20 years ago.

The IHM congregation embarked on a long range planning process in 1996. The need to transform their 64-year-old Motherhouse to respond to the aging and health care needs of their members offered an opportunity for re-visioning their entire Monroe campus in ways that responded to the wider needs of the world. Through research, discernment, and study, the IHMs decided to renovate their home and renew their campus in ways that expressed their commitment to sustainable living. The IHM Sisters consider sustainability a moral mandate for the 21st century and they have transformed their entire campus into a learning laboratory for sustainable living. In addition to the award winning LEED certified renovated Motherhouse, the integrating vision for the campus included the restoration of the site to pre-settlement conditions. A sense of place and connectedness to the River Raisin watershed and the Great Lakes bioregion guided the decisions and actions with respect to site restoration. The plan included the conversion of 11 acres of lawn to a native prairie system, bio swales in the parking lots, a constructed wetland to support a grey water filtration system, and numerous contemplative landscape features.

The IHM commitment to ecological stewardship began decades before the sustainable renovation of their Motherhouse. Beginning in the early 1960s the sisters committed themselves to an ongoing process of environmental stewardship. The congregation decided to actively manage the woodlot on their property. These changes were fostered by the mission of the IHM Sisters to care for their common home and live sustainably.
The historic as well as ecological value of the woodlands on the IHM campus has been a focus of all of the surveys and recommendations from external consultants. One aspect of renovating their Motherhouse and restoring their site included a tree inventory on their campus in 2000. Conducted by *EcoLogic*, LLC, the tree inventory included 163 specimen trees surrounding the

IHM buildings and within potential construction areas. In 2005 the IHM sisters welcomed an AmeriCorps team that worked in the oak savannah for 5 weeks to remove invasive species such as autumn olive. The AmeriCorps crew used debris to create wood lined trails throughout the woodlot to make it accessible to the sisters. In 2012 The Nature Conservancy (TNC) and IHM entered into a management agreement to allow TNC to undertake activities of restoration and invasive plant management in the 35-acre remnant oak opening on the IHM campus. Realizing that their woodlot offered a unique restoration opportunity, the IHM sisters welcomed the opportunity to work with TNC Ohio on a full restoration of the oak savannah. All restoration work in the oak savannah ceased when issues arose with the State Historic Preservation Office (SHPO) approval of the plan. Federal funding required SHPO approval so TNC had to stop their work due to the lack of funding. There has been no restoration work since that time.

In 2012, an opportunity arose for the IHM Sisters to sell 120 acres of their property that was no longer being farmed. La-Z-Boy was searching for a site to build a new world headquarters in Monroe and wondered whether the IHM Sisters would be open to selling their land for that purpose. La-Z-Boy wanted a park like setting for their headquarters and the IHM land met that requirement perfectly. In 2013 IHM and La-Z-Boy finalized the purchase agreement for La-Z-Boy to acquire the IHM back property, including the oak savannah woodlot. The IHM sisters wanted to make sure that the oak savannah was preserved and restored and La-Z-Boy agreed to that condition of the sale. In 2016, La-Z-Boy executed a conservation easement for the 35-acre oak savannah. The conservation easement calls for the restoration and preservation of the oak savannah and prohibits the development or removal of the woodlot. As the grantee, the IHM Sisters have the right to participate in the restoration of the oak savannah and to conduct educational site visits. Later in 2016, a restoration specialist from TNC Ohio did a site visit and explained the process for oak savannah restoration with IHM staff. IHM is hopeful that in the coming years the oak savannah will be fully restored and actively managed through the partnership between La-Z-Boy and IHM.

4.2 Layhew Residence

Monroe, Michigan

The Layhews moved into their residence in 1989. What used to be a single parcel field was now a young forest in succession. The original land was divided into separate parcels and sold to numerous landowners having homes on the outskirts of the forest. The Layhews own roughly two acres of the woodlot, like many other neighbors who own less than 5 acres. There are a select few neighboring property owners who own more than 20 acres of the forested land.

Although Diane and Len Layhew use the woodland area for recreational purposes, their appreciation for native species has kept them managing it for many years. The entire wooded area is privately owned and only accessed by the surrounding landowners. Hunting is prohibited and many of the residents do not manage their wooded property, but some use it for low-impact recreation. The Layhews often clear hazardous or dying trees from the woodlot. Last year, they selectively cut 11 trees to thin out areas that are used heavily. Their woodlot has extremely sandy soils, and windthrow is very common. To provide enough sunlight to the wildflowers that are prominent, they clear a lot of the brush from the understory. Mrs. Layhew often propagates many of the forest flowers near the tree line backing up to their home. Their property consists of mostly oak, soft maple, cottonwood, dogwood, birch, and planted evergreen species. They have not had an issue with invasive species other than garlic mustard, which they pull annually. However, neither they nor their neighbors have had a survey done by a forester to inventory tree species or identify invasive species throughout the entire forest.

They have a significant amount of wildlife that inhabit their property and the surrounding portions of the woodlot. They often see raccoon, opossum, deer, a substantial amount of various bird species, hawks, and have even seen a red fox and a coyote on their property. They have vernal pools present in their woodlot during the spring with excessive flooding in the fall when they frequently hear a chorus of amphibians.

The Layhews and their family enjoy recreational opportunities using their woodlot. Their grandchildren enjoy riding off road vehicles through their trails and have a small shooting range in the woodlot. Many of their neighbors do not use their woodlot property while others horseback ride through the trails. The Layhew's appreciation for nature has provided them with a very lovely, usable, easily managed woodlot that they can enjoy with their family. The work that they have done to care for their property has resulted in a woodland that supports wildlife, produces desirable plants species, provides opportunities for recreation, and adds a natural aesthetic for their home.

4.3 Monroe Conservation District

Monroe, Michigan

Written by Ben Lehr, WLEB MAEAP Technician

Conservation districts provide many resources regarding conservation practices and land management to landowners at a county-wide scale. Technicians are on staff to assist landowners in implementing conservation programs on their property, connect them with proper agencies for their inquiries, and provide knowledge about local conservation issues. Technicians can provide guidance for compliance with program requirements, technical support throughout each step, and education about different conservation practices that are a part of each program.

Ben Lehr is one of the technicians with the Monroe Conservation District whose job focuses on assisting landowners in the Western Lake Erie Basin with enrollment into the Michigan Agriculture Environmental Assurance Program (MAEAP). The program verifies that enrollees' farms or properties are environmentally conscious and low-risk to water quality by meeting standards determined by the state-wide program. MAEAP can verify private land in any of these four areas: Farmstead, Cropping, Livestock, and the new Forest, Wetlands, and Habitats System. The conservation district attracts interested landowners through outreach events in the community where they collaborate with other local organizations that focus on conservation to provide interested landowners with current information on best management practices. One example of this was their partnership with Pheasants Forever to host an event introducing landowners to federal conservation programs. In the Monroe County area, a lot of the interest in the Conservation Reserve Program (CRP) comes from word of mouth, since it is a small community where many landowners and farmers have good relationships with each other and share information.

Once an individual is interested, a MAEAP technician helps the landowner enroll in the program and implement the initial planning stages of the practices that are required to meet the verification that they are interested in obtaining. Sometimes this is as simple as planting a riparian buffer strip or can be as large as replanting an out of commission crop field to allow for the establishment of a wetland. The technician is there to support the landowner through the process by providing them with technical support and knowledge to ensure successful projects. They can offer referrals to appropriate nurseries or contractors who share a similar philosophy about their goals. Ben believes that participation in these programs is made easiest and most successful when the landowner and technician can form a personal relationship. When the landowner understands that the technician is there to tell them the things that they don't know and will always be available to assist with decision making, then the implementation of practices have a better chance of success and the landowner will have a more positive experience. A landowner will feel more confident committing to a 10-year contract for funding knowing that they have an expert to rely on and don't have to do it all on their own.

Ben says that often times participating landowners won't ever come back to him with concerns or questions, while other times landowners rely on MAEAP technicians quite heavily to ensure that they are knowledgeable in the best methods for completing their requirements. Having a good experience navigating the requirements of these federally funded programs is what ensures that a landowner will consider re-enrolling in a program. According to Ben, if a program assessment doesn't initially show that the landowner is already meeting the program criteria or still doesn't after a secondary assessment following practice implementation, those individuals are more likely to resist re-enrollment or new enrollment in conservation programs. This is often due to the fact that their particular case wasn't viewed as "successful" by the criteria, or challenges caused them to have to do more work than they had initially expected, resulting in a bad experience implementing conservation practices.

One limitation to some of these federal conservation funding programs is that they are designed on a state-wide basis and don't allow for flexibility in practices that may be more beneficial to a specific geography. For example, the wetland restoration programs allow landowners to convert agricultural land to a wetland, but only in the form of a wet meadow. Generally, lands often being enrolled in the program are poorly drained with hydric soils and will naturally revert back to a wetland comprised of emergent vegetation, shrubs, and upland tree species. However, the criteria of CRP require the landowner to keep the wetland maintained at a wet meadow stage and not allow natural succession to alter the landscape any further. This seems slightly counterproductive to promoting the restoration of natural wetland areas and creating an ecosystem to support biodiversity and conserve wildlife habitat. However, for a 10-year time frame in which landowners are under contract with the CRP program, these expectations of creating and maintaining a wetland at a wet meadow stage are fairly adequate. The challenge comes when a landowner's contract ends. Once the contract ends, landowners have a decision to make as to whether they want to re-enroll in the program and keep their land in its current state or leave the program and either stop managing the land or manage it by implementing additional or different practices. This decision is not easily predicted and therefore hard to forecast what kinds of landscape modifications will be present in the area long term.

Aside from facilitating the MAEAP program locally, the Monroe Conservation District also hosts annual educational events available to the public. These include numerous workshops that cover topics such as soil health, native species selection, and tree care. They host a spring tree sale and a native plant sale annually and participate in many other partner organizations' public, educational events.

4.4 Reinventing the Farm: The Loughney Residence

Petersburg, Michigan
Written by Peter Loughney

The Lay of the Land

In 1953 my parents bought a beat up little one-hundred-acre farm in Ida Township. Mostly sand hills and swamps, it had roughly sixty-five acres of "tillable" farm land and thirty-five acres of second growth woodlot. The farm sits on old Lake Erie beach environment at the northern end of the oak openings region so it has sandy soil with a high water table. The property had a huge sand hill running east and west across it as well as a couple of additional smaller sand ridges. Around 1960 the sand was sold off and now lays under US 23, about a mile to the west. Although there are remnants of the sand ridges still in the wooded sections, the tillable portions are now largely flat, tiled farm land. It has proven great for farming, but is a much altered topography from its natural state.

In the early 1980s, the farm was split lengthwise into two parcels, and I acquired the west half. The property is long and narrow, running north and south, and is divided almost exactly in half by the long abandoned rail bed of the Lakeshore and Southern rail line that ran from Adrian to Monroe. The north half of our property is roughly 1550' by 700' with the front corners split off into residential lots long ago. The rail bed occupies a 100' by 700' east / west strip almost exactly in the middle of the parcel and the south portion is about 1500' by 700'. The north half is farm land and woodlot while the south parcel is entirely wooded; all in all, just a bit less than 48 acres.

The north half, bordering Ida West Rd, has about ten acres of farm land and a long narrow strip of wooded land running down the west border, widening out near the rail bed. In the late 1980s we built our home on the edge of the woods just as it widens out, about a quarter mile south of the road, and began to make plans for the six to seven acres near the house. We hoped to craft an enjoyable natural environment in those acres and eventually to do something with the twenty-four acres south of the rail bed.

Getting started

While in the process of building the house, we took the time to plant several pines and spruces in the open areas north and east of the house, maples along the drive, and maples east of the house. There was an existing double row of white pines about three hundred feet north of the house so they became the northern border of our plan.

One of the main features we wanted on our property was a pond. There was a naturally wet area east of the house that had to be dealt with no matter what. A pond served as a fix for the flooding issue and was a much desired feature of our property that also provides suitable aquatic habitat. Construction on the pond began in 2007 with an experienced contractor who we worked with to accomplish our plans. The project was complete in December resulting in a constructed pond of about an acre.

Prairie and grassland habitats are not too common in our area which is dominated with farm fields and small woodlots. A good deal of the grass like environment we do have is managed pasture for sheep and horses or hay fields. So, another feature that we wanted to develop as part of the overall plan was a prairie. We have a lot of wildlife that visit us here on the farm, and we hoped that adding a prairie would help to provide wildlife habitat and increase the richness and diversity of native species.

In fall of 2015 we began our prairie system project. The area that we converted was an 80-foot strip along our north and east borders which resulted in about an acre of prairie. We began the preparation process of killing off the weed populations by treating the area with herbicide. We then planted our native seed mix in late October. We purchased our native seed mix from Ohio Prairie Nursery. The Monroe County Conservation District has a planter specifically designed to plant native seed which is available for the public to rent. The benefit of using their equipment is that it is set up to plant native seed at the appropriate depth. The prairie showed to be very successful in the spring. There are some minor issues with weeds, but the prairie seems to be doing well. Now that the prairie is established we hope to become part of the Monarch butterfly waystation effort.

