FOREST STEWARDSHIP PLAN FOR

LAKE MACBRIDE STATE PARK

July 2013

Department of Natural Resources

State of Iowa

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INTRODUCTION

This Forest Stewardship Plan was developed to guide management activities that will improve the long term health and resiliency of woodlands in Lake Macbride State Park. It provides an assessment of the current conditions, threats and concerns for the woodland's health, and identifies specific management practices that are recommended to help achieve the goals set forth by State Park managers for conservation & recreation uses.

Iowa's forests and woodlands contribute to the health of Iowa's citizens and economy in a number of ways, including scenic beauty, wildlife habitat, water quality protection for lakes and streams, air quality improvement, renewable wood products, recreation & tourism, outdoor educational opportunities, and more. It is imperative that the quality, health, and condition of these woodlands and forests be maintained and preserved for future generations as Iowa's forests age and adapt to new health threats.

This plan was made possible by a grant from the U.S. Forest Service and represents a collaborative effort between the State Parks and Forestry Bureaus of the Iowa Department of Natural Resources.

OVERVIEW OF LAKE MACBRIDE WOODLANDS

OWNERSHIP & EXTENT

Lake Macbride State Park contains approximately 1,000 acres of woodlands and forest land cover within its boundaries, which is over 2/3 of its total land surface area. Some of this land is owned by the U.S. Army Corps of Engineers as part of the Coralville Reservoir floodplain, with management activities on those lands being handled by the State of Iowa subject to the easement agreements with the federal government. Figure 1 provides a map depicting the ownership demographics of Lake Macbride State Park and surrounding areas.

To develop this plan, all woodland areas were delineated and divided into compartments, or "stands," which are the basic units of forest management. Stands were delineated based on a variety of biophysical attributes such as terrain features (ridges and valleys), streams, roads, trails, tree species composition, tree age, tree density, and more. Each stand represents a relatively homogenous unit in which silvicultural practices can be applied uniformly throughout, for the most part. There were 102 different stands identified comprising a total of 933 acres, ranging in size from 1 acre up to 39 acres in size (average = 9 acres). The Appendix contains a map and data for these stands.

SOILS & TERRAIN

The soils in Lake Macbride State Park's woodlands are predominantly classified as Fayette silt loam (81% of all soils). Fayette are well-drained soils that evolved under forest vegetation and are suitable for a wide variety of native Iowa tree species. They generally have a silty clay or loam texture. Erosion and compaction can be concerns if not properly managed. All other soil types comprise less than 5% of the total woodland area.

The terrain in woodland areas is variable, with slopes ranging from 2% up to 40%. Lake Macbride lies in the Southern Iowa Drift Plain Ecoregion, so the landscape is well-dissected, rolling terrain. Figure 2 provides a LiDAR hillshade image depicting the terrain features of the park.

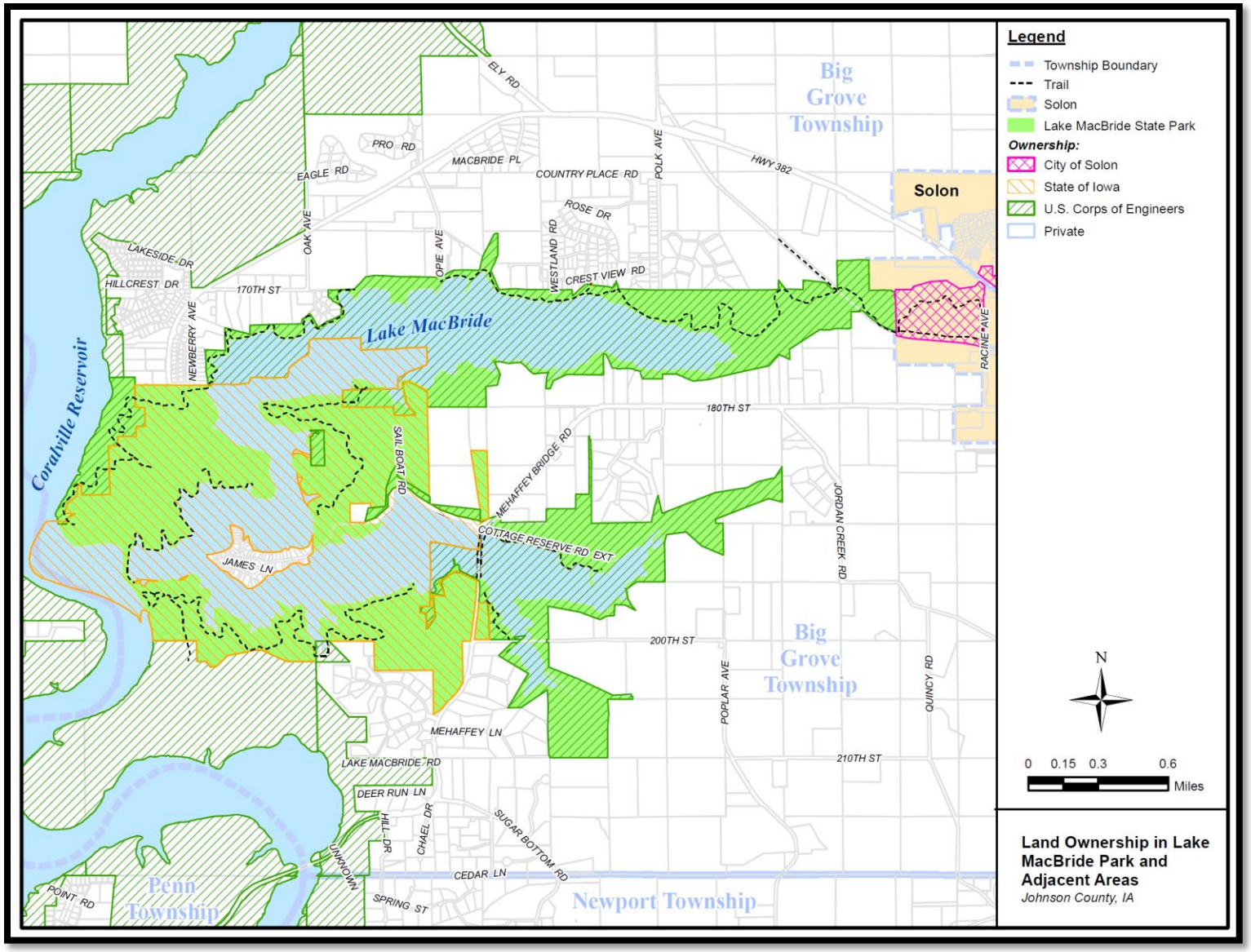


Figure 1. Land ownership of Lake Macbride State Park (courtesy of Johnson County IT Department).

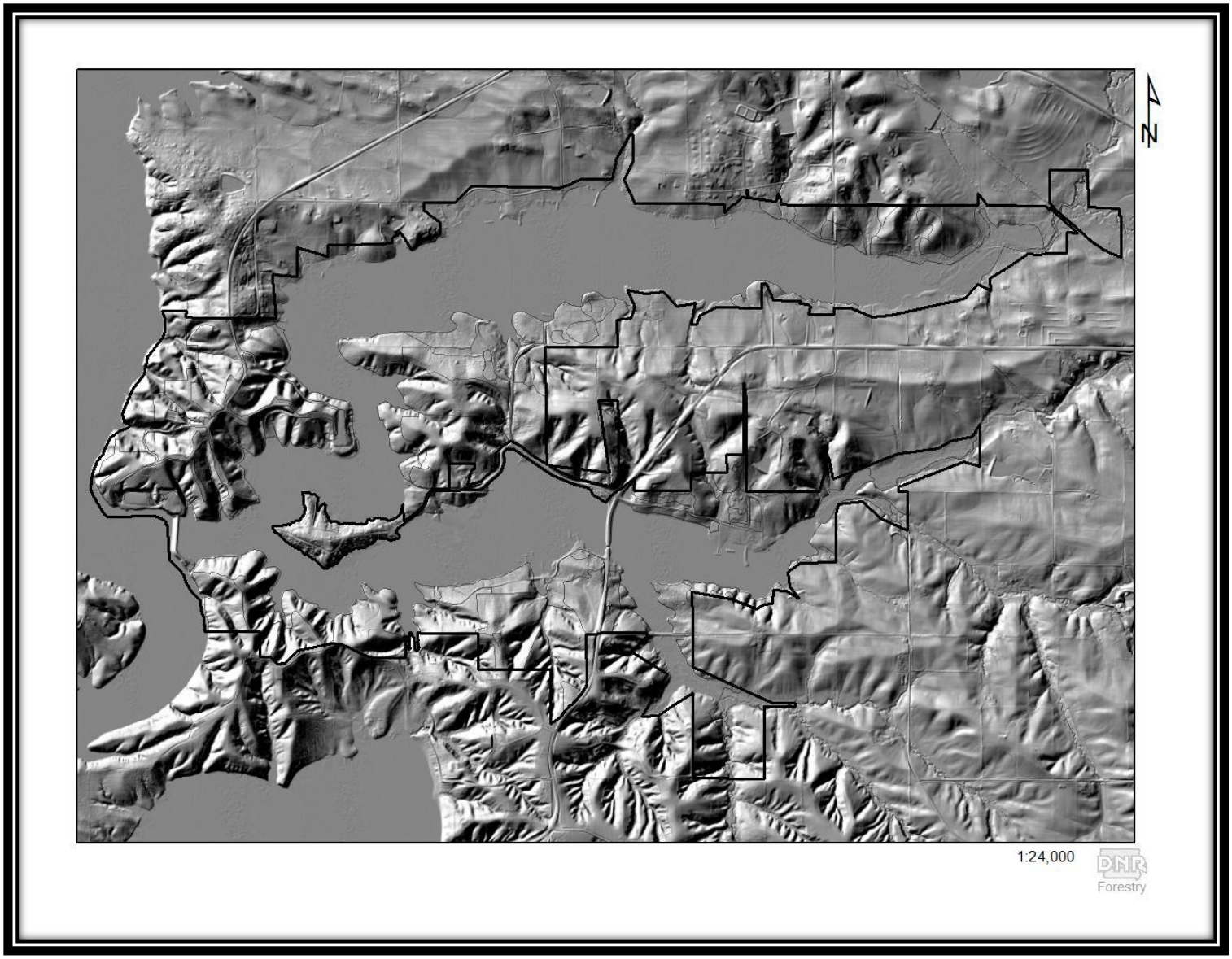


Figure 2. Terrain map of Lake Macbride.

HISTORICAL CONTEXT OF IOWA'S WOODLANDS

The present condition of any forest is essentially just a single snapshot in time, as the forest is always changing. A forest evolves as a product of the environment (climate, soils, slope, elevation, aspect, etc.), biological processes and interactions (seed dispersal, growth, competition, animal browse, decomposition, etc.), natural disturbances (lightning, wind, wildfire, etc.) and past management (intentional fire, logging, pasturing, etc.).

Over the past 15,000 years, Iowa's landscape has changed considerably. After the Wisconsinan glacier melted, the landscape was a cold and damp environment that supported a boreal forest of spruce, fir, and larch bogs, much like northern Minnesota and Canada today. As the climate grew out of the ice age and became warmer and drier, the coniferous forest was replaced by a deciduous forest of elm, maple, oak, hickory, ironwood, and others. At around 4,000 years before present, the climate had reached its hottest and driest period, in which prairie vegetation dominated the landscape due to its drought and heat tolerance.

However, around that point in time, the climate reverted to a cooling pattern with more rainfall, and the deciduous forests began re-invading from the east. Periodic droughts and frequent prairie fires (often ignited by Native Americans) worked to slow down the tree invasion and limited the woodlands to steep areas along river valleys and water features, because those areas were more cool and moist. Nonetheless, the trees gradually gained ground. Oak seedlings had a particular advantage because they could usually resprout after fires from their large tap root and their thicker bark increased survival after low intensity fires. By the time settlement arrived, there was an estimated 6-7 million acres of woodland cover in Iowa. Oak savannas and open oak woodlands were very common, and there were large numbers of shrubby oak seedlings and saplings (called "grubs" by the settlers) that were ready to bolt with any break in the fire cycle. As it happened, this occurred around the 1850's-1860's when the state became more populated with settlers and the prairie fires were no longer allowed to burn uncontrolled. As the conservationist Aldo Leopold wrote, with fires no longer keeping them at bay, the oaks "forthwith romped over the grasslands in legions."

