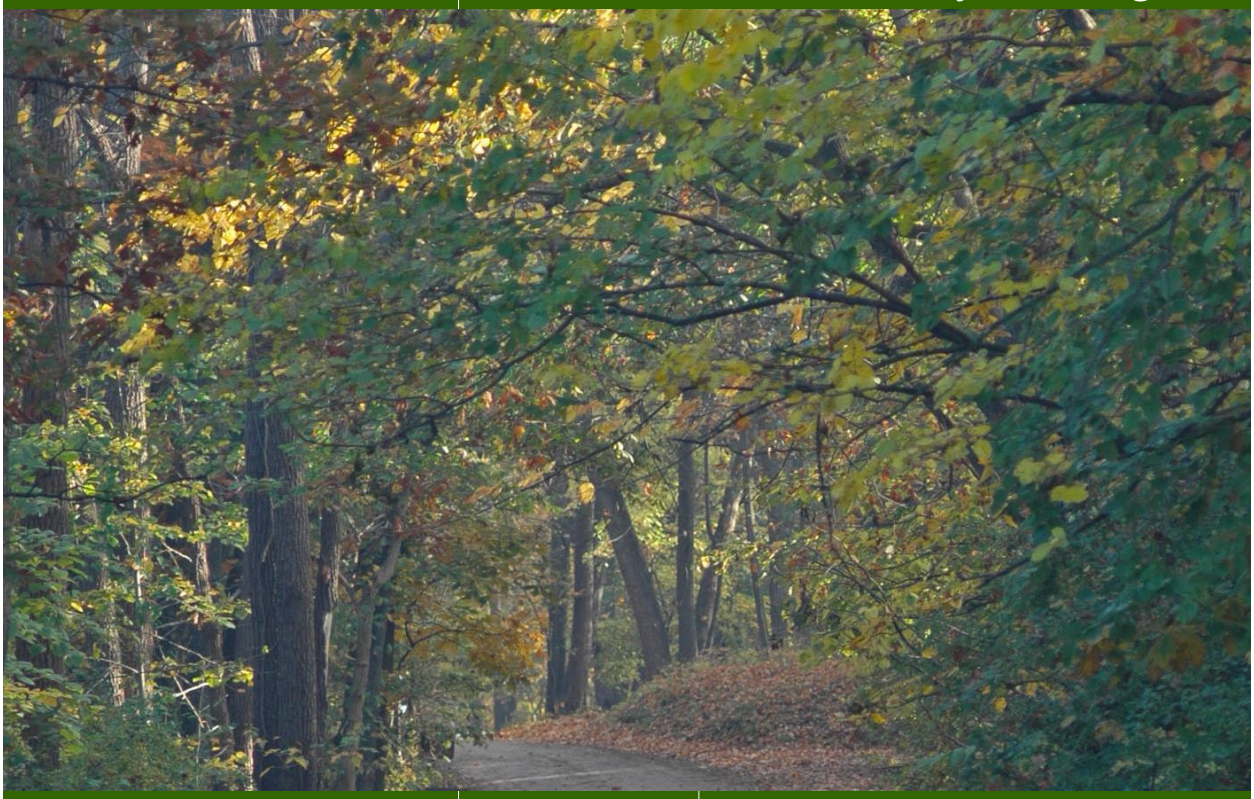
LANDSCAPE STEWARDSHIP PLAN:

Oakland County, Michigan



PREPARED BY	LISA BRUSH & TYLER MITCHELL THE STEWARDSHIP NETWORK
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The Stewardship Network
Connect to Conserve

Landscape Stewardship Plan for Oakland County, Michigan

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Acknowledgements

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1. Executive Summary

This Landscape Stewardship Plan for Oakland County is one of nine such plans that were developed through a larger grant project funded by U.S. Forest Service and administered by the Michigan Department of Natural Resources (DNR). The intent of developing this plan was to connect the people and organizations to each other and to forest stewardship information, resources, and assistance programs, thereby increasing our collective capacity to protect and maintain the forests products, services, and values on which this region depends. Only by working collaboratively at the landscape scale we can better address landscape-scale challenges that threaten the health and sustainability of our forests and other natural resources.

Oakland County is a region with a diverse economy and a varied landscape. Boasting over 1,400 inland lakes and the headwaters of 6 major rivers, Oakland County's landscape is in a constant struggle over preserving natural areas while serving more than 12% of the population of the state of Michigan. Once considered "up north" to Detroiters, the region's tourism and outdoor recreation economies are under constant threat of being swallowed up by urban sprawl. Oakland County is home to several threatened and endanger species including the Poweshiek skipperling, eastern massasauga rattlesnake, and northern long-eared bat. The maintenance of healthy and productive forests, protection of rare species, and preservation of high quality water resources is integral to maintaining the sustainable natural resource base needed to serve the diverse population of Oakland County.

The sustainable management of this resource base faces a diverse set of threats and challenges. Factors such as climate change, invasive species, tree diseases and insect pests, habitat fragmentation, nonpoint source pollution, limited financial resources for sustainable land stewardship practices place our forests, water resources, wildlife, and human communities at risk. A major goal of the Landscape Stewardship Plan is to increase interest, awareness, and participation in active land stewardship opportunities throughout Oakland County, which is also an important first step in alleviating many of the other challenges mentioned above.

A good first step in this process is to coordinate with landowners to develop customized Forest Stewardship Plans, which characterize existing resource features found on a particular property and identify strategies for meeting each landowners' goals through on-the-ground stewardship activities that also yield public benefits such as protection of clean water, provision of wildlife habitat, and mitigation of various negative factors acting on the landscape scale. In fact, the idea for this Landscape Stewardship Plan project was based on the idea of these individual Forest Stewardship Plans, which, due to their limited geographic scope, fail to fully address some of the biggest challenges to management. While a collaborative landscape-scale approach to stewardship is therefore critical, success ultimately still depends on the participation of individuals.

Each of the nine Landscape Stewardship Plans characterizes the focal ecosystem's physical, biological, and cultural resources, including a summary of existing resource assessments and

stewardship plans. The process of developing each Landscape Stewardship Plan has brought resource professionals and other stakeholders closer together, and the plans serve to connect landowners and land managers with information about practices and programs that will help people take the next step toward becoming more engaged land managers.

A key element of each Landscape Stewardship Plan is the collection of inspirational stewardship stories told by the people living or working within the focal landscapes. Through these stories, local landowners and land managers share why and how they are active stewards of their own forests. Whether that means a small private property or a vast area of public land, these stories are told with the hope of inspiring other landowners and land managers to join in and become actively involved in the stewardship of our collective forest resources. Our forests are, after all, interconnected with all of the other physical, ecological, and cultural elements of the landscape we call home.

2. Project Introduction

This Landscape Stewardship Plan focuses on The Stewardship Network's Headwaters Cluster, which includes all of Oakland County, and 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 (DNR) received a grant from the United State Forest Service (USFS) to partner with Huron Pines, The Nature Conservancy, and The Stewardship Network (all of which are 501(c)(3) nonprofit and non-governmental conservation organizations) to develop nine such landscape stewardship plans, each covering unique Michigan ecosystems (Figure 2.1).

Each of the nine Landscape Stewardship Plans 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 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 each focal landscape. Rather than simply listing recommended land management practices, these stories demonstrate why and how real people, in their own words, choose to actively and sustainably manage their land.

The purpose of these Landscape Stewardship Plans is to inspire people to become more active environmental stewards by showcasing opportunities through stories and by connecting people with the resources that can help them take the next steps in that process. By increasing the voluntary participation in land stewardship activities, we are ultimately working to protect and preserve Michigan's unique natural resources. This can only be achieved at the landscape scale – with private and public land managers all working in concert 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. This region is a mosaic of densely populated urban areas, sprawling agricultural lands and small private forests. There is comparatively little forest land under public ownership in southern Michigan. Seventy-five percent of Michigan's 10 million residents live in this region, so land management activities across this area of the state have the potential to impact a large number of people.

Huron Pines developed two of the nine Landscape Stewardship Plans. In addition to the Jack Pines Ecosystem plan, Huron Pines wrote a second plan featuring Michigan's Northern Hardwoods, with a focus on Cheboygan and Otsego counties. Both of these 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 long-term protection of these resources faces many challenges.

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 public and private forest land.

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 upon existing resource assessments, stewardship plans, and other available literature.

Project partners also worked with Dr. Stuart Gage, Michigan State University professor emeritus, to install at least one acoustic monitoring device in each landscape to capture the "soundscape" of each landscape. The sounds of the forest tell a story of their own. Eventually, a web site will be created to host an interactive "story map" that will allow people to view stories in their region, share their own stories, and listen to the stories of the forest.

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.

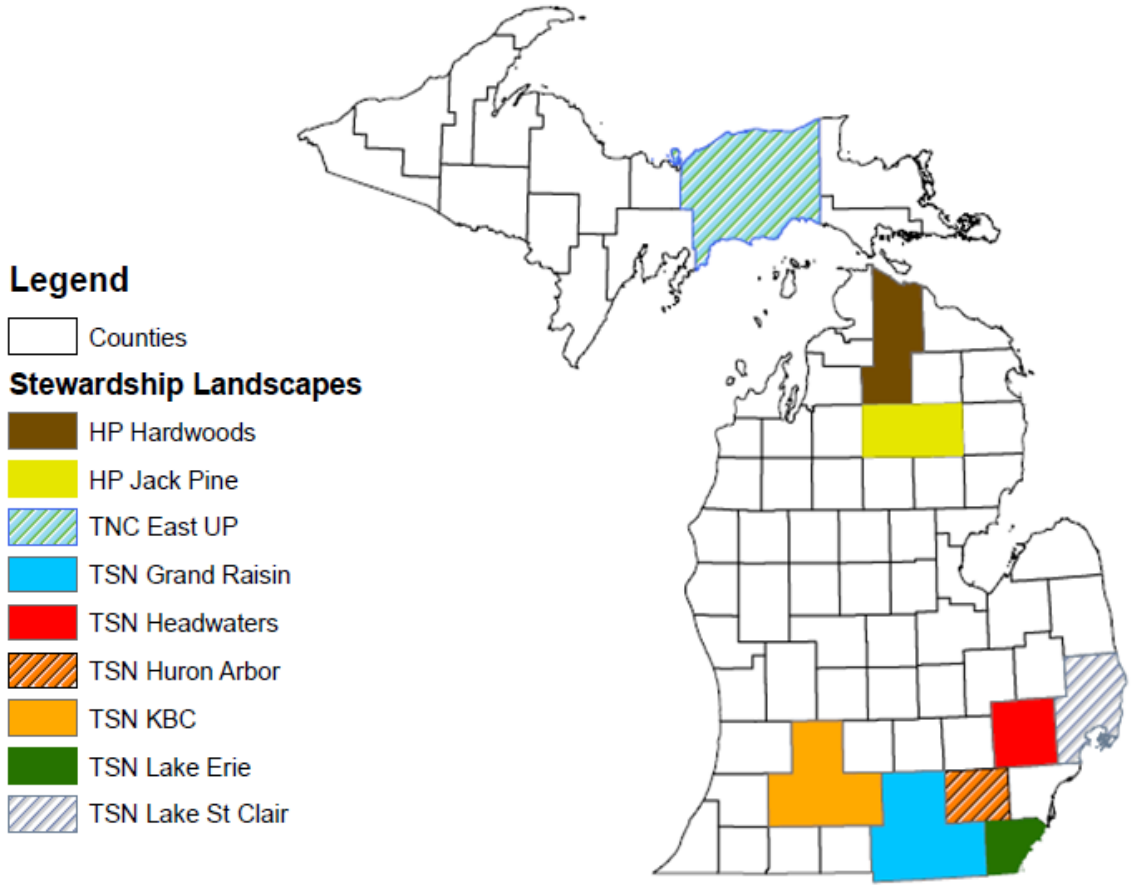


Figure 2.1 Map of areas covered by the nine Landscape Stewardship Plans. TSN Headwaters is Oakland County. (Michigan DNR)

2.1 Project Goals and Objectives

Michigan's forests face myriad threats—invasive species, tree diseases, habitat fragmentation, financial challenges—that sometimes make it difficult to achieve forest stewardship goals. It is estimated that only 20% of Michigan's 12 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, Parcelization, 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 of those acres are privately owned. State and federal agencies are responsible for managing our 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. Unfortunately, a survey conducted by Michigan State University revealed that only about 20% of Michigan's non-industrial private forest lands are currently under active management.

The condition of a particular forest property is highly dependent on the condition of other forest lands throughout the landscape. Conversely, the management actions (or lack of active forest management) on a single property can impact forests, rivers, wildlife, property, and people far beyond the boundary of that individual piece of land. Native wildlife, forest fires, harmful invasive species, diseases, and insect pests all move freely among private and public land—they do not recognize 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).

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 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 Huron Pines, The Stewardship Network, and The Nature Conservancy 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 Headwaters region in Oakland County was identified as a good landscape of focus because of its important resources that make this region unique, and the large population located in the area. Oakland County's distinctive geologic history has shaped the features of this landscape. Nearly all the hills and lakes in Oakland County were formed during the retreat of the last continental glacier. Deposition of glacial till across this region led to many natural areas being saved from becoming farm land. Early settlers had difficulty removing the unevenly distributed pebbles and boulders from their lands. Many properties that were once farmed have since returned to nature as Oakland County's economy boomed alongside the developing auto industry of Detroit. Dubbed "Automation Alley" by local leaders, Oakland County has grown with one foot in the urban culture of Metro-Detroit, and one foot in the history of its roots as an "up-north" getaway in Southeast Michigan.

The Stewardship Network coordinated with the Landscape Stewardship Plan 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 conducted a review of existing resource assessments and management plans/strategies. We 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 to make it easy for property owners and land managers to learn more and to take the next step toward becoming a more active land steward.

A collection of stewardship stories, told by local landowners and land managers, are included in Section 4 to illustrate some of the opportunities and practices that people are doing in the area. Rather than simply providing a list of recommendations that property owners should be doing, we hope these stories inspire others to learn more about their properties unique qualities, examine their relationship with the land, and take advantage of the opportunities that are out there to help them as they begin or continue to act as a steward of the earth. The Stewardship Network and our partners identified people that are doing great things on their land and who

want to tell their stories. We had conversations with individual, corporate, state, and federal land owners, and managers to hear about the wide range of land stewardship activities people are doing here in Oakland County. 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.

Forests also tell their own stories. An acoustic monitoring device was placed in a forested preserve in Rose Township, which recorded for one minute every thirty minutes from October through December 2016. Similar acoustic monitoring devices were deployed in several other landscapes throughout the state of Michigan. The Michigan DNR is planning to host an online story map where people can read the stewardship stories collected through this project, submit their own stories, view images and listen to sounds of our forests.

For your convenience, a summary of the available assistance programs, additional resources, and contacts is included at the end of the plan to guide you to becoming an active land steward.

3. Landscape Context

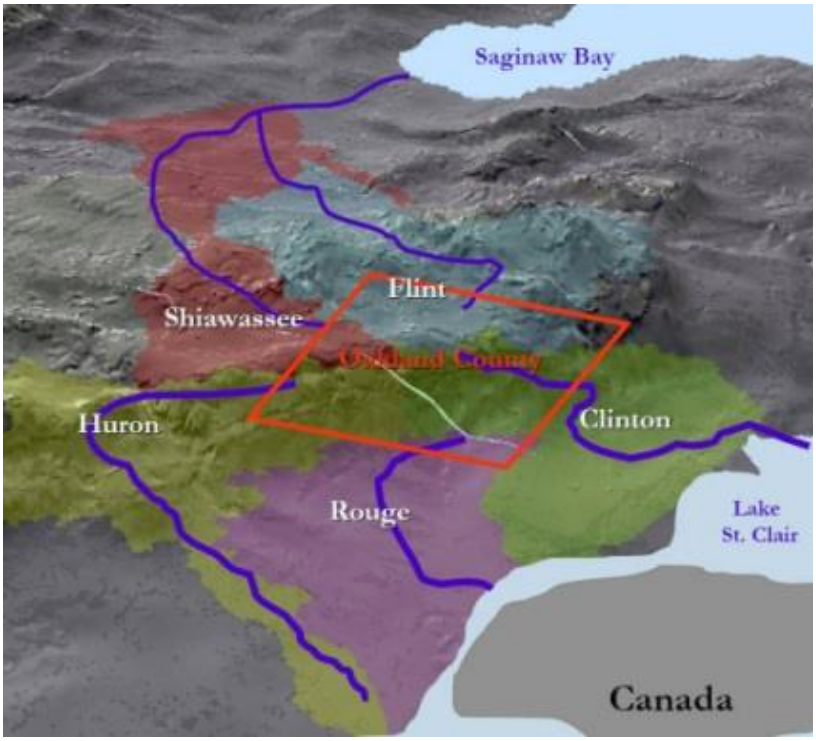
The Headwaters ecosystem of Oakland County invokes a variety of images and feelings from different folks. It is a landscape defined by pocket lakes and abundant rivers and streams. It is all at once rural, urban, and suburban. It is also defined by the diversity of the people of Oakland County. Communities in Oakland County rely heavily on the various natural resources that surround them, and the health and continued existence of those natural resources depend on the people who care for and manage them. Active and collaborative stewardship of private and public lands will be essential if we are to successfully address the threats facing our forests, water resources, and wildlife that define who we are and how we live in Oakland County.

Our use and management of the Headwaters landscape has evolved over time—from the early settlement homesteading of the nineteenth century and subsequent failed attempts to farm the rock laden soils, to its current use for outdoor recreation, commercial enterprise, and private residences.

3.1 The Physical, Ecological and Cultural Landscape

3.1.1 Geographic Scope

This Landscape Stewardship Plan covers Oakland County in Southeast Michigan. This county lies at the heart of six watersheds that extend out across most of Southeast Michigan. (Figure 3.2 and 3.3). Oakland County extends over 907 square miles (or 580,549 acres) including 40 square miles of surface water features. Population density steadily climbs heading from the urbanized Southeast to rural Northwest.



Although this plan has been specifically tailored for the landowners and land managers living or working Oakland County, most of its information and many of the listed resources, assistance programs, and Best Management Practices (BMPs) in this plan are largely applicable to the greater Headwaters Region, which extends into several surrounding counties.

Figure 3.2 Aerial perspective of the 5 rivers originating within the Headwaters Region of Oakland County.

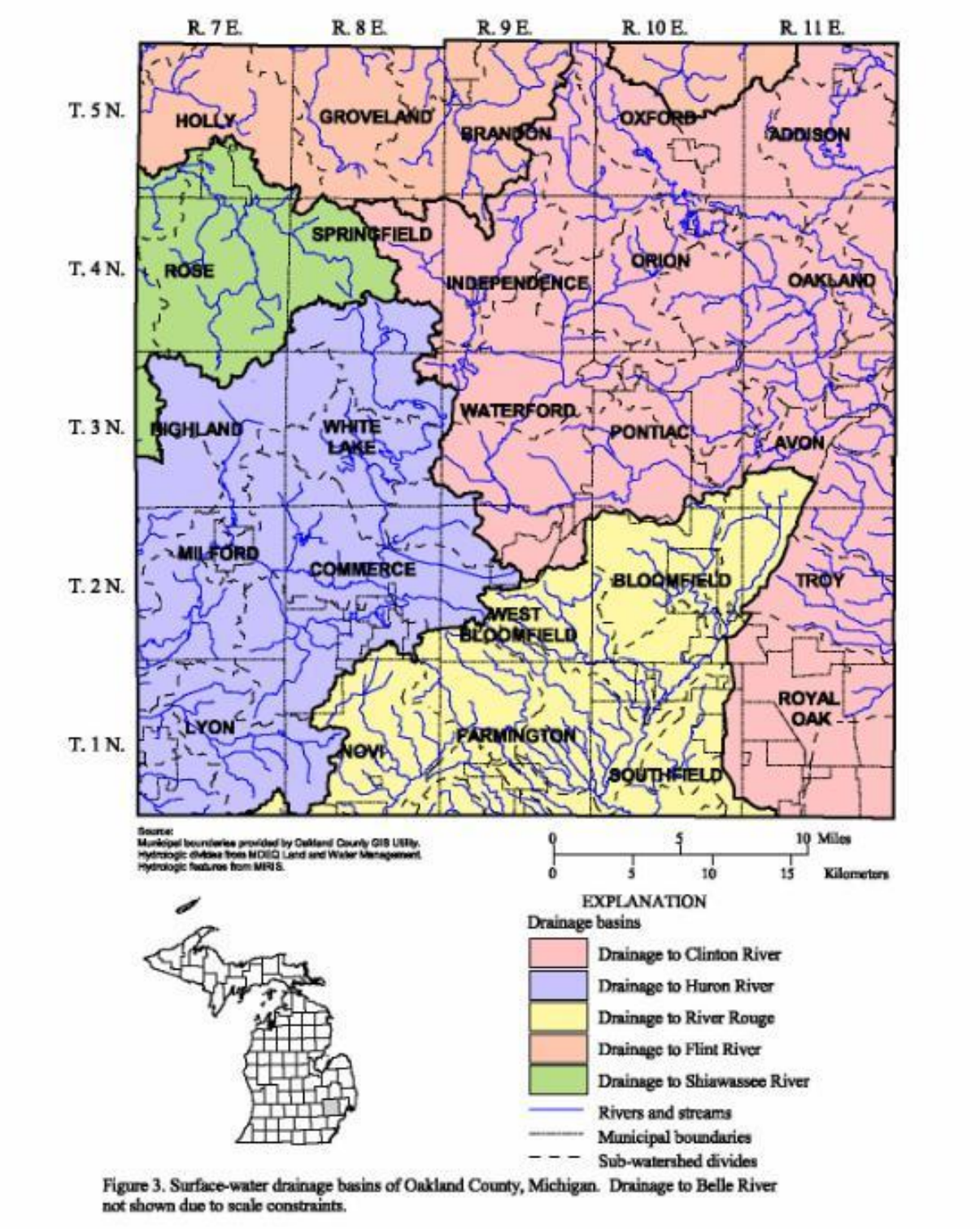


Figure 3. Surface-water drainage basins of Oakland County, Michigan. Drainage to Belle River not shown due to scale constraints.

Figure 3.3 Major watershed drainage basins and township boundaries of Oakland County.