<u>Trouble in Paradise</u>

In the early 1980s we bought about seven hundred small autumn olive starters from the local conservation district and planted a row running north and south just about three hundred feet east of the house. We soon realized that we had created an invasive plant nursery on a monumental scale. With the hedge about eight feet in height by then it took three days of steady backhoe work to rip the entire hedge out. Never-the-less, we had, or I should say still have, autumn olive plants all along our field and wood lot edges. We began the arduous process of trying to eradicate them from our property through cut-stump treatment. Following treatment, the dead stumps then get removed, and the area is planted with a mowable grass mix. By mowing it once or twice a year, new plants are clipped off before they become problematic. We continue to fight this battle but hope to have it under control within the next year or two.

In addition to the autumn olive, we have identified buckthorn, burning bush, amur honeysuckle, a bit of garlic mustard, oriental bittersweet, and Phragmites on our property. I have no doubt that we will find additional invasives and more of what we already have

identified, but now we hope to get the worst of it under control and be able to keep up with the necessary treatments annually.

Looking to the future.

We are aware that appropriately treating invasive species on our property will consume a lot of the time spent managing our property, but we do have additional efforts that we plan to undertake. We are very pleased with our prairie so we will be expanding it by increasing the width of the current area by an additional forty feet. We have also identified another half to three quarters of an acre that we will start to prep this spring through the summer to be able to plant in late October. Following that we will be cleaning out about one hundred and fifty feet of the old rail bed to a few scattered trees. There is a small quarter acre plot of open area just south of the rail bed and that will be prepped and planted as a prairie as well. When these two projects are complete we should have about three acres of prairie habitat. Also planned for the summer is to create four hundred to six hundred square feet of shallow frog and turtle habitat on the east side of the pond. Hopefully these projects will prove to be a huge step toward achieving our goal of increased wildlife habitat, especially for Monarchs, and preserving biodiversity.

While we will be thrilled to see the end of the autumn olive, we do want some low to middle story environment. We have begun to plant native species like redbud and dogwood and are saving selective sumac bushes in some of the woodlot and edge environments. The last part of the plan is to begin work on the woodlots. We have a small start already, but have a list of things that we plan to do. Beginning last year and continuing this winter we are clearing brush, small trees, and down timber to create open, drivable lanes through the south portion of the woodlot so that we can get the tractor around comfortably without damaging much of the environment nor the equipment. When completed we will have a lane around the entire perimeter and a diagonal through the middle. This will also allow us to walk the woods more comfortably and enjoy a part of the property that is currently rarely visited.

While all of this is a lot of work, we both enjoy the effort and get a lot of satisfaction from the results. In many ways, our little piece of land is not a big deal but it is what we have and we intend to make the most of it. Hopefully our work will leave it in a better condition than it was when we began and continue to support wildlife for years to come.

4.5 Oak Openings Restoration

The Nature Conservancy

The Nature Conservancy (TNC) in Ohio has been actively engaged in restoration projects throughout Monroe County, Michigan for the past decade. They have completed restoration projects on both public and private lands. In the past 5 years, the TNC Ohio has worked through the Green Ribbon Initiative to achieve restoration and management of rare, globally imperiled natural communities. For example, much of Monroe County focuses on the Lakeplain Oak Openings which historically stretched from Wayne County south to northwest Ohio.

TNC has actively managed 1,200 acres of land in 10 separate sites in Monroe and Wayne County. This work has engaged 17 different landowners. The restoration team completes a full restoration of the landowner's property by removing invasive species, prescribed burning, and removing trees, thus allowing the reestablishment of grasslands and prairies. Aside from the actual restoration, TNC can provide landowners with knowledge of the specific ecosystems present in their geographic area for them to better understand how to manage their property. Through the Green Ribbon Initiative, TNC offers numerous informational tools, training workshops, and "learnshops" to the public throughout the year.

According to TNC's Oak Openings Restoration Manager, Wade Ulrey, they have a pretty well defined structure that is common to all of their restoration contracts. They generally get landowners interested in having their land restored through word of mouth. Public exposure of their work is what makes their restorations so successful. Once a landowner has shown interest in having their oak opening property restored, a TNC staff member will do a site visit and assess the property. This process helps TNC identify landowner use of the property, rare plants and animals that warrant special concern, invasive species that will need to be managed, and potential barriers to accomplishing tasks in the restoration process.

The two main goals of a restoration project facilitated by TNC are to complete a full-scale restoration of the desired property and provide the landowner with a plan to address future management needs. Contracts between landowners and TNC generally cover a 10-year timeframe for the completion of the restoration project. At the completion of each project, the plan produced by TNC will help the landowner understand what type of technical and financial requirements will need to be met in the future to maintain the high quality of the restored property.

The restoration process of an oak opening begins with the mechanical removal of most of the forest understory and large undesired tree species that contribute significantly to canopy cover. This step is necessary to open the canopy to allow light to penetrate down, hit more of the plants at ground level, and remove species that are not desired for the ecosystem. Mechanical treatment for this purpose is very expensive and time consuming. TNC staff and contractors have the capability to do this as efficiently as possible, and the treatment is generally done in the winter or summer season to create a restoration timeline that favors naturally processes. If

both removal of large "junk" trees and understory brush cannot be accomplished in one season, it is recommended that the large trees be removed first and then the understory brush can be removed. Though is seems very destructive, it is a crucial strategy for the restoration process.

Once the understory is cleared, chemical treatment of invasive species and unwanted woody vegetation follows. Though many people are opposed to the use of herbicide, this step prevents the regrowth of species that have a detrimental impact on the entire ecosystem. Once these two steps have been completed, the forest can naturally regenerate with favored oak and herbaceous species that are characteristic of the ecosystem historically.

The final disturbance phase of the restoration project is a prescribed burn. Burning the landscape facilitates the regeneration of native species prominent in certain ecosystems by activating the native seed bank. A prescribed burn begins the maintenance regime cycle. Ecosystems like Oak Savannahs are generally burned every 3 years to support the growth of native species and prevent the establishment of invasive species. In between burns, invasive species should be treated on an annual basis. Following the prescribed burn TNC generally handles maintenance of invasive species for the next few years and then hands over the reins to the landowner with a management plan to follow for long term maintenance.

The Nature Conservancy has produced an amazing resource titled *Living in the Oak Openings* which provides a tremendous amount of information for landowners to understand the characteristics of this rare ecosystem. This guide can help them identify if their forested area may be one of the remnant Oak Openings left in the lakeplain region of southeast Michigan and Northwest Ohio. This book is available to the public through the TNC Ohio office and can also be found online at:
http://oakopenings.org/landowner-guide/

4.6 Oak Savannah Restoration

Temperance, Michigan
Tomahawk Archers

In 1950 a group of like-minded individuals passionate about archery originated Tomahawk Archers Club. They later purchased 43 acres of forested property in Temperance, Michigan that would become their club facility. This property was designated for recreational use by the current 110 members. What they didn't know upon inhabiting this property is that it is a rare forest ecosystem known as a remnant oak opening.

By chance, Patrick (Pat) Hogan, Tomahawk Archers' Vice President, met Lindsey Reinarz, GRI Partnership Specialist, Oak Openings Region at The Nature Conservancy Ohio (TNC). She was part of TNC's Green Ribbon Initiative which focuses on educating landowners and restoring the Oak Openings region which stretches from Northwest Ohio to Southeast Michigan. Lindsey Reinarz made a site visit to Tomahawk Archer's property and immediately recognized that their forest had numerous characteristics of the rare oak savannah ecosystems. TNC identified the property as a high integrity forest and formed a partnership that allowed Tomahawk to have much of their land restored to the high quality Oak Savannah and wet prairie ecosystems that it had likely been a century ago.

Pat convinced the Tomahawk board of directors that the restoration of the property was an excellent opportunity for them, because some of the plants and animals that were present on their property were extremely rare. Also, some of the tasks involved in the restoration, like opening the forest canopy and burning the understory, would allow them to navigate their woodlot more easily and have better lines of sight when shooting their target courses. He asked his members to go and look at a neighboring city's property that had been restored by TNC only a few years prior to see what their property could look like when finished. After checking out the Whiteford Township Stoneco Park, the Tomahawk board members quickly realized that the work TNC would be doing on their property was going to be advantageous to their members. They were going to end up with a woodlot that had greater biodiversity, more high quality trees, and improved wildlife habitat.

The oak savannah restoration project began on the front half of the property at Tomahawk Archers in 2014. TNC began mechanical removal of the understory and undesirable tree species in the fall, followed up with herbicide treatment of re-sprouting invasive species, then burned the wet prairie and savannah areas in March of 2016. These steps allow the forest canopy to open up causing more light to reach the understory, and the clearing of the understory promotes the desired regeneration of the prominent oak species. Burning these ecosystems encourages the regeneration of native species present in the soil's seed bank and is a

disturbance necessary for many species of plants to thrive. TNC has produced a management plan for the property and has a 10-year contract with Tomahawk Archers to ensure the complete restoration of the site and help assist the club with maintenance of the forest and prairie areas.

Some of the challenges that Tomahawk faced doing this work are that after some of the necessary treatments, the prairie and forest areas weren't aesthetically pleasing due to burnt and debris cluttered areas. They were able to get help from local Boy Scout troops to "clean up" the property through the removal of debris from their highly utilized areas. Because so many people visit the club and members utilize the property for public archery shoots, it was a little shocking to see the after math of the restoration process.

However, since the restoration began, club members have noticed more bird and turtle species present on their property. They believe since the beginning of this project they have had a tremendous increase in plant and animal diversity, and also a reduction in pests such as ticks and mosquitos. More of the members are taking the time to appreciate the uniqueness of their property and taking an interest in the diversity that they have.

Tomahawk Archers has since hosted numerous public educational hikes on their property for Girl Scouts Troops, Wild Ones, and the Michigan Botanical Club. Pat Hogan hopes that the Tomahawk Archers' property will become a TNC Adopted Natural Area. This will bring more people onto their property and provide them with an opportunity to appreciate the rare ecosystem that is found in small areas throughout southern Monroe County. Participating in this project has brought Tomahawk Archers more publicity and increased the uniqueness and usability of their acreage.

4.7 Stoneco Park

Whiteford Township, MI

Written by Walter Ruhl, Whiteford Township Supervisor

Whiteford Stoneco Park is 100-acre lot residing at the corner of Sterns Rd. and Whiteford Center Rd. in Whiteford Township, MI. This piece of property was formerly owned by Stoneco and used as a storage lot until 2002, when it was donated by the local company to Whiteford Township as a park. This property had little life to it except the 12-acre woodlot present. The remaining 85 acres was uneven gravel. Since its donation, the township has spent the last 14 years trying to make the "park" more user friendly.

The renovation began with Pheasants Forever planting a grass mix to try and turn the park into something a bit more usable and sustaining, but that effort showed little promise. Sometime later work was being done on US-23 and the township accepted a donation of dirt from the project to fill roughly 10 acres of the park. After this process was underway, the township was given the opportunity to share office space with the Ohio Nature Conservancy (TNC) beginning in 2012. Upon inspection of the park TNC staff recognized the "woodlot" as an Alvar prairie and oak opening based on some of the rare species that they had observed.

TNC asked the township if they could begin treating the invasives that had begun to overtake the landscape. The township wanted to show off the work that had been done to this unique town asset. They used stone donated from Stoneco to create a trail system throughout the park. This was a way of getting people to visit the park. It also proved to be an asset for maintenance because it created a barrier for controlled burns which would be a management practice done every few years on the 12-acre prairie. In the fall of 2013, TNC staff completed a controlled burn on the property as the final, major step in restoring the site. TNC will continue to manage the site for invasives over the next couple of years and then hand off the effort to the township with a site management plan that outlines necessary tasks needed to maintain the site's quality.

Partnership with TNC allowed Whiteford Township to restore this acreage at essentially no cost. While all this restoration work was being done, the township continued to brainstorm ways to use the remaining acreage in the park and make it as user friendly as possible. Six baseball diamonds were built to allow for additional recreational use. The county road commission used space in the park during a project and, in return, paved walking trails around the entire front half to make it more accessible. The township continues to explore opportunities to get people into the park and appreciate all that it has to offer.

Walter Ruhl, current township supervisor, says that they are beginning to incorporate a disc golf course into different aspects of the park and that they are considering using some of the space as a dog park. These additions will provide other recreational opportunities to the public while also immersing people into the natural areas. He says that the park has become an attraction for bird watchers who understand how necessary that type of ecosystem is as habitat for certain species. He has spent much of his time in office ensuring that park becomes a benefit for the community.

He mentioned that since most of the work done in the park up to this point in time has essentially been donated, the township hasn't considered how future improvements and management will be handled. Due to the limited capacity of township staff, he sees the need for a volunteer group to assist with management efforts in the future and sponsors to invest in the park. However, he is extremely hopeful that this park will continue to be an inspiring legacy for the region.

4.8 Phragmites Control Partnership

By Glenn Palmgren

At least 10 public and private landowners in the northern portion of the River Raisin delta had indicated an interest in controlling phragmites in wetlands they owned. The goal of this project was to fund 3–5 years of phragmites control across all of these participating ownerships. During the course of the project, fourteen partners (or participating landowners) were involved with phragmites control in the project area, including the owners of all wetlands capable of supporting phragmites within the project area.

Phragmites is the most widespread and damaging invasive plant in the River Raisin delta. Many species of wildlife, including wetland-dependent birds, reptiles, amphibians, and mammals, have already lost hundreds of acres of emergent marsh and wet prairie habitat in the project area to expanding stands of phragmites. Native plants populations have declined as well. Many landowners in the area recognize phragmites because it has become so ubiquitous in the local area, but are either unaware of the damage it causes, unaware of the proper control techniques, or are financially unable to afford initial control. This phragmites control partnership represented one of the few opportunities to improve habitat for fish and wildlife on private lands in the River Raisin Area of Concern.