Simultaneously, settlers began harvesting mature trees for fuel and timber, with heavy cutting reaching its peak in the 1870's – 1890's as the railroads passed through. Conversion of woodlands to pasture use and agriculture was prevalent. Since that time, the forests and woodlands of Iowa have essentially rebounded back to about 3 million acres through reforestation efforts and as trees naturally grow up in the absence of fire, cutting, and grazing. Figure 4 below shows an example of this natural succession of forest encroachment.

Figure 3. Encroachment of tree cover at Macbride over time, in the absence of disturbance. (From left to right: 1930's-1960's aerial photos by USDA).

CURRENT CONDITIONS OF LAKE MACBRIDE WOODLANDS

To assess the current conditions of the woodland, three District Foresters walked the 933 acres of forest cover in January and February 2013 and recorded data that would help classify and describe the woodland on a stand-by-stand basis. Information collected included mean tree diameter, species composition of the overstory canopy and understory layers, presence of invasive species and pests that could affect forest health, and more. This information was then entered into a Geographic Information System and is summarized below.

SIZE CLASS

The size class of the dominant overstory trees indicates the relative age and successional stage of the forest. This metric is useful for understanding the overall diversity of wildlife habitat as well as forest health threats throughout the park, because these are both influenced by stand age and structure. For instance, older forests are generally considered to be a more complex ecosystem than younger forests, but they are also more at risk for catastrophic wind/tornado damage and diseases such as oak wilt.

In Lake Macbride State Park, 39% of the forest is larger than 18" diameter at breast height, and another 27% is greater than 12" diameter (Figure 4). Less than 5% of the woodlands are sapling size (1-4"). In other words, the majority of Macbride's woodlands are considered mature or old, while there is not as much young forest. The implications to this that are discussed more in the *Forest Health Threats & Concerns* section and *Understanding Forest Succession* in the Appendix.

OVERSTORY SPECIES

The species composition of the woodland reflects the most dominant species in the overstory canopy layer, which are typically the largest and oldest trees. The current breakdown of forest type for Lake Macbride is as follows:

Oak-Hickory	45%	Contains lesser amts. of ash, elm, basswood, etc.
Central Hardwoods	34%	Mixed upland deciduous trees; no single species dominates
Bottomland Hardwoods	10%	Silver maple, cottonwood, green ash, willow, elm, etc.
Planted Forest	5%	Generally mixed pine species
Eastern Red Cedar/Shrubs	3%	Young successional forest growing up in open areas
Invasives/Exotic Species	3%	Autumn olive, honeysuckle, multiflora rose
Maple-Basswood	0%	Late-successional stands dominated by these two spp.

UNDERSTORY SPECIES/REGENERATION

The understory of a woodland is that canopy layer which exists at eye level, under the shade of the larger overstory trees or in the sunny gaps where saplings shoot up after an old tree has died or fallen. The trees in this layer are critically important to identify because they represent the future species compostion of the forest, and its subsequent value for wildlife and all other benefits of the woodland. Currently, the understory/regeneration layer of the woodlands in Lake Macbride are as follows:

Central Hardwoods	89%	Hackberry, elm, ironwood, hard maple, basswood, white ash
Bottomland Hardwoods	7%	Primarily boxelder, willow, and elm
Invasives/Exotic Species	3%	Autumn olive, honeysuckle, multiflora rose
Oak-Hickory	0.3%	

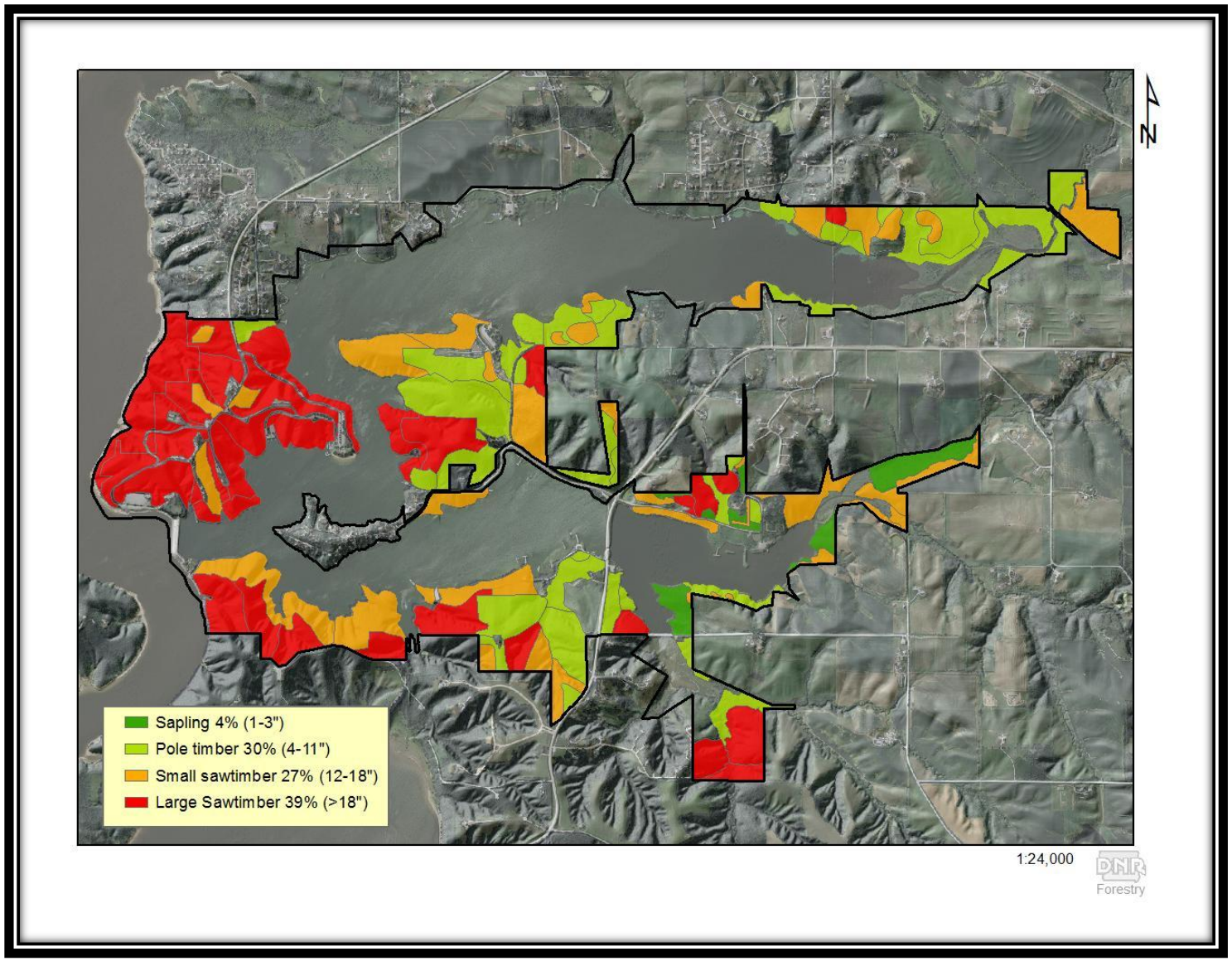


Figure 4. Size class distribution of Macbride woodlands.

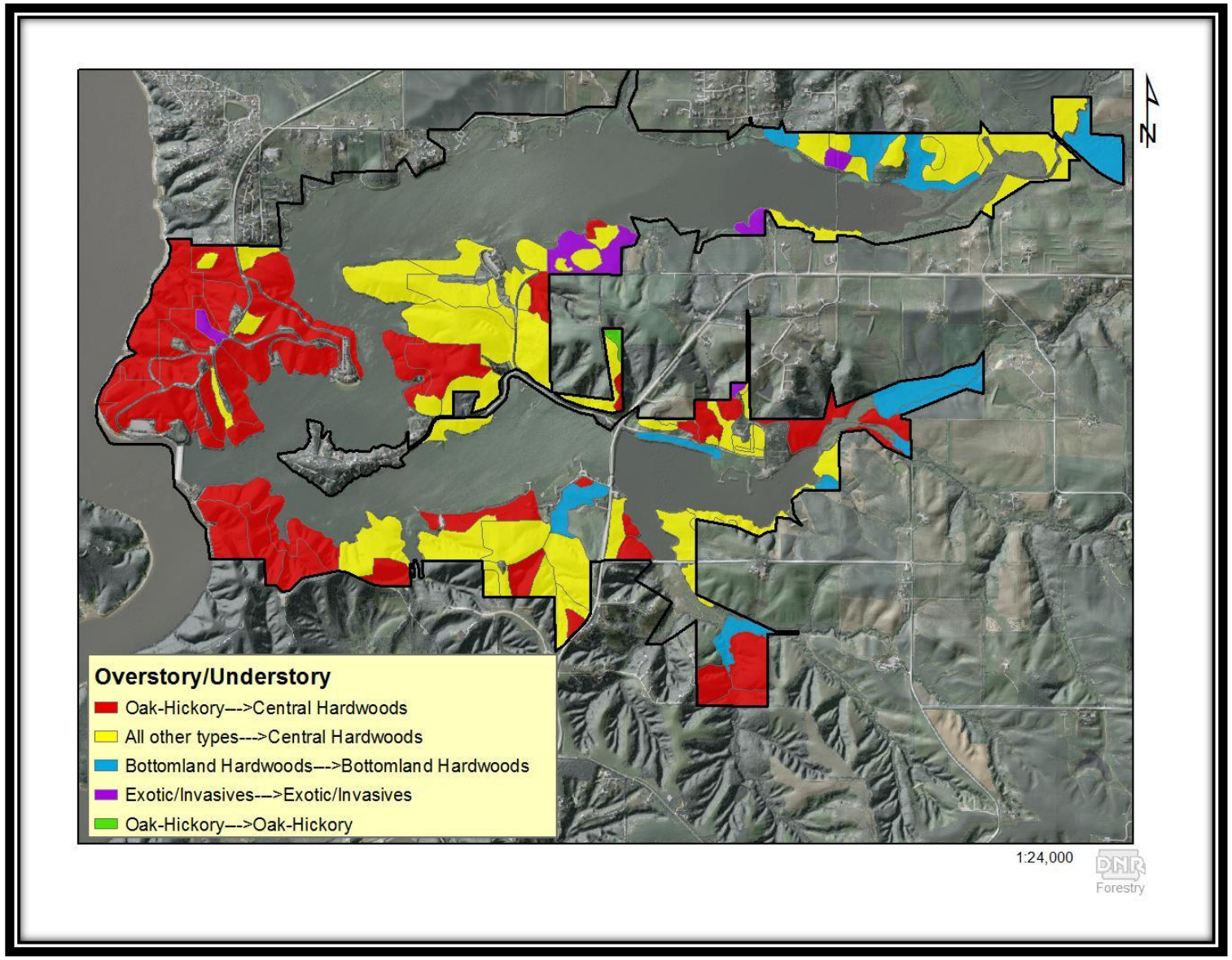


Figure 5. Relationship of overstory species to understory species, indicating forest succession to shade-tolerant mixed species.

FOREST HEALTH THREATS & CONCERNS

Iowa's woodlands today face unprecedented levels of forest health threats in the forms of invasive species, exotic insect pests and pathogens, urbanization, and more. At Lake Macbride, the chief concerns that will affect the forest's functional value to its current and future users include the following, in no particular order.

LOSS OF OAKS

Oaks are Iowa's official State Tree and are considered by many ecologists to be a "keystone" species to the forest ecosystem, meaning they play a unique and critical role in the ecosystem that other plants cannot provide. Their lack of recruitment into the understory and regeneration is a problem throughout many parts of the state, Midwest, and Eastern U.S., and is largely blamed on the lack of disturbance (i.e., fire) which kept this slow-growing species competitive. With no fire to set back the encroachment of competing trees, the oaks do not succeed and are replaced by more common trees such as hackberry, elm, ironwood, hard maple, basswood, and bitternut hickory which have relatively low value to wildlife and few lumber uses compared with oak. Oak's aesthetic value is also arguably greater than the mix of trees that typically succeed it.

The natural lifespan of oak trees varies by species as well as the multitude of genetic and environmental conditions of each individual tree. Still, most literature sources and experts cite life expectancies for trees in the white oak group (bur, white, swamp white, etc) to be up to 250 years of age, and trees in the red oak group (black, red) to be 150 years of age.

