Oakland County Potential

Natural Areas Assessment: 2017 Update

Prepared by: John J. Paskus and Helen D. Enander

Michigan Natural Features Inventory
Michigan State University Extension
PO Box 13036
Lansing, MI 48901

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Michigan Natural Features Inventory (MNFI) maintains a continuously updated information database, the only comprehensive, single source of data on Michigan's endangered, threatened, or special concern plant and animal species, natural communities, and other natural features. MNFI has responsibility for inventorying and tracking the State's rarest species and exceptional examples of the whole array of natural communities. MNFI also provides information to resource managers for many types of permit applications regarding these elements of diversity.

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Introduction

Oakland County has a population of over 1.2 million people and is one of the fastest growing counties in Michigan (U.S. Census Bureau 2017). In order for Oakland County to remain a highly desirable destination for current and future residents and businesses, key natural assets should be retained, conserved, and enhanced. Depending on the course of future growth, opportunities that exist today are likely to be critically diminished within the next ten years. The Oakland County Economic Development & Community Affairs Department (EDCA) has recognized for a longtime that natural resource conservation is a fundamental component of the region's long-term environmental, social, and economic health. Natural areas perform important functions such as water filtration and flood control, and they provide recreational opportunities and wildlife habitat that enhance the overall vitality of a community's quality of life.

Abundant natural resources once surrounded population centers in Oakland County. Now, much reduced in size, an increasing number of natural areas are becoming isolated islands surrounded by human development. These remaining sites are the foundation of Oakland County's natural heritage; they represent the last remaining remnants of Oakland County's native ecosystems, natural plant communities, and scenic qualities. Consequently, it is in Oakland County's best interest and to a community's advantage that these sites be carefully integrated into all future planning efforts.

Striking a balance between development and natural resource conservation and preservation is critical if Oakland County is to maintain its unique natural heritage and competitive edge in an increasingly competitive world. Natural features attract residents and businesses, enhance local tourism and promote spending by visitors that contribute to the local economy (Adelaja et al. 2012). Maintaining and enhancing local natural areas provides one of the best opportunities to maintain high property values and continued market demand. Part of what makes Oakland County such a unique and desirable place to work, live, and play is the combination, quality, and accessibility of its natural landscapes, lakes, rivers, and streams.

Successful land use planning requires more than simply protecting small preserves and trusting that they will remain in their current condition indefinitely. Many human activities such as road construction, chemical and fertilizer application, fire suppression, and residential development can have a detrimental impact on populations of plants, animals, fish, and insects and the natural communities in which they live. In order to maintain the integrity of the most fragile natural areas, a more holistic approach to resource conservation must be taken, an approach that looks beyond the borders of the site itself and takes into account integrity, buffers, and connectivity. What happens on adjacent farmland, in a nearby town, or upstream should be considered equally as important as what happens within a preserve. By looking to the past, understanding the present, and considering the future, it becomes apparent that a balance must be struck between human development and natural resource preservation.

The primary purpose of this project is to improve natural resource-based decision-making throughout Oakland County by building upon and updating the previous 2000, 2002, and 2004 Potential Natural Area assessments in Oakland County (Oakland County PEDS et al. 2000; Paskus and Enander 2002; Paskus and Enander 2004). For the purposes of the project, Potential Natural Areas (PNAs) 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, wildlife corridors, migratory bird stopover sites, sources of genetic diversity, and floodwater retention.

This 2017 effort also added two additional information resources that build off of the updated PNA assessment: 1) identifying potential high quality natural communities, and 2) summarizing previous ecological survey efforts. To further assist local communities and conservation organizations in identifying and conserving the best remaining natural areas, MNFI identified potential high quality natural communities within priority PNAs. The purpose for identifying potential high quality natural communities is two-fold. First, natural communities are units of land that have recognizable ecological and biological attributes and boundaries. While PNAs identify intact landscapes, they typically consist of several natural community types. Natural communities help determine how to manage a given area, how to assess ecological health, and which species are likely to occur there. Some of these natural communities are high quality, while others may be impacted by invasive species or previous human activities such as logging or agriculture. Second, since these natural communities have the highest probability of having high ecological health and value, they also serve to further prioritize conservation actions in a world with limited financial and human resources.

To further assist Oakland County and others prioritize where to focus on-the-ground inventory, restoration, and management activities, MNFI also developed a summary of biological survey efforts that have taken place in Oakland County since the late 1980s. The summary includes inventories that have taken place in state parks, local parks, private preserves, and Metroparks, and includes surveys for targeted species and natural communities. This summary will help prioritize which PNAs and/or high quality natural communities should be targeted for future biological surveys. As stated earlier, the only way to confirm the quality of any given PNA or natural community is to conduct targeted field surveys at appropriate times of the year. The assumption is that areas previously surveyed are less of a priority than high priority sites that have never been formally surveyed by professional biologists. Exceptions to this general rule are sites that haven't been surveyed in over twenty years. Based on experience, the quality of any given site can change dramatically over time, particularly in the southern portion of the state.

When combined, the PNA update, identification of potential high quality natural communities, and the summary of ecological surveys provides the best available information to direct future on-the-ground survey work (targeted at natural communities, rare plants, and animals, and/or invasive species control), conservation efforts, and stewardship actions.

Note: The term "Potential Natural Area," should not to be confused with the legal term "dedicated Natural Area" as described in Part 351, Wilderness and Natural Areas, of the Natural Resources and Environmental Protection Act of 1994 which provides special legal protection to lands that meet the criteria.

Oakland County Background Information

Introduction

To understand the current status of ecological and biological health within Oakland County, it is best to place the contemporary landscape within the context of past events. For the purposes of this project, it makes the most sense to review the geophysical changes that occurred during the most recent glaciation period, approximately 14,000 years ago.

Based on previous geologic investigations, Oakland County actually consists of four major glacial formations. In the very northwest corner of the county lies a very small sliver of the Lansing Till Plain. East of the Lansing Till Plain is a complex of broad outwash, end moraines, and ground moraines called the Jackson Interlobate sub-subsection. Dissecting the middle of the county is a complex of narrow end moraines and ground moraine, called the Ann Arbor Moraines sub-subsection. The southeastern corner of the county falls within a broad, flat, lakeplain called the Maumee Lakeplain sub-subsection (Albert 1995). These four different landforms combine to create diverse, topographical variation and soil types within the county, which in turn provides conditions for a diversity of natural communities, as well as plant and animal species (figure 1).

Sub-subsection VI. 4.1 Lansing Till Plain (17,011 acres; 2.9% of county)

Sub-subsection VI 4.1 Lansing Till Plain is located in a very small portion of the northwest corner of Oakland County. The Lansing Sub-subsection is characterized by a broad, medium textured ground moraine with rich loamy soils, and has been largely converted to agriculture. In several places, the ground moraine is broken up by outwash channels and end moraine ridges. A small area of sandy ground moraine occupies southwestern Shiawassee County and the small portion of Oakland County that falls within this sub-subsection. Although this sub-subsection was historically dominated by beech-sugar maple forest, drier ridges and outwash supported oak-hickory forests.

Sub-subsection VI. 1.3 Jackson Interlobate (326,556 acres; 56.3% of county)

The Jackson Interlobate sub-subsection is the northern portion of an interlobate area between three glacial lobes, which formed approximately 13,000 – 16,000 years ago (Albert 1995). This sub-subsection is characterized by relatively steep end-moraine ridges surrounded by pitted outwash deposits characterized by ice contact features such as kettle lakes and wetlands, kames, and eskers. Slopes are quite variable, and range from 0 percent on the outwash channels to 40 percent along the edges of steep end moraines. Soils are typically well and excessively well-drained on the moraines, and poorly or very poorly drained in the kettles and outwash channels.

Historically, open oak savannas and barrens were common on the sandy moraines, and oak dominated forests were found on the droughty, ice contact features (kames and eskers). The lower,

wetter depressions supported a variety of wetland types including hardwood swamp, shrub swamp, tamarack swamp, and prairie fen (Albert 1995). This sub-subsection is also where the headwaters of four major river systems in Southeast Michigan originate: Huron, Clinton, Shiawassee, and Flint Rivers (Figure 1).

Sub-subsection VI. 1.2 Ann Arbor Moraines (152,446 acres; 26.3 % of county)

The Ann Arbor Moraines sub-subsection is a long narrow band of fine and medium textured end and ground moraine. Slopes range from 0 percent on the ground moraines to 15 percent on the end moraines. The loam and sandy loam soils supported oak and oak-hickory forests. Beech sugar maple forests were rarer, and restricted to silt loam and clay soils. Lower, wet areas supported a variety of forested wetlands, particularly hardwood swamp and floodplain forest. According to Albert (1995), most of the land in this sub-subsection was converted to agriculture by the mid-19th century.

Sub-subsection VI. 1.1 Maumee Lakeplain (84,304 acres; 14.5 % of county)

The Maumee Lakeplain sub-subsection is a relatively flat, poorly drained clay lakeplain dissected by broad glacial, sandy drainageways (Albert 1995). The lakeplain was created as the glacial lake receded to its current level and formed present day Lake Erie and the connecting channels to the north. Although soils are poorly to very poorly drained and permeability is generally low in the lakeplain, the Oakland County portion of the Maumee Lakeplain is actually higher in elevation, contains more sand, and is better drained compared to areas closer the Lake Erie and the connecting channels, such as Detroit. Historically, this area supported lowland deciduous forests, such as swamps, flatwoods, and floodplains, emergent marshes, a unique type of wet prairie called lakeplain prairie, and beech maple forests on the slightly higher elevations. The Maumee Lakeplain was one of the first areas in the state to be farmed by European settlers. As a result of several centuries of settlement and land use change, the majority of the lakeplain in Oakland County is currently dominated by urban and suburban development.

Human Settlement and Demographics

Humans have settled in Oakland County for at least 10,000 years. Native American tribes, such as the Ottawa, Ojibwa (Chippewa), and Pottawatomi, have lived within the borders of present Oakland County for many centuries – probably since the glaciers last retreated from the area some 10,000 years ago. Native American settlements are known to have occurred at what is now present day Pontiac. Additionally, four major Native American trails ran through portions of the County that served as important routes for trade. These included the: 1) Saginaw Trail, 2) Shiawassee Trail, 3) Pontiac Trail, and 4) Grand River Trail.

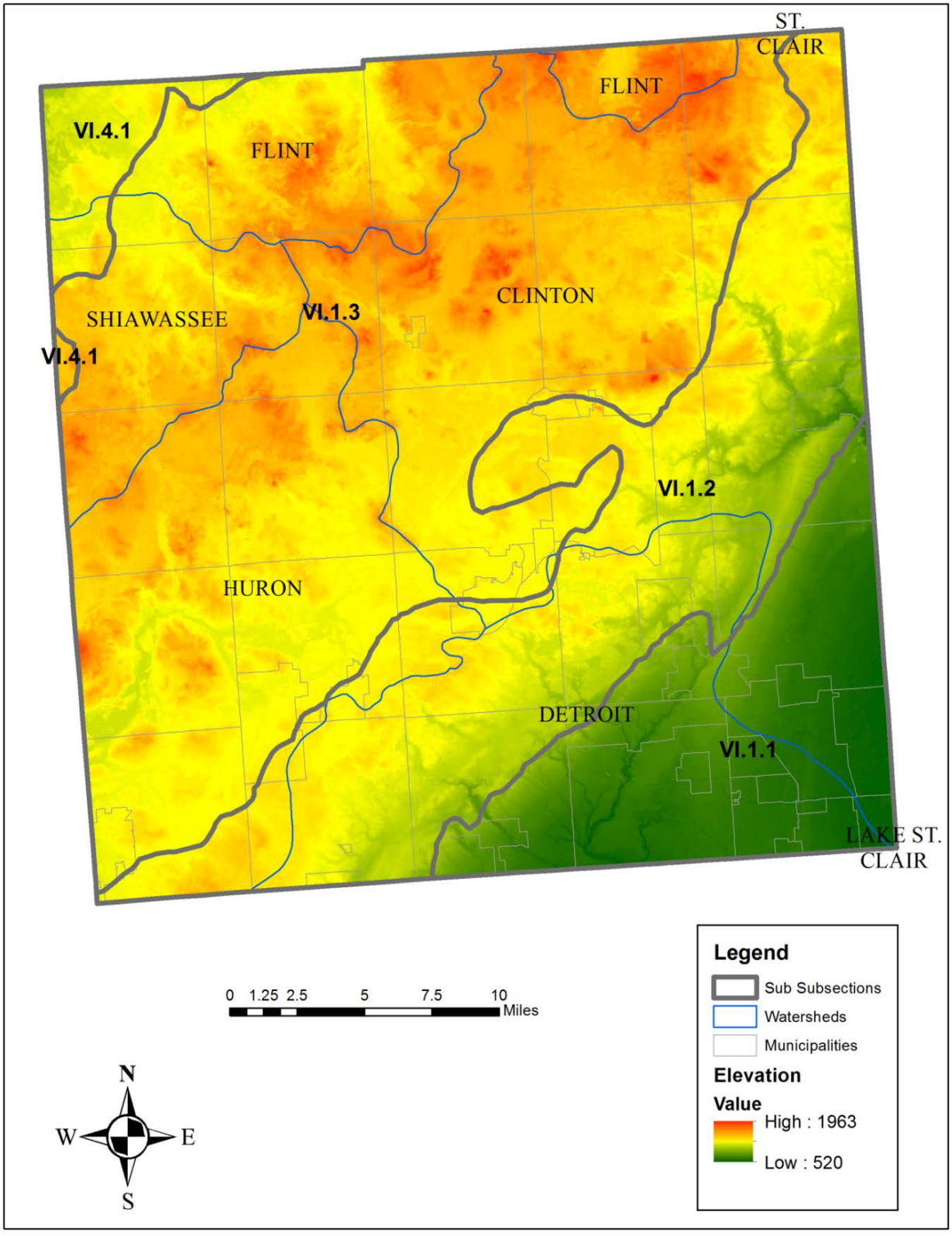

Figure 1. Subsections, elevations, and major watersheds within Oakland County.

Oakland County was founded in 1819 and officially organized in 1820 (Durant 1877). It was also one of the first counties in Michigan to be settled by European settlers. Over time, new settlements developed along key trade routes such as the trails mentioned above. By 1840, Oakland had more than fifty lumber mills, processing wood harvested from the region and the Upper Peninsula. Pontiac, located on the Clinton River, was Oakland's first official town and eventually became the county seat. In 1879, Oakland County was officially recognized as a county in Michigan. Currently, Oakland County consists of 21 townships, 30 cities, and 10 villages. The county has a total area of 907 square miles, of which 852 square miles consists of land (93.9%), and 55 square miles (6.1%) is water.