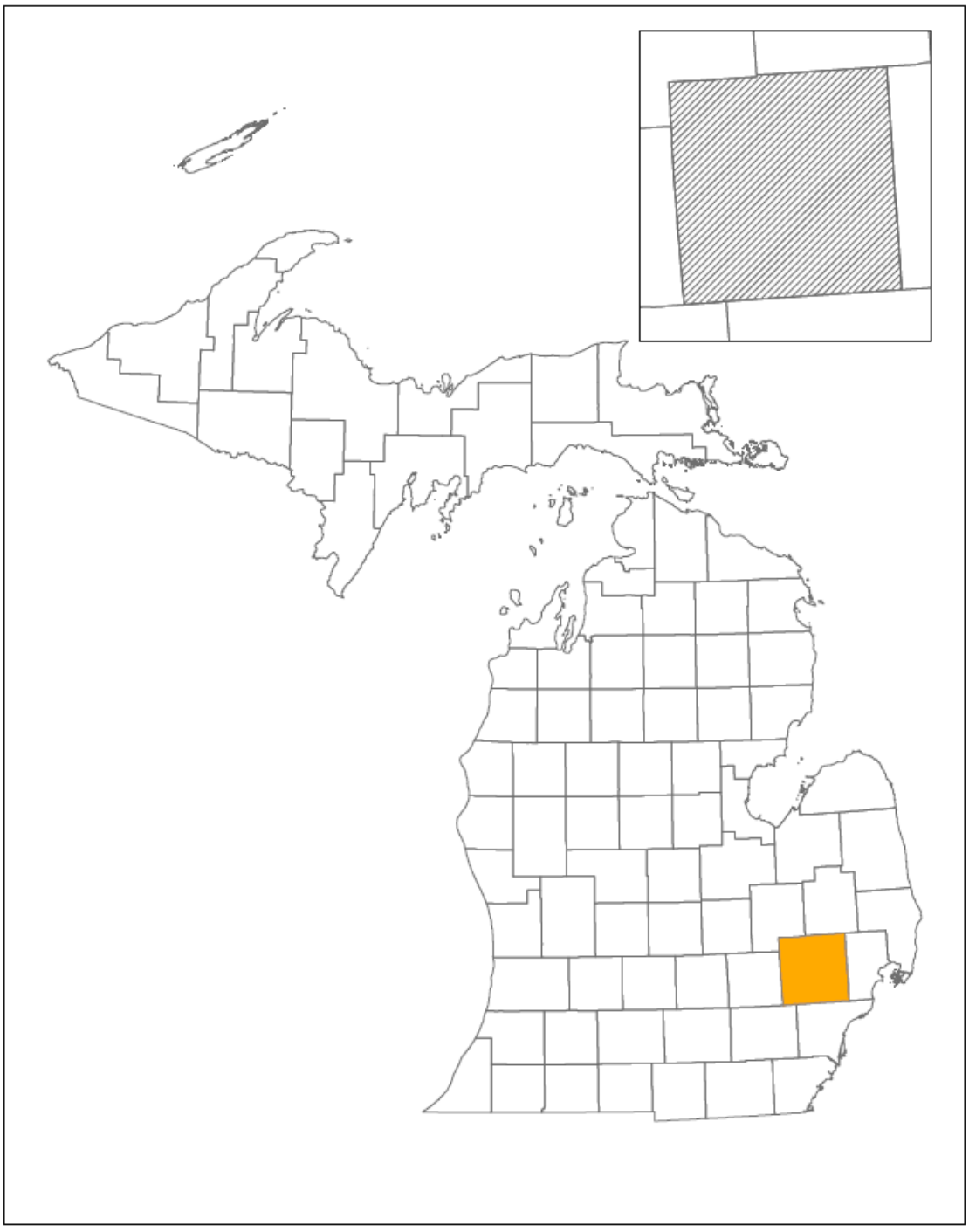


Figure 3.4 Oakland County in the larger context of the state of Michigan (Michigan DNR)

3.1.2 Cultural Landscape

The cultural landscape of Oakland County, a county with over 1.2 million residents (2010 US census), is a rapidly changing and growing identity. Its largest communities are located in the urbanized south in the cities of Troy, Farmington Hills, and Southfield. Farther north and west lay the rural communities of Rose, Holly, and Springfield. Oakland County has little in the way of agricultural land, representing only 4.5% of land use in the county. Rural communities are surrounded in large part by recreation and conservation areas. This mostly undeveloped landscape is dominated by expansive wetland complexes, rolling hills left behind on the terminal moraines of retreating glaciers, and of course many inland lakes. A drive through the rural northwest will reveal miles of scenic dirt roads lined with pockets of privately owned forests and open grasslands. The sense of common identity comes from a feeling that these diverse communities are united by a single thread – the surrounding natural resources that we all rely on to maintain the quality of life enjoyed in Oakland County.

The people of Oakland County have always had close relationship with the forests, waters, and wildlife of the Headwaters region. Early European settlers utilized the abundant rivers and streams for transporting and milling timber to be shipped to Detroit. The lack of land suitable for farming led to the preservation of large areas to be used for recreation, hunting, fishing, and trapping.

Outdoor recreation is a favorite pastime for Oakland County residents. The County boasts two major park systems, several state recreation areas, and numerous municipal parks. Major festivals and events are centered around natural resources, and draw hundreds of visitors annually. Hunting, hiking, camping, wildlife viewing, and winter sports also draw visitors to the area and are important recreational activities for the people that live here.

The residents of the Headwaters Region in Oakland County primarily own small lots according to 2015 Oakland County Government statistics. The large majority (>90%) of landowners own parcels less than an acre in size. Private landowners holding more than 10 acres represent a mere 0.5% of parcels in Oakland County. Due to the fragmented nature of forested lots in this region, collaboration between neighbors and communities is imperative to ensure the protection of privately held forested lands.

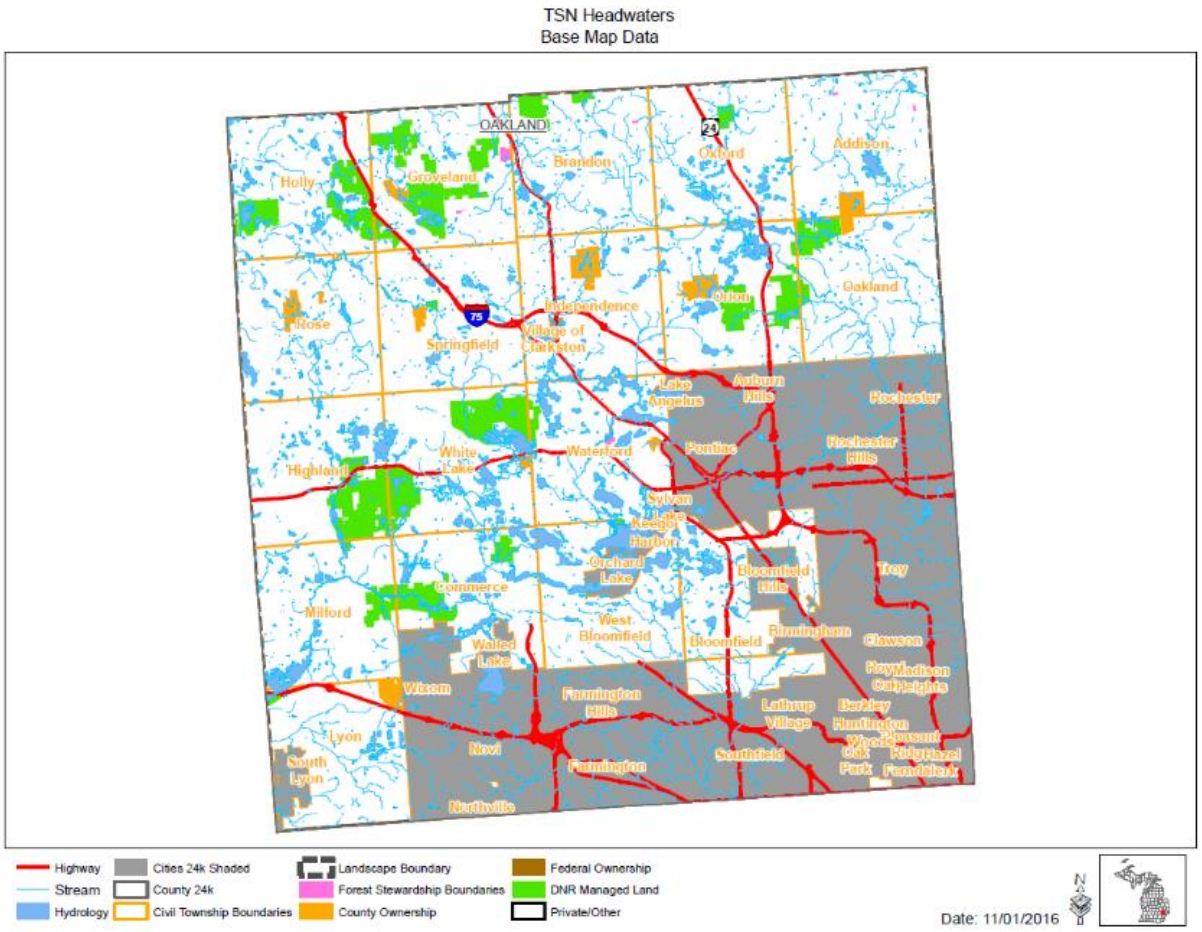


Figure 3. 5 Base Map for Oakland County (Michigan DNR)

3.1.3 Climate, Geology, Topography and Land Cover

Oakland County, Michigan has a humid continental climate with hot summers and no dry season. Rainfall in this region is lower than other areas in the United States. The average rainfall is about 30 inches annually, compared to a national average of 36.5 inches annually. However, Oakland county has more precipitation days than the national average.

The warm season lasts from late May to mid-September. The cold season spans from late November through early March (Figure 3.6). Oakland County, Michigan averages lower temperatures in summer and winter than the national average. This gives this area a pleasant summer, but can result in harsh winter weather patterns. The presence of many lakes and wetlands can help buffer summer heat waves and prevent rapid drops in overnight temperature during the winter. As global climate destabilization becomes a more widespread issue, residents of Oakland County will rely on these surface water features to maintain a comfortable local climate and ecologically vibrant natural communities.

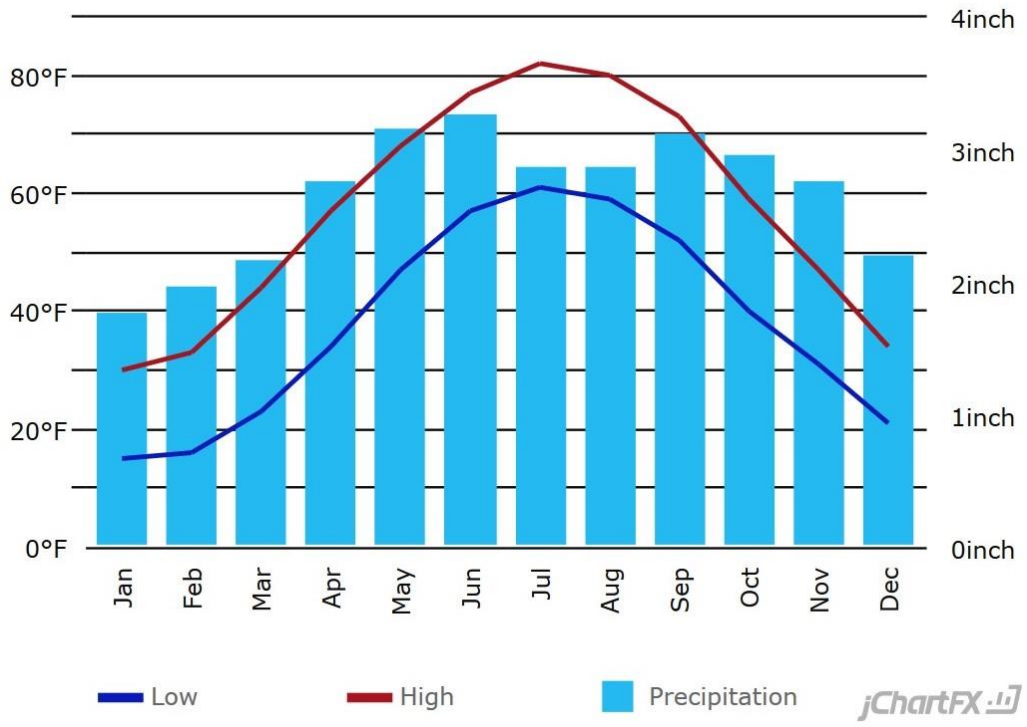


Figure 3.6 Temperature and Precipitation averages for Pontiac, Michigan, a city located near the middle of Oakland County (http://www.usclimatedata.com/climate/pontiac/michigan/united-states/usmi0681)

The Headwaters region of Oakland County is an area of relatively little elevation change. The topography of the county is generally sloping from higher elevation in the northwest corner, dropping to the southeast as the landscape shifts from rolling hills left by glacial terminal moraines to the outwash plain of the southeast. This relatively flat topography of the southeast may have been an important factor for early settlers looking for places to build, leading to the increased population density and urbanization of this region of Oakland County.

Land use in Oakland County is dominated by small parcel single family residential homes (Figure 3.7) The glacial till soils left little area suitable for farming, and this history has translated to very little agricultural land use in this region. The urbanized southeast landscape shows very few large recreation and conservation areas, and smaller mean residential lot sizes. The majority of the large conservation areas, almost all of the agricultural lands, and the majority of the larger parcel-size single family residences are concentrated in the rural northwest. As urban sprawl continues to encroach from the southeast, many of these agricultural lands are being developed into sub-acre residential and commercial plots.

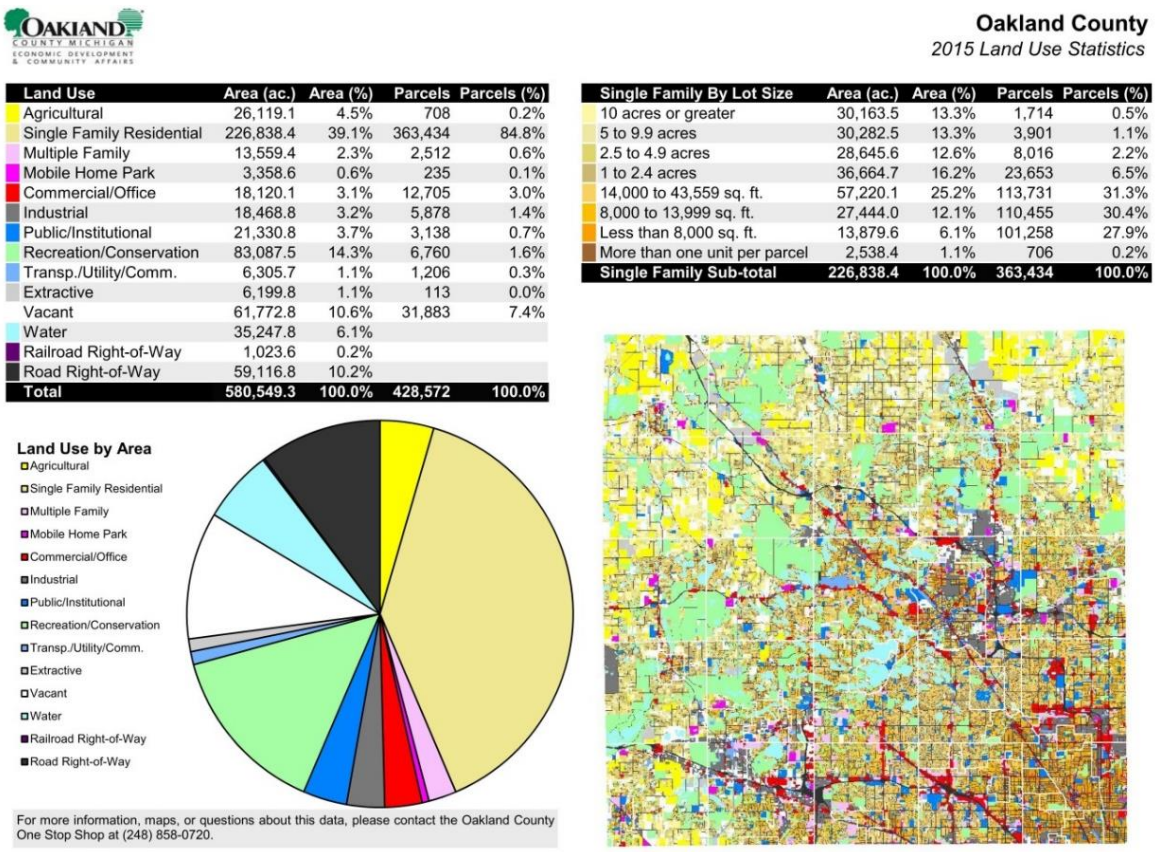


Figure 3.7 Oakland County Land Use Statistics (Oakland County Economic Development and Community Affairs)

Pre-1800s vegetation of Oakland County was dominated by Black Oak Barrens as well as Beech-Sugar Maple Forest and Oak-Hickory Forest communities (Figure 3.8) Black Oak Barren communities are highly dependent on natural fire cycles, with a seasonally bimodal peak in flammability. These habitats relied heavily on fire to prevent canopy closure and woody vegetation dominance. With European settlement and the ensuing disruption of natural fire cycles, canopy closure began to create woody dominated landscapes and have changed much of the vegetated landscape in Oakland County. Many native species, including Threatened and Endangered species, rely on the functional ecosystem services these landscapes provide. Forest managers and other natural areas managers in Oakland County have begun to reintroduce a natural fire cycle to these overgrown areas in an attempt to restore pre-settlement vegetation communities.

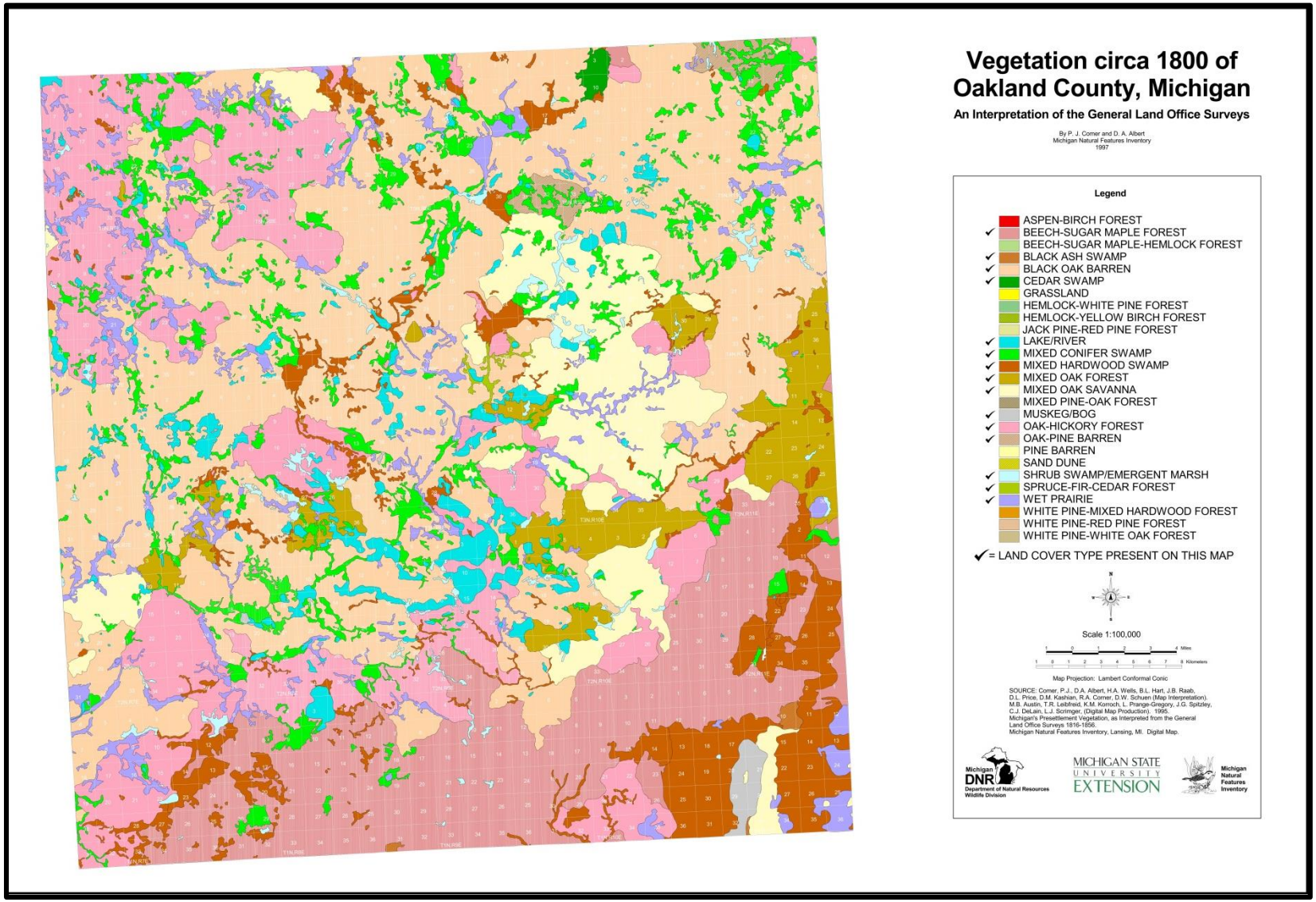


Figure 3.8 Map of Pre-1800s vegetation communities in Oakland County. (MNFI)

3.1.4 Soils

The history of Oakland County can be read in its surface geology and soil makeup. Oakland County is referred to as the "interlobate" region of Southeast Michigan. The last glaciation period ended approximately 14,000 years ago, when two large glacial lobes retreated across Oakland County. The Saginaw Lobe in the northern part of the county and the Huron-Erie Lobe to the south were separated by an ice-free area which tracked through Commerce, Waterford, and Oxford Townships (Figure 3.9)

This area formed a conduit for large quantities of water and sediment flowing off the melting glaciers, known as outwash. The sediments transported in this conduit were sorted by size and layered vertically. Deposits left on either edge of this outwash plain by the terminal moraine resulted in an unsorted deposition of clays, sands, pebbles, and boulders. These areas have a much lower rate of permeability due to the higher fraction of clay deposits.

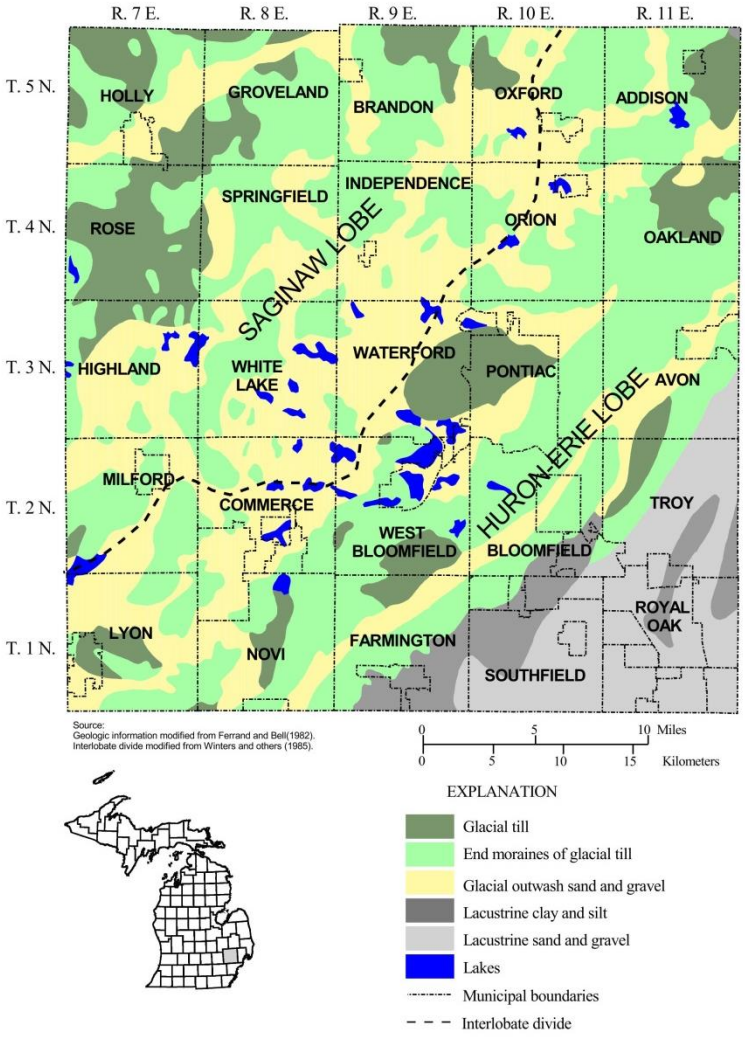


Figure 3.9 Surficial geology of Oakland County. (Geologic information from Ferrand and Bell, 1982 and Interlobate divid modified from Winters and others, 1985)

3.1.5 Water

The headwaters region in Oakland County is highly dependent on its local surface and ground water features. From the unique geologic history of its formation and soil composition, to the presence of more than 1,000 inland lakes, Oakland County has been endowed with an abundance of water resources. Waters from Oakland County discharge into six major river systems: Clinton, Detroit, Flint, Huron, Shiawassee, and St. Clair. More than half of the water flowing in these rivers over the course of a year is ground-water discharge to the river through the streambed. The Environmental Protection Agency has maps of the watersheds and information about water quality and other characteristics at: https://cfpub.epa.gov/surf/county.cfm?fips_code=26125

The principal source of drinking water varies by municipality, with a clear line drawn along the glacial divide previously represented. The northwest region of Oakland County relies mainly on ground-water supplies, whereas the urbanized southeast region relies on surface-water supplies (Figure 3.10) Non-point source pollution caused by industrial and agricultural run-off is a constant threat to these water resources. Forestry and land managers must take steps to ensure surface and ground water resources are considered and protected. The services these features provide to Oakland County residents include recreation, drinking water, wildlife habitat, stormwater and flood storage, temperature regulation, and property value improvement. The protection of these resources is paramount to ensure the health of natural communities in Oakland County, and farther downstream from these headwaters.