In Iowa, US Forest Service inventory data suggests we are "losing" over 5,000 acres of oak forest per year on average as the old oaks die and do not replace themselves. Figure 6 predicts the slow conversion of the forests of Lake Macbride from the current species mix in the overstory (oak-hickory) over to a mixed forest of mesic, shade-tolerant species in the understory. Figure 6 below shows that there are very few young stands of oak in the park to serve as replacements when the old stands move on.

Oak wilt is very abundant in Lake Macbride State Park, as evidenced by the map in Figure 7. Oak wilt is a major player in the decline of oaks, especially red oaks, as it can kill large overstory trees rapidly and can spread via root systems from tree to tree.

In addition to losing oaks as individual trees themselves, the loss of entire oak savanna and open oak woodland ecosystems is a concern throughout Iowa and here at Lake Macbride. These communities provide a unique habitat type with elements of both woodland and prairie, and were formerly kept "open" by routine fire and grazing. Over the past 100 years they have largely filled in and grown up to mixed species forest in the absence of fire, grazing, and other disturbance.

INVASIVE PLANT SPECIES

Exotic (non-native) plant species that are introduced to an ecosystem without the benefits of co-evolution can become invasive and disruptive to the balance of the natural ecosystem. Such is the case with a suite of invasive species in Lake MacBride State Park, primarily consisting of garlic mustard, autumn olive, and honeysuckle. These have the ability to outcompete native species and subsequently cause a decline in biodiversity and ecosystem health. Oriental bittersweet, an aggressive vine, was also noted in increasing abundance in Lake Macbride.

Multiflora rose, white mulberry, black locust, Siberian elm, barberry, trumpet vine, and reed canary grass are also present in varying levels in the park (Figure 8).

Insect Pests: Emerald Ash Borer, Gypsy Moth, Walnut Twig Beetle, Asian Long-Horned Beetle

The Emerald Ash Borer and Gypsy Moth are both present in northeast Iowa and will presumably be making their way to Lake Macbride in the coming years. Emerald Ash Borer attacks and kills any and all species of ash, which is a fairly important component of the forests of Lake Macbride. White ash is a prized tree for its fall foliage and stature, and for its wood properties. Green ash is an important bottomland tree for water quality and environmental services. They are estimated to comprise somewhere between 10-20% of the species mix in most stands of Macbride.

The Gypsy Moth has been a pest in the Eastern U.S. for over a century and is finally making its way into Iowa. It causes heavy defoliation of oak, maple, and other hardwoods during the early summer months and degrades recreational and aesthetic uses of the forest. Repeated defoliations can cause decline and death of mature trees.

The Walnut Twig Beetle is not yet known to exist in Iowa, but has the potential to cause very serious harm to the state's black walnut population. It vectors the recently discovered "1,000 Cankers Disease" which has caused walnut mortality in 9 western and 5 eastern states. Although it rarely constitutes a major portion of any single stand, black walnut is a major species as an individual tree throughout nearly all of Lake Macbride State Park with some very high value trees being present.

Aging Forests

Mature late-successional forests provide critical habitat for many migratory songbirds and other specialist wildlife species, and they also offer high quality recreation and aesthetic benefits. However, very young forests also provide a crucial habitat type for certain types of wildlife. Young forest is also called "early successional habitat" and is typically very brushy with a high density of trees per acre. Early successional habitat occurs on a timeline following a clearcut, major windstorm, or the abandonment of old fields/pasture and typically lasts somewhere between 10-20 years until the trees reach 30-40 feet in height. Some examples of wildlife that especially prefer or require young forest include Ruffed Grouse, White-eyed Vireo, Kentucky Warbler, Yellow-Billed Cuckoo, Black-Billed Cuckoo, Blue-Winged Warbler, and Golden-Winged Warbler.

The relative scarcity of young and early successional forest in Lake Macbride State Park as shown previously in Figure 5 indicates that while the needs of some wildlife will be met, others may be in shortage.

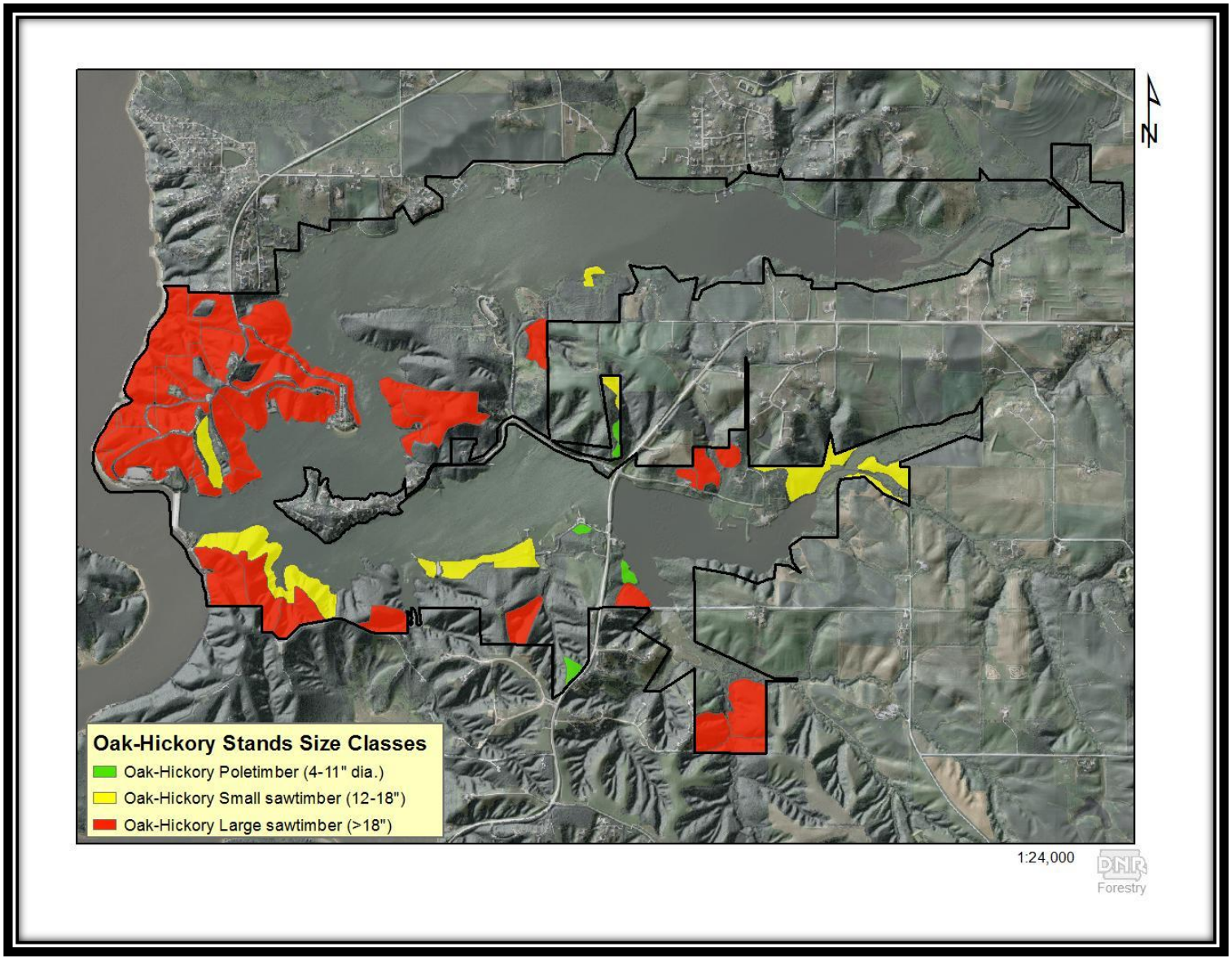


Figure 6. Size classes of oak stands in Macbride.

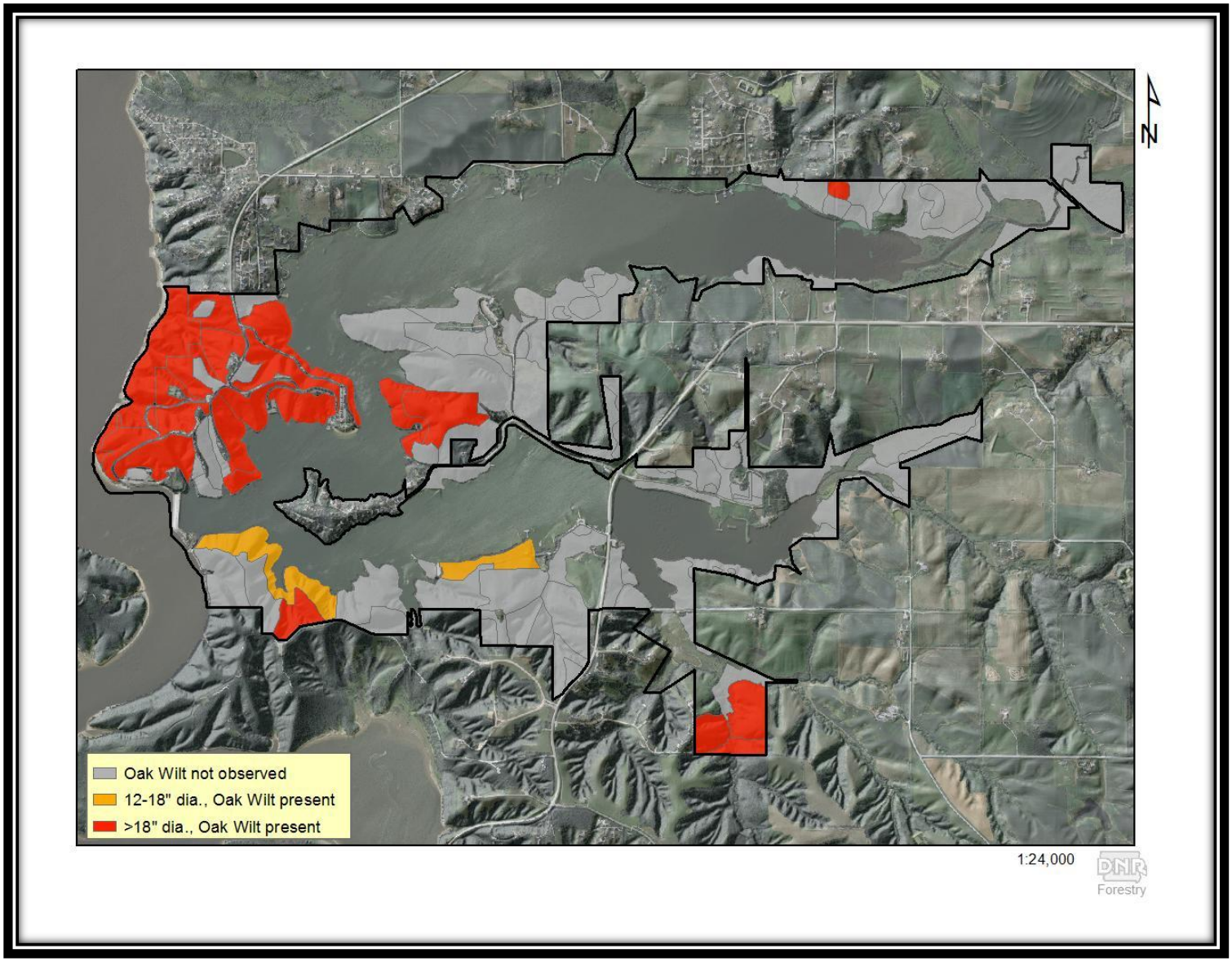


Figure 7. Oak wilt occurrence in Macbride.