Today, single family residential (39.1 %) makes up the majority of land use in Oakland County, followed by recreation/conservation lands (14.3 %), vacant lands (10.6 %), and road right-of-ways (10.2%) (figure 2). Only 4.5 % of the county is in some sort agricultural use. The majority of the urban areas are located in the southeastern portion of the county.

As of the 2010 Census, Oakland County's population was 1,202,362 making it the second-most populous county in Michigan (just behind neighboring Wayne County to the south). The median income for a household in the county was $86,567, making Oakland County the 21st wealthiest county in the U.S., (http://www.worldatlas.com/articles/richest-counties-in-the-united-states.html), and the wealthiest county in Michigan.

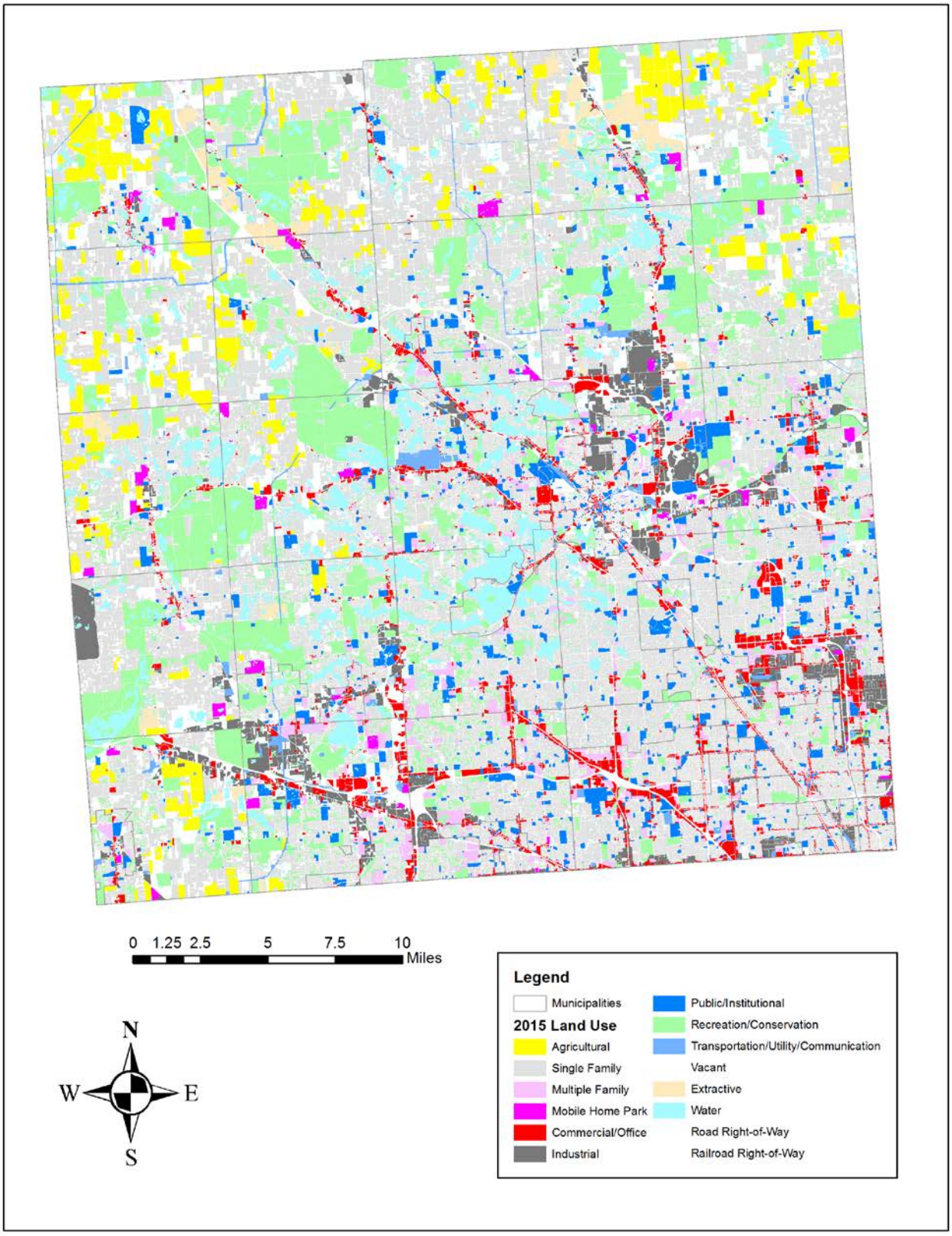

Figure 2. 2015 Land use of Oakland County.

Previous Natural Area Assessment Efforts

In 1987, the foundation for preserving Oakland County's natural heritage was put in place when the Oakland County Planning & Economic Development Services (PEDS) Division contracted with MNFI to conduct the first inclusive natural area survey of Oakland County. This survey identified 37 sites of high natural quality and relatively undisturbed native vegetation (Reese et al. 1988). This survey proved useful in numerous preservation efforts in areas of acquisition, establishing conservation easements, and helping to guide the efforts of local land trusts. The survey's limitation was in its ability to identify the larger ecosystems that maintain the long-term integrity of county's highest quality natural areas.

Subsequently, in the fall of 1997, six Oakland County municipalities (Rose, Springfield, Highland, Milford, and White Lake Townships, and the Village of Milford) PEDS decided to undertake a more comprehensive study of their natural areas. This new survey took a more holistic approach to natural resource protection and was the foundation of the Shiawassee & Huron Headwaters Resource Preservation Project (S&H project). This project was a multi-jurisdictional, community based, public/private partnership, which demonstrated how to comprehensively identify and prioritize natural resources and critical ecosystems and identify tools for the protection and sustainability of these resources. A systematic process was developed in order to identify and prioritize potential natural areas for preservation and/or further field survey efforts. This process was substantiated by the natural features data that the ecologists, botanists, and zoologists collected during field survey work performed at several of the S&H project sites (Oakland County PEDS et al. 2000).

In order to make comparable data available for the entire county, Oakland County PEDS contracted with MNFI to complete the mapping and ranking of areas not included within the S&H project. Using a more refined process than was utilized during the S&H project, over 600 potential natural areas were identified and ranked. These sites represent what appeared to be the least disturbed natural areas remaining within the county (Paskus and Enander 2002).

In 2004, MNFI was contracted to update both the 2002 PNAs as well as the PNAs that were identified in the original five-township area. Again, the process was slightly refined to try and improve the results. The 2002 boundaries were "tightened up" and natural lands that had changed to development or agricultural lands were removed. This process utilized heads up digitizing based on a number of digital data layers including the best available digital aerial photography (2002). As a result, the newer boundaries were much more accurate than those identified in previous efforts. Over 800 PNAs were identified and ranked. These sites represented what appear to be the least disturbed natural areas remaining within Oakland County. The increase in the number of sites from 600 to 800 (increase of 33%) was primarily due to the use of all roads to define sites (as opposed to only major roads), not an increase in additional lands. In fact, 2002 PNA acreage decreased from 110,000 acres countywide to 93,520 acres, representing a 15% reduction. The 93,520 acres represented approximately 16% of the total county acreage (Paskus and Enander 2004).

2017 Process for Delineating and Ranking Potential Natural Areas

Materials and Methodology

Interpretation of the 25 geographic township area in Oakland County was conducted by using digital aerial photography taken in 2015 and provided by Oakland County EDCA.

Similar to the 2002 and 2004 efforts, delineation of sites was done primarily through aerial photography interpretation, with an emphasis placed on: 1) intactness, 2) wetlands and wetland complexes, 3) riparian corridors, and 4) forested tracts. Delineation of sites during this phase of the process was done conservatively, such that the chance of capturing sites that may end up being eliminated upon closer inspection was greater than the chance of omitting sites that should have been delineated. Sites were delineated by focusing on wetlands and forest tracts and eliminating as much development (including roads), active agriculture and old fields as possible. Boundaries typically were defined by hard edges such as roads, parking lots, developments, and railroads. All potential natural areas were identified and delineated regardless of size. Municipal boundaries were not utilized to delineate site boundaries unless the boundary corresponded to a defined hard edge, such as a road. Once all sites were delineated, sites under 20 acres were removed from consideration. This was done in order to ensure consistency across a highly varied landscape, as well as to help communities focus on the most viable tracts of natural areas.

Site Selection and Prioritization

Following the aerial photo interpretation and the delineation of potential natural areas, a more rigorous level of examination was undertaken based upon specific scaled criteria to prioritize sites. Each criterion was translated to a numerical scale. Each site could then be assessed based upon each criterion as well a total calculated score (which was based upon the sum of the scores for each criterion).

The set of criteria, described below, was chosen based on several universally accepted principles of biodiversity conservation. Ecological principles considered were primarily based on patch size and shape, landscape context, habitat condition, ownership patterns, and rarity. In order to provide consistency with both the 2002 and 2004 results, the 2017 GIS models were run **with** and **without** the **Enhanced Criteria** added**.** These principles are briefly described below. More detailed information can be found in Appendix A and Appendix B.

- **Total Size of a Patch** – The total size of a site is recognized as an important factor for viability of species and ecosystem health. Larger sites tend to have higher species diversity, higher reproductive success, and improved chances of plant and animal species surviving a catastrophic event such as a fire, tornado, ice storm, or flood.

- **Size of Core Area of a Patch** – A number of studies have shown that there are negative impacts

associated with the perimeter of a site regarding "edge-sensitive" animal species, particularly amphibians, reptiles, and forest and grassland songbirds. For example, the light and humidity levels at the edges of forests surrounded by openlands are significantly different than conditions within the center of the forest. Additionally, edges tend to contain a significantly higher number and density of invasive plant species, as well as problematic species such as brown-headed cowbird, which parasitizes the nests of other songbirds. Buffers vary by species, community type, and location, however most studies recommend a buffer somewhere between 200 and 600 feet to minimize negative impacts. Based on the literature, 300 feet is considered a sufficient buffer for most "edge sensitive" species in forested landscapes. Core area is different from total area of the site because it takes into account the shape of the site. Typically, round shapes contain a larger core area relative to the total site as compared to long narrow shapes such as corridors.

- **Stream Corridor (presence/absence) –** Water is essential for life. Streams are also dynamic systems that interact with the surrounding terrestrial landscape creating new habitats. Waterways also provide the added benefit of a travel corridor for wildlife, connecting isolated patches of natural vegetation in a relatively fragmented landscape.

- **Landscape Connectivity –** Connectivity between habitat patches is considered a critical factor for wildlife health. High connectivity improves gene flow between populations, allows species to recolonize unoccupied habitat, improves resilience of the ecosystem, and allows ecological processes, such as flooding, fire, and pollination to occur at a more natural rate and scale.

- **Restorability of surrounding lands –** Restorability is important for increasing the size of existing natural communities, providing linkages to other habitat patches, and providing a natural buffer from development and human activities such as agriculture, mining, recreation, and forestry.

Enhanced Criteria

- **Vegetation Quality –** Evaluating the condition of a site without field based data is extremely difficult. However, assessing the condition of each natural area is one of the highest priorities, since condition typically determines conservation value. Vegetation structure, species diversity, age, and rarity can reflect disturbance, external impacts, soil texture, moisture gradient, aspect, and geology.

- **Parcel Fragmentation –** Although this criteria varies somewhat from the ecologically based criteria, it can be a useful indicator in determining the long-term conservation success of a project. While parcel boundaries are simply lines on a map, the associated consequences of splitting parcels can adversely affect habitat and species. Sites that contain a large number of small parcels are typically much more difficult to manage and protect than sites with a few large parcels. Associated problems with smaller parcels include increased wildlife/human conflicts, stewardship coordination, increased septic systems and fences, introduction of invasive plants

and general loss of vegetation.

- **Number of Known Rare Species and Natural Communities (Element Occurrence) –** The location of high quality natural communities and rare species tracked by MNFI are often, although not always, indicative of the quality of a site. These occurrences are important regardless of site condition, and can at the very least provide priorities for future restoration activities.

Potential Natural Area Rankings

Each of the 824 delineated sites, totaling 90,663 acres, was given a total score based upon the criteria described in the following table.

Results (Without Enhanced Criteria)

Total PNA scores ranged from 22 points (out of a possible 25) to a low of 1 point. Once the total scores were tabulated, the next step was to determine a logical and reasonable break between priority one, priority two, and priority three sites. Many potential natural area sites can be just one point away from being placed into another category. The mean or average score was 5.6.

The 2002 classification method was an iterative process taking into account the number of sites in a given category, the number of sites with the same score, and a visual inspection of spatial data layers in a geographic information system (GIS). For 2004, MNFI decided to review different methodical classification schemes. In the end, MNFI decided to use the natural break classification (or Jenks optimization) because it provided an objective division of classes that produced a distribution very similar to the more subjective approach that was used in 2002. The natural break method is the default classification method in ArcGIS 10.3. This method identifies breakpoints between classes using a statistical formula called Jenks optimization. The Jenks optimization method finds groupings and patterns inherent in the data by minimizing the sum of the variance within each of the classes. The Jenks optimization method was also used in the 2017 analysis.

Despite the more methodical approach to classification, it still could be argued that sites scoring one point below should be included in the higher category or that sites scoring right at the low end of a category should be placed in the next lowest category. To help alleviate anxieties about which category a particular site is placed, actual numeric total scores can be displayed in the middle of each polygon. This allows the viewer to see how a site compares directly to another site without artificially categorizing it within a group.

Using the Jenks optimization method, a total of 477 sites were placed in the priority three category, 281 sites were placed in the priority two category, and 66 sites were placed in the priority one category (see map on page 11). Breaking it down into percentages of total sites identified, 57.8% were labeled priority three (down from 58.4%), 34% were labeled priority two (up from 31.5%) and 8% of the sites were identified as priority one (down from 10.1%). It is important to note that although only 8% of the sites were identified as priority one, these 66 sites total 32,241 acres. This corresponds to 35.6% of the total acreage of all delineated sites (90,633 acres).