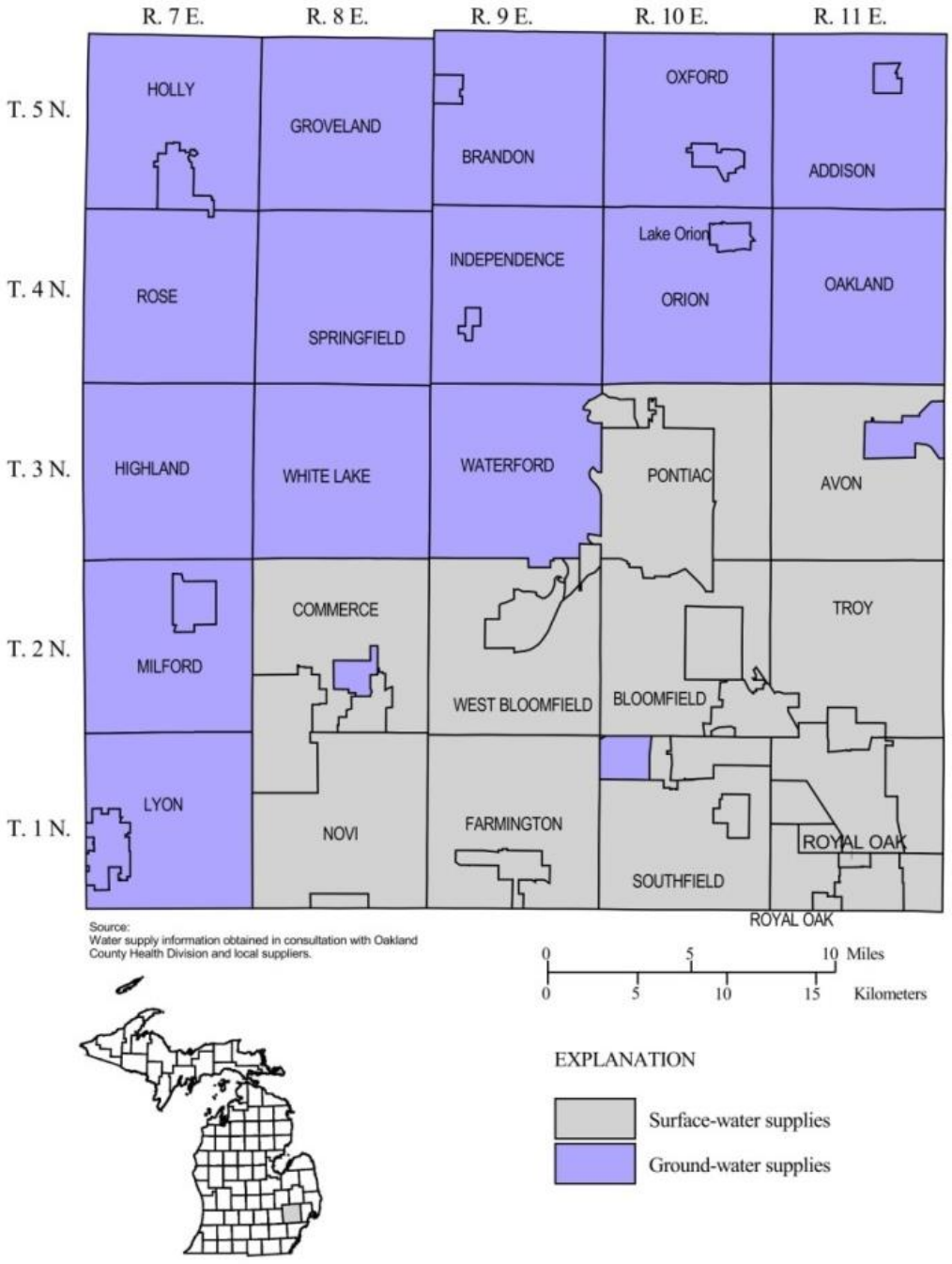


Figure 3.10 Principal sources of drinking water, by municipality, in Oakland County. (Oakland County Health Division)

3.1.6 Wetlands

Wetlands are incredibly important to the health of natural communities in the Headwaters Region of Oakland County. Wetlands are excellent filters, removing contaminants, sediments, and nutrients from waters moving downstream. They provide habitat to a variety of unique species including rare orchids, endangered reptiles and insects, and migrating waterfowl. Wetlands operate as precipitation and evapotranspiration regulators, helping buffer rapid temperature change in adjacent forested areas. In Oakland County, wetlands are scattered across the northwest region's landscape, with some diminishing of size and number in the urbanized southeast. However, many soil areas that include wetland soils can still be found in this highly urbanized area.

The Michigan Department of Environmental Quality reported on the "Status and Trends of Michigan's Wetlands: Pre-European Settlement to 2005 in 2014" and showed a loss of about 55% of the county's wetlands from pre-settlement to 2005. Losses for the county for the period of 1978 to 2005 were 4% leaving 51,601 acres of wetlands intact.

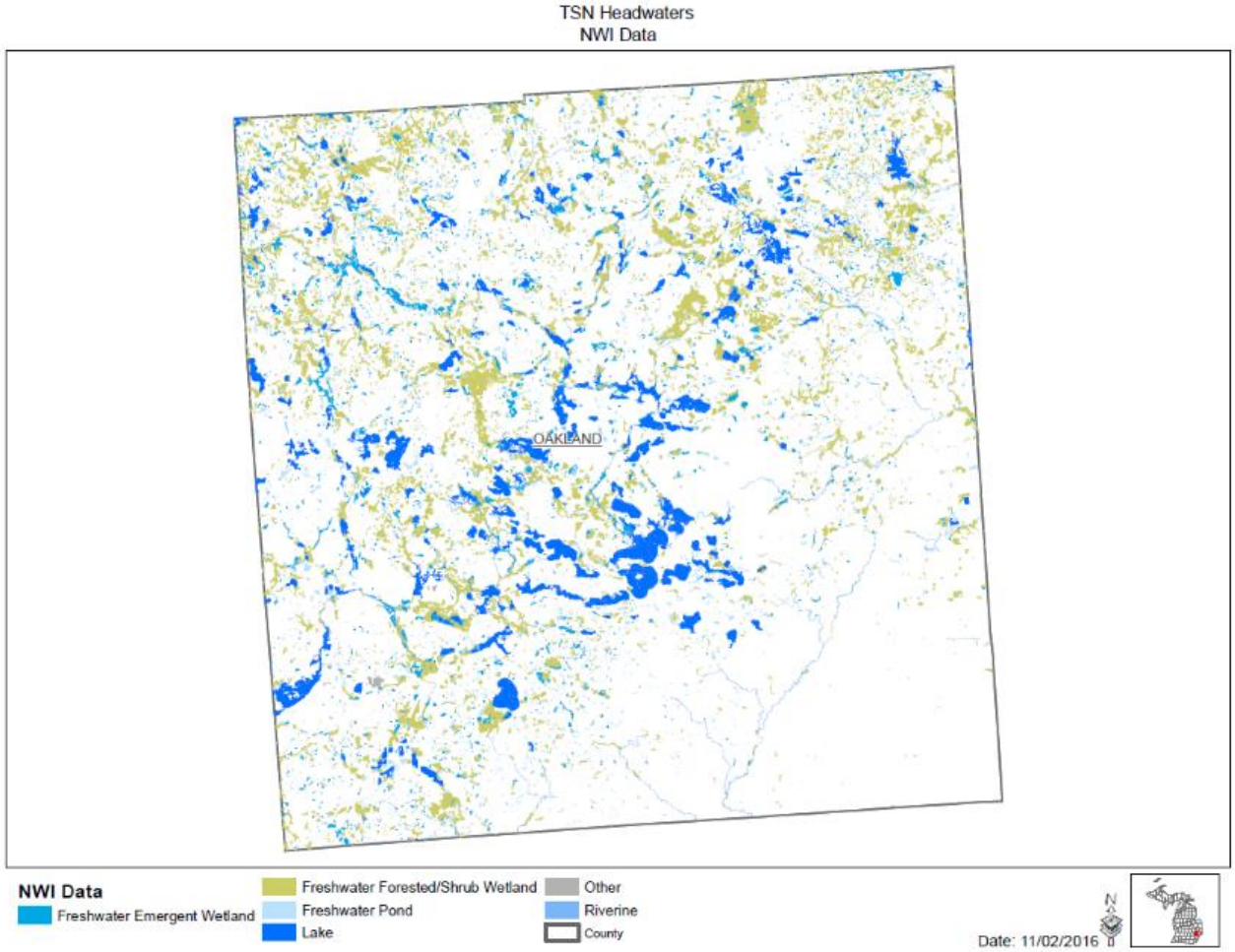


Figure 3.11 National Wetland Inventory Map of Oakland County (Michigan DNR)

The development of the southeastern zone, and the conversion of historically wetland area to residential properties, has led to a number of complications including a major loss in stormwater storage and flood control capacity. These communities have struggled to adapt to the loss of these natural stormwater retention areas as hardscape cover has expanded with continued development. These issues were highlighted in 2012 and 2013 when rainwater from severe storms closed highways, flooded homes, and stopped commerce and business in this region for several days. It is important that land managers and foresters understand the symbiosis that exists between wetlands and forests, and that they ensure the protection of these adjacent wetland areas is worked into any forest management plan.

3.1.7 Biological Diversity

The careful and consistent management of forested areas in Oakland County helps sustain the unique biological diversity enjoyed in the Headwaters Region. Boasting over 1,400 inland lakes, the county has productive sport fisheries, a diverse array of natural shoreline and submerged plants, and rare mussels, reptiles, amphibians and insects that live in or near many of the lakes. The quality of these aquatic habitats is highly dependent on the responsible management of adjacent forested lands, and the protection of the riparian areas that border our lakes.

Similarly, the protection and stewarding of our forested lands helps protect local game species including the white-tailed deer and wild turkey. These resources are important to local communities who have a strong legacy of hunting in these forests, and provide an opportunity for residents to personally connect with the protection of these lands. Invasive plant species are a constant threat to these forested lands, where rapid overgrowth interferes with young tree generation, reduces native species habitat, and can impact recreational access and thus community valuation of these forest resources. Oakland County has also had issues with tree diseases and pests which reduce the diversity of trees in forested areas.

According to the Michigan Natural Features Inventory's Rare Species Explorer, there are 102 plant and animal species that are listed as endangered, threated, or of special concern in Oakland County. The MNFI website can be searched by taxonomy (type of organism), habitat, state and federal status, and county. https://mnfi.anr.msu.edu/explorer/search.cfm (For a complete list of these species, see Appendix C.)

Forest types

This portion of Michigan is comprised of three distinct regional landscape ecosystems known as the Maumee Lake Plain, Ann Arbor Moraine, and Jackson Interlobate regions, which are the predominate systems throughout southeast Michigan. The Jackson Interlobate sub-subsection comprises over 50% of Oakland County. This sub-subsection, located between three glacial lobes, is more than 150 miles long. It is characterized by relatively steep ridges and outwash deposits. Small kettle lakes and wetlands are common within the outwash. Oak savannas, once prevalent on large parts of the landscape, have almost all disappeared due to extensive agriculture or degraded by fire exclusion. The Maumee Lake Plain is a flat, clay lake plain separated by sandy glacial drainage. Most of the clay lake plain supported either upland or

wetland forest. In contrast, the sand lake plain supported oak barrens (savanna) on the uplands and wet prairies or marshes in the lowlands (Comer P. J., et al., 1993). The Ann Arbor Moraine is a long, narrow band end moraine and ground moraine bordered by flat lake plain on the east and by sandy outwash, end moraine, to the west. Most of the area has been farmed, but some oak forest remains on steeper ground as well as some flood-plain forests or small woodlots (Albert D. A., 1995). *(Oakland County, Five Year Parks and Recreation Master Plan,2013-2017 https://www.oakgov.com/parks/.../OCPR-RecPlan6-LandAcquisitionandMgt.pdf) (Albert, D., Cohen, J., Kost, M., Slaughter, B., & Enander, H. (2008). Distribution Maps of Michigan's Natural Communities. 166. Lansing, MI: Michigan Natural Features Inventory. Report No. 2008-01.)*

Before European settlement and the logging era, the landscape of this part of southeast Michigan consisted of Black oak barrens and oak savanna, beech-maple and oak-hickory forest, mixed hardwood swamp, southern swamp, floodplain forest as well as pockets of relict conifer and poor conifer swamp. Oak barrens and savannas as well as beech-sugar maple forests were situated on well-drained sites, while hardwood and mixed conifer-hardwood swamps were scattered throughout the clay lake plain in depressions and sandy glacial drainage areas. Other scattered pockets of wooded and open wetlands such as tamarack swamp, black ash swamp, shrub-car, and emergent marsh were also found with floodplain forests occurring along the counties watercourses.

The 19th and 20th century brought about significant changes for the landscape with a sharp increase in lumbering, agricultural development, and urban growth. The most dramatic for this region is the nearly complete elimination of the oak barrens and oak savanna systems which have for the most part been converted to agriculture or abandoned agriculture fields, recreation or have succeeded to a closed canopy forest system in the absence of natural, periodic fires (Cohen 2001a). The conversion of oak barrens and oak savanna to closed-canopy oak forest was rapid, typically taking place within 30 years following the onset of fire suppression in Wisconsin (Curtis 1959), and likely also in Michigan. The forests today are either degraded or highly fragmented into many small, isolated areas surrounded by residential and urban landscape. (*Kost, M.A., J.G. Cohen, A.L. Bozic, R.P. O'Connor, B.S. Walters and H.D. Enander. Natural Features Inventory and Management Recommendations for Independence Oaks, and Rose Oaks, Oakland County Parks***.** *Report for Oakland County Parks. 91pp., 2006).*

Southern hardwood swamp

Southern hardwood swamp is a forested wetland occurring in southern Lower Michigan on mineral or occasionally organic soils dominated by a mixture of lowland hardwoods such as silver maple (*Acer saccharinum*), red maple (*A. rubrum*), green ash (*Fraxinus pennsylvanica*), and black ash (*Fraxinus nigra*). Conifers are typically absent or local. Southern hardwood swamp occurs in poorly drained depressions on glacial lakeplain, outwash plains and channels, end moraines, till plains, and perched dunes. Historically, the Maumee Lake Plain in southeastern Michigan supported large areas of lowland hardwood forest that bordered lakeplain prairie, lakeplain oak openings, wet-mesic flatwoods, and mesic southern forest. *(Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber, and K.A. Chapman. 2007. Natural*

Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report No. 2007-21, Lansing, MI.)

Hardwood-conifer swamp
Hardwood-conifer swamp is a forested wetland dominated by a mixture of lowland hardwoods and conifers, occurring on poorly drained organic and mineral soils. The community is often associated with headwater streams and areas of groundwater discharge. *(Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber, and K.A. Chapman. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report No. 2007-21, Lansing, MI.)*

Floodplain forest
Floodplain forest is a bottomland forest community occupying low-lying areas adjacent to streams and rivers and subject to periodic over-the-bank flooding and cycles of erosion and deposition. Floodplain forests occur along major rivers throughout the state, but are most extensive in the Lower Peninsula. Species composition and community structure vary regionally and is richest in the southern Lower Peninsula, where many floodplain species reach the northern extent of their range. The southern floodplain forest is one of Michigan's most diverse natural communities as well as one of its most threatened. Damming, dredging, and channelization are all human induced threats to these forests. These forests are widely used by a surprisingly large variety of birds, mammals and herptofauna for both food and cover and rearing of young. *(Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber, and K.A. Chapman. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report No. 2007-21, Lansing, MI.)*

Mesic Southern Forest
Mesic southern forest is an American beech- and sugar maple-dominated forest distributed found on flat to rolling topography are found throughout Michigan, usually occurring in moist, rich, well-drained soils. They are also the most common forest type in the state. Prevalent topographic positions of this community are gentle to moderate slopes and low, level areas with good drainage. Historically, mesic southern forest occurred as a matrix system, dominating vast areas of rolling to level, loamy uplands of the Great Lakes region. These forests were multi-generational, with old-growth conditions lasting many centuries.

Mesic southern forests are dominated by American beech, sugar maple, red oak, swamp white oak, and burr oak. Basswood, yellow birch, white ash, black cherry, shagbark hickory, black walnut, American elm, red maple, and tulip poplar may also be present. A diverse mesic hardwood stands offer varied habitats that are used by a wide variety of songbirds, invertebrates, amphibians, and mammals. Seasonal pools also attract many migrating and nesting birds due to the large amount of insects produced. *(Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber, and K.A. Chapman. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report No. 2007-21, Lansing, MI.)*

Dry-Mesic Southern Forest
Dry-mesic southern forests are forests located primarily in southern Michigan on very well drained, acidic, sandy beach ridges, and slightly higher elevations of the lakeplain. White, black, and red oak and pignut hickory are the typical dominant tree species in most dry mesic southern forests found in Michigan. Most plants found in these forests tend to be adapted to fire and in fact, these forests depend on fire to maintain an open canopy, remove competition from shade tolerant species, release nutrients, remove the leaf litter, prepare a seedbed for acorns and nuts to germinate, and warm the soil in the spring to hasten germination. When fire is removed from the landscape, such as it is now in many places, these oak-hickory forests tend to be invaded by more shade tolerant species and converted to beech-maple forests.

Today it is estimated that approximately 5% of the state supports this type of forest. The difference is that the distribution has changed. Southern Michigan has actually lost two-thirds of its original dry forests, while dry forests in the northern lower peninsula have dramatically increased. In addition, many of the remaining oak-hickory forests in southern Michigan are contained in small fragmented woodlots of 20 to 40 acres (Paskus, 2003). *(Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber, and K.A. Chapman. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report No. 2007-21, Lansing, MI.)*

Mixed oak forests are dominated by black and white oaks, with lesser components of trees such like black cherry, pignut hickory, and sassafras. Frequently found adjacent to oak savanna, they are slightly less fire-prone habitat, yet they were drier and more fire-prone than oak hickory forests. The largest concentration of this habitat type occurred on sand plains and sandy, rolling ridges in the southeast Michigan including Oakland County. Mixed oak forests made up 1.1% of Michigan's landforms.

Black oak barrens at one time comprised about 1.9% of Michigan's landscape. They occurred on flat sand plains and rolling, gravelly hills in the interior portion of the southern Lower Peninsula, and probably burned quite frequently. Oakland County historically contained more black oak barrens than any other county. The typical dominant tree was black oak, but Northern pin oak, white oak, and scarlet oak were also found. Much of this habitat has been converted to farmland, but mostly abandoned by the 1930's because of the droughty and infertile soils and is in the process of succeeding to a closed-canopied oak forest, due to the lack of fire. *(Stony Creek Ravine Nature Park Comprehensive Management Plan, David Mindell, Matt Demmon, PlantWise, LLC. Ann Arbor, MI May 2010)*

3.1.8 Forest Resources and Timber
The Headwaters Region in Oakland County has valuable timber resources available in its forested lands. These areas are generally protected from commercial logging operations as they are ecologically valuable and not of a commercially viable size. Oakland County is home to 108 forest industries, which utilize wood materials in the manufacture of value-added products. For more information, visit michigandnr.com/wood/

Landowners who are interested on 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 its pro's and con's. 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 that the process can be quite expensive, especially for a large parcel of property. The third option of planting seedlings is the most common approach of tree planting, and is suitable for all size of projects. The results are faster than planting from seed, survivability is typically good, it's relatively inexpensive to do 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 or unwanted trees once established, can be time consuming.

Regardless of which method is chosen, the landowner will need to take into account their property's specific soil type and fertility, moisture availability, light conditions, and other factors in order to achieve good 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-natives. Plantings should be monitored regularly, especially over the first several years, and may need to be watered and mulched to encourage good growth. Tree guards may also be necessary if the area has high populations of deer and rodents. The placement of new trees is also an important thing to consider. Property owners should avoid planting near utilities, especially power lines, and stay a reasonable distance from sidewalks, driveways and structures. The local conservation district can provide native tree recommendations and typically sells bare-root seedlings, usually 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. A professional forester will mark trees that have reached their optimal size and should be harvested, but, equally importantly, identify trees to be retained to optimize yield or be used as seed trees for the next generation. A professional forester is capable of bringing an 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, 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 wish 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, MSU 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, forest 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. 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, from a variety of forest plants as well as mushrooms can be harvested for family use or for sale.
http://www.edibleforestgardens.com/

Permaculture

Permaculture is agriculture with trees in which the production system is designed to be self-sustaining and regenerative. Permaculture was developed in Australia by Bill Mollison and David Holmgren in 1968, but has gained international acceptance. 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."

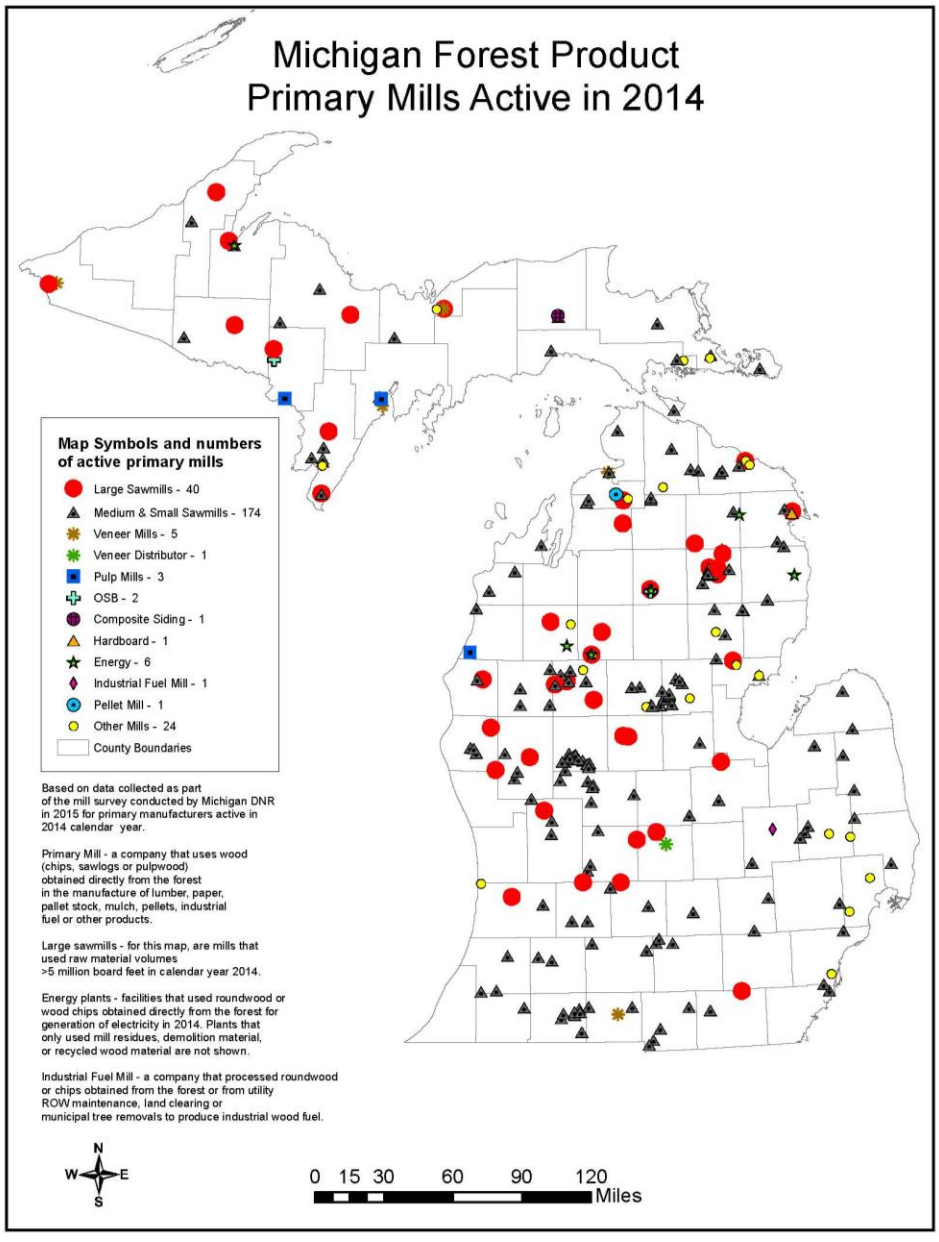


Figure 3.12 Forest Product Industry Map of Michigan (Michigan DNR)

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.
Training Manual for Applied Agroforestry Practices. 2015. Edited by Michael Gold, Mihaela Cernusca & Michelle Hall. http://www.centerforagroforestry.org/pubs/training/index.php

Resources for Land Owners
There's a wide array of resources available to assist landowners with the creation of a forest stewardship plan and managing the forest for productivity and health. The Department of Natural Resources Forestry Division has a wealth of information on their website and they maintain a list of professional foresters. See Section 3.4 for more information.