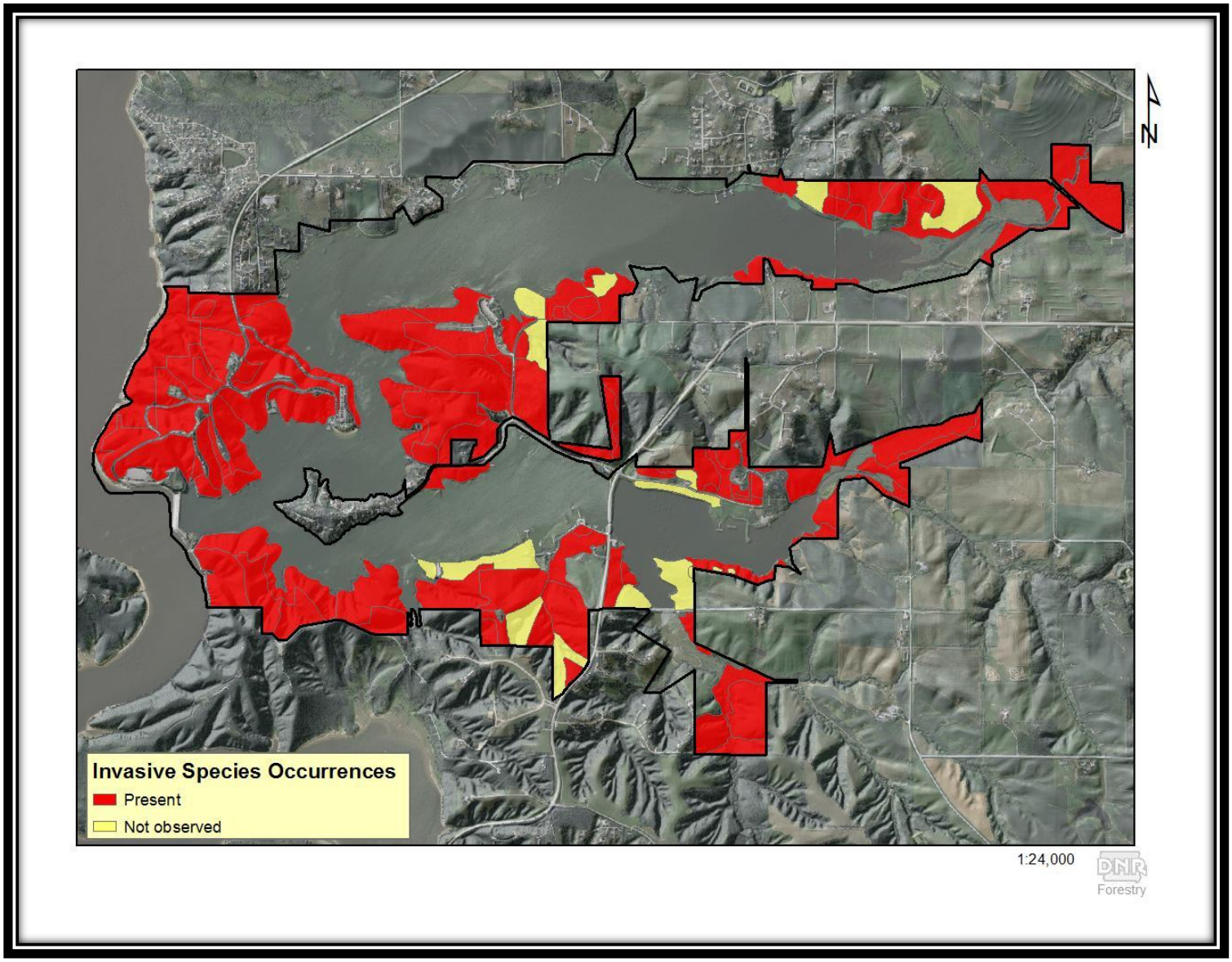


Figure 8. Invasive species occurrence in Macbride.

Deer Density

Whitetail deer can be a problem at Lake Macbride State Park, as they have the potential to overbrowse vegetation to harmful levels at times. As a large forested area with low hunting pressure, the park serves as a refuge and deer can become stockpiled during the fall and winter. This can make tree planting and regeneration efforts difficult, especially for oaks which are a preferred browse species.

Hazard Trees

Hazard trees are trees that carry a particularly high risk of structural failure which could cause property damage or personal injury. To be considered a hazard tree, a tree must have both of the following: 1) major structural defect that makes it very prone to failure and 2) a nearby target that it could land on, which could be a picnic table, parking lot, campsite, bench, etc. As trees grow larger and bear more weight and become greater in height, they need to be frequently monitored for structural decline in high-use areas on a routine basis.

Desired Future Conditions and Goals for Lake Macbride's Woodlands

Establishing clear and objective goals for the future woodland condition is critical to identifying what management actions are needed to get there. The 2005 Strategic Plan for Iowa's State Parks system outlines several goals and objectives related to increasing land stewardship and resource management, including the creation of demonstration areas for educational purposes and public outreach. Specifically in Eastern Iowa and Lake Macbride, park managers have identified the following as some key goals:

- Focus on replacing invasive/non-native species with native forest habitat for songbird and other wildlife benefits
- Open up woodland canopies and put fire back on the forest floor to let sunlight return and stimulate native herbaceous vegetation, with the goal of helping to stabilize gullies & reduce erosion
- Promote new growth of forest trees, particularly oak regeneration, through active forest management and harvesting
- Preserve and enhance habitat for unusual, threatened, rare, and endangered plants and animals
- Provide high quality and safe recreational opportunities for park users
- Establish relationships with and engage adjacent landowners in land stewardship activities

Silvicultural Recommendations

Forest ecosystem management involves the use of silvicultural practices such as planting, thinning, prescribed burning, and harvesting to achieve a specific goal. All silvicultural actions involve tradeoffs, meaning there will be some positive outcomes and some negative. These tradeoffs must be considered on both spatial and temporal scales so as to optimize the overall forest benefits for society and the environment.

Woodland stands were assigned silvicultural recommendations based on their current conditions and the general goals for the park during the stand mapping process (see Appendix for individual stand summaries). A review and filtering process was then done to identify the highest priority projects that will help move the woodlands toward achieving the goals set forth for Lake Macbride State Park. These "high priority" practices are summarized below:

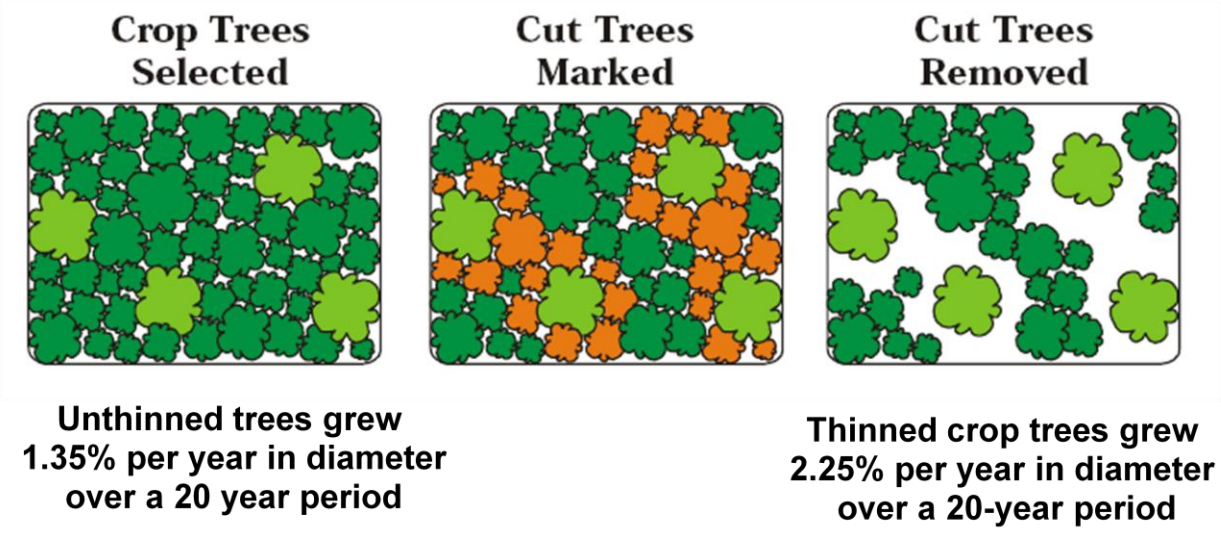
IMMATURE WOODLAND THINNINGS (CROP TREE RELEASE)

This work aims to reduce overcrowding and density for long-term tree health and vigor. The word "immature" implies relatively young or middle-aged stands of hardwoods which have not attained full crown size. It is based on the premise that there are too many trees in the forest canopy competing for limited resources, and to keep the stand healthy some trees should be thinned. The most promising trees in the overstory are identified throughout the stand and marked as "leave" trees or "crop" trees, and then those adjacent trees that are interfering with them are cut or killed to give them more space. In most stands, there are between 25-75 crop trees per acre that receive release. The trees that are chosen comprise a mix of desirable, long-lived species in the upper canopy that show good health, including oak, hickory, walnut, maple, cherry, basswood, coffee tree, and others.

This practice will have the following benefits:

- Enhance tree health, vigor, and resilience. Fast-growing trees that aren't crowded are better able to withstand attacks by pests such as gypsy moth, oak wilt, and others.
- Grow bigger trees, faster. Trees receiving release from competition can attain a larger size in half or a third as much time as crowded trees.
- Create snags for wildlife. Trees that are girdled will become cavity and den trees which are required by dozens of species of wildlife.
- Enhance complexity and structure of the forest. The additional sunlight into the woodland will encourage herbaceous growth on the forest floor, and fallen trees and logs add large woody debris for fungi, insects, and wildlife habitat.

There are 14 stands for a total of 101 acres identified as good candidates for this practice (Figure 9). More information about crop tree release can be found at http://www.na.fs.fed.us/pubs/ctm/ctm_index.html.



Source: Perkey et al., 2011. U.S. Forest Service General Tech Report NRS-83.

Mature Oak Woodland Restoration

These projects will enhance the opportunity for oak regeneration for future generations, diversify the forest age class structure, reduce invasive species, and increase biodiversity of the herbaceous layer on the forest floor. Silvicultural practices that will be employed include prescribed burning, weed tree removal/understory thinning, tree planting, and timber harvesting. These practices are described below --- not all treatments will be applied to every stand.

Prescribed burning will be used in many stands to help set back the competition and favor the recruitment of oaks. To accomplish this, burning must be done often and for many consecutive years. A detailed burn plan should be prepared for each stand to be burned and reviewed annually. Burning can be done in either late Fall or early Spring. Use media and signage to inform the public of the burning work and smoke issues. Burning will be done in as many oak restoration stands as possible, subject to funding and staff resources.

Weed tree removal/understory thinning is a form of Timber Stand Improvement (TSI) that will be used to restore the open oak woodland conditions. It will focus on removing unwanted woody species from the understory and midstory layers that are overly abundant and preventing oak establishment, such as ironwood, elm, hackberry, autumn olive, honeysuckle, and others. The stumps are chemically treated to prevent resprouting. Larger trees that are killed during this process are generally girdled and left standing to provide snags for wildlife den trees. This practice will be applied to most stands classified for oak restoration work.

Tree plantings will be limited in size and scope, and are generally done only where no seed source exists to facilitate natural oak regeneration. This would apply to areas that have recently been cleared of invasive species and are being renovated as well as areas scheduled for timber harvests. Some plantings will involve direct seeding with acorns and nuts, and others will use bare root seedlings and wildlife protectors.

Timber harvests are an essential tool in forest ecosystem management as they create canopy openings to let sunlight reach the forest floor and initiate the renewal process. Without access to full sunlight, young oaks cannot compete and survive. At Lake Macbride, two different types of timber harvesting will be used to facilitate oak regeneration: shelterwood harvests and small patch clearcuts (3-5 acres in size). Shelterwoods will only be used in limited situations where existing oak trees are too crowded for seedlings to become established underneath. Clearcuts will be used to salvage areas of dying oak and suppress the spread of oak wilt. The *Management Considerations* section addresses many issues associated with the impacts of these proposed timber harvests, and more technical details about these two harvesting systems can be found in the Appendix.

There are 25 stands for a total of 248 acres identified to receive oak restoration treatments (Figure 9).