DNR, Parks and Recreation Division (PRD) has been controlling phragmites successfully since 2003, at Sterling State Park and at many other state parks and recreation areas throughout Michigan. Phragmites cover can be reduced dramatically through an initial herbicide application, and can be further reduced and maintained at low coverage levels through annual follow-up targeted herbicide application. Control techniques used in this project were consistent with those recommended in A Guide to the Control and Management of Invasive Phragmites (www.michigan.gov/documents/deq/deq-ogl-ais-guide-PhragBook-Email_212418_7.pdf), a publication by Michigan Department of Environmental Quality that PRD co-authored with many other experts on the topic.

In September–October 2011, an initial herbicide application of a glyphosate and/or imazapyr-based chemical (varied based on the specific site) approved for use in aquatic environments was made by a combination of aerial (helicopter) and ground-based (truck, marsh vehicle, boat, and backpack/hand) techniques depending on the density, size, and context of each phragmites stand. After the initial treatment, phragmites was reduced considerably, but follow-up treatment was required to control re-sprouts as expected.

Prescribed burning was done in several of the treatment areas within Sterling State Park to help remove dead thatch and stimulate fresh growth, but only chemical control was used on partner lands. Follow-up chemical treatments were completed annually to further control the remaining plants and any new plants that had invaded each site. Phragmites in southeast Michigan, particularly Monroe County, is extremely prevalent and will likely be for the foreseeable future. However, once existing stands are controlled the population can be reduced to manageable levels where it is possible to do relatively simple annual control. Similar to controlling weeds in a lawn or garden, periodic control will be necessary. Control in a larger area will reduce sources for re-infestation.

Throughout this partnership PRD staff worked closely with partner landowners to identify and delineate phragmites populations on their lands and educated them on the significant problem of phragmites and other invasive species. Memorandums of Understanding (MOUs) were signed annually between PRD and each partner landowner prior to treatment. Phragmites mapping and treatment was contracted through a competitive bid process each year by Michigan DNR, with the following vendors receiving contracts for phragmites control work over the course of the project: Hamilton Helicopter, Natural Community Services, Niswander Environmental, Plantwise, and PLM Lake & Land Management. The challenge in this partnership is securing future funding to continue to monitor and control phragmites that has been treated.

4.9 Sterling Marsh and Prairie Restoration

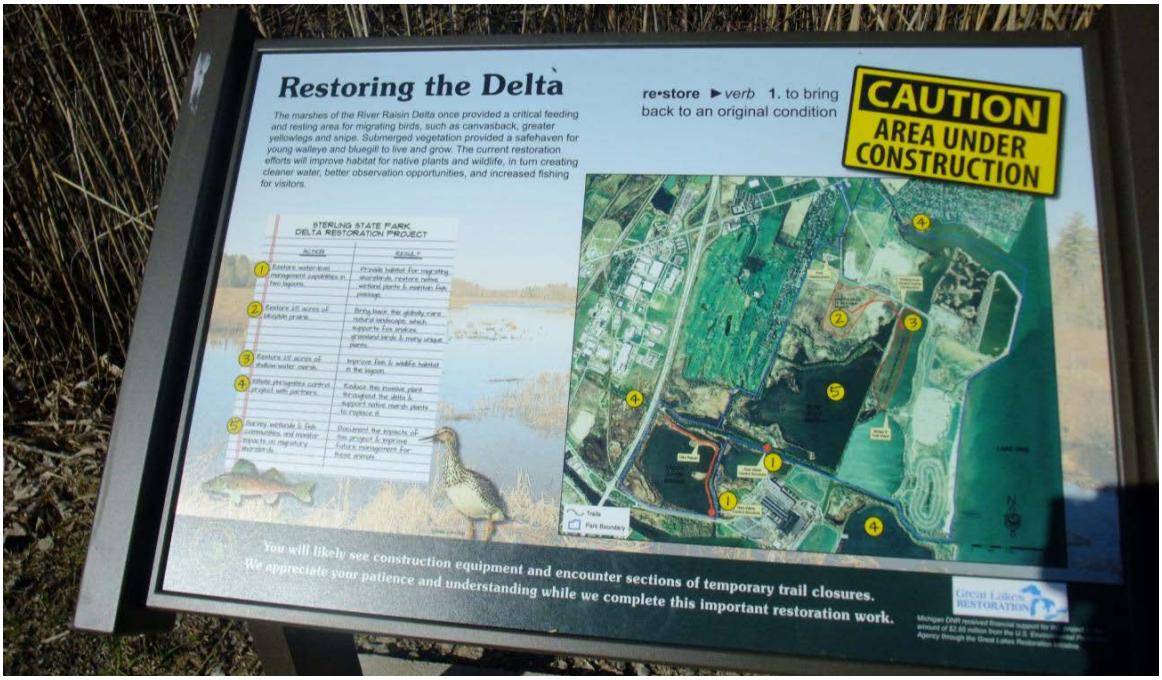
By Glenn Palmgren

Project Description

The original goal of this project was to create 25 acres of Great Lakes submergent and emergent wetland and 25 acres of lakeplain prairie at Sterling State Park. This was to be accomplished by removing fill material originally placed on former lakeplain prairie and placing it in nearshore areas of a nearby deep water lagoon that was historically dredged from Great Lakes marsh. In total, approximately 50 acres of habitat were to be restored along Lake Erie. This project was a rare opportunity to reverse Lake Erie wetland loss.

Indicative of the wetland loss throughout the western basin of Lake Erie, well over half of the wetlands along the western shore have been lost. The loss of wetlands in the River Raisin delta has been even greater. Few opportunities remain in the delta to create new shallow-water wetland habitat for fish, other wildlife, and native plants.

The fill was originally placed on Sterling State Park in the 1980s by the US Army Corps of Engineers when they created a Confined Disposal Facility (CDF) at the park. Uncontaminated material was excavated from along the Lake Erie shoreline and bottomlands to create two CDF cells and placed in several locations within the park. The CDF was created as a disposal site for contaminated dredge spoils. The federal action to create the CDF and place the fill in the park resulted in a loss of wetlands in the 1980s. This project was an opportunity for a federal program to reverse the wetland loss in this critical Area of Concern.



Close-up of project sign.

The hour-glass-shaped lagoon at Sterling State Park was formerly Great Lakes marsh before it was dredged in the 1950s by the Works Progress Administration, to create what is now the upland park day-use area and campground along the Lake Erie shoreline. This lagoon has direct connections with Lake Erie. As part of this GLRI project, 19 acres of wetland was re-established along the lagoon's western edge. The undulating shoreline with deeper water inlets was designed to enhance fish habitat and shorefishing. There will be a net increase in productive, littoral zone and limnological shoreline development as this wetland matures. This will improve aquatic productivity and enhance populations of amphibians, reptiles and fish. Anglers are now better able to access more edge habitat. This provides much better fish habitat and should lead to enhanced fishing success. A Michigan Department of Natural Resources fisheries biologist served on the planning/design team.

Lake plains are broad flat landscapes formed by the lake bottoms of the much larger precursors to our present day Great Lakes. Michigan's lake plains are home to several unique types of plant communities, including lakeplain prairies, lakeplain oak openings (savannas), and Great Lakes marshes. Lakeplain prairies are currently known from only a handful of small areas in Michigan scattered along the Lake Erie, Lake Huron, and Lake Michigan shorelines. Based on a wide-range of studies of these rare plant communities by Michigan Natural Features Inventory (MNFI), less than 1% of Michigan's 158,000 acres of former lakeplain prairies remain today. Before European settlement Monroe County had over 56,000 acres of wet prairie. Today there is less than 2,000 acres. Those lakeplain prairies that remain are in small patches of a few acres or less, and most are badly in need of restoration. MNFI and NatureServe consider lakeplain prairies imperiled globally. Sterling State Park presents an uncommon opportunity to re-establish a large lakeplain prairie landscape, with this project site an integral link connecting existing Great Lakes marsh with a lakeplain prairie restoration already in progress at the park. Under this GLRI project, 33 acres of lakeplain prairie was restored by removal of fill material.

Lakeplain Prairie Area Being Planted

Sequence of Methods and Events

The project began with establishment of the project team and competitively bidding the engineering/design contract in late 2010 and 2011. A public meeting was also held in January 2011 to inform the public of this project. We retained a single engineering/design contractor for this project together with the water control structure and dike restoration work in EPA GLRI project GL-00E00506-1. The purpose was to improve time- and cost-efficiency for both projects because of their close proximity and similar type of work. However, Michigan DNR tracked all expenses under separate accounts for each project to ensure appropriate financial separation between the two grants.

Ducks Unlimited was retained as the engineering/design contractor. Project signs were installed and Ducks Unlimited completed the final design for the project by May 2012. Permits were obtained in June 2012. The construction work was competitively bid. Geo. Gradel Company was retained as the construction contractor and they began work on site in August 2012.

The design for this project involved innovative methods to create the shallow-water wetland. Rather than trying to place and contour fill in up to 9 feet of standing water in the lagoon, Ducks Unlimited's design involved first constructing a dike/haul road in the lagoon along the outer perimeter of the new wetland from shore to shore. Then the area inside the dike was dewatered (pumped out), allowing fill to be placed and dozers to contour the relatively dry ground. Once the interior of the wetland was complete, the dike was breached and progressively demolished by a dredge casting the dike material into the wetland. The design of the wetland accounted for the volume of fill in the dike to be placed within casting reach of the dredge on top of the already-contoured wetland to get it to the final design elevation.

Outcomes

Wetland habitats have been restored (through movement of fill and re-contouring), which improved habitat for native fish and other wildlife. The Michigan Department of Natural Resources used available information to initiate wetland restoration actions through this project, and in doing so has demonstrated to other local and state government agencies involved in the River Raisin AOC (e.g., River Raisin Public Advisory Council, City of Monroe, Michigan Department of Environmental Quality) how it can be done. This project, combined with related habitat projects in the River Raisin AOC, is expected to result in the removal of the fish and wildlife habitat and fish and wildlife populations beneficial use impairments. The removal of these beneficial use impairments contributes to the eventual delisting of the River Raisin AOC.

5. Develop Your Own Story: Resources and Services for Landowners

5.1 Best Management Practices for Forest Health, Water Quality and Wildlife

Best Management Practices (BMPs) are stewardship activities that are generally accepted by resource professionals to be the most effective and up-to-date management practices available for protecting natural resources, including forest health, water quality, and wildlife habitat. Local agencies and organizations can help you select appropriate BMPs to meet your land management objectives. Financial and technical assistance may be available to help you implement certain BMPs on your land, while other BMPs are simple things you can do on your own to become a better steward of your land.

Contacts provided (in Section 3 and Appendix 4) can help you enroll in the programs mentioned, develop a Forest Stewardship Plan, and identify and implement on-the-ground Best Management Practices that will allow you to achieve your own management objectives while also protecting and enhancing Michigan's unique landscape.

Forestry Best Management Practices

Best management practices (BMPs) for forestry involve using practices that reduce impacts to forest health, water quality and wildlife. Some activities such as construction of stream crossings, work in wetlands, and impacts in floodplains are regulated. One of the keys to good BMPs is to work with a professional forester (or other natural resource consultant) to develop a plan for your property (See Forest Stewardship Program in Section 5.2 and American Tree Farm in Section 5.5).

Elements of plans include goals (desired future condition) and objectives (a strategy that moves the system towards the goal in a measurable way). Work plans (or actions) to accomplish goals and objectives are the operations required to obtain the objectives and should identify the person responsible for the action and the resources needed (labor, seed, and other inputs). Setting goals depends on what the landowner values: wildlife habitat, scenery, financial return, etc. A starting point for most plans is to consider past land use (this affects what can be grown), document what is currently present, and inventory the resources on the site (soil, water, plant communities, etc.).

Forest management plans should include an inventory of trees with a description of the stands (tree areas that can be managed similarly). If timber harvesting is part of the plan, it is usually beneficial to have the logging managed by a professional forester. To increase the economic potential of a forest, a timber stand improvement project may be appropriate to remove less valuable trees and thin trees that may be weak or damaged. Pruning can be done to improve the quality of saw logs, but guidance to avoid spread of oak wilt and other cautions should be followed.

Landowners should also consider the financial aspects of implementing the plan. Costs can include consulting fees (for the plan), plant material (seeds or seedlings), site preparation (clearing or tillage), soil amendments (fertilizer, lime, etc.), invasive species control, infrastructure improvements (fencing, signage, and trails) and labor to install practices. Government agencies usually provide technical assistance for free, but incentive programs normally require application and awards are normally competitive. Landowners can work with professional foresters, wildlife biologists, and conservation-minded wildlife groups to identify cost-sharing programs that may fit their particular situation.

Forest Management Plans

A written plan is the foundation for good forest management and accomplishing your unique goals for your forest. There are two programs in Michigan that offer financial assistance to help pay for a portion of the total cost of developing a forest management plan. Plan writers are allowed to set their own prices, so interview several foresters before hiring one to develop your forest management plan.