The US Forest Service has a "Managing the Land" section on their website (http://www.fs.fed.us/managing-land) that covers natural resources on public and private land. The MSU Extension Service has links to the Natural Resource Enterprises Program designed for landowners and community leaders to encourage informed decision-making regarding the management of land and enterprises.

http://msue.anr.msu.edu/program/info/natural_resource_enterprises
A highly recommended book is "A Landowner's Guide to Managing Your Woods" by A.L. Hansen, M. Severson, and D.L. Waterman published in 2011 by Storey Publishing. It covers how forests grow, successional processes, planning, inventorying, working safely in the woods, and how to do a timber sale.

3.1.9 Forest Health
The health of forested natural areas is constantly threatened by the continued urban sprawl occurring in Oakland County. The last areas of relatively large, continuously forested areas are protected as recreation and conservation areas. Habitat fragmentation is a major issue in Oakland County, where there are no State or Federally protected forests. (There are, however, State parks and recreation areas that are partially forested.) It falls to the individual landowner to ensure the protection of their forested lands.

Anyone who has recently looked at forests in southeastern Michigan has seen the effects of the emerald ash borer (*Agrilus planipennis*) which has decimated most types of ash and left skeletons of trees in the forest. That may be the most obvious example of impacts to forest health but there are a host of other concerns worthy of attention. Keeping trees healthy requires observation to detect problems and taking appropriate action to maintain them. Non-native species such as autumn olive (*Elaeagnus umbellate*) and garlic mustard (*Alliaria petiolata*) also threaten forest health and landowners should be knowledgeable about identification and control of invasive species.

The health of individual trees can be assessed by looking at their structure and appearance. Having a canopy that branches over at least one third of the height of the tree is helpful to obtain the light required for photosynthesis. Emergents are trees that are above others in the canopy, dominants get light from above and some from the sides, codominants get light from above and but not from the sides and suppressed or overtopped trees have crowns below the canopy which reduces light and tree vigor. Trees that have small or low canopies are more likely to lose the competition for light and die before reaching optimum size (this applies less to trees and shrubs that are adapted to low light conditions).

The insect with the most impact on Michigan forests in recent years has been the emerald ash borer (EAB). Many of the larger ash trees in the Lower Peninsula have been infected and the area is under a quarantine which prevents the movement of regulated materials (any timber product except wood chips smaller than one inch in two dimensions) outside of the quarantined area. The borer tends not to attack small-diameter trees and ash trees still being established from seed, so if the borer population can be controlled, there may be more ash trees in Michigan forests in the future. One of the most important practices is to not transport firewood more than about 10 miles from its original location to help prevent another disaster like emerald ash borer. EAB Link: http://www.michigan.gov/mdard/0,4610,7-125-2390_18298---,00.html

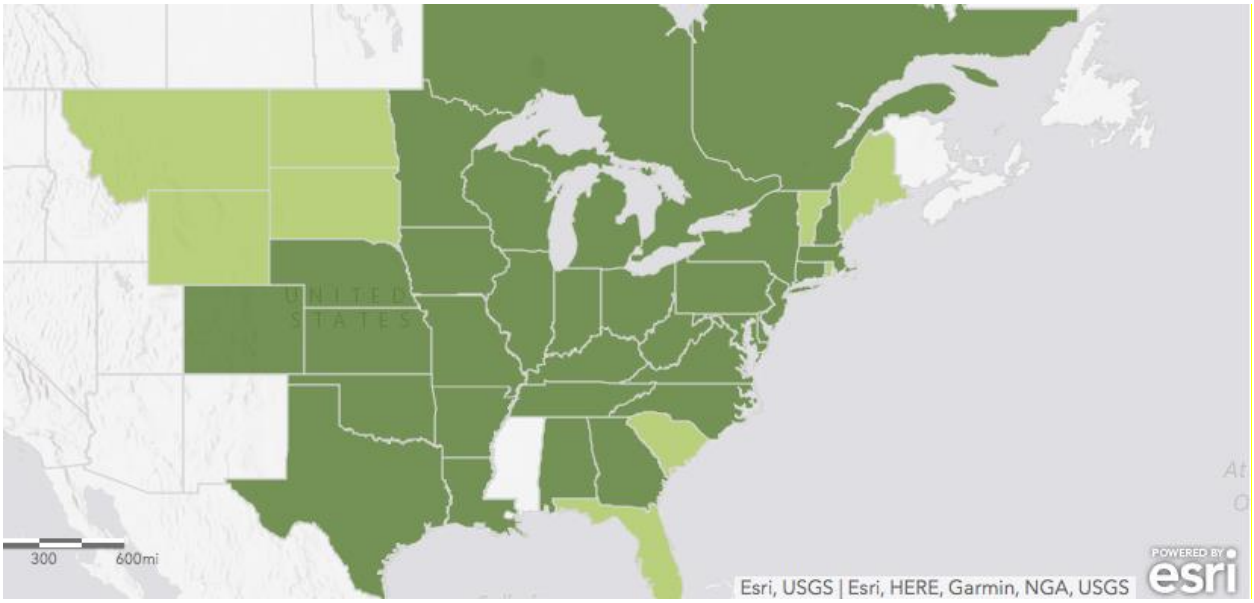


Figure 3.13 Emerald Ash Borer range in the U.S. and Canada, 2017. (http://www.emeraldashborer.info/index.php)

Gypsy moths (*Lymantria dispar dispar)* have also presented a problem for area forests. The Michigan Department of Agriculture and Rural Development has a Gypsy Moth Suppression Program that assesses gypsy moth damage, provides landowners with information, and treats areas where landowners permit with aerially applied Bt and Gypcheck. Populations have subsequently declined to a minimal level. Landowners should be observant and contact their local Conservation District if populations reach a nuisance level.

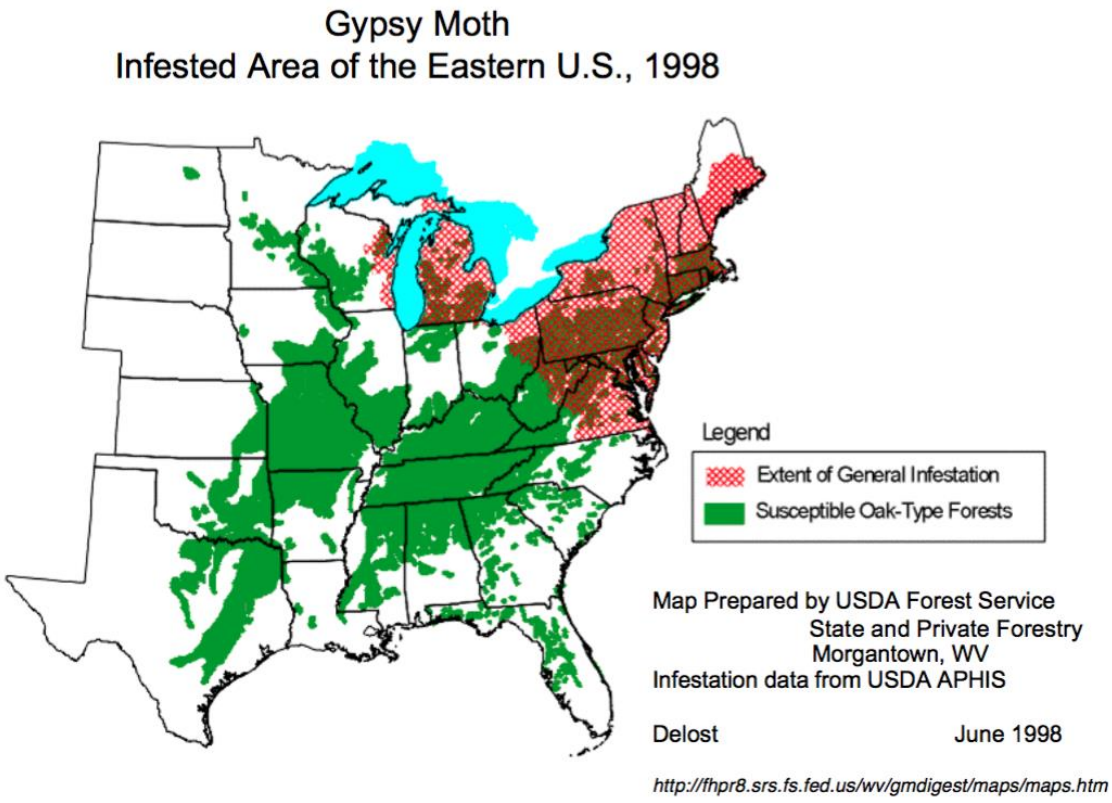


Figure 3.14 Gypsy moth infestation and forests at risk, 1998 (USFS)

Other insects that are on the watch list for Michigan include the Asian longhorned beetle (*Anoplophora glabripennis),* spruce budworm (*Choristoneura fumiferana*), and hemlock wooly adelgid (*Adelges tsugae)*. Although it has not yet been reported in Oakland County, the Asian longhorned beetle is a major threat because it is a generalist that attacks maples, oaks, and many other species of trees. The adult beetles are about 1-inch-long and have very long antennae (about 2 inches) with distinctive black and white bands on each segment. The females create roundish pits when they lay their eggs and the adults leave round exit holes when they emerge after having developed from the larval stage. The damage (like emerald ash borer) is done by the larvae that feed and excavate channels below the bark. Given the level of commerce and travel by people in and out of Michigan, landowners should monitor their woods to see if any obvious signs of forest pests are present and contact a forester or other natural resource professional for advice with dealing with such problems. For more information, see: http://msue.anr.msu.edu/news/forest_pests

The breaking up of large tracks of land into smaller parcels to be sold off for residential or commercial development is a major contributor to the stress on wildlife populations in this region. Some animal populations rely on large, intact habitats in which they can freely move without the interruption of human development. Fragmented habitats are also more vulnerable to the introduction of invasive species, the effects of climate change, and pollution from surrounding land uses.

One major threat to forest health in Oakland County is the presence of the fungus oak wilt (*Ceratocystis fagacearum*), which can decimate healthy oak forests (especially red oaks). The wounding of trees or improper pruning and tree management can expose the sap of these trees to a beetle which carries the fungus on its carapace. The fungus enters the vascular tissue of the tree and disrupts its normal regulatory functions, causing the tree to die in a matter of weeks. Treatment of oak wilt (Figure 3.15) is costly and difficult, because trees showing symptoms of oak wilt are generally already doomed. In the case of this fungus, an ounce of prevention is indeed worth a pound of cure, and educating professional foresters and private landowners alike can lead to successful outcomes in dealing with this disease proactively.

One key for control is to avoid pruning or harvesting during warm months (April to Oct. 15) and to remove infected trees quickly to avoid spread of the fungus. If red or black oaks are damaged during warm months, tree wound sealant or latex house paint should be applied immediately to prevent infection. Cut trees can be debarked or chipped and processed as saw logs or biomass. If used for firewood, it should be covered under a clear plastic tarp sealed by soil or rocks to avoid transmission of spores by insects. Other techniques such as trenching to prevent spread by root grafts or injection of fungicide can be used to protect neighboring trees but these practices are relatively expensive and more appropriate for residential areas or individual trees with high value.

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Figure 3.15 A mature oak tree is treated with a fungicide via root flare injection to prevent oak wilt

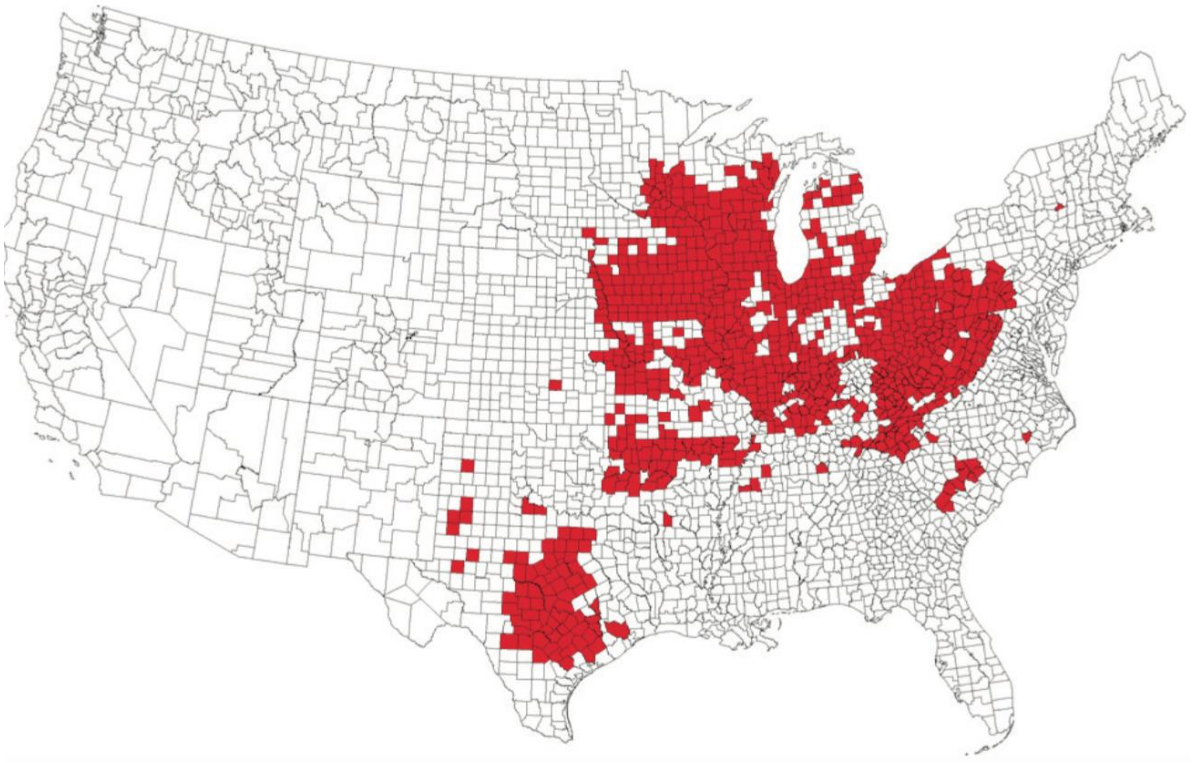

Figure 3.16 Distribution of oak wilt in the U.S. From U.S. Forest Service, *How to Identify and Prevent Oak Wilt.* https://www.na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

Additional diseases that may impact Michigan trees include sudden oak death, thousand cankers (attacks walnut trees), Heterobasidion root disease (a fungal pathogen), white pine blister rust, and beech bark disease. Spruce needlecast is a common fungal pathogen frequently seen on Colorado blue spruce trees older than fifteen years. The DNR publishes a Forest Health Highlights Report annually that contains information on pests and diseases (the 2015 report is available on their website). DNR Link: http://www.michigan.gov/dnr/0,4570,7-153-30301_30830--,00.html

Timber stand improvement involves pruning and the removal of trees that are of lower quality or in the wrong place. Pruning (which should be done in the dormant season) can be used to remove low limbs to produce a higher quality saw log. There are many common mistakes made in pruning, so the landowner should study the subject or hire a professional to do this work. A forester can be hired to mark the trees to be thinned or weeded (just like in a vegetable garden, one can select preferred plants). These operations can contribute to forest health by increasing growth of remaining trees and helping them to resist insects and diseases. There are several ways to deal with the material removed, including pulp sale, fire-wood harvest, or creating brush piles for wildlife. There are also machines that can grind up woody debris and create mulch on the soil surface (resulting in faster decomposition of branches).

Tree Owner's Manual: www.na.fs.fed.us/urban/treeownersmanual/

Invasive Plant Species

A non-native invasive species is one whose introduction causes harm to the economy, environment, or human health, and usually spreads aggressively. Many non-native species in Michigan, including fruits, vegetables, field crops, livestock, and domestic animals, are important to our economy and most are not harmful. Compared to natives, non-native invasive plants typically have less herbivory (consumption by animals) and fewer disease organisms affecting them in their new environment. Invasive species cause harm when they out-compete native species by reproducing and spreading rapidly thus reducing the health of natural and managed communities.

Typical, prioritized steps in planning and implementing an invasive species control program are:

- Map known populations.
- Determine whether it occurs in high-quality habitat or on important recreational lands
- Prioritize high-value sites for treatment
- Choose appropriate control methods, given site conditions and available resources
- Obtain permits (if required for method used, i.e., herbicide application in wetlands)
- If using herbicide, be sure to read the product label before applying and follow manufacturers' directions closely
- Eradicate smaller satellite populations focusing on seed-producing plants first
- Treat larger infestations on sites with lower value later
- Monitor to ensure desired results are being achieved

One of the keys to avoiding infestation by invasive plants is to have a healthy community of native or intentionally introduced plants (crops, orchards, etc.). The more robust the desired vegetation is, the less likely that invasive species will proliferate. Soil-disturbing activities such as plowing, land clearing, and vehicle use can create a favorable zone for invasive plant establishment. Disturbance should usually be followed quickly by reseeding or planting to limit invasive species competition.

A timber harvest can have serious unintended negative effects on a forest ecosystem if the landowner does not realize that there are invasive species in the understory. If the harvest opens the canopy, the extra light could cause invasive species that had been fairly innocuous to grow, reproduce, and take over the open ground rapidly. For this reason, landowners should be aware of invasive species in the area and plan to treat such infestations prior to a harvest. Cutting or mowing is not effective on many of these species and may actually make them more of a problem, so please seek treatment recommendations from Michigan DNR, Cooperative Invasive Species Management Area, or your local conservation district. Information, including photos and identification modules, can be found at www.misin.msu.edu

Invasive Shrubs

Woody invasive shrubs such as autumn olive, bush honeysuckles, and common and glossy buckthorns are a particularly important problem because they completely alter the forest

community and, in many cases, prevent the growth of native species. Many invasive herbaceous shrubs (Japanese knotweed, giant knotweed, Bohemian knotweed, Japanese barberry, and multiflora rose) can negatively impact forest systems. The following paragraph covers autumn olive, but information for other invasive shrubs is similar.

Autumn olive can reach heights of 20 feet with multiple stems supporting leaves that are olive colored on the bottom (making it fairly easy to identify). The shrub leafs out in March and can retain leaves until November making it difficult for other plants to survive in its shade. It is a nitrogen fixer and the altered nutrient levels can change the native plant and microbial communities. While it grows faster in full sun, it is moderately shade tolerant and will invade forests. It produces thousands of seeds that are transported by birds and mammals. Control can be achieved through several methods, some of which can be used in combination. Fire will set the plant back, but will not usually kill the autumn olive shrub. Because the plant stump sprouts after fire or cutting, it is usually treated with herbicide (triclopyr appears to be an effective chemical). 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, Norway maple, and tree of heaven are the key invasive tree species found in Oakland 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 vines (oriental bittersweet, English ivy, Japanese honeysuckle, Chinese yam, black swallow-wort, pale swallow-wort, mile-a-minute weed, and kudzu) should be treated. They can cause structural problems because they add so much weight that can break branches or topple the tree. The vines also shade the tree's leaves and the competition can reduce tree growth. A few vines even grow thick enough to "strangle" the tree. Some vines that start as a groundcover (such as ivy), form a dense mat of leaves on the tree's base which traps moisture against the trunk and can result in fungal and bacterial diseases. Native grape vines can cause damage, but poison ivy and Virginia creeper usually don't damage trees and they do serve as a food source for wildlife.
https://midwesternplants.org/2015/02/25/vines-growing-on-trees-good-or-bad/

Invasive Herbaceous Plants

Depending on how open the canopy is, a landowner may encounter herbaceous invasive species such as garlic mustard, spotted knapweed, black jetbead, dame's rocket, and others. Garlic mustard is a biennial, herbaceous plant that has the ability to dominate the forest floor, limit the growth of other species, and prevent reproduction of native species. It spends its first

year as a rosette and then sends up a flowering stalk in the second year that produces a prolific number of seeds. The seed is transported by birds, rodents, deer, and humans and can remain viable for 10 years, even in very harsh condition. 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) and by limiting disturbance and maintaining a high level of canopy. Treatment has to be performed over multiple years to reduce the negative impacts of the invasive. 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.
http://www.ipm.msu.edu/invasive_species/garlic_mustard/about_garlic_mustard

Aquatic Invasive Species
There are many problem plants that thrive in water and property owners on lakes, streams, and wetlands should be aware and able to identify them as they can limit land use and cause significant harm to healthy systems. Wetland and aquatic invasive species in the area include flowering rush, European frogbit, yellow floating heart, non-native phragmites, reed canarygrass, purple loosestrife, hydrilla, curly leafed pondweed, and Eurasian milfoil. Plant growth is accelerated by excess nutrients from lawn and agricultural runoff, increased surface runoff due to increased impermeable surfaces (roads), failed septics, and other sources. Treatment of invasive species in wetlands or aquatic systems should only be done with wetland safe products and with the appropriate DEQ permits. Establishing natural vegetative shoreline buffers can also reduce issues with problem plants.

Some of the aquatic invasive animals 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 only be disposed of in a trash can.
http://www.michigan.gov/deq/0,4561,7-135-3313_3681_3710-134641--,00.html

Resources for Landowners
Cooperative Invasive Species Management Areas (CISMA) are a collaboration of private landowners, non-governmental organizations, natural resource management groups, governmental agencies, and others who are interested in combating invasive species. Michigan's DNR, DEQ, and the Agriculture and Rural Development Department (DARD) funded a CISMA for Oakland County. CISMA:
http://www.michiganinvasives.org/occisma/

The Midwest Invasive Species Information Network (MISIN) is a regional effort to develop and provide an early detection and rapid response resource for invasive species. The goal of this regional resource is to assist in the detection and identification of invasive species in support of the successful management of invasive species. To report an invasive species sighting, visit www.michiganinvasives.org

The USDA also offers links to numerous invasive plant fact sheets for many species:
https://www.invasivespeciesinfo.gov/plants/factsheets.shtml)
https://mnfi.anr.msu.edu/ - Michigan Natural Features Inventory
http://www.mipn.org/ - Midwest Invasive Plant Network

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

3.1.10 Tourism and Recreation

Oakland County draws in tourism from nearby counties, including nearly half of the county's work force who commute from neighboring counties. This Oakland County also has the highest per capita income of any in the state, and is among the highest in the nation. This means that ample tax dollars are available to fund recreation and environmental stewardship initiatives.