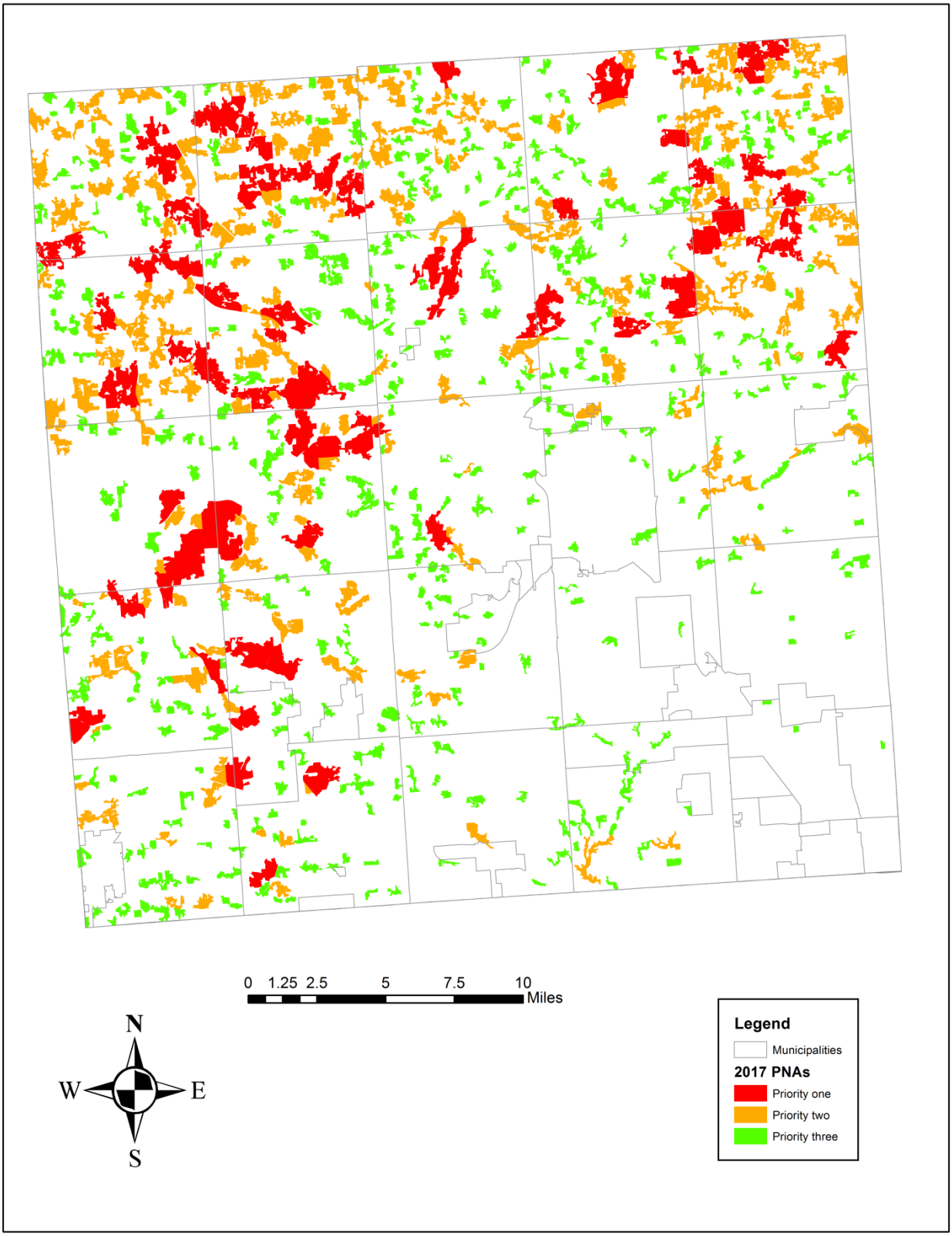

Figure 3. 2017 Map of Potential Natural Areas in Oakland County (without enhanced criteria).

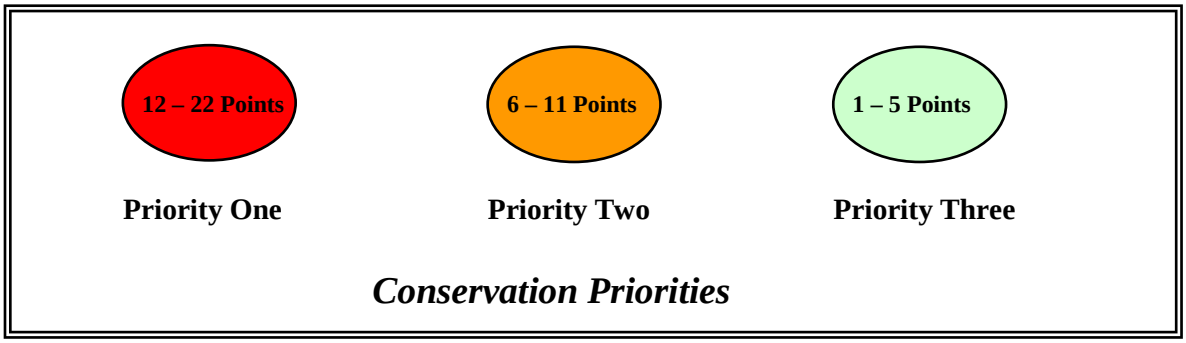

Table 1. Summary of PNA analysis for Oakland County (without Enhanced Criteria).

PNA Class	Count	% of PNAs	Acres	% of PNA Area	% of County Area
Low (1-5)	477	57.9%	25,445	28.1%	4.4%
Mod (6-11)	281	34.1%	32,947	36.3%	5.7%
High (12-22)	66	8.0%	32,241	35.6%	5.5%
Total	824	100.0%	90,633	100.0%	15.6%

Compared to the PNA analysis completed in 2004, there were some notable changes. For example, the total acres decreased by 2,917 acres, representing a 3.1% drop. Another important change is that both the number and acres decreased in the priority three and one categories, but increased in the priority two category. This can be explained by some of the top sites becoming more fragmented over the past 12 years, and by some of the poorer ranking sites in 2004 becoming a bit less fragmented.

Table 2. Comparison between 2004 and 2017 PNA count and acres (without enhanced criteria).

PNA Class	Count 2004	Count 2017	Count- Net Change	Count - % Change	Acres 2004	Acres 2017	Acres - Net Change	Acres - % Change
Low	484	429	-55	-11.4%	25,256	20,824	-4,433	-17.6%
Medium	262	328	66	25.2%	29,589	37,498	7,909	26.7%
High	84	67	-17	-20.2%	38,675	32,311	-6,364	-16.5%
Total	830	824	-6	-0.7%	93,520	90,633	-2,888	-3.1%

Results (with Enhanced Criteria)

There are multiple ways of interpreting and analyzing datasets for ranking the priority of a site. Since the process of ranking potential natural areas continues to evolve with new and improved datasets, a section has been added to the report that includes this ranking with enhanced criteria.

It is felt that the addition of vegetation quality and parcel fragmentation enhances the existing set of criteria. As mentioned, the actual ecological value of PNAs can only be truly established through on-the-ground biological survey. When establishing sites for possible field inventory, each community, group, or individual should look at all available criteria in conjunction with any unique local conditions.

With the element occurrence data plus two new considerations (vegetation quality and parcel fragmentation) included in the criteria, total scores ranged from a high of 33 points (out of a possible 40 points) to a low of 2 points. The mean or average score was 10.

Using the Jenks optimization method and all criteria, a total of 429 sites were placed in the priority three category, 328 sites were placed in the priority two category, and 67 sites were placed in the priority one category. Breaking it down into percentages of total sites identified, 52% were labeled priority three, 39.8% were labeled priority two, and 8.1% of the sites were identified as priority one. It is important to note that although only 8.1% of the sites were identified as priority one, these 67 sites total 32,311 acres. This corresponds to 35.6% of the total acreage of all delineated sites (90,633 acres).

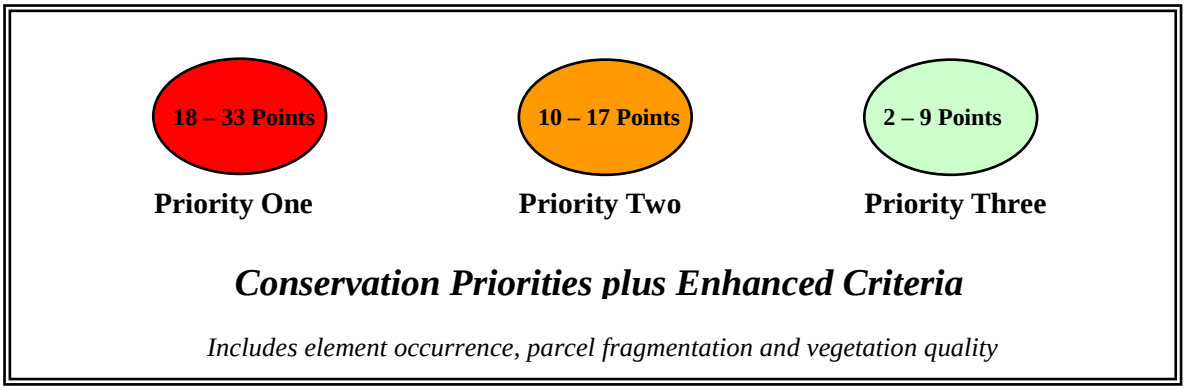

Table 3. Summary of PNA analysis for Oakland County (with Enhanced Criteria)

PNA Class	Count	% of PNAs	Acres	% of PNA Area	% of County Area
Low (2-9)	429	52.1%	20,824	23.0%	3.6%
Mod (10-17)	328	38.8%	37,498	41.4%	6.5%
High (18-33)	67	8.1%	32,311	35.6%	5.5%
Total	824	100.0%	90,633	100.0%	15.6%

Similar to the analysis using the base criteria, there were some notable changes compared to the PNA analysis completed in 2004 using the enhanced criteria. Both the number and acreage decreased in the priority three and one categories, but increased in the priority two category. Again, this can be explained by some of the top sites becoming more fragmented over the past 12 years, and by some of the poorer ranking sites in 2004 becoming a bit less fragmented due to natural

succession. Other explanations include more accurate boundary delineation due to higher quality aerial imagery and/or more time spent on reviewing each PNA boundary.

Table 4. comparision between 2004 and 2017 PNA count and acres (with enhanced criteria).

PNA Class	Count 2004	Count 2017	Count-Net Change	Count - % Change	Acres 2004	Acres 2017	Acres - Net Change	Acres - % Change
Low	436	429	-7	-1.6%	21,618	20,824	-794	-3.7%
Medium	312	328	16	5.1%	33,647	37,498	3,851	11.4%
High	82	67	-15	-18.3%	38,255	32,311	-5,944	-15.5%
Total	830	824	-6	-0.7%	93,520	90,633	-2,887	-3.1%

When using this information for planning purposes, it is important to keep in mind that site boundaries and rankings are a starting point and tend to be somewhat general in nature. Consequently, each community, group, or individual using this information should determine what additional expertise is needed in order to establish more exact boundaries and the most appropriate conservation efforts.

After running the model with and without the element occurrence criterion as well as the two new criteria (parcel fragmentation and vegetation quality) some comparisons could be drawn, although the differences between the two results are actually very minimal. Based on the model outcomes, **MNFI recommends the use of the Enhanced Criteria which includes parcel fragmentation, vegetation quality and element occurrence**. If a community wishes to use the Enhanced Criteria ranking, please contact Oakland County EDCA for a map and explanation of the changes for their community.

Conclusion

Similar to the two previous PNA assessments, this natural areas assessment continues to show that despite new development occurring throughout the county, Oakland County is still home to a fair number of high quality natural areas. Some of these sites are already known to harbor rare species and high quality natural communities, while some of these sites haven't been surveyed yet, but have the potential of harboring endangered, threatened, or special concern animal and plant species. With the high rate of development and its associated stresses on the natural environment in Southeast Michigan, the protection and conservation of these remaining areas and their native plant and animal populations are vital if the county's diverse natural heritage is to be maintained.

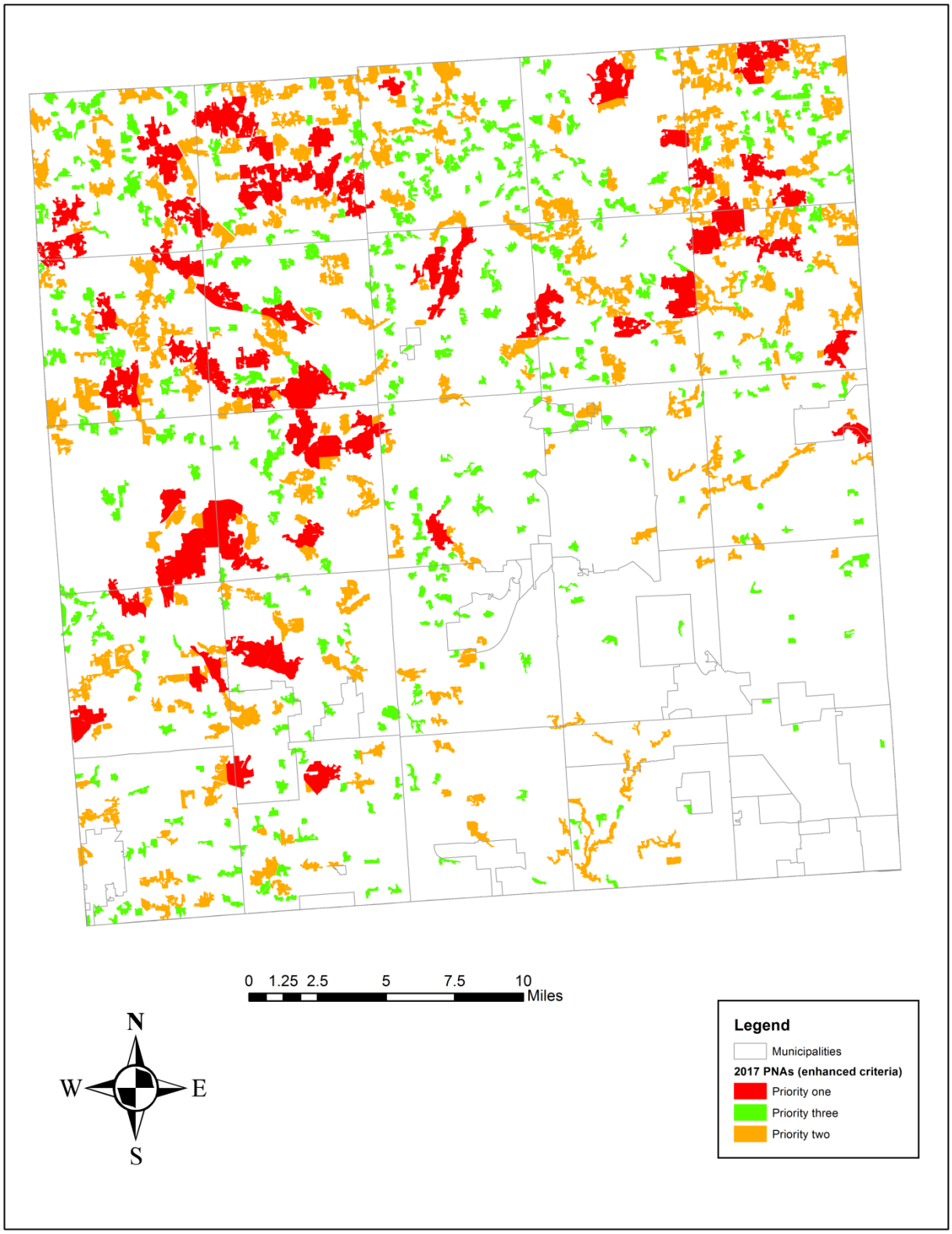

Figure 4. 2017 Map of Potential Natural Areas in Oakland County (with enhanced criteria).

