



FOREST STEWARDSHIP PLAN

Prepared for the DeWitt Public Schools

Plan Prepared by Mike Smalligan of Smalligan Forestry LLC
State of Michigan Registered Forester #46010
American Tree Farm Inspector #88296
Technical Service Provider #128611

Plan Start Date: January, 2014



Department of Natural Resources – Forest Resources Division

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

This Forest Stewardship Plan also complies with the requirements of NRCS Forest Management Plans (CAP 106) and the American Tree Farm System.

Landowner: DeWitt Public Schools	Plan Writer: Mike Smalligan
John Deiter, deiter@dewittschools.net	Phone: (517) 755 - 7430
Rob Spagnuolo, spagnuolr@dewittschools.net	Address: PO Box 27494, Lansing, MI 48909
Phone: (517) 668 - 3000	Email: mike@smalliganforestry.com
Address: 2957 West Herbison Road DeWitt MI 48820	Web: www.smalliganforestry.com

Location of Parcel (Town/Range/Section): 92.0 acres north of I-69 in the SW ¼ of Section 17 and 21.0 acres in the NE ¼ of the SE ¼ of Section 18, DeWitt Township, T5N, R2W, Clinton County

Township: DeWitt	County: Clinton	Plan Expiration: January, 2024
Total Acres: 113.0	Forested Acres: 61.8	Acres Included in Plan: 61.8

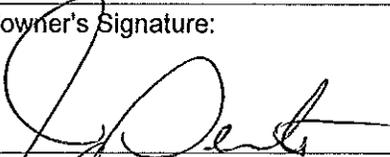
How to Find Parcels from Nearest Town: From DeWitt, go south 1 mile on DeWitt Road, go west ½ mile on Herbison Drive, go south on Panther Drive ¼ mile to the school office.

Describe the Landowner's Goals and Objectives for this Forest Stewardship Plan:

To actively manage and improve the forests owned by the school district for outdoor education for school children and community members.

Michigan's Stewardship Ethic

Stewardship is an ethic recognizing that the land and its natural inhabitants have an inherent worth and that we have a responsibility to manage our actions as part of that. It guides us to manage our activities to the utmost of our abilities, to insure the future health, productivity, and well being of the land, its natural communities and species, and to allow our successors opportunities at least equal to ours to use the land and its resources. This plan is compatible with my goals and objectives. I understand that Landowner Stewardship Management Plans are voluntarily accepted. This acceptance represents a good faith, but non-binding commitment to implement strategies suggested in this plan. As a non-binding commitment, private property rights cannot be jeopardized as a result of receiving a plan.

Landowner's Signature: 	Date: 7-14-14
Plan Writer's Signature: Mike Smalligan	Date: 14 July 2014
DNR Service Forester's Signature: 	Date: 8/4/14

After signature of both the Landowner and Plan Writer, the Plan Writer will submit the entire FSP to Mike Hanley, the DNR Service Forester for the Lower Peninsula, for his review and signature upon approval. Copies of the signature page will be provided to the Landowner and Plan Writer after being signed by the DNR Service Forester.

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Introduction

“No book or hired forester is a substitute for the instinct an owner can develop by simply watching their woods, year in, year out.” (*Working with Your Woodland: A Landowner’s Guide*)

“Your woodlot is, in fact, a historical document that faithfully records your personal philosophy. Let it tell a story of tolerance toward living things, and of skill in the greatest arts: how to use the earth without making it ugly.” (Aldo Leopold, 1937 radio address)

My goal with this Forest Stewardship Plan is to provide accurate information that will help you to manage your forest and to achieve your goals and objectives for your land. This plan is meant to complement your observations about your forest and to stimulate your enjoyment of learning about your land. Although I will base my recommendations upon sound forestry science, your experience in your woods over the years creates a wisdom that is just as valuable as the science that comes from the university. As the steward of your forest, you make the final decisions about how to manage and improve your land. I hope that this plan will help you to consider your forest as part of the larger landscape that extends beyond your legal property boundary lines, with a time scale that extends well beyond human lifetimes, and as woods so wonderful and complex that it is greater than the limited understanding of just one forester. I see interesting and beautiful things every time that I visit a forest, whether it’s a large forest or just a small woodlot. I hope that this Forest Stewardship Plan will be part of an exciting process of discovery for you and a useful resource as you manage your land and make decisions to improve your forest for the next generation. I always enjoy walking through the woods with landowners so please contact me if I can be of further assistance.

Mike Smalligan

Landowner’s Goals

The DeWitt Public Schools has a variety of goals for their property that reflect their personal preferences, the attributes of their forest, and their desired future conditions for their land. Their primary mission is to provide an outdoor education center for school children and other adult community members. The primary goal with this Forest Stewardship Plan is to help them actively and responsibly manage the three forested areas on the main campus of the school. This plan is intended to be a science-based resource for the School Board, administrators, the Friends of DeWitt Nature Center, and other decision makers for evaluating forest management options for these public forests. When presented with a list of potential goals for the three school forests, school staff and community volunteers ranked them in the following list:

Ranking of Landowner Goals:

- | | |
|-----------------------|---|
| 1 – public safety | 6 - water and soil quality |
| 2 – outdoor education | 7 – timber production |
| 3 – aesthetics | 8 - wetland & riparian protection |
| 4 – recreation | 9 – reforestation |
| 5 – wildlife habitat | 10 - rare & endangered plants & animals |

General Property Description

The DeWitt Public Schools is located on a 113.0 acre campus along Herbison Road just north of Interstate 69 and south of the main part of the city of DeWitt. The land use on the campus is a mixture of school buildings, parking lots, athletic fields, row crop agriculture, and forest. The school forests are a little more than half of the total property with 61.8 acres combined in the three separate woodlots. Throughout this Forest Stewardship Plan I describe the DeWitt Public Schools forests as three separate “stands” or management units. A stand is a forestry term for an area of land containing a similar cohort of trees according to species, age class, site conditions, or management practices. The three stands of the DeWitt Public Schools are very different in age, species composition, and past management. All three school forests provide outstanding opportunities for outdoor education for students and partnerships with the local community.

Stand One is the 15.5 acre woodlot in the center of the campus that is called the DeWitt Nature Center. The DeWitt Nature Center is used by the school for outdoor education and by the community for recreation. Stand One is a mature northern hardwoods forest dominated by red maple and very large red oak. The stand, within a short walk of four schools, has great aesthetics and good biodiversity for outdoor education. The soils in the stand are somewhat poorly drained and moderately well drained so most of the plant species are typical upland forest species like red oak, red maple, bitternut hickory, and black cherry. The timber in this stand is economically valuable with many very large, high quality trees in commercially desirable species like red oak, black cherry, and sugar maple. However, the “non-consumptive” value of this beautiful forest is also very high as demonstrated by the community support to not harvest most of the largest trees in this stand when the school planned a timber harvest in 2012.

Stand Two is a 20.3 acre northern hardwoods forest on the south side of the school campus just southeast of the High School building. This stand is dominated by black cherry with almost half of the overall density, but it also has a large component of red maple and sugar maple. The soils in Stand Two are somewhat poorly drained, and the tree species composition reflects these mesic soil conditions. Stand Two has smaller trees and a much lower volume than Stand One even though both appear to be mature forests on the 1950 aerial photo in Appendix II. This woodlot is also used by teachers and students for outdoor education. A gas pipeline bisects the stand, but the forest is similar on both sides of the buried pipeline and is considered a single stand.

Stand Three is a 26.0 northern hardwoods forest dominated by red maple on the east side of the campus between the athletic fields and DeWitt Road. This is the youngest woodlot on campus. The eastern third and western third of this stand were used for agriculture through the 1970’s so most of the forest is less than 35 years old – see 1973 aerial photo in Appendix II. The largest trees are in the central third of the stand which was not used for agriculture because it was too wet to farm. The soils in Stand Three are a mixture of well drained, somewhat poorly drained, and moderately well drained soil types. The marsh in the middle of the stand appears to hold water throughout the year. This woodlot is primarily used for recreation, and a cross country running trail loops through the forest.

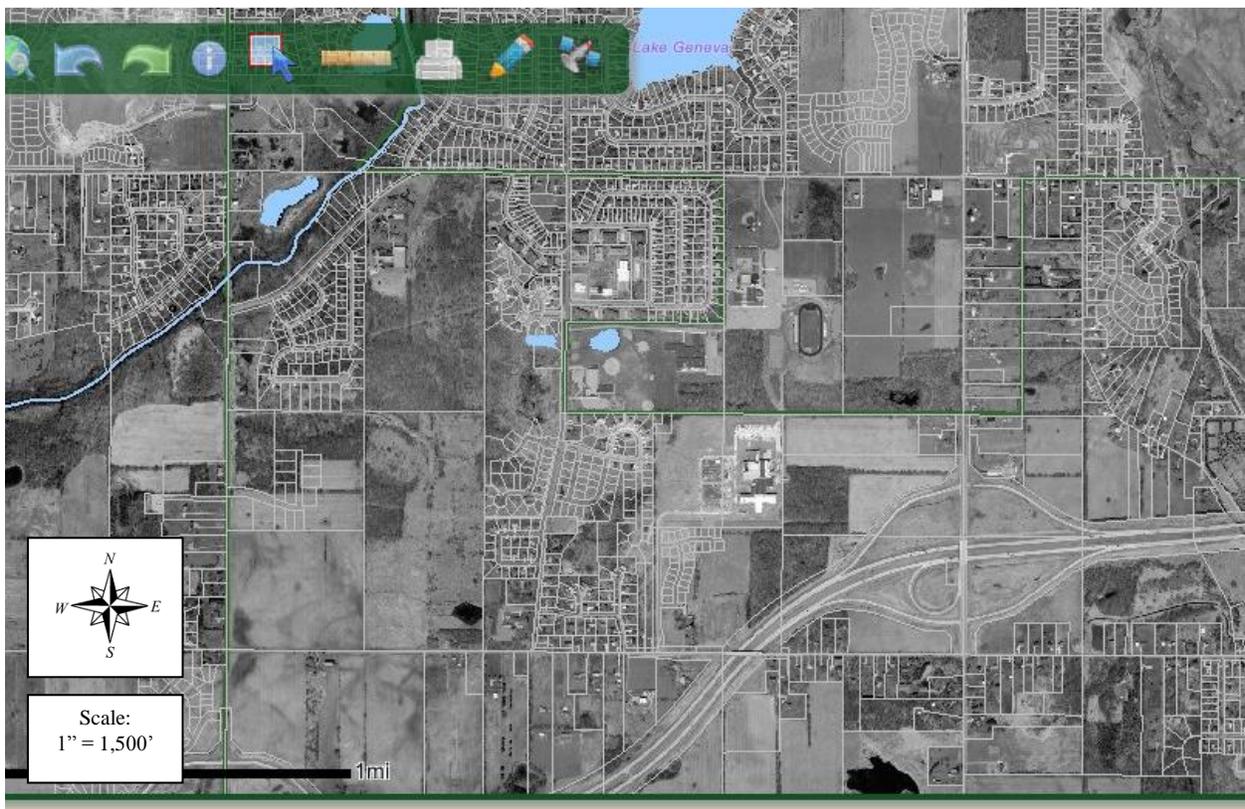
Although Clinton County is now a mixture of suburban residential land, agricultural land, and small forest woodlots, the Michigan Natural Features Inventory shows that Section 17 of DeWitt

Township was historically an oak-hickory hardwoods forest in 1800 (see maps in the Appendix and the MNFI website <http://web4.msue.msu.edu/mnfi/>).

Interaction with Surrounding Landscape

The three school forests on the campus of the DeWitt Public Schools are surrounded by school buildings, private residential property, or an interstate highway. Stand Two does continue as forest onto the adjoining private property to the west. There does not appear to be much surface hydrological interaction with the surrounding properties. The topography is generally flat, and none of the school forests borders a lake or stream where soil erosion could be a major concern. The Looking Glass River is about a half mile to the northwest of the school property.

Figure 1. Map of Surrounding Property Ownership.



(Image Source: Clinton County Online GIS Map - <http://maps.clinton-county.org/MapView/>)

Planning Process

Rob Spagnuolo contacted several local consulting foresters, including Mike Smalligan, in February of 2012 to get input about a potential timber sale on the DeWitt Public Schools property. Mike recommended that the school invest in a forest management plan before conducting a timber harvest to provide adequate information to the School Board prior to making a decision with such public implications. The DeWitt Public Schools hired Rob Munsters of Woodland Management Specialties to administer the timber sale. Rob marked 231 trees for sale, including about 89 very large trees in Stand One, the DeWitt Nature Center. The local community expressed concern that the aesthetic and educational value of the old growth forest ecosystem far exceeds the economic value from harvesting timber (\$52,500). Community members formed the “Friends of DeWitt Nature Center” to prevent the timber sale in Stand One and to help the school to optimize the educational value of the DeWitt Nature Center. After an ongoing discussion with the community throughout the summer of 2012, the School Board decided to revise the timber sale and to not harvest the 89 large trees in the Nature Center. The winning bidder, Maple Rapids Lumber Mill, agreed to revise the timber sale contract with the school and harvested about 140 trees in February of 2013, mostly in Stand Two and a few in Stand Three. The school agreed to partner with the Friends of DeWitt Nature Center in the management and educational use of Stand One, the Nature Center.

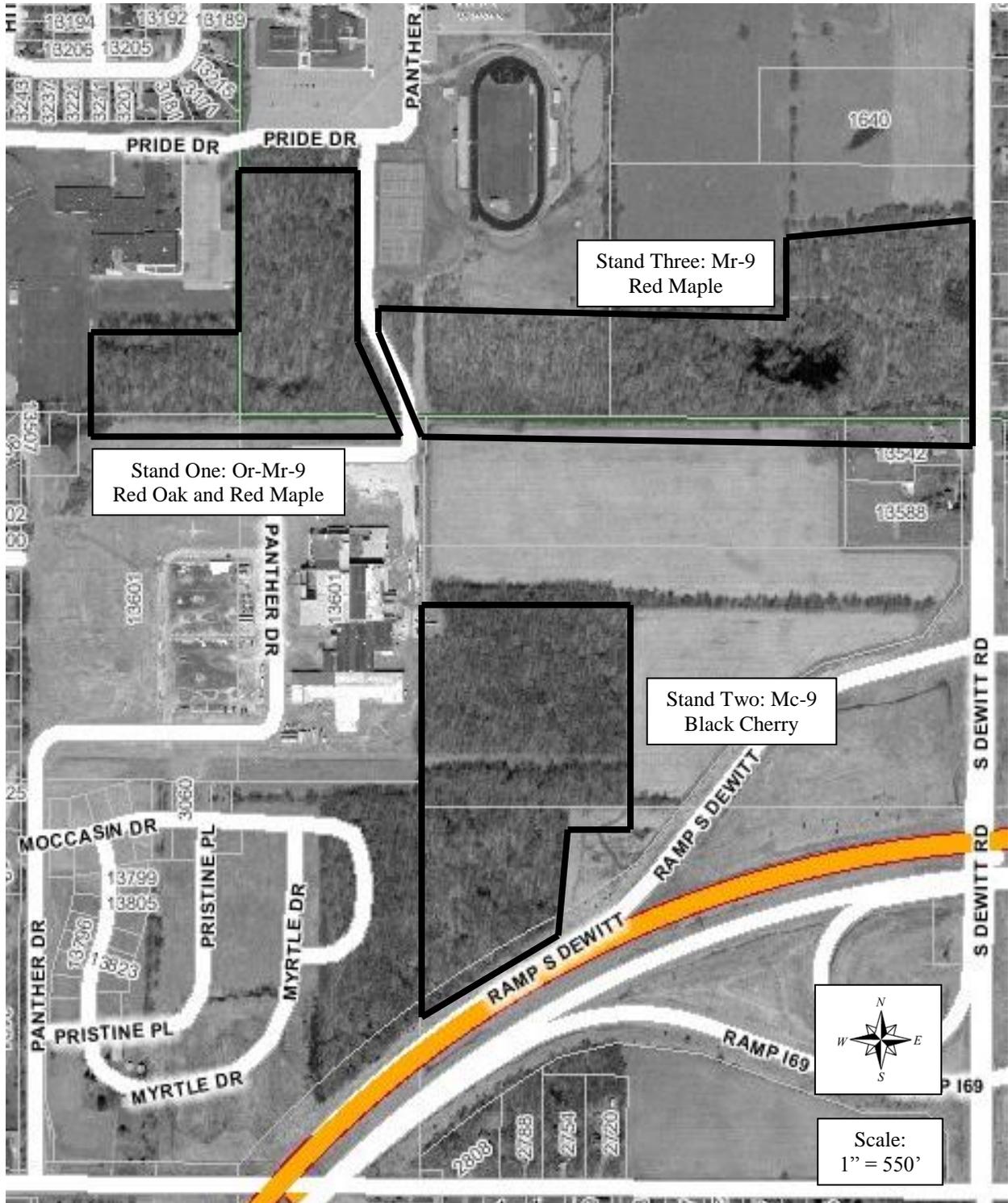
Phil Harner contacted Mike Smalligan in May of 2013 when the Friends of DeWitt Nature Center (FDNC) was interviewing local consulting foresters to write a forest management plan for the school. Mike, Phil Harner, Larry Arbanas, Rob Spagnuolo, and John Deiter met on June 20, 2013 to walk through the three school forests and to discuss their goals for a Forest Stewardship Plan. The DeWitt Public Schools, with input from the Friends of DeWitt Nature Center, hired Mike in November of 2013 to write this Forest Stewardship Plan. Mike, Phil, Larry, Rob, and John met again in the school offices on November 21, 2013 to review the schools goals for the forest and to discuss some possible management activities in Stand One.

Stand Assessment Method

Mike returned on January 5, 2014 to conduct a forest inventory of the three school forests. The forest inventory consisted of 30 sample plots with 10 plots in each of the three stands. The sample design is a systematic grid with a random starting location. The sampling intensity is one plot for every two acres in each stand. The plot design was a “point sample” using a 10 ft² basal area cruiser’s crutch to determine if trees were in or out of the plot. For each tree included in the plot, I measured the diameter at breast height, recorded the species, and estimated the log length to determine merchantable volume. I also noted saplings and shrubs in the understory, invasive plants, and insect or disease issues at each plot location. The ice storm in December of 2013 had just recently caused damage (broken branches, felled trees) throughout the three stands.

Forest Type Map

Figure 2. Forest type map of the DeWitt School Forests.



(Image Source: Clinton County Online GIS Map - <http://maps.clinton-county.org/MapView/>)

Species Codes

Mc = black cherry

Mr = red maple

Or = red oak

Size and Density Codes

0 = Non-stocked - Not enough trees to be classified forest (non-forest land)

1 = Seedlings (0-4.9" DBH) - Poorly Stocked (100-399 trees per acre)

2 = Seedlings (0-4.9" DBH) - Medium Stocked (400-699 trees per acre)

3 = Seedlings (0-4.9" DBH) - Well Stocked (≥ 700 trees per acre)

4 = Pole timber (5-9.9" DBH) - Poorly Stocked (10-39 ft² /acre basal area)

5 = Pole timber (5-9.9" DBH) - Medium Stocked (40-69 ft² /acre basal area)

6 = Pole timber (5-9.9" DBH) - Well Stocked (≥ 70 ft² /acre basal area)

7 = Saw timber (≥ 10 " DBH) - Poorly Stocked (10-39 ft² /acre basal area)

8 = Saw timber (≥ 10 " DBH) - Medium Stocked (40-69 ft² /acre basal area)

9 = Saw timber (≥ 10 " DBH) - Well Stocked (≥ 70 ft² /acre basal area)



Phil, Larry, and Rob on a planning visit in Stand One, the DeWitt Nature Center.

Resource Descriptions

The United States Forest Service provides general guidelines for the contents of a Forest Stewardship Plan. The USFS guidelines suggest describing thirteen natural resources that are commonly present in a forest or may be of concern to the landowner. Important resources should be described in detail while resources that are not present or of little interest to the landowner may be discussed quite briefly.

Natural Resource Elements to be Described in a Forest Stewardship Plan.

1. Soil and Water
2. Biological Diversity
3. Aesthetics
4. Recreation
5. Timber
6. Fish and Wildlife
7. Threatened and Endangered Species
8. Forest Health
9. Archeological, Cultural, Historic Sites
10. Wetlands
11. Fire
12. Carbon Cycle
13. Agroforestry and Range

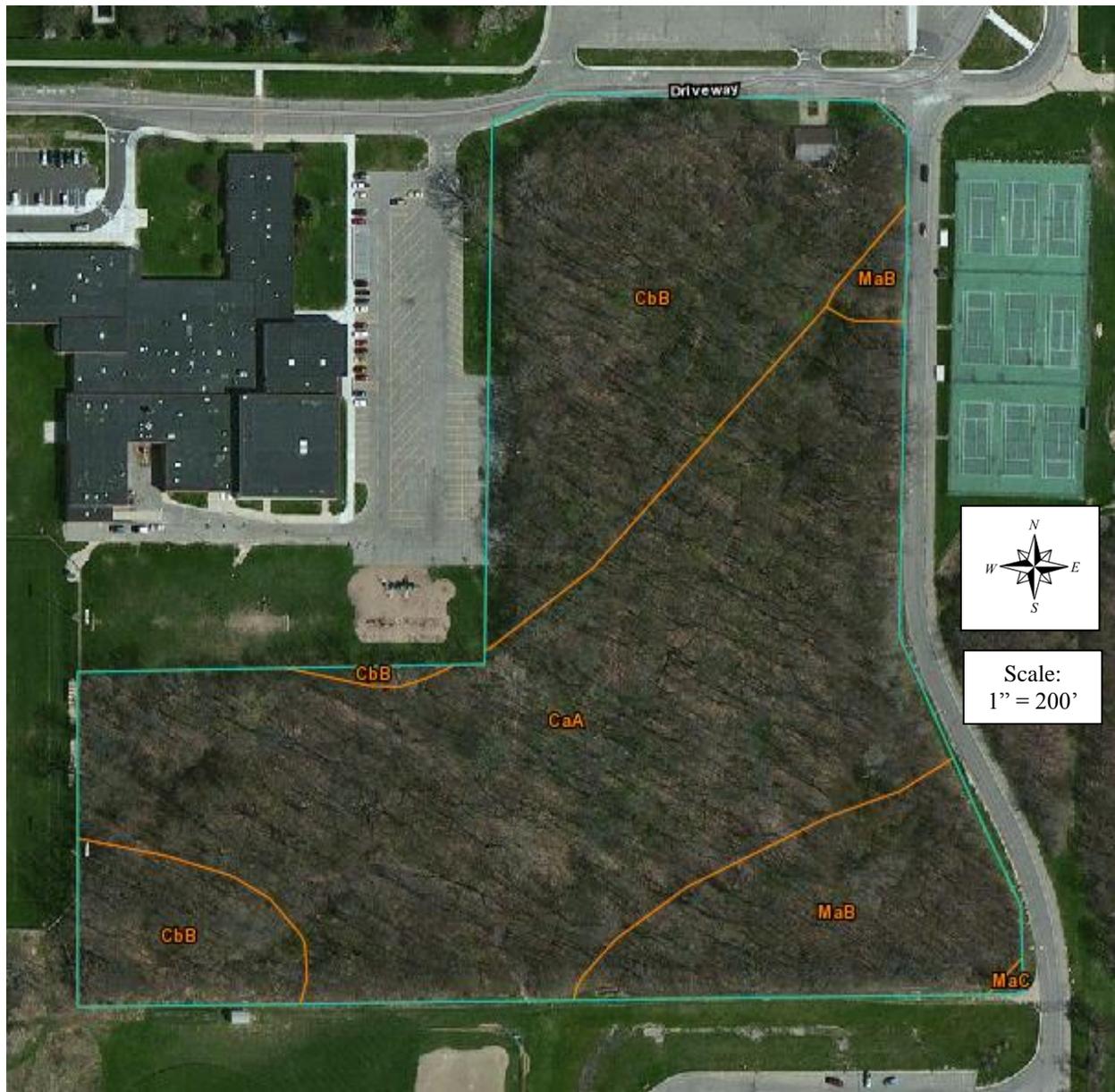
The DeWitt Public School has a 113.0 acre campus with a mixture of buildings, athletic fields, forest, and even agriculture. The property is well managed and its natural resources are in good condition. The property inspection and forest inventory conducted by the plan writer is the basis for the following description of the natural resources owned and managed by the School.



Agricultural field on school property between Stand Two and Stand Three.

Soils Maps

Figure 3a. Soil Map of Stand One (USDA Soil Web Survey).



Legend for Stand One Soil Types

Symbol	Soil Name	Percent Slope	Acres	Percent
CaA	Capac loam	0 to 4	8.3	54.0%
CbB	Capac-Marlette loams	1 to 6	5.1	33.0%
MaB	Marlette loam	2 to 6	2.0	12.9%
MaC	Marlette loam	6 to 12	0.0	0.1%
Totals for Area of Interest (AOI)			15.5	100.0%

Figure 3b. Soil Map of Stand Two (USDA Soil Web Survey).



Legend for Stand Two Soil Types

Symbol	Soil Name	Percent Slope	Acres	Percent
CaA	Capac loam	0 to 4	8.8	43.6%
CbB	Capac-Marlette loams	1 to 6	11.2	55.1%
UdB	Udorthents, loamy	0 to 8	0.3	1.3%
Totals for Area of Interest (AOI)			20.3	100.0%

Figure 3c. Soil Map of Stand Three (USDA Soil Web Survey).



Legend for Stand Three Soil Types

Symbol	Soil Name	Percent Slope	Acres	Percent
BnC	Boyer sandy loam	6 to 12	1.6	6.3%
CaA	Capac loam	0 to 4	8.0	31.0%
CbB	Capac-Marlette loams	1 to 6	4.1	15.8%
MaB	Marlette loam	2 to 6	12.1	46.4%
MaC	Marlette loam	6 to 12	0.1	0.5%
Totals for Area of Interest (AOI)			26.0	100.0%

MAP LEGEND

Area of Interest (AOI)		Area of Interest (AOI)		Spill Area
Soils		Soil Map Unit Polygons		Stony Spot
		Soil Map Unit Lines		Very Stony Spot
		Soil Map Unit Points		Wet Spot
Special Point Features		Blowout		Other
		Borrow Pit		Special Line Features
		Clay Spot	Water Features	
		Closed Depression		Streams and Canals
		Gravel Pit	Transportation	
		Gravelly Spot		Rails
		Landfill		Interstate Highways
		Lava Flow		US Routes
		Marsh or swamp		Major Roads
		Mine or Quarry		Local Roads
		Miscellaneous Water	Background	
		Perennial Water		Aerial Photography
		Rock Outcrop		
		Saline Spot		
		Sandy Spot		
		Severely Eroded Spot		
		Sinkhole		
		Slide or Slip		
		Sodic Spot		

Soil Map Source: <http://websoilsurvey.sc.egov.usda.gov/>

Soil Series Descriptions

NOTE: The following soil series descriptions are taken from the USDA's Soil Web Survey (<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>). The soils series are listed alphabetically and only the primary soil series are included (>10%).

Boyer Sandy Loam. The Boyer series consists of very deep, well drained soils formed in sandy and loamy drift underlain by sand or gravelly sand outwash at depths of 20 to 40 inches. The soils are on outwash plains, valley trains, kames, beach ridges, river terraces, lake terraces, deltas, and moraines. Slope ranges from 0 to 50 percent. Mean annual precipitation is 34 inches and mean annual temperature is 49 degrees F.

DRAINAGE: Well drained. Depth to the seasonal high water table is greater than 6 feet. Potential surface runoff is negligible to medium depending upon slope. Permeability is moderately rapid in the solum and very rapid in the substratum.

USE AND VEGETATION: Soils are cultivated in most areas. Principal crops are corn, small grain, soybeans, field beans, and alfalfa hay. A few areas remain in permanent pasture or forest. The dominant forest trees are oaks, hickories, and maples.

FORESTRY: The USDA reports that common trees growing on Boyer soils include basswood, black oak, red oak, sugar maple, and white oak. The site index for red oak is 66 and the expected annual growth rate is 57 ft³/acre. [Site index is the expected height at age 50 and is used to compare the quality of multiple sites for growing trees.] The USDA suggests managing for red pine, white pine, red oak, and white oak. Boyer soils are well suited for harvesting equipment.

Capac Sandy Loams. The Capac series consists of very deep, somewhat poorly drained soils formed in loam or clay loam till. These soils are on moraines and till plains. Slope ranges from 0 to 6 percent. Mean annual precipitation is 32" and mean annual temperature is 47 degrees F.

DRAINAGE: Somewhat poorly drained. Depth to the top of an apparent seasonal high water table ranges from 0.5 to 1.5 feet below the surface at some time from September to May in normal years. The potential for surface runoff is negligible to high.

USE AND VEGETATION: This soil is used to grow corn, beans, sugar beets, small grains, and grass-legume hay. A small part is in hardwood forest, pasture, or remains idle.

FORESTRY: The USDA reports that common trees growing on Capac soils include basswood, beech, bitternut hickory, black cherry, red oak, pin oak, red maple, sugar maple, and white ash. The site index for red oak is 65 and the expected annual growth rate is 57 ft³/acre. The USDA suggests managing for red pine, red oak, and white spruce. Capac soils are moderately suited for harvesting equipment because of low strength and wetness.

Marlette Sandy Loam. The Marlette series consists of very deep, moderately well drained soils formed in till. These soils are on till plains, ground moraines, and end moraines. Slope ranges from 2 to 12%. Mean annual precipitation is 33" and mean annual temperature is 48° F.

DRAINAGE: Moderately well drained. Depth to the top of a seasonal high water table ranges from 2 to 6 feet between October and May in normal years. Potential for surface runoff is medium or high depending upon slope. Permeability is moderately slow.

USE AND VEGETATION: Most areas are cropped to corn, beans, wheat, and grass-legume hay. A small part, usually the steeper areas, is in pasture or hardwood forest.

FORESTRY: The USDA reports that common trees on Marlette soils include basswood, black cherry, black oak, black walnut, red oak, pin oak, red maple, sugar maple, white ash, and white oak. The site index for red oak is 65 and the expected annual growth rate is 57 ft³/acre. The USDA suggests managing for black walnut, red pine, white pine, and white spruce. Marlette soils are well suited for harvesting equipment.

Stand One

Narrative Description – Stand One is the 15.5 acre DeWitt Nature Center in the center of the school campus. It is an uneven aged, very large sawtimber (>10” DBH – “diameter at breast height”) size stand with an exceptional distribution of size and age classes. The dominant species are red oak and red maple. The stand has good diversity with thirteen tree species occurring in the ten sample plots and at least five other trees species observed but outside the plots (around ten tree species is typical in a forest of this size). The stand is on Capac sandy loam, a somewhat poorly drained soil, and Marlette sandy loam, a moderately well drained soil.

Soil and Water. Stand One is growing on Capac sandy loam (somewhat poorly drained) and Marlette sandy loam (moderately well drained). Management activities should protect soil and water quality by minimizing soil disturbance and preventing erosion. The soil in Stand One should be protected by doing management activities that require heavy equipment when soils are frozen (Dec-Feb) or dry (late summer-fall). Consult the “Sustainable Soil and Water Quality Practices on Forest Land” at www.michigan.gov/privateforestland for more information about Best Management Practices to protect soil and water quality.

Site Quality and Site Index – Stand One has medium high site quality because of its moderately well drained soils. The site index for red oak on Capac soils is 65. (Site index is the expected height of a tree at age 50 and is used to compare the soil quality of different sites. See Table A11 in Appendix I for a comparison of different site index values.)

Biological Diversity. Stand One has a good mixture of tree species with thirteen tree species occurring in the ten sample plots. Stand One has 302 trees per acre with 75% in the 2” to 6” diameter size classes. The most common trees in Stand One are hophornbeam and black cherry with 25% and 24% of the trees per acre respectively. Hophornbeam is a small, shade tolerant tree that grows in the understory beneath larger trees. Most of the black cherry are pole size trees (5” to 10” DBH), but there are a few large black cherries in the stand. Sugar maple, another shade tolerant tree, has another 18% of the trees per acre, again mostly in small diameters. Red oak, the most dominant tree by size, is only 2% of the trees per acre. Other species in Stand One include ash, basswood, bitternut hickory, black oak, bur oak, musclewood, red maple, shagbark hickory, and white oak. I also observed a few sassafras, beech, boxelder, elm, and prickly ash, but these trees did not fall in the sample plots.

Aesthetic Quality. Stand One has excellent aesthetics because it is an old northern hardwoods forest dominated by very large red oak and red maple. It is highly visible in the center of the school campus surrounded by roads or parking lots on all sides.

Recreation. Stand One is heavily used by the school for education and the by the community for recreation. There are several walking trails in the stand that are frequently used by students and community members.

Roads and Trails – There are no roads for vehicle traffic in Stand One, but there is a nice network of foot trails used by teachers and students for outdoor education.

Timber. Stand One is a northern hardwoods forest that is dominated by big red maple and huge red oak. The DNR terminology for this cover type is “Or-Mr-9.” The “Or” represents red oak, the “Mr” represents red maple, and the “9” represents sawtimber size (>10” DBH) with a basal area of >70 ft² per acre (see legend for Figure 2).

Density – The basal area for Stand One is 133 ft²/acre. This is a high basal area for this forest as many mature hardwoods forests in southern Michigan have a basal area between 90 and 120 ft²/acre. Red oak, red maple, and bitternut hickory dominate the basal area with 21%, 20%, and 15% of the basal area respectively. [Note: The *basal area of a tree* is the area of the cross section of the trunk at 4.5 feet above ground. The *basal area of a stand* is the sum of each individual tree’s basal area. Basal area is an expression of the density of trees in a forest and is given in square feet per acre. Larger trees (14” DBH = 1 ft²) have a much bigger basal area and influence the basal area of a stand much more than small saplings (4” DBH = 0.1 ft²).]