The county has multiple DNR State Recreation Areas including: Highland Holly Lake, Ortonville Pontiac Lake, and Proud Lake all of which have hiking and other recreational opportunities available. There are also state parks such as Dodge No. 4, Pontiac Lake, and Seven Lakes. In addition, there are many other parks managed by local units of government (cities, townships, etc.). Oakland County is home to the Detroit Zoo and the Sea Life Michigan Aquarium.

A seven-mile water trail in the Shiawassee River begins in Holly, Michigan at Water Works Park and extends downstream to Strom Park in Fenton, Michigan. There are signs that discuss the trail, its history, and what to expect along the trail. Access points include the City of Fenton's boat launch at Strom Park, the Keepers of the Shiawassee's canoe launch in Bush Park, and the Michigan Department of Natural Resources' boat launch in Lake Ponemah. The City of Linden has a take-out above and a put-in below Linden Mill Pond Dam. The trail continues to be extended as University of Michigan-Flint's University Outreach program works with local governments. https://en.wikipedia.org/wiki/Shiawassee_River_Heritage_Water_Trail

Canoeing the Shiawassee River in February 2006 near Holly, Michigan. Image by Willi H2O
https://commons.wikimedia.org/w/index.php?curid=4625621

Trail and Transportation Planning

Active trail and pathway planning has been going on in Oakland County for more than 40 years. This resulting non-motorized network is envisioned to serve a diverse range of users of all ages and abilities, to promote active and healthy lifestyles, and to provide safe and well-

maintained linkages to important natural, cultural, and civic destinations, as well as other points of interest within and outside the county. The 61 communities in Oakland County represent a cross section of urban to suburban to rural. There are a variety of non-motorized facilities that exist and are planned to create a connected system of greenways and trails across the landscape. https://www.oakgov.com/edca/planning/Pages/trails-pathways.aspx

3.1.11 Fish and Wildlife Habitat

The habitat needs of different animal species vary greatly from patches of plants measuring less than an acre to territories of about ten square miles for large predators such as bears and coyotes. Some species prefer edge habitat, while others require large blocks of grassland or forests. What benefits one species may be detrimental to another, so a landowner who wants to manipulate habitat needs to decide which animals they want to favor. Another strategy is to have multiple types of habitat (mature forest, early successional forest, prairie, wetlands, etc.) to satisfy the needs of several species. Most stewardship plans address wildlife habitat and there are many practices that can be used to create or improve support for animals. To survive, animals need 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.

White-tailed Deer

The premier game species in Michigan is the white-tailed deer which thrives in a mixed habitat of woodlots, brushy areas, meadows, and croplands. They feed in different areas depending on season but will eat grasses, legumes, weeds, fruit, agricultural crops, acorns, leaves, and woody plant stems. Cedar swamps, shrubby areas, and tall prairie grasses can help provide winter cover. Overpopulation can damage the understory of wood lots, reduce yields in crop fields, and result in higher mortality due to diseases, parasites, and malnourishment. Management to increase deer populations includes creating forest openings, thinning timber stands, burning to reduce invasive shrubs that are not readily eaten, establishing food plots, and planting native trees and shrubs for year-round food and cover. The most common strategy for reducing deer numbers is through hunting. For natural areas near human dwellings, harvesting can be done by sharpshooters or bow hunters who have demonstrated proficiency. The desired deer population depends on management goals, but 20 to 30 deer per square mile can be supported by much of the local area habitat. Most landowners don't have enough area to support the home range of larger animals like deer that can use several hundred acres or more so they may want to cooperate with neighbors to achieve management goals.
For more information, see: http://www.michigan.gov/dnr/0,4570,7-153-10363_10856_10905-56904--,00.html

Resources for Landowners

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. See Section 3.4.

There are also many nonprofit organizations that are dedicated to providing wildlife habitat including: Audubon, Ducks Unlimited, National Wild Turkey Federation, Pheasants Forever, Ruffed Grouse Society, Quality Deer Management Association, and Trout Unlimited. Many of these organizations have programs to provide financial and technical assistance for enhancing wildlife. Michigan United Conservation Clubs form local units to help property owners manage habitat for animals that range more widely such as deer and turkeys. Conservation Districts work with all of these groups as well as landowners to provide wildlife habitat assistance. See Section 3.4.

3.1.12 Forests of Recognized Importance (FORI)

Forests of Recognized Importance (FORI) are defined by the American Tree Farm organization as "globally, regionally and nationally significant large landscape areas of exceptional ecological, social, cultural or biological values." FORI occur at the landscape level, not the individual stand or ownership level. In Michigan, FORI on private forest land are mostly associated with important wildlife habitat, rare forest types, corridors of unique rivers, and Great Lakes coastlines. In the Southern Lower Peninsula, large intact forests greater than 500 acres that provide habitat for state and federally listed species or for species that require core interior habitat can be considered FORI.

The Long Lake area, located in Springfield, Rose and Holly Townships has both public/private lands, one of the highest rated Prairie fens and supports one of the last populations of the endangered Poweshiek skipperling. The Buckhorn Lake complex in Rose Township is another area that we would include in the forests of recognized importance in this region of fragmented habitats and highly developed land uses.

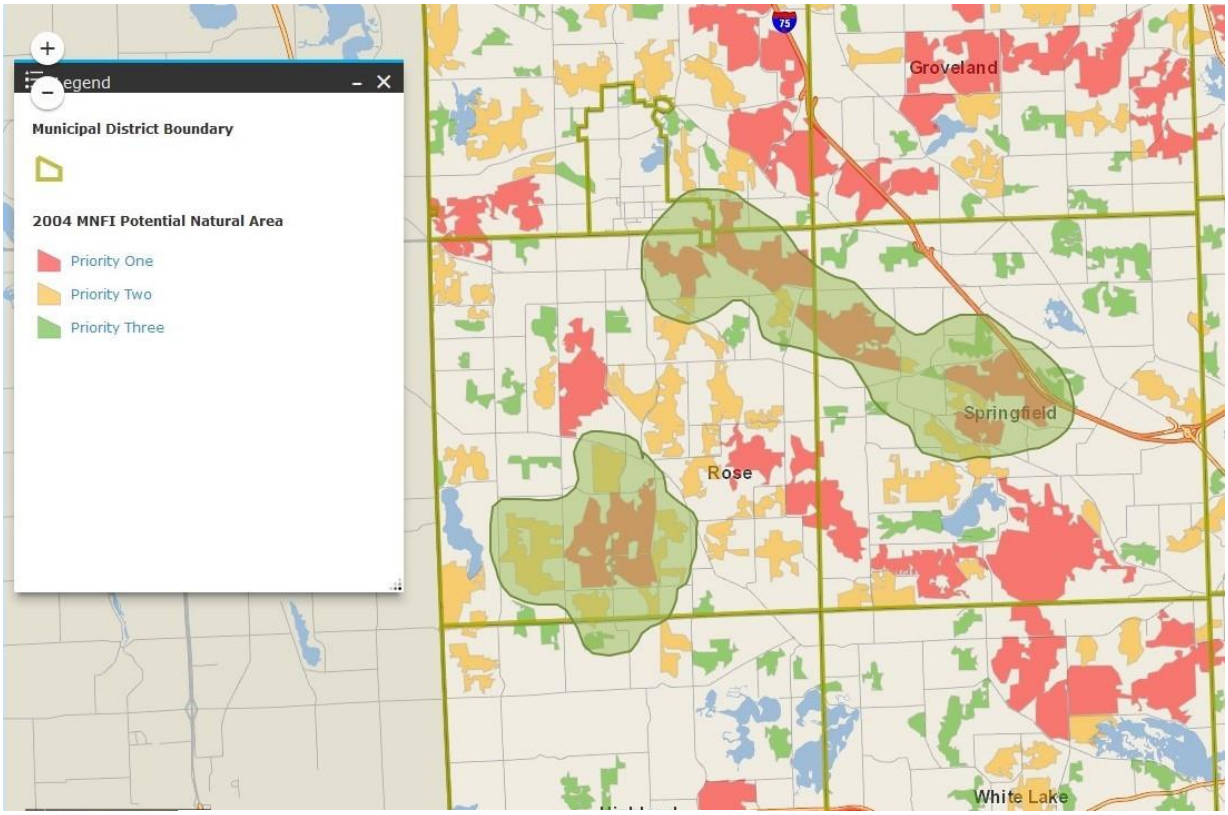

Figure 3.17 FORI areas in Northwest Oakland County (https://gis.oakgov.com/ocnr/)

3.1.13 Threatened and Endangered Species

Biological diversity is a term that describes the variety and abundance of species, communities, and ecosystems at spatial scales that range from local to global. Michigan has more vegetation types than any other Midwestern state (it is also the 11th largest state and the biggest state east of the Mississippi River). Oakland County has a diverse collection of animals, plants, and plant communities. The main repository for plant and animal distribution information is the Michigan Natural Features Inventory (part of Michigan State University Extension).

The Michigan Natural Features Inventory (MNFI) program conducts field surveys to locate and identify threatened and endangered species and communities throughout the state; 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. This information can be used to reveal population trends and ecological requirements, and guide land use and management activities. According to the MNFI, Oakland County is home to 55 rare or threatened animal species which depend on the protection of quality natural areas throughout the Headwaters Region. (See Appendix 3 for the complete list.) There are five state endangered mussels in the county, three of which are also on the federal endangered list. Conservation of existing known populations of these species depends on protecting their habitat and providing for corridors to allow migration to and from areas suitable for the animals.

The Poweshiek skipperling (*Oarisma Poweshiek*) is a federally endangered butterfly found primarily in the fen habitat type in Michigan. Michigan and Wisconsin are the only two remaining states with confirmed presence of these rare butterflies, and Michigan is the only state with multiple sites. Conservation groups in Oakland County and the Shiawassee Headwaters area are working to identify critical habitat areas for these insects, to ensure their continued survival in Oakland County.

The eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) is a species of concern in Michigan, and has threatened federal conservation status. A small to medium-sized snake with distinctive color and pattern, this animal is known for its signature rattle sound. Although these snakes are not generally considered a highly charismatic species, they are vital to the ecosystems in which they are found. Oakland County has the highest number of reported massasauga sightings anywhere in Michigan, and several communities are coordinating to manage natural areas in a way that conserves the presence of these snakes. These animals utilize both forested upland habitat and wetland areas seasonally, further reinforcing the need to integrate management plans across habitat boundaries.

The copperbelly water snake (*Nerodia erythrogaster neglecta*) is another threatened species that lives in wooded and permanently wet areas and is on the FWS list for Oakland County. 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.

Oakland County is home to 47 rare and threatened grass and flowering plant species, some of which rely on healthy forests to provide a buffer to outside disturbances. Invasive woody and herbaceous plants can move through forest understory rapidly, and advance into native prairies where they can degrade these sensitive communities. Controlling invasive plants in forested areas therefore should be a priority for land managers concerned with sensitive prairie plants in adjacent habitats. https://mnfi.anr.msu.edu/explorer/search.cfm

Ecological Reference Areas

Ecological Reference Areas (ERAs) are a category of High Conservation Value Area. They are based on the Michigan Natural Heritage Database of known natural community occurrences, and represent both rare and common natural areas. These areas are mostly found on land managed by the MDNR, but can also exist on federal, local government, or conservancy lands. To date, most ERAs exist in the northern two-thirds of Michigan but the map below shows small areas in Oakland County that are critical habitat for the Poweshiek skipperling.

Ecological Reference Areas managed by the MDNR will be monitored and prioritized for restoration and/or maintenance when possible. There are not management requirements or activity limitations for ERAs exiting on private land.

Figure 3.18 Ecological Reference Areas in Oakland County Map (Michigan DNR)

3.1.14 Archaeological, Cultural and Historic Sites

There is a limited history of archaeological sites within Oakland County due to the rapid urbanization of the southern region. 246 prehistoric sites were recorded throughout Oakland County. Many remains appear to represent artifacts from the earliest Paleo Indian period through archaic, Woodland and Historic periods. Thirty-two historic sites were located which date to the 19th century. The data collected on these sites were passed on to the Oakland County planning department, so that these sites could be preserved in a region enveloped in rapid expansion.

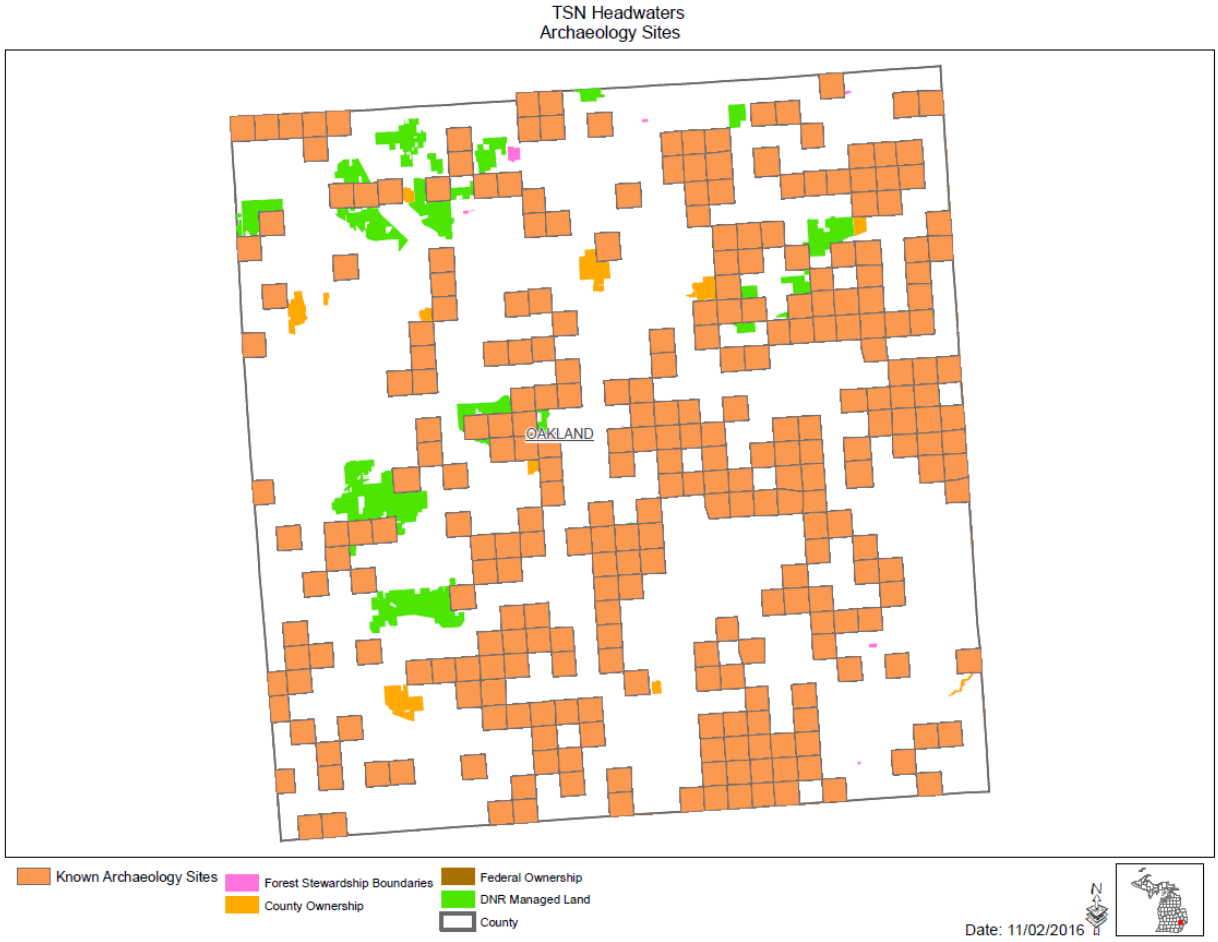

Figure 3.19 Archaeology Sites in Oakland County (Michigan DNR)

3.1.15 Fire Management

The use of prescribed fire as a management tool in Oakland County has been an important technique in the restoration and maintenance of prairie remnants and has been used in some forest ecosystems. Restoring natural fire cycles will ensure that the natural areas of Oakland County remain healthy and vibrant communities.

Many plant communities (prairies, oak savannas, fens, oak-hickory forests, etc.) in southeast Michigan are fire dependent. Many plants coevolved with fire but some trees (such as maples and beech) are sensitive to burning. Landowners who want to manage fire-dependent communities may need to burn or to introduce that disturbance with other practices such as mowing or chemical control of non-target species. One of the problems that most landowners experience is the growth of invasive plants such as autumn olive, bush honeysuckle, and other

woody shrubs. Fire can top kill these shrubs, but they will resprout from the stumps. Because of the low amount of fuel, areas invaded with bush honeysuckle don't carry fire well. Many land managers use fire as a complement to mechanical (pulling or cutting) or chemical methods to control the invasive species. Fire was used by Native American tribes for a variety of purposes but one effect was to reduce the number of woody plants in cultivated lands and around settlements.

Michigan Natural Features Inventory has documented the benefits of prescribed fire as the single most significant factor in preserving communities such as oak barrens, dry sand prairie, and prairie fen. Many current dry-mesic southern forests are degraded oak openings that have been long deprived of fire. The use of prescribed fire is a management tool for promoting oak regeneration, deterring the succession of shade-tolerant species, and reducing the encroachment by invasive shrubs such as honeysuckles and autumn olive. Open canopy conditions can be restored by mechanical thinning or girdling. Restored sites will need to be maintained by periodic prescribed fire, control of woody invasive species, and may require native plant seeding.

Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber, and K.A. Chapman. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report No. 2007-21, Lansing, MI

Fire involves risk because of changing winds, unpredictable fuel conditions, human error, etc. Particularly during drought conditions, appropriate care must be taken to keep prescribed fires under control. Property owners should also check their insurance coverage before introducing prescribed fire. Unless the landowner has experience with fire management, it is prudent to hire contractors to conduct burns (See links to a list in Section 3.4.3).

Under DEQ air quality rules, the burning of logs, stumps, trees, and brush is not allowed within 1,400 feet of a city or village. Local regulations vary so check before lighting your fire.

Burns for land clearing and related activities require a burn permit issued by the local DNR Fire Manager. The DNR encourages residents with Internet access to get their burn permits online (www.michigan.gov/burnpermit). Residents can use the interactive map to find the burn conditions in their area. If a "yes" is shown in the "burning permits issued" column, burning is allowed for that day. There is no need to print anything; this serves as a burn permit. The DNR's toll-free burn permit number is (866) 922-2876. (http://www.michigan.gov/dnr/0,4570,7-153-30301_30816_44539---,00.html)

3.2 Acoustic Monitoring

Land managers, researchers, and educators have typically utilized standardized protocols in the collection of biological data to create an ecological integrity assessment of their property or study site. Traditionally, visual field observations of vegetation, animal, and invertebrate populations are collected to help better understand biological makeup, conservation status, and potential changes to ecological health.

Today, an emerging assessment tool, acoustic monitoring, is a potential game changer for researchers and landowners looking to record and analyze information in their forests and other properties that can't necessarily be collected by visual means or with people present. This acoustic assessment expands on the traditional audible data collection of bird and frog calls to include the entire soundscape of a particular ecosystem.

A "soundscape" is a term aptly used to describe a recording of all the sounds within a landscape. This includes:

- Geophony: Sounds created by non-biological sources (rivers, wind, precipitation, etc.)
- Biophony: Sounds created by organisms within a habitat (the calls of birds, frogs, mammals, etc.)
- Anthropophony: Sounds created by humans, both intentionally and unintentionally (Music, walking, the sounds of machinery, etc.)

An undisturbed habitat would play host to both geophony and robust amount of biophony, with organisms creating noise for a plethora of reasons including calling potential mates, confusing predators, and warning competitors to avoid their territory. By carefully dissecting and analyzing recordings, researchers can separate out different sounds and calls to get a sense of the diversity and density of the sound-making species present in the area of study. Soundscapes undoubtedly fluctuate throughout seasons with species migration, seasonal mating vocalization, or in response to natural events such as instances of severe weather. But researchers are finding that resource extraction, climate change, and the effects of humans living and recreating within close proximity of forests are also having an impact on ecosystems; impacts that otherwise may not have seemed significant through optical observation, if apparent at all.

In addition to hearing stories about the focus areas for this project from land managers, it is important to allow the ecosystems to tell their own stories through acoustic monitoring. Dr. Stuart Gage, Professor Emeritus from Michigan State University has spent much of his career developing principles, methods, and applications behind ecoacoustics, or the assessment of biodiversity based on sounds emanating from the environment. Under Dr. Gages' direction, sound recorders were placed within each of the Landscape Stewardship Plan areas. Audio data was collected from a preserve in the Oakland County landscape from October 2016 to December 2016. A battery powered recorder was attached to a tree in Rose Oaks County Park. One

minute of soundscape was recorded every half hour. This data was stored on an SD card and sent to Dr. Gage's REAL (Remote Environmental Assessment Laboratory) group for storage and analysis. The REAL website (www.real.msu.edu) has a section devoted to the Landscape Stewardship Plan project, in addition to many other projects and information on acoustic monitoring. Visitors have access to the background information of the project, monitor locations, and the ability to listen to sound clips from each site. Select recordings will be made available on this project's online story map.

For landowners, scholars, and researchers who are interested in doing acoustic monitoring on their land *Ecoacoustics: The Ecological Role of Sounds*, Almo Farina and Stuart H. Gage (Editors) Wiley Press July 2017, provides additional information, tools and references based on the current state of this field of research.

Also, many ornithologists and herpetologists are well versed in the calls of the organisms they study. For a more species specific method of learning about the organisms present on the land, individuals may contact their local Audubon chapter, Michigan Society of Herpetologists, Michigan Partners in Amphibian and Reptile Conservation or the Michigan Department of Natural Resources, to learn about the experts, enthusiasts, and resources in their area who may be able to help identify species.

3.3 Existing Stewardship Plans

Planning can occur at multiple scales, from multi-state areas such as the U.S. Fish and Wildlife Services Landscape Conservation Cooperatives, to pocket habitats on residential city yards. The following section outlines preexisting plans that are available to private landowners for guidance, reference, or inspiration. Elements of these plans may not apply to every project due to differences in ecosystems, scale, or region, but they can serve as models for people looking to write their own plan and show the value of collecting management information and organizing it in one place. To date, 12 landowners in Oakland County have created forest stewardship plans for their properties, which covers 533.5 acres of this landscape.