The Forest Stewardship Program (FSP) encourages long-term stewardship of family forest land by connecting landowners with professional foresters to develop a Forest Stewardship Plan that helps landowners manage, protect, and enjoy their forests. Since 1990, more than 5,700 landowners in Michigan have used a Forest Stewardship Plan to help them manage, protect, and enjoy over 900,000 acres of forest land. The MDNR has trained and certified 150 private sector foresters (available in every county) and 20 wildlife biologists. Funding from the U.S. Forest Service (USFS) helps lower the total cost to landowners, and this partial cost share is made available through grants to the Plan Writer. The cost share is $225 per plan plus $0.50 per acre up to $2,500 per landowner. Landowners can enroll in the program any time of the year by completing an easy two-page form with their Plan Writer. A DNR Service Forester reviews the plan to ensure that it meets USFS standards for a simple yet comprehensive Forest Stewardship Plan. More information about the Forest Stewardship Program is available online at www.Michigan.gov/ForestStewardship.
See Section 5.2.

The Natural Resources Conservation Service (NRCS) also administers a financial assistance program (Environmental Quality Incentives Program) to develop a forest management plan. The financial assistance from the NRCS is much greater than the Forest Stewardship Program,

but the landowner must apply for a contract with the local NRCS for a "conservation activity plan" (CAP 106). Applications for funding are accepted year round, but there is usually a "sign-up cutoff date" in the winter, and contracts are usually funded in the summer. After getting a contract, the landowner then hires a Technical Service Provider (professional forester certified by the NRCS) to write the plan. The NRCS District Conservationist in each county reviews the forest management plan to verify that it meets program guidelines. The Michigan NRCS has more information about forestry and financial assistance programs on its website. https://www.nrcs.usda.gov/wps/portal/nrcs/main/mi/technical/landuse/forestry/

Fees, plan quality, and plan contents can vary widely so call at least three professional foresters to ask about prices and the contents of their plans. Ask for references and a sample plan to read before you hire them. Consulting foresters frequently travel several counties away from their office, so do not feel obligated to hire the closest forester. Very low prices or very high prices are not always accurate indicators of plan quality. You do not have to use either of these two financial assistance programs to develop a forest management plan, but they are helpful to ensure consistent quality of the plan and also to lower your costs.

Timber Sales

One of the primary benefits of investing in a forest management plan is that it helps you prepare for a timber sale. A well-planned timber sale should have both economic benefits for you and ecological benefits for your forest. A forest management plan will help you to determine what trees to sell and, more importantly, what trees to keep so that you can improve your forest when you harvest your timber. All timber sales should be conducted to accomplish your stated goals for your forest, whether those are improving wildlife habitat, increasing access for recreation, removing diseased trees, modifying the species composition, improving "crop trees" for future harvest, or generating some current income.

Timber sales can be a long and complicated process so it is often a good investment to hire a consulting forester to help you administer your timber sale. A consulting forester will help you decide what trees to sell and market the sale to multiple buyers to get the best price for your trees. Your forester will also ensure that the loggers follow "Best Management Practices" to protect your soil and water resources. Consulting foresters also provide customized timber sale contracts which are often more detailed than the typical contract that a timber buyer provides. Foresters can also help you reduce the taxes on the profits of your sale by calculating your "basis" and "depletion" for capital gains. Consulting foresters may charge hourly rates, set fees, or a percentage of the sale price for their services in administering your sale.

Most timber sales in Michigan are either a "lump sum" sale where the buyer pays in full for the marked trees before the harvest begins or a "mill tally" sale where the buyer pays an agreed price for a unit of wood (cords, boardfeet, tons, etc.) when it is cut and delivered to the sawmill. Most selection harvests in hardwoods forests (oak, maple, beech, cherry, etc.) are sold in a lump sum sale. If you are thinning a pine plantation or clearcutting an aspen stand, those types of

large volume harvests are often sold in a mill tally sale. Mill tally sales require a higher level of trust and usually some extra oversight.

Whether you hire a consulting forester or not, be sure that you have a clearly written contract that describes exactly what will occur and when it will occur during your timber sale. The seasonal timing of the harvest is important to protect your soil and to reduce the potential to spread diseases like oak wilt. A detailed contract will protect both the seller (landowner) and the buyer (logger or sawmill) in a timber harvest. It is the landowner's responsibility to know the location of their property corners and property lines so investing in a boundary survey conducted by a licensed land surveyor can be a good investment.

There are many excellent loggers in Michigan so be sure that you are working with a "Qualified Logging Professional." Look for loggers that have been trained by the Michigan Sustainable Forestry Initiative, are members of the Michigan Association of Timbermen, or are certified as a Master Logger.

Sustainable Soil and Water Quality Practices on Forest Land

The MDNR has a Sustainable Soil and Water Quality Practices on Forest Land Manual that describes a set of voluntary Forestry Best Management Practices (BMPs), which protect soil and water resources while allowing appropriate use of forest resources. Any forest management activities should minimize soil erosion near wetlands and surface water. The Manual contains a section on forest wetland protection practices to use when constructing roads and guidance to reduce soil rutting. It addresses forest management activities that affect the integrity and function of Riparian Management Zones. BMPs include proper location and construction of logging roads, the use of riparian management zones, installation of culverts and other stream crossings, proper use of pesticides and other chemicals, and site preparation for planting. BMPs also include the proper seasonal timing of activities to minimize the spread of insects or disease. The manual has updated information on vegetative erosion control and incorporated information on designated trout streams, vernal pools, fens, and bogs. The Michigan Department of Natural Resources strongly encourages their use by everyone involved with growing, managing, and harvesting trees, such as loggers, foresters, and forest landowners. Tree Farm certification requires compliance with best management practices.

Sustainable Soil and Water Quality Practices on Forest Land - Complete Version (5.60 MB)
http://www.michigan.gov/dnr/0,4570,7-153-31154_31261---,00.html

Michigan's Forestry BMP Program contact: David Price, Forest Planning and Inventory Manager 517-284-5891 PriceD1@michigan.gov.

Management of Wetlands and Aquatic Systems

Many of the Best Management Practices for forestry apply to other land uses as well.

Protection of water quality and improvement of wildlife habitat can be achieved by Best Management Practices that are targeted for wetlands, streams, and lakes. Wetlands serve to store runoff and decrease downstream flooding, but many of the area's wetlands have been drained or altered. Especially in urban areas, this can result in flashiness of stream flow (higher peak discharge during rainfall events and lower base flows during dry periods). Increasing infiltration of precipitation by use of vegetation or structures can increase movement of water into the soil thus reducing runoff which transports sediment, nutrients, and chemicals into water bodies. Sediment can clog drainage ways and aggravate flooding as well as reducing light into streams and lakes (thus reducing photosynthesis). Excess nutrients, particularly nitrogen and phosphorus, can increase algal growth and, in some cases, result in the proliferation of cyanobacteria that produce toxic compounds (this caused drinking water problems in Toledo in 2014).

A starting point for management is to consider which land uses and plant communities are prevalent in the watershed (an area of land that directs surface runoff to a particular point such as the junction with another stream). Impervious surfaces (roads, roofs, etc.) have a greater amount of runoff than a similar land area that is in forest, grass, or cropland. Natural areas tend to have very low amounts of runoff and their water quality is higher than more intensively used areas.

Soil testing should be used to determine the appropriate amount of fertilizer to apply to crops and lawns which helps to limit nutrient losses. Pesticides use can be reduced by following principles of Integrated Pest Management (IPM) which uses economic analysis to determine whether the benefits of applying chemicals to crops is greater than the cost of the treatment. IPM relies on crop scouting to monitor pest (insects, weeds, and diseases) to see if the levels are above the economic threshold for treatment. IPM also advocates use of non-chemical approaches to pest management such as biological controls (predatory insects, planting of resistant varieties, etc.). Landowners who want to avoid synthetic pesticide use completely can follow organic practices (www.attra.ncat.org/organic.html).

Water quality can be protected by keeping vegetation and plant residues on the soil surface to increase infiltration and reduce the water runoff which can cause soil erosion. On crop lands (and other areas such as garden plots) cover crops such as annual rye, oats, and clover can be used to protect the soil surface from the energy of falling raindrops and overland flows. The use of perennial plants (alfalfa, switchgrass, etc.) protects the soil longer than annual crops such as corn and soybean. Erosion control can also be achieved by use of vegetative practices (like grassed waterways) or by installing structures (check dams, detention basins, etc.) that decrease the potential for gully formation.

To protect streams and lakes from excess nitrogen and phosphorus, nutrient management practices such as soil testing to determine appropriate levels of fertilization and the proper timing, placement, and form of fertilizers should be used. Pesticide use can be reduced by following principles of Integrated Pest Management (IPM) which uses economic analysis to

determine whether the benefits of applying chemicals to crops is greater than the cost of the treatment. IPM relies on crop scouting to monitor pest (insects, weeds, and diseases) to see if the levels are above the economic threshold for treatment. IPM also advocates use of non-chemical approaches to pest management such as biological controls (predatory insects, planting of resistant varieties, etc.). Remember to read and follow labels on pesticide containers. Landowners who want to avoid synthetic pesticide use completely can follow organic practices (www.attra.ncat.org/organic.html).

See Michigan Nonpoint Source Best Management Practices Manual at:
www.michigan.gov/documents/deq/deq-wb-nps-Intro_250601_7.pdf

Buffer strips around water bodies can reduce the amount of sediment and chemicals that reach the aquatic zone. The buffers can be planted with grasses, forbs, shrubs, trees, or some combination of the plant types. Growing plants (and dead plant residues) can reduce the velocity of water that travels across the soil surface, thus trapping sediment and the chemicals that are attached to it. The width of the recommended buffer or filter strip depends on several factors, such as slope and length of the flow path for water being intercepted, but should be at least 20 feet. Wider strips (100 feet or more) can improve wildlife habitat and provide corridors for animal movement. Inclusion of trees in the buffer can shade streams, moderate water temperature, and improve oxygen supply (dissolved O_2 is higher in water with lower temperatures).

See "BMP Design, Pollutants Controlled Calculation Assistance, and other Technical Manuals" at:
www.michigan.gov/deq/0,4561,7-135-3313_71618_3682_3714-118554--,00.html

Control of invasive species is another important task in maintaining high quality aquatic environments. Plants such as Eurasian milfoil and Asiatic clams can replace native species and disrupt natural ecological processes. It is very difficult to control invasive species after they get a toehold in a new location, so preventing the introduction of these pests is an important strategy to reduce impacts. Cleaning of boats and equipment, avoiding use of invasive species as bait, and proper disposal of pet species can help minimize invasions.
See: www.michigan.gov/invasives/0,5664,7-324-68001-364395--,00.html

Michigan Natural Shoreline Partnership
The Department of Environmental Quality's Inland Lakes and Streams program has been participating in the Michigan Natural Shoreline Partnership to promote natural shoreline landscaping to protect Michigan's Inland Lakes. One of the goals of the Michigan Natural Shoreline Partnership is to educate property owners about using native plants and technologies that benefit lake ecosystems. (www.mishorelinepartnership.org/)

Soil Erosion Control

There are many techniques to control soil erosion, including planting vegetative barriers such as buffer strips discussed in the Management of Wetlands and Aquatic Systems section above. There are numerous structures for water and sediment management including Water and Sediment Control Basins, which are earth embankments constructed across the slope of minor watercourses to trap runoff and direct it to a stable outlet such as a pipe inlet or grassed waterway. Other structures include terraces, drop inlets (allows water to move safely to a lower elevation), rock check dams, and rock chutes. Because rip rap (stones used to allow water to move without transporting the soil below) can be expensive and unsightly in some locations, biological methods can be a viable alternative. These bioengineered solutions employ living or dead plant material to prevent stream bank erosion with willow stakes, coconut fiber logs, brush mats, or fascines (bundles of sticks held in place with stakes). Silt fence (typically a plastic mesh with fine holes) can be dug into the ground at the bottom of slopes to prevent sediment transport. Erosion control blankets made with biodegradable mesh and filled with straw or wood fibers can be used in channels to keep soil in place. These blankets stabilize the surface and allow plants to grow in areas that would be difficult to establish vegetation (areas of concentrated water flow). Seed and other materials (fertilizer, mulch, etc.) can be applied to steep slopes with hydroseeding. Many other erosion control products are available (see listings at:
http://iecaerosionprofessionalsmarketplace.com/

The MDEQ is responsible for administering the state and federal construction storm water statutes that cover earth change activities (clearing, grading, excavating, etc.) which disturb one or more acres of land or are within 500 feet of a lake or stream. Such actions are regulated under Part 91, Soil Erosion and Sedimentation Control (SESC), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Owners of properties on which regulated earth changes will occur must obtain a SESC permit from the appropriate Municipal or County Enforcing Agency (typically the county's conservation district or the city planning office).
See: www.michigan.gov/deq/0,4561,7-135-3311_4113---,00.html

Wildlife Management
Your land plan should address what wildlife is desired and how it is to be managed. Wildlife benefit from having appropriate habitat, plentiful food sources, and adequate water supply. Existing natural areas can be managed by inventorying communities present to see if adequate resources are available to support target species. If the desired habitat is not present, the landowner can consider creating the plant community that benefits the target species. Restoration activities can range from planting a few trees, shrubs, grasses, or forbs to large-scale conversions to forest, prairie, or other habitat

Four basic steps to improve wildlife habitat are:
1. Determine the species of wildlife that live in your area.
2. Select the species you want to attract and learn about their habitat and food requirements.

3. Inventory the habitat available and habitat needs on your land and that of adjacent landowners.
4. Design projects to improve wildlife habitat.