Size Class – Stand One is a sawtimber size stand with 85% of the basal area in trees ≥10” in diameter. Merchantable sawtimber is usually in the 16” to 24” DBH range.

Stand Quality – Stand One has outstanding stand quality from a timber perspective because many of the abundance of very large, high quality trees in valuable commercial species like red oak, black cherry, and sugar maple.

Age – Stand One is an uneven aged stand with many age classes that has been a mature forest for decades (see 1950 aerial photo in Appendix II that shows closed forest cover). The stand has a good distribution of size classes from 2” to 48” diameters indicating an “old growth” ecosystem.

Volume – The merchantable volume in Stand One in trees ≥10” DBH is 13,271 board feet per acre using the Doyle log rule. This is an exceptional volume for a mature northern hardwoods forest with oak, hickory, and maple. For comparison, many mature hardwood forests in southern Michigan have between 5,000 to 10,000 boardfeet per acre. Red oak, red maple, and bitternut hickory again dominate the merchantable volume.

Stand Harvest History – About 35 trees near the trails were removed in 2012 for public safety (mostly dead or dying ash). This stand has not had a commercial harvest since the school bought the property in the early 1970s.

Fish and Wildlife. Stand One has adequate cover for wildlife habitat and many oaks that produce “hard mast” acorns. There are no lakes or streams in the Stand for fish.

Threatened and Endangered Species. The Michigan Department of Natural Resources (DNR) and the Michigan Natural Features Inventory (MNFI) report that there are not any known threatened or endangered species present in this part of DeWitt Township.

Forest Health. Emerald Ash Borer is the primary insect problem with signs (insect damage) and symptoms (plant response) of infection in all ash trees. I did not observe other insect or disease issues. Living ash trees are a minor component with only 1% of the stand basal area.

Noxious and Invasive Species Present – I did not observe any invasive plants in Stand One.

Archeological, Cultural, and Historic Sites. The DNR reports that the archeological database does not show any concerns for historical sites in DeWitt Township. Standard Seven of the American Tree Farm System is Protect Special Sites – “Special sites are managed in ways that recognize their unique historical, archeological, cultural, geological, biological or ecological characteristics.” There are no known issues on the property. While not likely a virgin forest that was never harvested, Stand One is a nice example of a very old forest.

Wetlands. I did not observe any surface water or wetlands in Stand One. More information about wetlands can be found on the DEQ website at www.mcgi.state.mi.us/wetlands/.



Stand Two

Narrative Description – Stand Two is a northern hardwoods forest where black cherry dominates the trees per acre (numbers), basal area (size), and merchantable volume (value) of the stand. Stand two is approximately 20.3 acres. The stand is uneven aged with many ages and size classes. The stand has good diversity with at least nine species occurring in the ten sample plots and at least another three tree species that did occur in the plots. Stand Two is on Capac sandy loam (somewhat poorly drained) and Marlette sandy loam (moderately well drained). There are about a dozen mature trees, mostly black cherry, that appear to have fallen recently – either windthrow from a wind storm after the February 2013 timber harvest or ice damage after the December 2013 ice storm.

Soil and Water. Stand Two is growing on Capac sandy loam (somewhat poorly drained) and Marlette sandy loam (moderately well drained). The soil should be protected from any heavy equipment by conducting management activities when soils are frozen or dry.

Site Quality and Site Index – Stand Two has medium high site quality because of its moderately well drained soils. The site index for red oak on Capac soils is 65.

Biological Diversity. There are 145 trees per acre in Stand Two with 47% in the small 4” to 8” diameter classes. The most common species are black cherry and sugar maple with 40% and 32% of the trees per acre respectively. The only other species with more than 10% of the trees per acre is red maple. The other species in the sample plots include basswood, black oak, elm, pignut hickory, sassafras, and white oak. I also observed ash, beech, and bigtooth aspen outside of the ten sample plots for at least twelve tree species in the stand.

Aesthetic Quality. Stand Two is not as majestic as Stand One, but it does have good aesthetics for a moderately old forest. The excessive number of grape vines impairs the aesthetics. Stand Two is on the south end of the campus, but it is visible from Interstate 69.

Recreation. Stand Two is used by the school for educational purpose and also by the community for recreation. Stand Two appears to have less recreational use than Stand One.

Roads and Trails – There are not any roads for vehicle traffic in Stand Two, although a gas pipeline does bisect the stand that could be used for light vehicles. Any walking trails in the stand are not obvious apart from a path along the north edge of the stand.

Timber. Stand Two is a northern hardwoods forest dominated by black cherry. The DNR code for this stand is Mc-9 where the “Mc” is black cherry and the “9” is a sawtimber size stand with a basal area > 70 ft²/acre.

Density – The basal area in Stand Two is 94 ft²/acre. This is a good basal area for a mature forest that has been harvested within the past year. Black cherry trees dominate the stand with 47% of the basal area. Red maple and sugar maple are secondary species with 22% and 16% basal area respectively. None of the other six tree species have even 5% of the basal area.

Size Class – Stand Two is a sawtimber stand with 87% of the basal area in trees ≥10” DBH.

Stand Quality – Stand Two has good stand quality from a timber perspective because of the abundance of black cherry, red maple, and sugar maple that all have good commercial value.

Age – Stand Two is an uneven-aged stand with many age classes and a good distribution of size classes. The stand appears to be a mature forest in the 1950 aerial photo in Appendix II.

Volume – The merchantable volume of Stand Two is 6,109 boardfeet per acre using the Doyle log rule. This is an average volume for a mature black cherry forest, but I am not sure how much volume was removed in the 2013 harvest. For comparison, many mature hardwood forests in southern Michigan have between 5,000 to 10,000 boardfeet per acre.

Stand Harvest History – This stand was harvested in February of 2013 by Maple Rapids Lumber Mill.

Fish and Wildlife. Stand Two has thick cover for wildlife habitat and both soft mast (cherries) and hard mast (acorns, nuts) bearing trees for wildlife. There are no lakes or streams for fish.

Threatened & Endangered Species. None present - see Stand One.

Forest Health. I did observe Emerald Ash Borer in the few ash trees in Stand Two. Live ash trees did not occur in any of the ten sample plots so ash is a very minor component in the stand. Dutch Elm Disease is a secondary forest health issue, but elm is a minor component at 2% basal area.

Noxious and Invasive Species – I did not observe any noxious or invasive species in Stand Two. However, while grape vines are not exotic or even invasive, per se, there are many large grape vines (>5” diameter) in Stand Two that are damaging the crowns of many mature and high value trees. Poison ivy is also very common in the stand so students and other visitors should know how to identify the dreaded poison ivy vine.

Archeological, Cultural, and Historic Sites. None present - see Stand One.

Wetlands. – I did not observe any surface water or wetlands in Stand Two. More information about wetlands can be found on the DEQ website at www.mcgi.state.mi.us/wetlands/.



Black cherry and sugar maple leaf stuck to the sap of a black cherry tree.

Stand Three

Narrative Description – Stand Three is a northern hardwoods forest dominated by young red maple. It is the largest of the three school forests at 26.0 acres, and is located east of the tennis courts extending all the way to DeWitt Road. The forest is a mixture of even age trees about 35 years old on either end of the stand and larger, uneven age trees by the wetland in the middle of the stand. The forest is growing on a mixture of soil types including well drained, moderately well drained, and somewhat poorly drained soils. The stand contains early succession forests that are valued for high quality wildlife habitat.

Soil and Water. Stand Three is growing on Capac sandy loam (somewhat poorly drained), Marlette sandy loam (moderately well drained), and Boyer sandy loam (well drained) soils. The soil should be protected by conducting any management activity that requires heavy equipment when soils are frozen (Dec-Feb) or dry (late summer-fall).

Site Quality and Site Index – Stand Three has medium high site quality because of its moderately well drained soils. The site index for red oak on Capac soils is 65.

Biological Diversity. There are 287 trees per acre in Stand Three with 64% in the small 2” to 4” sapling size classes. The most common species by far is red maple with an extremely high 71% of the trees per acre, largely because of the abundance of the small 4” diameter red maples on the western and eastern thirds of the stand. The only other species with at least 10% of the trees per acre is elm. The other species in the sample plots include basswood, black cherry, black oak, cottonwood, hophornbeam, musclewood, pignut hickory, red oak, and sugar maple. I also observed ash, hawthorn, and shagbark hickory outside of the ten sample plots for at least fourteen tree species in the stand.

Aesthetic Quality. Stand Three is the youngest of the forests and also has the least aesthetic qualities. It is highly visible from DeWitt Road but less so from the campus.

Recreation. Stand Three has an extensive trail network and is used frequently by athletic programs for trail running.

Roads and Trails – There is a cross country running trail that loops throughout the stand that appears to be large enough to allow for vehicle traffic if necessary.

Timber. Stand Three is a northern hardwoods forest dominated by red maple. The DNR code for this stand is Mr-9 where the “Mr” is red maple and the “9” is a sawtimber size stand with a basal area > 70 ft²/acre.

Density – The basal area in Stand Three is 83 ft²/acre. This is a low basal area for a mature forest, but most of Stand Three is quite young and the middle third was harvested within the past year. Red maple dominates the stand with a very high 61% of the basal area. Cottonwood is a secondary species with 11% basal area, growing mostly near the marsh in the middle.

Size Class – Stand Three is a sawtimber size stand with 67% of the basal area in trees ≥10”.

Stand Quality – Stand Three has average stand quality from a timber perspective because of the abundance of small red maples that are several decades away from maturity. The stand does have good potential for future timber management and the stand has good wildlife value now with the relatively early succession habitat.

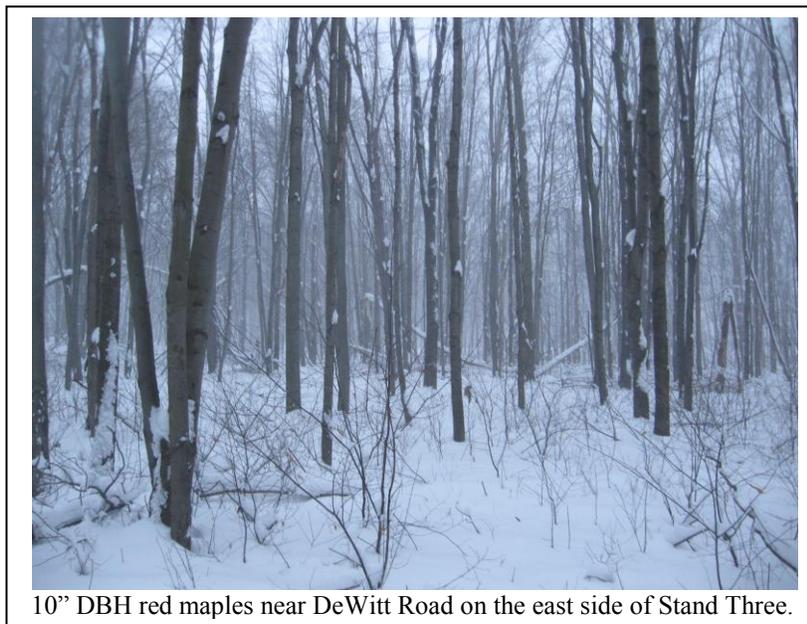
Age – Stand Two is a mix of both even age trees about 35 years old and uneven age trees of various ages. Many of the red maples are even aged and started about the same time when agriculture was abandoned in the late 1970s. The western and eastern thirds of the stand were agricultural land in the 1973 aerial photo in Appendix II. The middle third of the stand was not farmed because it was too wet so it is uneven-aged with many age classes and a larger distribution of ages and size classes. The stand should be managed using uneven aged silviculture even if it is mostly an even aged stand (more in the Recommendations section).

Volume – The merchantable volume of Stand Three is 3,902 boardfeet per acre using the Doyle log rule. This is a low volume for a red maple forest, but it is appropriate for a young forest and a forest that had a limited timber harvest within the past year. For comparison, many mature hardwood forests in southern Michigan have between 5,000 to 10,000 boardfeet per acre.

Stand Harvest History – A few mature trees in the middle of this stand were harvested in February of 2013 by Maple Rapids Lumber Mill.

Fish and Wildlife. Stand Three has excellent wildlife habitat with thick cover, mast bearing trees, and water available most of the year for wildlife. The small pond in the middle of the stand does not likely support any fish.

Threatened & Endangered Species. See Stand One.



Forest Health. It appears that the Emerald Ash Borer has already killed all the ash trees in Stand Three. Most of the large ash trees were growing near the wetland in the middle of the stand. Dutch Elm Disease is a secondary forest health issue, but elm is a minor component at 8% basal area. I did not observe any noxious or invasive species in Stand Three.

Archeological, Cultural, and Historic Sites. None present - see Stand One.

Wetlands. – Stand Three contains one of the few sources of surface water on the entire 113.0 acre campus with a small wetland in the middle of the stand. More information about wetlands can be found on the DEQ website at www.mcgi.state.mi.us/wetlands/.

Entire Property

The following resources are not major concerns for the DeWitt Public Schools at the stand level and can be described in general terms for the entire property.

Fire. 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 insured professionals. More information about prescribed fire is available on the Michigan Prescribed Fire Council website at <http://firecouncil.org>.

Wildfire is not a significant risk in Clinton County or for the forest types present on the DeWitt School campus. However, more information about minimizing the risk of wildfire in Michigan can be found at <http://firewise.msu.edu>.

Carbon Cycle. Carbon dioxide is removed from the atmosphere through photosynthesis and decomposition of organic matter into the soil. Carbon dioxide is then released to the atmosphere through respiration, deforestation, and soil tillage. More than 63% of the terrestrial carbon stocks in Michigan's forests are in soil organic carbon while only 19% is in the above ground biomass (trunk, branches, leaves). Below ground biomass (roots), dead wood, and litter (dry leaves) make up the remaining 17% of the carbon stocks in Michigan's forests. More information about the forest carbon cycle is at www.fs.fed.us/ecosystems/services/carbon.shtml.

Agroforestry and Range. Agroforestry is a land-use system that combines both agriculture and forestry in one location. The five most common agroforestry systems in temperate regions like Michigan are alley cropping, forest farming, riparian forest buffers, silvopasture and windbreaks (see definitions in the glossary in the Appendix 1). The DeWitt Public School is not presently doing any agroforestry practices in their forest. More information about agroforestry can be found at the Center for Agroforestry website at www.centerforagroforestry.org.

Range generally refers to grazing cattle in natural landscapes. Free ranging cattle are more common in the national forests in the western United States, but the practice is rarely used in Michigan.

Recommendations

My role as a consulting forester is to provide you with relevant, science-based information that will help you to make your long term plans and a series of informed decisions over the next ten years as you manage your forest. I hope that the data and information in this plan will help you decide what actions to take or other conservation practices to implement to accomplish your goals. We can discuss multiple management options and their potential consequences based on sound forestry science, but you always have the final decision regarding your property. There are several places in this forest management plan where you can make notes to record your decisions over the next ten years. Forests in themselves do not *require* human management. Unless it is subdivided and paved over, your forest should be just fine for hundreds of years after we have died. All management activities reflect human values and desired future conditions. However, there is nothing wrong with imposing your human values on your forest, especially when the following recommendations and your actions are based on the stewardship ethic found on page two or other similar land use values and environmental ethics. The recommendations in a Forest Stewardship Plan are voluntary unless the property is enrolled in the Commercial Forest Act or the Qualified Forest Property program (see information in Appendix I). Participation in some NRCS cost share programs may also require complying with the specifications in an approved forest management plan in order to comply with a federal contract.

Stand Specific Goals Statement (Desired Future Conditions)

Forestry management activities are meant to accomplish the landowner's goals for that particular stand and to bring about desired future conditions for the forest. The primary mission of the DeWitt Public Schools is to provide outdoor education for school children and adult community members. The goals for the entire property include outdoor education, maintaining aesthetics, recreation and athletics, providing wildlife habitat, protecting soil and water quality, and conducting sustainable timber harvests. All forest management goals and activities at these school forests should first consider their impacts on public safety. Please be vigilant in regularly monitoring for hazardous trees in the forest and removing them quickly and safely. The three stands of the DeWitt Public Schools forest are very different from each other in age, species composition, and past management. The unique attributes of each stand provide a great opportunity to showcase diverse management activities suited for their respective ecosystem.

Stand One – This 15.5 acre red oak and red maple forest has outstanding aesthetics and good biodiversity for outdoor education. It has high quality veneer and mature sawtimber trees with very high economic value. However, the DeWitt Nature Center also has some old growth characteristics that provide even higher non-consumptive values to the community. Therefore, the school board and administrators have agreed to protect the very large trees and allow natural processes to drive the changes in the ecosystem. This stand will be managed as a preserve with minimal, low intensity human management activities to provide a high quality outdoor classroom for the DeWitt Public Schools and the local community.

Stand Two – This 20.3 acre sawtimber size black cherry forest has good biodiversity and above average potential for sustainable timber production of high value forest products. This stand is also used for educational purposes, but possibly less frequently than the Nature Center. However, because this stand is very different from Stand One, it too provides great opportunities for outdoor education right outside the doors of the high school. I suggest managing this stand to demonstrate sustainable timber production that is compatible with the educational mission of maintaining biodiversity, improving forest health, and providing a high quality outdoor classroom.

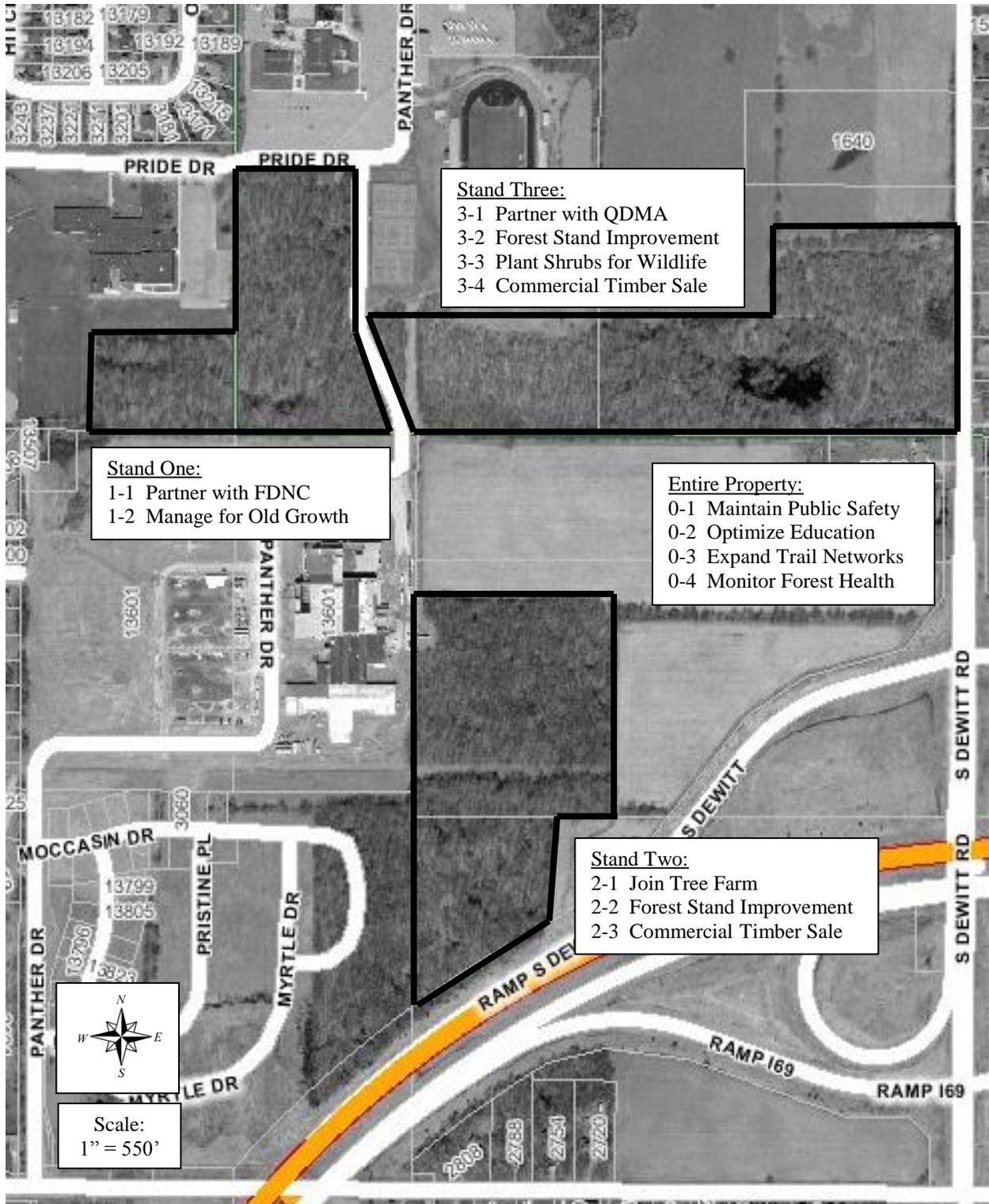
Stand Three – This 26.0 acre red maple forest is relatively young compared to the other woodlots on the school campus. While this young age limits the timber production potential for several decades, the early succession stage of this stand provides very good wildlife habitat. I suggest managing Stand Three for its wildlife habitat values as this activity could provide partnership opportunities with local hunting and wildlife organizations for natural resource education that could benefit students and adults in the community. Managing for quality wildlife habitat is also compatible with the current use for recreation and athletics.

Schedule of Prescribed Activities for the Next Ten Years

The following recommendations fall into two major categories – those with the potential for Natural Resources Conservation Service (NRCS) cost share funding for their “planned conservation practices” and those that have other “additional management considerations” that are not covered by any NRCS cost share program. While public schools are not usually eligible for NRCS cost share funding, it may be possible to get some funding if the activity is done by a private party with a lease arrangement with the school. Even though the school may not require the cost share funds or desire to enter into a lease agreement, I include NRCS specifications in every forest management plan so that the plan provides options for the landowner to consider. Common NRCS forestry conservation practices include tree/shrub establishment, forest trails and landings, brush management, early succession habitat, and forest stand improvement. I will include NRCS specifications for conservation practices eligible for NRCS cost share funding. Commercial timber sales are eligible for NRCS cost share, but I am skeptical that a forest landowner could win a competitive award for that practice so I do not usually include NRCS specifications for timber sales. There are also many additional management practices not typically covered by the NRCS including: surveying property lines and corners, enrolling in property tax programs, joining the Tree Farm and other forestry associations, or other management activities where the activity produces income rather than an expense.

Activity Map

Figure 4. Activities map of the DeWitt School Forests.



Activities Map Legend:

Entire Property

- Activity 0-1 Maintain Public Safety
- Activity 0-2 Optimize Educational Opportunities
- Activity 0-3 Maintain and Expand Trail Networks
- Activity 0-4 Monitor Forest Health

Stand One

- Activity 1-1 Partner with Friends of DeWitt Nature Center and other Conservation Groups
- Activity 1-2 Manage for Old Growth Forest Ecosystem

Stand Two

- Activity 2-1 Join Tree Farm and other Forest Owner Groups
- Activity 2-2 Forest Stand Improvement
- Activity 2-3 Commercial Timber Sale

Stand Three

- Activity 3-1 Partner with Quality Deer Management Association or other Wildlife Groups
- Activity 3-2 Forest Stand Improvement
- Activity 3-3 Plant Shrubs for Wildlife
- Activity 3-4 Commercial Timber Sale



General Activities for the Entire Property

Activity 0-1 Maintain Public Safety

Because these public forests are used by hundreds of students and the general public every year, maintaining a safe environment must be the top priority for the DeWitt Public Schools. All forested areas should be intentionally monitored at least quarterly for hazardous trees, especially near trails. School staff and community volunteers should walk through the forest looking up for broken branches, leaning trees, or defective trunks that may soon fall. Mark any hazardous tree with bright paint or flagging to alert visitors and also to identify trees for removal. Keep a written record of trees identified as hazardous and when they are removed. While timber harvests every decade or so can be used to remove unsafe trees, it will be necessary to hire a local arborist to remove very hazardous trees near trails and other high traffic areas on more frequent basis as needed based on weather events. *The DeWitt Public Schools should also consider hiring a certified arborist to give a professional evaluation of potentially hazardous trees at a minimum of once each year, likely in the summer before school starts.* Look for an arborist with International Society of Arboriculture certification (www.isa-arbor.com).

Other potential hazards in the forest include old fencing or other tripping hazards. The entire network of trails should be inspected quarterly to identify ground hazards that may need to be corrected. While the very small wetland in Stand Three does not look deep enough to be a drowning hazard, it may be worthwhile to have a throwable flotation device available in case of emergency. I observed several wasp nests in the forests so it may be a good idea to scout along the trails for stinging insects. Students with known allergies to insects should have an epinephrine pen available. I saw lots of poison ivy vines growing on the trees in Stand Two so teachers should help students to identify this dreadful plant to avoid unpleasant allergic reactions.

I have also included several publications in the Appendix for some example school forest safety policies. It may be prudent to develop a written safety policy to provide guidance to teachers bringing students into the forest and for community members volunteering in or just visiting the forest.

Activity 0-2 Expand Educational Programs for Forest Ecosystems

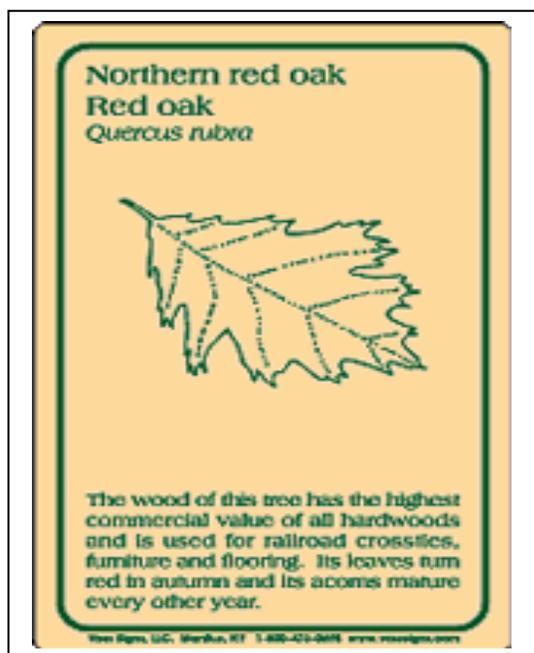
The DeWitt Public School 113.0 campus provides excellent opportunities for outdoor education in both forest and non-forest ecosystems. All three school forests, not just the Nature Center, are forest ecosystems worthy of study, appreciation, and enjoyment.

The school forests offer an unlimited variety of learning opportunities for all grade levels in science, math, economics, history, social studies, art, and technology. The forests are an obvious science laboratory for ecological studies to examine soils, plants, insects, birds, and mammals in the forest (and agricultural) ecosystem. There are multiple math lessons in forest inventory methods and data that include traditional objectives like measuring boardfeet or newer objectives like quantifying the carbon stocks in the five terrestrial carbon pools of above ground biomass, below ground biomass, dead wood, leaf litter, and soil organic carbon. (The dead wood pool is very large in Stand One and Two but quite small in Stand Three.) Stand One, the Nature Center, is a great case study to examine the economic value of forest products, the value of ecosystem

services like carbon sequestration, and methods to quantify non-consumptive economic values that cause society to preserve large trees rather than harvest them. The aerial photos in the Appendix clearly illustrate the land use change history of the school and surrounding properties over the past sixty years. The community conversation in the summer of 2012 is a great social study, and a microcosm of the nationwide debate in the 1970s and 1980s to preserve federal forests rather than continue with high levels of timber harvesting on public forest lands.

One way to expand the educational value of the forest is to add labels that identify the species and give some brief information about the tree. If you decide to label some trees, be sure to use their Latin name as many tree species have multiple common names. See Table A10 in the Appendix for a list of common trees in Michigan. Voss Signs, and likely other commercial vendors, sell informational signs that identify and describe many tree species in North America. See Figure 5 for an example. The signs should be placed on ground plaques or attached to the tree in a way that does not damage any high value tree that may be included in a future timber sale or is being preserved as old growth.

Figure 5. Example tree identification sign from a commercial source.



(Source: www.vosssigns.com/Tree.htm)

One idea for a student project that integrates technology with natural resources education is to have students design and develop Quick Response Codes (QR) to be placed throughout the forest. These QR matrix bar codes can be scanned with a smartphone to connect the user to a website with much more information about the tree or ecosystem or management practices identified by the QR code. This new technology allows visitors to access much more information in the forest than can be placed on the small and fixed signs as shown in Figure 5.

It might also be possible to integrate a student art project with natural resources education by having art students draw the leaf shape of common trees in the forest. These drawings can be incorporated into signs made by the students for laminating or engraving onto a plaque. The text to describe each tree species can be taken from tree identification books or other sources.

If you do conduct any large scale forest management activities like commercial timber sales, hazard tree removal, or tree planting, you should also put up some larger signs that explain the goals and methods of the land management activities. Include information about the objectives, methods, costs/profits, date of the activity, etc. Be sure to include some *before and after photos* to illustrate the impacts of the activity. Contractors that perform the work (like Maple Rapids Lumber Mill for the 2013 timber harvest) may be interested in sponsoring the cost of the signs as a way to showcase their work and advertise their services to the community.

There are many great resources that provide lesson plans and ideas for outdoor education. One of the best forestry programs is developed by Project Learning Tree, sponsored by the American Forest Foundation. Project Learning Tree (PLT) provides great educational plans for pre-kindergarten all the way through twelfth grade. Ada Takacs is the PLT coordinator for Michigan (takacs@michigan.gov) and she can arrange workshops for teachers at DeWitt Public Schools to learn more about the PLT curriculum. See www.michiganplt.org for more information.

Michigan Forests Forever, sponsored by Michigan State University Extension, the Michigan Forest Resource Alliance, and the Michigan Forest Association, provides a teacher's guide on many forestry topics at www.mff.dsisd.net/Default.htm. Michigan Forest Pathways, sponsored by the Michigan Forest Association and MSU Extension also provides K-12 forestry curriculum at www.miforestpathways.net/4-Curriculum.htm. Contact Bill Cook of MSU Extension in Escanaba at cookwi@msu.edu for more information.

One of the best books on the need for outdoor education is *Last Child in the Woods: Saving Our Children from Nature Deficit Disorder* by Richard Louv. It is available at www.amazon.com or www.richardlouv.com. Don Dickmann, a retired MSU Forestry professor, and David Glenn, a Michigan high school science teacher, have published a forestry book for high school science classes called *Forestry Field Studies: A Manual for Science Teachers*. It is available at www.amazon.com or www.forestry-suppliers.com.

Other resources for K-12 outdoor education include Project WET, Project WILD, Future Farmers of America, Council for Environmental Education, North American Association for Environmental Education, and Children and Nature Network. Contact information for these groups is available at www.smalliganforestry.com/teachers.html.

Activity 0-3 Maintain and Expand Forest Trails, NRCS Code #655 , 6925 feet, fall 2015-17

A good network of trails throughout the school forests will facilitate public safety, promote the educational value of the forests, and minimize the impact of hundreds of visitors to the forest. It will be more cost effective to prioritize and remove hazardous trees that are localized along a trail network rather than removing every hazard tree throughout the entire 61.8 acre forest. Trails facilitate access to the forest that makes it easier for teachers to bring their students to the forest in a single class period. Trails that are barrier free will also allow all students to enjoy and

learn about the forest. Trails also direct heavy traffic towards areas that are suited for high volumes of visitors to minimize the impacts of hundreds of feet and hands exploring the forest. The Friends of DeWitt Nature Center are doing a great job of maintaining and expanding the trail network in Stand One, the Nature Center. The FDNC has developed almost 900 feet of new trails in 2013 using local materials like 1,260 wheelbarrow loads of woodchips and about 1,000 hours from more than 200 volunteers including both school children and community members.

All three stands will benefit from continued efforts to maintain existing trails and to add new trails where appropriate. The DeWitt Public Schools currently has about 7,000 feet of existing trails – an outstanding resource! Stand Two in particular could benefit from developing a loop around the perimeter in the stand to facilitate access and learning about this interesting black cherry forest. The understory is not too thick to prevent easy walking without a trail, but adding a new trail will allow for the benefits described above. Stand Three has an extensive trail network over 3,750 feet long for cross country running, but it would benefit from a trail through the middle of the stand to connect existing loops. Stand One, with its good network of trails about 2,400 feet long, does not appear to have a trail to the southeast corner of the Nature Center.

Building trails is hard work as illustrated by the big numbers of volunteer hours required to expand the trail network in Stand One. Trail building can be a great effort or expense, but there are some options available for reducing the expense for *private* forest owners. The Natural Resources Conservation Service (NRCS) offers several cost-share programs that might provide partial funding for certain forest management activities. The most common program for forest landowners is the Environmental Quality Incentives Program (EQIP). This program requires a forest management plan to guide the implementation of some activities and this Forest Stewardship Plan is an approved NRCS forestry plan. Potential cost-share activities include forest trails & landings, planting trees & shrubs, forest stand improvement, early succession habitat development, and stream habitat improvement. These cost-share programs offer some generous payments, but the process of qualifying for these government programs can be long, tedious and often highly selective.

Public schools are usually not eligible for NRCS cost share funding because they are not a private landowner. However, a private group like the Friends of DeWitt Nature Center *may* be eligible for receiving NRCS cost share funds if they have a lease arrangement for some management activities with the school. Contact your local NRCS District Conservationist for Clinton County in St Johns for more information and to explore this option (2343 North US-27, St Johns, MI 48879; 989-224-3720). As with all federal programs, there is plenty of paperwork involved so plan ahead for many months of effort and be ready for a slew of acronyms and applications. The contracts, awarded once a year in late winter, usually allow three years to perform the work described in the contract. See www.smalliganforestry.com/programs.html for information and links to these programs. If you do apply for NRCS funding for one or more of the following activities, I provide NRCS specifications in this Forest Stewardship Plan to help you comply with NRCS requirements for implementing their cost share contracts. The NRCS conservation practice code for Forest Trails and Landings is #655.