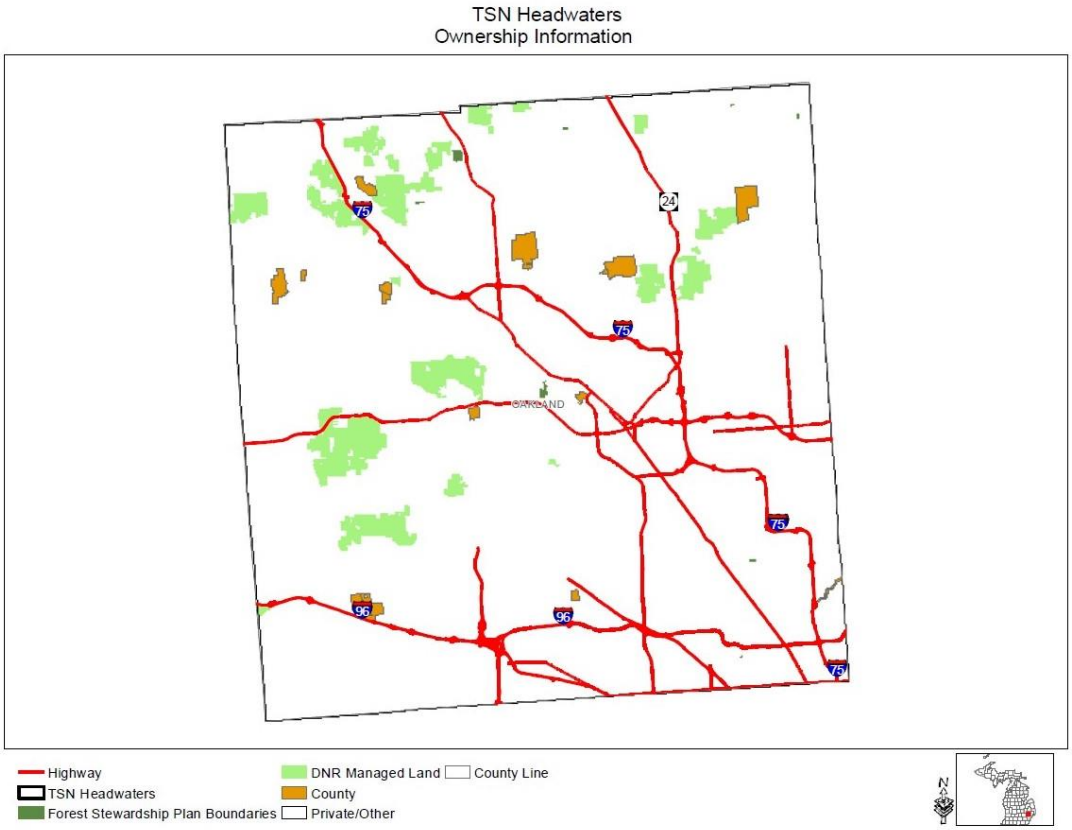

Figure 3.20 Shows the ownership information for Land Managed by Oakland County and Michigan's Department of Natural Resources. (Michigan DNR)

3.3.1 Government Stewardship Plans

Michigan Department of Natural Resources

The Michigan Department of Natural Resources (DNR) is a large landowner in Oakland County, with 37,129 acres (about 6.4%) of the County's land, including the Bald Mountain, Holly, Pontiac Lake, Proud Lake, and Ortonville State Recreation Areas as well as Dodge No. 4 and Seven Lakes State Parks. The DNR manages these lands for diverse habitat and recreation goals using many forest management approaches.

In addition to its role in Oakland County, 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 recreation activities. To encourage this $14 billion/ year industry, the Forest Division has completed several planning activities.

Statewide forest surveys by the USFS has estimated that Michigan supports approximately 19.3 million acres of forest, (*Michigan Forest Resource Assessment and Strategy, MDNR Forest Management Division, June 2010)* of which 18.6 million acres considered timberland, making Michigan's timberland acreage the 5th largest in the United States. *(www.michigan.gov/documents/dnr/1.2Introduction_242962_7.pdf)*

DNR State Forest Management Plans:

The DNR administers state forest resources for economic, recreational, and environmental values and is committed to the sustainable management of this valuable commodity. "Sustainability assures the viability of biological communities and their economic vitality by protecting and maintaining the natural environment upon which the citizens and economy of Michigan depend". (*Michigan Department of Natural Resources, Forest, Mineral, and Fire Management and Wildlife Divisions, April 10, 2008, Michigan State Forest Management Plan, David L. Price, Editor).* In order to achieve their management goal, the DNR Forest Resources Division has developed a five-year strategic plan *(Seeing the Forest, The Trees & Beyond, Forest Resources Division Strategic Plan, 201-2018, MDNR)* to help guide decision making regarding the health of Michigan's state forest resources. The strategic plan lays the groundwork for meeting the division's mission and strategic direction.

Michigan's State Forest Management Plan – 2008 (10-year plan) is a strategic planning document, intended to be a framework containing the goals and objectives for resource uses and values of state forestlands. The document reflects the challenges of managing forests for multiple benefits, achieving sustainability objectives, and integrating ecosystem management practices. The plan was amended in 2014. *(www.Michigan.gov/forestmanagement)*

The **Regional State Forest Management Plans**, which were approved in 2013, are more prescriptive and designed to inform landscape-level decision making and provide operational direction for the management of state forest resources for all 101 management areas throughout the entire state. *(www.Michigan.gov/forestmanagement)* Each Regional State Forest Management Plan is organized into Management Areas —groupings of roughly 30 forest compartments in each region (Western Upper Peninsula, Eastern Upper Peninsula and Northern Lower Peninsula) that range in size from approximately 17,000 to 105,000 acres. (*Managing Michigan's State-owned Forests: Harvest Levels, Market Trends and Revenue Realities, Michigan Environmental Council, (May 1, 2013 Rev.)*

Michigan's Forest Action Plan is a statewide assessment of forest conditions and forest resource strategy to be addressed over a 10 year period (2010-2012). Since over 60% of forestland in

Michigan is privately owned, the Forest Action Plan was developed to focus on assisting private landowners through cooperative programs for forest stewardship, urban and community forestry, forest health, wildfire management, and forest legacy. The planning period for the Forest Action Plan is 2010-2020. The Michigan Forest Resource Assessment and Strategy (Forest Action Plan) strives for greater integration of cooperative forestry programs, wildlife management goals and comprehensive outdoor recreation planning for the long-term, sustainable stewardship of the private forest resources of Michigan. *(State and Private Forestry, Michigan Forest Resource Assessment and Strategy (Michigan's Forest Action Plan), Mid-Term Five-Year) Review, Michigan Department of Natural Resources, Forest Resources Division, 2015)*

State of the Existing Forest Summary
A forest plan was developed for Oakland County Parks and Recreation by Davey Resource Group with a focus on addressing short and long-term maintenance needs for inventoried trees. The tree inventory was done to gain an understanding of the needs of the existing forest and to project a recommended maintenance schedule for tree care. Analysis of inventory data and information about Oakland County's existing program and vision for the park and golf course trees was utilized to develop this management plan.
https://www.oakgov.com/parks/Resources/NRS-Tree_Mangaement_Plan_2014_ExecSummary.pdf

The 2014 inventory included trees within the built landscape and a subset of trees along trails within 13 county park properties which included: Addison Oaks, Catalpa Oaks, Groveland Oaks, Highland Oaks, Independence Oaks, Lyon Oaks, Orion Oaks, Red Oaks, Rose Oaks, Springfield Oaks, Waterford Oaks, Glen Oaks Golf Course, and White Lake Oaks Golf Course. A total of 19,577 trees were recorded during the inventory: 16,234 built landscape trees and 3,343 trail system trees. Analysis of the tree inventory data found that one genus, Pinus (pine), makes up a large percentage of the built landscape population (21%). Other common genera include Acer (maple), Malus (apple), Picea (spruce), Prunus (cherry), and Quercus (oak).

On the overall population level, not one species exceeds 10% of the built landscape trees; however, within many of the 13 parks' populations species do exceed 10%. Those species include Red maple (*Acer rubrum*), Thornless honeylocust (*Gleditsia triacanthos var. inermis*), Black walnut (*Juglans nigra*), Flowering crabapple (*Malus spp.*), Norway spruce (*Picea abies*), White spruce (*Picea glauca*), Colorado spruce (*Picea pungens*), Austrian pine (*Pinus nigra*), Black cherry (*Prunus serotine*), Eastern white pine (*Pinus strobus*), Scotch pine (*Pinus sylvestris*), White oak (*Quercus alba*), and Scarlet oak (*Quercus coccinea*).

The condition of the built landscape tree population is rated Fair, and the overall condition of the trail system tree population is rated Dead/Fair. Overall, the diameter size class distribution of the inventoried tree population trended towards the ideal with a greater number of young trees than established, maturing, or mature trees.

Quantifiable Benefits
The appraised value of Oakland County's inventoried tree population is $50.0 million. Inventoried trees provide approximately $2.0 million in the following annual environmental benefits:
Aesthetic and Other Tangible Benefits: valued at $750,000 per year.
Energy Conservation: valued at $853,000 per year.
Stormwater: valued at $208,000 per year (interception of 26,051,621 gallons).
Air Quality: valued at $152,000 per year (27,754 pounds of air pollutants).
Carbon Sequestration: valued at $19,000 per year (5,770,278 pounds of carbon dioxide [CO2]).

Tree Maintenance and Planting Needs
Trees provide many environmental and economic benefits that justify spending the time and money for planting and maintenance. Maintenance needs recommended during the inventory include tree removal (18%), pruning (72%), and planting (11%). Reducing tree-related risk should be prioritized so that trees with the highest risk are addressed first. The inventory noted several Severe and High Risk trees (less than 1% and 15% of trees assessed, respectively); these trees should be removed or pruned immediately to promote visitor safety. Moderate and Low Risk trees should be addressed after all elevated risk tree maintenance has been completed.

Oakland County's park and golf course trees will benefit greatly from a three-year young tree training cycle and a five-year routine pruning cycle. Proactive pruning cycles improve the overall health of the tree population and may eventually reduce program costs. In most cases, pruning cycles will correct defects in trees before they worsen, which will avoid costly problems. Based on inventory data, approximately 700 trees should be structurally pruned each year during the young tree training cycle, and approximately 2,300 trees should be cleaned during the routine pruning cycle each year.

Planting trees is necessary to maintain canopy cover and to replace trees that have been removed or lost to natural mortality (expected to be 1–3% per year) or other threats. We recommend planting at least 400 trees of a variety of species each year to offset these losses and maintain canopy and maximum benefits. Trees of varied species should be planted; however, the planting of red maple, thornless honeylocust, black walnut, flowering crabapple, Norway spruce, white spruce, Colorado spruce, Austrian pine, eastern white pine, Scotch pine, black cherry, white oak, and scarlet oak should be limited until the species distribution normalizes within individual parks.

3.3.2 Non-Governmental Organization Stewardship Plans

Natural Resource Inventory and Recommendations for Independence Oaks, Lyon Oaks, and Rose Oaks, Oakland County Parks
This report from Michigan Natural Features Inventory contains recommendations for the management of native ecosystems existing in Oakland County Parks. Readers can get a sense of

the characteristics of the unique and valuable natural communities in this region, and the species to look for on their own property that may share similarities. https://mnfi.anr.msu.edu/reports/2006-04_Oakland_County_Parks.pdf

A number of reports developed by Michigan Natural Features Inventory (MNFI) that may also be of interest to property owners are available on the MNFI website: https://mnfi.anr.msu.edu. These reports do an exceptional job of explaining Michigan's natural communities and the unique plants and animals that inhabit them.

Great Lakes Restoration Initiative (GLRI) Action Plan (II) was a catalyst for the coordination of federal agencies to address concerns related to the health of Great Lakes' ecosystems. Many of this plan's goals are directly related to forestry and support efforts to prevent and control invasive species, along with restoring habitat to protect populations of native species. Threats to the Great Lakes ecosystems are prioritized and then funded accordingly.

Identifying risks and preventing the spread of harmful invasive species are addressed through early detection monitoring and public education. Federally funded projects are implemented in the identified area at risk, and afterward, local partners continue to care for the area with less costly maintenance and stewardship activities to insure long-term health.

Priority areas are protected to "sustain diverse, complex, and interconnected habitats for species reproduction, growth, and seasonal refuge." Many species that are listed by the State or federal government are under threat because of habitat loss. The GLRI Plan provides strategies to restore habitats and increase the chance for some threatened and endangered species to reach self-sustaining populations. https://www.glri.us/actionplan/pdfs/glri-action-plan-2.pdf

Make No Little Plans: Developing Biodiversity Strategies for the Great Lakes
Conservation strategies have been developed by The Nature Conservancy (TNC) for each of the Great Lake's watersheds to assess threats to biodiversity in this region. In the TNC plan, climate change and terrestrial invasive species were identified as two of the biggest threats to ecosystem health in these watersheds. Complexities generated by the sheer size of these issues make the significant need for collaboration and implementation strategies apparent.

As developed and utilized by the TNC, Conservation Action Planning (CAP) is an effective ten step approach to projects which is accomplished by defining conservation targets, identification of critical threats (social, biological, political, economic) to the project, and the development of management and monitoring programs based on the targets and collected information. Once regional priorities are determined, Conservation Action Planning can be utilized to determine a plan of action for the priorities. Then, as actions are taken and the outcomes monitored and measured, planning can be revised to incorporate new knowledge.

https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/wholesystems/greatlakes/Pages/synthesispaper.aspx

Clinton River Watershed Council

For over 44 years, the Clinton River Watershed Council (CRWC) has provided opportunities for citizens, schools, governments, businesses, and other community groups to get involved and active in ensuring a healthy Clinton River for us all through education, stewardship, and watershed management—to make a difference in your community…today and for future generations. The watershed covers 760 square miles in 4 Counties with 72 Communities and 1.5 million people. Their 2012 strategic plan is posted on the website. http://www.crwc.org

Huron River Watershed Council

The Huron River is considered to be the cleanest urban river in Michigan. Much of the credit for this status goes to the Huron River Watershed Council and the persons who saw the need for the river's protection. Even though the Council has no enforcement powers, it has accomplished its goals through the use of technical data, factual information, and citizen stewardship to influence decisions made by various local agencies, businesses, and individuals. Today, the Council's eleven-person staff coordinates a dozen programs and hundreds of volunteers who serve on our boards, committees, and in other volunteer activities. The HRWC's efforts fall into three major categories of Education, Technical Assistance, and Science/Conservation. The programs cover pollution prevention and abatement, hands-on citizen education and river monitoring, natural resource planning, mass media education and information, and wetland and floodplain protection.

Huron River Watershed Management Plans

If we manage activities on the land that drains to bodies of water, we will protect and improve our local water resources. Almost every activity on land can affect the quality and quantity of water in our waterways. Watershed planning brings people from the watershed together to address those activities. Individuals working together can design a coordinated watershed management plan that builds on the strengths of existing programs and resources, and addresses water quality and quantity concerns in an integrated, cost-effective manner.

Development of a watershed management plan is a requirement of the State of Michigan and the U.S. Environmental Protection Agency for communities to be eligible for grant funds through the Clean Water Act. HRWC facilitates the watershed planning process, and implementation of those plans, throughout the watershed.
Following are links to plans developed in full or part by HRWC.

- Kent Lake Subwatershed Management Plan
- Huron Chain of Lakes Watershed Management Plan
- Brighton Lake Phosphorus Management Plan
- Strawberry Lake Phosphorus Management Plan, 1.4 MB

- Portage Creek Watershed Plan and Project
- Mill Creek Subwatershed Management Plan, 11.7 MB
- Watershed Management Plan for the Huron River in the Ann Arbor-Ypsilanti Metropolitan Area (Middle Huron)
- Watershed Management Plan, 42 MB
- Appendices, zip-compressed file, 67 MB
- Huron River Pathogen Management Plan, 2.3 MB
- Malletts Creek Biota Restoration Plan, 1.8 MB
- Swift Run Biota Restoration Plan, 1.1 MB
- Ford and Belleville Lakes Phosphorus Management Plan, <1 MB
- Lower Huron Watershed Management Plan
- Management Plan, 1.7 MB
- Action Table, <1 MB
- Maps, 16.2 MB
- Bacteria Reduction Implementation Plan for the Honey Creek Watershed, 1.2 MB

Flint River Watershed
Within Oakland County, four branches of the Flint River watershed begin in our northern communities. Kearsley Creek, Swartz Creek, and Thread Creek are part of the Middle Flint subwatershed group and a small portion of the South Branch in Addison Township. The Flint River subwatershed group has developed a coalition to address watershed issues, the Flint River Watershed Coalition. Communities and other Middle Flint watershed partners have worked cooperatively to develop the Middle Flint Watershed Management Plan. For more detailed information regarding watershed activities and programming in the Flint, visit Flintriver.org or call (810) 767-6490.

3.4 Local Resource Providers

This section explains the resources that are available to private landowners that may help individuals with their own plans and management.

3.4.1 Resources from Government Agencies

Michigan's Forest Legacy Program is a product of a partnership between Michigan's DNR and the 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.

DNR Forest Stewardship Program (MDNR-FSP) offers resources to private landowners to support forest stewardship efforts, in recognition of the fact that a majority of the state's forests are on private property. MDNR-FSP certifies forest stewardship plan writers to assure that they can offer sound information on best forest stewardship practices, maintains a listing of plan writers in different regions, and offers cost-sharing to landowners to assist them in forest stewardship planning.
The DNR Forest Stewardship office offers several programs that help fund Forest Stewardship plans
Helping Private Forest Landowners Develop Plans for Sustainable Forest Management: A Landowner's Guide. www.michigan.gov/foreststewardship

Michigan Landowner Forest Stewardship Plan (Sample)
www.michigan.gov/.../FSP_Plan_Example_September2014_468852_7.pdf

Plan Writers: www.michigan.gov/dnr/0,4570,7-153-30301_34240_68762---,00.html

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, 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.

A useful publication for management of deer as well as many other game and non-game species is provided by the DNR Landowner's Guide. This 1999 publication also offers instructions on land management planning for forests, grasslands, wetlands, cropland, and backyard habitats.
http://www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/

U.S. Fish & Wildlife Service (Michigan)
Jim Hudgins
2651 Coolidge Road
East Lansing, MI 48823
(517) 351-4230
Jim_Hudgins@fws.gov

Michigan Department of Environmental Quality
The Michigan Department of Environmental Quality 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 septage, and use of flood plains.

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

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
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 "Promoting 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.
www.mishorelinepartnership.org/

Michigan's Water Strategy
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.
http://www.michigan.gov/deq/0,4561,7-135-3313_3677_76614---,00.html

Oakland County Potential Conservation/Natural Areas Report.
This 2004 report identifies and ranks Potential Conservation/Natural Areas remaining in Oakland County using a process established by the Michigan Natural Features Inventory (MNFI) of identifying potential conservation areas. Potential Conservation Areas are defined as places on the landscape dominated by native vegetation that have various levels of potential for harboring high quality natural areas and unique natural features. In addition, these areas may provide critical ecological services such as maintaining water quality and quantity, soil development and stabilization, pollination of cropland, wildlife travel corridors, stopover sites for migratory birds, sources of genetic diversity, and floodwater retention. However, the actual ecological value of these areas can only be truly ascertained through on the ground biological surveys.

The Michigan Natural Features Inventory recommended that Oakland County Planning & Economic Development Services Division incorporate this information into their comprehensive natural area mapping services. The site map and ranking data can be used by local municipalities, land trusts, and other agencies to prioritize conservation efforts and assist in finding opportunities to establish an open space system of linked natural areas throughout Oakland County.

Using the natural break classification, a total of 484 sites (58%) were placed in the priority three category, 262 sites (32%) were placed in the priority two category, and 84 sites (10%) were placed in the priority one category. It is important to note that although only 10% of the sites were identified as priority one, these 84 sites total 38,674 acres (41.3% of the total acreage of the 93,521 acres in all delineated sites).
https://mnfi.anr.msu.edu/pub/publications-list.cfm (scroll down by date to 2004)

Southeast Michigan Council of Governments
Working with local watershed groups and member governments, Southeast Michigan Council Of Governments (SEMCOG) provides technical assistance on watershed management issues and regulatory requirements within their jurisdictions. A watershed is an area of land that captures rainwater and eventually carries it to the nearest lake, river, or stream. Michigan has numerous watersheds and Watershed Management Plans serve as guides for communities to protect and improve water quality and related natural resources. These plans consider all uses, pollutant sources, and impacts within a drainage area. More than 150 Watershed Management Plans exist at the local level across the state, many funded through MDEQ nonpoint source

grant opportunities. A Watershed Management Plan was required for communities using Michigan's unique watershed-based Phase II permit. Many of these plans also meet Federal EPA Section 319 requirements.

Common elements of watershed plans across Southeast Michigan include goals, objectives, and actions to address water quality and water quantity (i.e., stream flashiness) challenges in addition to identifying protection and restoration opportunities. This led to development of the Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers.

Additionally, SEMCOG led the development of the Green Infrastructure Vision for Southeast Michigan. The vision brings together a holistic, coordinated plan that addresses all unique elements of green infrastructure, including natural areas, wildlife habitat, parks, hiking/biking trails, water trails, tree canopy, agricultural lands, conservation property, vacant property, and many others. It also focuses on the relationship of green infrastructure to our water resources. http://semcog.org/Watersheds

Oakland County Government
The County's Environmental Stewardship Initiative's mission is to provide information, plans, and options to promote the conservation of Oakland County's natural environment while supporting sustainable economic growth, development and redevelopment. The Planning Division provides numerous programs and services revolving around environmental stewardship that can help a variety of stakeholders. Some resources include information on Natural Areas Inventory, Riparian Corridor Planning, and Native Landscaping.
https://www.oakgov.com/edca/planning/environmentalstewardship/Pages/default.aspx

Oakland County Parks
Oakland County Parks function as major ecological "hubs" within the region by supporting important ecosystems, protecting air and water quality, and providing wildlife habitat. The Oakland County Park system's, natural resources management program focuses on an ecosystem approach to ensuring the health and function of 21 distinct natural communities, including 1200 acres of open water resources and adjacent wetland habitat. Control of deer densities, removal of invasive species, restoration of natural fire cycles through prescribed burns, and reintroduction of native plants are among the suite of land management tools applied to achieve this goal.

Forest resources within Oakland County Parks range from stands of oak-hickory and beech-maple to hardwood-conifer complexes. The appraised value of Oakland County's inventoried tree population is $50.0 million. Annual environmental benefits provided by park forests include energy conservation, storm water and air quality improvements, and carbon sequestration. To ensure the long-term provision of these benefits, forestry staff focuses management efforts on hazardous tree removals, disease detection and prevention, and tree planting programs.
https://www.oakgov.com/parks/getinvolved/Pages/Natural-Resource-Management.aspx

2800 Watkins Lake Road
Waterford, MI 48328
1-888-OCPARKSOC
Parks@oakgov.com

Oakland County Water Resources Commissioner
The Oakland County Water Resources Commissioner has the responsibility of planning, developing and maintaining designated surface water drainage systems in Oakland County under Michigan State law, known as Drain Code, Act 40 of 1956 (and has other statutory duties as Agent for the county). The office staff of more than 225 highly trained professional and technically skilled people is dedicated to providing the best and most cost effective service to the citizens of Oakland County.

Jim Nash
Water Resources Commissioner
One Public Works Drive,
Building 95 West Waterford, MI 48328-1907
Phone: (248) 858-0958
wrc@oakgov.com

Oakland County is part of the headwaters of the Clinton River watershed. The watershed stakeholders have been very active in working to protect and restore the watershed. The Oakland County Water Resources Commissioner's Office (WRC) constructed the George W. Kuhn Retention Treatment Facility to control combined sewer overflows (CSOs) and protect water quality. The WRC has also implemented a number of stormwater projects including public education and illicit discharge elimination activities.
https://www.oakgov.com/water/Pages/services/ws_clinton.aspx

Oakland Conservation District (Deer Lake Center)
The Conservation District provides educational programs and encourages participation in programs provided by the USDA Natural Resources Conservation Service and the Great Lakes Restoration Initiative.