The size of your property, the vegetative types and their location, the types of wildlife you want to attract, and the habitat and land management practices on adjoining land determine what can be done to encourage wildlife use in your area. Trees, shrubs, grasses, wildflowers, and perennial and annual flower gardens all provide food and cover for wildlife. Rock piles, brush piles, decaying logs, and compost piles are also valuable cover components. They supply cover for chipmunks, rabbits, weasels, salamanders, toads, snakes, snails, and beneficial insects.

Trees and Shrubs
Trees and shrubs that provide food and cover for backyard wildlife are sought by many birds and mammals. The heavy cover of dense conifers, such as spruce and cedar, attract winter songbirds like cardinals and provide shelter for gamebirds such as ruffed grouse. Trees and shrubs that provide food in the form of seeds and fruit for birds and mammals are highly desirable. Plants which supply fruit (soft mast) that last into the winter include crabapples, mountain ash, American high-bush cranberry, nannyberry, arrowwood viburnum, staghorn sumac, and wild grape. Plants that furnish fruit during spring, summer, and early fall include serviceberry, mulberry, elderberry, raspberries, cherries, and dogwoods. Conifers such as tamarack, white spruce, blue spruce, hemlock, and white cedar, which hold their seeds in a semi-loose cone, may attract crossbills, finches, evening grosbeaks, chickadees, and red squirrels. Trees such as oak, walnut, hickory, hazelnut, or beech that provide hard mast (nuts) attract large seed-eating birds, small mammals, and deer. Standing dead trees (snags) are very attractive to many wildlife species and can furnish cavity nest sites for many songbirds, squirrels, or bats, as well as provide insect larvae for woodpeckers, nuthatches, and flickers.
http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx

Grasses and Wildflowers
Converting mowed areas to grass meadow provides nest sites, food, and cover for wildlife. Tall, native prairie grass such as switchgrass, big bluestem, and Indian grass provide a lush variety of cover 4-7 feet tall; nest sites; and winter cover for quail, pheasants, songbirds such as cardinals and blue jays, rabbits, and deer. Prairie grasses, mixed with prairie wildflowers such as gray-headed coneflower, woodland sunflower, and aster are an attractive way to provide wildlife habitat. Another option to mowed grass is a perennial wildflower garden. These areas are also called songbird or butterfly gardens. Many wildflower mixtures that provide colorful flowers from late April until the October frosts are commercially available. These wildflower mixtures can include a variety of species such as coreopsis, black-eyed Susan, phlox, blazing star, yarrow, and bee balm.

The Michigan Amphibian and Reptile Best Management Practices
The Michigan Amphibian and Reptile Best Management Practices document was created for the Michigan Department of Environmental Quality to provide a comprehensive guide to Best

Management Practices that improve and maintain the viability of Michigan amphibian and reptile populations. The manual contains actions to protect wildlife with specific recommendations for regulators, agency land managers, consultants, residential developers, and private citizens to protect, preserve, and restore herpetofauna.
www.herprman.com/amphibian-reptile-management-practices-michigan

Most wildlife prefers native plants and control of invasive species can improve habitat quality. Methods of invasive plant control include: mechanical, chemical, fire, grazing, and competition from noninvasive species. The ability to identify plants is important and there are guides listed in Section 5.8 that can assist in this activity. The BCK Cooperative Invasive Species Management Area coordinators may be able to provide helpful information about invasive species control (see page 55).

Backyard Wildlife Management Link:
www.michigan.gov/dnr/0,1607,7-153-10370_12148-30777--,00.html

A variety of programs and informational resources are offered by state and federal resource agencies and nonprofit conservation organizations to help you take the next steps toward meeting your own land stewardship goals. See Sections 5.2 through 5.6 for more information.

Enjoyment
Many landowners who have forest land spend many hours every year working in their woods for a variety of reasons. For some landowners, forests are an economic investment to secure future income. For others, owning a forest is an ethical choice to improve the world by slowing urban sprawl or providing environmental services such as clean air and water. But for many landowners, the primary motive for owning forest land is the enjoyment that they receive by spending time in their woods. Forest owners do a lot of activities in their woods because it is just plain fun! So as you work with your forester to navigate these programs and choose the best ones for you and your property, don't forget that most family forest owners in Michigan own their forest because they simply enjoy being out in their own woods. Good forest management should not only improve the ecology and economics of your forest, but also your enjoyment of your land.

5.2 Forest Stewardship Program

The Forest Stewardship Program was created by the USFS in 1991 to encourage long-term stewardship of family forest land by providing professional planning and technical assistance to private landowners. Ultimately, the purpose of the program is to enhance and sustain the long-term productivity of forest resources and produce healthy and resilient forest landscapes. As part of the process, landowners work with a certified Forest Stewardship Plan Writer to develop

a custom plan that describes your personal land stewardship goals, unique forest resources, and suggested management activities.

There are many benefits to developing a Forest Stewardship Plan, including enhanced access to USDA conservation programs, forest certification programs, and forest product and ecosystem service markets. For example, you can use your Forest Stewardship Plan to prepare for a timber sale, improve wildlife habitat, or to enroll in other programs that require a forest management plan. Participation in the Forest Stewardship Program is voluntary and landowners can obtain information and cost-share assistance throughout the year. In Michigan the Forest Stewardship Program is administered by the Michigan DNR, who trains and certifies private sector professional foresters and wildlife biologists to write Forest Stewardship Plans.

Visit www.michigan.gov/foreststewardship to connect with a certified plan writer and take your next step toward managing your land to meet your stewardship goals. More information about the program can also be found at http://www.fs.fed.us/spf/coop/programs/loa/fsp.shtml/.

5.3 Qualified Forest Program

The purpose of the Qualified Forest Program, administered by the Michigan Department of Agriculture and Rural Development, is to encourage landowners to actively manage their privately owned forests for commercial harvest, wildlife habitat enhancement, and improvement of other non-forest resources. In exchange for managing their forests in a sustainable fashion, enrolled landowners will receive an exemption from the local school operating millage (up to 18 mills). In order to qualify for the program, landowners must have between 20 and 640 acres; have an approved forest management plan written by a "Qualified Forester;" and must comply with the prescriptions included in that plan. There is a $50 application fee and an annual fee equivalent to 2 mills to help fund the operation of the program. See www.michigan.gov/qfp for more information or to begin the enrollment process. The application deadline in order to receive tax benefits the following year is September 1.

Qualified Forest Program: Rich Harlow, Program Administrator (517) 284-5630

5.4 Commercial Forest Program

The Commercial Forest Act gives property tax breaks for forest owners in Michigan that voluntarily enroll in the Commercial Forest Program. Landowners must have at least 40 acres of contiguous forest, an appropriate forest management plan (written by a Registered Forester), and conduct commercial harvests as prescribed in their plan. Land that is included under the Commercial Forest Program must be open to the public for non-motorized recreational use (e.g., hunting and fishing). Under this program, landowners pay a specific rate of $1.25 per acre for property taxes and the state of Michigan pays counties another $1.25 per acre. The application fee is $1 per acre with a minimum fee of $200 and a maximum fee of $1,000. More information about this program, which is administered by the MDNR, is available online at

www.michigan.gov/commercialforest. The application deadline in order to receive tax benefits the following year is April 1.

Commercial Forest Program: Shirley Businski, Program Administrator (517) 284-5849.

Note: While it is not required to use a financial assistance program for developing a plan for these two tax programs, many landowners benefit from using either the FSP or NRCS programs to develop their forest management plan and then enroll in the separate Commercial Forest or Qualified Forest programs. Participating in a financial assistance program may hinder the schedule for developing a forest management plan in time for the application deadlines of the Commercial Forest program (April 1) or the Qualified Forest (September 1) program and delay entry into the tax program for an entire year.

5.5 American Tree Farm System

The American Tree Farm System is a certification program of the American Forest Foundation that acknowledges land management practices meeting certain Standards of Sustainability. As part of this program, a network of more than 82,000 family forest owners sustainably manage 24 million acres of forestland across the country. The American Tree Farm System is recognized by the Programme for the Endorsement of Forest Certification, which is an international forest certification system. Landowners following the Standards of Sustainability can feel proud to be recognized as ambassadors for sustainable woodland stewardship.

The eight Standards of Sustainability that must be met in order to gain recognition as a certified tree farm under the American Tree Farm System program are listed below. An approved Forest Stewardship Plan completed through the Forest Stewardship Program or a qualifying NRCS incentives programs can be written to also serve as a qualifying forest management plan under the American Tree Farm System. A free inspection from one of the Tree Farm Inspecting Foresters is required to enroll. For more information please visit www.treefarmsystem.org.

- **Commitment to Practicing Sustainable Forestry**: Landowner demonstrates commitment to forest health and sustainability by developing a forest management plan and implementing sustainable practices.
- **Compliance with Laws**: Forest-management activities comply with all relevant federal, state, and local laws, regulations, and ordinances.
- **Reforestation and Afforestation**: Landowner completes timely restocking of desired species of trees on harvested sites and nonstocked areas where tree growing is consistent with land-use practices and the landowner's objectives.
- **Air, Water and Soil Protection**: Forest-management practices maintain or enhance the environment and ecosystems, including air, water, soil, and site quality.
- **Fish, Wildlife and Biodiversity**: Forest-management activities contribute to the conservation of biodiversity.
- **Forest Aesthetics**: Forest-management activities recognize the value of forest aesthetics.

- **Protect Special Sites**: Special sites are managed in ways that recognize their unique historical, archaeological, cultural, geological, biological, or ecological characteristics.
- **Forest Product Harvests and Other Activities**: Forest product harvests and other management activities are conducted in accordance with the landowner's objectives and consider other forest values.

My Land Plan
MyLandPlan.com is a resource for woodland owners to help you protect and enjoy your woods provided by the American Forest Foundation (AFF) that provides information about keeping your woods healthy. The AFF planning tool helps you keep track of all your woodland activities and experiences in one place. After you create a profile, you will have access to the Land Plan tool, an exclusive area of the website. The planning tool lets you: map the boundaries of your land; add features and special sites; set goals and plan actions; receive information specially tailored for what you want to do on your land; and record your actions and experiences in your own personalized forest journal.

5.6 USDA Financial and Technical Assistance Programs

Forest Stewardship Plans are accepted by the NRCS when applying for the Environmental Quality Incentives Program funding, although they do not require the same level of detail as NRCS conservation activity plans. Work with your NRCS District Conservationist and forester to fill out supplemental "Job Sheets." For info see:
www.mi.nrcs.usda.gov/technical/forestry.html

Some of the recommended activities in this plan have potential for financial assistance. NRCS forestry "conservation practices" include forest trails and landings, stream crossings, riparian forest buffers, stream habitat improvement, forest stand improvement, tree and shrub establishment, brush management, early succession habitat, wetland wildlife habitat, and upland wildlife habitat. NRCS conservation practices address "resource concerns" (environmental problems) like soil erosion, soil quality, water quality degradation, plant productivity, habitat fragmentation, invasive plants, forest health, etc. Contact your local NRCS Service Center to apply for financial assistance (see **www.nrcs.usda.gov/wps/portal/nrcs/main/mi/contact/local**).

Environmental Quality Incentives Program
The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program administered by the USDA Natural Resources Conservation Service. It supports production agriculture and environmental quality as compatible goals. Through EQIP, farmers, ranchers, private forest land owners and federally-recognized American Indian tribes may receive financial and technical assistance to implement structural and land management conservation practices on eligible agricultural land. Program priorities aim to address resource concerns including soil erosion, soil quality, water quality degradation, plant productivity, habitat

fragmentation, invasive plants, and forest health. Conservation practices related to forestry may include forest trails and landings, stream crossings, riparian forest buffers, forest stand improvement, tree and shrub establishment, brush management, early succession habitat, wetland wildlife habitat, and upland wildlife habitat. EQIP activities are carried out according to a site specific conservation plan developed in conjunction with the producer. Forest Stewardship Plans are accepted by the NRCS when applying for EQIP funding. All conservation practices are installed according to NRCS technical standards.

The Conservation Reserve Program
The Conservation Reserve Program (CRP) pays a yearly rental in exchange for farmers removing environmentally sensitive land from agricultural production and planting species that will improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. The USDA Farm Service Agency contracts are 10 to 15 years in duration and include a number of practices: CRP-CP2 Native Grass Planting, CRP-CP3 General Tree Planting, CRP-CP4D Wildlife Habitat, CRP-CP12 Wildlife Food Plot, CRP-CP25 Rare and Declining Habitat (Prairie), CRP-CP25 Rare and Declining Habitat (Savanna), CRP-CP42 Native Pollinator Habitat, and others.

Conservation Stewardship
Conservation Stewardship is a program that provides technical and financial assistance to qualified farmers whose applications rank high enough to be accepted into the program. It uses the Conservation Measurement Tool to score current and planned environmental performance. Beginning and socially disadvantaged farmers as well as non-industrial forestland applications compete in separate ranking pools. Supplemental payments reward improved or newly adopted resource-conserving crop rotations. The five-year contracts are eligible for renewal.

Agricultural Conservation Easement Program
The Agricultural Conservation Easement Program has several components including Agricultural Land Easements and Wetlands Reserve Easements. These both provide financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Some easements are permanent while others are 30 year contracts. Contact your local District Conservationist or forester for information and enrollment forms for USDA-NRCS assistance programs. For more information please visit www.nrcs.usda.gov/wps/portal/nrcs/main/mi/programs/.