NRCS Specifications for Forest Trails and Landings #655

Site Map – Figure 6 shows the approximate location of current trails (yellow lines) and suggested location for some potential new trails (red lines). The primary objectives for building new trails are to facilitate outdoor education, enhance recreation, and optimize efforts to maintain safety.

Timing – If the Friends of DeWitt Nature Center or other private group applies NRCS funding in 2014, they *may* get a contract award early in 2015. Trail building in Stand One should wait until the fall of 2015 to avoid wounding red oaks during “oak wilt season.” Stands Two and Three have very few oaks so trail construction work could occur any time when soil conditions are suitable. Many NRCS contracts have a three year window for completion.

Detailed Design Information – Most of the school forests are internal within the school property boundaries where property corners and lines are not relevant. The property line for the western side of Stand Two should be confirmed before building a trail along the west edge of the stand. The soils throughout all three stands are moderately well drained and suitable for trails, except for near the wetland in the middle of Stand Three. The trail surface should be slightly crowned to encourage drainage.

Length, Width and Slope of Trails – The topography is relatively flat throughout the property so the slope of the trails and potential for soil erosion are minimal concerns. The width of the foot trails should be six to eight feet to allow for easy access for groups of students. The trail around the perimeter of Stand Two could be wider, about twelve to fourteen feet, to accommodate vehicles in future timber harvests. The foot trail on the southeast side of Stand One might be about 425 feet long. The trail around the perimeter of Stand Two might be about 3,300 feet long. The connecting trails in Stand Three might be about 1,700 feet long and the loop to the northeast corner about 1,500 feet long. The total length of potential new trails is around 6,925 feet.

Location of Buffer Zones for Streams – Roads and trails should be kept 100 feet from rivers or lakes for a riparian buffer zone if possible. There are no streams or lakes on the school property.

Location of Structural Erosion Control – All forest trails should comply with the “Sustainable Soil and Water Quality Practices on Forest Land.” These guidelines are available online at http://www.michigan.gov/documents/dnr/IC4011_SustainableSoilAndWaterQualityPracticesOnForestLand_268417_7.pdf.

Specifications for Timing of Operating – Fall is likely the best time to construct trails on the property. The work could also take place in the winter, but avoid constructing the trails in the spring (wet soils) in any stand and the summer in Stand One (prevent oak wilt). This activity can certainly be done over the course of several years with higher priority trails done earlier.

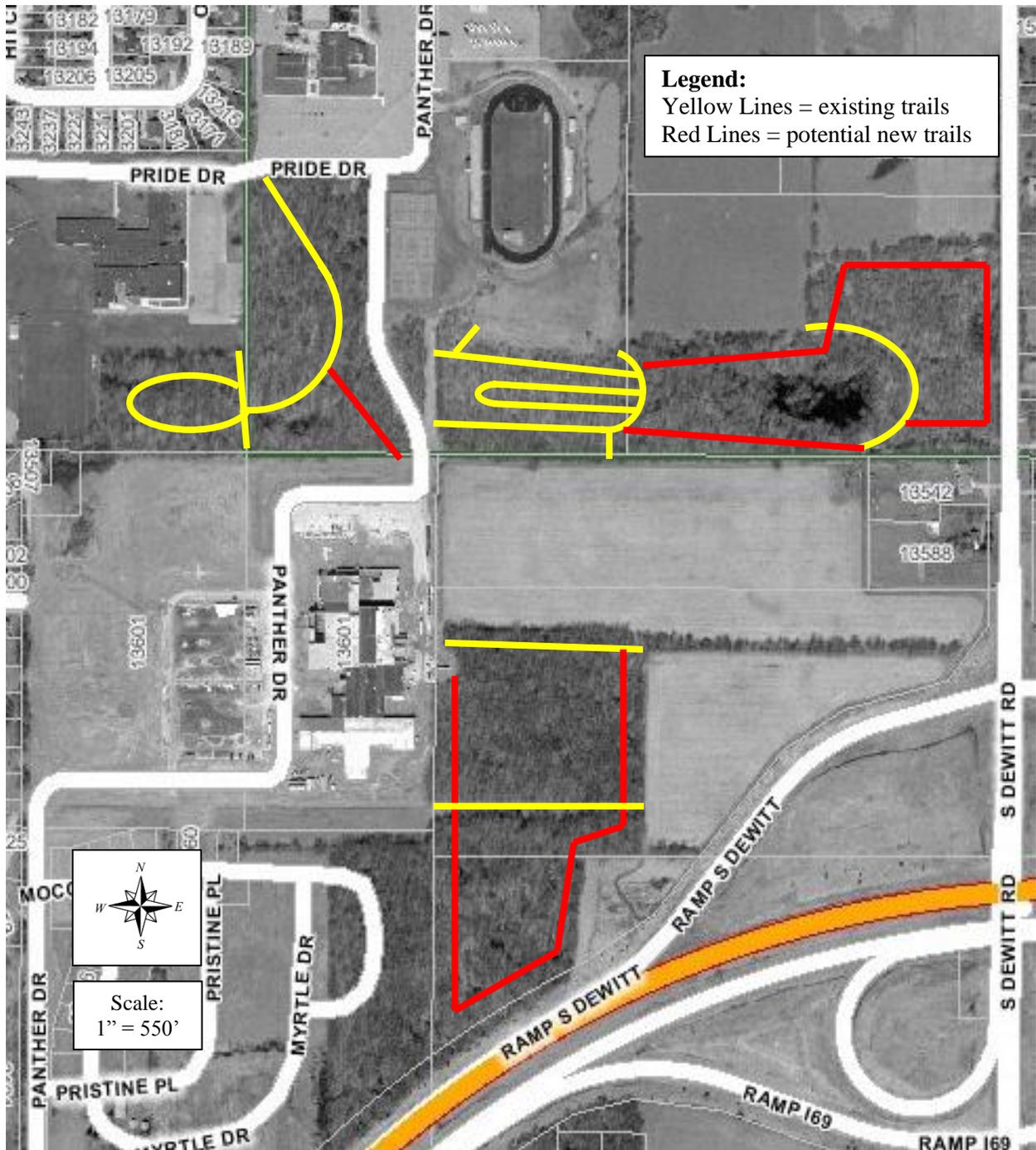
Location of Seeding Sites – Forest trails should be seeded with vegetative cover to help stabilize soil and prevent erosion. An alternative is to continue using wood chips as a mulch to protect the soil.

Seeding Species, Rates and Planting Information – Use native species for re-vegetating trails when possible. Be sure to select species that tolerate shade for the forest trails. Potential species that could provide vegetative cover for erosion control and utility as a food plot for wildlife

habitat value include annual rye, Alsike clover, brassicas, and turnips. Follow rates and planting recommendations on the seed packaging.

Operation and Maintenance – Conduct regular inspections of the trails and landings in every season of each year. Note especially the condition of the trails after heavy rain events, spring thaw, or heavy use of the trails from special events.

Figure 6. Approximate location of existing and potential trails in the three school forests.



Activity 0-4: Monitor Forest Health Annually

Forest health is an issue of moderate concern in the DeWitt Public Schools forest. The few remaining live ash trees in the three stands show signs (insect damage) and symptoms (plant response) of the Emerald Ash Borer (EAB). There are a few elm trees in Stand Two and Three so Dutch elm disease is also likely to be present. There are many large red oak trees in Stand One, but I did not see any indication of oak wilt. Beech bark disease has not arrived in Clinton County yet but it may in the next decade. I recommend monitoring the forest regularly (each year and during different seasons) for changes that may indicate additional insect or disease problems. There are several new insects (Asian longhorn beetle) and diseases (Thousand cankers for black walnut) that are impacting forests in other states and are not yet present in Michigan. However, informed landowners should monitor their forest and report any unusual problems to the DNR for an early response to a new pest outbreak. See the DNR publication, *2012 Forest Health Highlights*, in the Appendix for more information.

Emerald Ash Borer. The Emerald Ash Borer (*Agrilus planipennis*) is attracted to both healthy and stressed (dying) ash trees. Almost all of the ash trees on the campus are already dead and most living ash trees of commercial value in Stand Two were included in the February 2013 timber sale or were felled by an arborist in Stand One. Harvest smaller ash trees in a forest stand improvement activity for firewood. Clinton County is within the Level One Quarantine Area and logs or firewood cannot legally leave the Lower Peninsula. Girdled trees could be left standing to provide tall snags for wildlife but ash crowns quickly become brittle and fall apart so this may be a safety concern with children playing in the forest. See bulletins in the Appendix or www.emeraldashborer.info for more information about EAB.

Dutch Elm Disease. Dead elm should be removed to minimize the spread of Dutch elm disease that is killing the few elm trees on the property. Dutch elm disease is caused by a fungus (*Ophiostoma novoulmi*) and is transported by elm bark beetles (*Hylurgopinus rufipes*, *Scolytus multistriatus*) and root grafts. Dutch elm disease is managed through woodlot sanitation that denies the beetles places to reproduce. Elm wood greater than one inch diameter should be chipped, burned or buried. Elm wood should not be piled for firewood with the bark still on as this is suitable habitat for elm bark beetles. See bulletins in the Appendix for more information.

Oak Wilt. I did *not* observe oak wilt anywhere on the property, and oak wilt is a low concern in Clinton County (see oak wilt map in the Appendix). However, oaks are a very important resource in Stand One, and it is far easier to prevent oak wilt than it is to treat a stand after infection. The best way to prevent oak wilt is to not harvest, wound or prune any oak trees between April and September when the trees are actively growing and the beetles are also active. Any timber sale with lots of oaks in the residual stand should be conducted when the trees are dormant in the fall or winter. Hazard tree removal should only occur in the summer growing season if a tree near a trail is extremely hazardous. See bulletins in the Appendix for more info.

Stand One Activities

Activity 1-1 Partner with the Friends of DeWitt Nature Center and Other Conservation Groups

One of the best outcomes from the proposed timber sale in 2012 was a community wide conversation about forests and the multiple ways to manage and enjoy them. As a response to the proposed harvest of biologically mature trees in Stand One, community members banded together and formed the Friends of DeWitt Nature Center (FDNC) to protect and promote the Nature Center in the heart of the DeWitt Public Schools campus. This group was formed in September of 2012 and incorporated in February of 2013.

The mission of the FDNC is to “foster an appreciation for nature in students and the community by protecting, preserving, and promoting a unique and natural old-growth forest habitat located on the property of the DeWitt Public Schools for the education of school children, the enjoyment and enrichment of the larger community, and the advancement of educational and scientific endeavors for future generations.”

The DeWitt Public Schools has agreed to work together with this volunteer organization to jointly manage the 15.5 acre Nature Center (Stand One). The school and FDNC are drafting a Memorandum of Understanding (see current draft of MOU in the Appendix) to establish the rights and responsibilities of both parties. As the owner of the Nature Center, the school retains the final decision in all management matters and activities. The school is represented by the Board of Education and John Deiter, the Superintendent of DeWitt Public Schools. The school is allowing the FDNC to develop and maintain trails, promote educational opportunities, assist with the cost of hazard tree removal, and assist with the development and cost of this Forest Stewardship Plan. The current president of the FDNC is Larry Arbanas (517-669-1239).

The FDNC has the potential to be a useful partner with the school in maintaining and promoting the forests on the DeWitt Public Schools campus. The FDNC has already contributed greatly to the maintenance and promotion of the Nature Center. More than 200 volunteers (students and community members) donated more than 1,000 hours in 2013 alone to improve the trails system in Stand One. The FDNC has hired a local arborist who is also a DeWitt Public Schools alumnus, Jon Stauffer of Majestic Tree (517-669-7311), to remove hazard trees in the Nature Center. Majestic Tree is not responsible for ongoing monitoring of safety in the Nature Center, but is only contracted to remove trees identified by the school or FDNC as hazardous. Local funds raised by the FDNC are used to pay for the arborist work to provide public safety in the Nature Center. However, the school must retain all final responsibility for monitoring and removing hazard trees. The school should consider hiring a certified arborist to monitor all three school forests for hazard trees at least once a year. FDNC funds for arborist work should be donated to a school forest fund rather than be spent directly on issues related to safety.

The DeWitt Public Schools may also benefit by engaging additional conservation organizations as resources for best management practices and models of public and private partnerships. For example, the Sierra Club and the Nature Conservancy have local chapters in Michigan and scientists on staff that may provide insight and resources for the management of the DeWitt Nature Center. While it may not be necessary or beneficial to have a formal association with multiple organizations, the school should at the minimum have a clear understanding of their

goals and objectives for their forest management in all three stands before seeking to partner with external organizations.

Activity 1-2 Manage for Old Growth Ecosystem

A timber sale to harvest biologically mature trees before they decline from their maximum economic value is a valid management choice. Not harvesting huge, veneer quality red oaks because they are awe inspiring and majestic is also a valid management choice. The economic value of not harvesting large trees may be worth more than their forest products at the sawmill, although it is much harder to measure. The community conversation held in DeWitt in the summer of 2012 indicates that the value of the Nature Center as a beautiful, old forest with outstanding aesthetics and great educational opportunities is higher than the commercial value of the thousands of board feet of lumber in the big red oaks. Therefore, Stand One will be managed as a preserve with minimal human activities that allows natural processes to dominate the disturbances in the forest.

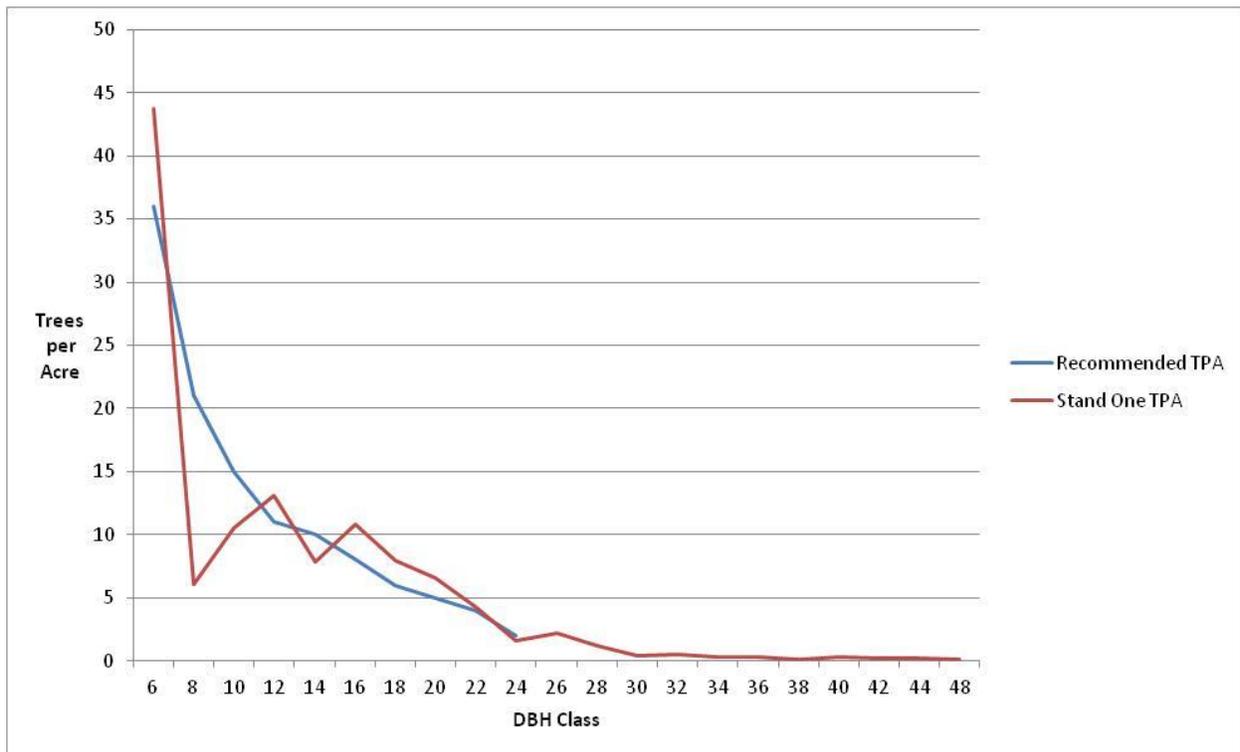
Even though Stand One will *not* be managed for timber production, I can't resist comparing it against common silvicultural guidelines for forest management. This comparison may help explain some of the choices to include large trees when planning the timber sale in 2012, but mostly it serves to contrast the exceptional quality of Stand One against the other two younger forests on the school campus.

Table 1. Comparison of a Managed Northern Hardwoods Forest and Stand One.

DBH Class	Recommended TPA	Stand One TPA	Recommended BA	Stand One BA
4	50	95.5	4	7
6	36	43.7	6	7
8	21	6.1	6	2
10	15	10.5	7	6
12	11	13.1	8	10
14	10	7.9	10	8
16	8	10.8	11	15
18	6	8.0	10	14
20	5	6.6	10	14
22	4	4.3	10	11
24	2	1.6	6	5
26		2.2		8
28		1.2		5
30		0.4		2
32		0.5		3
34		0.3		2
36		0.3		2
38		0.1		1
40		0.3		3
42		0.2		2
44		0.2		2
48		0.1		1
Total	168	213.9	88	130.0

Stand One was originally marked for harvest using single tree selection, an uneven aged silvicultural method. This selection system method compares an ideal distribution of trees per acre for a managed hardwoods forest against an inventory of the forest. Individual trees are selected for harvest when the actual trees per acre exceed the recommended trees per acre in each size class - see Table 1 and Figure 7. Trees that might be selected for harvest in Stand One are those where the red line is above or beyond the blue line in Figure 7. Note that the blue line in Figure 7 stops at 24" diameter. A forest economist would argue that trees are financially mature when their biological growth rate slows and they are no longer rapidly increasing in volume and value. This is typically around 24" DBH for many hardwood species. There are many valid reasons to keep these large trees ≥ 24 " trees (aesthetics, wildlife, biodiversity, etc), but an economist would recommend harvesting them to capture their economic value before they start to decline and are lost to natural mortality. A forest ecologist might recommend harvesting these large trees to allow new trees to get established. Notice that there are no oaks less than 20" DBH in Stand One (see Appendix III) because oaks need more sunlight to reproduce and survive.

Figure 7. Comparison of a Managed Northern Hardwoods Forest and Stand One.



One of the most striking attributes of Stand One, the DeWitt Nature Center, is the number of huge trees greater than 24" diameter at breast height. It is very unusual for a forest in southern Michigan to have trees in every two inch diameter class from two inches to forty-four inches. Very few forests have a four foot diameter tree of any species, much less a gorgeous red oak. Most of Michigan was clearcut in the mid to late 1800's, and many second growth forests have already been harvested a few times in the past 150 years so it is surprisingly rare to find such big trees in a state that is 50% forested. It is unusual to find a 15.5 acre forest in Michigan with so

many huge red oaks, especially a school-owned forest that is accessible to the entire community for public education and enjoyment.

So while I understand the scientific and economic perspectives to harvest large trees that are biologically mature to reproduce the next class of trees and to capture their full economic value, I also appreciate the human desire to save huge trees because they are so majestic. The people of DeWitt are participating in community-based natural resource management, and their vote has been to preserve the large trees in Stand One for their aesthetic and educational value. I applaud the school for having the conversation, listening to, and working with their community.



Red oak in Stand One removed from the 2013 timber harvest.

The DeWitt Public School is now working with the Friends of DeWitt Nature Center, and other members of the community, to manage Stand One as a natural area with minimal human management activities. The school has agreed to not harvest trees in a commercial timber sale in the Nature Center, even excluding the dying ash trees scheduled for harvest for safety reasons.

Allowable management activities in Stand One are focused on maintaining and improving the trail system to facilitate outdoor education and recreation. The FDNC is utilizing hundreds of community volunteers to improve existing trails and building new trails. The FDNC is also developing several areas that can serve as outdoor classrooms by providing thirty log seats for students to use during outdoor exercises. The FDNC is actively promoting the educational value of the forests on the school property. The FDNC will work with the school to develop and place appropriate signs that will enhance the educational value of the Nature Center. The FDNC is also monitoring the forest for hazardous trees for removal by a professional arborist. The only trees to be felled by humans in Stand One are hazardous trees, and the wood is to remain in the forest to decompose and enhance the communities that rely upon dead wood.

Prohibited activities in Stand One include commercial timber harvests, cutting non-hazardous trees, planting trees or shrubs, removing logs or other woody debris, planting or removing

herbaceous plants, the use of motorized vehicles, hunting, riding bicycles, storing pallets or other school supplies, and dumping yard waste.

Even though timber harvesting is now prohibited in Stand One, natural disturbances like insects, disease, wind, fire, and ice still occur that damage trees, kill large trees, and create hazardous conditions. For example, the very recent ice storm in December of 2013 damaged many trees over the Christmas break. Many broken branches are hanging up in the canopy and at least one very large 27" DBH black oak that was scheduled for harvest was killed by the ice storm. Volunteers are regularly monitoring the Nature Center for hazardous trees. After the hazard trees in Stand One are identified by staff or volunteers, they are professionally removed by a local arborist. The FDNC is raising money to cover the costs for John Stauffer of Majestic Tree to remove hazard trees in Stand One. However, the DeWitt Public Schools retains legal responsibility for the safety of its students so school staff should also monitor all of the school forests for hazardous trees at least quarterly, especially near trails or other high traffic areas.



27" DBH black oak saved from harvest but felled by December 2013 ice storm.

Stand Two Activities

Activity 2-1 Consider Joining the American Tree Farm System and other Forest Owner Groups

Stand Two has the best potential to demonstrate the sustainable production of timber and other traditional forest products of the three stands on the school campus. In the same way that partnering with the FDNC and other conservation organizations may enhance the management and use of Stand One, partnering with organizations related to the natural resources industry may enhance the educational value of Stand Two. There are several potential organizations to consider partnering with including the Michigan Forest Resource Alliance (www.mfra.org) or the Michigan Forest Products Council (www.michiganforest.com). However, the easiest action would be to join the American Tree Farm System (www.treefarmssystem.org).

The Tree Farm System is one of three certification organizations for forest owners in the United States. Certification is a means of verifying that forests are sustainably managed and that forest products are identified throughout the chain of custody as having been grown in sustainably managed forests. Certified forest products sometimes have a higher retail price but may not generate higher prices for the forest owner. The other two certification organizations, Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI), are expensive and difficult to achieve but the Tree Farm System is currently free for non-industrial, private forest owners (NIPF). The minimum requirements are ten acres of forest, a current written management plan, compliance with the principles of the American Tree Farm System (listed in the Appendix), and a free inspection by a certified Tree Farm Inspector. I am a certified Tree Farm Inspector and I would be happy to help you enroll in the program (there is no additional cost for you after this Forest Stewardship Plan). I have included several references to the various Tree Farm standards throughout this plan to demonstrate compliance with the standards.

You may also want to consider joining other Forest Owner Groups. According to USFS research, only 4% of nonindustrial, private forest owners have a written forest management plan (Butler, 2008). Your investment in this management plan puts you into an elite group of forest owners! I believe that you may enjoy spending time with other active and involved forest owners. The Michigan Forest Association is an organization of private forest owners in Michigan and costs around \$40 in annual dues (www.michiganforests.com). The National Woodland Owners Association is the national organization of private forest owners and costs around \$35 in annual dues (www.woodlandowners.org). Both of these organizations provide useful forest management information (magazines, newsletters, emails) and opportunities for networking with other landowners (annual conferences, workshops, field days).

Activity 2-2 Forest Stand Improvement, NRCS Code #666, 20.3 acres, Summers 2015-2017

The primary management goals for Stand Two are education, aesthetics, recreation, wildlife habitat, and the sustainable production of timber. The stand can be managed with a commercial timber sale that will generate income as in the February 2013 harvest, but it could be another decade before the next timber sale. Therefore, there is an opportunity to have ongoing forest stand improvement activities between the commercial timber sales that only occur every ten to fifteen years. The primary forest stand improvement activity for Stand Two is to reduce the excessive number of large grape vines that are starting to kill valuable black cherry and sugar maple trees. Secondary objectives include improving aesthetics, removing hazardous trees, expanding recreational trails, and managing for wildlife habitat.

NRCS Specifications for Forest Stand Improvement (Practice #666) in Stand Two

Purpose of Treatment: to reduce the population of very large (up to 5" diameter) riverbank grape vines (*Vitis riparia*) that are impairing the growth and survival of high value trees like sugar maple, black cherry, and red maple.

Map of Practice: see location on Figure 4. FSI activities can be done throughout Stand Two.

Harvest Regeneration Strategy: Stand Two should be managed as an uneven-aged stand using single tree or group selection to maintain a large distribution of age classes and species.

Pre-Treatment and Post-Treatment Characteristics: The pre-treatment characteristic of Stand Two is the abundance of grape vines growing up into the crowns of mature sawtimber size trees. The post-treatment characteristics seek to reduce the number of grape vines to no more than one per acre.

Number, Species and Size of Trees Removed: Stand Two was thinned in a commercial harvest in February of 2013. No additional trees in any species need to be removed in this forest stand improvement activity to enhance biological growth of the residual stand. (A few trees may need to be removed if they are hazard trees or trees to be removed for trail building.) The focus of this FSI treatment is to remove the riverbank grape vines that are reducing the timber quality of the stand. Select grape vines more than 0.5” diameter for culling. It is not necessary to eliminate all grape vines in the forest, but focus on removing large vines that are already growing into the crowns of mature trees.

Method, Timing, and Equipment: Grape vines should be cut near the ground level with a hand saw or small chainsaw. It is not necessary to pull the severed vines from the tree canopy as this may cause excessive damage to the branches. Apply some glyphosate to the cut stump of the grape vine to kill the roots of the vine. This activity should be done when the vines are actively growing in late spring or summer. If a private group with a management arrangement with the school seeks cost share funding from the NRCS in 2014, then this forest stand improvement activity might in the summers of 2015-17.

Mitigation Measures: Fire risk is low in Stand Two.

Operation and Maintenance: Inspect FSI activities every three to five years and repeat treatments as necessary.



Large grape vines that contributed to the demise of a high value black cherry. (Primary cause of falling was likely a wind storm rather than just the vines.)

Activity 2-3 Commercial Timber Harvest, 20.3 acres, Winter of 2025

Stand Two is a very different forest than the Nature Center in Stand One. Stand Two is younger, has smaller trees, a lower basal area, and a different species composition. Black cherry is the species that dominates the stand more than any other tree species with 40% of the trees per acre, 47% of the basal area, and 51% of the merchantable volume. Although Stand Two has lower commercial value than the exceptional Stand One, it can be managed using commercial timber sales as a tool to accomplish the goals of the DeWitt Public Schools. The school currently uses Stand Two for education, but less so than Stand One, even though it is very interesting in its own right. The goals for Stand Two include education, aesthetics, recreation, wildlife habitat, and the sustainable production of timber.

Timber Harvest Objectives. The primary objective for any timber sale is to *improve the forest*, as defined according to the values of the landowner and the attributes of the forest. A timber sale should improve the species composition and growing conditions of remaining trees for future timber sales. As a forester, my primary concern is *keeping quality trees* in your forest, instead of selling most of your quality trees (a practice called high-grading). A timber sale can be used to create wildlife habitat and favor the reproduction of trees useful for wildlife. A timber sale can be used to improve recreation by laying out skid trails where the landowner would like to create or maintain walking or riding trails. A timber sale should also improve forest health by removing trees infected with insects or disease. A timber sale can be used to remove mature trees in order to regenerate a new class of trees in the forest. A timber sale should also seek to *optimize* the profits for the landowner in keeping with the above objectives. *For the DeWitt Public Schools, another objective for a timber sale is removing hazardous trees to ensure public safety.*

Timber Harvest Method. Foresters use two categories of timber harvest methods – even age and uneven aged methods. Even aged methods create a whole new cohort of trees with a similar age throughout the entire stand while uneven aged methods preserve a large variation in age classes in the stand. Even age harvest methods include “shelterwood” and “clearcuts” – both of which favor the regeneration of shade intolerant species like aspen, oak or black walnut that require lots of sunlight for reproduction and survival. Even age methods are also used in plantation forestry. Uneven aged harvest methods include “single tree selection” or “group selection” – both of which favor the regeneration of shade tolerant species like sugar maple and beech that can reproduce and survive under full shade. The timber harvest in February 2013 used uneven aged methods, and I recommend continuing to use uneven aged methods to manage Stand Two.

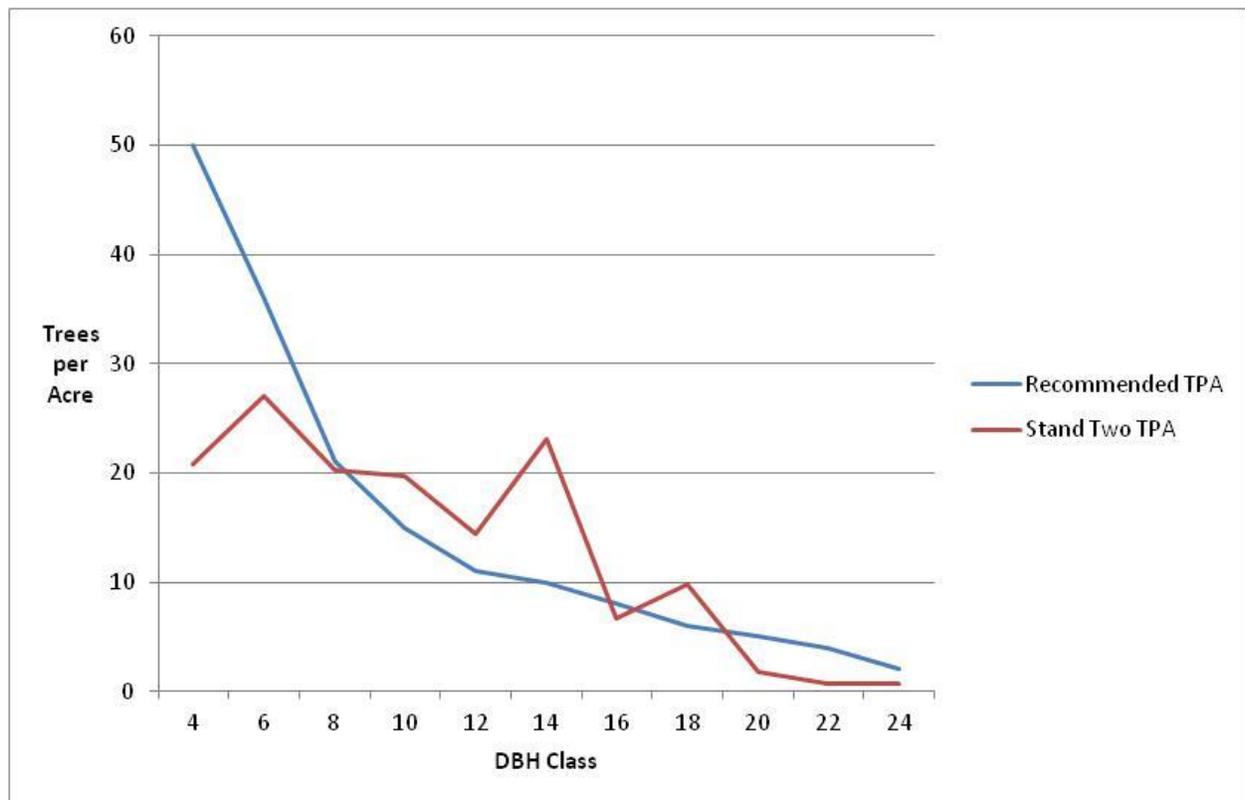
The common silvicultural method for harvesting and reproducing trees in an uneven aged forest is the single tree selection or group selection system. The tradeoff for this silvicultural method is that it favors shade tolerant species like sugar maple and beech over the less shade tolerant species like pines, aspen, oak or black walnut. Group selection should be employed to favor the reproduction of oaks, pines, and other intermediate shade tolerant species. Removing a group of five to ten trees at each location should create enough sunlight (50'-100' canopy gaps) to encourage better reproduction of shade intolerant species in the understory. This selection system method compares an ideal distribution of trees per acre for a managed hardwoods forest against the actual inventory. Individual trees are selected for harvest when the actual trees per

acre exceed the recommended trees per acre in each size class (see Table 2). Trees for harvest in Stand Two are those where the red line is above or beyond the blue line as in Figure 8.

Table 2. Comparison of a Managed Northern Hardwoods Forest and Stand Two.

DBH Class	Recommended TPA	Stand Two TPA	Recommended BA	Stand Two BA
4	50	20.8	4	2
6	36	27.0	6	4
8	21	20.2	6	7
10	15	19.7	7	11
12	11	14.5	8	12
14	10	23.0	10	24
16	8	6.7	11	9
18	6	9.8	10	17
20	5	1.8	10	4
22	4	0.8	10	2
24	2	0.6	6	2
Total	168	145.0	88	94.0

Figure 8. Comparison of Ideal Managed Northern Hardwoods Forest and Stand Two.



Timber Sale Process. You can hire a consulting forester to assist you with a timber sale or you can manage your own sale. Either way, there are five basic steps in a timber sale. The timber

sale process can take six to eighteen months, so start planning ahead at least a year before the desired time of the harvest. Spring is often a good time to start preparing for a fall or winter harvest.

Step One. A forest inventory measures the attributes of the forest to determine how to proceed with the sale. This Forest Stewardship Plan includes this inventory (see Appendix III), but the January 2014 inventory included in this plan will be out of date by the next timber harvest in another decade or more. Please hire a consulting forester to conduct another inventory *prior* to marking any trees for sale to provide data, information, and recommendations for the School Board to review before implementing the next timber harvest.

Step Two. The inventory data are used to decide which trees to sell by applying silvicultural methods appropriate for that forest type in accordance with the landowner's goals. You or your forester should determine which trees to sell, paint those trees at stump and breast height, measure approximate volume, and determine approximate current market value. It is important that the landowner knows the exact location of their property corners and property lines so that all trees included in the sale are well within their property lines.