7150 Dixie Highway Suite 2
Clarkston, MI 48346
(248) 922-7822
oaklandconservation@gmail.com

USDA Natural Resources Conservation Service and Farm Service Agency
The United States Department of Agriculture (USDA) administers the Natural Resources Conservation Service (NRCS) and the Farm Service Agency programs at service centers in the plan area. The Natural Resources Conservation Service has tools and other technical resources to assist with Conservation Planning, Conservation Compliance on highly erodible land, nutrient and pest management, and Rapid Watershed Assessment. The agency also conducts the Soil Survey Program, the National Resource Inventory and the Conservation Effects Assessment Project. Some of the key financial assistance programs (see Section 5.5) are Environmental Quality Incentives, Conservation Stewardship, and Agricultural Conservation Easement. Conservation Stewardship is a program that provides technical and financial assistance to qualified farmers whose applications rank high enough (on the Conservation Measurement Tool) to be accepted into the program.

The Farm Service Agency's 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 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.

Lapeer Service Center (Lapeer & Oakland counties)
700 South Main Street
Suite 120C
Lapeer, MI 48446
(810) 664-0895

3.4.2 Resources from Non-Governmental Agencies

The Stewardship Network (TSN)
The Stewardship Network (TSN) is a 501(c)(3) corporation with a mission to connect, equip, and mobilize people and organizations to care for land and water in their communities. TSN is dedicated to training, developing, and supporting a vibrant group of volunteer and professional stewardship leaders. TSN builds the capacity of partner organizations and individuals through development of model projects and implementation of region-wide initiatives. TSN helps groups and individuals tap into the Network's wealth of knowledge and experience in preserving and protecting our native biodiversity. The Stewardship Network trains volunteers in scientifically-based, field-proven conservation techniques they put into practice on partner organizations' properties.

The Stewardship Network is the recognized national and international award-winning leader in this approach. Founded and headquartered in Ann Arbor, TSN supports 16 local collaborative conservation clusters (CCCs) in Michigan, Ohio, Indiana, Minnesota, and New Hampshire. In honoring TSN with its 2015 Science & Practice of Ecology and Society award, the journal *Ecology and Society* commended "the local roots" of TSN, writing "Different from other organizations, TSN asks communities the critical question, 'What do you need to care for land and water?'" TSN then helps each local cluster determine its geographic boundaries and program priorities; recruit, train and engage volunteers; and secure the resources and expertise to act as stewards for its local land and water.

The Network hosts a series of initiatives that support their on-the-ground CCCs, including monthly webcasts; the Science, Practice & Art of Restoring Native Ecosystems Conference; the Spring Clean-up Challenge (removal of invasive species, starting with Garlic Mustard); the October Volunteer Restoration Challenge (starting with biodiverse tree planting, native prairie grasses, wetlands restoration); websites; newsletters; and turnkey systems for database management, e-communication, registration, and contributions.

416 Longshore Dr., Ann Arbor, MI 48105
(734) 996-3190
staff@stewardshipnetwork.org
www.stewardshipnetwork.org

The Headwaters Cluster of the Stewardship Network
The Headwaters Cluster (HWC) formed in the fall of 2003. The Michigan Chapter of The Nature Conservancy (TNC) with the Huron Clinton Metroparks led the formation of the Cluster as a way to build cooperative relationships between the various agencies that were responsible for managing high quality ecosystem areas under protection in Oakland County and surrounding areas, thereby enhancing the stewardship of those areas. Oakland County is home to the headwaters of five different river systems along with an exceptional ecological diversity and is experiencing extreme development pressure on remaining natural areas.

The HWC has two main areas of focus: 1) on the ground conservation action and planning, and 2) educating community members in conservation issues, techniques and other relevant topics. We focus on local stewardship issues and plans to address those concerns through implemented action. The HWC provides unique educational opportunities through events, workshops, activities and online networking to share ideas, information, skills and resources. Contact the Headwaters Cluster Coordinator for more information at:
Headwaters@StewardshipNetwork.org

Michigan State University Extension Service
Michigan State University's Extension Service offers information on natural resources, agriculture, lawn and gardens and other topics. They also have a Conservation Stewards Program: http://msue.anr.msu.edu/program/info/conservation_stewards_program

1200 N. Telegraph Road #26
E Pontiac, MI 48341
(248) 858-0880
msue.oakland@county.msu.edu
http://www.oakgov.com/msu

Michigan Nature Association
The Michigan Nature Association (MNA) is dedicated to the conservation of rare, threatened and endangered species, imperiled natural communities and unique geological features throughout the State of Michigan. Established in 1952, MNA is Michigan's oldest land conservancy. Today MNA protects over 170 nature sanctuaries encompassing over 12,500 acres across Michigan.

Within Oakland County the Michigan Nature Association protects and manages six nature sanctuaries. Lakeville Swamp sanctuary protects 76 acres of unique areas including a white cedar swamp and has 400 species of plants (the greatest amount of diversity in the county). Timberland is a 245-acre southern hardwood swamp on poorly drained glacial lake plains.
http://www.michigannature.org/

Andrew Bacon
Stewardship Coordinator,
abacon@michigannature.org.

Land Trusts
There are three local Land Trusts operating in Oakland County:
North Oakland Headwaters Land Conservancy, Inc., Clarkston, MI
Six Rivers Land Conservancy, Rochester, MI
Southeast Michigan Land Conservancy, Superior Township, MI

One of their primary methods of land protection is Conservation Easements which are legal agreements negotiated between the Conservancy and the landowner which restrict certain land uses, such as residential development, mining, and other activities that affect the conservation values of the land. Those values include providing wildlife habitat, protecting soil and water quality, and maintaining scenic vistas. Conservation Easement lands are not owned by the Conservancy but they conduct annual monitoring to ensure that the terms of the easement are enforced. Preserves are different in that they are owned and managed by the land trust.

In addition to the environmental benefits of placing land in a Conservation Easement (CE), there are potential financial benefits that arise from federal, state and local tax policies. Landowners should consult their lawyer, accountant and other professionals in order to fully understand these laws. If a landowner donates a CE, they may be eligible for an income tax reduction on the difference between the value of the property with and without a CE (as determined by a certified appraiser). Additionally, there may be a reduction in estate and property taxes. A decision to enter into a CE should not be made lightly because it is held in perpetuity (at least for those CEs that qualify for income tax reduction). This means that future landowner (heirs or buyers) must abide by the terms of the CE which is recorded in the property record at the Courthouse.

From: Internal Revenue Code § 170(h)(4)(A): In order to qualify for a tax deduction, the land must meet a "conservation purpose" test that addresses at least one item in the following language:
the preservation of land areas for outdoor recreation by, or the education of, the general public,
the protection of a relatively natural habitat of fish, wildlife, or plants, or similar ecosystem,
the preservation of open space (including farmland and forest land).

North Oakland Headwaters Land Conservancy, Inc.
North Oakland Headwaters Land Conservancy (NOHLC) is a private, non-profit, community supported, citizen run organization with 44 years' experience in preserving open space in northwest Oakland County and nearby communities. Over 1,500 acres have been preserved in six townships and two counties, with parcels ranging from a half acre to over 250 acres. Their mission is to conserve the woods, fields, streams, and other natural resources in the headwaters area of the Clinton, Shiawassee, Huron and Flint Rivers.

PO Box 285
Clarkston, MI 48347-0285
(248) 795-2808
mail@nohlc.org
www.nohlc.org

Six Rivers Land Conservancy
Six Rivers Land Conservancy is a private non-profit land conservation organization that believes it is important to sustain the quality and character of the natural resources around us. They recognize the value of an inviting landscape and a strong and vibrant natural resource base in our communities; it makes them attractive and healthy places to live and attracts people and institutions that create prosperity. They work with private landowners who share these values for our natural heritage and choose to act on them in measurable, permanent ways.

PO Box 80902
Rochester, MI 48308-0902
(248) 601-2816
hpaterson@sixriversrlc.org
www.sixriversrlc.org

The Southeast Michigan Land Conservancy
The Southeast Michigan Land Conservancy conserves natural land and open space -- including forests, wetlands, meadows, agricultural lands, and places of scenic beauty -- to provide habitat for wildlife and to enrich the lives of people. "Southeast Michigan: a beautiful place where people and nature coexist in healthy, sustainable balance." SMLC's vision statement expresses how we feel about this special place we call home. Preserving natural areas and farmlands is good for all of us. SMLC protected more than 3,400 acres in this region.

Southeast Michigan Land Conservancy
8383 Vreeland Road
Superior Township, MI 48198-9619
(734) 484-6565
jlewis@smlcland.org
www.smlcland.org

Wild Ones - North Oakland Chapter
The North Oakland chapter of Wild Ones serves those in northern Oakland County, Michigan who are interested in native plants. Their goal is to educate and promote the benefit and use of Michigan native plants, which they do by bringing in local speakers and organizing field trips to nearby locations, including parks and members' homes. They generally have public presentations or events the third Wednesday of every month, preceded by a short member meeting except during the summer. http://northoakland.wildones.org/

Shiawassee River Watershed
The Shiawassee River Task Force (SRTF) is a group of communities and interest groups at the headwaters of the main branch of the Shiawassee River within Oakland County. The SRTF consists of the local governments (Rose Township, Holly Village, Holly Township, and Springfield Township) organizations including the Six Rivers Regional Land Conservancy, North Oakland Headwaters Land Conservancy, Oakland County Planning and Economic D development Services, Michigan State University Extension, and others. The Oakland County Water Resources Commissioner's Office (WRC) provides assistance in both water quality monitoring advice and service, planning, and education outreach to the SRTF. For more detailed information regarding downstream organizations working toward similar goals, visit the Saginaw Bay Watershed Initiative Network website: http://www.saginawbaywin.org/ or call

Friends of the Shiawassee (FOS) at 989-723-5256. WRC's Environmental Team also participates in watershed planning in the Upper-2 Shiawassee River (USR) watershed located predominately in Livingston County, although small portions of Rose and Highland Townships in Oakland County fall within the watershed boundaries. or phone.

Ric Lawson
734-769-5123 x609
rlawson@hrwc.org

Sources of Michigan Native Plants
This list of suppliers is meant to provide a start in your search for native plant suppliers near you. Note: The Michigan Department of Environmental Quality's bio-engineering permit does require the use of Michigan native plants below the ordinary high water mark when doing work that requires a permit.

Michigan Native Plant Producers Association (www.mnppa.org/)
The Michigan Native Plant Producers Association comprises 7 independently owned nurseries located throughout the state of Michigan. Together they grow and sell over 400 species of Michigan native plants and seeds, including, trees, shrubs, wildflowers, grasses, and ferns.

Wildflower Association of Michigan (www.wildflowersmich.org/)
The Wildflower Association of Michigan encourages the preservation and restoration of Michigan's native plants and native plant communities. They provide education on native plants and native landscaping through their conference, website, grant program, and quarterly newsletter. They also have sources of native plants and a business directory listed on their website.

Michigan Association of Conservation Districts
Many of Michigan's 78 Conservation Districts host native plant sales in the spring and fall.

3.4.3 Private Sector Natural Resource Professionals

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.

MDNR 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
brownd94@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)
The Stewardship Network has compiled a directory of contractors who perform an array of services related to ecosystem restoration and stewardship in Southern Lower Michigan. Visit http://stewardshipnetwork.org/resources/southern-michigan-restoration-contractors for the most recent version of this document. If you would like to add your own company or suggest a contractor that you have had success with, suggestions may be emailed to staff@stewardshipnetwork.org.

Michigan Certified Natural Shoreline Professionals
Certified Natural Shoreline Professionals have demonstrated competency in shoreline and near shore soils, plant communities, aquatic habitats, water law and permitting, wave energy assessment and the methods and techniques involved in designing natural shoreline landscaping and bio-engineered erosion control on inland lakes. Certification is provided by the Michigan Natural Shoreline Partnership (MNSP) and is updated every three years through continuing education. (from http://www.mishorelinepartnership.org/)

To find a Natural Shoreline Professional in your area, visit http://www.mishorelinepartnership.org/find-a-shoreline-contractor.html Professionals can be found easily by name or county (there are also many who work state-wide) on spreadsheets created and maintained by MNSP.

4. Landscape Stewardship Stories

Rather than just listing recommended practices that should be done, we spoke with your neighbors and are sharing their stories about how they've managed their own forest lands in order to inspire other landowners to become more actively engaged in creating their own stories.

Please note that while the stories and interviews are completely factual, the names of the interviewees have been changed to protect the privacy on contributors who wished to remain anonymous.

4.1 Oak Wilt Prevention and Treatment in Oakland County

Have you ever taken a walk through the woods on a warm summer day in Michigan? The trees are full and green with a lush canopy looming overhead. But you might come upon a patch of trees that have no foliage at all. These trees are dead or dying. It is not unusual to find a dead tree still standing in the forest, but it is quite unusual to find a group of dead trees, and even more unusual if they are all varieties of oak trees. This mass die-off of groups of oak trees can often be attributed to a tree disease called oak wilt.

Oak wilt is a tree disease caused by the fungus *Ceratocystis fagacearum* which infects the vascular tissue of many native oak trees in Michigan. The fungus is spread by a number of insects, including the Oak Bark Beetle (*Psuedopityophilorus spp.*), and can spread rapidly through a forest system by using interconnected roots systems.

The park service foresters in Oakland County are on the front lines of the challenging fight against this disease. Employing both chemical and physical barriers, foresters are beginning to turn the tide in the struggle to control oak wilt. The disease cannot be cured once a tree is infected, which means prevention is the only way to slow its spread.

Park service foresters within Oakland County seek to identify outbreaks of oak wilt and respond rapidly to contain them. "Early detection is really important," says Park Forester Leslie The summer months are the easiest time to identify oak wilt, because you can find stands of oak trees that are completely bare or severely wilted. "We're working really closely with the maintenance staff in our parks to help keep an eye out," says Leslie. "We are also adjusting our maintenance schedule to finish all our oak trimming before April 1st," explains Leslie. The trimming schedule allows the trees sufficient time to heal before the warming weather results in beetles moving the oak wilt to new trees.

Using a technique called "trenching," foresters in Oakland County cut the roots of infected trees before the fungus can spread to other healthy, nearby oaks. If an oak tree is found to have oak wilt, nearby trees can be treated with a fungicide using a process called root flare injection. "We

have invested a lot in our healthy oaks with treatments of Propiconazole, and have had a lot of success in stopping oak wilt," Leslie explained. The battle is ongoing, but, with collaborative public education and outreach campaigns, foresters are making strides towards controlling this oak damaging disease in the tree's namesake county.

4.2 Using Prescribed Fire to Manage the Oak Barrens Ecosystem

The oak barrens habitat historically covered around 2 percent of the state, but currently constitutes less than a 10th of a percent of the present vegetation in Michigan. The rare habitat is a savanna type characterized by fire-dependence, dominance of oaks, and canopy cover between 5 and 60 percent. With oaks being a central piece of this ecosystem, the use of prescribed fire to promote oak regeneration has become a necessary tool in the forester's plan to restore this rare community.

Natural resource managers in Oakland County use prescribed fire in a number of habitats for a variety of management goals. In Michigan, natural fire cycles help control the growth of certain tree, shrub, and grass species, particularly invasive ones. Prior to European settlers moving to the area, the natural fire cycles promoted the presence of oak barrens habitat. With human expansion into Michigan, the interruption of the natural fire cycle has largely resulted in the succession of open oak barrens into closed canopy forests. Additional stresses were put on the oak barren community as settlers selectively harvested white oaks from these habitats.

"Prescribed fire is a critical management tool for restoring and maintaining these landscapes," says Ron, a natural resource professional in Oakland County. "It's very important for us to explain to the community the need for this sort of management, and how these fires are part of the ecosystem historically." Ron explains that the community of homeowners and landowners in this area of the county sometimes are hesitant to accept prescribed fire as an essential process

in protecting these valuable resources. “We hear from folks who are concerned with the smoke generated by these fires, or worry that the fire will escape our burn unit and spread to their lands.” While the use of prescribed fire as a management tool is not new to Oakland County, explaining the tool to the public is still an important part of the process.

The Michigan Prescribed Fire Council updates their list of best management practices (BMPs) for performing prescribed burns regularly. These BMPs allow for land managers to tailor a prescribed fire program to achieve a particular result in their habitat management plan. In the restoration and maintenance of oak barrens, frequent but low-intensity fires are performed to maintain an open grass understory and preserve mature oaks. High intensity fires have shown to kill mature oak trees and result in more abundant but scrubby oak populations.

Having such a rare savanna type in Oakland County adds to the richness and diversity of our natural areas and reinforces the need for prescribed fire to maintain these habitats. With the careful application of prescribed fire, Oakland County natural resource managers will continue to preserve existing oak barrens remnants and expand efforts to reclaim this unique ecosystem from our many fire-suppressed landscapes.

4.3 Managing Hazardous Trees in Oakland County's Parks

We've all taken a stroll through a forested park and enjoyed the scenery of mature trees lining the path. But have you ever wondered why you don't see trees falling over into the path, while you may see trees leaning over in the forest? These trees which have fallen, or have the potential to fall, on public paths are known as hazardous trees by foresters working within park systems. It is a complicated task to inventory and manage the thousands of trees that line our park paths, but parks foresters have created innovative solutions to managing this hazard.

Hazardous trees generally have a structural defect which may cause the entire tree, or a large portion of it, to fall on a person or piece of property and cause damage. Deep in the forest, where humans don't live or walk, trees falling over are a natural and important part of the forest ecology. Changes in canopy openings can present opportunities for new species to thrive, and many downed trees provide critical habitat for animals and insects. The forester's job is to decide which trees could be potentially hazardous to humans and human property and which trees can be left to stand.

Foresters must look for trees that exhibit signs of potential instability. The presence of a forked trunk, cankers, cavities, wounds, or cracks may be clear indications that the tree is not stable Fand more prone to falling when stressed by high winds or storms. Foresters are always aware of dead branches or limbs hanging overhead, often referred to as 'widowmakers.' These dead snags can fall at any moment without any additional stress, even on a perfectly calm and sunny day.

Park foresters within Oakland County are tasked with the management of these trees as just a part of their overall duties. Parks Forester Tom explains, "Hazardous tree inventory and management is just part of the job, and we manage thousands of acres of forested area and miles of trails." The task of identifying and managing these trees seems like an overwhelming process. "We definitely have to prioritize which trees we cut down or remove and which trees we continue to monitor." Tom noted.

The easiest way to ensure the safety of park patrons and property is to be proactive about the management and prevention of trees falling, but the reality of hazardous tree management does not always follow this model. “Sometimes we spend all day just responding to reports of downed trees, especially after heavy storms,” Tom explains. “It can be hard for us to keep up.” The pressure of patron complaints about losing access to trails due to fallen trees or perceived danger from leaning trees can often drive an incident-response based management protocol and make it difficult to practice proactive management.

Park foresters often use the winter months when less patrons are in the park to inventory and remove hazardous trees. This allows foresters to remove trees from high-use areas before they become a problem in the following spring storm season. The management of hazardous trees continues to be an essential service of the park forester and allows for the enjoyment of the beautiful old growth forests of southeast Michigan from the safety of a manicured trail.

4.4 Planning Green Corridors in a Highly Urbanized Region

Oakland County is a highly urbanized region, and its population of over 1 million people makes it the second-most populous county in Michigan. Nearly half of the 580,000 acres in Oakland County are covered by single-family homes, with the majority of these homes sitting on parcels less than one acre. The parcelization of the land means that greenspace and urban forests in Oakland County are an extremely important resource that urban foresters must steward. Whether it is the planting of trees that line our roadways or deciding what types of forests should be encouraged within our parks, urban foresters help protect the fragmented ecosystems that exist in the cracks of our dense urban landscapes.

Many studies have shown that the presence of trees in urban settings have a litany of positive effects. Trees lining roadways keep water off the road as their canopy absorbs storm water. The effect of tree canopy closing over roadways leads to drivers slowing down and having less accidents. Property values are higher when large, mature trees are present. Even in sidewalk shopping environments, shoppers are more likely to linger and spend more time and money when the sidewalks are lined with shade providing trees. Natural resource managers have the tendency to think of forests as a large, contiguous landscape with little or no human presence, but urban foresters are beginning to help shift that mentality.

Aside from the many benefits urban forests provide for the people that live in these communities, they also provide important habitat and ecosystem function for animal life moving through these urban settings. Urban foresters have many criteria when planning a green corridor that will run through their city. They plant and manage for landscapes of mature trees spaced out from one another with infrastructure function in mind. They choose trees that are less prone to needing pruning, cleanup, or heavy maintenance that will become a hazard to the people living near them. They also consider how they might aid in connecting large natural areas through the use of green corridors, allowing for the safe movement of animal life from one space to another.

In planning green corridors, multiple stakeholders are involved. “We have to keep the public’s needs in mind,” says natural area planner April. “These green corridors we’re planning have to serve multiple functions.” The functions include providing an oasis of green space to dense urban areas, providing pathways for animal and insect life to move through the city, and providing a mechanism for gene flow to occur for trees and other plant species. When these corridors are planned around a natural feature such as a river, it can greatly enhance the protection and diversity of the natural feature. “Planning green corridors on the banks of the cities’ rivers helps protect the river from pollutants,” explains April. These corridors are known as a riparian buffers, areas that are kept natural and protected from human disturbance.

The planning of infrastructure in cities is changing. In the past, urban areas planned mostly for what is known as ‘gray infrastructure’ that relies heavily on concrete and steel to provide stormwater management and roadways with large barren margins covered in short grass. This practice is shifting to a more ‘green infrastructure’ model, where natural channels are being

used for stormwater management, and mature trees and a variety of grasses are being incorporated in road margins. These urban forests are critical to maintaining the diversity of wildlife in our populated county and have the added benefit of providing a pleasing aesthetic to those who reside in the urban areas of Oakland County.

4.5 Managing County Road Right-of-way Trees

Trees line the roadways of many Michigan cities, and the maintenance and management of these linear forests fall to the Road Commission of the County. Whether the trees were planted intentionally to provide aesthetic value or infrastructure to the city, fall on private property, or are simply left standing from when the roads path was cut through the forest, these forested lands represent a complex problem for the road commission.

Foresters for the road commission have to balance the needs and safety of public using the roads, the private landowners' wishes, and the need to provide the infrastructure and habitat that these small forests sustain. The Road Commission measures the road right-of-way (ROW) as a varying distance from the center line of a road. This property is managed by the road commission, and any trees or vegetation that they feel is dangerous to road use can be removed at their discretion. When, where, and how to remove trees and vegetation can be a touchy subject. "Sometimes homeowners resist to the removal of trees from the right-of-way," explains Donna. "They have a connection with trees along their property and hate to see the removal of a large tree that may have been there for their whole life."

In balancing the need to provide the public safe access to the roads with landowners' needs, the importance of the ecological or practical value of these linear forests sometimes takes a back seat. "While these trees may be providing a nice aesthetic value or be habitat for birds that homeowners enjoy, the bottom line is maintaining a safe road for the public to use." explains Donna. It would be difficult to explain to a motorist struck by a falling tree that the tree was left in place to preserve animal habitat. While not the chief focus of a ROW forester's management plan, the function these trees provide as habitat and infrastructure are additional benefits that city managers should consider.

One emerging issue in Michigan is the documented outbreaks of white-nose syndrome, a fungal disease that affects bats. What does this have to do with road ROW tree management? The answer is that the Northern Long-Eared Bat is one species that is heavily impacted by the fungus and has been listed as a federally threatened species. This bat, while not yet confirmed to be reproducing in Oakland County, is the target of a number of laws and regulations that effect tree management. The bats roost and reproduce in the summer months in dead stands of hardwood trees. If this federally threatened species is found to be reproducing in dead hardwood trees in Oakland County, this will stop any maintenance of these potentially hazardous trees during the summer months. This will have a drastic effect on the planning of the Road Commission Foresters, as they will have to complete all tree trimming and pruning over the winter months.