Healthy Forests Reserve Program
The Healthy Forests Reserve Program (HFRP) helps landowners restore, enhance, and protect forestland resources on private lands through easements and financial assistance. HRFP aids the recovery of endangered and threatened species under the Endangered Species Act, improves plant and animal biodiversity, and enhances carbon sequestration. HFRP provides landowners with 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. HFRP applicants must provide proof of ownership, or an operator (tenant) must provide written concurrence from the landowner of tenancy for the period of the

HFRP restoration agreement in order to be eligible. Visit your local USDA Service Center to apply or visit www.nrcs.usda.gov/getstarted

5.7 Capital Gains Information

If you own timber for more than twelve months, profits from timber sales are taxed as capital gains, rather than ordinary income. Expenses, including the cost of a management plan or a consulting forester's fees for a timber sale, can be deducted from profits to determine net income. There are many great tax related resources available on www.TimberTax.org, including the most recent edition of the annual "Tax Tips for Forest Landowners."

5.8 Resources for Landowners

General Forestry Information

- Forestry Assistance Program – MACD/MDARD/DNR - www.michigan.gov/mifap
- Michigan Forest Association - MFA – http://www.michiganforests.org
- MSU Extension – MSU - http://msue.anr.msu.edu/topic/info/forestry
- National Association of Conservation Districts Forest Notes: http://www.nacdnet.org/news-and-events/publications/forestry-notes/

Forest Management Plans

- Conservation Activity Plans – NRCS - www.nrcs.usda.gov
- Forest Stewardship Program – DNR/USFS - www.Michigan.gov/ForestStewardship

Forest Certification

- American Tree Farm System – AFF - www.TreeFarmSystem.org
- Forest Stewardship Council – FSC – www.us.fsc.org

Property Tax Incentives

- Commercial Forest Program – DNR - www.Michigan.gov/CommercialForest
- Qualified Forest Program – MDARD - www.Michigan.gov/qfp

Working Forest Easements

- Farmland and Open Space Preservation – MDARD - www.Michigan.gov/Farmland
- Forest Legacy Program – DNR/USFS - www.Michigan.gov/PrivateForestLand
- Healthy Forest Reserve Program - NRCS - www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/
- Michigan Land Conservancies - www.heartofthelakes.org

USDA Financial Assistance

- Conservation Stewardship Program – NRCS - www.nrcs.usda.gov
- Environmental Quality Incentives Program – NRCS - www.nrcs.usda.gov

Forest Health

- DNR Forest Health - www.Michigan.gov/ForestHealth
- DNR Invasive Species Info - www.Michigan.gov/InvasiveSpecies
- MDARD Exotic Forest Pests – www.Michigan.gov/ExoticPests
- USFS Forest Health - http://fhm.fs.fed.us/

Professional Forester Classifications

Consulting Foresters

Consulting foresters are independent businesses that work directly for the landowner. Consulting foresters administer timber sales, write Forest Stewardship Plans, manage wildlife habitat, plant trees, and offer other services for forest landowners. There are about 125 consulting foresters in Michigan.

Association of Consulting Foresters : www.acf-foresters.org

Forest Stewardship Plan Writers – www.Michigan.gov/ForestStewardship

Industry Foresters

Industry foresters work for local forest products companies to buy timber from private landowners or to manage forest land owned by their company. Industry foresters buy timber from private landowners and write forest management plans. There are about 100 industry foresters in Michigan.

Michigan Association of Timbermen : www.timbermen.org

Michigan Forest Products Council : www.michiganforest.com

Great Lakes Timber Professionals Association : http://gltpa.org

Government Foresters

Government foresters, funded by your tax dollars, provide general forestry information to landowners. Government foresters conduct workshops, hold field days, write articles, and make professional referrals. There are about 35 government foresters who help private landowners (and another 200 working on public land).

Conservation Districts – 20 foresters in the Forestry Assistance Program – www.Michigan.gov/mifap

MSU Extension – 5 educators statewide: http://msue.anr.msu.edu/topic/info/forestry

DNR – 5 foresters statewide – www.Michigan.gov/PrivateForestLand

USFS : www.fs.fed.us/spf

Credentials and Programs

- "ACF Foresters" are members of the Association of Consulting Foresters: www.acf-foresters.org

- "Certified Foresters" are certified by the Society of American Foresters: www.safnet.org
- "Forest Stewardship Plan Writers" write Forest Stewardship Plans – www.Michigan.gov/ForestStewardship
- "Master Loggers" are trained, audited and certified by other professional loggers: www.mimlc.com
- "Qualified Foresters" write plans for the Qualified Forest Program – www.Michigan.gov/qfp
- "Qualified Logging Professionals" are loggers trained by the Sustainable Forestry Initiative: http://sfimi.org
- "Registered Foresters" are recognized by the State of Michigan – www.Michigan.gov/Foresters
- "Technical Service Providers" write plans for the Environmental Quality Incentives Program: www.nrcs.usda.gov

Appendix A: Glossary of Common Forestry Terms

The following glossary is adapted from www.dnr.state.md.us/forests/gloss.html.

Agroforestry - a land-use system that combines both agriculture and forestry in one location.
Alley Cropping - widely spaced rows of trees with annual crops growing in between the rows.
Basal Area (Tree) - cross sectional area of a tree at 4.5 feet off ground in units of square feet (ft^2).
Basal Area (Forest) - basal area of all trees per acre summed up, in units of ft^2/acre; measure of density.
Biomass – harvesting and using whole trees or parts of trees for energy production
Board Foot – a measure of volume 1 foot by 1 foot by 1 inch or 144 cubic inches of wood.
Bolt – 8-foot-long log
Browse - parts of woody plants, including twigs, shoots, and leaves, eaten by forest animals.
Carbon Cycle – the biogeochemical cycle to exchange carbon between the biosphere and atmosphere by means of photosynthesis, respiration and combustion.
Clearcut - the harvest of all the trees in an area to reproduce trees that require full sunlight.
Cord - a unit of wood cut for fuel that is equal to a stack 4 x 4 by 8 feet or 128 cubic feet
Cordwood - small diameter or low quality wood suitable for firewood, pulp, or chips.
Crop Tree - a young tree of a desirable species with certain desired characteristics.
Crown - the uppermost branches and foliage of a tree.
Cruise - a forest survey used to obtain inventory information and develop a management plan.
Cull - a sawtimber size tree that has no timber value as a result of poor shape or damage.
Diameter at Breast Height (DBH) - diameter of a tree trunk taken at 4 1/2 feet off the ground.
Diameter-Limit Sale - a timber sale in which all trees over a specified DBH may be cut. Diameter-limit sales often result in high grading and is a very poor forestry practice.
Endangered Species – a species in danger of extinction.
Even-Aged Stand - stand with age difference between oldest and youngest trees is minimal (<10 years).
Food forest – an agroforestry or permaculture cropping system in which woody plants that produce food (including fruit and nut trees and berry-producing shrubs) are intermingled with other perennial and annual food plants in a way that mimics natural forest ecosystem structure.
Forestland – land at least one acre in size that is at least 10 percent stocked with trees.
Forest Farming - cultivating high value specialty crops in the shade of natural forests.
Forest Stand Improvement (FSI) - any practice that increases the health, composition, value or rate of growth in a stand. Also called Timber Stand Improvement when focused on timber**.**
Group Selection - harvesting groups of trees to open the canopy and encourage uneven aged stands.
Habitat - the ecosystem in which a plant or animal lives and obtains food and water.
Hardwoods - a general term encompassing broadleaf, deciduous trees.
High Grading - to remove all good quality trees from a stand and leave only inferior trees.
Intolerance - characteristic of certain tree species that does not permit them to survive in the shade.
Landing - cleared area where logs are processed, piled, and loaded for transport to a sawmill.

Log Rule - a method for calculating wood volume in a tree or log by using its diameter and length. Scribner, Doyle and the International 1/4-inch rule are common log rules.
Lump-Sum Sale - a timber sale in which an agreed-on price for marked standing trees is set before the wood is removed (as opposed to a mill tally or unit sale).
Mast - nuts and seeds such as acorns, beechnuts, and chestnuts that serve as food for wildlife.
Non-timber forest products – include forest plant products harvested for food (such as nuts, berries, maple sugar), medicine, crafts, or purposes other than commercial timber. The website http://www.ntfpinfo.us offers information on hundreds of uses for more than 1,000 forest species.
Over-mature - trees that have declined in growth rate because of old age and loss of vigor.
Overstocked - trees are so closely spaced that they do not reach full growth potential.
Pole Timber - trees 4 to 10 inches DBH.
Pre-Commercial Operations - cutting to remove wood too small to be sold.
Prescribed Fire – an intentional and controlled fire used as a management tool used to reduce hazardous fuels or unwanted understory plants (invasive, undesirable species, etc.).
Pulpwood - wood suitable for use in paper manufacturing.
Range - cattle grazing in natural landscapes.
Regeneration - the process by which a forest is reseeded and renewed.
Riparian Forest Buffers - strips of land along stream banks where trees, shrubs and other vegetation are planted and managed to capture erosion from agricultural fields.
Salvage Cut - the removal of dead, damaged, or diseased trees to recover value.
Sapling - a tree at least 4 1/2 feet tall and between 1 inch and 4 inches in diameter.
Sawlog - log large enough to be sawed economically, usually >10"diameter and 16' long.
Sawtimber stand - a stand of trees whose average DBH is greater than 11 inches.
Sealed-Bid Sale - a timber sale in which buyers submit secret bids.
Seed-Tree Harvest - felling all trees except for a few desirable trees that provide seed for the next forest.
Selection Harvest – harvesting single trees or groups at regular intervals to maintain uneven-aged forest.
Shelterwood Harvest – harvesting all mature trees in two or more cuts, leaving trees to protect seedlings.
Silvopasture - growing trees and improved forages to provide suitable pasture for grazing livestock.
Silviculture - the art and science of growing forest trees.
Site Index - measure of quality of a site based on the height of a dominate tree species at 50 years old.
Site Preparation - treatment of an area prior to reestablishment of a forest stand.
Skidder - a rubber-tired machine with a cable winch or grapple to drag logs out of the forest.
Slash - branches and other woody material left on a site after logging.
Snag - a dead tree that is still standing and provide food and cover for a variety of wildlife species.
Softwood - any gymnosperm tree including pines, hemlocks, larches, spruces, firs, and junipers.

Species of Special Concern – not threatened or endangered yet, but has low or declining populations.
Stand - a group of forest trees of sufficiently uniform species composition, age, and condition to be considered a homogeneous unit for management purposes.
Stand Density - the quantity of trees per unit area, evaluated in basal area, crown cover or stocking.
Stocking - the number and density of trees in a forest stand. Classified as under-, over-, or well-stocked.
Stumpage Price - the price paid for standing forest trees and paid prior to harvest.
Succession - the replacement of one plant community by another over time in the absence of disturbance.
Sugarbush – plantation of sugar maples, or woodlot managed for maple syrup production.
Sustained Yield - ideal forest management where growth equals or exceeds removals and mortality.
Thinning - partial cut in an immature, overstocked stand of trees to increase the stand's value and growth.
Threatened Species - a species whose population is so small that it may become endangered.
Timberland - forest capable of producing 20 ft^3 of timber per acre per year.
Tolerance – the capacity of a tree species to grow in shade
Under-stocked - trees so widely spaced, that even with full growth, crown closure will not occur.
Understory - the level of forest vegetation beneath the canopy.
Uneven-Aged Stand - three or more age classes of trees represented in a single stand.
Unit Sale - a timber sale in which the buyer makes regular payments based on mill tally and receipts.
Veneer Log - a high-quality log of a desirable species suitable for conversion to veneer.
Well-Stocked – stands where growing space is effectively occupied but there is still room for growth.
Windbreaks - rows of trees to provide shelter for crops, animals or farm buildings.

Appendix B: Forest Laws and Programs

Note: This list is not comprehensive and other laws may apply to your situation. Consult an attorney or resource professional for additional assistance.

