Forest Stewardship Plan

Landowner: Oceana Conservation District — Benona Twp., Oceana County

Plan Writer: Rod Denning—District Forester

Plan Start Date: 2020

Plan Duration: 20 Years

Starflower

Renewal or Revision of Prior Forest Stewardship Plan? NO

Department of Natural Resources

Forest Resources Division

www.michigan.gov/foreststewardship

Required by authority of Part 501 of Act 451, PA 1994 as amended to certify that this Forest Stewardship Plan has been reviewed and approved by the Landowner, Plan Writer, and the DNR Service Forester.

Michigan Department of Natural Resources – Forest Resources Division

LANDOWNER APPLICATION
FOREST STEWARDSHIP PROGRAM

Please complete this form with your Plan Writer. The Plan Writer will submit the form to the DNR at the start of the planning process.

CONTACT INFORMATION

Plan Writer Name	Landowner Name
Rod Denning	Oceana Conservation District

Landowner Complete Mailing Address (street, city, state, zip)
1064 Industrial Park Dr., Shelby, MI 49455

Landowner Telephone Number (including area code)	Landowner E-mail
231-861-5600	suzie.knoll@macd.org

Ownership Type (Individual, Family, Multiple Families, Club, Trust, Corporation, LLC, Association, Indian Tribe)

PROPERTY LOCATION

County	Township	Town	Range	Section Number
Oceana	Benona (N)	14N	19W	13

Basic Legal Description
T14N R19W, Sec. 13, S1/2 of SE1/4
Parcel # 64-011-113-400-03

Forested Acres in Plan	
80	There is no minimum or maximum acreage to develop a Forest Stewardship Plan. Financial assistance is available for forests ≥20 acres. The cost share formula is based on acres in the plan, excluding large bodies of water or agricultural land not being planted in trees.

ELIGIBILITY

Yes	No	
✔		Is the property non-industrial private forest land owned by an individual, family, group, corporation, tribe, or other private entity?
	✔	Have you applied for a contract with the NRCS to do a CAP 106 forest management plan for this same property?
	✔	Is this an update or modification of an earlier Forest Stewardship Plan for this parcel that is less than ten years old?

OTHER PROGRAMS THAT REQUIRE FOREST MANAGEMENT PLANS

Yes	No		
	✔	Are you applying separately to the Qualified Forest Program to lower your property taxes?	[Michigan.gov/QFP]
	✔	Are you applying separately to the Commercial Forest Program to lower your property taxes?	[Michigan.gov/CommercialForest]
	✔	Are you interested in applying to the NRCS for financial assistance to implement this plan?	[nrcs.usda.gov]
✔	✔	Would you like to join the American Tree Farm System to certify your exemplary forest stewardship?	[TreeFarmSystem.org/MI]
✔	✔	Would you like to certify your forest management through the Forest Stewardship Council?	[us.fsc.org]

The Michigan Forest Stewardship Program gives you a free one-year membership in the Michigan Forest Association (MFA). MFA provides education, fellowship, advocacy and a quarterly magazine for family forest owners (MichiganForests.org). *****Write "YES" to give the DNR permission to share your contact information with the Michigan Forest Association.*****	n/a

MICHIGAN STEWARDSHIP ETHIC

Stewardship is an ethic recognizing that the land and its natural inhabitants have an inherent worth and that humans have a responsibility to consider the land as we manage, protect and enjoy the forest. Stewardship guides us to conduct our activities to the utmost of our abilities, insure the future health, productivity, diversity and well-being of the forest, its natural communities and species. We must provide opportunities to our successors that are equal to ours to use and enjoy the forest and its resources.

LANDOWNER GOALS

What are your goals for your woods over the next 10 to 20 years?

Promote forest health, maintain and improve songbird habitat.

Potential Management Activities	Not Applicable	Not Important	Somewhat Important	Very Important	Comments
Protect soil resources			✔		
Protect water quality (rivers, lakes, etc)	✔				
Maintain or improve biological diversity				✔	
Enjoy beauty, scenery and aesthetics				✔	
Hunting (indicate preferred game species)	✔				
Recreation other than hunting (indicate activity)				✔	Nature observation/study
Produce timber for commercial harvest		✔			
Produce firewood		✔			
Produce other non-timber forest products		✔			
Plant trees or shrubs			✔		
Improve wildlife habitat (indicate species)				✔	non-game species mostly
Protect threatened or endangered species				✔	specifically-Hooded warbler
Forest health – insects, disease, invasive plants				✔	
Protect archeological, cultural or historic features	✔				
Protect unique natural features				✔	
Protect or restore wetlands	✔				
Minimize the risk of wildfire			✔		
Manage carbon stocks to mitigate climate change				✔	
Pass land to children or other heirs	✔				

PLAN PREPARATION COSTS AND DISCOUNTS

The cost to develop a Forest Stewardship Plan is determined by the plan writer and agreed upon by the landowner. A partial cost share, made possible with funding from the United States Forest Service, may be available through an annual grant to the plan writer. **The cost share formula is "$200 per plan plus $0.50 per forested acre up to an annual maximum of $2,500 per landowner."** Landowners should expect to pay for a significant portion of the total plan costs. The DNR must report matching funds to the Forest Service so landowners must report the amount that they contribute to the total cost of the plan. This form is not a legal contract.

Amount paid by the landowner for this Forest Stewardship Plan	$ n/a
Cost share from DNR paid to the plan writer after DNR review and approval	$ n/a
Write "100" for additional cost share from DNR to plan writer if landowner enrolls in American Tree Farm System. Plan writer must be a Tree Farm Forester and submit "004 Form" to Tree Farm prior to payment.	$ n/a

LANDOWNER SIGNATURE

My Forest Stewardship Plan will describe my goals, forest resources and recommended activities to achieve my goals over the next 10 to 20 years. Participation in the *voluntary* Forest Stewardship Program indicates my intent to use my plan to take good care of my woods. I understand that enrolling in *separate* programs (Qualified Forest, Commercial Forest, American Tree Farm System, Forest Stewardship Council, Environmental Quality Incentives, etc.) requires compliance with those independent program guidelines.

Landowner Signature	Date
Suzie Knoll - Oceana Conservation District, Executive Director	8-26-2020

APPLICATION APPROVAL AND PROPERTY REVIEW BY DNR	
DNR Service Forester Signature Mike Smalligan	Date 8/28/2020
State Historic Preservation Office Database Results Negative (If positive, contact Stacy Tchorzynski, State Archeologist, at TchorzynskiS@michigan.gov for more detailed information.):	
Threatened & Endangered Species Database Results Negative (If present, see the Michigan Natural Features Inventory at mnfi.anr.msu.edu for more information.)	

PLAN APPROVAL AND COST SHARE PAYMENT AUTHORIZATION BY THE DNR	
Service Forester Signature to Approve Plan	Date
FSP Coordinator Signature to Authorize Payment Mike Smalligan	Date 9/11/2020

Forest Stewardship Plans must be completed within a single federal fiscal year starting October 1 and ending September 30. *Plans must be submitted to the DNR prior to September 15 to allow for year-end reporting.* Payment will be authorized if the Forest Stewardship Plan includes required components and if the Plan Writer has a prior grant agreement with the DNR for cost share payments.

FOREST STEWARDSHIP PROGRAM

The Forest Stewardship Program is a partnership between the United States Forest Service, the Michigan Department of Natural Resources, 160 professional foresters and landowners to develop a custom Forest Stewardship Plan for their woods. Since 1991, more than 6,600 landowners in Michigan have developed their own Forest Stewardship Plan to help them *manage, protect, and enjoy* over one million acres of forest. See Michigan.gov/ForestStewardship for information.

DNR CONTACT INFORMATION

DNR Service Foresters

Western UP - Gary Willis; 906-353-6651; willisg2@michigan.gov; 427 US 41 North, Baraga, MI 49908
Eastern UP - Ernie Houghton; 906-789-8208; houghtone@michigan.gov; 6833 Highway 2, Gladstone, MI 49837
Northern LP - Mike Hanley; 517-675-5445; hanleym@michigan.gov; 9870 West Stoll Road, Haslett, MI 48840

Forest Stewardship Coordinator

Southern LP - Mike Smalligan; 517-284-5884; smalliganm@michigan.gov; 525 West Allegan, Lansing, MI 48933

THE DNR AND USFS ARE EQUAL OPPORTUNITY PROVIDERS AND EMPLOYERS

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INTRODUCTION

Forest Stewardship Program

The purpose of the Forest Stewardship Program is to encourage nonindustrial private forest landowners to actively manage their property to accomplish their personal goals for their land. The voluntary program provides landowners with professional services from private sector foresters, wildlife biologists or other resource professionals to create a Forest Stewardship Plan and then potentially assist with the implementation of their plan. The U.S. Forest Service (USFS) started the Forest Stewardship Program in 1991 because so few private landowners (only about 5%) have a written plan to guide their forest management activities. The Department of Natural Resources (DNR) administers the Forest Stewardship Program in Michigan.

Landowner's Goals

The Oceana Conservation District was graciously donated this property by Richard and Lorayne Otto in 2019. The Ottos' wanted to leave a family legacy and preserve this parcel as natural open space that could be enjoyed by the general public. Therefore, the primary management goal is to protect the properties ecological health, by maintaining its natural character. The primary property uses will include outdoor recreation, educational programming, forest conservation management, and research.

General Property Description

The 80 acre parcel (Otto Nature Preserve – Otto NP) can be consider a mesic northern hardwoods forest of beech-sugar maple-hemlock. The forest type is typically found on moist to dry-mesic sites found mostly north of the climatic tension zone (or floristic tension zone). The

climatic zone is generally around the Oceana and Muskegon County lines, putting the parcel very close to the boundary of the north-south zone. Forests of this type are dominated by northern hardwoods of sugar maple and American beech. Also, conifers such as Eastern hemlock and Eastern white pine are important canopy associates.

This plan has identified six different management units on the property with each area being grouped according to species/forest type. (see Map – Page 7).

- Management Unit A – This stand is dominated by Northern red oak, red maple, and American beech. A few minor associates include sugar maple, Eastern hemlock and four other species. Bigtooth aspen patches are scattered about the unit. Northern red oak is the most abundant tree in this stand. From a timber perspective, this stand has the most valuable trees on the property.
- Management Unit B – This stand is dominated by American beech, Eastern hemlock, paper birch, and yellow birch. American beech is the most abundant tree in this stand, with much of the beech of large diameter and showing signs of Beech Bark disease.
- Management Unit C – This stand is dominated by American beech, Northern red oak, paper birch, and Eastern hemlock. Five other species are minor associates, making this stand one of the most diverse on the property.
- Management Unit D – This stand is dominated by American beech, sugar maple, red maple, and Northern red oak. Four other species are minor associates. Large mature sassafras trees can be found here.
- Management Unit E – This stand is dominated by sugar maple, American beech, and red maple. Four other species are minor associates. Sugar maple is the most abundant tree in this stand.
- Management Unit F – This stand is dominated by sugar maple, American beech, paper birch, and Eastern hemlock. Four other species are minor associates. Eastern hemlock is abundant, providing dense shade and cover for white tailed deer.

Property location:

The property is in Benona Twp. (T14N R19W), Oceana County. The property is in the south 1/2 of the southeast 1/4 of section 13. The parcel number for the property is 64-011-113-400-03.

Elevation and Topography (See Maps)

Elevation on the property ranges from a low elevation of 692' in the central valley and west side of the property to a high elevation of 778' at the east side of the property near Scenic Dr. The steepest slopes (>50%) on the property are on the west side of the central valley area with an east to northeast aspect. Topography is gentle to flat at the east end of the property along Scenic Dr. and just west of the central valley area. Slopes increase as you approach the west side of the property. There are numerous small ridges, draws, and knolls throughout the parcel.

Planning Process

Field data collection began in March of 2020 and continued throughout the summer. The Forest Stewardship Plan was completed in September. After its completion, the plan was sent to the Forest Stewardship Program, Michigan Department of Natural Resources for their review and approval.

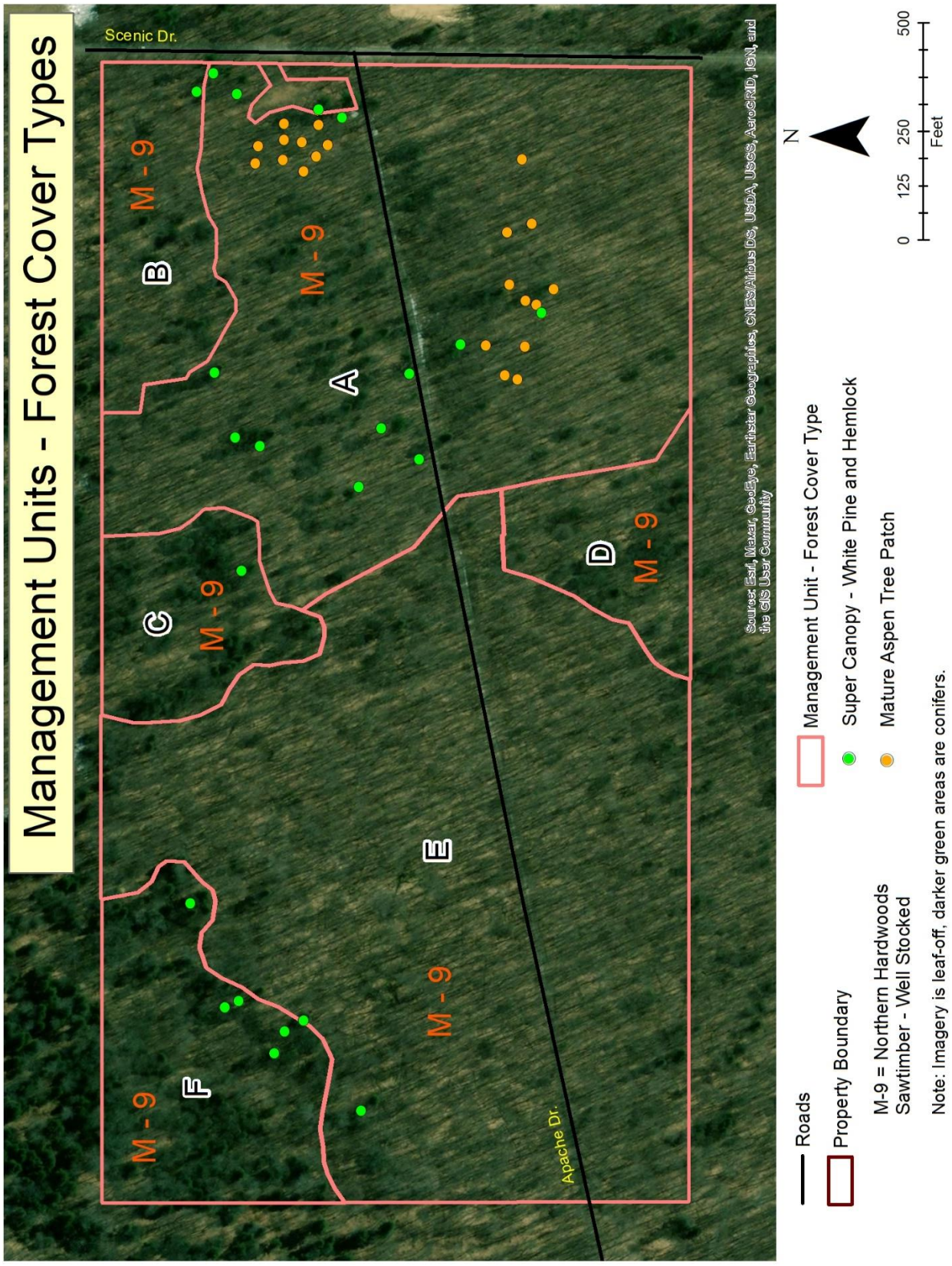
Property Assessment Methods

Management unit information was collected based on visual survey while walking through the property on numerous occasions. After the first couple of visual walk-through surveys the six management units for the property were determined with the aid of aerial photography and topographic data. A forest inventory in each management unit using a 20 basal area factor was used to established a total of 46 variable plot samples across the property. Data collected

included tree species, tree condition and health, tree diameter, tree stocking density (basal area), understory vegetation assessment and downed woody debris assessment. The inventory was completed in June. See Maps for Forest Inventory map.