The next time you are travelling down a high-speed highway, or a shady, back-country dirt road, consider the value of these linear forests and the work of those who manage them. Road right-of-way forests may not be the most important ecological niches, but they do provide a critical role in protecting natural areas from our road pollutants and reminding us of our

connection with our forested natural areas. It will continue to be the job of Road Commission foresters to provide for the safe use of public roads, while preserving any green space they can along our roads for these linear forests.

4.6 Managing your forest as a private landowner

Managing forests on private lands can be a daunting proposition for an individual. Where do you start? How do you learn how to manage forests safely and effectively? The answer is: you just start. Many homeowners begin from their back door and work outwards; this is an effective way to get the ball rolling. Others have a special place of interest on their property, and they work out from there. Consulting with a forester who is specialized in the management of private forests can be a great first step for those who are worried about mismanaging their forests.

A program such as the Environmental Quality Incentives Program (EQIP) can provide farmers, ranchers, and private forest land owners assistance with the technical details of forest management, as well as financial assistance for implementing forest land conservation practices. This is an ideal way for homeowners who manage large properties to get assistance with setting up these practices on their own property. Other methods may include private landowners working collaboratively with experts in their local area. In Oakland County, many townships and cities have expert natural areas managers who are happy to provide advice to private landowners interested in managing their lands.

Jerry, a landowner in Oakland County, has been managing his private property of over 20 acres for the last decade. He works with professional land managers in Oakland County to manage upland and wetland habitat on his property. “It’s been a real labor of love,” says Jerry. “Where we started versus where we are now, it’s like night and day.” He explained that he has taken the management of the property to new levels after speaking with professional foresters and land managers. “We have incorporated prescribed burns to manage forest understory and begin selectively harvesting certain trees to open up the canopy.” These processes mimic natural forest processes and allow for the healthy growth and regulation of the forest canopy and understory.

“Managing invasive species has been a big part of our effort,” Explains Jerry. Invasive shrubs such as honeysuckle and autumn olive have invaded the forest understory and are pushing out native plants. Jerry’s efforts to manage these shrubs have resulted in a rebounding of the native forest understory. “Aside from the ecological benefit, I get to enjoy the results of all my hard work,” adds Jerry. He explained that he can now forage for mushrooms and morels in the forest understory and enjoys the view from his house much more than he did a decade ago.

By planning and executing a land and forest management plan, a private homeowner can greatly improve the value of their property. This value stems from improvements to aesthetics, wildlife habitat, ecological services such as cleaner air and water, and the value of the trees themselves for timber that is preserved through proper management. If you would like to improve the value of your property in these ways, you should seek out professional foresters and land managers in your area and contact your county conservation district for more information on how to get started.

4.7 Christmas Tree Farms and Sustainable Practices

Each winter, many residents of Oakland County begin to deck the halls for the holiday season. Central to this festivity is the harvesting and decorating of an evergreen tree. Some residents may be lucky enough to be able to harvest a tree from their backyard, but most end up at a tree farm where trees are planted specifically to harvest for the holidays. Tree farms can operate in a number of ways, and each farm may specialize in only one type of service or even a particular variety of tree.

In Oakland County, one Christmas tree farm specializes in raising trees for harvest using organic and natural methods. This farm employs a number of best management practices to minimize the impact their forestry practices have on the surrounding communities. Many chores are done using hand tools or battery operated equipment. Weed control is done using precise applicators which produce a micro-droplet mist directly to the plant without affecting surrounding communities. This method also results in a reduction of herbicide needed to control weeds by about 75%.

Because these trees will end up in people's homes around their kids and pets, it is important for tree farms like this to utilize organic farming methods where able and limit the exposure of these trees to herbicides which can impact human health. The Michigan Agricultural Environmental Assurance Program (MAEAP) is a voluntary program that promotes the use of these sustainable farming practices by Michigan farmers and encourages farms to adopt pollution prevention practices in compliance with state and federal law.

The goal of this farm is to truly create a sanctuary for trees within our landscape. Oakland County communities benefit from the safe and environmentally friendly practices of community tree farms, as these farms provide important benefits for clean air and water protection, wildlife habitat, and safe and healthy trees for seasonal festivities. Working with the state and national Christmas tree associations, the Michigan Farm Bureau, Michigan Department of Agriculture and Rural Development, and state universities, tree farms are able to find support in engaging in sustainable farming practices that benefit the communities we live in. So the next time you are decking the halls with a beautiful tree, remember to thank a tree farmer who works hard to promote this sustainable and environmentally friendly festivity.

4.8 Acoustic Monitors in Forest Management

If a tree falls in the forest, and no one is around to hear it, does it make a sound? This is an age old question and a philosophical thought experiment that questions how we perceive reality and what happens beyond the range of our observation. Depending on who you talk to, you may get a philosophical answer about the nature of human observation or a straight forward explanation of the physics of sound. One thing we can be sure of now is that we don't have to be present to hear the sounds of the forest any longer. Using rapidly improving technology, audio recorders and analysis software are allowing researchers to listen in on the forest from afar.

This technology involves placing an acoustic monitor deep in the woods in an area of interest to the researcher. After programming the machine, a recording of the forest symphony can be collected at regular intervals over a long period of time. The sound data allows researchers to determine how specific variables affect the soundscape by examining changes in the frequency and pitch of the tones recorded. For instance, how active are the spring peepers following a night of cool temperatures versus a night of warm temperatures? Or what time of day do we see bluebirds beginning to sing? What types of calls are made by the Kirkland Warbler in May versus in June? By analyzing these recordings, researchers can begin to form hypotheses about what is happening in the forest when we are not there to observe it.

Aside from picking up the sounds of the forest wildlife, these acoustic monitors are also providing an insight into human impacts on forest soundscapes. In their analysis of these sounds, researchers are able to separate the sounds made by animals (biophony) from the sounds coming from human sources (technophony). This allows researchers to gauge the impacts of human activities on the sounds that animals produce. Researchers may be interested in separating these variables to study the effects of construction noise on the behavior of singing birds, the impact re-routing airplane traffic over a forest has on the diversity of animals that rely on sound to mate or find food, or the difference in forest biodiversity before and after a shopping mall is built nearby.

The answer to all of these questions can have concrete management implications for how humans interact with forested environments. How close and how active we are to these environments can determine how serious a disruption we are creating to the forest soundscape, and how that affects the ways animals interact. Additionally, these acoustic monitors can provide useful information for how people interact with the forests, such as how often do we hear people walking down a trail or during what times of day is the noise generated by traffic most intense. The budding science of acoustic monitoring is changing the questions that forest managers and city planners discuss when considering how to best manage our forests. One thing is for sure, we will now know if a tree falling in a forest makes a sound, because some*thing* is there to record it.

4.9 Protecting Forest Integrity in Oakland County

In the battle for ground in terrestrial upland habitats, there is a complex interaction of communities of trees, shrubs, forbs, and grasses as a terrestrial system moves towards equilibrium. There is also a successional process where young forests mature and change in diversity and distribution of plant species over many hundreds of years. These complex processes depend on changes of soil type, hydrology, animal community interaction, and a mosaic of competitive interactions that result in a healthy forest community. These diverse and complex systems serve important functions in providing wildlife habitat, protecting clean air and water production, and protecting the diversity of neighboring forests.

Invasive plant species throw a wrench into the complex systems that govern our natural forests. These plants can severely disrupt the natural forest processes which results in the destabilization and destruction of these healthy ecosystems. Invasive species are defined as a species that is non-native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm to human health. Obviously we are very concerned as humans of any threats that plants may represent to human health and property, but what are the concerns for our forests? Non-native species have been invading our forests throughout Michigan and especially in Oakland County, where they wreak havoc on our natural systems and result in a loss of forest species and habitat.

Land conservancies in Oakland County provide a wealth of experience to private landowners and spend much of their time speaking about how invasive species negatively impact our forests. Two species of chief concern are Oriental Bittersweet (*Celastrus orbiculatus*) and Buckthorn (*Rhamnus cathartica* and *Frangula alnus*) which have the potential to significantly harm native forest species. Bittersweet is a vining plant that grows from a small stem into a massive vine that can reach up tens of feet into a trees canopy. This vine then competes with the tree for sunlight and stresses the tree with its weight as it grows. This can lead to the tree suffering from lack of light, being weakened by nutritional deficiency and the weight of the vine, and dying then crashing down under the weight of this invader. Buckthorn is a common name given to two species of woody shrubs, which both invade forest floors. These plants grow to extreme density and block animals' access to the forest floor as they take over and displace native understory plants.

"Buckthorn is a serious problem," explains Andy, a local land conservancy steward. "We have a hard time keeping up with removing it. It grows extremely fast." These invasive shrubs grow fast because they can outcompete native plants for space, sunlight, and nutrients. The complex competitive interactions found in a plant's native environment do not exist in our environment to control the distribution of invasive species. "We have watched as bittersweet has claimed a number of large trees in our preserves," Andy explains. The protection of these old growth trees is a primary goal of a land conservancy's management plan for a forest.

Prevention is the best tool in a foresters fight against invasive species. Once an invasive species is established, it is nearly impossible to eradicate it from the ecosystem. With land conservancies playing a key role in raising public awareness of these invaders, private landowners are able to take steps to prevent these plants from taking root on their property. Vigilance is a key practice in the fight against invasive plants, and with the help of local conservation agencies, Oakland County residents are starting to rally the troops to fight these invaders.

4.10 Permaculture and Trees in Oakland County

Permaculture is the word used to describe the emerging practice of private landowners engaging in sustainable farming techniques. The motto of these groups might be summed up as 'grow food not lawns,' and they are passionate about the education of citizens on how to cultivate edible landscapes. In addition to growing vegetable gardens, installing rain gardens, and encouraging the use of edible ornamentals, these groups promote the planting of fruit and nut orchards that can help provide a sustainable source of healthy food to landowners.

These orchards are a different type of forest but provide a similar range of beneficial functions to the ecosystem, such as bird habitat, food for foraging animals, stabilizing sediment during periods of heavy storm, and complementing the aesthetics of a landowner's yard. In short, it is better to have fruit trees than no trees at all. "We wanted to find a way to connect people back to the food that they eat," described one of the group's members. "There is a tendency in today's society to not think about where our food comes from and to think that we can't grow it ourselves." This mentality is changing as more private landowners convert lawns and back yards into gardens, orchards, and micro-farms.

The use of trees to produce food is a great way to incorporate farming into landscape design. These trees can provide cover for wildlife, aesthetic value, and food for landowners, as well as essential ecosystem functions important for preserving local quality of life. Landowners actively engage in the management of the trees by pruning, feeding, and tending to the needs of these fruit and nut producing trees. These best management practices, once learned in the context of cultivating, can be spread and applied to all of the trees on a landowner's property. This art of cultivating trees can be the gateway to an individual's involvement in broader tree care awareness and practices.

If you are interested in the permaculture movement or growing fruiting trees in your yard, you should reach out to the Oakland County Conservation District and local permaculture groups. You can also reach out to local native plant nurseries that can provide you with advice and plants to start your own permaculture tree project.

The Oakland County Permaculture Meetup (OCPM) is an open network dedicated to connecting like-minded individuals interested in permaculture design and the practices of sustainability. Through fostering collaboration and cooperation, the OCPM serves as a resource hub for sharing ideas, information, experiences, tools, and more. See them on Facebook at: https://www.facebook.com/groups/OCPMpermaculture/

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

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.

5.1 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.

Administration of the Forest Stewardship Program varies by state. In Michigan the program is administered by the Michigan DNR, who trains and certifies 130 professional foresters and 15 wildlife biologists in the private sector to write simple yet comprehensive Forest Stewardship Plans. Since 1991, almost 5,000 Michigan landowners have used their Forest Stewardship Plan to help them to protect, manage, and enjoy their forest.

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/.

5.2 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 managing 24 million acres of forestland across the country. The American Tree Farm System is recognized by the Program 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. There is no additional cost to be enrolled in the American Tree Farm System certification program. 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.

5.3 Qualified Forest Program

The purpose of the Qualified Forest Program, administered by MDARD, 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. In order to qualify for the program, landowners must have between 20 and 640 acres, have an approved forest management plan, and must comply with the prescriptions included in that plan. 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.

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. 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. Landowners must have at least 40 acres of contiguous forest, an appropriate forest management plan, 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. 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.

5.5 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.

Contact your local District Conservationist or forester for information and enrollment forms for EQIP or other USDA-NRCS assistance programs. For more information please visit www.nrcs.usda.gov/wps/portal/nrcs/main/mi/programs/.

5.6 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 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.

Table 5.1, below, makes it easy for you to get in touch with the local agency and nonprofit organization contacts that can help you enroll in any of the programs mentioned above, develop your Forest Stewardship Plan, and identify and implement on-the-ground Best Management Practices that will allow you achieve your own management objectives while also protecting and enhancing Michigan's unique landscapes.

Table 5.1: Forest Stewardship Contacts serving Oakland County, MI

Organization	Contact	Email	Phone
The Stewardship Network	Tyler Mitchell, CISMA Coordinator	tmitchell@stewardshipnetwork.org	(808) 321-2634
Website: Stewardshipnetwork.org			
Comments: The Stewardship Network is a 501(c)(3) nonprofit organization working to fulfill its mission to connect, equip and mobilize people and organizations to care for land and water in their communities.			
Michigan DNR, Forest Stewardship Program	Mike Smalligan, Forest Stewardship Coordinator	SmalliganM@michigan.gov	(517) 284-5884
Website: www.michigan.gov/foreststewardship			
Comments: The Michigan DNR is heavily involved with forest stewardship in Michigan. MDNR manages state forests and recreational areas under its ownership and also offer a variety of forms of assistance for private landowners. MDNR administers the Forest Stewardship Program in the state of Michigan and can help you find certified Forest Stewardship Plan Writers and guide you through the process of developing and implementing a forest stewardship plan and enrolling in other forestry related assistance programs.			
USDA–NRCS (Oakland)	Albert Jones, Area Conservationist, Area 4	albert.jones@mi.usda.gov	(810) 230-8766
USDA–NRCS	Becky Otto, EQIP Coordinator	becky.otto@mi.usda.gov	(517) 324-5257
Website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/mi/programs/financial/eqip/			
Comments: USDA-Natural Resources Conservation Service offers a variety of technical and financial assistance programs for landowners, including agricultural producers and private forest landowners. The Environmental Quality Incentives Program (EQIP) helps landowners address resource concerns including soil erosion, soil quality, water quality degradation, plant productivity, habitat fragmentation, invasive plants, and forest health.			
Oakland Conservation District	Patrick Costello, Chair Board of Directors	oaklandconservation@gmail.com	(248) 922-7822
Website: http://www.oaklandconservationdistrict.org/			
Comments: Conservation Districts work closely with various partners to provide educational workshops, connect landowners with agricultural stewardship cost-share opportunities and sell trees and other native plants.			
Michigan Department of Agriculture and Rural Development (MDARD)	Qualified Forest Program	MDARD-QFP@michigan.gov	517-284-5630
Website: https://www.michigan.gov/mdard/0,4610,7-125-1599_28740---,00.html			
Comments: MDARD administers the Qualified Forest Program as well as the Forestry Assistance Program, which provides grant funding to Conservation Districts to help them connect landowners with forest stewardship opportunities. Contact MDARD for more information about the Qualified Forest Program.			

5.7 Capital Gains Tax Information

Profits from timber sales are taxed as capital gains, rather than ordinary income, if you own the timber for more than twelve months. Expenses, including the cost of a management plan or a consulting forester's fees for a timber sale, can be deducted from profits. 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 Opportunities for Partnerships between different types of landowners

As we think about stewardship in each of the focal landscapes for The Stewardship Network, partnerships across boundaries are key to the successful stewardship of our forest resources. As noted in many places of this plan, ecosystems don't respect political, jurisdictional, or property boundaries. Much like natural ecosystems, human diversity throughout a landscape can create strength, foster resiliency, and promote efficiency. Caring for large swaths of land and water that contain a plethora of biotic organisms and abiotic factors whose health and survival are intricately interwoven with the natural system is an immense task that can undoubtedly be daunting to a single landowner. But just as communities come together to celebrate culture, work on local improvement projects, and sustain institutions that support the common good, harnessing the power of human relationships can be a powerful force in preserving the natural world.

These plans have shared the great diversity of resources – public, private and non-profit – available to individual property owners to help them become more engaged in forest management and stewardship. We encourage readers of these plans to become more familiar with these programs and tap into the ones that meet your needs. We encourage you to think about your municipal, state, federal, and tribal governments; non-profits; private businesses; volunteers; foundations and funding mechanisms; and your fellow private landowners as resources you can reach out to and learn from. We encourage you to reach across your property line to let your neighbor know how you are (or would like to) manage your property, and to learn from them and their approaches. We know property owners who have pooled resources to hire a stewardship crew; to share tools; to share their successes and lessons learned as they engage in forest stewardship. The process of getting to know your property is a lifelong one as you watch, listen, and feel to how your land responds to your management activities. Attend workshops, online webinars, conferences. You can find many activities in your community at The Stewardship Network's searchable calendar of events: www.stewardshipnetwork.org/event-calendar. Reach out to us to ask a question; share your idea; tell your stewardship story. We would love to include your story in our ongoing commitment to collecting and sharing stories of stewardship.

Email us or give us a call: staff@stewardshipnetwork.org 734-996-3190. We look forward to hearing from you!

Appendix 1: 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 square feet.
Basal Area (Forest): Basal area of all trees per acre summed up, in units of square feet/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 4.5 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 minimal age difference between the oldest and youngest trees (e.g. <10 years).
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. Called Timber Stand Improvement when focused on timber**.**
Group Selection: Harvesting groups of trees to open the canopy and encourage development of 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.
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.
Overmature: 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 ranging from 4 to 10 inches Diameter at Breast Height.
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 4.5 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 of trees at regular intervals to maintain uneven-aged forest.
Shade-Intolerance: Characteristic of certain tree species that does not permit them to survive in the shade of other trees. Shade-intolerant trees require full sunlight.
Shade-Tolerance: The capacity of a tree species to grow in shade.
Shelterwood Harvest: Harvesting all mature trees in two or more cuts, leaving trees to protect seedlings.
Silvopasture: Growing trees and 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 providing food and cover for a variety of wildlife.
Softwood: Any gymnosperm tree such as pines, hemlocks, larches, spruces, firs, junipers, etc.
Species of Special Concern: Not a designated threatened or endangered species 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.
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 cubic feet of timber per acre per year.
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 2: Michigan Laws Related to Forestry

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

- 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 3: Threatened, Endangered, and Special Concern Species

The following tables reflects presents the Endangered (E), Threatened (T), and Presumed Extirpated (X) animal species of Oakland 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

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 henslowii	Henslow's sparrow	E
Ammodramus savannarum	Grasshopper sparrow	SC
Amorpha canescens	Leadplant	SC
Angelica venenosa	Hairy angelica	SC
Aristida longespica	Three-awned grass	SC
Asclepias sullivantii	Sullivant's milkweed	T
Asio otus	Long-eared owl	T
Astragalus canadensis	Canadian milk vetch	T
Baptisia lactea	White or prairie false indigo	SC
Boechera missouriensis	Missouri rock-cress	SC
Bouteloua curtipendula	Side-oats grama grass	E
Buteo lineatus	Red-shouldered hawk	T
Calephelis mutica	Swamp metalmark	SC
Carex lupuliformis	False hop sedge	T
Carex richardsonii	Richardson's sedge	SC
Castanea dentata	American chestnut	E
Catinella protracta	A land snail (no common name)	E
Cincinnatia cincinnatiensis	Campeloma spire snail	SC
Cirsium hillii	Hill's thistle	SC
Cistothorus palustris	Marsh wren	SC
Clemmys guttata	Spotted turtle	T
Clinostomus elongatus	Redside dace	E
Coregonus artedi	Lake herring or Cisco	T
Cryptotis parva	Least shrew	T
Cyperus acuminatus	Cyperus, Nut grass	X
Cypripedium candidum	White lady slipper	T
Dichanthelium microcarpon	Small-fruited panic-grass	SC
Drosera anglica	English sundew	SC
Emydoidea blandingii	Blanding's turtle	SC

Epioblasma torulosa rangiana	Northern riffleshell	E
Epioblasma triquetra	Snuffbox	E
Erynnis persius persius	Persius dusky wing	T
Euonymus atropurpureus	Wahoo	SC
Eutrochium fistulosum	Hollow-stemmed Joe-pye weed	T
Falco peregrinus	Peregrine falcon	E
Flexamia huroni	Huron River leafhopper	T
Fraxinus profunda	Pumpkin ash	T
Fuirena pumila	Umbrella-grass	T
Galearis spectabilis	Showy orchis	T
Gavia immer	Common loon	T
Gentiana puberulenta	Downy gentian	E
Gentianella quinquefolia	Stiff gentian	T
Haliaeetus leucocephalus	Bald eagle	SC
Hieracium paniculatum	Panicled hawkweed	T
Hybanthus concolor	Green violet	SC
Hydrastis canadensis	Goldenseal	T
Jeffersonia diphylla	Twinleaf	SC
Lampsilis fasciola	Wavyrayed lampmussel	T
Lepyronia angulifera	Angular spittlebug	SC
Ligumia recta	Black sandshell	E
Linum sulcatum	Furrowed flax	SC
Linum virginianum	Virginia flax	T
Meropleon ambifusca	Newman's brocade	SC
Mesomphix cupreus	Copper button	SC
Microtus pinetorum	Woodland vole	SC
Morus rubra	Red mulberry	T
Muhlenbergia richardsonis	Mat muhly	T
Myotis lucifugus	Little brown bat	SC
Nerodia erythrogaster neglecta	Copperbelly water snake	E
Nicrophorus americanus	American burying beetle	X
Notropis anogenus	Pugnose shiner	E
Noturus miurus	Brindled madtom	SC
Oarisma poweshiek	Poweshiek skipperling	T
Oecanthus laricis	Tamarack tree cricket	SC
Panax quinquefolius	Ginseng	T
Pantherophis spiloides	Gray ratsnake	SC
Papaipema beeriana	Blazing star borer	SC
Platanthera ciliaris	Orange- or yellow-fringed orchid	E
Platanthera leucophaea	Prairie white-fringed orchid	E
Pleurobema sintoxia	Round pigtoe	SC
Poa paludigena	Bog bluegrass	T
Polemonium reptans	Jacob's ladder	T

Potamogeton vaseyi	Vasey's pondweed	T
Prosartes maculata	Nodding mandarin	X
Ptychobranchus fasciolaris	Kidney shell	SC
Pyrgulopsis letsoni	Gravel pyrg	SC
Rhynchospora scirpoides	Bald-rush	SC
Setophaga cerulea	Cerulean warbler	T
Setophaga citrina	Hooded warbler	SC
Setophaga discolor	Prairie warbler	E
Sistrurus catenatus	Eastern massasauga	SC
Smilax herbacea	Smooth carrion-flower	SC
Speyeria idalia	Regal fritillary	E
Sphaerium fabale	River fingernail clam	SC
Sporobolus heterolepis	Prairie dropseed	SC
Terrapene carolina carolina	Eastern box turtle	SC
Toxolasma lividus	Purple lilliput	E
Trichophorum clintonii	Clinton's bulrush	SC
Trichostema dichotomum	Bastard pennyroyal	T
Trillium sessile	Toadshade	T
Utterbackia imbecillis	Paper pondshell	SC
Valeriana edulis var. ciliata	Edible valerian	T
Ventridens suppressus	Flat dome	SC
Villosa fabalis	Rayed bean	E
Villosa iris	Rainbow	SC
Viola pedatifida	Prairie birdfoot violet	T

Appendix 4: Additional Resources for Landowners

Internet Sources (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
USFS Wetland Mapper https://www.fws.gov/wetlands/Data/Mapper.html

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.