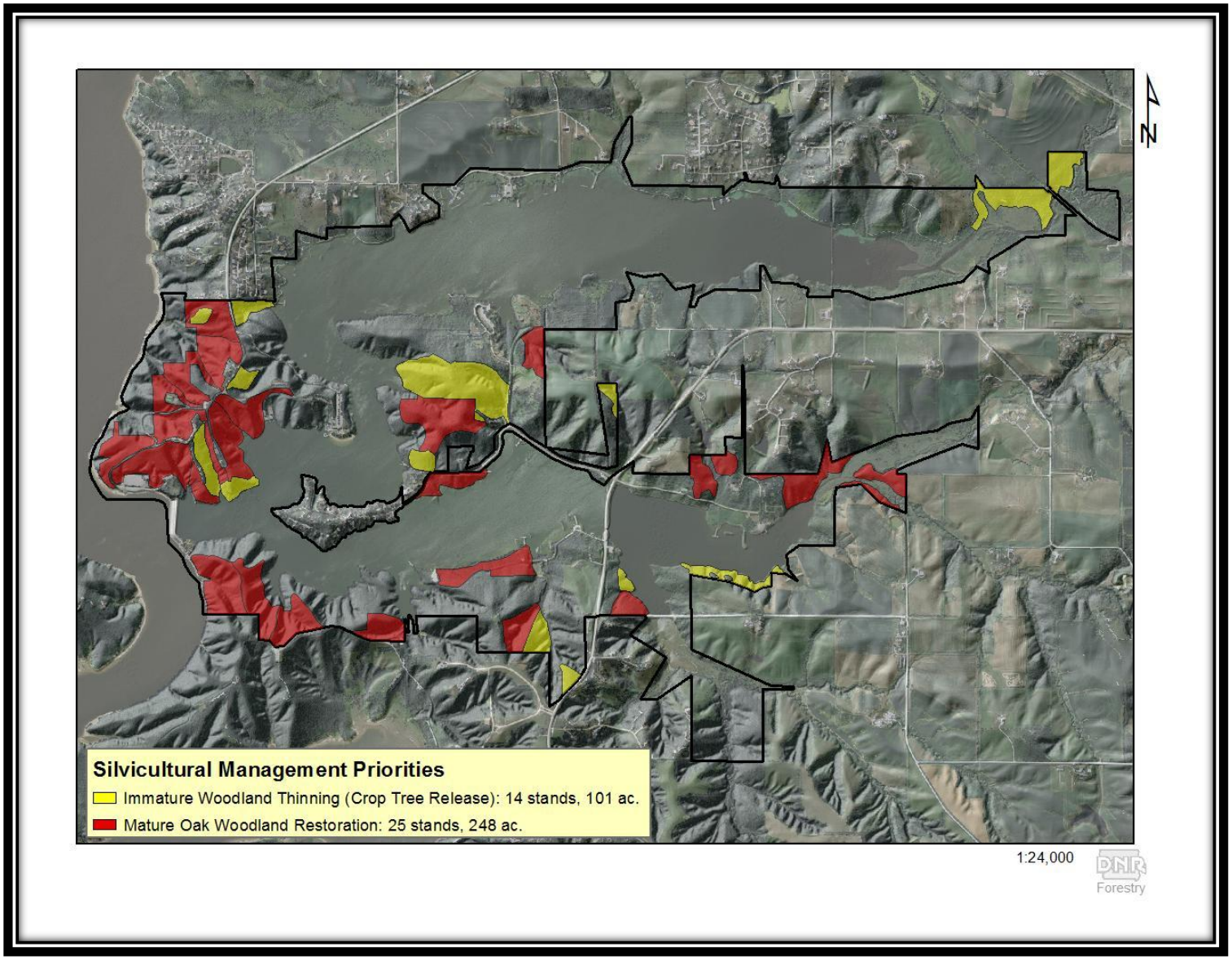


Figure 9. Recommended management priorities.

WORK PLAN

Implementation of this plan will begin in Fall 2013 and be carried out over the next 10-15 years. Adaptive management will be used to adjust treatments and work as conditions change. The plan should be updated and new priorities established once all work is complete or in approximately 15 years.

The following table sets the priority work schedule:

Year	Activity	Stands	Total Amt.
2013-16	Crop Tree Release	10, 23, 63, 69, 75, 76, 79 85, 89, 92, 94, 97, 99, 100	101 ac.
2013-16	Oak restoration: Weed tree removal	2, 4, 5, 20, 22, 28, 30, 31, 34, 40, 50, 55 , 56, 57, 58, 59, 60, 61, 62, 70, 74, 86, 95, 96, 98	248 ac.
2013-28	Oak restoration: Rx burning	TBD from stands above	30-60 ac./yr
2013-28	Oak restoration: Timber harvests & Replanting	40, 86, 22…	4 ac/yr

All other stand prescriptions are listed in the Appendix of this plan.

OTHER GENERAL MANAGEMENT RECOMMENDATIONS

HAZARD TREE MITIGATION

Hazard tree management should be an ongoing task of routinely surveying high use areas of the park and removing high risk trees as promptly as possible. These areas include campgrounds, shelters, maintenance and office buildings, picnic areas, and along trails.

PUBLIC FORESTRY FIELD DAYS

Workshops that showcase and demonstrate land stewardship and conservation to the public in ways that are easy to understand and apply are a very effective way to reach out to adjacent landowners. As improvement projects get underway, Parks and Forestry staff should coordinate and hold tours of project sites and invite expert guest speakers for public education and promotion of good conservation practices.

MANAGEMENT CONSIDERATIONS

INVENTORY OF RARE, THREATENED, AND ENDANGERED FLORA & FAUNA

The State's Natural Areas Inventory database was reviewed for the presence of any rare, threatened, or endangered species in Lake Macbride State Park's woodlands. Three occurrences were found:

- Pinesap (*Monotropa hypopithys*) --- State Threatened.
- Frost Grape (*Vitus vulpina*) --- State Special Concern.
- Muskroot (*Adoxa moschatellina*) --- State Special Concern.

An on-site environmental review must be done in all management units prior to the commencement of work to assess the presence and abundance of these or other rare, threatened, or endangered species and to ensure no harm is done to them.

Johnson County is located within the range of the State- and Federally-Endangered Indiana Bat (*Myotis sodalist).* Precautions must be taken to ensure the forest management activities in this plan do not threaten the potential for habitat of this species. Also, some forest management actions can be done to have a potentially beneficial effect for the Indiana Bat. These considerations will include the following:

- All activities which require tree felling (harvesting and thinning) will only be done outside of the maternity summer nesting season, which is defined as April 15-September 15.
- Large non-commercial trees in clearcut or thinning units will be girdled and left standing to die and provide loose, peeling bark
- Fragmentation of mature forest will be minimized by limiting the size of harvest areas to <5 acres

WILDLIFE

Forest management activities such as tree harvesting, thinning, burning, planting, and others can have both beneficial effects and detrimental effects for wildlife, depending on the species and its needs. The conscious decision to do no forest management (i.e., "hands off" preservation) also has pros and cons. Such tradeoffs can be hard to quantify and understand due to the complexity natural ecosystems. The Appendix contains a primer on how forest succession and wildlife habitat are affected by traditional forestry practices.

Iowa's Wildlife Action Plan (available at www.iowadnr.gov) identifies 296 "Species of Greatest Conservation Need" which are rare, threatened, endangered, or declining in numbers in Iowa. Table 1 in the Appendix summarizes the habitat information from the Iowa Wildlife Action Plan for these species in Eastern Iowa. The activities recommended in this plan are meant to optimize the overall diversity and quality of wildlife habitat for both common wildlife species as well as those that are in need of habitat protection and restoration.

BEST MANAGEMENT PRACTICES FOR SOIL, WETLAND, AND WATER QUALITY PROTECTION

Protection of soil and water resources is of utmost importance. Forest management and timber harvesting activities have the potential to negatively impact these qualities, but with careful timing and best management practices these impacts can be made negligible:

- Timber harvests and any work involving heavy equipment will only be done during times when the ground is frozen and not wet. This prevents compaction of the soil and also protects the fragile herbaceous plants of the forest floor
- No logging slash or debris is to be left in streams or flow pathways
- Pesticides used for invasive species control are to be applied in the appropriate dosage and at the proper time, according to product label

All other considerations and best practices for protecting water & soil resources are discussed in Iowa's Forestry Best Management Practices manual, available online at www.iowadnr.gov.

Aesthetics & Recreation

The expansive woodlands of Lake Macbride State Park are a large part of its popularity for outdoor recreation and enjoyment. Forest management activities can negatively impact these qualities in the short term. Trees and tops left after thinning and harvest operations are seen by some as unsightly "brush" and prescribed burning leaves the ground bare and black scorch marks and char on the trees & down wood. Some of this must be dealt with by educating park users on what they are seeing and why it is being done for long term ecological benefits. Beyond that, the following measures are meant to help minimize the impact of forest management to the aesthetic beauty and recreation capacity of Lake Macbride S.P.:

- Limit the size of harvest areas to <5 acres and do not locate them near campgrounds, picnic areas, or scenic vistas
- Require slash from logging and thinning operations to be cut to within 4' of the ground and maintain clean trails and roads at all times. Do not leave hazardous snags within striking distance of trails or infrastructure.
- Carefully lay out skid roads and landings for each harvest to minimize visual impacts with park users
- Require stumps from logging and thinning operations be left no higher than 6" above the top of the root flare
- Promptly reseed or reforest log landings with grass and shrubs for wildlife

Sustainable Harvest Guidelines

Sustainable harvest guidelines are meant to establish a baseline for how much woodland area can or should be harvested annually to achieve a balanced age-class distribution and to ensure that cutting does not exceed regeneration. This is done by dividing the total number of acres by the stand rotation age, which is the age at which the stand is deemed mature and ready for harvest & regeneration. For Lake Macbride, there are 590 acres under consideration for active even-age management. With a projected rotation age of 140 years, there is an allowable harvest of 4.2 acres per year or roughly 8 acres every other year. Hypothetically, at this pace, it will not be until the year 2153 that the forest will achieve sustainability and become fully balanced in terms of an equal number of age classes.

Forest Health & Integrated Pest Management

Forest ecosystem health is best maintained by using management practices that promote maximum diversity of native species, environments, and habitats throughout the area. This will help buffer major, catastrophic losses to pests such as gypsy moth, EAB, oak wilt, and others. Harvests and successional management are extremely important to diversifying the age structure of the forest population and prevent catastrophic storm damage.

Limiting all or most management work to the dormant season helps minimize soil disturbance and injury to non-target plants & trees, and reduces the incidence of invasive pests, insects, and diseases. For instance, to prevent and hasten the spread of oak wilt, all tree cutting activities are to be done between November and March.

Incidental tree damage by harvesting and thinning activities is to be minimized by timing these activities to occur during the dormant season and through the requirement of careful selective felling practices. Machinery must be kept to skid trails and roads to minimize physical injury to the bases of trees along skid routes.

The use of pesticides will be minimized by using silvicultural practices that promote native species when possible (e.g., prescribed burning), and using selective cut-stump application methods at the appropriate timing and rates, according to label instructions.

Important Cultural, Archeological, or Ecological Sites

If it is determined that there are any unique archeological, cultural, or historic sites of significance in the proposed work zones, management activities should be conducted in a way that will not adversely affect them. Such sites might include original cabins, human burial sites, special land features, or artifact caches. No excavation of stumps or earthwork is being proposed by this plan which would disturb Native American burial mounds.

Monitoring

Monitoring the long-term results of forest management decisions, including the decision to do nothing in a specific stand or area, is important in order to document successes and failures and ensure that the desired effects are being had on native flora and fauna. Ideally, monitoring should be an interdisciplinary effort that includes foresters, wildlife biologists, botanists, and ecologists, and it should be founded on science-based methodology and should be ongoing to capture long-term effects. Historically, limited staff and funding have constrained the amount of monitoring that can be done. Thus, every effort will be made by DNR staff to collaborate internally to measure and assess the effects of forest management subject to resource availability.

Acknowledgements

The woodland inventory and stand mapping field work for this plan was conducted by District Foresters David Bridges, Mark Vitosh, and Joe Herring of the DNR Forestry Bureau. Input and guidance on the plan and the identification of goals and desired conditions for Lake Macbride State Park were given by DNR State Parks staff Gwen Prentice (Park Ranger), Ron Puettmann (Park Manager), and Tom Basten (District Supervisor). Plan prepared by Joe Herring, DNR Forestry Bureau.