If the school staff are not absolutely certain about the location of property corners and boundary lines, I recommend that the DeWitt Public Schools invest in a professional boundary survey from a licensed surveyor to clearly mark the property corners and several points along the property line on the west side of Stand Two. An acceptable alternative to hiring a surveyor is to walk the boundary lines with your neighbors and come to a "gentleman's agreement" about the location of the property corners, boundary lines, and an agreed upon set-back distance for management activities (not harvesting trees within ten feet of the assumed line). However, this can be a time consuming process, and it also lacks any legal clarity that may be required for a school owned property. A professional boundary survey is a very good investment to minimize any conflict with neighbors and to avoid unintended timber trespass in future timber sales. Surveyors are expensive, but they are a lot cheaper than lawyers!

The inventory included in this plan was conducted eleven months after the most recent timber harvest in February 2013. Notice that there is currently a deficit in the 16" and 20-24" diameter trees that are the best candidates for harvesting in a commercial timber sale. Stand Two is healthy and in good shape now, but it does not require another commercial timber harvest for another decade.

Step Three. You or your forester should advertise your timber sale. The true market value of the trees marked for sale is determined by marketing a timber sale prospectus to multiple potential buyers. A forester would write a timber sale prospectus describing the trees for sale and send the prospectus to around twenty reputable timber buyers to invite them to inspect the trees for sale prior to bidding. I have included a list of sawmills, loggers, and timber buyers in the mid-Michigan area in the Appendix. Although there are many quality independent loggers in Michigan, it is often less risky for a landowner to work with a local sawmill that wants to maintain a long term relationship with area landowners. Hopefully three or more timber buyers would submit bids with their offer for the trees for sale to establish the current market value of your timber. Prices given in Appendix III are *very rough estimates* based on DNR timber sales.

[Note: Maple Rapids Lumber Mill was the winning bidder for the February 2013 timber harvest. Several people have commented on their good citizenship by allowing the school to revise a signed contract on a timber sale administered by a consulting forester after the community became concerned about the harvest of big trees in Stand One. While I always recommend a competitive bidding process to determine true market value, it may also be worthwhile to continue working with a previous sawmill that has done good work for you in the past by giving Maple Rapids Lumber Mill the right of first refusal to match the highest bid.]

Step Four. The fourth step is to negotiate a timber sale contract between the landowner and the timber buyer. You or your forester should select the best buyer based on price and other factors (reputation, timing of the harvest, equipment to be used, etc), check references of the winning bidder, write unique contract between landowner and timber buyer, collect a performance bond to ensure contract compliance, verify liability and workman's compensation insurance, and collect full payment *prior to* harvest (for a stumpage sale). The contract period should include two or even three winters to allow the loggers enough time to perform the harvest in suitable conditions. I have included a MSU Extension bulletin on timber sale contracts in the Appendix. Be sure to specify that any harvest must occur when the soil conditions are suitable – preferably in the summer or fall when soils are dry or better yet, in the winter when the soil is frozen.

Step Five. You or your forester should supervise the timber harvest to ensure the contract is followed. You can determine the location of skid trails and log landing for harvest equipment (place them where you would like to improve recreational trails for later use), confirm property lines with neighboring owners, visit the site during timber harvest to verify performance, and also visit the site after the harvest to determine the refund of performance bond.

Timber Sale Timing. Stand Two does not require a timber sale to optimize biological growth for another decade when the basal area is higher than its current 94 ft²/ acre. The next timber sale in Stand Two might occur sometime around 2024-25. Start planning for the sale the summer before you intend to harvest by marking the trees that the school wants to sell to meet their objectives for the sale. The timber sale should be conducted in a season when the soil is frozen (winter) or dry (late summer or fall). Fall or winter is the best time to also minimize damage to the bark of the residual trees and to reduce the exposure of wounded trees to insects or disease. Avoid a summer harvest when leaves on the fallen tops negatively affect the aesthetics after the harvest. Avoid a spring harvest (March-May) to minimize rutting which damages both the soil and the roots of the residual trees and takes years to repair. Selection harvests are often done on a ten to fifteen year return interval to harvest the growth that exceeds the recommendations.

American Tree Farm Certification. Standard Three of the American Tree Farm System is Reforestation and Afforestation – “Forest owner completes timely restocking of desired species of trees on harvested sites and non-stocked areas where tree growing is consistent with land use practices and the forest owner's management objectives.” Natural seeding from the residual trees in the stand should produce more than adequate regeneration. Planting seedlings to regenerate the forest is not likely to be biologically necessary, economical, or even successful with the high deer population.

Standard Four is Air, Water, and Soil Protection – “Forest management practices maintain or enhance the environment and ecosystems, including air, water, soil, and site quality.” Logging operations should be conducted in the winter when the soil is both dry and frozen. Harvest

operations should be suspended if soils are too wet and susceptible to damage. Few trees should be marked on poorly drained soils if possible because it is difficult to use large harvesting equipment on poorly drained soils without rutting. Consult the “Sustainable Soil and Water Quality Practices on Forest Land” for recommendations on best management practices – www.michigan.gov/dnr/0,1607,7-153-30301_31154_31261---,00.html.

Standard Six is Forest Aesthetics – “Forest management plans and management activities recognize the value of forest aesthetics.” A single tree or group selection harvest in this stand will have minimal impacts on aesthetics. Conducting the harvest in the right season and including a conservative number of trees (three to five trees per acre) will maintain aesthetics.

Standard Eight is Forest Product Harvests and Other Activities – “Forest product harvests and other management activities are conducted in accordance with the management plan and consider other forest values.” This standard requires using qualified natural resource professionals, utilizing a contract, and complying with this plan when conducting a timber sale.

Stand Three Activities

Stand Three is the youngest forest on the school campus. About two thirds of the stand is less than 35 years old as shown in the aerial photos in Appendix II and by the abundance of uniformly small (5” to 10”) trees on the western and eastern thirds of the forest. The middle third of the stand is older and has larger trees growing around the wetland. Red maple is the dominant tree in the stand with 71% of the trees per acre, 61% of the basal area, and 49% of the merchantable volume. Even though most of the stand is too young to consider a commercial timber harvest as a management tool for more than a decade, the early succession attributes of the stand are very attractive as wildlife habitat. This stand can be managed for wildlife by conducting forest stand improvement activities, planting some supplemental trees and shrubs, and conducting sustainable timber harvests every decade or so.

Activity 3-1 Consider Partnering with QDMA and other Wildlife Organizations

Although school children are the primary audience for the educational mission of the DeWitt Public Schools, adult community members could also participate in educational programs here. I think that there are several like-minded wildlife organizations that may become useful partners with the DeWitt Public Schools in managing Stand Three and utilizing the educational potential of the young forest. Possible organizations include The Audubon Society, Pheasants Forever, Michigan United Conservation Clubs, and the Quality Deer Management Association. Any of these local chapters may be interested in partnering with DeWitt Public Schools in science-based land management and educational programs. They also might be able to provide limited finances, volunteer labor, or even help obtain NRCS cost share funding for specific projects.

While any of these or other wildlife organizations are worth contacting to pursue partnerships, I think that the Quality Deer Management Association (QDMA) offers some interesting potential, even though hunting is quite rightly prohibited on school property. QDMA is a national organization that promotes scientific management related to deer hunting. Their four

cornerstone principles are herd management, habitat management, hunter management, and herd monitoring. Herd management includes managing the gender ratio and age classes in the local deer population. Habitat management focuses on providing diverse ecosystems that include early succession cover. Hunter management includes ethics, safety, knowledge, and involvement with the organization. Herd monitoring includes collecting data on both the deer herd and hunter behavior.

QDMA has recently launched a Land Certification Program to help their members demonstrate that they are complying with their cornerstone principles and managing their land for quality wildlife habitat. One of the requirements to become certified is to have a management plan for the property. Forest Stewardship Plans are approved management plans and this FSP could be expanded to elaborate on the QDMA principles. I think it may be mutually beneficial to both the DeWitt Public Schools and the local QDMA to certify Stand Three as a QDMA property for educational purposes. See bulletins in the Appendix for more information about the program, including the standards for certification.

I suggest contacting the local chapter of the QDMA to discuss potential partnership in educational programs for deer hunters and other wildlife enthusiasts in Clinton County. There is a cost to join the Land Certification Program (\$200 application, inspector site visit fee, \$150 renewal fee every five years) in addition to this Forest Stewardship Plan. The local QDMA chapter may be willing to cover these expenses and part of the cost of this Forest Stewardship Plan too.

Hunting is prohibited at the DeWitt Public School forests for safety reasons and this policy should certainly be upheld. Partnering with QDMA should focus on outdoor education and habitat management and the entire school campus should continue to be a “sanctuary,” to use a common QDMA term for a part of the property where deer are left alone and not hunted.

I include some references to wildlife habitat management and the QDMA principles in this plan. However, I am not a wildlife biologist, and it may be useful to later supplement this Forest Stewardship Plan with additional information specific to the QDMA cornerstone principles.

Activity 3-2 Forest Stand Improvement, NRCS Code #666, 26.0 acres, Winters 2016-2018

The primary management goals for Stand Three are education, aesthetics, recreation, wildlife habitat, and the sustainable production of timber. The stand can be managed with a commercial timber sale that will generate income, but much of the stand is too young to be of much interest for local sawmills for a few more decades. There is an opportunity to have ongoing forest stand improvement activities between the commercial timber sales that may only occur every ten to fifteen years. The primary forest stand improvement activity for Stand Three is to enhance the species diversity of the stand by removing low quality red maple trees to allow other species to reduce the dominance of red maple. Secondary objectives include managing for wildlife habitat, improving aesthetics, removing hazard trees, and expanding recreational trails.

Conducting FSI activities in Stand Three for wildlife habitat is a potential area of common interest with the QDMA. It is possible that the local chapter of the QDMA would be willing to help with labor and costs associated with a demonstration of managing Stand Three for deer and

other wildlife habitat. It also might be possible for the local QDMA chapter to obtain NRCS cost share funding to defray the costs of implementing a FSI activity.

NRCS Specifications for Forest Stand Improvement (Practice #666) in Stand Three

Purpose of Treatment: The primary objective is to reduce the dominance of red maple in the stand to encourage the growth of other trees with higher wildlife value.

Map of Practice: see location on Figure 4. FSI activities can be done throughout Stand Three.

Harvest Regeneration Strategy: Stand Three should be managed as an uneven-aged stand using single tree or group selection to maintain a large distribution of age classes and species.

Pre-Treatment and Post-Treatment Characteristics: The pre-treatment characteristic of Stand Three is the excessive dominance of red maple (61% basal area) that has limited potential to provide quality wildlife habitat. The post-treatment characteristics seek to reduce the dominance of red maple and encourage the reproduction of higher value wildlife species like oak, hickory, and black cherry.

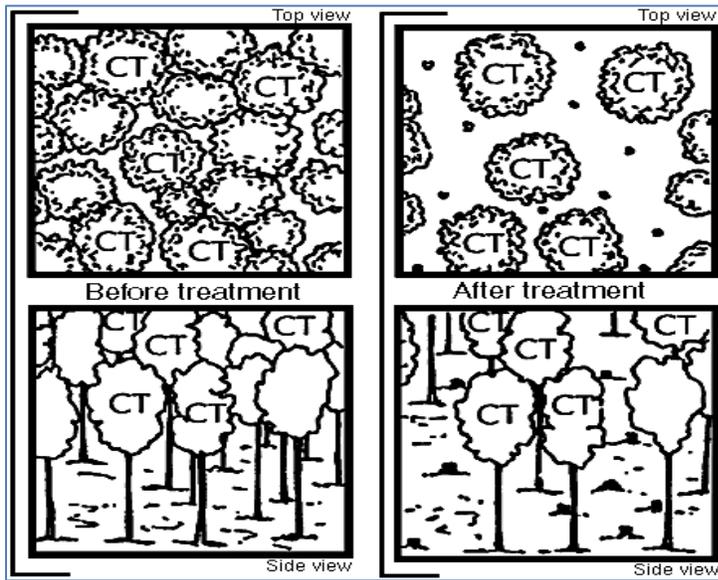
Number, Species and Size of Trees Removed: There is an overwhelming number of red maples in Stand Three (203.6 TPA x 26.0 acres = 5,293 trees). Most of these red maples are in the 2” to 6” diameter trees that are too small to bother with for a FSI activity. Rather than focusing on the red maples, instead identify your “crop trees” that have higher wildlife value and seek to enhance their growth. The most limiting resource for all trees is sunlight. Identify high value species that provide mast (food) for wildlife like red oak, black oak, white oak, pignut hickory, and black cherry. Select red maples or other low value wildlife trees that are touching the crowns of the crop tree and consider culling the competing tree, especially if it has low timber potential. Remove competing trees on at least two or three sides of the crop tree to allow more sunlight to reach the crown. See Figure 9 for an illustration. Do not cull small trees whose crown is below the crop tree as this will have little benefit for the crop tree. Identify three to five crop trees per acre, and cull competing trees to enhance the wildlife potential of the stand. Cull trees could be felled to the ground or killed by girdling. Felled trees can be removed for trail building, firewood, or other uses. Leaving dead trees standing after girdling will provide additional food and habitat for birds and other small mammals, but too many large snags may be a safety hazard for visitors to the school forest, especially near cross country running trails. Please use this forest stand improvement activity to improve public safety - identify any hazardous trees in the stand and remove them quickly and safely through this management activity.

Method, Timing, and Equipment: Trees selected for removal can be felled or girdled with a small chainsaw. If girdling, cut two rings around the trunk to ensure that the inner bark is completely cut. This activity should be done when the trees are dormant (fall, winter, early spring) to prevent any possible introduction or spread of oak wilt. If a private group applies for funding for NRCS cost share in 2014, this activity could start in December of 2015. Forest stand improvement activities therefore might occur during the winters of 2016-18.

Mitigation Measures: Fire risk is low in Stand Three.

Operation and Maintenance: Inspect FSI activities every three to five years and repeat treatments as necessary.

Figure 9. Illustration of the Crop Tree Method of Forest Stand Improvement.



(Source: www.extension.umn.edu)

Activity 3-3 Plant Shrubs and Trees for Wildlife, NRCS Code #612, 26.0 acres, Spring 2015-17

With almost 300 trees per acre, Stand Three does not have a shortage of trees in the forest. But the excessive dominance of a single species can be moderated by planting some supplemental trees and shrubs that have wildlife value. The soils in Stand Three are suitable for a large variety of plants, even near the wetland in the middle of the stand where plant diversity is highest. Planting trees is also a great educational exercise for the students and surprisingly difficult to do well. Any potential tree planting efforts in Stand Three should focus on shrubs and small trees that provide wildlife value. Shrubs with wildlife value for wet soils include nannyberry, red osier dogwood, silky dogwood, elderberry, and hawthorn. Shrubs with wildlife value for drier soils include highbush cranberry, grey dogwood, hazelnut, serviceberry, sumac, crabapple, hawthorn, ninebark, and wild plum. Any of these shrubs and small trees should do well if matched with the right soil type and sunlight conditions in Stand Three.

If you are considering planting a large number of seedlings, the NRCS does provide cost share for tree/shrub establishment. The NRCS also provides cost share funding for related practices like Tree and Shrub Site Preparation (#490), Early Succession Habitat (#647), and Upland Wildlife Habitat Management (#645) that may include tree/shrub planting, constructing brush piles or other nesting cover, and other vegetation management. Because the school may not be eligible for NRCS funds, this activity may also be a good opportunity to partner with the local chapter of the QDMA or other conservation organizations to find external sources of funding for seedlings, planting and spraying equipment, supplies like pesticides, and labor.

Specifications for Tree/Shrub Establishment (NRCS practice #612)

Purpose of Planting: to plant widely scattered shrubs and trees throughout Stand Three to enhance the wildlife habitat value of a stand dominated by red maple.

Tree/Shrub Species to be Planted: Focus your efforts on native shrubs including highbush cranberry, nannyberry, grey dogwood, serviceberry, and elderberry in the shady areas of the stand. Consider red osier dogwood, silky dogwood, hazelnut, hawthorn, ninebark, and wild plum in some of the open areas in the middle of the stand where timber was harvested in February 2013. See Table 3 for potential shrubs to plant for wildlife. Select only plants matched to the soil moisture and sunlight conditions for your planting site.

Table 3. Potential Shrubs for Wildlife Habitat Improvement Plantings.

Species	Soil Conditions	Sunlight Requirements
Highbush cranberry	Moist to well drained	Shady to sunny
Nannyberry	Wet or poorly drained	Shady to sunny
Redosier dogwood	Poorly drained	Sunny
Silky dogwood	Poorly drained	Sunny
Grey dogwood	Well to poorly drained	Shady to sunny
Elderberry	Wet to poorly drained	Shady to sunny
American hazelnut	Wet to dry	Sunny
Serviceberry	Moist to dry	Shady
Sumac	Dry and infertile	Sunny
Crabapple	Moist to dry	Sunny
Hawthorn	Poorly drained to moist	Sunny
Ninebark	Moist, sandy, or rocky	Sunny
American plum	Moist to well drained	Sunny

Source: NRCS Conservation Sheet #645 – Shrub Plantings for Wildlife

Planting Dates: Plant hardwood shrubs and trees in the spring when the soil thaws (April – May) and before the heat of the summer. Conifers can be planted in the spring with the hardwoods or also in the fall after their shoot growth has stopped and they have set bud (late Sep-Oct). The entire 26.0 acres does not need to be planted in a single year. It would increase the educational value of this project to plant just a few acres every year to include more students over the years.

Spacing: While plantations for timber are often at close spacing for very high density (red pines are planted at 6'x9' for 807 trees per acre), the purpose of this planting is to supplement a closed canopy red maple stand for enhanced wildlife habitat. Therefore, plant at much lower densities like only 25 to 50 trees per acre. The shrubs and trees can be planted randomly or in clumps rather than in straight rows with uniform spacing.

Planting and Seeding Rates: Plant at a rate that mimics natural conditions rather than trying to quantify a specific number of seedlings per acre. I would only plant around 25 to 50 trees per acre. Plant higher density in the open areas in the middle of the stand and at lower density on the edges of the stand with lots of pole size red maples competing with your seedlings.

Planting Methods: Although some wetland species like dogwood and willow can be vegetatively propagated from cuttings, most of the shrubs and trees listed above could be purchased as seedlings from the local Clinton Conservation District tree sale or from other commercial nurseries in Michigan. The Clinton Conservation District (2343 North US-27, St Johns, 48879; 989-224-3720; www.clintonconservation.org) may offer a discount on seedlings for local schools. Shovels or specialized “dibble bars” can be used to transplant the bare root seedlings by hand. The Conservation District may rent mechanical tree planters for large scale planting, but using large equipment will not be possible in Stand Three. The small number of seedlings to be planted each year is manageable with hand planting.

Site Preparation Requirements: The application of herbicides before planting trees will greatly increase their ability to compete with nearby grasses. Consider planning the planting location in the fall before your plant seedlings and applying an herbicide in the fall in addition to a second spring herbicide application prior to planting. Read and follow label instructions closely, especially if applying herbicides near pond on the east side. NRCS conservation practice Tree/Shrub Site Preparation (NRCS Code #490) may be a source of funding for large scale plantings. The vegetative competition is likely to be higher in the sunny areas in the middle of the stand. Herbicides may not be required if planting shade tolerant shrubs and small trees under the red maples where less grass is likely to be present to compete with the seedlings.

Post-Planting Weed Control Requirements: Weeds should be controlled for three years after transplanting the bare root seedlings while their root systems get fully established. NRCS conservation practice Herbaceous Weed Control (NRCS Code #315) may be a source of funding for large scale plantings.

Operation and Maintenance Requirements: Hardwood tree or shrub seedlings will likely require protection by a fence or tree tube from deer browse until the seedlings are greater than six feet tall. Deer tend to prefer hardwood trees for winter browse over most conifers apart from northern white cedar. See Table A7 in Appendix I for forage preferences for whitetail deer.

Activity 3-4 Commercial Timber Harvest, 26.0 acres, Winter of 2025

Most of Stand Three is very young and will not require a timber harvest for several decades. However, the middle third of the stand does have some mature trees and a few large oaks, maples, and ash were harvested in this area in the February 2013 timber harvest. Although Stand Three may not contribute much volume or value to a commercial timber sale for a few decades, it will be beneficial to continue to harvest Stand Three on the same schedule as Stand Two. It would be difficult to conduct an independent harvest in Stand Three because of the low volume and value of the stand alone.

Timber Harvest Objectives. The primary objective for any timber sale is to *improve the forest*, as defined according to the values of the landowner and the attributes of the forest. A timber sale should improve the species composition and growing conditions of remaining trees for future timber sales. As a forester, my primary concern is *keeping quality trees* in your forest, instead of selling most of your quality trees (a practice called high-grading). A timber sale can be used to create wildlife habitat and favor the reproduction of trees useful for wildlife. A timber sale can be used to improve recreation by laying out skid trails where the landowner would like to create

or maintain walking or riding trails. A timber sale should also improve forest health by removing trees infected with insects or disease. A timber sale can be used to remove mature trees in order to regenerate a new class of trees in the forest. A timber sale should also seek to *optimize* the profits for the landowner in keeping with the above objectives. *For the DeWitt Public Schools, another objective for a timber sale is removing hazardous trees to ensure public safety.*

Timber Harvest Method. Foresters use two categories of timber harvest methods – even age and uneven aged methods. Even aged methods create a whole new cohort of trees with a similar age throughout the entire stand while uneven aged methods preserve a large variation in age classes in the stand. Even age harvest methods include “shelterwood” and “clearcuts” – both of which favor the regeneration of shade intolerant species like aspen, oak or black walnut that require lots of sunlight for reproduction and survival. Even age methods are also used in plantation forestry. Uneven aged harvest methods include “single tree selection” or “group selection” – both of which favor the regeneration of shade tolerant species like sugar maple and beech that can reproduce and survive under full shade.

Stand Three does have some even aged characteristics because the agricultural fields on the west and east ends of the stand were abandoned about the same time in the late 1970s resulting in a uniform class of red maples. While Stand Three could be managed using even aged methods, the aesthetic impacts of five to ten acre clearcuts in this relatively small forest would likely be unacceptable. Therefore, I recommend using uneven aged silvicultural methods for Stand Three to develop a more diverse age class and species composition in the forest.

The common silvicultural method for harvesting and reproducing trees in an uneven aged forest is the single tree selection or group selection system. The tradeoff for this silvicultural method is that it favors shade tolerant species like sugar maple and beech over the less shade tolerant species like pines, aspen, oak or black walnut. Group selection should be employed to favor the reproduction of oaks, pines, and other intermediate shade tolerant species. Removing a group of five to ten trees at each location should create enough sunlight (50'-100' canopy gaps) to encourage better reproduction of shade intolerant species in the understory. This selection system method compares an ideal distribution of trees per acre for a managed hardwoods forest against the actual inventory. Individual trees are selected for harvest when the actual trees per acre exceed the recommended trees per acre in each size class (see Table 4). Trees for harvest in Stand Three are those where the red line is above or beyond the blue line in Figure 10.

Notice that there is a deficit in the commercial sawtimber size trees in every diameter class from 14” to 24” diameter. This reflects the young age of the stand and the harvest of most of the mature trees in the February 2013 timber sale. The few large trees in the 26” and 30” diameters were left as “seed trees” to encourage the reproduction of high value red oak, sugar maple, and red maple species.

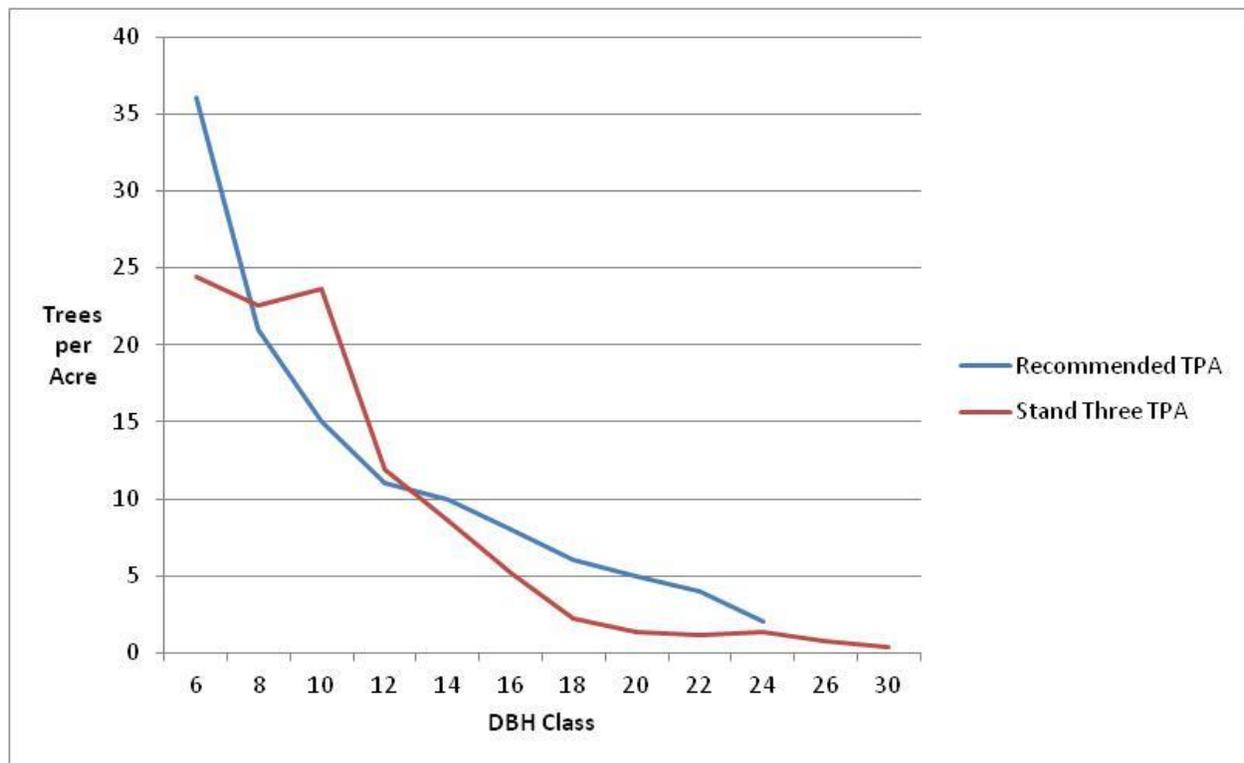
Timber Sale Process. You can hire a consulting forester to assist you with a timber sale or you can manage your own sale. Either way, there are five basic steps in a timber sale. The timber sale process can take six to eighteen months, so start planning ahead at least a year before the desired time of the harvest. Spring is often a good time to start preparing for a fall or winter harvest.

Step One. A forest inventory measures the attributes of the forest to determine how to proceed with the sale. This Forest Stewardship Plan includes an inventory (see Appendix III). This January 2014 inventory will be out of date by the next timber sale in a decade or more. Please hire a consulting forester to conduct another inventory *prior* to marking any trees for sale to provide data, information, and recommendations for the School Board to review before implementing the next timber harvest.

Table 4. Comparison of a Managed Northern Hardwoods Forest and Stand Three.

DBH Class	Recommended TPA	Stand Three TPA	Recommended BA	Stand Three BA
4	50	160.5	4	13
6	36	24.5	6	5
8	21	22.6	6	8
10	15	23.7	7	12
12	11	11.9	8	9
14	10	8.6	10	9
16	8	5.2	11	7
18	6	2.2	10	4
20	5	1.4	10	3
22	4	1.2	10	3
24	2	1.3	6	4
26		0.8		3
30		0.4		2
Total	168	264.2	88	82

Figure 10. Comparison of Managed Northern Hardwoods Forest and Stand Three.



Step Two. The inventory data are used to decide which trees to sell by applying silvicultural methods appropriate for that forest type in accordance with the landowner's goals. You or your forester should determine which trees to sell, paint those trees at stump and breast height, measure approximate volume, and determine approximate current market value. It is important that the landowner knows the exact location of their property corners and property lines so that all trees included in the sale are well within their property lines. A professional boundary survey is a very good investment to minimize any conflict with neighbors and to avoid unintended timber trespass in future timber sales. Surveyors are expensive, but they are a lot cheaper than lawyers!

Step Three. You or your forester should advertise your timber sale. The true market value of the trees marked for sale is determined by marketing a timber sale prospectus to multiple potential buyers. A forester would write a timber sale prospectus describing the trees for sale and send the prospectus to around twenty reputable timber buyers to invite them to inspect the trees for sale prior to bidding. I have included a list of sawmills, loggers, and timber buyers in the mid-Michigan area in the Appendix. Although there are many quality independent loggers in Michigan, it is often less risky for a landowner to work with a local sawmill that wants to maintain a long term relationship with area landowners. Hopefully three or more timber buyers would submit bids with their offer for the trees for sale to establish the current market value of your timber. Prices given in the Table 9 are *very rough estimates* based on DNR timber sales.

[Note: Maple Rapids Lumber Mill was the winning bidder for the February 2013 timber harvest. Several people have commented on their good citizenship by allowing the school to revise a signed contract on a timber sale administered by a consulting forester after the community became concerned about the harvest of big trees in Stand One. While I always recommend a competitive bidding process to determine true market value, it may also be worthwhile to continue working with a previous sawmill that has done good work for you in the past by giving Maple Rapids Lumber Mill the right of first refusal to match the highest bid.]

Step Four. The fourth step is to negotiate a timber sale contract between the landowner and the timber buyer. You or your forester should select the best buyer based on price and other factors (reputation, timing of the harvest, equipment to be used, etc), check references of the winning bidder, write unique contract between landowner and timber buyer, collect a performance bond to ensure contract compliance, verify liability and workman's compensation insurance, and collect full payment *prior to* harvest (for a stumpage sale). The contract period should included two or even three winters to allow the loggers enough time to perform the harvest in suitable conditions. I have included a MSU Extension bulletin on timber sale contracts in the Appendix. Be sure to specify that any harvest must occur when the soil conditions are suitable – preferably in the summer or fall when soils are dry or better yet, in the winter when the soil is frozen.

Step Five. You or your forester should supervise the timber harvest to ensure the contract is followed. You can determine the location of skid trails and log landing for harvest equipment (place them where you would like to improve recreational trails for later use), confirm property lines with neighboring owners, visit the site during timber harvest to verify performance, and also visit the site after the harvest to determine the refund of performance bond.

Timber Sale Timing. Stand Three does not require a timber sale to optimize biological growth for another decade or two when the basal area is much higher than its current 83 ft²/ acre.

However, harvesting some red maples when Stand Two is next harvested around 2025 will benefit the species diversity of the stand and yield better returns for the next timber sale around 2040. I recommend considering a commercial timber sale in both Stand Two and Stand Three around the winter of 2025. Start planning for the sale the summer before you intend to harvest by marking the trees that the school wants to sell to meet their objectives for the sale. The timber sale should be conducted in a season when the soil is frozen (winter) or dry (late summer or fall), especially in the middle of Stand Three by the wetland. Fall or winter is the best time to also minimize damage to the bark of the residual trees and to reduce the exposure of wounded trees to insects or disease. Avoid a summer harvest when leaves on the fallen tops negatively affect the aesthetics after the harvest. Avoid a spring harvest (March-May) to minimize rutting which damages both the soil and the roots of the residual trees and takes years to repair. Selection harvests are often done on a ten to fifteen year return interval to harvest the growth that exceeds the recommendations.

American Tree Farm Certification. Standard Three of the American Tree Farm System is Reforestation and Afforestation – “Forest owner completes timely restocking of desired species of trees on harvested sites and non-stocked areas where tree growing is consistent with land use practices and the forest owner’s management objectives.” Natural seeding from the residual trees in the stand should produce more than adequate regeneration. Planting tree seedlings for timber production is not likely to be biologically necessary, economical, or even successful with the high deer population.

Standard Four is Air, Water, and Soil Protection – “Forest management practices maintain or enhance the environment and ecosystems, including air, water, soil, and site quality.” Logging operations should be conducted in the winter when the soil is both dry and frozen. Harvest operations should be suspended if soils are too wet and susceptible to damage. Few trees should be marked on poorly drained soils if possible because it is difficult to use large harvesting equipment on poorly drained soils without rutting. Consult the “Sustainable Soil and Water Quality Practices on Forest Land” for recommendations on best management practices – www.michigan.gov/dnr/0,1607,7-153-30301_31154_31261---,00.html.

Standard Six is Forest Aesthetics – “Forest management plans and management activities recognize the value of forest aesthetics.” A single tree or group selection harvest in this stand will have minimal impacts on aesthetics. Conducting the harvest in the right season and including a conservative number of trees (three to five trees per acre) will maintain aesthetics.

Standard Eight is Forest Product Harvests and Other Activities – “Forest product harvests and other management activities are conducted in accordance with the management plan and consider other forest values.” This standard requires using qualified natural resource professionals, utilizing a contract, and complying with this plan when conducting a timber sale.

Best Management Practices.

Best Management Practices (BMPs) are guidelines published by the State of Michigan to protect Michigan’s water resources from non-point source pollution and erosion while working on forest land. BMPs include proper location of logging trails, the use of buffer strips, installation of culverts, proper use of pesticides, and site preparation for planting. BMPs also include the

proper seasonal timing of activities to minimize the spread of insects or disease. Any management activities should minimize soil erosion near wetlands, ponds, and county drains. More information on BMPs can be found online at http://www.michigan.gov/dnr/0,1607,7-153-30301_31154_31261---,00.html. BMPs are now called “Sustainable Soil and Water Quality Practices on Forest Land.” Standard Four of the American Tree Farm System requires that certified landowners must comply with all of their state’s best management practices (which are often voluntary apart from Tree Farm certification).

Summary Table

The previous recommended activities are summarized in Table 5. This table includes space for you to make notes about your management decisions over the next ten years. See descriptions above for the proper season to conduct management activities. The timing of timber sales should be based primarily upon biological considerations like stand age, density, and forest health issues but timing can be modified by several years according to other factors including economics (changing timber prices, timing of income needs, taxes), buyer preferences for larger sales or certain species, family preferences, etc. Several activities like forest stand improvement, tree planting, or controlling invasive plants can occur in a single year or be repeated over several years. Monitoring forest health should occur annually.