Federal and State Laws Related to Forest Management

- USA - Federal Insecticide, Fungicide, and Rodenticide Act, 1947
- USA - National Historic Preservation Act, 1966
- USA - Clean Water Act, 1948 and 1972
- USA - Endangered Species Act, 1973
- MI - Michigan Pesticide Control Act, Public Act 171 of 1976
- MI - Natural Resources and Environmental Protection Act, Public Act 451 of 1994
- MI - Right to Forest Act, Public Act 676 of 2002

Michigan Laws Related to Forestry

- Natural Resources and Environmental Protection Act, Public Act 451 of 1994
- Right to Forest Act, Public Act 676 of 2002
- Commercial Forest Act, Parts 511 and 512 of Public Act 451, 1994, as amended
- Qualified Forest Program, Public Acts 42 and 45 of 2013

Appendix C: Threatened, Endangered, and Special Concern Species

The following tables reflects presents the Endangered (E), Threatened (T), and Presumed Extirpated (X) animal species of Monroe County, which are protected under the Endangered Species Act of the State of Michigan (Part 365 of PA 451, 1994 Michigan Natural Resources and Environmental Protection Act). For more information visit: https://mnfi.anr.msu.edu/data/county.cfm

Threatened, Endangered, and Special Concern Species

Scientific Name	Common Name	State Status
Acris blanchardi	Blanchard's cricket frog	T
Agalinis gattingeri	Gattinger's gerardia	E
Alasmidonta marginata	Elktoe	SC
Alasmidonta viridis	Slippershell	T
Ambystoma texanum	Smallmouth salamander	E
Ammocrypta pellucida	Eastern sand darter	T
Ammodramus savannarum	Grasshopper sparrow	SC
Angelica venenosa	Hairy angelica	SC
Aristida longespica	Three-awned grass	SC
Asclepias hirtella	Tall green milkweed	T
Asclepias purpurascens	Purple milkweed	T
Asclepias sullivantii	Sullivant's milkweed	T
Atrytonopsis hianna	Dusted skipper	SC
Baptisia lactea	White or prairie false indigo	SC
Boechera missouriensis	Missouri rock-cress	SC
Callophrys irus	Frosted elfin	T
Camassia scilloides	Wild hyacinth	T
Carex crus-corvi	Raven's-foot sedge	E
Carex davisii	Davis's sedge	SC
Carex festucacea	Fescue sedge	SC
Carex squarrosa	Sedge	SC
Castanea dentata	American chestnut	E
Chondestes grammacus	Lark sparrow	X
Chrosomus erythrogaster	Southern redbelly dace	E
Cincinnatia cincinnatiensis	Campeloma spire snail	SC
Cistothorus palustris	Marsh wren	SC
Cuscuta polygonorum	Knotweed dodder	SC
Cyclonaias tuberculata	Purple wartyback	T
Diarrhena obovata	Beak grass	SC

Dichanthelium leibergii	Leiberg's panic grass	T
Emydoidea blandingii	Blanding's turtle	SC
Epioblasma obliquata perobliqua	White catspaw	E
Epioblasma torulosa rangiana	Northern riffleshell	E
Epioblasma triquetra	Snuffbox	E
Erimyzon claviformis	Creek chubsucker	E
Etheostoma spectabile	Orangethroat darter	SC
Euphyes dukesi	Dukes' skipper	T
Eurybia furcata	Forked aster	T
Falco peregrinus	Peregrine falcon	E
Flexamia reflexa	Leafhopper	SC
Gallinula galeata	Common gallinule	T
Gentianella quinquefolia	Stiff gentian	T
Haliaeetus leucocephalus	Bald eagle	SC
Helianthus mollis	Downy sunflower	T
Hibiscus laevis	Smooth rose-mallow	X
Hydrastis canadensis	Goldenseal	T
Hypericum gentianoides	Gentian-leaved St. John's-wort	SC
Hypericum sphaerocarpum	Round-fruited St. John's-wort	E
Ixobrychus exilis	Least bittern	T
Juncus brachycarpus	Short-fruited rush	T
Justicia americana	Water willow	T
Lactuca floridana	Woodland lettuce	T
Lampsilis fasciola	Wavyrayed lampmussel	T
Lechea minor	Least pinweed	X
Lechea pulchella	Leggett's pinweed	T
Leucospora multifida	Conobea	SC
Ligumia nasuta	Eastern pondmussel	E
Ligumia recta	Black sandshell	E
Lipocarpha micrantha	Dwarf-bulrush	SC
Lycaeides melissa samuelis	Karner blue	T
Macrhybopsis storeriana	Silver chub	SC
Mesodon clausus	Yellow globelet	SC
Mesodon elevatus	Proud globe	T
Mesodon pennsylvanicus	Proud globelet	SC
Mesomphix cupreus	Copper button	SC
Morus rubra	Red mulberry	T

Nelumbo lutea	American lotus	SC
Notropis photogenis	Silver shiner	E
Noturus miurus	Brindled madtom	SC
Nycticorax nycticorax	Black-crowned night-heron	SC
Obliquaria reflexa	Threehorn wartyback	E
Obovaria olivaria	Hickorynut	E
Obovaria subrotunda	Round hickorynut	E
Opsopoeodus emiliae	Pugnose minnow	E
Oxalis violacea	Violet wood sorrel	X
Panax quinquefolius	Ginseng	T
Pantherophis gloydi	Eastern fox snake	T
Papaipema beeriana	Blazing star borer	SC
Papaipema maritima	Maritime sunflower borer	SC
Papaipema sciata	Culvers root borer	SC
Papaipema silphii	Silphium borer moth	T
Percina copelandi	Channel darter	E
Percina shumardi	River darter	E
Phalaropus tricolor	Wilson's phalarope	SC
Platanthera ciliaris	Orange- or yellow-fringed orchid	E
Platanthera leucophaea	Prairie white-fringed orchid	E
Pleurobema sintoxia	Round pigtoe	SC
Polygala cruciata	Cross-leaved milkwort	SC
Pomatiopsis cincinnatiensis	Brown walker	SC
Potentilla supina	Sand cinquefoil	T
Ptychobranchus fasciolaris	Kidney shell	SC
Pycnanthemum pilosum	Hairy mountain mint	T
Pyrgulopsis letsoni	Gravel pyrg	SC
Quercus shumardii	Shumard's oak	SC
Rallus elegans	King rail	E
Regina septemvittata	Queen snake	SC
Sagittaria montevidensis	Arrowhead	T
Sander canadensis	Sauger	T
Scleria triglomerata	Tall nut rush	SC
Silphium perfoliatum	Cup plant	T
Simpsonaias ambigua	Salamander mussel	E
Spiza americana	Dickcissel	SC
Sterna hirundo	Common tern	T
Strophostyles helvula	Trailing wild Bean	SC

Stylurus plagiatus	Russet-tipped clubtail	SC
Symphyotrichum praealtum	Willow aster	SC
Terrapene carolina carolina	Eastern box turtle	SC
Toxolasma lividus	Purple lilliput	E
Toxolasma parvum	Lilliput	E
Tradescantia virginiana	Virginia spiderwort	SC
Truncilla donaciformis	Fawnsfoot	T
Truncilla truncata	Deertoe	SC
Tyto alba	Barn owl	E
Utterbackia imbecillis	Paper pondshell	SC
Valerianella umbilicata	Corn salad	T
Vallonia parvula	Trumpet vallonia	SC
Villosa fabalis	Rayed bean	E
Villosa iris	Rainbow	SC
Zizania aquatica	Wild rice	T

Appendix D: Resource Contact Information

General contact information and main websites for the organizations and programs listed in Section 3.

Michigan Department of Natural Resources

Executive Division
P.O. Box 30028
Lansing, MI 48909
http://www.michigan.gov/dnr/

Documents

- DNR Forest Management Plan: www.Michigan.gov/forestmanagement
- Five-year strategic plan: www.michigan.gov/dnr/0,4570,7-153-30301_30505_62551---,00.html
- Helping Private Forest Landowners Develop Plans for Sustainable Forest Management: A Landowner's Guide. www.michigan.gov/foreststewardship
- Landowner Forest Stewardship Plan (Sample): www.michigan.gov/.../FSP_Plan_Example_September2014_468852_7.pdf
- Michigan's 2010-2020 Forest Action Plan: http://www.michigan.gov/documents/dnr/Strategic_457570_7.pdf?20140530081757
- Regional State Forest Management Plans: www.Michigan.gov/regionalforestplans
- The State Forest Management Plan: http://www.michigan.gov/dnr/0,4570,7-153-30301_30505---,00.html
- 1999 DNR Landowner's Guide http://www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/

Program Information

- **Michigan's Forest Legacy Program:**
  Kerry Wieber – Forest Land Administrator
  (989) 348-6371 Ext. 7441
  wieberk4@michigan.gov
  http://www.michigan.gov/dnr/0,4570,7-153-30301_34240_68250---,00.html
- **Wildlife Action Plans**
  Amy Derosier – Wildlife Action Plan Coordinator
  (517)-284-6166
  derosiera@michigan.gov
  http://www.michigan.gov/dnr/0,1607,7-153-10370_30909---,00.html

- **Fish and Wildlife Habitat Programs**
  http://www.michigan.gov/dnr/0,4570,7-153-10370_12148---,00.html
- **DNR Private Lands Program**
  (517) 641-4903 ext. 228
  parkerm5@michigan.gov
  http://www.michigan.gov/dnr/0,4570,7-153-10370_36649-118332--,00.html
- **The Wildlife Habitat Grant Program (WHGP)**
  Clay Buchanan - Wildlife Division Grant Coordinator
  (517) 284-6214
  buchananc1@michigan.gov
  or
  Chip Kosloski - Wildlife Habitat Grant Program Manager
  (517) 284-5965
  kosloskic3@michigan.gov
  http://www.michigan.gov/dnr/0,4570,7-153-58225_67395-324696--,00.html

DNR Contacts and Customer Service
http://www.michigan.gov/documents/dnr/DNR_customer_service_guide_407568_7.pdf

Michigan Department of Environmental Quality

- **MiWaters**
  Permit Coordination is available through the Environmental Assistance Hotline at 800-662-9278. https://miwaters.deq.state.mi.us/miwaters/#/external/home
- **Michigan Natural Shoreline Partnership:**
  Julia Kirkwood - MNSP-Chair
  MDEQ Water Resources Division
  (269) 312-2760
  kirkwoodj@mi.gov

  Brian Majka - MNSP Vice-Chair
  GEI Consultants
  MNSP Vice-Chair
  (616) 843-3635
  bmajka@geiconsultants.com

  Contractor Training Questions:
  Bob Schutzki
  schutzki@msu.edu

Contractor Listing:
Amy Frankmann
amyf@mnla.org

Shoreline Educator Training and Listing
Julia Kirkwood
kirkwoodj@mi.gov

- **Michigan's Water Strategy**
  (517) 284-5035
  http://www.michigan.gov/deq/0,4561,7-135-3313_3677_76614---,00.html

- Aquatic Plant Management Information and Resources
  http://www.michigan.gov/deq/0,4561,7-135-3313_3681_3710-134641--,00.html

US Fish and Wildlife Service
2651 Coolidge Road, Suite 101
East Lansing, Michigan 48823

- **Landscape Conservation Cooperatives (LCCs)**
  www.GreatLakesLCC.org

- **The Partners for Fish & Wildlife Program**
  Michigan Private Lands Office
  (517) 351-2555
  EastLansing@fws.gov
  https://www.fws.gov/partners/

- **The Northern Institute of Applied Climate Science**
  NIACS- U.S. Forest Service
  Northern Research Station
  410 MacInnes Dr.
  Houghton, MI 49931
  (906) 482-6303
  http://www.nrs.fs.fed.us/niacs/

  Christopher Swanston- NIACS Director
  (906) 482-6303 x20
  cswanston@fs.fed.us
  or

Maria Janowiak - Scientist, Climate Change Adaptation & Carbon Management
(906) 482-6303 x29
mjanowiak02@fs.fed.us

Forest Adaptation Resources

www.forestadaptation.org

Detroit & Western Lake Erie CWMA

Contact: Chris May- Director of Stewardship
The Nature Conservancy in Michigan
101 E. Grand River Avenue
Lansing, MI 48906
(517) 316-2274
cmay@tnc.org
http://www.michiganinvasives.org/detroitlakeeriecwma/

Monroe County Planning Department

125 East Second Street
Monroe, MI 48161
(734) 240-7375
http://www.co.monroe.mi.us/officials_and_departments/departments/planning/iindex.php

Monroe Conservation District

1137 South Telegraph Road
Monroe, MI 48161
(734) 265-9311
http://www.monroecd.org/

Michigan Natural Features Inventory

PO Box 13036
Lansing, MI 48901-3036
(517) 284-6200
https://mnfi.anr.msu.edu/

Southeast Michigan Land Conservancy

Monroe County Chapter
8383 Vreeland Rd.
Superior Township, MI 48198
(734) 484-6565
http://www.smlcland.org/

The Nature Conservancy

The Nature Conservancy - Michigan
101 East Grand River Avenue
Lansing, MI 48906
https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/michigan/index.htm

The Nature Conservancy - Ohio
6375 Riverside Dr., Suite 100
Dublin, OH 43017
https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/ohio/index.htm

The Stewardship Network

416 Longshore Drive
Ann Arbor, MI 48105
(734) 996-3190
wlec@stewardshipnetwork.org
https://www.stewardshipnetwork.org/

River Raisin Institute

610 W. Elm Ave. Monroe, MI 48162
(734) 240-9750
director@rriearth.org
www.rriearth.org

Appendix E: Additional Resources for Landowners

Other Internet Resources for Landowners
(alphabetically)