Mayapple – a common spring ephemeral.

Map – Management Units & Forest Cover Types



Management Unit Description Table

Management Units	Cover Types	Size & Stocking Level	Acres
A	M = Northern Hardwoods, Northern red oak predominates	9 = Sawtimber, Well Stocked, Actual Basal Area 174 sqft/ac	28
B	M = Northern Hardwoods, American beech predominates	9 = Sawtimber, Well Stocked, Actual Basal Area 150 sqft/ac	4
C	M = Northern Hardwoods, American beech and Northern red oak predominates	9 = Sawtimber, Well Stocked, Actual Basal Area 175 sqft/ac	4
D	M = Northern Hardwoods, American beech and sugar maple predominates	9 = Sawtimber, Well Stocked, Actual Basal Area 187 sqft/ac	3
E	M = Northern Hardwoods, sugar maple predominates	9 = Sawtimber, Well Stocked, Actual Basal Area 149 sqft/ac	34
F	M = Northern Hardwoods, sugar maple and American beech predominates	9 = Sawtimber, Well Stocked, Actual Basal Area 145 sqft/ac	7
		Total Acres	80

(See Map on page 7 for the location of the Management Units)

Maple-leaved Viburnum shrub – commonly found on the property

RESOURCE DESCRIPTIONS – Entire Property

Soils on the Property

Spinks-Tekenink loamy fine sands (96B, 96C, 96D) are found throughout the property. The parent material of this soil consists of sandy glaciofluvial deposits (sediments laid down primarily by waters issuing from ice sheets and glaciers) and/or eolian deposits (wind deposited materials that consist primarily of sand or silt-sized particles). Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. This soil is not flooded or ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This soil does not meet hydric (wetland) criteria. Spinks has a 7 conservation tree-shrub group, Tekenink has a 5 conservation tree-shrub group.

Ecological site concept – Rich Sandy Drift uplands. This ecological site typically has a more southern flora than sites further north. Vegetation trends towards mesophytic forest (which are neither adapted to particularly dry nor particularly wet environments) with a poor herb understory and a low fire frequency.

Pre-European Settlement Historic Landscape – Early 1800's

The Otto property was once part of a massive beech-sugar maple-hemlock forest that dominated Oceana County, covering at least two-thirds of land area. During the 1800's the white pine in the forest was heavily harvested for lumber, and the hemlock was harvested for

bark to produce tannin for the tanning industry. Later in the 1900's sugar maple and red oak where extensively harvested for their valuable lumber.

(Presettlement information is from: Atlas of early Michigan's forest, grasslands, and wetlands: an interpretation of the 1816-1856 General Land Office Surveys by Dennis Albert and Patrick Comer, 2008.)

Regional Landscape

The Otto NP is within an eight square mile watershed that drains directly into Lake Michigan. From just south of Stony Lake to Silver Lake there is about 9 miles of forested Lake Michigan shoreline that provides an extensive wildlife travel corridor that allows many species of wildlife to access the property for cover, food, and water. The Otto NP is also part of approximately 3 square miles of continuous forest cover that goes north to Shelby Rd., east to S. 24th Ave., south to Meadow Dr. and west to the Lake Michigan shoreline. Habitat for interior forest birds is abundant in this large forested area.

This area is part of the Lake Michigan Flyway that follows the north-south shore line from Chicago to the Upper Peninsula of Michigan. Lake Michigan's shoreline is acknowledged as one of the most important flyways for migrant songbirds in the United States by ornithologists and bird watchers worldwide. Many other families of migrating birds - hawks and falcons, owls, waterfowl, gulls, terns and shorebirds - also follow Lake Michigan's shoreline or winter just offshore (From: The Lake Michigan Flyway: Chicagoland's Role in the Miracle of Bird Migration A Green Paper by the Bird Conservation Network, Authors: Terry Schilling and Christine Williamson).

The Otto NP is also found within Landtype Association (Ecoregion) VII.4, the Manistee Subsection, that runs along the west coast of Michigan. Climate in this area is moderated by Lake Michigan. Because of this, lands in this ecoregion are used intensively for horticulture and vineyards. See Maps for Regional Landscape map.

Current Forest Health Conditions

Emerald Ash Borer

The Emerald Ash Borer (EAB) is an exotic beetle from Asia that was detected in southeast Michigan in 2002. The beetle has since spread to most all counties in Michigan (except for a few counties in the western Upper Peninsula). EAB is active on the Otto NP. In a few scattered places, white ash trees have been heavily impacted with dead and dying trees observed. Overall however, ash is not very abundant on the property, so the disease's impact is relatively minor.

Hemlock Wooly Adelgid

The Hemlock Wooly Adelgid (HWA) is a tiny invasive aphid-like insect from Asia. The insect is active on the property and the property has an extensive population of the host tree Eastern hemlock. The trees can be found in the understory, mid-story, and also in the super canopy where the trees are some of the tallest on the property. Visible evidence of the "ovisacs" has been observed, however we do not know how extensive the HWA population is. Tree ID tags and evidence of insecticide injection are on most of the hemlock trees on the property.

A coordinated effort is underway to survey and treat hemlocks for the HWA all along the coast of Lake Michigan. The Michigan Department of Agriculture and Rural Development, Michigan Department of Natural Resources, Ottawa Conservation District, The Nature Conservancy,

Ottawa County Parks, and regional Cooperative Invasive Species Management Areas (CISMAs) are all involved in the effort. Hemlock trees in the Otto NP have been injected with imidacloprid insecticide to kill the insects and to prevent the insect from impacting hemlock trees that have not been infested. This insecticide is slow moving, but it is long lasting, needing only to be applied every five years or so. We are fortunate that this program is underway, otherwise the hemlock resource on the property would be in serious trouble. The District Forester should continue to monitor hemlock tree health and communicate with the effort as needed.

Tagged trees that have been injected with insecticide – red dots indicate injection sites.

Beech Bark Disease (BBD)

Oceana County is considered part of the "killing front" stage of the disease in Michigan. Here stands have high beech scale populations and the Nectria fungus is abundant, causing tree decay and mortality. This is definitely the case on the Otto NP. The non-native beech scale insect is very active on the property, with beech scale infested trees being very common. The scale nymphs secrete a white-woolly substance as a protection that is very easy to identify on the bark of a beech tree. This is a first stage of the disease.

Evidence of beech scale – "White Wooly" substance

As the insects feed, they pierce the bark and make small openings that the Nectria fungus invades and infects the inner bark, this fungus then kills the bark and allows wood rot fungus to also invade the tree. Eventually, as decay spreads infected trees are susceptible to "beech snap" the breaking of the tree trunk. Numerous examples of "beech snap" can be found on the property.

Evidence of “Beech Snap”

As the disease progresses evidence of cracked, blocky bark can become evident. Also, small black tarry spots can be seen on the bark surface. Evidence of later stages of the disease includes dead limbs, branch dieback, yellowing leaves, and “beech snap”.

Cracked – Blocky Bark Patches

Oak Wilt

This was not identified on the property, but be on the lookout for oak wilt. The host trees of Northern red oak are abundant on the property. This disease is a serious exotic fungal pathogen that is very active in Michigan. A common symptom of an infected tree is the sudden loss of leaves during early summer. Infected trees die of the disease typically within 6 to 8 weeks. Once a tree is infected the wilt can move slowly through its roots, and were roots are grafted with another oak it can spread to a new host. Also, the disease can travel overland when spores are attached to beetles, and when the beetles come to rest on open wounds on another potential host tree, that tree can become infected. Once the disease is established and not treated, oak wilt will continue to spread, killing the red oaks throughout a forest.

There are two practices that can help prevent the establishment of the disease on the property, 1) Avoid wounding oaks from April 15th through July 15th, this will help keep sap beetles from being attracted to the property. Do not have a timber harvest during this time span. 2) Do not bring oak wood (firewood etc.) onto the property from unknown sources.

Invasive Plants

Populations of non-native, invasive plants are very rare on the property. A few autumn olive shrubs are in the opening on the east side of the property that is to become the parking lot. Also, along Apache Dr. are some scattered individuals of broad-leaved helleborine (Epipactis helleborine) along with a few individuals found in the woods. A small patch of siberian squill (Scilla siberica) were found near Scenic Dr., just north of the parking lot area (see photos next page). None of these plants are a problem at this time, but they should be eliminated as soon as possible.

Broad-leaved Helleborine

Siberian Squill

Threatened, Endangered and Special Concern Species and Archeological, Cultural, and Historic Sites

A search of the Michigan Natural Features Inventory Web database suggests that there are no known threatened, endangered or special concern species within section 13 where the property is located. However, expanding the search to surrounding sections does identify a few such species nearby. The Hooded warbler was identified as a breeding bird on the property.

Species	Status	Last Observed	Sections
American bumble bee	Special Concern	1932	1,2,11,12
Bald eagle	Special Concern	2017	24
Open sand dune	Community	1985	25
Dune cutworm	Special Concern	1992	1,2
Hooded warbler	Special Concern	2007	1,12
Pitcher's thistle	Endangered	2019	24,25

The State Historic Preservation Office of Michigan reports that the archeological database does not show any known concerns for historical sites in this section of the Township.

Hooded Warbler – photo from The Cornell Lab of Ornithology

Biological Diversity

Overall species diversity on the property is summarized in the table below. The information is based on a limited number of field visits during the spring and summer of 2020, it is not a complete list of all plants and animals that use or live on the property.

PLANTS	
Category	**Number of Species Observed**
Ferns	5
Large Trees	15
Shrubs and Vines	3
Herbaceous Forbs	17
Total	40
ANIMALS	
Frogs and Toads	3
Mammals	3
Birds	38

Trees

Fifteen species of trees in total were identified on the property. The most common trees include American beech, sugar maple, red maple, and Northern red oak. Only single individuals were found of basswood, white oak, and ironwood (hop-hornbeam).

Birds

Based on seven site visits between May and July, a breeding bird inventory conducted by Suzie Knoll identified 38 bird species. Ten species were confirmed to be breeding, eight were possible breeders, and 20 were probable breeders. Overall, the forest structure of trees with different age classes, and a mix of tree species, provides good habitat suitable for a variety of birds. However, vertical structure complexity is only of moderate quality, with low ground cover spotty in many places.

Herbaceous Forbs

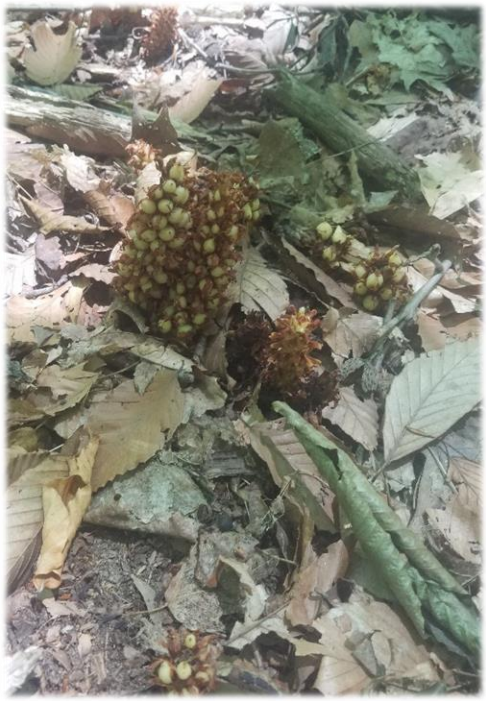
Forty herbaceous forbs were identified on the property, this is not a complete listing, there are others not yet identified. The woodlot does not have extensive diversity, however, it should be noted that three species were identified that have a coefficient of conservatism of 10.

Coefficients of conservatism – C, range from 0 to 10 and represent an estimated probability that a plant is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition. For example, a C of 0, is given to plants such as Acer negundo, box elder, that have demonstrated little fidelity to any remnant natural community, i.e. may be found almost anywhere. Similarly, a C of 10 is applied to plants like Indian cucumber-root (Medeola virginiana) that are almost always restricted to a pre-settlement remnant, i.e. a high quality natural area (from Wisconsin Plant of the Week Website www.wiplants.org).

Indian Cucumber-root – C of 10, usually in moist forests, and acid soils

Photo from Herabarium – University of Michigan

Beech-drops – C of 10, a parasitic plant, it's only known host is the American beech



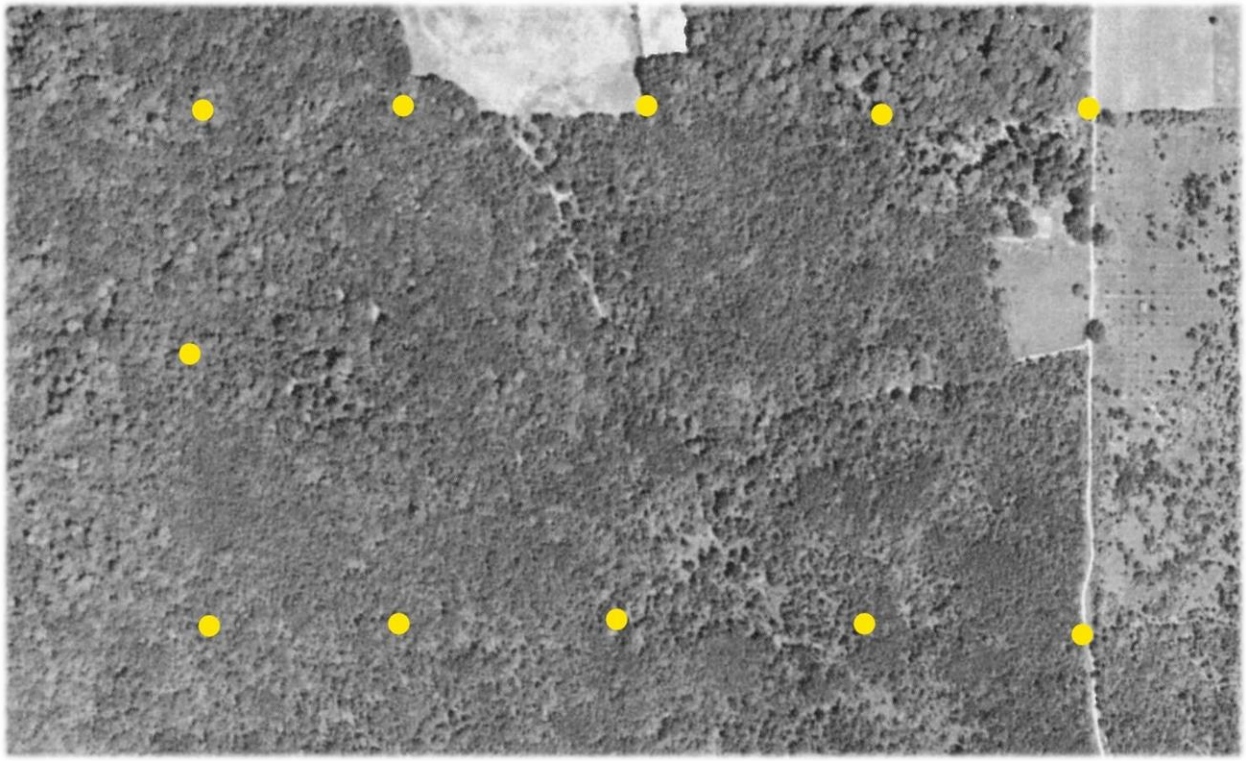
Squaw-root – C of 10, a parasitic plant, it's only known host is oak, especially red oak in Michigan

Listing of plants and birds identified on the property can be found at the end of this document.