Table 5. Summary of Recommended Management Activities for the Next Ten Years.

Stand	#	Acres	Activity Description	Dates		Cost Share	Cost / Income
				Planned	Complete		
All	0-1	61.8	Monitor Public Safety	quarterly			
All	0-2	61.8	Expand Educational Opportunities	annual			
All	0-3	61.8	Monitor Forest Health	quarterly			
All	0-4	4,725'	Maintain and Develop Trails	2015-17		EQIP #655	
One	1-1	15.5	Partner with Friends of DeWitt Nature Center	annual			
One	1-2	15.5	Manage for Old Growth	annual			
Two	2-1	20.3	Partner with Tree Farm & other Forestry Associations	annual			
Two	2-2	20.3	Forest Stand Improvement	2015-17		EQIP #666	
Two	2-3	20.3	Commercial Timber Sale	2025			
Three	3-1	26.0	Partner with QDMA or other Wildlife Groups	annual			
Three	3-2	26.0	Forest Stand Improvement	2016-18		EQIP #666	
Three	3-3	26.0	Plant Trees and Shrubs to Enhance Wildlife Habitat	2015-17		EQIP #612	
Three	3-4	26.0	Commercial Timber Sale	2025			

Appendix I – General Forestry Information

Forest Economics

Forest economics is far more than just the value of lumber in trees. Natural resource economists refer to Total Economic Value (TEV) to describe the total economic benefits that a forest provides. The Total Economic Value includes both use values and non-use values. Non-use values describe the satisfaction of knowing that something exists even if it is not used for economic gain. For example, how much money would you be willing to accept to give up seeing your favorite bird, animal or plant in your forest? How much would you be willing to pay to keep your forest from being destroyed?

There are several types of use values. The most common use value is direct use which can be either consumptive or non-consumptive. Consumptive uses include harvesting timber or hunting. How much are your trees worth for lumber? How much do you spend to improve food plots in your forest? How much do you charge to lease your land to hunters? Non-consumptive uses values include recreation or cultural activities that do not include harvesting products. Entrance fees at parks are examples non-consumptive direct use values. Indirect use values are benefits that a forest provides outside itself. A forest may provide windbreaks to shelter cattle or shade for a house. Forests provide important indirect use values by sequestering carbon to mitigate global climate change. Option values are the value of preserving the option to use the forest in the future. The value of harvesting at some time in the future is an option value. Leaving option values to heirs or others is a bequest value. How much is it worth to you to keep your land in the family after you die? Please consider all of these values that your forest provides and how your management activities will affect these values now and in the future.

Property Tax Reduction Programs

The Qualified Forest property tax program (Public Act 42 of 2013 replaces PA 378 of 2006) exempts forest owners from paying school taxes up to 18 mills in each tax jurisdiction (township). This is similar to the agricultural property tax break, based on the philosophy that each *household* rather than every *acre* of land should contribute to funding local schools. Landowners must have between 20 and 640 acres, an approved forest management plan, and agree to comply with the prescriptions in their forest management plan. This Forest Stewardship Plan qualifies landowners to apply for the Qualified Forest program. For more information, see www.michigan.gov/qfp.

The Commercial Forest Act (Michigan Public Act 451 of 1994) gives property tax breaks for forest owners in Michigan. Landowners only pay \$1.25 per acre for property taxes and the State of Michigan pays counties another \$1.25 per acre. Landowners must have at least 40 acres of contiguous forest, a management plan, and conduct commercial harvests as prescribed in the plan. Landowners must allow public foot access for hunting and fishing. A Forest Stewardship Plan qualifies landowners for the Commercial Forest program. For more information, see www.michigan.gov/dnr/commercialforest.

Capital Gains Tax Information

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

"The tax rules vary depending on whether your woodland is personal, income-producing (investment), or business property. You must make this determination for your holding each tax year. If you do not have a profit motive, your timber may be personal property, which provides limited opportunities for deductions. If you have a clear profit motive, your property may be an investment property, or it may be business property if your management activity is more regular, frequent, and intensive than required for an investment. A written management plan is one of the best places to document a profit motive. For a timber held as a business, you also must determine whether you materially participate in its operation, in order to establish whether you face restrictions (called *passive loss restrictions*) on the deduction of business losses. The tests for material participation are based on factors including the number of hours of your participation."

"Your basis in purchased timber is the total cost of acquisition (e.g., purchase price, survey, legal fees). Your basis in inherited timber is its FMV on the date of death, but your basis in gifted timber is the lesser of its FMV or the donor's basis. Your basis in land and timber acquired together should be divided in proportion to their FMV and kept in separate accounts. If you didn't allocate basis when you acquired your woodland a professional forester can determine it retroactively, but you should weigh the cost against the potential tax savings."

"If you have a profit motive for your woodland, you can deduct ordinary and necessary timber management expenses, such as costs incurred to protect the woodland from insects, disease or fire, control brush, or do a pre-commercial thinning or mid-rotation fertilization. You must file Form T, Forest Activities Schedule, if you claim a depletion deduction, sell cut products under sec. 631(a), or have a lump-sum sale of timber held as business property (sec. 631(b)). Taxpayers in the trade or business of farming (e.g., crops, dairy, or livestock) file Schedule F. Woodland business owners also file Schedule F if their timber ownership is incidental to a farming operation; otherwise, they should use Schedule C."

(Source: "Tax Tips for Forest Landowners for the 2010 Tax Year" on www.timbertax.org.)

Cost Share Assistance Programs Available

The Environmental Quality Incentives Program (EQIP) is administered by the Natural Resources Conservation Service and provides some financial assistance to forest owners to implement conservation practices on their land in accordance with an approved forest management plan. More information is available at www.mi.nrcs.usda.gov/technical/forestry.html.

Basal Area

Basal area is an important forestry term to describe the density of a forest. The basal area of a single tree is the cross-sectional area of the tree at 4 1/2 feet above the ground expressed in units of square feet (see Figure A1). A quick formula to calculate basal area is $BA \text{ (ft}^2\text{)} = (\text{DBH in inches})^2 * 0.005454$. The basal area of a forest (per acre) is the sum of the basal areas of all the trees (per acre) expressed in units of ft^2/acre . Note in the table below that large diameter trees have much larger basal area than small trees and therefore have a greater influence on forest density than small diameter trees. Use the table below to determine how many of what size trees should be removed for management activities that target a certain basal area.

Figure A1. The Basal Area of a Single Tree.

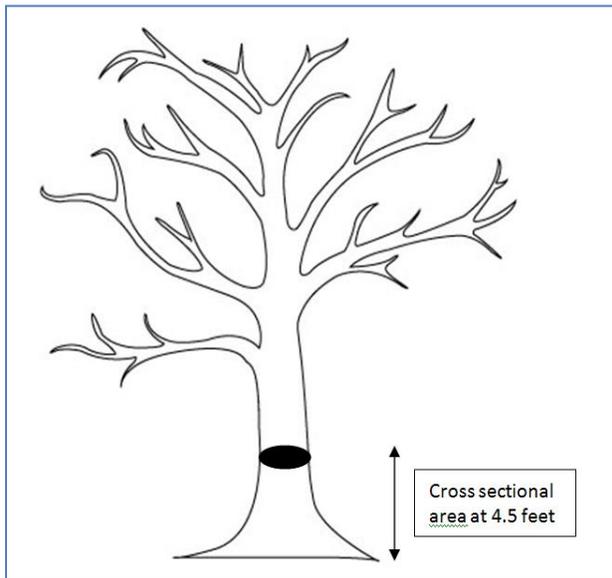


Table A1. Basal Area According to Tree Diameters.

DBH	Basal Area per Tree (ft ²)	# Trees for 1 ft ² BA	# Trees for 10 ft ² BA	# Trees for 20 ft ² BA	# Trees for 50 ft ² BA
2	0.02	45.8	458	917	2,292
4	0.1	11.5	115	229	573
6	0.2	5.1	51	102	255
8	0.3	2.9	29	57	143
10	0.5	1.8	18	37	92
12	0.8	1.3	13	25	64
14	1.1	0.9	9	19	47
16	1.4	0.7	7	14	36
18	1.8	0.6	6	11	28
20	2.2	0.5	5	9	23
22	2.6	0.4	4	8	19
24	3.1	0.3	3	6	16
26	3.7	0.3	3	5	14
28	4.3	0.2	2	5	12
30	4.9	0.2	2	4	10

Volume Estimates for Trees and Logs

The next two tables can be used to estimate the merchantable volume in units of boardfeet (12"x12"x1") in standing trees or cut logs. For standing trees, measure the diameter of the tree outside the bark at 4.5' off the ground and estimate the length of the log to about a 10" diameter top. For cut logs, measure the diameter inside the bark on the small end of the log and the length of the log. The tables below use Doyle Log Rule, one of three common log rules. International ¼ is generally a more accurate log rule but Doyle is commonly used by loggers and sawmills in southern Michigan to estimate merchantable volume in boardfeet. You can easily estimate tree volumes in your forest using a "tree scale stick" available from www.forestrysuppliers.com for around \$15.

Table A2. Boardfeet in Standing Tees (Doyle Log Rule)

DBH (in)	Log Length (ft)						
	16	24	32	40	48	56	64
10	14	17	20	21	22		
12	29	36	43	48	53	54	56
14	48	62	75	84	93	98	103
16	72	94	116	132	149	160	170
18	100	132	164	190	215	232	248
20	135	180	225	261	297	322	346
22	174	234	295	344	392	427	462
24	216	293	370	433	496	539	582
26	266	362	459	539	619	678	737
28	317	434	551	651	750	820	890
30	376	517	658	778	898	984	1,069
32	441	608	776	922	1,068	1,176	1,283
34	506	700	894	1,064	1,235	1,361	1,487
36	581	808	1,035	1,234	1,434	1,583	1,732

Table A3. Boardfeet in Cut Logs – Diameter at Small End Inside Bark (Doyle Log Rule).

Diameter at small end (in)	Log Length (ft)		
	8	12	16
6	2	3	4
8	8	12	16
10	18	27	36
12	32	48	64
14	50	75	100
16	72	108	144
18	98	147	196
20	128	192	256
22	162	243	324
24	200	300	400
26	242	363	484
28	288	432	576
30	338	507	676
32	392	588	784
34	450	675	900
36	512	768	1,024

Chainsaw Safety Training Courses

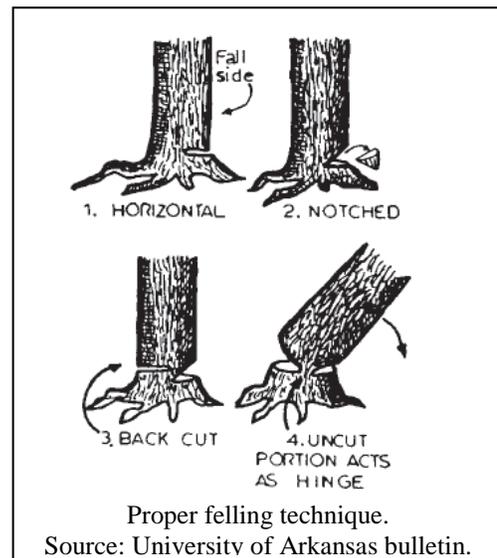
There are many activities that landowners can do themselves if they have the right equipment and the time to invest in their forest management. The most common tool in forest management is a good quality chainsaw (I recommend either Stihl or Husqvarana) with a sharp chain. However, chainsaws are also inherently dangerous and felling large trees in the forest requires some specialized skills. As a forester, I have a huge respect for professional loggers that fell trees all day long safely and exactly where they want them to fall. I personally do not have their level of skill, so I compensate for this by using abundant safety equipment when I am working in the woods with my Stihl 250 chainsaw. I recommend to every landowner that they use chainsaw chaps, safety toe boots, and a chainsaw helmet whenever they are using their chainsaw in their forest. Helmets are essential equipment, especially for felling dead ash trees where dead branches may break off and drop straight down on the chainsaw operator at the base of the tree.

I also enjoy learning from professional loggers about good techniques to fell trees safely and in the direction where I want the tree to go. The photo below shows a medium size ash tree that was felled without a “face cut” to direct the tree’s fall or a “hinge” left uncut in the middle to control the tree as it falls from kicking back in a “barber chair” motion. This could potentially be a very, very dangerous tree as it could swivel on the stump and fall anywhere, or worse, the trunk could split before it falls and spring back directly at the chainsaw operator.

Unfortunately there are limited options for obtaining quality chainsaw safety training in Michigan. Anthony Weatherspoon, a retired DNR forester, offers a series of three courses for groups of ten participants (salaam45@wwdb.org). The Michigan Sustainable Forestry Initiative sometimes offers chainsaw safety course for loggers that landowners may join (www.sfimi.org/). The Game of Logging is a well known chainsaw and tree felling course in the northeast but they rarely have training events in Michigan (www.gameoflogging.com). Even if taking an official course is not possible, I strongly encourage you to read about safe felling techniques to increase your woodsman skills. I have included a few chainsaw safety bulletins in the Appendix to help get you started.



Ash tree cut through the “hinge” – a dangerous technique.



Timber Sale Resources

For a list of more than 100 Sawmills, Loggers and Timber Buyers that work in Mid-Michigan, see www.smalliganforestry.com/timberbuyers.pdf.

[Note: There are many excellent timber buyers, loggers, and sawmills in Michigan but I have not worked directly with everyone on this list. Landowners should always get multiple bids for their timber sale and verify references and insurance of those working in their forest.]

Helpful Internet Resources

National Timber Tax - www.timbertax.org

DNR Timber Prices - www.michigan.gov/dnr/0,1607,7-153-10368_22594-81536--,00.html

DNR Forest Products Industry Database - www.michigandnr.com/wood/

Sample Timber Sale Contract - <http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E1656.pdf>

Sample Timber Sale Contract - <http://extension.unh.edu/Forestry/Docs/timbersaleagreement.pdf>

Michigan Association of Timbermen - www.timbermen.org or 800.682.4979

Michigan Timber Buyers Network - www.timberbuyer.net

Michigan Forest Products Council - www.michiganforest.com

DNR Private Forests - www.michigan.gov/dnr/0,1607,7-153-30301_30505_34240---,00.html

MSU Forestry Extension - http://www.for.msu.edu/extension_outreach/extension_publications/

List of Consulting Foresters - http://www.for.msu.edu/extension_outreach/consulting_foresters

Smalligan Forestry LLC: Timber Sales - <http://www.smalliganforestry.com/timber.html>

Forest Ecology

Three fundamental concepts in forest ecology are tolerance, succession, and disturbance. Tolerance refers to a tree's ability to grow in certain environmental conditions. Tolerance usually describes the ability to grow in shade but it can also refer to soil moisture. Trees are considered shade tolerant if they can survive for many years in low light conditions under a full canopy of leaves. For example, sugar maple and beech seedlings will survive in shade while aspen seedlings will not. Intolerant trees require full sunlight to survive and grow and are often the first to colonize an open field. A list of trees by their tolerance categories is in the Appendix.

Succession is the continuous change in species composition and structure in a forest through time (decades to hundreds of years). Primary succession is the growth of plants on rocks and newly formed soil for the first time. Secondary succession is the re-growth of trees following a disturbance that killed trees but did not remove the soil. The first stage in succession is stand establishment where trees, usually shade intolerant, begin to grow on a site. The second stage in succession is stem exclusion where trees begin to die because of competition for light, water and nutrients. Shade tolerant trees begin to replace the intolerant trees. The third stage is understory initiation where new seedlings begin to grow in openings caused by tree mortality. The fourth and final stage is climax or old growth where the species composition of the forest will maintain itself in the absence of a major disturbance. (See Figure A2 in Appendix I.)

The stages of succession are re-set by disturbances, whether natural or human. Natural disturbances include fire, wind, disease outbreaks, insect outbreaks, ice storms, tornadoes, avalanches, glaciers, and volcanoes. Some forest types have frequent cycles of disturbance while others have very infrequent disturbances. For example, a stand replacing fire occurs in dry jack pine forests in northern Michigan every 75 years or so while a stand replacing fire in moist beech-maple forests might have a 500 year or greater cycle.

Many forestry activities mimic the natural disturbances that drive forest succession. Removing individual trees mimics isolated death from old age that does not usually change the species composition of the forest. Removing an entire stand with mimics a large fire that resets the process of succession and typically alters the species mix in a forest. Forest management activities are matched to the requirements of individual tree species and the landowner's goals. For example, single tree selection harvests are used to perpetuate the shade tolerant species in northern hardwoods. Aspen require full sunlight to reproduce so a clearcut is the best method to regenerate an aspen stand if the landowner wishes to retain aspen on their land.

Management activities can help speed natural processes or manipulate the final species composition in a different direction. However, forests tend to do rather well without human interference and some activities might even have unintended negative impacts. Thinning a stand of trees will increase the growth of the remaining trees by removing competition, but it might also damage the residual trees and soil if it is done poorly. Various harvesting methods and planting trees can change the species composition of the forest. Any management activity should help fulfill the owner's goals and also consider both positive and negative impacts of the activity. Sometimes doing nothing is the appropriate management strategy.

Table A4. Shade Tolerance of Common Michigan Trees.

<i>Very Intolerant</i>	<i>Intolerant</i>	<i>Intermediate</i>	<i>Tolerant</i>	<i>Very Tolerant</i>
tamarack jack pine	red pine red cedar	white pine white spruce	white cedar black spruce	hemlock balsam fir
trembling aspen bigtooth aspen cottonwood balsam poplar black locust willows pin cherry	bitternut hickory black ash white ash black cherry black walnut butternut paper birch sassafras tuliptree	American elm rock elm hackberry red oak white oak bur oak black oak yellow birch sycamore shagbark hickory	silver maple red maple boxelder basswood slippery elm ironwood green ash hophornbeam	American beech sugar maple flowering dogwood

(Silvics of North America, Vol. 1 & 2. 1990. USDA Forest Service, Agr. Handbook 654, 1552p.)

Tree Planting Check List

1. Develop your written plan for tree planting and map out your plantation. What species are you planting and why?
2. Match the tree species to the specific site conditions (soil, water, sunlight) and your objectives (timber, wildlife, nuts, aesthetics).
3. Prepare the site for tree planting several months or seasons in advance (till soil, control weeds, fencing).
4. Purchase quality seedlings from local commercial nursery or Conservation District tree sale. Place your order early in the winter to ship or pick up the trees in the spring.
5. Properly plant your trees in the appropriate spacing. Plant conifers close together for timber production (6'x9') and most hardwoods wider apart for wildlife or nut production.
6. Prepare to deter deer or rodent damage by using tree tubes for each seedling or fencing the entire plantation.
7. Control weeds after planting with mowing and herbicide applications for 2-3 years after planting.
8. Replace dead seedlings in the second and third years if necessary.
9. Prune saplings if necessary, especially valuable hardwoods like black walnut, about 5-10 years after planting.
10. Thin the plantation when necessary (likely decades after planting) to optimize the growth and quality of your trees.
11. Have fun watching your trees grow!

For further information, see resources on www.smalliganforestry.com/planting.html. The Clinton Conservation District conducts tree sales in the spring and fall (2343 North US-27, St Johns, MI 48879; 989-224-3720; www.clintonconservation.org).

Wildlife Management Information

Table A5. Wildlife Habitat According to Stages of Forest Succession.

Species	Herbaceous Openings	Shrubs and Saplings	Pole Stage	Mature Forest
<i>Amphibians</i>				
American toad	X	X	X	X
Gray tree frog		X	X	X
Red-backed salamander			X	X
Slimey salamander			X	X
Red-spotted newt			X	X
Wood frog		X	X	X
<i>Reptiles</i>				
Eastern box turtle	X	X	X	X
Eastern garter snake	X	X	X	X
Northern redbelly snake			X	X
Smooth green snake	X	X		
Wood turtle	X	X	X	X
Black rat snake	X	X	X	X
<i>Birds</i>				
American woodcock	X	X		
Black-capped chickadee		X	X	X
Chipping sparrow	X	X		
Eastern meadowlark	X			
Great-horned owl	X			X
Ovenbird				X
Pileated woodpecker				X
Red-eyed vireo			X	X
Red-tailed hawk	X			X
Ruffed grouse	X	X		X
Rufous-sided towhee		X		
Song sparrow		X		
Wild turkey	X			X
<i>Mammals</i>				
Black bear				X
Cottontail rabbit	X	X		
Gray squirrel				X
Meadow vole	X			
Red fox	X			X
White-tailed deer	X	X		X

(Source: <http://www.dcnr.state.pa.us/forestry/sfrmp/fauna.htm>)

Table A6. Trees and Shrubs of Value as Food for Forest Wildlife.

Plant Species	Wildlife Species Using Plant For Food	No. of Species Using Plant	Seasons Available
Blackberry	brown thrasher, chipmunk, gray catbird, rabbit, robin, white-tailed deer	56	S, F
Cherry	black bear, cedar waxwing, raccoon, red squirrel, rose-breasted grosbeak, ruffed grouse, white-footed mouse	56	S, F
Grape	black bear, cardinal, fox sparrow, gray fox, ruffed grouse, wild turkey	53	S, F, W
Dogwood	cardinal, cedar waxwing, rabbit, ruffed grouse, wild turkey, wood thrush	47	S, F, W
Oak	black bear, blue jay, raccoon, ruffed grouse, white-tailed deer, wild turkey, wood duck	43	Sp, F, W
Sedge	horned lark, ruffed grouse, sparrows, wild turkey	43	Sp, S
Serviceberry	beaver, bluebird, cardinal, cedar waxwing, gray catbird, red squirrel, scarlet tanager, veery, white-tailed deer	39	Sp, S
Blueberry	black bear, gray catbird, rabbit, rufous-sided towhee, skunk, white-footed mouse, white-tailed deer	37	S, F
Elderberry	brown thrasher, cardinal, indigo bunting, rabbit, rose-breasted grosbeak	36	S
Pine	black-capped chickadee, brown creeper, gray squirrel, mourning dove, porcupine, nuthatches	33	W
Panic grass	dark-eyed junco, sparrows, red-winged blackbird, wild turkey	32	F
Beech	black bear, blue jay, chipmunk, porcupine, ruffed grouse, squirrels, tufted titmouse, white-tailed deer, wild turkey	31	Sp, F, W
Poison Ivy	black-capped chickadee, gray catbird, downy woodpecker, flicker, hairy woodpecker, hermit thrush, wild turkey	28	F, W
Sumac	bluebird, cardinal, black-capped chickadee, hermit thrush, rabbit, robin	28	F, W
Poleweed	bluebird, cedar waxwing, gray catbird, gray fox, mourning dove, raccoon, red fox	25	F
Greenbriar	gray catbird, hermit thrush, mockingbird, raccoon, ruffed grouse	23	F, W
Birch	black-capped chickadee, beaver, porcupine, rabbit, ruffed grouse	22	Sp, S
Virginia creeper	bluebird, great-crested flycatcher, pileated woodpecker, red-eyed vireo	22	F, W
Hickory	chipmunk, red-bellied woodpecker, rose-breasted grosbeak, squirrels, wood duck	19	Sp, S, F, W
Aspen	beaver, porcupine, ruffed grouse, white-tailed deer	17	Sp, S, F, W
Hawthorn	fox sparrow, gray fox, raccoon, ruffed grouse	15	S, F
Hemlock	black-capped chickadee, porcupine, red squirrel, ruffed grouse, white-footed mouse	13	F, W
Alder	beaver, goldfinch, ruffed grouse	11	Sp, S, F, W

(Source: <http://www.dcnr.state.pa.us/forestry/sfrmp/fauna.htm>)

Table A7. Seasonal Forage Preferences for Whitetail Deer.

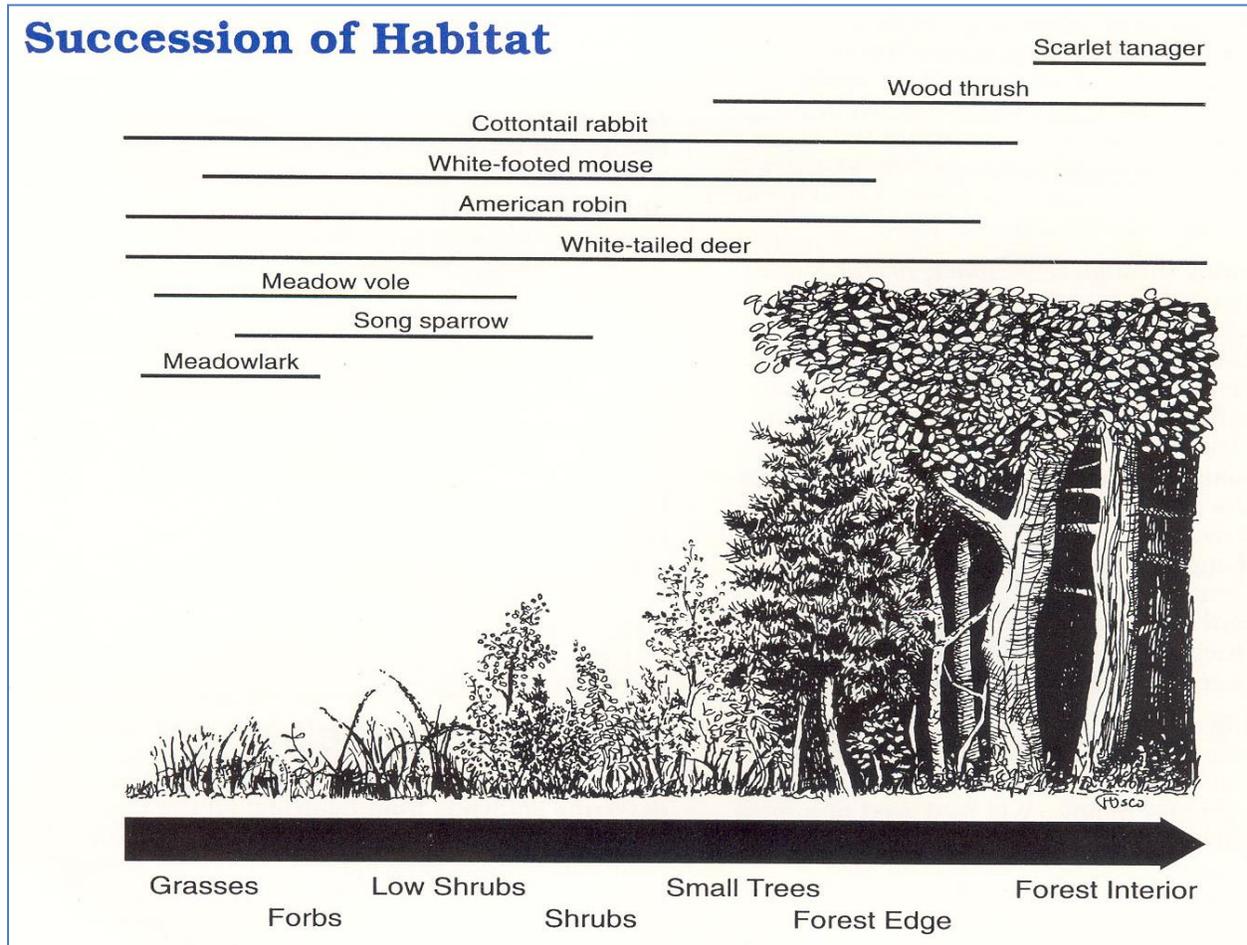
Common Name	Scientific Name	Plant Part	Seasonal Forage Preferences											
			J	F	M	A	M	J	J	A	S	O	N	D
Conifers														
balsam fir	<i>Abies balsamea</i>	entire	U	U	U	U	U	U	U	U	U	U	U	U
red spruce	<i>Picea rubens</i>	leaves	U	U	U	U	U	U	U	U	U	U	U	U
eastern white pine	<i>Pinus strobus</i>	stems	D	D	N	N	N	N	N	N	N	N	N	D
eastern hemlock	<i>Tsuga canadensis</i>	leaves	D	D	D	N	N	N	N	N	N	N	N	D
Broadleaves														
red maple	<i>Acer rubrum</i>	entire	N	N	N	D	D	D	D	D	D	N	N	N
striped maple	<i>Acer pensylvanicum</i>	leaves	N	N	N	P	P	P	P	P	P	N	N	N
sugar maple	<i>Acer saccharum</i>	leaves	N	N	N	P	P	P	P	P	P	N	N	N
paper birch	<i>Betula papyrifera</i>	leaves	N	N	N	P	P	P	P	P	P	N	N	N
sweet birch	<i>Betula lenta</i>	entire	N	N	N	P	P	P	P	P	P	N	N	N
yellow birch	<i>Betula alleghaniensis</i>	leaves	N	N	N	D	D	D	D	D	D	N	N	N
American beech	<i>Fagus grandifolia</i>	leaves	U	U	U	U	U	U	U	U	U	U	U	U
American beech	<i>Fagus grandifolia</i>	seed	N	N	N	N	N	N	N	P	P	P	N	N
white ash	<i>Fraxinus americana</i>	leaves	N	N	N	D	D	D	D	D	D	D	N	N
eastern hophornbeam	<i>Ostrya virginiana</i>	leaves	N	N	N	D	D	D	D	u	N	N	N	N
bigtooth aspen	<i>Populus grandidentata</i>	leaves	N	N	D	D	D	D	D	D	N	N	N	N
Other Plants														
eastern hayscented fern	<i>Dennstaedria punctilobula</i>	entire	N	N	P	P	P	P	P	P	P	N	N	N
woodfern	<i>Dryopteris</i>	entire	N	N	P	P	P	P	P	P	P	N	N	N
clubmoss	<i>Lycopodium</i>	entire	N	N	P	P	P	P	P	P	P	N	N	N
Canada beadruby	<i>Maianthemum canadense</i>	leaves	N	N	D	D	D	D	D	D	D	N	N	N
western brackenfern	<i>Pteridium aquilinum</i>	entire	N	N	P	P	P	P	P	P	P	N	N	N
American starflower	<i>Trientalis borealis</i>	entire	N	N	N	N	D	D	D	D	D	U	N	N
sessileleaf bellwort	<i>Uvularia sessilifolia</i>	flower	N	N	N	N	D	D	D	D	D	U	N	N
P = preferred; D= desirable; U = undesirable; N = not consumed														

(Source: NRCS 1998 Forestry Manual)



Field mouse out for a winter stroll in Stand Three.

Figure A2. Wildlife Habitat Distribution According to Stages of Forest Succession.



(Source : www.naturalresources.umd.edu/Publications/BranchingOut/20094Fall.html)

Insect and Disease Information

Integrated Pest Management. Standard Four of the American Tree Farm System is Air, Water, and Soil Protection – “Forest management practices maintain or enhance the environment and ecosystems, including air, water, soil, and site quality.” One of the primary ways to protect soil and water quality is to practice Integrated Pest Management (IPM). IPM requires correctly identifying pests, setting an economic or action threshold, and then implementing the best method to control the pest. IPM actions may include cultural, mechanical, biological, and chemical controls. Chemical pesticides are a useful tool but should not be the first or only choice to control pests. For example, the best way to prevent oak wilt is not to apply fungicides, but a cultural practice of not wounding oaks between April and September. If oak wilt is established, the primary action is a mechanical control of severing roots to prevent the spread of the fungus through root grafts. I am a licensed Commercial Pesticide Applicator if pesticides need to be applied in a forest, but I always recommend considering all other viable alternatives before

applying a chemical. I do not expect that you will need to apply any pesticides (insecticides, fungicides, or herbicides) in your forest. Please contact me if you have any questions about insects and diseases in your forest.

Emerald Ash Borer. The Emerald Ash Borer (*Agrilus planipennis*) is attracted to both healthy and stressed or dying ash trees. However, it does not lay its eggs or reproduce in dead ash trees. All ash trees should be monitored for dieback of crown and sucker sprouting along the lower trunk. D-shaped exit holes also indicate the presence of EAB but these holes may be too high up in the tree to be seen from the ground. Any sick ash tree should be cut down or girdled. Dead logs on the ground or standing dead snags are not suitable hosts for EAB larvae. Harvested trees could be removed for firewood or left in place for large woody debris on the forest floor. The movement of all firewood is strictly controlled and it is best to use ash firewood on site to minimize the spread of the beetles. Clinton County is within the Level One Quarantine Area and firewood cannot legally leave the Lower Peninsula. Girdled trees could be left standing to provide tall snags for wildlife. The adult beetles are active in May and June so trees should be felled or girdled earlier in the spring to prevent feeding and egg laying. See bulletins in the Appendix or www.emeraldashborer.info for more information about EAB.