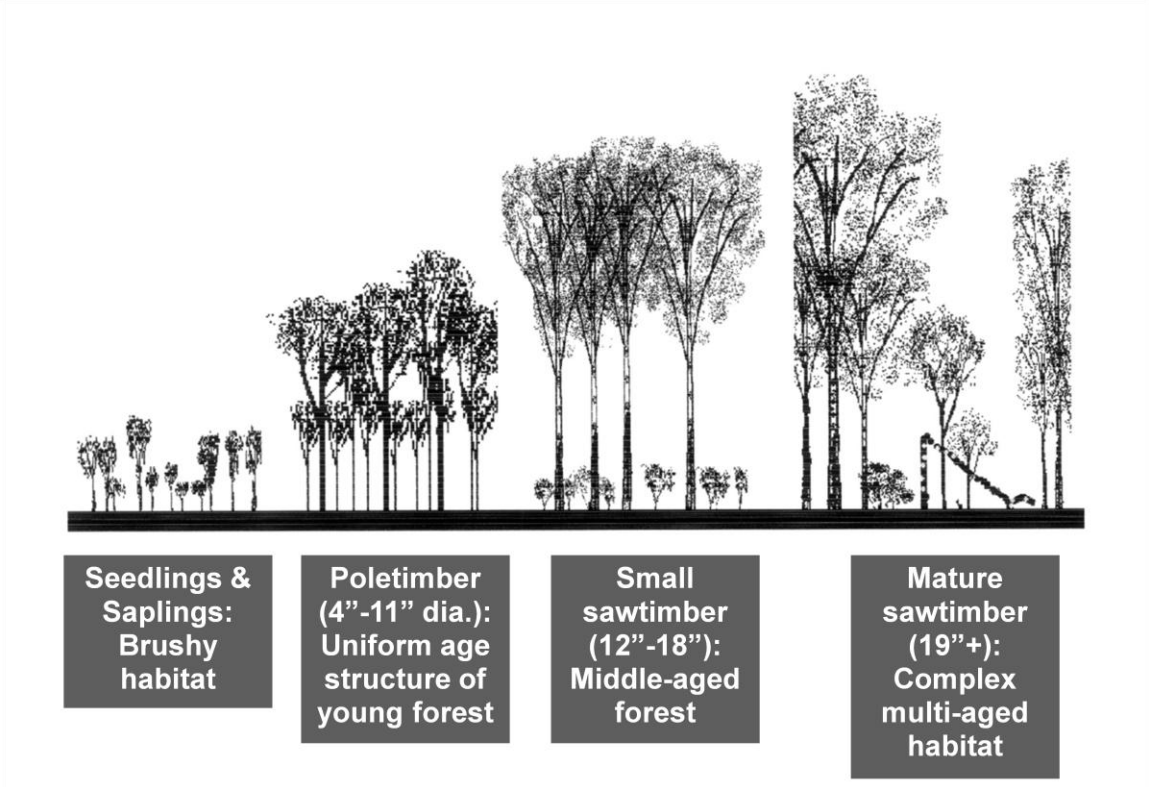
"Our streams are for use. Conservation bids us to use them and use them wisely; likewise our forests, these shall not simply stand as in the ages primeval, they must stand and be productive, be used."

- Thomas Macbride, 1911. "The Conservation of our Lakes and Streams." *Report of the Iowa State Waterways, Drainage, and Conservation Commission.*

APPENDICES

FOREST SUCCESSION MANAGEMENT AND WILDLIFE HABITAT

The basic tool or means of enhancing wildlife habitat and biodiversity in the forest is to manipulate the successional stages through vegetative management (cutting and/or planting). Successional stages are the different phases a forest goes through in time as it grows from infancy to maturity, as shown in the diagram below. As a forest naturally progresses through these stages, the plant communities and wildlife inhabitants will also change:



The **seedlings & saplings** stage, also known as early successional cover, contains a mixture of grasses, weeds, small shrubs, thorny brambles, and young trees. It is best described as brushy habitat. Many types of small game such as rabbits, mice, voles, & snakes use this cover. Not surprisingly, it’s also preferred hunting ground for avian predators including hawks, owls, and kestrels. Pheasants, quail, woodcock, and ruffed grouse will use this cover at certain times of the year when heavier cover is desired. Deer will use it for bedding, fawning, browsing, rubbing, and staging. Female wild turkeys use it for nesting. Songbirds that prefer this cover include gold-winged warbler, blue-winged warbler, black-billed cuckoo, yellow-billed cuckoo, eastern towhee, and prairie warbler.

During the **poletimber** stage, the forest canopy closes in and very little sunlight reaches the ground. The grasses, weeds, and other ground plants are shaded out by the dense layer of trees up above, which are all about the same age and fairly uniform in height and form. Consequently, this stage of the forest offers the least amount of diversity for wildlife and it’s usually desirable to manually thin some of the trees out to enhance tree growth and speed up the transition to the next stage, which is the **small sawtimber** stage. Thinning will also increase acorn & fruit production of favored trees, and make the trees stronger, healthier, and more immune to disease & insect

attacks, and get sunlight to the ground to stimulate vegetation and new cover for wildlife. As the forest goes deeper into the small sawtimber stage, the habitat becomes more complex with different layers and new shrubs & saplings emerging.

When the forest reaches the **mature sawtimber** stage, some trees have begun to die from natural causes like lightning strikes, wind, snow & ice, competition, or old age. Selective tree harvesting can also have this effect. Trees that have died but are still standing are called snags and are very important to cavity-nesting critters and woodpeckers. Fallen logs & tree tops house or hide animals on the ground such as whitetail deer, and then rot back into the soil. Wild turkeys roost in the tops of mature trees and eat the sweet acorns of oak trees. Mosses and wildflowers become more abundant and insects find refuge in small microhabitats. Many birds prefer this more diverse habitat structure with its complex layers, such as the acadian flycatcher, cerulean warbler, veery, and the black & white warblers among others. Near large rivers, bald eagles and various species of herons may make their nests in mature trees. Various reptiles and amphibians also like mature bottomland forests and the mixture of seasonal ponds, emergent logs for sunning, and hiding places.

As this process of succession evolves, certain trees that require full sunlight such as oak & walnut are gradually replaced by tree species that can tolerate shade (such as hard maple, basswood, & hackberry, among others). Vegetative management practices such as tree cutting, burning, or planting are needed to reset the process back to the beginning if the goal is to restore certain species like oak and walnut.

Another important woodland habitat type in Iowa is the oak savanna or open oak woodland, which is generally defined as a combination or transition between grassland and forest cover. These ecosystems have scattered oak trees at wide spacing with an understory of native forbs, grasses, and shrubs. They have a pleasing “park-like” appearance and are used by many types of wildlife including red-shouldered hawks, redheaded woodpecker, deer, turkeys, and many more. These habitats need routine fire to keep tree encroachment in check while allowing the fire-tolerant oaks to gradually replace themselves. Without burning or cutting, they fill in with other trees and become mixed-species forests. In many parts of Iowa, conservationists are restoring savannas and open oak woodlands that have grown up to forest over the past century by manually cutting and removing the in-growth, and reintroducing fire.

Table 1. Habitat Preferences for Species of Greatest Conservation Need in eastern Iowa.

Group	Common Name	Preferred Habitat (From Tables 14 & 15 in Iowa Wildlife Action Plan)
Breeding Birds	Black-crowned night heron	Wetlands ringed with shrubs
	Yellow-crowned night heron	Prefers mature lowland woods
	Osprey	Wetland, riparian forest
	Bald eagle	Riparian forest, deciduous forest
	Red-shouldered hawk	Riparian forest
	Broad-winged hawk	Large contiguous deciduous forest
	Swainson's hawk	Savanna, open woodland
	Peregrine falcon	Riparian forest, deciduous forest
	American woodcock	Moist, brushy woodlands w/ openings
	Black-billed cuckoo	Woodland thickets w/ 2' to 6' shrubs
	Yellow-billed cuckoo	Woodland thickets w/ 4' to 8' shrubs
	Long-eared owl	Woodland-grassland interface
	Whip-poor-will	Ungrazed forest w/ open understory
	Red-headed woodpecker	Oak savanna w/ snags
	Acadian flycatcher	Riparian areas of large unfragmented forests
	Willow flycatcher	Willow thickets on wetland edges
	Veery	Moist forests w/ low tree & shrub understory
	Wood thrush	Mature, moist forest with closed canopy
	Northern mockingbird	Thickets of savanna or very open woodland
	White-eyed vireo	Woodland edge brushy habitat
	Bell's vireo	Thickets in savanna/grasslands
	Blue-winged warbler	Overgrown brushy areas in forest clearings
	Cerulean warbler	Large, mature, unfragmented forest
	Black-and-white warbler	Large, mature, unfragmented forest
	Prothonotary warbler	Swampy, mature riparian forest
	Worm-eating warbler	Large, unfragmented forests w/ shrub understory
	Louisiana waterthrush	Large, mature forests with permanent streams
	Kentucky warbler	Riparian ravine areas within forest understory
	Hooded warbler	Large, mature, unfragmented forest
	Yellow-breasted chat	Early successional woodland
	Eastern towhee	Brushy, wooded edges of woodland
	Field sparrow	Brushy successional habitat
Migratory birds	Golden-winged warbler	Woodland openings with brush and grass
	Canada warbler	Mature forest with shrubby undergrowth
	Rusty blackbird	Shrubby wetlands
Mammals	Evening bat	Forest, riparian areas
	Indiana bat	Forest, riparian areas
	Northern myotis	Forest
	Woodland vole	Forest
	Bobcat	Forest, woodland, grassland
Butterflies	Pepper and salt skipper	Woodland edges
	Pipevine swallowtail	Forest, open fields, and roadsides
	Dreamy duskywing	Woodland openings or edges
	Olympia marble	Open woodlands
	Zabulon skipper	Brushy openings
	Edward's hairstreak	Forest edge or clearings
	Striped hairstreak	Forest openings and edges

Group	Common Name	Preferred Habitat (From Tables 14 & 15 in Iowa Wildlife Action Plan)
Reptiles & Amphibians	Central newt	Well vegetated woodland pools
	Smooth green snake	Open shrubland
	Bullsnake	Deciduous woodland edge

Technical Description of Timber Harvest Systems

(Adapted From US Forest Service Central Hardwood Notes 2.07-5)

Shelterwood Harvests

The shelterwood system is used to encourage natural regeneration of desirable species before a stand is clearcut. It has the potential to reproduce heavy seeded, shade-intolerant species such as oaks. However, this method has not consistently yielded good results and is still under study.

This method involves removing trees in two or more cuttings within a period of about 20 years. In a mixed hardwood stand, 20 to 30 percent of the basal area is generally removed from the overstory in the first cut along with all of the undesirable trees in the mid- and understory. The worst trees are removed first while the best trees are left in the woods to provide a seed source for natural regeneration. Once desirable reproduction is well established, the remaining overstory trees can be removed in one final cut and a new stand begins growing.

Clearcut Harvests

Clearcutting is a silvicultural practice done in mature and overmature stands where tree growth rates are slowing down or disease is present, and the current stand needs to be replaced with a new vigorous stand. It may also be done in stands that are so badly degraded that no desirable growing stock exists, and there is a need to start over. Normally all trees 1.0 inches diameter and above are felled to permit full access to sunlight for all seedlings on the ground.

Clearcutting is done for tree species that are shade-intolerant, meaning they require full sunlight for regeneration. There is no optimum stand size for clearcuts, but a minimum of about ½-acre is needed to establish and develop most shade-intolerant species. Both shade-intolerant and shade-tolerant species are reproduced after a clearcut.

If there is no desirable regeneration present in the understory at the time of clearcutting, seedlings are planted immediately prior to or after the harvest. A high density of seedlings is needed to offset mortality and wildlife depredation.

Where clearcutting is done periodically on a large property, stands of different ages will contribute to diverse habitat and foster a variety of wildlife species. Well-planned clearcuts in a forest provide variety in tree species and wildlife.

Clearcuts are aesthetically displeasing to most peoples' point of view for 5-10 years following the harvest.

FOREST MANAGEMENT SYSTEMS

The Iowa DNR Forestry Bureau uses a classification system for managing large forested tracts on public areas such as state parks, state forests, wildlife management areas, etc. This system helps to establish the "big picture" of long-term management goals and actions that will take place in a forest stand, so that the appropriate short-term actions can be decided upon. Each stand is assigned a unique classification:

Early successional management: This system establishes a very short rotation period in which the entire area is clearcut every 15 years or so and then allowed to grow back naturally. It applies to woodland edges where the goal is to maintain a young, brushy stage of wildlife habitat that provides a soft edge between a mature woodland and field, and also to aspen stands in NE Iowa to maintain high quality grouse habitat. In southern Iowa, it's a useful practice to help quail, woodcock, pheasants, and other wildlife.

There are no stands in Lake Macbride S.P. under this management system.

Even-aged management: Even-aged forests are ones that all began growing at about the same time. In other words, all the dominant canopy trees are the same age. Trees that demand full sunlight to grow well, such as pines, oaks, walnut, aspen, and bottomland species are all best managed using an even-aged system, because it affords them the open light they need and is the most efficient way to regenerate them. Even-aged management practices include crown release thinning in young immature stands, and then eventually, a clearcut to start the process over. The smallest even-aged stand is usually no less than 3 acres; beyond that, it is considered a forest "gap" or "opening".

There are 66 stands for a total of 590 acres under even-age management in Lake Macbride (Figure 11). This includes many stands which are immature and will undergo thinning as well as stands of invasive species that will be cleared and reforested.

Uneven-aged management: This system is used to culture a forest with at least 3 different age classes present throughout the stand continuously. It can involve doing single-tree or small "gap" selection harvests which then fill back in quickly. Thus, it is not an efficient way to manage for shade-intolerant species such as oak, but can be used successfully for tolerant species like hard maple and basswood that tend to accumulate in the understory of mature woodlands on fertile sites. In Lake Macbride, the trees and shrubs that have accumulated in the understory are mostly elm, hackberry, white ash, and invasive species.

No stands are being considered for active uneven-age management at Lake Macbride. All stands that are not being managed as even-aged stands are in fact currently multi-aged stands and will remain that way as natural succession progresses.

Viewshed management: The "viewshed" classification is meant for areas of high visual stature for park users, so as not to distract from the aesthetic and recreational qualities. It can also include environmentally-sensitive sites such as wetlands or fragile slopes. Viewshed designation may also imply that active management of an area is simply not feasible or practical due to location, access, or a limitation of resources. Invasive species control, hazard tree mitigation, salvage harvesting after storms, or other low-impact activities might be necessary from time to time, but otherwise these areas will not be aggressively managed.

There are 36 stands for 343 acres designated as viewshed areas in Lake Macbride. (Figure 10)

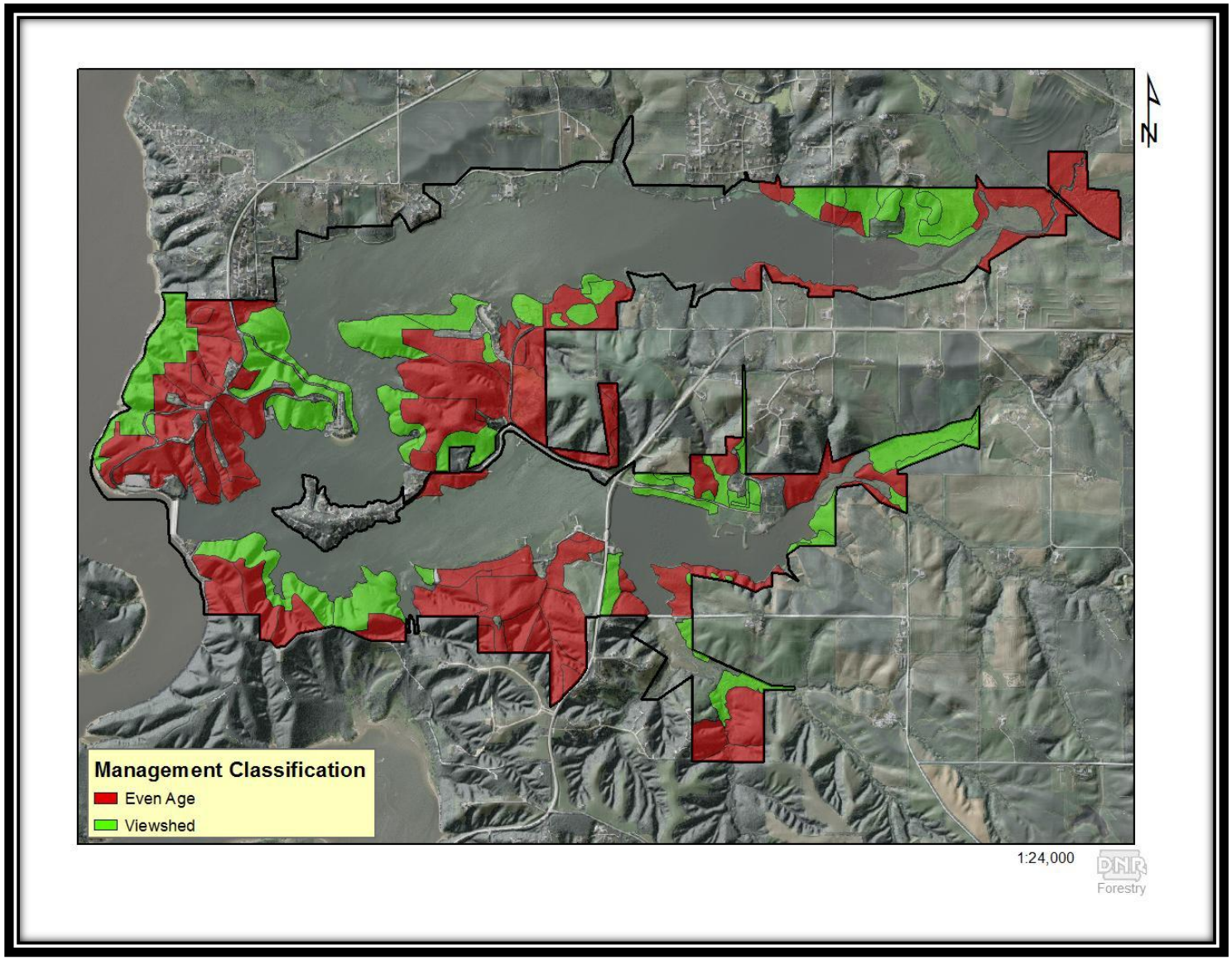


Figure 10. Long term forest management system.

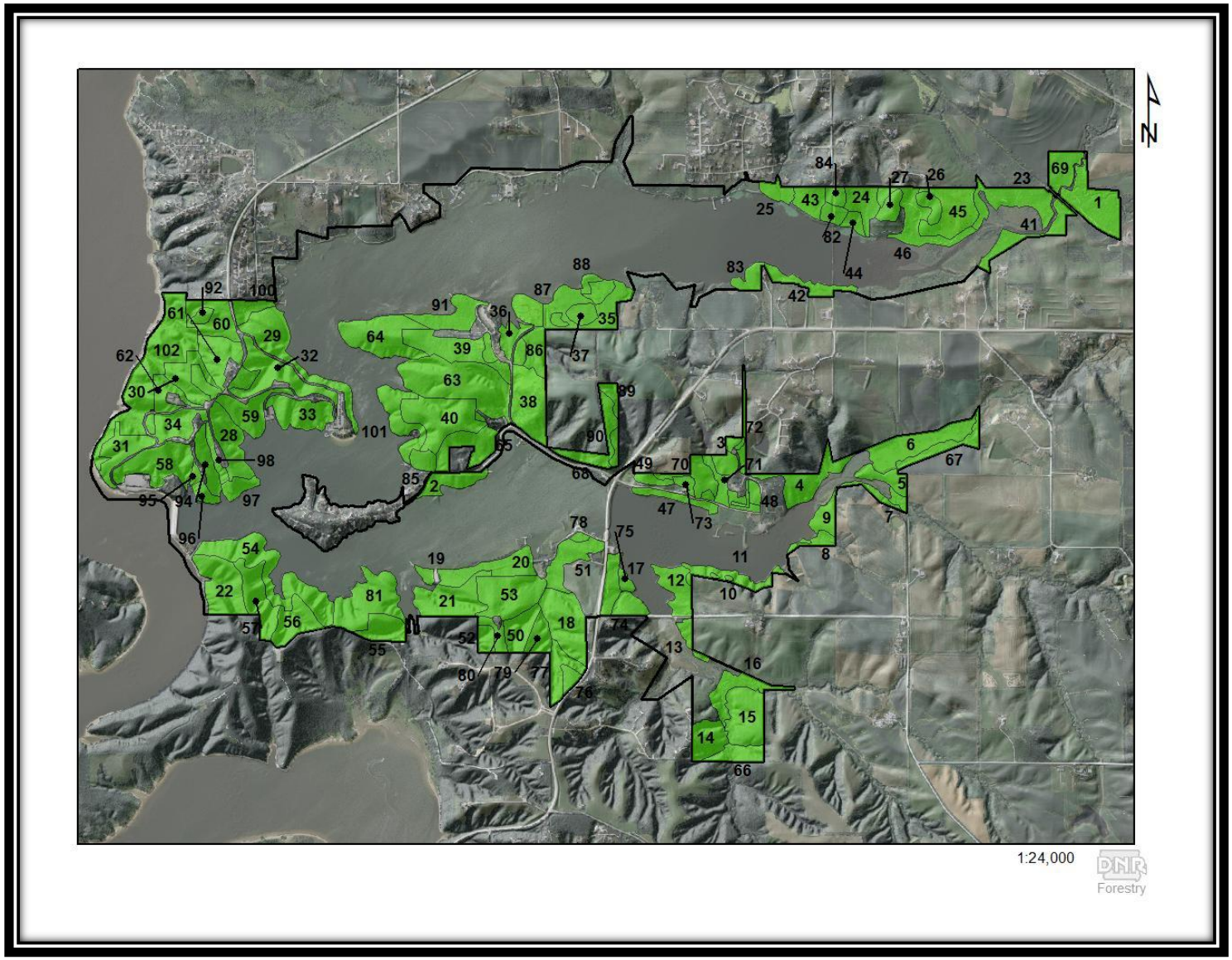


Figure 11. Map of woodland stands in Macbride.

INVENTORY DATA AND PRESCRIPTIONS FOR ALL 102 STANDS

Stand No.	Acres	Overstory Spp.	Understory/Regen.	Size Class	Management	Forest Health	Invasives	Prescriptions
1	17.2	Bottomland Hardwoods, Second Bench	hackberry-elm-black cherry	small sawtimber	Even Age		Honeysuckle	no action
2	7.3	Central Hardwoods	mixed upland hardwoods	small sawtimber	Even Age		Black Locust, Honeysuckle	prescribed fire, weed tree removal
3	1.2	Exotics	exotics	pole timber	Even Age	Invasive Infestation, Low Diversity	Black Locust, Garlic Mustard	stand conversion
4	12.7	Oak-Hickory	elm-bitternut hickory-ironwood	small sawtimber	Even Age	Invasive Infestation	Multiflora Rose, Honeysuckle	prescribed fire, weed tree removal
5	8.2	Oak-Hickory	elm-ash-hackberry	small sawtimber	Even Age	Invasive Infestation,	Honeysuckle, Garlic Mustard	prescribed fire, weed tree removal
6	17.1	Bottomland Hardwoods, First Bench	elm-ash-cottonwood-willow	sapling	Viewshed		Reed Canary Grass	no action
7	1.9	Bottomland Hardwoods, First Bench	hackberry-silver maple-elm-ash	small sawtimber	Viewshed		Reed Canary Grass	no action
8	2.5	Bottomland Hardwoods, First Bench	elm-ash-cottonwood-willow	small sawtimber	Viewshed	Dutch Elm	Reed Canary Grass,	no action
9	5.9	Eastern Red Cedar	nearly absent	sapling	Viewshed	Invasive Infestation	Autumn Olive,	no action
10	6.9	Central Hardwoods	elm-bitternut hickory-ironwood	pole timber	Even Age	Invasive Infestation	Honeysuckle, Oriental Bittersweet	crop tree release, vine removal
11	0.9	Conifers	nearly absent	small sawtimber	Viewshed	Low Diversity		no action

Stand No.	Acres	Overstory Spp.	Understory/Regen.	Size Class	Management	Forest Health	Invasives	Prescriptions
12	9.7	Eastern Red Cedar	nearly absent	sapling	Even Age	Low Diversity		no action
13	3.1	Central Hardwoods	nearly absent	pole timber	Viewshed	Invasive Infestation	Honeysuckle, Autumn Olive	no action
14	9.0	Oak-Hickory	elm-bitternut hickory-ironwood	sawtimber	Even Age	Oak Wilt, Dutch Elm	Garlic Mustard, Honeysuckle	prescribed fire, weed tree removal
15	16.1	Oak-Hickory	elm-bitternut hickory-ironwood	sawtimber	Even Age	Oak Wilt, Dutch Elm	Garlic Mustard, Honeysuckle	prescribed fire, weed tree removal
16	9.0	Bottomland Hardwoods, First Bench	elm-ash-cottonwood-willow	pole timber	Viewshed	Dutch Elm, Invasive Infestation	Reed Canary Grass, Honeysuckle	no action
17	6.6	Central Hardwoods	mixed upland hardwoods	pole timber	Viewshed	Invasive Infestation, Dutch Elm	Honeysuckle, White Mulberry	no action
18	18.3	Central Hardwoods	nearly absent	pole timber	Even Age	Invasive Infestation,	Autumn Olive, Honeysuckle	no action
19	1.8	Oak-Hickory	nearly absent	small sawtimber	Viewshed			no action
20	12.7	Oak-Hickory	hackberry-elm-black cherry	small sawtimber	Even Age	Oak Wilt		prescribed fire, weed tree removal
21	16.3	Central Hardwoods	mixed upland hardwoods	sawtimber	Even Age		Garlic Mustard, Oriental Bittersweet	no action
22	17.1	Oak-Hickory	elm-bitternut hickory-ironwood	sawtimber	Even Age		Barberry	harvest, woodland planting
23	14.6	Central Hardwoods	red cedar-mixed hardwoods	pole timber	Even Age		Honeysuckle, Autumn Olive	crop tree release
24	7.8	Black Walnut	boxelder	small sawtimber	Viewshed		Honeysuckle	no action
25	4.2	Bottomland Hardwoods, Second Bench	boxelder	pole timber	Even Age	Invasive Infestation	Honeysuckle	crop tree release

Stand No.	Acres	Overstory Spp.	Understory/Regen.	Size Class	Management	Forest Health	Invasives	Prescriptions
26	3.8	Conifers	nearly absent	small sawtimber	Viewshed		Honeysuckle	no action
27	4.1	Conifers	nearly absent	small sawtimber	Viewshed	Invasive Infestation	Autumn Olive, Honeysuckle	no action
28	13.0	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Garlic Mustard, Garlic Mustard	prescribed fire, weed tree removal
29	19.3	Oak-Hickory	mixed upland hardwoods	sawtimber	Viewshed	Oak Wilt	Honeysuckle, Autumn Olive	prescribed fire, weed tree removal
30	9.7	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Honeysuckle, Garlic Mustard	prescribed fire, weed tree removal
31	10.6	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Honeysuckle, Garlic Mustard	prescribed fire, weed tree removal
32	16.7	Oak-Hickory	mixed upland hardwoods	sawtimber	Viewshed	Oak Wilt	Honeysuckle, Autumn Olive	prescribed fire, weed tree removal
33	13.4	Oak-Hickory	mixed upland hardwoods	sawtimber	Viewshed	Oak Wilt	Honeysuckle, Autumn Olive	prescribed fire, weed tree removal
34	9.1	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Garlic Mustard, Honeysuckle	prescribed fire, weed tree removal
35	16.8	Exotics	nearly absent	pole timber	Even Age	Invasive Infestation	Black Locust, Autumn Olive	stand conversion
36	6.9	Central Hardwoods	hackberry-elm-black cherry	pole timber	Even Age	Invasive Infestation	Honeysuckle, Autumn Olive	crop tree release, stand conversion
37	7.4	Conifers	hackberry-elm-black cherry	small sawtimber	Viewshed	Low Diversity	Honeysuckle	no action
38	17.2	Central Hardwoods	red cedar-mixed hardwoods	small sawtimber	Even Age	Invasive Infestation	Honeysuckle	no action
39	16.0	Central Hardwoods	nearly absent	pole timber	Even Age	Invasive Infestation	Autumn Olive, Honeysuckle	no action
40	21.5	Oak-Hickory	mixed hardwoods	sawtimber	Even Age	Oak Wilt	Honeysuckle, Barberry	harvest, woodland planting

Stand No.	Acres	Overstory Spp.	Understory/Regen.	Size Class	Management	Forest Health	Invasives	Prescriptions
41	9.1	Central Hardwoods	hackberry-elm-black cherry	pole timber	Even Age	Invasive Infestation	Honeysuckle, Reed Canary Grass	crop tree release
42	6.3	Central Hardwoods	hackberry-elm-black cherry	pole timber	Even Age	Invasive Infestation, Dutch Elm	Honeysuckle, Autumn Olive	no action
43	6.1	Plantation	elm-ash-hackberry	small sawtimber	Viewshed			prescribed fire
44	2.8	Central Hardwoods	mixed hardwoods	pole timber	Even Age	Invasive Infestation	Autumn Olive, Honeysuckle	crop tree release
45	15.8	Eastern Red Cedar	red cedar-mixed hardwoods	pole timber	Viewshed			prescribed fire
46	14.0	Central Hardwoods	boxelder	pole timber	Viewshed	Invasive Infestation	Honeysuckle	no action
47	5.0	Bottomland Hardwoods, First Bench	elm-ash-cottonwood-willow	small sawtimber	Viewshed			native prairie
48	1.9	Plantation	nearly absent	pole timber	Viewshed	Invasive Infestation	Honeysuckle, Siberian Elm	native prairie
49	3.9	Conifers	nearly absent	small sawtimber	Viewshed	Low Diversity, Invasive Infestation	Garlic Mustard, Honeysuckle	no action
50	8.1	Oak-Hickory	basswood-elm	sawtimber	Even Age			prescribed fire
51	10.6	Bottomland Hardwoods, First Bench	nearly absent	pole timber	Even Age	Invasive Infestation	Black Locust, Honeysuckle	no action
52	3.4	Central Hardwoods	mixed upland hardwoods	small sawtimber	Even Age		Oriental Bittersweet, Barberry	no action
53	18.9	Central Hardwoods	nearly absent	pole timber	Even Age	Invasive Infestation	Autumn Olive, Multiflora Rose	no action

Stand No.	Acres	Overstory Spp.	Understory/Regen.	Size Class	Management	Forest Health	Invasives	Prescriptions
54	27.3	Oak-Hickory	mixed hardwoods	small sawtimber	Viewshed	Oak Wilt, Dutch Elm	Barberry	prescribed fire, weed tree removal
55	8.0	Oak-Hickory	mixed hardwoods	sawtimber	Even Age		Barberry	prescribed fire, weed tree removal
56	10.6	Oak-Hickory	elm-bitternut hickory-ironwood	sawtimber	Even Age	Oak Wilt	Oriental Bittersweet, Autumn Olive	prescribed fire, weed tree removal
57	13.1	Oak-Hickory	elm-bitternut hickory-ironwood	sawtimber	Even Age	Dutch Elm	Autumn Olive, Barberry	prescribed fire, weed tree removal
58	17.9	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Honeysuckle, Garlic Mustard	prescribed fire, weed tree removal
59	11.4	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Honeysuckle, Autumn Olive	prescribed fire, weed tree removal
60	10.6	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Garlic Mustard, Oriental Bittersweet	prescribed fire, weed tree removal
61	11.2	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Honeysuckle, Garlic Mustard	prescribed fire, weed tree removal
62	6.5	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Honeysuckle, Garlic Mustard	prescribed fire, weed tree removal
63	34.2	Central Hardwoods	mixed upland hardwoods	pole timber	Even Age	Invasive Infestation, Dutch Elm	Honeysuckle, Autumn Olive	crop tree release
64	20.1	Central Hardwoods	elm-ash-locust	small sawtimber	Viewshed	Dutch Elm	Garlic Mustard, Black Locust	no action
65	11.3	Central Hardwoods	elm-ash-hackberry	pole timber	Viewshed		Black Locust, Barberry	no action
66	6.1	Oak-Hickory	elm-bitternut hickory-ironwood	sawtimber	Even Age	Oak Wilt, Dutch Elm	Garlic Mustard, Honeysuckle	prescribed fire, weed tree removal
67	6.6	Bottomland Hardwoods, First Bench	elm-ash-cottonwood-willow	small sawtimber	Viewshed		Reed Canary Grass	no action

Stand No.	Acres	Overstory Spp.	Understory/Regen.	Size Class	Management	Forest Health	Invasives	Prescriptions
68	8.6	Plantation	nearly absent	pole timber	Even Age	Invasive Infestation	Autumn Olive, Honeysuckle	stand conversion
69	7.8	Central Hardwoods	hackberry-elm-black cherry	pole timber	Even Age	Dutch Elm	Honeysuckle	crop tree release,vine removal
70	9.7	Oak-Hickory	elm-bitternut hickory-ironwood	sawtimber	Even Age	Invasive Infestation	Honeysuckle, Garlic Mustard	prescribed fire, weed tree removal
71	4.0	Central Hardwoods	hackberry-elm-black cherry-bitternut	pole timber	Viewshed		Honeysuckle, Garlic Mustard	no action
72	7.4	Central Hardwoods	nearly absent	sapling	Viewshed	Invasive Infestation	Honeysuckle, Autumn Olive	no action
73	2.0	Oak-Hickory	nearly absent	sawtimber	Viewshed			no action
74	5.0	Oak-Hickory	elm-bitternut hickory-ironwood	sawtimber	Even Age			prescribed fire, weed tree removal
75	1.9	Oak-Hickory	mixed upland hardwoods	pole timber	Even Age		Honeysuckle	crop tree release
76	2.6	Oak-Hickory	mixed upland hardwoods	pole timber	Even Age		Autumn Olive, Autumn Olive	crop tree release
77	7.7	Central Hardwoods	mixed hardwoods	small sawtimber	Even Age			no action
78	1.1	Oak-Hickory	nearly absent	pole timber	Even Age	Invasive Infestation	Garlic Mustard, Honeysuckle	no action
79	5.7	Black Walnut	elm-ash-hackberry	small sawtimber	Even Age		Multiflora Rose	basal area thinning
80	3.3	Central Hardwoods	hackberry-elm-black cherry-bitternut	pole timber	Even Age	Invasive Infestation	Autumn Olive, Multiflora Rose	no action
81	21.0	Central Hardwoods	mixed hardwoods	small sawtimber	Viewshed	Dutch Elm	Barberry	no action
82	3.4	Exotics	elm-ash-hackberry	pole timber	Even Age	Invasive Infestation	Black Locust, Garlic Mustard	stand conversion

Stand No.	Acres	Overstory Spp.	Understory/Regen.	Size Class	Management	Forest Health	Invasives	Prescriptions
83	4.4	Exotics	hackberry-elm-black cherry-bitternut	small sawtimber	Even Age	Invasive Infestation, Dutch Elm	Black Locust, Honeysuckle	stand conversion
84	2.8	Central Hardwoods	hackberry-elm-black cherry-bitternut	sawtimber	Viewshed	Oak Wilt	Garlic Mustard	no action
85	3.8	Central Hardwoods	elm-ash-hackberry	pole timber	Even Age		Black Locust	crop tree release
86	6.7	Oak-Hickory	hackberry-elm-black cherry-bitternut	sawtimber	Even Age			harvest, woodland planting
87	9.3	Central Hardwoods	red cedar-mixed hardwoods	pole timber	Viewshed			prescribed fire, weed tree removal
88	1.9	Oak-Hickory	ironwood	small sawtimber	Viewshed	Invasive Infestation	Autumn Olive, Honeysuckle	prescribed fire, weed tree removal
89	2.5	Oak-Hickory	oak-hickory	small sawtimber	Even Age		Garlic Mustard, Honeysuckle	crop tree release
90	2.0	Oak-Hickory	mixed upland hardwoods	pole timber	Even Age		Garlic Mustard, Honeysuckle	crop tree release, weed tree removal
91	10.5	Bottomland Hardwoods, First Bench	hackberry-elm-black cherry	small sawtimber	Viewshed		Honeysuckle	no action
92	2.0	Central Hardwoods	elm-ash-hackberry	small sawtimber	Even Age		Garlic Mustard, Multiflora Rose	crop tree release
93	3.7	Exotics	other hardwoods	small sawtimber	Even Age	Invasive Infestation	Multiflora Rose, Honeysuckle	stand conversion
94	6.9	Oak-Hickory	nearly absent	small sawtimber	Even Age		Honeysuckle	crop tree release
95	1.5	Oak-Hickory	maple-basswood	sawtimber	Even Age		Garlic Mustard, Honeysuckle	prescribed fire, weed tree removal
96	2.9	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age		Honeysuckle	prescribed fire, weed tree removal

Stand No.	Acres	Overstory Spp.	Understory/Regen.	Size Class	Management	Forest Health	Invasives	Prescriptions
97	4.3	Oak-Hickory	mixed upland hardwoods	sawtimber	Even Age	Oak Wilt	Honeysuckle	crop tree release
98	3.2	Central Hardwoods	mixed upland hardwoods	sawtimber	Even Age		White Mulberry, Honeysuckle	no action
99	3.2	Central Hardwoods	mixed upland hardwoods	small sawtimber	Even Age	Invasive Infestation	Honeysuckle	crop tree release
100	4.6	Central Hardwoods	elm-ash-locust	pole timber	Even Age		Honeysuckle, Multiflora Rose	crop tree release
101	11.8	Oak-Hickory	mixed hardwoods	sawtimber	Viewshed	Oak Wilt	Honeysuckle, Barberry	prescribed fire, weed tree removal
102	38.7	Oak-Hickory	mixed upland hardwoods	sawtimber	Viewshed	Oak Wilt	Honeysuckle, Garlic Mustard	prescribed fire, weed tree removal