Summary of Past Biological Field Survey Efforts

Introduction

A key step in determining the best places to target conservation action as well as where to prioritize future ecological surveys, is to assess past field survey efforts in Oakland County. Prior to initiating this study, a summary of past field surveys had never been completed for Oakland County. Considering the diversity of ownership types in the county, as well as the high amount of ownership fragmentation, this shouldn't be surprising. For a variety of reasons, communication between various public and private conservation agencies and organizations within the county does not appear to be a high priority amongst these entities. In addition, the diverse nature of public and private ownership in the county makes it a time consuming and difficult process. Fortunately, Oakland County staff as well as the Project Advisory Committee saw the benefits of pursuing this type of analysis across ownership types.

Methods

Existing information and documentation on recent (since 1988) biological survey efforts that have taken place in Oakland County and that are available publically were identified, collected, and summarized. This information included ecological and biological surveys of state lands, regional and local parks, and private preserves, as well as targeted species and natural community surveys. Data from the MNFI Biotics database on rare species and natural communities was also included in the summary. The information was summarized according to place as well as major biological category in the table below.

This information was combined with the results of the aerial photo interpretation to help guide future on-the-ground ecological surveys, conservation efforts, and stewardship activities to the most appropriate places in the county. Based on that information, areas that appear to be potential high quality natural communities but haven't been surveyed by professional field biologists (or areas that haven't been surveyed in over 20 years) were highlighted.

Results

Oakland County contains a relatively high number of state, regional, county, and local government land holdings, as well as a number of parks and preserves owned by private entities and non-governmental organizations. In total, these conservation and recreation lands cover 98,452 acres or 16.97 % of the entire county. The majority of these areas are located in the upper two tiers of townships as well as the western edge of the county. Probably due to Oakland County's close proximity to a number of major universities and colleges, as well as to a relatively large percentage of the state's population, many of the public parks and private preserves have benefited from some sort of field survey over the past 20 years. Although most of these surveys were not comprehensive

(both spatially and by taxon), many of them appear to have at least focused on the most significant natural features of a given site. Significant features include: populations of rare plants or animals, intact natural communities, large contiguous natural areas, and river systems.

Table 5. Summary of Conservation and Recreation Lands in Oakland County.

Ownership Type	Count	Min. Size	Max. Size	Avg. Size	Total Acres	% of park lands	% of County
County	14	0.69	1,283.84	474.53	6,643.35	6.75%	1.14%
Educational Facility	505	0.11	937.60	26.56	13,413.47	13.62%	2.31%
Huron-Clinton Metropolitan Authority	3	1,212.88	4,029.32	2,593.49	7,780.47	7.90%	1.34%
Multi-Jurisdictional Trails	7	1.08	124.95	57.86	405.01	0.41%	0.07%
Municipality	517	0.10	645.04	28.84	14,911.78	15.15%	2.57%
Private Owner (includes Land Conservancies)	913	0.05	1,246.76	29.25	26,704.96	27.12%	4.60%
State of Michigan	30	0.92	7,729.65	953.11	28,593.23	29.04%	4.93%
Total	1,989				98,452.27	100.00%	16.97%

By far, the category of public lands that has received the most attention in Oakland County from an ecological and biological perspective is state park and recreation areas. Oakland County is very fortunate to contain seven (7) state recreation areas and four (4) state parks, and ten of these state park and recreation areas have been surveyed since 1996 (in the past 21 years). However, since these surveys were conducted by MNFI, the focus of all these efforts was on high quality natural communities, as well as targeted rare plant and animals. The Michigan Department of Natural Resources (MDNR) Parks and Recreation Division (PRD) has recently contracted with MNFI ecologists to conduct “wall to wall” natural community surveys. Although much more intensive and time consuming, this type of effort results in a GIS map of all natural communities within a given area (as opposed to just high quality sites). PRD is currently contracting with MNFI to conduct a wall to wall survey in the Holly State Recreation Area (SRA) (the largest publically owned tract in Oakland County – 7,730 acres).

Oakland County also contains three parks owned and managed by the Huron-Clinton Metropolitan Authority. Kensington, Indian Springs, and Stony Creek Metroparks have each been visited by a professional field ecologist since 2002 (within the past 15 years). These surveys documented a total of eleven (11) natural community, four (4) rare plant, and two (2) rare animal element occurrences. In addition, targeted surveys for the eastern massasauga rattlesnake have taken place intermittently over the past 20 years in Indian Springs Metropark. There are also fourteen (14) County parks scattered across Oakland County. Three of these parks were visited by ecologists in 2006, twelve were visited by field biologists in 2015, and four were visited for a lake assessment in 2012. These surveys documented four (4) natural community, two (2) rare plant, and two (2) rare animal element occurrences. Other areas that were recently surveyed for natural communities, plants,

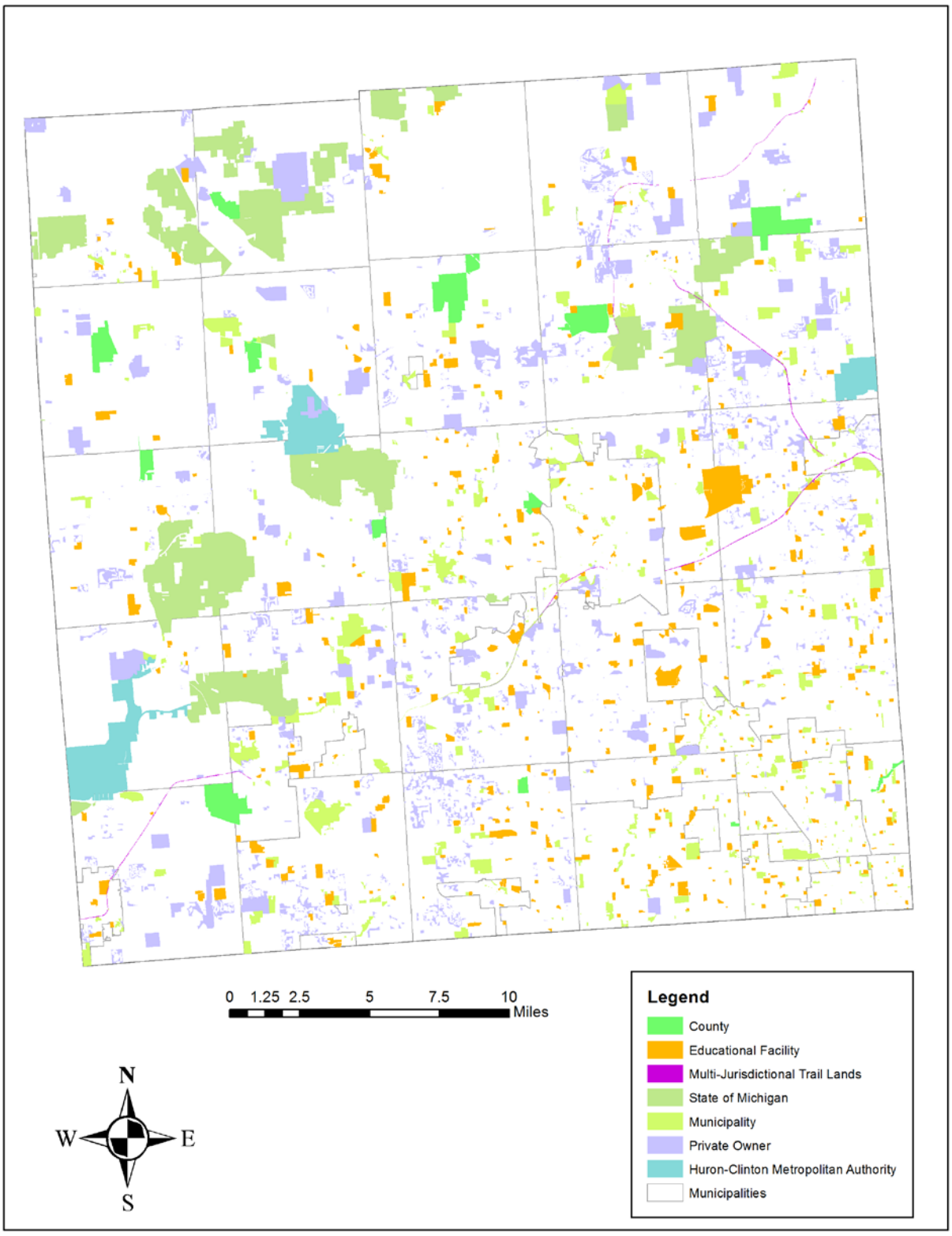

Figure 5. Map of 2016 Conservation and Recreation Lands in Oakland County.

and/or animals include several township parks in Oakland and Springfield Townships, as well as a number of preserves owned and managed by various land conservancies.

Table 6. Summary of Previous Biological Survey Efforts in Oakland County.

Report Name	Site(s)	Year Published	Natural Communities	Plants	Birds	Herpetofauna	Insects	Aquatics	Notes
A Natural Features Inventory of Oakland County, Michigan	Oakland County	1988	X						36 separate areas containing 62 natural communities were identified
Shiawassee and Huron Headwaters Resource Preservation Project (5 townships)	8 sites - Big Valley, Huron Swamp, GM Road, Perch Lake Complex, Huron River Corridor, I-75 Woods, Long Lake and Buckhorn SE	1999	X	X	X				Described natural communities, plants, and animals found at these 8 sites: Big Valley, Huron Swamp, GM Road, Perch Lake Complex, Huron River Corridor, I-75 Woods, Long Lake and Buckhorn SE
Inventory and Management Recommendations for Bald Mountain State Recreation Area's Natural Communities, Rare Plants, and Rare Animals	Bald Mountain SRA	2001	X	X	X	X	X		0 natural community, 0 plant, and 1 animal EO documented. Previously documented 9 natural community, 3 plant, and 2 animal EOs.
Inventory and Management Recommendations for Highland State Recreation Area's Natural Communities, Rare Plants and Rare Animals	Highland SRA	2001	X	X	X	X	X		Documented a total of 24 natural community, 6 rare plant, and 9 rare animal EOs
Inventory and Management Recommendations for Holly State Recreation Area's Natural Communities, Rare Plants and Rare Animals	Holly SRA	2001	X	X	X	X	X		Documented a total of 6 natural community, 0 rare plant, and 1 rare animal EOs
Inventory and Management Recommendations for Island Lake Recreation Area's Natural Communities, Rare Plants and Rare Animals	Island Lake SRA	2001	X	X	X	X	X		Documented a total of 3 natural community, 0 rare plant, and 2 rare animal EOs
Ortonville State Recreation Area Natural Features Inventory and Management Recommendations	Ortonville SRA	2001							Summary of previous survey efforts. Most recent observed dates are from 1996. > 20 years ago. 1 observation of Blanding's turtle - 2000.
Pontiac Lake State Recreation Area	Pontiac Lake SRA	2001							Summary of previous survey efforts. Most recent observed

Report Name	Site(s)	Year Published	Natural Communities	Plants	Birds	Herpetofauna	Insects	Aquatics	Notes
Natural Features Inventory and Management Recommendations									dates are from 1997 ~ 20 years ago.
Inventory and Management Recommendations for Proud Lake State Recreation Area's Natural Communities, Rare Plants and Rare Animals	Proud Lake SRA	2001	X	X	X	X	X		Documented 4 natural community, 0 rare plant, and 1 rare animal EOs
Dodge Bros. SP No. 4 Inventory and Management Recommendations	Dodge Bros. SP No. 4	2001	X	X					No EOs documented. Includes Summary of previous survey efforts.
Seven lakes State Park Natural Features Inventory and Management Recommendations	Seven Lakes State Park	2002							Summary of previous survey efforts. Most recent observed dates are from 1996. > 20 years ago.
Natural Features Inventory and Management Recommendations for Kensington and Oakwoods Metroparks	Kensington Metropark	2003	X	X					Documented 3 natural community, 1 rare plant, and 2 animal EOs
Natural Features Inventory and Management Recommendations for Delhi, Dexter-Huron, Hudson Mills, and Stony Creek Metroparks	Stony Creek Metropark	2002	X	X					Documented 3 natural community and 2 rare plant EOs
Natural Features Inventory and Management Recommendations for Indian Springs, Lower Huron, and Willow Metropark	Indian Springs Metropark	2004	X	X					Documented 5 natural community and 0 plant EOs at Indian Springs Metropark
Natural Features Inventory and Management Recommendations for Independence Oaks, Lyon Oaks, and Rose Oaks, Oakland County Parks	Independence Oaks, Lyon Oaks, and Rose Oaks, Oakland County Parks	2006	X	X					Documented 4 natural community and 2 rare plant EOs
O'Connor Nature Park Plant species list, floristic quality assessment, and map.	O'Connor Nature Park, Oakland Township		X						FQI = Map of natural communities. Included: dry-mesic southern forest, southern shrub-carr, mesic southern forest, and emergent marsh.
Paint Creek Heritage Area - floristic quality assessment and map.	Paint Creek Heritage Area	2014	X	X					FQI = 29.9. Four natural communities were documented: Prairie fen, wet prairie, rich tamarack swamp, and prairie.