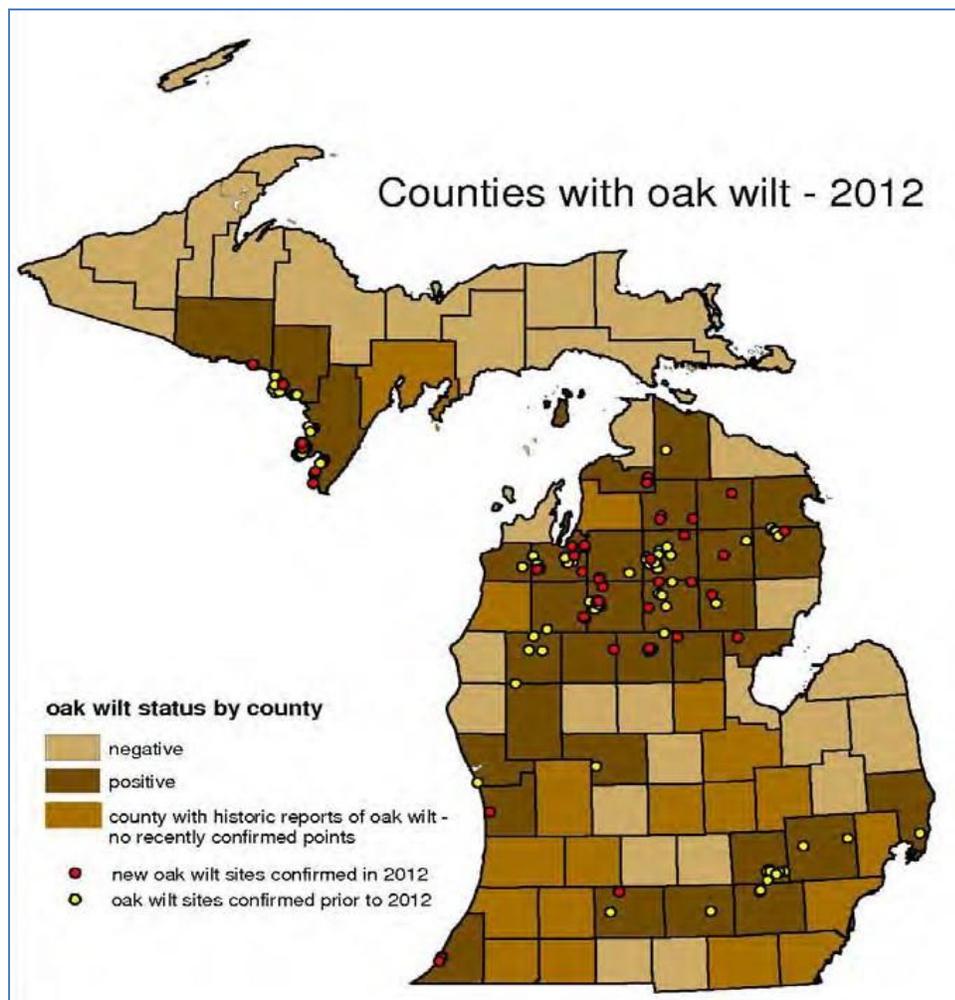
Dutch Elm Disease. Dead elm should also be removed to manage the Dutch elm disease that is killing elm trees on the property. Dutch elm disease is caused by the fungus (*Ophiostoma novoulmi*) and is transported by elm bark beetles (*Hylurgopinus rufipes*, *Scolytus multistriatus*) and root grafts. Dutch elm disease is managed through woodlot sanitation that denies the beetles places to reproduce. Elm wood greater than 1" diameter should be chipped, burned or buried. Elm wood should not be piled for firewood with the bark still on as this is suitable habitat for elm bark beetles. See bulletins in the Appendix for more information.

Thousand Cankers. Thousand Cankers is a new disease for black walnuts discovered in 2008. It is caused by a fungus (*Geosmithia morbida*) that is transported to the tree by the walnut twig beetle (*Pityophthorus juglandis*). It is currently located primarily in western states and it has not been observed in Michigan yet. However, it may be difficult to limit the disease and it may get established in Michigan in the future. The State of Michigan has quarantined all nursery materials in the *Juglans* genus to prevent the introduction of the disease. You should monitor your valuable black walnut trees to look for early signs and symptoms of the disease. "Early symptoms are yellowing of leaves and foliage thinning of the upper crown of the tree. As the disease progresses larger limbs are killed which may have dead, flagging leaves associated with them. In end stages the fungus may be introduced into the trunk and large cankered areas develop in the trunk. In susceptible hosts, such as black walnut (*Juglans nigra*), trees usually die within three years after initial symptoms are observed in the crown of the tree." More information is available online at www.thousandcankerdisease.com. [I did not see any walnuts in the school forests.]

Oak Wilt. I did *not* observe oak wilt anywhere on the property and oak wilt is a low concern in Clinton County (see oak wilt map below). However, it is far easier to prevent oak wilt than it is to treat a stand after infection. The best way to prevent oak wilt is to not harvest, wound or prune any oak trees between April and September. Openings in the bark allow the fungus to enter the tree and establish the disease that quickly results in mortality. Oak wilt is a vascular

disease of oaks caused by the fungus *Ceratocystis fagacearum*. Trees usually die within a few weeks after the symptoms first appear. Usually scattered individuals or small groups of trees are killed, but several acres may be affected. The disease is spread from tree to tree through root grafts and over larger distances by sap-feeding beetles (*Nitidulidae*) and the small oak bark beetle (*Pseudopityophthorus spp.*) Oaks in the red oak family are more susceptible to oak wilt than oaks in the white oak family because of their more open vascular tissue that allows the fungus to spread faster. Any pruning or harvesting of oak trees should occur in the winter when the trees are dormant and not susceptible to insects transferring fungal spores. See bulletins in the Appendix for more information.

Figure A3. Oak Wilt Distribution in 2012.

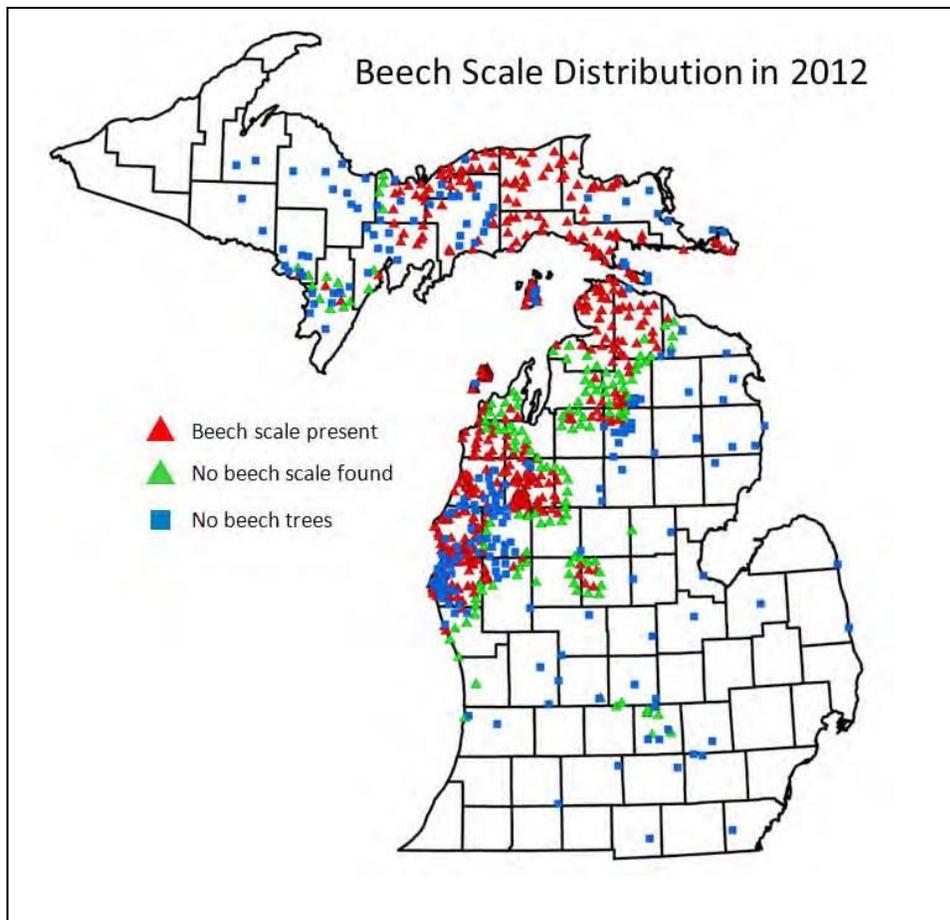


(Source: 2012 Forest Health Highlights Report, MI DNR)

Beech Bark Disease. Beech bark disease (BBD) was discovered in Michigan in 2000. Unfortunately this exotic disease (origins in Europe) is spreading widely and rapidly through Michigan's forests. BBD is initiated by a scale insect (*Cryptococcus fagisuga*) that attaches to the tree and feeds on sap. The tiny scale (~1 mm) secretes a white, wooly, waxy covering and the trunks look like they are covered in white powder. Damage from this feeding allows one of two

fungi (*Neonectria faginata* or *Neonectria ditissima*) to invade the tree. The fungus inhibits the flow of sap through infested portions of the tree which causes a general decline in tree health and eventually kills the beech tree. The leaves may yellow and fall off the tree during the growing season. The insect and fungal infection weakens the tree and the beech sometimes snap off. Controlling the natural spread of BBD is not feasible because both the scale and fungus are moved by the wind. If the scale is not yet present in your forest, consider lowering the amount of beech in your forest so that beech are at least <20% of the stand basal area. Focus especially on harvesting large, mature trees with rough bark. Retain vigorous young beech trees with smooth bark and monitor your forest for the presence of scale. If beech scale is present or within 25 miles of your forest, harvest infected trees. Some beech may be resistant to the scale and should be left in your woods, especially smooth barked beech trees <10" DBH. Do not move infested firewood as this will help to spread the scale and fungus that causes beech bark disease.

Figure A4. Beech Scale Distribution in 2012



(Source for text and figure: Wieferich and McCullough in the 2012 Forest Health Highlights Report)

Table A8. Firewood Heat Values

<u>Wood Species</u>	<u>Weight (lbs/cord)</u>	<u>Million BTU's / cord</u>
Hickory	4,327	27.7
Hornbeam, Hop	4,267	27.3
Hornbeam, American	3,890	26.8
Birch, Black	3,890	26.8
Locust, Black	3,890	26.8
Apple	4,140	26.5
Oak, White	4,012	25.7
Maple, Sugar	3,757	24.0
Oak, Red	3,757	24.0
Beech, American	3,757	24.0
Ash, White	3,689	23.6
Birch, Yellow	3,689	23.6
Hackberry	3,247	20.8
Tamarack	3,247	20.8
Fir, Douglas	3,196	20.6
Birch, White	3,179	20.3
Birch, Gray	3,179	20.3
Birch, Paper	3,179	20.3
Cherry	3,120	20.0
Cherry, Black	2,880	19.9
Elm, American	3,052	19.5
Elm, Oyen	3,052	19.5
Elm, White	3,052	19.5
Ash, Black	2,992	19.1
Maple, Red	2,924	18.7
Boxelder	2,797	17.9
Alder	2,708	17.6
Pine, Jack	2,669	17.1
Pine, Norway	2,669	17.1
Pine, Pitch	2,669	17.1
Spruce, Black	2,482	15.9
Hemlock	2,482	15.9
Pine, Ponderosa	2,380	15.2
Aspen	2,295	14.7
Spruce	2,100	14.5
Willow	2,100	14.5
Butternut	2,100	14.5
Pine, Western	2,236	14.3
Fir, Balsam	2,236	14.3
Basswood	2,108	13.5
Cottonwood	2,108	13.5
Cedar, White	1,913	12.2

Weight and heat content figures are based on seasoned wood at 20% moisture content, and 85 cubic feet of wood per cord. A cord of wood is defined as a stack 4 feet high, 4 feet deep and 8 feet long, which comes to 128 ft³, but we deduct for air space between the pieces in the stack.

(Source: www.chimneysweeponline.com/howood.htm)

Recommended Reading

Tree Identification

Michigan Trees, Burton Barnes and Warren Wagner
Trees of Michigan: Including Tall Shrubs, Linda Kershaw
Trees of Michigan and the Upper Great Lakes, Norman Smith
Trees of Michigan, Stan Tekiela

Michigan Forests

The Forests of Michigan, Don Dickmann
Michigan Forest Communities, Don Dickmann

Forest Management

Woodland Stewardship, University of Minnesota Extension
Positive Impact Forestry, Thom McEvoy
Common Sense Forestry, Hans Morsbach
Working with your Woodland, Mollie Beattie, Charles Thompson, Lynn Levine
The Woodlot Management Handbook, Stewart Hilts and Peter Mitchell

Forestry Legal Issues and Estate Planning

Owning and Managing Forests: A guide to legal, financial and practical matters, Thom McEvoy
Ties to the Land, Oregon State University
Estate Planning for Private Forest Owners (<http://www.timbertax.org/estate/penn/fullver.pdf>)

Wildlife Habitat

Wildlife & Woodlot Management, Monte Burch
Managing Michigan's Wildlife (Out of print but online at
http://www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/index.htm)
A Guide to Successful Wildlife Food Plots: Blending Science with Common Sense,
University of Tennessee, <http://www.utextension.utk.edu/publications/pbfiles/PB1769.pdf>
Enhancing Wildlife Habitats: A Practical Guide for Forest Landowners
Natural Resource, Agriculture, and Engineering Service Publication #64

Private Forest Owners

Birch, T.W. 1996a. Private forest-land owners of the United States, 1994. Resource Bulletin NE-134. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 183 p. <http://www.treesearch.fs.fed.us/pubs/20920>.
Butler, Brett J. 2008. Family Forest Owners of the United States, 2006. Gen. Tech. Rep. NRS-27. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 72 p. http://nrs.fs.fed.us/pubs/gtr/gtr_nrs27.pdf.

Individual Tree Species

Information about other great forestry books and links to places to purchase them is available at www.smalliganforestry.com/links.html.

American Tree Farm System - Standards of Sustainability

Standard One: Commitment to Practicing Sustainable Forestry

Forest owner demonstrates commitment to forest vitality by developing and implementing a sustainable forest management plan.

Standard Two: Compliance with Laws

Forest management activities comply with all relevant federal, state and local laws, regulations and ordinances.

Standard Three: Reforestation and Afforestation

Forest owner completes timely restocking of desired species of trees on harvested sites and non-stocked areas where tree growing is consistent with land use practices and the forest owner's management objectives.

Standard Four: Air, Water, and Soil Protection

Forest management practices maintain or enhance the environment and ecosystems, including air, water, soil and site quality.

Standard Five: Fish, Wildlife and Biodiversity

Forest management activities contribute to the conservation of biodiversity.

Standard Six: Forest Aesthetics

Forest management plans and management activities recognize the value of forest aesthetics.

Standard Seven: Protect Special Sites

Special sites are managed in ways that recognize their unique historical, archeological, cultural, geological, biological or ecological characteristics.

Standard Eight: Forest Product Harvests and Other Activities

Forest product harvests and other management activities are conducted in accordance with the management plan and consider other forest values.

For an expanded list including performance measures and field indicators, see handout in the Appendix and also the American Tree Farm System website at www.treefarmssystem.org.

The Michigan Tree Farm System website is at www.michigantreefarmssystem.org.

This Forest Stewardship Plan is written to help you comply with all of the above standards. I recommend that you enroll your property in the American Tree Farm System forest certification program. As a Certified Tree Farm Inspector, I would be happy to come out to your forest for the free inspection and help you enroll in the program. There is no additional cost to enroll.

Ecosystem Services and Carbon Sequestration in Forests

Ecosystem services are those services that forest and other ecosystems provide to society as “public goods.” Ecosystem services include aesthetics, biodiversity and conservation of plants and animals, improving of air and water quality, the protection of soil, sequestering carbon from the atmosphere, and other services. As with many public goods, landowners are not usually paid for the ecosystem services that they provide to society. However, markets are emerging in the United States and other countries to compensate landowners for the ecosystem services that their well managed forests provide to society. These markets are sometimes referred to as payments for ecosystem services (PES).

One of the primary emerging markets is for sequestering, or removing, carbon dioxide from the atmosphere and storing it in the biomass of trees as they grow. Forests improve air quality by taking in carbon dioxide through photosynthesis, storing it in their tissues (leaves, branches, trunk, roots), and then emitting oxygen. Because plant photosynthesis absorbs carbon dioxide, the main greenhouse gas, forests help to mitigate the impacts of climate change. The dry weight of woody biomass is typically 50% carbon.

Proper forest management can help lower the amount of carbon dioxide emitted into the atmosphere and increase the amount of carbon removed from the atmosphere. For example, afforesting poor quality crop land and pasture land into forests will sequester several tons of carbon dioxide per acre which is much more than carbon dioxide storage in crop or pasture land. We could also minimize the amount of forest land that is converted to other land uses (agriculture or development into homes or commercial buildings). We can continually improve the way we take care of both public and private forests.

Forest soil also contains a substantial amount of carbon in the soil organic matter. Proper soil conservation techniques in forest management will minimize the release of carbon held in the soil. Forest soil carbon is released by soil disturbances such as rutting during harvests or other means of exposing lower layers of soil. Proper management of roads, trails, and logging jobs will enhance the ability of the soil to retain the carbon sequestered within it.

Carbon accumulation in forests and soils eventually reaches a saturation point, beyond which additional sequestration is no longer possible. This happens when a forest reaches maturity (“old growth”) or when the organic matter in soils builds back up to original levels before losses occurred. Even after saturation, the trees or agricultural practices need to be sustained to maintain the accumulated carbon and prevent subsequent losses of carbon back to the atmosphere.

The deforestation of tropical forests around the world contributes around 18% of global greenhouse gas emissions. Reducing the emissions from deforestation and degradation (REDD) is a new global initiative to compensate major tropical forest countries (Brazil, Indonesia, Democratic Republic of Congo) to reduce their rates of deforestation.

Carbon markets attempt to put prices on the sale of carbon credits. Unfortunately regulatory uncertainty (domestic and global) is currently keeping forest carbon credits very low in value. If

these markets do become viable in the future, landowners may be able to participate in carbon trading by establishing a baseline inventory of the carbon that is stored on their land, and then enrolling in a program that trades these ecosystem credits.

If you decide to enroll your land in any carbon or ecosystem trading program, it is very important that you carefully consider all offers and markets. It is not necessary to sign an agreement that gives away your rights to your forest management decisions, particularly the timber rights. If you have questions about carbon sequestration, contact your local DNR Service Forester or the DNR Forest Stewardship Coordinator at 517-284-5884. For more information about ecosystem services, see the USFS website at www.fs.fed.us/ecosystems-services/.

Table A9. Forestry Practices that Sequester or Reduce Emissions of Carbon Dioxide.

Forestry Practices	Typical Definition and Examples	Effect on Greenhouse Gases
Afforestation	Tree planting on lands previously not in forestry (e.g., conversion of marginal agriculture land to forest land).	Increases carbon storage through sequestration.
Reforestation	Tree planting on land that in the last 50 years were forests, excluding the planting of trees immediately after harvest (e.g., restoring trees on severely burned lands that will not regenerate without intervention).	Increases carbon storage through sequestration.
Improved Forest Management (IFM)	Modification to forestry practices that produce wood products to enhance sequestration over time (e.g., lengthening the harvest-regeneration cycle, adopting low-impact logging).	Increases carbon storage by sequestration and may also avoid CO ₂ emissions by altering management.
Reduced Impact Logging (RIL)	Using silvicultural systems and logging practices to reduce the number of trees per acre harvested and to minimize the soil disturbances (e.g. harvesting 15 trees per acre instead of 25 TPA, reducing rutting on skid trails and log landings).	Avoids CO ₂ emissions from more aggressive logging practices
Reducing Emissions from Deforestation and Degradation (REDD+)	Protection of forests that are threatened by land cover conversion to non-forests or unsustainable and illegal logging	Avoids CO ₂ emissions from deforestation to other land uses or degradation of the forest land

(Source: www.epa.gov/sequestration/forestry.html)

Table A10. Common Trees, Shrubs and Vines in Michigan (Native and a Few Exotic Species).

Genus	species	Common Name	Genus	species	Common Name
<i>Abies</i>	<i>balsamea</i>	balsam fir	<i>Magnolia</i>	<i>acuminata</i>	cucumbertree
<i>Abies</i>	<i>concolor</i>	white fir	<i>Morus</i>	<i>alba</i>	white mulberry
<i>Acer</i>	<i>negundo</i>	box elder	<i>Morus</i>	<i>rubra</i>	red mulberry
<i>Acer</i>	<i>nigrum</i>	black maple	<i>Nyssa</i>	<i>sylvatica</i>	black gum
<i>Acer</i>	<i>pennsylvanicum</i>	striped maple, moosewood	<i>Ostrya</i>	<i>virginiana</i>	hophornbeam, ironwood
<i>Acer</i>	<i>platanooides</i>	Norway maple	<i>Parthenocissus</i>	<i>quinquefolia</i>	Virginia creeper
<i>Acer</i>	<i>rubrum</i>	red maple	<i>Picea</i>	<i>abies</i>	Norway spruce
<i>Acer</i>	<i>saccharinum</i>	silver maple	<i>Picea</i>	<i>glauca</i>	white spruce
<i>Acer</i>	<i>saccharum</i>	sugar maple	<i>Picea</i>	<i>mariana</i>	black spruce
<i>Aesculus</i>	<i>glabra</i>	Ohio buckeye	<i>Picea</i>	<i>pungens</i>	Colorado blue spruce
<i>Aesculus</i>	<i>hippocastanum</i>	horse chestnut	<i>Pinus</i>	<i>banksiana</i>	jack pine
<i>Ailanthus</i>	<i>altissima</i>	tree of heaven	<i>Pinus</i>	<i>nigra</i>	Austrian pine
<i>Alnus</i>	<i>rugosa</i>	tag alder	<i>Pinus</i>	<i>resinosa</i>	red pine
<i>Amelanchier</i>	<i>arborea</i>	serviceberry	<i>Pinus</i>	<i>strobus</i>	white pine
<i>Asimina</i>	<i>triloba</i>	pawpaw	<i>Pinus</i>	<i>sylvestris</i>	Scotch pine
<i>Betula</i>	<i>allegahaniensis</i>	yellow birch	<i>Platanus</i>	<i>occidentalis</i>	sycamore
<i>Betula</i>	<i>lenta</i>	sweet birch	<i>Populus</i>	<i>balsamifera</i>	balsam poplar
<i>Betula</i>	<i>nigra</i>	river birch, black birch	<i>Populus</i>	<i>deltooides</i>	eastern cottonwood
<i>Betula</i>	<i>papyrifera</i>	paper birch	<i>Populus</i>	<i>grandidentata</i>	big-tooth aspen, popple
<i>Betula</i>	<i>pumila</i>	bog birch	<i>Populus</i>	<i>tremuloides</i>	trembling aspen, popple
<i>Carpinus</i>	<i>caroliniana</i>	musclewood, blue beech	<i>Prunus</i>	<i>pensylvanica</i>	pin cherry
<i>Carya</i>	<i>cordiformis</i>	bitternut hickory	<i>Prunus</i>	<i>serotina</i>	black cherry
<i>Carya</i>	<i>glabra</i>	pignut hickory	<i>Prunus</i>	<i>virginiana</i>	choke cherry
<i>Carya</i>	<i>laciniosa</i>	shellbark hickory	<i>Quercus</i>	<i>alba</i>	white oak
<i>Carya</i>	<i>ovata</i>	shagbark hickory	<i>Quercus</i>	<i>bicolor</i>	swamp white oak
<i>Castanea</i>	<i>dentata</i>	American chestnut	<i>Quercus</i>	<i>coccinea</i>	scarlet oak
<i>Catalpa</i>	<i>speciosa</i>	northern catalpa	<i>Quercus</i>	<i>ellipsoidalis</i>	northern pin oak
<i>Celtis</i>	<i>occidentalis</i>	northern hackberry	<i>Quercus</i>	<i>imbricaria</i>	shingle oak
<i>Cephalanthus</i>	<i>occidentalis</i>	buttonbush	<i>Quercus</i>	<i>macrocarpa</i>	bur oak
<i>Cercis</i>	<i>canadensis</i>	redbud	<i>Quercus</i>	<i>muehlenbergii</i>	chinkapin oak
<i>Comptonia</i>	<i>peregrina</i>	sweetfern	<i>Quercus</i>	<i>palustris</i>	pin oak
<i>Comus</i>	<i>alternifolia</i>	alternate dogwood	<i>Quercus</i>	<i>rubra</i>	northern red oak
<i>Comus</i>	<i>amomum</i>	silky dogwood	<i>Quercus</i>	<i>velutina</i>	black oak
<i>Comus</i>	<i>florida</i>	flowering dogwood	<i>Rhamnus</i>	<i>cathartica</i>	buckthorn
<i>Comus</i>	<i>racemosa</i>	grey dogwood	<i>Rhus</i>	<i>copallina</i>	winged sumac
<i>Comus</i>	<i>stolonifera</i>	red-osier dogwood	<i>Rhus</i>	<i>glabra</i>	smooth sumac
<i>Corylus</i>	<i>americana</i>	American hazelnut	<i>Rhus</i>	<i>hirta</i>	staghorn sumac
<i>Crataegus</i>	<i>succulenta</i>	succulent hawthorn	<i>Robinia</i>	<i>psuedoacacia</i>	black locust
<i>Elaeagnus</i>	<i>angustifolia</i>	Russian olive	<i>Salix</i>	<i>babylonica</i>	weeping willow
<i>Elaeagnus</i>	<i>umbellata</i>	autumn olive	<i>Salix</i>	<i>discolor</i>	pussy willow
<i>Fagus</i>	<i>grandifolia</i>	American beech	<i>Salix</i>	<i>exigua</i>	sandbar willow
<i>Fraxinus</i>	<i>americana</i>	white ash	<i>Salix</i>	<i>nigra</i>	black willow
<i>Fraxinus</i>	<i>nigra</i>	black ash	<i>Sambucus</i>	<i>canadensis</i>	common elderberry
<i>Fraxinus</i>	<i>pennsylvanica</i>	green ash	<i>Sambucus</i>	<i>pubens</i>	red berried elder
<i>Fraxinus</i>	<i>quadrangulata</i>	blue ash	<i>Sassafras</i>	<i>albidum</i>	sassafras
<i>Gaylussacia</i>	<i>baccatta</i>	black huckleberry	<i>Staphylea</i>	<i>trifolia</i>	American bladdernut
<i>Ginkgo</i>	<i>biloba</i>	ginkgo	<i>Taxus</i>	<i>canadensis</i>	Canada yew
<i>Gleditsia</i>	<i>triacanthos</i>	honey locust	<i>Thuja</i>	<i>occidentalis</i>	northern white cedar
<i>Gymnocladus</i>	<i>dioicus</i>	Kentucky coffeetree	<i>Tilia</i>	<i>americana</i>	basswood
<i>Hamamelis</i>	<i>virginiana</i>	witch hazel	<i>Toxicodendron</i>	<i>radicans</i>	poison ivy
<i>Ilex</i>	<i>verticillata</i>	winterberry	<i>Toxicodendron</i>	<i>vernix</i>	poison sumac
<i>Juglans</i>	<i>cinerea</i>	butternut, white walnut	<i>Tsuga</i>	<i>canadensis</i>	eastern hemlock
<i>Juglans</i>	<i>nigra</i>	black walnut	<i>Ulmus</i>	<i>americana</i>	American elm
<i>Juniperus</i>	<i>virginiana</i>	eastern redcedar	<i>Ulmus</i>	<i>pumila</i>	Siberian elm
<i>Larix</i>	<i>laricina</i>	tamarack, eastern larch	<i>Ulmus</i>	<i>rubra</i>	slippery elm, red elm
<i>Lindera</i>	<i>benzoin</i>	spicebush	<i>Vaccinium</i>	<i>angustifolium</i>	lowbush blueberry
<i>Liquidambar</i>	<i>styraciflua</i>	sweetgum	<i>Viburnum</i>	<i>acerifolium</i>	mapleleaf viburnum
<i>Liriodendron</i>	<i>tulipifera</i>	tuliptree	<i>Viburnum</i>	<i>lentago</i>	nannyberry
<i>Lonicera</i>	<i>maackii</i>	amur honeysuckle	<i>Vitis</i>	<i>riparia</i>	riverbank grape
<i>Maclura</i>	<i>pomifera</i>	osage orange	<i>Zanthoxylum</i>	<i>americanum</i>	prickly ash

Glossary of Common Forestry Terms

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

- Alley Cropping** - widely spaced rows of trees with annual crops growing in between the rows.
- Basal Area (of a Tree)** - the cross sectional area of a tree trunk at 4.5 feet off the ground and expressed in units of ft².
- Basal Area (of a Forest)** - the basal area of all trees on an acre of land is summed up for the basal area of a forest and expressed in ft²/acre; used as a measure of forest density.
- Board Foot** – a measure of volume 1 foot by 1 foot by 1 inch or 144 cubic inches of wood.
- Bole** - the trunk of a tree.
- Bolt** – 8 foot long log
- Browse** - parts of woody plants, including twigs, shoots, and leaves, eaten by forest animals.
- Buck** - to cut trees into shorter lengths, such as logs or cordwood.
- Butt log** - a log cut from the bole immediately above the stump.
- Canopy** - the continuous cover formed by tree crowns in a forest.
- Carrying Capacity** - the maximum number of individuals of a wildlife species that an area can support during the most unfavorable time of the year.
- Clearcut** - the harvest of all the trees in an area. Clearcutting is used to aid species whose seedlings require full sunlight to grow well.
- Codominant Tree** - a tree that extends its crown into the canopy and receives direct sunlight from above but limited sunlight from the sides. One or more sides of a codominant tree are crowded by the crowns of dominant trees.
- Commercial Forestland** - any area capable of producing 20 cubic feet of timber per acre per year that has not been protected from such use by law or statute.
- Commercial Treatments** - timber stand improvements, such as thinning, that generate income from the sale of the trees removed.
- Community** - A collection of living organisms thriving in an organized system through which water, energy, and nutrients cycle.
- Conifer** - any tree that produces seeds in cones. See softwood.
- Cord** - a unit of wood cut for fuel that is equal to a stack 4 x 4 by 8 feet or 128 cubic feet
- Cordwood** - small diameter or low quality wood suitable for firewood, pulp, or chips.
- Crop Tree** - a young tree of a desirable species with certain characteristics desired for timber value, water quality enhancement, or wildlife or aesthetic uses.
- Crown** - the uppermost branches and foliage of a tree.
- Crown Classes** - see dominant, co-dominant, intermediate, and suppressed.
- Crown Cover or Crown Closure** - the percentage of a given area covered by tree crowns.
- Crown Ratio or Live-Crown Ratio** - the ratio of the leaved portion of a tree's height to its total height.
- Cruise** - a forest survey used to obtain inventory information and develop a management plan.
- Cull** - a sawtimber sized tree that has no timber value as a result of poor shape or damage from injury, insects or disease.
- Cutting Cycle** - the period of time between major harvests in a stand.
- Deciduous** - shedding or losing leaves annually; the opposite of evergreen.
- Defects** - characteristics of an individual tree that reduce its quality and utility.

Den Tree - a tree with cavities suitable for birds or mammals to nest in.

Diameter at Breast Height (DBH) - standard measurement of a tree's diameter taken at 4 1/2 feet above the ground.

Diameter-Limit Sale - a timber sale in which all trees over a specified DBH may be cut. Diameter-limit sales often result in high grading and is a very poor forestry practice.

Dominant Trees - trees that extend above surrounding individuals and capture sunlight from above and around the crown.

Epicormic Branching - branches that grow out of the main stem of a tree from buds produced under the bark. Severe epicormic branching increases knottiness and reduces lumber quality.

Even-Aged Stand - a stand in which the age difference between the oldest and youngest trees is minimal, usually no greater than ten to twenty years. Even-aged stands are perpetuated by cutting all the trees within a relatively short period of time.

Forest Farming - cultivating high value specialty crops in the shade of natural forests.

Forest Types - associations of tree species that have similar ecological requirements.

Girdling - a method of killing trees by cutting through the stem, thus interrupting the flow of water and nutrients.

Group Selection - a process of harvesting patches of trees to open the forest canopy and encourage the reproduction of uneven aged stands.

Growth Rings - the layers of wood a tree adds each season; also called annual rings. These rings frequently are visible when a tree is cut and can be used to estimate its age and growth rate.

Habitat - the ecosystem in which a plant or animal lives and obtains food and water.

Hardwoods - a general term encompassing broadleaf, deciduous trees.

Harvest - the cutting, felling, and gathering of forest timber.

Herbaceous Vegetation - low-growing, non-woody plants, including wildflowers and ferns, in a forest understory.

High Grading - to remove all mature, good quality trees from a stand and leave inferior species and individuals. High grading should be distinguished from even-aged management in which mature and immature trees are removed to aid regeneration. See Diameter-Limit Sale.

Improvement Cut - a weeding done in stands of pole-size or larger trees.

Intermediate Crown Class - trees with crowns that extend into the canopy with dominant and co-dominant trees. These trees receive little direct sunlight from above and none from the sides. Crowns generally are small and crowded on all sides.

Intermediate Tolerance - a characteristic of certain tree species that allows them to survive, though not necessarily thrive, in relatively low light conditions.

Intolerance - a characteristic of certain tree species that does not permit them to survive in the shade of other trees.

Landing - a cleared area within a timber harvest where harvested logs are processed, piled, and loaded for transport to a sawmill or other facility.

Log Rule - a method for calculating wood volume in a tree or log by using its diameter and length. Scribner, Doyle and the International 1/4-inch rule are common log rules.

Lopping - cutting tree tops to a maximum specified height above the ground after a tree is felled.

Lump-Sum Sale - a timber sale in which an agreed-on price for marked standing trees is set before the wood is removed (as opposed to a mill tally or unit sale).

Marking Timber - indicating by paint or other means which trees are to be cut or otherwise treated. It is advisable to mark trees to be harvested twice - at eye level and on the stump.

Mast - nuts and seeds such as acorns, beechnuts, and chestnuts that serve as food for wildlife.

Merchantable Height - the point on a tree stem to which the stem is salable. Limits are: the point at which a sawlog tree is less than 8 inches in diameter, measured inside the bark (DIB); the point at which a pulpwood tree is less than 4 inches DIB; or the point on any tree where a defect is found that cannot be processed out.

Northern Hardwood Forest Type - an association of tree species common to the Northeastern United States that includes sugar maple, red maple, yellow birch, hemlock, and American beech.

Oak-Hickory Forest Type - an association of tree species common to the Northeastern United States that includes oak, hickory, yellow poplar, and red maple.

Old-Growth Forest - a wooded area, usually greater than 200 years of age, that has never been altered or harvested by humans. An old-growth forest often has large individual trees, a multi-layered crown canopy, and a significant accumulation of coarse woody debris including snags and fallen logs.

Overmature - a quality exhibited by trees that have declined in growth rate because of old age and loss of vigor.

Overstocked - the situation in which trees are so closely spaced that they compete for resources and do not reach full growth potential.

Overstory - the level of forest canopy that includes the crowns of dominant, co-dominant, and intermediate trees.