Property History

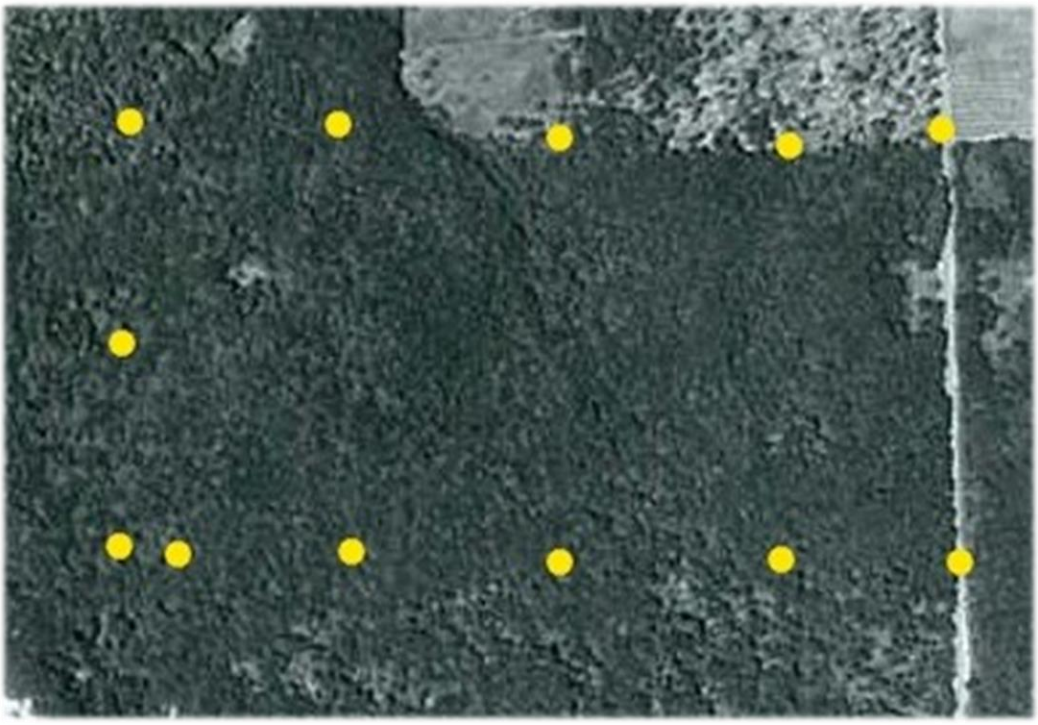
The 1938 aerial photo below shows the property as it was 82 years ago. The large opening along Scenic Dr. is very visible, maybe a small pasture? Looks like a small segment of Apache Dr. is visible, maybe a small two track at this time. In the “central valley” a trail is visible, maybe connecting the opening to the north? Another pasture? Barbed wire was found close to the “central valley” trail suggesting possibly the east side of the property was used by cows or horses and they moved between these two pastures? Also, in the southcentral “central valley” the forest canopy is somewhat open in a small area.

1938 Aerial Photo



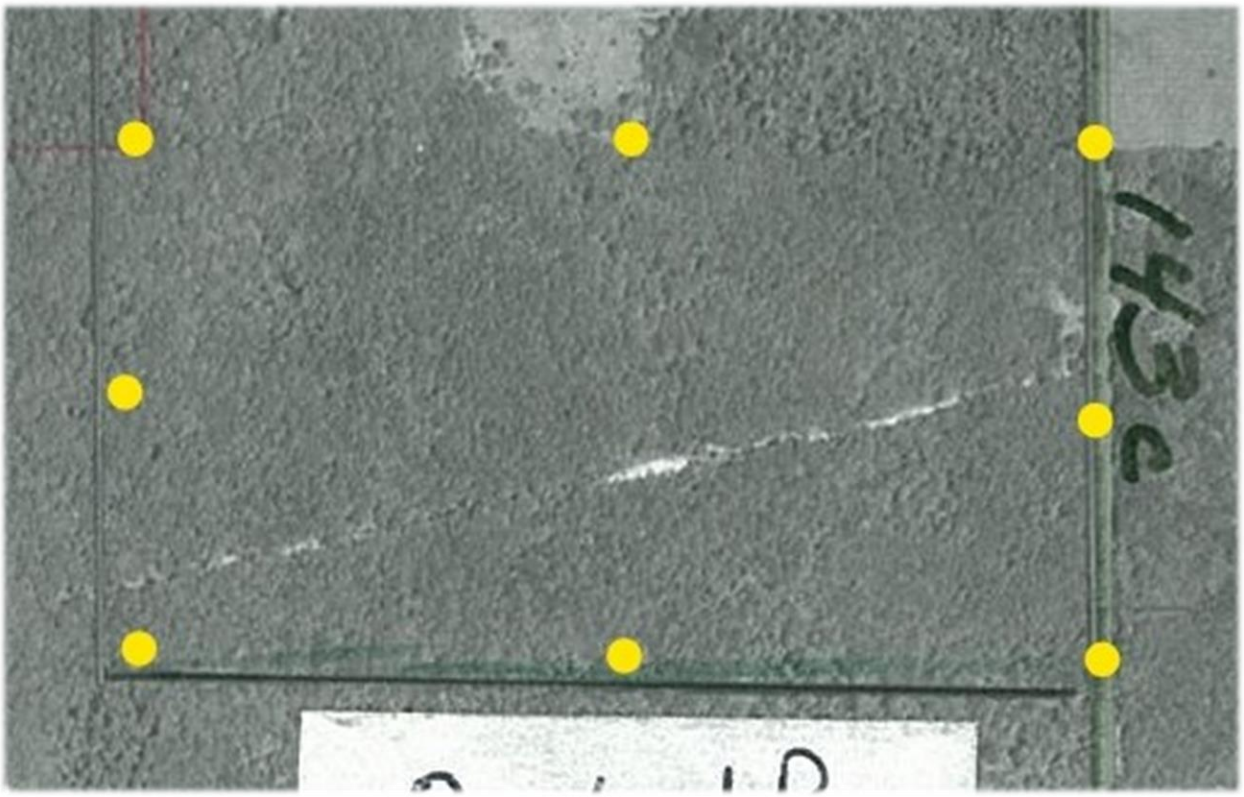
The 1965 aerial photo below shows the property as it was 55 years ago. The large opening along Scenic Dr. is filling in with trees. The presumed Apache Dr. is no longer visible, as is the trail that was in the “central valley”. If pasturing was happening in 1938, now approximately 30 years later, it appears to have stopped.

1965 Aerial Photo



The 1972 aerial photo shows the property as it was 48 year ago. The opening along Scenic Dr. continues to fill in, and is not real noticeable. Apache Dr. has been built sometime between 1965 and 1972, it is clearly visible.

1972 Aerial Photo



Past logging activity is evident throughout the property. Based on the previous landowners' comments, the last harvest on the property was in 1999. Another nearby landowner suggests that there have been three timber sales on the property in the last 30 years. Many stumps are visible, and some do appear to have been cut long before 1999 (see below).

Older stumps that remain

Typical rot-prone stumps like maple, beech, and birch are often completely decayed in 30 to 40 years. Fairly common in the parcel are old stumps that are coated with charcoal mat fungus. The fungus is commonly found during later stages of decay on maple or beech tree stumps (see next page).

Charcoal mat fungus on part of an old stump

Past Agricultural Use

Some evidence was found that indicated that maybe the east side of the parcel from the "central valley" area was once pastured by cows or horses. An old barbed wire strand was found in the trunk of a beech tree. The tree is about 20" DBH, suggesting the wire was placed there years ago.

Barbed wire at the middle of a tree

Barbed wire knot – how old?

Deep History – Evidence of an Old Forest

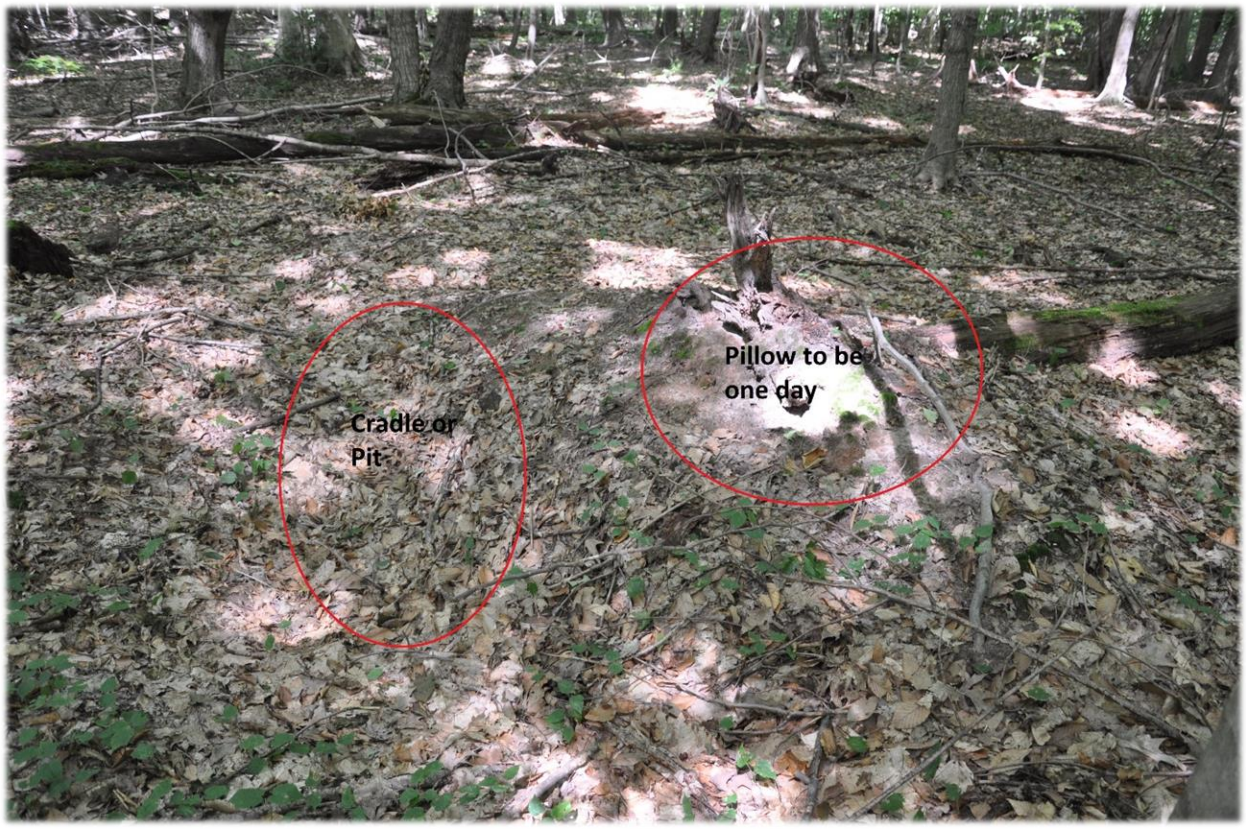
Large, old growing trees are common on the property. For example, the largest, oldest trees have very coarse bark and deformed canopies. Old-growth birch, maple, beech, and red oak can reach over 300 years of age. Old growth white pine and hemlock can reach over 400 years of age. How old are the trees below? The bark suggests maybe 120 to 140 years old as an estimate.

White pine - old growth

Red oak - old growth

When trees are toppled in a forest their roots rip out of the ground creating features called cradles (a pit). As the tipped-up roots decay, they drop the soil they excavated creating a pillow (a mound) adjacent to the cradle. When these structures are common throughout a forest you know that canopy disturbance (wind throw or other) has been common. When the features are everywhere and seem to suggest the trees have fallen in multiple directions, it can take **centuries** to create this type of forest floor texture. If you look closely at the Otto NP the forest floor is riddled with these structures, indicating a very old forest.

Stilt-rooted trees are also a common feature in the forest. This is another indication that the tip-ups were abundant and as the tip-ups decayed, old structures acted as "nurse stumps" for new trees to take root in.



A Pillow and Cradle in the making, the fallen tree is still evident

Stilt-rooted Yellow Birch – Indicating a very old structure

Aesthetic Quality

This forested property presents high quality aesthetic opportunity to the visitor. The mature tall trees, many of which are of large diameter, give the visitor the feel of an old mature forest in many places. Topographic features of ravines, draws and knolls, allow the visitor to see off into the distance in some places, providing a nice far off wooded perspective. Scenic Dr. runs along the eastern edge of the property, and travelers along that corridor get a great view of the wooded parcel as they travel. Maintaining and protecting this view should be a management priority. Also, Apache Dr. runs completely through the property. Private landowners use the road to access their homes/cottages along Lake Michigan. Views from the road provide a “deep

forest" look, where forest dominates the landscape. Minimizing disturbance to the woods along this roadway would be a good strategy to maintain aesthetics ("Central Valley" photo below).

Recreation

Recreational use of the property is dedicated to educational opportunities provided to the general public. Uses such as nature observation and study, birding in particular, and hiking will be promoted. To facilitate recreational use, a trail system will be developed. Currently, access to the interior area of the property is via old logging roads that wind throughout much of the property. Two hiking trail loops have been identified on the property (See Maps for Hiking Trials map and Points of Interest map). In total 1.5 miles of trails will be available to the user to explore the property.

Fish and Wildlife

Deer in particular are very abundant, with sign of deer plentiful. Deer tracks and scat were observed throughout the parcel as are well-worn deer trails winding through the woods. One active, well used porcupine tree was identified with scat and quails identified.

Thirty-eight species of birds were identified on and near the property during site visits from April through July. Many of these birds are summer residents and most are probably breeding on or near the property in spring.

The population of reptiles and amphibians on the property has not been well identified and needs additional study. However, during site visits, the American toad, the less common Fowler's toad, and the Spring peeper were identified using the property. Unfortunately, wet areas needed for breeding by many amphibians are not available.