Report Name	Site(s)	Year Published	Natural Communities	Plants	Birds	Herpetofauna	Insects	Aquatics	Notes
Paint Creek Heritage Area - floristic quality assessment and map.	Paint Creek Heritage Area	2006	X	X					FQI = 60.42. Four natural communities were documented: Lake plain wet-mesic prairie; southern wet meadow; southern floodplain forest; and dry-mesic southern forest.
Amphibian and Reptile Surveys of Bear Creek Nature Park, Cranberry Lake Park and Marsh View Park in Oakland Township, Michigan	Bear Creek Nature Park, Cranberry Lake Park and Marsh View Park in Oakland Township	2008				X			A total of 20 species of amphibians and reptiles were observed. Only 1 listed species was observed.
Stony Creek Corridor Park Acquisition - Ecological Assessment	Stony Creek Park Corridor, Oakland Township	2005	X	X					FQI = 46.05 and 39.43. 3 Natural Communities were documented.
Oakland Township Herpetological Survey Report	Marsh View and Stony Creek Corridor, Oakland Township	2005				X			A total of 7 species of Herptofauna were documented.
Aquatic Inventory of Three State Recreation Areas: Island Lake State Recreation Area, Pontiac Lake State Recreation Area, and Proud Lake State Recreation Area	Island Lake SRA, Pontiac Lake SRA, and Proud Lake SRA	2005						X	Fish and mussel inventory. 2 rare mussel species documented.
Oakland County Parks Lakes Assessments	Orion Oaks, Independence Oaks, Highland Oaks, and Rose Oaks County Parks	2012						X	
Orchard Lake Nature Sanctuary Herpetofauna Inventory Report	Orchard Lake Nature Sanctuary,	2014				X			15 species of herpetofauna were documented; no rare species
Ecological Management Plan and Visitor Access Recommendations for River Run Preserve	River Run Preserve, Springfield Township	2015	X	X					Three natural community types were observed. No rare plant species.
Oakland County Parks Herpetological Inventory	Addison, Orion, Independence, Waterford, White Lake, Groveland, Springfield, Rose, Highland, Lyon, Glen, and Red Oaks County Parks	2016				X			28 species of herpetofauna were documented; including 2 rare animal species (Blanding's turtle, and e. massasauga rattlesnake).
The Insects of Oakland Township Parks: An Entomological Survey	Lost Lake Nature Park, Paint Creek Trail, Bear Creek Nature Park, Cranberry Lake Park, Blue Heron Environmental Area, Draper Twin Lakes Park, Stoney Creek Ravine	2008					X		Species from 57 different families were observed. Only 1 special concern species was documented.

Report Name	Site(s)	Year Published	Natural Communities	Plants	Birds	Herpetofauna	Insects	Aquatics	Notes
Southeast Michigan DNR Fisheries Newsletter	Loon Lake, Lakeville Lake, Paint Creek, and Gallagher Creek	2010						X	Loon Lake = 25 species; Lakeville Lake = 15 species; Paint Creek = brown and rainbow trout; Gallagher Creek = brook trout, brown trout, sculpin, and blacknose dace.
Preservation of Great Blue Heron Rookery, Oakland Township, MI	Blue Heron Environmental Area, Oakland Township	1994			X				Recorded number of nests in GBH. Provided management recommendations to preserve the rookery.
Ongoing Poweshiek Skipperling surveys - MNFI Biotics database	Confidential	2005 - 2017					X		Tracking number of powersheik shipperlings at several sites in Oakland County. The populations are consistently decreasing, as are the number of sites. Currently only 4 sites still harbor skipper populations.
Ongoing Vernal Pool Surveys – MNFI and Volunteers	Proud Lake SRA, Highland Lake SRA, and Proud Lake Park	2012	X			X	X		170 potential vernal pools were mapped; 32 were surveyed; 21 were verified as vernal pools.
Vernal Pool Surveys – Oakland Township	Bear Creek Nature Park, Charles Ilsley Park, Marsh View Park, Stony Creek Ravine Nature Park, Watershed Ridge Park, Blue Heron Environmental Area, Cranberry Lake Park, Gallagher Creek, Lost Lake Nature Park, and Paint Creek Heritage Area	2016	X			X	X		128 potential vernal pools were mapped. 4 vernal pools were surveyed.

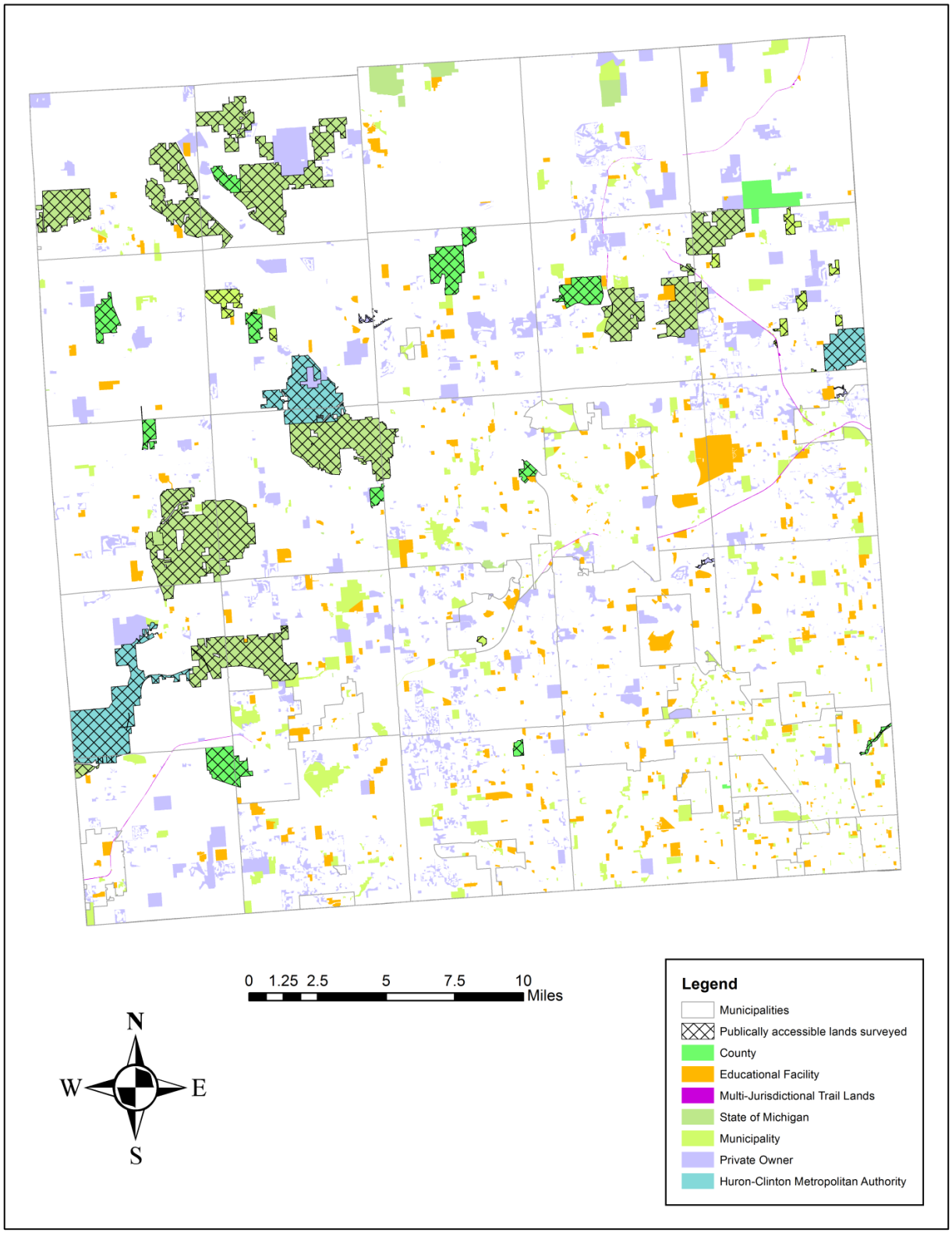

Figure 6. Public Lands and private preserves where some type of biological survey has been conducted since 1997 (past 20 years).

Biotics Database Summary

MNFI maintains the most comprehensive database on Michigan's unique natural features. Currently (December 2017), there are over 19,000 element occurrences (EOs) in the database. Natural features include rare plants, rare animals, natural communities, and an "other" category. These records can be sorted spatially including by jurisdiction. As of December 2017, there were a total of 440 element occurrences known to occur in Oakland County (MNFI Biotics Database 2017). All records noted in each of the following tables have been entered into the MNFI Biotics database. The origin of these records come from a variety of sources including museum records, universities, amateur scientists, professional biologists and ecologists, consulting firms, public land managers, and MNFI staff.

Breaking it down by element occurrence category, a few patterns begin to emerge. There are 85 natural community, 112 plant, 136 terrestrial animal, 98 aquatic animal, and 10 other EOs. All of the EOs in the "other" category are great blue heron rookeries. It is also important to note the dates of last observation. Some of these records are fairly old (1848) while a few of these records are very recent (2017). In fact, of the 440 known element occurrences in Oakland County, 204 (46%) are greater than 20 years old. Of these 204 records, 94 are animal EOs (40% of all animal EOs), 73 are plant EOs (65% of all plant EOs), 28 are natural community EOs (33% of all natural community EOs), and 9 are other EOs (90% of all other EOs). This represents a very significant percentage of known EOs that should be revisited to determine presence/absence, as well as current condition.

Based on the database, there are several species found in Oakland County that should be highlighted for future or continued survey/monitoring efforts. Poweshiek skipperling (*Oarisma poweshiek*), state threatened and federally endangered, has declined precipitously over the past decade throughout its range. Michigan currently harbors four (4) EOs, or 66 % of the remaining populations in the world. Interestingly, all of the four remaining populations in Michigan are now located only in Oakland County. In Michigan, this rare butterfly is strictly associated with a unique wetland community called a prairie fen. Another species that has a high affinity for prairie fens in Michigan is the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*), state and federally threatened. The eastern massasauga rattlesnake can be found in isolated locations throughout the Lower Peninsula. There are several known strongholds for the rattlesnake in Michigan, and one of them is Oakland County (26 EOs). Both of these species should be highlighted for additional surveys, research and monitoring, particularly areas that contain suitable habitat that have yet to be surveyed.

Other species with a high number of occurrences in Oakland County include: Blanding's turtle (*Emydodea blandingii*), state special concern (21 EOs); white lady slipper (*Cypripedium candidum*), state threatened plant (EOs); goldenseal (*Hydrastis canadensis*), state threatened plant (9 EOs); tamarack tree cricket (*Oecanthus laricis*), state threatened insect (9 EOs); and hooded warbler (*Wilsonia citrina*), state special concern bird (10 EOs). There are also ten great blue heron rookeries scattered throughout the county.

Table 7. Summary of High Quality Natural Community Occurrences in Oakland County.

Common Name	Count	Acres	State rank	Global rank
Bog	3	44.1	S4	G3G5
Coastal Plain Marsh	1	3.4	S2	G2
Dry-mesic Southern Forest	14	1077.8	S3	G4
Emergent Marsh	2	46.1	S4	GU
Floodplain Forest	1	20.7	S3	G3?
Hardwood-Conifer Swamp	4	667.0	S3	G4
Inundated Shrub Swamp	2	7.9	S3	G4
Mesic Sand Prairie	1	0.4	S1	G2
Mesic Southern Forest	6	388.7	S3	G2G3
Oak Barrens	1	20.7	S1	G2?
Poor Conifer Swamp	2	72.4	S4	G4
Prairie Fen	22	623.2	S3	G3
Rich Conifer Swamp	3	114.8	S3	G4
Rich Tamarack Swamp	4	99.0	S3	G4
Southern Hardwood Swamp	4	713.8	S3	G3
Southern Shrub-carr	1	21.7	S4	GU
Southern Wet Meadow	8	371.1	S3	G4?
Submergent Marsh	2	51.4	S4	GU
Wet-mesic Prairie	3	15.9	S1	G2
Total	85	4,360.3		

Table 8. Summary of Rare Aquatic Animals in Oakland County.

Common Name	Scientific Name	Count	State rank	Global rank	MI Status	US Status
Black sandshell	*Ligumia recta*	3	SNR	G5	E	
Brindled madtom	*Noturus miurus*	3	S2S3	G5	SC	
Campeloma spire snail	*Cincinnatia cincinnatiensis*	2	G5	SNR		SC
Eastern sand darter	*Ammocrypta pellucida*	1	S1S2	G3	T	
Elktoe	*Alasmidonta marginata*	5	S2S3	G4	SC	
Gravel pyrg	*Pyrgulopsis letsoni*	1	G5	SU		SC
Kidney shell	*Ptychobranchus fasciolaris*	5	SNR	G4G5	SC	
Lake herring or Cisco	*Coregonus artedi*	7	S3	G5	T	
Northern riffleshell	*Epioblasma torulosa rangiana*	1	S1	G2T2	E	LE
Paper pondshell	*Utterbackia imbecillis*	4	SNR	G5	SC	
Pugnose shiner	*Notropis anogenus*	4	S3	G3	E	
Purple lilliput	*Toxolasma lividus*	3	S1	G2	E	
Rainbow	*Villosa iris*	12	S2S3	G5Q	SC	
Rayed bean	*Villosa fabalis*	4	S1	G2	E	LE
Redside dace	*Clinostomus elongatus*	2	S1S2	G3G4	E	

River fingernail clam	*Sphaerium fabale*	1	SNR	G5	SC	
Round pigtoe	*Pleurobema sintoxia*	11	S2S3	*G4G5*	SC	
Slippershell	*Alasmidonta viridis*	17	S2S3	G4G5	T	
Snuffbox	*Epioblasma triquetra*	6	S1	G3	E	LE
Wavyrayed lampmussel	*Lampsilis fasciola*	6	S2	G5	T	

Table 9. Summary of Known Rare Plant Occurrences in Oakland County.

Common Name	Scientific Name	Count	State Rank	Global Rank	MI Status	US Status
American chestnut	*Castanea dentata*	4	S1S2	G4	E	
Bald-rush	*Rhynchospora scirpoides*	1	S2	G4	T	
Bastard pennyroyal	*Trichostema dichotomum*	1	S2	G5	T	
Bog bluegrass	*Poa paludigena*	1	S2	G3	T	
Canadian milk vetch	*Astragalus canadensis*	1	S1S2	G5	T	
Clinton's bulrush	*Scirpus clintonii*	4	S3	G4	SC	
Cyperus, Nut grass	*Cyperus acuminatus*	1	SX	G5	X	
Downy gentian	*Gentiana puberulenta*	1	S1	G4G5	E	
Edible valerian	*Valeriana edulis var. ciliata*	1	S2	G5T3	T	
English sundew	*Drosera anglica*	1	S3	G5	SC	
False hop sedge	*Carex lupuliformis*	1	S2	G4	T	
Furrowed flax	*Linum sulcatum*	2	S2S3	G5	SC	
Gattinger's gerardia	*Agalinis gattingeri*	1	S1	G4	E	
Ginseng	*Panax quinquefolius*	2	S2S3	G3G4	T	
Goldenseal	*Hydrastis canadensis*	9	S2	G4	T	
Green violet	*Hybanthus concolor*	1	S3	G5	SC	
Hairy angelica	*Angelica venenosa*	7	S3	G5	SC	
Hill's thistle	*Cirsium hillii*	1	S3	G3	SC	
Hollow-stemmed Joe-pye weed	*Eupatorium fistulosum*	1	S1	G5?	T	
Jacob's ladder	*Polemonium reptans*	1	S2	G5	T	
Leadplant	*Amorpha canescens*	1	S3	G5	SC	
Mat muhly	*Muhlenbergia richardsonis*	8	S2	G5	T	
Missouri rock-cress	*Arabis missouriensis var. deamii*	2	S2	G5?QT3?Q	SC	
Nodding mandarin	*Prosartes maculata*	1	SX	G3G4	X	
Orange-fringed orchid	*Platanthera ciliaris*	2	S1S2	G5	E	
Prairie birdfoot violet	*Viola pedatifida*	1	S1	G5	T	
Prairie dropseed	*Sporobolus heterolepis*	1	S3	G5	SC	
Prairie white-fringed orchid	*Platanthera leucophaea*	1	S1	G3	E	LT
Pumpkin ash	*Fraxinus profunda*	3	S2	G4	T	
Purple twayblade	*Liparis liliifolia*	2	S3	G5	SC	
Red mulberry	*Morus rubra*	2	S2	G5	T	
Richardson's sedge	*Carex richardsonii*	5	S3S4	G4	SC	
Showy orchis	*Galearis spectabilis*	8	S2	G5	T	

Side-oats grama grass	*Bouteloua curtipendula*	1	S1	G5	E
Small-fruited panic-grass	*Dichanthelium microcarpon*	1	S2	GNR	SC
Smooth carrion-flower	*Smilax herbacea*	1	S3	G5	SC
Stiff gentian	*Gentianella quinquefolia*	1	S2	G5	T
Sullivant's milkweed	*Asclepias sullivantii*	1	S2	G5	T
Three-awned grass	*Aristida longespica*	1	S2	G5	T
Toadshade	*Trillium sessile*	1	S2S3	G4G5	T
Twinleaf	*Jeffersonia diphylla*	2	S3	G5	SC
Umbrella-grass	*Fuirena pumila*	1	S2	G4	T
Vasey's pondweed	*Potamogeton vaseyi*	2	SH	G4	T
Virginia flax	*Linum virginianum*	3	S2	G4G5	T
Wahoo	*Euonymus atropurpurea*	2	S3	G5	SC
White lady slipper	*Cypripedium candidum*	15	S2	G4	T
White or prairie false indigo	*Baptisia lactea*	1	S3	G4Q	SC

Table 10. Summary of Rare Terrestrial Animals in Oakland County.

Common Name	Scientific Name	Count	State Rank	Global Rank	MI Status	US Status
A land snail	*Catinella protracta*	1	SNR	G2Q	E	
American burying beetle	*Nicrophorus americanus*	1	SH	G2G3	X	LE
Angular spittlebug	*Lepyronia angulifera*	1	S1S2	G3	SC	
Bald eagle	*Haliaeetus leucocephalus*	2	S4	G5	SC	
Blanchard's cricket frog	*Acris crepitans blanchardi*	1	S2S3	G5T5	T	
Blanding's turtle	*Emydoidea blandingii*	21	S3	G4	SC	
Blazing star borer	*Papaipema beeriana*	2	S1S2	G2G3	SC	
Cerulean warbler	*Dendroica cerulea*	4	S3	G4	T	
Common loon	*Gavia immer*	1	S3S4	G5	T	
Copper button	*Mesomphix cupreus*	2	SU	G5	SC	
Copperbelly water snake	*Nerodia erythrogaster neglecta*	1	S1	G5T3	E	LT
Eastern box turtle	*Terrapene carolina carolina*	3	S2S3	G5T5	SC	
Eastern massasauga	*Sistrurus catenatus catenatus*	26	S3S4	G3G4T3T4Q	T	LT
Flat dome	*Ventridens suppressus*	1	SNR	G5	SC	
Grasshopper sparrow	*Ammodramus savannarum*	4	S3S4	G5	SC	
Gray ratsnake	*Pantherophis spiloides*	1	S3	G5T5	SC	
Henslow's sparrow	*Ammodramus henslowii*	2	S2S3	G4	E	
Hooded warbler	*Wilsonia citrina*	10	S3	G5	SC	
Huron River leafhopper	*Flexamia huroni*	5	S1	GNR	T	
Least shrew	*Cryptotis parva*	1	S1S2	G5	T	
Little brown bat	*Myotis lucifugus*	1	S5	G5	SC	
Marsh wren	*Cistothorus palustris*	1	S3S4	G5	SC	
Newman's brocade	*Meropleon ambifusca*	1	S1S2	G3G4	SC	
Peregrine falcon	*Falco peregrinus*	1	S1	G4	E	

Persius dusky wing	*Erynnis persius persius*	1	S3	G5T1T3	T	
Pinetree cricket	*Oecanthus pini*	1	S1S2	GNR	SC	
Poweshiek skipperling	*Oarisma poweshiek*	7	S1S2	G2G3	T	LE
Prairie warbler	*Dendroica discolor*	1	S1	G5	E	
Red-legged spittlebug	*Prosapia ignipectus*	6	S2S3	G4	SC	
Red-shouldered hawk	*Buteo lineatus*	3	S3S4	G5	T	
Regal fritillary	*Speyeria idalia*	1	SH	G3	E	
Smallmouth salamander	*Ambystoma texanum*	1	S1	G5	E	
Spotted turtle	*Clemmys guttata*	5	S2	G5	T	
Swamp metalmark	*Calephelis mutica*	4	S1S2	G3	SC	
Tamarack tree cricket	*Oecanthus laricis*	9	S1S2	G1G2	SC	
Wild indigo duskywing	*Erynnis baptisiae*	2	S2S3	G5	SC	
Woodland vole	*Microtus pinetorum*	1	S3S4	G5	SC	

Information Gaps

Like most counties in Michigan, information on natural features in Oakland County is inconsistent. There has never been a comprehensive biological survey of Oakland County. As a result, what is known is based on opportunistic surveys of specific areas for reasons that vary from proposed housing developments and infrastructure projects to park and recreation planning. A key finding from this analysis is that there are significant areas and large parcels that are still privately owned and have never been surveyed for natural features. Many of these areas will be addressed in the next chapter: identifying potential high quality natural communities.

Secondly, most of the state owned and managed lands have had some level of biological survey conducted over the past 20 years. Many of these surveys were conducted by MNFI, and the MDNR PRD is currently contracting with MNFI to complete more comprehensive surveys on several State Park and Recreation Areas. Given the attention state lands have and will continue to receive in the future, state owned lands in Oakland County should be considered a lower priority for future surveys from a county and municipality perspective. Similarly, the three Metroparks and many of the County Parks have also been surveyed in the recent past. It is important to note however, that most of these surveys focused on high quality natural communities and associated rare plant species. Surveys for rare and declining animal species were typically not conducted due to funding limitations. In addition, there may be other areas within these public land holdings that may harbor significant plant and/or animal populations, but were not surveyed due to past disturbances. An

example might be a large upland forest that has been logged in the past, but provides significant habitat for declining forest interior songbirds.

Areas that should be the highest priority for future biological surveys include: 1) county parks that haven't been surveyed recently or comprehensively, 2) township parks, and 3) land conservancy preserves and easements. Although a few townships, such as Oakland Township, have had many of

their parks and preserves surveyed, most township parks in Oakland County have never been surveyed.

Third, there has been increasing interest in identifying and documenting vernal pool communities across the state. As part of a larger statewide effort, two state recreation areas and one nearby park were evaluated for vernal pools in Oakland County in 2012. Due to funding and time constraints, only 32 out of 170 (18.8 %) potential vernal pools were surveyed in the field. Following the same mapping protocol, Oakland Township mapped 128 potential vernal pools. However, they were only able to survey four of these vernal pools in 2016. Given the high number of potential vernal pools mapped in these limited areas of the county, vernal pool mapping and surveys should be completed for the remainder of the county, including appropriate habitat within high density urban areas.

Lastly, Oakland County boasts over 1,400 lakes. With the exception of a few lakes within County Park and State Park boundaries, there is no record of lakes being surveyed for rare species, evaluated for a lake classification, or assessed for their physical, biological and chemical composition. This is a large data gap for such an important resource in Southeast Michigan. The same can be stated for river and stream systems within the county. Although several watershed councils regularly conduct water quality sampling in several of the major watersheds, the majority of river and stream miles have never been surveyed, particularly for native fish and mussels. The southeast portion of the Lower Peninsula is known for its freshwater mollusk diversity, and Oakland County is no exception. An increased focus on biological surveys of the numerous rivers, streams, and lakes within Oakland County could result in the discovery of a significant number of new freshwater mussel and fish populations.

Identifying Potential High Quality Natural Communities

Purpose

The primary purpose of this step in the project was to identify specific patches of natural vegetation within the larger intact landscapes (PNAs that were identified in the first step) that have potential for high quality natural communities and/or harboring rare plants and animals. These patches represent places on the landscape that appear to have experienced the least amount of impact or degradation from human activities since the early 1800s.

In the previous steps, intact patches of natural lands were delineated and prioritized. These are the PNAs that can be found throughout Oakland County. These PNAs represent patches of various natural land cover that also vary in size, quality, and landscape context. The natural land cover types within these PNAs also vary by type and quality. The objective is to identify specific patches of natural land cover (forest, wetland) within priority PNAs, that have a high likelihood of exhibiting ecological intactness and integrity.

Methods

The purpose of this assessment was to delineate the highest quality patches of natural land cover within high scoring PNAs that demonstrate the greatest opportunity for conservation value. Conservation value can be defined by a number of different factors, such as: the presence of rare and declining species, high plant and/or animal species diversity, structural diversity, presence of biological legacies such as large dead and downed trees, intact ecological processes, intact hydrology, and/or lack of key threats. The problem is that all of these factors are almost impossible to detect from aerial imagery, and almost always require field inspection.

However, understanding that there are limitations with remote analysis, this assessment was based on aerial imagery from several different time periods: 1940, 1963 and 2015. The earliest time period available for aerial imagery of Oakland County was from the 1940. As with most of the Lower Peninsula, Oakland County had been significantly altered by European settler activities by the turn of the 20th century. This is the best representation of patches of forests and wetlands that appear to still be intact almost 80 years ago. A key habitat type that is missing from this landscape analysis is grassland. Unfortunately, native grassland systems such as prairie, savanna, and barrens, were virtually eliminated by the early 1900s throughout Michigan, and the remaining small, isolated patches of native grassland are essentially impossible to identify from old, low quality, black and white aerial photographs.

Due to the fact that there were not enough funds or resources to delineate and characterize every patch of natural land cover within every PNA, the first step in the process was to identify PNAs with the highest potential for conserving ecological value. That was determined by three key factors: 1)

PNA total scores (with enhanced criteria), 2) percentage of private land (higher the better), and 3) proximity to public land (closer the better). First, all enhanced criteria total scores greater than 15 were identified. From that selection, PNAs with greater than fifty percent private ownership were selected. This was determined using the Oakland County 2015 conservation lands database. These were placed in the first priority category for natural community assessment. Once those were selected, PNAs adjacent to or in close proximity to publically owned lands were the first to be evaluated for high quality natural land cover. There were a total of 70 first priority PNAs. Once these were assessed, a second set of PNAs were identified. Although these PNAs also had high total scores (based on the enhanced criteria), they also had a higher percentage of public land; in some cases they were 100 percent publically owned. A key factor for prioritization was the amount of privately owned land (the higher the better), and whether or not the area had been surveyed within the past 20 years. The majority of the highest ranking second priority PNAs had some form of regional or local public ownership (as opposed to state ownership, such as state park and recreation areas). A total of 18 second priority PNAs was identified.

Table 11. Priority PNAs for the Identification of High Quality Natural Communities.

Count	Lowest Total Score	Highest Total Score	Mean Score	Smallest PNA (ac)	Largest PNA (ac)	Total Acres	% of all PNAs (ac)	Mean Size
88	7	30	17.2	42	1,207	27,549	30.4%	313

Once the priority PNAs were identified, the next step in the process was to determine which patches of natural land cover within these PNAs, had a high probability of still being in good condition. This was done by identifying all natural land cover patches from the 1940 aerial photographs. Once these patches were identified, the next step was to eliminate all portions of these patches that demonstrated major alterations based on the 1963 aerial photographs. In addition, forest patches or portions of forest patches that did not show up as forest on the digital USGS quadrangle topographic maps were also removed. All remaining patches of habitat were considered high quality, and delineated using heads up digitizing. They were also attributed with primary land cover type, size, and notes. Primary land cover types used for this analysis included: 1) lowland deciduous forest, 2) lowland mixed forest, 3) lowland conifer forest, 4) non-forested wetland, 5) mixed wetland complex, and 6) upland forest. These cover types were chosen because of the high confidence levels for delineating each type in this portion of Michigan's Lower Peninsula. If an MNFI Scientist was able to identify more specific natural community types based on topography, soils, hydrology, aspect distinct aerial imagery signature, or other factors, that information was also included in the notes field of the database.

Results

Over the course of the project, MNFI scientists were able to identify, delineate, and attribute a total of 306 potential high quality natural communities within the 88 priority PNAs. These 306 polygons covered a total of 13,206 acres. The polygons ranged in size from 3 acres to 236 acres. Average size ranged from a low of 31 acres (for lowland conifer forest) to a high of 59 acres (for lowland deciduous forest). The average patch size across all natural land cover types was 42.5 acres.

Table 12. Summary of Natural Land Cover Types Within all Priority PNAs.

Land Cover Type	Count	% of Total	Smallest Patch	Largest Patch	Average Size	Total Acres	% of Total
Lowland Conifer Forest	37	12%	3	161	31	1,154	8.7
Lowland Deciduous Forest	56	18.3%	6	199	59	3,312	25.0
Lowland Mixed Forest	21	6.8%	4	133	34	718	5.4
Mixed Wetland Complex	42	13.7%	4	236	53	2,214	16.7
Non-forested Wetland	61	20%	3	195	39	2,376	18.0
Upland Forest	89	29%	3	195	39	3,432	26.0
Total	**306**				**42.5**	**13,206**	**100.0**

Somewhat surprisingly, upland forest was the most common natural land cover type encountered in the assessment, with 89 polygons delineated (29%) representing 3,432 acres (26%). In Oakland County, upland forest consists of mesic southern forest, dry-mesic southern forest, and dry southern forest. However, as noted in the table, the average size of these forests is only 39 acres. Historically, upland forests in Michigan were considered matrix communities and typically averaged in the 1000s of acres in size. However, due to the relative rarity of large, mature upland forests in southern Michigan, it is strongly recommended that the largest remaining patches of upland forest be targeted for long-term protection.

Upland forest was followed by 56 (18.3%) lowland deciduous forest polygons, covering 3,312 acres (25%). Lowland deciduous forest types on Oakland County consist of floodplain forest, southern hardwood swamp, and wet-mesic flatwoods. Lowland deciduous forest was followed by non-forested wetlands, which consisted of 61 (20%) polygons and represented a total of 2,376 (18%) acres. Non-forested wetlands in Oakland County are quite diverse, and consist of emergent marsh, submergent marsh, wet meadow, prairie fen, lakeplain prairie, shrub swamp, and shrub-carr. Of these types, prairie fen and lakeplain prairie are considered by NatureServe and MNFI to be a globally and state imperiled natural communities. Both of these wetland types also provide habitat to a disproportionate number of rare plants and animals in Michigan, and are two of southern Michigan's highest conservation priorities.

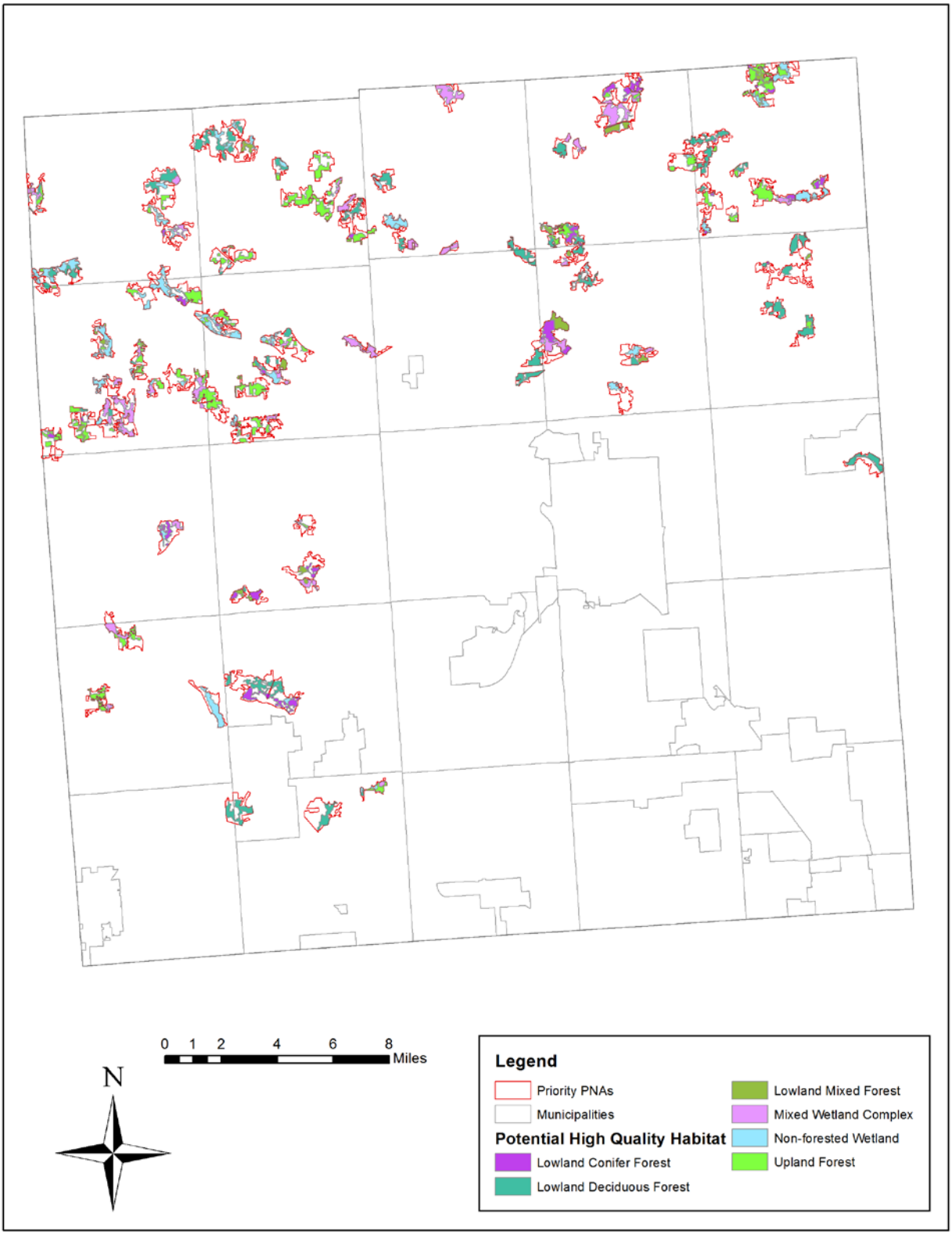

Figure 7. Map of Priority PNAs, and delineated potential high quality natural communities.

Non-forested wetland was followed closely by mixed wetland complex, which consisted of 42 polygons (13.7%) and 2,214 acres (16.7%). This category was added to the natural land cover types due to a number of areas that contained a very complex mosaic of different wetland types. It was too difficult and time consuming to delineate each and every wetland patch within these complexes. These complexes typically contained emergent marsh, wet meadow, shrub-carr and islands of hardwood swamp and/or tamarack swamp.

The two least common natural land cover types found in the priority PNAs were lowland conifer forest and mixed lowland forest. Lowland conifer forest consists of bog, rich tamarack swamp, and rich conifer swamp. All of these are somewhat rare in southern Michigan, with rich conifer swamp being the rarest in this region of the state. Based on that, it isn't surprising that only 37 polygons (12%) covering only 1,154 acres (8.7%) were identified and delineated. Additionally, mixed lowland forest is another uncommon natural land cover type found in southern Michigan. This primarily consists of hardwood-conifer swamp. Only 21 polygons (6.8%) covering 718 acres (5.4%) were identified within the priority PNAs.

Discussion

All of the PNAs that were a high priority for identifying high quality natural land cover polygons were located in the northern two tiers of townships as well as White Lake and Milford Townships. Due to the amount of human based alteration since the early 1800s in Oakland County, all of the natural land cover polygons identified in this assessment should be considered a high priority for conservation action. Only a small fraction of the landscape in Oakland County can be considered unaltered due to human activities such as farming, mining, residential, commercial, recreational and industrial development, and roads and utilities. The highest priority for conservation action should be placed on the largest high quality polygons that are adjacent to other potential high quality polygons. As noted above, due to the relative rarity of some of these systems in southern Michigan, some of these types should be considered a priority regardless of size or landscape context.

For example, large, mature upland forests are relatively rare in southeast Michigan. As a result, it is strongly recommended that the largest remaining patches of upland forest be targeted for long-term protection (unless field observations show a high level of degradation). Lowland conifer forests and mixed lowland conifer forests are also relatively rare in southeast Michigan, particularly rich conifer swamps and hardwood-conifer swamps. All forest patches should be evaluated for their conservation value regardless of size or landscape context.

Next Steps

Introduction

The primary driver behind this project is to continue the progress made on strategic conservation action throughout Oakland County. This assessment builds on and refines the previous countywide PNA spatial analyses conducted in 2002 and 2004. Since that initial assessment in 2002, a number of important conservation actions have taken place across the county on both publically and privately owned lands. Through this update: 1) all previous PNAs were revisited and reassessed, boundaries were redefined, 2) previous field survey efforts were summarized, and 3) potential high quality natural communities within priority PNAs were identified and delineated for further investigation and potential conservation action. In order for Oakland County to fully capitalize on this effort, the authors of this study recommend five key steps moving forward: 1) complete the natural community aerial photography interpretation for all PNAs; 2) conduct targeted on-the-ground ecological/biological surveys; 3) inform the Oakland County Cooperative Invasive Species Management Area (CISMA) strategic invasive species management plan; 4) develop an integrated network of conservation and recreation lands; 5) integrate new and updated information into land use planning documents and conservation efforts; and 6) spread the word.

Complete the Natural Community Aerial Photography Interpretation

Since only a portion of the PNAs were reviewed for potential high quality natural communities, an important step moving forward is to complete the aerial photo interpretation for the remainder of the PNAs. The vast majority of natural land cover within the PNAs has been impacted by various human activities within the recent past. Due to the limitations of this project, MNFI strictly focused its efforts on areas that appeared to be minimally impacted by human activity. However, it would also be beneficial to identify and assess the remaining areas in each PNA. Knowing the type and potential condition of each of these areas will help land managers and private landowners better understand the impact of various land management and development options, and hopefully lead to more informed land and water based decisions across Oakland County. Many of these areas provide a number of benefits, including: a buffer to the higher quality natural communities; habitat for rare and/or declining plants and animals; and a number of other ecosystem services such as flood control, outdoor recreation, nutrient cycling, and removing toxins. In addition, the condition of many of these areas could be improved upon via a number of ecological restoration or management actions.

Conduct Targeted Ecological/Biological Surveys

Field inventories should be conducted on identified potential natural areas. This fieldwork would provide much needed additional site-specific data that should be considered when developing in and around such areas. Areas currently unprotected that demonstrate a high probability of

harboring high quality natural communities and associated rare species should be the highest priority.

Inform the Oakland County CISMA Strategic Invasive Species Management Plan

The Oakland County CISMA contracted with Applied Ecological Services (AES) in 2016 to develop a long-term invasive species strategic management plan for the county Strategic Plan (Lehnhardt et al. 2017). As part of that effort, AES identified and scored areas in Oakland County based on the probability of harboring invasive plant species. Additionally, they used the 2004 PNA assessment conducted by MNFI to identify the most important places to focus invasive species management and stewardship activities in the County. The updated 2017 PNA assessment completed as part of this project will provide even better spatial guidance on where the most important places are for controlling or preventing invasive plant species. In addition, the potential high quality natural communities' data layer should serve as an excellent source of information for guiding future invasive species work.

Develop an Integrated Network of Conservation and Recreation Lands

Despite its propensity for economic growth and its proximity to the largest population in Michigan, Oakland County still contains an abundance of natural features. Fortunately, many of these features are located within various public land holdings, such as state park and recreation areas, county, township, and city parks, Metroparks, or land conservancy preserves. However, this fragmentation of ownership, despite being mostly public ownership, poses both a barrier as well as an opportunity. The number of different land managers within Oakland County is actually rather large. This fragmentation of ownership makes it difficult for managers to communicate across boundaries, and for the public to fully understand and appreciate the wealth of outdoor recreational opportunity available to them. The opportunity lies in bringing these various land holdings together into a single, interconnected network of recreational lands (parks, preserves, access points, and trails). Similar outdoor recreational networks exist in other parts of the country, such as Lake and Dupage Counties near Chicago, Illinois. Given the number of similarities between Lake and Depage Counties and Oakland County, it makes sense to reach out and connect to these two northern Illinois Counties and learn from their experiences.

Integrate New and Updated Information into Land Use Planning and Conservation Efforts

Like many states in the Midwest, Michigan is a "home rule" state. This means that land use decisions are determined at the smallest unit of government. In other words, a township or village master plan would override a county master plan. As a result, there is potential for over sixty master plans in Oakland County alone. Each one of these plans has the potential to impact land use patterns as well as the larger environment such as water quality, air quality, recreation, and other ecosystem services.

One way of minimizing the potential negative impact of multiple land use decisions across the county, is for each local unit of government to review the material provided in this report and integrate as much of the spatial information as possible. This information could be integrated into a master plan as well as associated functional or special plans such as a parks and recreation plan, transportation plan, and/or economic development plan. Local units of government, individuals, and conservation groups using the information provided in this report, should also consult the Shiawassee & Huron Headwaters Resource Preservation Project (2000). The report from that initial study contains important information on tools and techniques that conserve natural resources and create open space linkages while facilitating economically compatible development.

Beyond local land use planning efforts, numerous conservation organizations and agencies have worked in Oakland County for several decades trying to improve water quality, protect natural areas, restore open space, and improve accessibility. These include watershed councils, land conservancies, and the Oakland Conservation District. As an example, it has been well documented that there is a direct relationship between natural area protection and long-term water quality. With the abundance of water resources found throughout Oakland County, and the potential economic impact associated with the degradation of these resources, the information from this report should be integrated into all existing and future watershed management plans. There are five major watersheds in Oakland County, and each one has a watershed management plan for at least a portion of their respective watersheds. Additional attention needs to be placed on any future updates to these watershed management plans.

Lastly, local municipalities should consider adopting a comprehensive Green Infrastructure plan. The conservation of potential natural areas is most effective, and successful, in the context of an overall Green Infrastructure plan that encompasses multiple municipalities, an entire county, or even multiple counties. Green infrastructure plans provide a well-designed structure for addressing the long term conservation of key natural assets, linking important places together, and balancing ecological protection with economic development. Oakland County's Green Infrastructure Vision (completed in 2009) should be referenced. The foundation of the Oakland County Green Infrastructure Vision is largely based on the 2004 PNAs along with significant input from a broad collection of stakeholders.

Spread the Word

One of the biggest challenges associated with a large landscape scale conservation effort is ensuring all stakeholders are well informed and supportive. Key aspects of this project were driven by input from an advisory committee. The advisory committee was made up of representatives from a variety of entities concerned about land and water issues in the county. Now that the assessment portion of this project has ended, this Advisory Committee will continue to meet as a group, implement and coordinate targeted land protection, management, and restoration, and conduct public outreach across the county.

Two of the most important tasks the Advisory Committee will focus on are spreading the word, and growing the support for strategic land protection across Oakland County. Although the committee consists of many of the most engaged groups in the county, the tremendous amount of work that needs to be accomplished will require the involvement of as many stakeholders as possible. Despite being the second most populated county in the state, Oakland County still possesses a significant amount of forests, wetlands, grasslands, water resources and associated populations of unique plants and animals. It is therefore imperative that local units of government, decision-makers, businesses, developers, landowners, and citizens fully understand the value of these natural assets, and what can be done to ensure their long-term health and protection.

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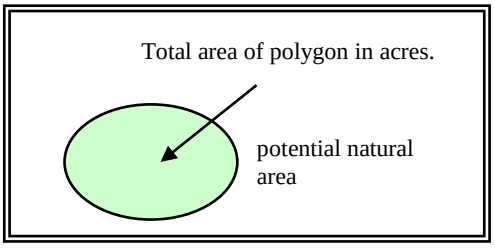
Appendix A:
Description of PNA Criteria

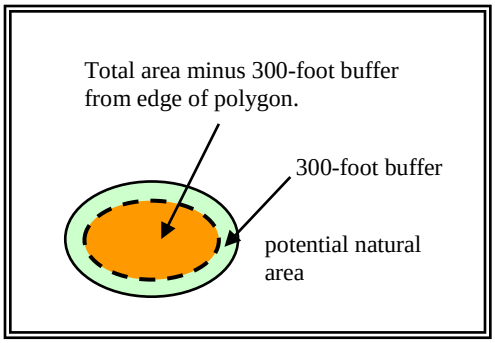
Description of Criteria

Total Size - The total size of a site is recognized as an important factor for viability of species and ecosystem health. Larger sites tend to have higher species diversity, higher reproductive success, and improve the chances of plant and animal species surviving a catastrophic event such as a fire, tornado, ice storm, or flood.



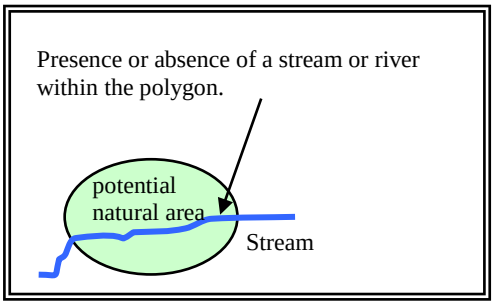
Size is defined as the total area of the polygon.

Size of Core Area - Many studies have shown that there are negative impacts associated with the perimeter of a site on "edge-sensitive" animal species, particularly amphibians, reptiles, and forest and grassland songbirds. Buffers vary by species, community type, and location, however most studies recommend a buffer somewhere between 200 and 600 ft. to minimize negative impacts. Three hundred feet is considered a sufficient buffer for most "edge-sensitive" species in forested landscapes.



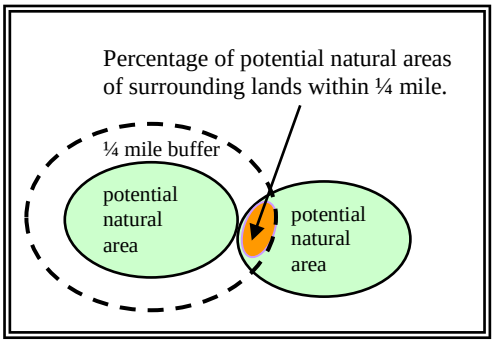
For this project, core area is defined as "size" (see above) minus a 300-foot wide buffer measured inward from the edge of the polygon. Core area is different from total area of the site because it takes into account the shape of the site. Typically, round shapes contain a larger core area relative to the total site than long narrow shapes.

Stream Corridor (presence/absence) - Water is essential for life. Streams are also dynamic systems that interact with the surrounding terrestrial landscape creating new habitats. Waterways also provide the added benefit of a travel corridor for wildlife, connecting isolated patches of natural vegetation.



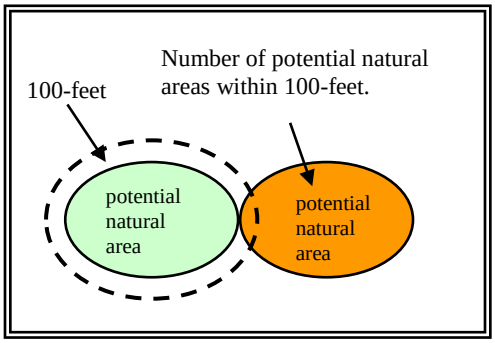
Sites that are part of riparian corridors were given a score of 2 or 0 points depending upon whether or not the site included a portion of a river or stream system. Oakland County GIS hydrography data layer was used to determine presence/absence of river or stream.

Landscape Connectivity - Connectivity between habitat patches is considered a critical factor for wildlife health. High connectivity improves gene flow between populations, allows species to recolonize unoccupied habitat, improves resilience of the ecosystem, and allows ecological processes, such as flooding, fire, and pollination to occur at a more natural rate and scale. Landscape connectivity was measured in two ways, *percentage* and *proximity.*



Percentage

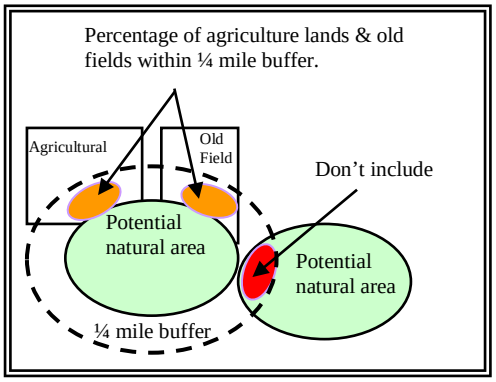
Landscape connectivity was measured by building a ¼ mile buffer around each polygon and measuring the percentage of area that falls within other potential natural areas.



Proximity

In addition to measuring the area around a polygon that is considered natural, connectivity can also be measured by the number of individual potential natural areas in close proximity to the site. The greater the number of polygons in "close proximity," the higher the probability for good connectivity. Close proximity was determined to be 100 feet. One hundred feet was chosen as the threshold based on digitizing error and typical width of transportation right-of-ways, pipelines, and powerline corridors.

Restorability of surrounding lands - Restorability is important for increasing the size of existing natural communities, providing linkages to other habitat patches, and providing a natural buffer from development and human activities.



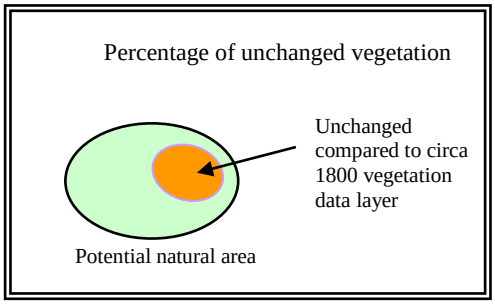
Restorability is measured by the potential for restoration activities in areas adjacent to the delineated site. First, a ¼ mile buffer was built around each site. Potential natural areas as defined by MNFI, located within the buffer area were then removed, and the percentage of agricultural land and old fields within the remaining buffer area was measured. Only

agricultural land and old fields were considered because they require the least amount of effort to restore back to some sort of natural condition. 1995 SEMCOG land cover data was used to identify areas of agricultural land and old fields.

Enhanced Criteria

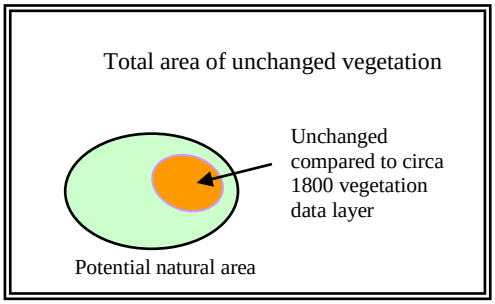
The process established by the Michigan Natural Features Inventory for prioritizing conservation areas continues to evolve. In order to incorporate the most up to date information available for assessing PNAs, an Enhanced Criteria category was added. Two new criteria were added in 2004 to try and address vegetation quality and parcel fragmentation. Element occurrence information was also added in2004.

Vegetation Quality – The quality of vegetation is critical in determining the quality of a natural area. Vegetation can reflect past disturbance, external impacts, soil texture, moisture gradient, aspect, and geology. Vegetative quality however is very difficult to measure without recent field information. As a surrogate to field surveys, a vegetation change map comparing the 2000 land cover data layer to the circa 1800 vegetation data layer was created. The resulting potential unchanged vegetation can then act as an indicator of vegetation quality.



Percentage

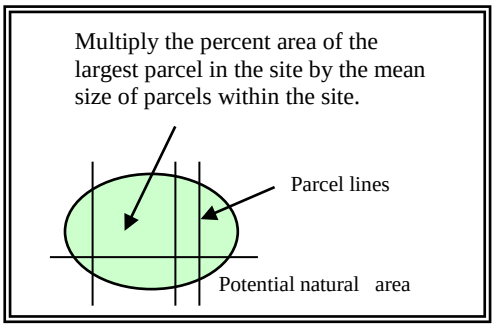
Vegetation quality was measured by calculating the percentage of the site that contains potentially unchanged vegetation. This allows small sites with a high percentage of potentially unchanged vegetation to score points.



Area

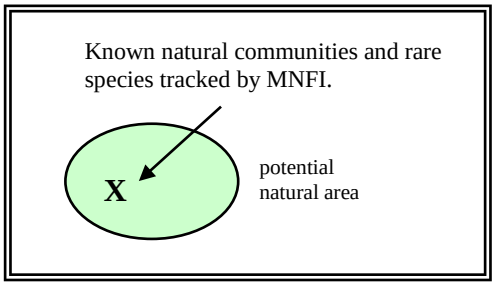
Vegetation quality was also measured by calculating the area of potentially unchanged vegetation that falls within each site. This balances the bias of small sites with high percentage of potentially unchanged vegetation by awarding points based on actual area covered.

Parcel Fragmentation – Although this criteria varies somewhat from the ecologically based criteria, it can be a useful indicator in determining the long-term conservation success of a project. While parcel boundaries are simply lines on a map the associated consequences of splitting parcels can adversely affect habitat. Sites that contain numerous small parcels are typically much more difficult to manage and protect than sites with a few large parcels. Associated problems with smaller parcels include increased wildlife/human conflicts, stewardship coordination, additional septic systems, fences, introduction of invasive plants and general loss of vegetation.



Parcel fragmentation was determined by multiplying the percent area of the largest parcel in the site by the mean size of parcels within the site.

Number of Element Occurrences - The location of quality natural communities and rare species tracked by MNFI are often, although not always, indicative of the quality of a site. The occurrences in and of themselves are important.



Three points were awarded to sites that had three or more element occurrences (EOs), two points for 2 EOs, one point for 1 EO, and zero points if there were no EOs. Since Oakland County has never received a comprehensive natural features site field inventory, two total scores were calculated, one with element occurrence scores and one without. Excluding the element occurrence criteria from the matrix eliminates survey bias towards public lands and complications associated with the variability of the last observed date amongst element occurrences.

Note: The number of points assigned for each criterion is in the *site criteria table*.

Appendix B:
Site Criteria Tables

Site Criteria Table

CRITERIA	*DESCRIPTION*	*DETAIL*	*PTS*
Total Size	Total size of the polygon in acres. ❑ *Size is recognized as an important factor for viability of species and ecosystems.*	20 - 40 ac.	0
		>40 - 80 ac.	1
		>80 - 240 ac.	2
		>240 ac.	4
Size of Core area	Acres of core area. - Defined as total area minus 300 ft. buffer from edge of polygon. ❑ *Greater core area limits negative impacts on "edge-sensitive" animal species.*	0 - 60ac	0
		>60 - 120 ac	2
		>120 - 230 ac	4
		>230 ac	8
Stream Corridor (presence/absence)	Presence/absence of a stream or river within the polygon. ❑ *Stream corridors provide wildlife connections between patches of habitat.*	none	0
		present	2
Landscape Connectivity Percentage	Percentage of potential natural areas within 1/4 mile. - build 1/4 mile buffer - measure % of buffer that is a potential natural area	0 - 11%	0
		>11 - 22%	2
		>22 - 33%	3
		>33%	4
Proximity	Number of potential natural areas within 100 ft.. ❑ *Connectivity between habitat patches is considered a critical factor for wildlife health.*	0	0
		1	1
		2	2
		3	3
		4+	4
Restorability of surrounding lands	Restorability of surrounding lands within 1/4 mi. - build 1/4 mile buffer - subtract potential natural areas from buffer - measure % agricultural lands and old fields ❑ *Restorability is important for increasing size of existing natural communities, providing linkages to other habitat patches, and providing a natural buffer from development.*	0 - 35%	1
		>35 - 65%	2
		>65%	3
Note Total possible points = 25			

Enhanced Criteria Table

ENHANCED CRITERIA	*DESCRIPTION*	*DETAIL*	*PTS*
Vegetation Quality Percentage	Estimates the quality of vegetation based on circa 1800 vegetation maps and 2000 IFMAP land cover data. Measures the percentage of potentially unchanged vegetation within a polygon.	1 - 10%	0
		10.1 -30%	1
		30.1 – 65%	2
		65.1 – 100%	4
Area	Measures the actual area within a polygon of potentially unchanged vegetation regardless of the size of the polygon. *The quality of vegetation is critical to determining the quality of a natural area.*	0 – 10ac	0
		10.1 – 40ac	1
		40.1 – 80ac	2
		80.1 - 160	3
		> 160ac	4
Parcel Fragmentation	Measures the feasibility of conservation for a site by analyzing parcel numbers and size. It is calculated by multiplying the percent area of the largest parcel in the site by the mean size of parcels within the site. The results were classified using the Jenks optimization model (numbers in the table are meters squared). *The associated consequences of subdividing land can adversely affect habitat.*	0 -2.5 ac	0
		2.6 – 8 ac	1
		8.1 – 18 ac	2
		18.1 – 43 ac	3
		< 43 ac	4
Number of Element Occurrences (EOs)	Known element occurrences increase the significance of a site. ❑ *The location of quality natural communities and rare species tracked by MNFI are often, although not always, indicative of the quality of a site.*	0	0
		1	1
		2	2
		3+	3
Note Total possible points with all enhanced criteria added = 40			