Overtopped - the situation in which a tree cannot sufficiently extend its crown into the overstory and receive direct sunlight. Overtopped trees that lack shade tolerance lose vigor and die.

Patch Cut - a clearcut on a small area.

Pole Stand - a stand of trees whose average DBH is between 4 and 10 inches.

Pole Timber - trees 4 to 10 inches DBH.

Pre-Commercial Operations - cutting in forest stands to remove wood too small to be marketed. Pre-commercial operations improve species composition and increase the quality, growth, and vigor of remaining trees.

Pruning - the act of sawing or cutting branches from a living tree. In forest management, pruning is done to promote the growth of clear, valuable wood on the tree bole.

Pulpwood - wood suitable for use in paper manufacturing.

Regeneration - the process by which a forest is reseeded and renewed. Advanced regeneration refers to regeneration that is established before the existing forest stand is removed.

Regeneration Cut - a timber harvest designed to promote natural establishment of trees.

Release - to remove overtopping trees that compete with understory or suppressed trees.

Residual Stand - the trees remaining intact following any cutting operation.

Riparian Forest Buffers - strips of land along stream banks where trees, shrubs and other vegetation are planted and managed to capture erosion from agricultural fields.

Rot - a tree defect characterized by woody decay in a standing tree or log.

Rotation - the number of years required to grow a stand to a desired size or maturity.

Salvage Cut - the removal of dead, damaged, or diseased trees to recover maximum value prior to deterioration.

Sapling - a tree at least 4 1/2 feet tall and up to 4 inches in diameter.

Sapling Stand - a stand of trees whose average DBH is between 1 and 4 inches.

Sawbolt - an 8 foot long sawlog

Sawlog - a log large enough to be sawed economically on a sawmill. Sawlogs are usually at least 8 inches in diameter at the small end and 16 feet long.

Sawlog Tree - a tree at least 11 inches DBH and suitable for conversion to lumber. Sometimes, trees 11 to 14 inches DBH are called small sawlog trees, and trees larger than 18 inches DBH are called large sawlog trees.

Sawtimber - trees from which sawlogs can be made.

Sawtimber stand - a stand of trees whose average DBH is greater than 11 inches.

Scale Stick - a calibrated stick used to estimate wood volume in a log.

Sealed-Bid Sale - a timber sale, usually offered through a consulting forester, in which buyers submit secret bids.

Seed Tree - a mature tree left uncut to provide seed for regeneration of a harvested stand.

Seed-Tree Harvest - the felling of all the trees in an area except for a few desirable individuals that provide seed for the next forest.

Selection Harvest - the harvest of all individual trees or small groups at regular intervals to maintain an uneven-aged forest. Selection harvests are used to manage species that do not need sunlight to survive.

Shelterwood Harvest - the harvest of all mature trees in an area in a series of two or more cuts, leaving enough trees of other sizes to provide shade and protection for forest seedlings.

Silvopastures - both trees and improved forages to provide suitable pasture for grazing livestock.

Silviculture - the art and science of growing forest trees. How trees grow, and how to grow trees.

Site - the combination of biotic, climatic, topographic, and soil conditions of an area.

Site Index - a measure of the quality of a site based on the height of dominate trees at a specified age (usually fifty years), depending on the species. See Table A11 for comparison of site quality for various common trees in Michigan.

Table A11. Site Index Classes of Michigan Trees

Tree Species	Site Index Classes (Height at Age 50)				
	High	Medium High	Medium	Medium Low	Low
Conifers					
Balsam Fir	≥66	65-58	57-50	49-41	≤40
White Pine	≥66	65-58	57-50	49-41	≤40
Jack Pine	≥71	70-61	60-51	50-41	≤40
Red Pine	≥66	65-58	57-50	49-41	≤40
Black Spruce	≥51	50-39	38-27	26-16	≤15
White Spruce	≥66	65-58	57-50	49-41	≤40
Tamarack	≥61	60-53	52-45	44-36	≤35
Northern White Cedar	≥51	50-39	38-27	26-16	≤15
Broadleaves					
White Ash or Green Ash	≥71	70-61	60-51	50-41	≤40
Quaking and Bigtooth Aspen	≥76	75-66	65-56	55-46	≤45
Basswood	≥71	70-61	60-51	50-41	≤40
Paper Birch	≥71	70-61	60-51	50-41	≤40
Yellow Birch	≥66	65-58	57-50	49-41	≤40
Cottonwood	≥106	105-96	95-86	85-76	≤75
Red Maple	≥71	70-61	60-51	50-41	≤40
Silver Maple	≥96	95-86	85-76	75-66	≤65
Sugar Maple	≥66	65-58	57-50	49-41	≤40
Red Oak	≥71	70-61	60-51	50-41	≤40

(Source: NRCS Michigan Technical Note #23)

Site Preparation - treatment of an area prior to reestablishment of a forest stand. Site preparation can include mechanical clearing, burning, or chemical (herbicide) vegetation control.

Skidder - a rubber-tired machine with a cable winch or grapple used to drag logs out of the forest.

Skidding - the act of moving trees from the site of felling to a landing area or landing. Tractors, horses, or specialized logging equipment can be used for skidding. Skidding methods vary in their impact on soils and the remaining stands.

Slash - branches and other woody material left on a site after logging.

Snag - a dead tree that is still standing. Snags provide important food and cover for a wide variety of wildlife species.

Softwood - any tree in the gymnosperm group, including pines, hemlocks, larches, spruces, firs, and junipers. Softwoods often are called conifers although some, such as junipers and yews do not produce cones.

Sprout - a tree growing from a cut stump or previously established root system.

Stand - a group of forest trees of sufficiently uniform species composition, age, and condition to be considered a homogeneous unit for management purposes.

Stand Density - the quantity of trees per unit area, usually evaluated in terms of basal area, crown cover and stocking.

Stocking - the number and density of trees in a forest stand. Stands are often classified as understocked, well-stocked or overstocked.

Stratification - division of a forest, or any ecosystem, into separate layers of vegetation that provide distinct niches for wildlife. See canopy, understory, and herbaceous vegetation.

Stumpage - the value of standing trees in a forest.

Stumpage Price - the price paid for standing forest trees.

Stump Height - the distance from the ground to the top of the stump. Good logging practice dictates that stumps be as low as possible (preferably as low as 12 inches) to reduce waste, to minimize visual impact on the logging site, and to promote re-sprouting of trees.

Succession - the natural replacement of one plant (or animal) community by another over time in the absence of disturbance.

Suppressed - a tree condition characterized by low growth rate and low vigor as a result of competition with overtopping trees. See overtopped.

Sustained Yield - an ideal forest management objective in which the volume of wood removed equals growth within the total forest.

Sweep - a tree defect characterized by a gradual curve in the main stem.

Thinning - a partial cut in an immature, overstocked stand of trees used to increase the stand's value growth by concentrating on individuals with the best potential.

Threatened Species - a species or subspecies whose population is so small or is declining so rapidly that it may become endangered in all or a significant portion of its range.

Timber Stand Improvement (TSI) - any practice that increases the value or rate of value growth in a stand of potential sawtimber trees. Pruning and thinning are considered TSI. Also called Forest Stand Improvement (FSI).

Tolerance - the capacity of a tree species to grow in shade

Tree Farm - a privately owned forest managed on a multiple use basis with timber production as an important management goal.

Trim Allowance - the extra 2 or 3 inches left on a bucked log to allow logs with end checks, pulls, or slanting buck cuts to be trimmed to standard lumber lengths.

Under-stocked - a stand of trees so widely spaced, that even with full growth potential realized, crown closure will not occur.

Understory - the level of forest vegetation beneath the canopy.

Uneven-Aged Stand - Three or more age classes of trees represented.

Unit Sale - a timber sale in which the buyer makes regular (weekly, monthly) payments based on mill receipts. Unit sales are useful when the amount of timber sold is so large that a pre-harvest, lump-sum payment would be prohibitive.

Veneer Log - a high-quality log of a desirable species suitable for conversion to veneer. Veneer logs must be large, straight, of minimum taper, and free from defects.

Watershed - a region defined by patterns of stream drainage. A watershed includes all the land that contributes water to a particular stream or river.

Well-Stocked - the situation in which a forest stand contains trees spaced widely enough to prevent competition yet closely enough to utilize the entire site.

Wildlife Habitat - the native environment of an animal. Habitats ideally provide all the elements needed for life and growth: food, water, cover and space.

Windbreaks - rows of trees to provide shelter for crops, animals or farm buildings

Windthrow - a tree felled by wind. Windthrows, also known as blowdowns, are common among shallow-rooted species and in areas where cutting has reduced stand density.

Wolf Tree - a large older tree with a spreading crown and little or no timber value.



Educational Stop Sign near Stand Two.

The Top Ten+ Ways to Have More FUN in Your Forest

Landowners purchase forests and spend many hours every year working in their woods for a variety of reasons. For some landowners, forests are an economic investment to secure future income. For others, owning a forest is an ethical choice to improve the world by slowing urban sprawl or providing other environmental services. But for many landowners, a primary motive for owning a forest is the enjoyment they receive by spending time in their woods. Forest owners do a lot of activities in their woods because it is just plain fun. As a consulting forester, I hope that any service I provide will increase a landowner's enjoyment of their forest, along with any economic or ethical benefit. The following is my Top Ten+ list of ways to have more fun in your forest.

#1 - Invest in a Forest Management Plan. Less than 5% of non-industrial, private forest owners in America have a written forest management plan according to United States Forest Service (USFS) research ([Birch, 1996](#); [Butler, 2008](#)). If you want to be an informed and active steward of your land, consider hiring a professional forester in your area to partner with you in writing a detailed plan to help you manage your forest. A forest management plan should include a clear description of *your* goals for your forest in the future, an inventory to describe what you currently have in your forest, and recommendations about activities over the next 10 years that will help you to accomplish your goals. Learning about your forest will help you to enjoy it even more because applying forestry science on your land can be both profitable and lots of fun. The USFS developed the [Forest Stewardship Program](#) to encourage landowners to invest in a [Forest Stewardship Plan](#) (FSP). In Michigan, Forest Stewardship Plans are written by certified private consultants and verified by Service Foresters in the Department of Natural Resources. The DNR offers a cost-share grant to plan writers that covers a small portion of the landowner's cost of the plan. More information is available on the DNR website for [Forest Stewardship Plans](#) in Michigan that includes the [list of approved plan writers](#) in your county. There are several other programs that also provide similar guidelines for forest management plans. The Natural Resource Conservation Service (NRCS) [Michigan forestry program](#) provides guidelines for a forest management plan and might also provide cost-share funding. The American Tree Farm System offers [guidelines for forest management plans](#) that comply with USFS and NRCS requirements.

#2 – Share your knowledge with others. It is lots of fun to spend time with other people who share your passion for forests. There are numerous opportunities to play and learn in the woods with other forest owners around the state. There are several forest owner associations you can join including the [Michigan Forest Association](#), the Michigan Tree Farm System, or even the [Michigan Nut Growers Association](#). Be sure to go on the field trips to visit interesting forests around the state. Michigan State University sponsors the Master Woodland Steward program during the fall of most years. After a weekend of intensive forestry training from MSU and DNR foresters, you get to volunteer 30 hours over the next year sharing your forestry knowledge with other landowners in your area. [Note: this program has not been offered the past few years so call your local MSU Extension office to request it again.]

#3 – Buy a(nother) chainsaw. Spending a few extra dollars for [professional quality equipment](#) will increase your fun in your forest. If you don't have a chainsaw, visit your local Husqvarna or [Stihl dealer](#) to buy a quality saw that won't break down in the woods. If you already own a saw, go ahead and splurge to get that bigger saw or lighter saw you've had your eye on for the last few months. Investing in other professional grade forestry equipment like a logger's tape, Biltmore stick, or a GPS unit can really increase your enjoyment in the woods. One of my favorite toys in the woods is a pair of Leupold binoculars to inspect the treetops and watch wildlife. If you aren't as nimble as you used

to be, a John Deere Gator HPX 4x4 is an expensive but very useful vehicle for getting around your woods. Remember, any of these items make great Christmas presents for your spouse!

#4 – Take lots of pictures. It is lots of fun to take pictures of your woods to record interesting things or changes over time. Digital cameras make it easy and inexpensive to take hundreds of photos throughout the year. I like to use a GPS camera that records the location of where the photos are taken. It is also very fun to find aerial photos of your forest. Several websites, including [Google Earth](#), provide aerial photos or high resolution satellite imagery where you can easily see trees in your forest. Even more fun than current aerial photos is finding *old* aerial photos of your property to see changes over time. The Department of Geography at MSU has an [Aerial Image Archive](#) where you can view aerial photos taken over the years as early as 1938. It is very interesting to see photos that show 70 years of changes in your forest.

#5 – Increase your income. What's more fun than earning some extra income? The surest way to increase your income is to hire a consulting forester when you have a [timber harvest](#). A forester can increase your current income by soliciting multiple bids from quality [timber buyers](#) to ensure you are getting full market value. A forester can also increase your *future* income by working to improve your forest with each harvest and prevent a short-sighted timber buyer from degrading your forest by taking just your best trees and leaving only poor quality trees in your woods. A second way to increase your income is to explore new markets for forest products and [ecosystem services](#). Forest owners in Michigan were among the first in the nation to get paid for sequestering carbon in their actively managed forests through a forest carbon offset program. [Note: the forest carbon markets have been slow to take off in the United States and there are very limited opportunities for landowners to sell forest carbon offset credits in 2013.] Other developing markets include cellulosic ethanol, biomass for power generation, and non-timber forest products like ginseng or mushrooms. Finally, hunting and other recreational leases are increasing in the Midwest and may be an option to generate some income from your property. Here is one [sample hunting lease](#). The Michigan DNR currently offers a [Hunting Access Program](#) (HAP) that will pay landowners up to \$20 per acre annually to allow public hunting access on private lands larger than 40 acres.

#6 – Reduce your expenses. The only thing more fun than earning some extra income is being able to keep it by reducing your expenses. There are several [cost-share programs](#) available to help pay for the activities that you want to do in your forest. The [Environmental Quality Incentives Program](#), administered by the NRCS, is the primary federal program available for private forest owners to help pay for some management practices. The State of Michigan offers two programs to reduce the property taxes for your forest. The [Commercial Forest](#) program reduces property taxes to only \$1.20 per acre but it is more attractive to very large, industrial forest owners because it requires public access onto your property for hunting and fishing. The [Qualified Forest](#) program reduces your property taxes by up to 18 mils and *does not* require public access onto your forest for hunting or fishing. Finally, be sure to minimize your taxes by properly filing any timber sale profits as capital gains rather than ordinary income and subtracting your basis (what you paid for your timber) from the profits. Work with an accountant who is aware of forestry law and consult the [National Timber Tax Website](#) for more information.

#7 – Expand your forest. Sometimes thinking globally and acting locally can be more fun than simply cliché. If you are concerned about the loss of forests to agricultural expansion in the tropics or suburban sprawl here in America, you can make a difference by expanding your own forest in several ways. If you have unproductive agricultural land on your property, allow it to succeed back to forest on its own. If Mother Nature is too slow or messy, you can speed the process and select the species you want by planting trees. Another way to reverse the fragmentation of forests is to

purchase your neighbor's property if it ever comes up for sale and incorporate it into your forest. Purchasing land is a rather expensive option so you may want to consider simply talking with your neighbor and if you share common values, work together to jointly manage a larger forest ecosystem. There can be a lot of satisfaction when you reverse the fragmentation of management and work together with neighbors towards common goals. Here is a long shot to get some [resources to expand your forest](#).

#8 – Start your own seedlings. There are many great [nurseries](#) in Michigan that sell quality and inexpensive seedlings, but it is a lot more fun to grow your own trees from seed. You can collect seeds from your own trees or from other impressive trees in the neighborhood. Several companies sell [trees seeds](#) from hundreds of interesting tree species. I prefer to grow plugs in [styroblocks](#) but you can also plant the seeds in your own mini nursery in your garden. Tree seeds often require special treatment before they will germinate so check the [Woody Plant Seed Manual](#) online for specific instructions. Plugs can be transplanted in the spring or fall but should be kept in a cold frame (unheated greenhouse) to protect the roots if you keep them in styroblocks over the winter. Buying seedlings from a nursery is probably much cheaper but seeing trees in your forest that you started from seed is a lot more fun.

#9 – Minimize your frustrations. Not knowing who to call when you have a question can be frustrating. Fortunately, there are many federal, state and local government foresters and private consulting foresters who are available to help you have more fun in your forest. The [Natural Resource Conservation Service](#) has Service Centers in many counties around the state. The Michigan [Department of Natural Resources](#) has several Service Foresters around the state to help private forest owners. [MSU Extension](#) has offices in most counties and can refer you to the Forestry Extension team for information. Some local [Conservation Districts](#) employ foresters and many districts offer tree sales in the spring and fall. Finally, there are many private consulting foresters around the state that you can hire who will work with you to protect your interests and improve your forest. The MSU Forestry Department maintains a website that lists the [consulting foresters](#) who work in your county.

#10 – Spend more time in your woods. If you enjoy working in your forest, find creative ways and new reasons to spend more time out in the woods. When you are looking to buy forest land, be sure to buy property close to home so you do not have to drive hundreds of miles to play in your woods on the weekend. If you are planning for a timber harvest, ask your forester to design skid roads that you can later use for recreational trails. You can build a campsite on a favorite spot and take your grandchildren on an overnight camping trip. Ask them to leave their ipods, cell phones, internet, video games and TV back at the house. After you have played in the woods with your own grandchildren, invite local youth groups to come explore your woods and share your enjoyment of your forest. One of the books sweeping through the forestry community right now is [Last Child in the Woods: Saving Our Children from Nature Deficit Disorder](#). Richard Louv argues that our children have become disconnected from nature and that we must find ways to get children back outdoors. You can invite local Boy Scouts, Girl Scouts, high school science classes, or even church youth groups to come to your property and learn about forestry and the wonders of nature. Everyone will have lots of fun.

#11 – Have a family meeting. If the Big Ten can have eleven schools, I thought I'd add an eleventh item to my Top Ten list too. Have you thought about who will enjoy your forest after you die? Do your adult children have Nature Deficit Disorder? One of the biggest challenges to keeping forests in the family is the transfer of your values to your children. Every forest owner in Michigan should have a forest succession plan to help pass their beloved forest to the next generation (or their chosen

beneficiary). Don't wait. Start working with an estate planning attorney to find the best method for you to pass your forest to your heirs. There are lots of great resources to help you think through this process. Oregon State University published a book called [Ties to the Land](#) that will help you get started. The National Timber Tax website also lists several [estate planning](#) resources. Finally, you may want to consider a [conservation easement](#) to ensure that your values and intentions for your forest carry on long into the future. Have lots of fun in your woods now, but make sure that your loved ones will enjoy your forest for many years to come.

#12 - Plant a wildlife food plot. OK, now that Nebraska is the 12th team in the Big Ten, I am adding a 12th item to my Top Ten list. Many forest owners enjoy hunting or just watching wildlife in their forests. Adding and maintaining a food plot in a forest opening can increase your chances of seeing the deer, birds and other animals that you want to see in your forest. There are several good resources available to help you design your food plot (there are a few books on my [Links](#) page). Contact your local chapter of the [Quality Deer Management Association](#) for networking and resources regarding food plots and improving habitat. You may also be eligible for cost share funding through the [Wildlife Habitat Incentive Program](#) - contact your local NRCS District Conservationist for more information about WHIP. Spend a few extra dollars and put a [trail camera](#) near your food plot to see who is coming to visit when you are not around.

#13 - Learn to identify plants, trees, and forests. Wow, Maryland and Rutgers are joining the really Big Ten so I'm expanding my list again.... Save some tuition money and teach yourself about tree identification. There are more than 100 tree species in Michigan and you can learn to identify most of them with a good tree ID book. You can buy one of several tree ID books (see my [Links](#) page) for less than \$25 but here is a nice free publication from the US Forest Service - [Important Forest Trees of the Eastern United States](#). You might also enjoy learning about the different types of forests that occur here in Michigan. Check out this book from MSU Extension by retired Forestry Professor Don Dickmann - [Michigan Forest Communities](#). I don't know about publications for herbaceous plants but the [Michigan Natural Features Inventory](#) website has lots of great information about native and [invasive plants](#). I sometimes encounter trees in the forest that I can't identify (it is possible to win "stump the chumps" with foresters too) but I always enjoy learning more about trees, plants, and natural communities in Michigan and other places when I travel. Make sure that you learn to identify and avoid [poison ivy](#) because it is no fun at all to encounter this plant in the forest!

#14 - Listen to your forest. While many hunters and wildlife enthusiasts have discovered that it is lots of fun to photograph the wildlife in their forest with [trail cameras](#), try closing your eyes and *listening* to your forest. We often think of the forest as a place to enjoy peace and quiet, but it can be rather noisy if you just stop and really listen. You will be amazed at the sounds of insects, birds, animals, wind, rain, rivers, and just how far human noise really travels. A friend of mine, Dr. Stuart Gage at MSU, is using some very fun methods to monitor and record sounds in the forest. His [Remote Environmental Assessment Laboratory](#) is developing interesting techniques to monitor nature and ecosystem health using acoustics. I partnered with Stuart to record forest sounds in [Kenya](#) and [Malaysia](#) but he has many recordings of the "soundscape" throughout Michigan that you will find very interesting. You can listen to these forest sound recordings on his [projects](#) webpage. If you would enjoy recording sounds in your forest, try the inexpensive [Zoom H1](#) microphone recorder (around \$95 on Amazon) or the very nice [Song Meter SM2+](#) by Wildlife Acoustics (around \$700).

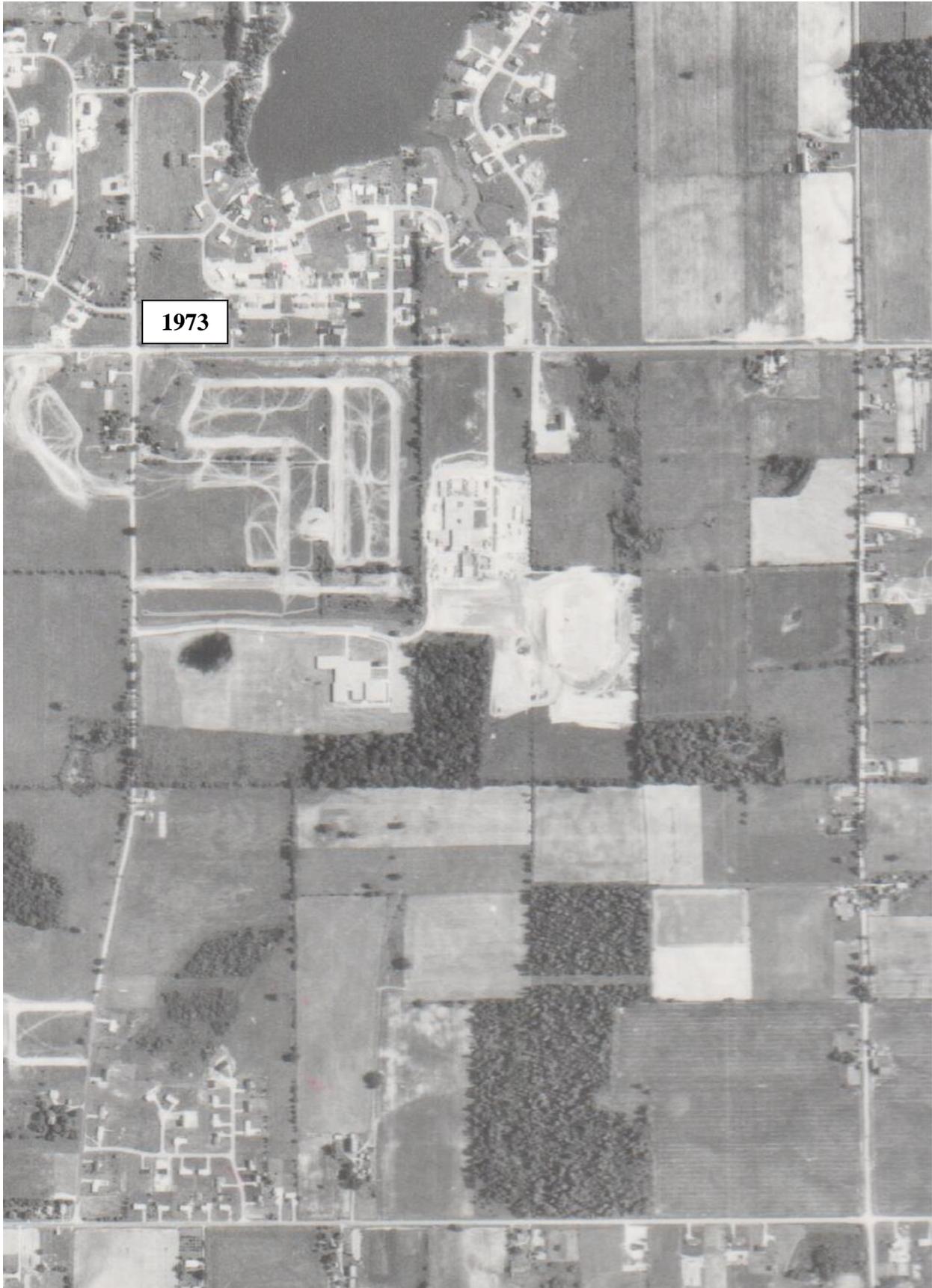
[Hyperlinks available at www.smalliganforestry.com/fun.html]

Appendix II - Historical Aerial Photos





1964



1973



1981



1993

Appendix III – Forest Inventory Data and Analysis

Table A3-1. Trees per Acre for Stand One.

DBH Class	ash	bass wood	bitternut hickory	black cherry	black oak	bur oak	hophorn beam	muscle wood	red maple	red oak	shagbark hickory	sugar maple	white oak	Total
2				37.9				25.2				25.2		88.2
4				9.1			70.6					15.9		95.5
6		7.3		18.4			5.6					12.3		43.7
8		2.4									3.7			6.1
10		1.8	2.1	1.7					1.8		3.1			10.5
12		5.5	4.8						1.3		1.5			13.1
14			2.6						2.0		3.2			7.9
16		0.8	4.2	0.7					4.4		0.7			10.8
18		0.6	1.1	1.7					3.5			1.1		8.0
20		0.5	1.0	0.5					1.4	1.4	0.9	0.9		6.6
22		0.4	0.4		0.4				1.6	1.2		0.4		4.3
24			0.3	0.9						0.3				1.6
26				0.3					0.5	1.1			0.3	2.2
28	0.2								0.3	0.7				1.2
30				0.2						0.2				0.4
32										0.5				0.5
34										0.2			0.2	0.3
36										0.3				0.3
38													0.1	0.1
40										0.3				0.3
42										0.2				0.2
44						0.1				0.1				0.2
48										0.1				0.1
Total	0.2	19.2	16.6	71.3	0.4	0.1	76.3	25.2	16.7	6.6	13.1	55.8	0.6	302.1
Percent	0%	6%	5%	24%	0%	0%	25%	8%	6%	2%	4%	18%	0%	100%

Figure A3-1. Distribution of Trees per Acre for Stand One.

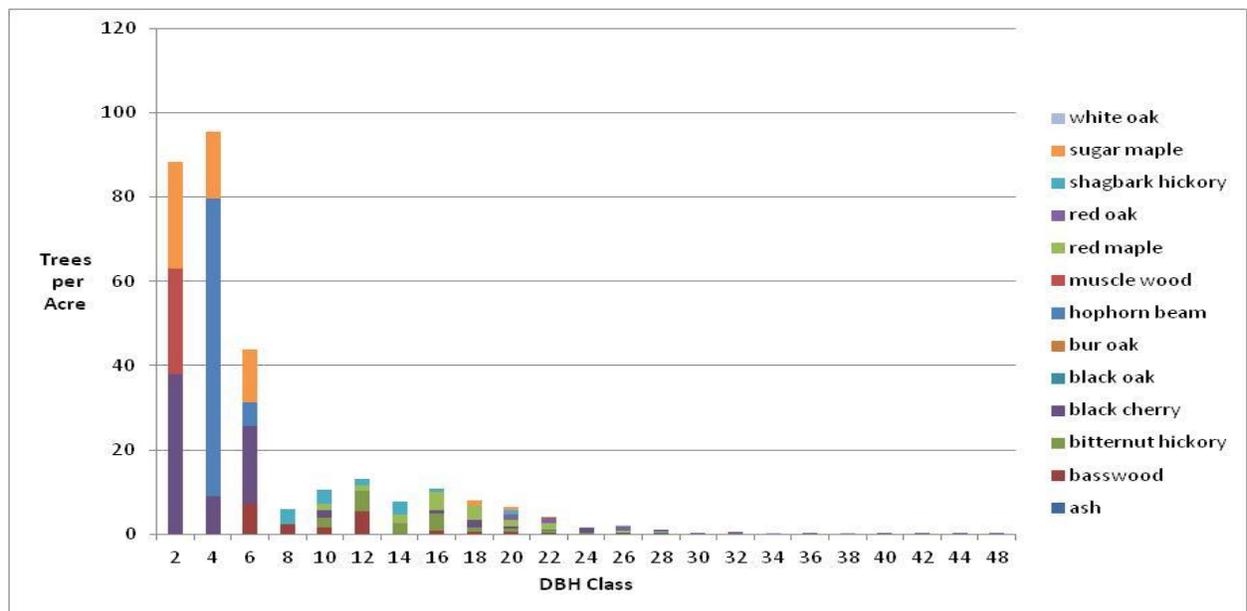


Table A3-2. Basal Area (ft²/acre) for Stand One.

DBH Class	ash	bass wood	bitternut hickory	black cherry	black oak	bur oak	hophorn beam	muscle wood	red maple	red oak	shagbark hickory	sugar maple	white oak	Total
2				1				1				1		3
4				1			5					1		7
6		1		3			1					2		7
8		1									1			2
10		1	1	1					1		2			6
12		4	4						1		1			10
14			3						2		3			8
16		1	6	1					6		1			15
18		1	2	3					6			2		14
20		1	2	1					3	3	2	2		14
22		1	1		1				4	3		1		11
24			1	3						1				5
26				1					2	4			1	8
28	1								1	3				5
30				1						1				2
32										3				3
34										1			1	2
36										2				2
38													1	1
40										3				3
42										2				2
44						1				1				2
48										1				1
Total	1	11	20	16	1	1	6	1	26	28	10	9	3	133
Percent	1%	8%	15%	12%	1%	1%	5%	1%	20%	21%	8%	7%	2%	100%

Figure A3-2. Distribution of Basal Area (ft²/acre) According to Species for Stand One.

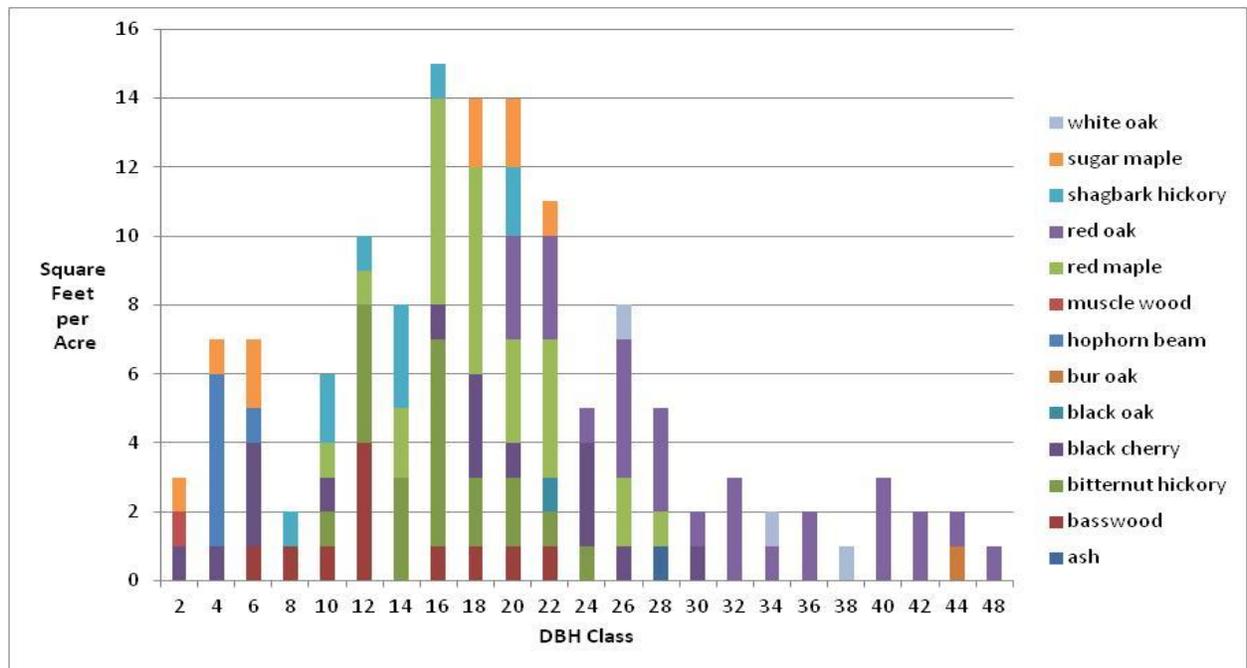


Table A3-3. Board Feet per Acre (Doyle Log Rule) for Stand One.

DBH Class	ash	bass wood	bitternut hickory	black cherry	black oak	bur oak	hophorn beam	muscle wood	red maple	red oak	shagbark hickory	sugar maple	white oak	Total
10		51	0	51					51		103			257
12		231	231						77		51			590
14			282						154		282			719
16		51	616	103					642		128			1,540
18		103	205	436					616			282		1,643
20		154	282	103					385	411	257	257		1,848
22		128	154		154				411	462		103		1,412
24			128	462						154				744
26				154					257	590			154	1,155
28	77								77	436				590
30				180						128				308
32										462				462
34										154			128	282
36										308				308
38													154	154
40										488				488
42										308				308
44						154				154				308
48										154				154
Total	77	719	1,900	1,489	154	154	0	0	2,670	4,210	821	642	436	13,271
Percent	1%	5%	14%	11%	1%	1%	0%	0%	20%	32%	6%	5%	3%	100%

Price: \$/bdft \$0.09 \$0.13 \$0.12 \$0.34 \$0.21 \$0.08 \$0.00 \$0.00 \$0.13 \$0.27 \$0.12 \$0.54 \$0.08
 Value: \$/acre \$7 \$93 \$228 \$506 \$32 \$12 \$0 \$0 \$347 \$1,137 \$99 \$347 \$35 \$2,843

Note: The values in Tables 3, 6, and 9 for the prices per board foot have been taken from the DNR Stumpage Report from October 2013 (available at www.michigan.gov). I have used the *average* sold price for timber sales on State-owned land. This is an indicator of *approximate* value for timber prices in Michigan but *actual prices may vary widely* from these estimates. These prices are from timber sales on State-owned land in the northern Lower Peninsula and the Upper Peninsula where markets and prices may be very different than Clinton County markets and prices. Accurate timber prices for your trees can only be determined by seeking multiple bids for the same trees from local timber buyers.

Figure A3-3. Distribution of Boardfeet per Acre (Doyle Log Rule) for Stand One.

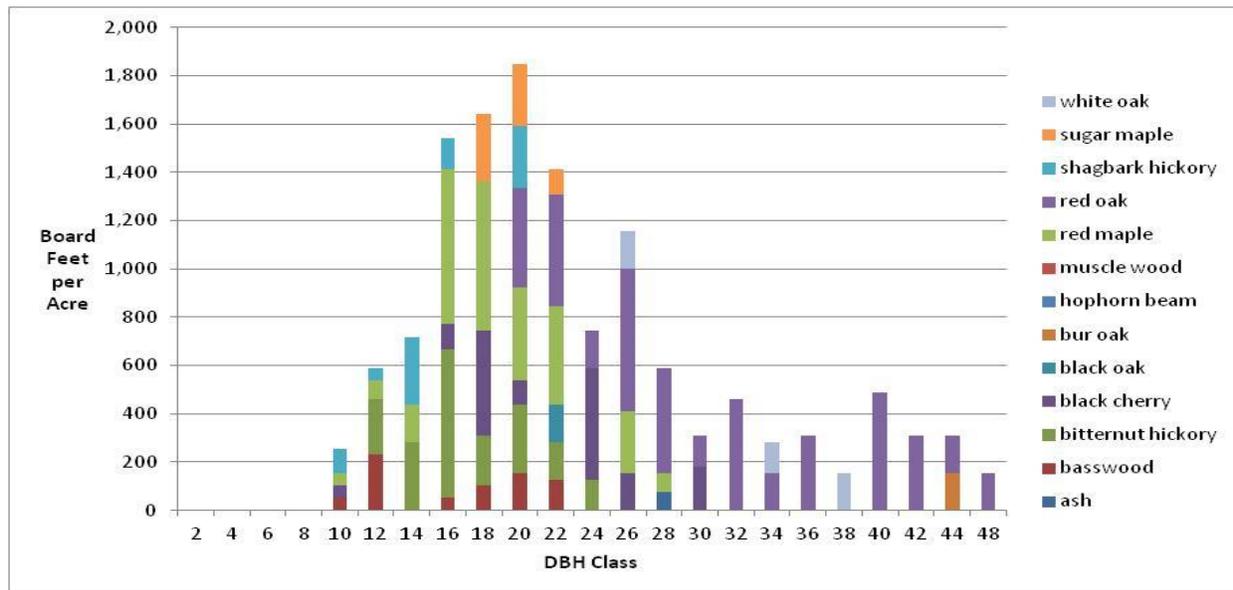


Table A3-4. Trees per Acre for Stand Two.

DBH Class	basswood	black cherry	black oak	elm	pignut hickory	red maple	sassafras	sugar maple	white oak	Total
4								20.8		20.8
6		13.6		6.1				7.3		27.0
8		6.0		2.7		5.5		6.0		20.2
10		7.0				4.3		8.4		19.7
12		8.3				5.0		1.2		14.5
14	0.9	14.3				5.9	1.0	1.0		23.0
16	1.6	2.3			0.8	0.6	0.6	0.8		6.7
18	0.5	5.2				3.0		1.1		9.8
20		0.9	0.5						0.5	1.8
22						0.4			0.4	0.8
24									0.6	0.6
Total	3.0	57.5	0.5	8.8	0.8	24.7	1.6	46.6	1.5	145.0
Percent	2%	40%	0%	6%	1%	17%	1%	32%	1%	100%

Figure A3-4. Distribution of Trees per Acre for Stand Two.

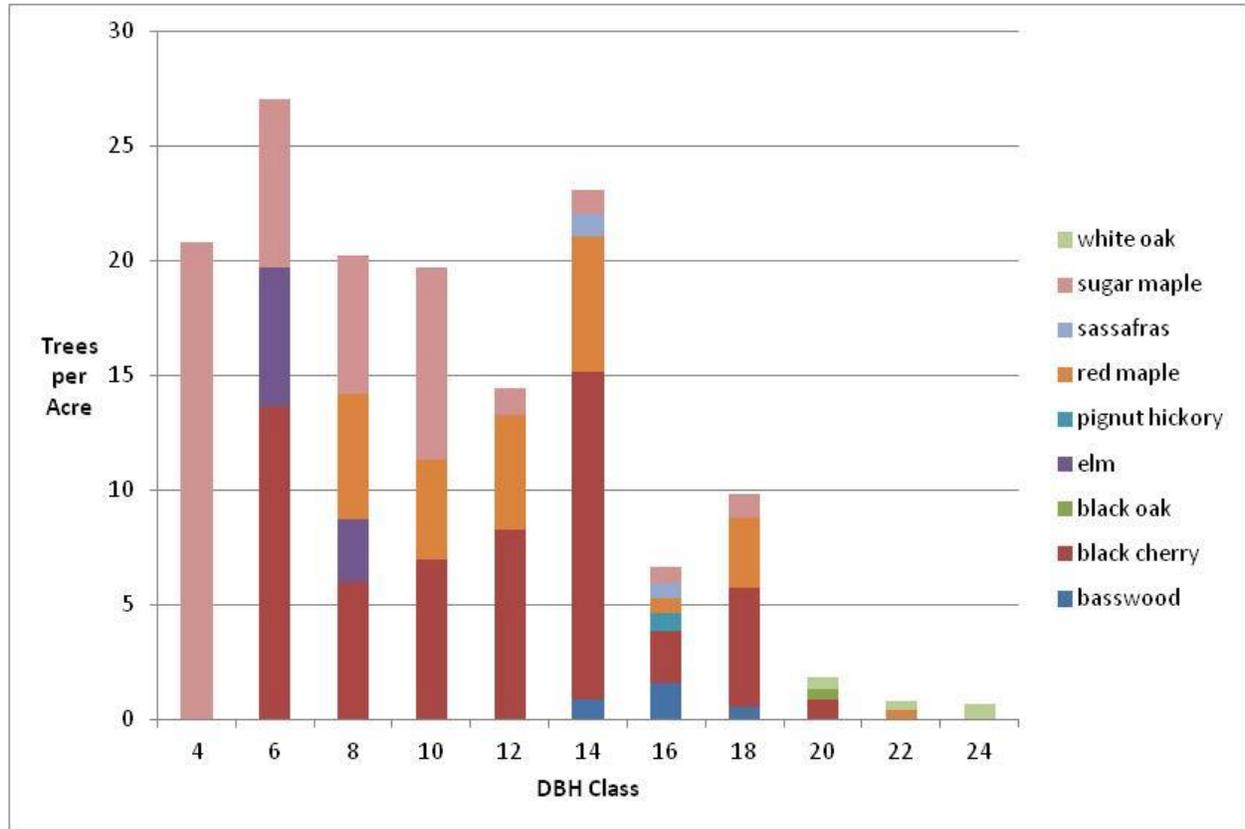


Table A3-5. Basal Area (ft²/acre) for Stand Two.

DBH Class	basswood	black cherry	black oak	elm	pignut hickory	red maple	sassafras	sugar maple	white oak	Total
4								2		2
6		2		1				1		4
8		2		1		2		2		7
10		4				2		5		11
12		7				4		1		12
14	1	15				6	1	1		24
16	2	3			1	1	1	1		9
18	1	9				5		2		17
20		2	1						1	4
22						1			1	2
24									2	2
Total	4	44	1	2	1	21	2	15	4	94
Percent	4%	47%	1%	2%	1%	22%	2%	16%	4%	100%

Figure A3-5. Distribution of Basal Area (ft²/acre) According to Species for Stand Two.

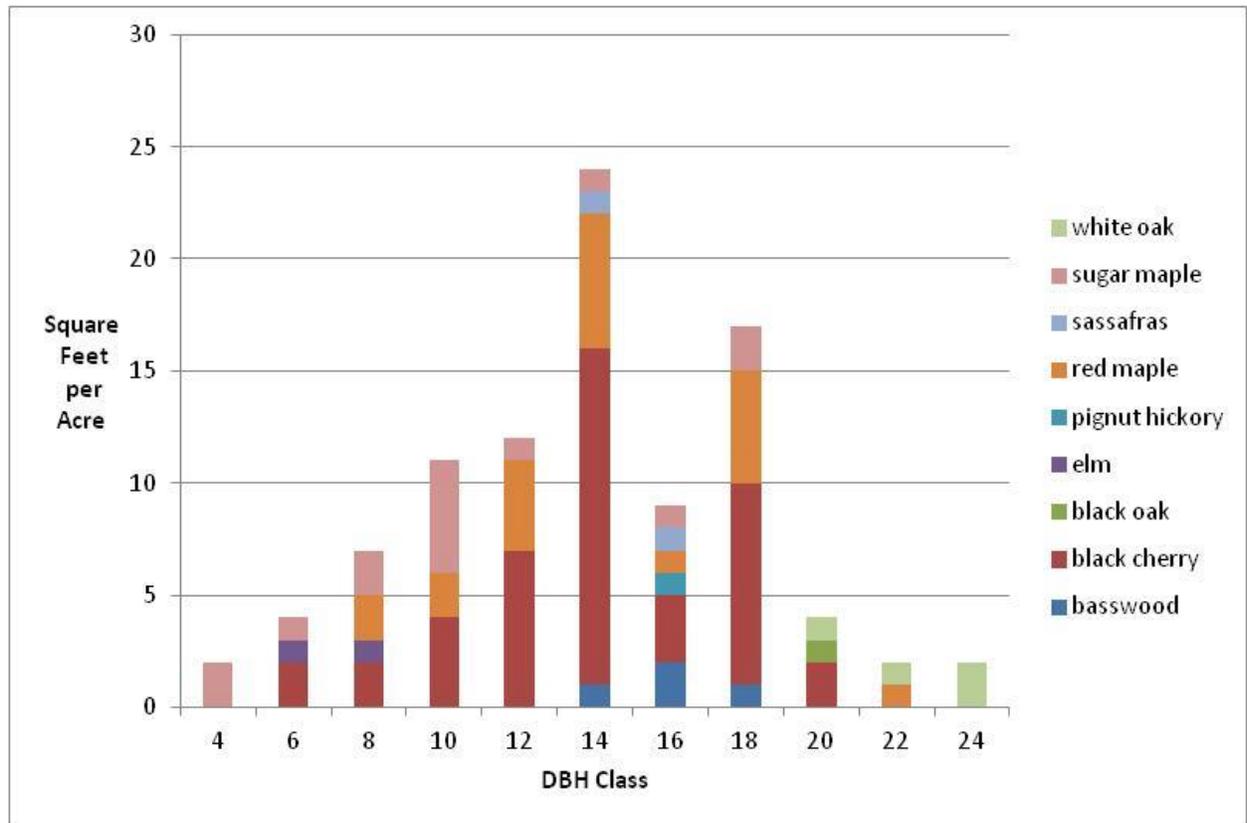


Table A3-6. Boardfeet per Acre (Doyle Log Rule) for Stand Two.

DBH Class	basswood	black cherry	black oak	elm	pignut hickory	red maple	sassafras	sugar maple	white oak	Total
10		205				0		205		411
12		359				205		51		616
14	51	1,129				488	51	77		1,797
16	154	334			77	103	77	77		821
18	77	847				385		154		1,463
20		257	128						154	539
22						103			103	205
24									257	257
Total	282	3,132	128	0	77	1,283	128	565	513	6,109
Percent	5%	51%	2%	0%	1%	21%	2%	9%	8%	100%
Price: \$/bdft	\$0.13	\$0.34	\$0.21	\$0.12	\$0.12	\$0.13	\$0.12	\$0.54	\$0.08	
Value: \$/acre	\$37	\$1,065	\$27	\$0	\$9	\$167	\$15	\$305	\$41	\$1,666

Figure A3-6. Distribution of Boardfeet per Acre (Doyle Log Rule) for Stand Two.

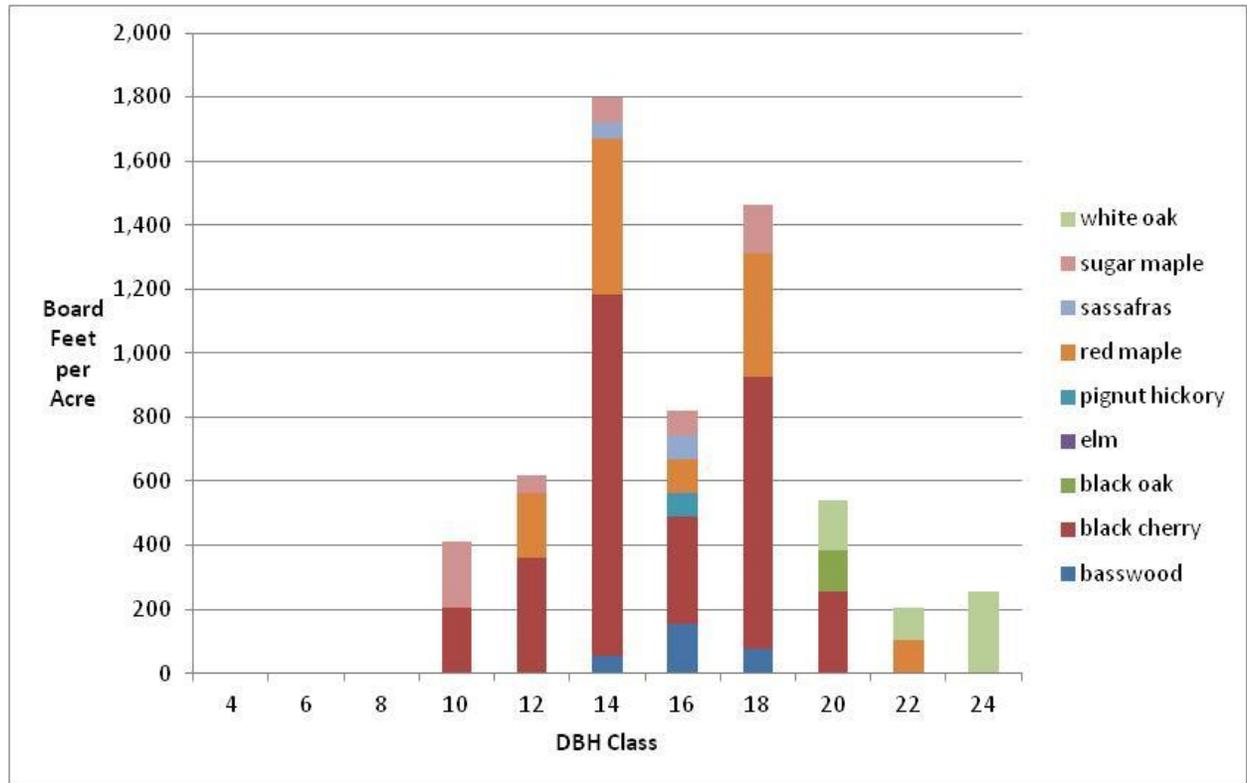


Table A3-7. Trees per Acre for Stand Three.

DBH Class	bass wood	black cherry	black oak	cotton wood	elm	hophorn beam	muscle wood	pignut hickory	red maple	red oak	sugar maple	Total
2									23.4			23.4
4					20.5	16.8	20.4		102.7			160.5
6									24.5			24.5
8					2.8				19.8			22.6
10		3.6			4.1				16.0			23.7
12		2.5							9.4			11.9
14	2.0	1.1		1.0	1.8				2.8			8.6
16		0.7		2.1				0.7	1.6			5.2
18		0.5		1.1					0.6			2.2
20			0.4						0.5	0.4		1.4
22									1.2			1.2
24									1.0		0.3	1.3
26				0.5					0.3			0.8
30				0.2						0.2		0.4
Total	2.0	8.4	0.4	5.0	29.3	16.8	20.4	0.7	203.6	0.6	0.3	287.6
Percent	1%	3%	0%	2%	10%	6%	7%	0%	71%	0%	0%	100%

Figure A3-7. Distribution of Trees per Acre for Stand Three.

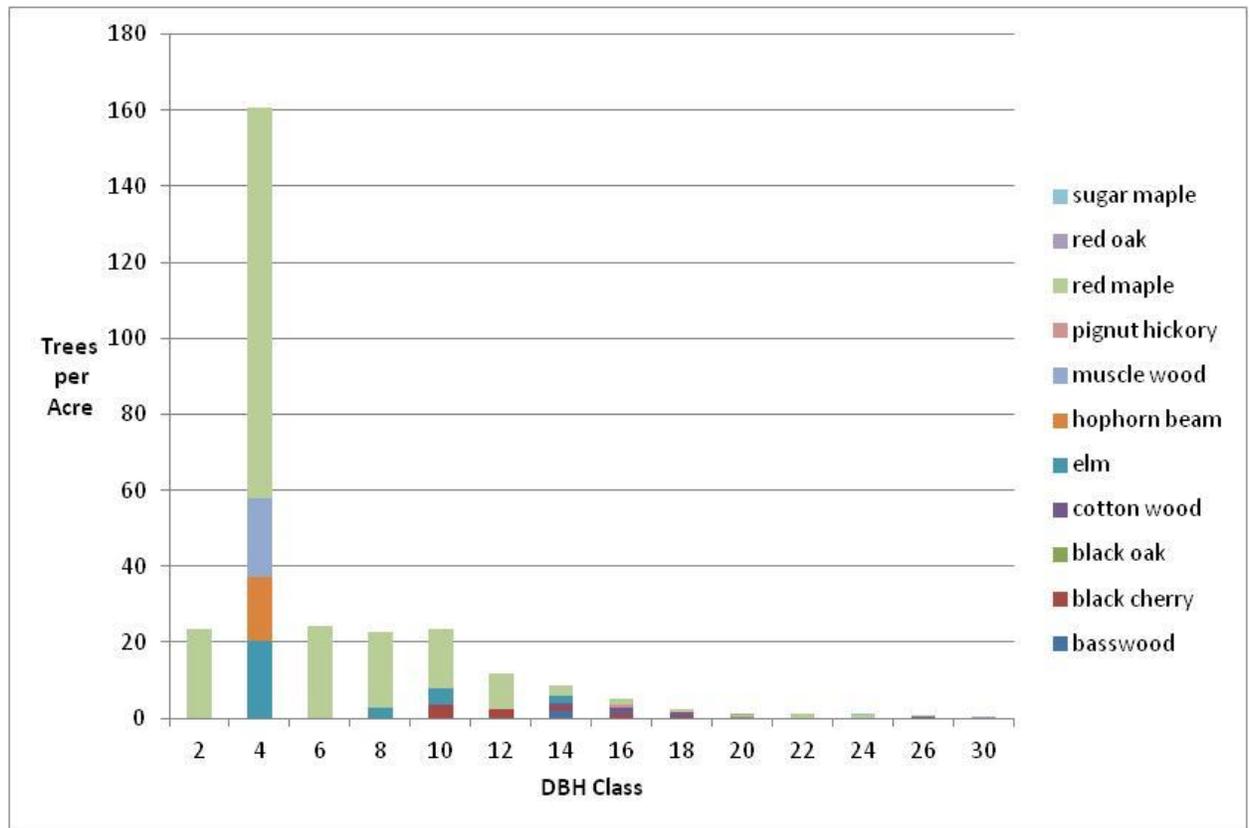


Table A3-8. Basal Area (ft²/acre) for Stand Three.

DBH Class	bass wood	black cherry	black oak	cotton wood	elm	hophorn beam	muscle wood	pignut hickory	red maple	red oak	sugar maple	Total
2									1			1
4					2	1	1		9			13
6									5			5
8					1				7			8
10		2			2				8			12
12		2							7			9
14	2	1		1	2				3			9
16		1		3				1	2			7
18		1		2					1			4
20			1						1	1		3
22									3			3
24									3		1	4
26				2					1			3
30				1						1		2
Total	2	7	1	9	7	1	1	1	51	2	1	83
Percent	2%	8%	1%	11%	8%	1%	1%	1%	61%	2%	1%	100%

Figure A3-8. Distribution of Basal Area (ft²/acre) According to Species for Stand Three.

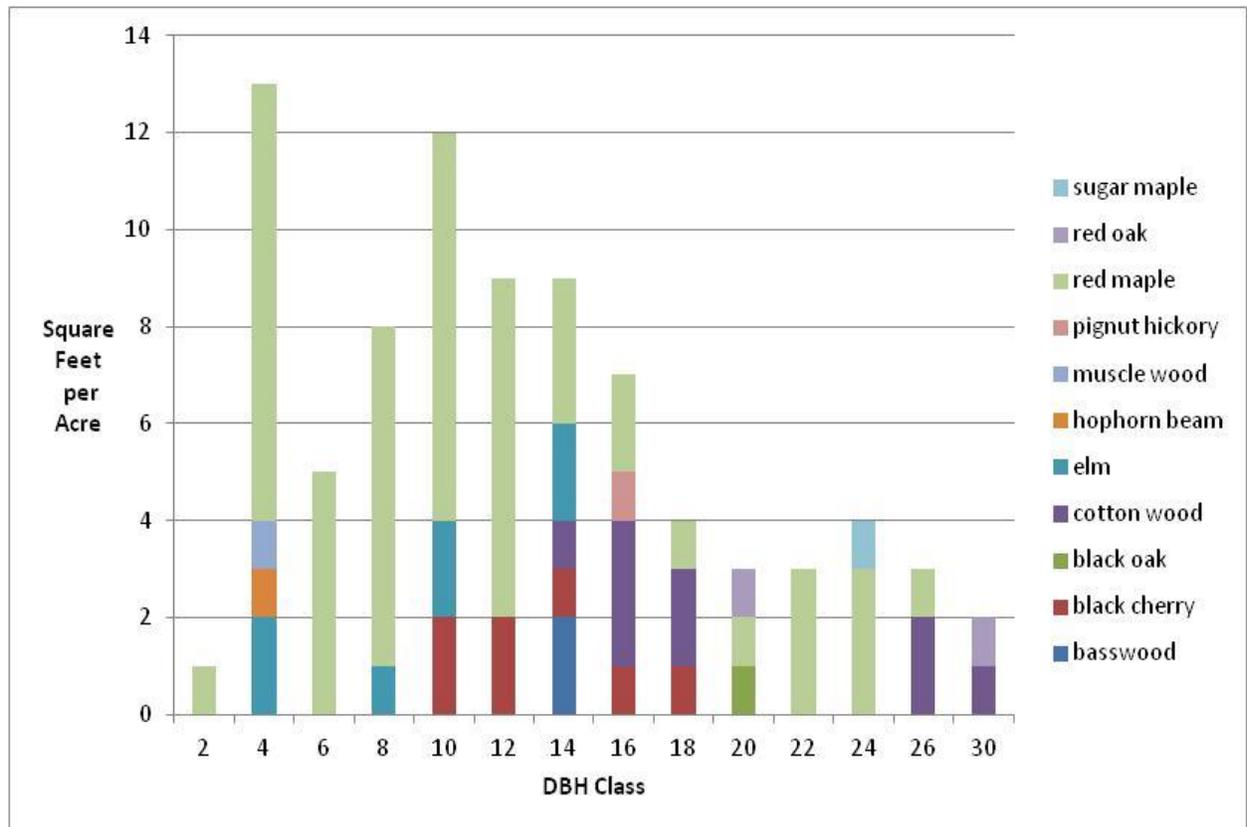


Table A3-9. Boardfeet per Acre (Doyle Log Rule) for Stand Three.

DBH Class	bass wood	black cherry	black oak	cotton wood	elm	hophorn beam	muscle wood	pignut hickory	red maple	red oak	sugar maple	Total
10		51			0				103			154
12		77							359			436
14	103	77		51	103				231			565
16		103		205				103	154			565
18		26		231					103			359
20			77						103	154		334
22									334			334
24									385		103	488
26				282					128			411
30				128						128		257
Total	103	334	77	898	103	0	0	103	1,900	282	103	3,902
Percent	3%	9%	2%	23%	3%	0%	0%	3%	49%	7%	3%	100%
Price: \$/bdft	\$0.13	\$0.34	\$0.21	\$0.08	\$0.12	\$0.00	\$0.00	\$0.12	\$0.13	\$0.27	\$0.54	
Value: \$/acre	\$13	\$113	\$16	\$72	\$12	\$0	\$0	\$12	\$247	\$76	\$55	\$618

Figure A3-9. Distribution of Boardfeet per Acre (Doyle Log Rule) for Stand Three.

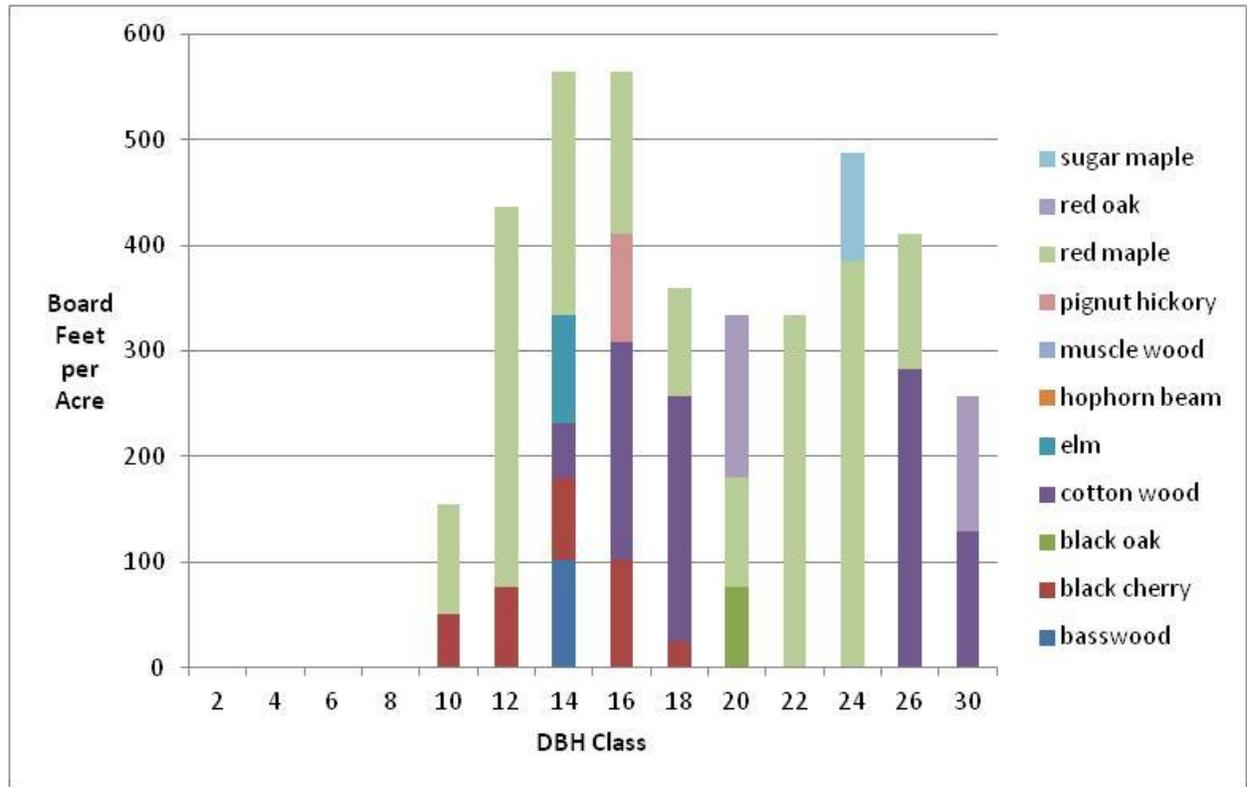


Table A3-10. Resource Considerations Field Inventory Guide Sheet (applies to entire property)

RESOURCE CONSIDERATIONS		Client/Plan Information:	
Field Inventory Guide Sheet - complete by landuse		DeWitt Public Schools	
Identify the resource concern(s) that need to be addressed and the assessment tool(s) used for the evaluation.			
SOIL	Erosion <input type="checkbox"/> Sheet and Rill <input type="checkbox"/> Wind <input type="checkbox"/> Ephemeral Gully <input type="checkbox"/> Classic Gully <input type="checkbox"/> Streambank <input type="checkbox"/> Shoreline <input type="checkbox"/> Irrigation Induced <input type="checkbox"/> Mass Movement <input type="checkbox"/> Road, Road Sides & Construction Sites <input type="checkbox"/> Other: _____		
	Condition <input type="checkbox"/> Organic Matter Depletion <input type="checkbox"/> Rangeland Site Stability <input type="checkbox"/> Compaction <input type="checkbox"/> Subsidence <input type="checkbox"/> Contaminants-Salts & Other Chemicals <input type="checkbox"/> Contaminants-Animal Waste & Other Organics <input type="checkbox"/> Contaminants-Commercial Fertilizer <input type="checkbox"/> Contaminants-Residual Pesticides <input type="checkbox"/> Damage from Soil Deposition Assessment tools, _____ Problems & Notes: _____		
WATER	Quantity <input type="checkbox"/> Excessive Seepage <input type="checkbox"/> Excessive Runoff, Flooding, or Ponding <input type="checkbox"/> Excessive Subsurface Water <input type="checkbox"/> Drifted Snow <input type="checkbox"/> Inadequate Outlets <input type="checkbox"/> Inefficient Water Use on Irrigated Land <input type="checkbox"/> Inefficient Water Use on Non-irrigated Land <input type="checkbox"/> Reduced Capacity of Conveyances by Sediment Deposition <input type="checkbox"/> Reduced Storage of Water Bodies by Sediment Accumulation <input type="checkbox"/> Aquifer Overdraft <input type="checkbox"/> Insufficient Flows in Water Courses <input type="checkbox"/> Rangeland Hydrologic Cycle <input type="checkbox"/> Other: _____		
	Quality <input type="checkbox"/> Harmful Levels of Pesticides in Groundwater <input type="checkbox"/> Excessive Nutrients and Organics in Groundwater <input type="checkbox"/> Excessive Salinity in Groundwater <input type="checkbox"/> Harmful Levels of Heavy Metals in Groundwater <input type="checkbox"/> Harmful Levels of Pathogens in Groundwater <input type="checkbox"/> Harmful Levels of Petroleum in Groundwater <input type="checkbox"/> Harmful Levels of Pesticides in Surface Water <input type="checkbox"/> Excessive Nutrients and Organics in Surface Water <input type="checkbox"/> Excessive Suspended Sediment & Turbidity in Surface Water <input type="checkbox"/> Excessive Salinity in Surface Water <input type="checkbox"/> Harmful Levels of Heavy Metals in Surface Water <input type="checkbox"/> Harmful Temperatures of Surface Water <input type="checkbox"/> Harmful Levels of Pathogens in Surface Water <input type="checkbox"/> Harmful Levels of Petroleum in Surface Water Assessment tools, _____ Problems & Notes: _____		
AIR	Quality <input type="checkbox"/> Particulate matter less than 10 micrometers in diameter <input type="checkbox"/> Particulate matter less than 2.5 micrometers in diameter <input type="checkbox"/> Excessive Ozone <input type="checkbox"/> Excessive Greenhouse Gas - CO2 <input type="checkbox"/> Excessive Greenhouse Gas - N2O <input type="checkbox"/> Excessive Greenhouse Gas - CH4 <input type="checkbox"/> Ammonia (NH3) <input type="checkbox"/> Chemical Drift <input type="checkbox"/> Objectionable Odors <input type="checkbox"/> Reduced Visibility <input type="checkbox"/> Undesirable Air Movement <input type="checkbox"/> Adverse Air Temperature <input type="checkbox"/> Other: _____		
	Assessment tools, _____ Problems & Notes: _____		
PLANTS	<input type="checkbox"/> Plants are not adapted or suited <input type="checkbox"/> Declining Species, Species of Concern <input checked="" type="checkbox"/> Productivity, Health and Vigor <input type="checkbox"/> Noxious and Invasive Plants <input type="checkbox"/> Wildfire Hazard <input type="checkbox"/> Other: _____		
	Condition <input type="checkbox"/> Impaired Forage Quality and Palatability <input type="checkbox"/> Threatened or Endangered Species Assessment tools, Forest inventory of Stands One, Two and Three. Problems & Notes: _____		
ANIMALS	Fish and Wildlife <input type="checkbox"/> Inadequate Food <input type="checkbox"/> Inadequate Water <input type="checkbox"/> Inadequate Cover/Shelter <input type="checkbox"/> Inadequate Space <input checked="" type="checkbox"/> Plant Community Fragmentation <input type="checkbox"/> Imbalance Among and Within Populations <input type="checkbox"/> Threatened and Endangered Species <input type="checkbox"/> Declining Species, Species of Concern		
	Domestic Animals <input type="checkbox"/> Inadequate Quantities and Quality of Feed & Forage <input type="checkbox"/> Inadequate Shelter <input type="checkbox"/> Inadequate Stock Water <input type="checkbox"/> Stress and Mortality <input type="checkbox"/> Other: _____ Assessment tools, Observation of general landscape and aerial photography. Problems & Notes: _____		