American toad

Fowler's toad

The Fowler's toad is much less common than the American toad. It's habitat are the wooded dunes along Lake Michigan, like those near the Otto NP. (Note: Fowler's toad identification needs confirmation.)

Spring Peeper – with visible X on the back

Bats and Bat Habitat

The Otto NP has existing high quality summer habitat for bats. Trees that provide multiple types of roosting features such as loose bark, cavities, crevices, broken limbs, and hanging dead foliage that remain viable for multiple years are abundant throughout the property. Cavities and crevices are common on many old growing trees. Oaks, beech, birches, maples, black cherries, and ash all provide the key habitat features identified above. Hemlock, when dead, also are good cavity suppliers. The little brown bat (Myotis lucifugus) a special concern species in Michigan has been identified near the Otto NP. Areas just three miles east of the preserve in

Benona Township have been reported in the historical records of the Michigan Natural Features Inventory database. However, the records are quite old, dating back to the early 1900's. Additional study is necessary to determine if the property is truly important bat habitat.

Wetlands

According to the Michigan Final Wetlands Inventory spatial dataset, there are no designated wetlands according to state and federal definitions on the property.

Fire

Based on land cover type, tree canopy density, and dry soil types, the Otto NP is considered in a high to very high wildfire risk area as identified by the statewide wildfire risk map developed by the Michigan Department of Natural Resources. However, typically forests dominated by pines and on sandy soils are the most prone to wildfire.

Prescribed fire is a management tool used to reduce hazardous fuels or unwanted understory plants (invasive, undesirable species, etc.). Prescribed fire should only be conducted by highly trained and properly insured professionals. Prescribed fire is not likely to be a suitable tool for this property. More information about prescribed fire is available on the Michigan Prescribed Fire Council website at http://firecouncil.org.

Carbon Cycle – Forest Carbon

Forests take in carbon dioxide from the atmosphere to make energy through photosynthesis. This energy is then used to feed trees and allow them to grow and maintain themselves. Carbon is captured in the tree in the form of wood, leaves and other organic matter. Typically, one half of a tree's weight consists of stored carbon. The Otto Nature Preserve plays an important role

in both sequestering and storing carbon, which can reduce carbon dioxide in the atmosphere to help reduce the impact of climate change.

Where is carbon stored in a Great Lakes forest? 55% of ecosystem carbon storage is in the leaves, trunks, branches, and roots of trees, and woody debris on the forest floor. The remaining 45% is stored below ground in soil organic matter. As a forest ages, the amount of carbon in these pools changes over time.

How well a forest sequesters carbon or stores carbon depends on its stage of successional development. A young forest that is growing rapidly and contains lots of intolerant tree species tends to maximize its rate of carbon sequestration (the process of removing carbon dioxide from the atmosphere) at this stage. An old forest that has lots of large diameter trees and species that are tolerant to shade tends to maximize its carbon storage potential (the amount of carbon retained in a forest) at this stage.

The Otto NP is an older forest that is approaching old growth conditions. Most of the tree species (12 of the 15 total species) in the forest are shade tolerant or intermediate in shade tolerance. Only three are intolerant of shade species. The Otto NP is at a forest development stage that provides high amounts of carbon storage. Future gains in forest carbon will primarily come from the diameter growth of trees, additions to the deadwood pool from dying trees, and the accumulation of soil organic carbon from root growth and decomposition.

In the future, the Otto NP could be a good candidate property to enroll in a forest carbon credit program such as the American Forest Foundation and the Nature Conservancy's "Family Forest Carbon Program" which has a pilot project underway in Pennsylvania. Also, Microsoft and

SilviaTerra have teamed up to develop a program called the Natural Capital Exchange (NCAPX) as a data-driven marketplace for forest carbon credits. They also have started a pilot project in Pennsylvania, and if all goes as planned, will be expanding the program to all 48 states in the continental US in 2022.

Shade Tolerance Table For Trees in the Otto NP

Common Name	Shade Tolerance	Frequency
American Beech	Tolerant	Abundant
Sugar Maple	Tolerant	Abundant
Red Maple	Intermediate	Abundant
Red Oak	Intermediate	Abundant
Eastern Hemlock	Tolerant	Common
Yellow Birch	Intermidiate	Occasional
Sassafras	Intermediate	Occasional
Paper (or White) Birch	Intolerant	Occasional
Wild Black Cherry	Intolerant	Occasional
White Pine	Intermediate	Uncommon
Big-tooth Aspen	Intolerant	Uncommon
Ironwood/Hop-hornbeam	Tolerant	Rare
White Oak	Intermediate	Rare
Basswood	Intermediate	Rare
White Ash	Intermediate	Rare

The most abundant species in the forest are beech, sugar maple, red maple, red oak, and hemlock. Most of these trees live long and have dense wood, making them excellent species for carbon storage.

(Information in this section is from: “Forest Carbon – An essential natural solution for climate change”, by Paul Catanzaro, University of Massachusetts – Amherst, and Anthony D’Amato, The University of Vermont and “Predicting Carbon Storage of Great Lakes Forests in the year 2050: Scientific Challenges and Management Decisions” Presentation by Peter S. Curtis, Department of Evolution, Ecology, and Organismal Biology, The Ohio State University. Supporting research was conducted at the University of Michigan Biological Station, Forest Carbon Cycle Research Program.)

Agroforestry and Range

Agroforestry is a land-use system that combines both agriculture and forestry in one location. The five most common temperate agroforestry systems are alley cropping, forest farming, riparian forest buffers, silvopasture, and windbreaks. See the web site www.centerforagroforestry.org at the University of Missouri for more information. Range refers to cattle grazing in natural landscapes. Free ranging cattle are much more common in the national forests and other public lands in the western United States; the practice is typically not used on public lands in Michigan.

Indian-Pipe or ghost plant found in Management Unit A – A parasitic plant with no chlorophyll that depends on fungi that are mycorrhizal with trees. The plant likes the dark understory of dense woods. It is often associated with beech trees.

RESOURCE DESCRIPTIONS and RECOMMENDATIONS for the Management Units

Management Unit A

Mesic Northern Hardwoods – Northern Red Oak Predominates
28 Acres

EXISTING CONDITIONS

COVER TYPE AND MAJOR SPECIES:

Unit A is a mature, uneven aged, Northern hardwoods stand. Overall, there are 9 species of trees growing here. The most abundant dominate and codominate trees in the overstory canopy are Northern red oak, red maple, and American beech. Common overstory associates include sugar maple and Eastern hemlock. Less common, scattered individuals of white pine, paper birch, bigtooth aspen, and black cherry are also present.

MANAGEMENT UNIT DESCRIPTION:

This unit has flat to steep sloping topography (0-40%) with numerous draws and ridges with aspects mostly southeast-south-southwest-west. The mid-story canopy – up to 30’ tall is mostly American beech, sugar maple, and Eastern hemlock. Maple-leaf viburnum shrubs are common in a few places. A few witch-hazel shrubs can also be found. Low ground cover in the unit is very light, with leaf-litter making up most of the ground cover. Starflower and Canada mayflower are the most abundant herbaceous forb. Beechdrops, Squaw-root, and Indian pipe, all parasitic plants, can be found here.

Seedling and sapling tree regeneration is mostly of American beech with lesser amounts of sugar maple, red maple and red oak. Red oak is not recruiting into the sapling stage, all of the oak seedlings are typically <6” tall. Overall regeneration is of low to moderate abundance, dominated with very shade tolerant tree species.

Super-canopy trees (the tallest trees) of old white pine and hemlock are the most common in this unit compared to the rest of the property.

Northern red oaks are very common in the Unit

Timber Resources

Tree Size Class: This unit is a small to large sawtimber size stand mostly 14" to 21" DBH. Overall average is about 15" DBH. Desirable merchantable sawtimber is usually 16" to 24" DBH.

Species	Tree Per Acre	DBH Range	Average DBH
Northern red oak	80	8" – 22"	16"
Red maple	51	6" – 28"	15"
American beech	36	5" – 20"	12"
Sugar maple	15	7" – 8"	7"
Eastern hemlock*	8	8" – 13"	11"
Bigtooth aspen	4	11" – 22"	17"
Paper birch	4	7" – 9"	8"
Black cherry	3	10" – 15"	14"
Eastern white pine	<1	25" – 33"	29"
Overall	201		14"

Note: Super canopy Eastern hemlock are 20"+ DBH, but were not captured in the forest inventory.

Stand Quality: Based on variable plot sampling about 45% of the trees inventoried are of acceptable growing stock (AGS). The typically high value red oak in particular has good natural form (limited forks, sweep, crook, and decay). However, codominate stems (forks), decay, poor form, and fire scars was extensive on many other trees. Beech scale and beech bark disease is common on the American beech trees.

Soil Types: Spinks-Tekenink loamy fine sand (96B & 96C), 0-12% slopes. These soil types are well drained. Spinks has sandy deposits throughout, Tekenink has loamy material throughout.

Site Quality: Medium high – based on site index below

Site Index red oak* – 66 or 57 ft^3/acre per year

(*Based on site index values for stand soil type 96B & 96C published by the USDA, Natural Resources Conservation Service, Soil Series data)

[Note: Site index is the expected height at age 50 for a species on a given soil type]

Stand Density: The basal area for this stand averages 174 ft^2/acre. Density varies from about 100 ft^2/acre to 260 ft^2/acre. Many mature northern hardwood forests in southern Lower Michigan have a basal area between 90 and 120 ft^2/ acre. This stand can be considered an overstocked stand.

[Note: The *basal area of a tree* is the cross sectional area of the trunk at 4.5 feet. The *basal area of the stand* is the sum of each individual tree's basal area.]

Stand Volume: The merchantable volume for this Unit was not determined. Typical mature, hardwood forests in southern Michigan may range from 5,000 to 10,000 (Doyle rule) board feet per acre.

Stand Age: Uneven-aged stand – overstory trees estimated to be 80 to 120 years old.

Growth Rate: Moderate to poor – due to overall stand age and overall crown closure of about 90% (considered high crown closure).

Witch-hazel shrub – can be found in the Unit

Management Unit B

Mesic Northern Hardwoods – American Beech Predominates
4 Acres

EXISTING CONDITIONS

COVER TYPE AND MAJOR SPECIES:

Unit B is a mature, uneven aged, Northern hardwoods stand. Overall, there are 8 species of trees growing here. By far the American beech is the most abundant dominate and codominate tree in the overstory canopy. Common overstory associates include Eastern hemlock and paper birch. Less common, scattered individuals of yellow birch, Northern red oak, red maple, sugar maple, and black cherry are also present.

MANAGEMENT UNIT DESCRIPTION:

This unit has flat topography (0-10%). The mid-story canopy – up to 30' tall is mostly American beech, sugar maple, and Eastern hemlock. Maple-leaf viburnum shrubs are uncommon. Low ground cover in the unit is very light, with leaf-litter making up most of the ground cover.

Seedling and sapling tree regeneration is mostly of American beech and sugar maple. Overall regeneration is of low to moderate abundance, dominated with very shade tolerant tree species.

Timber Resources

Tree Size Class: This unit is a small to large sawtimber size stand mostly 12" to 34" DBH. Overall average is about 20" DBH. Desirable merchantable sawtimber is usually 16" to 24" DBH.

Species	Tree Per Acre	DBH Range	Average DBH
American beech	75	6" – 34"	21"
Eastern hemlock	9	12" – 17"	14"
Paper birch	7	14" – 19"	16"
Yellow birch	5	n/a	14"
Northern Red oak	4	21" – 22"	21"
Red maple	3	n/a	17"
Sugar maple	2	n/a	20"
Black cherry	2	n/a	21"
Overall	107		20"

Note: Super canopy Eastern white pine are 20"+ DBH, but were not captured in the forest inventory.

Stand Quality: Based on variable plot sampling about 20% of the trees inventoried are of acceptable growing stock (AGS). Evidence of beech bark disease (BBD) is extensive with decay, conks, and poor form, on a large number of beech trees. Some trees have "beech snap" damage. Old fire scars are on many trees. However, beech scale is not extensive. The beech scale insect does not like host trees that have extensive decay caused by the disease, they prefer more healthy trees.

Soil Types: Spinks-Tekenink loamy fine sand (96B), 0-6% slopes. These soil types are well drained. Spinks has sandy deposits throughout, Tekenink has loamy material throughout.

Site Quality: Medium high – based on site index below

Site Index red oak* – 66 or 57 ft^3/acre per year

(*Based on site index values for stand soil type 96B published by the USDA, Natural Resources Conservation Service, Soil Series data)

[Note: Site index is the expected height at age 50 for a species on a given soil type]

Stand Density: The basal area for this stand averages 150 ft^2/acre. Density varies from about 120 ft^2/acre to 160 ft^2/acre. Many mature northern hardwood forests in southern Lower Michigan have a basal area between 90 and 120 ft^2/ acre. This stand can be considered an overstocked stand.

[Note: The *basal area of a tree* is the cross sectional area of the trunk at 4.5 feet. The *basal area of the stand* is the sum of each individual tree's basal area.]

Stand Volume: The merchantable volume for this Unit was not determined. Typical mature, hardwood forests in southern Michigan may range from 5,000 to 10,000 (Doyle rule) board feet per acre.

Stand Age: Uneven-aged stand – overstory trees estimated to be 80 to 120 years old.

Growth Rate: Moderate to poor – due to overall stand age and overall crown closure of about 85% (considered high crown closure). Some canopy gaps have developed due to BBD.

Large boulder undisturbed in the Unit

Management Unit C

Mesic Northern Hardwoods – American Beech & Northern Red Oak Predominates
4 Acres

EXISTING CONDITIONS

COVER TYPE AND MAJOR SPECIES:

Unit C is a mature, uneven aged, Northern hardwoods stand. Overall, there are 9 species of trees growing here. American beech, Northern red oak, and paper birch are the most abundant dominate and codominate trees in the overstory canopy. Common overstory associates include sugar maple and red maple. Less common, scattered individuals of bigtooth aspen, sassafras, Eastern hemlock, and Eastern white pine are also present.

MANAGEMENT UNIT DESCRIPTION:

This unit has gentle to steep sloping topography (5-40%) with the “central valley” area cutting through the unit. Aspects are mostly south to west. The mid-story canopy – up to 30’ tall is

dominated by Eastern hemlock with some sugar maple, and American beech. Low ground cover is light, with leaf-litter cover nearly 100%.

Seedling and sapling tree regeneration is mostly of American beech and sugar maple with some red oak and bigtooth aspen seedlings. None of the red oak or aspen have recruited into the sapling stage. Overall regeneration is of moderate abundance, dominated with very shade tolerant tree species.

Timber Resources

Tree Size Class: This unit is a small to large sawtimber size stand mostly 12" to 22" DBH. Overall average is about 16" DBH. Desirable merchantable sawtimber is usually 16" to 24" DBH.

Species	Tree Per Acre	DBH Range	Average DBH
American beech	40	8" – 19"	13"
Northern red oak	36	11" – 21"	16"
Paper birch	33	12" – 18"	14"
Eastern hemlock	25	5" – 12"	9"
Sugar maple	18	10" – 22"	18"
Red maple	15	12" – 17"	14"
Bigtooth aspen	6	16" – 20"	18"
Sassafras	4	n/a	15"
Eastern white pine	<1	n/a	32"
Overall	177		16"

Stand Quality: Based on variable plot sampling about 35% of the trees inventoried are of acceptable growing stock (AGS). Evidence of beech bark disease (BBD) is common, with decay and poor form on a large number of beech trees. Beech scale is common.