- Audubon Society: www.MichiganAudubon.org
- Conservation Easements: www.landtrustalliance.org/topics/taxes/income:tax-incentives-land-conservation
- DNR Forest Resources Division: www.Michigan.gov/Forestry
- DNR Hunting Access Program: www.michigan.gov/hap
- DNR Private Forest Land: www.Michigan.gov/PrivateForestLand
- DNR Urban and Community Forestry: www.michigan.gov/ucf
- DNR Wildlife Division: www.Michigan.gov/Wildlife
- DNR Wildlife Landowner Incentive Program: www.michigan.gov/dnrlip
- Field Identification Guides to Invasive Plants in Michigan:
    - www.mnfi.anr.msu.edu/invasive-species/InvasivePlantsFieldGuide.pdf
    - www.michigan.gov/dnr/0,4570,7-153-10370_12146---,00.html
- Foresters for the Birds: http://vt.audubon.org/foresters-birds
- Forestry Taxes: www.timbertax.org
- Heart of the Lakes (Collective of Michigan's land conservancies): www.heartofthelakes.org
- Leafsnap: An Electronic Field Guide: www.leafsnap.com
- Michigan Association of Conservation Districts: www.mcad.org
- Michigan Chapter of the Soil and Water Conservation Society: www.miglswcs.org
- Michigan Environmental Education Curriculum Support: www.michigan.gov/meecs
- Michigan Forest Association Foresters List: www.michiganforests.com/forester.htm
- Michigan Forest Pathways: http://miforestpathways.net
- Midwest Invasive Species Network: www.misin.msu.edu
- Michigan Nature Association: https://www.michigannature.org
- Michigan Society of American Foresters: http://michigansaf.org
- Michigan State University Department of Forestry: www.for.msu.edu
- Michigan State University Diagnostics Laboratory: www.pestid.msu.edu
- Michigan State University Extension Forestry: http://msue.anr.msu.edu/topic/info/forestry
- Michigan State University Soil Testing Laboratory: www.spnl.msu.edu
- Michigan Sustainable Forestry Initiative: http://sfimi.org
- Michigan Technological University School of Forest Resources & Environmental Science: www.mtu.edu/forest
- Michigan United Conservation Clubs: www.mucc.org
- My Land Plan: www.mylandplan.org

- National Wild Turkey Federation: www.nwtf.org
- National Woodland Owners Association: www.woodlandowners.org
- NRCS Financial Assistance: www.nrcs.usda.gov/wps/portal/nrcs/main/mi/technical/landuse/forestry
- NRCS PLANTS Database: www.plants.usda.gov http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx
- NRCS Technical Service Providers: www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/tsp/
- Pheasants Forever: www.pheasantsforever.org
- Project Learning Tree: www.michiganplt.org
- Project WILD: www.michigan.gov/michiganprojectwild
- Quality Deer Management Association: www.qdma.com
- Ruffed Grouse Society: www.ruffedgrousesociety.org
- Sample Timber Sale Contract: www.nhdfl.org/library/pdf/Forest%20Protection/timbersaleagreement.pdf
- Ties to the Land (succession planning to pass forest to next generation): www.tiestotheland.org
- Tree Sales: www.michigan.gov/documents/dnr/DirectoryOfMichiganSeedlingNurseries:IC4175_25882 8_7.pdf?20141113140132
- Trout Unlimited: www.michigantu.org
- USDA Soil Web Survey: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm
- USFS Ecosystem Services: www.fs.fed.us/ecosystemservices/index.shtml
- USFS Private Woodland Owners: http://na.fs.fed.us/pubs/misc/flg
- USFS State and Private Forestry: www.fs.fed.us/spf
- Whitetails Unlimited: www.whitetailsunlimited.com
- Woodland Stewardship: www.woodlandstewardship.org

Books for Landowners

1. Woodland Stewardship: A Practical Guide for Midwestern Landowners (2nd Edition). 2009. This book, written by a team of educators and foresters from Minnesota, Wisconsin, and Michigan is an excellent manual on how to manage your forest for a wide variety of goals. (A free pdf of the entire book is online at): http://woodlandstewardship.org

2. Owning and Managing Forest: A Guide to Legal, Financial, and Practical Matters (Revised). 2005. This book is written by Thomas McEvoy, an Extension Professor at the University of Vermont. It contains excellent advice on the legal and financial issues of owning and managing a family forest.

3. A Landowner's Guide to Managing Your Woods. 2011. This book is authored by a landowner, forester, and logger to give a balanced view of forest management and how to maintain a small forest for long-term health, biodiversity, and high-quality timber production.

4. Michigan Trees: A Guide to the Trees of the Great Lakes Region (Revised). 2004. This book is the classic text on tree identification in Michigan authored by two U of M professors. It has drawings instead of photos, but the book has more complete information than the ID books with prettier photos.

5. Michigan Forest Communities: A Field Guide and Reference. 2004. This book, by Dr. Don Dickmann at MSU, describes 23 forest communities in Michigan. The book is available from MSU Extension. A free pdf is at http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E3000.pdf.

6. The Forests of Michigan (Revised). 2016. This book by two MSU forestry professors is an interesting history of Michigan's forests over the last few centuries and is available at the University of Michigan Press.

7. Positive Impact Forestry: A Sustainable Approach to Managing Woodlands. 2004. This book is written by Thomas McEvoy, an Extension Professor at the University of Vermont. It is a great introduction to silviculture, the science and art of growing and managing forests.

8. Estate Planning for Forest Landowners: What Will Become of Your Timberland? 2009. Nothing is more dreadful than death and taxes, but this book helps landowners prepare for both. To ease your pain, it is free at http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs112.pdf. See also www.timbertax.org

9. Trees Are the Answer (Revised). 2010. This book is written by Dr. Patrick Moore, one of the founders of Greenpeace. His perspective on forestry will appeal to both tree huggers and loggers.

10. Managing Michigan's Wildlife: A Landowner's Guide. 2001. This book, edited by two biologists for the Michigan Department of Natural Resources, is the classic text in Michigan for landowners on wildlife habitat and managing forests for preferred game species. This book about wildlife habitat management is only available at: www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/index.htm

11. A Sand County Almanac. 1949. This book by Aldo Leopold is one of the foundations for environmental ethics that continues to inform forest stewardship of both private and public lands. This book will help you to articulate your own ethical approach to managing your forest.

12. Last Child in the Woods. 2008. This book by Richard Louv is a strong argument that our nation's children are suffering from "nature deficit disorder." This book will give you great ideas about how you can bring school groups, scout groups, church groups, or even your own children out into your forest to experience and enjoy nature.

Appendix F: Bibliography

Adams, G. (2009, June 5). Michigan State University Extension. *Improved elms for Michigan's urban landscapes.* Retrieved from http://msue.anr.msu.edu/news/improved_elms_for_michigans_urban_landscapes

Archambault, L., B. V. Barnes, and J. A. Witter. (1990). Landscape ecosystems of disturbed oak forests of southeastern Michigan, USA. Canadian Journal of Forest Research 20: 1570–1582.

Bakowsky, W. 1988. The phytosociology of Midwestern savanna in the Carolinian Region of Southern Ontario. M.S. thesis. University of Toronto. 118 pp.

Bioagricultural Sciences & Pest Management. *National Elm Trial.* Retrieved from http://bspm.agsci.colostate.edu/national-elm-trial/

Bowman, W.L. (1981,). Home NRCS. *Soil Survey of Monroe County, Michigan.* Retrieved From http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/michigan/MI115/0/monroe.pdf

Bricult, B. (2014, May 23). Michigan State University Extension. *Return of the American elm.* Retrieved from http://msue.anr.msu.edu/news/return_of_the_american_elm

Cohen, J.G. 2001. Natural community abstract for lakeplain oak openings. Natural Features Inventory, Lansing, MI. 10 pp.

Community Planning Committee. 2013. Resilient Monroe Resource Atlas. Monroe County, MI. http://www.resilientmonroe.org

Cook, B. 2016. Oak Wilt Disease. Michigan State University Extension News. April 11, 2016. Retrieved online from http://msue.anr.msu.edu/news/oak_wilt_disease_1 on April 15, 2017.

Cregg, B. et al. 2015. What is spruce decline and what should you do about it? Frequently asked questions about spruce decline. Michigan State University Extension Newsletter: March 2015.

Derosier, A.L., S.K. Hanshue, K.E. Wehrly, J.K. Farkas, and M.J. Nichols. 2015. Michigan's Wildlife Action Plan. Michigan Department of Natural Resources, Lansing, MI. http://www.michigan.gov/dnrwildlifeaction

Dickmann, D.I. (2004). *Michigan Forest Communities: A Field Guide and Reference.* Retrieved From http://www.miwaterstewardship.org/Portals/0/docs/MSUE%20Bulletins/Michigan.Forest.Communities.Field.Guide.and.Reference-E3000.pdf

Ducks Unlimited. 2004. Ducks Unlimited International Conservation Plan. Ducks Unlimited Headquarters, Memphis, TN. http://www.ducks.org/media/conservation

Elm renaissance: a new chance for a beloved American tree. Retrieved from https://www.fs.fed.us/psw/topics/urban_forestry/products/psw_cufr688_American_Elm_Renaissance.pdf

Erickson, D.L., Ryan, R.L., and De Young, R. 2002. Woodlots in the rural landscape: landowner motivations and management attitudes in a Michigan (USA) case study. Landscape and Urban Planning 58: 101-112.

Fleury, T.; Blinn, C.R. 1996. Ownership fragmentation in the nonindustrial private forest lands of Northern Minnesota between 1965 and 1990. In: Baughman, M.J., ed. Proceedings of a symposium on nonindustrial private forests: Learning from the past, prospects for the future. St. Paul, MN: University of Minnesota: 238-247.

Great Lakes Interagency Task Force. 2014. Great Lakes Restoration Initiative Action Plan II. Environmental Protection Agency, Chicago, IL.

Kost, M.A., Albert, D.A., Cohen, J.G., Slaughter, B.S., Schillo, R.K., Weber, C.R., & Chapman, K.A. (2010, July 9). Michigan Natural Features Inventory. *Michigan's Natural Communities.* Retrieved from https://mnfi.anr.msu.edu/reports/2007-21_Natural_Communites_of_Michigan_Classification_and_Description.pdf

Marzluff, J.M., and K. Ewing. 2001. Restoration of fragmented landscapes for the conservation of birds: A general framework and specific recommendations for urbanizing landscapes. Restoration Ecology 9: 280-292.

McCullough, D.G., Heyd, R.L., & O'Brien, J.G. (2005). Biology and Management of Beech Bark Disease: Michigan's Newest Exotic Forest Pest. *Michigan State Extension Bulletin,* (E-2746), 11. Retrieved from http://msue.anr.msu.edu/uploads/files/e2746.pdf

Michigan Archaeology. *Michigan State Historic Preservation Office*, Brochure. Retrieved from http://www.michigan.gov/documents/mshda/mshda_shpo_20140211_archaeology_brochure_447191_7.pdf

Michigan Department of Natural Resources. 2008. Michigan state forest management plan. D.L. Price, editor. Michigan Department of Natural Resources, Forest, Mineral, and Fire Management Division and Wildlife Division, Lansing.

Michigan Department of Natural Resources. 2010. Michigan Forest Resource Assessment and Strategy. D.L. Price, editor. Michigan Department of Natural Resources, Forest Management Division, Lansing, MI. http://www.michigan.gov/dnre

Monroe County 5-Year Recreation Plan 2013-2017. Retrieved from http://www.co.monroe.mi.us/Parks-Recreation/recplan2013_final_approved.pdf

Mozola, A.J. 1970. Geology for Environmental Planning in Monroe County. Michigan Geological Survey Division Report of Investigation 13.

Nicholas, J.R., G.L. Rowe, and J.R. Brannen. 1996. Hydrology, Water Quality, and Effects of Drought in Monroe County, Michigan. U.S. Geological Survey -Water Resources Investigations Report 94-4161

O'Brien, J.G., Mielke, M.E., Starkey, D., & Juzwik, J. (2017, March). *How to Identify, Prevent, and Control Oak Wilt.* Retrieved from https://www.na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

Paskus, J. and Barondess, M. 2017. I-75 Corridor Conservation Action Plan in Monroe County. Published by SEMCOG.

Pearsall, D.R., et al. 2013. "Make No Little Plans": Developing Biodiversity Strategies for the Great Lakes. Environmental Practice, 15:4.

Pure Michigan. *Great Lakes- Lake Erie.* Retrieved from http://www.michigan.org/michigan-s-great-lakes/lake-erie

Pure Michigan. *River Raisin National Battlefield Park.* Retrieved from http://www.michigan.org/property/river-raisin-national-battlefield-park

SEMCOG. (n.d.). SEMCOG 2008 Land Use [Chart]. In *Land Use*. Retrieved from http://semcog.org/Land-Use#dnn_HeaderPane --

Sherzer, W. H. 1900. Geological Report on Monroe County Michigan. Volume VII of Geological Survey of Michigan Lower Peninsula 1896- 1900. Michigan Board of Geological Survey.

Slaughter, B.S. 2009. Natural community abstract for southern hardwood swamp. Michigan Natural Features Inventory, Lansing, MI. 16 pp.

Slaughter, B.S., J.G. Cohen, and M.A. Kost. 2010. Natural community abstract for wet-mesic flatwoods. Michigan Natural Features Inventory, Lansing, MI. 14 pp.

Snyder, M. (2014, October 13). Northern Woodlands. *What Is Forest Fragmentation and Why Is It A Problem?* Retrieved from http://northernwoodlands.org/articles/article/forest-fragmentation

Thomas, S.A., Y. Lee, M. A. Kost, & D. A. Albert. 2010. Abstract for vernal pool. Michigan Natural Features Inventory, Lansing, MI. 24 pp. Retrieved from https://mnfi.anr.msu.edu/abstracts/ecology/vernal_pool.pdf

Tori, G. M., Robb, J.R., and J. L. Weeks. 1990. American black ducks staging in Ohio's Lake Erie marshes. Presented at fifty-second Midwest Fish and Wildlife. Conf., Minneapolis, MN.

Wayne State University Center for Urban Studies. (2013, September 9). 2012 Population density (miles) for Southeast Michigan [Map]. In *Drawing Detroit*. Retrieved from http://www.drawingdetroit.com/outlying-counties-in-southeast-michigan-have-lower-population-density/

Web Soil Survey. Retrieved from https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm