Operational Plan

For Management of Sand Dunes State Forest 2013-2022

REPLACES: Appendix C of the Anoka Sand Plains Subsection Forest Resource Management Plan, "Operational Plan for Management of Sand Dunes State Forest, Sherburne County, Minnesota"; Released Feb. 4, 2013

Minnesota Department of Natural Resources

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Dear Reader,

Thank you for taking the time to read and understand this Sand Dunes State Forest Operational Plan.

The Sand Dunes State Forest is a very important unit within Minnesota's State Forest System. There are many valuable and unique natural resources within the Sand Dunes, including valuable timber, abundant wildlife, regionally important recreational trails, and nationally important ecological features and rare species.

This plan builds on an earlier operational plan, and it is the result of many hours of conversation with neighbors, local governments, statewide interest groups, and natural resource managers. Those discussions have enhanced our understanding of stakeholder perspectives and helped us identify new opportunities to meet and balance multiple management objectives. The actions outlined in this plan will guide DNR's management of the Sand Dunes State Forest for the next five years.

We are committed to meeting annually with neighbors and other interested stakeholders to discuss our progress with implementing the plan. We look forward to our continuing collaboration with you and other members of the public.

If you have any questions about the operational plan, I encourage you to contact our Area Forester for the Sand Dunes State Forest, who is located in our Little Falls Office (320-616-2450).

Thanks again for your commitment to helping us manage Minnesota's outstanding natural resources.

Yours truly,

Tom Landwehr

Commissioner, Minnesota Department of Natural Resources

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Executive Summary

Sand Dunes State Forest (SDSF) contains a diverse mosaic of ecosystems that provide habitat for rare plants and animals, high-quality recreational opportunities for Minnesota residents and visitors, and valuable timber products that help fuel Minnesota's economy and fund K-12 education. The Minnesota Department of Natural Resources (DNR) manages SDSF for all of these values. This plan provides a framework for managing SDSF between the years 2013 and 2022. It is an update to the operational plan that was released February 4th, 2013.

The purpose of this operational plan is to:

1. Refine the goals of the Anoka Sand Plain Subsection Forest Resource Management Plan to fit the unique circumstances and landscape within SDSF
2. Guide DNR staff decision-making during implementation of natural resources management in SDSF
3. Inform the public about the DNR's management goals for SDSF

This plan contains three sections: Section I provides context for SDSF and a summary of the process used to develop this plan; Section II provides a detailed action plan for vegetation management, recreation, Permanent School Trust Land, and forest roads in SDSF for the 2013-2022 period; Section III discusses general operational considerations for the implementation of this plan, including health and safety, native plant community information, climate change, communication with the public, and inter-agency cooperation.

Section I: Development of the Operational Plan

An operational plan for SDSF was initially released in February 2013 as an appendix to the 2013-2022 Anoka Sand Plain Subsection Forest Resource Management Plan (SFRMP). The plan laid out 10-year and 50-year timeframes for implementing vegetation management in SDSF, dividing the State Forest into multiple zones.

After the plan was published, public concern developed over various aspects of the plan. In fulfillment of the plan's direction to continue public outreach efforts, DNR developed communication materials and held a public meeting about the plan in February 2016. Then during the 2016 legislative session, the legislature requested a report from the DNR on its progress in collaborating with citizens on managing SDSF, and also put a one-year moratorium on most timber harvesting activities in the Sand Dunes. In response, DNR launched a new, more intensive public engagement process in the summer of 2016 to discuss the management of the SDSF with interested stakeholders.

Stakeholders presented a variety of diverse viewpoints about the plan, and their concerns and preferences for management of SDSF. Particular areas of interest included land cover/vegetation choices for SDSF, and how various vegetation choices would impact wildlife and biodiversity; timber harvest techniques used in SDSF; impacts of management choices to personal/public enjoyment of SDSF; health and safety impacts of management; and issues concerning Permanent School Trust Lands.

Key Changes from the 2013 Operational Plan

As a result of this collaborative process, DNR is now replacing the 2013 plan with this revised edition. The 2017 operational plan retains the vision for SDSF as a healthy and diverse ecosystem while shortening the planning horizon to allow for more flexible response to change; expanding the plan's scope to include direction for recreation, Permanent School Trust lands, and forest roads; and responding to some specific concerns raised by stakeholders. This response includes the following actions:

1. Collaborate with adjacent landowners to address buffer requests and aesthetic concerns along the shared boundary, prior to future timber sales.
2. Retain the pine trees within the campsites of the Ann Lake Campground except when removal is necessary to maintain public safety or for forest health.
3. Communicate with local residents and local government about upcoming planned timber sales, timber harvests, prescribed burns, restoration projects, and changes to School Trust land status.
4. Continue to engage stakeholders with informational meetings, educational field trips, GovDelivery email messages, and specific SDSF web resources.
5. Work with the Orrock Town Board to resolve the township roads located on state land that do not currently have easements.
6. Use science-based adaptive management tools to inform decisions on restoring, protecting, and managing rare plants and wildlife (e.g., mechanical treatments vs. herbicide application, smaller rotation-age harvests).

2017 Legislation

This revised plan is also in compliance with 2017 Minn. Law Ch. 93, Sec. 155 which specifies, in summary:

- DNR will not convert additional land in SDSF to oak savanna or convert oak savanna to non-forest land during the life of the legislation (two years).
- Any prairie seed used for restoration in SDSF much be native species local to Sherburne or Benton County.
- DNR will comply with Minnesota Forest Resource Council guidelines for aesthetics when harvesting timber in SDSF near residential areas.
- DNR will notify local residents of upcoming prescribed burns in SDSF through a variety of mediums at least 40 days before a burn.
- DNR will provide an easement to Orrock township for any non-township-owned parts of 233rd Avenue.
- The legislation does not impact DNR's ability to manage School Trust Lands in SDSF for long-term economic return.
- The legislation sunsets two years from its enactment.

Section II: Ten-Year Action Plan

The Ten-Year Action Plan contains an overview of DNR's planned activities in SDSF's 5,732 acres for the duration of the 2013-2022 planning horizon. The action plan focuses largely on planned activities for 2017-2022, rather than activities that were completed between 2013 and 2017. This plan also does not

cover the specific management actions scheduled for the Uncas Dunes Scientific and Natural Area (676 of the 5,732 acres), which is managed through its own planning process.

Below are key points from each section of the action plan.

Vegetation Management Action Plan (2017-2022):

- SDSF has valuable timber resources in its red pine, white pine, and oak woodlands that will be managed, thinned, and harvested according to best management practices, including those described in the Minnesota Forest Resources Council Forest Management Guidelines (MFRC 2012).
- SDSF has very important high conservation value forests that will be managed to support rare plants, animals, and natural features. DNR will evaluate the effectiveness of its habitat enhancement activities.
- Invasive species are very prevalent in SDSF and controlling them will enhance habitat for a wide range of plants and animals, and improve forest health.
- 1,520 acres are proposed for commercial harvest through thinning, pending assessment.
- 679 acres are proposed for final harvest at rotation age, pending assessment.
- 336 acres are proposed for management for habitat enhancement using burning, invasive species control, and seeding.
- 73 acres are scheduled to be managed for habitat enhancement using selective tree removal
- Additional acres may be managed to control invasive species using mechanical treatment and herbicide application, pending funding.

Recreation Action Plan (2017-2022):

- SDSF is uniquely positioned between the Twin Cities and the St. Cloud metropolitan areas. As such, SDSF provides regionally important recreational opportunities.
- 29 miles of designated trails (18 equestrian and 11 multi-use) will be maintained.
- DNR will explore how to connect North Unit and South Unit trail networks.
- Pine trees in the Ann Lake Campground will be maintained unless they pose a safety or disease risk.
- SDSF will support continuing hunting and fishing opportunities.
- SDSF will provide opportunities for visitors to view wildlife and experience native ecosystems and rare natural features.

Permanent School Trust Lands Action Plan (2017-2022):

- There are no current plans to change the School Trust status of any parcels in SDSF.
- If plans to change the status arise during this planning cycle, the DNR will notify local landowners and other interested stakeholders. The DNR also will hold public informational meetings on any proposed School Trust land status change.
- Any revenues generated on School Trust lands (e.g., through timber harvest, camp fees) will be deposited in the Permanent School Fund as required by law.

Forest Roads Action Plan (2017-2022):

- 8 miles of system forest roads will be maintained in SDSF.
- Approximately 45 miles of temporary access roads will be maintained in SDSF.

- DNR will continue to work with Orrock Township to resolve the issue of township roads on state lands that do not currently have easements.
- DNR will explore routes that minimize heavy truck impacts on township roads.

Section III: Operational Considerations

In response to stakeholder concerns, this revised plan contains more detailed information and guidelines for topics including health and safety considerations related to prescribed burns and herbicide use, climate change impacts and adaptation considerations, and communication strategies for engaging the public throughout implementation of the operational plan. Section III also includes context for the native plant communities in SDSF with descriptions of oak woodland and savannah communities, and an explanation of the specific roles that various DNR Divisions will play throughout implementation of the SDSF operational plan.

I. Development of the Operational Plan

A. Reason for the operational plan

1. Purpose Statement

The purpose of this operational plan is to:

1. Refine the goals of the Anoka Sand Plain Subsection Forest Resource Management Plan (SFRMP) (MN DNR 2012; Appendix A) to fit the unique circumstances and landscape within Sand Dunes State Forest
2. Guide DNR staff decision-making during implementation of natural resources management in Sand Dunes State Forest
3. Inform the public about the DNR's management goals for Sand Dunes State Forest

2. Social and ecological context

Located within Orrock Township in central Sherburne County, Sand Dunes State Forest (SDSF) is approximately three miles west of Zimmerman and 5 miles north of Big Lake. The forest can be reached by taking Sherburne County Highway 5 north from Highway 10 in Big Lake, or by following Sherburne County Highway 4 west from Highway 169. Currently, over 24,000 residents live within a five-mile radius of SDSF and the population is growing as surrounding areas continue to be developed for residential use throughout the Highway 10 and Highway 169 corridors (Map 11). Much of the surrounding landscape is in private ownership and represents a mix of agricultural uses and fragmented private forest. The 30,000-acre Sherburne National Wildlife Refuge is located mainly to the north of SDSF.

SDSF has a statutory boundary of 11,040-acres and sits within the Anoka Sand Plain ecological subsection of central Minnesota. Within SDSF's statutory boundaries, 5,732 acres is owned by the State of Minnesota and is managed by the Minnesota Department of Natural Resources. Minnesota's 59 state forests were established to produce timber and other forest products, provide outdoor recreation, protect watersheds, and perpetuate rare and distinctive species of native flora and fauna. Pines and small amounts of spruce were planted in the state forest starting in the 1940s to stabilize the shifting dunes during time of drought, and planting has continued since that time to supply timber to economic markets. To date, over 2,400 acres of tree plantations have been established in SDSF, the majority of which are pine (Map 17, Map 18). These high-quality pine plantations are located on dry, sandy soils that allow for summer harvest in some locations, with minimal impact to the soil; this is valuable because many places in the state can only be harvested in the winter once the ground is frozen hard. SDSF also contains several woodland, savanna, and grassland communities. In SDSF, as in all state forests, the DNR applies multiple-use management principles to meet the needs of Minnesota citizens.

SDSF is a unique state forest with something for everyone, including 29 miles of maintained trails that provide opportunities for hiking, cross-country skiing, mountain biking, horseback riding and snowmobiling. The 353-acre Bob Dunn Recreation Area, nestled within the forest, holds the 40-unit Ann Lake Campground and Day-Use area and the 15-unit Sand Dunes Horse Camp, a popular destination on summer weekends. The recreation area also provides access to 183-acre Ann Lake and its public beach. The 676-acre Uncas Dunes Scientific and Natural Area offers ample opportunity for viewing and photographing many native plant, bird, and wildlife species.

SDSF contains a number of rare geologically and ecologically significant features (MN DNR 2009a). Sand dune formations are rare in Minnesota, and the dune fields found on the Anoka Sand Plain are the largest and best-formed dunes remaining in the state. The dune formations within SDSF (Map 12) support a diverse array of native plant communities as well as a number of rare plant and animal species. There are four globally imperiled native plant communities within the SDSF boundaries, five sites ranked by the Minnesota Biological Survey (MBS) as having outstanding biodiversity significance, and six MBS sites ranked as having high biodiversity significance. The Dry Oak Barrens Savanna native plant community is considered the most imperiled native plant community in the Midwest United States, occupying approximately 0.02% of its pre-European settlement extent. To date, nine state-listed species of plants and twenty-five state-listed species of animals have been documented in SDSF, and these species depend upon the mosaic of unique habitats that occur there (Appendix B). Minnesota's Wildlife Action Plan 2015-2025 also identifies SDSF as a hotspot for populations of Species in Greatest Conservation Need (SGCN) (MN DNR 2016).

Because of the rare and distinct ecological and geological features that occur within SDSF, key areas will be restored and managed for rare plant and animal species and the native plant communities on which they depend, including oak savanna, oak woodland, tamarack swamp, emergent marsh, and sedge meadow. At the same time, commercial timber harvest and recreational uses will be maintained and the perspectives of nearby residents and other stakeholders will be carefully considered. SDSF is designated as a Special Management Unit within the Anoka Sand Plain SFRMP. The following operational plan describes how DNR will work to implement its goals of multiple-use management, and will serve as a document to guide future management activities in SDSF as outlined in the SFRMP.

B. Public engagement during operational plan development

1. 2013 Initial Planning Process

In February 2013, an operational plan for management of SDSF was released as an appendix to the Anoka Sand Plain SFRMP, following a 30-day public review. The operational plan was created to provide direction to field managers when developing site-specific management. Neighboring landowners to SDSF were sent a letter in September 2014 to inform them that the plan had been completed (Appendix C).

After the plan was published, public concern developed over various aspects of the plan. These concerns ranged from issues such as overall land cover management direction, including proposed restoration and tree harvests, to more site-specific issues such as forest management techniques used on sites adjacent to private property. In fulfillment of the plan's direction to continue development of public outreach efforts, DNR developed communication materials and held a public meeting about the plan in February 2016. Then during the 2016 legislative session, the legislature requested a report from the DNR on its progress in collaborating with citizens on managing the SDSF, and also put a one-year moratorium on most timber harvesting activities in the Sand Dunes (MN Session Law Ch. 189 Sec. 47). In response, DNR launched a new, more intensive public engagement process in the summer of 2016 to discuss the management of SDSF and collect feedback from local and statewide interests on their issues related to SDSF.

2. 2017 Plan Revision

a. Public engagement and the Stakeholder Advisory Group

The DNR organized a Stakeholder Advisory Group that represented a range of local and statewide interests and perspectives related to the operational plan for SDSF. There were six Stakeholder Advisory Group meetings between June and December 2016. All meetings were open to the public, and audience members were invited to participate and provide verbal and written feedback during meetings as well. Based on feedback from stakeholders, meeting topics included: tree and timber management; recreation; wildlife and native plant community management; School Trust Land management; and forest road-related issues.

b. Results of collaboration

DNR collected feedback and provided responses to questions and suggestions throughout the process. While stakeholders expressed a wide range of concerns and interests related to the 2013 operational plan, major areas of concern and/or contention can be summarized as:

- Land cover (i.e., vegetation) decisions and impacts to environment/biodiversity
- Timber harvest techniques
- Impacts to public/personal enjoyment
- Health and safety concerns
- Short- and long-term fate of Permanent School Trust lands

These issues are addressed in greater detail in this operational plan revision. In response to these issues, DNR will be moving forward with the following commitments in SDSF:

1. Collaborate with adjacent landowners to address buffer requests and aesthetic concerns along the shared boundary, prior to future timber sales.
2. Retain the pine trees within the campsites of the Ann Lake Campground except when removal is necessary to maintain public safety or for forest health.
3. Communicate with local residents and local government about upcoming planned timber sales, timber harvests, prescribed burns, restoration projects, and changes to School Trust land status.
4. Continue to engage stakeholders with informational meetings, educational field trips, GovDelivery email messages, and specific SDSF web resources.
5. Work with the Orrock Town Board to resolve the township roads located on state land that do not currently have easements.
6. Use science-based adaptive management tools to inform decisions on restoring, protecting, and managing rare plants and wildlife (e.g., mechanical treatments vs. herbicide application, smaller rotation-age harvests).

Additionally, this revised plan differs in scope and timeline from the 2013 version. The original plan contained little information about recreational management and roads, as little change was expected to the current management regarding these issues. However, at the request of stakeholders the revised plan contains more information about recreation and roads, as well as other topics of interest such as School Trust Land, climate change, and pesticide use in SDSF.

The original plan divided SDSF into ‘zones’ and described 10- and 50-year strategies for managing SDSF. The revised plan addresses only the 10-year period that corresponds with the Anoka Sand Plain SFRMP,

rather than projecting a 50-year management strategy, and does not divide SDSF into 'zones', as only portions of SDSF are addressed in the shorter timeframe rather than the entire state forest. The original plan described 631 acres of "immediate" rare features management in the 10-year period, and an additional 1,398 acres of "eventual" rare features management over the 50-year time period (excluding Uncas Dunes Scientific and Natural Area). The revised plan focuses on only the most pressing habitat enhancement needs for the remainder of the 2013-2022 time period: 336 acres of maintenance work and 73 acres of selective tree removal (excluding Uncas Dunes). An additional 154 acres will be assessed for potential management needs (see Table 1 of the Vegetation Management Action Plan for more details). These changes will allow DNR to adapt more readily to findings from initial management and to changing circumstances on the landscape.

Further information about the Stakeholder Advisory Group process can be found in the *Sand Dunes State Forest Public Engagement Project* report for the Minnesota State Legislature submitted on January 13, 2017 (MN DNR 2017f).

c. 2017 Legislation

In May 2017, the Minnesota Legislature passed 2017 Minn. Law Ch. 93, Sec. 155, "Sand Dunes State Forest management." This revised plan is in compliance with the new legislation. The legislation states:

> *Subdivision 1. Forest management. When managing the Sand Dunes State Forest, the commissioner of natural resources must:*
>
> *(1) not convert additional land to oak savanna or convert oak savanna to nonforest land unless it is done as a result of a contract entered into before the effective date of this section;*
> *(2) require all prairie seeds planted to be from native species of a local ecotype to Sherburne or Benton County; and*
> *(3) comply with the Minnesota Forest Resources Council's guidelines for aesthetics in residential areas.*
>
> *Subd. 2. Prescribed burns; notification. At least 40 days before conducting a prescribed burn, the commissioner must:*
>
> *(1) publish a notice in a newspaper of general circulation in the area;*
> *(2) notify the county and township in writing; and*
> *(3) notify residents within a quarter mile of the prescribed burn in writing.*
>
> *Subd. 3. School trust lands. Nothing in this section restricts the ability of the commissioner or the school trust lands director from managing school trust lands within the Sand Dunes State Forest for long-term economic return.*
>
> *Subd. 4. Township road. If the commissioner of natural resources finds that any portion of 233rd Avenue within the Sand Dunes State Forest is not owned by the township, the commissioner must convey an easement over and across state-owned lands administered by the commissioner to the township under Minnesota Statutes, section 84.63, for the width of 233rd Avenue.*
>
> *Subd. 5. Sunset. This section expires two years from the day following final enactment.*
>
> *EFFECTIVE DATE. This section is effective the day following final enactment.*

C. Vision for Sand Dunes State Forest

The DNR wants to ensure that SDSF remains a diverse landscape that meets a variety of ecological, social, and economic needs. The future landscape of SDSF will have:

- highly engaged and well-informed neighbors and stakeholders
- a diverse mosaic of habitats that sustainably support a wide variety of plants and animals, especially the rare species and features unique to the area
- healthy forests that are managed to provide a sustainable supply of timber
- ongoing access to high-quality recreational opportunities
- ongoing financial contributions to the Permanent School Trust
- increased resilience to growing pressures – such as climate change, invasive species, and population growth – using adaptive management practices

*White pine (*Pinus strobus*) and bur oak (*Quercus macrocarpa*)*

II. Ten-Year Action Plan

This section contains an overview of the actions DNR will take in Sand Dunes State Forest (SDSF) during the Anoka Sand Plain Subsection Forest Resource Management Plan (SFRMP) planning horizon (2013-2022) to achieve the vision described in Section I, Part C. This includes 10-year action plans for:

- Vegetation Management
- Recreation
- Permanent School Trust Land
- Forest Roads

Note that this 10-year action plan goes into greater detail than the SFRMP (which focuses largely on vegetation/habitat management) by encompassing specific actions for recreation, roads, and School Trust lands. These issues were identified by stakeholders during the SDSF public engagement project. However, this plan is intended to broadly guide resource and management decisions for SDSF; site-specific management will be determined by annual management planning processes, after staff are able to thoroughly assess the sites and coordinate with stakeholders (e.g., annual meetings).

A. Vegetation Management Action Plan

At-A-Glance:

- SDSF has valuable timber resources in its red pine, white pine, and oak woodlands that will be managed, thinned, and harvested according to best management practices, including those described in the Minnesota Forest Resources Council Forest Management Guidelines (MFRC 2005).
- SDSF has very important high conservation value forests that will be managed to support rare plants, animals, and natural features. DNR will evaluate the effectiveness of its habitat enhancement activities.
- Invasive species are very prevalent in SDSF and controlling them will enhance habitat for a wide range of plants and animals, and improve forest health.
- 1,520 acres are proposed for commercial harvest through thinning, pending assessment.
- 679 acres are proposed for final harvest at rotation age, pending assessment.
- 336 acres are proposed for management for habitat enhancement using burning, invasive species control, and seeding.
- 73 acres are scheduled to be managed for habitat enhancement using selective tree removal.
- Additional acres may be managed to control invasive species using mechanical treatment and herbicide application, pending funding.

In Minnesota, the commissioner of the DNR is required by law to manage state forests "according to the principles of multiple use and sustained yield." These principles require DNR to manage forest resources to meet current economic, environmental, and recreational needs, without risking the ability of future generations to do the same. These multiple uses include production of timber and other forest products, providing outdoor recreation, protecting watersheds, providing wildlife habitat, perpetuating rare and distinctive species of native flora and fauna, and contributing funds to the Permanent School Trust.

Minnesota is nationally renowned for exceptional forest management – which is the art and science of managing forest vegetation and uses in ways that have important short and long-term benefits to society. Nearly 5 million acres of DNR-administered land, including SDSF, has been certified as "well-managed" by two third-party certification entities, the Forest Stewardship Council® (FSC) and the Sustainable Forestry Initiative® (SFI), since 2005. In addition to verifying sound forest management, the DNR's FSC and SFI certifications are economically important to Minnesota's forest products industries.

1. High Conservation Value Forest in SDSF

The FSC requires its certificate-holders to identify and map the presence of High Conservation Value Forests (HCVFs) for a variety of critical and globally, regionally, or nationally significant conservation values defined by FSC (FSC 2010). This aligns with DNR's statutory requirement to manage for a broad set of objectives and forest resources (M.S. 89 & M.S. 89A). DNR has identified approximately 262,000 acres of lands to be managed under the HCVF principle. Of those 262,000 acres, 174,000 acres are designated as HCVFs, while the remaining 89,000 acres are on School Trust lands and are not designated, but will be managed consistent with the FSC HCVF Principle unless there is a conflict with the DNR's legal responsibility to secure the maximum long-term economic return from School Trust lands.

Management decisions are made to maintain or enhance the 'high conservation values' in these forests (MN DNR 2015b). In most cases, HCVFs are maintained as working forests. Out of the 5,732 acres of state-owned land in SDSF, 2,055 acres are managed for HCVFs (Map 15) (MN DNR 2017a). Approximately 1,505 acres are designated HCVFs and 550 acres are on School Trust lands. These sites vary greatly in quality, but include many rare species of animals and plants that depend on the unique savanna and barren habitats of SDSF.

HCVFs provide context for vegetation management in SDSF. On HCVF lands, management activities will be tailored to maintain and enhance the natural features and rare resources of these lands. Managers will seek opportunities to foster native trees and other vegetation, enhance habitat for rare species, protect fragile dune structures, and remove non-native species that risk damaging conservation values.

2. Purpose of Vegetation Management in SDSF

a. Importance of Tree Harvest in SDSF

There are several reasons why timber harvest is an important tool for forest management in SDSF. First, timber harvest is the best tool we have to establish and maintain the wide range of forest ages and conditions needed to create diverse wildlife habitat. Some wildlife species depend on young forests, while others need older forests; and some require both. Regular timber harvest ensures that a range of different-aged forest remain on the landscape.

Harvesting trees also supports a valuable forest products industry. This brings jobs and income to communities statewide. The forest products industry is the fifth largest manufacturing sector in Minnesota by employment. Minnesota's forest products industry consistently ranks in the top 10 in the U.S. for contribution to gross state product per capita. SDSF currently has a good supply of valuable red pine and other timber species to contribute to the local forest products economy. These pines are located on dry, sandy soils, meaning they can be harvested in the summer in certain locations with minimal impact to the soil. Many places in Minnesota can only be sustainably harvested in the winter,

when the ground is frozen; so the pines in SDSF are particularly valuable since they provide summer logging work.

The wood that come from SDSF is dual-certified as sustainably managed. Wood from well-managed forests is generally a more environmentally-friendly raw material than options like metal and concrete. Wood is renewable, meaning that more grows in its place after it is used. Trees also pull carbon dioxide (a greenhouse gas) from the air, which can then be stored as carbon in long-lived wood products such as lumber for buildings. From 2012-2016, approximately 9,200 cords of pine were sold from SDSF; 75% of that volume was used for dimensional lumber (e.g., '2x4' boards). The majority of this volume resulted from thinning pine plantations, which gives remaining trees more space to grow and continue to capture carbon.

Managed forests are also at a lower risk for wildfire and attacks from forest pests than are forests that are not actively managed. Harvesting trees helps prevent dead wood from building up in the forest, which is a fire risk. It also helps reduce crowding of trees; crowded trees are at greater risk for both fire and the spread of insects and disease outbreaks. Timber harvests also give DNR an opportunity to remove certain harmful invasive woody plants. Overall, managing forests in this way helps to keep them healthy.

Finally, state law requires DNR to manage state forests for revenue production. Income from timber harvest on School Trust Lands is constitutionally dedicated to earn income for the Permanent School Trust. Timber harvest provides a revenue stream that allows DNR to keep forests on the landscape, instead of losing forests to other potential land uses such as agriculture or residential development. Forests provide a wide variety of important ecosystem services, such as clean air, healthy soils and reduced soil erosion, and healthy watersheds. Forests also provide a wide variety of recreational opportunities for Minnesotans during the decades between harvests. Timber harvest in SDSF helps DNR continue to provide these important services.

b. Importance of protecting rare species and habitat in SDSF

SDSF is part of the Anoka Sand Plain ecological subsection, a landscape characterized by broad, mostly flat outwash sands and numerous wetlands. Over 5,000 years ago the sand was shaped into dunes in a few places on the Anoka Sand Plain (Keen and Shane 1990). Many of these dunes have been destroyed by reshaping and disturbance associated with housing development. The remaining dunes support a rich array of native plant communities, some of which are sand specialists that depend on the unique features of the dune systems. The largest remaining area of intact dunes on the entire Anoka Sand Plain are found in SDSF.

With its unique sand dunes geology and ecology, SDSF serves as an oasis of global significance for a variety of rare plants and animals. Nine state-listed rare plant species have been documented in SDSF, including four state threatened species and five state special concern species. Twenty-five state-listed rare animals have been documented in SDSF, including three state-listed endangered species, two state-listed threatened species, and eight state-listed species of special concern (Appendix B).

The Dry Barrens Oak Savanna (Southern) is one of the most rare plant communities in the state, as most oak savannas have been converted to agricultural or development uses, or have succeeded to oak forest in the absence of natural disturbance. Oak savanna has a rarity rank of G2, meaning it is imperiled across its entire global range; today this plant community occupies only about 0.02% of its pre-European

settlement extent (Nuzzo, 1986). Open dry oak savanna or prairie habitats in SDSF support six state-listed rare plant species and fifteen state-listed rare animal species. Oak woodlands are more prevalent than savannas, but even they have been greatly reduced from their original extent (Wovcha et al 1995). High quality examples of these communities are rare in the present-day Anoka Sand Plain subsection. Oak woodlands and associated wetlands provide habitat for red-shouldered hawks *(Buteo lineatus)*, a state-listed species of special concern. In addition, diverse wetland communities occur here that support a state-listed threatened plant species *(Viola lanceolata)* and provide habitat for the state- listed threatened Blanding's turtle *(Emydoidea blandingii)*.

Pines and other evergreen conifers, including white pine, Norway (red) pine, jack pine, and spruce, have been planted throughout the dunes in SDSF since the 1930s, originally for the purpose of stabilizing the shifting dunes during a time of prolonged drought across the Great Plains. "Though white pine was found elsewhere in the Anoka Sand Plain, we do not have evidence that these conifers occurred naturally in the SDSF dune communities prior to European Settlement (Map 13). Their presence has resulted in conversion of portions of the site to forests that consist of a mix of large oak trees, pines, tall shrubs, and understory plants adapted to shady environments. Pine plantations have had a major impact on the upland dune native plant communities in SDSF (which include Southern Dry-Mesic Oak (Maple) Woodland, Dry Barrens Oak Savanna (Southern), Dry Barrens Prairie (Southern), and Southern Mesic Prairie) (MN DNR 1995). In some cases, pines have formed dense plantations that have displaced oak savanna vegetation, and in other cases, the pines are interspersed with oak savanna vegetation. There are still excellent examples of native plant communities occurring throughout the state forest in places where pines have failed or have not been planted.

During the writing of this operational plan, federally endangered rusty-patched bumblebees (*Bombus affinis*) were found within SDSF along with several other new occurrences of species of conservation concern. Management of the state forest will adapt as needed, over time, to new significant discoveries like this. Managers of the SDSF will coordinate with the US Fish and Wildlife Service as needed when federally listed species are found. The annual stand review process considers all rare features during management planning.

Species profiles (see the Rare Species Guide for more information - MN DNR 2017e)

Plains Hog-nosed Snake (*Heterodon nasicus*)

Plains hog-nosed snakes are found in sparsely vegetated habitats like the dry prairie and oak savannas in SDSF. They also use the wetlands in SDSF for hunting grounds. Plains hog-nosed snakes are well adapted for SDSF's sandy habitat, as they have sharply upturned snouts that they use to dig into the sand to create burrows or escape predators. Plains-hognose snakes have unique defense mechanisms. They may flatten their head and look like a cobra when threatened. They may also feign death by writhing around, rolling onto their back, and remaining motionless with their mouth open and tongue hanging out. They will lift their head occasionally to see if the threat has passed, if it is still there they will pretend they are dead again, if not they will turn over and slither away. The major threat to this species is habitat loss.

Plains Pocket Mouse (*Perognathus flavescens*)

The Plains Pocket Mouse gets its name because it has fur-lined pockets on its cheeks. They use these pockets to store food, usually seeds. This species lives in areas of sparsely vegetated, sandy habitats like the dry prairie and oak savannas in SDSF. This species was once fairly common in the dune-sand region of Sherburne County, but habitat loss has led to this species decline. Human intervention, such as prescribed fire, is necessary to prevent their open habitats from becoming over-grown, as meadow voles may outcompete them by moving into the denser habitat.

3. Vegetation Management Techniques Used in Sand Dunes State Forest

Choice of vegetation management techniques are driven by:

- Objectives or goals for the management such as providing wildlife habitat, improving the health of the land, providing recreational opportunities, and income generation/provision of raw materials.
- The type of vegetation that is on the land (or the desired vegetation) and its need for light, moisture, and nutrients.
- The ecology of the site; factors such as climate, soils, and topography impact which type of vegetation is a good "fit" for a particular site, and which is not.

a. Timber Harvest

Commercial timber harvest is a common technique used to remove mature and/or less-desirable trees to make more room for remaining or young regenerating trees. Timber is sold on the open market to the highest bidder; all permit contracts require compliance with DNR's harvest practices. DNR foresters oversee permits during the harvest to ensure that the work is done as directed. Funds received from timber harvest on state land help pay for future forest management as well as K-12 education via the Permanent School Trust.

Thinning

Thinning is the selective removal of trees, primarily undertaken to improve the growth rate or health of the remaining trees. Thinning is often used in pine plantation stands, and can also be used in hardwood stands such as oak. Most often in SDSF, the first red pine plantation thinning occurs around age 25 for the stand, when the trees first become "commercial," meaning they can be sold to cover the costs of the harvest. Thinning can be repeated every 10 to 15 years or so until the trees reach their rotation age and a final regeneration harvest is desired. Thinning cannot be used to regenerate tree species that require almost full sunlight, such as red pine and oak.

Red pine plantation; source: myminnesotawoods.com

Rotation-age Harvest

Rotation-age harvests occur at a stand's rotation age – which is the age that the stand will bring peak commercial value. It is the most economically efficient means of harvesting trees and delivers the highest rate of return. During a rotation-age harvest on state land, some trees are almost always left somewhere on site as "reserve" trees for habitat, aesthetics, or natural re-seeding. Rotation-age harvest has the biggest immediate visual impact, but also reduces the total number of logging entries over a period of time, thus reducing risk of invasive plant introduction and movement, as well as disruption of native species. Further, rotation-age harvests create blocks of different-aged forests; some wildlife species need young forest, some need older forest, and some require a mix. Finally, some rotation-age harvests will be needed to achieve restoration goals and desired future conditions outlined in the SDSF operational plan. For these reasons, total exclusion of rotation-age harvests would not be desirable or practical in SDSF.

b. Reforestation

All areas designated to continue in forest cover are reforested with tree species that are appropriate for the site and provide a variety of benefits such as habitat, aesthetics, and revenue. This usually takes place within one or two years after a timber harvest. However, reforestation may also occur after a storm, disease, or some other event has damaged a stand, or in some cases in advance of a harvest to allow establishment of the next generation (shade-tolerant species only). DNR uses direct seeding and planted seedlings to reforest SDSF, in addition to the trees that grow back naturally.

As pine plantations in SDSF are thinned to improve timber production, hardwoods will be allowed to naturally seed into understory openings. When these stands reach final harvest stage, hardwoods will be

harvested also and allowed to regenerate along with pine. In stands where oak is predominant, pines will be encouraged to blend into the stand through artificial planting and natural seeding, where doing so does not conflict with other management goals for SDSF. Diversification of forest stands (at an individual stand and landscape scale) can help increase resilience to threats such as climate change (see Section III, Part C – "Climate Change Considerations) and disease.

It is often necessary to control competing vegetation to allow desirable tree regeneration to grow freely on reforested sites. Similar methods may be used to control competing native vegetation as are used to control invasive vegetation (see next section, Invasive Species Control). These methods are designed to set back, not eliminate, the competing vegetation. Once the trees are taller than the competing vegetation and considered "free to grow," vegetation control ceases. On an average tree planting site in SDSF, there may be 2-4 mechanical treatments or 1-2 herbicide treatments (depending on which method is applied) over a 60-year period.

Red oak seedling

c. Invasive Species Control

Invasive species are plants, animals, and microorganisms that are not native to a particular area and are capable of causing damage. Invasive species can cause significant harm to the economy, environment, or human health once they become established. European buckthorn, Amur maple, and fungi that cause Dutch elm disease and oak wilt are among the most damaging invasive species in SDSF. These and other currently known invasive species in SDSF include:

- Common and glossy buckthorn (*Rhamnus cathartica* and *Frangula alnus* respectively)
- Amur maple (*Acer ginnala*)
- Exotic honeysuckles (*Lonicera tatarica, L. morrowii, L. x bella, L. maackii)*
- Black locust (*Robinia pseudoacacia*)
- Canada thistle (*Cirsium arvense*)
- Cow vetch (*Vicia cracca*)
- Hoary alyssum (*Berteroa incana*)
- Leafy spurge (*Euphorbia esula*)

- Norway maple (*Acer platanoides*)
- Perennial sow thistle (*Sonchus arvensis*)
- Siberian elm (*Ulmus pumila*)
- Siberian peashrub (*Caragana arborescens*)
- Spotted knapweed (*Centaurea stoebe spp. micranthos*)
- White sweet clover (*Melitotus alba*)
- Two fungal diseases:
    - Dutch elm disease (caused by the *Ophiostoma novo-ulmi*)
    - Oak wilt (caused by *Ceratocystis fagacearum*)

Historically, invasive species were not as prevalent in these habitat communities. However, introductions of invasive species thrive when conditions are suitable for their growth, natural predators are lacking, and historical disturbances are absent. Successful invasive species control requires an integrated pest management approach. This may include the use of one or a combination of the following methods:

- Herbicide treatments
- Mechanical treatments
- Cultural treatments
- Biological control treatments

Treatment options are evaluated for each management scenario based on their availability, efficacy, cost, environmental persistence, and site characteristics, including context of the neighboring landscape.

Herbicide treatments

Herbicides treatments are utilized because they are an important tool for successful habitat restoration and maintenance. Mechanical and prescribed burning treatments alone may not achieve the desired outcomes without follow-up applications of herbicide, often through spot treatments with direct targeting of invasive species. The MN DNR has a responsibility to manage invasive species on SDSF under Operational Order 113 (MN DNR 2007). Avoiding herbicide use can lead to much more expensive treatments and loss of initial restoration investment. Herbicide application is often a cost-effective means to control undesirable species (e.g., invasive woody plants in an oak savanna or oak woodland). All herbicides used in SDSF are approved by DNR's third-party certifiers (i.e., FSC and SFI) and DNR follows herbicide label instructions for environmental and human safety..

Multiple stems sprout from this common buckthorn plant after it has been cut (no herbicide application).
Source: http://ipaw.org/TheSolution/Control/UsingHerbicides.aspx

More information about DNR's use of herbicides in SDSF can be found in Section III, Part A (Health and Safety Considerations) and Appendix D (List of Herbicides Used in SDSF).

Mechanical treatments

Mechanical treatments include:

- Mowing
- Vibratory plow
- Rotation-age timber harvest
- Timber thinning
- Cut stump
    - Used alone could require multiple entries depending on the target species being managed.
        - Eastern redcedar = one treatment
        - Common and glossy buckthorn = multiple treatments
- Prescribed burning

Cultural treatments

Cultural Treatments to reduce the spread of invasive species include:

- Boot brushes for removing dirt, seeds, etc.
- Public information campaigns (e.g. "Come Clean, Leave Clean" and "Play, Clean, Go)

Biological control treatments

Biological controls use natural enemies to control non-native pests, which can be an effective tool in managing invasive plants. Non-native plants can become invasive because they lack the insects and diseases that control them in their native environments. Biological controls reunites natural enemies, such as herbivores and pathogens, with their host (invasive plant) to reduce impacts caused by the pest. The goal of biological control is to reduce the target pest population and its corresponding impact to an acceptable level. Biological control agents are specialized insects or pathogens that were tested extensively to ensure they specifically target a specific non-native invasive plant and produce the desire reduction result without harming native species.

The following successful biological control programs have been implemented statewide (Chandler, Skinner, and Van Riper):

- Leafy spurge
- Spotted knapweed
- Purple loosestrife

Development of new biological controls for buckthorn and others continue to be researched in an effect to discover new tools for controlling invasive species.

d. Habitat enhancement

Habitat enhancement uses a variety of management techniques to establish and maintain native vegetation, including prescribed burns, invasive species management, and selective removal of trees where necessary to restore critical habitat. Section III (Operational Considerations), Part B (Native Plant Communities in SDSF) provides details on the composition of oak savanna and oak woodland native plant communities in SDSF.

Habitat continuity is important for rare animals and other wildlife species. Small, isolated habitat patches will not generally be sufficient to ensure the survival of animals into the future. Corridors for animals to travel from one part of their habitat to another and to disperse to new habitats must be protected and managed appropriately. Protection of intact ecosystems is generally believed to be the most effective way to manage and protect rare features. In the case of SDSF, the natural landscape consists of dunes, and upland continuum of oak savanna to woodland to forest, and a diversity of wetland communities from forested swamps to fens, wet meadows, and marshes. Connectivity in the SDSF between wetlands, upland savanna habitat, and the St. Francis River is important for Blanding's turtles and other native turtles.

Protecting rare features requires mimicking their natural history. Historically, regular fires were an important process in oak savannas and associated communities. The natural history of SDSF fire-dependent communities indicates that light surface fires occurred every 10 years on average, and catastrophic fires occurred every 110 years on average. Fire intensities depended on fire frequency and the amount of fuel accumulated between fires. Information on prescribed fire safety procedures can be found in Section III, Part D (Health and Safety Considerations).

However, some rare species such as creeping juniper and Leonard's skipper may be harmed by intense fires, so it is important to manage fire carefully. The dune topography, wetlands, lakes, and rivers in the area may have resulted in a pattern of frequent, relatively small, low-intensity fires much of the time, with hotter and more expansive fires burning during periods of drought. The shifting of dunes over time in response to wind and climate maintained open sand habitats that protected these species from fires.

Management techniques for restoring oak savanna

On portions of the SDSF being restored to oak savanna, all tree species that are not part of this plant community type will be removed. Tree species native to oak savanna will be retained. These include bur oak, northern pin oak, black cherry, quaking aspen, and eastern redcedar. Eastern redcedar will be thinned to one to three trees per acre, with a focus on retaining larger trees. Bur oak, northern pin oak, black cherry, and quaking aspen will be thinned to meet the age class and density goals for the canopy (10-50% canopy density), with an emphasis on retaining older trees. Where possible, northern pin oak

should be largely removed and bur oak should be retained, as the proportion of northern pin oak to bur oak is currently much higher than what is naturally found in this plant community. Stumps of the hardwood trees for which sprouting is not desirable should be treated with an appropriate herbicide that meets all legal and forest certification requirements. All non-native shrubs will also be removed either by cutting and treating stumps with herbicide or by direct herbicide application. Staging areas will be located in already disturbed sites that do not have rare species populations. Slash should be removed or burned.

Fire is a critical component in restoring and maintaining oak savanna and will be used as a management tool to maintain an open canopy, and may also reduce prevalence of invasive species, particularly through repeated prescribed fires early in the restoration process. Adaptive management techniques will be used to determine whether or not prescribed fire is resulting in desired conditions; techniques will be adjusted accordingly. Fire breaks will be established and maintained to facilitate prescribed burning. These breaks can also be used to access stands for management activities. Burn units will be planned to ensure that animals will have unburned habitat for refugia. Timing of burns may vary depending on specific burn objectives and weather.

Seeding of understory or dune slopes will use locally-harvested plant seed (grasses, sedges, forbs); seed will come from within SDSF whenever possible. Plants that are important to rare animal species include hairy grama grass (*Bouteloua hirsute*), blazing star (*Liatris* spp.), large-flowered beard-tongue (*Penstemon grandiflorus*), round-headed bush clover (*Lespedeza capitata*), and leadplant (*Amorpha canescens*).

Oak savanna pictured at different canopy densities. Oak savanna in SDSF ranges from 10-70% (typically 25-50%) canopy cover.

Management techniques for restoring oak woodland

For portions of the SDSF being restored to oak woodland, a number of different vegetation management activities will be employed including timber harvest, invasive species removal and control, and prescribed burning. All tree species that are not part of this plant community type will be removed and eastern redcedar can be removed if desired, particularly from areas where they may have become dense due to exclusion of fire. All non-native shrubs will be removed either by cutting and treating

stumps with herbicide or by direct herbicide application. Staging areas are to be located in already disturbed sites that do not have rare species populations.

Stands will be evaluated for their potential older forest characteristics. These stands may include woodlands adjacent to wetlands, which presumably were less likely to have historical catastrophic fires compared to stands not adjacent to wetlands; those with non-game wildlife that utilize older forests such as red-shouldered hawks; and those that have diverse, high quality native plant communities. These stands will receive non-native species control and may have longer rotation ages. In other stands, management will focus on oak regeneration to achieve canopy cover goals and to reduce fire-intolerant sub-canopy species such as elm, red maple, ironwood, and green ash.

Fire will be used as a management tool to control invasive species and enhance native species habitat. Adaptive management techniques will be used to determine whether or not prescribed fire is resulting in desired conditions; techniques will be adjusted accordingly. Fire breaks will be established and maintained to facilitate prescribed burning. These breaks can also be used to access stands for management activities. Burn units will be planned to ensure that animals will have unburned habitat for refugia. Timing of burns may vary depending on specific burn objectives and weather.

In cases where prescribed burning is not feasible, understory timber stand improvement (TSI) techniques can be used to kill or remove undesirable species and enhance the quality of the native plant community.

Oak woodland ranges from 50-70% canopy cover in SDSF.

4. Vegetation Management Activities in SDSF: 2013-2022

With each subsection plan DNR develops a Stand Examination List. The Stand Examination List is a set of forest stands to be considered for treatment (e.g., harvest, thinning, regeneration, prescribed burning, reinventory) over the planning period based on established criteria (e.g., rotation age, site index, basal area, desired future cover type composition). Our forest inventory data is queried for stands that currently meet these criteria. These stands are assigned preliminary prescriptions and an associated year for a field evaluation. Most receive the prescribed treatment. However, based on the field evaluation, prescriptions may change for some stands because of new information on the stand or its condition. Examples of when a prescription might change: a) a stand with a preliminary prescription code of Thinning may be changed to a rotation-age harvest if an insect or disease problem is discovered during the field evaluation; b) it may be discovered that the stand composition has changed since the last inventory data was collected and all that's needed at this time is the collection of new inventory data; c) some large stands with a preliminary prescription code of Rotation-Age Harvest may be treated in several blocks over a period of years rather than harvesting the entire stand in one year; d) it may be decided to defer the treatment to a future year.

Between 2013-2022, sites were or will be assessed annually as part of the annual work planning and annual stand review processes. Specific harvest and management plans for each site were or will be developed after site evaluations, invasive species surveys, silvicultural assessments, and rare species surveys are completed. These areas were or will be actively managed with appropriate techniques including timber harvest, prescribed burning, invasive species control, and other restoration practices. Management of the Uncas Dunes SNA units will continue to follow the Uncas Dunes SNA Management Plan (MNDNR 2009).

It should be noted that from 2013-2017, approximately 1,000 acres in SDSF were sold for treatments of either thinning or rotation-age harvest. Not all of these stands were harvested as of May 2017.

Table 1 provides a summary of remaining proposed vegetation management actions in SDSF (excluding Uncas Dunes SNA) for the 2013-2022 planning period, as of March 2017. Plans will be adjusted as needed based on site assessments.

Table 1: Vegetation management proposed for 2017-2022

Proposed vegetation management action	**Number of acres in SDSF affected (excluding Uncas Dunes SNA)**
Thinning assessment	1,443
Rotation-age harvest assessment	654
Habitat enhancement, selective tree removal	73
Habitat enhancement, other maintenance (invasive species treatment*, seeding, slash management, prescribed burns, etc.)	336

Proposed vegetation management action	Number of acres in SDSF affected (excluding Uncas Dunes SNA)
Habitat enhancement assessment (management need unknown)	154
Total	**2,577****

*More invasive species management throughout SDSF may be necessary, depending on results of site assessments, which sometimes lead to discovery of new infestations. Acres planned for treatment will be discussed at the annual management planning meeting.
**The total number of acres to be managed is fewer than the sum of the various management actions because some acres will receive more than one type of management treatment.

These management actions are detailed in a series of maps and tables located in Section VI of this plan. These maps (and supplemental tables) include:

- Proposed vegetation management: thinning and rotation-age harvest for 2017-2022
  - Map 1: 2017 proposed thinning and rotation-age harvest
  - Map 2: 2018 proposed thinning and rotation-age harvest
  - Map 3: 2019 proposed thinning and rotation-age harvest
  - Map 4: 2020 proposed thinning and rotation-age harvest
  - Map 5: 2021 proposed thinning and rotation-age harvest
  - Map 6: 2022 proposed thinning and rotation-age harvest
- Summary of proposed harvest actions for 2017-2022:
  - Map 7: Summary of proposed thinning, 2017-2022
  - Map 8: Summary of proposed rotation-age harvest, 2017-2022
  - Table 4: Total acres of proposed thinning and rotation-age harvest, by year, 2017-2022
- Map 9: Summary of acres sold in 2013-2016, but not yet harvested (separated by thinning and rotation-age harvest)
- Proposed vegetation management: habitat enhancement for 2017-2022
  - Map 10: Proposed habitat enhancement for SDSF, 2017-2022
  - Table 5: Detailed descriptions of proposed habitat enhancement actions

5. Monitoring and Evaluation: Vegetation Management Impacts on Rare Species

DNR is working to assess the effectiveness of habitat enhancement activities in SDSF on a suite of six focal species: lark sparrows, eastern towhee, plains hog-nosed snake, gophersnake, northern barrens tiger beetle, and the Leonard's skipper butterfly. Improved understanding of the factors that influence rare wildlife habitat use on the Anoka Sand Plain will help inform management and predict how habitat enhancement activities are likely to influence the occurrence of these species.

Monitoring efforts will build upon rare species research in SDSF that has been ongoing since 2008 (Harper et al. 2010; Hoagland, Smith, and Texler 2012). We will continue to gather information before and after habitat enhancement work to be able to assess the impact of management. The adaptive management approach used in SDSF will allow lessons from early habitat enhancement efforts to be

applied to any future enhancement efforts in SDSF's High Conservation Value Forest (HCVF), and will be applicable to habitats hosting our focal species statewide.

B. Recreation Action Plan

At-a-Glance:

- SDSF is uniquely positioned between the Twin Cities and the St Cloud metropolitan areas. As such, SDSF provides regionally important recreational opportunities.
- Maintain 29 miles of designated trails (18 equestrian and 11 multi-use).
- Explore how to connect North Unit and South Unit trail networks.
- Maintain pine trees in the Ann Lake Campground unless they pose a safety or disease risk.
- Support continuing hunting and fishing opportunities within SDSF.
- Provide opportunities for visitors to view wildlife and experience native ecosystems and rare natural features.

1. Summary of Recreational Opportunities - Features and Amenities

State forests provide a tremendous recreational asset to the public, allowing access to lands that provide a variety of recreational opportunities. Outdoor recreation opportunities offered in the Sand Dunes State Forest (SDSF) are particularly significant for many Minnesotans because it is the closest State Forest to the metro area. This proximity to high population centers makes SDSF a popular destination year-round. This Recreation Action Plan for SDSF incorporates recreational opportunities with timber management and rare features management objectives, to successfully manage SDSF for multiple uses in a safe, sustainable, environmentally-sound, and fiscally efficient manner.

Recreational opportunities offered in SDSF provide the public an array of outdoor based activities to select from. Outdoor recreation facilities in SDSF include the Bob Dunn Recreation Area, which features the Ann Lake Campground, the Ann Lake Day Use area, and the Sand Dunes Horse Camp (Map 14). In addition, both within and outside of the Bob Dunn Recreation Area are many miles of multi-use recreational trails. There is also a Public Water Access on the St. Francis River, offering fishing and kayak/canoeing opportunities. The PWA is located east of where County Road 10 and County Road 15 join. The carry-in access provides parking and direct access to the St. Francis River and into the Sherburne National Wildlife Refuge.

The Bob Dunn Recreation Area is located in the north unit of SDSF. It encompasses 353 acres and borders Ann Lake to the east and the Uncas Dunes SNA to the south. The Ann Lake Campground provides a rustic camping experience with 30 drive-in campsites, 6 walk-in sites, and 4 group campsites. It offers firewood sales, council ring seating for interpretive programs, drinking water, vault toilet facilities, and an onsite campground host. It also provides access to many miles of year-round hiking trails, and options for ungroomed cross-country ski trail access in the winter. The campground is close to the Ann Lake Day Use Area, which features a popular swimming beach and offers scattered picnic areas, access to hiking trails, shoreline fishing, and a large parking area. The SDSF Horse Camp is located west of the Campground and Day Use Area and features rustic camping with 13 individual campsites and 2 group campsites. It offers access to 18 miles of designated equestrian trails. The Horse Camp provides a day use parking area, drinking water, toilet facilities, picket lines for tying up horses, manure bunkers, and an accessible loading ramp.

Overall, SDSF has over 29 miles of maintained trails, including 18 miles of designated equestrian and 11 miles of multi-use trail. These trails offer a journey through the mosaic of native and managed landscapes in SDSF. Among the most popular trail activities in SDSF are hiking, biking, hunting, skiing, bird watching and other nature viewing, and snowmobile riding. There are many additional trails maintained as fire breaks that are also open for recreational use but not signed, mapped, or maintained for specific recreational uses.

There are two designated trailheads in SDSF that provide parking and direct access to the trail system. The North Trailhead is located at the intersection of County Road 4 and 168th Street. It offers truck/trailer parking, direct access to equestrian, hiking, and snowmobile trails, a picnic table, a vault toilet, picket lines for tying up horses, and manure bunkers. The South Trailhead is located in the South Unit of the Sand Dunes along 233rd Ave, approximately 1 mile east of County Road 15. It offers truck/trailer parking, direct access to equestrian, hiking, and snowmobile trails, hand well pump, a vault toilet, and manure bunkers.

Trail-oriented recreational opportunities within the Sand Dunes are guided by principles that consider ecological sustainability and trail experience, among other things. For example, SDSF is classified as a "Closed Forest", indicating that no motorized OHV-ATV use is allowed (MN DNR 2017d). This designation was a result of an earlier evaluation, assessment, and public review process. Public requests for events or activities that may have the potential to cause significant environmental effects, are likely to attract large numbers of people, or are not normally allowed are reviewed through an application process. Approved activities are managed through special use or special event permits.

Through the implementation of this action plan, the landscape of SDSF will offer ongoing access to high quality recreational opportunities while providing a diverse mosaic of habitats that enrich and complement recreational experiences.

The recreation action plan for SDSF includes guidance on:

- Vegetation management
- Hunting and fishing
- Trail systems

2. Vegetation Management

Implementation of land management techniques applied within the Bob Dunn Recreational Area (BDRA) and along the recreational trails throughout the state forest will be conducted in accordance with the plant community objectives outlined in the 10-year Vegetation Management Action Plan.

Trail users can refer to Maps 1-10 to identify the management efforts planned near trails and the BDRA. In addition to the management identified on these maps, DNR will continue to inventory and apply invasive species control techniques to high priority invasive species found along trail corridors. This is ongoing work consistent with the agency's commitment to comply with DNR Operational Order 113 (MN DNR 2007). As directed in the general procedures of the MN DNR Parks and Trails (PAT) Division Guidelines for Implementation of Operational Order 113, trail managers will monitor and apply rapid response treatments to new infestations of invasive species (MN DNR 2015a). Integrative pest management techniques and treatments will be applied as time and resources allow.

Throughout the eastern portion of the BDRA, invasive species control treatments will be applied in an effort to maintain and strengthen the oak savanna and oak woodland native plant communities present. Invasive species within the BDRA will be managed in accordance with the procedures outlined in the MN DNR PAT Division Guideline for Implementation of Op Order 113 (MN DNR 2007). Current practices include both mechanical and chemical treatments. Chemical spot treatments are designed to minimize non-target exposure. Invasive species control treatments will be applied to non-native woody species that are encroaching on native habitats. Non-native invasive species such as garlic mustard, Siberian pea shrub, and Amur maple will be surveyed and controlled as time and labor resources allow. Native species that are considered noxious such as poison ivy, will be controlled using spot treatments, where deemed necessary.

DNR will reserve existing pine trees immediately within and bordering campsites in the Ann Lake Campground. Pine trees will not be removed from the campsites unless they are found to be a hazard to recreational users or forest health. Permanent School Trust lands can be found in the northern most portion of the BDRA. Land management efforts planned for this area can be found within the Permanent School Trust Lands Action Plan.

3. Hunting and Fishing

As a large contiguous tract of public land, SDSF is a popular destination for hunting and fishing recreation in the central part of the state. The optimal mix of habitat types paired with the diversity of vegetation and terrain create many opportunities for hunting and fishing recreation. Seasons and game species include:

- White-tailed deer: firearms, archery, and muzzleloader seasons in the fall; SDSF is part of deer permit area 223.
- Turkey: both spring and fall seasons; SDSF is included in turkey permit area 507.
- Small game: many species including squirrel, rabbit, grouse, pheasant, woodcock and partridge; refer to regulations for season dates.
- Waterfowl: opportunities on the marshy fringe of Ann Lake, Larson Slough, and along the St. Francis River; SDSF is in the central zone for waterfowl hunting.
- Fishing: Ann Lake is a popular pan fish and bass fishing lake, and the St. Francis River also provides angling opportunities.

SDSF and Uncas Dunes SNA are open to public hunting and fishing according to the annual regulations, seasons, and bag limits, except in the Bob Dunn Recreation Area, where hunting is not allowed. Hunting and fishing regulations handbooks are available each year on the DNR's website and in print anywhere licenses are sold.

4. Trail Systems

DNR will consider opportunities to improve or enhance the recreational trail system in SDSF based on ecological impacts, social trends, use compatibility, and public safety to create a positive, sustainable trail experience. Opportunities to improve trail systems may arise from planned timber harvests, vegetation management plans, natural events, or public inquiries. Where feasible and justified, trail re-routes are considered to avoid sensitive soils, steep slopes, rare plant communities, or unsafe trail

conditions. DNR follows Division of Forestry Policy 12: Timber Harvest and/or Extractive Operations on State Lands Adjacent to Recreational Trails, where timber harvests occur adjacent to designated recreational trails (MN DNR DOF 2016). In addition, as part of the DNR's State Forest trail use review process, recreational trails are re-evaluated based on established use designations. DNR is scheduled to review trail designations and/or special management areas for SDSF in the next few years through a public scoping and formal review process that solicits ideas, comments, and feedback. This will be discussed at the SDSF annual meeting.

SDSF is a destination for equestrians, offering many miles of equestrian trails. In 2017, the DNR held a public hearing to consider a change in equestrian and snowmobile trail use at Uncas Dunes SNA. The DNR will develop a new designation order for the SNA to replace the original order (MN DNR 1997) that will clarify trail opportunities on the unit.

The northern unit of SDSF contains about 15 miles of designated trails and the southern unit contains about 14 miles of designated trails. Currently, the trail systems in the two units are not connected, limiting the value of the overall trail system and posing a safety risk for users who wish to cross County Road 15 to experience the entire system. This affects hikers, bikers, equestrians, and snowmobilers alike. The DNR, based on requests and inquiries from user groups, has identified the need for a safe trail connection between the north and south units of SDSF to enhance recreational opportunities. A shared partnership among the user groups, local units of government, and the DNR is needed to build a route across County Road 15 and the St. Francis River. Funding a project of this scope will likely require multiple partnerships and funding sources.

C. Permanent School Trust Lands Action Plan

At-a-Glance:

- There are no current plans to change the School Trust status of any parcels in SDSF.
- If plans to change the status arise during this planning cycle, the DNR will notify local landowners and other interested stakeholders. The DNR also will hold public informational meetings on any proposed School Trust land status change.
- DNR will deposit net revenues generated on School Trust lands (e.g., through timber harvest and camp fees) to the Permanent School Fund as required by law.

Permanent School Trust lands are owned by the state in trust for all K-12 public schools of Minnesota. The DNR manages the School Trust lands *as trustee*, for maximum long-term economic return under sound natural resource and conservation practices.

1. School Trust Land in SDSF

There are 1,035.63 acres of Permanent School Trust land in SDSF (Map 16).

2. Generating Revenue on School Trust Lands

State law provides that it is the goal of the Permanent School Trust to secure maximum long-term economic return from the School Trust lands consistent with the fiduciary responsibilities imposed by the School Trust relationship established in the Minnesota Constitution, with sound natural resource

conservation and management principles, and with other specific policy provided in state law. (Minnesota Statute, Section 127A.31)

Net revenue generated from School Trust land is deposited into the Permanent School Fund, which is managed by the State Board of Investment. Interest and dividends from the Permanent School Fund are distributed to school districts based on the number of students.

Across the state, revenue from the School Trust lands comes from:

- Mineral leases - iron ore/taconite, nonferrous metallic minerals, industrial minerals, and others
- Timber sales
- Surface leases - gravel, hunting cabins, miscellaneous, agriculture, and others
- Utility licenses
- Easements
- State forest campground fees
- Sale of land
- Compensation for other uses (e.g. public water access sites)

Some examples of revenue generation on School Trust land in the SDSF include Grant-in-Aid snowmobile trail leases (paid annually), easements (one-time payments), and timber sale revenue (paid as the timber sale occurs).

3. Sale of School Trust Land

School Trust land can be sold (Minn. Const., Art. XI, Sec. 8; M.S. 92.01-92.29). Pursuant to M.S. 92.13, the commissioner shall hold public sales of school and other state lands when it is advantageous to the state and to intending buyers and settlers. Sale of School Trust land must first be approved by the Regional Director (DNR), Land Administrating Director (DNR), Lands and Minerals Director (DNR), and the Land Asset and School Trust Administrator (DNR). In addition, the School Trust Lands Director (MN) has authority under M.S. 127A.353 to advise the commissioner of natural resources on the management of school trust lands, including land sales. Prior to sale, the DNR publishes a notice of the sale in a newspaper of general distribution in the county in which the real property to be sold is situated (M.S. 94.10 Subd. 2). Prior to the sale, there is also notification provided to adjacent landowners. After the above listed requirements are met, the DNR holds a public auction (M.S. 92.13).Sale of School Trust land must be done at public auction and sold to the highest bidder.

As of May 2017 there were no plans to sell School Trust land in SDSF. However, should management of the school trust lands in SDSF be impacted so as to restrict or prohibit revenue generation; it would then be in the best interest of the school trust to consider a divestment strategy.

4. Exchange of School Trust Land

The School Trust designation of one parcel may be exchanged with another parcel of state-owned land. This is considered an internal exchange and would need to adhere to the authorities granted to the commissioner of natural resources under M.S. 94.343. Any proposed exchange involving trust lands requires approval by the Regional Director (DNR), Land Administrating Director (DNR), Lands and Minerals Director (DNR), and the Land Asset and School Trust Administrator (DNR). In addition, the

School Trust Lands Director (MN) has authority under M.S. 127A.353 to advise the commissioner of natural resources on the management of school trust lands, including land exchanges. A public hearing would be required by statute. Prior to exchange, the DNR coordinates the notification of the required public hearing (per M.S. 94.343, subd. 7) and also holds the public hearing. Following the public hearing, the appropriate next step is to brief the DNR Commissioner and the Land Exchange Board (LEB) on the land exchange proposal and request approval of the exchange (per M.S. 94.341). All exchanges involving public lands of the state for any publicly or privately held lands must receive the approval of the LEB. The Land Exchange Board consists of the Governor, State Auditor, and Attorney General. Meetings of the LEB are held quarterly.

There are several reasons why the state may consider exchange of School Trust lands. For example, the horse camp in Sand Dunes State Forest is located on School Trust land. The revenue from camping fees is deposited into the Permanent School Fund. There is currently no provision to use any of those funds for campground upkeep or improvement. If the School Trust designation is exchanged and the horse camp is situated on acquired land, fee income can be used to help offset the cost of maintaining and improving the campground. Another situation where the state may wish to exchange School Trust designation is in cases when managing for the high conservation values on HCVF land may prohibit or limit the ability to generate revenue. In these cases, DNR may first seek opportunities to compensate the School Trust before considering an exchange. No tree removal for habitat enhancement would occur on SDSF School Trust land until the School Trust is financially compensated.

A real estate analysis including the revenue-generating capability of all involved parcels must be completed before any exchange could occur. There must be a reasonable expectation that the parcel receiving the new School Trust designation has at least equal capability to generate revenue as the parcel with the current School Trust designation. In addition, School Trust lands cannot be exchanged for lands of lesser market value.

Exchange of School Trust designation has been considered in SDSF but is on hold as of May 2017.

For more information on School Trust lands and DNR's management of them visit the DNR's School Trust lands webpage.

D. Forest Roads Action Plan

At-a-Glance:

- Maintain the 8 miles of System Forest Roads in SDSF.
- Maintain the approximately 45 miles of temporary access roads in SDSF.
- Work with Orrock Township to resolve the issue of township roads on state lands that do not currently have easements.
- Explore routes that minimize heavy truck impacts on township roads

1. Overview of Roads in SDSF

The DNR maintains a variety of forest roads and access routes, and trails for public access to forest lands and for forest management. "Forest roads" are defined in statute (M.S. 89.001 subd. 14) as "a road constructed, acquired, maintained, or administered by the commissioner for the purpose of carrying out forest resource management policy."

Some key features of forest roads include:

- Forest roads are generally open to the public for recreational use.
- A forest road is not considered a public road, and DNR is not a road authority.
- Forest roads do not provide legal access to private land or property.
- State forest roads can be closed for "wildfire hazards" and during conditions that "render forest trails impassable by driving thereon during wet seasons" (M.S. 88.22 subd.1).
- Forest roads are normally not plowed in winter. Loggers and other contractors are allowed to plow forest roads in order to complete work under contracts on state land. Private individuals who wish to plow state forest roads to access private property will need an Access Permit, an easement, or a lease.

There is one class of forest road present in SDSF: system forest roads. System forest roads are usually well-maintained with a gravel surface and generally capable of accommodating two-way traffic. Most of these roads are connected to state, county, or township public highways. In SDSF, only highway-licensed vehicles are allowed on system forest roads; off-highway vehicles are prohibited throughout SDSF.

All other forest access features in SDSF are defined as "temporary access routes". These are most often associated with forest management activities, particularly timber harvesting. Temporary access routes do not have legal standing as forest roads, and are generally not maintained or managed beyond the lifespan of the temporary access need, such as a timber sale (Jacobson, Pitt, and Deckard 2013). Forest roads and temporary access routes may be used for multiple purposes. Some temporary access routes are also designated snowmobile trails, for example.

"Trails" are forest access features designated for specific uses like horseback riding or snowmobile use. For more information on trails in SDSF, see the 10-year Recreation Action Plan.

2. Roads in the Sand Dunes State Forest

Road Type	Road Name	Miles
System Forest Roads	North Sand Dunes Road	2.0
	Day Use Road	0.5
	Ann Lake Campground Road	1.5
	South Sand Dunes Road	3.0
	South Sand Dunes Road – North Branch	1.0
Temporary Access Roads	Unnamed, multiple	45

In addition to State Forest Roads, there are a number of County and Township roads that provide access to the SDSF. These roads are controlled and maintained by their respective governing agency.

An issue has been identified with some township roads that are located on state land that do not currently have easements. DNR has committed to work with the Orrock Town Board to resolve this.

DNR recognizes that easements for many township roads on what is now DNR-owned land were likely established while in private ownership; however, the easements were not recorded on the deed. There are about 2.35 miles of designated township roads on DNR-owned land that do not have recorded easements.

On School Trust Fund land, the handling of easements is outlined in MN Statutes 84.63, 84.631, 84.632, and 85.015. There are about 1.5 miles of designated township roads on School Trust Fund land that do not have recorded easements.

Approximately 6.5 miles of road and trail segments in the North Unit of the SDSF have been identified as "persistence corridors" for rare features. The rights-of-way of these segments contain native grasses and forbs that provide habitat for rare animals, amphibians, and insects such as butterflies. Disturbances in these persistence corridors should be minimized and coordinated with staff from DNR's Division of Ecological and Water Resources.

III. Operational Considerations

A. Health and Safety Considerations

In all of the DNR's work, safety is our number one priority. Therefore, habitat and facility management activities implemented within SDSF will be carried out with in a manner that prioritizes the health and safety of the general public, DNR employees, private contractors, conservation partners, public recreational users, and neighboring landowners inside and outside SDSF's boundaries. Habitat management activities include restoring, enhancing, and maintaining SDSF's fire-dependent plant communities using various management activities that mimic historical natural disturbances. These activities include timber thinning, rotation-age timber harvest, tree planting, prescribed burning, and invasive species control. Facility management requires developing, maintaining, or improving user facilities under our care; this includes work on parking lots, gates, trails, access roads, etc., in and around SDSF with township, county and state partners.

Following are some specific health and safety considerations for prescribed burning and herbicide application in SDSF.

1. Health and safety considerations for prescribed burns

Prescribed burn plans are based on ecological objectives to maintain SDSF's fire-dependent or fire-adapted plant communities. These native plant communities have been damaged by the exclusion of natural fire, due to invasion of non-native plants as well as native plants that normally would have succumbed to frequent fires. Therefore, prescribed burns can be used to restore these globally rare ecosystems. The frequency, timing, and location of prescribed burns are designed to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities); certain areas are left unburned to provide refuge for sensitive species.

Use of prescribed burns to manage these native plant communities will follow the MN DNR Prescribed Burn Guidelines outlined in Operational Order 47 (MN DNR 2010a) and the MN DNR Prescribed Burn Handbook (MN DNR 2010b), which provides information on appropriate personal protective equipment for personnel implementing prescribed fire. Importantly: the safety of firefighters and the public is the number one priority when planning and implementing a prescribed burn project.

SDSF prescribed burns are typically implemented during the months of April and May with ignition times occurring during the day. Upcoming planned burns will be discussed with interested stakeholders at the annual management planning meeting for SDSF, and a news release will be distributed at the start of the season detailing the planned prescribed burning activity. Local emergency services will also be contacted about planned burns. Weather conditions suitable for safe burning can vary from day to day, limiting the amount of advance notice that can be given to the public for the implementation of any particular planned prescribed burn. However, when weather conditions are favorable to implement a burn, day-of notice is provided to adjacent landowners.

Prescribed burn personnel obtain fire qualifications through required in-depth training on firefighting roles and specialized equipment. SDSF prescribed burn unit plans provide guidance on smoke management, fuel loading reduction strategies, timing of treatment, and other considerations, including addressing adjacent landowner concerns.

Prescribed burn unit plans include several specific components to insure safety (MN DNR 2010c):

- **Fire complexity rating**: Identifies items that need mitigation using a rating system guide.
- **Burn unit maps:** Identify burn locations.
- **Overall safety plan**: Identifies safety zones and escape routes for the burn. Includes a communications plan to ensure adequate communications with burn staff and emergency resources, and a traffic control plan if burning near roads.
- **Medical plan**: Identifies locations and contact information for ground and air ambulance, 9-1-1 dispatcher, nearest hospital, availability and location of first aid supplies at the burn site, and any key medical supply contacts.
- **Smoke management plan**: Describes how smoke effects on roads, firefighters, neighbors, and other sensitive receptors will be mitigated. All prescribed fire must follow the Minnesota Smoke Management Plan (MNICS 2016). Considerations include avoiding "smoke sensitive areas" such as livestock barns, airports, residences, and towns (usually located within a 2-3 mile radius of the burn); ensuring the smoke dispersion index is sufficient the day of the burn to adequately disperse smoke (based on wind speed and other weather elements); and posting appropriate signage (e.g. "Controlled Burn" or "Smoke on Road") when burning near roads.

Final prescribed burn unit plans require review by appropriate Area Forestry Office staff or designee to obtain burn permits. Burn plans can be shared with other interested groups (e.g., Orrock Township). On the day of the burn, the burning permit must be activated by the prescribed burn boss by contacting the appropriate Area Forestry Office staff. Next, all items on the "Go/No Go checklist" must be completed before a burn can be ignited. If any item is a "no go," the burn will not be carried out.

Go/No Go checklist items include the following:

- ALL burn prescription elements met.
- ALL personnel have the required PPE with them.
- ALL smoke management specifications met.
- ALL pre-burn considerations (line preparation) identified in the plan addressed.
- ALL current and projected fire weather forecasts have been obtained and are favorable.
- ALL the required notifications been made (landowners, media, cooperators, sheriff etc.)
- ALL planned operations personnel and equipment on-site, available and operational.
- ALL permits and approvals been obtained. (open burning permit, non-DNR land permission)
- APPROPRIATE contingency resources have been confirmed and are available
- ALL on-site holding forces adequate for containment under the expected conditions.
- ALL personnel briefed on the burn objectives, their assignment, safety hazards, escape routes, communications and contingency plan.
- Burn Boss believes the burn can be carried out according to the prescribed burn unit plan and will meet the planned objectives.

Once the checklist is completed, the prescribed burn crew is authorized to move forward with a test fire on the downwind side of the prescribed burn unit under the direction of the prescribed burn boss. This ensures the observed fire behavior matches closely with the predicted fire behavior. Assuming this is confirmed, implementation proceeds. Firefighters provide the resources needed to contain the fire within the prescribed burn unit boundaries, while igniters use wind patterns to provide strategic

ignitions around the burn unit, eventually encircling it. After the prescribed burn unit fuels are consumed, firefighters mop-up the burn unit from the boundaries inward ensuring smoldering snags and other fuels are extinguished.

2. Health and safety considerations for herbicide application

All herbicides used in SDSF are approved by DNR's third-party certification providers and are used per the label restrictions. Herbicide application is used in SDSF when:

- Biological controls are not an option.
- Mechanical control alone does not kill the targeted plant.

SDSF herbicide treatments of invasive species utilize licensed applicators. Application methods include backpack sprayers and ATVs equipped with tanks for wand application. Spot spraying of herbicides (i.e. basal bark & cut stump treatments) are used following mechanical treatments (cut stump) to reduce or eliminate the need for additional reentry into managed areas that have been treated this way. See **Appendix D** for common label names of herbicides used within SDSF and target plants.

Broadcast spraying using BTK (*Bacillus thuringiensis,* subspecies *kurstaki*), a bacterial insecticide, was accomplished by helicopter in 2007 for a severe outbreak of jack pine budworm in SDSF (MN DNR 2017b).

Herbicide application signage is located at entrances to treated sites for the growing season and describes the following:

- Pesticide used
- Purpose
- Treatment date
- Re-entry period

Personal protective equipment (PPE) is utilized as appropriate and directed according to the labeled instructions of any pesticide or herbicides used within SDSF for the safety of those individuals directly

using them. Safety Data Sheets are available for additional information on each pesticide; these are usually available through the manufacturer.

Minnesota pesticide applicator certification and licensing is handled by the Minnesota Department of Agriculture. The agency encourages the use of integrated pest management to control invasive species, noxious weeds, and other pests. Pesticide applicators are responsible for recording application locations, weather, and date of application. Mixed solutions must be labeled with an EPA tracking number including the mixing rate and date. Each targeted invasive species typically has multiple recommended herbicide options to consider; the applicator can choose the most appropriate option for the health and safety of the applicator and public, as well as nearby non-target plants. Herbicide containers and applicators are triple rinsed after use.

Testing for potential groundwater contamination attributable to herbicide use in SDSF would be difficult and costly, as it would be difficult to distinguish between the inputs from SDSF and inputs from surrounding agricultural and residential lands. However, as most wells in and around SDSF are greater than 20 feet deep, and herbicide use in SDSF is limited and done per label instructions, it is unlikely that the herbicides used to treat invasive and undesirable plants in SDSF are leaching into the groundwater at that depth. The Minnesota Pollution Control Agency or the Environmental Protection Agency may be able to provide additional information regarding herbicides potentially reaching groundwater.

B. Native Plant Community Context in SDSF: Oak Savanna and Oak Woodlands

The habitat enhancement prescriptions in this operational plan focus on oak savanna and oak woodland native plant communities. A summary table comparing and contrasting the desired characteristics of oak savanna and oak woodland native plant communities can be found below (Table 2). More detailed information and species lists can be found in the Native Plant Communities of Minnesota Field Guide (MN DNR 2005).

There are a number of other important native plant communities within SDSF including southern dry barrens prairie, southern mesic prairie, emergent marsh, tamarack swamp, and sedge meadow. In this plan, goals and methodology for restoration of southern dry barrens prairie and southern mesic prairie are treated as part of the oak savanna native plant community because rare species and management needs are similar. There is no scheduled maintenance for emergent marsh, tamarack swamp, and sedge meadow for the duration of this plan.

Table 2: Desired characteristics of oak woodland and oak savanna native plant communities in SDSF.

Characteristic*	**Oak Woodland**	**Oak Savanna**
NPC Classification	FDs37	UPs14a2
Tree Canopy Cover	50-70% canopy cover 25-70% sub-canopy cover 25-70% shrub cover	10-50% tree canopy cover (lowest on south- to west-facing slopes) Less than 30% shrub cover
Growth Form	Open- or moderately open-grown	Open-grown
Basal Area	80 – 150 square feet/acre	5 – 50 square feet/acre
Tree Species Canopy	Bur oak and northern pin oak as canopy dominants. Also northern red oak, white oak, red maple, black cherry, quaking aspen, paper birch	Bur oak as dominant, northern pin oak in lower density in all age classes from seedlings and stump sprouts to mature trees. Other hardwoods kept in very low density by fire include black cherry, quaking aspen
Subcanopy	Ironwood, red maple, black cherry, quaking aspen, paper birch, bigtooth aspen in subcanopy	
Shrub Cover	Chokecherry, American hazelnut, gray dogwood, prickly ash	Eastern redcedar density reduced to 1-3 trees/acre
Ground Layer	Generally shade-tolerant with some prairie/savanna species present. Species include pointed-leaved tick trefoil, Clayton's sweet cicely, hog peanut, Canada mayflower, wild geranium, Pennsylvania sedge	Dominated by mix of native graminoids and forbs typical of prairies/savannas. Areas of bare sand, especially on steep dune slopes

*Please refer to the Native Plant Communities field guide for more detailed information and species lists (MN DNR 2005).

1. Oak savanna NPC considerations

The oak savanna in SDSF is classified as Dry Barrens Oak Savanna (Southern) (Southern) Oak Subtype, referred to here as Dry Barrens Oak Savanna (Southern). This type of savanna occurs on sand on landforms varying from level to steeply sloping dune formations. It is dominated by northern pin oak *(Quercus ellipsoidalis)* and bur oak *(Quercus macrocarpa)*, generally with open-grown forms, occurring individually or in groves. Dune crests, south to southwest-facing slopes, and sand blowouts are generally open and sparsely vegetated by grasses and forbs. Some common and characteristic herbaceous species include porcupine grass *(Stipa spartea),* June-grass *(Koeleria pyramidata)*, sand reed-grass *(Calamovilfa longifolia)*, gray goldenrod *(Solidago nemoralis)*, tall wormwood *(Artemisia campestris)*, hoary frostweed *(Helianthemum bicknellii)*, and prairie golden aster *(Chrysopsis villosa)*. More than eighty-five native plant species have been recorded in Dry Barrens Oak Savanna (Southern) in SDSF in recent years.

The goal for oak savanna habitat enhancement within SDSF is to ensure that conditions match the native plant community classification of UPs14a2: Dry Barrens Oak Savanna (Southern) (Southern) Oak Subtype (MN DNR 2005). Oak savanna is a fire-dependent community characterized by scattered open-grown oak trees with a diverse understory dominated by warm season grasses and prairie forbs (USFWS 2005). The guidance provided for oak savanna is also applicable to the two prairie native plant community classifications found in the state forest: UPs13a – Dry Barrens Prairie (Southern), and UPs23a – Southern Mesic Prairie.

The desired canopy cover for oak savanna in the state forest is between 10-50% with trees displaying an open-grown growth form and consisting of an overall patchy horizontal structure on the landscape. Basal area should fall within the range of 5-50 square feet per acre (Law et al. 1994, USFWS 2010). Tree cover will vary with slope and aspect, with south- to west-facing dune slopes having the lowest tree cover. Bur oak is the target dominant tree species, with northern pin oak serving as a co-dominant species in much lower density. All size classes of bur oak should be present, from seedlings and stump sprouts to mature trees. Other hardwood trees, generally kept in very low density by fire, may include black cherry and quaking aspen. Eastern redcedars should be reduced in density to 1-3 scattered trees per acre that are at least 15 feet in height. Shrub cover is patchy, short in stature, and should be less than 30%. The ground layer should be dominated by a mix of native grasses and forbs typical of prairie and savanna habitat. Small exposed areas of bare sand amongst the vegetation are of the utmost importance for certain rare species, especially on steep dune slopes.

2. Oak woodland NPC considerations

Southern Dry-Mesic Oak (Maple) Woodland in SDSF are native plant communities dominated by northern pin oak and/or bur oak. They often have dense to patchy tall brush cover of American hazel, red raspberry, smooth sumac, prickly ash, and/or redcedar. Groundlayers contain a mix of savanna species in openings and species more typical of dry oak forest in denser areas such as poison ivy *(Toxicodendron rydbergii)*, Canada mayflower *(Maianthemum canadensis)*, woodbine *(Parthenocissus quinquefolia*, and sun-loving sedge *(Carex pensylvanica)*. Quality of these communities in SDSF is highly variable, ranging from high quality areas to lower quality areas; characteristics of the latter include dense European buckthorn *(Rhamnus cathartica)*, disturbed groundlayers, presence of planted pines, and presence of dense saplings of shade-tolerant deciduous forest trees such as basswood *(Tilia americana)* and elm *(Ulmus spp.)*.

The goal for oak woodland habitat enhancement within SDSF is to ensure that conditions match the native plant community classification of FDs37: Southern Dry-Mesic Oak (Maple) Woodland (MN DNR 2005). The desired canopy cover for this fire-dependent community in SDSF is between 50-70% (up to 100% in some areas) with trees displaying an open-grown or moderately open-grown growth form. The basal area should range between 80 – 150 square feet per acre. Bur oak and northern pin oak are the target dominant canopy tree species. Other canopy species include northern red oak, white oak, red maple, black cherry, quaking aspen, and paper birch. Sub-canopy cover should range between 25-70% and consist of species such as ironwood, red maple, black cherry, quaking aspen, paper birch, and bigtooth aspen. Shrub cover should also range between 25-70% and consist of species such as chokecherry, American hazelnut, gray dogwood, and prickly ash. Ground layer species are generally shade-tolerant, but some prairie/savanna species will be present as well. Common species include

pointed-leaved tick trefoil, Clayton's sweet cicely, hog peanut, Canada mayflower, wild geranium, and Pennsylvania sedge.

C. Climate change considerations

Minnesota's climate has been undergoing changes over the last several decades, and is projected to continue changing well into the future. Excess greenhouse gases (such as carbon dioxide) that have been rapidly accumulating in our atmosphere since the mid-1850s are trapping more of the sun's heat, leading to observed changes such a warming temperatures and shifting precipitation patterns. These changes are impacting and will continue impacting Minnesota's lands and natural resources in multiple ways, including potential heat and water stress on vegetation; increased damage from insects, diseases, and invasive plants that thrive under the new conditions; increased storm damage; and shifts in the natural ranges of native species. A key management consideration for state lands both now and looking forward is how best to adapt to these impacts and maintain healthy ecosystems on the landscape.

Climate change impacts will increasingly stress already vulnerable species and habitats. Habitat enhancement efforts in SDSF should aim to increase the resistance and resilience of rare species through protection of refugia and restoration of degraded habitat in order to increase the likelihood that these species will be able to persist in the future (Stein et al. 2013; Groves et al. 2012).

In terms of tree management, climate models indicate that some species of trees are projected to do better in SDSF under expected climate changes while some will do worse, due to changes in the availability of suitable habitat. Table 3 summarizes the expected impact to SDSF tree species across the entire Anoka Sand Plain subsection, under low and high future greenhouse gas emissions scenarios. Red pine, the most abundant plantation species in SDSF, is expected to decrease across the Anoka Sand Plain under the new climate regime, while white pine is expected to increase. Northern red oak and northern pin oak are expected to decrease, while bur oak—which was once the most common tree species in the Sand Dunes—is expected to remain steady, and white oak will increase.

Increasing tree diversity in pine plantations may help to offset the expected loss of red pine. Increasing the focus on bur oak in SDSF, as the historically dominant tree species in SDSF's oak woodlands and savannas, may also help create climate resilience, as even under a high greenhouse gas emissions scenario bur oak is not expected to be negatively impacted by climate change in the region.

Table 3: Sand Dunes State Forest Trees—Response to Climate Change across the Entire Anoka Sand Plain

Species name*	**Predicted change low emissions scenario**	**Predicted change high emissions scenario**
Northern red oak	Decrease	Large Decrease
Quaking aspen	Large Decrease	Large Decrease
Bur oak	No Change	No Change
American Elm	Increase	Increase
Green ash	No Change	No Change
Basswood	No Change	No Change
Black cherry	Increase	Large Decrease
Paper birch	Large Decrease	Large Decrease

Species name*	Predicted change low emissions scenario	Predicted change high emissions scenario
Northern pin oak	Decrease	Large Decrease
Red pine**	Decrease	Large Decrease
Red maple	Increase	Increase
Ironwood	No Change	No Change
White oak	Large Increase	Increase
Eastern redcedar (juniper)	Large Increase	Large Increase
Jack pine**	Increase	Increase
White pine**	Increase	Increase
Big-toothed aspen	No Change	Large Decrease
Tamarack	Increase	Increase
White spruce**	Decrease	No Change

*Listed in order of abundance, relative to other tree species across the entire Anoka Sand Plain.
**Not known to be native to SDSF; planted for timber

D. Communications and Public Engagement

DNR is committed to sustaining communications and outreach around SDSF following a series of in-depth stakeholder engagement meetings in 2016. Information about upcoming planned timber sales, timber harvests, prescribed burns, restoration projects and changes to School Trust land status will be shared with local residents, local government and other stakeholders in a variety of ways. Opportunities for public input will be provided through annual meetings each winter, and during 10-year revisions of the Anoka Sand Plain Subsection Forest Resource Management Plan and SDSF Operational Plan. Comments and questions specific to SDSF can best be addressed to the Little Falls Area Forestry office (320-616-2450).

Communication and outreach efforts will include:

- Maintaining a dedicated SDSF stakeholder webpage and information repository on DNR's website.
- Continuing the GovDelivery listserv email messages specific to SDSF.
- Hosting annual meetings to review upcoming SDSF management.
- Creating informational posters, kiosks, or interpretive signage located at SDSF parking lots, forest campsite areas, or at specific sites on trails that are in the process of restoration or timber harvest to highlight active forest management techniques, native plant communities, rare species, and unique geological features.
- Collaborating with adjacent private landowners to address buffer requests and aesthetic concerns along shared boundaries, prior to future timber sales.
- Contacting neighboring landowners prior to prescribed burns and other management activities that require notification.

It should also be noted that this plan contains references and links to a variety of DNR policies and documents that may not be immediately accessible to the public. These links will help DNR staff access these documents on our intranet site. However, we are always pleased to share these documents with the public. Please contact DNR staff at any time for assistance with accessing these documents.

E. DNR Intra-agency Roles and Cooperation

The DNR has a common mission of working with citizens to manage diverse natural resources for a sustainable quality of life. The agency is organized as a set of divisions that work together to provide sound natural resource management. The DNR Division of Forestry is delegated responsibility to manage Minnesota State Forests, and it coordinates with other DNR divisions to accomplish this important charge.

As such, the Division of Forestry staff will be responsible for all 5,732 acres of the state forest. This includes the protection and restoration of the rare ecological features as well as harvest and reforestation. Based on guidance set forth in this plan, Forestry will implement adaptive management prescriptions for SDSF and provide silvicultural and economic expertise. Ecological and Water Resources staff will partner with Forestry in helping to set strategic direction, providing the essential technical assistance, and formulating on-the-ground tactics for habitat enhancement. Division of Fish and Wildlife staff will partner in setting strategic direction for habitat enhancement and restoration projects, along with plan implementation. The Scientific and Natural Areas program, with its goals of protection and restoration, manages Uncas Dunes SNA in consultation with Forestry. The recreational facilities of SDSF are administered by the Division of Parks and Trails; this includes trail maintenance, campground management, facility care and upkeep, and development.

F. Looking Forward: The Sand Dunes State Forest 2023-2032 Operational Plan

This operational plan provides overall management direction for SDSF through the year 2022. The next round of planning (which will occur in conjunction with planning the next SFRMP for the region) will build upon this 2013-2022 plan, rather than replace it. The vision for SDSF described in Section I of this plan is intended to be long-term, encompassing goals that DNR should strive to implement indefinitely into the future. This vision will guide future planning efforts for SDSF.

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V. Glossary

adaptive management: A decision process that promotes flexible decision making in the face of uncertainty or changing conditions, and allows for adaptation as the effect of management actions and outcomes become better understood. Monitoring of conservation actions and outcomes is a key component of adaptive management.

basal area: The common term used to describe the average amount of an area (usually an acre) occupied by tree stems. It is defined as the total cross-sectional area of all stems in a stand measured at breast height, and expressed as per unit of land area (typically square feet per acre).

biodiversity (biological diversity): The variety of living organisms that are recognized and analyzed by biologists at three levels of organization: ecosystems; the species that comprise those ecosystems; and the genetic variability within those species (Wilson 2001). Species present in an ecosystem include animals, plants, fungi, protists, and bacteria and range enormously in size and ecological functions. **functional diversity** (see definition) is an aspect of biological diversity that some scientists believe may be of particular importance to ecosystem resilience. Biological diversity can be measured at different spatial scales (Whittaker 1960):

alpha-diversity: the number of species found in a small homogeneous area.

beta-diversity: extent of change in species composition among habitats or communities.

gamma-diversity: total species diversity in a landscape.

canopy: The layer of foliage formed by the crowns of the tallest trees, which shades the layers of vegetation below

canopy cover: The area of ground covered by a vertical projection of the canopy, expressed as a percent.

canopy closure: The proportion of the sky hemisphere obscured by vegetation when viewed from a single point, expressed as a percent.

climate change: A long-term change in the earth's climate, especially a change due to an increase in the average atmospheric temperature.

conditions: attributes that characterize the Priority Feature and describe the quality, or degree of intactness of the priority feature or the suitability of the site to provide for its designated uses. It can include measures of the composition, structure, biotic interactions and population variables or comparable measures for abiotic Priority Features.

conifer: A tree that bears cones and evergreen needlelike or scale-like leaves. Conifers present in SDSF include red (Norway) pine, white pine, jack pine, scotch pine, white spruce, eastern redcedar, Norway spruce, tamarack, and northern white-cedar.

Conservation Focus Areas: Priority areas for working with partners to identify, design, and implement conservation actions and report on the effectiveness toward achieving the goals and objectives defined in the Wildlife Action Plan. Conservation Focus Areas are intended to focus conservation efforts over the next 10 years to maintain and enhance the resiliency of the *Wildlife Action Network*.

Desired Future Conditions: Desired Future Conditions (DFCs) identify goals for management and restoration activities. The term acknowledges that natural landscapes change over time and that humans play a key role in determining the degree and direction of that change. Desired Future Conditions are targeted native plant communities, and will guide the implementation and management direction.

dune: A mound or ridge of sand or other loose sediment formed by the wind.

ecological classification system: A system used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The system uses associations of biotic and environmental factors, including climate, geology, topography, soils, hydrology, and vegetation. Map units for six levels occur in Minnesota: Provinces, Sections, Subsections, Land Type Associations, Land Types, and Land Type Phases (MN DNR 2017c).

factors: Aspects of the environment or human activities that have potential to affect the Condition of the Priority Feature or usage of the site either positively or negatively. Negative factors are also known as 'threats'.

fire break: An obstacle to the spread of fire, such as a short-mowed swath of grass, a plowed line in the soil, or a strip of open space in a forest.

forest roads: Defined in statute (M.S. 89.001 subd. 14) as "a road constructed, acquired, maintained, or administered by the commissioner for the purpose of carrying out forest resource management policy."

Forest Stewardship Council© (FSC): An international non-profit organization focused on protecting forests for future generations by initiating standards and certifications under which companies and forests are rated.

functional diversity: A component of biodiversity that generally concerns the range of things that organisms do in communities and ecosystems. functional diversity can help explain and predict the impact of organisms on ecosystems

ground cover: The assemblage of plants such as grasses ferns, mosses and low shrubs growing close to the ground and covering the soil in a specific area.

growth form: The general shape of an individual tree's canopy and spreading branches. An open-grown oak tree covers more horizontal area and is suggestive of open growing conditions and lower tree density over a specific area.

habitat: A place (ecosystem) where a species lives and interacts with the physical environment and other species. Some species require multiple habitats at different stages in their life cycle.

habitat continuity: Large continuous blocks of habitat or connected blocks of habitat, rather than small, isolated and separated patches of habitat.

habitat enhancement: Changes made to a habitat that serve to improve its ecological value and ability to meet the requirements of one of more organisms.

High Conservation Value Forest: A Forest Stewardship Council management designation used to describe forests that meet forest stewardship criteria, including forests that contain rare, threatened and endangered species and ecosystems.

implementation plan: A multiple (typically ten) year plan of activities to meet objective(s).

indicators: Measurable descriptions of Conditions. They define what is measured to keep track of the status of the Condition or Factor attributes.

indicator ratings: Used to place the indicator value in an appropriate context or frame of reference to assess current condition relative to a desired target condition. Ratings provide a range of values that place indicator in three to four categories such as poor, fair, good, and excellent.

invasive species: An organism that causes ecological or economic harm in a new environment where it is not native.

locally-harvested seed: Refers to seed from non-woody species such as grasses, sedges, and forbs which is collected within SDSF whenever possible; when SDSF seed is not available, seed will come from within the county or the multi-county plant zone.

management plan: A written document that provides management guidelines specific to a single site. It includes a description and location of the site; the significance of the site in the landscape or ecological province or subsection; lists significant features related to a site including: rare plants and animals, Species in Greatest Conservation Need (SGCNs), Minnesota Biological Survey (MBS) Sites of Biodiversity Significance, MBS native plant communities, soils and geology, and historic vegetation; provides recommended management practices; outlines on a map locations of development and management needs; and an Implementation Table.

Minnesota Biological Service (formerly MCBS): A program of MNDNR's Ecological and Water Resources Division that inventories the plants and animals of Minnesota, maintains the Natural Heritage Information System (NHIS), produces publications and survey summaries, and provides technical assistance and education.

MBS sites of Biodiversity Significance: A ranking of biodiversity significance for a survey site based on the presence of rare species, condition of native plant communities and landscape location context of the site. Rankings include outstanding, high, moderate or below as an expression of biodiversity significance.

native plant community: A unique plant species composition and structure related to geography, to important ecological processes, and linked to abiotic environmental factors.

oak savanna: A type of savanna, or lightly forested grassland, where oaks are the dominant trees. Typically 10-70% (typically 25-50%) crown closure, these savannas were maintained historically through wildfires set by lightning or humans, grazing, low precipitation, and/or poor soil.

oak woodland: An oak-dominated community with a crown closure of 50% to as much as 70%, intermediate between the more open oak savanna and the more closed oak forest.

oak forest: A more dense and closed forest type dominated by oak trees with a typical crown closure of 70% - 95%.

objectives: Measurable outcomes, results, or targets that aim to maintain or improve the condition of the priority features and/or maintain a factor that affects their condition. Objectives should be SMART (Specific, Measurable, Achievable, Relevant, Time bound) and relate to the condition and factor indicators as well as be directed at the goals or desired future conditions.

prescribed burn: The controlled application of fire to a predetermined area of vegetative fuels, under specified environmental conditions and following appropriate precautionary measures, to achieve specific objectives such as maintaining or enhancing fire-dependent native plant communities (prairies, savannas, woodlands), controlling brush, producing high-quality browse, or reducing fuel hazards.

priority features: the key (priority) ecological and socioeconomic attributes (features or functions) of the site. This is not an exhaustive list of features on the site, but rather they are key components of the site that require management attention and specific objectives.

- An ecological Priority Feature could be the ecosystem, ecological processes, native plant communities, rare features, groups of species, Species in Greatest Conservation Need, Threatened &Endangered species, individual species, other significant natural resources.
- Socioeconomic Priority Features are the public, educational and/or research purposes of the site that need management attention. (Note: "management" as used in this context includes development, management, and administrative activities included in this plan.)

rare features: The general term used to encompass rare plants, rare animals, native plant communities, geologic features, and animal aggregations (such as breeding bird colonies). This includes all State- or Federally-listed endangered, threatened, and special concern species, S1-S3 native plant communities, and colonial waterbird colonies.

restoration: Ecosystem restoration is the process of assisting in the recovery of ecosystems that have been degraded, damaged, or destroyed and focuses on establishing the ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions.

rotation-age harvest: A logging practice in which trees are harvested upon reaching optimal age and/or when attaining maximum economic value, usually associated with an even-aged stand of trees all of the same species. This optimal harvest age tends to be fairly consistent for a given species over a fairly large geographic area and is based on economics, site condition, growth rates, and other factors.

reconstruction: a restoration that includes the conversion of an area where the native plant community has been removed, usually by cultivation for agriculture or other development.

rehabilitation: a restoration that includes enhancement or improvement of an existing native plant community that has endured some degree of disturbance yet still harbors elements of that community.

refugia: an (often localized) area where special environmental circumstances have enabled a species or a community of species to survive through a period of unfavorable conditions or persist after extinction in surrounding areas.

resilience: The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, and feedbacks, and therefore identity (Folke et al. 2010)

selective tree removal: The harvesting of trees in which individual trees or small groups of trees are harvested based on pre-determined objectives and desired results, leaving minimal damage to the remaining stand. This generally results in the removal of about one third of the trees on a given site with

the purpose of improving the growing space for the remaining trees. Selective tree removal in this plan also refers to removing a specific tree species from a given site.

Special Management Unit: An area of land with specific goals or objectives that typically is managed or monitored differently than the surrounding area and typically has features or resources that warrant additional attention.

Species in Greatest Conservation Need (SGCN): An official statewide designation for native animals whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability. All states are required to maintain a SGCN list and Wildlife Action Plan to receive certain federal funding.

stem density: Measure of the density of a stand of trees based on the number of trees per unit area. In forestry, also defined as the degree of crowding within stocked areas, using various growing space ratios based on crown length or diameter, tree height or diameter, and spacing.

subcanopy: The layer of a forest immediately beneath the upper layer of forest cover commonly referred to as the canopy, which can include or refer to an area directly below a single tree or group of trees. The subcanopy is comprised of trees (and tall shrubs) that do not reach as high as the tallest trees (often termed dominants or co-dominants) in the forest.

Sustainable Forestry Initiative© (SFI): A North American 'forest certification standard' and program of SFI Inc., a non-profit organization. The Sustainable Forestry Initiative is the world's largest single forest certification standard by area of land under certification. It is considered a commitment to sustainable forest management protecting water quality, soil, wildlife and unique resources; promoting human health and safety; providing employee training and education; and communicating the benefits of the practice of *sustainable forestry* to the general public.

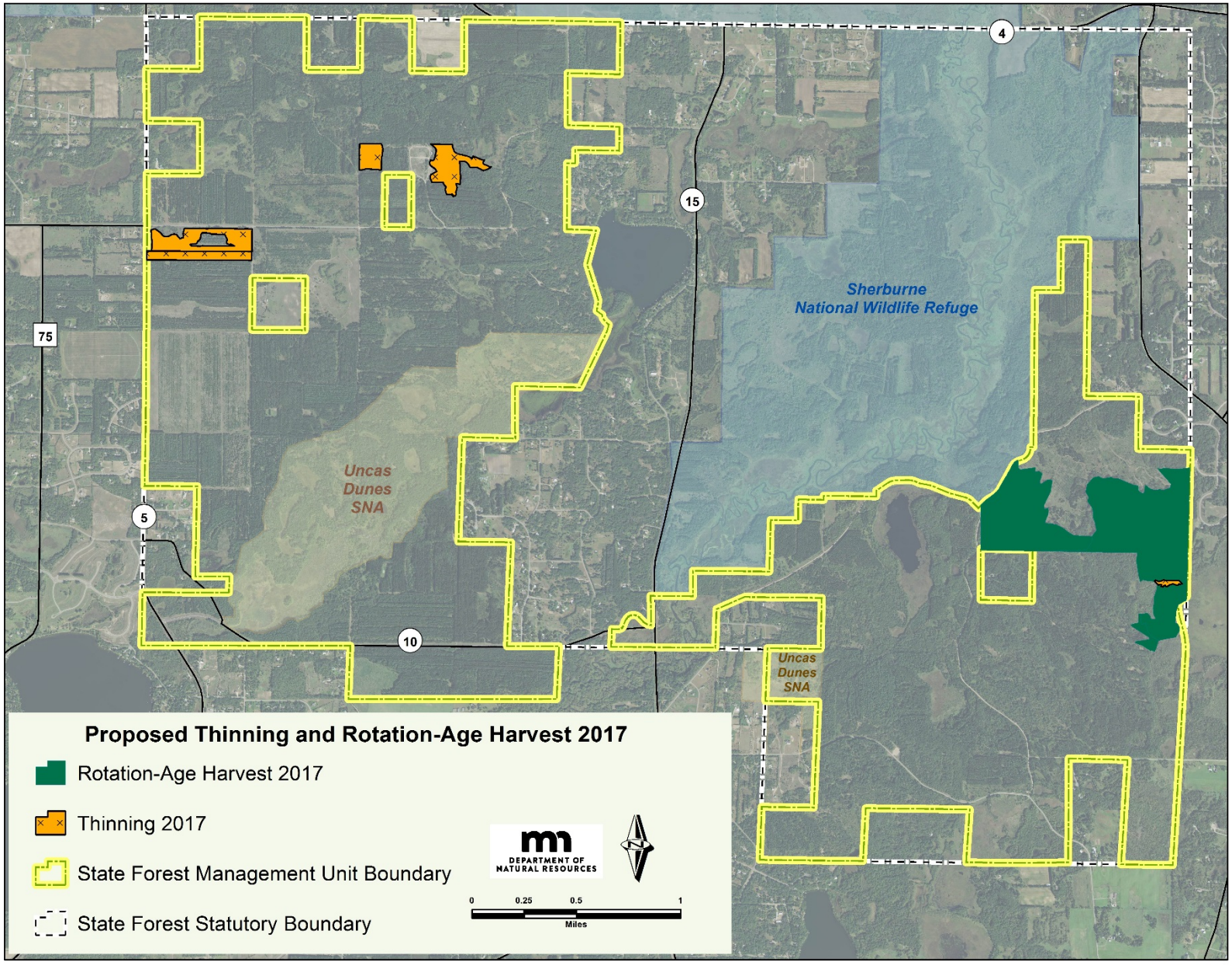
thinning: A silvicultural treatment made to reduce the density of trees within a forest stand primarily to improve growth rates of the remaining trees or utilize potential mortality (e.g., selective thinning, row thinning).

Wildlife Action Network. Mapped aquatic and terrestrial habitats, buffers, and connections that represent a diversity of quality habitats that contain populations of Species in Greatest Conservation Need.

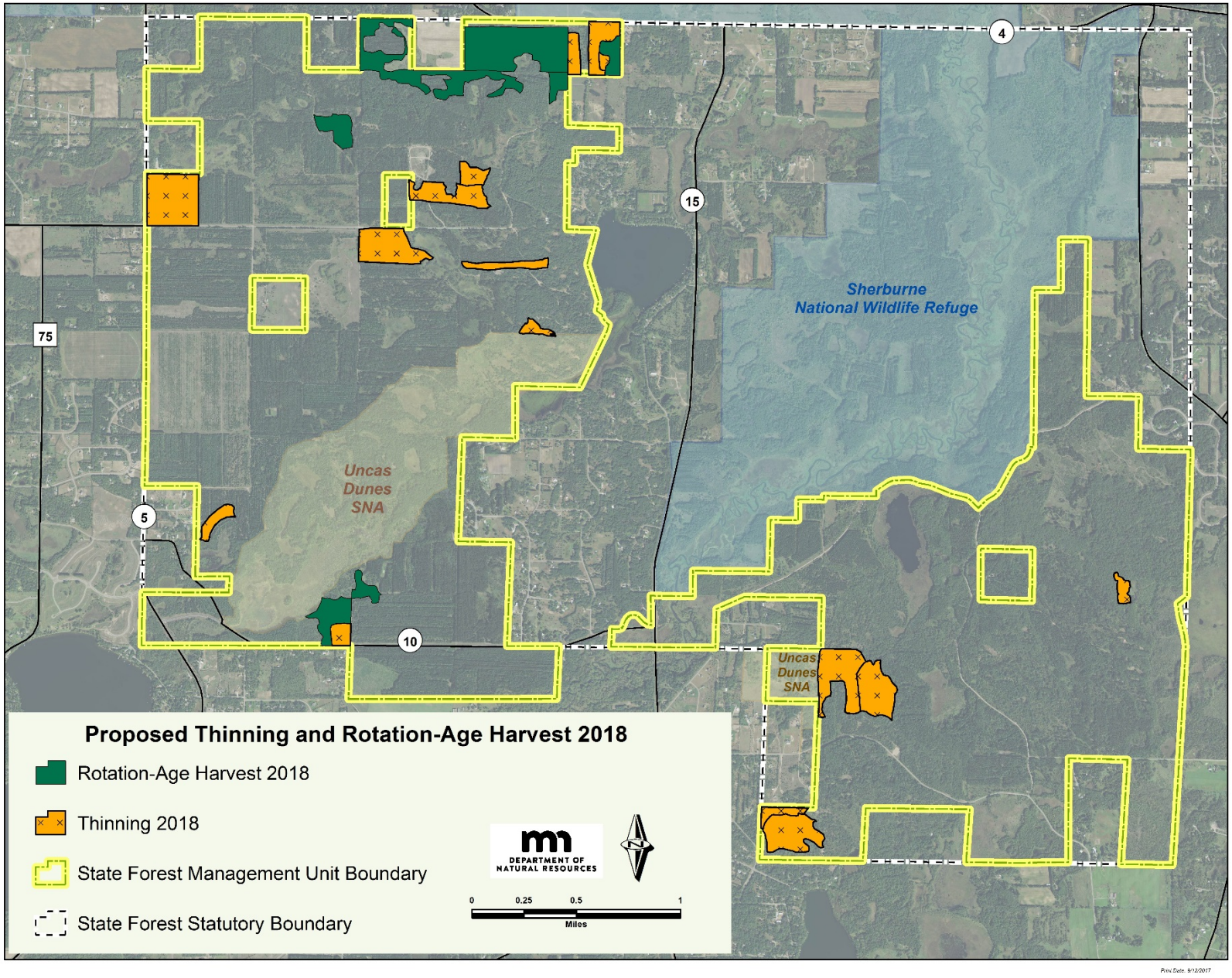
VI. Maps

- Proposed vegetation management: thinning and rotation-age harvest for 2017-2022
  - Map 1: 2017 proposed thinning and rotation-age harvest
  - Map 2: 2018 proposed thinning and rotation-age harvest
  - Map 3: 2019 proposed thinning and rotation-age harvest
  - Map 4: 2020 proposed thinning and rotation-age harvest
  - Map 5: 2021 proposed thinning and rotation-age harvest
  - Map 6: 2022 proposed thinning and rotation-age harvest
- Summary of proposed harvest actions for 2017-2022:
  - Map 7: Summary of proposed thinning, 2017-2022
  - Map 8: Summary of proposed rotation-age harvest, 2017-2022
  - Table 4: Total acres of proposed thinning and rotation-age harvest, by year, 2017-2022
- Map 9: Summary of acres sold in 2013-2016, but not yet harvested (as of March 2017)
- Proposed vegetation management: habitat enhancement for 2017-2022
  - Map 10: Proposed habitat enhancement for SDSF, 2017-2022
  - Table 5: Detailed descriptions of proposed habitat enhancement actions
- Map 11: Population Block Group Density (from American Community Survey, 2013)
- Map 12: Topological Relief and Dunes in SDSF
- Map 13: Bearing Trees from the 1848–1907 Public Land Survey (Marschner 1974)
- Map 14: Recreational Features in SDSF
- Map 15: High Conservation Value Forest (HCVF) in SDSF
- Map 16: Permanent School Trust Land (shown by 40-acre parcel)
- Map 17: Cover Types in Northern SDSF, Forest Inventory Management (FIM) Database, 2017
- Map 18: Cover Types in Southern SDSF, Forest Inventory Management (FIM) Database, 2017

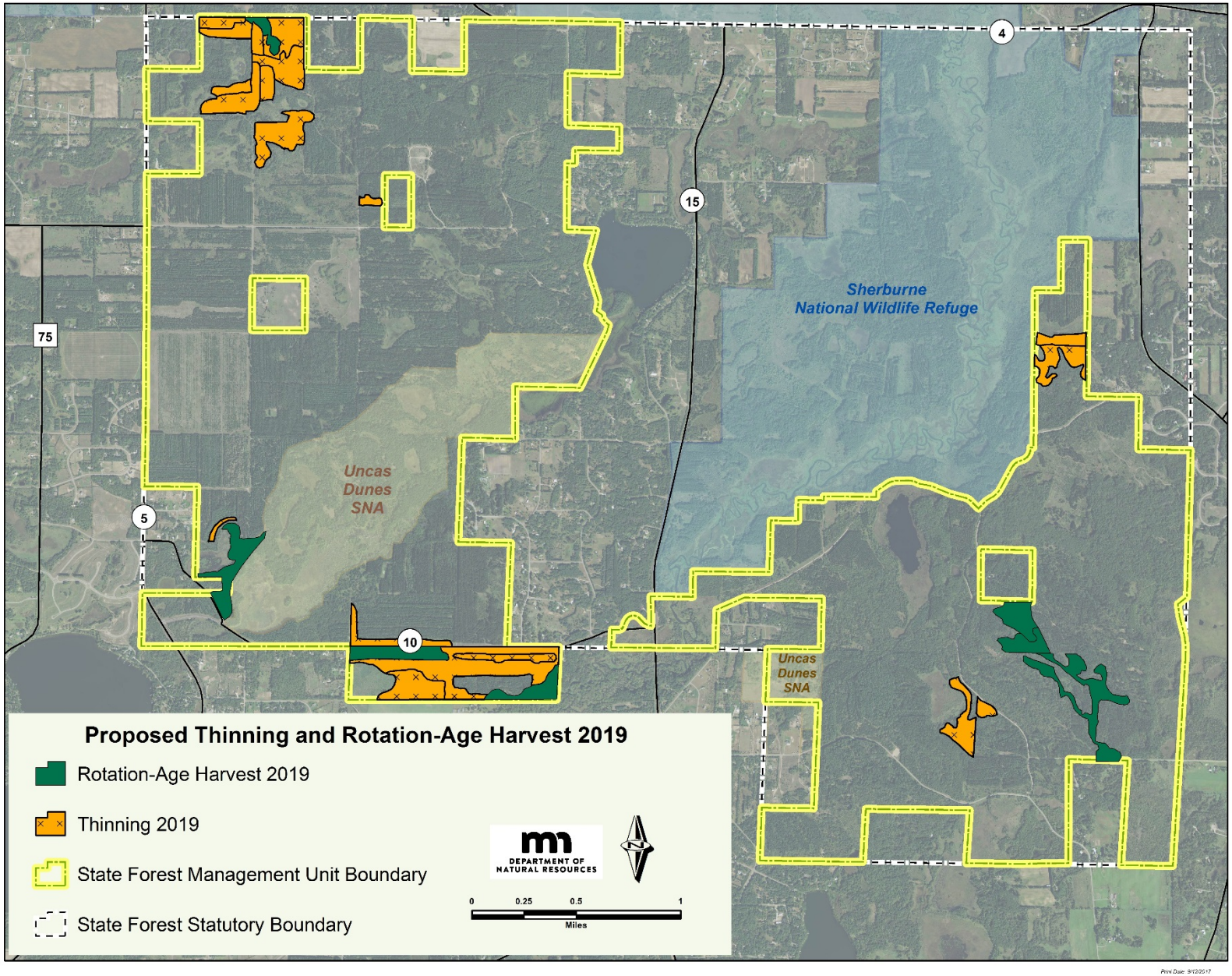
Map 1: Proposed Thinning and Rotation-Age Harvest, 2017



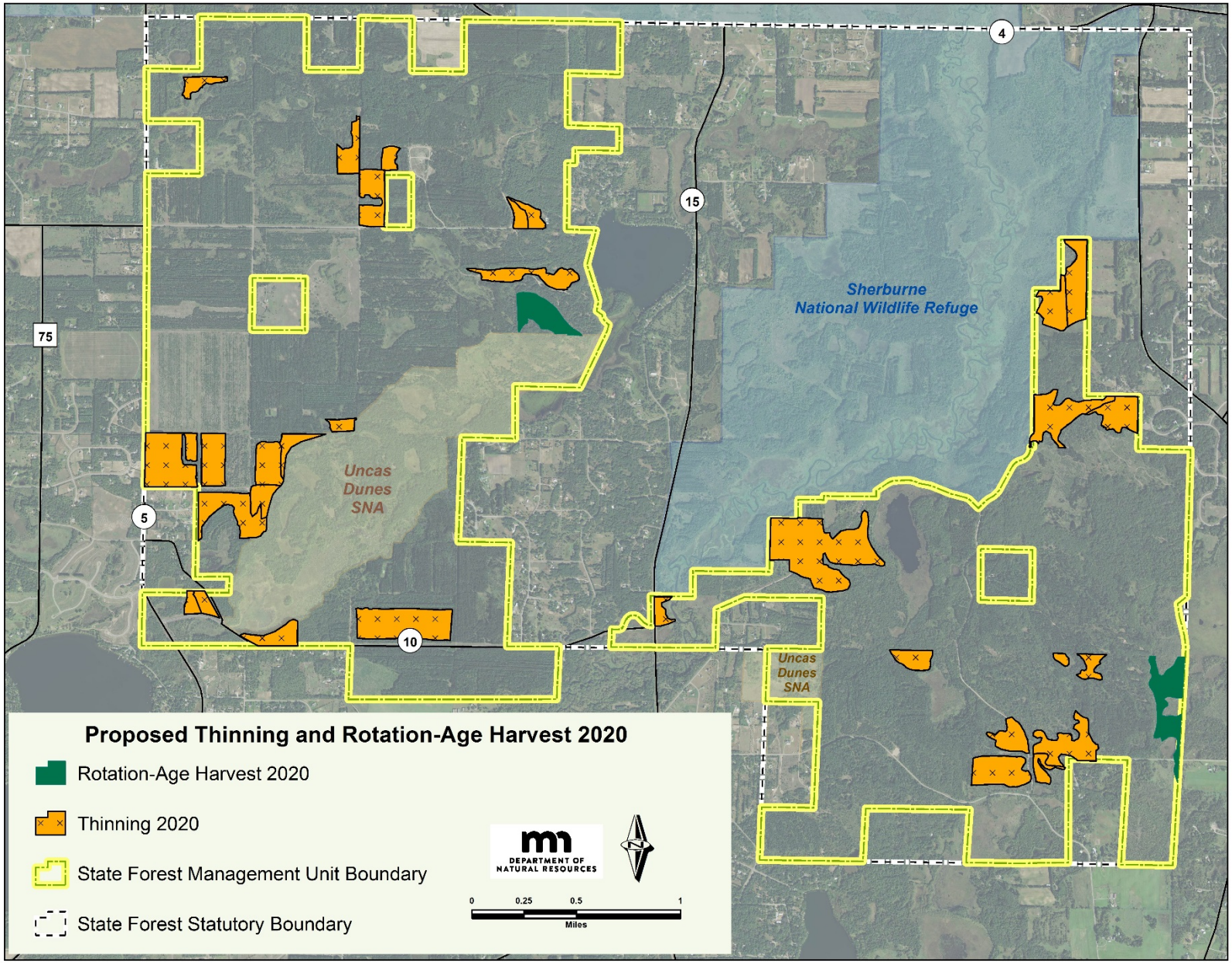
Map 2: Proposed Thinning and Rotation-Age Harvest, 2018



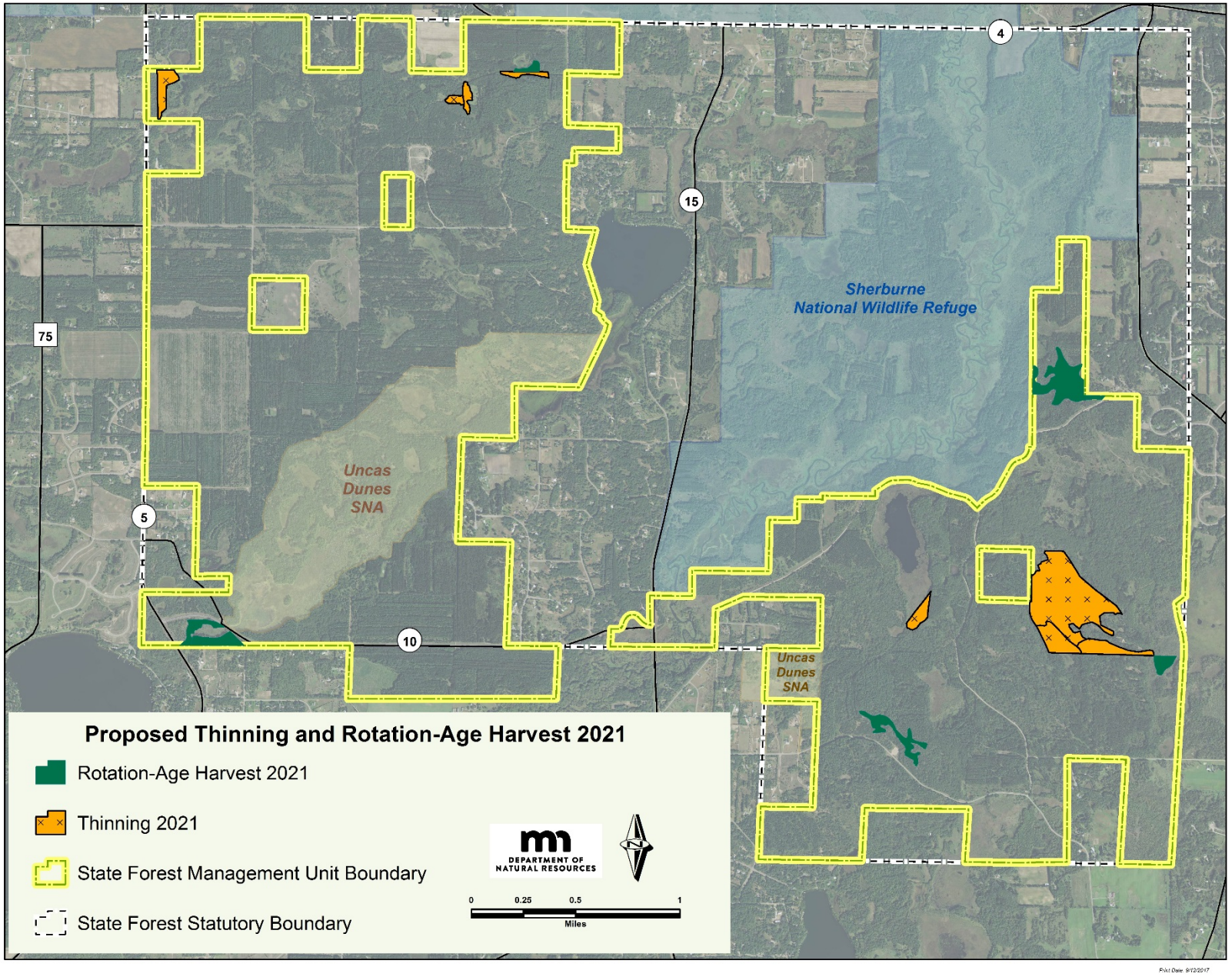
Map 3: Proposed Thinning and Rotation-Age Harvest, 2019



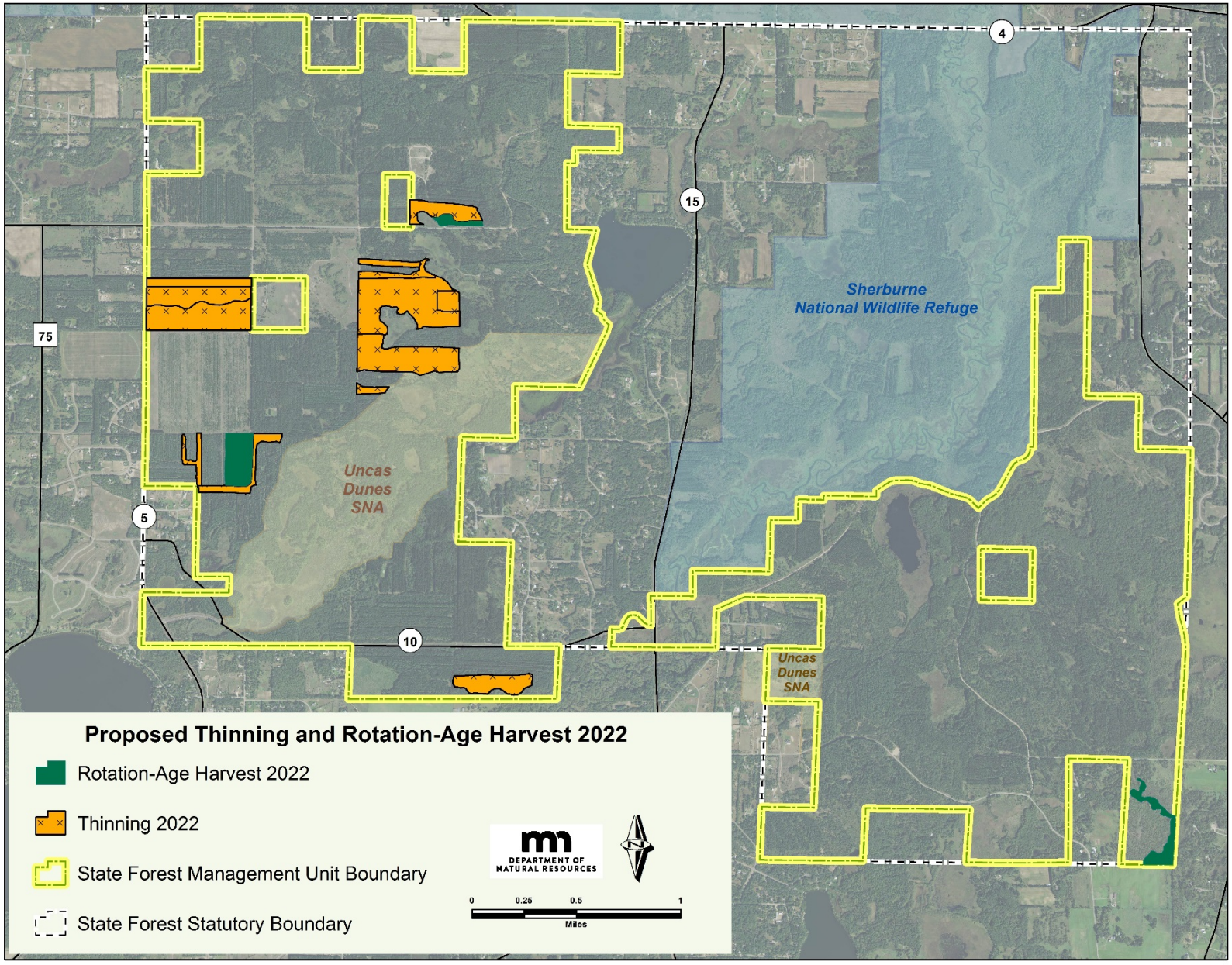
Map 4: Proposed Thinning and Rotation-Age Harvest, 2020



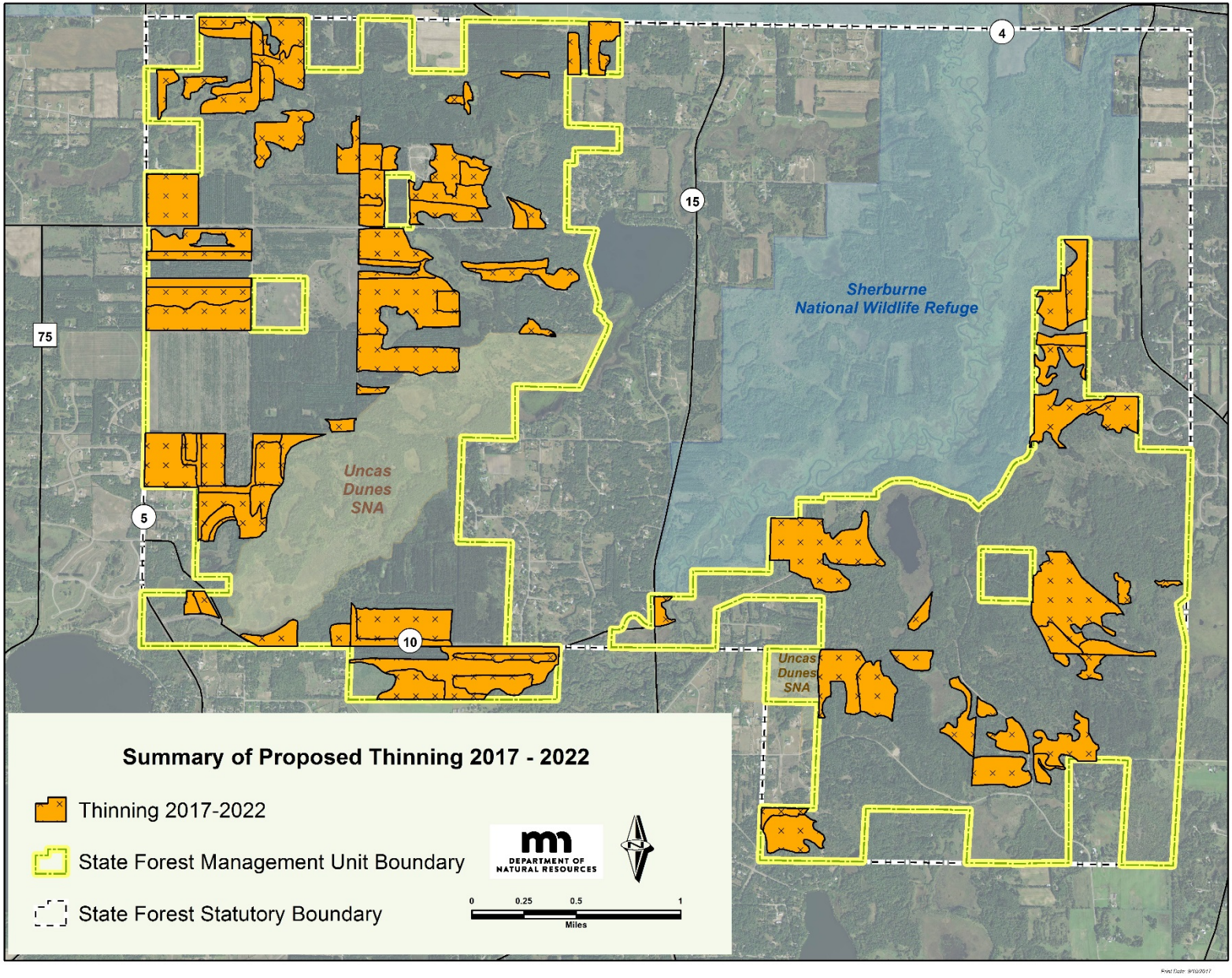
Map 5: Proposed Thinning and Rotation-Age Harvest, 2021



Map 6: Proposed Thinning and Rotation-Age Harvest, 2022



Map 7: Summary of Proposed Thinning, 2017-2022



Map 8: Summary of Proposed Rotation-age Harvest, 2017-2022

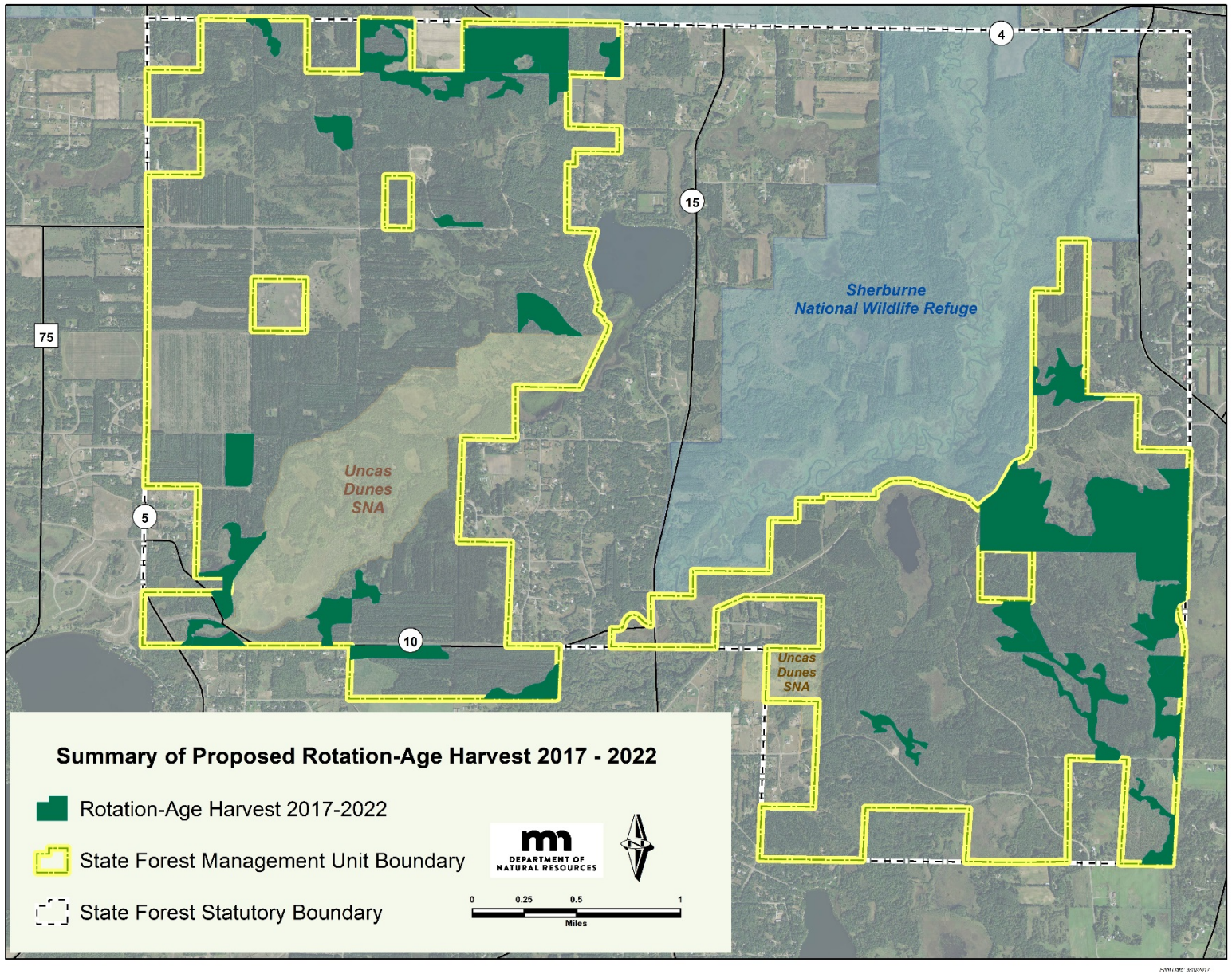
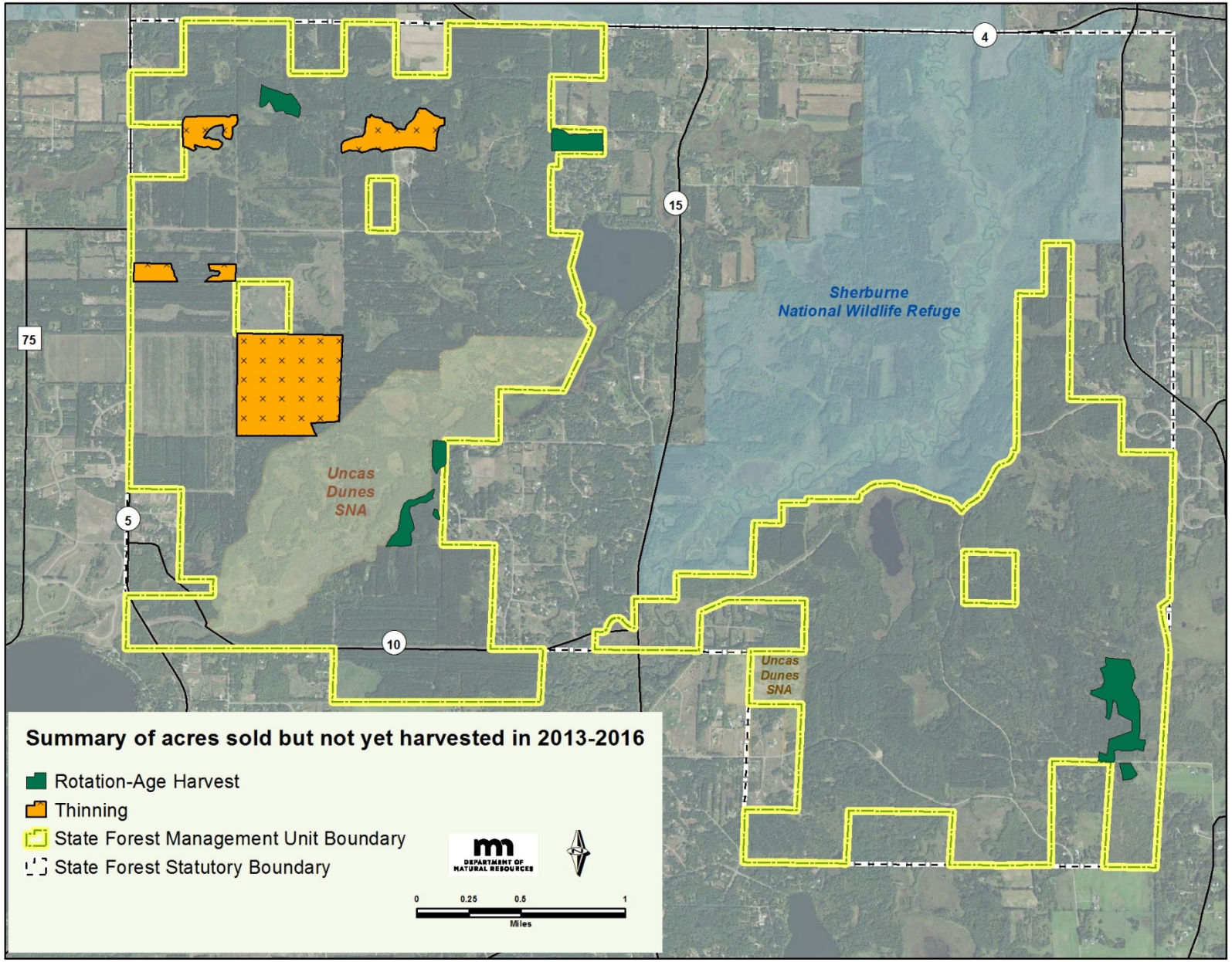


Table 4: Total acres of proposed thinning and rotation-age harvest, by year, 2017-2022 (Maps 7 and 8)

Fiscal Year	Rotation-age Harvest (acres)	Thinning (acres)
2017	234	80
2018	156	273
2019	124	267
2020	50	536
2021	50	108
2022	65	256
Total	**654**	**1,443**

Map 9: Summary of acres sold in 2013-2016, but not yet harvested (as of March 2017)



Map 10: Proposed Habitat Enhancement, 2017-2022

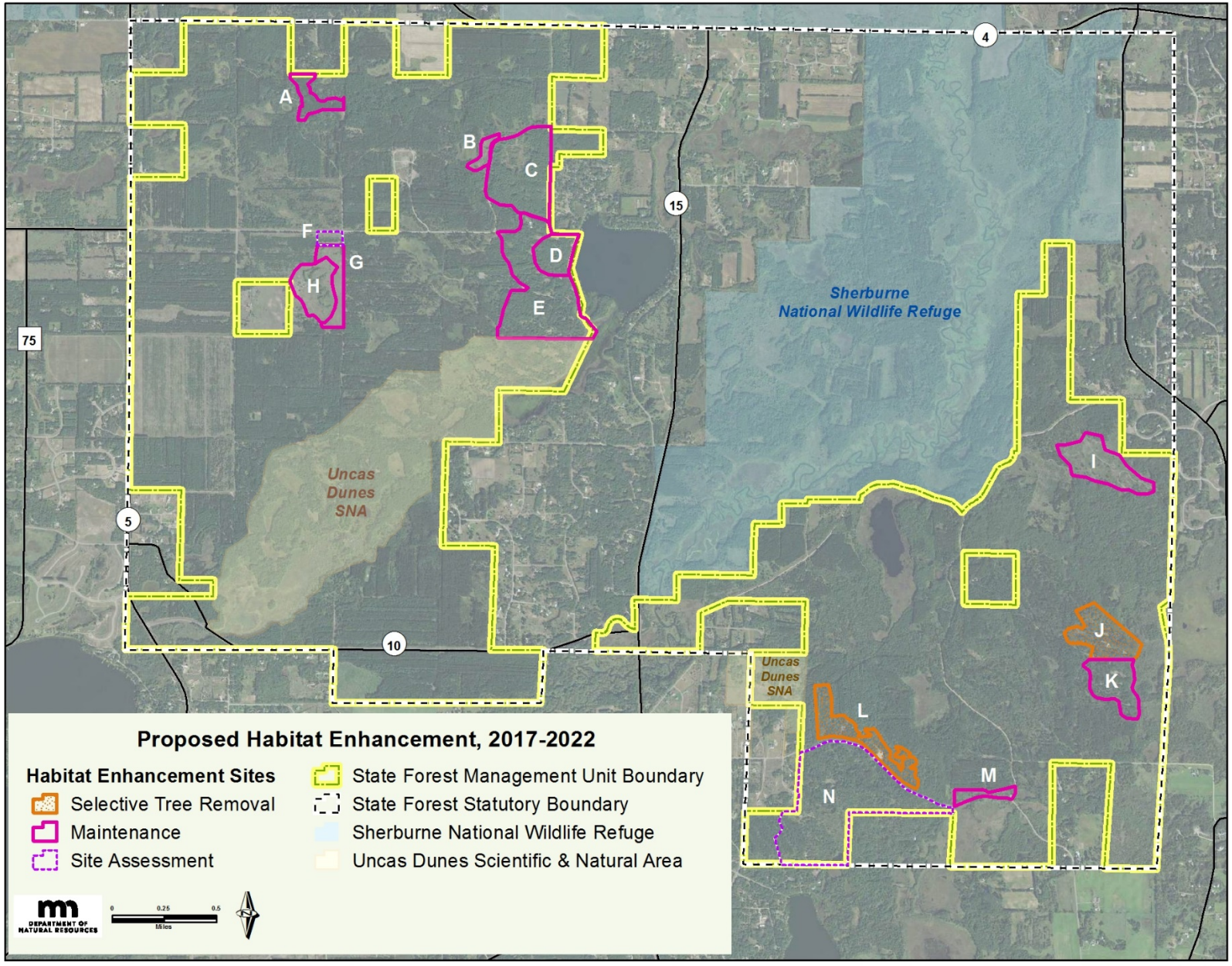


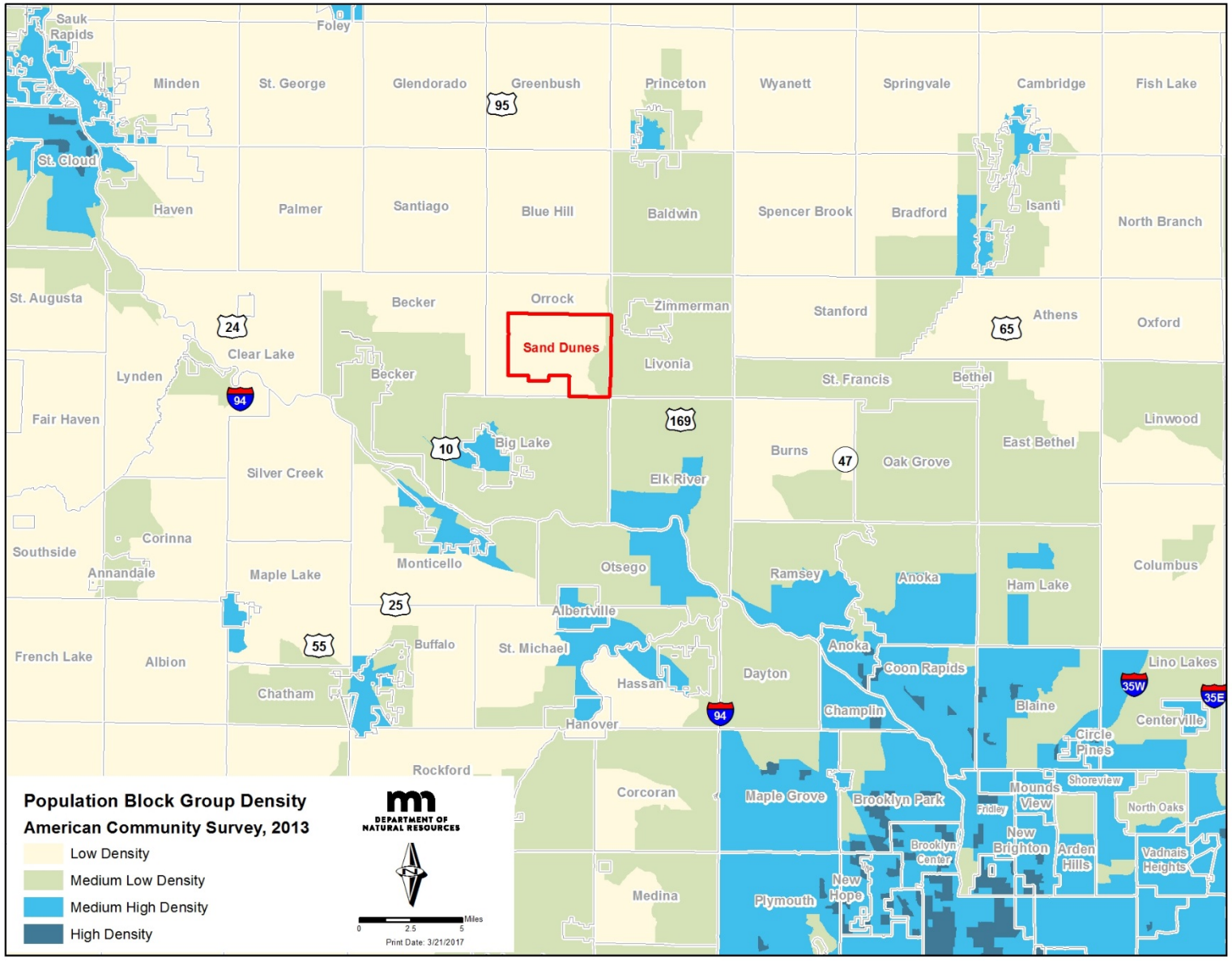
Table 5: Detailed descriptions of proposed habitat enhancement actions (Map 10)

Map 10 Label	Acres	10 year management plan	Comments/Challenges/Management Practices
A	15	Restore understory to oak savanna native plant species post timber harvest. Invasive species survey, invasive species control, site assessment, rare plant surveys, slash removal, install mineral fire breaks, prescribed fire, possible seeding	Site has been harvested recently. Slash left from the commercial timber harvest will be removed or piled and burned. Assess site after management work for native seed regeneration. If poor regeneration seeding may be needed.
B	6	Restore to oak savanna post timber harvest. Invasive species survey, invasive species control, silvicultural assessment, fuel reduction, prescribed fire, seeding	Site has been harvested recently and restoration is needed. Invasive species removed and treated and/or burned. The site will be monitored for invasive species. Mineral soil burn break installed along north boundary of units. Will most likely require native seeding, there are potential remnant savanna seed sources nearby.
C	70	Site assessment, possible invasive species control, silvicultural assessment, rare features survey, possible prescribed burn and seeding	Site is with Bob Dunn and contains Trust Lands
D	21	Follow-up on Invasive species surveys with invasive species control, silvicultural assessment, rare features assessment	Site is within Bob Dunn. Garlic mustard, Siberian pea shrub, requires treatment; steep slopes present so work must take this into consideration.
E	116	Follow-up on Invasive species surveys with invasive species control, assess for prescribed burn, special considerations for camp ground	Site is within Bob Dunn
F	5	site assessment; possible invasives removal, future management planning	Cow vetch treatment.
G	17	Invasive species survey, rare plant surveys, prescribed burn	Site management plan drafted
H	30	Invasive species survey, rare plant surveys, prescribed burn	Site management plan drafted

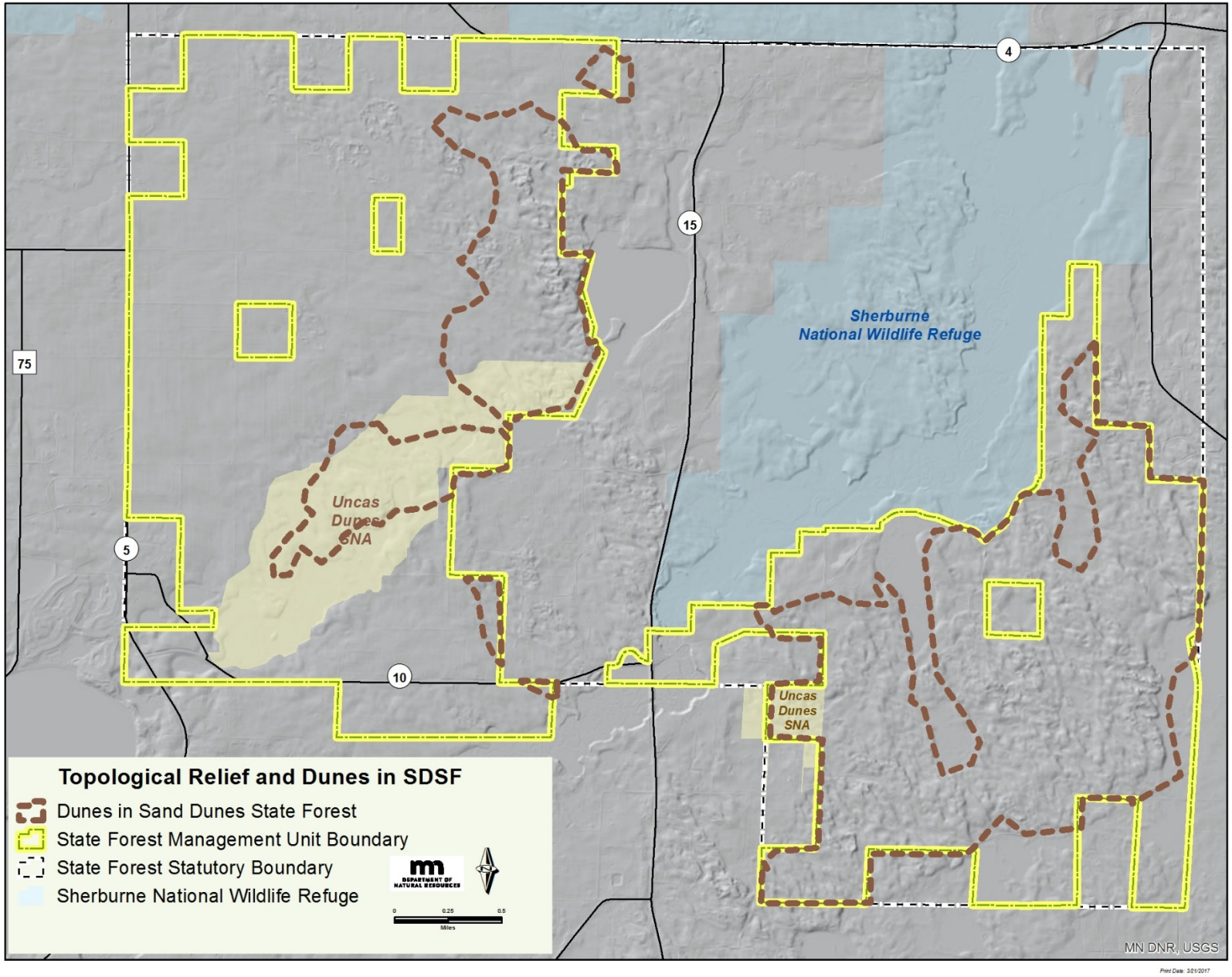
Map 10 Label	Acres	10 year management plan	Comments/Challenges/Management Practices
I	41	Invasive species survey, invasive species control, prescibed burn units determined, fuel reduction, prescribed fire, possible seeding	Site is already open habitat. Burn and invasive treatment are priorities, followed by an assessment of management needs after those actions are implemented; mineral fire break needed on north site of site and burn unit subdivision needed; remove remaining wood chip piles before burning; leave aspen around wet areas.
J	36	Site assessment, invasive species survey, invasive species control, silvicultural assessment, rare features survey, possible commercial timber harvest, possible prescribed fire, seeding	Oak woodland should be sought on north sides of slopes and lower pockets. Dunes faces and summits should be maintained open.
K	31	Site assessment, invasive species survey, invasive species control, silvicultural assessment, rare features survey, possible commercial timber harvest, slash removal, possible prescribed fire, possible seeding	Site was recently harvested, and site restoration is needed. Trust fund site, management beyond reparation and maintenance will wait until trust status determinations are made. Dunes faces and summits will be maintained in sparse grasses/open. Approximately 4 acres remain to be harvested in current sale. North-facing slopes can be burned to encourage grass on unstable slopes. Creative patch burns are desired. Monitoring North-facing slopes is needed in the future. This site cannot support further soil disturbance from heavy machinery. Remaining slash and debris will need to be removed sufficient to permit a prescribed burn in the area in the future. All mounds of slash and debris that have been mounded along and around logging roads need to be removed by hand.
L	37	Site assessment, invasive species survey, invasive species control, silvicultural assessment, commercial timber harvest (thinning)	This unit is scheduled for a commercial thinning. unit and follow-up invasive species treatment.

Map 10 Label	Acres	10 year management plan	Comments/Challenges/Management Practices
M	8	Site assessment, invasive species survey, invasive species control, rare features survey, possible commercial timber harvest, possible prescribed fire	Invasive species needs to be removed and then site assessed for further management needs.
N	219	Site assessment, invasive species survey, invasive species control, silvicultural assessment, rare features survey, possible commercial timber harvest, possible prescribed fire, possible seeding	Some of this site was recently harvested and has not been assessed since. Site needs to be assessed for further management direction and order of operations.

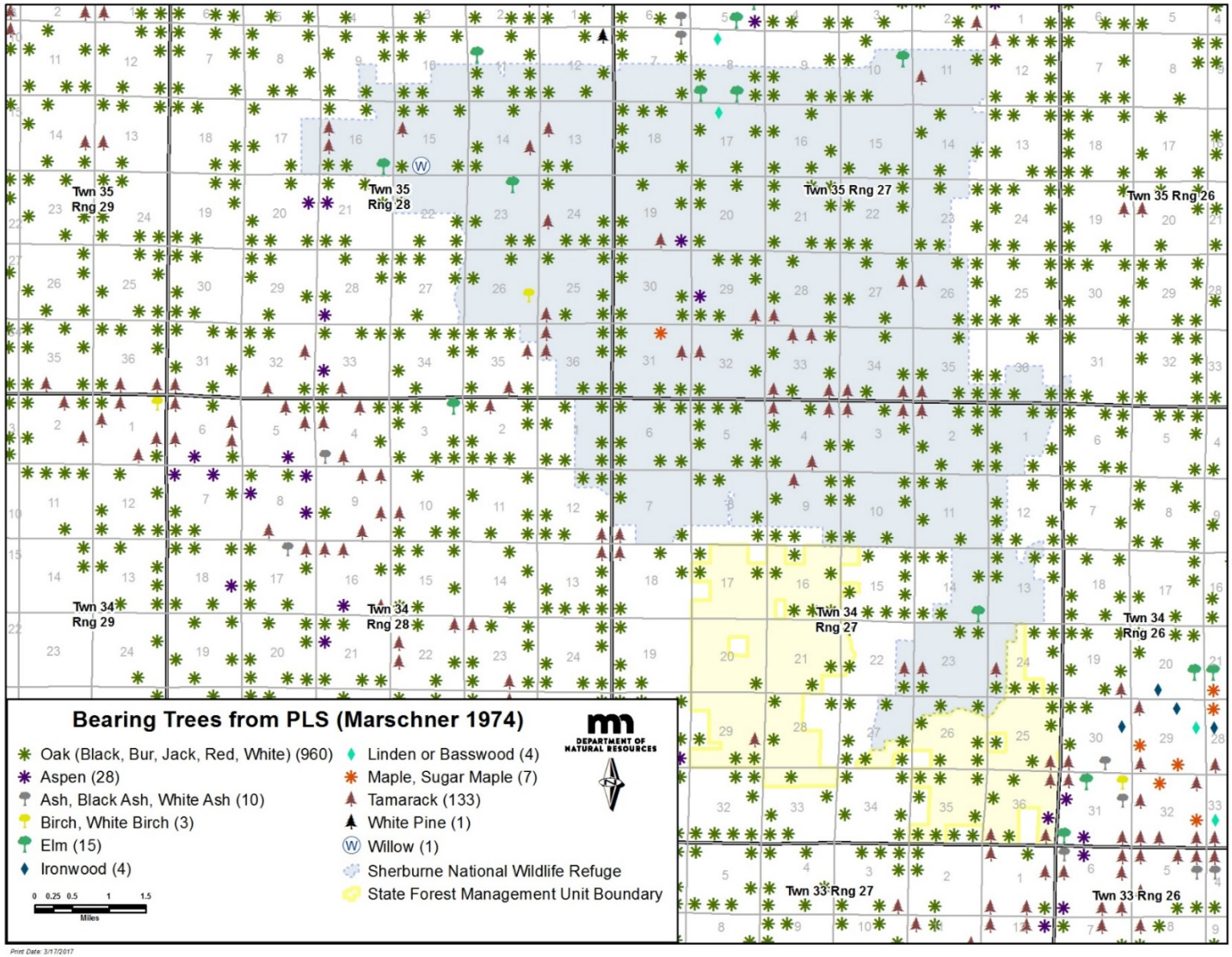
Map 11: Population Block Group Density (from American Community Survey, 2013)



Map 12: Topological Relief and Dunes in SDSF

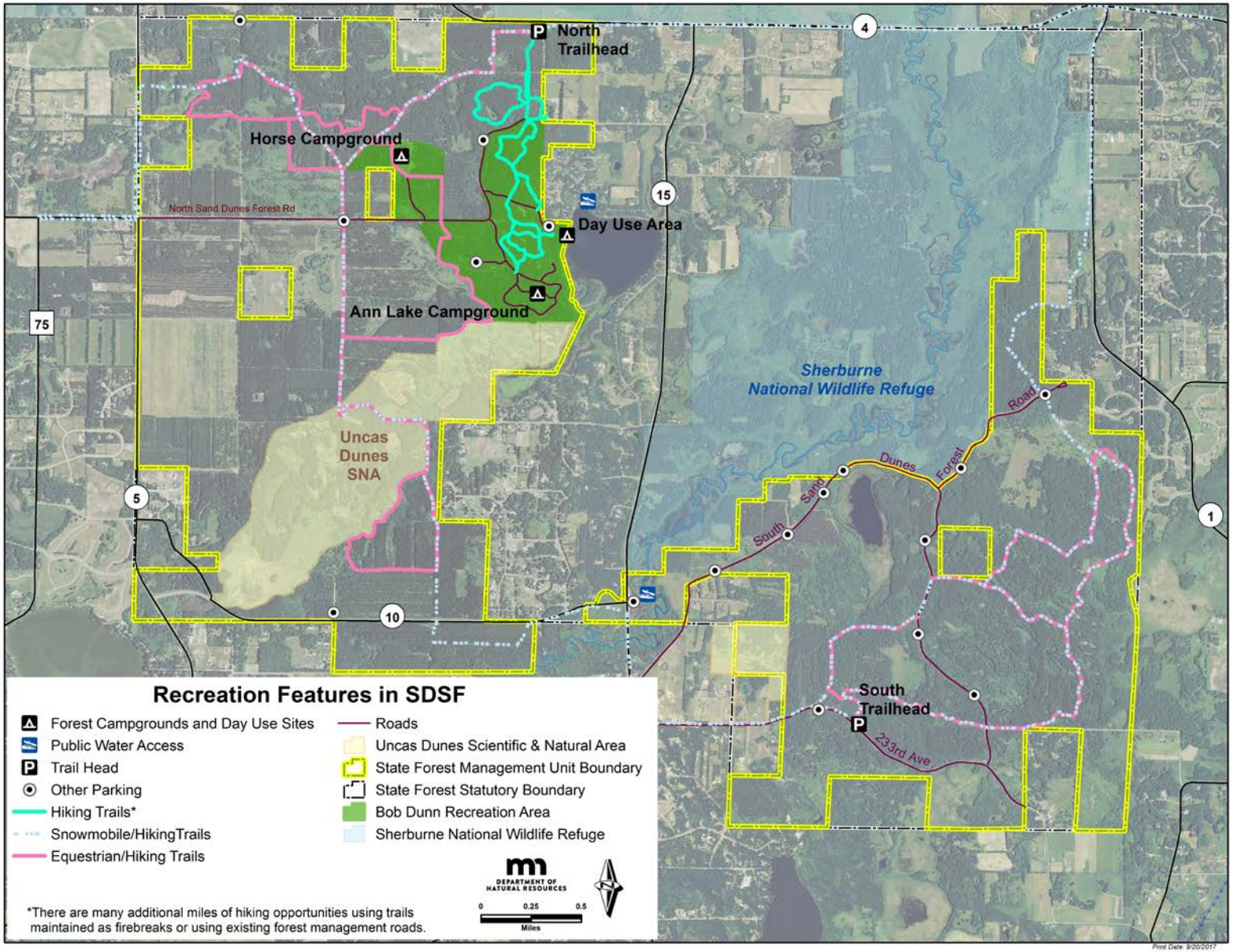


Map 13: Bearing Trees from the 1848–1907 Public Land Survey (Marschner 1974)

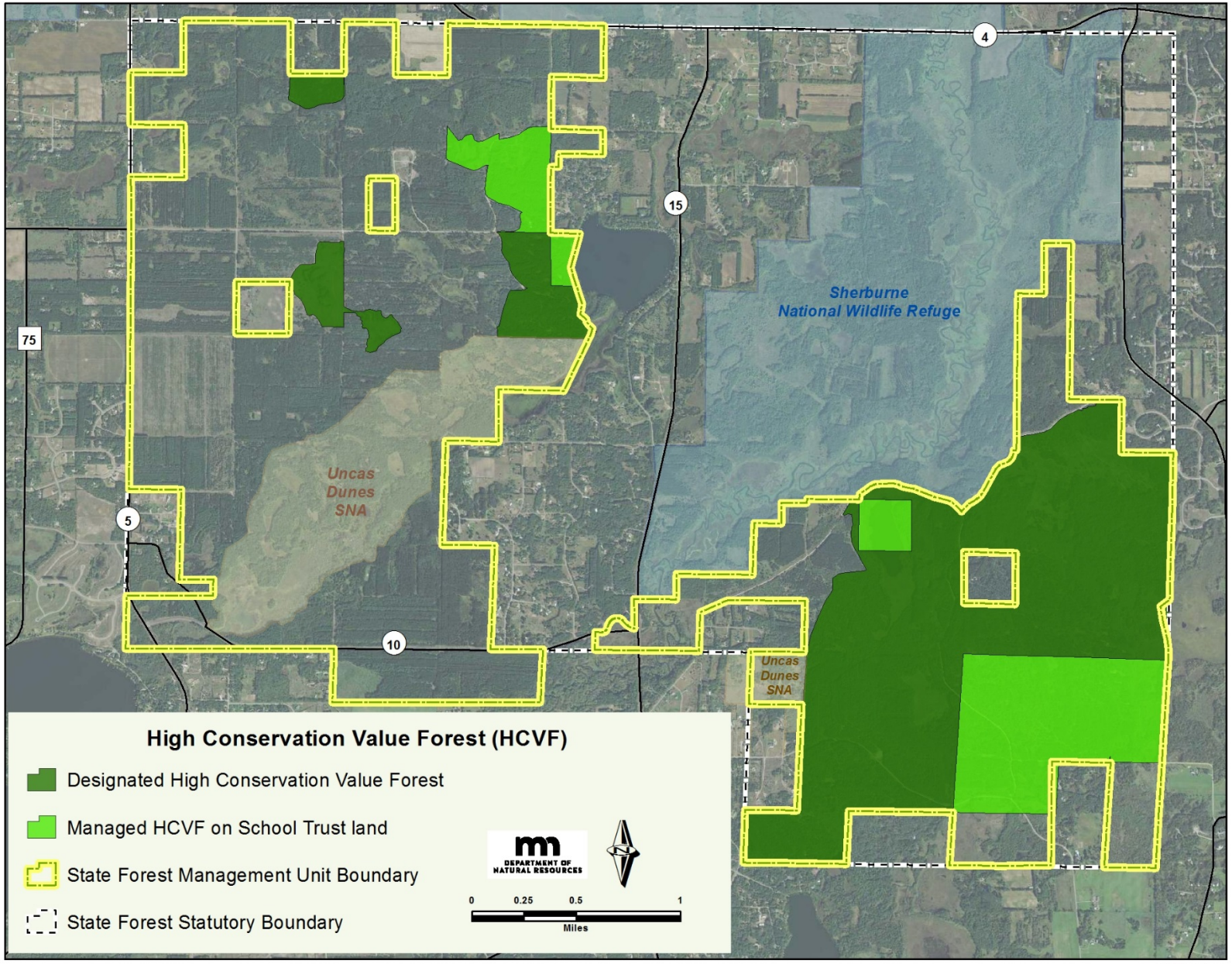


Note: This map shows bearing trees chosen during the late 19th century Public Land Survey (PLS). PLS records include bearing trees, meander trees, line trees, note trees, and the trees listed in summary of each mile of line surveyed. These records suggest that the only forests and timber in SDSF occurred either in swamp forests or in the bottoms of the St. Francis River. Most of the area was occupied by brushland or widely spaced trees variously described as openings, oak barrens, scattering of oak, or thickets. Extremely flat portions of SDSF were described as open prairie, including the Craig Prairie as documented on the survey plat and in the Geological and Natural History Survey of Minnesota (Winchell and Upham ca. 1882).

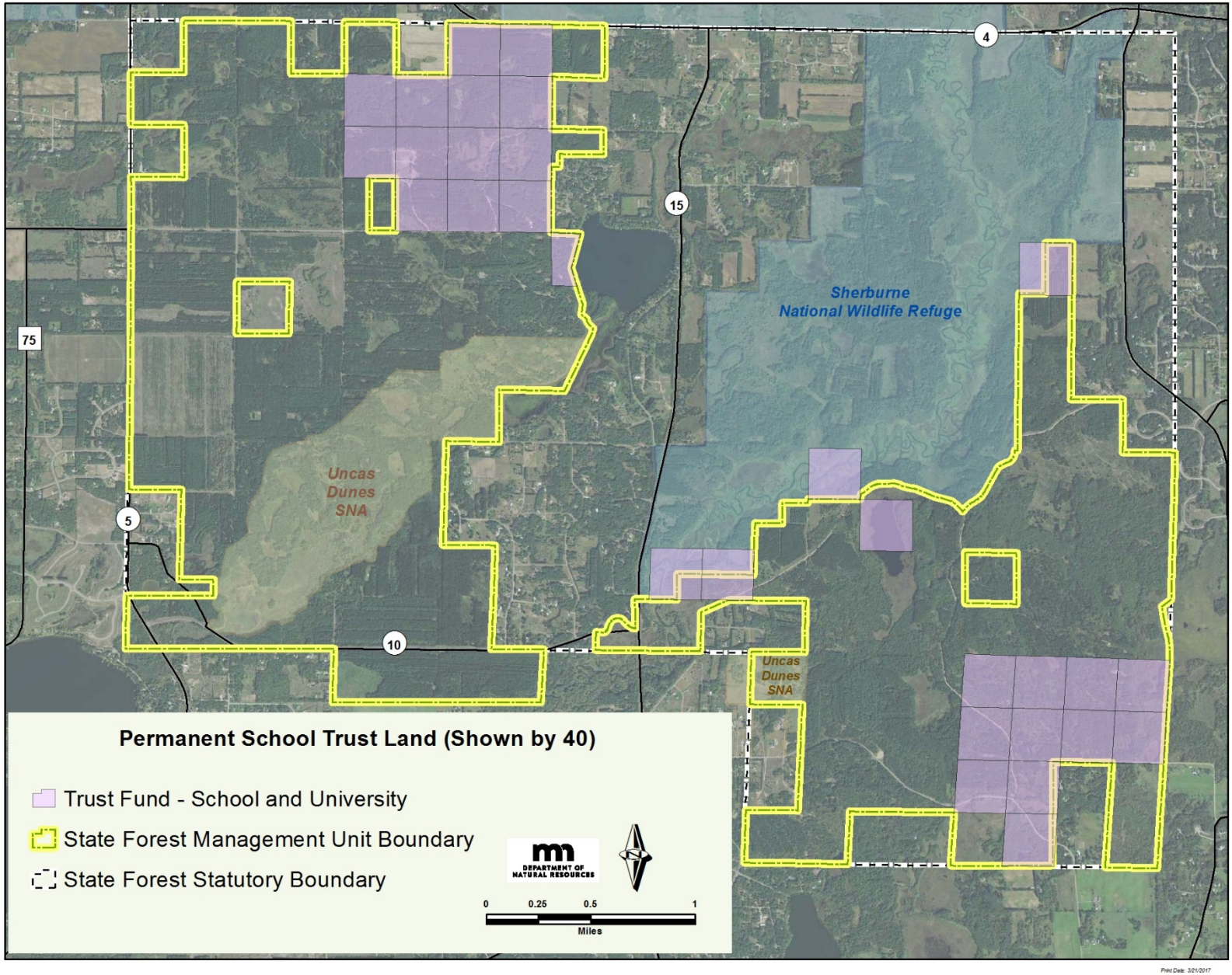
Map 14: Recreation Features in SDSF



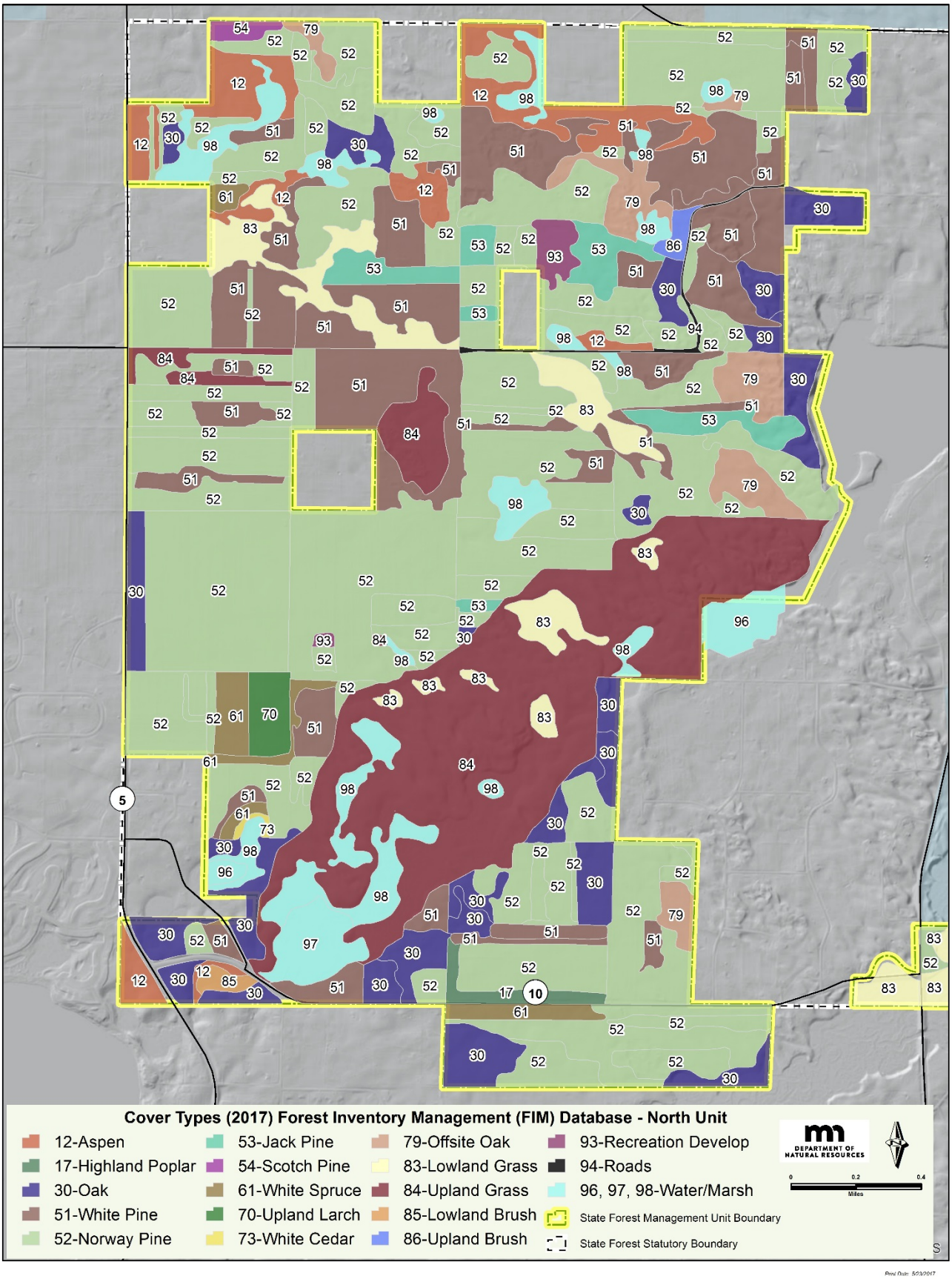
Map 15: High Conservation Value Forest (HCVF) in SDSF



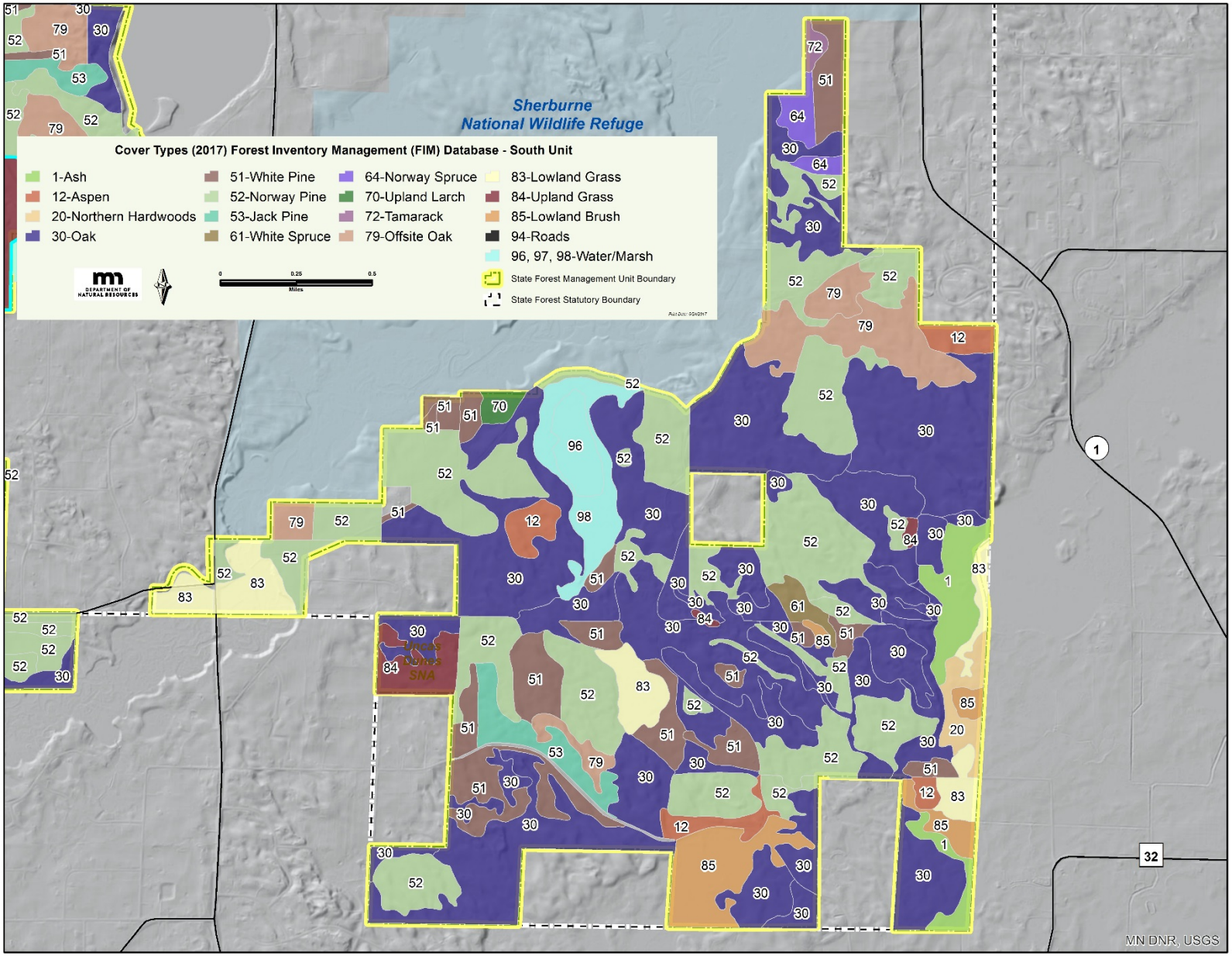
Map 16: Permanent School Trust Land (shown by 40-acre parcel)



Map 17: Cover Types in Northern SDSF, Forest Inventory Management (FIM) Database, 2017



Map 18: Cover Types in Southern SDSF, Forest Inventory Management (FIM) Database, 2017



VII. Appendices

Appendix A: General Direction Statements from the Anoka Sand Plain SFRMP

The overall desired management objective of the Sand Dunes State Forest (SDSF) is broad ecosystem health that balances opportunities to enhance recreation, economic investments, water quality, biodiversity, and wildlife habitat. This objective is reflective of the management direction laid out in the Anoka Sand Plain Subsection Forest Resources Management Plan (SFRMP), the guiding document for the landscape which surrounds and encompasses SDSF.

The following statements are drawn from the Anoka Sand Plain SFRMP, and reflect the objectives of the SDSF operational plan (MN DNR 2012).

- Some stands on state lands will be managed to reflect the composition, structure, and function of native plant communities.
- Species, age, and structural diversity within some stands will be maintained or increased.
- The SFRMP treatment level for each cover type moves toward the desired age-class structure of even-age managed cover types (both normal and extended rotation forest), and improves the age-structure of managed forest areas and Native Plant Communities of uneven-age managed cover types.
- The harvest of non-timber forest products is managed to provide a sustainable supply for humans while providing for wildlife habitat and biodiversity.
- Old forest in this subsection is distributed across the landscape to account for timber products, wildlife habitat, and ecological diversity.
- Species in Greatest Conservation Need and Key Habitats are maintained or enhanced in the subsection.
- Forest cover-type composition on state lands moves closer to the range of cover-type composition that historically occurred within the ecosystems found in the subsection.
- Managers of state lands in MCBS sites of statewide biodiversity significance implement measures to sustain or minimize the loss to the biodiversity significance factors on which these MCBS sites were ranked
- Rare native plant communities are protected, maintained, or enhanced in these subsections.
- Even-age managed cover types will be managed to move toward a balanced age-class structure.
- ERF stands in even-age managed cover types will be managed to achieve a declining age-class structure from the normal rotation age to the maximum rotation age
- State lands will include representation of each of the Native Plant Community growth stages that historically occurred in these subsections.
- Adequate habitat and habitat components exist, simultaneously at multiple scales, to provide for nongame species found in these subsections.
- Adequate habitat and habitat elements exist, simultaneously at multiple scales, to provide for game species found in these subsections.
- Riparian areas are managed to provide critical habitat for fish, wildlife, and plant species.
- Reduce the negative impacts caused by exotic species on forest vegetation on state forest lands.
- Forest management on state lands adequately protects wetlands and seasonal ponds.

- Timber productivity and quality on state timber lands is increased.
- Limit damage to forests from native and introduced insects and diseases to acceptable levels where feasible.
- Reduce the negative impacts caused by wildlife species on forest vegetation on state forest lands.
- Forest management on state lands attempts to mitigate global climate change effects on forest lands. Management is based on our current knowledge and will be adjusted based on future research findings.
- Cultural resources will be protected on state-administered lands.
- Natural disturbance events that occur on state land within these subsections are promptly evaluated to determine the appropriate forest management needed to respond to impacts.
- Continue to use prescribed fire as a forest vegetation management tool in the Anoka Sand Plain subsection
- The changing structural development and urbanization pattern will be considered as forest management is implemented in the subsection.
- Continue to cooperate and coordinate with adjacent land owners (public and private) supporting the overall multiple use and enjoyment concept that applies to state administered land.

Appendix B: Rare or Specially Protected Species of Sand Dunes State Forest

Group	Common Name	Scientific Name	State Status	Federal Status
Bird	American Bittern	*Botaurus lentiginosus*	SGCN	
Bird	American Kestrel	*Falco sparverius*	SGCN	
Bird	American White Pelican	*Pelecanus erythrorhynchos*	SPC	
Bird	Bald Eagle	*Haliaeetus leucocephalus*	NL	protected*
Bird	Belted kingfisher	*Megaceryle alcyon*	SGCN	
Bird	Black-billed Cuckoo	*Coccyzus erythropthalmus*	SGCN	
Bird	Brown Thrasher	*Toxostoma rufum*	SGCN	
Bird	Chimney Swift	*Chaetura pelagica*	SGCN	
Bird	Common Gallinule	*Gallinula galeata*	SPC	
Bird	Common Loon	*Gavia immer*	SGCN	
Bird	Eastern Towhee	*Pipilo erythrophthalmus*	SGCN	
Bird	Eastern Whip-poor-will	*Antrostomus vociferus*	SGCN	
Bird	Field Sparrow	*Spizella pusilla*	SGCN	
Bird	Golden-winged Warbler	*Vermivora chrysoptera*	SGCN	
Bird	Grasshopper Sparrow	*Ammodramus savannarum*	SGCN	
Bird	Henslow's Sparrow	*Ammodramus henslowii*	END	
Bird	Hooded Warbler	*Setophaga citrina*	SPC	
Bird	Lark Sparrow	*Chondestes grammacus*	SPC	
Bird	Least Bittern	*Ixobrychus exilis*	SGCN	
Bird	Loggerhead Shrike	*Lanius ludovicianus*	END	
Bird	Northern Harrier	*Circus cyaneus*	SGCN	
Bird	Northern Pintail	*Anas acuta*	SGCN	
Bird	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	SGCN	
Bird	Olive-sided Flycatcher	*Contopus cooperi*	SGCN	
Bird	Peregrine Falcon	*Falco peregrinus*	SPC	
Bird	Prothonotary Warbler	*Protonotaria citrea*	SGCN	
Bird	Purple Martin	*Progne subis*	SPC	
Bird	Red-headed Woodpecker	*Melanerpes erythrocephalus*	SGCN	
Bird	Red-necked Grebe	*Podiceps grisegena*	SGCN	
SGCN	Species in Greatest Conservation Need (MN DNR 2016)			
NL	Not Listed			
*	Protected specially under the Bald and Golden Eagle Protection Act			
**	As of March2017 this status is petitioned for this species			
MBTA	Protected under the Migratory Bird Treaty Act			
SPC	Special Concern			
THR	Threatened			
END	Endangered			

Group	Common Name	Scientific Name	State Status	Federal Status
Bird	Red-shouldered Hawk	*Buteo lineatus*	SPC	
Bird	Sedge Wren	*Cistothorus platensis*	SGCN	
Bird	Veery	*Catharus fuscescens*	SGCN	
Bird	Virginia Rail	*Rallus limicola*	SGCN	
Bird	Western Kingbird	*Tyrannus verticalis*	SGCN	
Bird	Wood Thrush	*Hylocichla mustelina*	SGCN	
Bird	Yellow-billed Cuckoo	*Coccyzus americanus*	SGCN	
Insect	A jumping spider	*Marpissa formosa*	SPC	
Insect	A Jumping Spider	*Pelegrina arizonensis*	SPC	
Insect	Dusted Skipper	*Atrytonopsis hianna*	SGCN	
Insect	Ghost Tiger Beetle	*Cicindela lepida*	THR	
Insect	Golden Northern Bumble Bee or Yellow Bumble Bee	*Bombus fervidus*	SGCN	
Insect	Leonard's Skipper	*Hesperia leonardus*	SPC	
Insect	Monarch	*Danaus plexippus*	SGCN	THR**
Insect	Northern Barrens Tiger Beetle	*Cicindela patruela patruela*	SPC	
Insect	Regal Fritillary	*Speyeria idalia*	SPC	
Insect	Rusty Patched Bumble Bee	*Bombus affinis*	SGCN	END
Insect	Uncas Skipper	*Hesperia uncas*	END	
Insect	Yellowbanded Bumble Bee	*Bombus terricola*	SGCN	THR/END**
Mammal	American Badger	*Taxidea taxus*	SGCN	
Mammal	Big Brown Bat	*Eptesicus fuscus*	SPC	
Mammal	Grey Wolf	*Canis lupus*	NL	THR
Mammal	Hoary Bat	*Lasiurus cinereus*	SGCN	
Mammal	Little Brown Myotis	*Myotis lucifugus*	SPC	Under Review
Mammal	Northern Long-eared Bat	*Myotis septentrionalis*	SPC	THR
Mammal	Plains Pocket Mouse	*Perognathus flavescens*	SPC	
Mammal	Prairie Vole	*Microtus ochrogaster*	SPC	
Mammal	Red Bat	*Lasiurus borealis*	SGCN	
Mammal	Silver-haired Bat	*Lasionycteris noctivagans*	SGCN	
Mammal	Tri-colored bat	*Perimyotis subflavus*	SPC	Under Review
SGCN	Species in Greatest Conservation Need (MN DNR 2016)			
NL	Not Listed			
*	Protected specially under the Bald and Golden Eagle Protection Act			
**	As of March 2017 this status is petitioned for this species			
MBTA	Protected under the Migratory Bird Treaty Act			
SPC	Special Concern			
THR	Threatened			
END	Endangered			

Group	Common Name	Scientific Name	State Status	Federal Status
Plant	Annual Skeletonweed	*Shinnersoseris rostrata*	THR	
Plant	Autumn Fimbry	*Fimbristylis autumnalis*	SPC	
Plant	Beach Heather	*Hudsonia tomentosa*	THR	
Plant	Creeping Juniper	*Juniperus horizontalis*	SPC	
Plant	Lance-leaf Violet	*Viola lanceolata var. lanceolata*	THR	
Plant	Old Field Toadflax	*Nuttallanthus canadensis*	SPC	
Plant	Seaside Three-awn	*Aristida tuberculosa*	THR	
Plant	Small-leaved Pussytoes	*Antennaria parvifolia*	SPC	
Plant	St. Lawrence Grapefern	*Botrychium rugulosum*	SPC	
Reptile	Blanding's Turtle	*Emydoidea blandingii*	THR	THR/END**
Reptile	Gophersnake	*Pituophis catenifer*	SPC	
Reptile	Plains Hog-nosed Snake	*Heterodon nasicus*	SPC	
Reptile	Smooth Greensnake	*Opheodrys vernalis*	SGCN	
SPC	Special Concern			
THR	Threatened			
END	Endangered			
**	As of March 2017 this status is petitioned for this species			

Appendix C: Letter sent to neighboring landowners

Minnesota Department of Natural Resources
Little Falls Area Forestry
16543 Haven Road, Little Falls, MN 56345
Telephone: (320) 616-2450 Ext. 626
Fax: (320) 616-2473

September 3, 2014

To Sand Dunes State Forest adjacent property owners:

The Minnesota Department of Natural Resources (DNR) has conducted an extensive planning process for future management of the Sand Dunes State Forest. This plan is part of a larger planning process that addresses management of all state land within the Anoka Sand Plain. The goal of the plan specific to the Sand Dunes State Forest is to identify, protect, restore and enhance rare or unique geological, plant, and animal features of the Anoka Sand Plain that occur within the state forest boundary. In order to protect rare features found in the state forest, DNR land management will shift away from pine plantations to restoration and management of native plant communities in some designated areas. On the attached map you will see an *Immediate Rare Features Restoration Zone* in which restoration work will begin over the next 5-10 years, and the *Eventual Rare Features Restoration Zone* which will be phased in more gradually.

Over the next decade management changes will become apparent in the southeastern unit of the Sand Dunes State Forest. In the *Immediate Rare Features Restoration Zone* all of the pine and spruce will be harvested. Work will begin to convert this zone to resemble native plant communities that existed prior to European settlement. In this portion of the state forest, shifting sand dunes were created by the wind as the glaciers retreated. A mosaic of plant communities developed on the dunes including prairie openings, oak savanna, oak brush land, and oak woodland. Timber harvesting will continue to be one of the management tools used to regenerate forests and savannas as older trees mature and decline. Other management tools include prescribed burning to restore fire-dependent plant communities and targeted application of herbicides to reduce non-native invasive plant species.

A slightly different approach will be used in the *Eventual Rare Features Restoration Zone*. Pine and spruce will continue to grow to the size and age at which they would normally be considered for harvest. This is a long-term process that will take 70 years or more to complete. Gradually pine and spruce will be eliminated or reduced to a minor component of the forest and native plant communities will be restored.

Outside of the *Immediate* and *Eventual Rare Features Restoration Zones*, pine and spruce will continue to be planted or allowed to naturally reproduce by seed. In these areas the

dominant tree cover will include a mix of white pine, pin oak, bur oak, aspen, red pine, and other species.

To maintain healthy natural resources for public benefit, the entire Sand Dunes State Forest will continue to be managed for compatible multiple uses including recreation, economic gain through harvest of timber, biomass and other products, wildlife habitat enhancement, and restoration of native plant communities. In some locations, visual changes on the landscape will be noticeable within the next few years. In other locations the changes will be gradual. Through a large portion of the forest there will be no major changes in management approach.

DNR land managers will make every effort to minimize the impact on adjacent landowners and continue to be good neighbors by following best management practices. If you have any questions or would like additional information, please feel free to contact me via phone or email at the addresses listed below.

Best Regards,

John Korzeniowski
Little Falls Area Forestry Supervisor
16543 Haven Road
Little Falls, MN 56345
320-616-2450 ext. 233
john.korzeniowski@state.mn.us

Appendix D : List of Herbicides Used in SDSF

Note: This list may not be exhaustive. For more information, see: Weed Control Methods Handbook, The Nature Conservancy, Tu *et al.*

Brand Name Examples	Herbicide	Target Species	Average Soil Half-life	Soil Mobility	Average Half-Life in Water
Garlon® 3A & Garlon® 4 Ultra	Triclopyr	Siberian Elm (*Ulmus pumila*), Common and Glossy Buckthorn (*Rhamnus cathartica* and *Frangula alnus*), and Amur Maple (*Acer ginnala*)	30 Days	Moderate - High	4 Days
RoundUp®	Glyphosate	Western Poison Ivy (*Toxicodendron rydbergii*)	47 Days	Low	12 Days to 10 Weeks
Transline®	Clopyralid	Spotted Knapweed (*Centaurea stoebe spp. micranthos*) and Cow Vetch (*Vicia cracca*)	40 Days	Moderate - High	8 to 40 Days

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