Soil Types: Spinks-Tekenink loamy fine sand (96C & 96D), 6-18% slopes. These soil types are well drained. Spinks has sandy deposits throughout, Tekenink has loamy material throughout.

Site Quality: Medium high – based on site index below

Site Index red oak* – 66 or 57 ft^3/acre per year

(*Based on site index values for stand soil type 96C & 96D published by the USDA, Natural Resources Conservation Service, Soil Series data)

[Note: Site index is the expected height at age 50 for a species on a given soil type]

Stand Density: The basal area for this stand averages 175 ft^2/acre. Density varies from about 140 ft^2/acre to 200 ft^2/acre. Many mature northern hardwood forests in southern Lower Michigan have a basal area between 90 and 120 ft^2/ acre. This stand can be considered an overstocked stand.

[Note: The *basal area of a tree* is the cross sectional area of the trunk at 4.5 feet. The *basal area of the stand* is the sum of each individual tree's basal area.]

Stand Volume: The merchantable volume for this Unit was not determined. Typical mature, hardwood forests in southern Michigan may range from 5,000 to 10,000 (Doyle rule) board feet per acre.

Stand Age: Uneven-aged stand – overstory trees estimated to be 80 to 120 years old.

Growth Rate: Moderate to poor – due to overall stand age and overall crown closure of about 90% (considered high crown closure).

Management Unit D

Mesic Northern Hardwoods – American Beech & Sugar Maple Predominates
3 Acres

EXISTING CONDITIONS

COVER TYPE AND MAJOR SPECIES:

Unit D is a mature, uneven aged, Northern hardwoods stand. Overall, there are 7 species of trees growing here. American beech, sugar maple, and red maple are the most abundant dominate and codominate trees in the overstory canopy. Common overstory associates include Northern red oak and sassafras. Less common, scattered individuals of Eastern hemlock, and black cherry are also present.

MANAGEMENT UNIT DESCRIPTION:

This unit has gentle to steep sloping topography (5-40%) with the “central valley” area along the east side of the unit. Aspects are mostly east and northeast. The mid-story canopy – up to

30’ tall is dominated by Eastern hemlock, sugar maple, and American beech. Low ground cover is light, with leaf-litter cover nearly 100%.

Seedling and sapling tree regeneration is mostly of American beech and sugar maple with some red oak. None of the red oak have recruited into the sapling stage. Overall regeneration is of low to moderate abundance, dominated with very shade tolerant tree species.

Timber Resources

Tree Size Class: This unit is a small to large sawtimber size stand mostly 12” to 30” DBH. Overall average is about 17” DBH. Desirable merchantable sawtimber is usually 16” to 24” DBH.

Species	Tree Per Acre	DBH Range	Average DBH
American beech	46	10” – 15”	12”
Sugar maple	46	8” – 24”	16”
Red maple	37	11” – 26”	18”
Northern red oak	18	16” – 30”	21”
Sassafras	12	13” – 16”	15”
Eastern hemlock	6	8” – 15”	13”
Black cherry	3	n/a	20”
Overall	168		17”

Stand Quality: Based on variable plot sampling about 18% of the trees inventoried are of acceptable growing stock (AGS). Many of the trees have codominate stems (forks), decay, and poor form. Beech scale and beech bark disease is common on the American beech trees.

Soil Types: Spinks-Tekenink loamy fine sand (96D), 12-18% slopes. These soil types are well drained. Spinks has sandy deposits throughout, Tekenink has loamy material throughout.

Site Quality: Medium high – based on site index below

Site Index red oak* – 66 or 57 ft^3/acre per year

(*Based on site index values for stand soil type 96D published by the USDA, Natural Resources Conservation Service, Soil Series data)

[Note: Site index is the expected height at age 50 for a species on a given soil type]

Stand Density: The basal area for this stand averages 187 ft^2/acre. Density varies from about 160 ft^2/acre to 220 ft^2/acre. Many mature northern hardwood forests in southern Lower Michigan have a basal area between 90 and 120 ft^2/ acre. This stand can be considered an overstocked stand.

[Note: The *basal area of a tree* is the cross sectional area of the trunk at 4.5 feet. The *basal area of the stand* is the sum of each individual tree’s basal area.]

Stand Volume: The merchantable volume for this Unit was not determined. Typical mature, hardwood forests in southern Michigan may range from 5,000 to 10,000 (Doyle rule) board feet per acre.

Stand Age: Uneven-aged stand – overstory trees estimated to be 80 to 120 years old.

Growth Rate: Moderate to poor – due to overall stand age and overall crown closure of about 95% (considered high crown closure).

Management Unit E

Mesic Northern Hardwoods – Sugar Maple Predominates
34 Acres

EXISTING CONDITIONS

COVER TYPE AND MAJOR SPECIES:

Unit E is a mature, uneven aged, Northern hardwoods stand. Overall, there are 7 species of trees growing here. Sugar maple is the most abundant dominate and codominate tree in the overstory canopy. Common overstory associates include American beech and red maple. Less common, scattered individuals of paper birch, Northern red oak, black cherry, and Eastern hemlock are also present.

MANAGEMENT UNIT DESCRIPTION:

This unit has flat to steep sloping topography (0-40%). Aspects are mostly north-northwest-west. The mid-story canopy – up to 30’ tall is dominated by sugar maple, and American beech. Eastern hemlock is a common associate. Maple-leaf viburnum is common in places. Herbaceous

forbs and ferns are common in places. This unit has the largest populations of forbs on the property. Also, ferns dominated by Northern lady fern, and ostrich fern are dense in some places. However, overall the low ground cover is generally light to moderate, and is typically not very abundant.

Seedling and sapling tree regeneration is mostly of American beech and sugar maple with some red oak, black cherry and sassafras. None of the red oak have recruited into the sapling stage. Overall regeneration is of low to moderate abundance, dominated with very shade tolerant tree species.

Timber Resources

Tree Size Class: This unit is a small to large sawtimber size stand mostly 12" to 33" DBH. Overall average is about 18" DBH. Desirable merchantable sawtimber is usually 16" to 24" DBH.

Species	Tree Per Acre	DBH Range	Average DBH
Sugar maple	64	6" – 33"	18"
American beech	27	7" – 25"	15"
Red maple	19	10" – 30"	20"
Northern red oak	5	17" – 27"	21"
Paper birch	5	13" – 25"	17"
Black cherry	4	18" – 22"	20"
Eastern Hemlock	2	n/a	10"
Overall	126		18"

Stand Quality: Based on variable plot sampling about 28% of the trees inventoried are of acceptable growing stock (AGS). Many of the trees have codominate stems (forks), decay, and poor form. Beech scale and beech bark disease is common on the American beech trees.

Soil Types: Spinks-Tekenink loamy fine sand (96B & 96D), 0-18% slopes. These soil types are well drained. Spinks has sandy deposits throughout, Tekenink has loamy material throughout.

Site Quality: Medium high – based on site index below

Site Index red oak* – 66 or 57 ft^3/acre per year

(*Based on site index values for stand soil type 96B & 96D published by the USDA, Natural Resources Conservation Service, Soil Series data)

[Note: Site index is the expected height at age 50 for a species on a given soil type]

Stand Density: The basal area for this stand averages 149 ft^2/acre. Density varies from about 100 ft^2/acre to 220 ft^2/acre. Many mature northern hardwood forests in southern Lower Michigan have a basal area between 90 and 120 ft^2/ acre. This stand can be considered an overstocked stand.

[Note: The *basal area of a tree* is the cross sectional area of the trunk at 4.5 feet. The *basal area of the stand* is the sum of each individual tree's basal area.]

Stand Volume: The merchantable volume for this Unit was not determined. Typical mature, hardwood forests in southern Michigan may range from 5,000 to 10,000 (Doyle rule) board feet per acre.

Stand Age: Uneven-aged stand – overstory trees estimated to be 80 to 140 years old.

Growth Rate: Moderate to poor – due to overall stand age and overall crown closure of about 88% (considered high crown closure). Some canopy gaps have developed due to BBD and/or windfall.

"The Pit" feature found in the Unit

Management Unit F

Mesic Northern Hardwoods – Sugar maple & American Beech Predominates
7 Acres

EXISTING CONDITIONS

COVER TYPE AND MAJOR SPECIES:

Unit F is a mature, uneven aged, Northern hardwoods stand. Overall, there are 8 species of trees growing here. Sugar maple and American beech are the most abundant dominate and codominate trees in the overstory canopy. Common overstory associates include paper birch, and Eastern hemlock. Less common, scattered individuals of yellow birch, Northern red oak, black cherry, and red maple are also present.

MANAGEMENT UNIT DESCRIPTION:

This unit has flat to gentle sloping topography (0-20%). Aspects are mostly west to variable. The mid-story canopy – up to 30’ tall is dominated by Eastern hemlock, sugar maple, and American

beech. Overall the low ground cover is generally light to moderate, and is typically not very abundant.

Seedling and sapling tree regeneration is mostly of American beech with some sugar maple. Overall regeneration is of low abundance, dominated by very shade tolerant tree species.

Timber Resources

Tree Size Class: This unit is a small to large sawtimber size stand mostly 12" to 28" DBH. Overall average is about 17" DBH. Desirable merchantable sawtimber is usually 16" to 24" DBH.

Species	Tree Per Acre	DBH Range	Average DBH
Sugar maple	41	9" – 21"	13"
American beech	37	8" – 28"	22"
Paper birch	28	10" – 13"	11"
Eastern hemlock	27	8" – 17"	12"
Paper birch	5	13" – 25"	17"
Yellow birch	8	16" – 22"	19"
Black cherry	2	n/a	22"
Red maple	2	n/a	22"
Northern red oak	2	n/a	20"
Overall	147		17"

Stand Quality: Based on variable plot sampling about 21% of the trees inventoried are of acceptable growing stock (AGS). Many of the trees have codominate stems (forks), decay, and poor form. Beech scale and beech bark disease is common on the American beech trees.

Soil Types: Spinks-Tekenink loamy fine sand (96B), 0-6% slopes. These soil types are well drained. Spinks has sandy deposits throughout, Tekenink has loamy material throughout.

Site Quality: Medium high – based on site index below

Site Index red oak* – 66 or 57 ft^3/acre per year

(*Based on site index values for stand soil type 96B published by the USDA, Natural Resources Conservation Service, Soil Series data)

[Note: Site index is the expected height at age 50 for a species on a given soil type]

Stand Density: The basal area for this stand averages 145 ft^2/acre. Density varies from about 80 ft^2/acre to 200 ft^2/acre. Many mature northern hardwood forests in southern Lower Michigan have a basal area between 90 and 120 ft^2/ acre. This stand can be considered an overstocked stand.

[Note: The *basal area of a tree* is the cross sectional area of the trunk at 4.5 feet. The *basal area of the stand* is the sum of each individual tree's basal area.]

Stand Volume: The merchantable volume for this Unit was not determined. Typical mature, hardwood forests in southern Michigan may range from 5,000 to 10,000 (Doyle rule) board feet per acre.

Stand Age: Uneven-aged stand – overstory trees estimated to be 80 to 120+ years old.

Growth Rate: Moderate to poor – due to overall stand age and overall crown closure of about 95% (considered high crown closure). Some canopy gaps have developed due to BBD or windfall.

Songbird Habitat Resources – All Management Units

Note: During the forest inventory a bird habitat inventory protocol (Audubon Vermont) was used at each of the 46 variable forest inventory plots to collect data and information about the songbird habitat on the Otto NP.

OVERSTORY CANOPY

Canopy height is greater than 60', mostly hardwoods with some conifers (hemlock and white pine), has uniform distribution, and has 90% crown closure. All management units are within this category.

This is a closed canopy condition (in all management units) that favors forest-interior nesting bird species such as ovenbird, black-throated green warbler, scarlet tanager, wood thrush, eastern wood peewee and many others. All of the mentioned species have been identified on the Otto NP.

This dense canopy cover has impacted the abundance of the understory layer, and in many places limited the understory growth because of dense shade. However, all of this canopy cover does provide a good amount of snag and cavity potential in dead and dying trees. Six species of woodpeckers were identified in the Otto NP during the breeding bird survey. Woodpeckers (including the northern flicker) favor the abundance of snags and dead and dying trees where they peck into rotting wood to make holes in which to raise their young.

Also, interesting to note that research has shown that many forest-interior birds prefer young or early-successional habitat during post-breeding seasons where they can find more abundant food resources as they prepare for migration. There is no early-successional or young forest on the Otto NP, however there is young forest on the western side (Westerfield property) and northern side (Bull and Fowler properties) of the nature preserve. These parcels have been logged and are now regenerating with young trees. I suspect many of our breeding birds are taking advantage of this condition.

Canopy Gap in Unit A (sun lite area)

MID-STORY – INTERMEDIATE CANOPY (5’-30’)

This is all live woody vegetation (trees and shrubs) within the 5’ to 30’ height range.

Mgt. Unit	% Cover (Avg of all assessment plots)	Distribution	Type
A	18	Patchy	Hardwoods
B	44	Uniform to Patchy	Hardwoods
C	37	Patchy	Mixed (hdwd-softwd)
D	12	Patchy	Mixed (hdwd-softwd)
E	28	Patchy	Mixed (hdwd-softwd)
F	31	Patchy	Mixed (hdwd-softwd)

Note: Mixed types are hardwoods mixed with Eastern hemlock.

Having high stem and foliage density in this forest layer provides potential nest sites, foraging vegetation, and protective cover. Uniform, stand wide distribution is ideal, but well distributed patches are beneficial. Some of the local birds that nest and/or forage within this layer include wood thrush, American redstart, magnolia warbler, and black-throated green warbler.

Softwood inclusions of Eastern hemlock are the most common in management units C, D, E, and F. Having softwood inclusions often provide increased structural complexity as well as a varied foraging and nesting opportunities. The black-throated green warbler, magnolia warbler and the blackburnian warbler benefit from these inclusions.

Management units B, C, E, and F have the most notable mid-story canopy and can be considered the best areas of habitat for birds that prefer this forest layer in the Otto NP.

Mid-story canopy in Management Unit B

UNDERSTORY VEGETATION (1'-5')

This layer is all live vegetation in the 1' to 5' height range that includes tree seedlings, saplings, shrubs, and herbaceous vegetation.

Mgt. Unit	% Cover (Avg. of all assessment plots)	Distribution	Soft Mast	Leaf-litter
A	11	Patchy	Absent	Adequate
B	8	Patchy	Absent	Adequate
C	7	Patchy	Absent	Adequate
D	12	Patchy	Absent	Adequate
E	12	Patchy	Absent	Adequate
F	0	Patchy	Absent	Adequate

Also, in this forest layer, having high stem and foliage density of woody vegetation provide potential nest sites, foraging vegetation, and protective cover. Uniform, stand wide distribution is ideal, but well distributed patches are beneficial. Herbaceous plants are also sometimes used by songbirds for foraging and nesting when it is dense.

As shown in the above table, most all of our management units have light understory cover. The majority of cover here is typically woody vegetation of young saplings of sugar maple, and American beech. Shrub woody vegetation is very limited. The mapleleaf viburnum is the most common shrub species, but it is not very dense or prolific. Songbirds and mammals do use the soft mast, but it not an abundant source of food at the Otto NP.

Wood thrush like to place nests in the understory when it is abundant.

The *litter layer* in the Otto NP is typically thick, moist, and well-developed. In this layer many insects, mites, and spiders provide a food source for songbirds. Wood thrush, veery, and ovenbird all depend on these soil dwelling creatures during the breeding season. The ovenbird also builds its ground nest using deciduous leaf litter.

Very limited understory cover in Unit F

COARSE WOODY MATERIAL (CWM) ON THE FOREST FLOOR

Mgt. Unit	# of Pieces of Downfall Per Acre of >10" Diameter and > 3' Long
A	11
B	17
C	17
D	43
E	24
F	17

Note: based on 1/10th acre fixed-radius (37.2') plot around overstory plot center, extrapolated to stand-wide condition.

CWM provides perch sites for singing (i.e. ovenbird) and other male courtship displays, and provides habitat for the insects and other arthropods that are a significant part of the breeding season diet of many birds. Ruffed grouse like large downfall >8" in diameter to use as drumming perches.

FINE WOODY MATERIAL (FWM) ON THE FOREST FLOOR

Mgt. Unit	# of Piles Per Acre of Small Branches <3" in diameter
A	29
B	20
C	27
D	40
E	64
F	4

Note: based on 1/10th acre fixed-radius (37.2') plot around overstory plot center, extrapolated to stand-wide condition.

When aggregated into piles, FWM offers a nesting substrate, cover, and feeding opportunities for birds like the white-throated sparrow and veery. Individual pieces have minimal habitat value.

Our data suggests that management units D and E on the west half of the property provide the best CWM and FWM habitat for breeding songbirds.

Note: Audubon Vermont provided the literature and information that was used in this section of the management plan. Two documents, "Silviculture with Birds in Mind" and "Forest Bird Habitat Assessment" were most helpful.

MAJOR UNIT OBJECTIVES and DESIRED FUTURE CONDITIONS: FOR THE ENTIRE FOREST

Major Objectives:

1) Manage the property to keep it as mature forest and promote its continued growth allowing it to become “old growth” forest.

2) Manage the property to protect and improve its long-term health. Continue to assess and monitor the hemlock wooly adelgid population on Eastern hemlock, and the beech bark disease on American beech.

3) Manage the property to provide aesthetics and visual attractiveness, and provide access for recreational activities.

4) Manage the property to maximize carbon storage in the standing timber and to improve the forests ability to sequester additional carbon dioxide.

5) Continue to assess, protect and promote the property’s rich biodiversity and to maximize the ecological services it provides.

Desired future condition: That it continues to mature and advance toward old growth conditions, remains visually attractive, provides recreational opportunity, and is a healthy northern hardwoods forest.

Ostrich fern colony – Fern Valley in Unit E

RECOMMENDED MANAGEMENT ACTIVITIES – 2020 TO 2040

#1 – Eliminate invasive plant populations. 2021 – 2025, and as needed.

A few autumn olive shrubs were identified in **management unit (MU) A,** near where the parking lot is going to be developed. Cut the stems of the plant and immediately apply a glyphosate herbicide (Roundup®) to the stump. Best time to do this would be between July and September.

Dig up or spray with herbicide the small patch of Siberian squill near Scenic Dr. in the northeast corner of the property **(MU A)**.

Dig up or spray with herbicide small individual plants of broad-leaved Helleborine **(MU E or where ever it is discovered).**

#2 – Promote passive forest management to maximize carbon storage. 2020 – 2040 (All management units).

Commercial harvesting to create forest products will not be a priority for the Otto NP. Instead, the property will be managed to allow natural tree senescence to happen at its natural rate of occurrence. Wind throw, ice storms, insect and disease issues will all impact tree growth as part of the natural growth of the forest. These factors will create "canopy gaps" for tree regeneration to establish itself.

This process is currently underway with canopy gaps providing enough light to promote the establishment of young trees of mostly sugar maple, American beech and some Eastern hemlock. The canopy gaps help improve the vertical structure of the property, promoting more forest layers to store carbon, creating a condition called "forest packing". Also, bird habitat should improve for some species because of the canopy gaps.

Currently the property is a mature forest moving toward "old growth" conditions. I would estimate the oldest trees on the property to be 120-140 years old. Old growth conditions can be considered around 200 years old. The forest is uneven aged, with the most mature trees being American beech, sugar maple, Northern red oak, yellow birch, Eastern hemlock. All of these trees can live to an advanced age greater than 200 years old. Many of these trees will continue to add girth (DBH) and store additional carbon as they age.

#3 – One option to consider is a timber stand improvement cut using single tree/group tree selection to remove the mature bigtooth aspen trees in this unit. 2020 – 2030 (MU A).

Northern red oak dominates management unit A. To help improve future carbon storage in the red oak resource, and to improve red oak regeneration, consider removing the aspen trees. Currently there is some red oak seedling regeneration, however, none of it is recruiting to older

sapling regeneration, probably because of the dense canopy conditions. Opening up the canopy here could encourage red oak regeneration and improve the growth rates of trees nearby the aspen trees that are removed. Also, removing some of the poor quality red maple at this time could also be considered. Maybe consider cutting and leaving the trees or even tree girdling as the removal tool so as to minimize disturbance and protect the residual trees from harvesting damage.

#4 – Plant native shrubs to improve songbird habitat. (All management units)

Soft mast is severely lacking in the understory layer of the property. Adding some shrubs could help provide more feeding opportunities for songbirds. Species to consider include, gray dogwood, American hazelnut, and Rubus sp. like black raspberry. And maybe other species to be determined. Plant near existing "canopy gaps" where lighting is better.

Recommended Management Activities – Summary Table 2020 to 2040

Mgt. Unit	Activity #	Activities	Treatment Acres	Date Planned
A & E	1	Eliminate invasive plant populations	62	2021 - 2025
A, B, C, D, E, F	2	Promote passive forest management to maximize carbon storage	80	2020 - 2040
A	3	Timber stand improvement cut – bigtooth aspen	28	2020 - 2030
A, B, C, D, E, F	4	Plant native shrubs to improve bird habitat	80	2020 - 2040
Entire Forest	X	Monitor Forest Health	80	Annually

Monitoring of Property

The successful implementation of this Forest Stewardship Plan is dependent upon frequent monitoring by the Oceana Conservation District. Conservation District staff and/or board members should walk the entire forest at least annually to inspect the forest for changes and to evaluate the success of any prior management activities. Forest Stewardship Plans should also be adaptable and flexible enough to accommodate changes in landowner goals or forest resources over the twenty year planning period.

Monitoring Activities – Entire Property

Beech bark disease, hemlock wooly adelgid, and oak wilt has been discussed in earlier pages of the plan. One additional health issue identified below certainly has the potential to impact the property in the future.

It is recommended that the property be monitored regularly (each year and during different seasons) for changes that may indicate additional insect or disease problems. If any new forest health problems become evident, the OCD can contact a DNR Forest Health Specialist to assist if needed. The property should also be monitored for any additional issues, for example illegal firewood cutting or trespass and hunting.

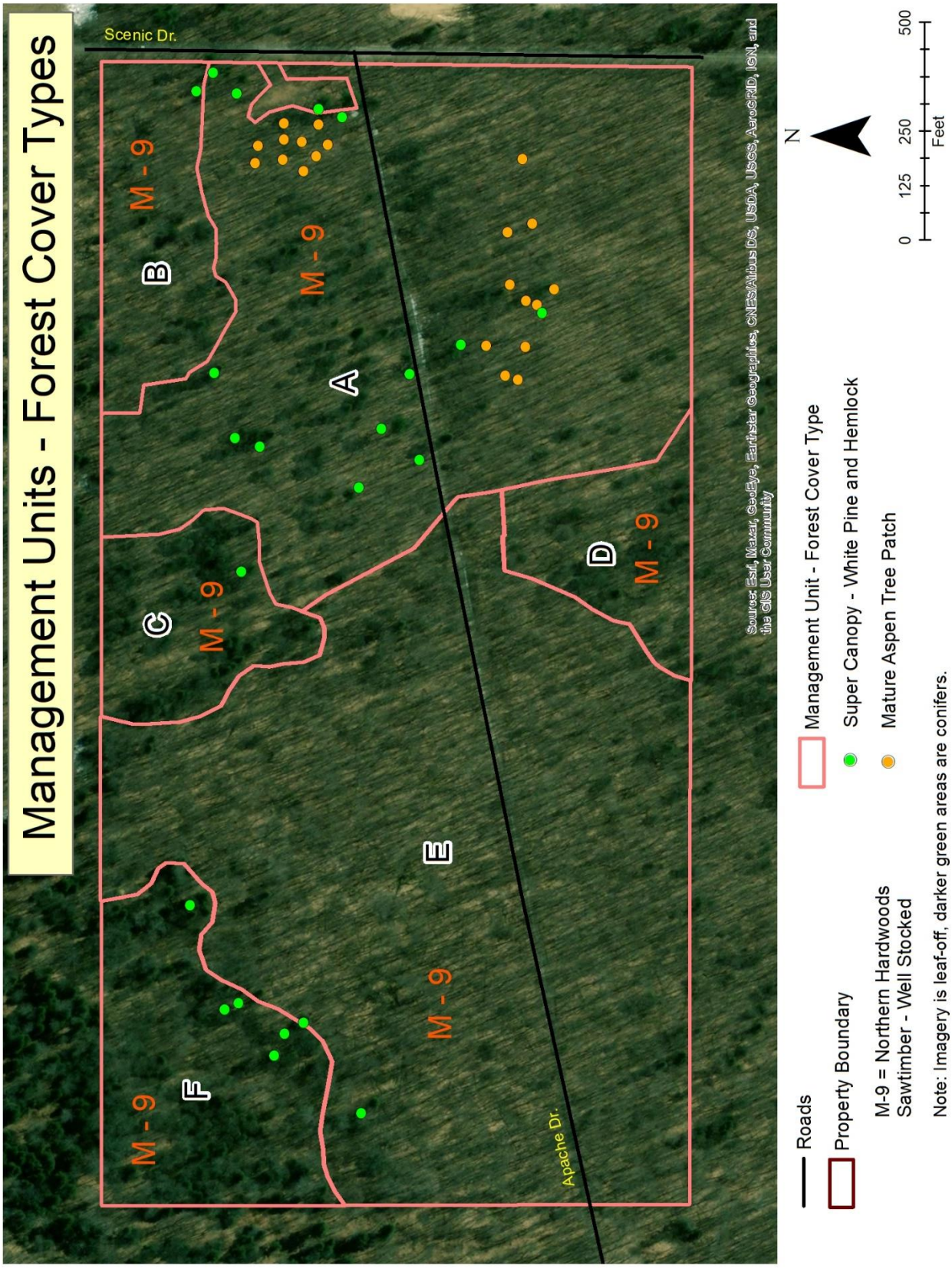
One additional health issue to be on the lookout for:

Asian Longhorn Beetle on Maple Trees

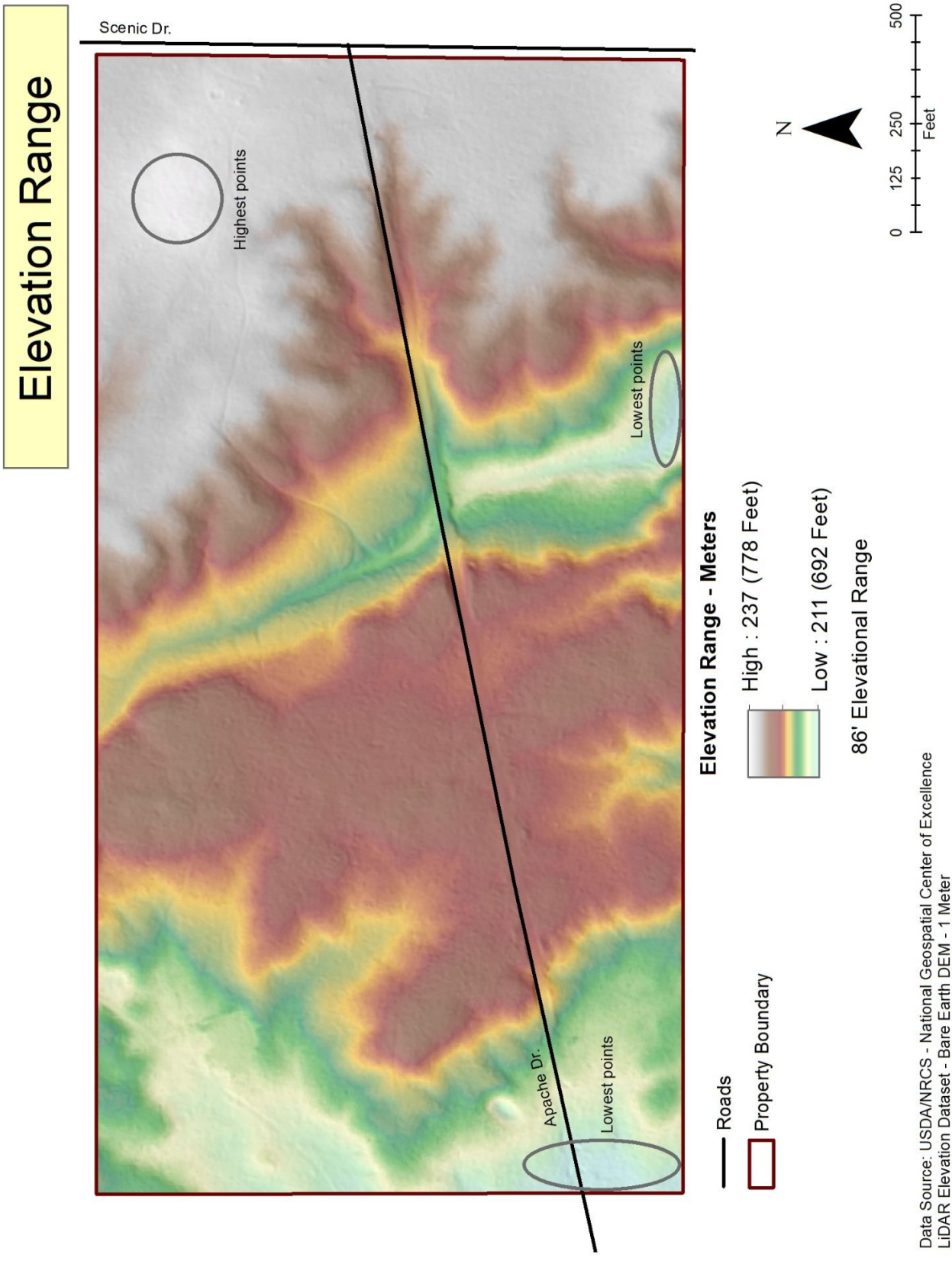
This disease ***is not in Michigan*** at this time but because sugar maple and red maple populations are extensive on the property, it is a good idea to be aware of this potential health threat.

Maps and Lists Section Follows

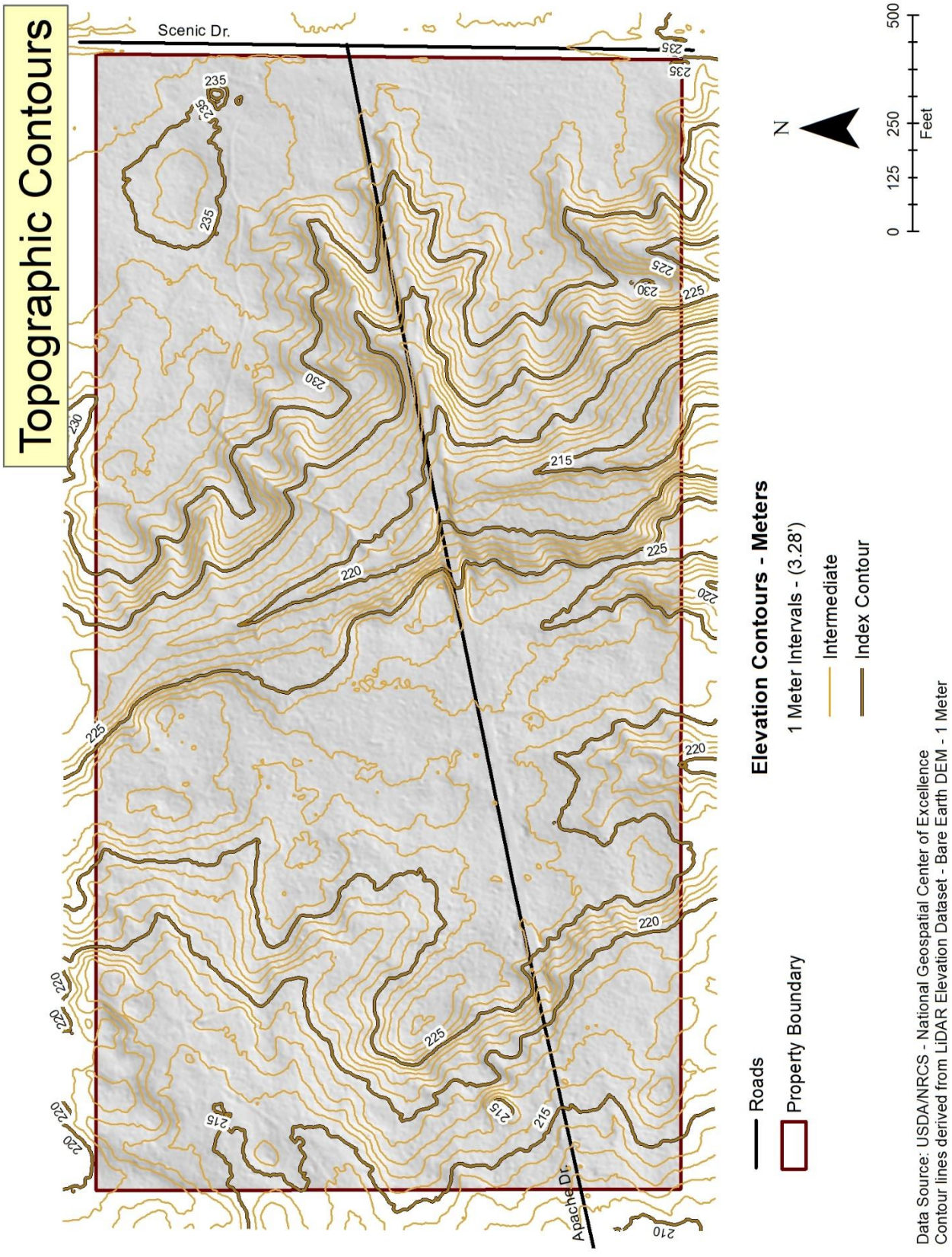
Map – Management Units of Forest Cover Types



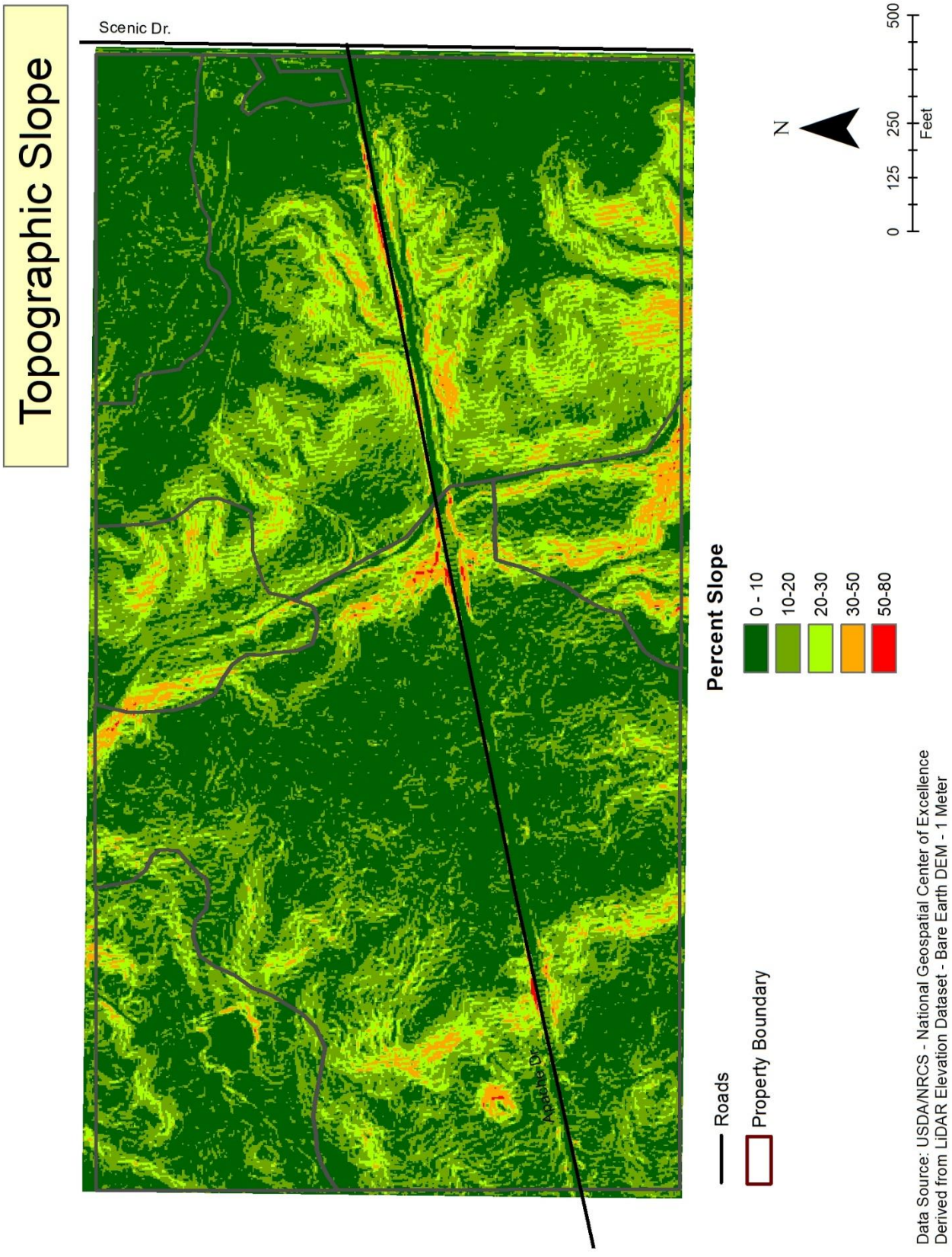
Map – Elevation Range



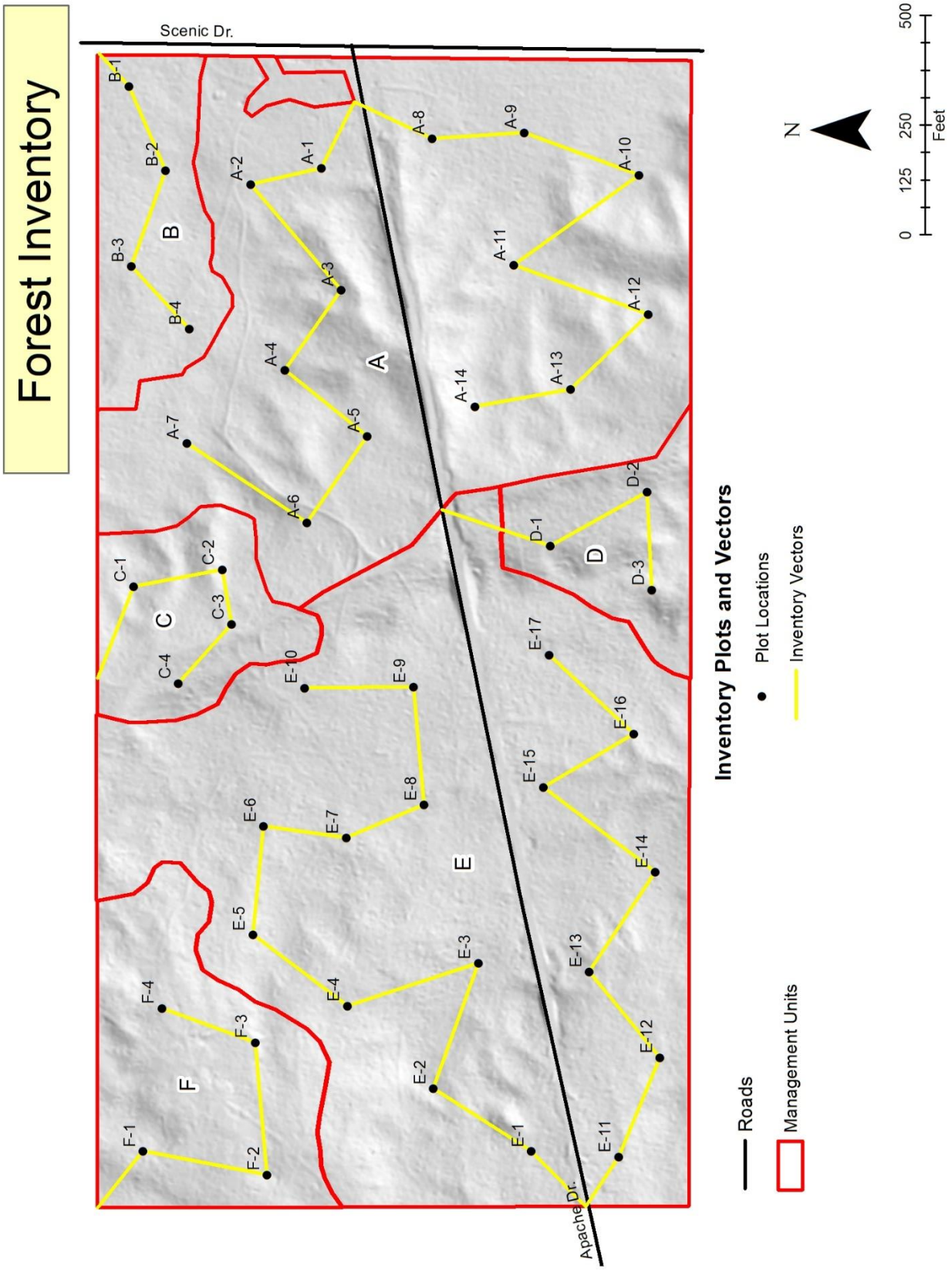
Map – Topographic Contours



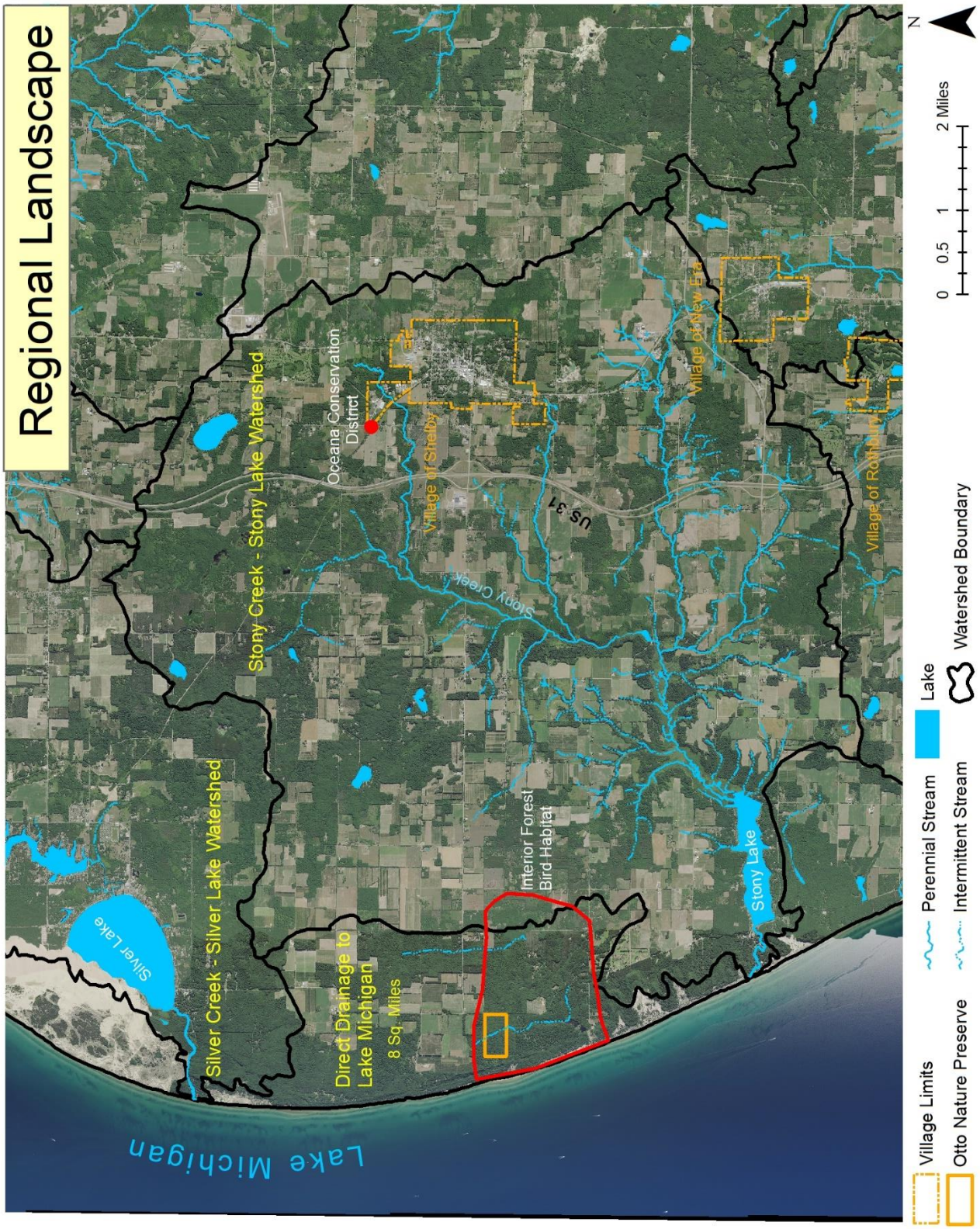
Map – Topographic Slopes



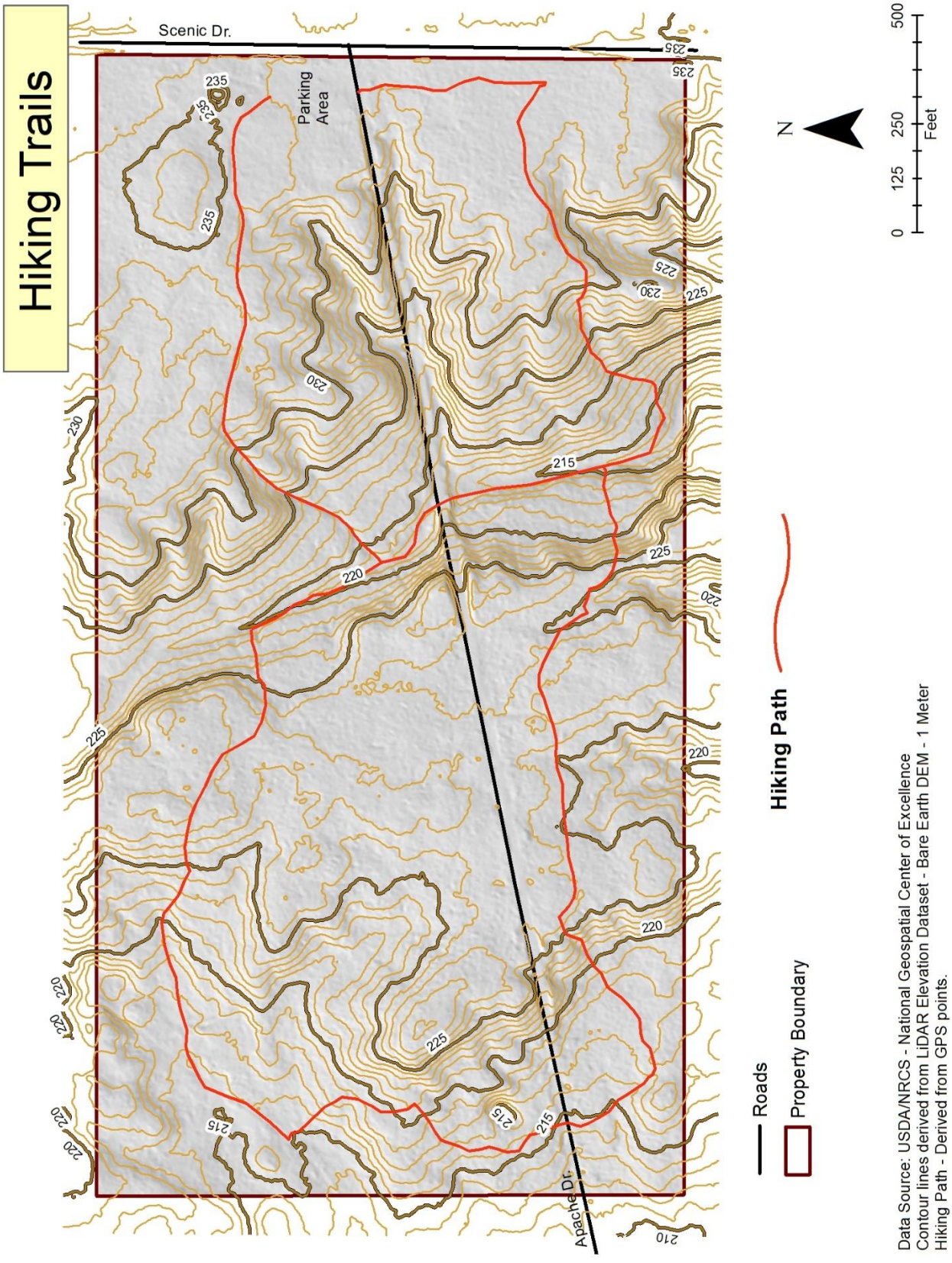
Map – Forest Inventory



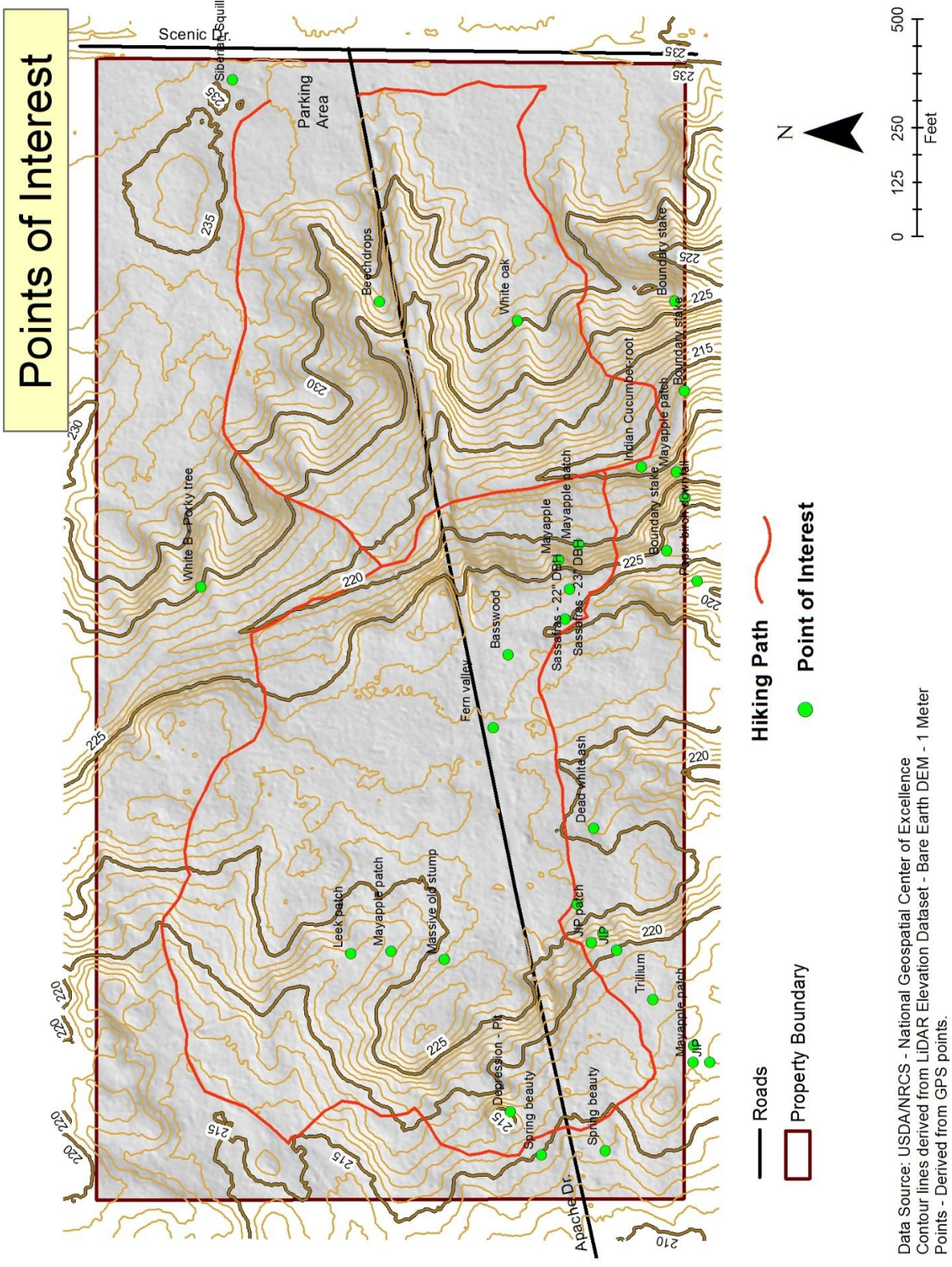
Map – Regional Landscape



Map – Hiking Trails



Map – Points of Interest



List of Plants

Plant Groups	Families/Latin Names	Common Name	C**	Frequency
Ferns				
	Lady Fern Family			
	Athyrium filix-femina	Lady Fern	4	Abundant
	Bracken Fern Family			
	Pteridium aquilinum	Bracken Fern	0	Uncommon
	Sensitive Fern Family			
	Onoclea sensibilis	Sensitive Fern	2	Common
	Matteuccia struthiopteris	Ostrich Fern	3	Common
	Royal Fern Family			
	Osmunda claytoniana	Interrupted Fern	6	Rare
Trees				
	Pine Family			
	Tsuga canadensis	Eastern Hemlock	5	Common
	Pinus strobus	White Pine	3	Uncommon
	Birch Family			
	Betula papyrifera	Paper (or White) Birch	2	Occasional
	Betula alleghaniensis	Yellow Birch	7	Occasional
	Ostrya virginiana	Ironwood/Hop-hornbeam	5	Rare
	Beech Family			
	Fagus grandifolia	American Beech	6	Abundant
	Quercus alba	White Oak	5	Rare
	Quercus rubra	Red Oak	5	Abundant
	Laurel Family			
	Sassafras albidum	Sassafras	5	Occasional
	Mallow Family			
	Tilia americana	Basswood	5	Rare
	Olive Family			

	Fraxinus americana	White Ash	5	Rare
	Rose Family			
	Prunus serotina	Wild Black Cherry	2	Occasional
	Willow Family			
	Populus grandidentata	Big-tooth Aspen	4	Uncommon
	Soapberry Family			
	Acer rubrum	Red Maple	1	Abundant
	Acer saccharum	Sugar Maple	5	Abundant
Woody Plants				
Shrubs & Vines				
	Oleaster Family			
	Elaeagnus umbellata	Autumn Olive*	0	Rare
	Witch-hazel Family			
	Hamamelis virginiana	American Witch-hazel	5	Occasional
	Viburnum Family			
	Viburnum acerifolium	Maple-leaved Viburnum	6	Abundant
Herbaceous Forbs				
	Onion Family			
	Allium tricoccum	Wild Leek	5	Uncommon
	Arum Family			
	Arisaema triphyllum	Jack-in-the-pulpit	5	Common
	Lily-of-the-valley Family			
	Maianthemum canadense	Wild Lily-of-the-valley	5	Occasional
	Polygonatum pubescens	Downy Solomon-seal	5	Occasional
	Medeola virginiana	Indian Cucumber-root	10	Rare
	Trillium Family			
	Trillium grandiflorum	Common Trillium	5	Uncommon
	Broom-rape Family			
	Epifagus virginiana	Beech-drops	10	Rare
	Conopholis americana	Squaw-root	10	Occasional
	Heath Family			

	Monotropa uniflora	Indian-pipe	5	Rare
	Buttercup Family			
	Aquilegia canadensis	Wild Columbine	5	Rare
	Madder Family			
	Mitchella repens	Partridge Berry	5	Rare
	Galium boreale	Northern Bedstraw	3	Rare
	Barberry Family			
	Podophyllum peltatum	May-apple	3	Occasional
	Violet Family			
	Viola sororia	Common Blue Violet	1	Uncommon
	Viola rostrata	Long-spurred Violet	6	Rare
	Blinks Family			
	Claytonia virginica	Spring-beauty	4	Uncommon
	Myrsine Family			
	Trientalis borealis	Star-flower	5	Occasional
Total Species	40			
Native Species	39			
Non-native Species	1			

Note: Frequency based on field observations: rare, uncommon, occasional, common, abundant

* Non-native species

** C = Coefficients of Conservatism: Range from 0 - 10 and represent an estimated probability that a plant is

likely to occur in a landscape relatively unaltered from what is believed to be pre-European settlement conditions

0 = have little fidelity to any remnant natural community, found almost anywhere

10 = almost always restricted to a presettlement remnant, i.e. high quality natural area

Intermediate values = certain it is faithful remnant natural communities, but it is uncertain that the condition of the

community from which it comes is still representative of presettlement conditions, i.e. the community may be degraded

List of Birds

Phylogenetic Order	Common Name	Scientific Name	Abundance in Oceana County	Maximum Daily Count	Breeding Status
1	Mourning Dove	*Zenaida macroura*	Very Common	3	Probable
2	Yellow-billed Cuckoo	*Coccyzus americanus*	Uncommon	1	Probable
3	Broad-winged Hawk	*Buteo platypterus*	Very Uncommon	1	Possible
4	Red-tailed Hawk	*Buteo jamaicensis*	Fairly Common	1	Possible
5	Barred Owl	*Strix varia*	Uncommon	2	Possible
6	Red-headed Woodpecker	*Melanerpes erythrocephalus*	Uncommon	1	Possible
7	Red-bellied Woodpecker	*Melanerpes carolinus*	Common	2	Probable
8	Downy Woodpecker	*Picoides pubescens*	Common	2	Confirmed
9	Hairy Woodpecker	*Picoides villosus*	Fairly common	2	Confirmed
10	Pileated Woodpecker	*Dryocopus pileatus*	Farily uncommon	1	Probable
11	Northern Flicker	*Colaptes auratus*	Common	3	Confirmed
12	Eastern Wood-Pewee	*Contopus virens*	Common	5	Probable
13	Acadian Flycatcher	*Empidonax virescens*	Uncommon	4	Probable
14	Great Crested Flycatcher	*Myiarchus crinitus*	Fairly Common	3	Probable
15	Warbling Vireo	*Vireo gilvus*	Fairly Common	1	Possible
16	Red-eyed Vireo	*Vireo alivaceus*	Common	7	Confirmed
17	Blue Jay	*Cyanocitta crsitata*	Very Common	3	Probable
18	American Crow	*Corvus brachyrhynchos*	Very Common	2	Probable
19	Black-capped Chickadee	*Poecile atricapillus*	Very Common	2	Probable
20	Tufted Titmouse	*Baeolophus bicolor*	Common	1	Probable
21	White-breasted Nuthatch	*Sitta carolinenesis*	Common	1	Probable
22	Veery	*Catharus fuscescens*	Uncommon	4	Confirmed
23	Wood Thrush	*Hylocichla mustelina*	Fairly Uncommon	6	Confirmed
24	American Robin	*Turdus migratorius*	Very Common	4	Confirmed
25	Gray Catbird	*Dumetella carolinensis*	Fairly Common	1	Probable
26	American Goldfinch	*Spinus tristis*	Very Common	1	Possible
27	Eastern Towhee	*Pipilo erythrophthalmus*	Farily Common	2	Probable
28	Brown-headed Cowbird	*Molothrus ater*	Common	2	Possible
29	Ovenbird	*Seiurus aurocapilla*	Fairly Common	4	Probable
30	Hooded Warbler	*Setophaga citrina*	Rare	4	Confirmed
31	American Redstart	*Setophaga ruticilla*	Common	4	Probable
32	Magnolia Warbler	*Setophaga magnolia*	Fairly Common	2	Confirmed
33	Chestnut-sided Warbler	*Setophaga pensylvanica*	Uncommon	2	Probable
34	Black-throated Green Warble	*Setophaga virens*	Fairly Common	3	Probable
35	Scarlet Tanager	*Piranga olivacea*	Fairly Common	4	Probable
36	Northern Cardinal	*Cardinalis cardinalis*	Very Common	1	Possible
37	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Fairly Common	5	Confirmed
38	Indigo Bunting	*Passerina cyanea*	Fairly Common	2	Probable

2020 Survey Dates
4-May
4-Jun
18-Jun
25-Jun
2-Jul
23-Jul
30-Jul